ERECTION AND MAINTENANCE INSTRUCTIONS

FOR

ARMY MODELS

A-26B and A-26C AIRPLANES

Published under joint authority of the Commanding General, Army Air Forces, the Chief of the Bureau of Aeronautics, and the Air Council of the United Kingdom.

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25 DECEMBER 1944

REVISED 20 MAY 1945

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LIST OF REVISED PAGES ISSUED

NOTE: A heavy black vertical line, to the left of the text on revised pages, indicates the extent of the revision. This line is omitted where more than 50 percent of the page is revised.

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5	20 May 1945
41	15 April 1945
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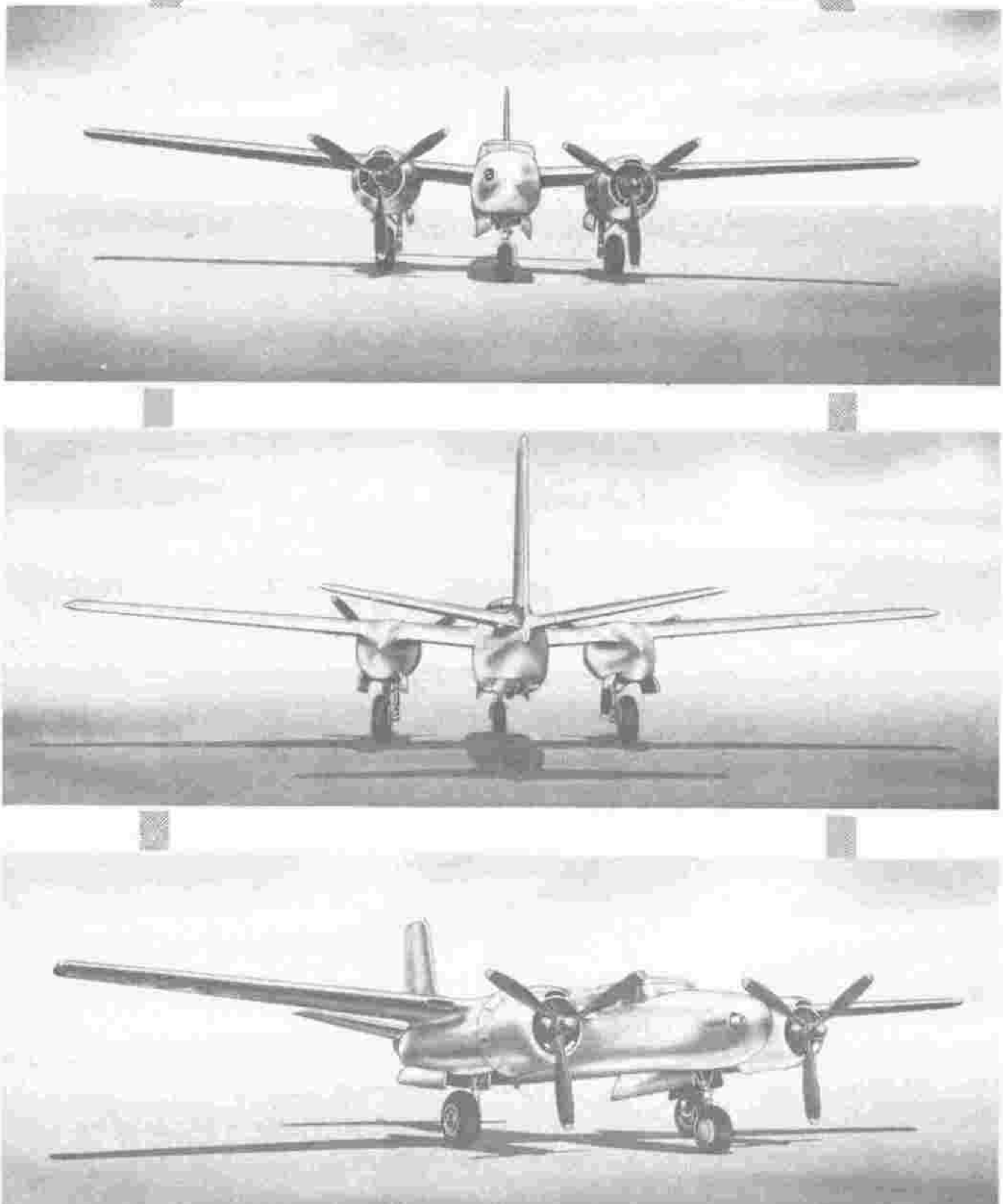


Figure 1 — Airplane Views (Sheet 1 of 2)

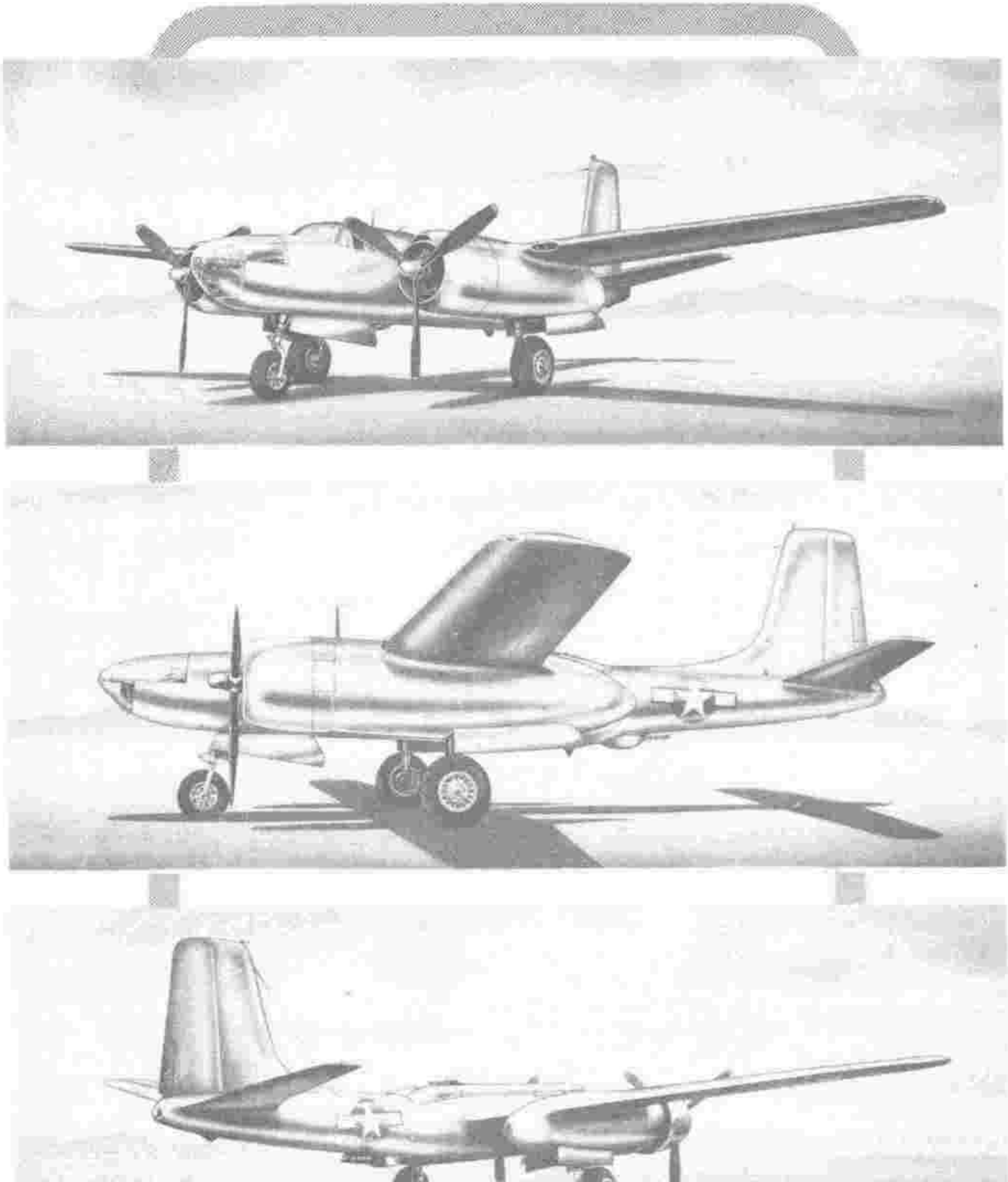
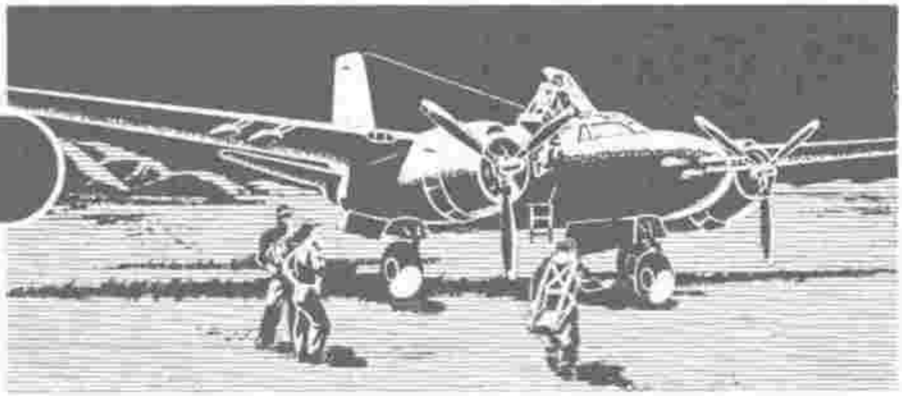


Figure 1 — Airplane Views (Sheet 2 of 2)

SECTION I



DESCRIPTION, DIMENSIONS AND LEADING PARTICULARS

1. DESCRIPTION.

This airplane is a three place, bi-motored attack bomber of all metal construction. Two Pratt and Whitney, two speed radial engines each rated at 2000 horsepower at take-off, provide the power for this airplane. The tricycle type alighting gear is retracted and extended hydraulically.

The manufacturer provides two type noses for this airplane: the All Purpose (Multi-Gun) nose which has provisions for the installation of cannon(s), machine guns or both and the Bombardier Nose which includes bombing controls, bomb sight brackets, two .50 cal. machine guns, etc. These noses are interchangeable. When equipped with the bombardier nose the airplane model designation is A-26C – with the all purpose nose A-26B.

2. DIMENSIONS. *—(See dimension drawing Figure 2.)*

(airplane at rest)

3. LEADING PARTICULARS.

PRINCIPAL DIMENSIONS

(Aircraft in level flight position unless otherwise stated)

GENERAL	
Span	70 ft. 0 in.
Length (overall fuselage)	A-26B 50 ft. 9 in.
	A-26C 51 ft. 3 in.
Height (at rest)	18 ft. 6 in.
WINGS	
Airfoil section (curve identification)	
Root	65,2-215 a=.8 b=1.0
Tip	65,2-215 a=.5 b=1.0
Chord at root	128 in.
Chord near tip (35 ft. from fuselage centerline)	58 in.
Incidence	Root 2°
	Tip 1°
Dihedral (measured on top face of front beam)	4.5°
Sweepback at station ±123 (20% wing chord)	0°
Maximum wing depth	18 in.
STABILIZER	
Span	23 ft. 1 in.
Maximum chord (Root)	7 ft. 5 in.
Incidence	0°
Dihedral	10° 35′ 1″

FUSELAGE

Width (maximum)	5 ft. 2.04 in.
Height (maximum)	5 ft. 10 in.
Length (less cannon)	49 ft. 11 in.

AREAS

WINGS (less ailerons)	513.3 sq. ft.
WINGS (with flaps extended) Increases Area	10%
AILERONS (total)	27.2 sq. ft.
FLAPS (total)	55.9 sq. ft.
STABILIZERS (including elevators)	116.51 sq. ft.
ELEVATORS (two) (including tabs) (aft hinge line)	32.7 sq. ft.
ELEVATOR TRIM TABS (total)	2.6 sq. ft.
FIN	48.23 sq. ft.
RUDDER (including tab) (aft hinge line)	23.1 sq. ft.
RUDDER TRIM TAB (total)	2.28 sq. ft.

SETTING AND RANGES OF MOVEMENT OF CONTROL SURFACES

AILERONS	up (from neutral)	20° ± 1°	5-21/32 in. ± 5/16 in.
	down (from neutral)	15° ± 1°	4-15/32 in. ± 5/16 in.
FLAPS	(total)	52° ± 2°	
ELEVATOR	up (from neutral)	30° ± ½°	14 in ± 5/32 in.
	down (from neutral)	16° ± ½°	7-17/32 in. ± 7/32 in.
RUDDER	right (from neutral)	17° ± ½°	11-9/32 in. ± 7/32 in.
	left (from neutral)	17° ± ½°	11-9/32 in. ± 7/32 in.
TRIM TABS			
Elevator	up (from neutral)	12° ± 2°	1-3/8 in. ± ¼ in.
	down (from neutral)	17° ± 2°	1-21/32 in. ± ¼ in.
Rudder	right (from neutral)	20° ± 2°	3-1/4 in. ± 11/32 in.
	left (from neutral)	20° ± 2°	3-1/4 in. ± 11/32 in.
Aileron	up (from neutral)	7° ± 1½°	5/8 in. ± 1/8 in.
	down (from neutral)	7° ± 1½°	5/8 in. ± 1/8 in.

ALIGHTING GEAR

Type	Hydraulically retractable
TREAD (width from center of tire to center of tire)	19 ft. 5.6 in.
SHOCK STRUT (main)	
Type	Oleo-pneumatic (air-oil)
Manufacturer	Cleveland Pneumatic Tool Co.
Part Number	8211
Fluid Required	
A. N. Specification	AAF3580 Navy M-339
British Equivalent	DTD 585
Approximate Maximum Air Pressure	Filled to full mark on strut.

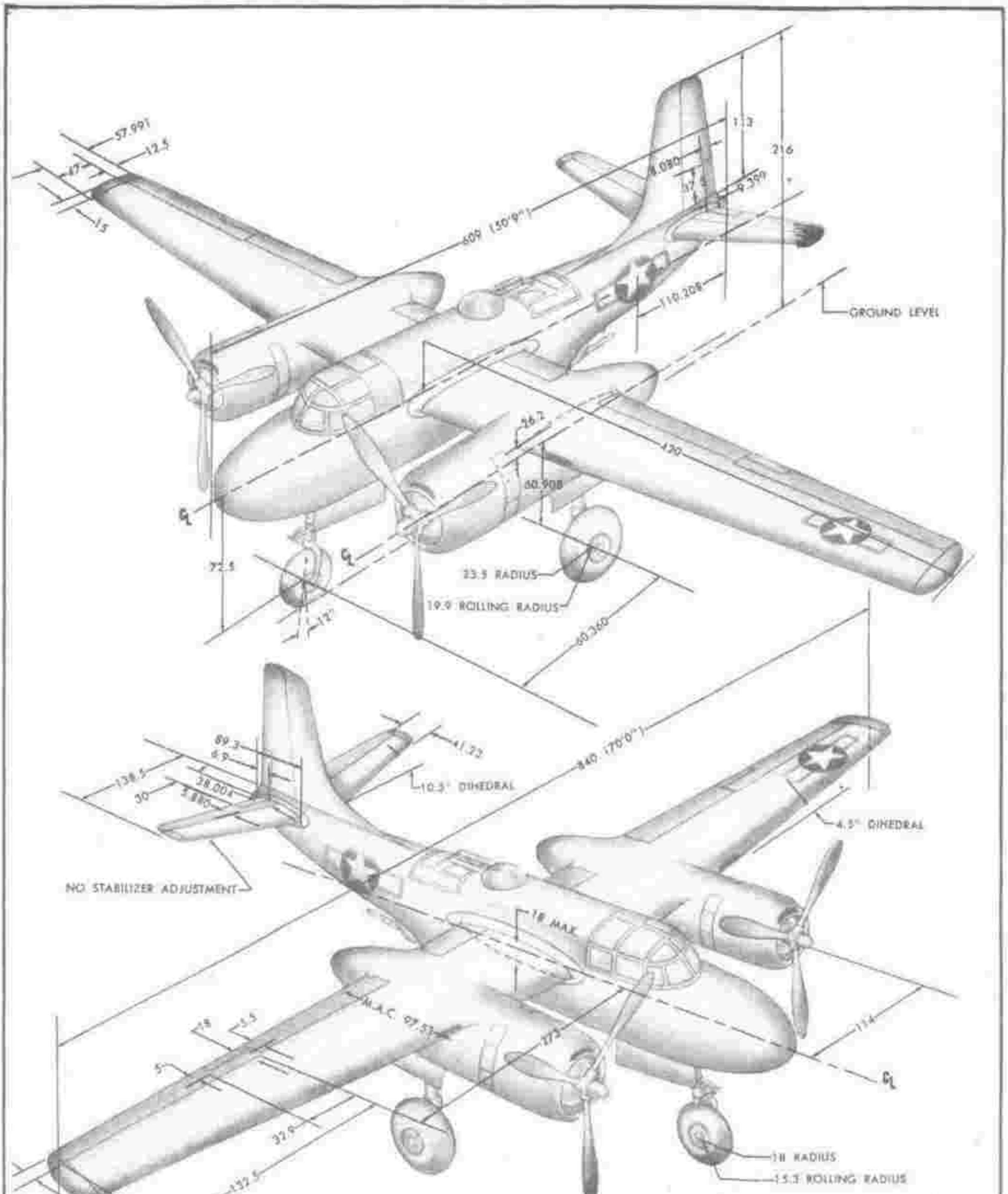


Figure 2 — Dimensions Diagram

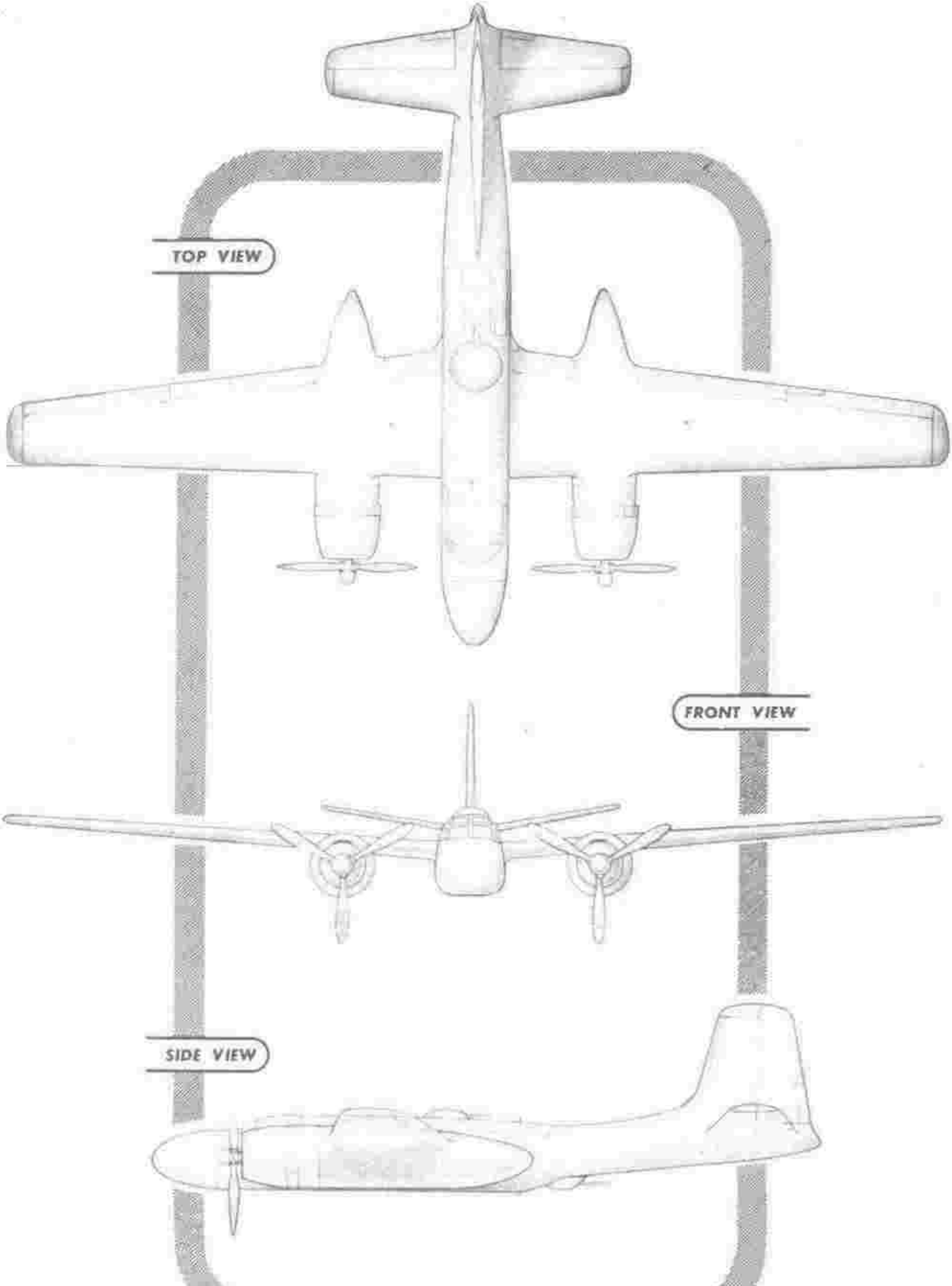


Figure 3 — Three Views of Airplane

WHEELS (main)

TYPE	Goodyear 530005M Type 3 47 in.
TIRE	Goodyear or equiv.—Smooth contour—10 Ply-47 in.
PRESSURE-AIR	At 27,603 pounds gross weight 54 p.s.i.

BRAKES

TYPE	Hydraulically operated Goodyear 510675M 47in., 12.7 x 14 disc type

NOSE WHEEL UNIT

TYPE	Hydraulically retractable
SHOCK STRUT:	
TYPE	Oleo-pneumatic (air-oil)
MANUFACTURER	Cleveland Pneumatic Tool Co.
PART NUMBER	8239
FLUID REQUIRED:	
A. N. SPECIFICATION	AAF3580 Navy M-339
BRITISH EQUIVALENT	DTD-585
APPROXIMATE MAXIMUM AIR PRESSURE	Filled to full mark on strut

WHEEL (Nose)

TYPE	Goodyear P/N 4109-530033 or Bendix P/N 4109-58175 36 in.
TIRE	Goodyear or equiv.—Smooth contour—36 in. 8 Ply
PRESSURE-AIR	At 27,603 pounds gross weight 38 p.s.i.

ENGINES (2)

NUMBER DESIGNATION	Pratt & Whitney — R 2800-BG AAF 2800-27 or -71
GEAR RATIO	2:1
OIL	Spec. AN-VV-O-446a — grade 1100a
FUEL	100 Octane — Spec. AN F28 grade 130

PROPELLERS

MANUFACTURER	Hamilton Standard
TYPE	3 blade (dural)
HUB NUMBER	23-E-50
BLADE NUMBER	6359A-18
DIAMETER	12 ft. 7 in.
CONTROL NUMBER	4G8-G15D Hamilton
PITCH SETTING	
LOW (FINE)	26° at 42 in. station
HIGH (COARSE)	90° at 42 in. station

CONTAINER CAPACITY

FUEL:	GALLONS EACH	
NACELLE (MAIN) CONTAINERS (2)	300 U.S. Gals.	250 Imp. Gals.
FUSELAGE (BOMB BAY) CONTAINER (1)	125 U.S. Gals.	104 Imp. Gals.
WING (AUXILIARY) CONTAINER (2)	100 U.S. Gals.	83.3 Imp. Gals.
FERRY TANK (1)	675 U.S. Gals.	562 Imp. Gals.
FUEL — TOTAL LESS FERRY TANK	925 U.S. Gals.	771 Imp. Gals.
FUEL — TOTAL INCLUDING FERRY TANK	1600 U.S. Gals.	1332 Imp. Gals.

OIL:	GALLONS EACH	
TANK (1) for each engine	34 U.S. Gals.	28.3 Imp. Gals.
EXPANSION SPACE	3.5 U.S. Gals.	2.91 Imp. Gals.
TOTAL OIL	68 U.S. Gals.	56.6 Imp. Gals.

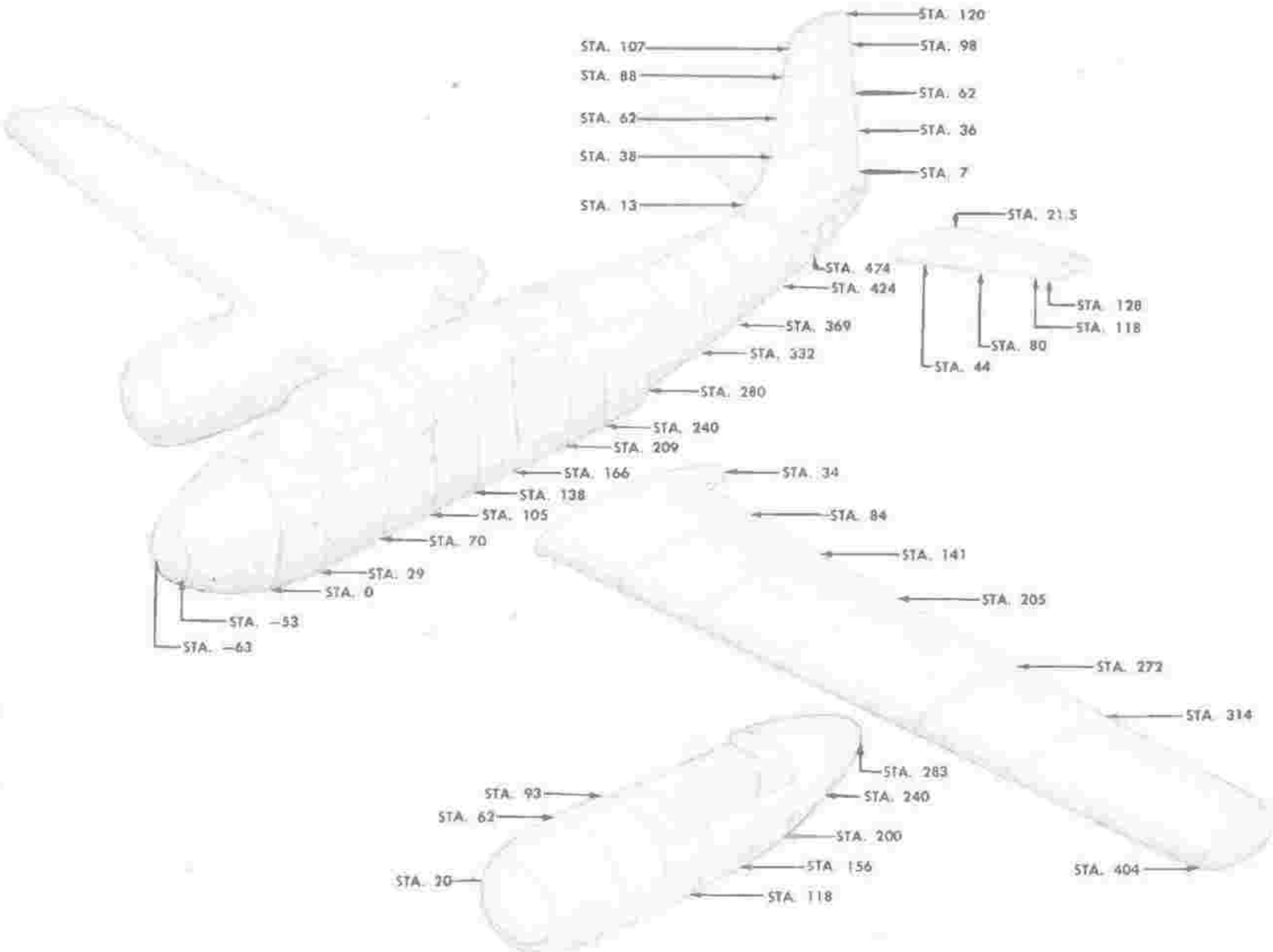
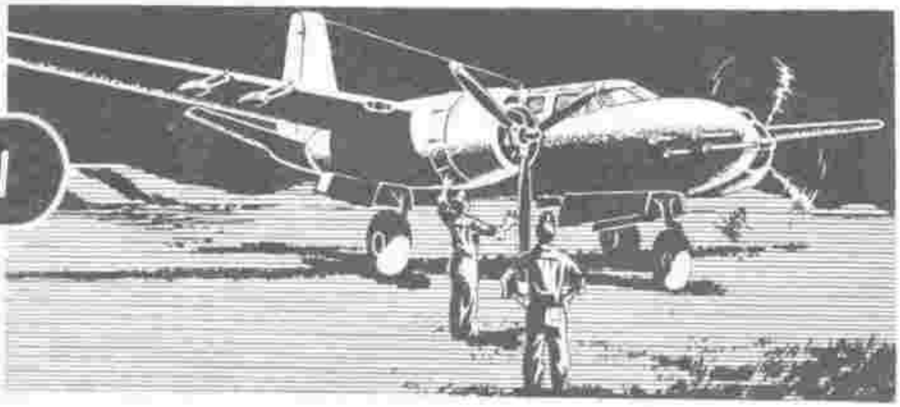


Figure 4 — Stations Diagram

SECTION II



SHIPPING AND ERECTION PROCEDURE

This airplane is equipped with a ferry fuel tank when delivered. The additional fuel capacity thus provided makes possible the delivery and point to point transfer by the FLY-AWAY method. If dismantling for shipment is necessary, the following drawing and chart indicate the component parts readily removable from the airplane, the text location for the removal and installation of these parts and their weights and sizes.

Due to the size of the wing (including nacelle) the route of transit should be carefully planned and checked to make certain there will be adequate clearance under bridges and in tunnels enroute.

1. SHIPMENT OF AIRCRAFT.

a. PREPARING THE ENGINES AND PROPELLERS FOR SHIPMENT.

(1) GENERAL.—Since the preparation of the ignition, fuel, and oil systems is necessary for the proper preparation of the engines for shipment, dismantling of the airplane should not be attempted until such preparation has been completed. The procedure outlined below should be carried out for each engine *within 48 hours* after arrival of the airplane at the disassembly point.

(2) PROCEDURE.

(a) CLEANING.—If necessary, clean the engine thoroughly with an approved solvent and dry it with an air blast. (Refer to Specs. AN-C-80 and AF28480.)

(b) CLEAR FUEL RUN.

1. Drain leaded fuel from all of the fuel containers.

2. Safety the landing gear in the "DOWN" position; then run the engine for a minimum period of 15 minutes on unleaded fuel, Grade 65, under its own power and at 40 to 45 percent of its rated speed. While the engine is running, the oil intake line should feed from an auxiliary oil tank which contains a blend of three parts lubricating oil, Grade 1120, and one part corrosive-preventive compound, AN-VV-C-576). Wash the screens and filters with solv- (Spec. AN-VV-C-576). A fresh supply of the oil-compound mixture should be used for each engine. If an auxiliary tank is not available, the engine's own tank may be drained and filled with the oil-compound mixture.

3. Before stopping the engine, make certain that the cylinder heads have been properly cooled. Shift the propeller to LOW rpm. Do not exceed 20 inches Hg. manifold absolute pressure. Just before stopping the engine increase its speed to between 1500 and 1600 rpm for approximately 30 seconds to permit maximum scavenging of the crankcase oil.

4. Stop the engine by moving the mixture control to the "IDLE CUT-OFF" position. When the engine has stopped firing, turn the ignition switch to the "OFF" position.

CAUTION

Do not stop the engine by running out of fuel.

5. Drain the residual fuel from the system.

(c) COWLING.—Remove all cowling according to the procedure outlined in Section IV, paragraph 6., ENGINE SECTION.

(d) SPARK PLUGS.—While the engine is hot, remove all spark plugs to permit the escape of the vapors of the last explosion before condensation takes place. When the plugs have cooled, clean them with solvent and adjust the gaps. Coat each electrode with corrosion-preventive compound (Spec. AN-VV-C-576), and install a brass thread-protector cap. Wrap each spark plug in waxed paper and pack all plugs together with their copper gaskets in a cardboard container.

(e) OIL SYSTEM.—Remove the drain plugs and allow the oil to drain from the system. Slush the drain plugs in corrosion-preventive compound (Spec. ent and dip them in corrosion-preventive compound (Spec. AN-VV-C-576). Reinstall all screens and filters.

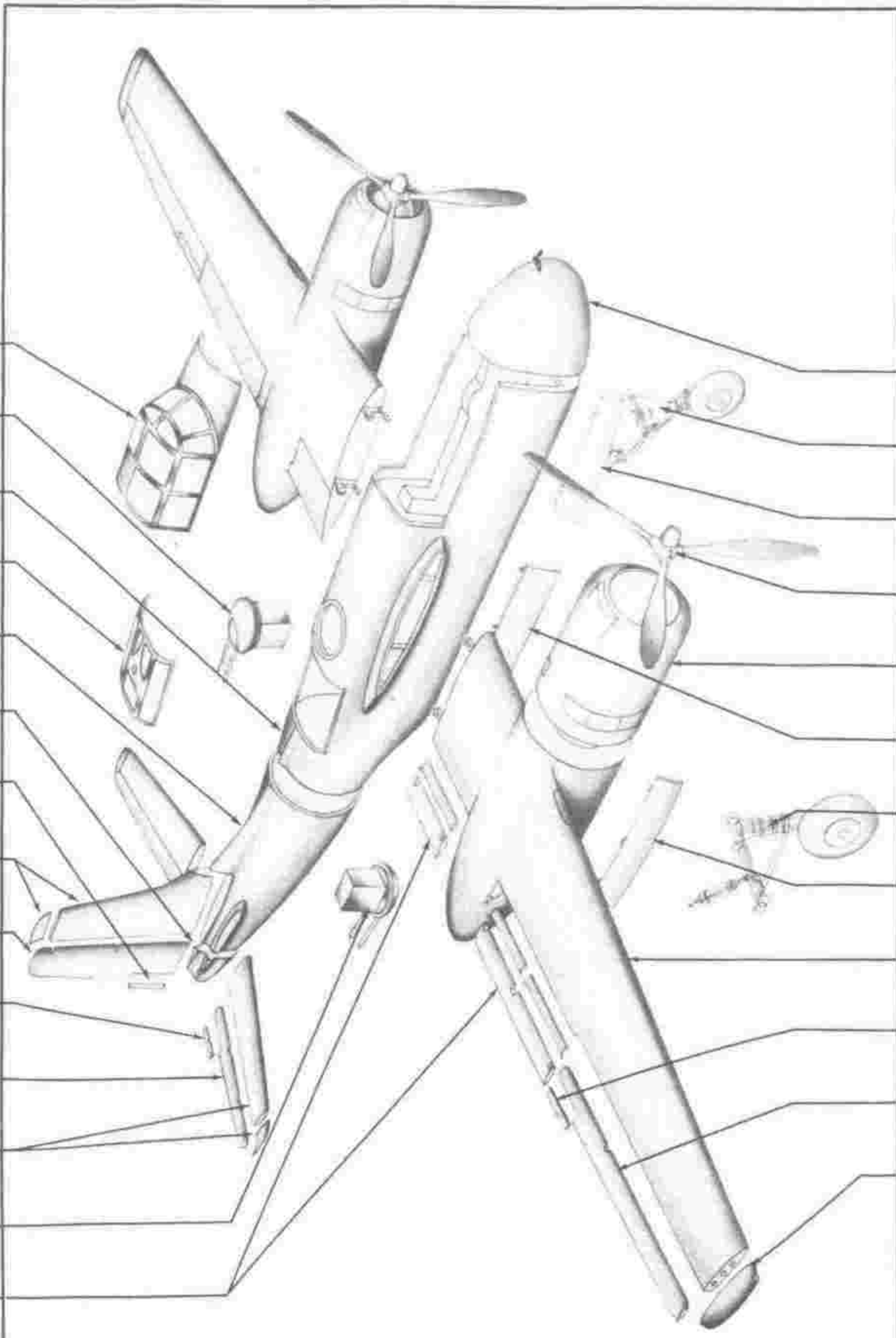


Figure 5 — Airplane Component Parts

KEY TO FIGURE 5—MAJOR COMPONENT PARTS

Key	Name	Removal Reference	Installation Reference	Weight Ea. lbs.	Width (Max.)	Length (Max.)	Depth (Max.)
1	Wing Flaps (Outer and Inner) (2 sets)	Sec. IV, Para. 3., b., (8), (b), 1 & 2.	Sec. IV, Para. 3., b., (8), (d).	142	32"	143½"	13½"
2	Lower Turret	Sec. IV, Para. 15., d., (16), (c), 2.	Sec. IV, Para. 15., d., (16), (c), 4.	429	41"	62"	42"
3	Horizontal Stabilizer and Tip (2)	Sec. IV, Para. 2., b., (2).	Sec. IV, Para. 2., b., (5).	102	56"	119"	8½"
4	Elevator (2)	Sec. IV, Para. 3., b., (4), (b).	Sec. IV, Para. 3., b., (4), (d).	71.2	38"	118"	6½"
5	Elevator Trim Tab (2)	Sec. IV, Para. 3., b., (5), (b).	Sec. IV, Para. 3., b., (5), (d).	1.77	7¼"	30"	2"
6	Rudder	Sec. IV, Para. 3., b., (6), (b).	Sec. IV, Para. 3., b., (6), (d).	91.6	56"	113"	7½"
7	Vertical Stabilizer and Tip	Sec. IV, Para. 1., c., (2).	Sec. IV, Para. 1., c., (5).	126	89½"	113"	9½"
8	Rudder Trim Tab	Sec. IV, Para. 3., b., (7), (b).	Sec. IV, Para. 3., b., (7), (d).	3.4	9"	37"	2"
9	Fuselage Tail Cone	Sec. IV, Para. 4., h., (2).	Sec. IV, Para. 4., h., (5).	71	41"	41½"	32"
10	Fuselage Aft Section	Sec. IV, Para. 4., g., (2).	Sec. IV, Para. 4., g., (4).	330	54½"	145"	46¾"
11	Gunners' Compartment Enclosure	Sec. IV, Para. 4., f., (2).	Sec. IV, Para. 4., f., (4).	74	56"	84"	13"
12	Fuselage Main Section (incl. 966 lbs. Useful Load)	To remove or install—The instructions given in Items 1, 15, 19, 24 and 26 must be followed.	To remove or install—The instructions given in Items 1, 15, 19, 24 and 26 must be followed.	5562	62"	352"	70"
13	Upper Turret	Sec. IV, Para. 15., d., (16), (b), 2.	Sec. IV, Para. 15., d., (16), (b), 4.	409	40½"	62"	40½"
14	Pilots' Compartment Enclosure	Sec. IV, Para. 4., d., (2).	Sec. IV, Para. 4., d., (3).	146	55½"	97"	17"
15	Wing Tip (2)	Sec. IV, Para. 1., c., (2).	Sec. IV, Para. 1., c., (4).	9	16½"	91"	9½"
16	Aileron (2)	Sec. IV, Para. 3., b., (2), (b).	Sec. IV, Para. 3., b., (2), (d).	65	25½"	132½"	6½"
17	Aileron Trim Tab (2)	Sec. IV, Para. 3., b., (3), (b).	Sec. IV, Para. 3., b., (3), (d).	1.85	10½"	32"	2"
18	Wing Complete (2)	Sec. IV, Para. 1., (b), (2).	Sec. IV, Para. 1., b., (4).	3185	180"	405"	50"
19	Nacelle Doors (3 pr.)	Sec. IV, Para. 5., b., (6), (b).	Sec. IV, Para. 5., b., (6), (e).	41	30½"	86½"	26"
20	Main Landing Gear (2)	Sec. IV, Para. 5., b., (1), (b).	Sec. IV, Para. 5., b., (1), (e).	729	47"	72"	28½"
21	Bomb Bay Doors (2)	Sec. IV, Para. 14., d., (10), (b).	Sec. IV, Para. 14., d., (10), (d).	69	28½"	172"	7"
22	Engine Section (2)	Sec. IV, Para. 6., b., (2).	Sec. IV, Para. 6., b., (4).	2923	60"	96"	60"
23	Propeller (2)	Sec. IV, Para. 10., b., (2).	Sec. IV, Para. 10., b., (6).	459	12'7"	12'7"	30"
24	Nose Wheel Doors (2)	Sec. IV, Para. 5., c., (2), (b).	Sec. IV, Para. 5., c., (2), (d).	40	23½"	83"	6"
25	Nose Wheel Gear	Sec. IV, Para. 5., c., (1), (b).	Sec. IV, Para. 5., c., (1), (e).	303	36"	71"	32"
26	Fuselage Nose Section (Bombardier Type—incl. guns and ammunition)	Sec. IV, Para. 4., b., (2).	Sec. IV, Para. 4., b., (4).	384	58"	59½"	54¾"
	(All Purpose—incl. mounts)	Sec. IV, Para. 4., b., (2).	Sec. IV, Para. 4., b., (4).	316	58"	59½"	54¾"

Reinstall all drain plugs except the sump plugs, which should be replaced with crankcase dehydrator plugs (AN4061) screwed to a tight seal. The regular sump plugs should be wrapped in waterproof paper, tagged, and tied to the engine structure adjacent to the sump.

(f) FUEL PUMP.—Disconnect the inlet line from the fuel pump and insert one end of a piece of hose. Insert a funnel into the other end of the hose; fill the funnel with 1 pint of corrosion-preventive compound (Spec. AN-VV-C-576), and drain the compound into the pump; rotate the propeller by hand in the normal direction. Drain the excess compound from the pump by turning the propeller in the opposite direction. Replace the fuel line.

CAUTION

Do not use the self-sealing fuel line for this operation as corrosion-preventive compound will be destructive to the line.

(g) CARBURETOR.—Drain the remaining fuel from the carburetor. Remove the fuel lines and the intake fittings, and insert brass nipples in the holes. Attach hose to the nipples, and connect them to a gallon can filled with Grade 1065 lubricating oil. Allow the oil to drain into the carburetor while the throttle and mixture controls are being operated. Remove the hose and the nipples, and allow the carburetor to drain thoroughly. Replace the intake fittings and the fuel lines. Lock the throttle in the "OPEN" position.

(h) VALVE ROCKER ASSEMBLY.—Remove the valve rocker box covers. Wash the rocker assembly with solvent and spray it with corrosion-preventive compound (Spec. AN-VV-C-576). Replace the covers carefully, and install new gaskets in place of any that may be damaged.

(i) CYLINDERS.

1. Through the spark plug holes, spray the inside of each cylinder with corrosion-preventive compound (Spec. AN-VV-C-576); rotate the propeller slowly during the spraying operation.

CAUTION

Insert the nozzle of the spray gun carefully to avoid damaging the spark plug insert threads.

2. Install and connect the dehydrator plugs (AN4062) in all of the cylinders.

(j) PROPELLER.

1. Remove the propeller according to the procedure outline in Section IV, paragraph 10, PROPELLER AND PROPELLER CONTROLS. Refer to Spec. AN-P-30.)

2. Plug the hydraulic oil connections of the propeller shaft, and spray the inside of the shaft with corrosion-preventive compound (Spec. AN-VV-C-576).

3. Thoroughly lubricate the threads on the end of the propeller shaft, and install a propeller shaft thread protecter cap (AN5012).

4. Coat the outside of the propeller shaft with Rust Veto A-5; wrap the shaft in waxed paper, and then in oilcloth; tie the oilcloth securely in place.

5. Cover the hub and dome openings with waxed paper and then with oilcloth to prevent the entrance of foreign matter into the propeller pitch actuating assembly.

(k) FINAL PROTECTIVE MEASURES.

1. Remove the engine from the nacelle according to the procedure outlined Section IV, paragraph 6., ENGINE SECTION, ENGINE ACCESSORIES AND ENGINE CONTROLS.

2. Mask all rubber and synthetic rubber fittings, and spray the entire engine section, including the accessories, with corrosion-preventive compound.

3. Seal all exterior openings with moisture-proof seals.

4. Fit an engine envelope (AN4073) to an engine case anchor plate or a saddle; fit the plate or the saddle and the envelope to the engine. Place the engine in the case and fasten the anchor plate or the saddle to the case. Distribute dehydrator bags symmetrically about the engine. Seal the envelope and lower the case cover over the enclosed engine; be careful not to break the envelope.

b. DISMANTLING THE AIRPLANE.

(1) GENERAL.—In order to reduce both disassembly and reassembly time to a minimum, it is strongly urged that, whenever practicable, major assemblies be detached complete in themselves rather than disassembled into their component subassemblies. For example, whereas the wing can be disassembled into panel, flaps, aileron, and tip, it is far more desirable to ship the wing complete unless shipping conditions necessitate such dismantling.

(a) TAGGING OF PARTS REMOVED AND REPLACEMENT OF SMALL PARTS.

1. A tag showing the airplane's serial number and the name and location (RH or LH) of the part should be attached to each part removed from the airplane before it is boxed or crated.

2. Assembly items such as nuts, bolts, washers, spacers, cotterpins, etc. should be replaced in their respective locations as soon as each part has been removed. Items which cannot be returned to their fittings should be packed together in a bag and securely attached to their unit; the bag should be tagged for identification.

3. Before disconnecting the adjusting rods, turnbuckles, etc., apply a thin strip of adhesive tape to the male fittings to indicate the points at which proper reassembly should be made with the female fittings.

(b) CHECK-OFF LIST.—Each assembly, together with its attaching parts, should be listed when it is dismantled and checked off when it is packed for shipment. It is recommended that a check-off list be made to cover all of the assemblies which are removed from an individual airplane. The list should be identified by the model and serial number of the airplane, and should be made in duplicate, one copy to be filed by the disassembly crew and the other copy to be forwarded with the shipment.

c. PREPARATION FOR SHIPMENT.

(1) GENERAL.—Preservation of the units to be shipped is accomplished by the application of protective compounds and/or wrappings.

(a) CLEANING.—Clean and thoroughly dry all surfaces before using protective compounds or dehydrating methods. Stoddard's solvent or naphtha are preferable as cleaning compounds.

(b) RUBBER AND SYNTHETIC RUBBER PARTS.—Before applying corrosion-preventive compounds to surfaces which are adjacent to rubber and synthetic rubber parts, mask all tires, tubing, etc. with waterproof adhesive shipping tape. Door and hatch sealing strips should be removed from the airplane and wrapped in Kraft paper before they are packed for shipment.

(c) UNPROTECTED METAL SURFACES.—Coat bare metal parts with corrosion-preventive compound (Spec. AN-C-52) all cables, tracks, unpainted landing gear parts, fittings, bolts, hinges, etc. Apply the compound by brush, spray, or dipping, and allow the parts to dry thoroughly before they are packed.

(d) GLASS AND PLEXIGLAS.—Cover glass or Plexiglas with three layers of Kraft paper which is held in place with tape (AN P-12).

CAUTION

Do not apply tape directly to any glass or Plexiglas surface. Reaction of the adhesive to the compound used to remove the tape causes serious crazing of the glass.

(e) DOPED FABRIC.—Completely cover all doped fabric with waterproof paper and tape the paper in place. Do not permit corrosion-preventive compound to contact any doped fabric surface.

(f) BATTERY.—Whether the battery remains installed in the nacelle or is shipped separately depends, generally, on the method of shipment. In either event, preparation is the same:

1. Disconnect both terminal cables; clean them thoroughly, and tie them securely away from the battery posts.

2. Clean the battery; check the cell contents, and add water if it is needed; or charge the battery, if necessary.

3. Coat each battery post with corrosion preventive compound (Spec. AN-C-52).

4. Make sure the battery drain hole is unobstructed, so that gases can escape from the container.

d. CRATING.

(1) GENERAL.—All units of the airplane can be crated for shipment. (See the preceding illustration.) However, because of the length of the wing panel and the location, height, and length of its integral nacelle structure, it is recommended that the wing be transported without crating if possible.

(2) MATERIAL.—Boxes or crates should be made of suitable wood or wood-cleated plywood. The choice of material depends principally on the size of the individual box and the weight of its contents.

(3) CONSTRUCTION.—Boxes or crates should be reinforced by struts or cleats at points of internal or external stress. As far as it is practicable, the individual members of crates should be bolted or screwed together so that the crates can be knocked down for reuse. Crates should be lined with waterproof paper; if they are double-walled, they should be interlined with waterproof paper. To facilitate handling, large crates should be constructed on skids which have been notched for hoisting slings.

(4) SPECIAL SUPPORTS.—Units with vulnerable contours, such as engines, tail cones, etc., should be padded, cradled, and/or bulkheaded so that they will be protected from damage by crate walls or by other items which may come adrift during transit. Parts which can be rigidly attached to or supported from the floor or the framework of the crate should be fastened, braced, or blocked to prevent shifting or straining caused by motion or distortion of the crate.

(5) INSTRUCTIONS FOR UNPACKING.—When a crate has been constructed for special parts and in such a manner as to be reusable, instructions to facilitate its unpacking should be prepared and forwarded with the crate.

(6) PAINTING AND MARKING. — Unless otherwise directed, the exteriors of all boxes and crates which contain aircraft or aircraft materiel should be painted with nonspecular paint and marked with the destination and other appropriate shipping data.

2. ERECTION PROCEDURE.

a. UNCRATING.

(1) GENERAL.—No assembly should, as a general rule, be uncrated until it is needed for installation on the airplane.

(2) PROCEDURE.

(a) Unpack all items carefully and in accordance with the instructions forwarded by the packer.

(b) Check all items against the packing or check list which accompanies the shipment.

(c) Knock down and save all crates suitable for reuse.

b. DEPRESERVATION AND INSTALLATION.

(1) GENERAL.—Functional assemblies, such as propellers, should not be depreserved until immediately before installation, especially in areas where damp or humid weather conditions prevail and where corrosive action can be inhibited by positive protective measures only.

(a) Remove paper and oilcloth wrapping.

(b) Remove adhesive tape and protective compound coatings by cleaning the part with solvent, naphtha, or vapor.

(c) When the part is thoroughly clean, air dry it and apply proper lubricants to parts requiring lubrication.

(2) WING GROUP.

	DEPRESERVATION
(a) Main panel.	Clean, if necessary.
(b) Tip.	Clean, if necessary.
(c) Aileron tab.	Remove paper.
(d) Flaps and deflectors.	Clean, if necessary.
(e) Main landing gear.	Clean.
(f) Battery.	Clean.

(g) Engine and propeller.—The engine and propeller require a series of operations to refit them for service after they have been preserved for storage or shipment. The recommended procedure is as follows:

1. Install the engine on the airplane according to the procedure outlined in Section IV, paragraph 6., ENGINE SECTION.

2. Remove protective coatings from all exterior surfaces of the engine with naphtha or solvent. Dry the surfaces with compressed air.

3. Remove the engine cylinder dehydrator plugs (dummy spark plugs).

4. Unpack and clean the propeller. Install the propeller according to the procedure outlined in Section IV, paragraph 10., PROPELLER AND PROPELLER CONTROLS.

5. Remove the dehydrator plugs from the oil sump and allow the corrosion-preventive mixture to drain from the engine; at the same time rotate the propeller to facilitate drainage. If necessary, use a hand pump to insure complete removal of the mixture.

6. Remove all screens; wash them thoroughly in solvent, and reinstall them.

7. Remove the three lowest intake manifold pipes in each cylinder bank, and allow the corrosion-preventive mixture to drain from the cylinders. If any excess mixture is found, remove the adjacent intake pipes and examine them; continue removal toward the top until no excess of the mixture appears. After they have been drained, reinstall all of the intake pipes which have been removed.

8. Slush the carburetor thoroughly with solvent or gasoline to remove the protecting oil.

9. Install and connect all spark plugs.

10. To insure that all excess oil and corrosion-preventive compound have been drained from the engine, rotate the crankshaft by hand *at least four complete revolutions.* Reinstall the regular drain plugs.

11. Place sufficient gasoline in one fuel tank, and enough oil in the oil tank to insure a minimum ground run-up of one-half hour, and run the engine to complete the depreservation. Upon completion of the run-up, drain the oil from the engine and from the oil system. Fill the system with fresh oil before again running the engine.

(3) FUSELAGE GROUP.

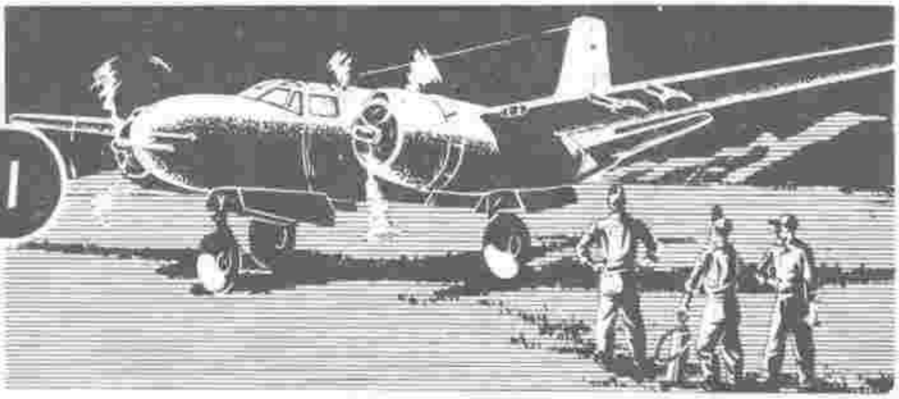
	DEPRESERVATION
(a) Fuselage.	Clean, if necessary.
(b) Nose section.	Remove paper and tape.
(c) Nose wheel gear.	Clean.
(d) Turrets.	Clean, if necessary.
(e) Armament.	Remove wrapping.
(f) Communications equipment.	Remove wrapping.
(g) Instruments.	Remove wrapping.

(4) EMPENNAGE GROUP.

(a) Horizontal stabilizer.	Clean, if necessary.
(b) Elevator.	Remove paper and tape.
(c) Vertical stabilizer.	Clean, if necessary.
(d) Rudder.	Remove paper and tape.
(e) Tail cone.	Remove paper and tape.

c. FINAL CHECK AFTER ERECTION.—Installation of the various members and the connection of electrical, hydraulic, fuel, and oil lines complete the erection of the airplane. It is assumed that the tightness of all connections will be tested at the time of assembly; the adjustment of the surface controls should be made with absolute accuracy to assure proper flying qualities for the airplane. These surface control adjustments are outlined in Section IV, paragraph 3.

SECTION III



HANDLING AND GENERAL MAINTENANCE INSTRUCTIONS

1. ACCESS AND INSPECTION PROVISIONS.

Inspection doors and cover plates are installed throughout the airplane. *(See figures 6, 7, 8, and 9.)*

2. GROUND HANDLING.

a. HOISTING PROVISIONS.

(1) HOISTING COMPLETE AIRPLANE.

(a) HOISTING POINTS. *(See figure 10.)*—The airplane is equipped with six hoisting points built into the structure. These are located in the following positions:

1. Two points, one on each side of the forward section of the fuselage where the nose joins the fuselage.

2. Two points located on top of the fuselage immediately aft of the rear gunner's compartment. (Used for hoisting fuselage-wings removed.)

3. One lifting point is located on the top of the rear spar at the center line of each nacelle.

(b) HOIST. *(See figure 11.)*—The standard hoisting sling provided for lifting the complete airplane is constructed of four ¾ inch diameter flexible steel cables complete with hooks and plugs. The two front suspension cables are held separate and in position by a spreader bar. Attached to the ends of the front cables are two plugs which fit and lock into sockets in the forward section of the fuselage. *(See figure 11.)* The two rear cables are fitted with hooks that engage into the attachments installed on the outboard surface of each nacelle.

(c) HOISTING. *(See figure 11.)*—Suspend the hoist directly over and aft of the pilot's enclosure; insert the plugs of front sling into sockets located in fore section of fuselage. With the hoist are two sets of shackles complete with pins. These shackles engage into built-in fittings located on the top of the rear spar, at center line of each nacelle. Remove the cover plates and attach shackles in place, then engage the rear sling hooks into them. After hoisting the airplane, these shackles and bolts shall be removed and stowed with the hoist.

CAUTION

When the four hoisting cables have been fitted into their respective positions, the hoist should be pulled taut, but before the airplane is lifted, a safety check should be made to ascertain that all hoisting fixtures have safely engaged. Raise the airplane a few feet and check for counterbalance.

(2) HOISTING COMPLETE AIRPLANE WITH WING TIPS REMOVED.—Proceed as in paragraph (c), above.

Note

As the amount of space gained by removing the wing tips is almost negligible, this procedure, therefore, is not recommended.

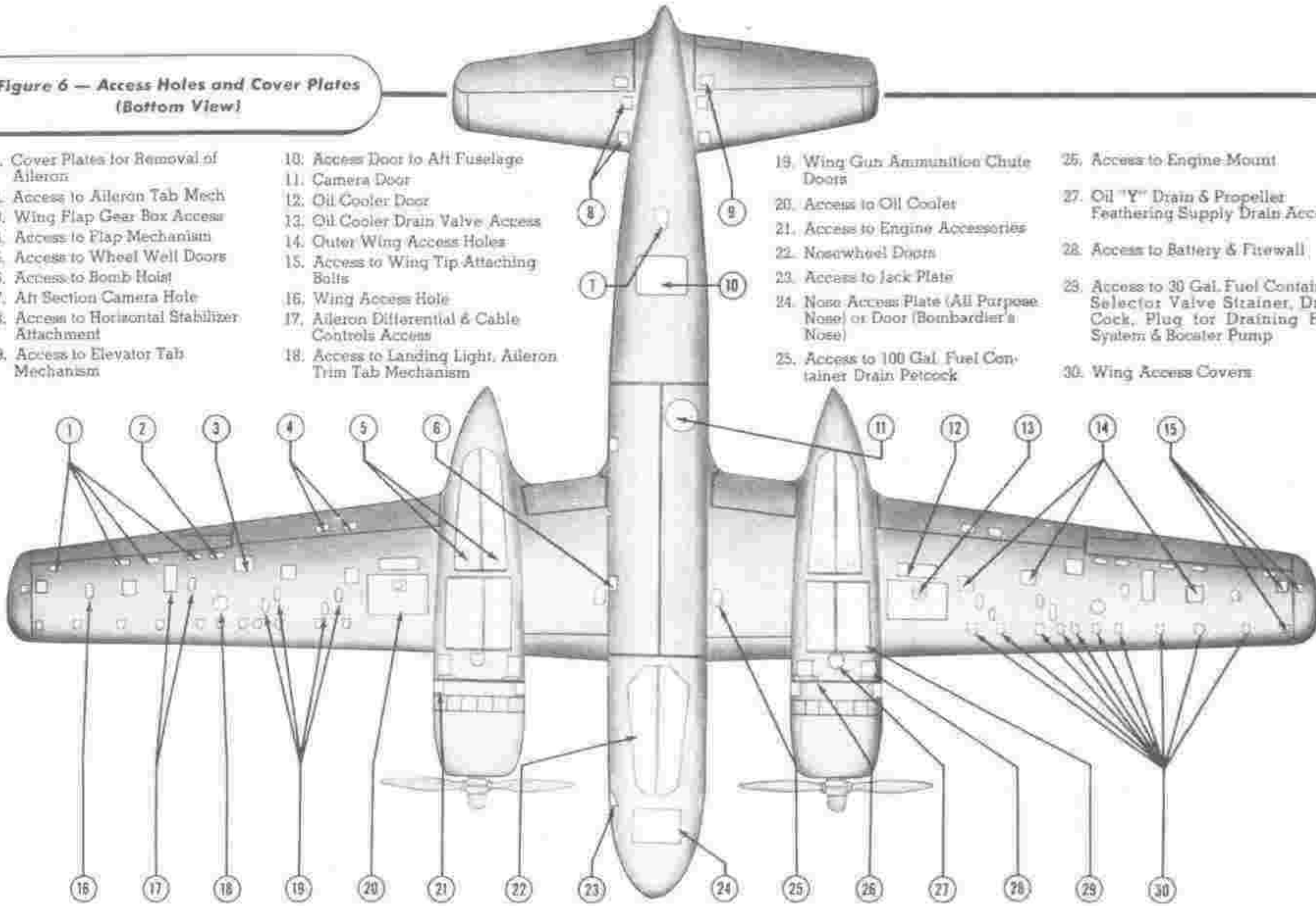
(3) HOISTING AIRPLANE WITH WING PANELS REMOVED. *(See figure 12.)*

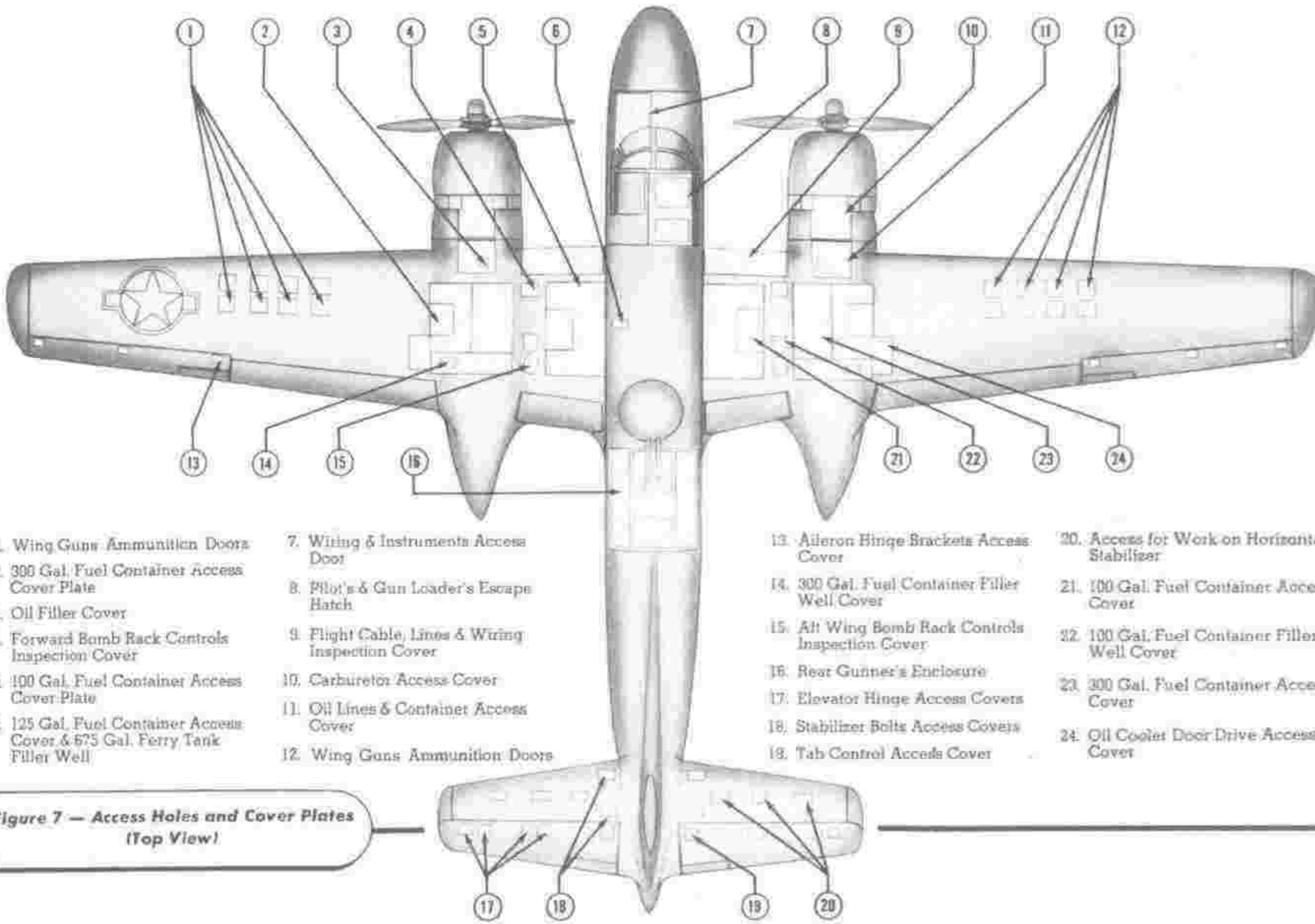
(a) HOIST.—The hoisting equipment for lifting the fuselage should be constructed of preformed flexible steel cable. A 4½" Dia. x 298" Blue Iron pipe acts as a spreader bar separating the front and rear slings. This hoist should be capable of carrying a safe load of 7000 lbs.

(b) HOISTING.—When the wing panels have been removed, the hoist should be suspended directly over the fuselage and the two plugs attached to the forward cables must be engaged into the two sockets built in the structure and located in the forward section of fuselage where the nose section attaches.

Figure 6 — Access Holes and Cover Plates (Bottom View)

1. Cover Plates for Removal of Aileron
2. Access to Aileron Tab Mech
3. Wing Flap Gear Box Access
4. Access to Flap Mechanism
5. Access to Wheel Well Doors
6. Access to Bomb Hoist
7. Aft Section Camera Hole
8. Access to Horizontal Stabilizer Attachment
9. Access to Elevator Tab Mechanism
10. Access Door to Aft Fuselage
11. Camera Door
12. Oil Cooler Door
13. Oil Cooler Drain Valve Access
14. Outer Wing Access Holes
15. Access to Wing Tip Attaching Bolts
16. Wing Access Hole
17. Aileron Differential & Cable Controls Access
18. Access to Landing Light, Aileron Trim Tab Mechanism
19. Wing Gun Ammunition Chute Doors
20. Access to Oil Cooler
21. Access to Engine Accessories
22. Nosewheel Doors
23. Access to Jack Plate
24. Nose Access Plate (All Purpose Nose) or Door (Bombardier's Nose)
25. Access to 100 Gal. Fuel Container Drain Petcock
26. Access to Engine Mount
27. Oil "Y" Drain & Propeller Feathering Supply Drain Access
28. Access to Battery & Firewall
29. Access to 30 Gal. Fuel Container, Selector Valve Strainer, Drain Cock, Plug for Draining Fuel System & Booster Pump
30. Wing Access Covers





1. Wing Guns Ammunition Doors
2. 300 Gal. Fuel Container Access Cover Plate
3. Oil Filler Cover
4. Forward Bomb Rack Controls Inspection Cover
5. 100 Gal. Fuel Container Access Cover Plate
6. 125 Gal. Fuel Container Access Cover & 675 Gal. Ferry Tank Filler Well
7. Wiring & Instruments Access Door
8. Pilot's & Gun Loader's Escape Hatch
9. Flight Cable, Lines & Wiring Inspection Cover
10. Carburetor Access Cover
11. Oil Lines & Container Access Cover
12. Wing Guns Ammunition Doors
13. Aileron Hinge Brackets Access Cover
14. 300 Gal. Fuel Container Filler Well Cover
15. Aft Wing Bomb Rack Controls Inspection Cover
16. Rear Gunner's Enclosure
17. Elevator Hinge Access Covers
18. Stabilizer Bolts Access Covers
19. Tab Control Access Cover
20. Access for Work on Horizontal Stabilizer
21. 100 Gal. Fuel Container Access Cover
22. 100 Gal. Fuel Container Filler Well Cover
23. 300 Gal. Fuel Container Access Cover
24. Oil Cooler Door Drive Access Cover

Figure 7 — Access Holes and Cover Plates (Top View)

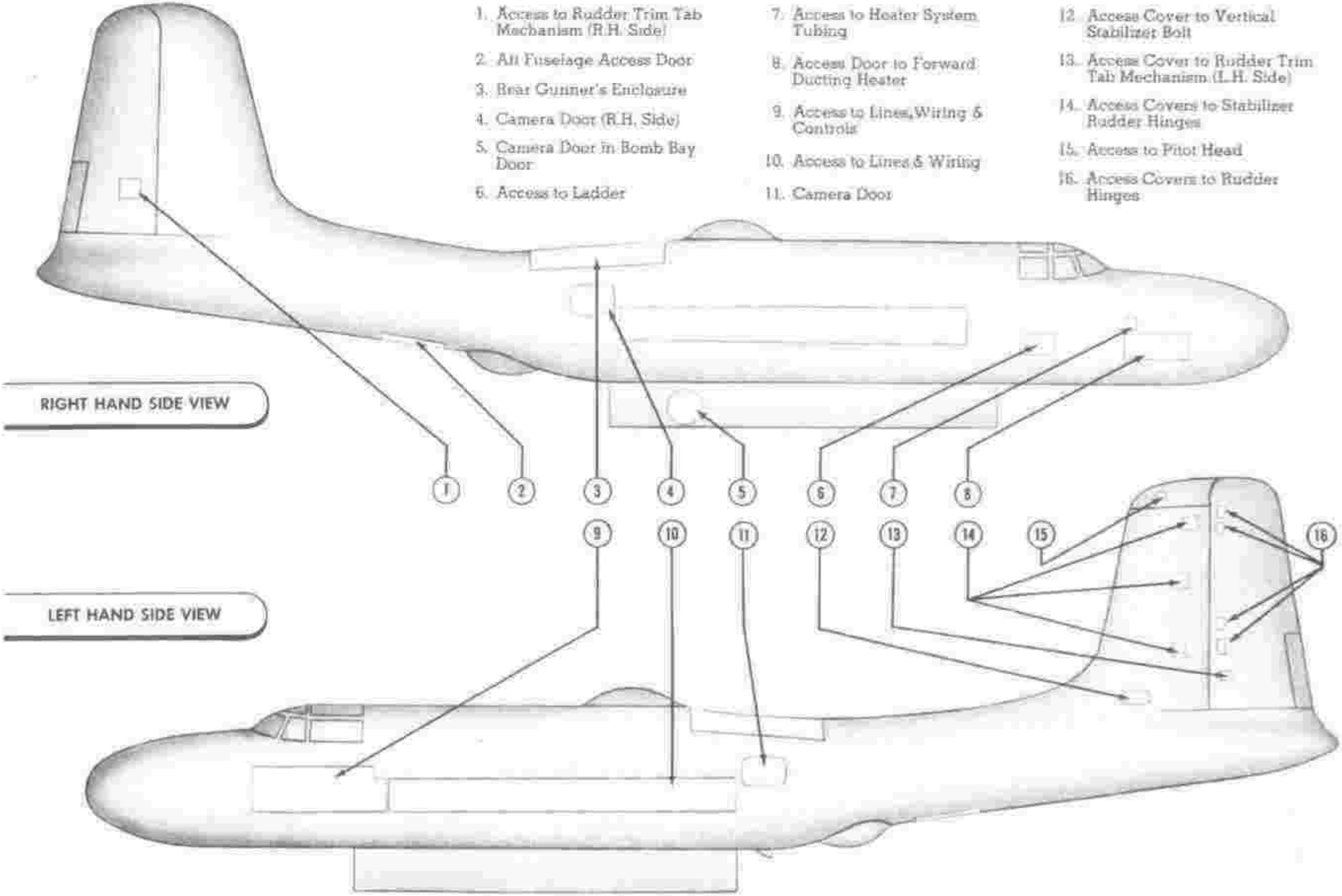


Figure 8 — Access Holes and Cover Plates (Side Views)

Two AN48 eyebolts should be inserted into the two built-in hoisting fixtures aft of the rear gunner's compartment and securely bolted into place *(figure 12)*. With the hoist spreader bar suspended parallel with the fuselage the two hooks attached to the rear sling shall be engaged into the eyebolts. These eyebolts are stowed in the miscellaneous handling equipment roll located in the rear of the left-hand nacelle.

CAUTION

Before lifting the airplane, the cables should be pulled taut and the four hoisting points checked to assure safe engagement. Then the fuselage should be raised a few feet to check for counterbalance.

(4) HOISTING FUSELAGE AFT SECTION. *(See figure 13.)*—In order to hoist the fuselage aft section, a cradle type sling may be constructed that will accomplish easier handling of this assembly. With the use of this sling, even balance is assured and no strain is placed upon the horizontal stabilizers. The upper frame of the sling secures the vertical stabilizer and rudder. This type hoist sling will be a great asset in preventing damage to the section when lifting fuselage aft section for any purpose.

(5) HOISTING VERTICAL STABILIZER AND RUDDER. *(See figure 15.)*—A sling may be fabricated that will greatly facilitate the handling of the vertical stabilizer with rudder attached. The hoist is so designed that the sling attachments fit and securely attach to the stabilizer by the removal of two screws from the second and twelfth screw holes (counting from the rear) at top spar of stabilizer and installing "T" screw plates *(3, figure 15)*.

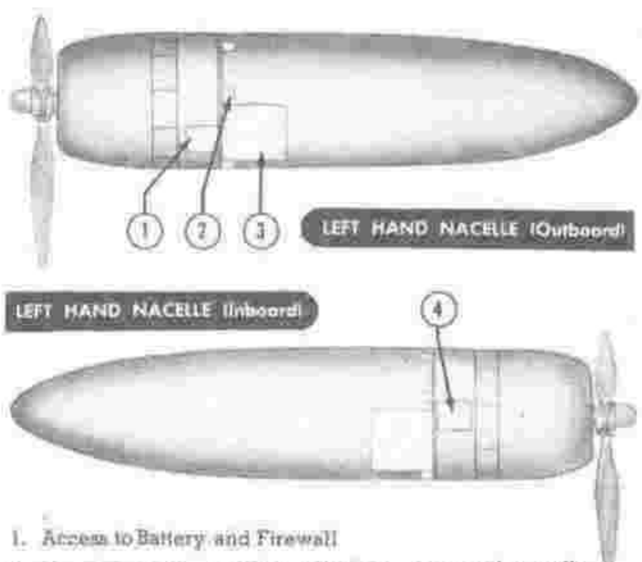
The sling is designed to hoist the complete assembly with the rudder secured. The attachments fitting into the vertical stabilizer at the spars, support the entire weight without strain. The screws removed should immediately be replaced when lifting attachments have been removed and hoisting operation completed.

(6) HOISTING THE PROPELLER. *(See figure 180)*—A simple yet practicable hoist sling may be constructed that will enable easy handling of this assembly. Two leather covered steel cables secured around the base of the propeller blades by means of safety lock hook, hold it in an inverted "Y" position. The vertical blade rests in a leather faced slot which prevents damage and slipping. The propeller, slung in this method, permits free working from either side in complete safety. It is important to check that the safety hook is correctly engaged into the shackle and that no metal parts of the sling come into direct contact with the propeller thereby causing nicking or scratching the assembly during the process of hoisting.

(7) HOISTING ENGINE. *(See figure 14.)*—Four hoisting attachments are built into the engine for convenience of lifting it during installation or removal. The engine sling must withstand a proof load of at least 8400 lbs. T sling *(figure 14)* may be constructed that will answer this purpose. It is essential that the correct specifications given be observed regarding length of cables to ensure correct balance. When hoisting the engine one man must always be alert to prevent the engine spinning when in the hoist, and it should be lifted slowly and without jerking. After the hoist hooks have been engaged in their respective connections the hoist cables should be pulled taut. Before clearing the engine from its supports make certain every hook is properly connected, then lift slowly, care being taken to observe balance.

(8) FUSELAGE NOSE ASSEMBLY SLING. *(See figure 17.)*—For the purpose of lifting either of the two types of nose a very practical sling may be devised with the use of leather covered cables and 3" cotton belting. Two lifting eyeplates are attached to each end of a "T" cross bar. From these plates, two cables are suspended and attached to the belting by riveted plates. The belting straps around the fore and aft section of the nose are secured at the bottom by a hook and eye. There are two side cables attaching the fore and aft sling that prevent the hoist from slipping during the hoisting operation.

b. MAIN LANDING GEAR HANDLING DOLLY. *(See figure 16.)*—In order to facilitate the handling and moving of the landing gear wheels when demounted from the airplane, a special portable dolly



1. Access to Battery and Firewall
2. Openings to Engine Mount Tiebolt — 6 on each nacelle
3. Access to Engine Accessories
4. Access to Flap Mechanism

Figure 9 — Access Holes and Cover Plates (Nacelle)

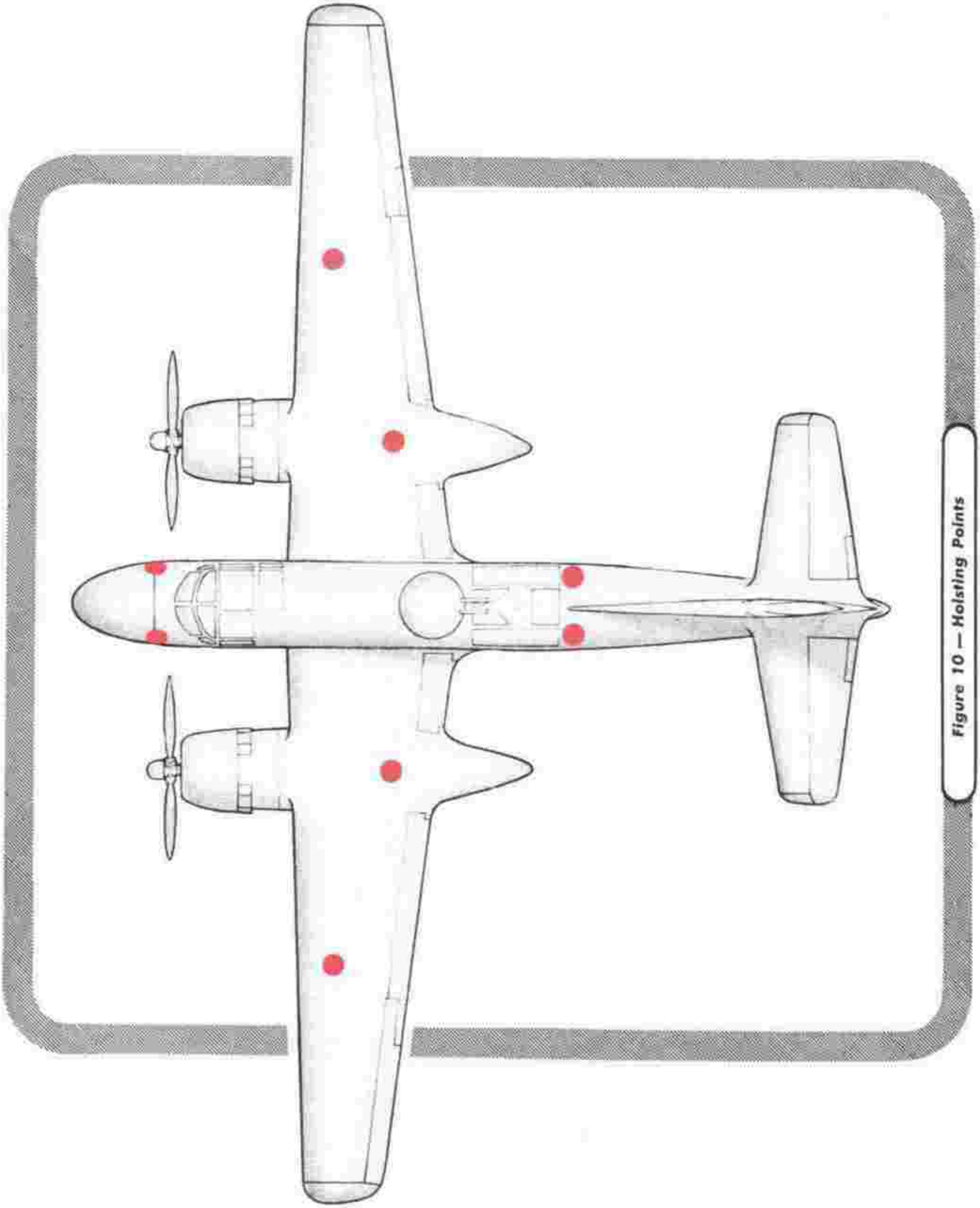


Figure 10 — Hoisting Points

may be constructed for this purpose. This type of dolly will be found convenient for supporting the main landing gear and wheel assembly when moving it from place to place as may be required; it also assists in eliminating possible damage. One man only is required to adjust the dolly in place or move it when this heavy assembly is loaded upon it. To attach the dolly to the landing gear, proceed as follows: Open the "T" handle bolt *(2, figure 16)* on the sleeve Push the dolly against the strut until the half sleeve fits flush. Close the sleeve and "T" handle bolt. To align the dolly in correct position, turn the adjustment screw bolts *(3, figure 16)* at top of dolly. The dolly is now in position to receive the full weight of the wheel. Care should be taken to check that the cross arm pads are pressing against the wheel rim and that the gear assembly is resting in the cradle arms before dismounting the gear assembly from airplane. Dismount wheel and pull dolly from under airplane. The dolly should be standing on a level area and the casters chocked or turned to prevent free motion.

c. JACKING PROVISIONS.–Jacks should be used for lifting the airplane to permit testing, replacement or servicing of the landing gear. With the exception of the nose and tail, it is practicable to jack at any jacking point on the airplane with a single jack. However, to jack at any point except under the main wheel axles, it will be necessary to secure a jack pad to the point.

Note

> Some jacks are equipped with jack pads. If using a single jack, do not jack through a range of more than seven inches without counterbalancing with another jack, as there is danger of slipping.

It is not necessary to do this at the main wheel jacking points because they are equipped with pads. The jack pads are carried in the miscellaneous handling equipment roll stowed on the outboard shelf in the left-hand nacelle. Jacking points are located as follows:

(1) FUSELAGE. *(See figure 26.)*–The fuselage forward jacking provisions are located on the lower surface of the fuselage, on the left-hand side, just aft of where the nose joins the fuselage. Remove the access cover plate *(23, figure 6)* to reach this jacking point. The fuselage aft jacking point is located directly forward of the tail skid fairing.

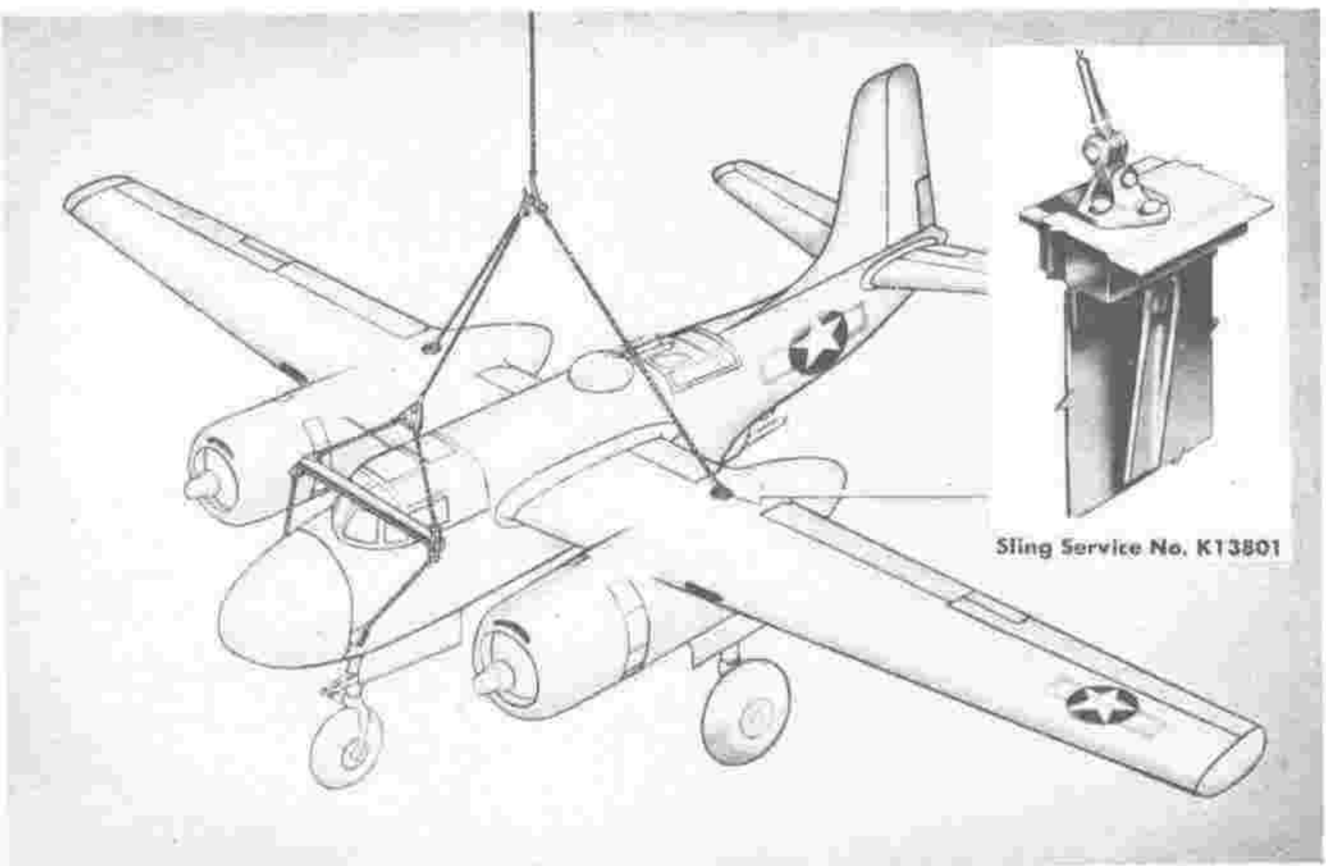
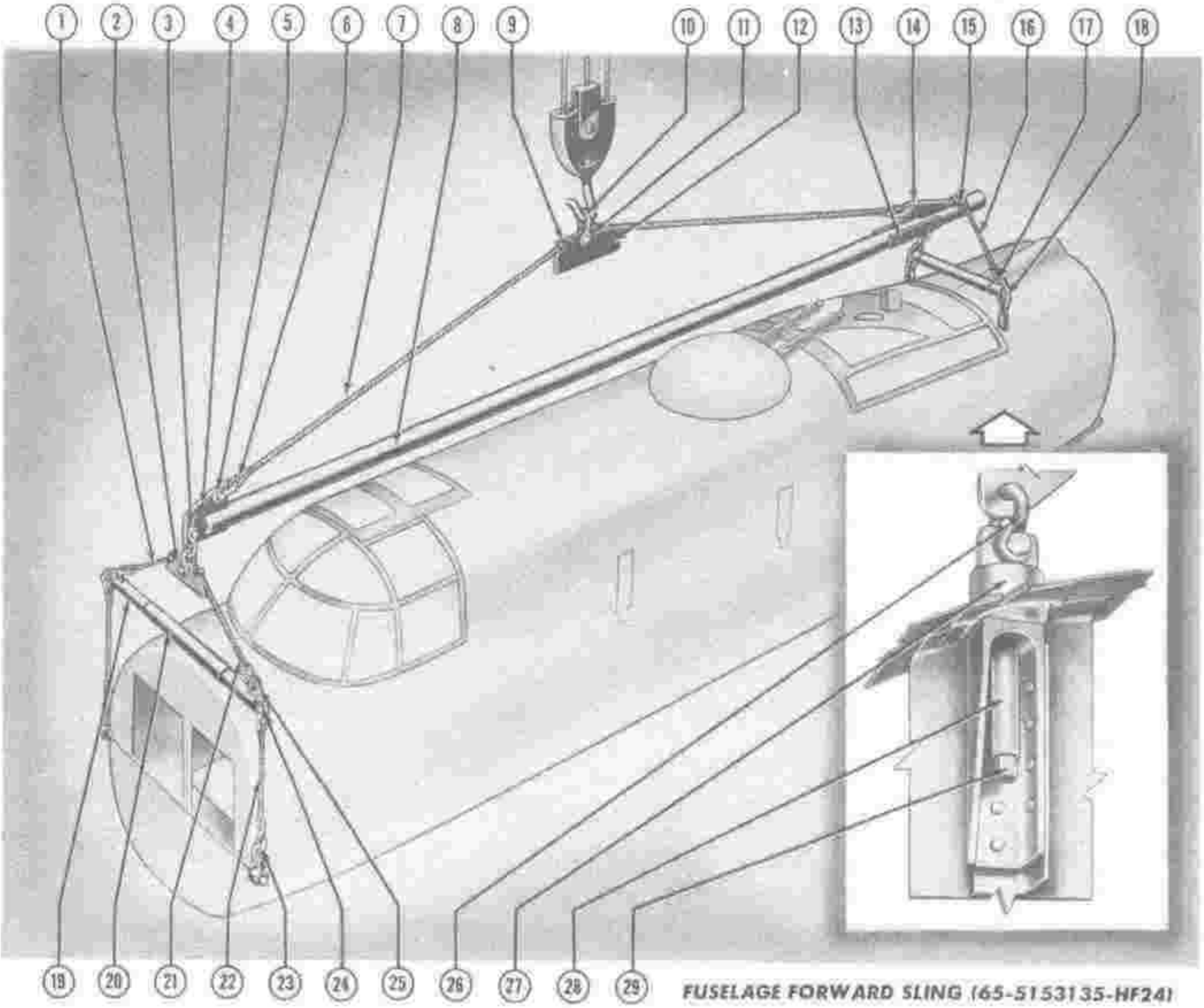


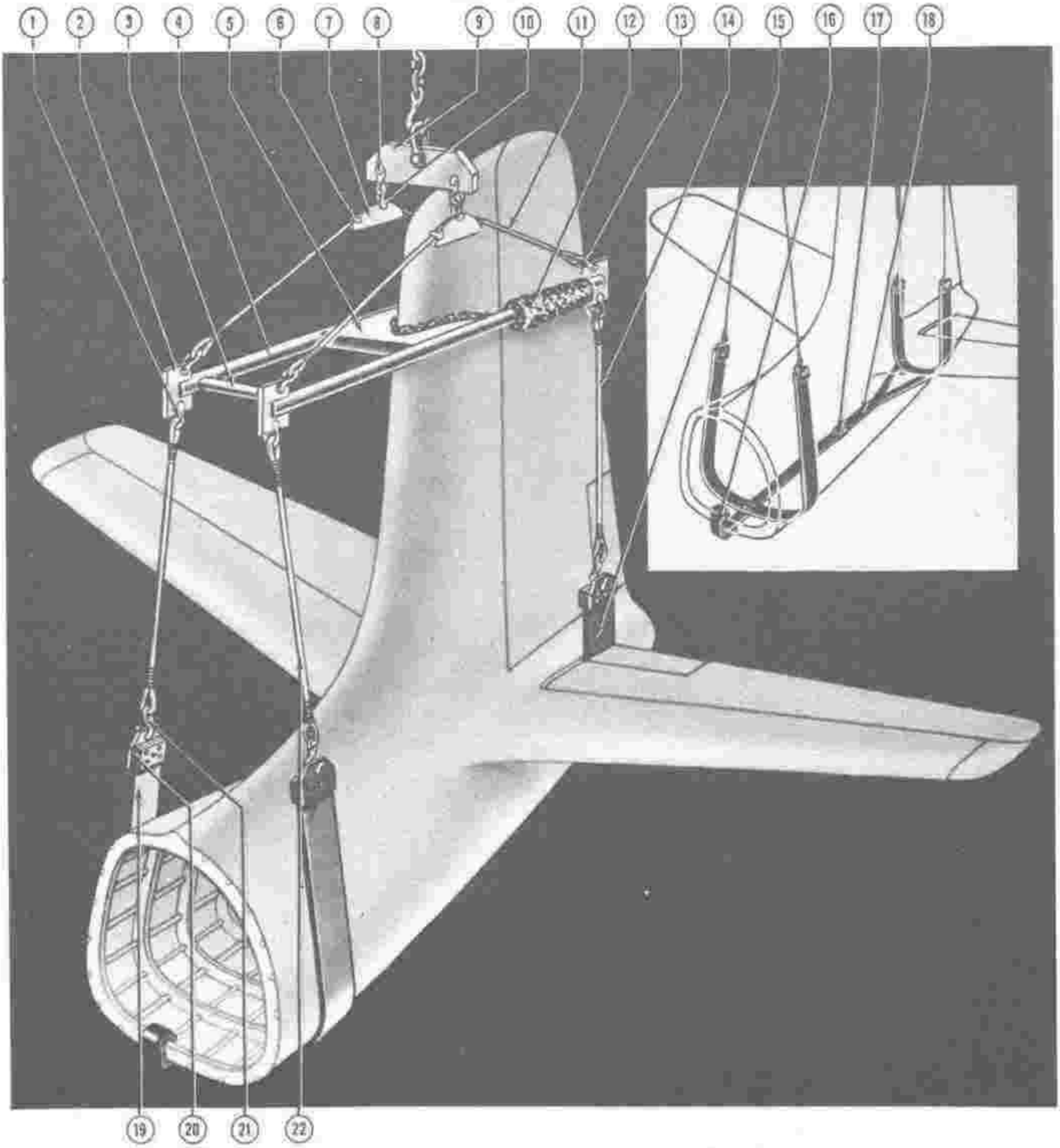
Figure 11—Hoisting Complete Airplane



FUSELAGE FORWARD SLING (65-5153135-HF24)

Ref. No.	Name	Size and Material	No. Req.
1.	Roebling Blue Center Wire Rope	1/2 x 126-1/2 (6 x 19)	1
2.	Eye Lift	1/2 (Cable Size)	1
	Plate	4 x 10-1/8 x 3/8 SAE 1020 CR	1
	Cable Clip (Ducommun)		2
	Anchor Shackle	3/8 x 11/16 x 7/8	1
3.	Round Pin Anchor Shackle	2-3/4 x 6-13/16 x 2-1/8	5
	Drop Forging	SAE 1025	5
	Hex. Nut	7/8-9	5
	Hex. Head Bolt	7/8-9 x 4-1/4	5
	Cotter Pin	1/16 x 1-1/4	5
4.	Plate	5/8 x 8-3/4 x 9-1/2 SAE 1020 HR	1
5.	Spacer	2 Dia. x 1-2 SAE 1020 HR	10
6.	Thimble	Cable Dia. 5/8 2-1/8 x 7/8 x 11/16 x 1-1/4 Wire Rope	2
7.	Roebling Blue Center Wire Rope	5/8 x 398 (6 x 19)	1
8.	STD. B.I. Pipe	4-1/2 Nom. x 298-7/8	1
9.	Cable Clamp (U Type)	5/8	4
10.	Round Pin Anchor Shackle	Drop Forging SAE 1025	1
	Hex. Nut	1-8	1
	Hex. Head Bolt	1-8 x 5-1/2	1
	Cotter Pin	1/16 x 1-1/4	1
11.	Spacer	2-1/2 Dia. x 3/8 SAE 1020 CR	2
12.	Plate	3/4 x 5-1/8 x 14-1/2 SAE 1020 HR	1
13.	Weights	As Req. For Balance	As Req.
14.	Plate	5/8 x 8-3/4 x 9-3/4 SAE 1020 HR c/s	1
15.	Eye Lift	3/8 Cable Size	1
	Plate	4 x 10-1/8 x 3/8	1
	Cable Clip (Ducommun)		2
	Anchor Shackle	11/16 x 3/8 x 7/8	1
16.	Roebling Blue Center Cable	5/16 Dia. x 37 Length (6 x 19)	1
17.	STD. B.I. Pipe	1-1/2 Nom. x 75	1
18.	Plate	5/8 x 6 x 9 SAE 1020 HR c/s	2
19.	STD. B.I. Pipe	1-1/2 Nom. x 61	1
20.	Cover	1/4 soft Gray Felt	As Req.
	Cover	12 oz. Canvas	As Req.
21.	Thimble	Cable Dia. 12-15/16 x 11/16 x 1-9/32 x 1-1/16 Wire Rope	2
22.	Roebling Blue Center Cable	5/16 Dia. x 31-1/4 Length (6 x 19)	2
23.	Roebling Hook with Safety Catch	#5	2
24.	Flat Washer	5/8	4
25.	Plate	1/2 x 6 x 8-3/16 SAE 1020 HR	2
26.	Round Pin Anchor Shackle	Drop Forging SAE 1025	6
	Hex. Nut	5/8-11	6
	Hex. Head Bolt	5/8-11 x 3-1/2	6
	Cotter Pin	1/16 x 1	6
27.	Bolt Assembly		2
	Pin	1/8 Dia. x 2 SAE 1020 CR	2
	Screw	1/2 Dia. x 4 SAE 4140 HR	2
	Hard White Felt	1/4 x 2 Dia.	2
	Head	2 Dia. x 2-3/4 SAE 1020 CR	2
28.	Nut (within Fuselage)	7/8 Dia. x 4-1/4 SAE 1020 CR	2
29.	Hex. Bar	7/16 x 3/4 SAE 1020 CR	2

Figure 12—Hoisting Fuselage Forward Section



1. 5/16" Shackle
2. 3/16" x 2-1/2" x 4" Mild Steel Plate
3. 1" I.P. x 10" Std. B.I. Pipe
4. 1" I.P. x 94" Std. B.I. Pipe
5. 2" x 12" x 9" Oregon Pine cut to fit
6. 5/16" "U" Type Cable Clip
7. 3/8" x 3" x 6" Mild Steel Plate
8. 7/16" Shackle
9. 3/8" x 3" x 12" Mild Steel Plate
10. 1/2" Shackle
11. 5/16" Dia. x 144" Finish Length Roebling Blue Center Cable
12. 1/2" Felt and Canvas
13. 5/16" Shackle
14. 1/4" Dia. x 66-1/2" Finish Length Roebling Blue Center Cable
15. 4" x 1/4" x 92" Rusco Woven Webbing or equivalent
16. 1/8" x 1-1/2" x 6-1/2" Mild Steel Bent Plate
17. 1-1/2" Harness Buckle
18. 1-1/2" x 3/16" x 148" Rusco Woven Webbing or equivalent
19. 4" x 1/4" x 121" Rusco Woven Webbing or equivalent
20. 3/16" x 4" x 4-1/2" Mild Steel Plate (Rivet as required)
21. #5 Roebling Safety Hook
22. 1/4" Dia. x 58-1/2" Finish Length Roebling Blue Center Cable

Figure 13—Hoisting Fuselage Aft Section

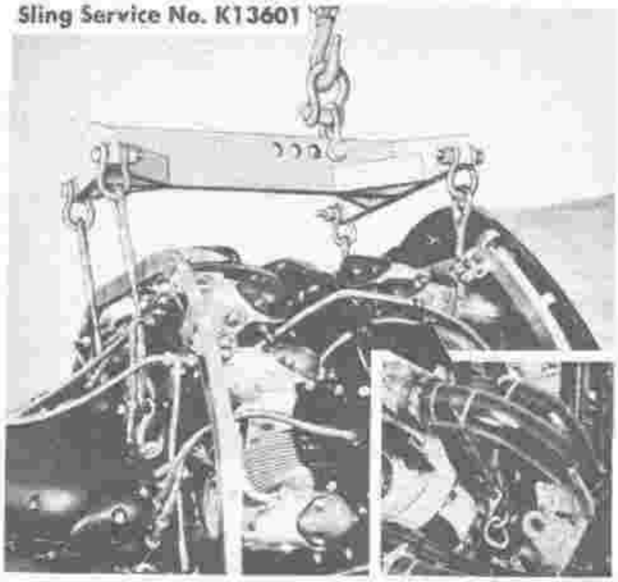
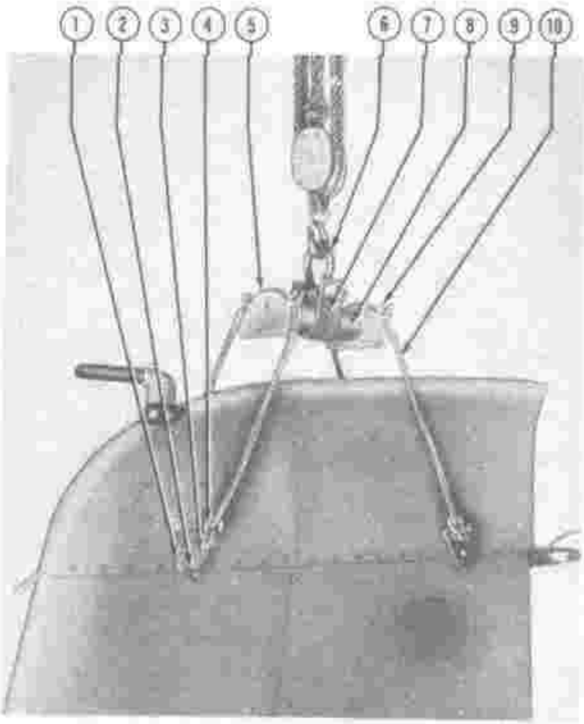
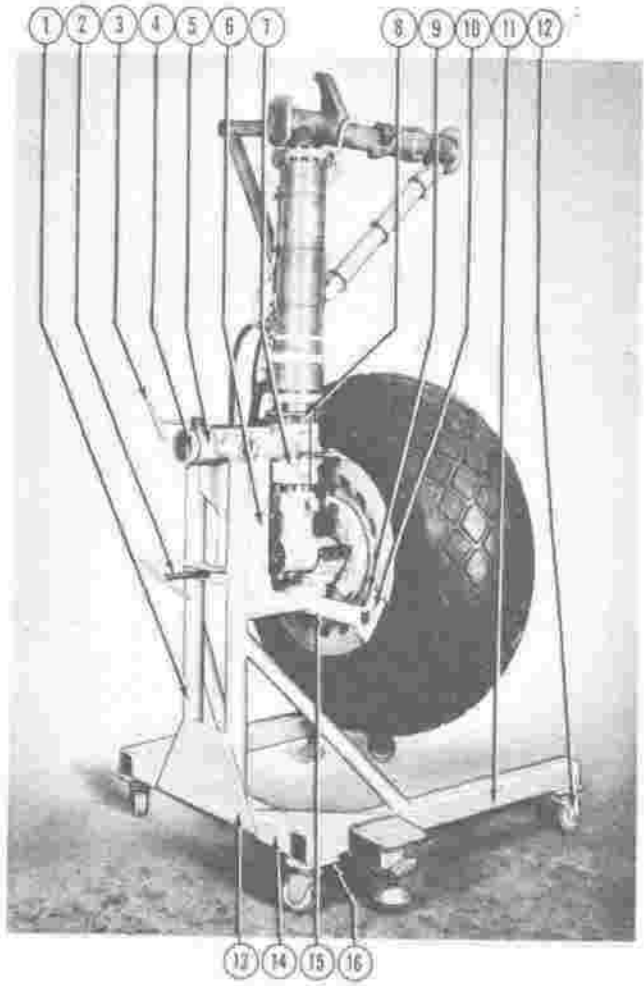


Figure 14 — Hoisting Engine



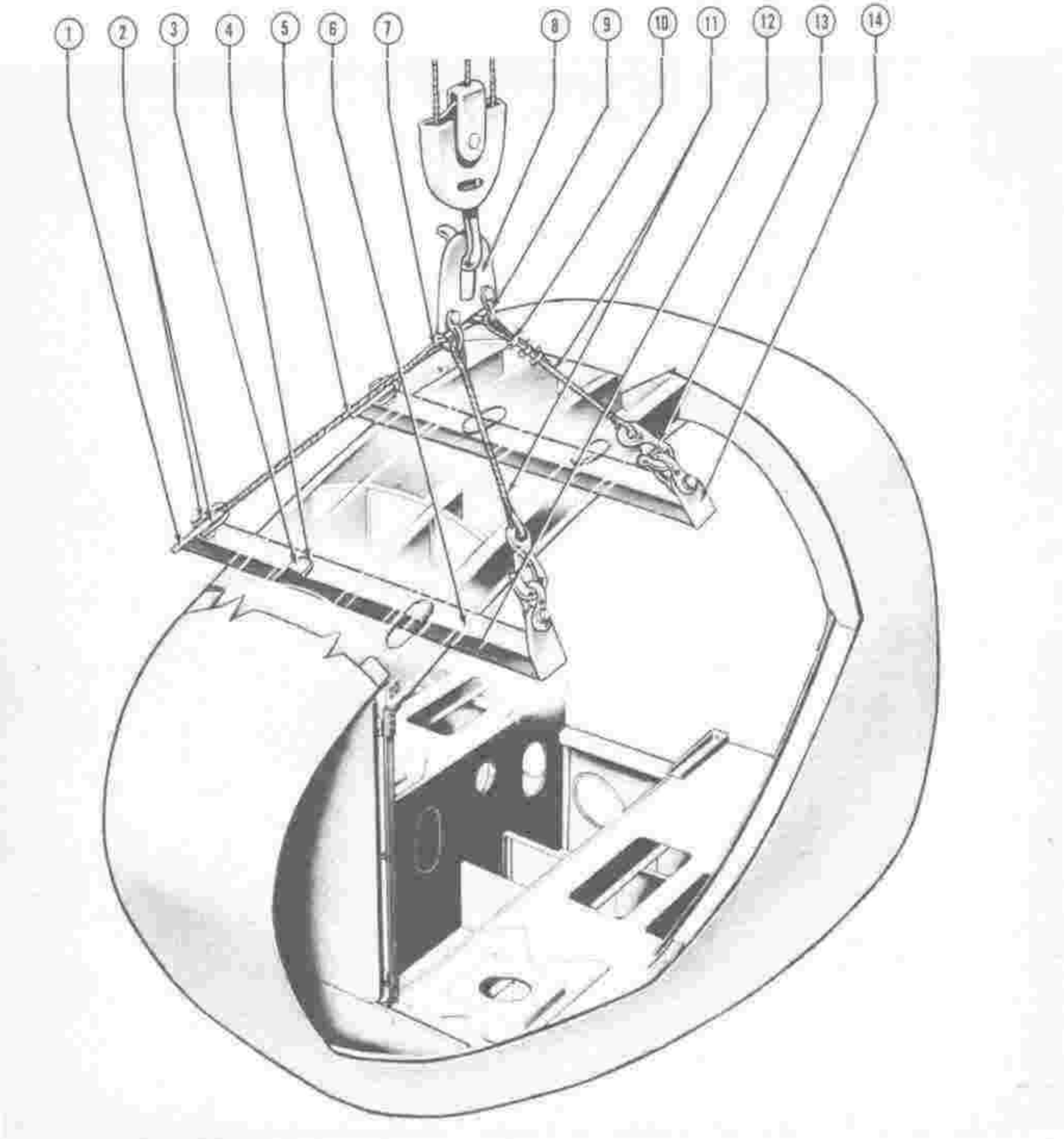
1. 1/8" Leather Cover
2. 10-24 Machine Screw
3. 1 1/2" x 1 1/2" x 1/4" x 3" Tee
4. 3/4" Shackle
5. 3/8" x 3" x 6" Mild Steel Plate
6. 3/4" Shackle
7. 1/4" x 2" x 9" Mild Steel Plate
8. 1 1/2" Inside Dia. x 7 1/2" STD. B.I. Pipe
9. 1/4" "V" Type Cable Clamp
10. 1/4" Dia. x 36" Finish Length Roebling Blue Center Cable

Figure 15 — Hoisting Vertical Stabilizer



1. 2" Inside Dia. x 40" Standard Blue Iron Pipe
2. 3/4" — 10 Tee Bolt
3. 5/8" — 11 Tee Bolt
4. 3 1/2" Inside Dia. x 15" Standard Blue Iron Pipe
5. 4" Inside Dia. x 7" Standard Blue Iron Pipe
6. 3" x 3" x .200" x 24" SAE 1025 H.R. Square Tube
7. 5" Inside Dia. x 7 1/4" Standard Blue Iron Pipe
   1/2" Dia. Hinge Pin
8. 1/4" Leather
9. 1/4" Leather
10. 3/8" x 2 1/2" x 6" Mild Steel Plate
11. 3" x 3" x .200" x 43" SAE 1020 H.R. Square Tubing
12. 1-74C1 Darnell Castor or equiv.
13. 1/4" x 10" x 20" Mild Steel Plate
14. 3" x 3" x .200" x 32" SAE 1025 H.R. Sq. Tubing
15. 2" x 2" x .145" x 22" SAE 1025 H.R. Steel Tube
16. 1/4" x 10" x 20" Mild Steel Plate

Figure 16 — Main Landing Gear Wheel Dolly



Sling Service No. K13901

Ref. No.	Name	Size and Material	No. Req.
1.	Bracket	1/4 x 3 x 4-3/16 SAE 1020 CR	2
2.	Spacer	1-1/2 Dia. x 3/16 SAE 1020 CR	8
3.	Plate	1/2 x 1-1/4 x 2-5/8 SAE 1020 CR c/l	4
4.	Pad	1/8 x 1/2 x 4 Leather	4
5.	Roebling Blue Center Cable	1/4 x 27 (6 x 19)	2
6.	Hard White Felt Covering	1/16	As Req.
7.	Wire Rope Thimble	1/4 Dia. 11/16 Width 1-3/8 Length	2
8.	Hoisting Link	5-3/4 x 4-1/4 x 1/2 SAE 1020 HR	1
9.	Anchor Round Pin Shackle	1-7/16 x 2-7/32	6
	Drop Forging	SAE 1035	6
	Hex. Nut	7/16-14	6
	Hex. Head Bolt	7/16-14 x 2	6
	Cotter Pin	1/16 x 3/4	6
10.	Safety Wire Rope Clip	1/4 Dia. x 2400 lbs. Wt.	6
11.	Roebling Blue Center Cable	1/4 x 35 (6 x 19)	2
12.	Tube	1/2 Sq. x .140 Wall x 23-1/2 SAE 1025 HR	2
13.	Chain Safety Snap Hook	For Chain Size 1/4 Load 450 lbs.	2
14.	Bracket	1/4 x 2 x 4-5/16 SAE 1020 CR	2

Figure 17 — Hoisting Fuselage Nose

CAUTION

The nose wheel should not touch the ground when jacking at this point.

(2) WING.—Each wing has two jacking points on the rear spar: one point *(figure 21)* is on the inner wing panel; the other point is outboard of the nacelle. If jacks high enough to reach the wing jacking points are not available, use supporting stands for shorter jacks. Make certain the stands are strong enough to support the airplane. With wing jacks of ample jacking range, it is not necessary to use restraining links on the oleos.

(3) LANDING GEAR.—A jack point *(figure 21)* is located on the lower end of each main landing gear shock absorber strut. Use either of these points when it is necessary to remove a tire or wheel, etc.

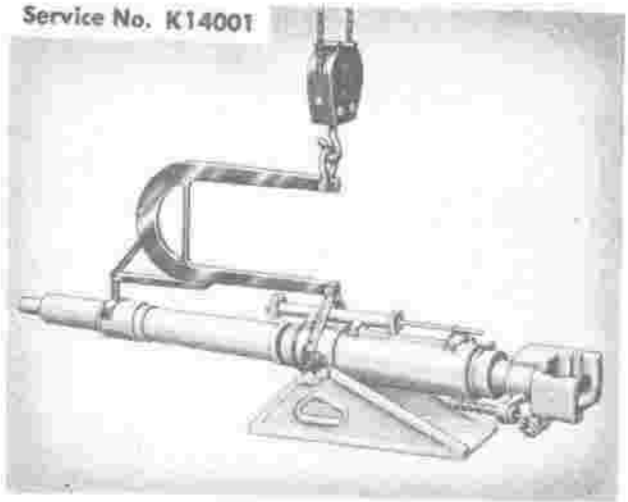


Figure 19 — Hoisting 75 mm Cannon

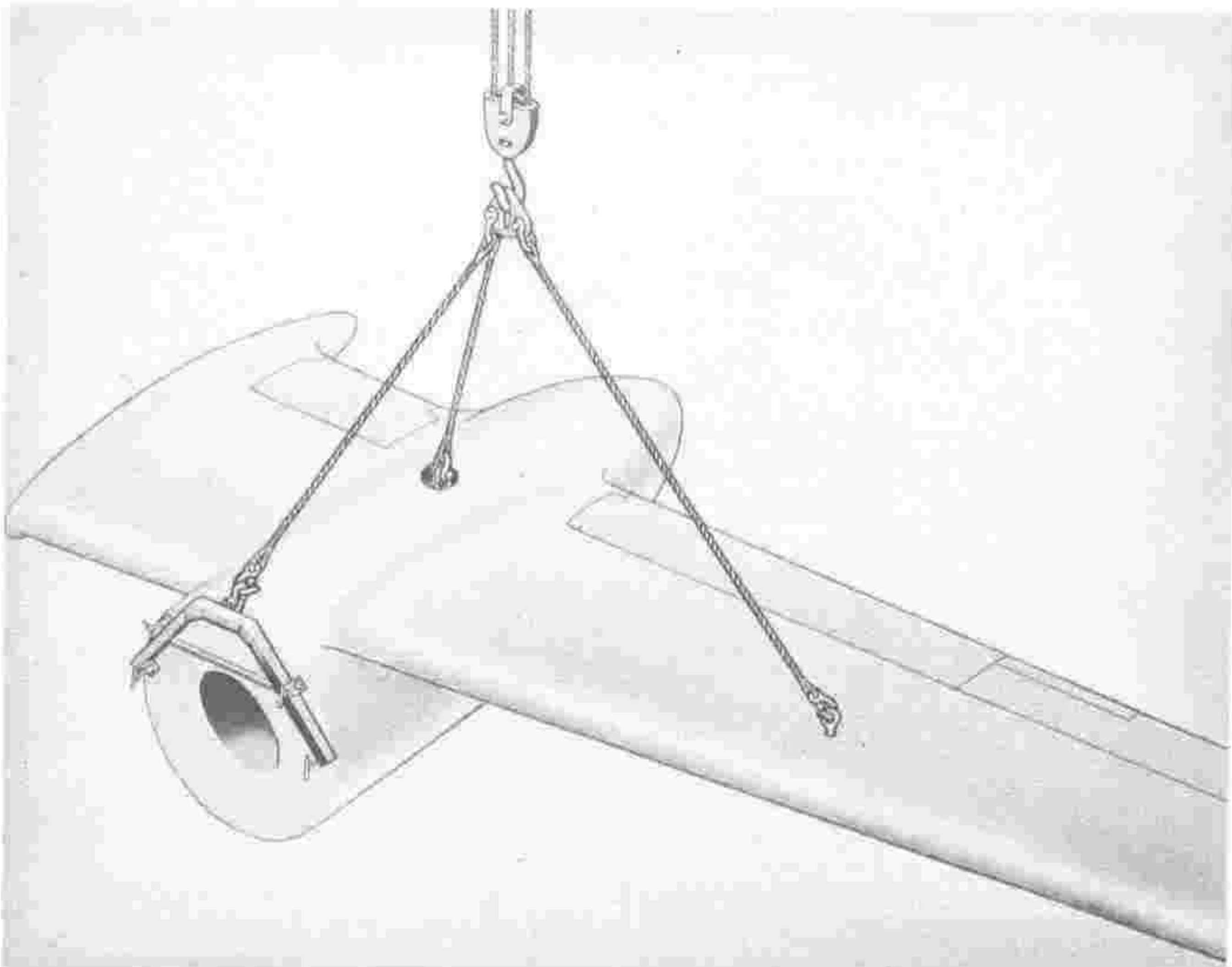
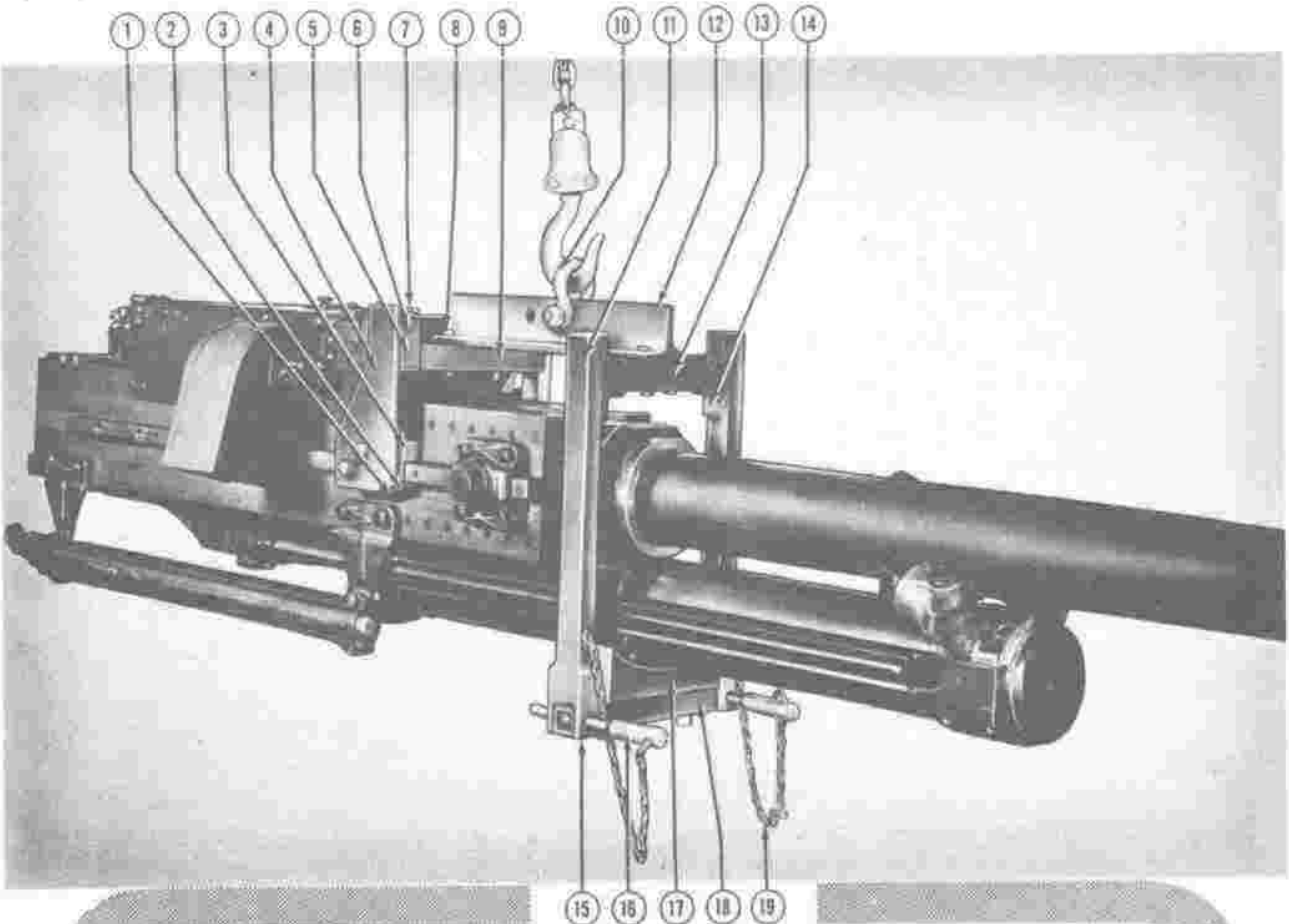


Figure 18 — Hoisting Wing



37 MM CANNON SLING C654-5202516-3HF1

Ref. No.	Name	Size and Material	No. Req.
1.	Angle	2½ x 2½ x ¼ x 3½	2
2.	Bar	½ x ½ x 3½ SAE 1020 CR	2
3.	Bar	¾ x ¾ x 3½ SAE 1020 CR	2
4.	Bar	¼ x 3½ x 7 SAE 1020 CR	2
5.	Bar	¼ x 1 x 2¼ SAE 1020 CR	2
6.	Bar	½ dia. x 1¾ SAE 1020 CR	2
7.	Bar	1 x 1 x 1 SAE 1020 CR	2
8.	Hex. Head Cap Screw & Nut	¼ — 20 x 1¾	4
9.	Square Tube	1 x 1 x .125 Wall x 6¾ SAE 1025 HR	1
10.	Shackle Assembly (K03-9649-5STK)		
	Drop Forging	Dia. ½ W. 1 13/16 L. 4¼	1
	Hex. Head Bolt	⅜ — 11 x 3½	1
	Hex. Nut	⅜ — 11	1
	Cotter Pin	1/16 x 1	1
11.	Square Tube	1 x 1 x .125 Wall x 13⅛ SAE 1025 HR	2
12.	Tee Angle	2 x 2 x ¼ x 12⅞	1
13.	Square Tube	1 x 1 x .125 Wall x 6 7/16 1025 HR	1
14.	Angle	1 x 1 x 3/16 x 1	6
15.	Bar	¼ x 1 x 2½ SAE 1020 CR Pin Hole Size .3750	2
16.	Jig Slip-Fit Pin (K652-9660-102 STK)	SAE 1020 CR	2
	Pin	Length 4⅝ Dia. .3745	2
	Handle	Length 2¾ Dia. ½	2
	Chain Hole	Dia. 5/16	2
17.	Micarta Bar	2 x 2 x 6	1
18.	Square Tube	1 x 1 x .125 Wall x 9½ 1025 HR	1
19.	Sash Chain		As Req.

Figure 20 — Hoisting 37 mm. Cannon

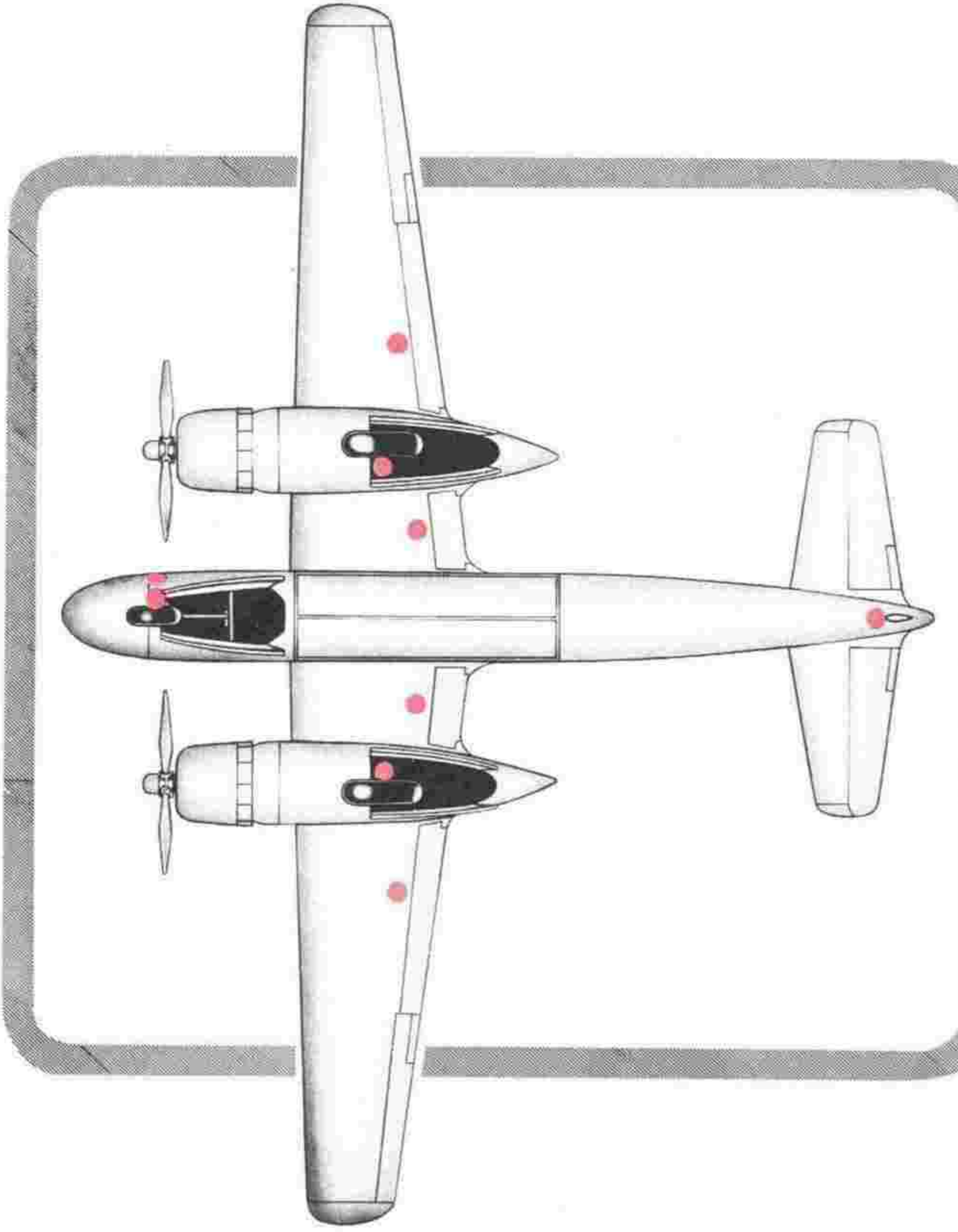


Figure 21 — Jacking Points

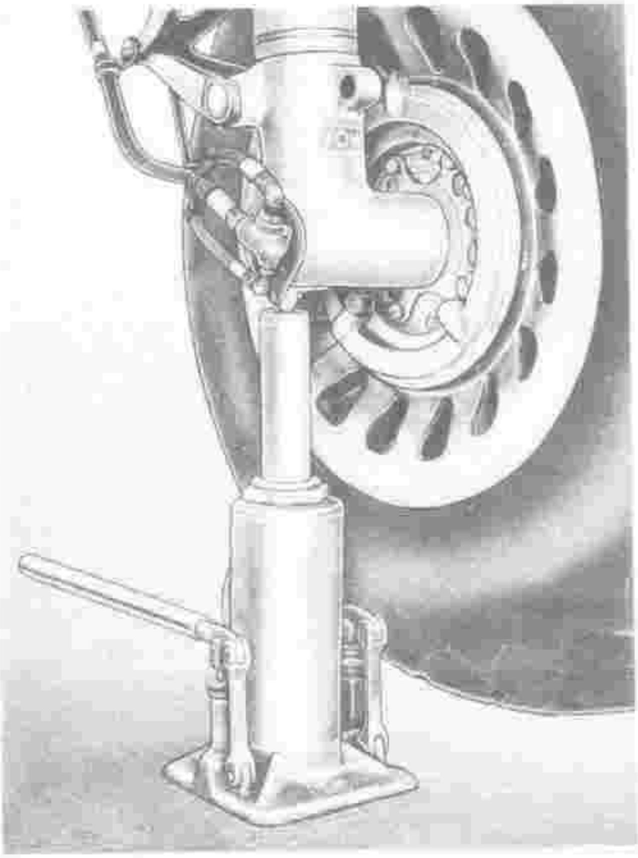


Figure 22 — Wheel Jack Installed

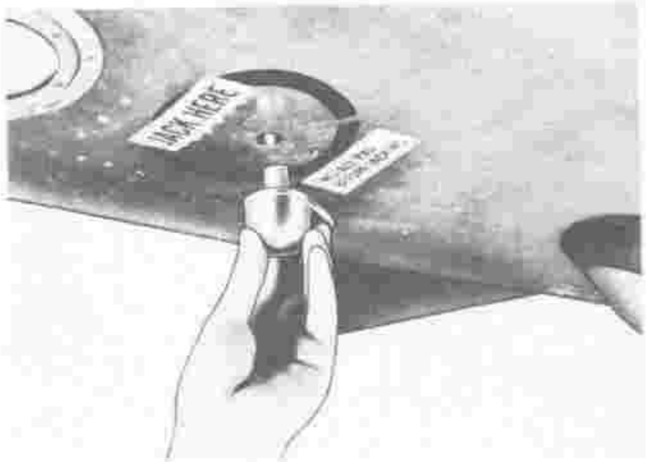
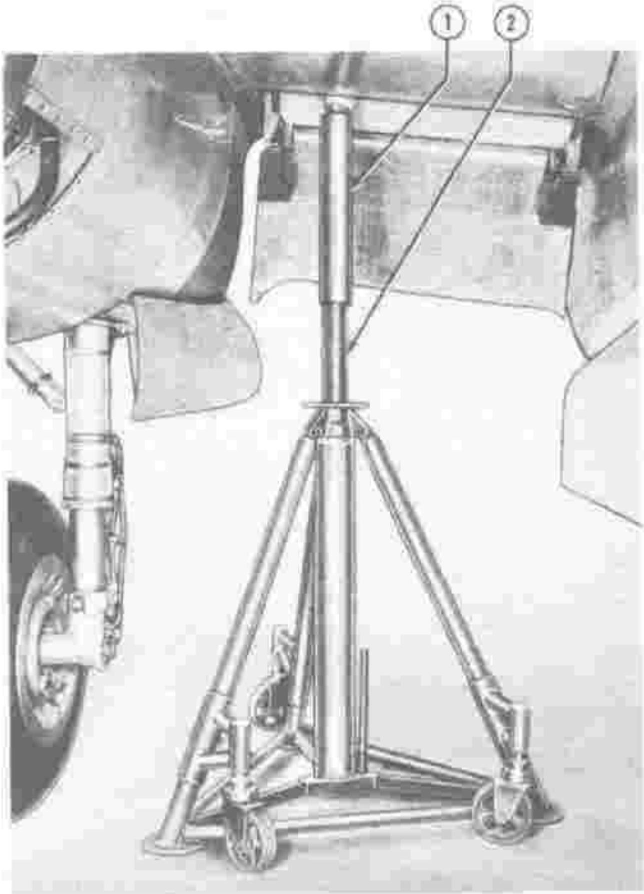


Figure 24 — Tail Jack Pad

CAUTION

For complete safety, the wing should also be jacked as there is danger of the wheel jack slipping.

Obviously neither may be used when it is necessary to retract the landing gear.



Name	No. Req.	Material	Dimensions
1. Hydraulic Jack Adapter			
Bar	1	SAE 1020 H.R.	5 Dia. x 3½
Seamless Mech. Tube	1	Steel	4½ O.D. x .375 W x 27
Pipe	1	B. Iron	3½ Nom. x 15¾
Bar	1	SAE 1020 H.R.	1 Dia. x ¾
Pipe	1	B. Iron	3½ Nom. x 11
2. Murrell Jack	1	Steel	Serial 2 M-800

Figure 25 — Wing Jack Installed

Figure 23 — Wing Jack Pad

(4) ENTIRE AIRPLANE.—To raise the entire airplane it is preferable to use at least four jacks. Jacks at the nose and tail are advisable in any combination of the four; and the other two must be separated by the fuselage.

WARNING

The airplane may be raised without the use of a tail jack; however, if the engines were removed or there were any other condition shifting the center of gravity toward the tail, it would be imperative to use a tail jack to prevent tipping the airplane back onto its tail. Considerable difficulty has been encountered in the field because of the single nose wheel jack having insufficient clearance for the retraction of the nose wheel. In such contingencies temporary jack pads or fittings may be fabricated to attach to the two nose hoisting points for the application of two jacks. One of these points is just above and aft of the regular nose jacking point; the other is in the same position on the right side of the fuselage. By employing two jacks in this manner, sufficient clearance for retracting the nose wheel is gained.

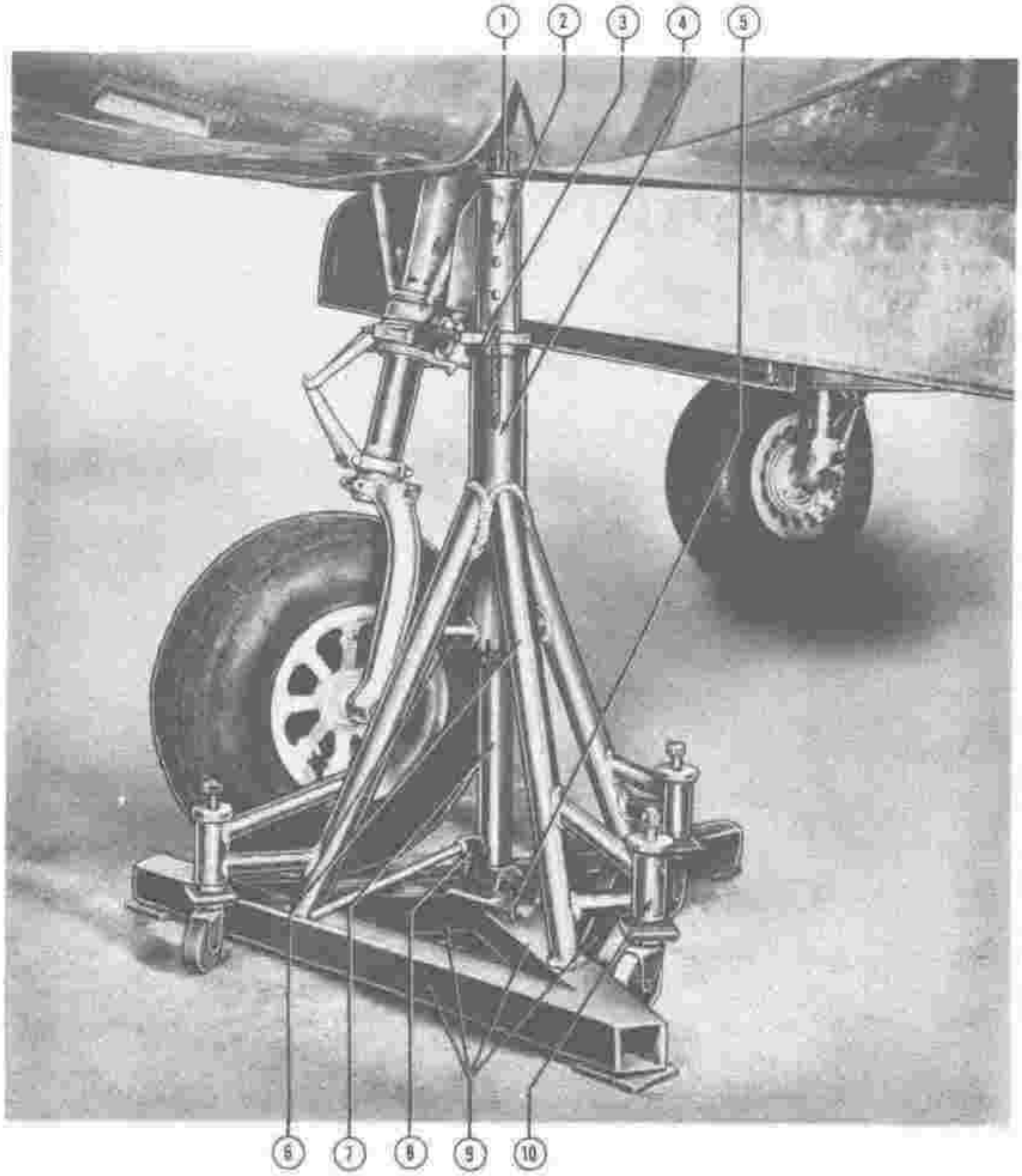


Figure 26 — Nose Jack Installed

KEY TO FIGURE 26—NOMENCLATURE NOSE JACK

NAME	*NO. REQ.*	*MATERIAL*	*DIMENSION*
1. Jack Pad Assem.			
Bar	1	SAE 1020 C.R.	⅝ Dia. x 1
Zerk Fitting	1		¼
Pipe	1	Std. B.I. Pipe	2 Nom. x 2¼
Base Plate	1	SAE 1020 C.R.	2¾ Dia. x ⅛
Belata Belting	1		⅛ x 2½ Dia.
Plate	1	SAE 1020 C.R.	2¼ Dia. x ⅜
Plate	1	SAE 1020 C.R.	2 Dia. x ½
2. Plunger Assem.			
Pipe	1	Std. B.I. Pipe	3½ Nom. x 23⅝
Pipe	1	SAE 1020 C.R.	4½ Dia. x 1
Pipe	1	Std. B.I. Pipe	2 Nom. x ½
3. Lock Pin Assem.			
Bar	1	SAE 1020 C.R.	¾ Dia. x 6
Bar	1	SAE 1020 C.R.	1 Dia. x 10
Safety Pin	1	SAE 1020 C.R.	
Elwel Chain	1		#5
4. Barrel Assem.			
Angle	3	SAE 1020 C.R.	1½ x 1½ x ¼ x 1
Pipe	1	Std. B.I. Pipe	4 Nom. x 5½
Pipe	1	Std. B.I. Pipe	4½ Nom. x 26¾
Collar	1	SAE 1020 C.R.	5½ Dia. x 1
5. Pin	1	SAE 1020 H.R.	¾ Dia. x 4
Pin	1	SAE 1020 H.R.	½ Dia. x 4½
6. Support Assem.			
Pipe	2	Std. B.I. Pipe	2½ Nom. x 43
Pipe	1	Std. B.I. Pipe	2½ Nom. x 44½
Pipe	2	Std. B.I. Pipe	1½ Nom. x 4½
Pipe	1	Std. B.I. Pipe	1½ Nom. x 6
7. Jack Shaft			
Pipe	1	Std. B.I. Pipe	¾ Nom. x 30
Pipe	2	Std. B.I. Pipe	1 Nom. x 4
8. Jack	1	Hein-Werner Hyd.	(C654-40873-D.P.) 5 Ton
9. Base			
Boiler Plate	1	SAE 1020 H.R.	½ x 14 x 12¼
Hex. Hd. Cap Screw	4		⅝ x 16 x 1½
Tube	2	SAE 1025 H.R.	4 x 4 x .250 Wall x 33½
Tube	1	SAE 1025 H.R.	4 x 4 x .250 x 81
Channel	1	SAE 1025 H.R.	4 x 6.25 x 35½
Tube	1	SAE 1025 H.R.	4 x 4 x .250 x 24
Channel	1		4 x .625 x 23½
Plate	3	SAE 1020 H.R.	.063 gage x 3¾ x 3⅝
10. Roller Assem.			
Pipe	1	Std. B.I. Pipe	1½ Nom. x 12½
Pipe	1	Std. B.I. Pipe	1½ Nom. x 7⅝
Pipe	2	Std. B.I. Pipe	1½ Nom. x 9½
Pipe	2	Std. B.I. Pipe	1½ Nom. x 5
Pipe	3	SAE 1020 C.R.	1 Dia. x 10⅛
Nut	3	Std. Hex. Castellated	⅞
Plate	3	SAE 1020 H.R.	3½ Dia. x 1
Spring	3	(Danley-9-0604-11)	⅝ x 3/16 x 1 (10 lbs.)
Pipe	3	Std. B.I. Pipe	2½ Nom. x 5⅞
Plate	3	SAE 1020 H.R.	2 Dia. x ¾
Pipe	3	Std. B.I. Pipe	2 Nom. x 5⅞
Caster Carriage	3		
Caster	3	Darnell	1.75-C1
Plate	3	SAE 1020 H.R.	½ x 5 x 6

(5) ENGINE SUPPORT JACK.—When work is to be performed on the wing above the nacelle that will require the removal or loosening of the stress plates, the engine must be supported to avoid any excessive strain. This support may be accomplished by jacking as shown in *figure 27*. A piece of wood approximately 4 x 8 x 36 should be cut so that one edge fits the contour of the engine. Place this on the jack head and pump jack until the curved edge fits under the engine rocker box covers. The jack head must never be placed against the rocker box covers directly; otherwise serious damage will result. If the jack is not of sufficient height a pedestal may be constructed by using a piece of wood of a suitable length and approximately 6 x 6. Fasten this in a vertical position to a base wide enough to avoid tipping. Brace the four sides. Secure the jack on top firmly. When the pedestal and jack are in position place the shaped piece of wood on top of the jack holding it in place as the jack is pumped. When the support is tight, it should be checked for center balance then jacked to take all extra strain from nacelle and wing.

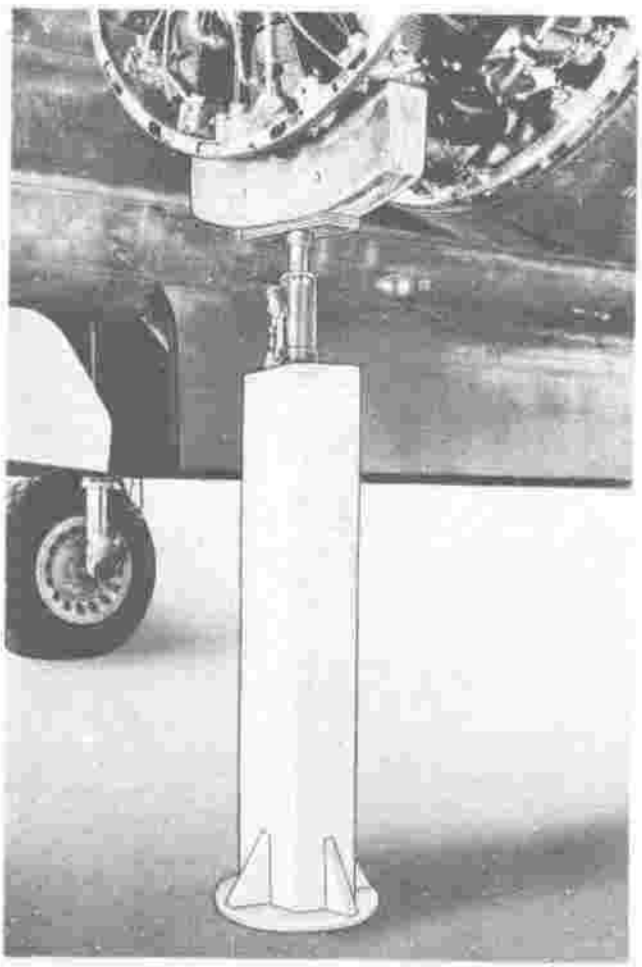


Figure 27 — Engine Support Jack Installed

(6) HOISTING AND JACKING PRECAUTIONS.—Observe the following precautions when hoisting the airplane or supporting it on jacks.

(a) Be sure that the jacks are of sufficient capacity to support the airplane safely.

(b) Rest the jacks on a level area.

(c) Airplane should be headed downwind and in no case raised when exposed to winds of more than 15 miles an hour velocity.

(d) Secure the airplane to prevent any yawing motion.

(e) Operate all jacks as simultaneously as possible when raising or lowering the airplane. Never use a single jack through a jacking range of over seven inches. Use two or more.

(f) Any movement of the airplane while it is resting on jack pads should be prevented.

(g) If the airplane is to remain supported and unattended for any length of time, ladders or other equipment should not be left where they will damage the airplane should a jack fail because of leakage of the hydraulic fluid. As a further safety precaution, in such cases, jacks should be supplemented with hoists from above or with shoring stands from below.

(h) Be sure a safety pin is used in the jack as a precaution against hydraulic failure if the airplane is to be left unattended.

(i) Disengage parking brakes before starting to jack.

d. LEVELING.—The airplane may be leveled, both longitudinally and laterally, to correctly adjust the instruments and armament. Place the leveling instrument in the following leveling points. (See *figure 585* for location of leveling points.)

(1) On the cross tie plate in the bomb bay.

(2) On the keel, inside the bomb bay.

e. SECURING.

(1) The airplane may be tied down, or moored, with cables or ropes which are attached to rings on the underside of each outer wing, and anchored to the ground. When mooring the airplane, proceed as follows: *(See figure 28* for location of tie-down and mooring points.)

(a) Head the airplane into the wind.

(b) Lock the surface controls *(15, figure 61)* in neutral position.

(c) Place the nose wheel in the fore and aft direction.

(d) Place wheel chocks in the fore and aft direction.

(e) Attach the mooring ropes to the tie-down fittings provided on the front of the main landing

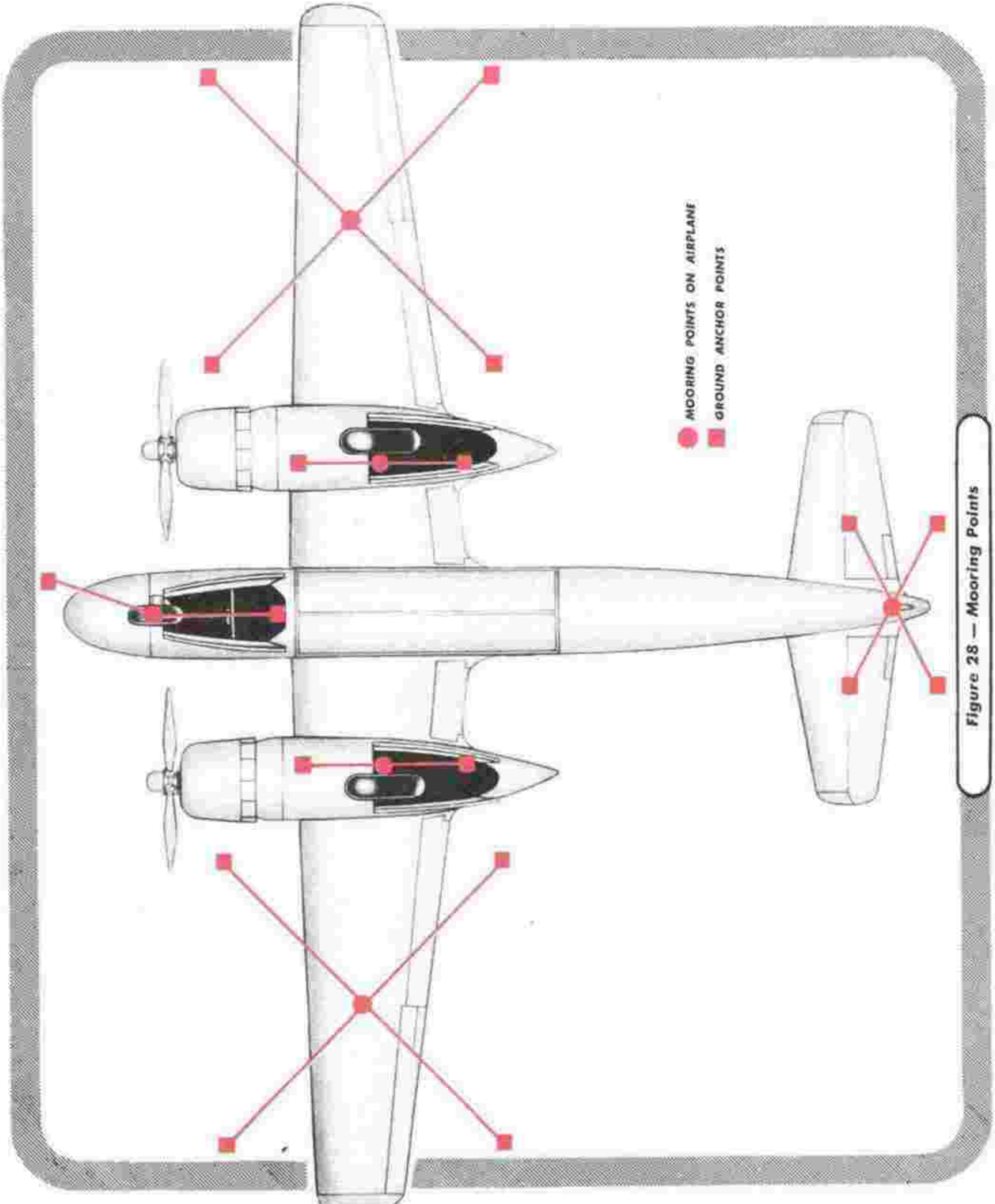


Figure 28 — Mooring Points

gear and nose wheel struts. The airplane must be parked in a level area.

(f) Gain access to the aft tie-down fitting *(figure 28)* by peeling back the rubber streamline fairing that encloses it.

(g) Engage the parking brakes.

(h) Be sure there is from 12 to 16 inches of slack in wing cables or ropes. Other lashings must be taut.

Note

Wing and tail ropes should be suspended at 45° angle.

(2) For emergencies, when warning of storms or high winds is received, install felt-padded, wooden clamps to lock securely all movable control surfaces. The clamps should be fabricated and used even though internal surface control locks are available. A spoiler should be clamped on the wings so as to avoid damage to the fabric covering of the aileron. The spoiler may consist of a wooden two-by-four, with a length equal to approximately 75% of the wingspan. It should be located at 10 to 15% of the average Sp. chord aft of and parallel to the leading edge of the wing, with the four inch dimension perpendicular to the wing surface and in such a manner that little or no space exists between the bottom of the spoiler and the wing surface.

(3) The diameter of the mooring cable should be ⅜ of an inch. If rope is to be used, it should be 1 inch in diameter.

f. SPECIAL MOORING EQUIPMENT.

(1) The location, number, and adequacy of permanent mooring rings on concrete aprons or ramps at activities having airplanes that must be moored in the open is a responsibility of the Director of Base Services, Headquarters, Army Air Forces. The attachment of mooring lines to airplanes moored on the aprons will conform as closely as possible to the mooring diagram outlined in *figure 28*.

(2) To use the type D-1 mooring kit, the anchor rod, part No. 36A4468 is screwed into the arrow, part No. 36A4467, and the driving rod, part No. 36A4466, slipped over the anchor rod and into the socket of the arrow. The cam on the driving rod must be turned so that the prongs of the arrow will not be spread by driving. If the ground is hard, the hardened surface will be broken first by using the ground breaking pin, part No. 38B3323. Care must be taken to align

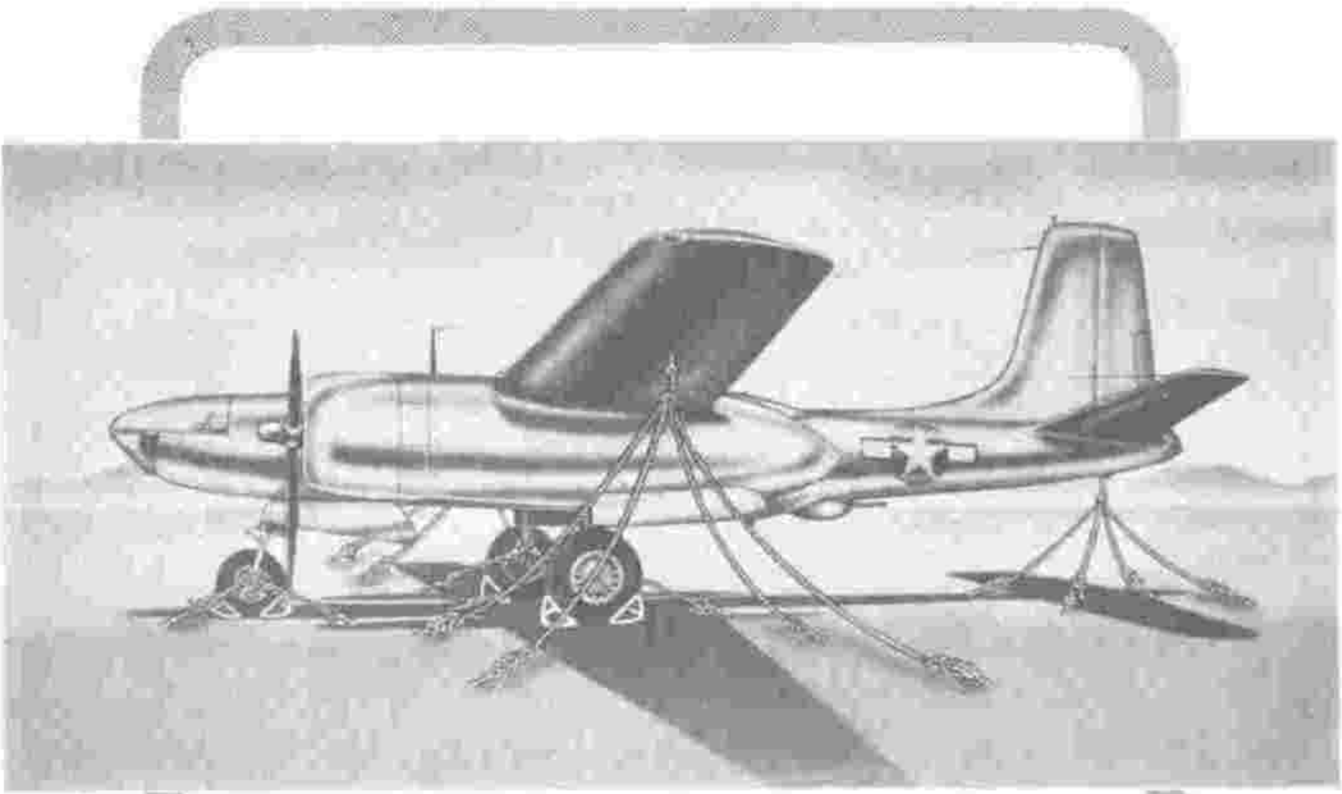


Figure 29—Ropes in Mooring Position

the rod with the point of attachment on the airplane. The arrow will be driven into the ground until the driving rod handle is within approximately three inches of the ground, the handle rotated approximately 90 degrees, and the driving rod given a sharp blow to spread the prongs of the arrow. The driving rod is then returned to the driving position and withdrawn from the ground. The squared socket of the eye assembly, part No. 36A4469, will then be aligned with the squared end of the anchor rod, fitted into place, and the knurled nut secured. The mooring rope will then be attached to the eye assembly and given an upward pull to spread and set the arrow prongs, as shown in *figure* 29. The mooring ropes will then be secured in accordance with the mooring diagram in *figure* 29. To withdraw the anchor rods, the mooring ropes are detached and the anchor rods unscrewed by turning the ring of the eye assemblies counterclockwise, leaving the arrows in the ground.

(3) Arrows for the type D-1 kit are expendable, and should be replaced upon return to the home station. The remaining items are also expendable but recoverable. Replacements will be obtained by requisitioning individual items. Property records and reports will likewise cover the component items, and not kit assemblies. This material will be carried and reported in Class 19.

(4) For semi-permanent and temporary mooring in the field, the "dead-man" mooring anchor may be used. The "dead-man" consists of a block of wood at least one foot long and of a square cross section at least 3 inches x 3 inches. Any other suitable material of equal strength or stronger that is available may be used. One end of a cable will be secured around the "dead-man" by splicing or the use of a cable clamp. A loop will be formed in the same manner at the free end to accommodate mooring ropes. The cable should be at least 3/4" in diameter. The "dead-man" will be buried on its side at a depth of 3 feet to 6 feet, depending upon the firmness of the earth, with the cable aligned with the airplane mooring fitting. In no case should the load on the cable be such as to cause the cable to assume a position perpendicular to the ground.

(5) Stakes similar to tent pegs may also be used. The stakes should be 2 inches to 3 inches in diameter and 3 feet to 5 feet long driven into the ground at an angle not to exceed 30 degrees from the vertical. The position of the stakes should be such that the load imposed by the mooring rope will tend to pull the stake into a vertical position. At no time should the direction of the rope be in line with the axis of the stake.

g. TOWING.

(1) When it is necessary to tow the airplane, extreme care must be taken to prevent damaging the fuselage or nose wheel assembly. Keep the towing speed low, avoiding quick starts and stops.

(2) The length of tow ropes if used should be approximately 3½ times the tread of the airplane, especially when towing over soft ground. Always attach tow rope to two main wheels, never to the nose wheel.

(3) The nose wheel fork on the subject airplane is provided with eye fittings for attachment of a towing bar. To attach the towing bar, place the towing bar fittings over the eye fittings on the nose wheel fork and insert a retaining pin. Insert the key chained to the towing bar in the end of the snubber release pin, and disengage the pin to allow 360° caster of the nose wheel.

CAUTION

The release plunger cap nut must be removed before the key can be inserted in the release pin.

Do not tow airplane with nose wheel strut fully extended.

Replace nose wheel towing release plunger cap nut after towing.

(4) There should always be one man in the cockpit to operate the brakes, one man or more at the tail, and a man at each wing tip when the airplane is being towed near a hangar or other airplanes.

CAUTION

Disengage parking brakes and make certain hydraulic pressure is at least 800 lbs. before towing airplane.

h. PARKING BRAKES AND CONTROL LOCKS.

(1) PARKING BRAKES.

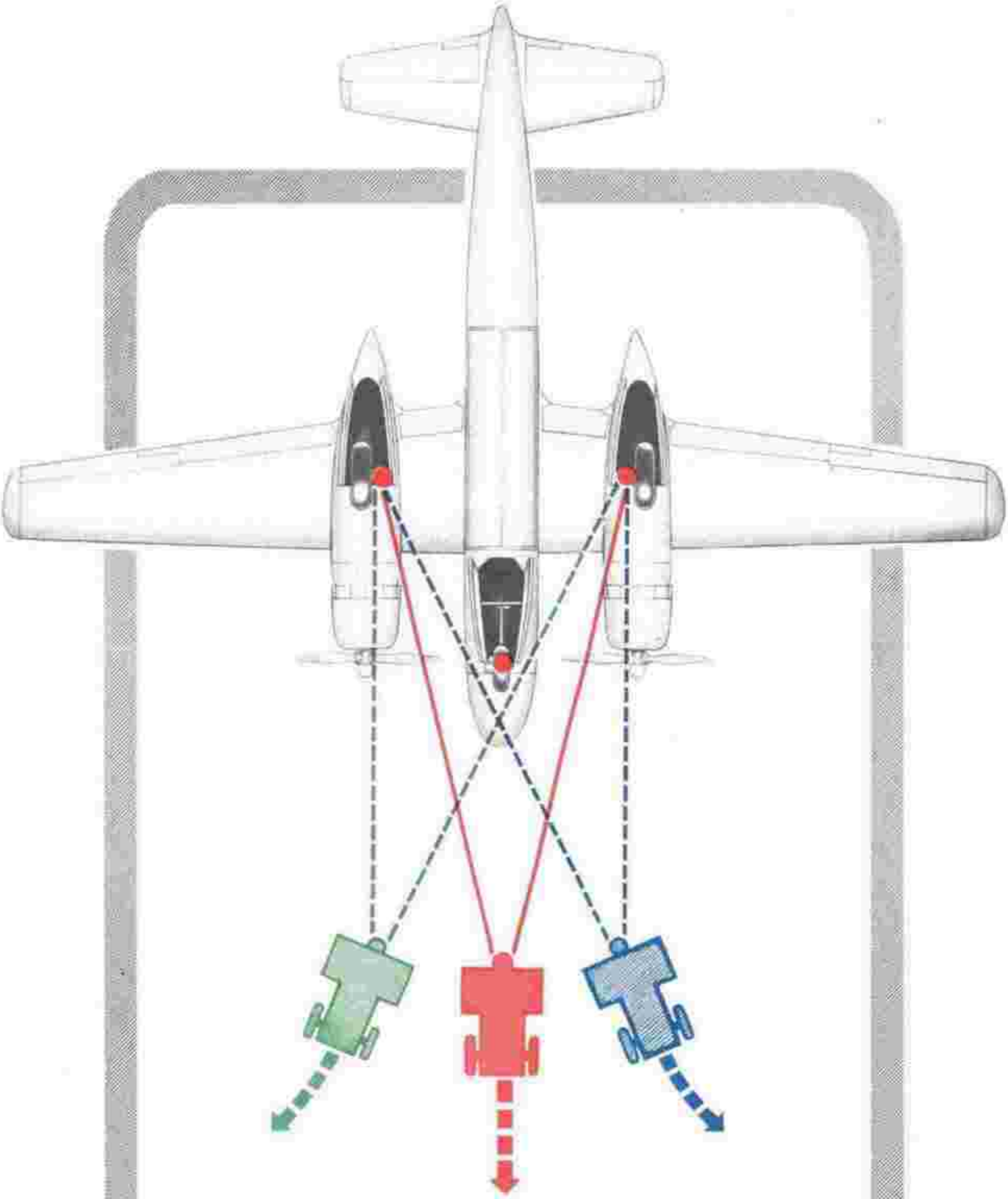
(a) A pull-type rod control mounted below the instrument panel, on the left-hand side, controls the parking of the wheel brakes.

(b) To set the parking brakes, depress the brake pedals and pull out the control knob; release the pedals before releasing the knob.

(c) To disengage the brakes, depress the pedals; the knob automatically returns to the "OFF" position.

(d) For satisfactory operation of the parking brakes, the hydraulic pressure gage should register 800 pounds per square inch minimum pressure.

(2) SURFACE CONTROL LOCKS. To engage the built-in surface control locks when parking the airplane, proceed as follows:



When using landing gear towing lugs, use ropes.

When using nose wheel landing gear towing lug, always use tow bar *(See Figure 31)*.

Figure 30 — Towing Points

1. Place the ailerons in a neutral position.

2. Move the control column to the neutral position.

3. Place the rudder and elevators in the neutral position.

4. The locking mechanism is operated by a lever in the forward bank of controls in the control pedestal. The throttles are stopped near the closed position by the control lock.

i. SERVICE INSTRUCTIONS.

(1) TO FILL THE FUEL CONTAINER.

(a) Each engine nacelle contains a self-sealing fuel container of 300 U. S.-249 Imp. gallon capacity and 9 U. S.-7.5 Imp. gallon expansion space. The containers are filled by means of a filler well, adjacent to the aft outboard corner of each container, and are accessible from the top side of the wing. A drain line from the filler well allows the excess fluid to flow to the ground at a point immediately outboard of the nacelle door.

(b) An auxiliary fuel container of the self-sealing type is located between the front and rear wing spars directly inboard of the nacelle in each wing. This container has a 100 U. S.-83 Imp. gallon capacity and 3.5 U. S.-2.9 Imp. gallon expansion space. The filler wells, which are inboard of the nacelle containers, are accessible from the top side of the wing. A drain line permits excess gas to flow from the filler neck to the ground.

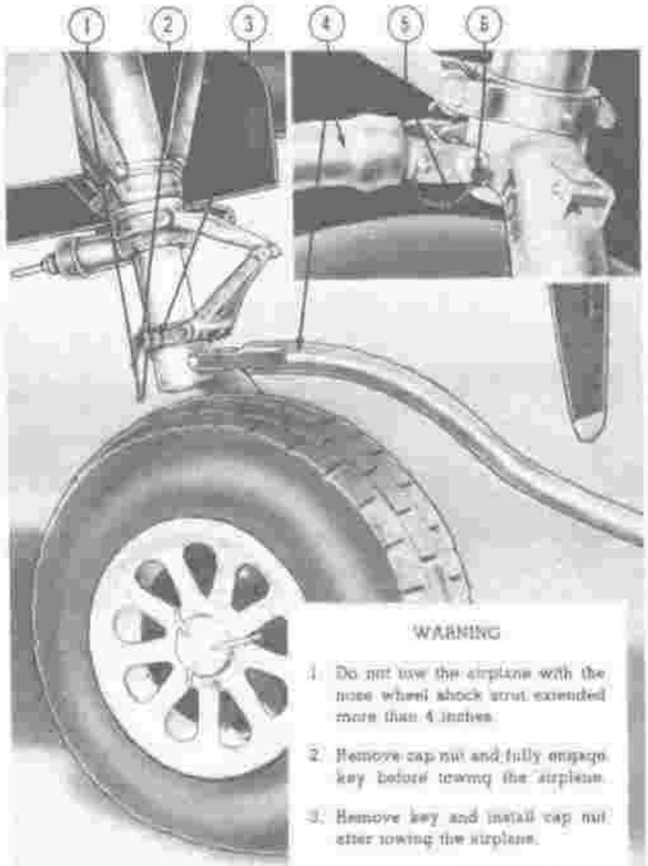
(c) A self-sealing bomb bay container of 125 U. S.-104 Imp. gallon capacity is installed in the forward section of the bomb bay. The filler well is at the top of the fuselage on the left-hand side, half-way between the forward and the second bomb rails. A drain line at the filler permits excess gas to flow to the ground. The ferry fuel tank, when installed, is attached to the bottom of the bomb bay fuel container. Both tanks are filled through the bomb bay tank filler neck. The ferry tank has a capacity of 675 U. S.-554 Imp. gallons.

(d) All fuel delivery hose should be metal-lined or otherwise bonded between the nozzle and the fittings on the opposite end. In addition, one end of a flexible bonding wire or cable should be permanently attached to the discharge nozzle. Whenever a fuel container is to be filled, the free end of this bonding wire will be attached to a convenient uninsulated metallic part of the airplane to insure an electrical bond between the container and the delivery hose. The bonding wire, however, must not be attached adjacent to the filler neck of the container. For convenience in quickly attaching or removing the bonding wire to or from the aircraft, a standard test clip can be used as a terminal on the free end. This bond must always be effected before removing the filler cap of the container, and not be disconnected until the cap has been replaced.

CAUTION

When fuel containers are being filled or drained, the work should be done out of doors. Care must be taken to avoid spilling the fuel. Smoking is prohibited as a guard against possible source of ignition. When fuel trucks are used, they must be equipped with a suitable static ground chain.

(e) Care must be exercised in servicing aircraft to avoid damage to the filler necks in the fuel containers. The nozzle is to be held by personnel, and should not be allowed to remain in the container without support.



1. Chain (Attaching Cap Nut and Key)
2. Cap Nut
3. Key
4. Tow Bar
5. Chain (Attaching Retaining Pin and Tow Bar)
6. Retaining Pin

Figure 31 — Tow Bar Installed

(2) TO FILL OIL CONTAINERS.

(a) An oil container is located in each engine nacelle, directly behind the firewall, and is of the bullet-sealing type. To reach the oil filler cap, remove the labeled access cover plate on top of the nacelle.

(b) The oil container filler opening is located on top of the container and is designed to facilitate filling without the use of a special funnel.

(c) A dip stick, which measures the oil in the tank, indicates the level as ¼, ½, ¾ and normal. Capacity of each oil tank is 39 U. S.-33 Imp. gallons; 30 U. S.-25 Imp. gallons of oil, and 9 U. S.-7.5 Imp. gallons of expansion space.

(3) TO FILL THE HYDRAULIC RESERVOIR.

(a) The main hydraulic reservoir is supported by brackets on the right hand side of the aft bulkhead in the pilot's compartment. A sight gage for determining the fluid level is incorporated in the reservoir, which has a fluid capacity of 1¾ U. S.-1½ Imp. gallons.

(b) The main hydraulic reservoir supplies fluid to the emergency reservoir in addition to the system.

(c) To fill the main hydraulic reservoir, proceed as follows using hydraulic fluid per AN Spec. AN-VV-O-366:

1. Use the funnel stowed in back of the pilot's seat for the purpose of filling the reservoir with hydraulic fluid. Fill the reservoir until the emergency reservoir is filled and the fluid registers to the normal level mark on the main hydraulic reservoir sight gage.

2. With the landing gear in the DOWN position, and the bomb doors OPEN, operate the hydraulic hand pump until the hydraulic pressure gage registers 1000 psi.

Note

If the hydraulic system has become airbound (caused by the replacing of lines, actuating cylinders, etc.) the airplane should be placed on stands and the landing gear and bomb bay doors should be operated through a complete cycle several times to force trapped air out through the reservoir vent.

(4) TO FILL THE ACCUMULATOR.

(a) Release all hydraulic system pressure, and check the hydraulic pressure gage for zero reading.

(b) Inflate the accumulator with an air bottle or air booster pump to between 600 and 750 pounds psi.

(c) The accumulator air pressure can be checked as follows:

1. Make certain that there is a zero reading on the hydraulic pressure gage.

2. Operate the hydraulic hand pump. The gage will remain at zero momentarily and then rise suddenly. The pressure reading after the rise is the amount of air pressure in the accumulator.

3. Release the system pressure by applying and releasing the brakes.

(5) FILLING THE ANTI-ICING FLUID TANKS.

(a) There are two anti-icing fluid tanks in this airplane; one carries 6 U. S.-5 Imp. gallons of alcohol for the propeller anti-icing system, the other carries 1 U. S.-.835 Imp. gallons of alcohol for the periscope anti-icing system. The propeller anti-icing system fluid tank is installed in the right-hand nacelle tail cone. The periscope system tank is located on the right-hand side of the gunner's compartment.

(b) Fill the propeller anti-icing system fluid tank as follows:

1. From inside the right-hand main landing gear wheel well, remove the canvas door which covers the entrance to the tail cone compartment.

2. Unscrew the filler neck cap and check the fluid level mark on the measuring stick attached to the filler cap. Fill as necessary with AN F-13 isopropyl alcohol.

(c) To fill the periscope anti-icing system fluid tank, remove the filler neck cap and check the fluid level mark on the measuring stick which is attached to the filler neck cap. Fill as necessary with AN F-13 isopropyl alcohol.

(6) TO INFLATE PNEUMATIC EQUIPMENT.

(a) MAIN LANDING GEAR TIRE. – The proper inflation pressure for the main landing gear tires depends upon the gross weight at which the airplane is to be operated. The tires should be inflated in accordance with the deflection mark on the tire. Normal pressure at 27,603 pounds gross weight is 54 psi.

(b) NOSE WHEEL TIRE.–The pneumatic tire on the nose wheel should be inflated in accordance with the deflection mark on the tire. Normal pressure at 27,603 pounds gross weight is 38 psi.

(c) LANDING GEAR SHOCK STRUT.

1. Remove the hex cap from the air valve on the upper end of the strut *(15, figure 94 and 11, figure 111)* and use a high pressure air pump, booster pump, or air bottle to inflate the strut.

WARNING

Compressed oxygen must not be used for this purpose.

2. Inflate the strut until the red line on the piston tube is 1⅞ inches from the end of the packing gland nut with the airplane at the operating load.

3. While inflating the strut, rock the airplane to alternately extend and compress the strut in order to overcome packing friction.

4. After the strut has been inflated, use soapy water to test the air valve, the valve core, and the filler plug for leaks. Replace the hex cap.

(d) FILLING SHOCK STRUTS.

1. Fill the strut with hydraulic fluid, Specification AAF 3580 through the filler plug hole until the fluid is level with the hole.

2. Insert the plug loosely and cause the strut to extend and compress completely several times in order to eliminate air traps.

3. Remove the plug and check the fluid level. If fluid is added, repeat the process again.

4. Insert the filler plug carefully to avoid damaging the threads. Screw it down tightly.

Note

Each time the filler plug is removed, replace the copper gasket in the filler plug seat.

(7) ARMAMENT LOADING INSTRUCTIONS.—For information on the loading of ammunition, bombs, and torpedoes, refer to section V.

3. GROUND OPERATING INSTRUCTIONS.

a. GENERAL.—The following instructions are applicable to normal starting, warm-up, and stopping procedures and are primarily intended for the use of the ground crew. Information regarding engine troubles, etc., will be found in paragraph 6., section IV.

b. BEFORE ENTERING THE COCKPIT.

(1) See that chocks are in front of the wheels.

(2) Check the gross weight, balance, and security if take-off is contemplated.

(3) Engage nose wheel snubbing pin.

Note

Destructive nose wheel shimmy will result if snubbing pin is not engaged.

(4) Remove pitot head cover.

(5) See that landing gear pins are installed.

(6) Visually check contents of fuel and oil tanks.

(7) Plug in battery cart receptacle. *Always use a ground battery cart for starting rather than the airplane batteries if the former is available.* Be sure battery switches are "OFF" if using a battery cart; "ON" otherwise.

c. ENTERING THE COCKPIT.—Enter the pilot's compartment through the compartment enclosure. Extend the access ladder by holding down on the access ladder control rod located within the foot step. Retraction of the ladder is accomplished by pushing the ladder up from the ground, or by pulling it up from within the pilot's compartment.

d. IN THE COCKPIT.

(1) Check hydraulic fluid supply for "NORMAL LEVEL" on gage.

(2) Hydraulic purolater—turn handle three or four times.

(3) Emergency air brake pressure gage—450 psi minimum.

(4) Parking brakes must be set.

(5) Carburetor air filter controls—"DIRECT" position. In dusty or desert areas "FILTER."

(6) Landing Gear Control lever—"DOWN."

(7) See that control surfaces are unlocked and free. Check flight controls for freedom of movement or slack. Set trim tabs at zero.

(8) Emergency hydraulic system selector valve control—"SYSTEM" position.

(9) Hydraulic hand pump lever—actuate lever and observe the hydraulic pressure gage for pressure increase.

(10) Observe the voltmeter to make certain the voltage output from the external power supply (ground battery cart) does not exceed 28.5 volts. Higher voltages may damage the radio and other electrical equipment.

(11) Check the functioning of the oil cooler doors by holding the oil cooler door switches in the "OPEN" position long enough (15 to 20 seconds) for the oil cooler doors to reach the full open position. Hold them in the "CLOSE" position long enough (15 to 20 seconds) for the oil cooler doors to reach the full closed position.

(12) Radio equipment—Check functioning.

(13) Compass and instruments—Check for proper settings and indications.

(14) Fuel quantity gages—Adequate supply.

e. SPECIAL CHECK FOR NIGHT FLIGHTS.

(1) Pilot's compartment lights—"ON."

(2) Instrument panel lights—"ON."

(3) Cockpit lamps—"ON."

(4) Adjust the rheostat for the engine instrument lights and flight instrument lights so that all instruments can be easily read.

(5) Navigation lights switch—"ON."

(6) Extend the landing lights and test the operation. Use landing lights only as necessary to conserve bulb life and to avoid current load on the batteries when the engines are not running. Retract the landing lights as soon as climb has been established and ground contact has been lost.

(7) Test operation of the recognition lights. *Do not allow the recognition lights* to remain "ON" longer than necessary (10 seconds maximum) when the airplane is on the ground. Prolonged use will cause the lenses to melt.

j. STARTING PROCEDURE.—If the engines have been idle for more than two hours, or if excessive priming has caused flooding of the engine, manually rotate the propeller twelve blades. If excessive compression exists remove the spark plugs from the lower cylinders and drain.

CAUTION

Make certain the ignition switches are "OFF."

(1) SET THE FOLLOWING CONTROLS FOR BOTH ENGINES.

(a) Fuel container selector valve controls—"MAIN ON."

Note

Each carburetor vapor vent line returns fuel at approximately 10 gallons per hour to the respective main container; therefore, when using fuel from other than the main fuel containers, room should be made in the main containers to accommodate this return.

(b) Fuel cross feed bomb bay tanks selector valve control "OFF."

CAUTION

If the control is in the "ON CROSS FEED" position, discharge of fuel to the engine not being started will cause excessive priming to that engine and a fire hazard. Have fire fighting equipment near engine being started.

(c) Mixture controls "IDLE CUT-OFF."

(d) Throttle controls—"¼ OPEN."

CAUTION

Do not move the throttle control levers more than necessary when the engines are inoperative, because movement of the throttles discharges fuel into the induction system. This may result in overpriming and/or backfiring.

(e) Propeller governor controls—"INCREASE RPM." (Low Pitch.)

(f) Supercharger blower ratio control levers—"LOW."

(g) Carburetor air temperature control levers—"COLD."

CAUTION

The control should not be in the "HOT" position; serious damage or fire may result from a backfire.

(h) Cowl flap switches "OPEN."

CAUTION

Do not close cowl flaps under any circumstances. If closed, the cylinder head temperature will quickly rise and exceed the critical temperature, 232°C (450°F); resulting in damaged spark plug elbow insulation.

(i) Oil cooler doors—Set to desired position.

(j) Master ignition switch—"ON."

(k) Generator switches—"ON."

(l) Instrument vacuum selector valve control—"R. H. PUMPS."

(2) START THE RIGHT ENGINE:

(a) Right wing fuel booster pump switch—"LOW BOOST" (7-9 psi).

(b) Primer switch—"ON" approximately 2 seconds.

Note

This is not intended as a priming operation, but to fill the priming lines with fuel so that priming is immediately effective.

(c) Prime the engine as necessary before and while accomplishing steps *(c)* through *(f)* below.

(d) Energize switch "R" about 20 seconds to bring starter up to speed.

(e) Engage switch "R" continuing to depress the energize switch.

CAUTION

After turning the energize switch and the engage switch "ON," continuous direct cranking must not exceed 30 seconds. If the engine does not start after 30 seconds, the starter must be allowed to cool for one minute before attempting to start the engine.

(f) Right engine ignition switch—"BOTH" after engine has turned over three or four times. Hold engage switch in "R" position until the engine fires.

CAUTION

In order to prevent backfiring, do not turn the ignition switch to "BOTH" until the engine is turning over.

Note

When engines are handcranked, they should be *manually* meshed (by pulling the meshing cable)—NOT electrically meshed. After the propeller starts to turn, the man in the pilot's compartment should turn "ON" the MESH switch until the engine fires (this connects the induction vibrator circuit). Then turn on the ignition switch. Before handcranking the engine starter, pull the manual meshing cable to lift brushes off the commutator (to prevent drag). Before electrically starting ("ENERGIZE") starter, momentarily push MESH switch to drop brushes on commutator.

CAUTION

After starter acceleration and meshing with the engine, continuous direct cranking must not exceed 30 seconds. If the engine does not start after 30 seconds of cranking, the starter must be allowed to cool for one minute before attempting to start the engine again.

(g) If the engine starts immediately, move the mixture control to "AUTOMATIC RICH." Adjust the throttle control to maintain 700 rpm for the first 30 seconds after starting. Watch for an indication of oil pressure on the gage.

CAUTION

If the oil pressure is not indicated within 30 seconds, stop the engine and investigate.

(h) If the engine does not start almost immediately after the engage switch is moved to "R," move the mixture control from "IDLE CUT-OFF" to "AUTOMATIC RICH" while maintaining 7-9 psi fuel pressure. If the engine does not start within approximately three seconds, return the mixture control to "IDLE CUT-OFF." If starting is not accomplished within the next five seconds, while the mixture control is in "IDLE CUT-OFF," continue to operate the starter, and repeat the above procedure. One to three repetitions will usually start the engine.

(i) If the engine does not start, it is probably due to one of the following conditions:

1. Over-loaded engine: An overloaded warm engine is indicated by a discharge of fuel from the engine blower drain. An overloaded cold engine is not necessarily indicated by discharge of fuel from this drain but by the presence of liquid fuel in the exhaust. If the engine is overloaded, "clear the engine out" by opening the throttle and turning the engine over either manually or with the starter.

2. Underprimed engine: If there is no fuel odor or vapor in the exhaust, it is probable, especially in cold weather, that the engine has not been sufficiently primed even though fuel may be draining from the blower. For this reason, priming is necessary to prevent flooding the blower and thus obviate a fire hazard. Additional priming should be accomplished cautiously. *Do not pump the throttle as this will discharge fuel into the blower throat.*

(j) Fuel primer switch—"ON" if necessary.

Note

When the engine is cold and has been exposed to outside temperatures below 15°C (60°F), it is usually necessary to prime the engine. Prime the engine 5 - 20 seconds, dependent upon the engine temperature.

(k) Idle engine at 700-800 rpm.

CAUTION

Running the engine for a long period of time below 700 rpm will foul the spark plugs.

(l) Oil pressure gage—25 psi minimum.

Note

Due to the thermostatic action of the oil pressure relief valve, an abnormally high oil pressure gage indication may exist until an oil temperature of 40°C (104°F) is attained.

(m) Fuel pressure gage—15 to 17 psi.

(n) Fuel booster pump switches—"OFF."

(o) Hydraulic pressure gage—850 psi minimum.

Note

Observe the hydraulic system pressure gage indication, open and close the bomb bay doors, then return the bomb bay door control lever to "NEUTRAL." As the bomb bay doors are being opened and closed the hydraulic system pressure will lower. After the bomb bay doors have reached the closed position, the hydraulic system pressure should increase to normal. This indicates that the right engine-driven pump is functioning properly.

(p) Suction gage—4.2 inches Hg.

(3) START THE LEFT ENGINE.—The starting procedure for the left engine is the same as that for the right engine.

Note

After starting the engine, move the instrument vacuum selector valve control to "L.H. PUMP" position. Recheck the instrument suction gage (for 4.2 inches Hg. indication) to ascertain that the left engine vacuum pump is functioning properly.

(4) ENGINE WARM-UP.

(a) With the nose of the airplane headed into the wind, idle the engines at 1000 rpm. Check the instruments for indication consistent with engine speed, excessive pointed oscillation, and over sensitivity.

(b) Momentarily decrease engine speed to 700 rpm, then open the manifold pressure gage drain cock for a period of 30 seconds in each position to clear the line of liquids and vapors.

(c) Allow the engines to idle at 1000 rpm until the following conditions exist:

1. Oil temperature indicator—40°C (104°F).

2. Oil pressure indicator—50-100 psi and relatively steady.

3. Cylinder head temperature indicator — 120°C (250°F) minimum.

CAUTION

Do not close cowl flaps.

(d) Open the throttle controls as necessary for 200 rpm.

Note

If the oil pressure "drops" when the throttle controls are open, further engine warm-up is necessary.

1. OIL TEMPERATURE — 40°C to 70°C (104°F to 158°F) 60°C (140°F) desired.

2. OIL PRESSURE—70 to 85 psi.

3. CYLINDER HEAD TEMPERATURE—232°C (450°F) maximum.

4. FUEL PRESSURE—15 to 17 psi.

CAUTION

Avoid operating the engines for prolonged periods at more than 1500 rpm. Do not exceed 2100 rpm: 2000 rpm engine speed should not be maintained for periods exceeding 30 seconds.

(e) Oil cooler door switches—"AUTOMATIC."

(5) ENGINE AND ACCESSORIES GROUND TEST.

(a) GENERATORS.

1. Check each generator "out-put."

a. Throttle controls set for 2000 rpm.

b. Note both ammeter indications.

c. Move the voltmeter check switch from neutral position to "L," then to "R." The voltmeter indication should not exceed 28.5 volts, and both indications must be the same.

2. Check generator "cut-in."

a. Set the throttles for 1000 rpm.

b. Right engine generator:

(1) Turn the battery switches and the left engine generator switch "OFF"; right "ON."

(2) Turn voltmeter check switch—"R" position.

(3) Move the right engine throttle gradually toward "OPEN," and observe the rpm at which the voltmeter shows the right engine generator to have started charging (1500 rpm desired).

Note

The generator is set to "cut-in" at approximately 1500 engine rpm.

3. Left engine generator: Check "cut-in" of the left engine generator in a similar manner.

CAUTION

Turn on both battery switches and both generator switches.

(b) IGNITION SYSTEM.—Check both magnetos at the same time at the same engine power.

Note

This will result in no disturbance of the nose wheel alignment. It also has the advantage of easily establishing the comparative positions of the throttles for even power by checking the dual indicators.

1. Open the throttle to 30 inches Hg. manifold pressure.

2. Move the left and right engine ignition switches from "BOTH" to "LEFT"—observe for a "drop-off" of 100 rpm maximum (50 to 100 rpm normal).

3. Return the ignition switches to "BOTH."

Note

Leave the switches in "BOTH" position until the engines have "picked up" the loss of rpm.

4. Move switches from "BOTH" to "RIGHT"—observe for a "drop-off" of 100 rpm (50-100 rpm normal).

5. Move switches from "RIGHT" to "BOTH."

6. If, during the test, one of the following conditions exist, stop the engines and inspect for malfunctions:

a. If the "drop-off" exceeds 100 rpm on either "LEFT" or "RIGHT."

b. If the difference between the "drop-offs" exceed 40 rpm with the switches in either "LEFT" or "RIGHT" positions.

c. If the engine vibrates excessively.

CAUTION

Make this check in as short a time as practicable. (30 seconds maximum.) Cooling of the cylinder heads, barrels, and ignition harness is insufficient when the engines are operated for prolonged periods above 1400 rpm. Do not allow the cylinder head temperature to exceed 232°C (450°F).

(c) TWO SPEED SUPERCHARGERS.—This test is made to help prevent sludge accumulation and to check the operation of the blower mechanism.

1. Set the throttle controls for 1700 rpm. The oil pressure should be at least 40 psi.

Note

40 psi oil pressure is necessary for the blower clutch to operate.

2. Supercharger blower control — shift to "HIGH" position: At the same time observe the engine oil pressure gage for a momentary "drop" in pressure, and check the manifold pressure gage to make certain that the manifold pressure does not lower.

Note

Prolonged fluctuation or loss of manifold pressure indicates improper clutch engagement: In this case the supercharger blower control should be returned to the "LOW" position, the engine speed reduced to 1000 rpm, the engine operated at 1000 rpm for two minutes, and the test repeated.

3. Open the throttle to obtain approximately 2000 rpm and lock the throttle control at that setting.

4. Immediately shift the supercharger blower control to "LOW" position without hesitation between stops (in order to avoid dragging or slipping the clutches). At the same time observe the manifold pressure gage for an indication of a sudden "pressure-drop."

Note

A manifold "pressure-drop" is positive indication that the control system is functioning properly. If the manifold pressure does not lower, operate the engine at 1000 rpm for two minutes. This permits the heat generated during the clutch operation to dissipate.

5. As soon as the test is complete reduce the engine speed to 1000 rpm.

6. Supercharger blower control—"LOW" position when the test is complete.

(d) PROPELLERS.—With the propeller control set for full increase rpm, advance the throttle until rpm reaches 2000. Move the propeller control toward decrease rpm until rpm drops to 1800. Return propeller control to full increase rpm, and note that the rpm returns to 2000.

Note

Minimum governing speed is 1200 rpm.

(e) FUEL CONTAINER SELECTION TEST.

1. Operate the engines, using fuel from each fuel container, for a period of 3 minutes to make certain the selector valves operate properly. Operate the engines for 3 minutes with the cross-feed valve control set at "ON CROSS FEED" with either the right or left selector valve "OFF" and the other set at "MAIN ON."

CAUTION

When fuel is being used from other than the main fuel containers, be certain that the fuel level in these containers is such that it will permit the return of 10 gallons of fuel per hour from the carburetor.

2. After the test has been completed return the cross-feed valve control to "OFF" and both selector valves to "MAIN ON."

g. STOPPING ENGINES.

(1) STOPPING ENGINES DURING WARM WEATHER.

(a) Supercharger blowers.—Check for proper functioning.

(b) Cowl flap switches—"OPEN."

Note

This facilitates the circulation of air over the engines. Residual heat above 120°C (248°F) within the engine section may damage the spark plug electrical insulation.

(c) Propeller governor controls—"INCREASE RPM."

(d) Fuel booster pump switches—"OFF."

(e) Idle the engines at 1000 rpm a sufficient length of time to allow the cylinder head temperature to decrease below 205°C (400°F).

(f) Stop the right engine in the following manner:

1. Carburetor mixture control – "IDLE CUT-OFF."

2. Throttle—"CLOSED" *immediately.*

Note

If the engine does not stop, turn off the ignition switch. Slowly open the throttle wide. An improperly adjusted carburetor is indicated if it is necessary to stop the engine by turning the ignition switch "OFF."

3. Ignition switch—"OFF" *after* the engine stops.

4. Generator switch and battery switch—"OFF."

(g) Check the left engine driven hydraulic pump for proper functioning by actuating the bomb bay doors until the hydraulic pressure drops below normal. Observe the hydraulic pressure gage for a pressure recovery above normal (850 psi).

(h) Stop the left engine in a manner similar to that for stopping the right engine. Turn off the ignition, battery, generator, and all other switches.

(2) STOPPING ENGINES DURING COLD WEATHER.—The following oil dilution procedure is applicable if a temperature below 5°C (41°F) is anticipated to exist before the next engine start:

(a) Idle the engine or allow the engine to remain inoperative until the cylinder head temperature is less than 150°C (300°F) and until the engine oil temperature is less than 50°C (120°F).

(b) With the engine idling at 800 to 900 rpm hold the oil dilution switch "ON" (one to ten minutes, depending on the expected temperature and the grade and amount of oil in the system) until a drop in oil pressure indicates the oil dilution system is functioning.

1. For ground temperature from 5°C (40°F) to −7°C (20°F)—"ON" for approximately two minutes.

2. For temperatures from −7°C (20°F) to −30°C (−20°F)—"ON" for approximately four minutes.

3. For temperature below −30°C (−20°F)—"ON" approximately ten minutes.

Note

At the end of the oil dilution period increase the engine speed to 1200 rpm. Move the propeller governor control slowly from "INCREASE RPM" to "DECREASE RPM" to allow diluted oil to enter the propeller dome. Return the control to "INCREASE RPM" and repeat this procedure three times.

(c) Carburetor mixture control—"IDLE CUT-OFF" as soon as the oil is diluted as much as desired.

(d) Continue the oil dilution until the engine stops, then turn off all switches.

h. BEFORE LEAVING THE PILOT'S COMPARTMENT.

(1) Fuel container selector valves—"OFF."

(2) Mixture controls—"IDLE CUT-OFF."

(3) Fuel cross-feed & bomb bay containers selector valve control—"OFF."

(4) All electrical switches—"OFF."

(5) Radio equipment switches—"OFF."

(6) Landing gear control—"DOWN" (and solenoid locking pin in extended position).

(7) Wing Flaps Control—"NEUTRAL."

(8) Throttle lever lock control—"LOCKED" position.

(9) Aileron, elevator and rudder trim tab controls—set at "0" degrees.

(10) Surface control lock lever—"LOCK" position.

(11) Parking brake control—"LOCK" position.

4. SPECIAL TOOLS AND EQUIPMENT.

a. HOISTS AND JACKS. – These have been adequately covered in this section where part numbers and specifications may be readily found.

b. TOOL KITS.

(1) PROPELLER TOOL KIT.–For contents refer to paragraph 21. *gg.*, section IV.

(2) MISCELLANEOUS HANDLING EQUIPMENT ROLL. – For contents refer to paragraph 21. *gg.*, section IV.

(3) ENGINE TOOL KIT.–The Engine Tool kit, part No. PWA-1798, is stowed in the aft section of the left nacelle and contains the following items:

Part No.	*Item*
36D	Tool Container
211G	Bag, Tool Kit
459F	Depressor-Valve Spring
672H	Gage-Valve Clearance
996A	Aligning Strip May Breaker Points
1059B	Mirror 4" x 2½"
2835C	Wrench-Valve Adj. Screw and Lock Nut
1217C	Distributor Gland Nut
1265C	Wrench-Oil Flange
1392D	Depressor-Rocker Arm
1395A	Drift-Fibre
1396A	Extension 16" 38" sq.
1424B	Wrench–Push Rod Cover Nut
1437B	Wrench–1⅜" Hex
1471C	Wrench–Starter of Generator
1560D	Wrench–Cylinder Nut
1585B	Wrench–1¼" OE. Rel Cover Valve
1609C	Wrench Palnut ⁷⁄₁₆"
1657B	Wrench–Push Rod Cover Nut
1683B	Wrench–Spark Plug Elbow
1786	Wrench–Int. Pipe Nut
1858A	Wrench–Starter Stud Nut
1886C	Wrench–Adjustable Strap
1950A	Wrench–1⁵⁄₁₆" Crow Foot
2210C	Wrench–Oil Sump Support Stud
2254C	Wrench–Spark Plug
2410A	Wrench–1⅛" Crow Foot
2334A	Seal for Tool Kit Bag
2682B	Wrench–⅜" x ⁷⁄₁₆" Box End

Note

Engine tools, not having any of these numbers, are service tools from other kits.

(4) OTHER KITS AND SERVICE TOOLS.–Listed in the following:

GROUND EQUIPMENT

Service Number	*Douglas Drawing Number*	*Nomenclature*
K13601	C65-5153327-HF7	Sling Quick Change Engine Unit
K13701	C65-5157240-HF1	Sling Fuselage Nose Assembly
K13801	C65-5195491-HF1	Sling Aircraft Hoisting
K13901	C65-5153004-HF11	Sling Outer Panel
K14001	C65-5157285-HF3	Sling 75mm Cannon
K14101	K652-3530-1HF	Stand Tail

SPECIAL TOOLS

K33801		Kit Tool Operational Squadron Assembly
K33901		Box Tool Operational Squadron Tool Kit
K34001		Kit Tool Service Squadron Assembly
K34101		Box Tool Service Squadron Tool Kit
K34201		Kit Tool Major Overhaul Assembly
K34301		Box Tool Major Overhaul Tool Kit
K27707	K652-3051-7GT	Spanner Wrench, Nose Oleo Packing Nut (8239-48)
K39701	K652-3144-1GT	Spanner, Wrench, Bearing Stop Nut, Nose Oleo (8239-74)
K27704	K65-3051-4GT	Spanner, Wrench, Piston Head, Nose Oleo (8239-3)
K26422	K65-3038-22GT	Spanner, Wrench, Lock Nut Nose Wheel Actuating Cylinder

Service Number	*Douglas Drawing Number*	*Nomenclature*
K26424	K65-3038-24GT	Spanner, Wrench, Shiming Damper Yoke Nut-N-L-G (8239-28)
K26421	K65-3038-21GT	Spanner, Wrench Lock Nut Nose Wheel Snubber (2150751)
K24305	K65-2964-5GT	Wrench, Angle Nut, M.L.G. and N.L.G.
K26423	K65-3038-23GT	Spanner, Wrench, Main Oleo Packing Nut
K33301	K65-3109-1GT	Spanner, Wrench, Plunger Nut, M.L.G.
K27705	K65-3051-5GT	Spanner, Wrench, Piston Head, M.L.G.
K27706	K65-3051-6GT	Spanner, Wrench, Cross Tube Packing Nut, M.L.G.
K26427	K65-3038-27GT	Spanner, Wrench, Lock Nut Main Wheel Actuating Cylinder
K26419	K65-3038-19GT	Spanner, Wrench-Lock Nut Nose Wheel Door Actuating Cylinder
K23302	K652-3041-2GT	Wrench, Propeller Governor
K26420	K65-3038-20-GT	Spanner, Wrench, Lock Nut Bomb Door Forward Actuating Cylinder
K26418	K65-3038-18GT	Spanner, Wrench, Lock Nut Bomb Door Rear Actuating Cylinder
K33101	K652-3114-1GT	Wrench, Engine Mount Bolts
K34401	K652-7138-1GT	Pin, Expansion-Aligning Wing to Fuselage (Front Spar)
K34402	K652-7138-2GT	Pin, Expansion-Aligning Wing to Fuselage (Rear Spar)
K26428	K65-3038-28GT	Wrench, Spanner, Wing Flap Gear Box
K33701	K652-3115-1GT	Wrench, Spanner, Control Column Cap
K33501	K652-3111-1GT	Adapter, Wrench, 37mm Cannon Receperator
K33401	K652-7135-1GT	Pin, Wing Joint Alignment
K33402	K652-7135-2GT	Pin, Wing Joint Alignment
K32002	K65-6823-2GT	Hose, Brake Bleeder (Add Hose)
K22908	K652-2910-108GT	Gage, Spacer-Brake Plate (Same as C-54)
K33601	K65-3110-1GT	Wrench, Accumulator
	403193 (Bendix)	
K35507	K652-3112-7GT	Wrench, Double End Open End Offset 11/16" x 3/4"
K35509	K652-3112-9GT	Wrench, Double End Open End Offset 13/16" x 7/8"
K35511	K652-3112-11GT	Wrench, Double End Open End Offset 15/16" x 1"
K35513	K652-3112-13GT	Wrench, Double End Open End Offset 1 1/16" x 1 1/8"
K35515	K652-3112-15GT	Wrench, Double End Open End Offset 1 3/16" x 1 1/4"
K35517	K652-3112-17GT	Wrench, Double End Open End Offset 1 5/16" x 1 3/8"
K35519	K652-3112-19GT	Wrench, Double End Open End Offset 1 7/16" x 1 1/2"
K35521	K652-3112-21GT	Wrench, Double End Open End Offset 1 9/16" x 1 5/8"
K35523	K652-3112-23GT	Wrench, Double End Open End Offset 1 11/16" x 1 3/4"
K35525	K652-3112-25GT	Wrench, Double End Open End Offset 1 13/16" x 1 7/8"
K35527	K652-3112-27GT	Wrench, Double End Open End Offset 1 15/16" x 2"
K22220	K652-6976-20GT	Adapter, Internal Wrenching Nut 5/16" across flats
K22221	K652-6976-21GT	Adapter, Internal Wrenching Nut 3/8" across flats
K22222	K652-6976-22GT	Adapter, Internal Wrenching Nut 1/2"
K22224	K652-6976-24GT	Adapter, Internal Wrenching Nut 5/8" across flats
K22225	K652-6976-25GT	Adapter, Internal Wrenching Nut 11/16" across flats
K22228	K652-6976-28GT	Adapter, Internal Wrenching Nut 7/8" across flats
K34403	K652-7138-3GT	Pin Expansion-Aligning Wing to Fuselage Lower Front Spar

5. LUBRICATION.

a. GENERAL. — Parts and mechanisms requiring lubrication must be lubricated at hourly intervals. See *figure* 33 for requirements at 25 hr., 50 hr., and other periods, and for code to symbols.

b. APPLICATION.—Oil is usually applied with a squirt can. On some parts it is applied with a brush. Apply grease to all Zerk fittings with a grease gun. Grease is applied to bearings by hand and some greases such as permalube are applied with a brush.

c. LUBRICATION OF BEARINGS.

(1) SEALED BEARINGS. — Do not lubricate sealed bearings. These have sufficient grease sealed within for normal service, after which they should be replaced.

Note

> Do not subject sealed bearings to excessive amounts of solvents such as gasoline. Solvents will seep through the seals and remove the grease within. Wiping or cleaning the outside of a sealed bearing with a solvent moistened rag is permissible, but take care not to saturate the bearing.

When absolutely necessary, sealed bearings must be re-lubricated. Apply an AAF tool No. 37B5054, Alemite tool No. 6212 or a similar purpose tool per T. O. No. 29-1-3, or latest revision thereof, to the bearing. Be sure all of the old grease is thoroughly flushed out. Use AN-G-3 preferably, or AN-G-10 if AN-G-3 is unobtainable.

(2) OPEN BEARINGS.—Unlike sealed bearings, open bearings require cleaning and repacking at regular intervals. *Figure 32* illustrates the cleaning and repacking of a main wheel bearing, which is typical for any open bearing. In cleaning the bearing, be sure to remove all old grease with a suitable solvent. Where equipment is unavailable to repack bearings under pressure, grease should be thoroughly worked into the bearing races and around the rollers with the palm of the hand until the grease can be seen oozing out on the other side. Smearing the grease on the outside of the rollers will not lubricate the inner bearing races and may cause freezing or failure of the bearing.

d. LUBRICATION IN VARYING CLIMATES AND TEMPERATURES.—The lubricants supplied in the airplane *(figure 33)* are suitable for operation in a wide temperature and climatic range. Special lubrication is not required for extremely cold temperature except for the following:

(1) WHEEL BEARINGS.—Change the AAF-3560 grease to AN-G-3 in the wheel bearings, socket joints, and other heavily loaded parts of the landing gear prior to take-off or landing in temperatures below —40°F (—40°C).

(2) OILED PARTS.—Below minus twenty degrees Fahrenheit (—29°C), use AXS 777 light oil on all oil parts calling for AN-VV-O-446A—Grade 1065, (Navy O-2), or SAE LOW (Low Pour) at higher temperatures.

(3) DRY, DUSTY CLIMATES. — Dust, dirt or sand combines with grease, oil or graphite to form a grinding compound. Therefore, remove excess lubricants from all moving parts subject to extreme dust conditions and from cables where they travel over pulleys. In desert operation, force out such dirt as may work into internal grease fittings by cutting lubrication period in half and removing all excess grease. Clean as often as possible.

CAUTION

> Bomb racks and bombing control system parts should not be greased or oiled. Clean racks when necessary with Federal Specification P-S-661 dry cleaning solvent, unleaded gasoline, or light naphtha.

(4) SALT AIR CLIMATES.—Use oil, grease and rust preventive plentifully to prevent corrosion. Do not wipe off excess oil or grease as in desert climates. Service all landing gear fittings immediately after exposure to extremes of wet or salty atmosphere.

(5) CONTROL CABLES.—Inspect control cables every fifty hours for wear of anti-corrosion coating and touch up, if necessary, with AN-C-52, Type I, or equivalent. If the anti-corrosion coating is undamaged, oil cables, particularly where they contact pulleys, drums, or fair-leads, lightly with ARMY ORDER (AXS-777) NAVY ORDER (OS-1361) lubricating and preservative oil.

e. MISCELLANEOUS LUBRICATION REQUIREMENTS.

(1) Lubricate surface control system activating and adjusting screws and trim tab actuating screws and nuts by hand with AN-G-10 grease.

(2) For treatment of air filters use three parts of engine oil (AN-VV-O-446 Grade 1120) to one part corrosion preventive concentrate, Spec. (AN-VV-C-576). See T.O. No. 01-1-23 for application.

(3) On the overlapping rub-point areas of engine cowl flaps which have been treated with permalube or with black enamel and graphite, re-treat when operating conditions warrant as given in the following:

(a) When the old graphite begins to wear thin, strip off coating and mask off area to be painted.

(*b*) Apply one coat of Amberry quick-drying dull black enamel (Berry loid made by Berry Bros. of Detroit, Michigan) or equivalent.

(*c*) Allow to dry for only a few minutes.

(*d*) Before paint is entirely dry, blow powdered flake graphite (No. 2-633 made by Jos. Dixon Crucible Co., Ticonderoga, New York), or equivalent over paint and allow to dry.

Note

Fill an old rubber hydrometer tube (for testing batteries) with the graphite and blow it on the surface.

(*e*) Add paint and graphite when necessary. The above method is preferable, but the graphite may be mixed with the enamel and applied by brush.

(4) MACHINE GUNS.—For treatment of machine guns refer to T. O. No. 11-1-28.

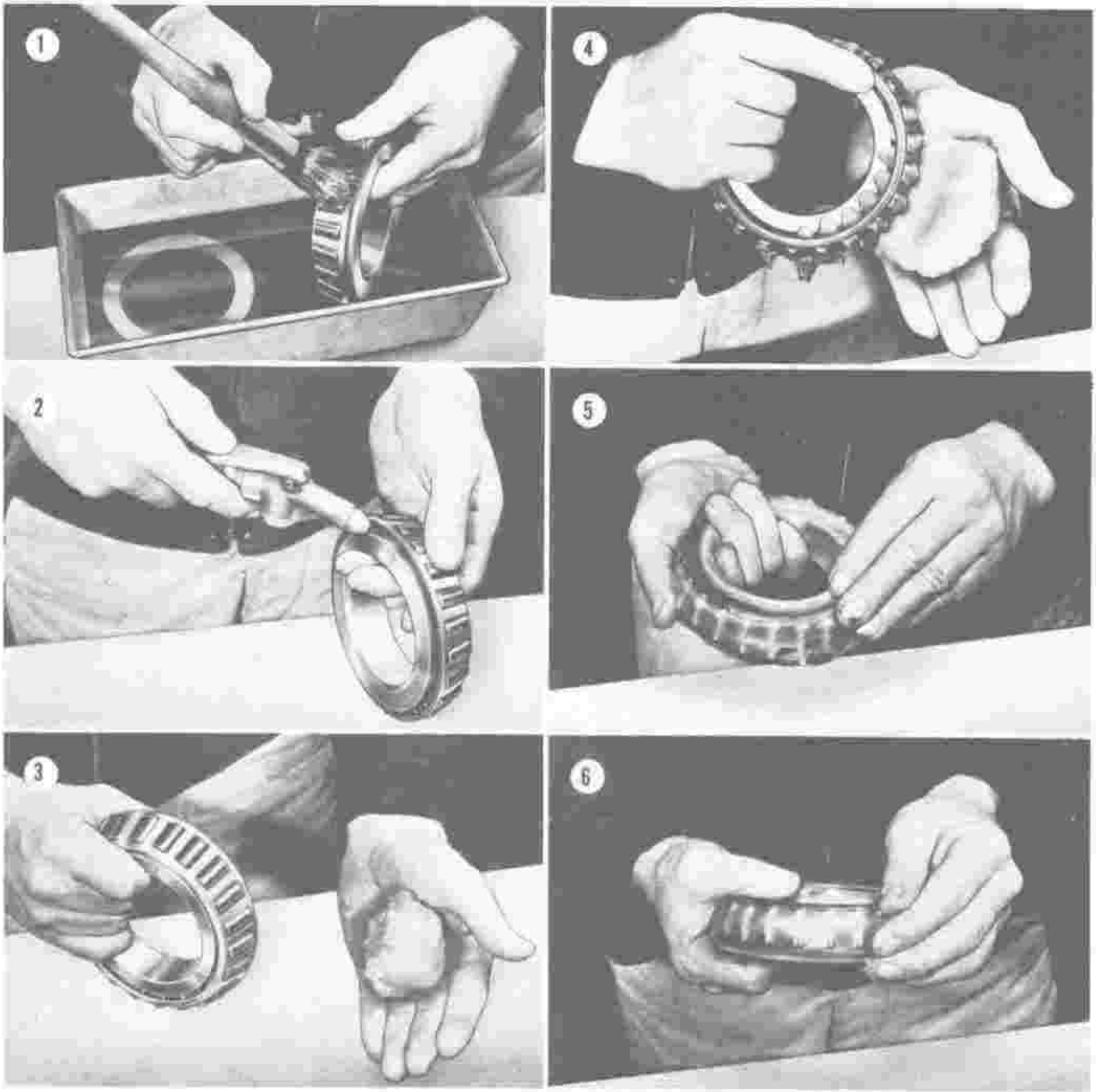


Figure 32 — Steps in Lubricating Wheel Bearings

TABLE OF LUBRICANTS

IDENTIFICATION	BASE SPECIFICATION	TYPE OF LUBRICANT	TEMP. RANGE (AMBIENT AIR T.) °F.	USES (HEREIN)	RECOMMENDED PRODUCT	APPROVED EQUIVALENT
A	AN G-3 (Nearest British Equiv. Spec. DTD577)	Grease—Low Temperature Lubricating	−65 to +160	All Zerk Fittings and Other Places Requiring Medium Body Grease. To Be Used in Wheel Bearings at Extreme Low Temperature (Below −40 °F.)	Beacon Lubricant M-285 (Std. Oil Co. of N. J.)	Kendall Formula "C" (Kendall Refining Co.)
B	AAF3560 Medium Grade	Grease—High Melting Point	−40 to +160	Wheel Bearings (Above −40 °F.)	PD433B—Medium (Socony-Vacuum Co.)	Andok Lubricant "B" (Std. Oil Co. of N. J.)
C		Grease—Graphited Lubricating	−65 to +160	Places Where Graphited Grease of Good Adhesive and Low Temperature Characteristics Are Required	W. S. 700 (RD-320-43) (S.O.N.J.)	AN G-3 Plus 3-5% Graphite (Compounded Thoroughly)
D	SAE ±10 W; or AN-VV-O-446 (Grade 1065)	Oil, Lub. (Light) Oil, Lub. (Medium)	−50 to +100 −10 to +160	General "Squirt Can" Lubrication	Triton 10W (low Pour (Union Oil Co., Cal.) Commercially Available	Commercially Available
E	Army Ord. AXS-777 Navy Ord. OS-1361	Oil—Low Temperature Lubricating and Preserving	−65 to +20	For Moderate Low and Extreme Low Temperature "Squirt Can" Lubrication—Control Cables	Commercially Available	
F	Navy O-2	Oil—Graphited Penetrating	+20 to +160	Exposed Hinge and Pin Joint Lubrication—Moderate Temperatures	Commercially Available	
H	Army 2-64	Graphite in Following Forms: Stick, Cake, Powder or Powder in Lacquer Base		Graphite Lubrication for Sliding Surfaces and General "Residual" Type Lubrication	Commercially Available	Dixon "Microfyne" (J. Dixon Co.) Powder, Cake & Stick "Permalube" (Lacquer Base Lubricant) (Andrew Brown Company, Los Angeles)
I	AN-VV-C-566 (British Equiv. DTD589)	Mica Base Anti-seize Compound		Surfaces Subjected to High Temperatures and Limited Motion (Exhaust Manifold Brackets, Etc.)	B. G. Mica Lubricant A719 (B. G. Corp., New York, N. Y.)	
J	AN G-10	Low Temp. Grease with Extreme Pressure Properties	−65 to +160	Control Surfaces Operating Mechanisms (Flap Gear Box, Tabs, Etc.)	W. S. 338 (S.O.N.J.)	Commercially Available
Y	AN-VV-C-576 (Nearest British Equiv. DTD587)	Corrosion Preventive Compound (concentrate)		Use One Part Compound Concentrate to 3 Parts Engine Oil AN-VV-O-446, Grade 1120, for Treatment of Carburetor Filters	"Rustban 606" (Concentrate) "Rustban 604" (Prepared Mixture with AN-VV-O-446, Grade 1120, in Correct Proportion) (S.O.N.J.)	Commercially Available "Stop Rust B" (Concentrate) "Stop Rust BB" (Prepared Mixture with AN-VV-O-446, Grade 1120, in Correct Proportion) (Union Oil Co., Cal.)
Z	AN-C-52 TYPE 1 (Nearest British Equiv. DTD279B)	Corrosion Preventive Exterior Surface		Cable Coating as Corrosion Preventive	Paralketone Type B (Alox Corp., Niagara, N. Y., or American Oil Supply Company of Newark, N. J.)	Commercially Available

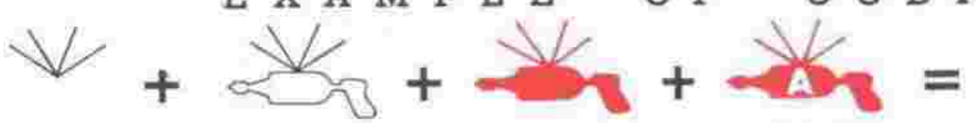
APPLICATION SYMBOLS

ZERK OR ALEMITE GUN — OIL CAN — BRUSH — HAND

FREQUENCY SYMBOLS

RED EVERY 25 HOURS — YELLOW EVERY 50 HOURS — GREEN EVERY 100 HOURS — PURPLE FREQUENCY OVER 100 HOURS

EXAMPLE OF CODING



POINTS OF LUBRICATION + METHOD OF APPLICATION + FREQUENCY OF APPLICATION + TYPE OF LUBRICANT = Indicated points lubricated with Zerk or Alemite gun every 25 hours using type "A" lubricant AN G-3. (See above table of lubricants.)

✱ ANG-3 GREASE DURING MAJOR OVERHAUL

✚ PERMALUBE DURING MAJOR OVERHAUL

Figure 33 — Lubrication Chart (Sheet 1 of 5)

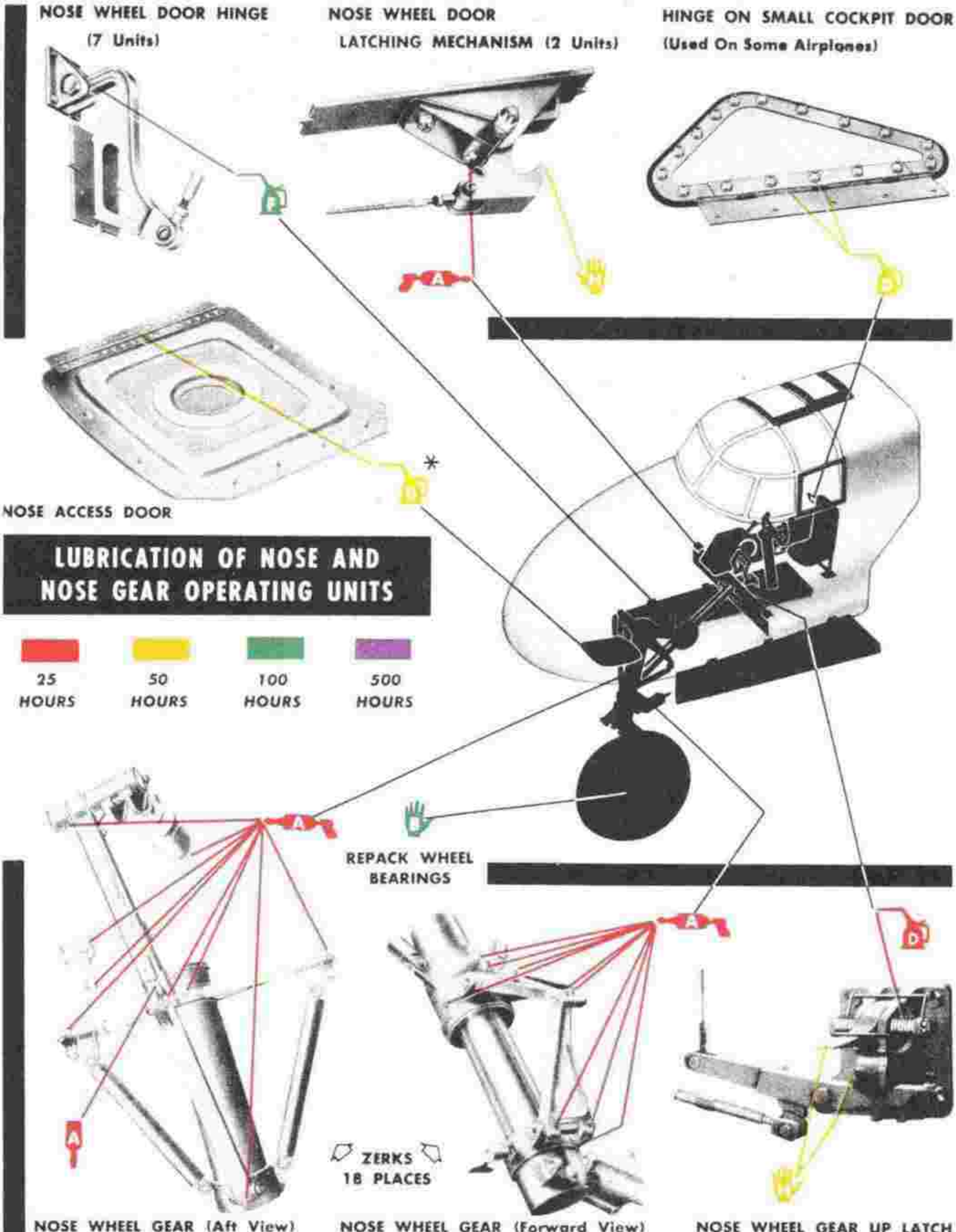


Figure 33 — Lubrication Chart (Sheet 2 of 5)

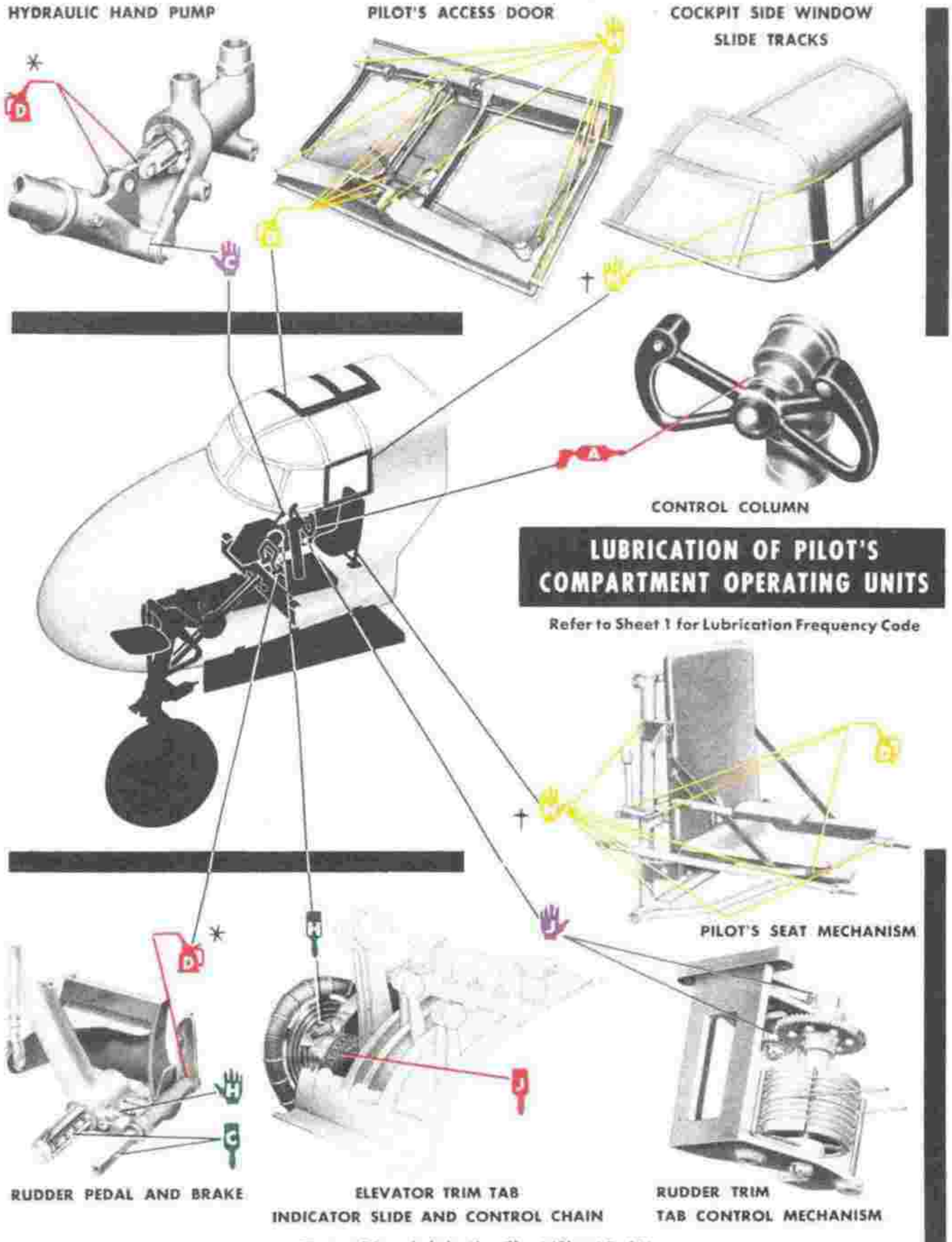


Figure 33 — Lubrication Chart (Sheet 3 of 5)

LUBRICATION OF FUSELAGE AND EMPENNAGE OPERATING UNITS

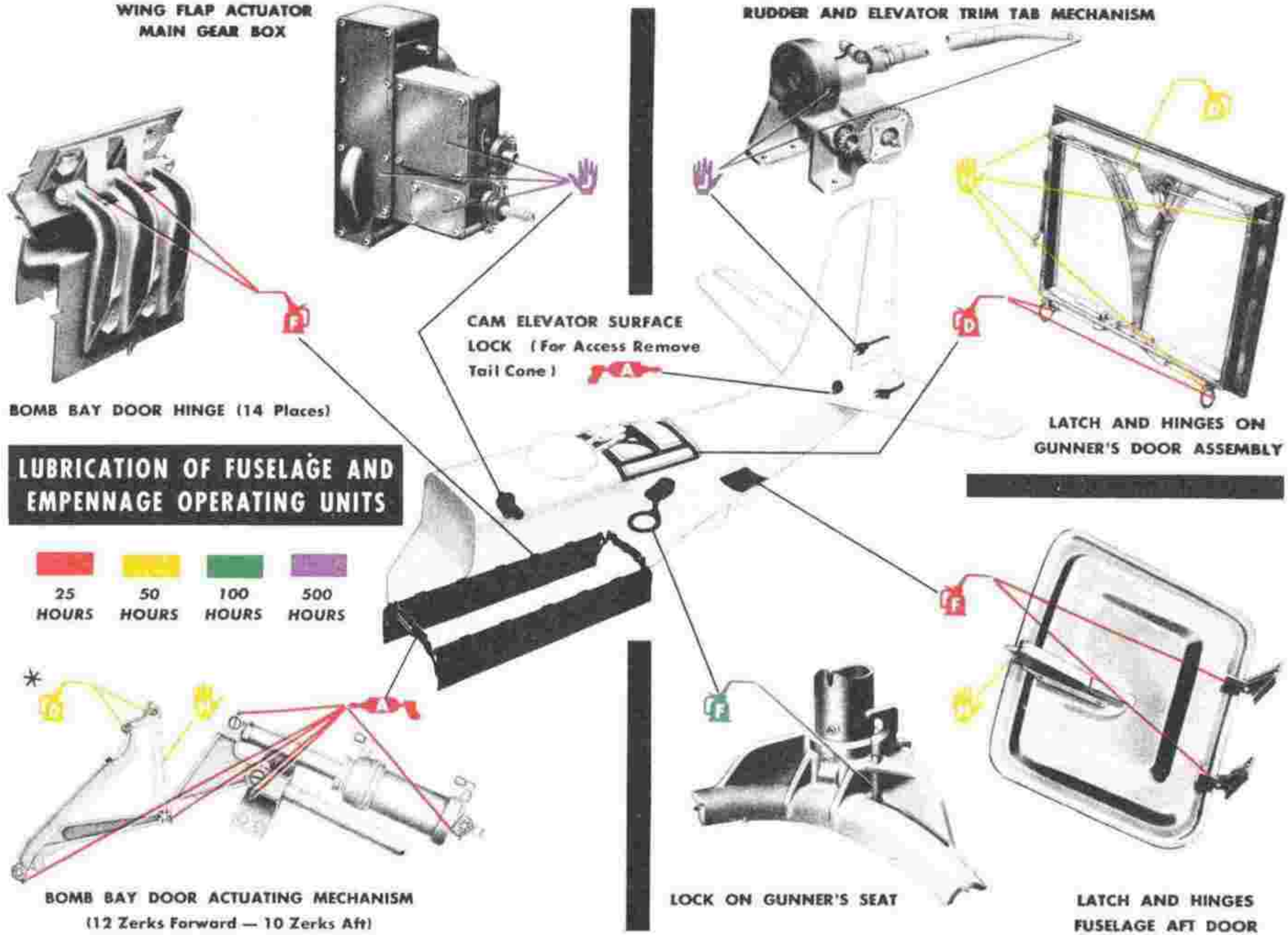


Figure 33 — Lubrication Chart (Sheet 4 of 5)

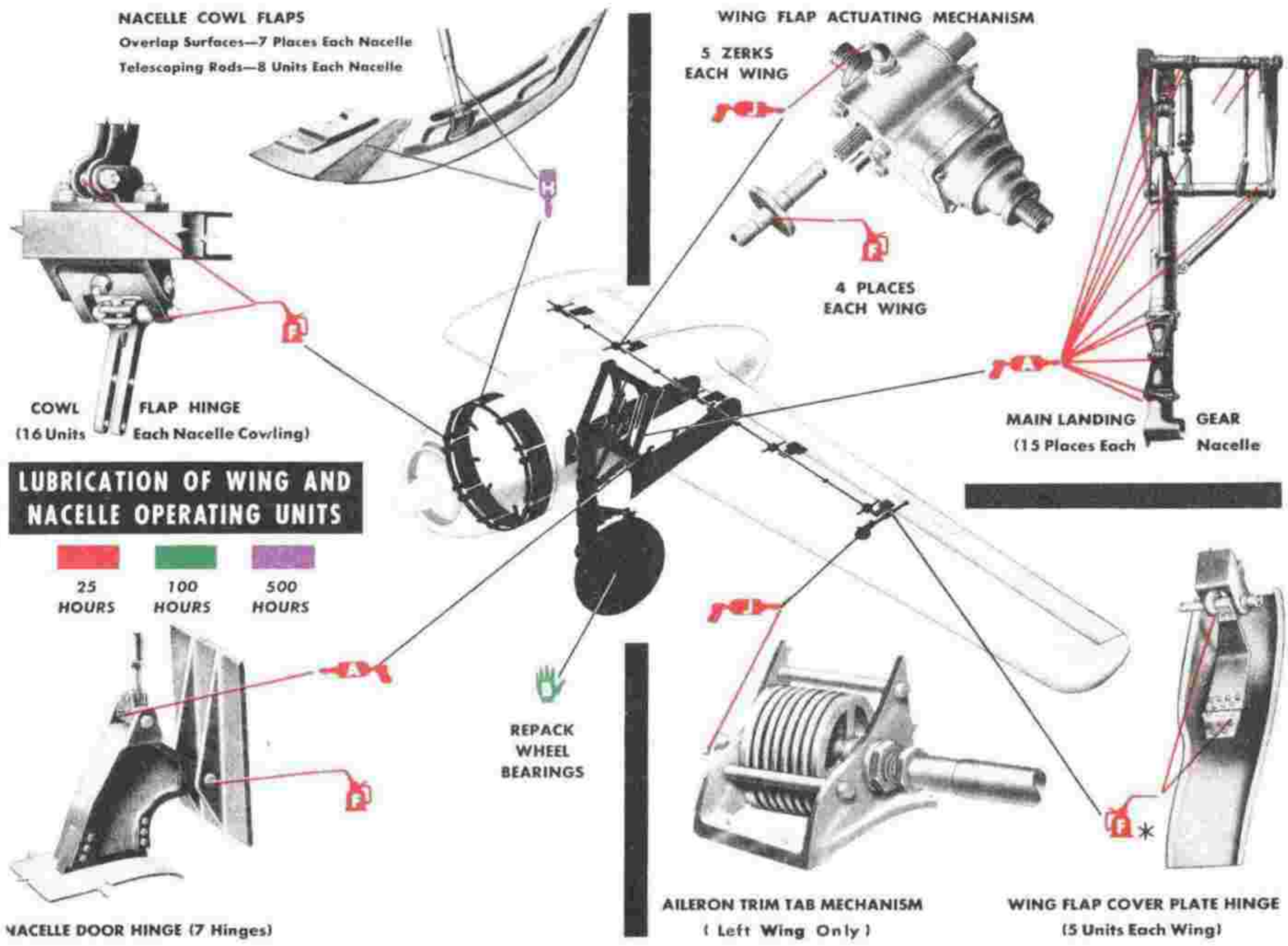


Figure 33 — Lubrication Chart (Sheet 5 of 5)

f. SPECIFICATION LUBRICATION REQUIREMENTS.—The oil or grease, the method and interval of its application to the particular part, and the code are fully covered in the following charts. It should be noted that a letter symbol such as A refers to AN-G-3, low temperature lubricating grease, etc. Very often only the symbol such as A, H, J, etc., will be given and it will be necessary to associate the symbol with the specification and method of application. The table of lubrication sets forth the lubricants and their commercial equivalents to aid commercial operators in selecting the correct lubricant. For safety and best results the *table should be strictly adhered to.*

Note

Specialized lubrication requirements of instruments, engines, and accessories are covered in their respective sections, not in this section.

To simplify and consolidate the table, some general observations may be made of the specific requirements as follows:

(1) SLIDING SURFACES.—Use H on sliding surfaces including the following:

(a) RUDDER PEDAL SPLINES AND TRACKS.—Apply graphite stick by hand—100 hrs.

(b) SLIDING GUIDES ON THE BOMB BAY DOOR ACTUATING MECHANISMS.—Apply graphite stick by hand—25 hours.

(c) LATCHES.—Apply graphite stick by hand to all door and hatch latches, latch points, and sliding contacts—50 hours.

Note

Remove emergency hatches, thoroughly clean, and lubricate every 50 hours.

(d) PILOT'S SEAT TUBES AND WINDOW TRACKS.—Apply graphite stick by hand—50 hours.

(e) TAB INDICATOR SLIDE. — Brush with permalube (graphite powder in lacquer base) — 100 hours.

(f) COWL FLAP TELESCOPING ROD.—Brush with permalube (graphite powder in a lacquer base)—500 hours.

(2) HINGES.—Apply F with a squirt can at 25 hours to the following hinges:

(a) COWL FLAP (16).

(b) NACELLE DOOR (7).

(c) FUSELAGE DOOR (aft door).

(d) BOMB BAY DOORS.

(e) NOSE WHEEL DOORS.

(f) WING FLAP COVER PLATE.

(g) SMALL COCKPIT ENCLOSURE VENTILATOR DOOR.—Apply D at 50 hours.

(3) BUSHINGS.—Apply D with a squirt can to the following bushings:

(a) PILOT'S ACCESS DOOR CENTER LATCH (4 places)—50 hours.

(b) NOSE WHEEL DOOR UP LATCH (pivot points)—25 hours.

(c) NOSE ACCESS DOOR—25 hours.

(d) BOMB BAY DOOR—50 hours.

(e) GUNNER'S DOOR EMERGENCY LATCH —25 hours.

(f) HYDRAULIC HAND PUMP—25 hours.

(4) ZERK FITTINGS. — Apply grease with an alemite gun at 25 hours to the following zerks:

(a) MAIN LANDING GEAR.—Apply A to 15 places.

(b) NOSE LANDING GEAR.—Apply A to 18 places.

(c) TOP OF CONTROL COLUMN.—Apply A to zerk.

(d) FORWARD BOMB BAY DOOR ACTUATING MECHANISM.—Apply A to 12 places.

(e) AFT BOMB BAY DOOR ACTUATING MECHANISM.—Apply A to 10 places.

(f) NACELLE DOOR MECHANISM.—Apply A to 7 places.

(g) AILERON TRIM TABS.—Apply J to the zerk in each trim tab.

(h) WING FLAP GEAR BOXES.—Apply J to zerk in each box—(10 boxes).

(5) GEARS.—Apply grease by hand to these as follows:

(a) WING FLAP ACTUATOR (main gear box in bomb bay).—Repack with J at 500 hours.

(b) RUDDER TRIM TAB CONTROL (in pilot's compartment).—Apply J to gears at 500 hours.

(c) ELEVATOR AND RUDDER TRIM TAB MECHANISMS (in empennage).—Apply A to needle bearing at end and repack gear box with A—500 hours.

(6) THREADS.—Brush the wing flap gear box threads with J at 25 hours.

(7) CHAINS.—Brush the control pedestal (chain elevator tab chain) with J at 25 hours.

(8) LINKAGE.—Apply D with a squirt can to the control pedestal linkage at 25 hours.

(9) BEARINGS.—Apply B by hand to the landing wheel bearings (6 places 2 in each wheel) at 100 hours.

(10) MISCELLANEOUS ITEMS.

(a) WING FLAP TORQUE TUBE GUIDES (plastic fairings).—Apply F with a squirt can at 25 hours.

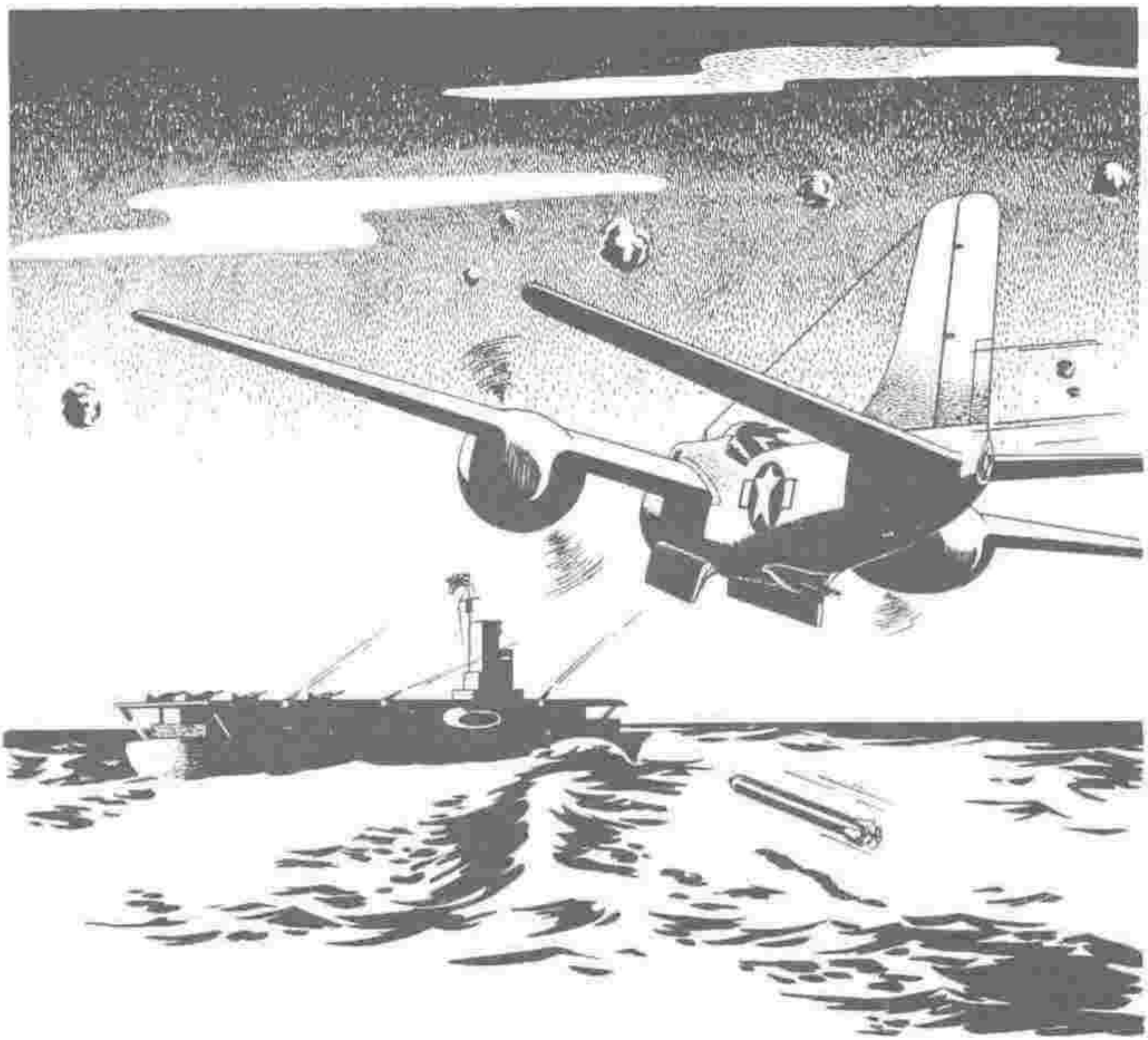
(b) LOCK ON GUNNER'S SEAT.—Apply F with a squirt can at 100 hours.

(c) PILOT'S SEAT ADJUSTING LEVER PIVOT POINT.—Apply D with a squirt can at 50 hours.

(d) HYDRAULIC HAND PUMP.—Apply C by hand to the socket joints at 500 hours. Apply D with a can to bushings at 25 hours.

(e) DISC (at top of lower retracting link on the nose wheel landing gear).—Brush shiny surface with C at 25 hours.

(f) RUDDER PEDALS.—Apply C to splines and spring slides by hand. Apply H to pin slide. Apply D to spring bushings. All 25 hours.



SECTION IV

MAJOR COMPONENT PARTS AND INSTALLATIONS

1. WING GROUP

a. GENERAL.—The wing is a two-spar, aluminum alloy frame-and-sheet structure fabricated in four parts. These are the left and right wing panels and left and right wing tips. A nacelle is built as part of each wing panel with the major portion protruding below the wing panel. The span of the full cantilever wing is 70 feet. Maximum width is 10 feet and maximum depth is 18⅓ inches. Aluminum alloy wing flaps and deflectors are installed inboard and outboard of each nacelle. Fabric-covered ailerons extend from the outboard end of each outboard flap to the wing tip. The wing tips are fabricated from molded plywood or metal.

b. WING.

(1) DESCRIPTION.—The inboard end of each wing panel houses spar fittings which extend into, and are attached to, the fuselage structure by means of steel pins and bolts. Equipment installed in each wing panel includes a self-sealing auxiliary fuel container located inboard of the nacelle; an oil temperature regulator with a removable air scoop, installed in the wing outboard of each nacelle; four ammunition boxes of dural construction which are permanently installed in each panel outboard of the nacelles, and located between the front and rear spars; and actuating mechanisms for the wing flaps and ailerons. Provision also is made for the installation of two rack supports attached to the under-surface of each wing panel, for carrying bombs, machine guns or chemical tanks. A removable nose section located in each wing panel between the fuselage and nacelle, provides access to wing systems lines, control cables, and electrical wiring. Access also is provided at the wing-to-fuselage fillet, which is removable in four parts.

(2) REMOVAL AND DISASSEMBLY.

(a) Support the wing at the jack points *(figure 21)* both inboard and outboard of the nacelle.

(b) Drain all fuel from the nacelle fuel container and the auxiliary wing fuel container as outlined in paragraph 11. *c.*, this section.

(c) Drain the oil container, as outlined in paragraph 12. *d.*, this section.

(d) Remove the engine, as outlined in paragraph 6. *b.* (2), this section.

(e) Remove the landing gear assembly as outlined in paragraph 5. *b.* (1) *(b)*, this section.

(f) Remove the flush head screws attaching the removable nose section of the wing and remove the nose section.

(g) Remove the complete fillet which fairs the wing to the fuselage.

(h) By means of the access gained by removal of the wing-to-fuselage nose fillet and the nose section, disconnect all lines, control cables, and electrical disconnect plugs at this location. Tape all surface control cables at the drums before disconnecting them.

(i) Disconnect the cross-feed fuel line at the fuel cross-feed valve located on the aft portion of the control pedestal.

(j) Disconnect all wires at the aft wing electrical disconnect terminal panel on the left-hand side of the aft bomb bay.

(k) Disconnect the fuel booster pump electrical plug in the forward bomb bay.

(l) In the pilot's compartment near the aft bulkhead disconnect the following equipment:

1. Forward wing disconnect electrical plug.

2. Forward wing disconnect instrument plug.

3. Voltage regulator electrical plug.

4. Ignition plug.

5. Main wing bus.

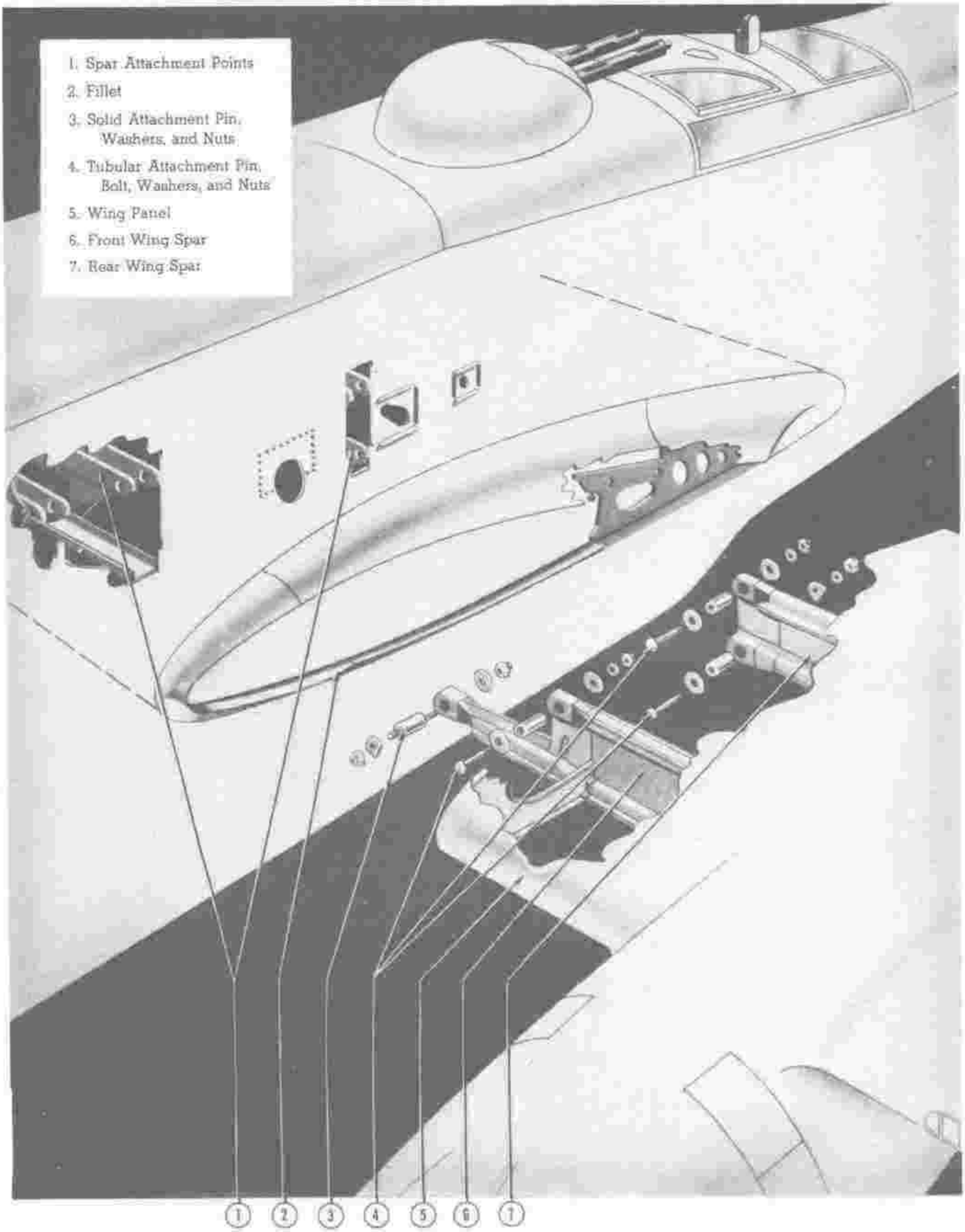


Figure 34 — Wing Attachment

(m) Remove the two solid pins *(3, figure 34)* from the forward inboard spar cap and the lock bolt and pin from the forward outboard spar cap.

(n) Remove the two lock bolts *(4, figure 34)* and pins from the rear spar caps.

(o) Remove the wing by moving it outward until the spar caps are clear of the fuselage skin. The wing flap actuating rod incorporates a universal slip joint, located inside the fuselage aft of the rear spar, which will separate when the wing is removed.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Ordinarily minor skin repairs can be made at Army Air Forces stations. Due to the heavy loads carried by the wing skin, damage cannot be ignored unless it consists of smooth dents which have not distorted the frame structure or caused rivets to shear. Dents should be carefully inspected to make certain they are not the result of high stress caused by the failure of any part of the structure. For instructions on skin and structural repairs, refer to Structural Repair Handbook (No. AN01-40AJ-3).

(4) ASSEMBLY AND INSTALLATION.

(a) Jack the wing panel until it is level with the wing attaching frames. Support the wing panel at the jacking points.

(b) Carefully move the front and rear wing spar fittings into the respective positions in the fuselage.

(c) Align the hole in each spar fitting with its frame attaching hole as closely as possible; then insert expansion bolts, and tighten them until the holes are perfectly aligned.

(d) Remove the expansion bolts one at a time and insert the wing attaching pins.

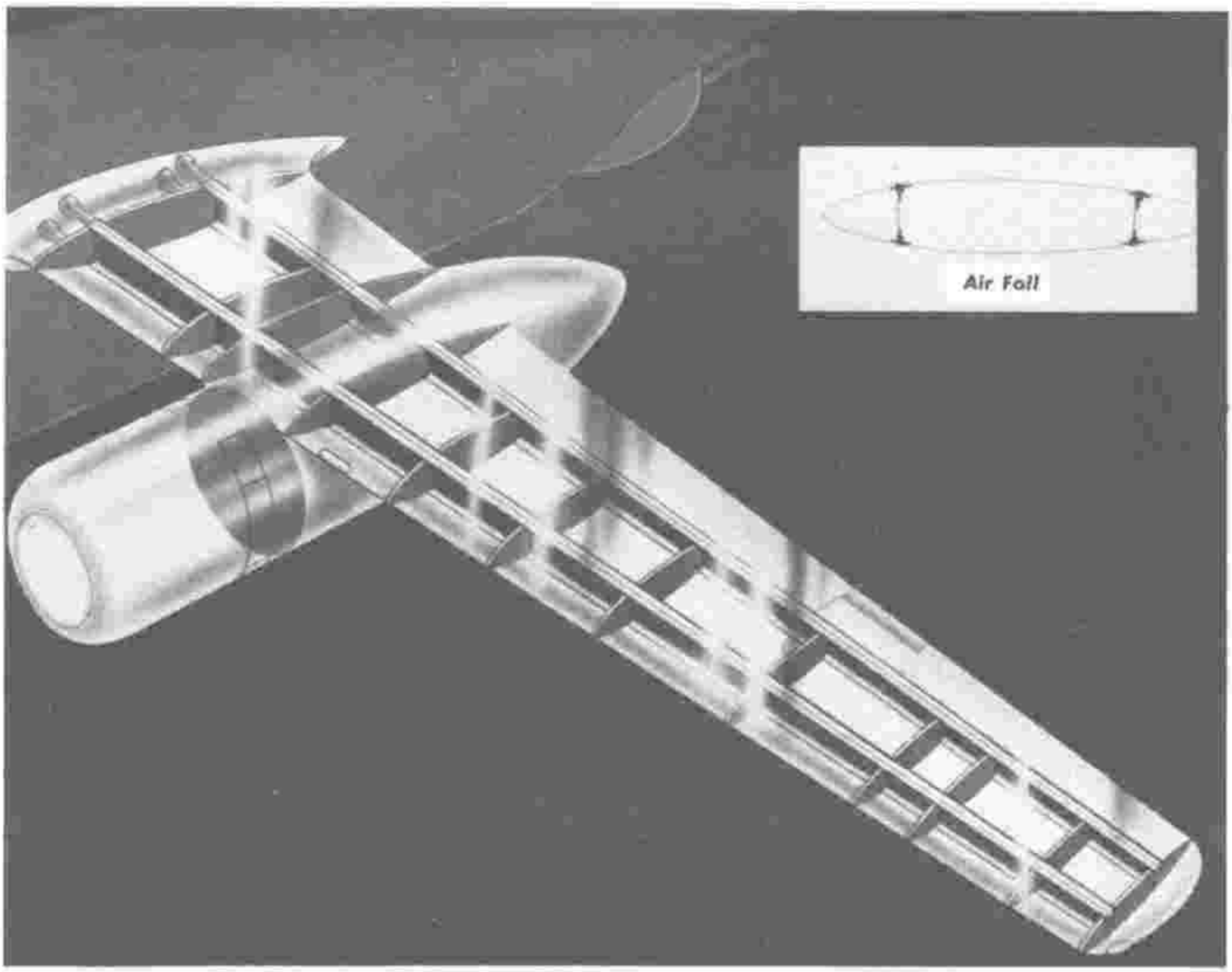


Figure 35 — Wing Structure

(e) Install the lock bolts in the pins, add the washers and tighten nuts. Because of clearance problems, install washers on lower inboard pins before pushing pin completely through the cap.

(f) Complete the wing installation by reversing the REMOVAL procedure.

(5) TEST AFTER INSTALLATION. – Make a trial operation of all systems which were disconnected when the wing panel was removed from the fuselage.

c. WING TIPS.

(1) DESCRIPTION.–Molded plywood or dural tips are installed on the wing panels. Each tip is attached to the wing panel spars with four bolts. Mounted in the forward part of each wing tip is a position lamp which is protected by a removable transparent plastic cover.

(2) REMOVAL.

(a) Remove the access door located on the under side of the wing tip.

(b) Remove the two access doors *(15, figure 6)* from the under side of the wing. Open the aileron seal zipper in the aft access opening.

(c) Remove the position lamp assembly as illustrated in *figure* 36. Disconnect the electrical wiring from the lamp.

(d) Detach the wing tip from the front wing spar by holding the nuts in the wing with an open end wrench and removing the two bolts.

(e) Remove the four bolts which attach the wing tip to the front and rear wing spar. Hold the nuts in the wing panel with an open end wrench and turn out the bolts in the wing tip with a socket wrench.

(3) MAINTENANCE REPAIR OR REPLACEMENT.–For repairs to the structure and skin refer to Structural Repair Handbook (No. AN01-40AJ-3).

(4) ASSEMBLY AND INSTALLATION. – Reverse the procedure outlined in paragraph (2), above.

(5) TEST AFTER INSTALLATION. – Test the position lamp for proper operation.

d. NACELLES.

(1) DESCRIPTION.–The nacelles are one piece, all metal structures which are permanently attached to the wing by means of bolts and rivets. A stainless steel firewall incorporating a removable center section separates each nacelle structure from the engine. An oil container and a main, self-sealing fuel container are located in the forward half of each nacelle and are made accessible through removable wing panels. The aft half of each nacelle contains a retractable main landing gear assembly. Nacelle doors which are mechanically operated by the movement of the landing gear, completely close the landing gear well when the gear is retracted.

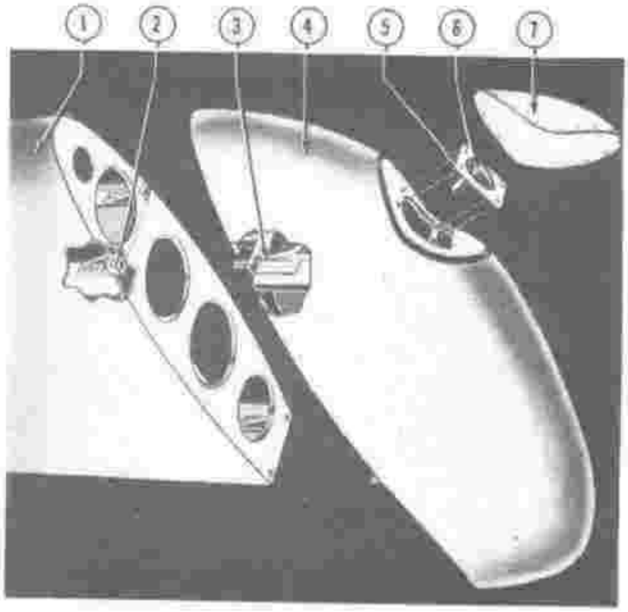
(2) REMOVAL AND DISASSEMBLY.

(a) NACELLES.–The nacelles are permanently attached to the wing structure and cannot be removed as a maintenance operation.

(b) NACELLE DOORS.–Refer to paragraph 5. *b.* (6), this section.

(c) ALIGHTING GEAR.–Refer to paragraph 5., this section.

(3) MAINTENANCE REPAIR.–For instructions on repair of the nacelle skin and framework refer to Structural Repair Handbook (No. AN01-40AJ-3).



1. Wing
2. Wing Tip Attaching Fitting (4 places)
3. Wing Tip Attaching Fitting (4 places)
4. Wing Tip
5. Position Lamp Support
6. Position Lamp
7. Plexiglas Cover

Figure 36 — Wing Tip Attachment

2. EMPENNAGE

a. GENERAL.—The empennage, or tail surface assembly, consists of two horizontal stabilizers, a vertical stabilizer, two elevators, each equipped with a trim tab, and the rudder and rudder trim tab.

The following information is applicable only to the removal, installation, and maintenance of the horizontal and vertical stabilizers. The movable control surfaces and surface controls are described in paragraph 3., this section.

b. HORIZONTAL STABILIZERS.

(1) DESCRIPTION.—The horizontal stabilizers are metal structures consisting of aluminum alloy structural members covered with alclad plating. Each stabilizer has a metal tip which is removable. Four steel bolts staked into the fuselage structure, securely attach each stabilizer to the fuselage. The joints between each stabilizer and the fuselage are sealed with strips of sponge neoprene cemented to the fuselage structure.

(2) REMOVAL.

(a) Remove the elevators as described in paragraph 3. *b.* (4) *(b)*, this section.

(b) Working inside the fuselage aft section, disconnect and cap the de-icer air supply lines.

(c) Remove the end of the aerial attached to left-hand horizontal stabilizer, and coil it for safety against damage.

(d) As each horizontal stabilizer weighs 103 lbs., at least two men are required to remove this part, or damage to attaching fittings will result. One should support the stabilizer, while the other unscrews the four cover plates over the access holes *(14, figure 37)* located in each stabilizer. Through these access holes, remove the nuts and washers *(13, figure 37)* which secure the stabilizer to the fuselage.

(e) Pull and lift the stabilizer horizontally from the fuselage until it is clear of the bolts. If the stabilizer does not come free immediately, jar it gently until it can be released from the fuselage.

CAUTION

Do not rock the stabilizer in any manner as so doing will cause serious damage to the four attaching bolts.

(3) DISASSEMBLY.—To remove the tip of the horizontal stabilizer, remove the attaching screws, and pull the tip horizontally away from the stabilizer.

(4) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Instructions on the repair of the horizontal stabilizer plating and structure will be found in the Structural Repair Handbook No. AN01-40AJ-3 stowed in this airplane as part of equipment.

(b) Damaged or worn sealing strips of sponge neoprene should be replaced. Following is the recommended procedure for attachment of new sealing strips to the fuselage:

1. First, prime the metal surface with cement primer, preferably 624N, manufactured by B and D Chemical Company, or equivalent.

2. After the primer has dried, apply a thin, even coat of neoprene cement, preferably DuPont Fairprene No. 1 or 4, or equivalent, on both the metal surface and the sealing strip. Allow the cement to dry until the solvent odor and the sheen are gone.

3. Press the neoprene sealing strip into place.

(5) ASSEMBLY AND INSTALLATION.—To install the horizontal stabilizer on the fuselage, reverse the REMOVAL procedure. Attach the four elastic stop nuts and washers to the fuselage bolts with a torque wrench force equal to 2900-3200 inch-pounds.

c. VERTICAL STABILIZER.

(1) DESCRIPTION.—The vertical stabilizer is a rigid, metal assembly consisting of an aluminum alloy structure covered with alclad plating. The stabilizer is secured to the fuselage at three points by means of five steel bolts which project from the fuselage. The joint between the structures is sealed with sponge neoprene strips cemented to the fuselage. The stabilizer has a removable metal tip which is secured by screws. A pitot-static tube and an aerial attachment are located on the leading edge of the tip assembly and a remote compass transmitter is mounted inside the stabilizer.

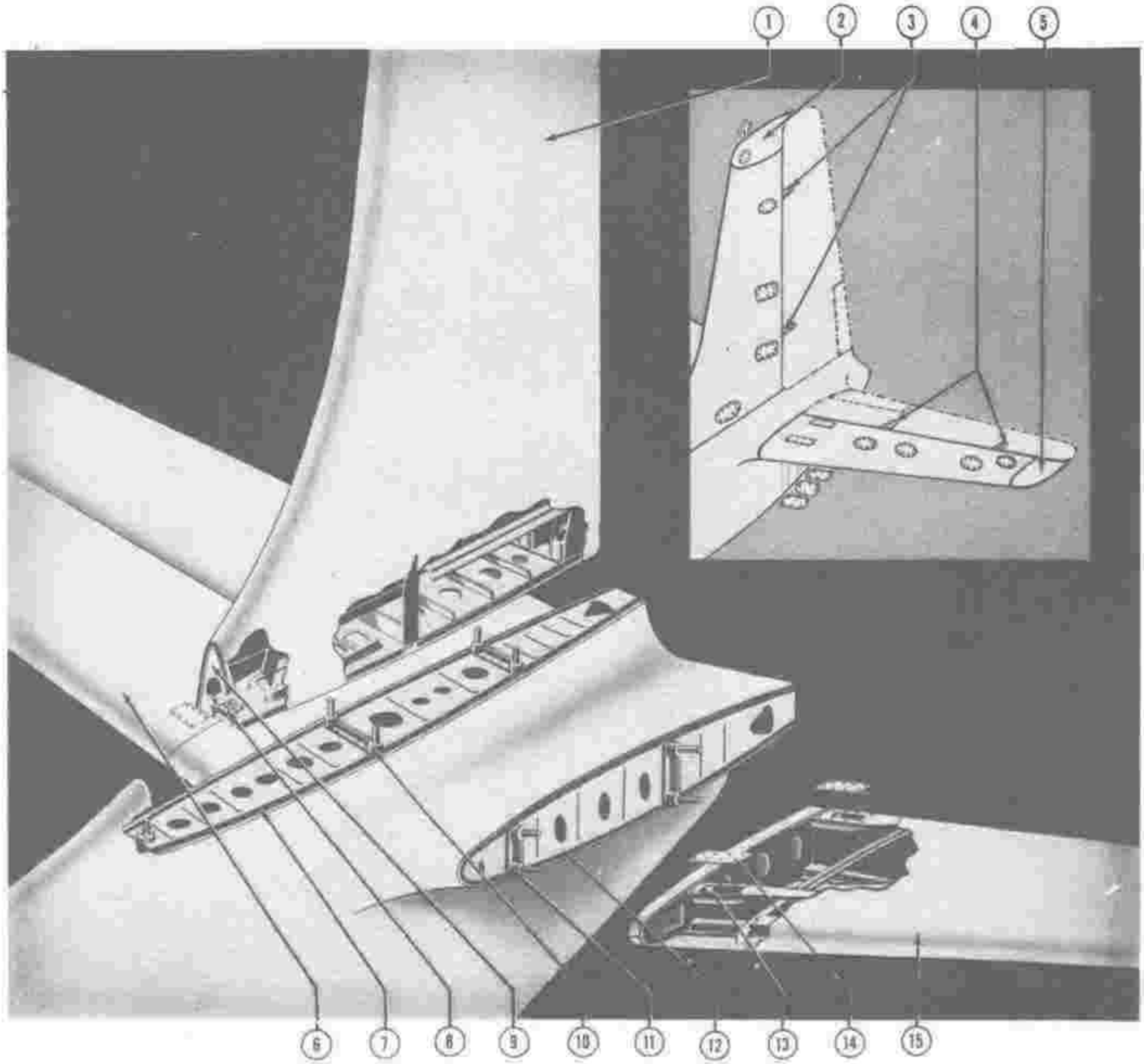
(2) REMOVAL.

(a) Remove the rudder as described in paragraph 3. *b.* (6) *(b)*, this section.

(b) Working within the fuselage aft section, disconnect the pitot-static instrument lines, the de-icer boot lines, and the pitot-static tube heater electric wire.

(c) Disconnect the aerial from the tip of the vertical stabilizer, and coil it.

(d) The weight of the vertical stabilizer is 140 lbs. and at least two men are required to remove it. One should work from within the fuselage, removing



1. Vertical Stabilizer
2. Vertical Stabilizer Tip (Removable)
3. Rudder Hinges
4. Elevator Hinges
5. Horizontal Stabilizer Tip
6. Horizontal Stabilizer
7. Sealing Strip (96 inches long)
8. Anchor Nut
9. Sealing Strip (22 inches long)
10. Vertical Stabilizer Attachment Bolt (5 places)
11. Horizontal Stabilizer Attachment Bolt (4 places)
12. Sealing Strip (85 inches long)
13. Elastic Stop Nut
14. Cover Plate
15. Horizontal Stabilizer

Figure 37 — Stabilizer Attachment

the five bolts which secure the vertical stabilizer in position on the fuselage structure. The nuts may be held through the access door provided between the spars on the vertical stabilizer.

(e) Lift the vertical stabilizer from the fuselage until it is clear of bolts and lines.

(3) DISASSEMBLY.–Remove the tip of the vertical stabilizer as follows:

(a) Disconnect and cap the instrument lines and disconnect the heater wire, working through the access hole located beneath the pitot-static tube.

(b) Remove the screws at the bottom of the tip, and lift the tip from the stabilizer.

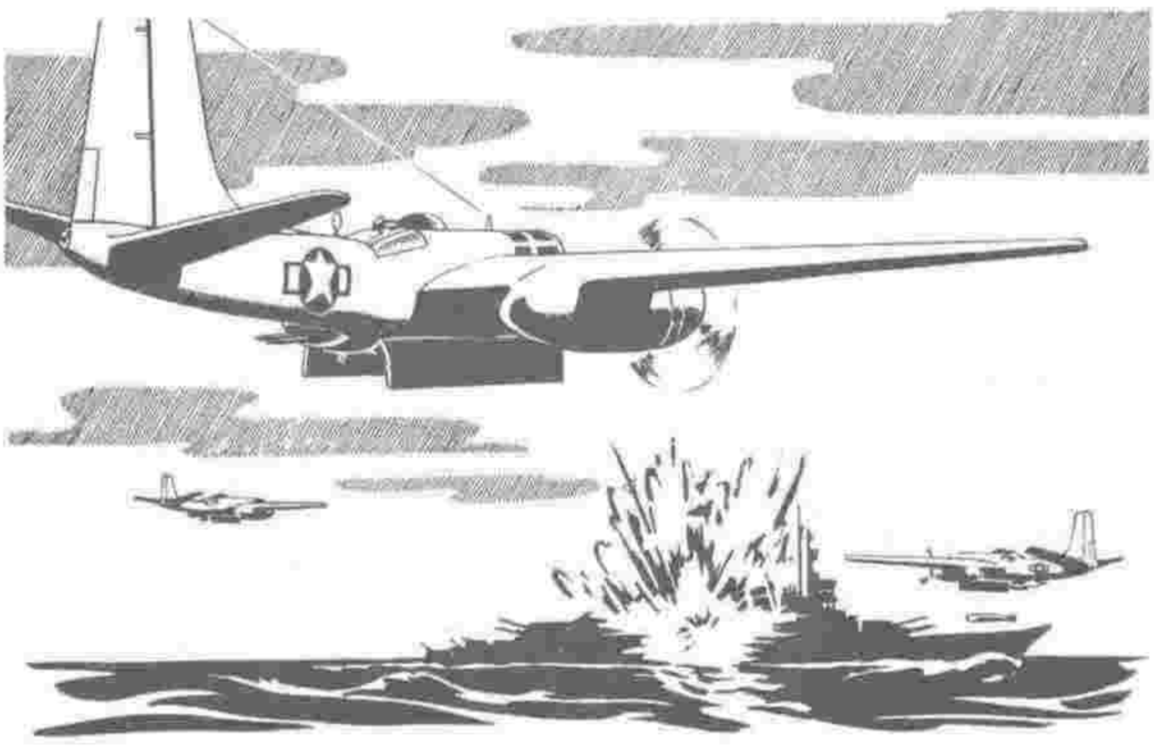
(4) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Instructions on the repair of the vertical stabilizer plating and structure will be found in the Structural Repair Handbook AN01-4AJ-3 supplied with this airplane.

(b) Damaged or worn sealing strips *(5, figure 47)* should be replaced. For instructions on replacement, refer to paragraph 2. *b.* (4) *(b)*, this section.

(5) ASSEMBLY AND INSTALLATION.–To install the vertical stabilizer, reverse the REMOVAL procedure. Attach the four bolts *(10, figure 37)* with a torque wrench force equal to 2900-3200 inch-pounds.

d. ELEVATORS, RUDDER, AND TRIM TABS.–Refer to paragraph 3., this section, for all information about these movable surfaces.



3. MOVABLE SURFACES AND SURFACE CONTROLS.

a. GENERAL.–The ailerons, elevators, rudder and trim tabs installed on the airplane are conventional in design and are operated by means of a single set of standard manual controls installed in the pilot's compartment. The similarity with other airplanes ends at this point, however, as several types of mechanisms are used to actuate the flight surfaces.

The wing flaps also differ from those used on most airplanes. They are attached to the wing by a linkage which permits greater extension than the standard flap mechanism provides. Efficiency is further increased by the use of deflectors which direct air flow to the top of the flap, providing additional drag.

b. MOVABLE SURFACES. *(See figure 38.)*

(1) GENERAL.–Movable surfaces used to control the airplane while it is in flight consist of two fabric-covered ailerons, two metal aileron trim tabs, two fabric-covered elevators and tabs, a fabric-covered rudder and tab, and four metal wing flaps equipped with self-acting deflectors.

To facilitate the pilot's control of the airplane, the ailerons, elevators and rudder are balanced aerodynamically and statically, and all the moving surfaces are attached with hinges containing sealed-in-grease bearings. A rubberized canvas gap seal is installed in the openings between the ailerons and the wing, the elevators and the horizontal stabilizers, and the rudder and the vertical stabilizer. The method of installation permits quick removal of the seals from the fixed surfaces.

(2) AILERONS. *(See figure 39.)*

(a) DESCRIPTION.–One aileron is attached to each wing panel, extending inboard from the wing panel tip for a distance of 11 feet. The rubber-impregnated gap seal which covers the opening between the ailerons and the wing is attached to the surfaces with screws and equipped with a metal zipper. The zipper permits rapid removal of the ailerons from the wing.

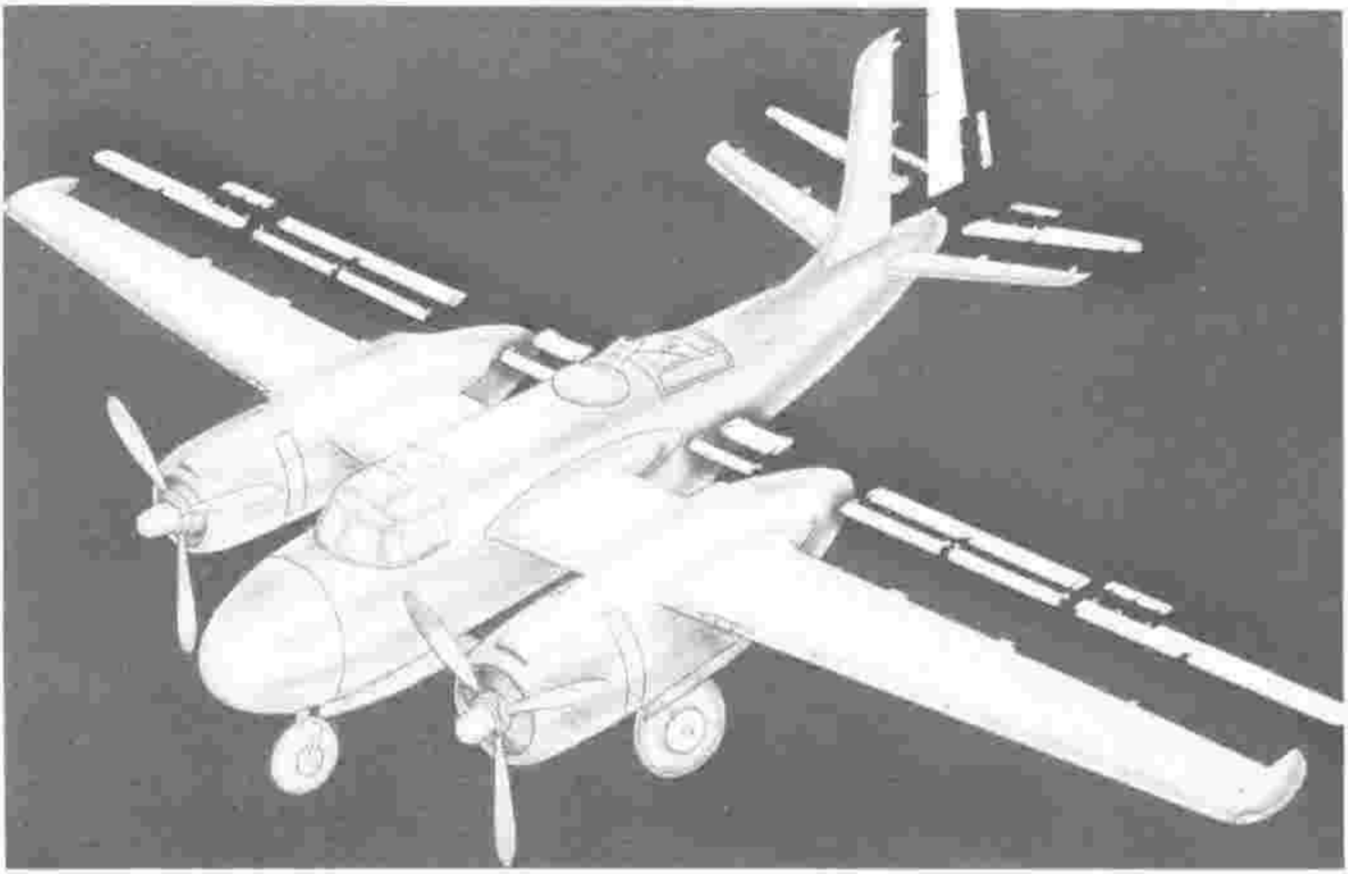


Figure 38—Movable Surfaces

The ailerons are operated simultaneously by revolving the pilot's control wheel to the left or right. The aileron control mechanisms are described in paragraph 3. *c.* (2), this section.

(b) REMOVAL.

1. Remove the aileron push-pull tube fairing and the aileron trim tab push-pull tube fairing.

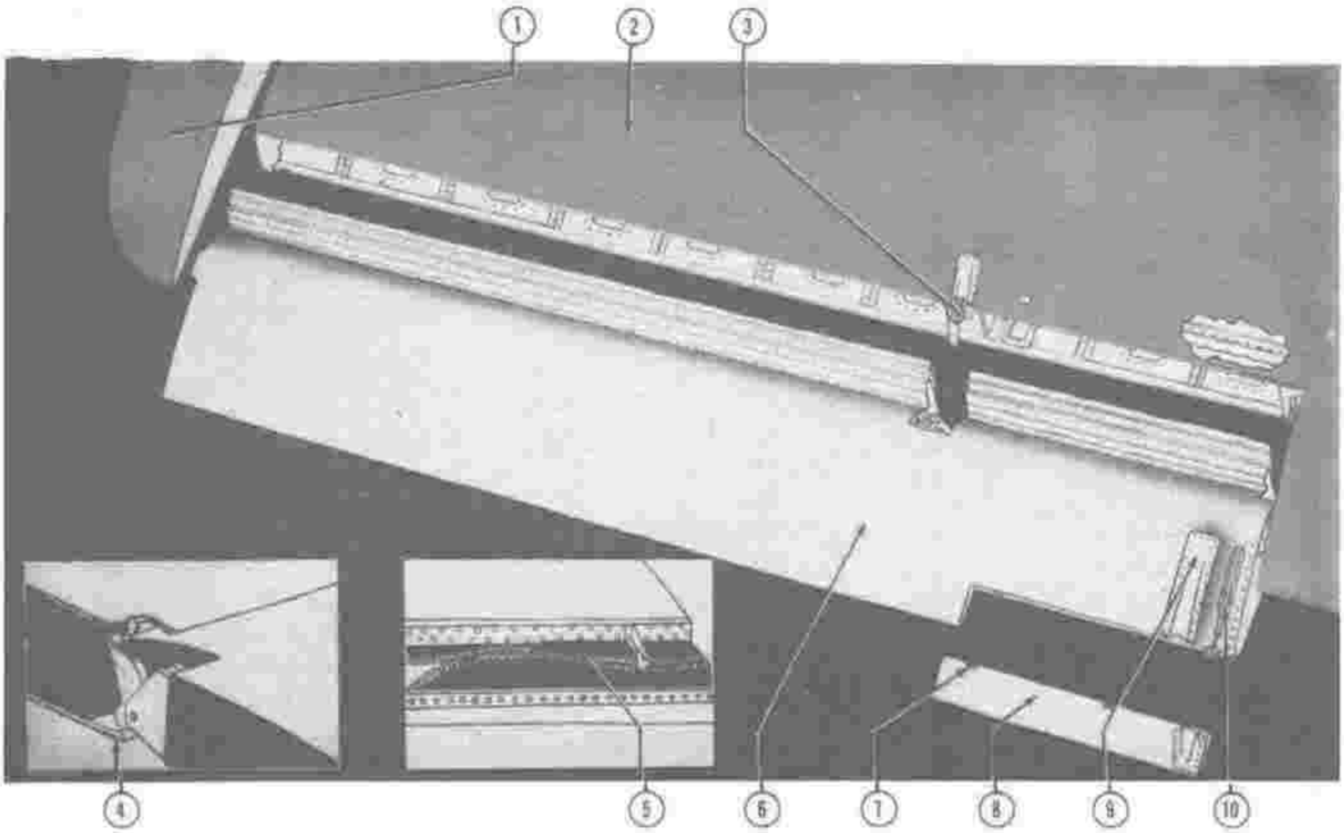
2. Disconnect the aileron push-pull tube and the aileron tab push-pull tube by removing the bolts at the aft fittings.

3. Open all the access doors located on the under side of the wing immediately forward of the aileron. *(See 1, figure 6.)*

4. Working through the access doors, starting at the center hinge, open the aileron gap seal zippers.

5. Disconnect the three bonding strips connected to the wing and the aileron at the three hinge points. To remove the bonding strip at the outboard hinge it will be necessary to work through the opening between the hinge and the wing tip, using a socket wrench and a 90 degree offset screw driver. Insert the wrench through the opening from the underside and bend the bonding strip attaching clip on the wing until the wrench can be fitted over the nut. After inserting the wrench, pull the aileron down and remove the screw by inserting the 90 degree screw driver from the upper side of the aileron.

6. Remove the inboard and outboard hinge bolts. The inboard bolt is reached through the inspection plate located on the top of the aileron. Hold the bolt head with a 7/16 inch, deep socket wrench and, with the wing flaps in the DOWN position, remove the nut with a deep socket wrench. To remove the outboard hinge bolt, remove the access door on the top of the aileron. Hold the nut with a 7/16 inch deep socket wrench and turn the bolt with a 7/16 inch offset box wrench inserted through the gap between the hinge and the wing tip. To remove the center



1. Wing Tip
2. Wing
3. Aileron Push-Pull Tube
4. Typical Hinge
5. Zipper Seal
6. Aileron
7. Aileron Trim Tab Hinge
8. Aileron Trim Tab
9. Push-Pull Tube Fairing
10. Trim Tab Push-Pull Tube

Figure 39 — Aileron and Aileron Trim Tab

hinge bolt, remove the aileron access cover on top of the wing and hold the bolt head while removing the nut through the aileron hinge fairing opening.

Note

Two men are required to remove an aileron properly, and three men are required in the installation procedure.

(c) INSTALLATION.—Reverse the REMOVAL procedure given in paragraph *(b)* above. Install the outboard hinge bolt first, using a mechanical finger to put the bolt in place. Safety-wire the hinge bolts.

Note

The right and left hand ailerons are not interchangeable.

(d) ADJUSTMENTS.

1. Correct aileron travel UP is 20 degrees, ± 1 degree, or 5$^{31}/_{32}$ inches, ± $^{5}/_{16}$ inch. Correct aileron travel DOWN is 15 degrees, ± 1 degree, or 4$^{15}/_{32}$ inches, ± $^{5}/_{16}$ inch. The measurement is made from the inboard trailing edge of the surface.

2. The degree of aileron movement is regulated by adjusting the stops *(1, figure 58)* which limit the movement of the aileron differential crank. An access door *(17, figure 6)* is provided on the under side of the wing. When the adjustments are made, the aileron differential crank should strike the stops but not with undue pressure. Left and right aileron movement must be symmetrical.

3. Neutral alignment of the ailerons relative to the trailing edge of the wing is obtained as follows:

a. Lock the controls in the neutral position.

b. Open the access doors *(17, figure 6)* on the under side of the wing.

c. Loosen the nuts at each end of the rod *(9, figure 58)* and turn it to the right or left as required

4. As control wheel is turned clockwise left aileron goes down, right aileron goes up.

Note

The stops which limit the movement of the control wheel are not adjustable.

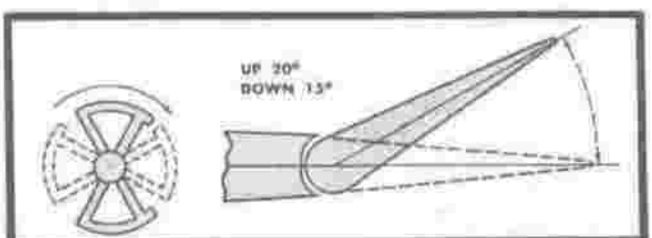


Figure 40 — R. H. Aileron Motion

(3) AILERON TRIM TABS. *(See figure 39.)*

(a) DESCRIPTION.—An all-metal trim tab is built into each aileron at the inboard trailing edge. The tabs operate automatically with the aileron, moving in the opposite direction. In addition, provision is made for the individual control of the left hand trim tab. The aileron tab control mechanisms are described in paragraph 3. *c.* (3), this section.

(b) REMOVAL.

1. Remove the tab push-pull tube fairing, screwed on the upper side of the aileron immediately forward of the tab inboard hinge.

2. Disconnect the push-pull tube at the tab.

3. Remove the hinge pins from the under side of the tab.

4. Disconnect the bolted bonding strip and remove the tab.

(c) MAINTENANCE REPAIR.—For repairs to the structure and skin, refer to the Structural Repair Handbook (No. AN01-40AJ-3).

(d) INSTALLATION.—Reverse the REMOVAL procedure given in paragraph *(b)* above.

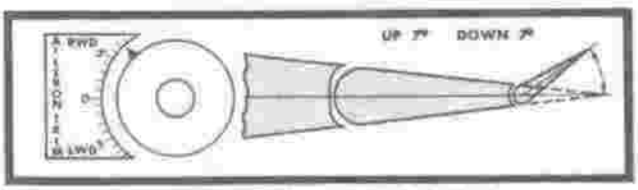


Figure 41 — Aileron Trim Tab Motion

Note

The right and left hand aileron trim tabs are not interchangeable.

(e) ADJUSTMENTS.

1. Correct travel of the left hand aileron trim tab is UP or DOWN 7 degrees ± 1½ degrees or ⅝ inch ± ⅛ inch. The measurement is made at the inboard trailing edge of the surface. The indicator *(22, figure 232)* and the tab must be in phase within ± 1½ degrees. When indicator points to "RWD" (right wing down) the left-hand trim tab is up.

2. The degree of L.H. aileron trim tab movement is regulated as follows:

a. Set the control dial in the pilot's compartment at zero.

b. Remove the fairing *(2, figure 59)* which covers the trim tab push-pull tube assembly in the aileron.

c. Loosen the end fitting on the push-pull tube assembly and remove the bolt which attaches the tab to the tube.

d. Adjust the tube.

3. If the adjustment at the push-pull tube is insufficient, proceed as follows:

a. Remove the landing light in the wing to gain access to the aileron trim tab drum.

b. Screw out the adjusting nut *(12, figure 59)* on the aileron trim tab drum, located in the wing adjacent to the tab.

c. Move the trim tab drum aft until the nut disengages from the drum.

d. Turn the nut to the right or left to obtain proper travel of the tab.

e. With the cables properly rigged and the tab control set at zero, re-engage the adjusting nut so that the drum is free to rotate and has a minimum of side play.

f. For a final adjustment, regulate the aileron tab push-pull tube assembly.

g. To obtain neutral alignment of the left hand aileron trim tab, adjust the cables at the turnbuckles.

h. Neutral alignment of the right aileron automatic trim tab is obtained by removing the fairing which covers the tube assembly, loosening the locknut at the tube end fitting, and turning the fitting to left or right. Travel ratio of the automatic tab is 1 degree for each degree of aileron motion, namely, 20 degrees ± 1½ degrees, or 1¾ inches, ± ¼ inch, measured at the inboard end.

(f) TEST AFTER INSTALLATION.—Check the left hand aileron trim tab for proper degree of travel.

(4) ELEVATORS. *(See figure 43.)*

(a) DESCRIPTION.—Each elevator is hinged to the horizontal stabilizer by two brackets fitted with sealed anti-friction bearings. The axis of rotation is located approximately eight inches aft of the leading edge of each elevator. When an elevator is raised or lowered, the surface forward of the hinge line provides aerodynamic balance. The openings between the elevators and horizontal stabilizers are covered with rubberized canvas gap seals. The seals are attached to the horizontal stabilizers with wing studs and grommets, and to the elevators with bolts and nut plates. The elevators are operated by moving the pilot's control column fore or aft of the neutral position. The elevator mechanisms are described in paragraph 3. *c.* (4), this section.

(b) REMOVAL.

1. Remove the tail cone and armor plate as described in paragraph 4. *b.* (2), this section.

2. Disconnect the elevator trim tab control cables by removing the cable drum from the gear box which is located beneath the cover plate at the inboard leading edge of the elevator. The cable drum is removed by detaching the bolt in the large composition gear at the bottom of the box. A small hole is provided in the elevator above the gear box, through which the nut may be held when the bolt is removed. After freeing the drum, tape it to prevent the cables from unwinding and lay it in the fuselage.

3. Disconnect the elevator torque tube by removing the bolts which secure it to the horn inside the fuselage.

4. Remove the gap seal installed along the trailing edge of the stabilizer by turning the wing studs with the fingers.

5. Detach the bond strip at the hinge points.

6. Remove hinge bolts.

7. Lift the elevator away from the fuselage.

(c) MAINTENANCE REPAIR.—For instructions on the repair of the elevator skin and structure, refer to the Structural Repair Handbook (T.O. No. AN01-40AJ-3).

(d) INSTALLATION.—Reverse the removal procedure given in paragraph *(b)* above.

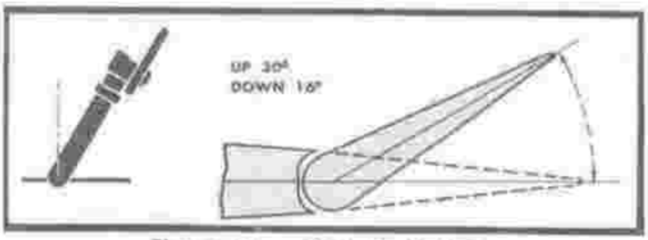


Figure 42 — Elevator Motion

(e) ADJUSTMENTS.

1. Correct elevator movement UP is 30 degrees ± ½ degree, or 14 inches ± 7/32 inches. Elevator movement DOWN is 16 degrees ± ½ degree, or 7 15/32 inches ± 7/32 inches. The measurement is made from the inboard trailing edge of the surface. The elevators must align with each other within ± ¼ degree or 1/16 inch. When the control column is aft, the elevators are up.

2. Elevator movement is regulated by removing the tail cone, as described in paragraph 4. *b.* (2), this section, and adjusting the four stops *(29, figure 73)* attached to the control support assembly. The stops limit the movement of the elevator horns.

3. Neutral alignment of the elevators is obtained by locking the controls in the neutral position, and adjusting the cable action at the turnbuckles. After making the adjustment, check cable tension *(figure 74)* with a tensiometer. Safety-wire the turnbuckles.

4. Fore and aft movement of the control column *(figure 54)* is adjusted by regulating the two stops *(11, figure 54)* which limit the travel of the elevator horns attached to the control column.

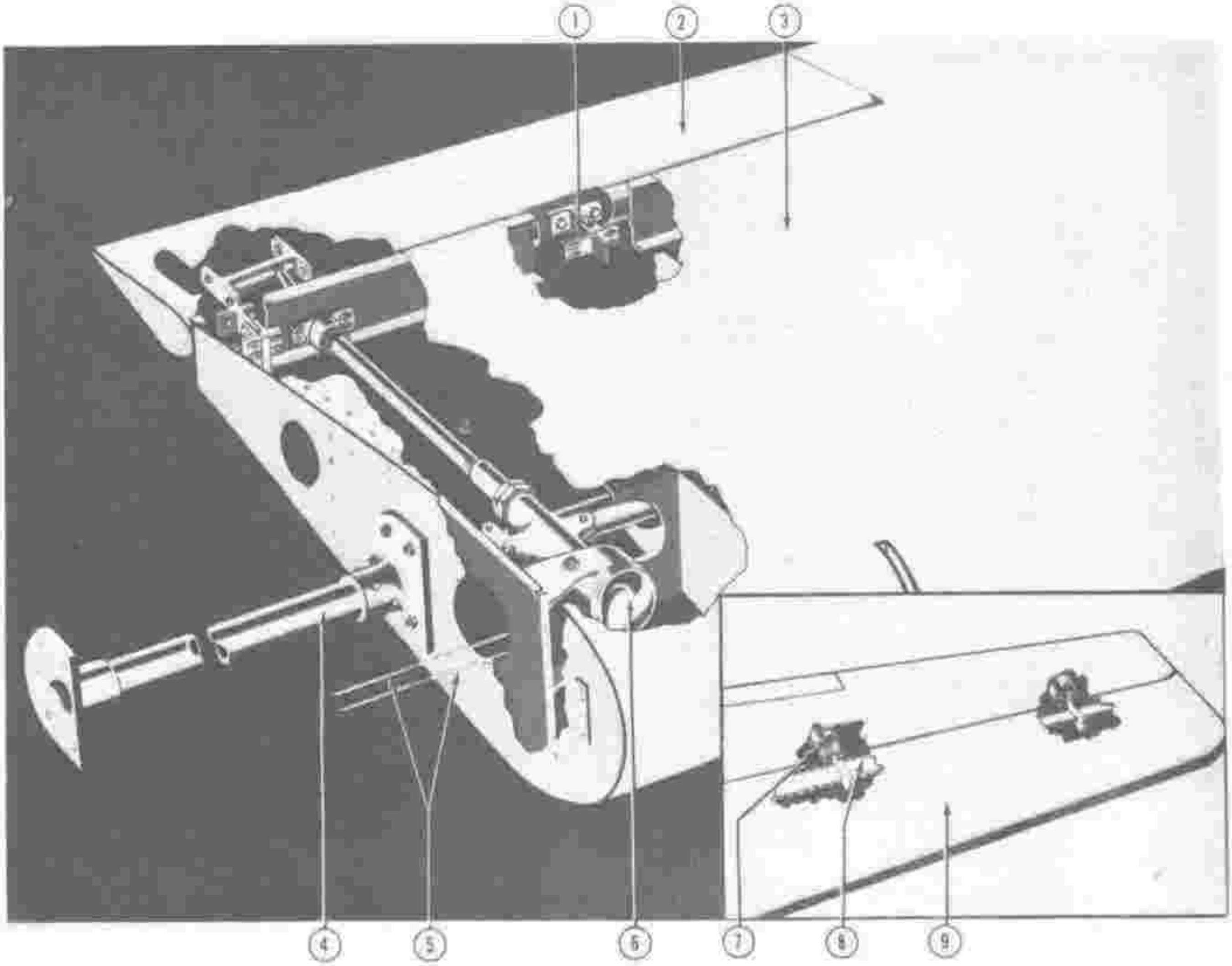
a. When the control column is aft and the elevator horn in the empennage is resting against the top stop, the distance between the forward edge of control column head and the instrument panel should be 18½ inches ± ¼ inch. Clearance between the pilot's compartment elevator horn and the aft stop should be $\frac{5}{16}$ of an inch, ± $\frac{1}{16}$ inch.

b. When the control column is forward and the elevator horn in the empennage rests against the bottom stop, the distance between the forward edge of control column head and the instrument panel should be 3 inches ± ¼ inch. The clearance between the pilot's compartment elevator horn and the forward stop should be $\frac{5}{16}$ inch ± $\frac{1}{16}$ inch.

(f) TEST AFTER INSTALLATION.—Make an operating test of the elevator controls and check for proper movement.

(5) ELEVATOR TRIM TABS. *(See 2, figure 43.)*

(a) DESCRIPTION.—A trim tab is installed on



1. Elevator Trim Tab Hinge
2. Elevator Trim Tab
3. Elevator
4. Torque Tube
5. Trim Tab Control Cables
6. Trim Tab Gear Box
7. Elevator Hinge
8. Elevator Seal
9. Horizontal Stabilizer

Figure 43 — Elevator

the inboard trailing edge of each elevator to provide for the longitudinal trim of the airplane. The elevator trim tabs are raised or lowered simultaneously by revolving a wheel *(figure 61)* located on the forward left hand side of the control pedestal. The elevator trim tab mechanisms *(figures 61 & 64)* are described in paragraph 3. *c.* (5) this section.

(b) REMOVAL.—Remove the three hinge bolts and pull the tab horizontally away from the elevator until it is clear of the tab actuating torque tube. Be careful not to lose the needle bearing installed in the tab slot.

(c) MAINTENANCE REPAIR.—For instructions on the repair of the elevator trim tab structure, refer to Structural Repair Handbook (No. AN01-40AJ-3).

(d) INSTALLATION.—Reverse the removal procedure given in paragraph *(b)* above. Be sure that the actuating torque tube is inserted in the bearing in the tab slot.

Note

The right and left hand elevator tabs are interchangeable.

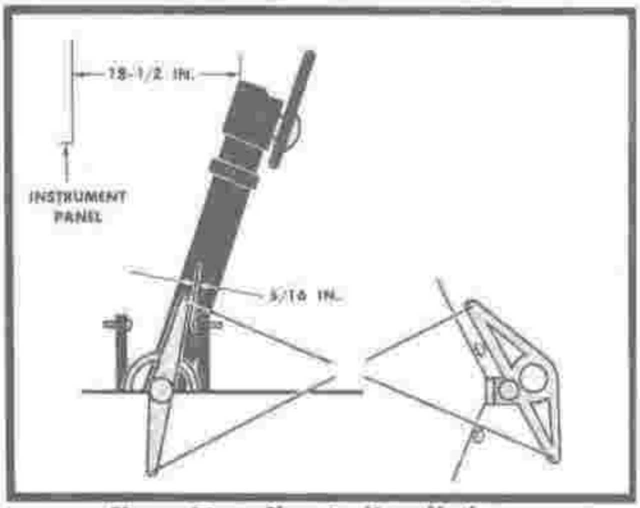


Figure 44 — Elevator Horn Motion

(e) ADJUSTMENTS.

1. Elevator tab movement UP is 12 degrees ± 2 degrees, or 1⅜ inches ± ¼ inch. Elevator tab movement DOWN is 17 degrees ± 2 degrees or 1³¹⁄₃₂ inches ± ¼ inch. The measurement is made from the outboard trailing edge of the surface. Indicator and tab must be in phase within ± 1½ degrees. Tabs must align with elevator ± 1 degree or ± ¹⁄₁₆ inch when dial is set at zero. The tabs must be in line with each other ± ½ degree at all positions. When tab indicator indicates "NOSE DOWN," tabs are up.

2. Travel of the elevator trim tabs is adjusted at the gear boxes in the elevators. (The stops on the control in the pilot's compartment are not adjustable.) When either tab is to be adjusted, place elevators in the neutral position. Loosen the nut on the larger of the two gears *(7, figure 64)* on the side of the gear box, and slip the larger gear out of mesh with the smaller gear *(See 6, figure 64)*. Set the trim tab control in the pilot's compartment to neutral. With the fingers, rotate the smaller gear on the tab gear box in the elevator until the tab is in neutral. Then remesh the larger gear with the smaller gear. Check both elevator tabs for correct travel by operating the tab control in the pilot's compartment. Check cables for proper tension.

Note

When the elevator trim tab control in the pilot's compartment is set at neutral, the drum in the pedestal (visible from the nose wheel well) should be wound as shown in *figure 62*. If the turns on each side of the drum are not equal, the trim tab cable is not properly rigged.

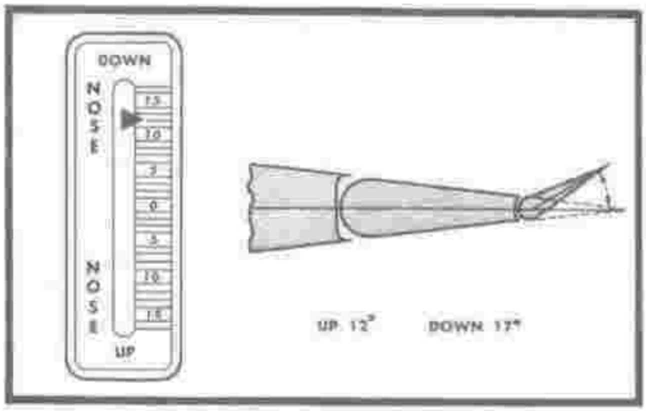


Figure 45 — Elevator Trim Tab Motion

(f) TEST AFTER INSTALLATION.—Operate the elevator trim tabs and check them for neutral alignment and proper travel.

(6) RUDDER. *(See figure 47.)*

(a) DESCRIPTION.—The rudder is hinged to the vertical stabilizer at two points and the opening between the two surfaces is covered with a rubberized canvas gap seal *(5, figure 47)*. The seal is attached to the vertical stabilizer with wing studs and grommets, and to the rudder with bolts and nuts. The rudder is operated by means of pedals *(figure 65)* installed in the pilot's compartment. The pedals are adjustable, fore or aft, over a range of four inches to accommodate pilots of varying stature. The rudder actuating mechanisms are described in paragraph 3. *c.* (6), this section.

(b) REMOVAL.

1. Remove the tail cone *(1, figure 81)* and the armor plate as described in paragraph 4. *b.* (2), this section.

2. Disconnect the rudder tab control cables by removing the cable drum from the gear box *(figure 66)* which is located beneath a cover plate on the lower right hand side of the rudder near the leading edge. The cable drum is removed by detaching the bolt *(7, figure 64)* in the large composition gear at the bottom of the box. A small hole is provided in the rudder directly above the gear box, through which the nut may be held when the bolt is removed.

3. Disconnect the rudder torque tube *(figure 46)* by removing the bolts which secure it to the horn *(32, figure 73)* within the fuselage.

4. Remove the rudder gap seal from the stabilizer by turning the wing studs with the fingers.

5. Detach the bonding strips at the hinge points.

6. Remove the two hinge bolts and lift the rudder until the torque tube clears the fuselage.

(c) MAINTENANCE REPAIR.—For instructions on the repair of the rudder structure and skin, refer to the Structural Repair Handbook (No. AN01-40AJ-3).

(d) INSTALLATION. – Reverse the removal procedure given in paragraph *(b)* above.

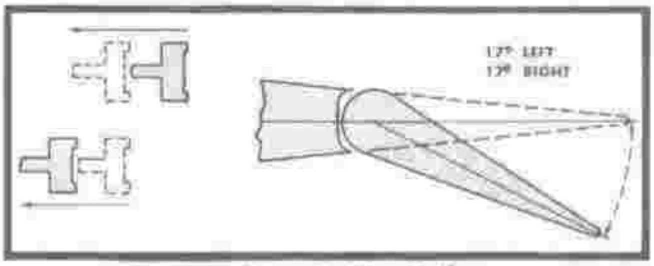


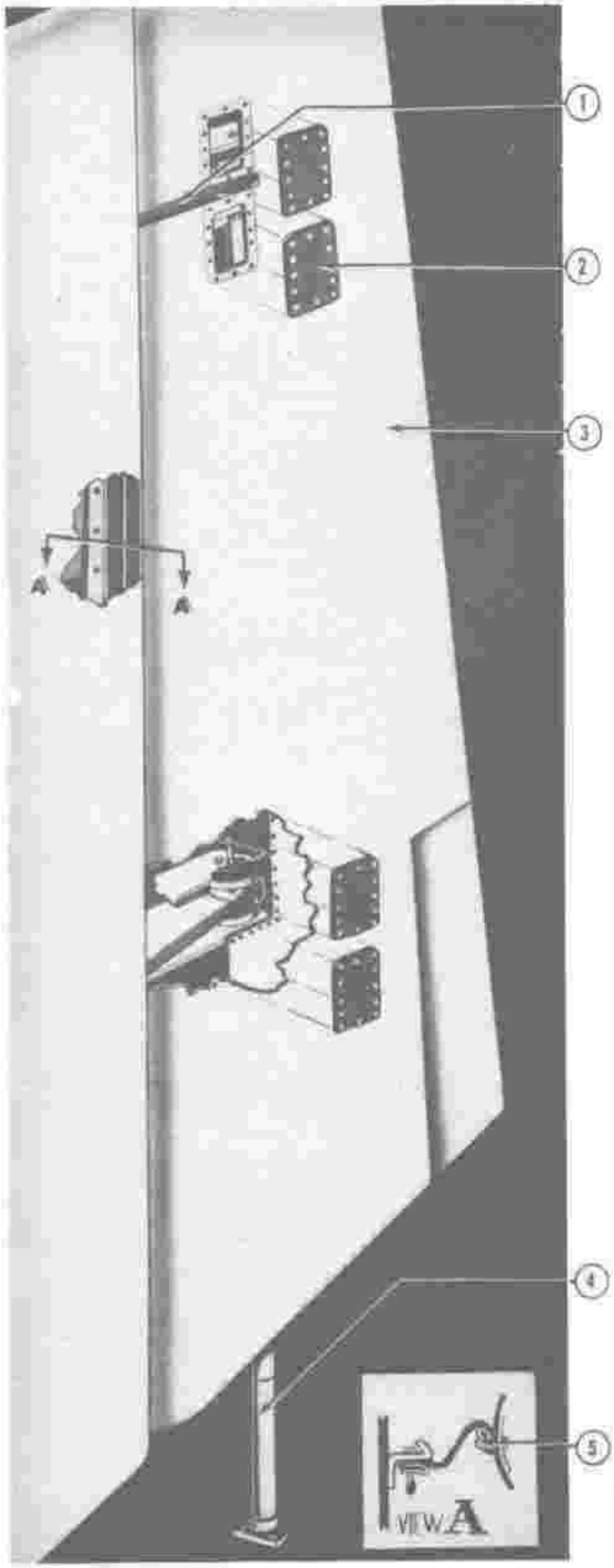
Figure 46 — Rudder Motion

(e) ADJUSTMENTS.

1. Correct movement of the rudder to the LEFT or RIGHT is 17 degrees ± ½ degree, or 11$\frac{7}{32}$ inches ± $\frac{1}{32}$ inch. The measurement is made at the bottom inboard edge. When the left rudder pedal is depressed, rudder moves to the left.

2. Movement of the rudder pedals is limited by adjusting the two stops *(10, figure 65)* attached to the pedal torque tube support. A clearance of $\frac{3}{16}$ of an inch between the torque tube arm *(14, figure 65)* and the pedal stop is required when the horn at the aft support assembly is in contact with the stop at that location.

3. Neutral alignment of the rudder pedals, relative to each other, is obtained by regulating the two adjustable rods *(3, figure 65)* which connect the pedals with the torque tube assembly.



1. Rudder Hinge (2 places)
2. Hinge Access Doors
3. Rudder Assembly
4. Torque Tube
5. Rudder Seal

Figure 47 — Rudder Attachment

4. The rudder is adjusted for movement and neutral alignment as follows:

a. Lock the controls in the neutral position.

b. Adjust the action of the rudder at the turnbuckles *(figure 71)* until the proper movement and alignment is obtained.

c. Check the cables for proper tension. *(See figure 74.)*

d. Safety the turnbuckles with wire.

(f) TEST AFTER INSTALLATION.—Make an operating test of the rudder controls and check the rudder surface for proper alignment and movement.

(7) RUDDER TRIM TAB. *(See figure 66.)*

(a) DESCRIPTION.—The rudder trim tab is installed in the bottom trailing edge of the rudder. The tab is hinged to the rudder at three points. The tab is operated by revolving a dial installed on the control pedestal. The mechanism which actuates the tab is described in paragraph 3. *c.* (7) this section.

(b) REMOVAL.—Remove the three hinge bolts and lift the tab aft and away from the rudder until it clears the trim tab torque tube.

(c) MAINTENANCE REPAIR.—For instructions on the repair of the skin and structure of the rudder trim tab, refer to the Structural Repair Handbook (No. AN01-40AJ-3).

(d) INSTALLATION. — Reverse the removal procedure given above, making certain that the trim tab torque tube is properly inserted in the bearing located in the tab slot.

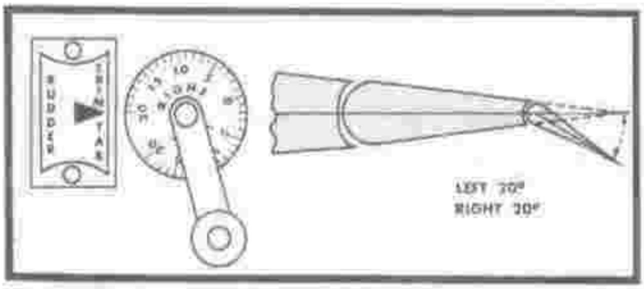


Figure 48 — Rudder Trim Tab Motion

(e) ADJUSTMENTS.

1. The correct movement of the rudder trim tab to the LEFT or RIGHT is 20 degrees ± 2 degrees; or 3¼ inches ± 13/32 inch. The measurement is made at the bottom aft edge of the tab. Indicator and tab must be in phase within ± 1½ degrees. When the rudder tab indicator indicates "RIGHT" the tab has moved to the left. Tab must align with rudder ± ½ degree or ± 1/16 inch.

Rudder tab movement must be adjusted at the tab gear box in the rudder. Place rudder in neutral. Loosen the nut on the larger of the two gears *(7, figure 64)* located on the gear box, and slip the larger gear out of mesh with the smaller gear. *(See 6, figure 64).* Set the trim tab control in the pilot's compartment to neutral. With the fingers, rotate the smaller gear on the tab gear box in the rudder until the tab is in neutral. Then remesh the larger gear with the smaller gear. Check tab for correct travel by operating the trim tab control in the pilot's compartment. Check cables for correct tension.

Note

When the rudder trim tab control in the pilot's compartment is set at neutral, the drum in the pedestal (visible from the nose wheel well) should be wound as shown in *figure 67.* If the turns on each side of the drum are not equal, the drum is not properly wound.

e. Safety-wire the turnbuckles.

(8) WING FLAPS. *(See figure 50.)*

(a) DESCRIPTION.—Two flaps are installed on each wing panel, one inboard of the nacelle and the other outboard of the nacelle. Attached to each flap is an air flow deflector which moves automatically with the flap. Each inboard flap and deflector is attached to the wing by two hinge assemblies. Each outboard flap and deflector is attached to the wing by three hinge assemblies.

The flaps and deflectors are electrically operated by the control lever *(figure 49)* which is installed on the control pedestal. LANDING position of the flaps is down 52 degrees ± 2 degrees.

For take-off the wing flaps may be operated to any desired downward position by moving the electric control lever to the "DOWN" position and holding it there until the desired degree of travel is ob-

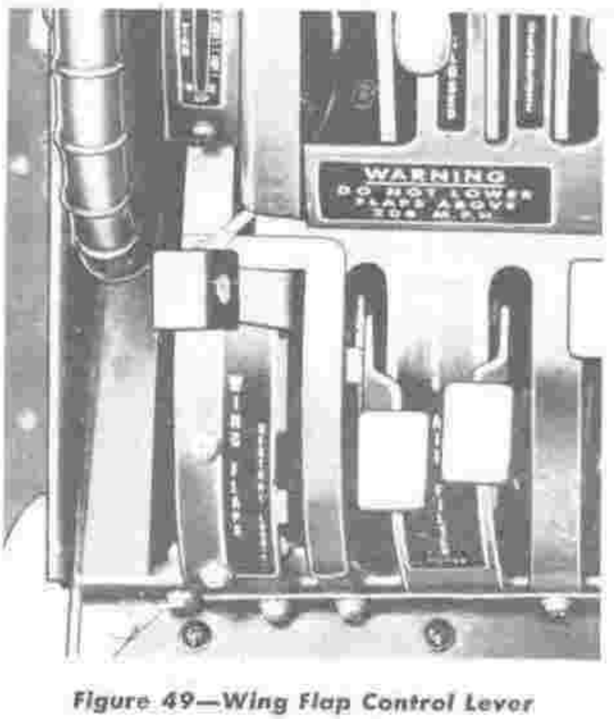


Figure 49—Wing Flap Control Lever

tained. At this point the control lever must be moved to the "NEUTRAL" slot. The wing flap mechanisms are described in paragraph 3. *c. (11)*, this section.

(b) REMOVAL.

1. INBOARD FLAPS.

a. Operate the flap to the 52 degrees down (landing) position. At least two men are required for the removal procedure. Adequate support must be provided so that hinge assemblies will not be damaged.

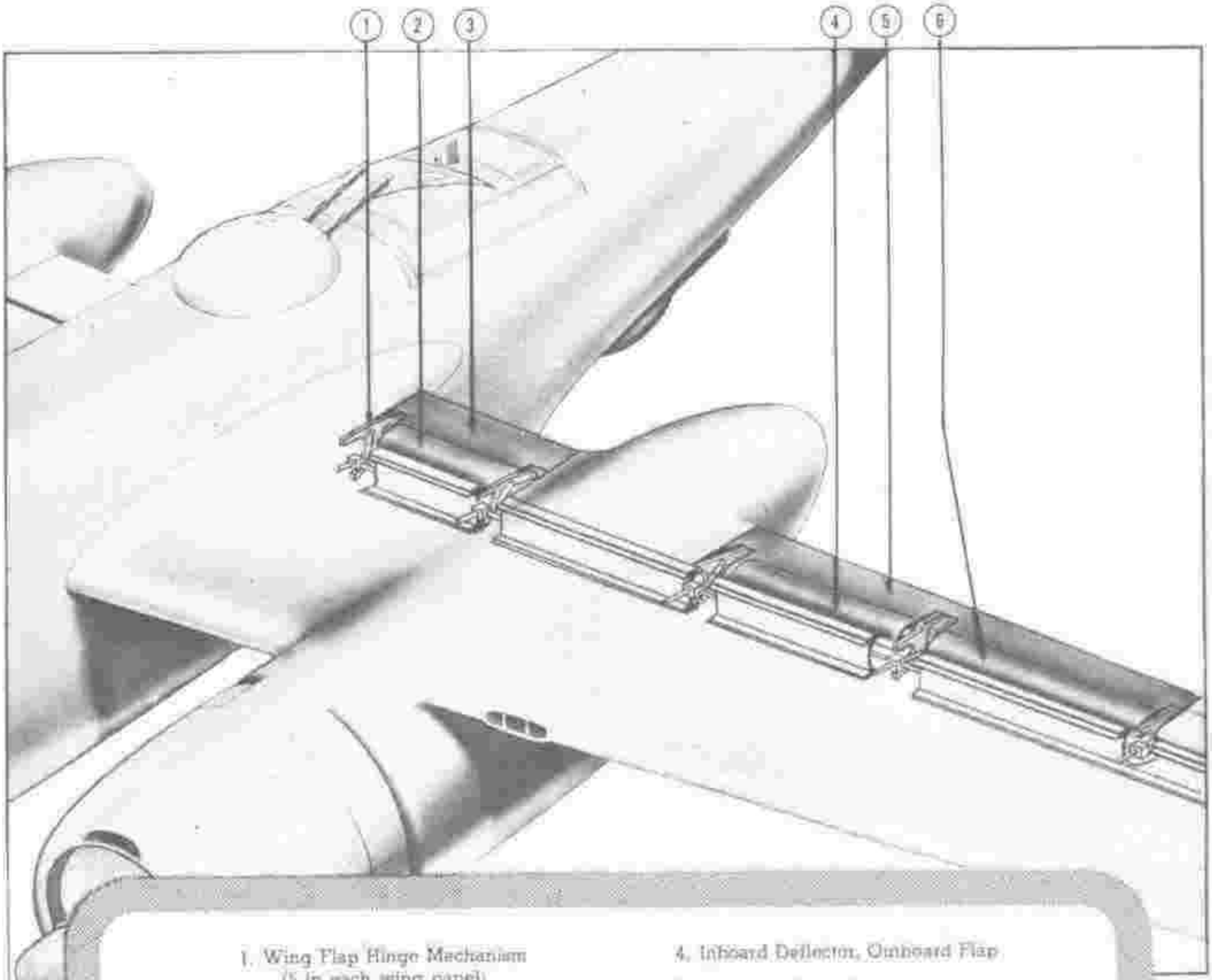
b. Disconnect the bolts from the top of the adjustment rods *(10, figure 51)* in each hinge assembly, relieving the pressure on the actuating screws *(3, figure 51.)*

c. Disconnect the actuating screw from the linkage in each hinge assembly by removing the bolt from the bearing or fork on each actuating screw.

d. Measure the extension of each actuating screw from the shoulder of the gear box to the center line of the bearing or fork and make a notation of the distance so that the actuating screws can be restored to the same positions when the flap is re-installed.

e. Turn the actuating screws into the gear boxes *(figure 78)* so that they will not be subject to damage.

f. Detach the links *(2 & 9, figure 51)* from the supports on each end of the flap by removing the



1. Wing Flap Hinge Mechanism (5 in each wing panel)
2. Inboard Wing Flap Deflector
3. Inboard Wing Flap
4. Inboard Deflector, Outboard Flap
5. Outboard Wing Flap
6. Outboard Deflector, Outboard Flap

Figure 50 — Wing Flaps and Deflectors

bolts. Provide adequate support for the flap so that the hinge assemblies will not be damaged.

g. Remove the flap and attached deflector.

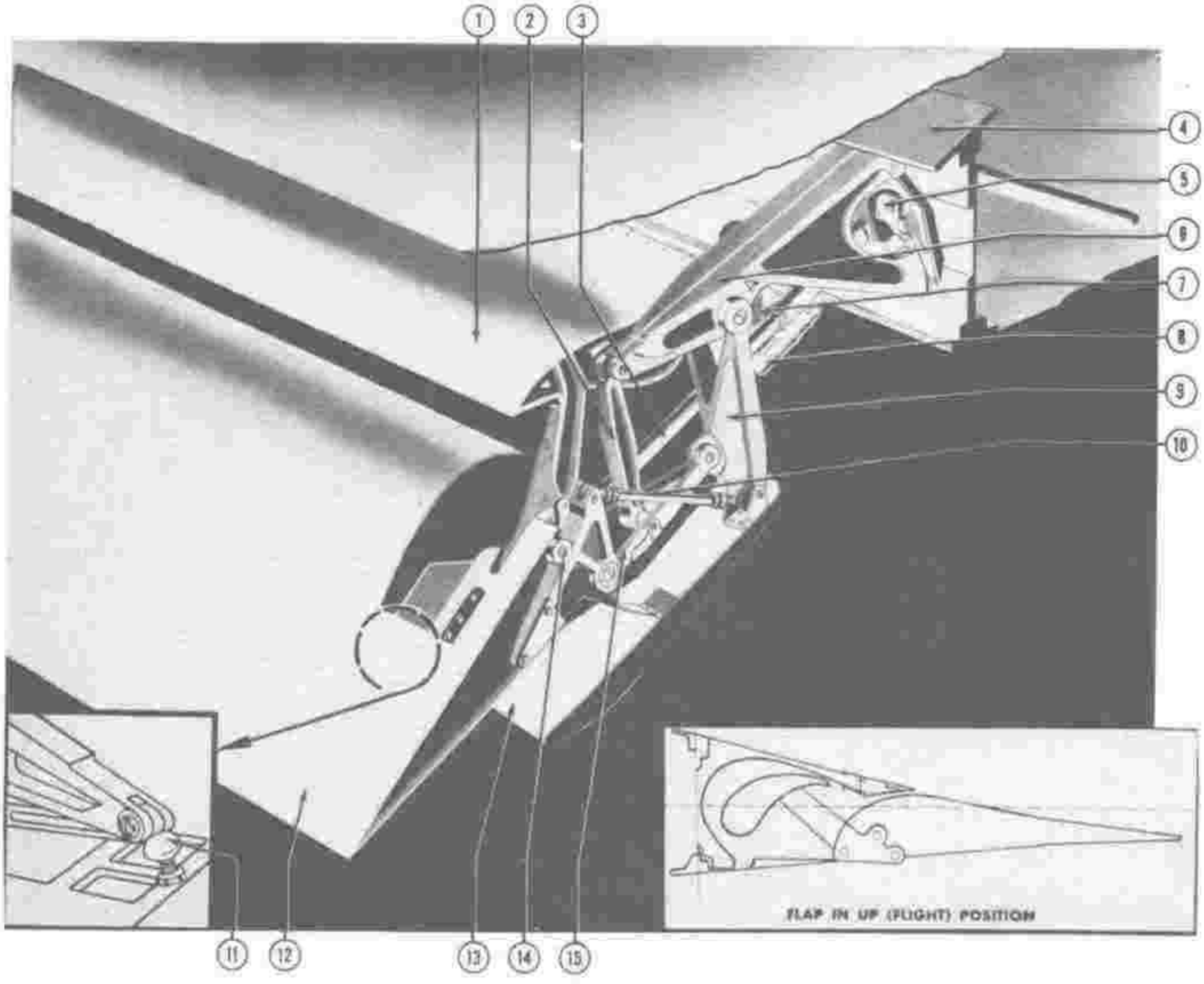
2. OUTBOARD FLAPS.

a. Operate the flap to the 52 degrees down (landing) position. At least two men are required to remove the flap. Adequate support must be provided so that hinge assemblies will not be damaged.

b. Disconnect the bolts from the top of the adjustment rods *(13, figure 53)* on each of the three hinge assemblies, relieving the pressure on the actuating screws. The forward bolts should be removed first.

c. Disconnect the actuating screw *(7, figure 53)* from the linkage in each hinge assembly by removing the long bolt from the bearing.

d. Measure the extension of the actuating screw from the gear box. Make a notation of the distance so that the actuating screws can be extended to the same position when the flaps are re-installed. Use



1. Wing Flap Deflector
2. Link Assembly
3. Flap Actuating Screw
4. Rear Wing Spar
5. Gear Box
6. Hinge Support
7. Flap Door Push Rod
8. Wing Flap Door
9. Link
10. Rotating Rod
11. Adjustable Stop for UP Position
12. Wing Flap
13. Cover
14. Rotating Rod Stationary Hinge
15. Hinge

Figure 51 — Typical Wing Flap End Hinge Assembly

the shoulder of the gear box and the center line of the bearing as measuring points. Make the measurement as precise as possible. Each thread length represents approximately one half of one degree of travel in the flaps.

e. Turn the actuating screws into the gear boxes *(figure 78)* so that they will not be damaged.

f. Beginning at the center hinge, detach the link assemblies *(8 & 12, figure 53)* from the supports at each hinge by removing the two bolts. Support the flap in the landing position until all of the bolts have been removed.

g. Remove the flap and attached deflector.

(c) DISASSEMBLY.—To remove the deflector from either the inboard or outboard flap remove the three bolts from each hinge point.

(d) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged or worn bolts, links and bearings in the wing flap hinge assemblies shall be replaced. Structural repairs shall be made in accordance with the instructions given in the Structural Repair Handbook (No. AN01-40AJ-3).

(e) ADJUSTMENTS.

1. VERTICAL ALIGNMENT.—To raise either end of the flap, relative to the trailing edge of the wing, turn the adjustment rod to the left. To lower the flap, turn the adjustment rod to the right.

2. HORIZONTAL ALIGNMENT.—To move either end of the flap aft from the wing, remove the bolt which attaches the actuating screw to the linkage and revolve the screw to the left; to move the flap forward, turn the screw to the right.

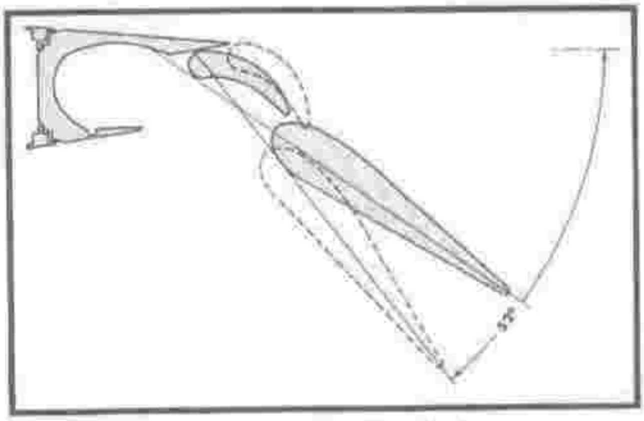


Figure 52 — Wing Flap Motion

3. CORRECT MOVEMENT.—Movement of the wing flaps when they are operated electrically is limited by two limit switches *(7, figure 76)* installed in the main gear box. The switches are operated by two cams mounted on a splined shaft in the gear box. When a cam depresses one of the limit switch box levers, the circuit to the flap motor is opened, halting the flaps at the desired position. The cams are labeled in the illustration as A and C. Cam A (the inboard cam) stops the lowering flaps in the LANDING position. Cam C stops the rising flaps in the UP or retracted position.

Movement of the wing flaps either up or down can be changed five degrees by turning the adjustment screws installed on the limit switches above the cams. If the flaps move too far either UP or DOWN, turn the proper adjustment screw up or counterclockwise; if the flaps do not attain required position, turn the adjustment screw down, or in a clockwise direction. Measurements of the degree of wing flap movement should be made by attaching a free swinging protractor to the trailing edge of the surface. DOWN position of the flaps is 52 degrees, ± two degrees.

WARNING

Check the wing flaps for proper travel both up and down after making an adjustment of the limit switches.

4. ALIGNMENT OF INDIVIDUAL FLAP.—If an individual flap fails to move to its proper position in respect to the other flaps, make the following adjustment:

a. Operate the flaps to the UP position.

b. Disconnect the flap from the torque tube at the disconnects located in the wing adjacent to each flap. *(See figure 78.)*

c. Rotate the shaft on the affected flap by hand until it has been returned to the proper position.

d. Reconnect the torque tube.

5. FORWARD MOVEMENT OF FLAPS.—The forward and upward movement of the flaps into the wing is limited to the proper fairing position by means of two adjustable stops *(3, figure 53)* installed on each flap.

Note

For instructions on the adjustment of the wing flap position transmitter *(figure 76)* mounted on the main gear box, refer to paragraph 15. *b.* (12) *(i)*, this section.

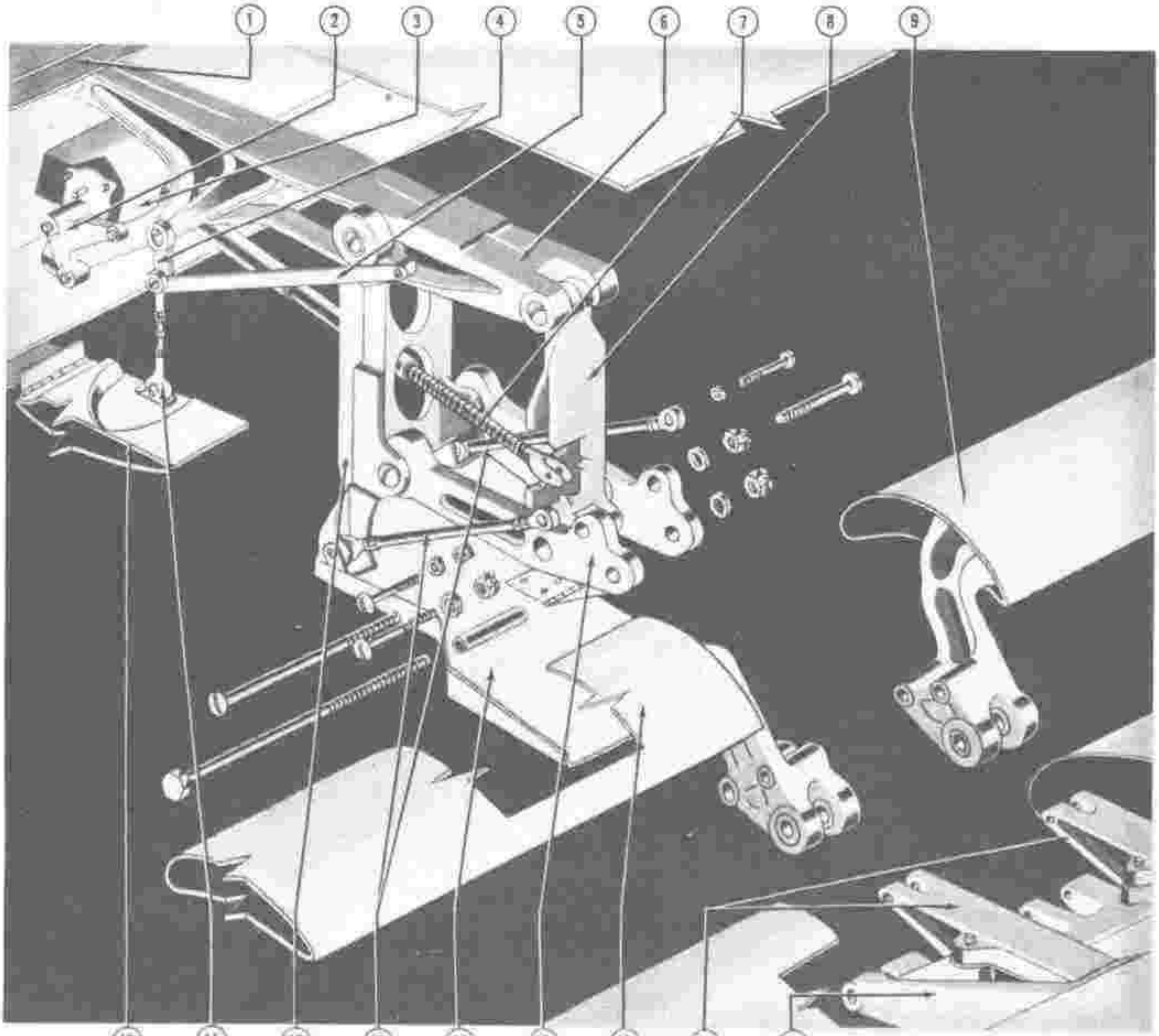
(f) INSTALLATION. — To install the wing flaps, reverse the REMOVAL procedure given above. Provide adequate support for the flaps to avoid damaging the hinge assemblies. Extend the gear box actuating screws to the point noted at time of removal. If

this measurement is lacking, extend the screws to the approximate landing position. After the flaps have been installed, operate them to the UP position and if necessary, synchronize them by disconnecting the torque tubes and rotating the gear boxes by hand until the proper adjustment is obtained.

(g) TEST AFTER INSTALLATION. – Check the flaps for proper movement with a free swinging protractor. Make certain that the landing gear and flap position indicator gives the correct indication of flap position.

c. SURFACE CONTROLS.

(1) GENERAL. – Controls for the ailerons, elevators, rudder, trim tabs and wing flaps are provided in the pilot's compartment. The ailerons and elevators are operated manually by means of a conventional type



1. Rear Wing Spar
2. Wing Flap Gear Box Support
3. Wing Flap Gear Box
4. Flap Door Up Link
5. Flap Door Aft Link
6. Hinge Support Fitting
7. Flap Actuating Screw
8. Flap Aft Link
9. Deflector
10. Flap Door
11. Flap Door Push Rod
12. Forward Link
13. Flap Rotating Rod
14. Flap Mechanism Cover
15. Flap Moving Hinge
16. Deflector
17. Flap Rotating Rod Hinge
18. Wing Flap Hinge

Figure 53 — Center Hinge Mechanism Outboard Wing Flaps

control column and wheel. The rudder is operated manually by means of pedals. The aileron trim tabs operate automatically with the aileron to ease the pressure on the control wheel. In addition, the left hand aileron trim tab can be adjusted separately for lateral trim of the airplane by turning a knob connected to a cable drum assembly in the control pedestal. The elevator and rudder trim tabs are operated similarly from the control pedestal. The wing flaps are operated electrically and are controlled by a lever installed on the control pedestal. Flexible carbon steel cables with swaged fittings and anti-friction bearing pulleys are used throughout the system. Doors *(figures 6, 7, 8, & 9)* installed in the wing panels, fuselage and empennage, provide access to the actuating mechanism.

(2) AILERON CONTROLS. *(See figure 69.)*

(a) GENERAL. — Aileron movement is controlled by rotation of the control wheel *(figure 54)* which is connected to a pulley shaft and cable assembly *(3, figure 54)* in the head of the control column. From the control column, cables run to the aft section of the pilot's compartment where they wind around a drum mounted on a torque tube *(14, figure 54))*. Cables wound around a second drum on the tube are directed outboard into each wing panel where they are connected to a differential crank assembly *(figure 58)*. Movement of the crank assembly actuates a push-pull tube *(9, figure 58)* which raises or lowers the aileron. Aileron movement is limited by adjustable stops *(1, figure 58)* attached to the wing structure adjacent to the differential crank. The stops which limit the movement of the pilot's control wheel are not adjustable. Access to the aileron mechanism is obtained through doors *(figures 6 and 7)* installed in the wing.

Note

The adjustment of the angular movement of the ailerons, and their position in relation to the wing surfaces is described in paragraph 3., *b.*, (2), *(d)*, this section.

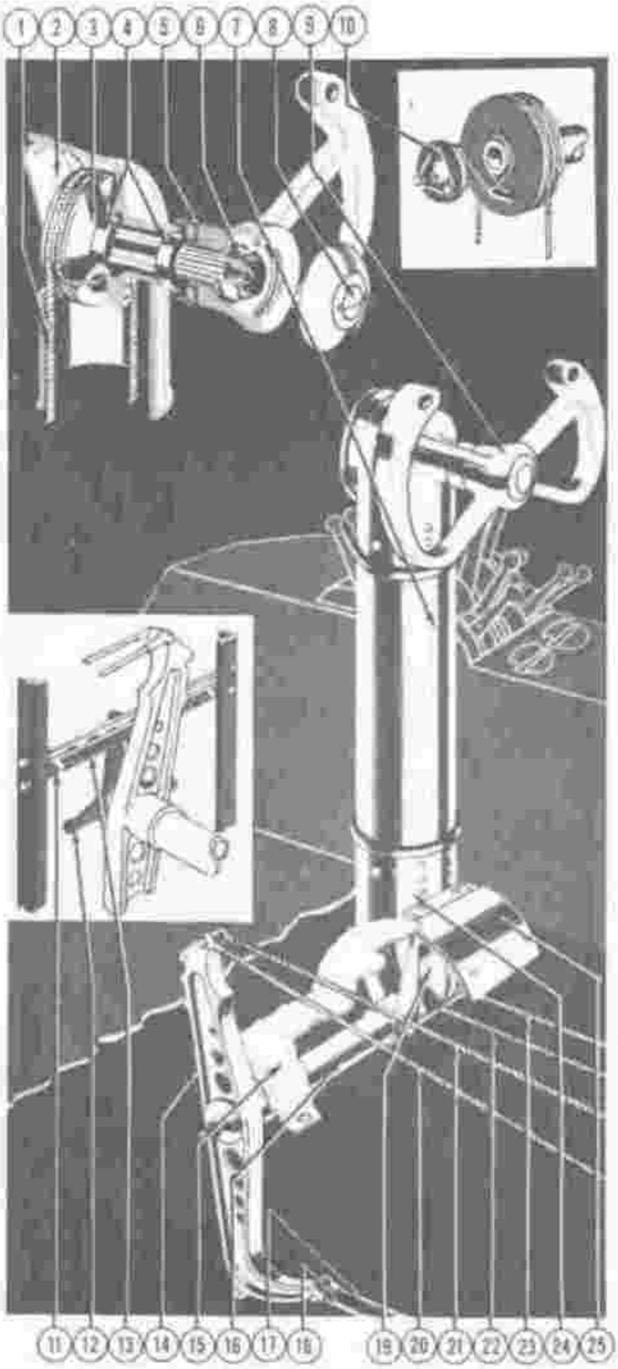
(b) CONTROL WHEEL ASSEMBLY. *(See figure 54).*

1. DESCRIPTION. — The control wheel assembly is mounted on the pilot's control column. The wheel is turned to the left or right to actuate the ailerons.

2. REMOVAL.

a. Remove spring cap *(8, figure 54)* from the control wheel, and detach the nut *(6, figure 54)* from the shaft.

b. Remove cover *(2, figure 54)* from rear of control column head, and detach electrical disconnect plugs.



1. Cable
2. Cover
3. Pulley Shaft Assembly
4. Bearings
5. Cap and Lock Ring
6. Nut and Lock Ring
7. Pilot Assembly
8. Cap
9. Control Wheel
10. Ring
11. Adjustable Stop
12. Support
13. Stop Support
14. Horn
15. Cover
16. Tube
17. Left Elevator Up Cable
18. Right Elevator Up Cable
19. Pulley
20. Left Elevator Down Cable
21. Right Elevator Down Cable
22. Left Aileron Down Cable
23. Right Aileron Down Cable
24. Pivot Housing
25. Cover

Figure 54 — Pilot's Control Column

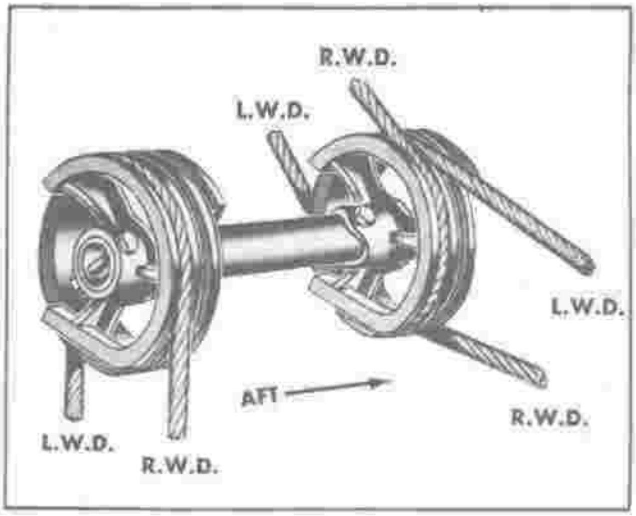


Figure 55 — Aileron Torque Drums Rigging

c. Lift off the control wheel.

d. Tape cables at pulley shaft drum *(3, figure 54)* in control column head and at forward drum *(figure 57)* in torque tube assembly located in aft part of pilot's compartment.

e. Disconnect cable ends at the turnbuckles *(figure 69)*, removing pulleys and fairleads where necessary.

f. Slide the pulley shaft and cable assembly out of column head through the opening in the back.

3. MAINTENANCE REPAIR OR REPLACEMENT. — Replace worn or damaged parts. Check the cable ends for security.

Note

A special wrench designed for removal of the control column head bearing retaining cap is supplied in the miscellaneous tool roll.

4. INSTALLATION. — Reverse the REMOVAL procedure above. Wrap cables onto drum in control column head as shown in *(figure 56)*.

5. ADJUSTMENTS.—To obtain proper cable tension, refer to Cable Rigging Chart *(figure 74)*.

6. TEST AFTER INSTALLATION.—Rotate the control wheel the maximum distance left and right and check the ailerons for proper degree of travel.

(c) AILERON TORQUE TUBE AND DRUMS ASSEMBLY. *(See figure 57.)*

1. DESCRIPTION. — The assembly, consisting of a tube and two drums, provides a means for simultaneous operation of both ailerons. The assembly is located in the aft part of the pilot's compartment.

2. REMOVAL.

a. Remove the radio shelf and equipment located back of the pilot's seat.

b. Tape the cables at the drums to prevent the cables from unwinding. *(See figure 56.)*

c. Disconnect the cables at the turnbuckles *(figure 69)*. Remove the fairleads and pulley wheels or guard pins where necessary.

d. Remove the nut from the forward end of the torque tube and the bolts from the bushing plate at the same end.

e. Slide complete assembly forward to allow the aft end of the assembly to clear the pulley guard and mount at the aft end.

f. Lift out the assembly, being careful not to damage surrounding lines and wires.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace drums if cracked or worn.

b. Check cable ends for security.

4. INSTALLATION.—Reverse the REMOVAL procedure given above. Wrap drums as shown in *figure 55*.

(d) AILERON DIFFERENTIAL CRANK ASSEMBLY. *(See figure 58.)*

1. DESCRIPTION. — An aileron differential bell crank assembly consisting of a horn and an arm assembly, is installed in each wing panel. The bell crank assembly actuates a push-pull tube assembly attached to each aileron.

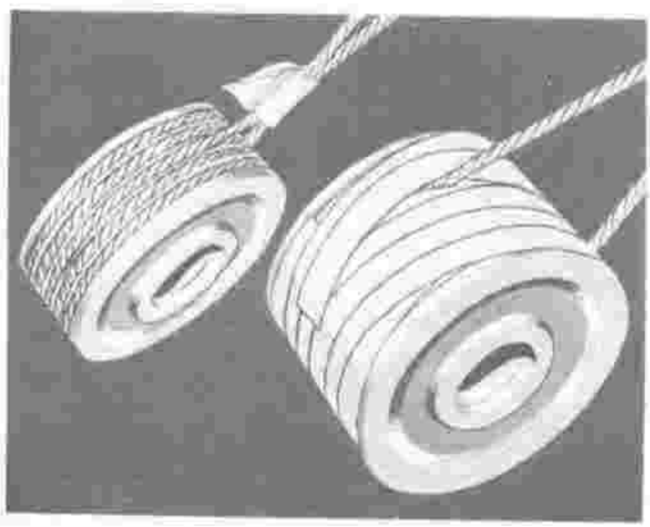
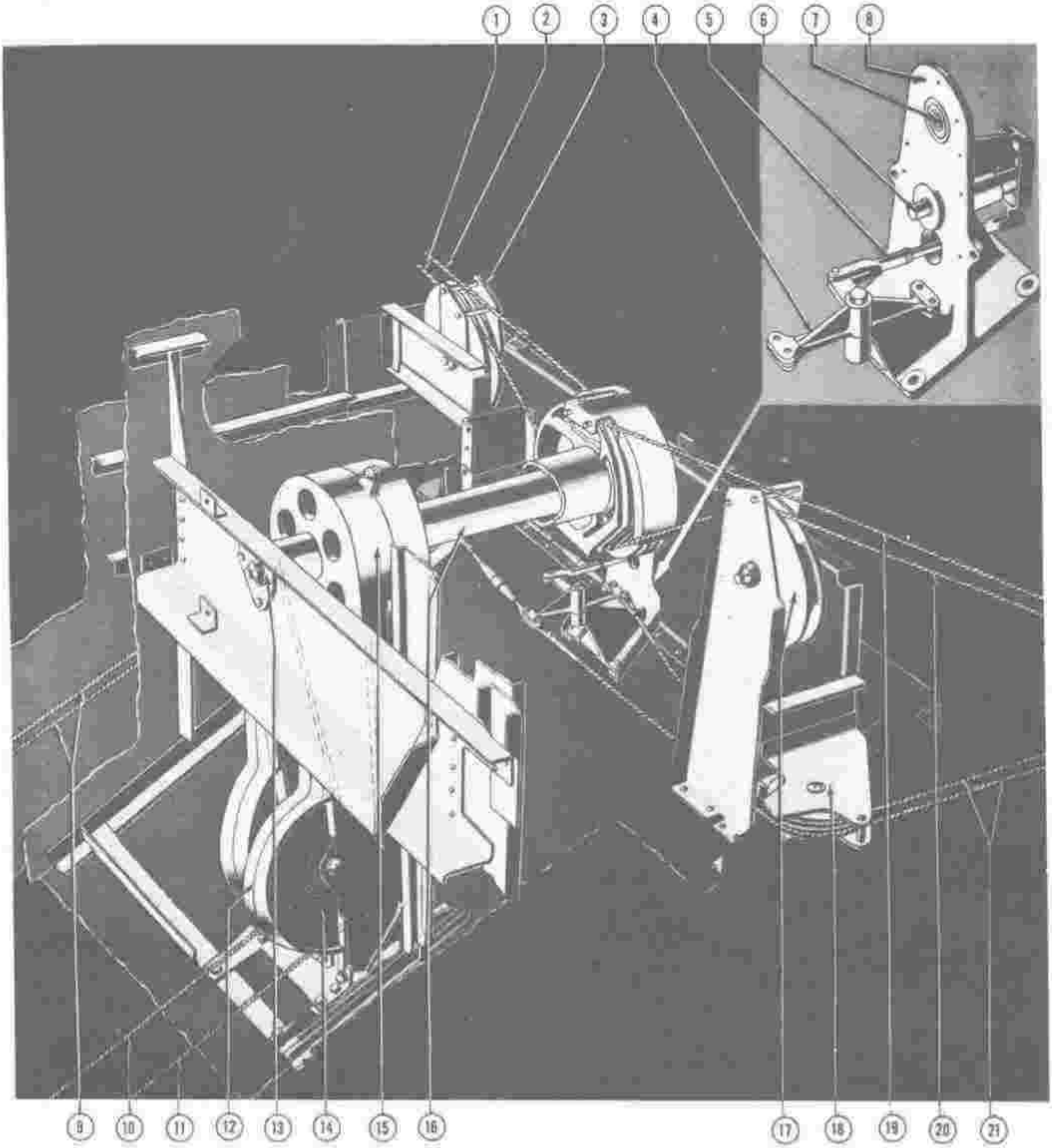


Figure 56 — Drum Taping Methods



1. Right Aileron Up Cable
2. Right Aileron Down Cable
3. Pulley
4. Bell Crank
5. Control Rod
6. Lock Pin
7. Torque Tube Bearing
8. Support
9. Control Lock Cables
10. Right Aileron Down Cable
11. Left Aileron Down Cable
12. Guard
13. Housing
14. Pulley
15. Guard
16. Torque Tube
17. Pulley
18. Guard
19. Left Aileron Up Cable
20. Left Aileron Down Cable
21. Control Lock Cables

Figure 57 — Aileron Torque Tube and Control Lock

2. REMOVAL.

a. Loosen the cable tension at turnbuckles.

b. Remove the bolts *(6, figure 58)* attaching the cables to the ends of the crank assembly.

c. Remove the crank assembly attaching nut, and the push-pull tube attaching bolt.

d. Remove the crank assembly through the access door *(17, figure 6)*.

3. MAINTENANCE REPAIR OR REPLACEMENT.

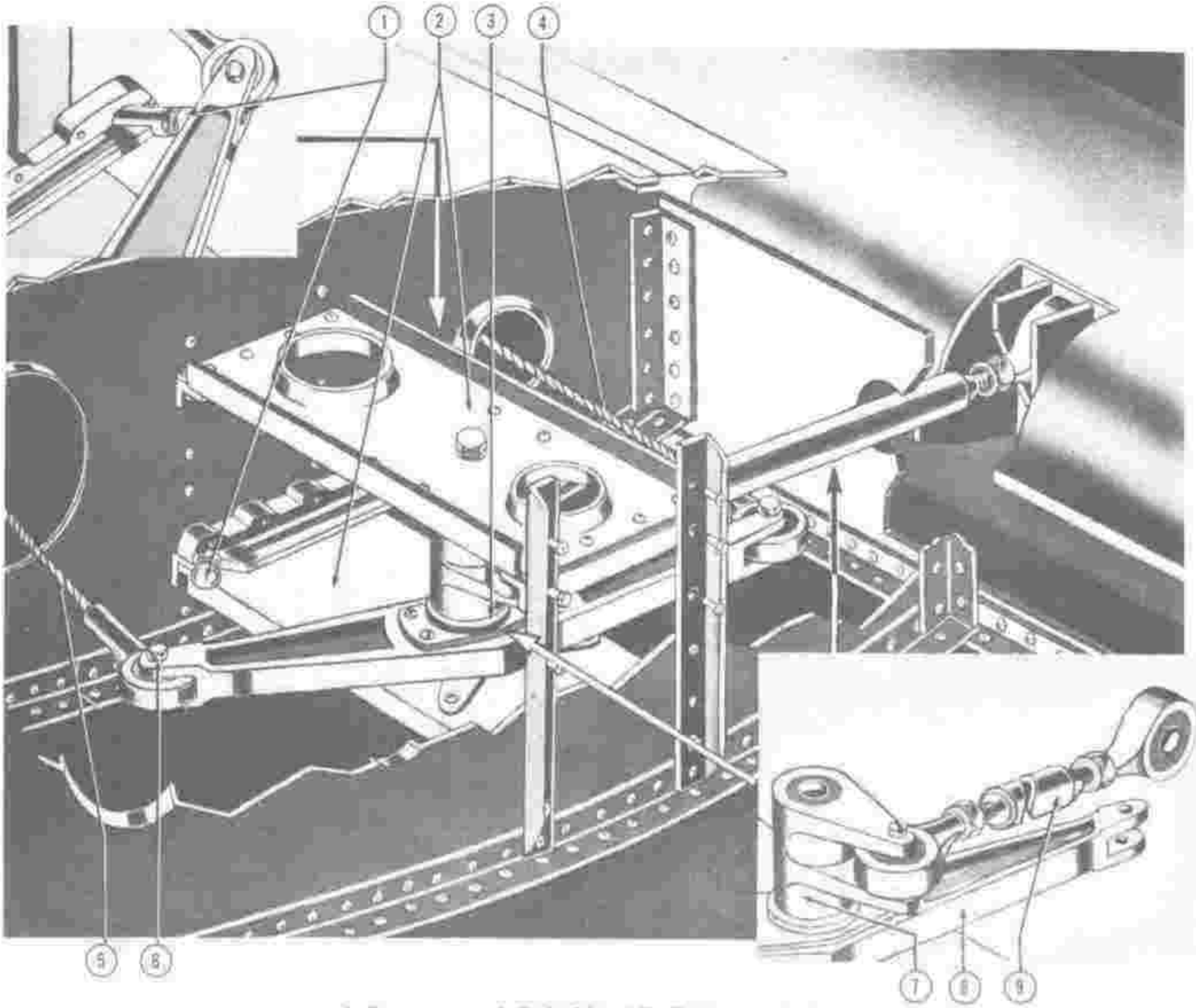
a. Replace the differential crank assembly if worn or cracked.

b. Replace the horn pivot stud if cracked or worn.

c. Check differential crank brackets for security and condition. Replace damaged brackets.

4. INSTALLATION.—Reverse the REMOVAL procedure above.

5. ADJUSTMENTS.—The stops *(1, figure 58)* which limit the movement of the aileron differential



1. Stop	4. Right Aileron Up Cable	7. Arm
2. Support	5. Right Aileron Down Cable	8. Horn
3. Bell Crank	6. Cable Attachment Bolt	9. Tube

Figure 58 — Aileron Differential Mechanism

crank are used to regulate the movement of the ailerons. For instructions on adjustment of aileron travel refer to paragraph 3. *b*. (2) *(d)*, this section.

6. TEST AFTER INSTALLATION. – Check the cables for proper tension and check differential crank for proper movement.

(e) AILERON PUSH-PULL TUBE ASSEMBLY. *(See 9, figure 58.)*

1. DESCRIPTION. – An aileron push-pull tube assembly is installed in each wing panel to transmit motion from the aileron differential crank assembly to the ailerons.

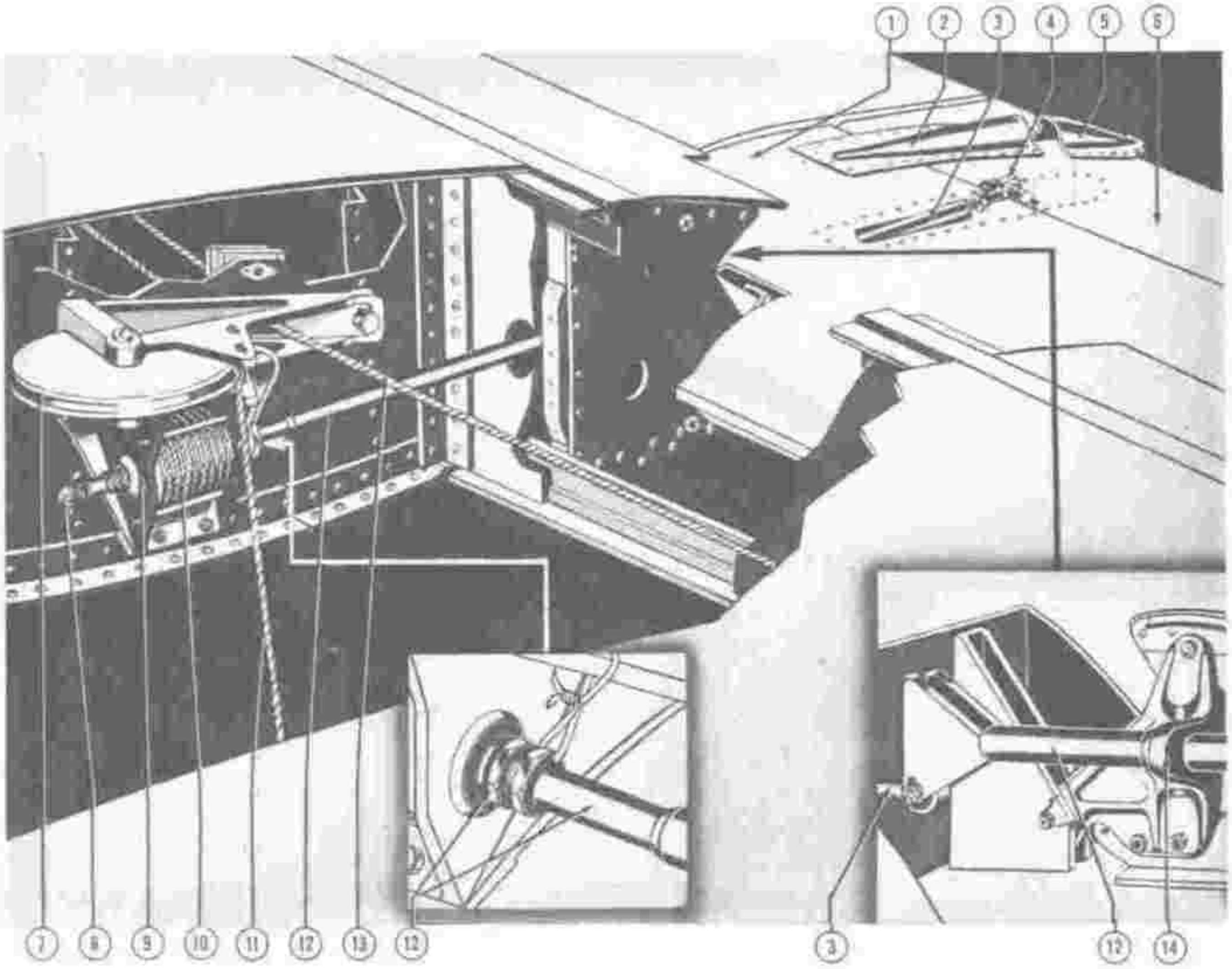
2. REMOVAL.

a. Remove the bolt which attaches the push-pull tube assembly to the aileron.

b. Remove the bolt which attaches the push-pull tube assembly to the differential crank assembly.

c. Remove the push-pull tube assembly through access door *(17, figure 6)*.

3. MAINTENANCE REPAIR OR REPLACEMENT.–If the threads on the push-pull tube are damaged, replace the rod.



1. L. H. Aileron
2. Actuating Tube Fairing
3. Tab Actuating Tube Aft
4. End Assembly
5. Fairing
6. L. H. Aileron Trim Tab
7. Pulley
8. Alemite Fitting
9. Bracket
10. Cable Drum
11. Right Aileron Down Cable
12. Actuating Tube (Forward) and Adjusting Nut
13. Left Aileron Down Cable
14. Fitting

Figure 59 — Aileron Left Hand Trim Tab Mechanism

4. INSTALLATION.–Reverse the REMOVAL procedure given above.

5. ADJUSTMENT. – Neutral alignment of the ailerons is obtained by loosening the nut and turning the rod *(9, figure 58)* to the right or left until the desired position is obtained. The controls should be locked in neutral while the adjustment is being made.

6. TEST AFTER INSTALLATION. – Check the aileron controls for proper operation. Make certain that the aileron is in line with the trailing edge of the wing when the control wheel is in the neutral position.

(3) AILERON TRIM TAB CONTROLS. *(See figure 69).*

(a) GENERAL.–Both the left-hand and right-hand aileron trim tabs move automatically with the aileron, but if so desired, the left-hand trim tab can be controlled separately by turning a dial *(14, figure 61)* on the control pedestal. The dial is connected to a drum with attached cables which are directed outboard into the left-hand wing. In the wing, the cables wind around a drum *(10, figure 59)* attached to a rod assembly *(12, figure 59)* which actuates the aileron tab. Doors providing access to the mechanisms are illustrated in *figures 6 and 7.*

Note

Adjustment of the angle of movement of the left hand trim tab, and of the position of both the left and right hand tabs is described in paragraph 3. *b.* (3) *(e)*, this section.

(b) AILERON TAB DRUM IN PEDESTAL. *(See 14, figure 61.)*

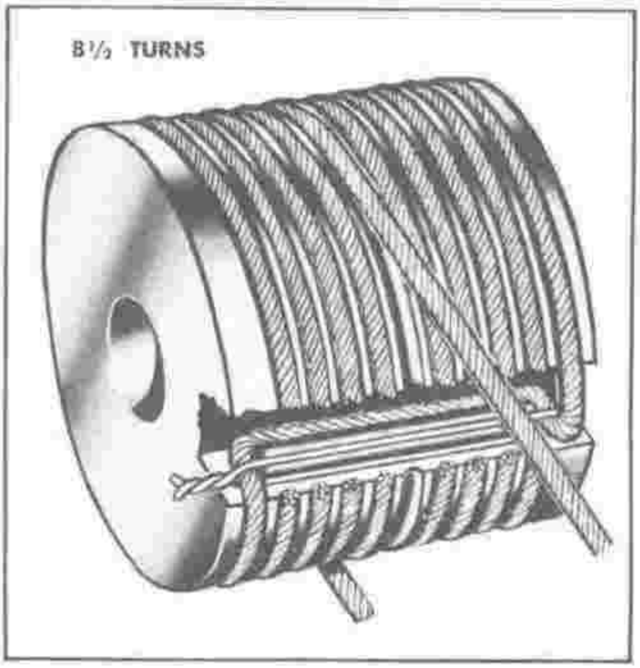


Figure 60 — Aileron Tab Drum Rigging

1. DESCRIPTION.–The aileron tab drum installed in the control pedestal is a part of the equipment provided for the individual adjustment of the position of the left hand aileron trim tab.

2. REMOVAL.

a. Remove the nut from the under side of the drum and slide the drum out of the control pedestal.

b. Tape the cables at the drum to prevent the cables from unwinding. *(See figure 56.)*

c. Disconnect the cables at the turnbuckles *(figure 69).*

d. Remove the cable fairleads and pulley guards if necessary.

3. MAINTENANCE REPAIR OR REPLACEMENT. – Replace drum if worn or cracked. Check the cable ends for security.

4. INSTALLATION.

a. Reverse the REMOVAL procedure given above.

b. If the cables must be rewrapped on the drum, refer to *figure 60.*

c. To restore cables to proper tension, refer *figure 74.*

(c) AILERON LEFT HAND TAB MECHANISM IN WING. *(See figure 59.)*

1. DESCRIPTION.–The mechanism, located in the left hand wing forward of the aileron, consists of a cable drum and gear assembly which actuates a push-pull tube assembly.

2. REMOVAL.

a. Remove the landing light assembly by removing the attaching screws.

b. Disconnect the electric wiring at the lamp motor, and remove grounding strap from wing structure.

c. Tape the cable drums *(10, figure 156)* to prevent unwinding.

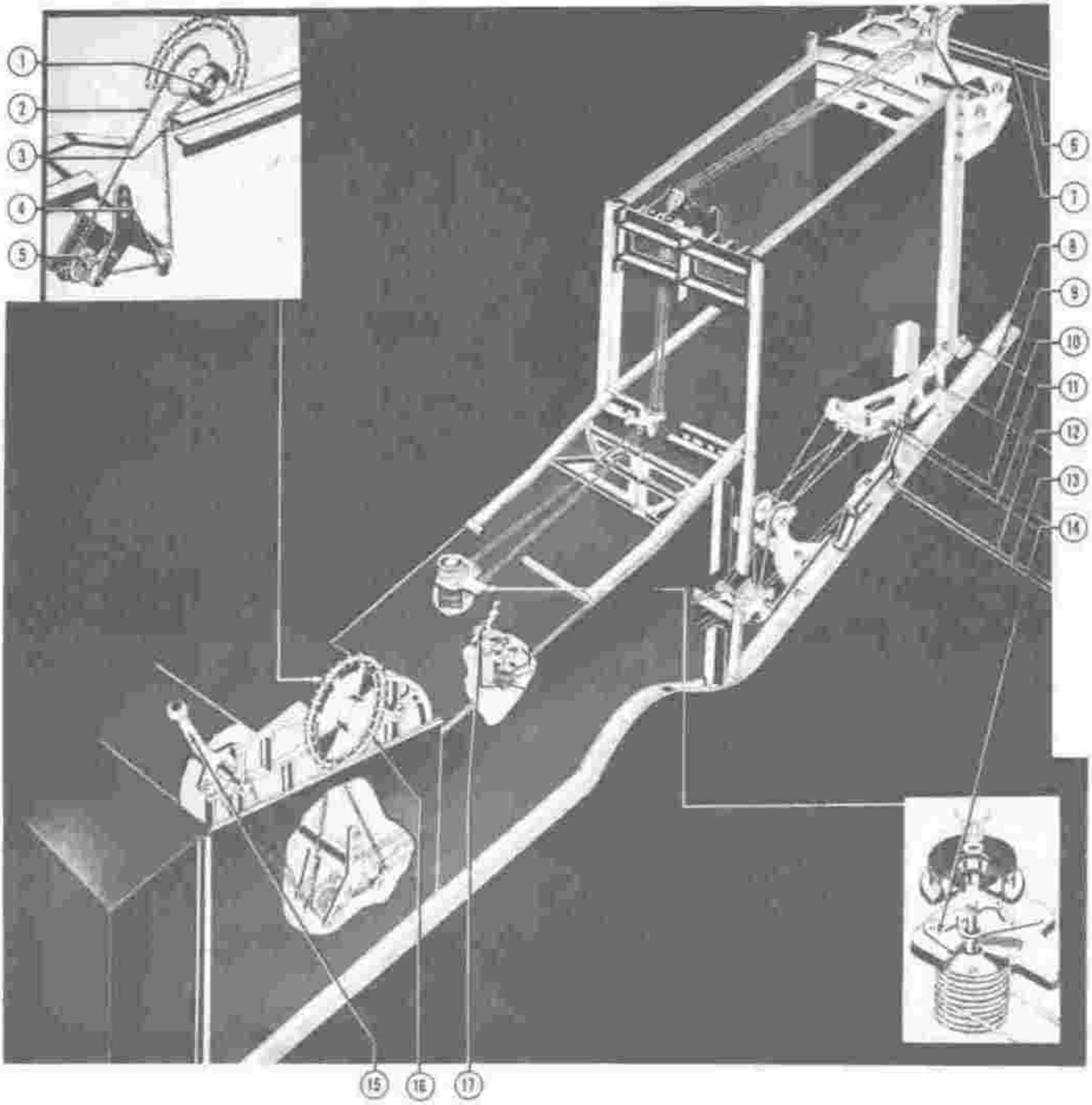
d. Disconnect the tab control cable at the turnbuckle *(figure 69).*

e. Remove the aileron as described in paragraph 3. *b.* (2) *(b)*, this section.

f. Remove the control pulley *(7, figure 59)* at the drum.

g. Loosen the four attaching bolts.

h. Remove the zerk fitting from the forward end of the acme threaded rod *(8, figure 59).*



1. Friction Adjustment Nut
2. Diamond Roller Chain
3. Sprocket
4. Adjustable Idler Sprocket
5. Drum and Cable Assembly
6. Aileron Trim Tab Down Cable
7. Aileron Trim Tab Up Cable
8. Control Lock Locked Cable
9. Control Lock Unlocked Cable
10. Rudder Trim Tab Right Cable
11. Rudder Trim Tab Left Cable
11. Elevator Trim Tab Up Cable
13. Elevator Trim Tab Down Cable
14. Aileron Trim Tab Control Assembly
15. Surface Lock Control Lever
16. Elevator Trim Tab Control Wheel
17. Rudder Trim Tab Control Assembly

Figure 61 — Trim Tab and Surface Lock Controls

i. Slide the complete assembly aft sufficiently to allow the end of the rod assembly to clear the wing structure. Unscrew this rod assembly and remove it from the airplane.

j. The drum and bracket mechanism is now to be removed through the landing light hole.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replace any part that is damaged or badly worn. For cable maintenance see paragraph 3. *c.* (8) *(c)*, this section. Lubrication is to be performed at service inspection periods.

4. INSTALLATION. — Installation is the reverse of the REMOVAL procedure. See Cable Rigging Chart *(figure 74)* for cable tensions. If the cables must be rewrapped on the drum, refer to *figure 60*.

5. ADJUSTMENT.—Refer to paragraph 3. *b.* (3) *(e)*, this section.

6. TEST AFTER INSTALLATION. — Make trial operation of the tab controls, measuring the travels and checking for correct neutral setting.

(4) ELEVATOR CONTROLS. *(See figure 70.)*

(a) GENERAL. — Elevator movement is controlled by the conventional fore and aft movement of the control column. The elevator control cables extend from the control column torque tube horn to the support assembly in the tail section where they are connected to the elevator torque tube horns.

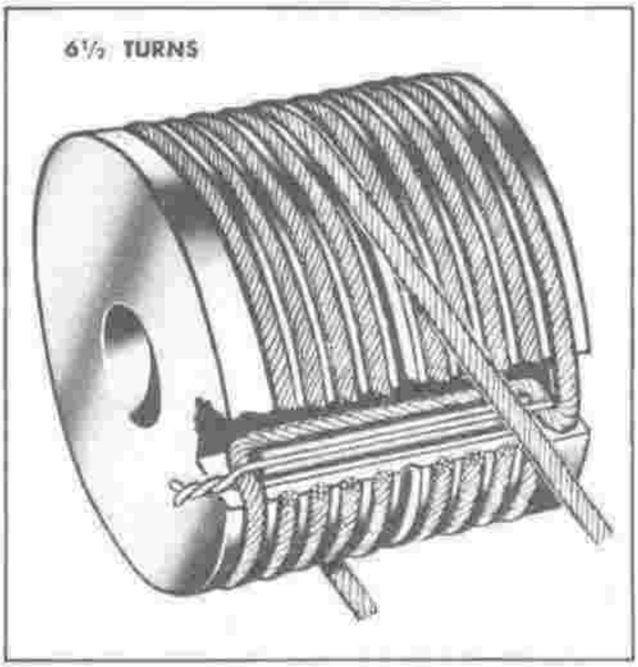


Figure 62 — Elevator Tab Drum Rigging (Pedestal)

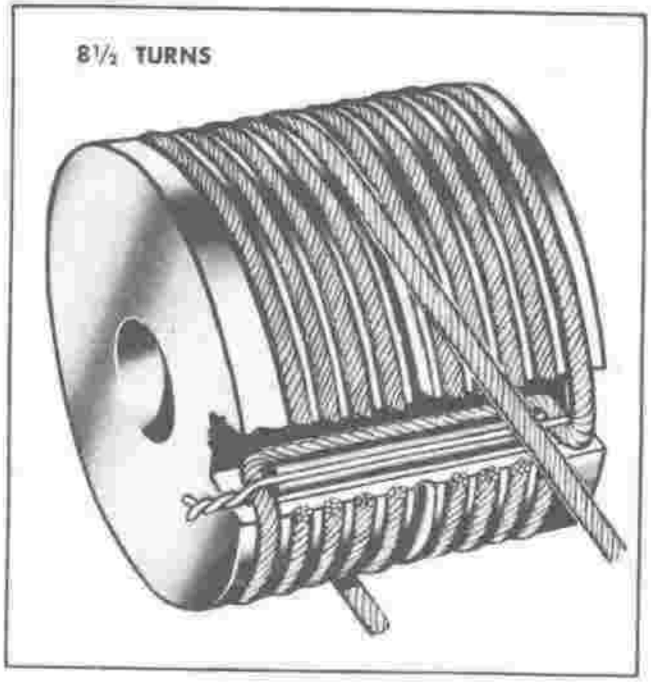


Figure 63 — Elevator Tab Drum Rigging (Elevator)

Note

The adjustment of the angular movement of the elevators, and their position in relation to the wing surfaces is described in paragraph 3. *b.* (4) *(e)*, this section.

(b) ELEVATOR CONTROL COLUMN ASSEMBLY. *(See figure 54.)*

1. DESCRIPTION.—The assembly consists of a control column and a horn. Two cables, one for each elevator, are attached to each end of the horn.

2. REMOVAL.

a. Disconnect the elevator control cables extending aft from the ends of the control column horn *(14, figure 54)*.

b. Tape the forward drum in the aileron torque tube and drums assembly *(figure 57)* located in the aft portion of the pilot's compartment.

c. Disconnect the aileron cables at the turnbuckles *(figure 69)*. Remove the cable fairleads where necessary.

d. Remove the dome-shaped cover on each side of the control column base.

e. Remove the radio compass loop azimuth control *(figure 305)* mounted on the control column by disconnecting the tach-shaft and the electrical plug and removing the screws which attach the unit to the bracket.

f. Remove the bracket-attaching bolts on the inboard end of the horizontal torque tube (lower member of the control column assembly), leaving the bracket attached to the column by the hinge bolt.

g. Remove the nut from the stud on the outboard end of the torque tube, freeing the complete control column assembly.

h. For removal of the wheel and drum assembly in the control column refer to paragraph 3. *c.* (2) *(b)* 2., this section.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Check the complete assembly for freedom of movement of the moving parts, and for cracks and worn bearing surfaces.

b. Check the cable ends for security of swaged fittings

c. Replace any worn or damaged parts.

4. ADJUSTMENTS.—For instructions on the adjustment of the stops *(11, figure 54)* which limit the forward and aft movement of the control column, refer to paragraph 3. *b.* (4) *(e)*, this section.

5. INSTALLATION.—Reverse the REMOVAL procedure given above. To restore the cables to the proper tension refer to the Cable Rigging Chart *(figure 74)*.

6. TEST AFTER INSTALLATION.—Operate controls and check control wheel, control column and elevator surfaces for proper movement. If adjustments are required, refer to paragraph 3. *b.* (4) *(e)*, this section.

(c) ELEVATOR HORNS IN EMPENNAGE. *(See 14 ,figure 73.)*

1. DESCRIPTION.—Two horns, one for each elevator, are installed in the control support assembly. Cables extend from the horns to the control column in the pilot's compartment.

2. REMOVAL.

a. Remove the tail cone as described in paragraph 3. *b.* (2), this section.

b. Remove the armor plate*(figure 555)*.

c. Disconnect the cables attached to the elevator horns.

d. Disconnect the two elevator torque tubes by removing the three bolts on each side.

e. Remove the hinge bolts *(13, figure 73)* which attach the elevator horns to the control support assembly.

f. Remove the elevator horns.

3. MAINTENANCE REPAIR. — A damaged elevator horn shall be replaced.

4. INSTALLATION.—To install the elevator horn in the control support assembly in the empennage, reverse the REMOVAL procedure given above.

5. ADJUSTMENT. — Travel of the elevator torque tubes and horns is regulated by adjustable stops attached to the control support assembly. For data on the proper travel of the elevators refer to paragraph 3. *b.* (4) *(e)*, this section.

6. TEST AFTER INSTALLATION. — Operate controls and check elevator surfaces for proper movement.

(5) ELEVATOR TRIM TAB CONTROLS. *(See figure 70.)*

(a) GENERAL. — The elevator trim tabs are operated simultaneously by means of a control wheel *(16, figure 61)* located on the control pedestal. The control wheel is attached to a sprocket and chain assembly which is connected to a sprocket and drum located beneath the control wheel in the control pedestal. An adjustable idler sprocket *(4, figure 61)* attached to the pedestal structure keeps the bicycle chain under proper tension. From the drum in the pedestal the cables extend aft to the elevators where they wind around drums installed in gear box assemblies. Connected to the gear boxes are torque tubes which raise or lower the elevator tabs when the control wheel is turned. Access to the mechanisms in the control pedestal is obtained by means of removable panels. The tab mechanisms in the elevators are reached through access doors *(figures 6 and 7)* located in the elevator surfaces.

Note

The adjustment of the elevator trim tabs to the neutral position is described in paragraph 3. *b.* (5) *(e)*, this section.

(b) ELEVATOR TRIM TAB CHAIN. *(See 2, figure 61.)*

1. DESCRIPTION. — The elevator trim tab chain is installed in the control pedestal and connects the elevator trim tab control wheel to the trim tab drum.

2. REMOVAL AND DISASSEMBLY.

a. Loosen the idler sprocket *(4, figure 61)* at the slotted fitting and lift chain from sprocket.

b. The chain may be taken apart by removing the spring slip on the connecting link and pulling the link from the chain.

3. MAINTENANCE REPAIR.—The elevator trim tab chain may be repaired by replacing the damaged links with roller-type links.

4. INSTALLATION.

a. Reverse the REMOVAL procedure outlined above.

b. After the chain is in place, move the idler sprocket in the slot to take up the slack. The chain should be held in place firmly but it should not be taut.

(c) ELEVATOR TRIM TAB DRUM IN PEDESTAL. *(See 5, figure 61.)*

1. DESCRIPTION.—The elevator trim tab drum in the control pedestal revolves on a special bolt which extends from one side of the pedestal to the other.

2. REMOVAL.

a. Tape the cables at the drum to prevent the cables from unwinding. *(See figure 56.)*

b. Disconnect the cables at the turnbuckles *(figure 70)*. Remove cable fairleads and pulleys if necessary.

c. Remove the nut from the bolt on the right-hand side of the pedestal. Pull the bolt out from the left-hand side of the pedestal far enough to free the drum.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace the cable drum if it is worn or cracked.

b. If it is necessary to rewrap the cables on the drum, refer to *figure 63.*

4. INSTALLATION. — Reverse procedure given in REMOVAL above. For proper cable tension refer to *figure 74.*

5. TEST AFTER INSTALLATION.—Check elevator tab controls for proper operation.

(d) TRIM TAB DRUM AND GEAR BOX ASSEMBLY IN ELEVATOR. *(See figure 43.)*

1. DESCRIPTION.—A cable drum and gear box assembly is installed in each elevator and is connected to a tube assembly which actuates the elevator trim tab.

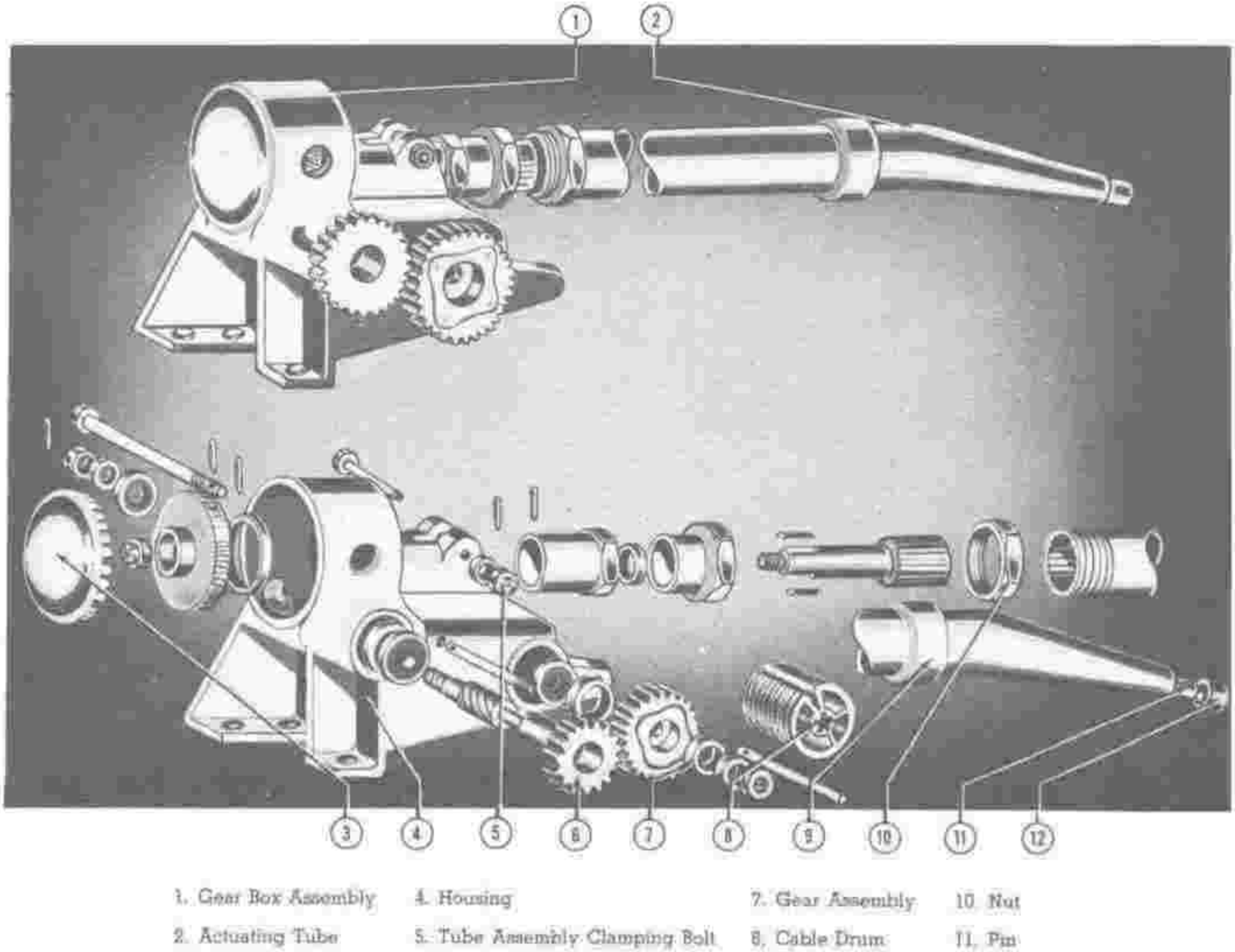


Figure 64 — Trim Tab Mechanism (Typical for Elevator and Rudder)

2. REMOVAL.

a. Disconnect the gear box assembly from the actuating assembly at the fitting *(2, figure 64).*

b. Remove the drum from the gear box by detaching the bolt *(7, figure 64)* from the large composition gear at the bottom of the box.

c. Tape the cables at the drum *(8, figure 64)* to prevent the cables from unwinding and put the drum to one side.

d. Remove the attaching bolts at the bottom of the box.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. If the drum is cracked or worn, it shall be replaced.

b. If the composition gear is damaged or worn, it shall be replaced.

c. If necessary to rewrap the cable on the drum, refer to *figure 62.*

4. INSTALLATION.

a. Reverse the REMOVAL procedure above.

b. To restore cables to the proper tension, refer to Cable Rigging Chart *(figure 74).*

(e) ELEVATOR TAB ACTUATING TUBE ASSEMBLY. *(See figure 64.)*

1. DESCRIPTION.—The tube assembly is the connecting unit between the drum and gear box assembly and the tab in each elevator.

2. REMOVAL.

a. Disconnect the tube from the fitting on the aft end of the gear box.

b. Remove the elevator tab from its hinges.

c. Pull the actuating tube out of the elevator.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Check the actuating tube, fitting bushings, and the bearing at the tab end of the tube and replace any of the parts which are worn or damaged.

4. INSTALLATION.—Reverse the REMOVAL procedure given above.

5. TEST AFTER INSTALLATION. — Make operating test of the elevator trim tabs.

(6) RUDDER CONTROLS. *(See figure 71.)*

(a) GENERAL. — Movement of the rudder is controlled by the rudder pedals located in the pilot's compartment. The rudder pedals actuate a rudder pedal torque tube *(14, figure 65)* and horn assembly *(15, figure 65)* to which cables are attached. The rudder cables extend aft to the control support *(figure 73)* in the empennage, where they are connected to a torque tube and horn assembly *(32, figure 73)* which actuates the rudder. The rudder pedals are adjustable fore or aft to accommodate pilots of varying stature. Movement of the rudder pedals is limited by adjustable stops *(29, figure 73)* attached to the fuselage structure.

Note

Adjustment of the travel and position of the rudder and rudder pedals is described in paragraph 3. *b.* (6) *(e)*, this section.

(b) RUDDER PEDAL ASSEMBLY. *(See figure 65.)*

1. DESCRIPTION. — The rudder pedal assembly, installed in the pilot's compartment, consists principally of a torque tube and a horn, to which the rudder cables are attached.

2. REMOVAL.

a. Disconnect the brake rod assembly *(1, figure 65)* at the rudder pedals.

b. Remove the rudder pedal rod assembly *(3, figure 65)* which attaches the rudder pedal arms *(2, figure 65)* to the torque tube assembly *(14, figure 65)* by removing the top rod attaching bolts.

c. Remove the hinge bolts from the rudder pedal arms and lift out the pedal assemblies.

d. If rudder follow-up cables are installed, remove the bolts which attach them to the rudder torque tube assembly.

e. Loosen the rudder control cables at the turnbuckles *(figure 71).*

f. Disconnect the cable ends from the rudder pedal horn *(15, figure 65).*

g. Remove the two attaching bolts at the hinge points and lift out the rudder pedal horn and torque tube assembly.

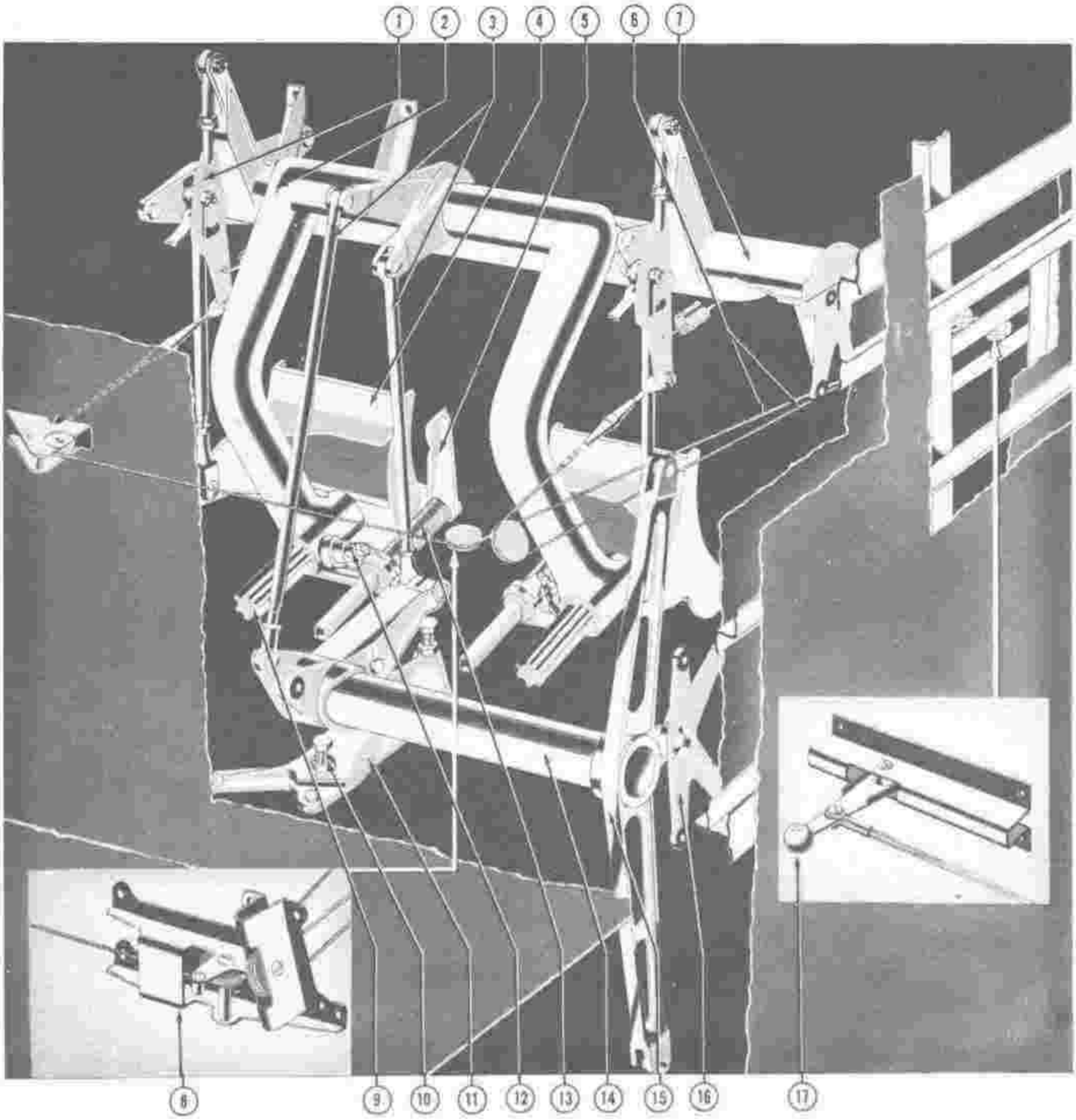
3. MAINTENANCE REPAIR OR REPLACEMENT.—Replace all parts found to be worn or damaged.

4. INSTALLATION.—Reverse the REMOVAL procedure above.

5. ADJUSTMENTS.

a. For instructions on the adjustment of the rudder pedal assembly refer to paragraph 3. *b.* (6) *(e)*, this section.

b. For instructions on the adjustment of main landing gear wheel brake valves, operated by means of the rudder pedals, refer to paragraph 14. *e.* (2) *(d)*, this section.



1. Brake Control Mechanism (See Figure 266)
2. Arm
3. Rod
4. Rudder Pedal
5. Pedal Adjustment Lever
6. Brake Control Cables
7. Support
8. Pulley Bracket
9. Splined Shaft
10. Adjustable Stop
11. Support
12. Pedal Adjustment Pin
13. Spring
14. Torque Tube
15. Horn
16. Support
17. Brake Control Lever

Figure 65 — Rudder Pedal Mechanism

6. TEST AFTER INSTALLATION. – Make an operating test of the rudder pedal mechanism.

(c) RUDDER HORN IN EMPENNAGE. *(See 32, figure 73.)*

1. DESCRIPTION.–The rudder horn is installed in the control support assembly in the empennage. The horn is attached to a torque tube which actuates the rudder. Cables extend from the horn to the rudder pedal assembly in the pilot's compartment.

2. REMOVAL.

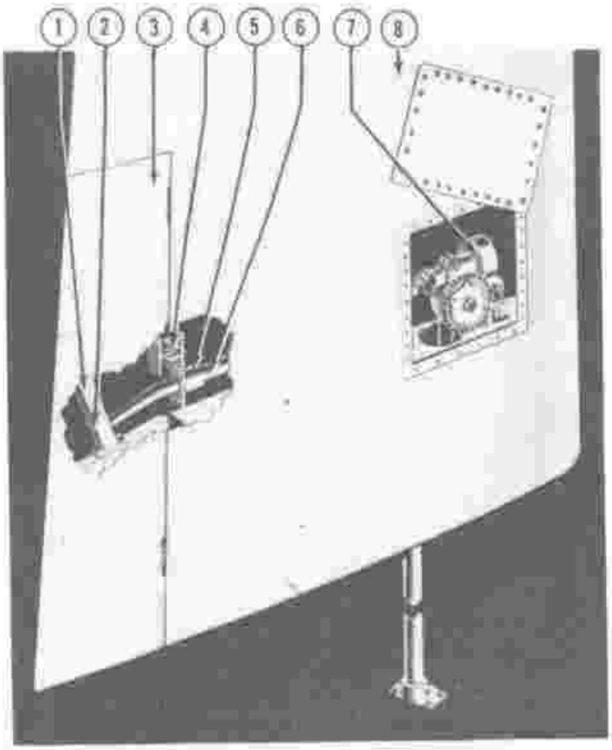
a. Remove the tail cone as described in paragraph *4. b. (2)*, this section.

b. Remove the piece of armor plate *(figure 555)*, secured by 12 bolts.

c. Remove the rudder cables at the turnbuckles *(figure 71)*.

d. Remove the four bolts which attach the rudder horn to the rudder torque tube.

e. Detach the clevis hinge pin *(30, figure 73)* and remove the rudder horn.



1. Bearing Track
2. Bearing
3. Tab Assembly
4. Hinge (3 places)
5. Housing Assembly
6. Actuating Tube
7. Gear Box Assembly
8. Rudder

Figure 66 — Rudder Trim Tab Mechanism Installed

3. MAINTENANCE REPAIR OR REPLACEMENT. – A damaged rudder horn must be replaced.

(7) RUDDER TRIM TAB CONTROLS. *(See figure 71.)*

(a) GENERAL. – The rudder trim tab is controlled by a handle and dial *(17, figure 61)* installed on the control pedestal. Rotation of the handle operates a gear drum in the pedestal to which the rudder tab control cables are attached. From the pedestal drum, the cables extend aft to the rudder where they are attached to a geared drum and torque tube assembly *(7, figure 66)*. Actuation of the torque tube causes the rudder trim tab to turn to the right or left. The door providing access to the trim tab mechanism in the rudder is illustrated in *figure 66*.

Note

Adjustment of the rudder trim tab travel and position is described in paragraph 3. *b. (7) (e)*, this section.

(b) RUDDER TAB PEDESTAL CONTROLS. *(See 17, figure 61.)*

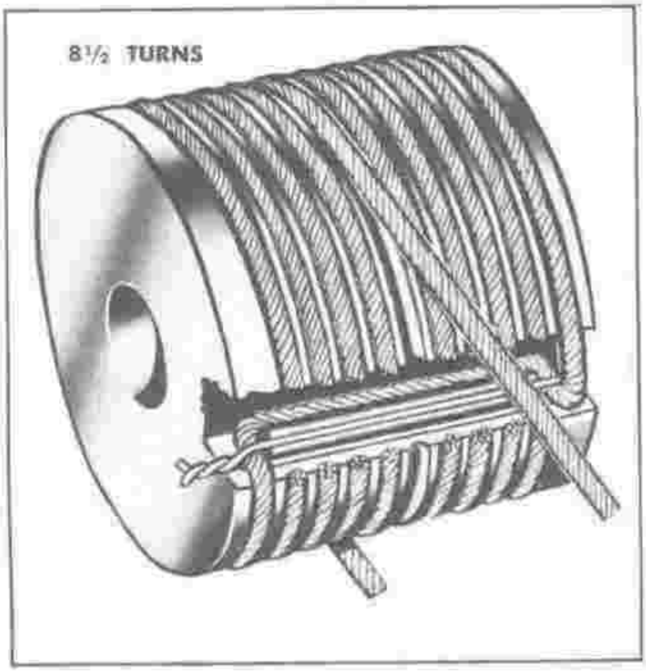


Figure 67 — Rudder Tab Drum Rigging (Pedestal)

1. DESCRIPTION.–The rudder tab controls consist of a handle and a dial mounted on the control pedestal and a cable drum located within the pedestal.

2. REMOVAL AND DISASSEMBLY.

a. Disconnect the nut at the top of the handle and remove the handle from the shaft.

b. Remove the four attaching bolts freeing the complete assembly.

c. Remove the three nuts on the under side of the assembly, which will make it possible to disassemble all the parts.

d. Tape the cables at the drum to prevent the cables from unwinding. *(See figure 56.)*

e. Disconnect the cables at the turnbuckles *(figure 71)*, remove fairleads and pulleys where necessary, and pull the cable and drum assembly from the pedestal.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace the worn or cracked cable drums.

b. Replace the worn or chipped gears.

c. Replace the worn or damaged attaching bolts and brackets.

4. INSTALLATION.

a. Reverse the REMOVAL procedure given above.

b. If the rudder trim tab drum in the pedestal must be rewrapped, refer to *figure 67.*

c. To restore the cables to proper tension refer to Cable Rigging Chart *(figure 74).*

5. TEST AFTER INSTALLATION.—Check the rudder trim tab controls for proper operation.

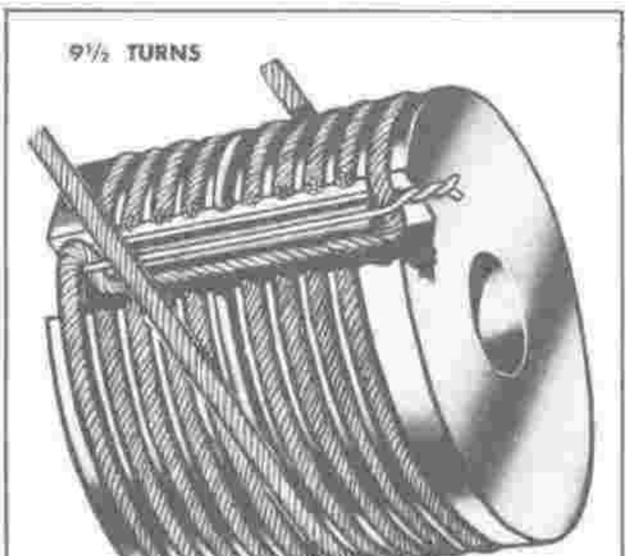


Figure 68—Rudder Tab Drum Rigging (Rudder)

(c) RUDDER TAB ACTUATING MECHANISM. *(See figures 64 and 66.)*

1. DESCRIPTION. – The rudder tab actuating mechanism installed in the rudder consists of a cable drum and gear box assembly to which a rudder tab actuating tube is attached.

2. REMOVAL.

a. Tape the rudder tab drum *(8, figure 64)* to prevent the cables from unwinding. *(See figure 58.)*

b. Disconnect the cables at the turnbuckles *(figure 71).*

c. Disconnect the gear box assembly from the actuating tube assembly at the fitting *(10, figure 64).*

d. Remove the drum from the gear box by detaching the bolt from the large composition gear at the aft end of the box.

e. Remove the attaching bolts at the bottom of the box.

f. Remove the rudder tab from its hinges *(figure 66)* and pull the actuating tube out of the rudder.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace the rudder tab drum if worn or cracked.

b. Replace the rudder tab drum gear if worn or cracked.

c. Replace the actuating tube if damaged.

d. Replace the bearing at the rudder tab end of the actuating tube if it shows wear.

e. Replace the fitting bushings if worn or damaged.

4. INSTALLATION.

a. Reverse the REMOVAL procedure given above.

b. If it is necessary to rewrap the cables on the drum, refer to *figure 68.*

c. To restore the rudder trim tab cables to the proper tension, refer to Cable Rigging Chart *(figure 74).*

5. TEST AFTER INSTALLATION. – Check the rudder trim tab controls for proper operation.

(8) CONTROL CABLES.

(a) DESCRIPTION. – Flexible steel cables, equipped with swaged fittings and turnbuckles, are used to actuate the ailerons, elevators and rudder, the left-hand aileron trim tab, the elevator trim tabs and the rudder trim tab. The cables are guided through

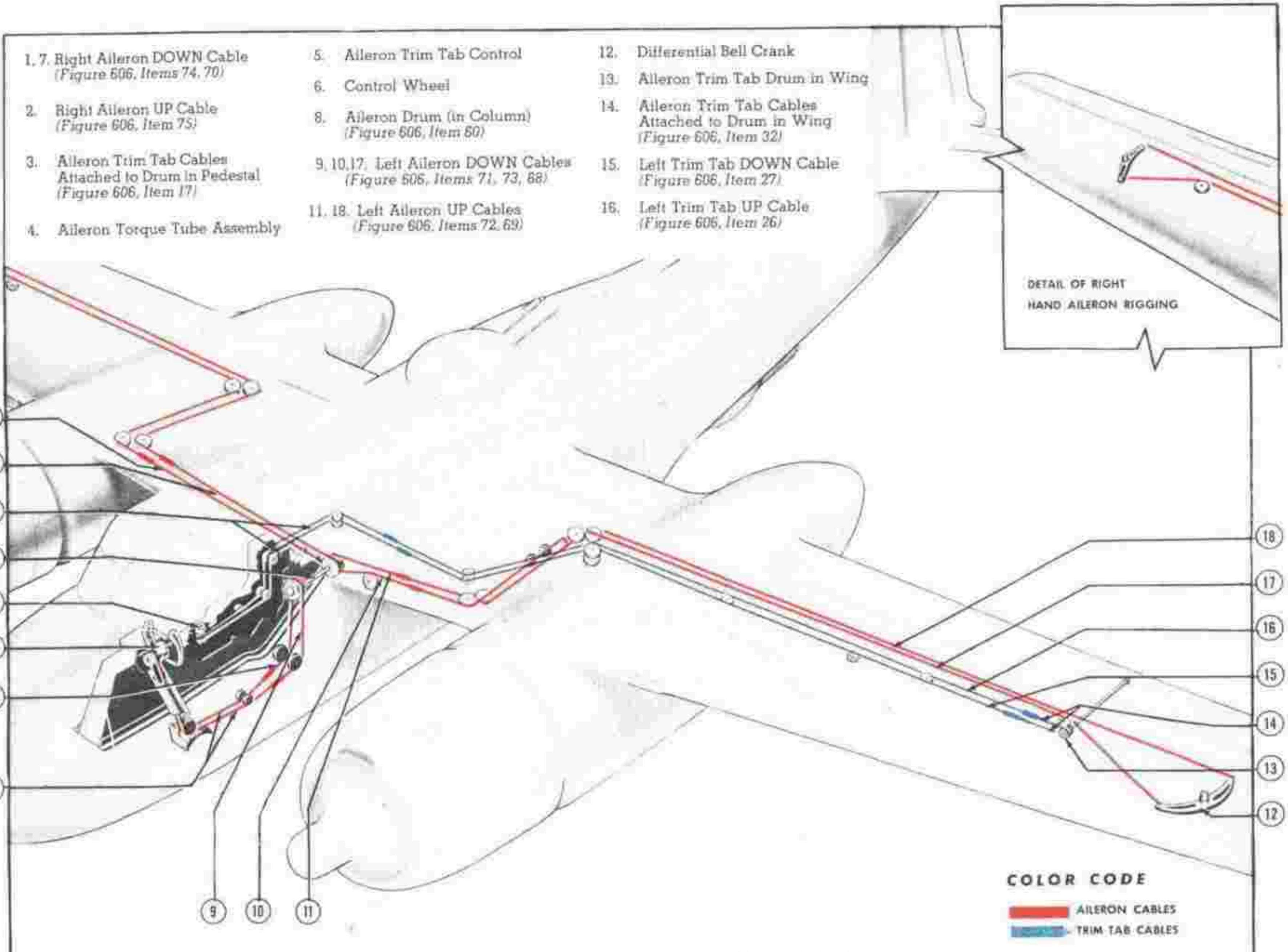


Figure 69 — Aileron and Aileron Trim Tab Control System

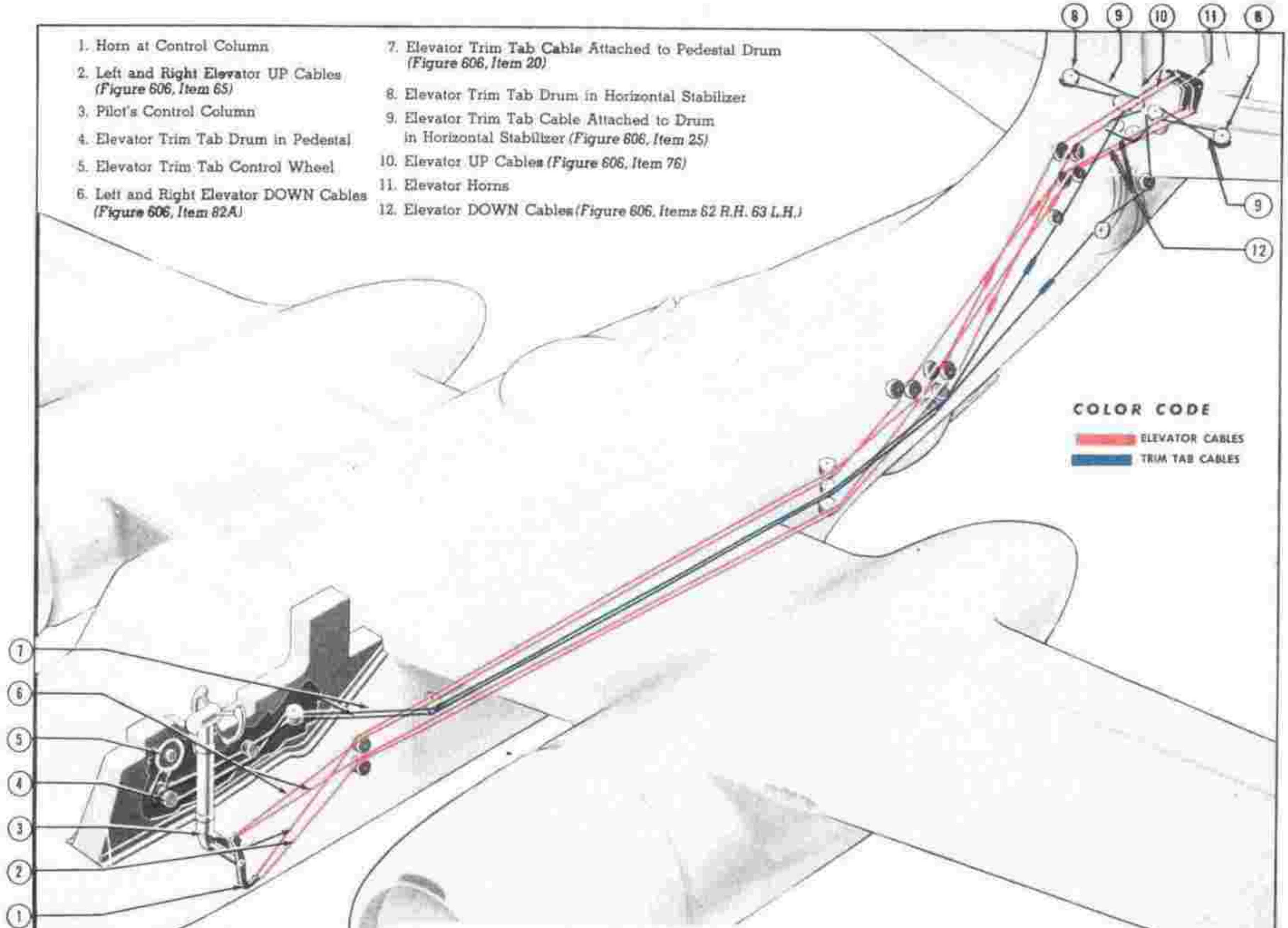


Figure 70 — Elevator and Elevator Trim Tab Control System

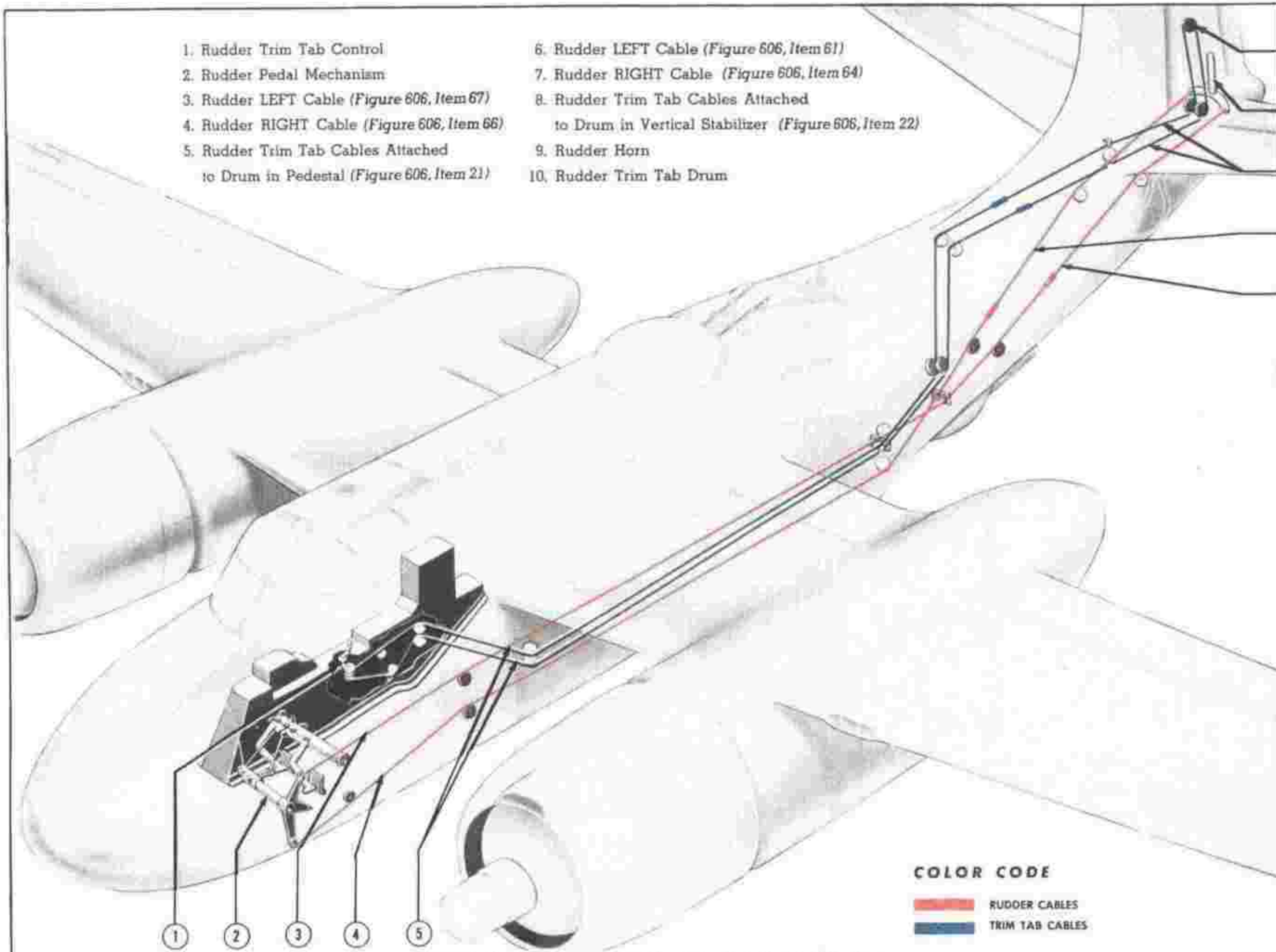


Figure 71— Rudder and Rudder Trim Tab Control System

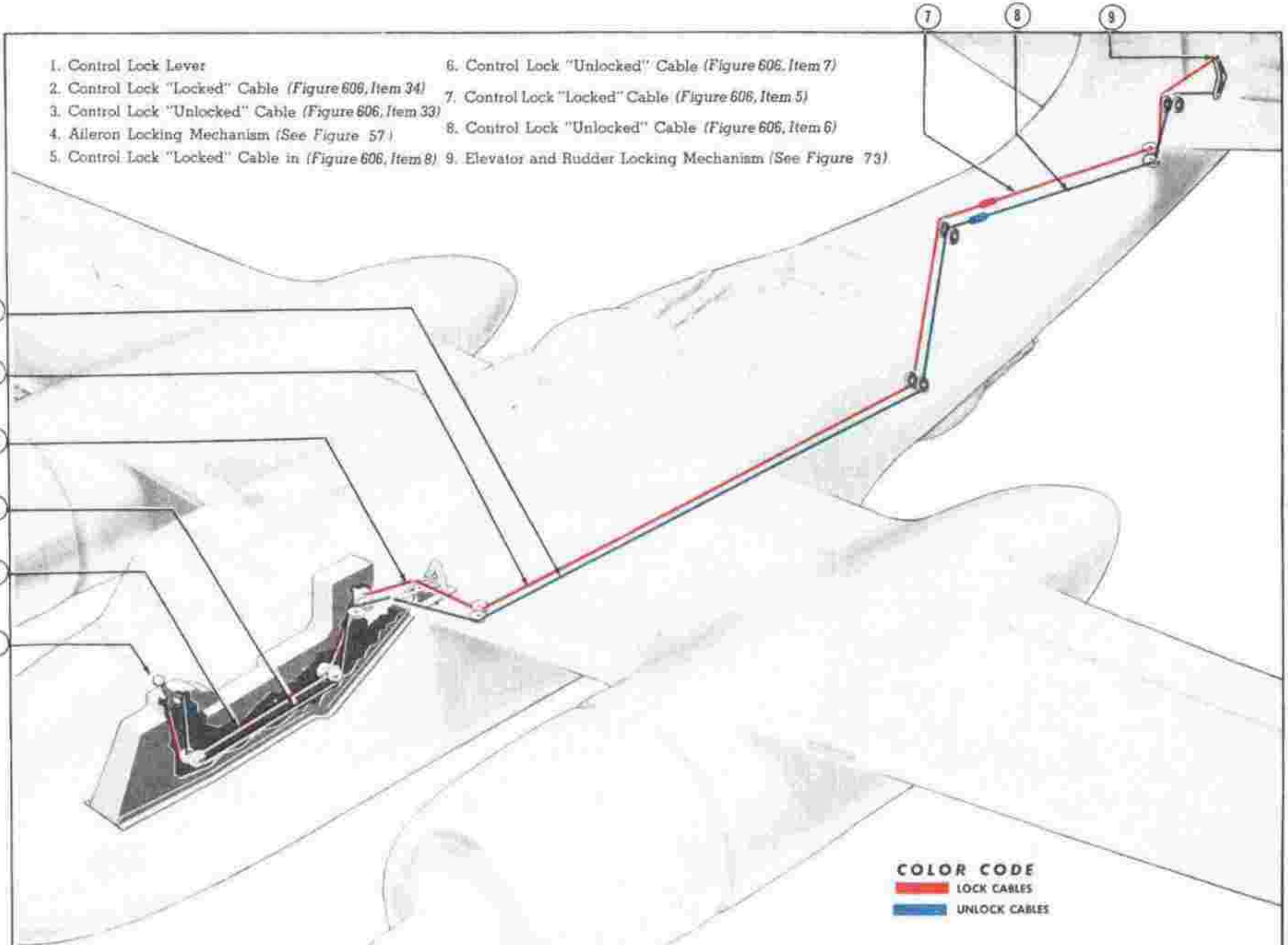
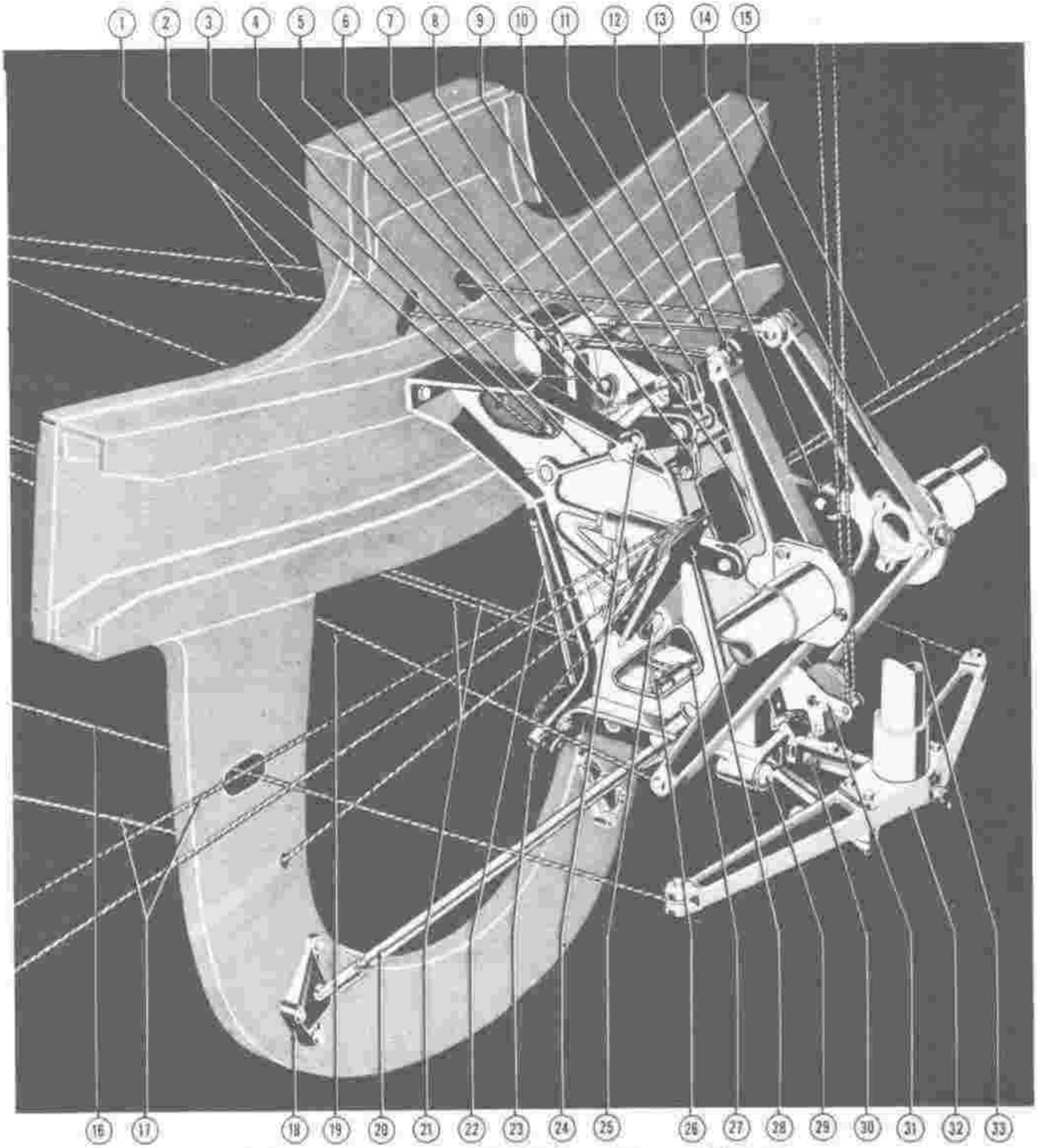


Figure 72 — Surface Control Locking System



1. Elevator Up Cables
2. Control Lock Release Cable
3. Surface Lock Actuating Crank
4. Elevator Idler Link Shaft
5. Control Lock "Locked" Cable
6. Surface Lock Tension Spring
7. Surface Lock Actuating Bell Crank
8. Surface Lock Actuating Idler Lever
9. Bracket
10. Lever
11. Elevator Interconnecting Rod
12. Cable Attachment Bolt
13. Elevator Horn Attach Bolt
14. Elevator Horn
15. Elevator Trim Tab Cables
16. Rudder Left Cable
17. Elevator Tab Down Cable
18. Bracket
19. Elevator Down Cable
20. Position Adjustment Rod
21. Rudder Trim Tab Cables
22. Rudder Lock Rod
23. Support
24. Elevator UP Stop (Adjustable)
25. Elevator DOWN Stop (Adjustable)
26. Surface Lock Tension Spring
27. Rudder Surface Lock Shaft
28. Pulley Bracket
29. Rudder Left Stop (Adjustable)
30. Rudder Clevis
31. Rudder Bracket
32. Rudder Horn
33. Rudder Right Cable

Figure 73 — Flight Control Mechanism—Fuselage Aft Section

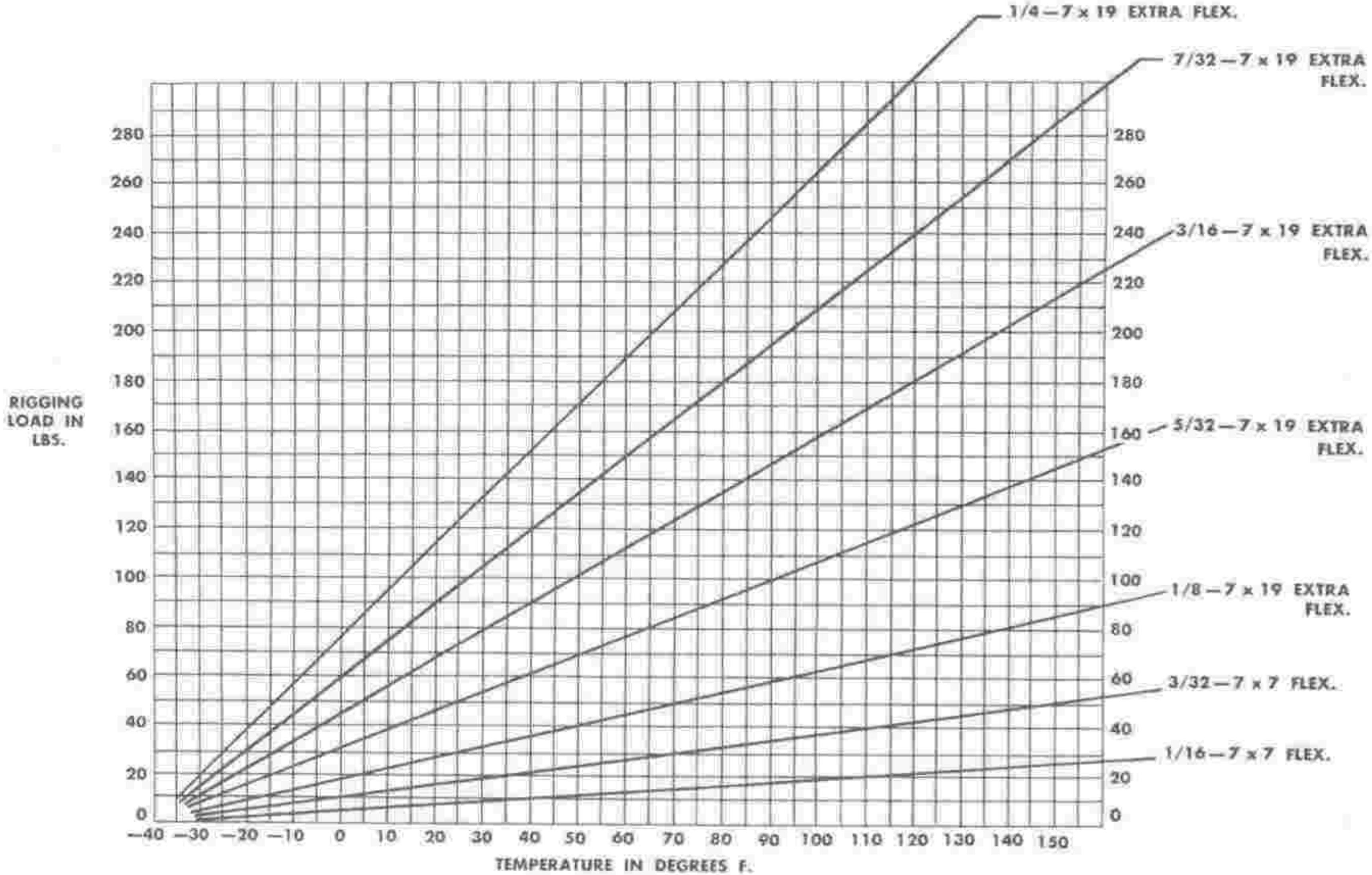


Figure 74 — Cable Rigging Chart

the fuselage and wing structures by means of micarta pulleys and fairleads. The various cable systems are illustrated in this section.

(b) REMOVAL.

1. Remove fairleads.

2. Free cables from pulleys by removing the guard pins or the pulley wheels if the guard pins are the pressed type.

3. Attach thread line to far end of cable and leave it in place of the cable. The line will serve as a guide when replacing the cable.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Worn or damaged flight control cables with swaged fittings cannot be repaired. Frayed 7 x 19 cables shall be considered serviceable unless there are six or more broken wires in any one-inch section of the cables. Frayed 7 x 7 cables shall be considered serviceable unless there are more than two broken wires in any one-inch section.

2. Fairleads which are cracked, broken or worn must be removed and replaced.

3. Pulleys which are cracked, worn or broken must be replaced. Pulleys with bearings which leak grease also should be replaced.

(d) INSTALLATION.—Install the cables as illustrated in this part. Before installing the cables, immerse them in a protective mixture consisting of one part grease and one part klenzine, by weight. (AAF Specification 35688.) A commonly used commercial mixture is "NO-OX-ID Grade A Special." The cables should be left in the liquid until thoroughly saturated, and then hung up to dry. After installing the cables, wire the turnbuckles and guard pins. Single .040 soft steel wire is recommended for turnbuckle safetying.

(e) ADJUSTMENT.—Use the Cable Rigging Chart *(figure 74)* at all times to obtain correct cable tension adjustment.

(9) SURFACE CONTROL LOCKS. *(See figure 72.)*—The ailerons, elevators, and rudder can be locked in the neutral position by means of a locking mechanism controlled by a lever *(15, figure 61)* which is located on the forward left hand corner of the control pedestal. Cables connected to the control lever extend to the aileron lock *(figure 57)* located aft of the aileron drum assembly. From the aileron lock, the cables run aft to the elevator and rudder locks on the control support assembly. When the lever is moved to the aft position, pins in the locks enter their respective stops, and thereby lock the controls. The lever also automatically restricts the throttle, limiting engine speed to 1,500 rpm.

(10) CONTROL SUPPORT ASSEMBLY. *(See figure 73.)*

(a) DESCRIPTION.—The control support assembly, located in the tail section, supports the elevator and rudder horns and torque tubes, the elevator and rudder control locks, and the pulley brackets for the elevator and rudder trim tabs. Provisions are made to adjust the assembly vertically. *(See 20, figure 73.)*

(b) REMOVAL.

1. First remove the tail cone, as described in paragraph 4. *b. (2)*, this section.

2. Remove the armor plate *(figure 555)*.

3. Remove the tension on all of the cables that extend to this assembly by loosening the turnbuckles until the cables sag.

4. Disconnect the four elevator cables and the two rudder cables at the horns.

5. Remove the two surface lock cables at the attaching points.

6. Remove the six elevator tab pulleys and the two rudder tab pulleys from the support.

7. Remove the two elevator torque tubes by removing the three bolts on each side. It is not necessary to remove the elevator horn.

8. Remove the four bolts which attach the rudder horn to the rudder torque tube.

9. Detach the clevis hinge pin and remove the rudder horn.

10. Remove the two adjusting rods *(20, figure 73)* which attach the bottom support to the fuselage structure.

11. Hold the support from the aft end while the two bolts at the top of the casting are being removed.

12. Remove the support through the aft section of the fuselage.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—A damaged control support assembly shall be replaced.

(d) ADJUSTMENT.—A slight vertical adjustment can be made on the control support assembly by removing the tail cone and armor plate and regulating the two adjustable rods which attach the control support to the fuselage.

(e) INSTALLATION.—To install the control support assembly reverse the REMOVAL procedure given above.

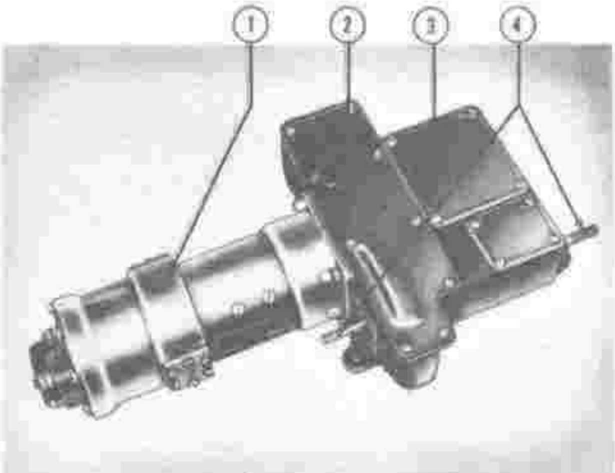
(11) WING FLAP CONTROLS.

(a) GENERAL.—The wing flaps are controlled electrically by means of a lever *(figure 49)* installed on the control pedestal. Operation of the pedestal control closes a circuit and starts an electrical drive unit *(figure 75)* installed on the rear spar cross tie plate in the bomb bay. The electrical drive unit consists of an electric motor *(1, figure 75)* attached to a main gear box *(2, figure 75)*. The motor actuates the main gear box, which in turn actuates torque tubes *(3, figure 78)* which extend into both wings and connect with smaller gear boxes. There are two of these wing gear boxes *(figure 80)* for each inboard flap and three for each outboard flap. When the gears in the wing gear boxes are revolved, they operate actuating screws *(8, figure 80)* which raise or lower the flaps. Position of the wing flaps is recorded on an electrically controlled flap and landing gear position indicator (Instrument Section) installed on the pilot's instrument panel. Wing flap flutter is prevented by an irreversible gear contained in the operating mechanism at each end of the flaps.

Note

The adjustment of the wing flaps for angular movement and for their position in relation to the wings is described in paragraph 3. *b.* (8) *(e)*, this section.

(b) WING FLAP ELECTRICAL CONTROL LEVER. *(See figure 49.)*—For instructions on the removal, maintenance repair and installation of the wing flaps electrical control lever mechanism on the control pedestal, refer to paragraph 15. *d.* (3), this section.



1. Electric Motor
2. Main Gear Box Access Door
3. Limit Switch Access Door
4. Torque Tube Actuating Shaft

Figure 75 — Wing Flap Electrical Drive Unit

(c) MAIN GEAR BOX.

1. DESCRIPTION.—The main gear box *(figure 76)* is a part of the wing flaps electrical drive unit installed on the rear spar cross tie plate in the bomb bay. Attached to the main gear box are an electric motor which actuates the gears, and torque shafts which extend into each wing panel. The main gear box is an assembly which consists of reduction gears, shafts, limit switches, cams and a wing flap position indicator transmitter. The limit switches and cams turn off the electric motor when the flaps have reached their proper degree of travel.

2. REMOVAL.

a. Remove the bolts from the torque shaft *(3, figure 76)* on either the right-hand or left-hand side of the main gear box.

b. Remove the cover *(2, figure 76)* from the limit switches on the right-hand side of the gear box.

c. Disconnect the electrical wiring from each limit switch.

Note

If these wires are not numbered according to their positions, they should be labeled to facilitate installation.

d. Disconnect the cam shaft *(8, figure 76)* on the middle right-hand side of the box by loosening the fitting.

e. Disconnect the electrical wiring from the motor.

f. Remove the electrical plug from the position indicator transmitter on the upper left-hand corner of the gear box.

g. Remove the nuts from the four mounting bolts and remove the gear box from the tie plate.

3. DISASSEMBLY.

a. Remove the motor *(1, figure 75)* attached to the gear box with four bolts.

b. Remove the limit switches *(7, figure 76)* by removing the screw assembly and the two adjusting bolts and springs.

c. Remove the oblong cover *(2, figure 75)* from the front of the gear box.

d. Remove the cap *(10, figure 76)* from the lower right-hand side of the box.

e. Remove the nut from the right-hand side of the flap drive shaft *(3, figure 76)*.

f. Remove the bolt from the main (largest) gear.

g. Tap on the right-hand side of the drive shaft *(3, figure 76)* to remove the left-hand bearing, the oil seal and the lock ring.

h. Pull the drive shaft to the left.

i. Remove the drive shaft, then remove the right-hand bearing.

j. Remove the lock ring and washer from the limit switch cam shaft *(4, figure 76)* and tap out the plug.

k. Remove the nut and 2 washers from the bronze cam shaft.

l. Pull out the cams.

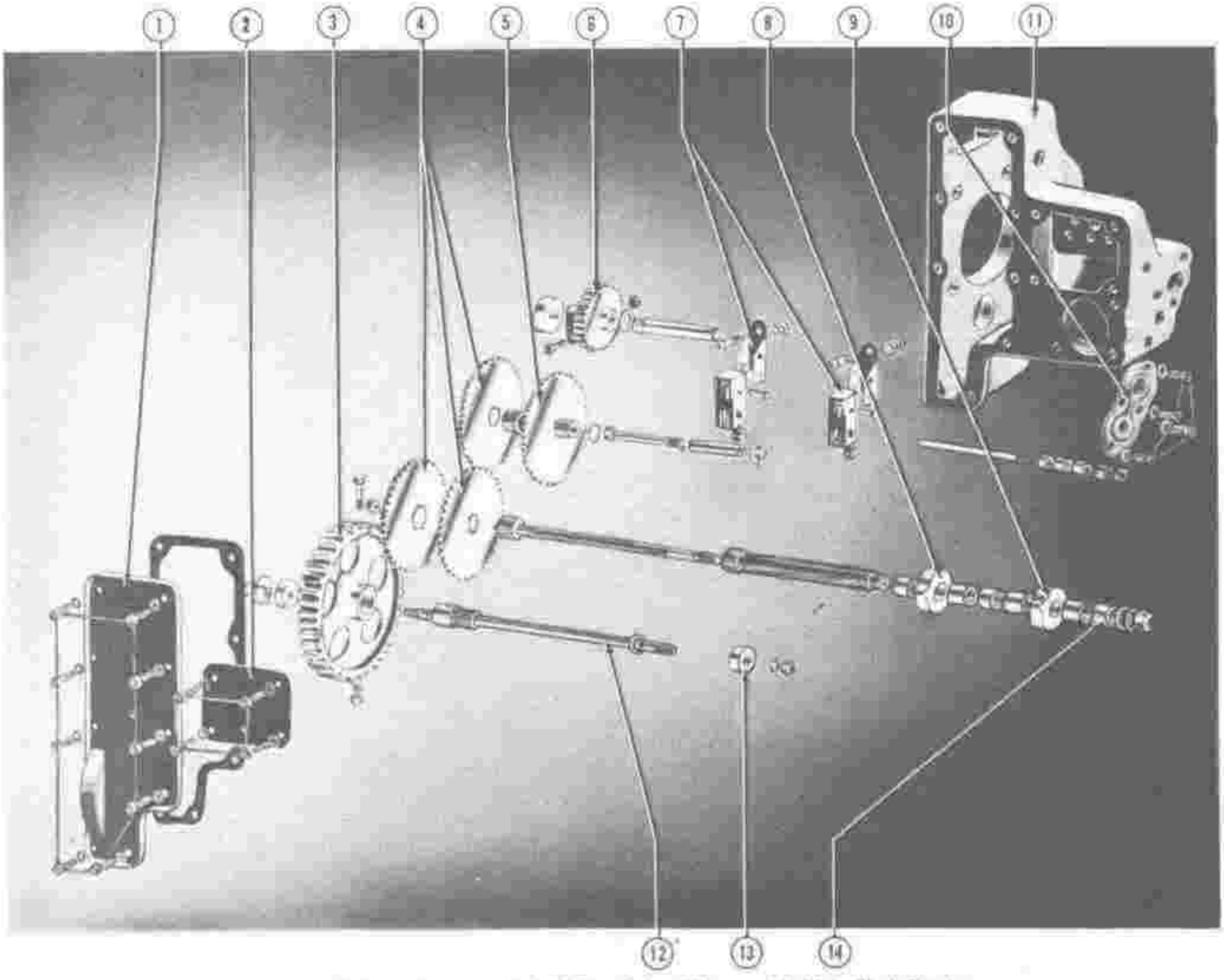
m. Remove the nut from the gear on the steel cam shaft *(4, figure 76)* on the left-hand side of the gear box and remove the gears.

n. Remove the steel cam shaft through the motor mounting hole.

o. Remove the bronze cam shaft.

p. Remove the upper bronze gears *(4, figure 76)* by removing the short bolt through the side of the box.

q. Loosen the bolt in the indicator gear *(6, figure 76)* in the upper part of the gear box and tap the shaft on the right-hand side of the box to remove the shaft and the left-hand seal from the left-hand side of the box. Protect the oil seal from the rivet on the shaft with a steel disc.



1. Wing Flap Gear Case Inspection Cover
2. Wing Flap Limit Switch Cover
3. Main Shaft Gear
4. Intermediate Gear
5. 1/10 Revolution Idler Spur Gear
6. Indicator Gear
7. Limit Switch
8. Cam A
9. Cam C
10. Main Shaft Bearing Cap
11. Wing Flap Actuator Case
12. Main Shaft
13. Fafnir Bearing
14. Spacers

Figure 76—Wing Flap Actuator (Main Gear Box)

4. MAINTENANCE REPAIR OR REPLACEMENT.—Replace worn or damaged parts in the gear box.

5. ASSEMBLY AND INSTALLATION.—Reverse the removal and disassembly procedure given above.

CAUTION

Install the motor mounting bolts in the proper positions on the main gear box before starting to assemble the gear box. Install the cams and bronze gears before final installation of the main (largest) gear. Do not disassemble the cams from the bronze shaft unless repair or replacement is required. If the cams must be removed, mark them so that they can be returned to the same place and position. Cam "C" *(9, figure 76)* should be in the position which causes the limit switch to be depressed. After the gear box has been assembled, spread Spec. G-10 grease on all of the gears. If adjustment of the limit switches or the gear box is required following installation of the main gear box, refer to paragraph 3. *b.* (8) *(e)*, this section.

6. ADJUSTMENTS.—To adjust the travel of the wing flaps, refer to paragraph 3. *b.* (8) *(e)*, this section.

7. TEST AFTER INSTALLATION.

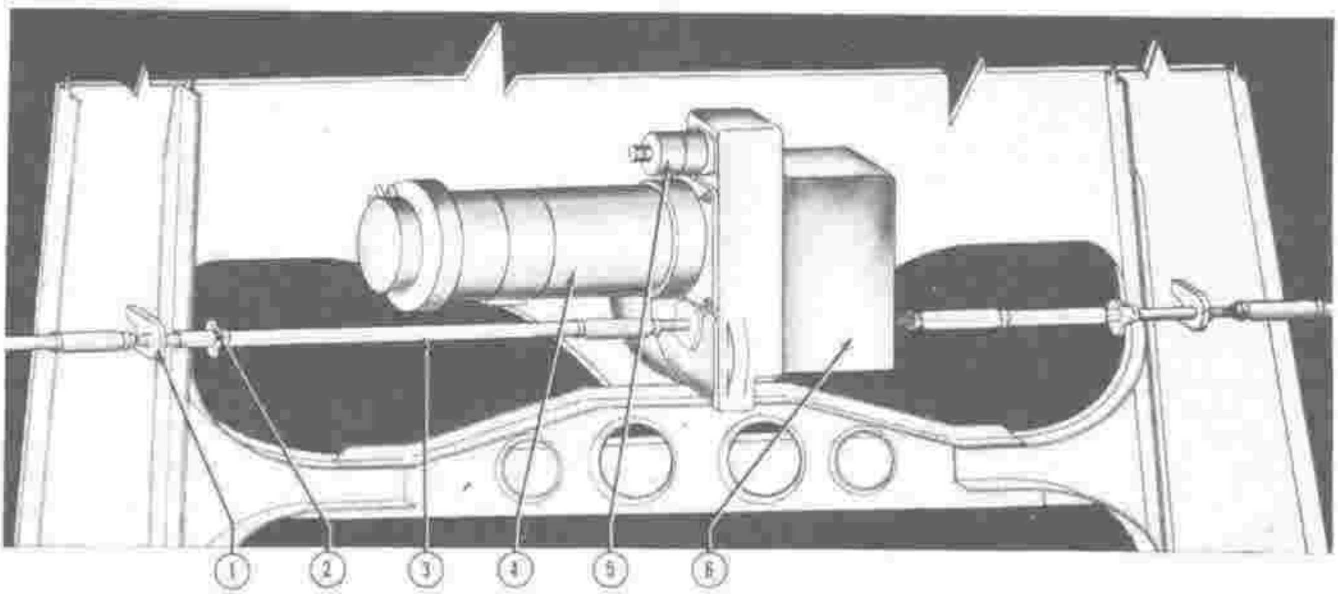
a. Place the control lever in the "UP" position and check for alignment of the flaps relative to the trailing edge of the wing.

b. Check the LANDING position in the same manner; the correct travel is 52 ± 2 degrees.

c. If the tests show any error in movement of the flaps, refer to the instructions on adjustment, paragraph 3. *b.* (8) *(e)*, this section.

(d) WING FLAP GEAR BOXES. *(See figure 80.)*

1. DESCRIPTION.—Five small gear box and actuating screw assemblies are installed on the aft spar in each wing panel. The gear boxes are connected to the torque shafts *(3, figure 78)* which extend from the main gear box in the bomb bay into each wing panel. When the wing flap gear boxes are actuated, the force is transmitted to the flaps by means of the actuating



1. Wing Flap Actuating Torque Tube Support
2. Wing Flap Actuating Torque Tube Disconnect
3. Wing Flap Actuating Torque Tube
4. Electric Motor
5. Wing Flap Position Indicator Transmitter
6. Wing Flap Actuator

Figure 77 — Wing Flap Operating Mechanism in Bomb Bay

screws. Protective shrouds *(6, figure 79)* are installed on the actuating screws on both sides of the gear boxes to keep out foreign matter which causes wear. Tubular shrouds, attached with clamps and sealed with friction tape, are installed on both ends of the actuating screws on the inboard flaps and on the forward end of the actuating screws in the outboard flaps. Telescopic shrouds attached with snap rings are installed on the outboard flap actuating screws aft of the gear boxes. The telescopic shrouds are assembled in two pieces and may be removed without removing the actuating screws from the gear boxes.

2. REMOVAL.

a. INBOARD FLAP GEAR BOXES.

(1) Operate the flaps to the down position.

(2) Disconnect the flap door actuating links *(7, figure 51)* and let the door hang down to make ample room for the removal of the gear box.

(3) Detach the torque tube *(5, figure 79)* at the disconnect *(7, figure 79)* between the two boxes.

(4) Remove the fairlead support at the center of the torque tube and remove the tube section from the airplane.

(5) Disconnect the aft shroud attaching clamp. *(See 1, figure 79.)*

(6) Disconnect the actuating screw *(10, figure 51)* from the linkage.

(7) Rotate the screw with the fingers to remove it from the gear box and the aft shroud. The shroud will remain suspended in the support. If desired the shroud may be taken out later by pushing it back into the opening left by the removal of the gear box.

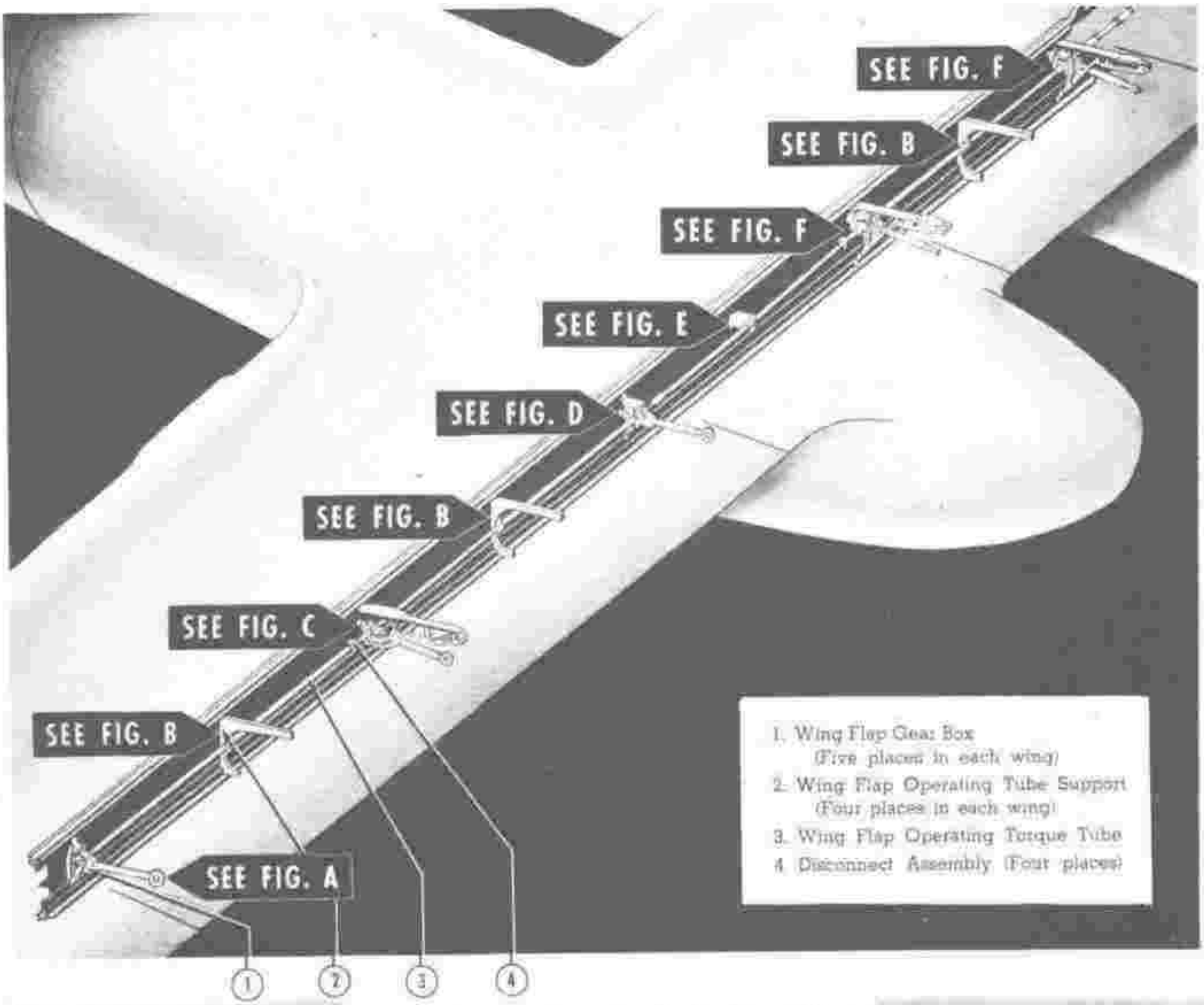
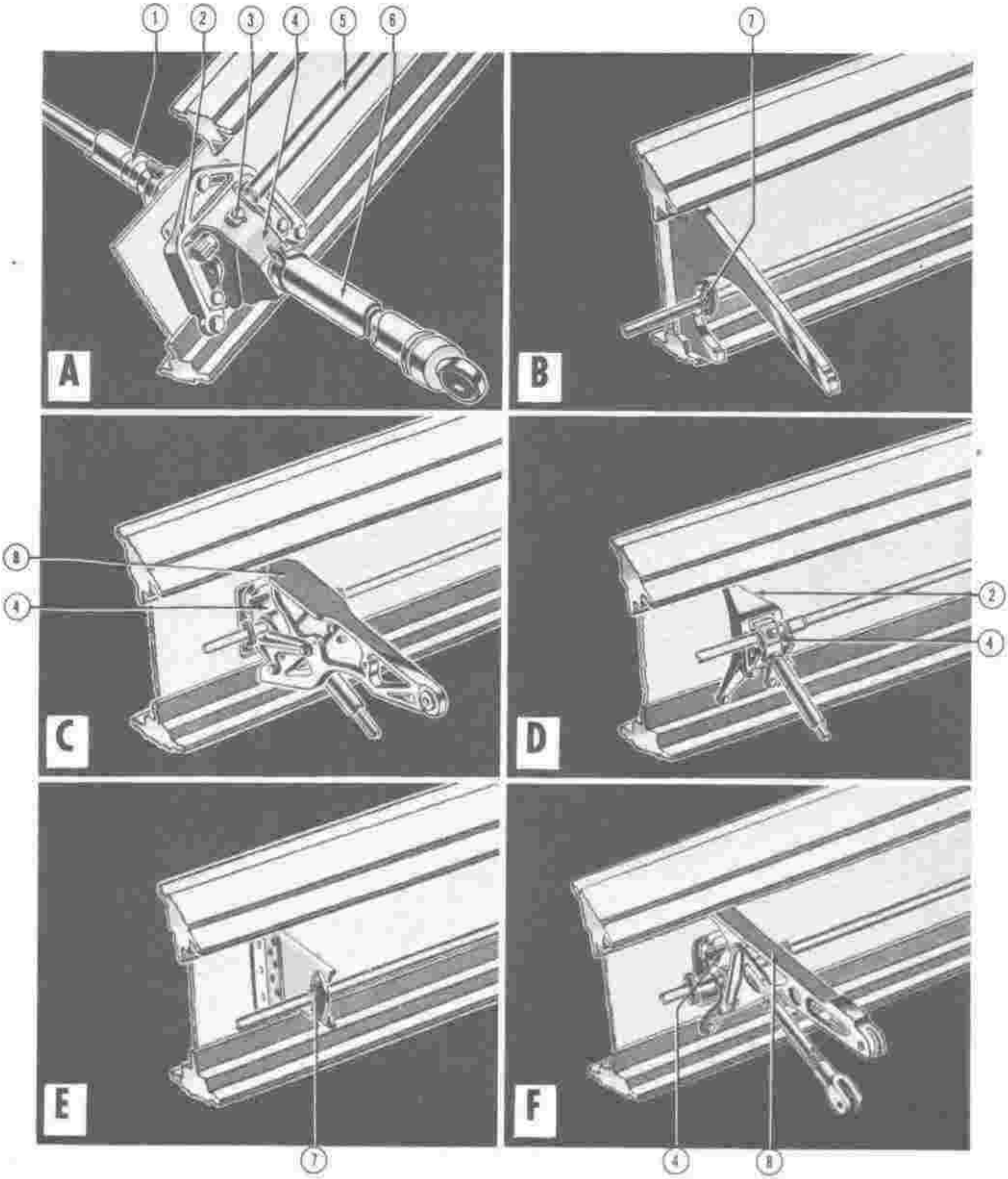


Figure 78 — Flap Operating Mechanism in Wing



1. Wing Flap Actuating Screw Shroud (Forward)
2. Gear Box Support
3. Alemite Lubricator
4. Flap Gear Box
5. Flap Actuating Torque Tube
6. Actuating Screw Shroud (Aft)
7. Torque Tube Support
8. Hinge Support

Figure 79 — Detail—Wing Flap Operating Mechanism

(8) Remove the brackets *(2, figure 79)* which attach the gear box to the wing rear spar.

(9) Remove the forward shroud from the gear box by loosening the attaching clamp. Be careful not to bend or damage the shroud.

(10) Remove the gear box and the shroud.

b. OUTBOARD FLAP GEAR BOXES.— The procedure for the removal of the outboard flap gear boxes is the same as that for the inboard flaps with the following exceptions:

(1) In the case of the center and outboard gear boxes the aft shroud will be removable from the airplane with the actuating screws.

(2) In the case of the inboard gear box the aft shroud will be removable with the actuating screw and the gear box and the forward shroud will be removable as an assembly.

3. DISASSEMBLY.

a. Remove the three bolts *(1, figure 80)* which secure both side plates on the case.

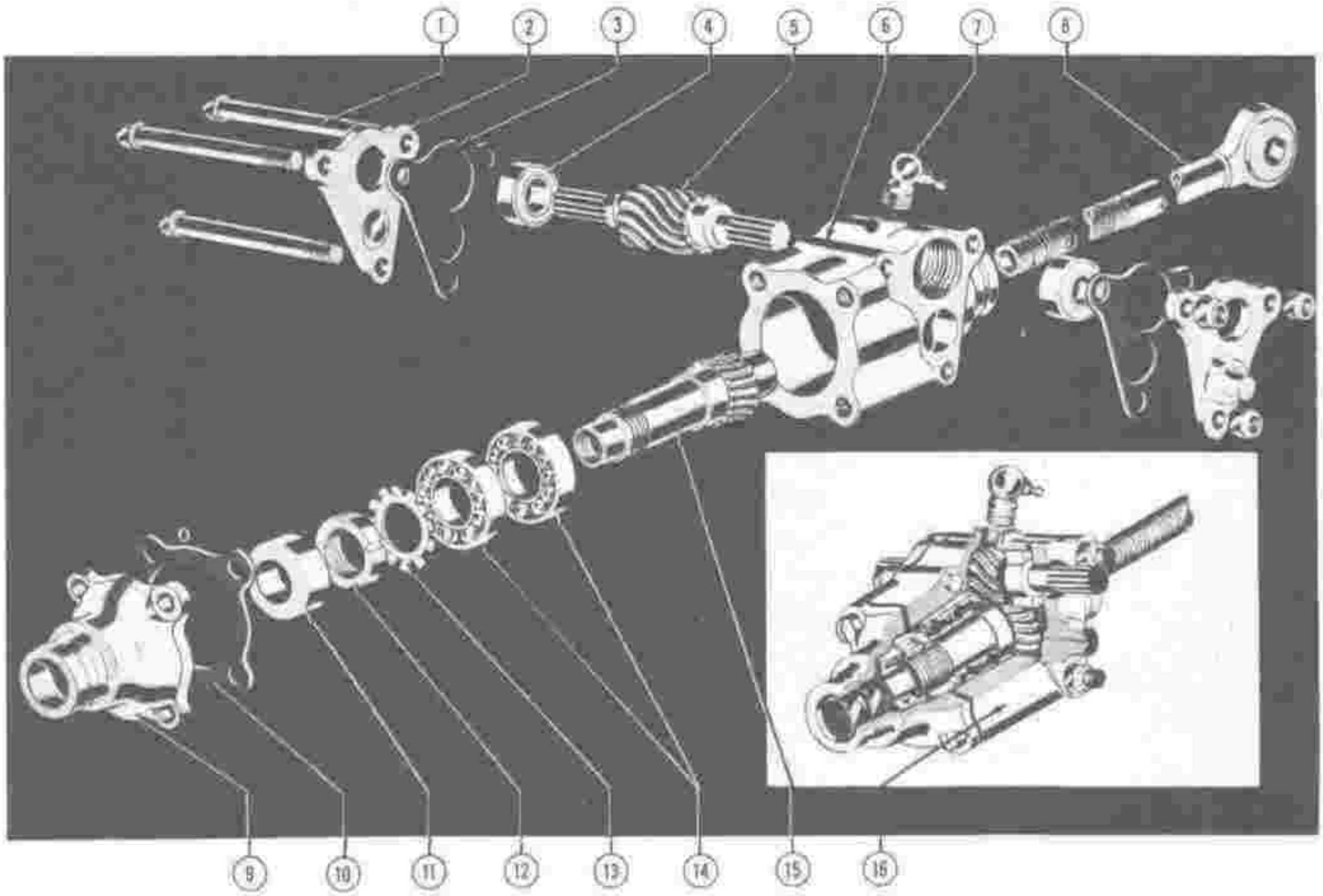
b. Remove the side plate gaskets carefully to avoid damaging them.

c. Remove the worm gear and shaft *(5, figure 80)* by hitting the end of the shaft on a wooden bench or block to force the shaft and one bearing out of one end.

d. Remove the four bolts and the cap *(9, figure 80)* from the end of the case.

e. Remove the gasket carefully to avoid damaging it.

f. With the gear box in hand, hit the end



1. Bolt (3 places)
2. Plate
3. Gasket
4. Bearing
5. Worm
6. Housing
7. Alemite Lubricator
8. Actuating Screw
9. Cap
10. Gasket
11. Oil Retainer
12. Nut
13. Washer
14. Fafnir Bearing
15. Worm Wheel (Phosphor Bronze)
16. Gear Box Assembly

Figure 80 — Typical Wing Flap Gear Box

of the actuating screw *(8, figure 80)* on a wooden bench or block to force the worm wheel and bearings out of the case.

g. Remove the actuating screw from the worm wheel.

4. MAINTENANCE REPAIR OR REPLACEMENT.—Worn or damaged actuating screws or worm gears in the wing flap gear boxes shall be replaced. Wear may be revealed by a chattering noise made when the gear boxes are operated, or it may be revealed on visual inspection of the actuating screws. However, wear is most apt to occur in the phosphor bronze worm wheel in the gear box. With the flap in any position other than up, excessive play can be detected by shaking the flap by hand.

5. ASSEMBLY.

a. If the bearings *(14, figure 80)* have been removed from the worm wheel, re-install them so that the marked sides are face to face.

b. Install the lock washers and the ring nut on the worm wheel *(15, figure 80)*; the tabs on the lock washer must be bent into slots on the ring nut.

c. Press the worm wheel and bearings into the case.

d. If the gaskets are not torn or damaged, they may be used again.

e. Place the gasket and cap *(9 & 10, figure 80)* on the end of the case, and secure with the four bolts and washers.

f. Press the worm gear *(5, figure 80)* and bearing into the case.

g. Place the gaskets and side plates *(2 & 3, figure 80)* on the side of the case, and secure them with the three through bolts and washers.

h. Fill the case with Beacon M-285 (Spec. ANG-3) grease or the equivalent.

6. INSTALLATION.

a. Place the gear box in position with the pivot pin inserted in the bracket.

b. Install the pivot bracket on the opposite side.

c. Screw the actuating screw into the gear box far enough to allow the other end to be connected to the hinge assembly.

d. Attach the shroud to the gear box with the clamp or snap rings. Seal the tubular shrouds with masking tape.

e. Slide the splined connection on the drive shaft of the gear box; install the bolts in the torque shaft connection and attach fibre stop nuts.

(e) TORQUE TUBES IN WING. *(See 3, figure 78.)*

1. DESCRIPTION.—The five wing flap gear boxes installed in each wing panel are actuated by a series of four torque tube assemblies attached to the aft side of the rear spar. The tubes extend from the main wing flap gear box in the bomb bay to the outboard end of the outboard flap. The tubes are interconnected by means of the splined shaft which extends through each wing flap gear box.

2. REMOVAL.—To remove any one or all of the torque tube assemblies from the trailing edge of the wing proceed as follows:

a. Operate the flaps to the down position.

b. Remove the fairlead support installed half way between the gear boxes by removing the two screws.

c. Disconnect the torque tube at the disconnect assembly by removing the three bolts.

d. Pull the other end of the torque tube from the joint assembly.

e. Remove the torque tube.

d. MOVABLE SURFACES TROUBLE SHOOTING LIST.

AILERON, ELEVATOR AND RUDDER CONTROLS

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Surface cannot be moved.	*a.* Foreign object in controls.	*a.* Remove the object.
	b. Broken control cable.	*b.* Replace cable. See Cable Rigging Chart, *figure 74.*
	c. Broken rudder pedal.	*c.* Replace broken part. *(See figure 65.)*
	d. Missing or broken cable connecting bolt.	*d.* Install a new bolt.
	e. Broken or damaged actuating rod.	*e.* Replace the actuating rod. See paragraph 3. c. (2).
	f. Broken rudder, elevator or aileron horn.	*f.* Replace the broken part. See paragraph 3. c. (2).
	g. Frayed cable in control column head.	*g.* Replace the cable. *(See figure 69.)*

TROUBLE	PROBABLE CAUSE	REMEDY
2. Insufficient travel.	*a.* Broken fairleads.	*a.* Replace broken fairlead.
	b. Cracked or damaged pulley.	*b.* Replace the pulley.
	c. Insufficient cable tension.	*c.* Adjust the tension according to the Cable Rigging Chart. *(See figure 74)*
	d. Improper setting of control horn stop.	*d.* Adjust the stop as outlined in this paragraph.

TRIM TAB CONTROLS

TROUBLE	PROBABLE CAUSE	REMEDY
1. Tab cannot be moved.	*a.* Foreign object in controls.	*a.* Remove the object.
	b. Broken cable.	*b.* Replace the cable. See Cable Rigging Chart, *figure 74.*
	c. Broken operating control.	*c.* Replace the broken part.
	d. Broken or damaged actuating rod.	*d.* Replace the rod. See paragraph 3. *c.* (5).
2. Insufficient tab travel.	*a.* Foreign object in controls.	*a.* Remove the object.
	b. Incorrect position of tab operating control.	*b.* Remove control, turn it to zero position when tab is in neutral position, and reinstall control.
	c. Broken pulley bracket.	*c.* Replace the bracket.
	d. Cracked or damaged pulley.	*d.* Replace the pulley.
	e. Cracked or broken fairlead.	*e.* Replace the fairlead.
	f. Drums improperly wrapped.	*f.* Re-wrap drum. (Illustrated in text.)
3. Excessive tab travel.	*a.* Incorrect position of tab control.	*a.* Remove control, turn it to zero position when tab is in neutral position, and reinstall control.

WING FLAP CONTROLS

TROUBLE	PROBABLE CAUSE	REMEDY
1. Flap comes up too tightly against stop.	*a.* Cam "C" limit switch out of adjustment.	*a.* Turn the adjustment screw on Cam "C" limit switch counterclockwise. See paragraph 3. *c.* (11), this section, and instructions inside cover on main gear box.
2. Flap does not come up far enough.	*a.* Cam "C" limit switch out of adjustment.	*a.* Turn the adjustment screw on Cam "C" limit switch counterclockwise. See paragraph 3. *c.* (11), this section, and instructions inside cover on main gear box.
3. Flaps travel beyond LAND- position.	*a.* Cam "A" limit switch out of adjustment.	*a.* Turn the adjustment screw on Cam "A" limit switch counterclockwise. See paragraph 3. *c.* (11), this section, and instructions inside cover on main gear box.
4. Flaps travel short of LANDING position.	*a.* Cam "A" limit switch out of adjustment.	*a.* Turn the adjustment screw on Cam "A" limit switch counterclockwise. See paragraph 3. *c.* (11), this section, and instructions inside cover on main gear box.
5. One flap out of alignment.	*a.* Actuating screws not set properly.	*a.* Detach the torque tubes from flap at disconnects, rotate torque tube on flap. See paragraph 3. *c.* (11), this section.
6. Motor runs but flaps fail to operate.	*a.* Gears jammed in main gear box.	*a.* Repair or replace main gear box. *(See figure 76.)*
	b. Torque tubes disconnected.	*b.* Connect the torque tubes. *(See 3, figure 78.)*
7. Motor fails to operate.	*a.* Broken electrical wire or faulty electrical connection.	*a.* Check the wiring. See Wiring Diagram following paragraph 15, this section.
	b. Oily commutator.	*b.* Clean commutator. See paragraph 15. *b.* (2), *(b)* 3. d., this section.
	c. Brushes worn.	*c.* Replace brushes. See paragraph 15. *b.* (2), *(b)* 3. b., this section.
	d. Motor burned out.	*d.* Install new motor.

4. FUSELAGE

a. GENERAL.—The fuselage of this airplane is an all-metal structure of alclad skin, shaped and reinforced by aluminum alloy ribs, bulkheads and longitudinal members.

Length of fuselage is 50 feet 9 inches (A-26B), 51 feet 3 inches (A-26C); maximum width is 5 feet, 2.04 inches; maximum height is 5 feet, 10 inches.

The fuselage is assembled in six parts: the nose, main fuselage, pilot's compartment enclosure, gunner's compartment enclosure, aft section, and tail cone. Entrance to these parts is accessible by means of doors *(figures 6, 7 & 8)* with the exception of the tail cone.

The nose wheel well, bomb bay, and pilot's and gunner's compartments are integral parts of the fuselage.

The alclad skin of the fuselage is fortified in vital areas *(figure 555)* by $^{3}/_{16}$-inch dural plates designed to deflect angular shell fire. The pilot's and gunner's compartment enclosures are fabricated of plexiglas.

b. NOSE. *(See figures 82 & 83.)*

(1) DESCRIPTION.—This nose section is located forward of the pilot's enclosure and is removable as a complete unit. Two types of interchangeable noses are manufactured for this airplane: a bombardier nose, and an all-purpose (multi-gun) nose. An access door is located on the under side and an access window for cleaning the bomb sight window from inside.

(a) BOMBARDIER NOSE.—The upper half of the bombardier nose consists of plexiglas. The bottom and side skin of the nose is made of $^{3}/_{16}$-inch dural deflector plating. At the forward end is a bomb sight window of laminated glass. The access door in the bottom of the nose is opened by pulling down a lever in the door. The lever releases latches inside and lets the door swing down to a vertical position. At the bottom end of the extended door is a sliding ladder for entrance.

(b) ALL PURPOSE NOSE.—The access door of the all-purpose nose *(24, figure 6)* contains no opening

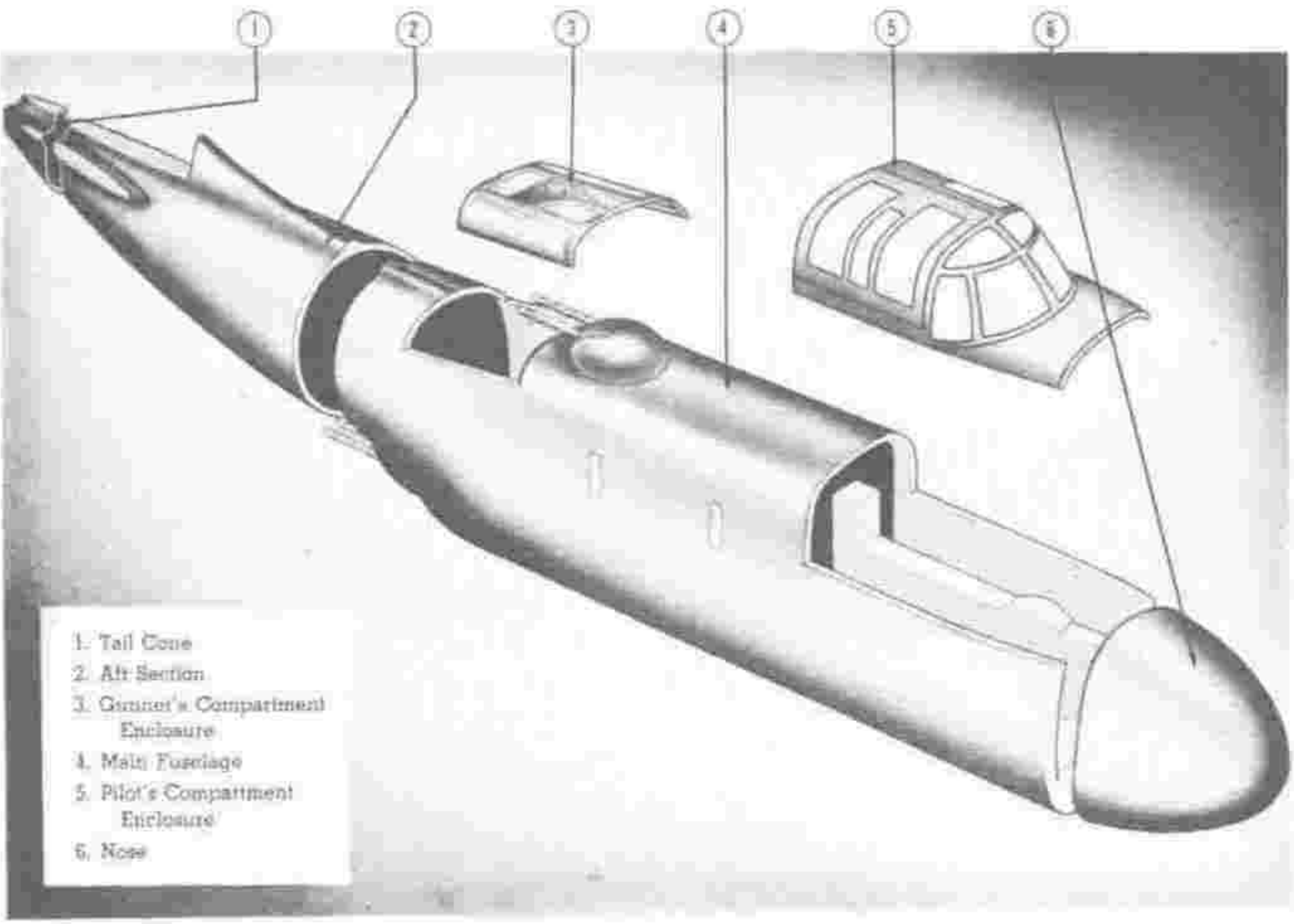


Figure 81 — Fuselage (Disassembled)

Figure 82—All-Purpose Nose

lever. The door must be opened by releasing the Dzus fasteners around the panel. The upper structure is all metal rather than plexiglas. On either side at the top are two access panels to the guns, and below these, two gun or cannon fairing access panels. The four panels may be removed by releasing the Dzus fasteners around the panels. Seals are provided where the guns penetrate the nose to keep out dust. Other seals at station No. 0 prevent the smoke resulting from the firing of the guns from entering the pilot's compartment. Heavy armor plate of "Rey" metal covers the entire area at station No. 0 where the nose is bolted to the main fuselage.

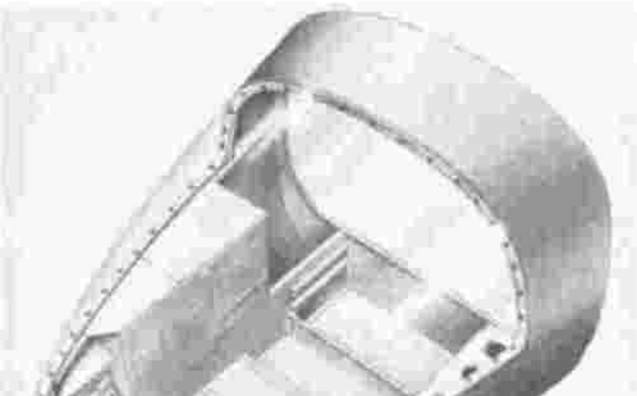


Figure 83—Bombardier Nose (Exterior View)

(2) REMOVAL.

(a) Support the nose section as shown in *figure 17.*

(b) If the nose is the bombardier type, disconnect the electrical plugs, bombing controls, heating system ducts, etc.

(c) Remove the tape covering the juncture of the fuselage and nose section.

(d) With the nose section securely supported, disengage the four lower steel bolts from within the fuselage. After rechecking to make certain that all wiring has been disconnected, remove the two remaining steel bolts at the top, and carefully move the nose section away from the airplane. On the all-purpose nose there are eight bolts, two on top and six on the bottom.

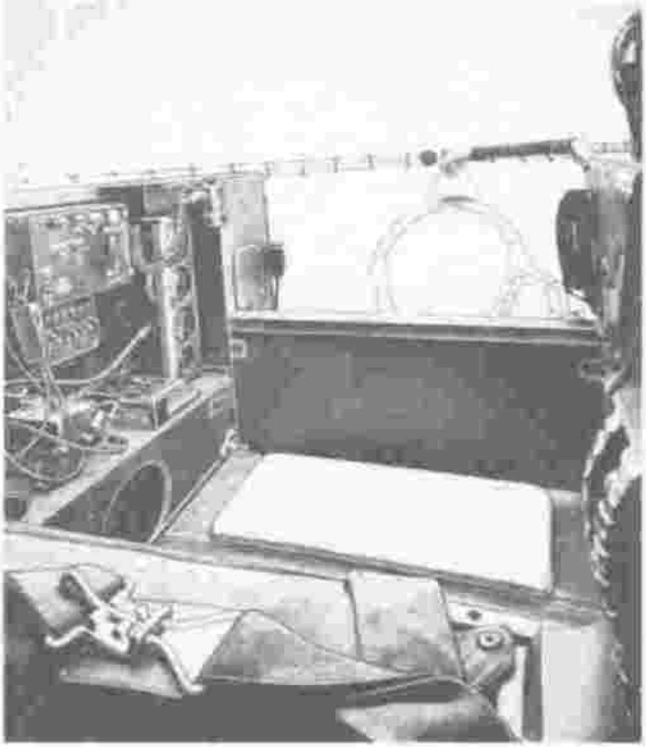


Figure 84—Bombardier Nose (Interior View)

(3) DISASSEMBLY.

(a) To remove the fixed plexiglas panels from the nose section of the bombardier model, remove the attaching bolts located at the edge of each panel.

(b) To remove the access door, remove the pins securing the bungee cord and latching arm; remove the wire from the strip hinge and remove the door.

(4) MAINTENANCE REPAIR OR REPLACEMENT.—For instructions on the repair of the nose skin and structure, refer to the Structural Repair Handbook (T.O. No. AN01-40AJ-3).

(5) ASSEMBLY AND INSTALLATION. – Reverse the procedure outlined in paragraphs (2) & (3) above. Attach cotton fabric sealing tape with clear nitrate dope. Install and tighten the NAS 147 bolts in the nose to a torque force equal to 570-640 inch-pounds.

(6) TEST AFTER INSTALLATION.–Check all equipment affected by removal of the nose for efficient operation.

c. NOSE WHEEL WELL. *(See 22, figure 6.)*–A nose wheel well, provided with hydraulically operated doors which are closed when the airplane is in flight, is located under the pilot's compartment. Description of nose wheel and doors, with maintenance instructions, will be found in paragraph 5. *c.* (6), this section.

d. PILOT'S COMPARTMENT.

(1) DESCRIPTION.–The pilot's compartment is located immediately aft of the nose section. In this compartment, compactly arranged, are the flight and engine controls for the airplane with seats for the pilot and gunloader. The normal entrance to the pilot's compartment is by means of a hinged door through the top of the enclosure. This door is also an emergency escape hatch. Entrance to this compartment can also be made through an opening from the bomb bay, provided the bomb bay is not loaded with torpedoes or bombs larger than the 300-pound size, or that the SCR-522 radio set is not installed behind the gunloader's seat. The entry is accomplished by detaching the cannon shellcase catcher, which is held over the opening by a zipper fastener, and raising the gunloader's hinged seat. A cable and ball assembly attached to the top of the pilot's enclosure is provided to hold the seat in the raised position. Insert the cable in the slot on the forward edge of the seat so that the ball catches under the forward edge. To the right of the gun-loader's seat is a dural collapsible ladder used for entrance and exit to and from the pilot's compartment. The ladder slides through the lower right side of the fuselage to an easy access distance from the ground.

The windshield *(5, figure 81)* consists of slanted panels of laminated glass. Plexiglas panels cover the top and sides of the enclosure. Neoprene seals are fitted between panels to exclude outside air and vibration. The enclosure may be fabricated in any one of the three following combinations:

No. 1. Sliding panels on the sides with a fixed panel and hatch at the top.

No. 2. Two fixed curved panels on the top and left with a small ventilating panel in the front panel, and a hatch on the top and right.

No. 3. Two panels hinged to the sides (clam shell type) and separated from a beam at the top. Each of the above hatches contain two release levers. One releases latches to lift the hatch for normal entrance and exit. The other (emergency) releases pins in the hinges and lets the air stream carry away the hatch for emergency exit.

CAUTION

When cleaning plexiglas, be certain that the agent used does not contain an abrasive or a solvent. The best cleaner is soap and water solution applied with a clean, soft cloth or sponge. Do not use aviation gasoline, Ethyl gasoline, acetone, lacquer cleaners, benzine, or fire extinguisher fluids, because these solvents will soften or "craze" the surface. If any of these fluids come into contact with the plexiglas at any time, they should be washed off immediately. As most window cleaning sprays may contain solvents, they should not be used on plexiglas. Kerosene or clear gasoline may be used to remove grease or oil.

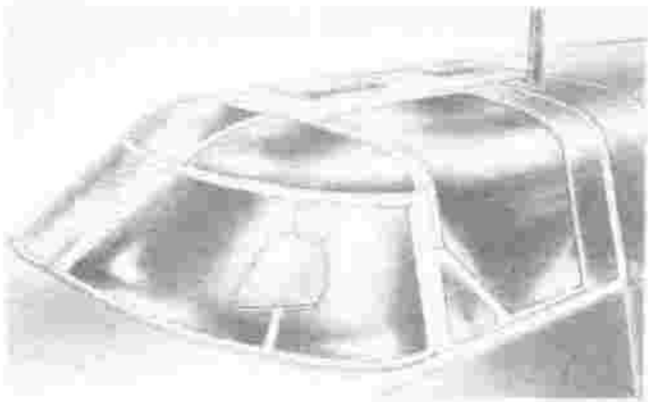


Figure 85—Pilot's Enclosure

(2) REMOVAL.

(a) PILOT'S COMPARTMENT ENCLOSURE.

1. Disconnect the windshield defroster ducts inside the nose section.

2. Disconnect the lines at the unions at the forward right-hand corner of the enclosure.

3. Working within the nose section, remove the sheet metal screws from the cowling plate located below the windshield.

4. Disconnect the four vacuum lines from the vacuum selector valve located above and aft of the pilot's seat.

5. Remove the clip from the line installed inboard of the radio shelf.

6. Disconnect the forward end of the radio equipment shelf located in back of the pilot's seat. Block up the shelf from below to prevent bending of the attached end of the shelf.

7. Remove the vertical brace supporting the instrument panel.

8. Disengage the bolts which attach the enclosure to the fuselage and remove the enclosure.

(b) WINDSHIELD.—To remove the windshield without removing the pilot's compartment enclosure, detach the screws installed around the edges of the windshield and lift off the retaining strip.

(c) SLIDING WINDOWS. (On some airplanes.)

1. Remove the upper and lower aft tracks.

2. Remove the latching lever.

3. Slide the window aft and out from the enclosure.

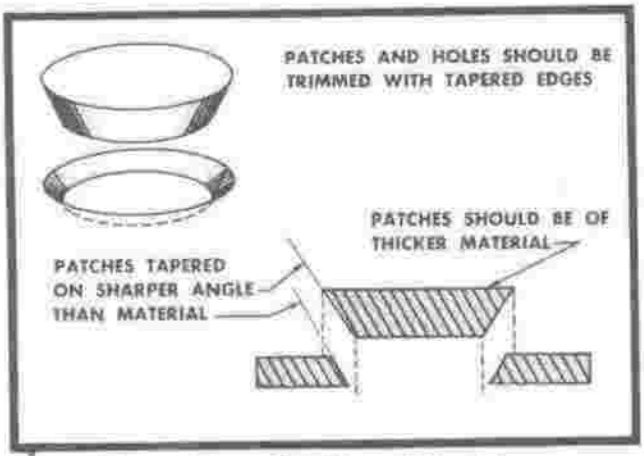


Figure 86 — Patching of Plexiglass

(d) FIXED PLEXIGLAS PANELS. — Remove the screws and the sealing strip, and lift out the panel.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) WINDSHIELD.—Replace if damaged.

(b) PLEXIGLAS PANELS.—Plexiglas panels, when damaged, may be repaired temporarily. The material is easy to work and readily softened by the application of heat or solvent. When replacement panels are not available, the following methods of repairing certain kinds of damage may be used:

1. CRACKS.—At the first sign of cracking, a hole $\frac{1}{8}$ inch to $\frac{3}{16}$ inch in diameter should be drilled at the end of the crack. This helps prevent further splitting by distributing the strain over a larger area. A quick method of patching involves the use of wing fabric or other tough cloth applied with a solvent, a plexiglas cement, or in emergency, acetate "dope." If a crack extends from channel to channel, a simple method of repair is to drill holes along each side of the crack at least one-half inch away from it, and bind the two pieces together by lacing them with flexible wire or stout cord. A more satisfactory method of patching a cracked panel until it can be replaced, is to cement a plexiglas or possibly a cellulose acetate patch over the crack. If the damaged panel is curved, heat the patch and form it by holding it against the damaged surface. To one of the surfaces, apply a cement such as that which can be made by dissolving plexiglas shavings in acetone or similar solvent until a syrup is obtained; apply the patch to the damaged surface with just enough pressure to force out all the air bubbles. The patch should be held in position from 10 to 20 minutes.

Note

In any repair operations requiring the use of cement, the area adjacent to the damaged surface should be covered with masking tape to protect it from the softening action of the cement.

2. BULLET HOLES.—When a bullet passes through plexiglas, it leaves a number of cracks radiating from the center of the hole. Drill holes at the end of these cracks, and then patch the bullet hole with plexiglas, cellulose acetate or fabric, following the same procedure as that for repairing cracks, described in the preceding paragraph. Another alternative is to insert a plexiglas or wooden plug in the hole until a more permanent patch can be cemented into place.

3. LARGE HOLES.—To patch a large hole in plexiglas, the hole is trimmed to a circle or oval and the edge of the hole is given a slight taper (the larger diameter on the outside). The patch should be cut out of plexiglas slightly thicker than the section to be repaired and given a more oblique taper than the hole itself. Edge of the patch is heated in an oven, or over an alcohol lamp, until it is soft and pliable. The patch is then forced into the hole and allowed to cool. Then it is removed, and its surfaces are masked with a tough masking tape or gummed cellophane, which is impervious to the action of plexiglas cement, or an equivalent such as ethylene dichloride. The edge of the patch is then allowed to soak in the cement until softened, the time varying from two to three minutes for ethylene dichloride, 30-45 minutes for plexiglas cement. The patch is inserted in the hole again, and left under pressure for 24 to 36 hours, preferably longer. Then clean up the patch by filing, sanding, and buffing it to the level of the patched surface.

4. CURVED SURFACES.—When the section to be patched is curved, a perfect fit may be obtained by cutting the patch first, and using it as a template. The patch first is heated until it is pliable, and then formed into the proper shape, by pressing it against the damaged surface. A protective layer of outing flannel or similar soft cloth should be used, while pressure is being applied. Outline of the patch, which should always be round or oval, is then scribed on the damaged surface. Then, saw at least a distance equal to the thickness of the plexiglas within the scribe lines, and sand or file the edges to a smooth 45-degree taper. Soak edge of patch in solvent until soft and then press patch into place. Let stand for 24 to 36 hours, and then dress the repaired surface.

WARNING

Adequate ventilation should be provided when working with plexiglas cements. Fumes from two of the solvents, ethylene dichloride and methylene, are apt to prove toxic if breathed for an extended period.

5. REMOVAL OF SCRATCHES.—When buffing equipment is not at hand, a good automobile body cleaner can be applied with a soft damp cloth to remove minor scratches. The area should be rubbed vigorously but not too long in one place. Rub with a free circular movement over a fairly wide area. When the scratches are removed or considerably reduced, the cleaner should be removed with a damp soft cloth and a good auto wax should be applied. Then polish with a dry, soft cloth. Deep scratches can be removed with a fine grade of sandpaper (320-A is suitable) which has been moistened to reduce the heat of friction. Wrap the paper around a block and sand with a free circular motion over a wide area.

(4) ADJUSTMENTS.—The sliding windows (if installed) in the pilot's compartment are so designed that they press tightly against the rubber seal. If a window is loose from the seal, the necessary tightness may be obtained by adjusting the two rods located above and below the window.

(5) ASSEMBLY AND INSTALLATION.—Reverse the procedure for removal as outlined in paragraph (2) above.

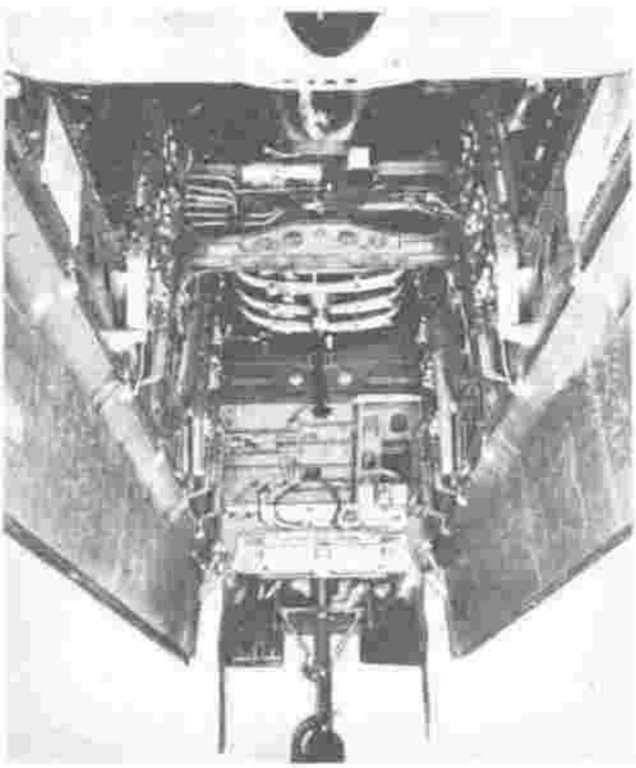


Figure 87—Interior View of Bomb Bay

e. BOMB BAY.—The bomb bay is located in the center portion of the fuselage and is divided by the wing rear spar cross tie plates into two compartments, fore and aft. The two hydraulically operated bomb bay doors, when closed, form part of the lower fuselage surface. Doors installed in the fore and aft bulkheads provide access to the pilot and gunner compartments, except when the bomb bay is carrying certain loads. (See *f.* (1), this section.) The right-hand bomb bay door incorporates a small removable door through which cameras may be operated.

Note

Maintenance of the bomb bay door structure is described in AN01-40AJ-3, Handbook of Structural Repair. Adjustment of the doors is described in paragraph 14. *d.* (10) *(b)*, this section.

f. GUNNER'S COMPARTMENT.

(1) DESCRIPTION.—The sighting station and control mechanism of the upper and lower gun turrets are installed in the gunner's compartment located aft of the bomb bay. The enclosure is constructed of plexiglas. An escape hatch is provided at the top of the enclosure. When the airplane is on the ground and the bomb bay doors are open, normal access to the gunner's compartment is gained by way of a sliding door located in the aft end of the bomb bay. However, when the airplane is loaded with torpedoes, or with bombs larger than the 300-pound size, the gunner's compartment is only accessible by way of the escape hatch (3, *figure 81*) in the gunner's enclosure. A removable camera door is installed in both sides of the compartment.

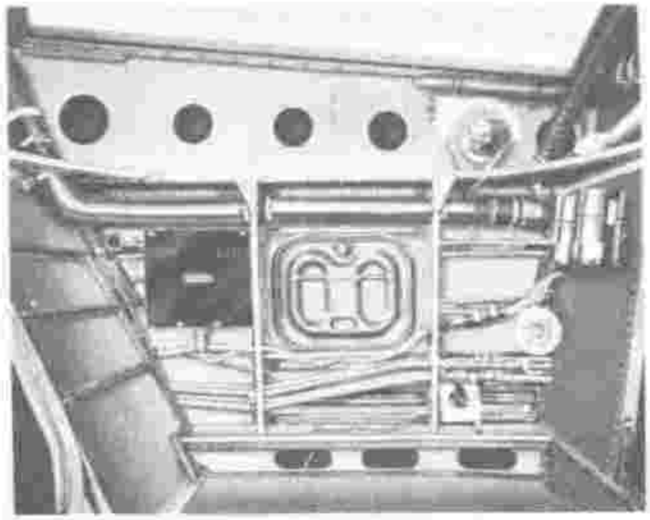


Figure 88—Gunner's Compartment (Sighting Station Not Installed)

(2) REMOVAL.

(a) GUNNER'S ENCLOSURE.

1. Remove the bolts at the upper sighting station bracket.

2. Remove the bolts around the enclosure. Remove the enclosure, being careful not to strike the sighting station.

(b) PLEXIGLAS PANELS.

1. Remove the screws and retainer strip from each panel.

2. Remove the panel and the sealing strip.

3. The sealing strip may be used again if in good condition.

(c) PILOT'S ESCAPE HATCH.—Pull the emergency release lever, freeing the hatch at the hinges and at the supporting braces.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—For the repair of cracks and holes in the plexiglas panels, refer to paragraph 4. *d.* (3) *(b)*, this section.

(4) ASSEMBLY AND INSTALLATION. — To assemble the gunner's compartment enclosure, reverse the removal procedure defined in *f.* (2) *(a)* above.

g. FUSELAGE AFT SECTION. *(See 2, figure 81.)*

(1) DESCRIPTION.—The fuselage aft section extends aft from a point (station 352), aft of the lower turret to the point (station 497) where the tail cone is attached. The fuselage aft section provides the attaching supports for the horizontal and vertical stabilizers, and the surface controls support assembly. This aft-section also houses radio, heating, ventilating, and photographic equipment. An access door for maintenance and inspection purposes is located immediately aft of the lower turret. A camera door is installed just aft of this access door.

(2) REMOVAL.

(a) Provide ample support for the fuselage aft section by means of jacks or hoists.

(b) Disconnect all fuselage lines at the bulkhead (station 352) directly aft of the lower turret compartment.

(c) Disconnect all cable turnbuckles at this location and tie them so that the cable will not unwind from the drums.

(d) Remove the tape which covers the juncture of the main fuselage and the fuselage aft section.

(e) Remove the attaching bolts.

Note

If handling problems make it advisable to remove the stabilizers, elevators, and rudder before detaching the fuselage aft section from the main fuselage, refer to removal instructions given in paragraphs 2. and 3., this section.

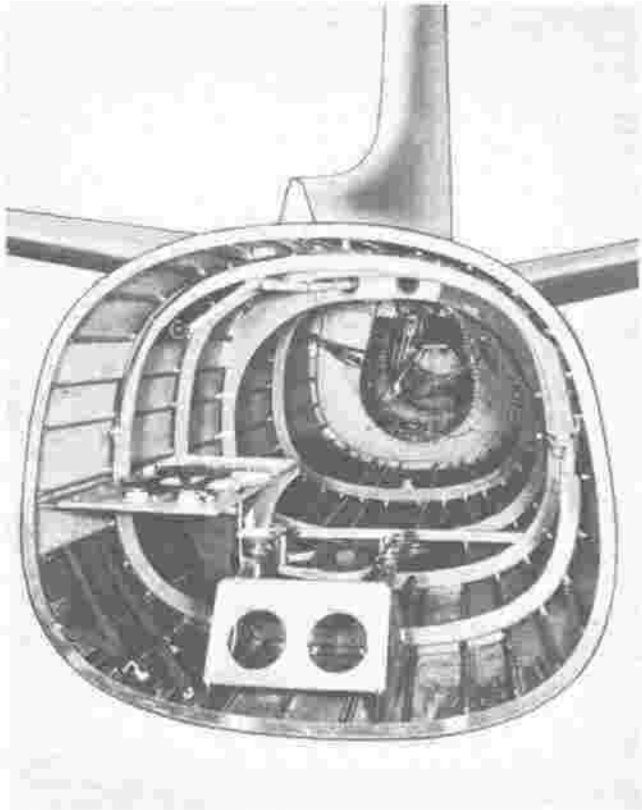


Figure 89—Fuselage Aft Section

(3) MAINTENANCE REPAIR.—For instructions on the repair of the fuselage structure or skin, refer to the structural Repair Handbook (No. AN01-40AJ-3).

(4) ASSEMBLY AND INSTALLATION.—Reverse the removal procedure given in paragraph (2) above. Use clear nitrate dope to attach a cotton fabric sealing tape of the juncture of the two sections. Tighten the AN4 bolts to a torque force equal to 50-60 inch-pounds.

(5) TEST AFTER INSTALLATION. — Check empennage flight controls for proper operation.

h. TAIL CONE. *(See 1, figure 81.)*

(1) DESCRIPTION.—The tail cone is located at the extreme aft end of the fuselage and is attached to the fuselage aft section by means of four bolts. Installed in the aft end of the cone is a plexiglas cover for the position and tail cone signal lamps.

(2) REMOVAL.

(a) A stand should be provided on which to lay the tail cone when it is removed. The working platform should not be more than three feet lower than the tail cone.

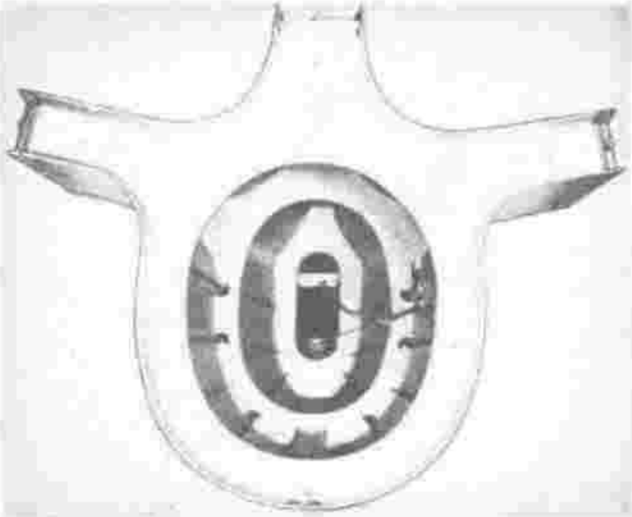


Figure 90—Tail Cone

(b) Remove the tape covering the juncture of the tail cone and the fuselage aft section.

(c) Remove the plate which covers the attaching bolt at the bottom of the tail cone by removing the two screws at the forward end of the cover plate, and pulling the plate forward about one-half inch to disengage the two spring clips which secure the cover plate at its aft end.

(d) Remove the bolt at the bottom of the tail cone.

(e) Removal of the tail cone requires two persons, one to hold the tail cone, while the other removes the remaining three bolts inside the fuselage. The bolts are located outboard of the closing channels, between the tail cone and the elevators, and between the tail cone and the rudder. To gain access to the bolts, move the elevators and rudder off the neutral position.

(f) After the bolts are removed, lay the tail cone on the stand. About three feet of free wire is provided for this purpose.

(g) Disconnect the electric wires at the front of the tail cone.

(3) DISASSEMBLY.—To remove the plexiglas cover from the tail cone, take out the screws located at the forward edge.

(4) MAINTENANCE REPAIR.—For instructions on the repair of cracks or holes in the plexiglas cover, refer to paragraph 4. *d.* (3) *(b)*, this section. For instructions on the repair of the skin or framework, see Structural Repair Handbook No. AN01-40AJ-3.

(5) ASSEMBLY.—To install the plexiglas cover on the tail cone, proceed as follows:

(a) Place the plexiglas cover against the adapter.

(b) Place the lower section of the metal strip against the plexiglas and insert the screws.

(c) Turn in the screws until they begin to drag.

(d) To install the upper section of the metal strip, repeat *(b)* and *(c)* above.

(e) Tighten all screws equally.

(6) INSTALLATION.—To install tail cone on fuselage, reverse the REMOVAL procedure given in paragraph (2) above. Use clear nitrate dope to attach the cotton fabric sealing tape.

(7) TEST AFTER INSTALLATION.—Check the position lamp and the tail cone signal lamp for proper operation.

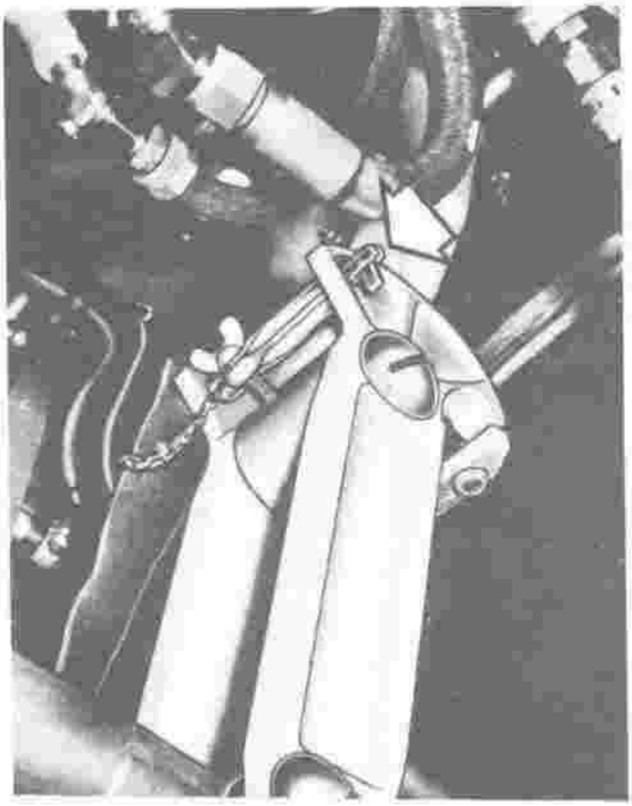
5. ALIGHTING GEAR

a. GENERAL.—A fully retractable, hydraulically operated tricycle alighting gear is installed. An emergency hydraulic system, operated by a hand pump located in the pilot's compartment, provides for emergency extension of the alighting gear. A control lever for normal operation of the alighting gear, is provided on the pilot's control pedestal. The alighting gear normally extends or retracts in approximately 12 seconds.

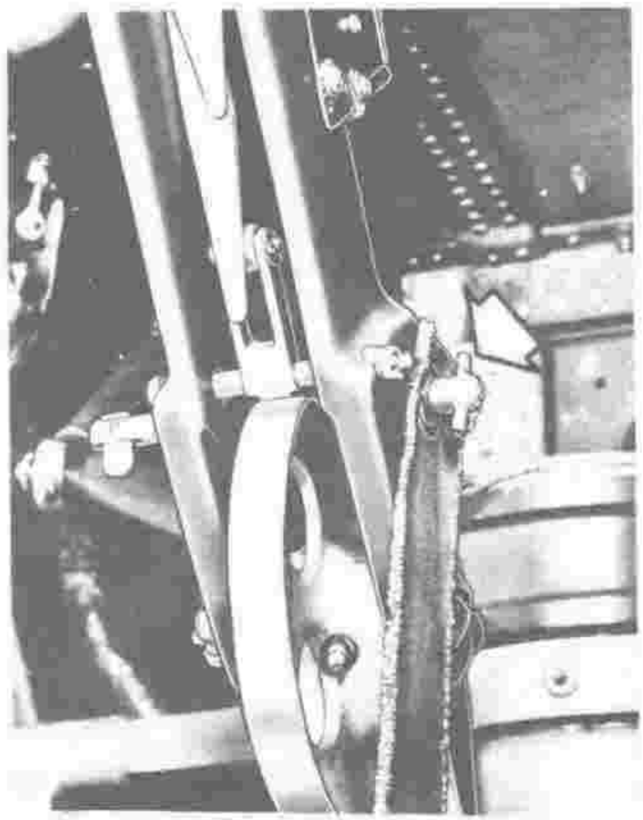
b. MAIN LANDING GEAR.

(1) GEAR ASSEMBLY.

(a) DESCRIPTION.—The two main gears extend up and aft into the nacelles and are enclosed by nacelle doors when retracted. Each main gear assembly consists of a wheel assembly, shock strut, and retracting mechanism. Dual, multiple disc brakes are provided in each wheel and are operated normally by hydraulic pressure or, in an emergency, by air pressure. See paragraph 14. *c.*, this section. Braking action is accomplished by applying toe pressure on the rudder-brake pedals. Inter-connecting linkage mechanically coordinates the opening and closing of the nacelle doors with the extension and retraction of the main gears. When extending the alighting gear, move the control lever to the "DOWN" position in a continuous operation. The movement from "NEUTRAL" to"DOWN" should not take longer than two seconds. Do not move the control lever by a series of light taps.

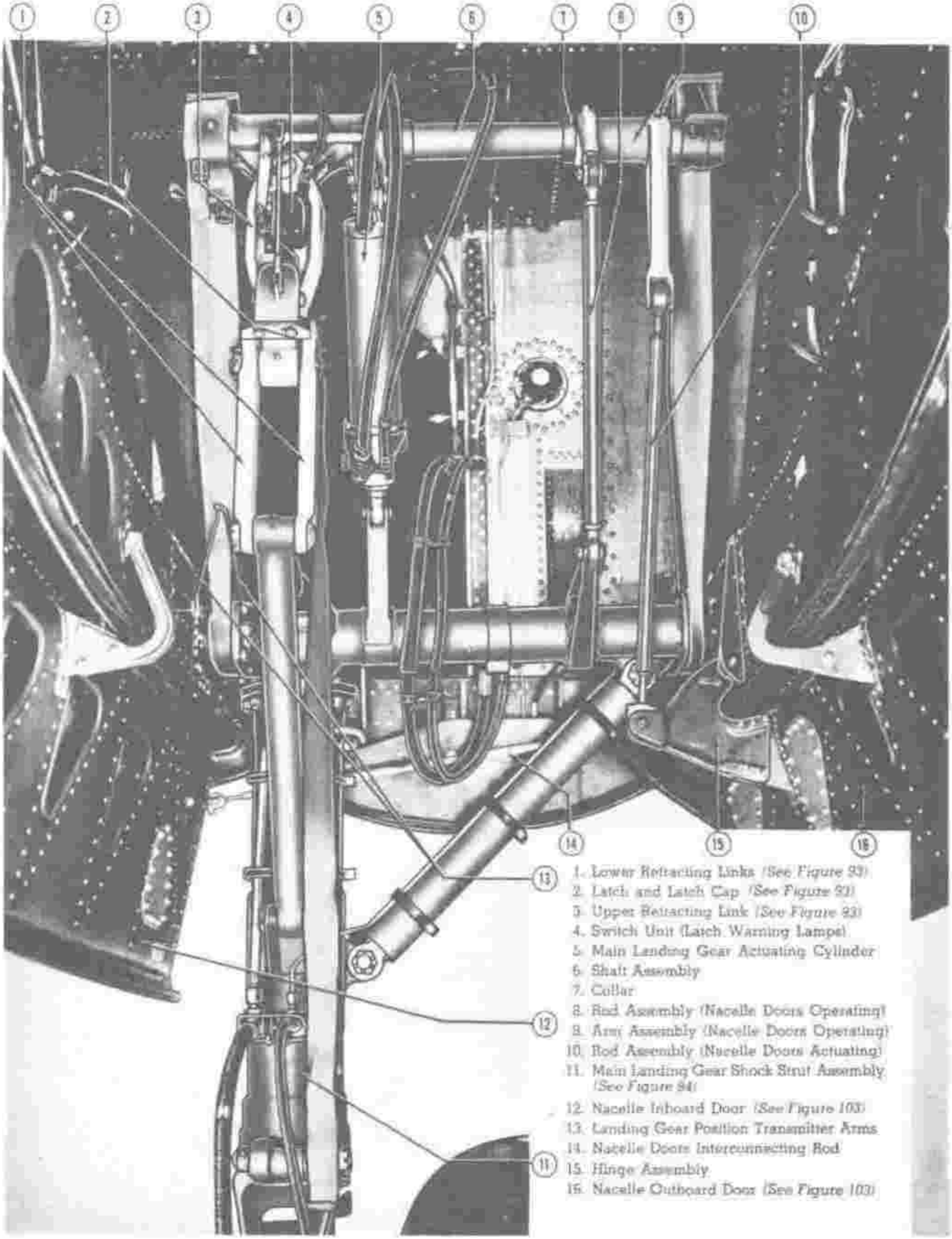


MAIN LANDING GEAR SAFETY PIN



NOSE WHEEL GEAR SAFETY PIN

Figure 91 — Alighting Gear Ground Safety Pins Installed



1. Lower Retracting Links *(See Figure 93)*
2. Latch and Latch Cap *(See Figure 93)*
3. Upper Retracting Link *(See Figure 93)*
4. Switch Unit (Latch Warning Lamps)
5. Main Landing Gear Actuating Cylinder
6. Shaft Assembly
7. Collar
8. Rod Assembly (Nacelle Doors Operating)
9. Arm Assembly (Nacelle Doors Operating)
10. Rod Assembly (Nacelle Doors Actuating)
11. Main Landing Gear Shock Strut Assembly *(See Figure 94)*
12. Nacelle Inboard Door *(See Figure 103)*
13. Landing Gear Position Transmitter Arms
14. Nacelle Doors Interconnecting Rod
15. Hinge Assembly
16. Nacelle Outboard Door *(See Figure 103)*

Figure 92 —Main Landing Gear Installed (Looking Forward)

(b) REMOVAL AND DISASSEMBLY.

1. Support the airplane on wing stands. See section III, paragraph 2., *c.* Install a ground safety pin in the nose wheel gear *(figure 91)*.

2. Relieve the hydraulic system pressure by applying and releasing the rudder-brake pedals.

3. Disconnect and cap the brake hydraulic and emergency air lines at the clamp on the shock strut cross shaft.

4. Remove the landing gear retraction release switch and electrical wiring attached by clamps to the left main gear shock strut ONLY.

5. Remove the bolt which locks the retracting link shaft (on the inboard end).

6. Disconnect the outboard door actuating rod *(10, figure 92)* and the bell crank actuating rod *(8, figure 92)* from the bell crank arms.

7. Remove the bolts which secure the three collars to the shaft.

8. Remove the half circle cap which holds the shaft to the outboard support. Slide the shaft *(6, figure 92)* out of the inboard support.

9. Remove the bolts used to attach the strut cros shaft to the supports on the nacelle inboard and outboard lower webs, and then remove the landing gear. The two top bolts and the lower aft bolt on the inboard side of the structure must be removed from the outboard side. The remaining three bolts must be removed from the inboard side.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—For maintenance information, refer to the detailed parts on the following pages.

(d) ADJUSTMENTS.

1. Support the airplane on wing stands and nose stand (See Section III, paragraph 2. *(c)*).

2. Install ground safety pins *(figure 91)* on the nose gear and one main gear. This is accomplished by inserting a locking pin in a hole in the retracting link.

Note

Adjust only one gear at a time.

3. Disconnect the door actuating rod.

4. Using either a hydraulic hand pump or engine-driven test stand pump to supply pressure, retract the landing gear, locking it in the UP position.

5. When the gear is retracted, install a ground safety lock.

6. Disconnect the piston rod eyebolt from the retracting arm.

7. With the piston rod FULLY EXTENDED, adjust the eyebolt to align its hole with the hole in the retracting arm.

Note

The entire piston and rod assembly may be rotated within the cylinder if necessary.

8. Lengthen the rod assembly 1/8 inch by turning the eyebolt OUT two full turns.

9. Lock the check nut.

10. Connect the eyebolt to the retracting arm with the grease fitting UP to avoid interference.

11. Place the landing gear control lever in the "UP" position and apply pressure.

12. Remove the ground safety pin and extend the gear.

13. Install the ground safety pin and relieve the pressure in the hydraulic system by applying toe pressure to and releasing the rudder-brake pedals.

14. Turn the bottoming cap IN until flush with the cylinder head end.

15. Turn the cap OUT one full turn.

16. Lock the check nut.

Note

Be sure the piston rod assembly does not turn while locking the check nut.

17. Apply UP pressure to cylinder. Shorten or lengthen latch rod until latch clearance of 1/16 inch minimum is obtained.

18. Latch engagement must have a depth of 5/16 inch minimum and 3/8 inch maximum.

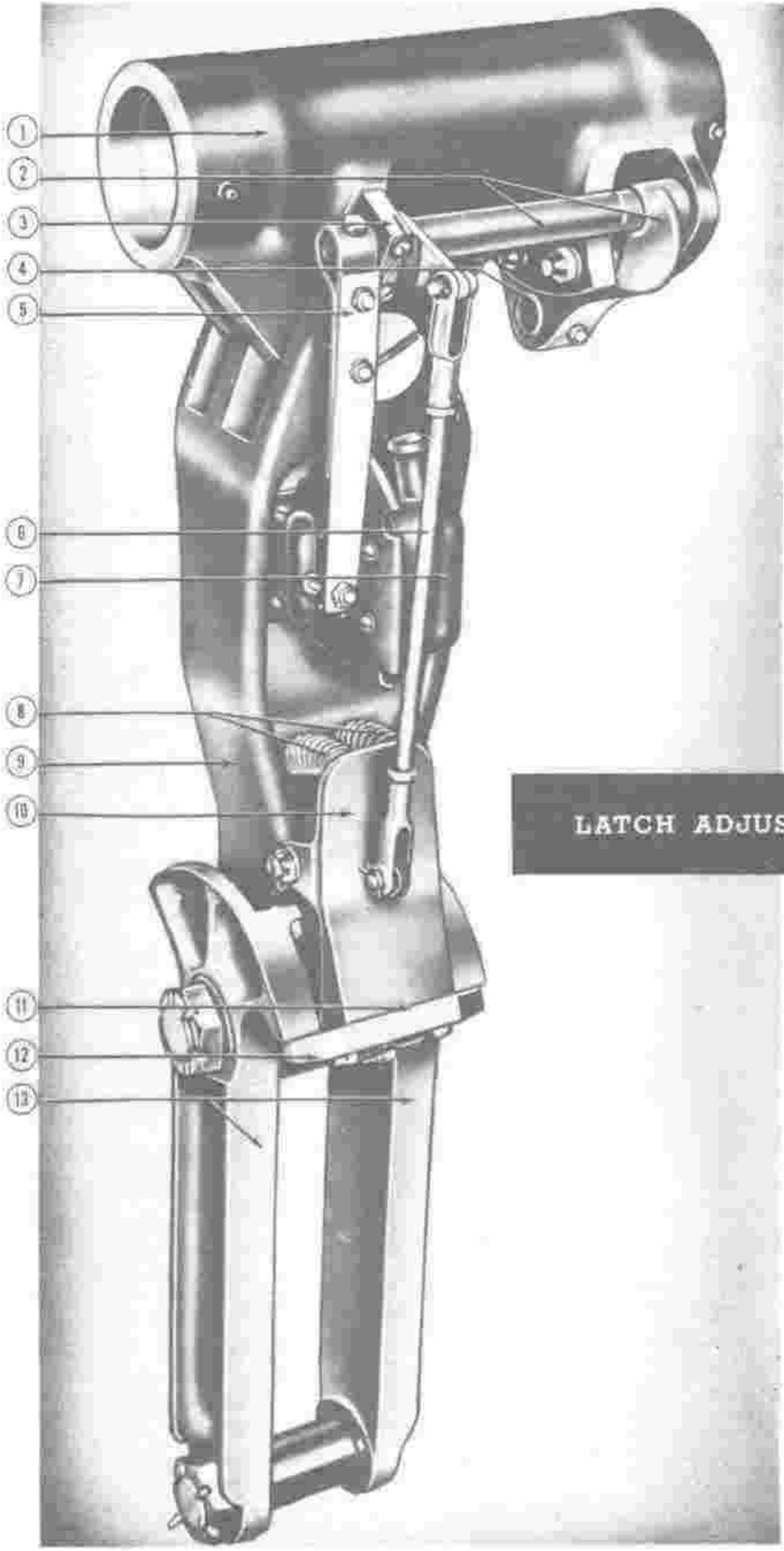
19. Tighten check nuts. Install cotter keys.

(e) ASSEMBLY AND INSTALLATION.—Reverse the procedure outlined in paragraph *(b)*, above.

(f) TEST AFTER INSTALLATION.—With the airplane supported on wing stands, extend and retract the landing gear. Check for any interference.

(2) RETRACTING MECHANISM.

(a) DESCRIPTION. — Power for operation of the main landing gear assembly is supplied by the hydraulic actuating cylinder. This cylinder is attached to bell crank arms on the retracting (upper) shaft and the shock strut cross shaft. *(See 5, figure 92.)* A spring tensioned, mechanical latch is assembled on the upper retracting link and locks against the lower retracting link sectors. A connecting rod extends from the retracting shaft to the latch. The first movement of the actuating cylinder trips the latch and starts retraction of the gear. This same latch secures the



LATCH ADJUSTMENT PROCEDURE ★

1. Adjust stop bolt under latch so that lower link aligns with upper link within .010 inches measured at lower bolt hole. (Use .990 inch bolt and 2.156 inch length spacer to align lower links while making adjustments.)

2. Place shims under latch cap to provide .005 to .015 clearance between engaging parts in latched position.

3. Unlatch and swing lower links to permit latch cap to rest on sectors of lower links. Adjust or file latch cap if necessary to obtain contact on both sectors.

4. Place .120 spacer between latch cap and link sectors and adjust latch actuating rod to provide .000 to .010 clearance between lug and the cam on shaft assembly. (The lug should be pushed toward the shaft as far as it will go when checking this clearance.)

5. Replace link in latched position and check latch engagement, which must be 5/16 inch minimum.

1. Support
2. Shaft and Cam Assembly
3. Bearing
4. Lug (To Attach Actuating Cylinder)
5. Lever (Latch Switch Unit)
6. Latch Actuating Rod (Latch Release)
7. Switch Unit (Landing Gear Warning Lamps)
8. Springs
9. Upper Link
10. Latch
11. Latch Cap Shims
12. Latch Cap
13. Lower Links

Figure 93 —Main Landing Gear Retracting Link Assembly

landing gear in either the completely retracted or extended position. A vee shaped brace assembly pivots from the end of the retracting link assembly with one arm attached to the top of the shock strut and the other arm to the center of the shock strut. A mechanical linkage opens or closes the nacelle doors in conjunction with the extension or retraction of the gear.

(b) REMOVAL AND DISASSEMBLY.

1. Support the airplane on wing stands. See section III, paragraph 2. *c.* Install a ground safety pin *(figure 91)* in the nose gear and one main gear. Disconnect the hydraulic line at the shock strut shaft brake line clamp.

2. Remove the bolt attaching the main landing gear actuating cylinder *(5, figure 92)* piston rod eyebolt to the shock strut arm.

3. Remove the bolt attaching the retracting link assembly *(1, figure 92)* to the shock strut brace.

4. Remove the bolt that locks the retracting link shaft *(6, figure 92)* on the inboard end.

5. Remove the bolts which secure the three collars to the shaft.

6. Remove the half circle cap which holds the shaft to the outboard support. Slide the shaft out of the inboard support.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Replace any parts that are bent, rusted or damaged.

2. For actuating cylinder or landing gear position selector valve information, refer to paragraph 14. *c.* (3), this section, and paragraph 14. *c.* (2), this section.

(d) ASSEMBLY AND INSTALLATION.–Reverse the procedure outlined in *(b)* above.

(e) ADJUSTMENTS.–To adjust the retracting link assembly refer to *figure 93.*

(f) TEST AFTER INSTALLATION. – With the airplane supported on wing stands, extend and retract the landing gear. Check for any interference.

(3) MAIN LANDING GEAR SHOCK STRUT ASSEMBLY. *(See figure 94.)*

(a) DESCRIPTION.–A shock strut cross shaft *(2, figure 94)* is bolted to the inboard and outboard walls of the landing gear well of each nacelle. An oleo-pneumatic shock absorber strut *(5, figure 94)* is connected to the inboard end of this shaft. A supporting brace is provided from the outboard end of the shaft to the collar at the center of the strut cylinder. Two torque arms *(7, figure 94)* one of which is attached to the strut cylinder and the other to the strut piston, prevents the piston from rotating inside the cylinder. The axle on which the main wheel is mounted *(11, figure 94)* extends from the lower end of the shock strut and is an integral part of the strut.

(b) REMOVAL AND DISASSEMBLY.

1. Support the airplane as instructed in Section III.

2. Relieve the hydraulic pressure by operating the brakes.

3. Disconnect the hydraulic lines at the shock strut shaft brake line clamp.

4. Remove the strut shaft bolts as instructed in paragraph 5. *b.* (1) *(b)*, this section.

5. Lower the strut assembly from the airplane.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. TIGHTENING THE SHOCK STRUT PACKING.–In case of packing gland leakage as evidenced by fluid seepage, or the presence of air bubbles when soapy water is applied, tighten the packing nut as follows:

a. Release the air pressure in the strut by partially backing off the filler plug *(15, figure 94)* located on the upper aft end of the strut. Packing cannot be tightened properly under pressure.

Note

Air must be completely exhausted from the unit before removing filler plug assembly *(15, figure 94). Do not release the air pressure by depressing the air valve core.*

b. Remove the packing nut lock wire.

c. Loosen packing nut *(6, figure 94)* about one turn and work piston up and down several strokes. Then tighten nut until snug, but not *too* tight.

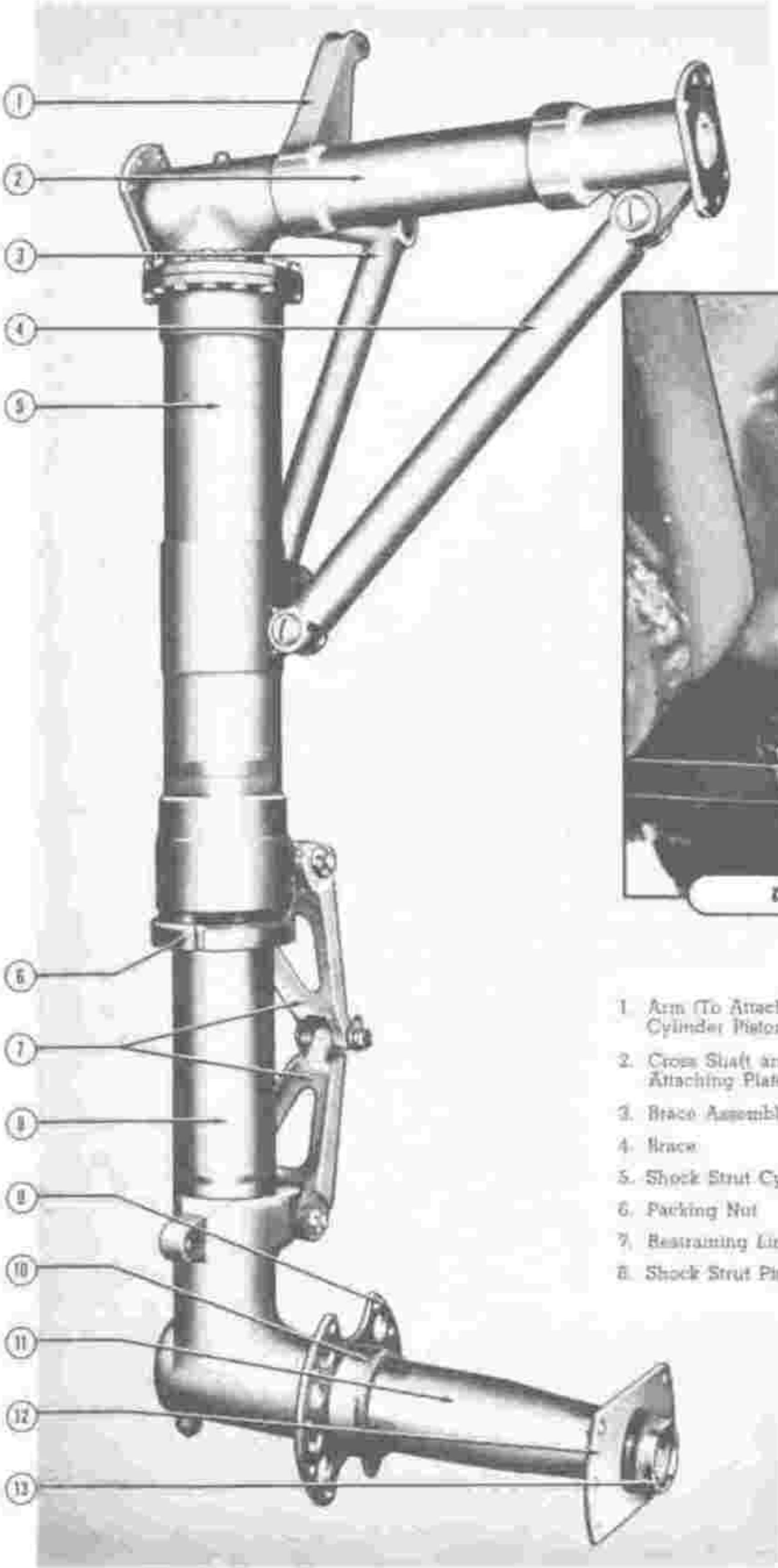
d. Replace the lock wire and inflate the strut as instructed.

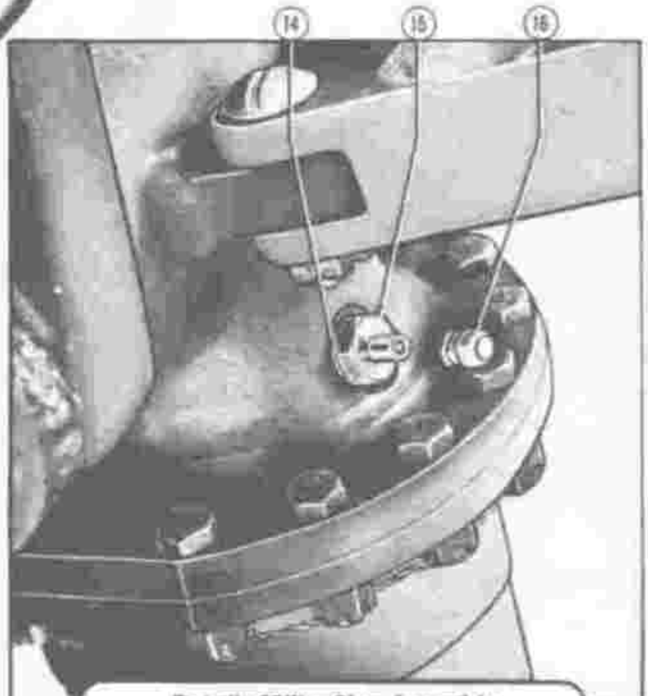
2. FILLING THE SHOCK STRUT.

a. Fill the strut with hydraulic fluid, AAF Specification 3580, through the filler plug hole until the fluid is level with the hole.

b. Insert the plug loosely and cause the strut to extend and compress completely several times to eliminate air traps.

c. Remove the plug and check the fluid level when the strut is fully compressed. If more fluid is added, repeat step b. above to insure that no air has been trapped in the strut.





Detail of Filler Plug Assembly

1. Arm (To Attach Actuating Cylinder Piston Rod)
2. Cross Shaft and Attaching Plates
3. Brace Assembly
4. Brace
5. Shock Strut Cylinder
6. Packing Nut
7. Restraining Links
8. Shock Strut Piston
9. Inboard Brake Torque Plate
10. Wheel Spacer
11. Axle
12. Outboard Brake Torque Plate
13. Main Wheel Axle Nut
14. Gasket
15. Filler Plug and Air Valve Assembly
16. Air Valve Cap (Apply 15 to 25 inch-pounds Torque Preload)

NOTE
Fill shock strut with hydraulic fluid AAF Specification 3580 (Red Color).

Figure 94 — Main Landing Gear Shock Strut Assembly

d. Insert the filler plug carefully to avoid damaging the threads. Screw it down tightly.

Note

Each time the filler plug is removed, replace the copper gasket on the filler plug seat.

3. INFLATING THE SHOCK STRUT.

a. Place airplane in hangar. It is impossible to make an accurate check of strut extension while airplane is subjected to wind force or slipstream from propellers. The strut will be supporting the full normal load of airplane while it is being inflated.

b. Remove the hexagon cap from the air valve on the upper end of the strut *(16, figure 94)* and use a high pressure air pump, booster pump, or air bottle to inflate the strut.

WARNING

Compressed oxygen, hydrogen, or acetylene should NEVER be used for this purpose.

c. Inflate the strut until the red line on the piston tube is 1⅞ inches from the bottom of the packing gland nut. A variation of ±¼ inch from the specified inflation dimension is permissible. Both main gear shock struts and the nose gear shock strut are inflated to the same extension.

d. While inflating the shock strut, rock the airplane to alternately extend and compress the strut in order to overcome packing friction, which might allow over-inflation. Over-inflation causes hard taxiing of the airplane.

Note

Do not reduce over-inflation by depressing the air valve core. To reduce the inflation and still retain accurate control of the air volume, unscrew the filler plug and tighten again rapidly with a wrench. Shake the airplane, if possible, while air is being released from the strut.

e. After the strut has been inflated, use soapy water to test the air valve, the valve core, and the filler plug for air leaks. Install the air valve cap (painted yellow) and preload the cap to 15-25 inch-pounds torque.

4. To reduce wear and the possibility of failure of the packing rings, wipe the exposed section of the piston rods of the alighting gear shock absorber struts free of ice, mud, dust, or sand with a cloth soaked with hydraulic fluid, AAF Specification 3580. In cold climates the piston rod should be cleaned immediately after flight, to prevent ice forming. Hydraulic fluid (second choice kerosene) is recommended for cleaning the alighting gear shock strut pistons.

5. Periodically inspect the entire outside portion of the shock strut assembly, especially in the locality of welds, lugs, and connections, for any evidence of cracks or indications of structural failure. If cracks or other unserviceable conditions are found, remove the strut assembly from the airplane and replace it with a new or reconditioned strut.

6. Inspect the chrome plating on the exposed outer wall of the piston for any evidence of corrosion, pitting or scoring. If plating is deteriorated or worn through at any place so that polishing will not restore it to proper condition, remove the strut from the airplane and replace it with a new or reconditioned strut assembly.

7. Examine cotters and safety wire on all nuts and lock screws for security and at the same time check the tightness of bolts, nuts, and screws. Replace safety wire and cotters that are broken or missing. Tighten all loose nuts, bolts, and screws.

(4) MAIN LANDING GEAR WHEELS AND BRAKES. *(See figure 95.)*

(a) DESCRIPTION.—Goodyear drop center 47 inch wheels with tapered roller bearings are mounted on the axle which extends from the end of the shock strut. Each wheel is equipped with integral, hydraulically operated, dual, multiple disc brakes. The brake assembly includes 14 bronze and 15 steel discs, assembled alternately. The bronze discs *(2, figure 99)* have keys which fit into the keyways on the wheel and therefore rotate with the wheel. The stationary steel discs *(1, figure 99)* are assembled alternately between the bronze discs and fit over keys on the brake anchor bracket which is attached to the axle. The braking action is accomplished when the annular ring piston *(3, figure 99)* is moved by hydraulic pressure and presses the discs together. Each wheel may be braked individually by means of the corresponding rudder-brake pedal. A power brake control valve is located forward and above each rudder-brake pedal. The brakes can be locked by depressing the pedals and pulling back on hte parking brake control knob in the pilot's compartment. For complete information about the brake hydraulic system refer to paragraph 14. *c.*, this section.

(b) REMOVAL AND DISASSEMBLY.

1. WHEEL ASSEMBLY.

a. Raise the shock strut at the jacking point on the bottom of the strut until the wheel clears the ground.

b. Relieve the hydraulic pressure by applying and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

c. Deflate the tire by removing the valve core.

d. Disconnect the brake line at the disconnect coupling *(1, figure 97)* at the outboard brake intake port.

e. Unscrew the axle nut *(2, figure 97)* and remove the outboard brake.

f. Slide the wheel assembly from the axle.

g. Compress and remove the bearing closure lock rings *(1, figure 96)*.

h. Remove the bearing closure discs and the felt bearing seals. Remove the inboard and outboard bearings.

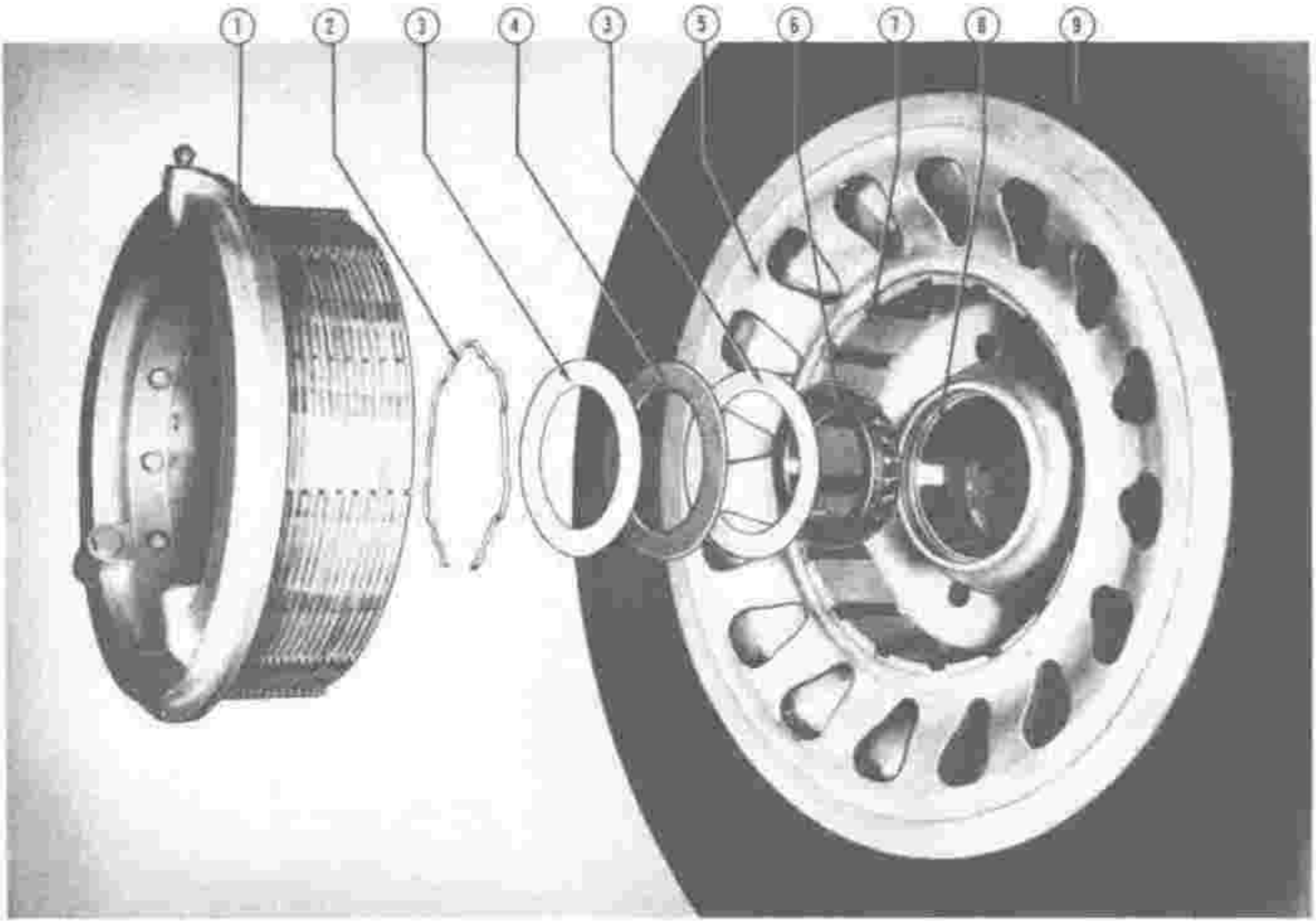
i. The bearing cups are to be removed only in exceptional circumstances. If it is necessary to replace the bearing cups without getting an entire new wheel casting, they must be removed and replaced only with proper heating equipment. A piece of dry ice placed in the bearing cup after heating the wheel will provide a large temperature differential, or the wheel can be placed in boiling water and the cup cooled with ordinary ice. When a temperature differential of approximately 56 degrees C. (100 degrees F.) is obtained, the bearing cup should loosen sufficiently to move freely in the wheel.

Note

Never force a bearing either in or out of a wheel by hammering or pressing.

2. BRAKES.

a. Remove the outboard brake and wheel assembly as described above *(b) 1.* a. through f.



1. AAF Specification 25258-I Brake Assembly (GOODYEAR No. 510675M)
2. Bearing Enclosure Lock Ring
3. Bearing Enclose
4. Felt Grease Retainer
5. AAF Specification 25258-I Wheel Assembly (GOODYEAR No. 530005M)
6. Wheel Bearing
7. Brake Disc Keyway
8. Bearing Cup
9. AAF Specification 26545-E 47 inch Smooth Contour 10 Ply Casing and AAF Specification 26546-C Type II A Inner Tube

Figure 95 —Main Wheel and Brake Assembly (Typical of Both Sides of Wheel)

b. Remove the bolts *(4, figure 97)* that attach the inboard brake to the axle torque plate.

c. Slide the brake off the axle.

d. Either brake unit may be disassembled in the following manner:

(1) Remove the cotter pin from the disc retaining nut lock screw *(1, figure 98)* and remove the lock screw.

(2) Unscrew the disc retaining nut from the brake anchor bracket. By keeping equal pressure applied with each hand at points 180 degrees opposite, the disc retaining nut is kept from binding.

(3) Remove the discs by sliding them out along the anchor bracket keys *(2, figure 98)*.

(4) Remove the insulator disc *(2, figure 98)* from the anchor bracket casting. Extreme care must be observed in removing the insulator disc, as it is fragile and easily damaged.

(5) Using a prying motion and an ordinary screwdriver, remove all piston return springs from the anchor bracket casting *(3, figure 98)*.

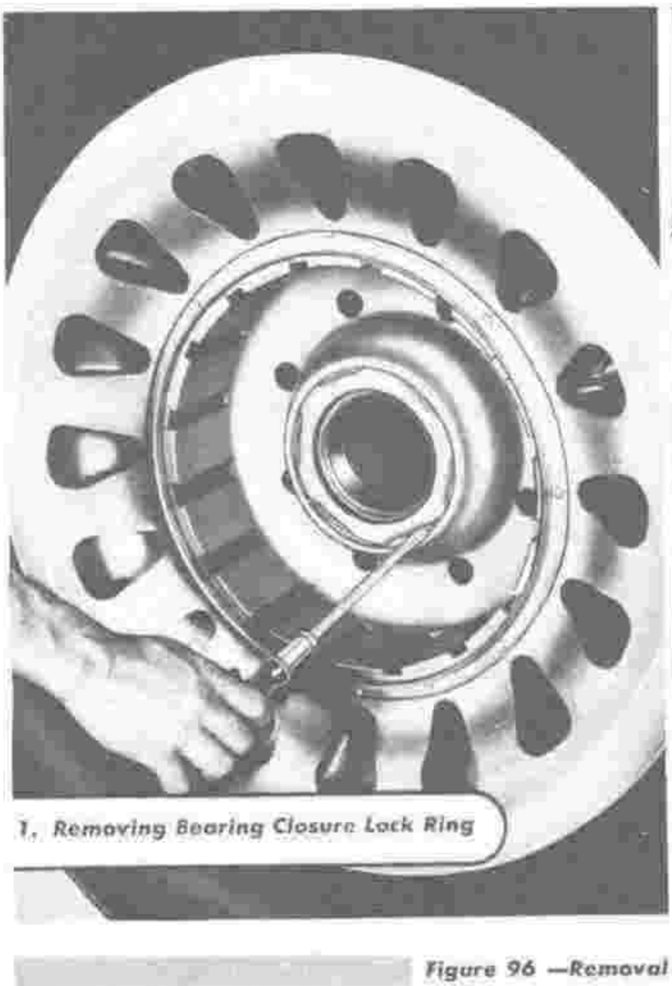
(6) Lift the annular ring piston out of the piston cavity *(4, figure 98)*. If the piston sticks, air pressure by means of a hand pump or pressure hose applied through the inlet port will release the piston.

(7) The piston seal gasket, because of its close fit, will require air pressure through the inlet port to release it from the piston cavity.

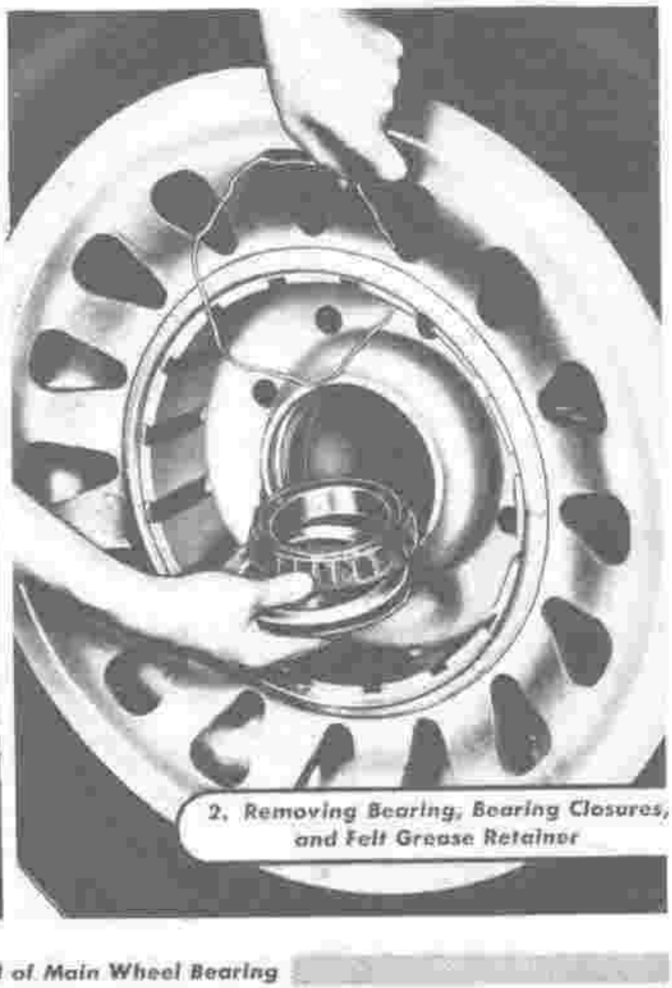
(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. WHEELS.

a. Portions of the wheel where the original finish has been peeled or chipped should be retouched with aluminum lacquer (clear and pigmented) Specification AN-TT-L-51. Two coats may be required. If it is necessary to refinish the entire surface, apply one coat of primer, zinc-chromate, Specification AN-TT-P-656, followed by two coats of lacquer, Specification AN-TT-L-51. Clean the surface thoroughly before applying the primer coat. Remove the old finish with acetone, Specification O-A-51-A. Never use wheels that are corroded on the inside, replace the wheel assembly with a new or serviceable wheel.

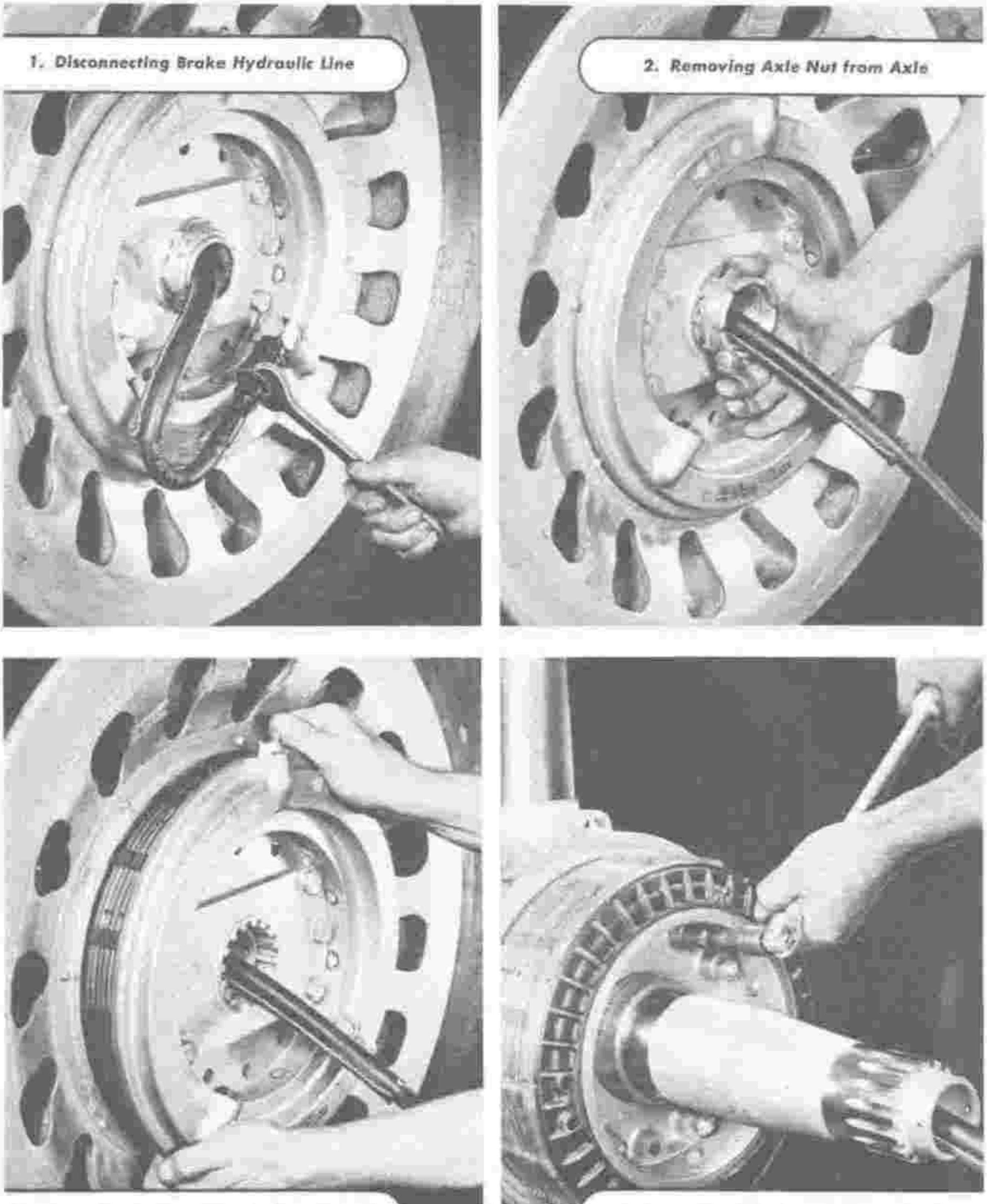


1. Removing Bearing Closure Lock Ring



2. Removing Bearing, Bearing Closures, and Felt Grease Retainer

Figure 96 —Removal of Main Wheel Bearing



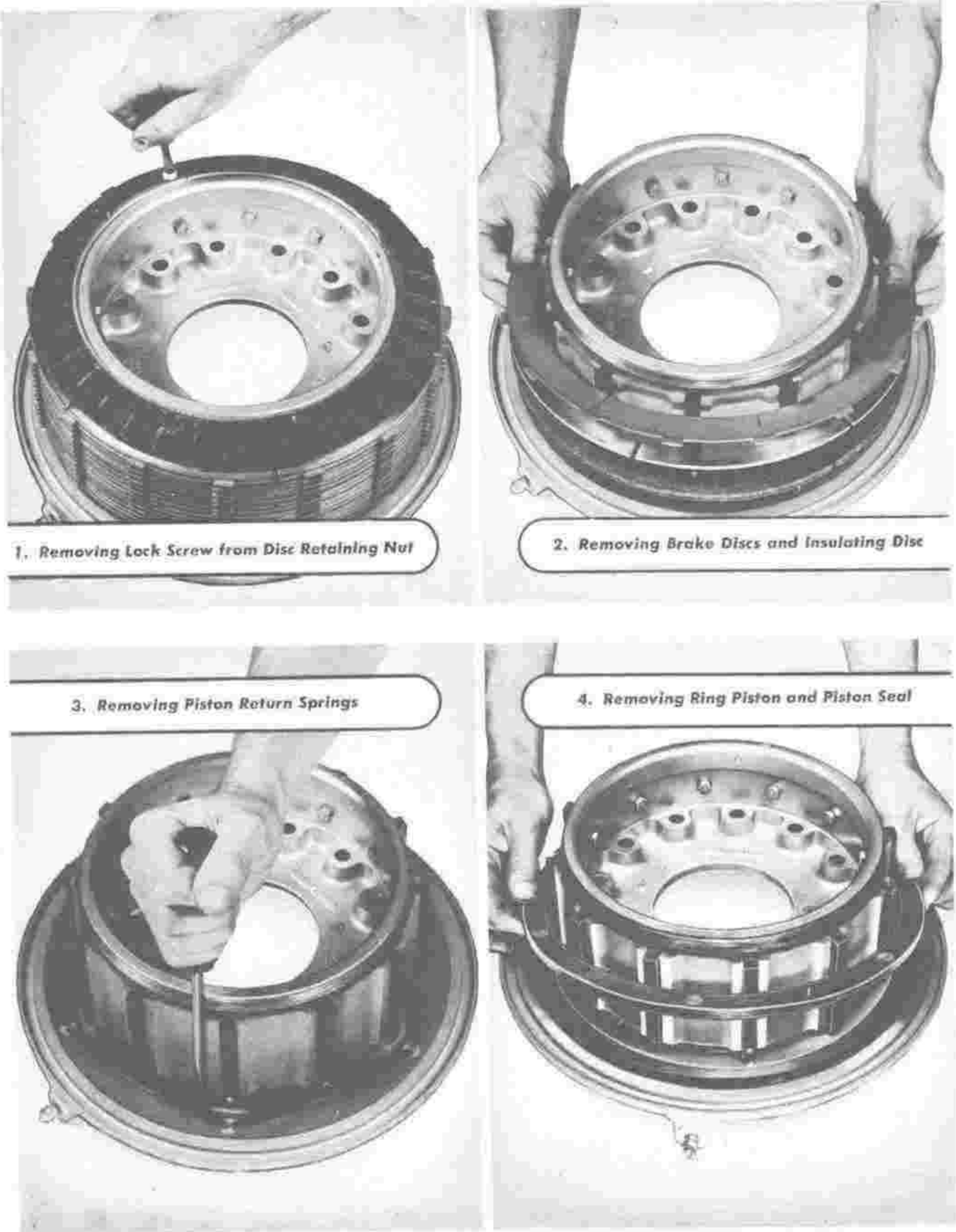
1. Disconnecting Brake Hydraulic Line

2. Removing Axle Nut from Axle

3. Removing Outboard Brake from Wheel

4. Removing Bolts from Inboard Brake

Figure 97 —Removal of Main Wheel Brakes



1. Removing Lock Screw from Disc Retaining Nut

2. Removing Brake Discs and Insulating Disc

3. Removing Piston Return Springs

4. Removing Ring Piston and Piston Seal

Figure 98 —Main Wheel Brake Disassembly

b. Cracks in the wheel casting necessitate replacement of the wheel.

c. Replace felt grease retainers that are saturated. If the grease retainers are in good condition, wash in gasoline and lubricate lightly with light machine oil, Grade 10, Specification VV-O-581.

d. Clean corroded or dirty rims thoroughly. If the rim flanges are cracked or corroded a new wheel must be installed.

e. Lubricate the wheel roller bearings according to the Lubrication Chart in Section III.

f. Replace any cracked or loose bearing cups. Remove and replace bearing cups either by heating the wheel or cooling the bearing sufficiently to permit easy movement of the bearing. A differential temperature of approximately 100 degrees F. between wheel and bearing is necessary. Do not force a bearing in or out of the wheel by hammering or pressing. When new bearing cups are installed, make certain that the cups are seated evenly against the shoulder inside the wheel casting.

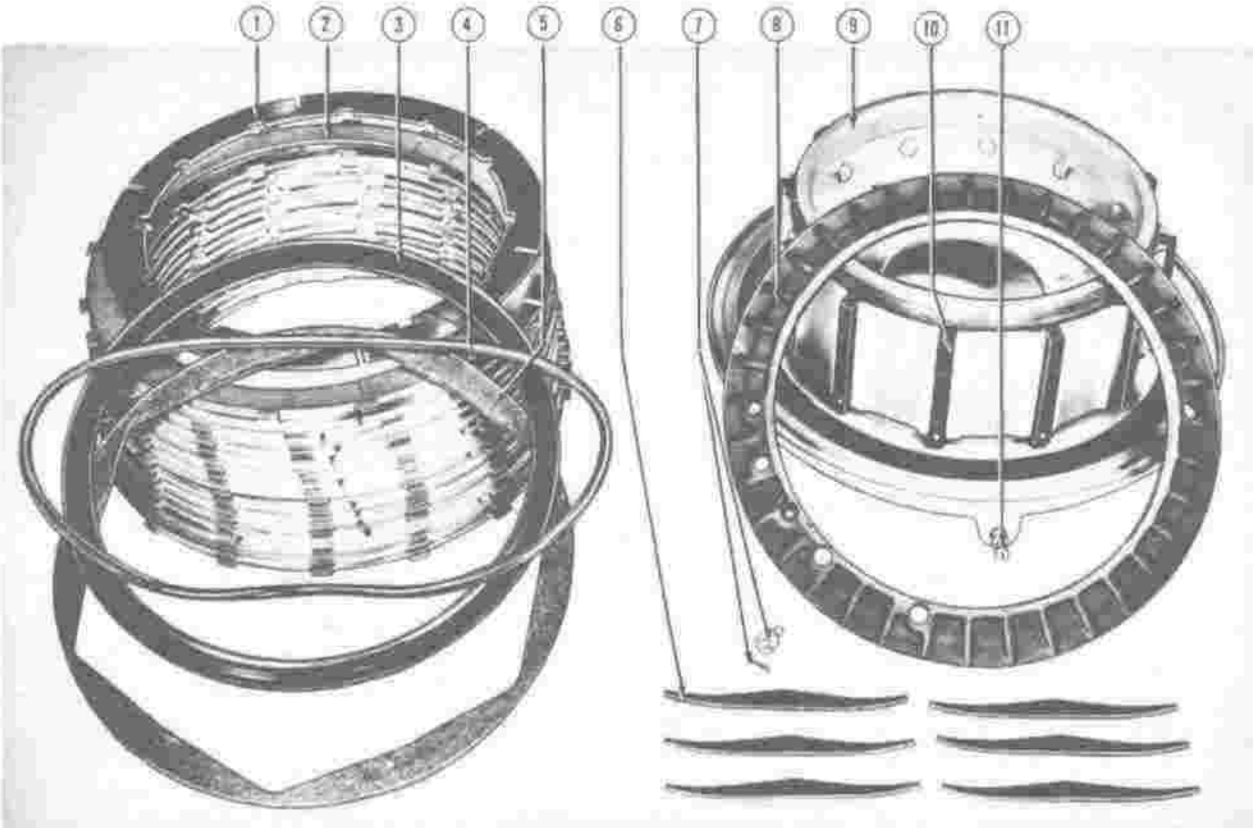
2. BRAKES.

a. Inspect the discs for wear. If bronze discs are worn more than .020 inch, they are no longer sufficiently coated for good service and must be replaced with new parts. The steel discs normally do not receive much wear.

b. Scored or badly distorted discs must be replaced. Slightly distorted discs may be repaired by being tapped with a hammer on a flat plate until they return to a flat condition. If the discs are dished, tap on the outer circumference. If the discs are warped, tap on the inner circumference.

c. Inspect the insulating disc for oil saturation, distortion from compression, and any other condition which would prevent proper heat insulation or return spring movement. Replace defective insulating discs.

d. Replace piston return springs that are weakened or broken.



1. Non-Rotating Disc (15 Required)
2. Rotating Disc (14 Required)
3. Annular Ring Piston
4. Piston Seal
5. Insulating Disc
6. Piston Return Spring
7. Lock Screw and Cotter
8. Disc Retaining Nut
9. Anchor Bracket
10. Anchor Key
11. Bleeder Valve

Figure 99 —Main Wheel Brake Disassembled

e. Replace piston seal gaskets that are shrunken, worn, or remolded.

f. See that the anchor bracket keys are free from grooving or wear from movement of discs.

g. Check fit of disc retaining nut on anchor bracket threads. Push nut as far as possible to one side and take micrometer reading of width of disc retaining plus anchor bracket thickness. Then push the retaining nut in the opposite direction and take a reading at the same place. The difference in the readings should not exceed .012 inch. The threads on the anchor bracket should be lubricated with thread compound, Specification AN-VV-0-566 before assembly.

(d) ADJUSTMENTS.

1. MULTIPLE DISC BRAKES. — Check the clearances of the brake discs and adjust each brake separately by observing the following procedure:

a. Remove the wheel assembly as described in paragraph 5. *b.* (4) *(b) 1.,* this section.

b. Disconnect the brake hydraulic line at the disconnect coupling *(1, figure 97)* at the inboard brake intake port.

c. Remove the bolts used to attach the inboard brake to the axle torque plate *(4, figure 97)* and slide the brake off the axle.

d. Remove the cotter pin from the disc retaining nut lock screw and remove the lock screw *(1, figure 98).*

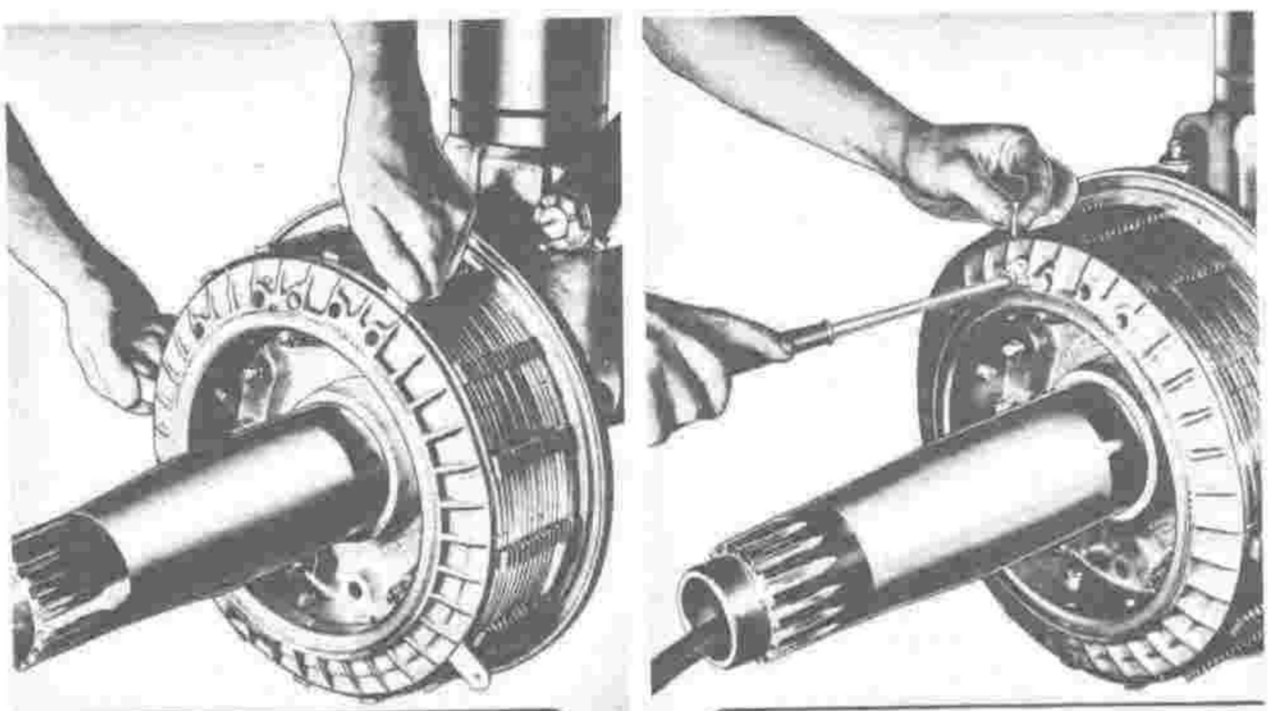
e. Turn the disc retaining nut tight against the discs. Be sure that the discs are free from dirt and foreign particles. Then turn back the disc retaining nut until a clearance of .112 ± .005 inches is obtained. Determine this clearance with three thickness gages inserted between the discs and the disc retaining nut. *(See 1, figure 100.)* Clearance should be inspected and adjusted every 50 hours.

f. When discs are worn to such an extent that the adjusting nut cannot be tightened to the specified clearance of .112 ±.005 inches, insert a stationary steel disc in stack next to adjusting nut and then adjust clearance.

g. When the discs are so thin that adjustment is impossible, replace the set of rotating discs. Normally, the wear on stationary discs is slight, but replacement may be necessary due to warping or dishing caused by extreme heat.

h. Replace the lock screw, lock in the next lock point and insert the cotter key.

i. Connect the inboard brake line to the brake unit.



1. *Three Thickness Gages Installed. Adjust Disc Retaining Nut to Obtain .112±.005 Inches clearance.*

2. *Locking and Safetying Disc Retaining Nut*

Figure 100—Adjusting Main Wheel Brake Disc Clearance

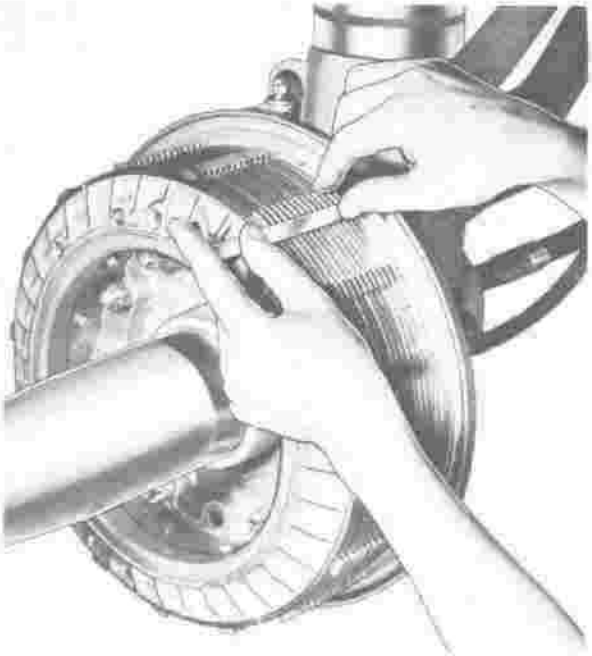


Figure 101—Aligning Brake Disc Keys

j. Line up the keys on the inboard brake unit with a straight edge *(figure 101)*.

k. Operate the hydraulic hand pump to supply pressure and apply the brake to hold the discs in position.

l. Slip the wheel on the axle, then slide it onto the inboard brake, making sure that the keyways in the wheel line up with the keys on the discs, and that the last disc is on the wheel.

m. Relieve the hydraulic pressure.

n. Adjust the outboard brake; align the bronze disc key with a straight edge, then carefully slide the brake along the keyways into the wheel. Make sure that the last disc is on the keyway, and that the bleeder port is on top and on the vertical center line of the wheel.

o. Replace the axle nut and tighten until the wheel will not turn freely; then back off one adjustment hole in the axle and safety with a cotter pin.

p. Connect the outboard brake line at the brake intake port.

q. Bleed the brakes as instructed in paragraph 14. *e.* (2) *(d)* *1.*, this section.

r. Threads on the large adjusting nut should be kept lubricated with a coating of thread lubricant, Specification AN-VV-O-566 or equivalent.

2. WHEEL BEARING ADJUSTMENT.

a. Be sure that no brake drag is present.

b. Spin the wheel and adjust the axle nut slowly until the bearing starts to drag.

c. Back off the axle nut to the next castellation.

d. Lock the axle nut with a cotter key.

Note

When adjusting the wheel bearings, brake drag must not be confused with bearing tightness. After adjustment, check the wheel for any side play.

(e) ASSEMBLY AND INSTALLATION.

1. BRAKES.

a. Be certain all parts of the brake unit are thoroughly clean before assembly.

b. Install the piston seal into the piston cavity on the anchor bracket casting. In order to prevent uneven tension of the seal during this operation, press the seal into place from opposite points at the same time, continuing around until the seal is evenly installed in the piston cavity. Do not allow the seal to rotate.

c. Install the piston next to the seal in the piston cavity on the anchor bracket casting.

d. Install the piston return springs on the anchor bracket casting. A small piece of sheet steel placed under one end of the spring will prevent the piston from becoming scratched and will aid in sliding the spring into position. When installation is complete, be sure that the ends of the springs rest on the hard steel inserts of the piston *(1, figure 102)*. The spring ends will groove and damage the piston, if allowed to rest on the softer magnesium part of the piston.

e. Install the insulator disc carefully, making sure that the piston dowel pins line up with the holes in the insulator disc.

f. Place the discs in position. The first disc next to the insulator disc must always be a stationary steel disc. Then place alternate rotating and stationary discs until all discs are in place. Be sure that the disc stack starts and ends with a stationary steel disc (a steel disc next to the insulating disc and next to the disc retaining nut).

g. Install the disc retaining nut on the anchor bracket casting. Care must be observed to see that the nut is properly started to prevent stripping the threads. Adjust the brake clearances and install the brakes as instructed in paragraph 5. *b.* (4) *(d)*, this section.

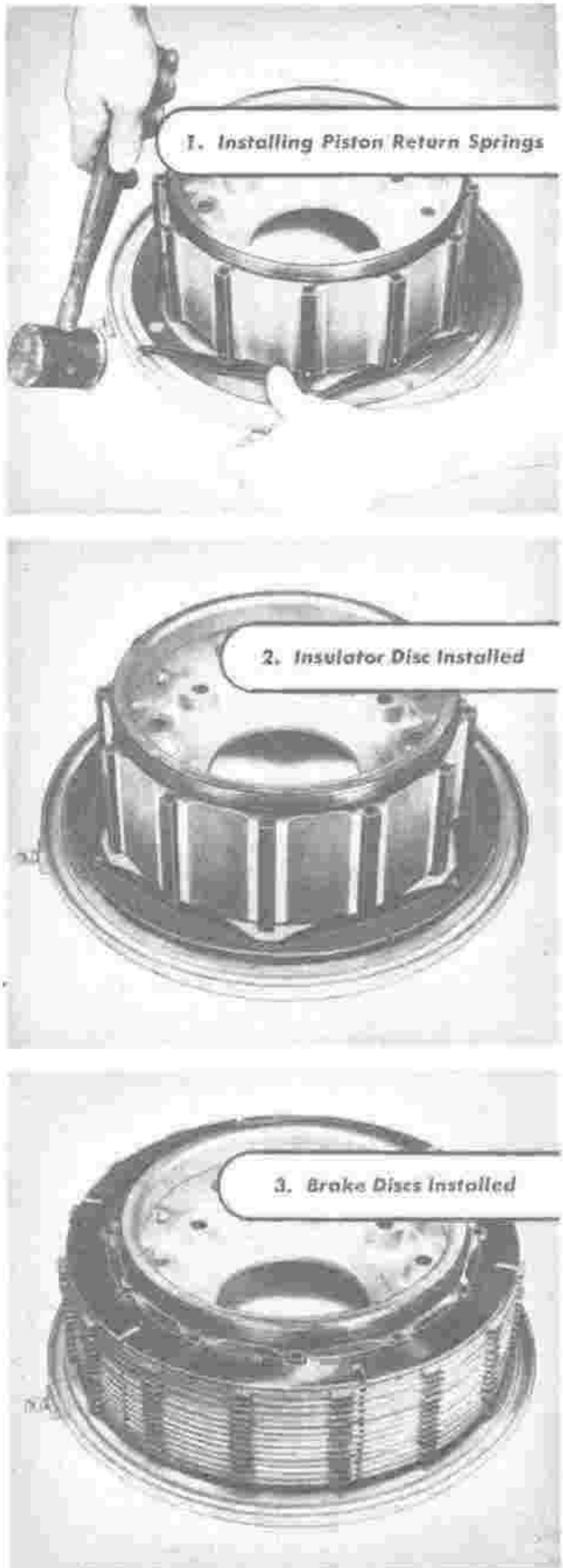


Figure 102—Main Wheel Brake Assembly

2. WHEELS.

a. If bearing cups have been removed install as instructed in paragraph 5. *b.* (4) *(c)* 1. f., this section.

b. Lubricate the wheel bearings as instructed in the Lubrication Chart in section III.

c. Install the wheel bearings. Insert the bearing inner closure rings, felt bearing seals, bearing outer closure rings and lock rings.

d. Install the wheel and brakes on the axle as instructed in paragraph 5. *b.* (4) *(e)*, this section.

(5) MAIN LANDING GEAR TIRES AND TUBES.

(a) DESCRIPTION.—This airplane uses 47-inch, 12-ply, smooth contour tires and smooth contour, type 2-A inner tubes on the main landing gear wheels.

(b) REMOVAL.

1. Remove the wheel assembly as described in 5., this section.

2. Remove valve cap and core and completely deflate the tube.

3. With a tire iron or heavy rubber mallet, break both beads loose from the rim flanges. Force as much of the oposite bead as possible into the well opposite the valve.

4. Starting at the valve stem, insert two tire irons about six inches apart under the outside bead and force it up and over the rim flange. Hold one tire iron in place and with the other pry the remaining portion of the bead over the rim flange in short progressive steps.

5. When the outside bead has been removed, reach inside the tire and remove the tube. Start at the valve to make sure it is free from the valve hole. Do not remove the tube by pulling on the valve.

6. Pry the inside tire bead over the outside rim flange and remove the wheel from the tire.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. At each 50-hour inspection period, the main wheel tires and rims will be inspected visually without removing the casings for the following conditions and remedial action taken as indicated.

a. Remove the casings for recapping when tread wear barely exposes the fabric of the casings.

Note

A frequent check will be made to determine the proper time to remove casings for re-capping. Care should be exercised not to remove casings prematurely, particularly when considerable tread rubber remains or by tardy removal when one or more plies have worn through.

b. If breaks, cuts, blisters, or other visible damage appear, remove the casing, and forward to area Air Service Command for repair.

c. When casings show evidence of cupping from camber condition or toe-in, remove the casing and reverse on the same wheel.

d. When there is evidence of excessive corrosion on the visible outside portion of the wheel rim, remove the casing and inspect it for possible damage. Inspect and refinish wheels as instructed in paragraph 5. *b.* (4) *(c)* *1.*, this section.

e. When there is evidence of damage to wheel rim edges due to hard landings or striking obstructions, remove casing and repair or replace wheel as instructed in paragraph 5. *b.* (4) *(c)* *1.*, this section.

2. Casings which are known to have struck large stones or other damaging objects or to have been subjected to abnormal usage during service, will be removed as soon as possible and inspected for possible damage to the tube or the interior cord body. If at any time it is necessary to remove the casing, the following inspection will be made.

a. Inspect cord body for ruptures or breaks.

b. Inspect beads for physical damage extending through the outside rubberized chafer strip.

c. Inspect tread for cuts through or cuts exposing fabric to moisture and dirt.

3. When the casing is removed at any time the inner tube will be inspected for the following defects:

a. Valves for physical damage.

b. Tubes for evidence of wrinkles and creases. Evidence of cuts, punctures, or thinning adjacent to the bead caused by brake heat. Indications of chafing or pinching due to casing breaks.

4. All defective tubes will be repaired by a permanent method if possible. If permanent repair facilities for inner tubes are not available, temporary repairs may be made by the cold patch method as follows:

a. Clean tube around hole with solvent. Thoroughly buff an area to which the patch can grip.

b. Spread a thin layer of rubber cement over buffed area covering slightly more area than size of patch to be applied.

c. Let cement set or dry until tacky. Remove half of fabric backing from patch. Center patch over hole and remove remainder of backing, taking care not to touch under side of patch. Roll patch down firmly, making sure it is smooth, and check tube for additional leaks.

5. Inspect the tires daily for indication of slippage on the wheel rims. Tire slippage is evident when the markings on the tire and wheel do not register. Deflate tube and re-align tire to its original position on the wheel. The airplane must not be flown until this re-alignment is completed.

6. Check tire pressures daily. Inflate the main wheel tires by the deflection method. Tires with deflection markers will be inflated, with the airplane loaded approximately as it will be flown, so that the deflection markers just touch the ground. Inflate the tires when the airplane is resting on a smooth, firm, and level surface.

7. Never permit oil or hydraulic fluid to soak into tire, because these fluids soften the rubber and cause rapid wear. Wipe off immediately with a gasoline dampened rag. Always protect the tires with covers whenever working above or near them.

(d) INSTALLATION.

1. Inspect the tire and tube. Inflate the tube so that it is barely rounded out before inserting it in the tire.

2. In order to obtain proper balance of the wheel, casing, and tube when assembled, the mark on the inner tube which represents the heavy portion in the tube, will be lined up adjacent to the red balance marker on the casing which represents the lightest portion of the casing.

Note

The valve stem is off center on the tube and should be inserted so the offset is on the side of the valve hole.

3. Lay the wheel flat with the outside of the wheel, containing the valve hole, facing up. Line up the valve hole. Force one bead of the tire over the flange. It may be necessary to use a tire iron for the last "bite."

4. Pull the valve through the valve hole and attach a valve fishing tool to make certain the valve does not drop back into the wheel.

5. Starting opposite the valve stem and using a tire iron, force the other casing bead over the rim flange and work progressively around the tire, holding the inserted portion of the bead in the wheel well. Proceed until the tire bead is forced over the rim flange.

6. Inflate the tire slowly. Deflate and inflate again to relieve the pressure of any folds or buckles and to allow the tube to assume its proper contour within the casing.

7. Remove the valve fishing tool.

(6) NACELLE DOORS AND OPERATING MECHANISM.

(a) DESCRIPTION.—Each nacelle is provided with an inboard and an outboard door which operate in conjunction with extension and retraction of the main landing gears. The inboard and outboard doors are connected by a rod *(1, figure 103)* and operate simultaneously. Both outboard doors are connected by rods to the door actuating bell crank which moves with the retracting shaft. The bell crank is connected by a rod *(8, figure 92)* extending from the shock strut cross shaft. Extension or retraction of the landing gear mechanically opens or closes the nacelle doors.

(b) REMOVAL.

1. Disconnect the door actuating rod by removing the bolt attaching the rod to the outboard door.

2. Disconnect the door interconnecting rod by removing the bolts attaching the rod at the forward end of the doors.

3. Remove the six hinge bolts (three inboard, three outboard) which fasten the doors to the nacelle structure and remove the nacelle doors.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check for looseness of hinge bolts and actuating rod attaching bolts.

2. Check the doors for freedom from binding or excessive overtravel.

3. Structural repair of the door is described in AN01-40AJ-3.

(d) ADJUSTMENTS.

1. Disconnect the rod that connects the inboard and outboard doors.

2. Retract the gear with the outboard door actuating mechanism connected until the door rod and its actuating arm *(10, figure 92)* are on dead center.

3. From this position adjust the actuating rod *(10, figure 92)* (between the bell crank arm and outboard door) until the door has moved as far out as it will go without binding at the hinges or damaging the nacelle skin.

4. Tighten the check nuts at both ends of the actuating rod.

5. With the gear latched in the "UP" position, adjust the bell crank actuating rod *(8 figure 92)* (which connects the bell crank to the arm on the shock strut cross shaft) until the door fits tightly against the nacelle. No binding, buckling or looseness must be present.

6. Tighten the check nuts at both ends of the rod.

7. Connect the door interconnecting rod.

8. Retract gear to check the preload on the inboard door.

Note

If necessary, extend the gear and adjust only the door interconnecting rod. Do not disturb the adjustments on the other rods.

9. Extend the gear and check the inspection holes in the rods for proper thread engagement.

10. Install cotter keys, after making a final check of all check nuts.

(e) INSTALLATION.—Reverse the procedure outlined in paragraph *(b)*, above.

(f) TEST AFTER INSTALLATION.—Make a trial operation of the main landing gear to check the doors for proper operation.

(7) ALIGHTING GEAR SIGNAL SYSTEM.—Two types of signal systems are installed on the airplane. On some airplanes an electrically operated combination wheel and flap position indication and red and green signal lamps are installed on the instrument panel. The indicator is wired to position transmitters on each gear. The signal lamps are wired to latch position switches on each gear. When the alighting gear is extended and all gears are safely latched down, the green signal lamp is lighted, indicating safe landing condition of the gear. If one or more of the gears is not latched down and the throttles are closed to less than one-fourth segment, the red signal lamp is lighted, indicating unsafe landing condition of the gears. It is possible to determine which gear is not latched down by the wheel position indicator. On other airplanes the wheel position indicator and transmitters are eliminated and four signal lamps are installed on the instrument panel. A green signal lamp is provided for each gear and the green lamp is lighted when the corresponding gear is latched down. The red lamp is lighted when the throttles are closed to less than one-fourth segment with any one or more of the gears not latched down. The unsafe gear is indicated by the unlighted green signal lamp. On all airplanes accidental retraction of the alighting gear, when the airplane is on the ground, is prevented by a solenoid detent pin installed on the landing gear position selector valve. This solenoid detent pin prevents movement of the landing gear control lever from the "DOWN" to the "UP" position when the airplane is

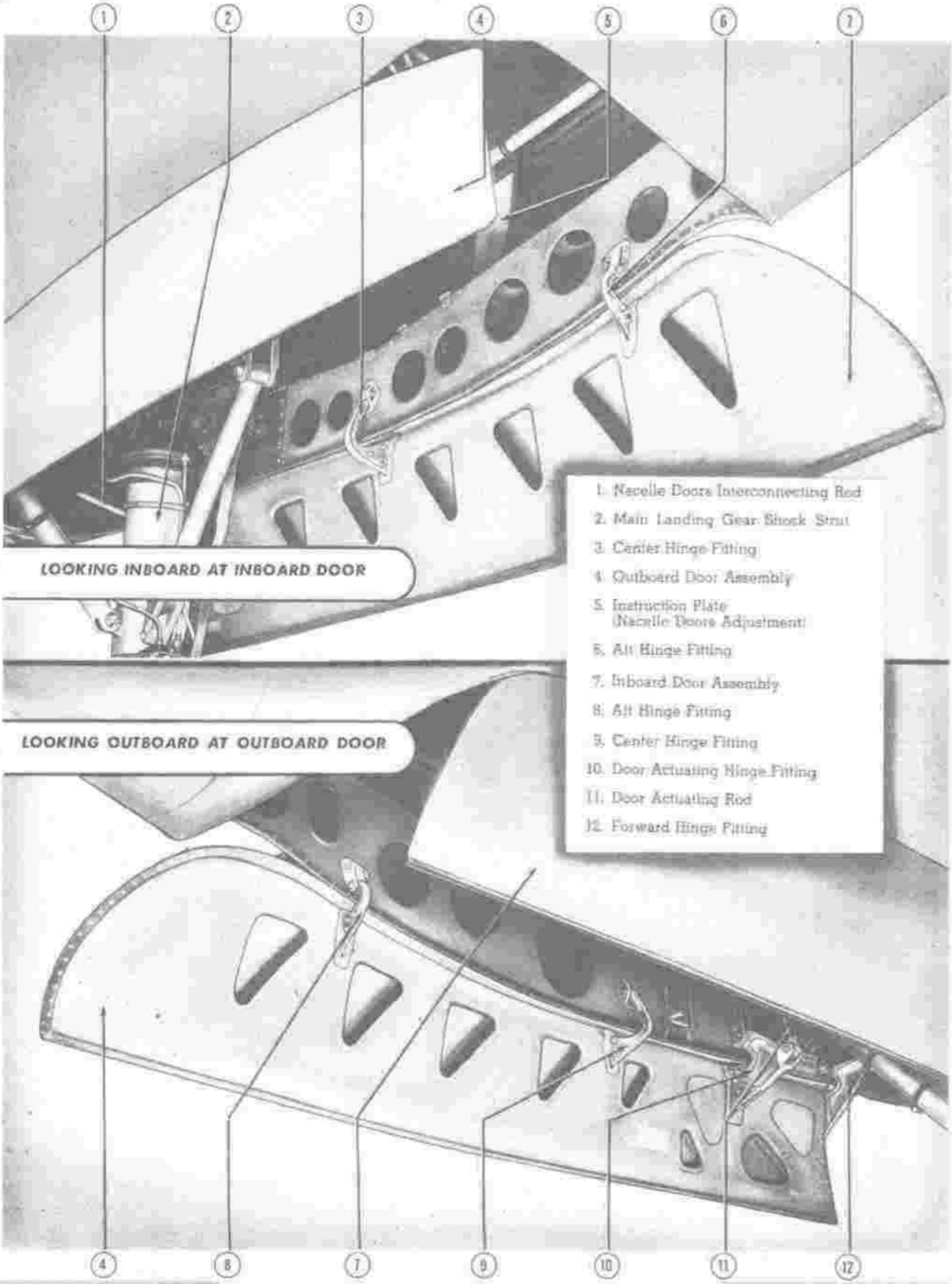


Figure 103—Nacelle Doors Installed (L. H. Nacelle Shown)

on the ground. The solenoid detent pin is controlled by the retraction release switch installed on the left-hand main shock strut. Refer to paragraph 15. *d.* (13), this section for complete details of the alighting gear electrical system.

c. NOSE WHEEL GEAR.

(1) GEAR ASSEMBLY.

(a) DESCRIPTION.—The nose gear is a single strut, fully retractable, cantilever assembly. The nose wheel gear is controlled by the same lever in the pilots' compartment, as is the main landing gear, and all gears receive hydraulic pressure at the same time through the landing gear position selector valve. For emergency purposes a mechanical release is provided to unlock the nose wheel gear up latch hook. This control can be operated by the pilot in the event the nose wheel door mechanism fails to trip the release lever *(9, figure 109)*. The nose wheel gear emergency release handle *(figure 115)* is located on the pilots' side of the control pedestal. A cable extends from the handle down into the nose wheel well and is attached to the up latch hook release bar. A static ground wire is installed on the nose wheel gear to provide a means of discharging into the ground any static electrical charges built up in the airplane. The ground wire is attached to the bottom of the shock strut wheel support.

Note

When extending the alighting gear, move the control lever to the "DOWN" position in a continuous operation. The movement from "NEUTRAL" to "DOWN" should not take longer than two seconds. Do not move the control lever by a series of light taps.

(b) REMOVAL AND DISASSEMBLY.

1. Support the airplane on a nose stand until the nose gear is about three inches above the ground in the extended position (see section III). Install ground safety pins *(figure 91)* on the main landing gears.

2. Relieve hydraulic system pressure by applying toe pressure to the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

3. Remove the bolt attaching the lower retracting link to the shock strut collar.

4. Disconnect the strut rotating arm *(5, figure 105)* from the rotating link *(6, figure 105)* by removing the attaching bolt and sliding the bearing off the arm.

5. Disconnect the nose wheel position indicator rod (if installed) from the indicator lever located at the left of the strut cross beam.

6. Remove the bolts and nuts attaching the two cross beam eyebolts to the supports on the nose wheel well side walls, after the nose wheel gear assembly is supported adequately.

7. Remove the nose wheel gear assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—For this information, refer to the detailed parts on the following pages.

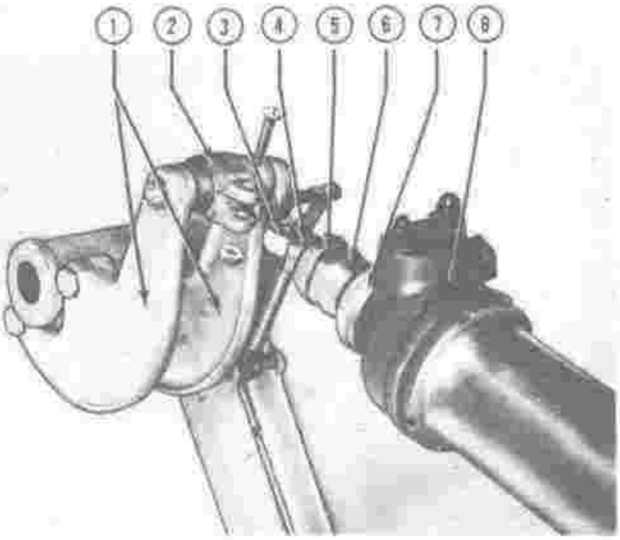
(d) ADJUSTMENTS.

1. To insure correct latching operations for both the nose wheel gear and doors, adjustments must be made at the same time.

CAUTION

Under no condition should the nose gear be retracted after reassembly until the following adjustments have been completed. Failure to make the adjustments before operation of the gear may result in serious damage to the nose wheel gear assembly or doors.

2. Support the airplane on a nose stand and install ground safety pins on the main gears and nose gear *(figure 91)*.



1. Retracting Arms
2. Clevis
3. Piston Rod Eyebolt
4. Eyebolt Check Nut
5. Bottoming Cap Check Nut
6. Bottoming Cap
7. Piston Rod Packing Nut
8. Nose Wheel Gear Actuating Cylinder

NOTE: Turn the bottom cap in until flush with the cylinder end. Then turn the cap out one full turn to create the required down position preload of 1/16 ± 1/32 inches.

Figure 104—Adjustments of Nose Wheel Gear Actuating Cylinder

Note

Use either the hydraulic hand pump or an engine-driven test stand pump to supply normal operating pressure during the adjustment procedure.

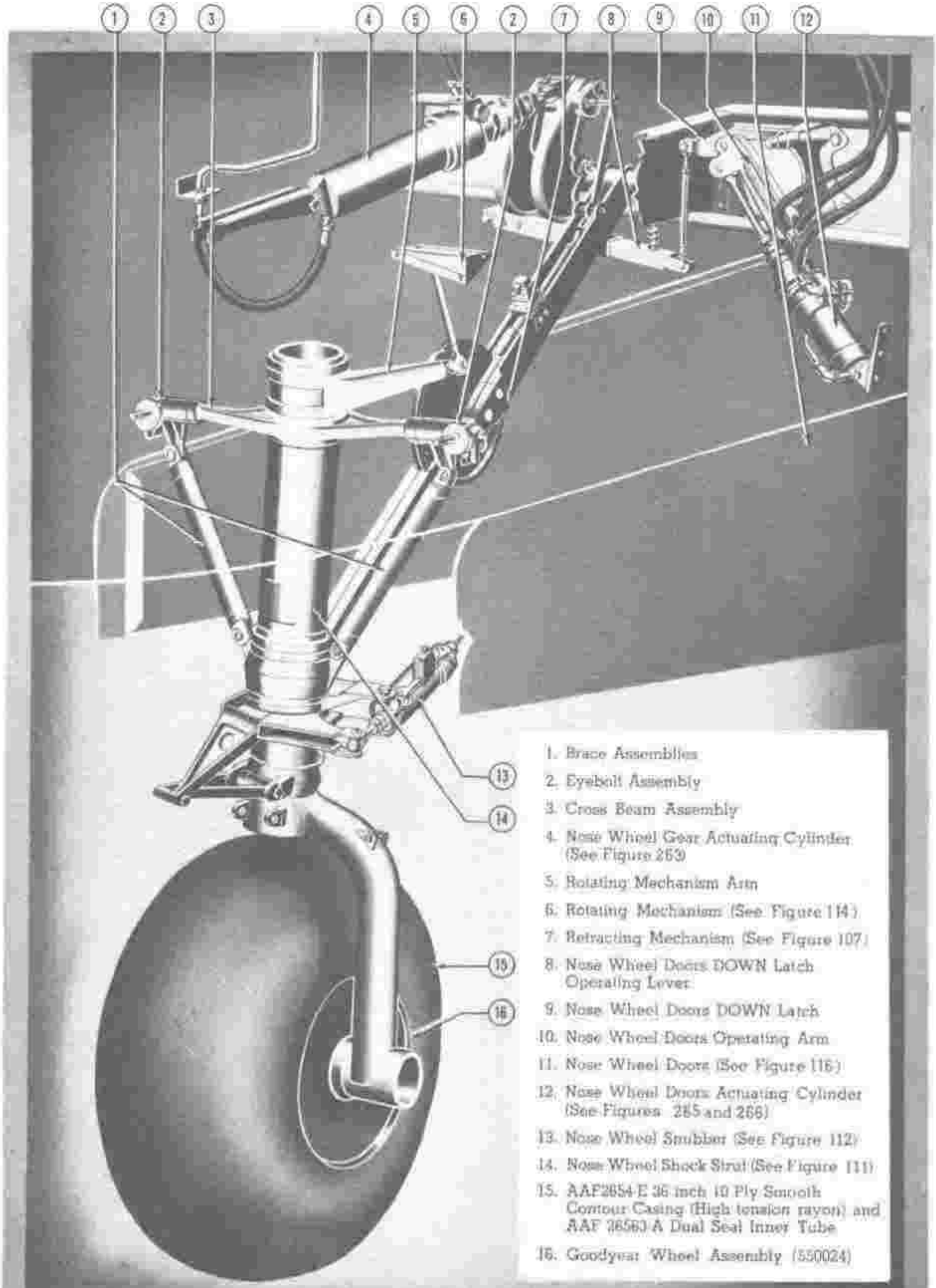
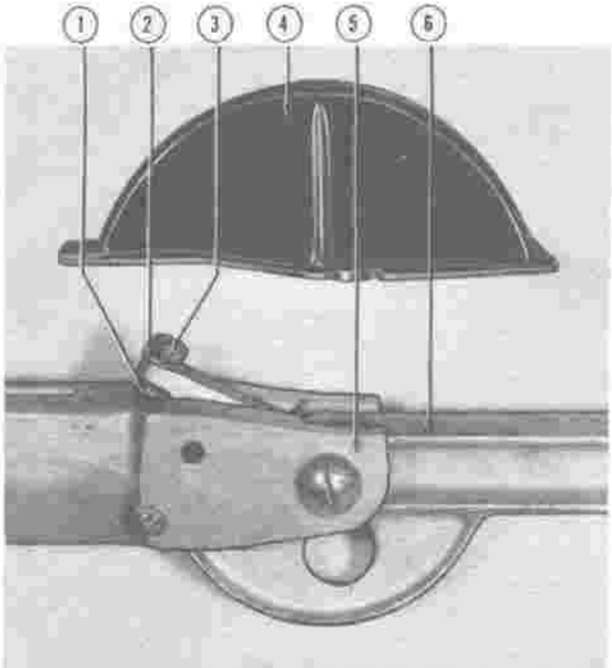


Figure 105—Nose Wheel Gear Installation



1. Retracting Link Stop Bolt
2. Washers and Shims
3. Retracting Link Adjustment Bolt
4. Guard
5. Upper Retracting Link (Latches are located inside this link)
6. Lower Retracting Link

ADJUSTMENT PROCEDURE

a. Disengage leaf spring assembly from latch assembly inside the upper retracting link. (Insert a tool between the leaf spring and latch assembly to maintain disengagement of the spring.)

b. Fully engage retracting link DOWN latch plunger, making certain the lower face of plunger is bottomed against bottom of slot. (Keep down latch plunger against bottom of slot while adjustment is being made.)

c. Use shims as required under head of adjustment bolt until .010 to .013 clearance is obtained between stop bolt and adjustment bolt after adjustment bolt has been tightened to 480 inch-pounds torque.

Figure 106—Adjustment of Nose Wheel Gear Retracting Links (Some Airplanes)

3. Remove the door actuating rods *(1 & 19, figure 109)* from the left and right-hand doors.

4. Disconnect the door actuating cylinder eyebolt from the cylinder attaching arm.

Note

> If the nose wheel door UP latches are installed, manually move the cylinder attaching arms *(9, figure 110)* downward until the door latch arms *(3 & 18, figure 109)* engage the door UP latches *(2, figure 109)*. Adjust the door operating link turnbuckle to permit both latch arms to engage the UP latches and to be locked at the same time.

5. Check the ground safety pins to see that they have been properly installed.

6. Move the landing gear control lever in the pilots' compartment into the "UP" position to retract the door actuating cylinder piston rod fully.

7. Adjust the door actuating cylinder to align with the hole in the cylinder attaching arm.

8. Decrease the cylinder length by turning the eyebolt IN one full turn to create the required over-travel on the doors in the CLOSED position.

9. Attach the eyebolt to the arm and tighten the check nut.

Note

> If the door UP latches are installed, adjust the latch release cables with the door latch arms engaged by the door UP latches and the landing gear control lever in the "NEUTRAL" position. The cables should be tight with both door UP latches fully engaged. If the control lever cannot be moved to the "DOWN" position, readjust (lengthen) the cable on the right hand door latch to permit the control lever to move to the "DOWN" position. At the same time care must be observed in making this adjustment so that the latches unlatch simultaneously or that the right hand latch unlatches slightly ahead of the left hand latch. This will preclude possible damage to the door mechanism operating link.

10. Place the door operating mechanism in the "OPEN" position.

11. Disconnect the piston rod eyebolt of the nose gear actuating cylinder, back off the bottoming cap until the piston bottoms.

12. Remove the ground safety pin from the nose wheel gear and check the main gear pins to be sure that they are properly installed. *(See figure 91.)*

13. Connect the eyebolt to the clevis between the retracting arm and retract the nose gear to the latched UP position.

14. Relieve pressure in the hydraulic system by operating the brakes, and allow the gear to be supported in the retracted position by the up latch hook.

15. Disconnect the rod end of the cylinder by removing the bolt from the rod and clevis.

16. Apply system UP pressure to the actuating cylinder and adjust the eyebolt to align with the clevis.

17. Increase the cylinder length by turning the eyebolt OUT three full turns to create the required over travel and UP position preload for the nose wheel gear.

18. Relieve the hydraulic system pressure by operating the brakes and reinstall the attaching bolt on the nose wheel gear actuating cylinder.

19. Adjust the door down latch release lever with the gear resting on the UP latch hook, to allow 3/16 inch clearance between the shock strut and the striking pad on the release lever *(1, figure 110)*. This is accomplished by adjusting the bolt located at the left end of the release lever *(3, figure 110)*.

20. Extend nose wheel gear. Install safety pin. The following instructions apply if the up latch hook release arm is actuated by a turnbuckle.

a. Apply full system DOWN pressure by operating the hand pump and allow the left-hand actuating assembly to complete its full over travel.

b. Maintain full DOWN pressure on the door actuating cylinder and adjust turnbuckle on aft side of zee angle to give $5/16 \begin{smallmatrix} -1/32 \\ +1/8 \end{smallmatrix}$ inches clearance between the release arm and the uplatch hook.

c. Apply full system UP pressure by operating the hand pump. Check to see that release arm is fully engaged with up latch hook when the roller in the nose wheel door left-hand actuating lever assembly is held by hook of the nose wheel door mechanical down latch assembly.

Note

If the up latch hook release arm is actuated by a screw assembly in the door operating link, the adjustment is made as follows: Fully extend the gear and check the gear up latch assembly for a clearance of 1/8–1/16 inch between the up latch hook and the hook release bar. The desired clearance should permit the nose wheel door cylinder attach arm to engage the door mechanism down latch properly and yet not allow the gear to drop off the up latch hook until the cylinder attach arm properly engages the door down latch. This clearance can be obtained by adjusting the latch up release screw which presses against the hook release bar and is located on the door operating link. In order to simulate flight conditions an additional check should be made as follows: Open the doors slowly (crack selector valve) until doors are approximately 30 degrees from full open position; then return selector valve to neutral. Apply a load on the doors, by having a man push on each door until 950 psi is registered on a gage installed in the down line of door cylinder. Move selector valve handle slowly to doors open position, at the same time retaining enough load on the doors to maintain 950 psi on the gage until the doors open far enough to release the gear. The gear should release when the doors are approximately fully opened. If gear does not release—re-adjust the up latch release screw to give more clearance between the up latch hook and hook release bar. This clearance must not be more than 3/16 inches maximum. Then repeat above procedure.

21. Relieve the hydraulic pressure with the door DOWN latch engaged and adjust the door DOWN latch turnbuckle. The adjustment is correct when the hook is 1/64 inch above the roller in its fully engaged position.

22. With the nose wheel gear in the extended position, relieve the pressure in the hydraulic system by operating the brakes.

23. Turn the nose wheel gear actuating cylinder bottoming cap IN until flush with the cylinder end.

24. Turn the cap OUT one full turn to create the required DOWN position preload of 1/16 +1/32-0 inches.

25. If the nose wheel gear retracting link has an adjustment bolt, refer to *figure 106* for proper adjustment of the bolt.

Note

If the retracting link has an adjusting screw, engage the retracting link DOWN latch fully. Turn the retracting link adjustment screw until it bottoms against the stop bolt in the upper retracting link. Back off the adjustment screw 1/8 turn and lock with the check nut.

26. Retract and extend the nose wheel gear several times, checking all clearances and latch operations for both the gear retracting mechanism and the door operating mechanism.

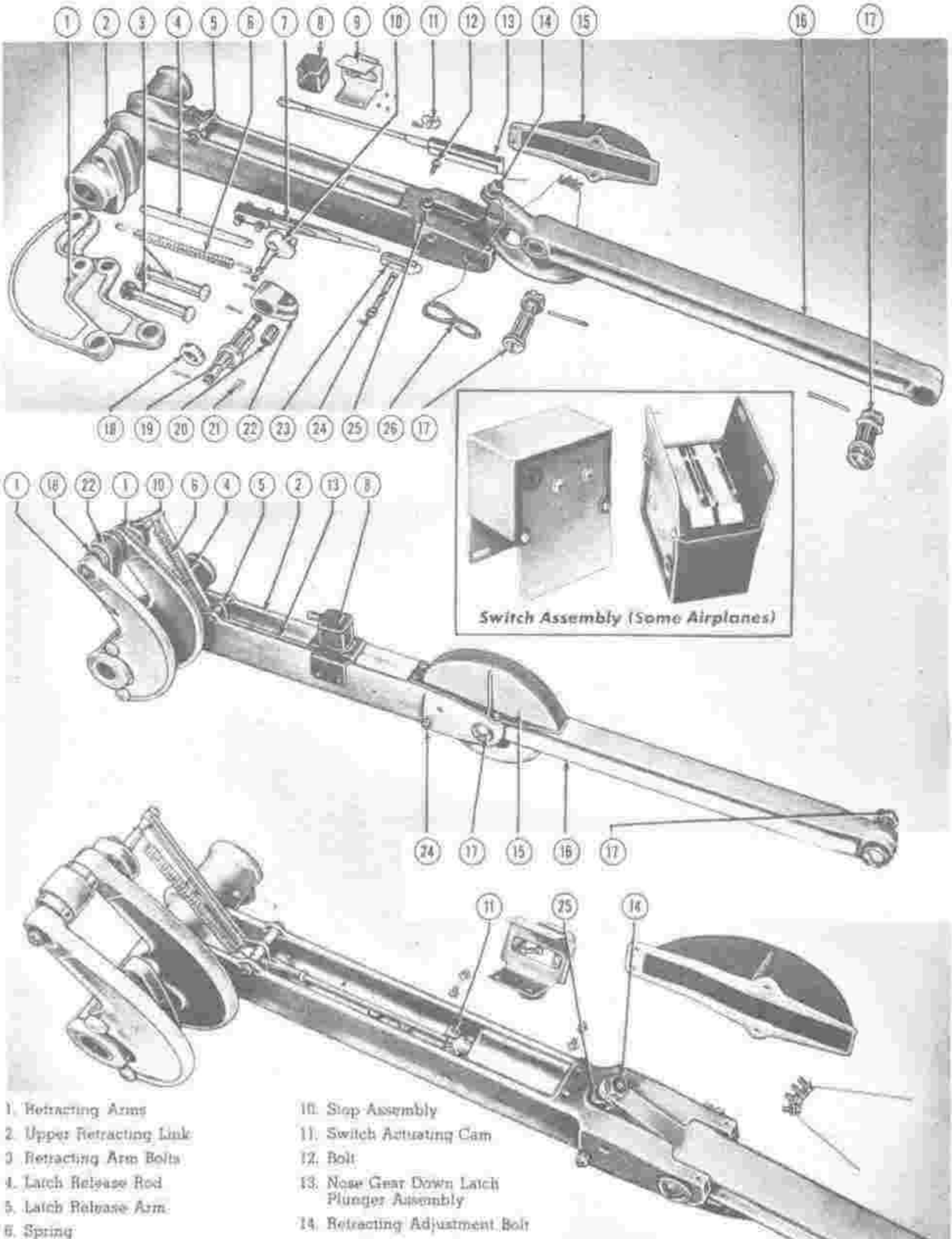
27. Attach the door actuating rod to the left-hand door center hinge only and retract the gear.

28. Manually swing the left-hand door up until it is closed.

29. Align the actuating rod end with the left-hand latch arm by shortening or lengthening the actuating rod.

Note

Do not connect the actuating rod to the latch arm. Align them and allow the door to swing open again.



1. Retracting Arms
2. Upper Retracting Link
3. Retracting Arm Bolts
4. Latch Release Rod
5. Latch Release Arm
6. Spring
7. Leaf Spring Assembly
8. Switch Cover
9. Switch Assembly—Nose Wheel Latched Down (Some Airplanes)
10. Stop Assembly
11. Switch Actuating Cam
12. Bolt
13. Nose Gear Down Latch Plunger Assembly
14. Retracting Adjustment Bolt
15. Guard
16. Lower Retracting Link
17. Bolt, Spacer, Washers, and Nut
18. Spacer
19. Cam
20. Spacer
21. Keys
22. Clevis
23. Latch Assembly
24. Bolt, Spacers, and Nut
25. Stop Bolt
26. Lock Wire

Figure 107—Nose Wheel Gear Retracting Mechanism

Figure 108—Inspection of Nose Wheel Gear Retracting Mechanism

30. Attach the door actuating rod to the right-hand door center hinge and repeat the alignment of the actuating rod with the latch arm, following the same procedure as used for the left-hand door.

31. Extend the gear and connect the left and right-hand actuating rods to the door latch arms.

32. Retract the gear and check the fairing of the doors with the fuselage skin. The desired fairing can be accomplished by shortening or lengthening the door actuating rods.

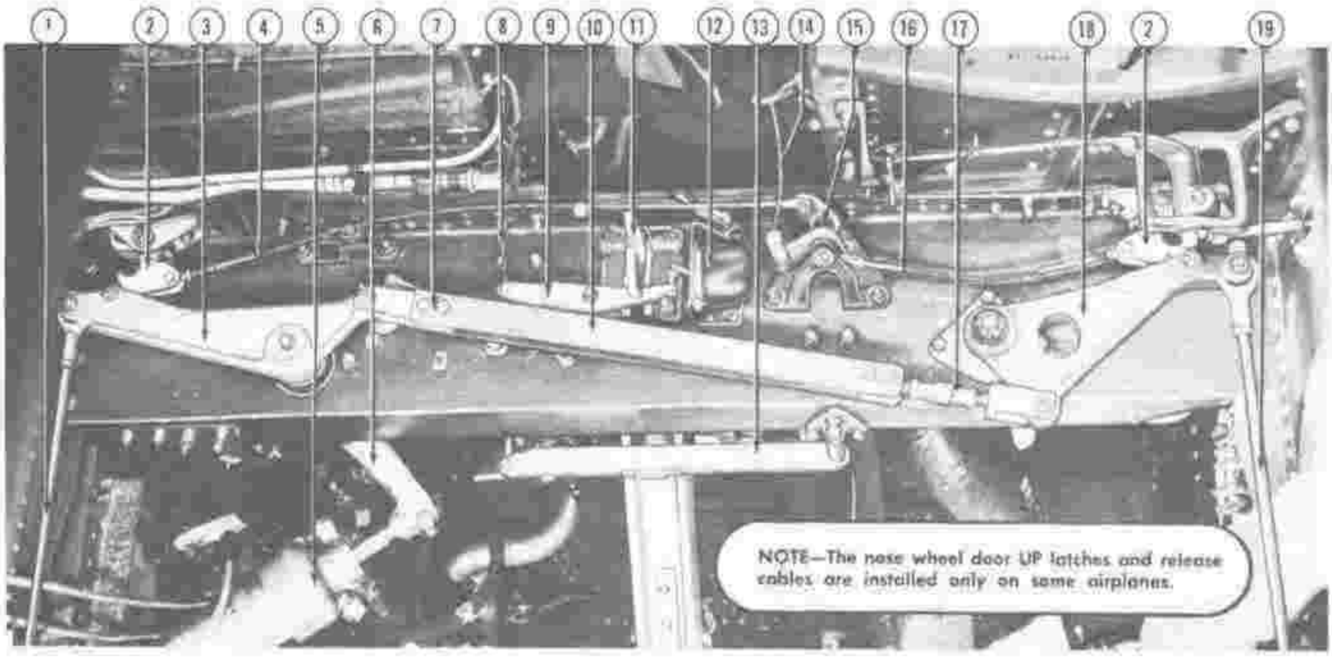
33. Lock all check nuts, tighten all bolts and nuts, and install lock wire and cotter pins as required.

(e) ASSEMBLY AND INSTALLATION.—Reverse the procedure outlined in paragraph 5. *c.* (1) *(b)*, this section.

(f) TEST AFTER INSTALLATION.—Make a trial operation of the nose wheel gear to insure proper operation.

(2) NOSE WHEEL GEAR RETRACTING MECHANISM.

(a) DESCRIPTION.—The nose wheel gear retracting mechanism revolves on a shaft and is operated by the hydraulic actuating cylinder *(4, figure 105)* attached to the pilots' compartment floor. The upper retracting link is connected at one end to the shaft, the other end to the lower retracting link *(16, figure 107)*. The lower retracting link extends from the upper DOWN latch *(13, figure 107)* which is assembled on the upper link, locks into a slot *(16, figure 107)* on the lower retracting link. During retraction, the actuating cylinder first releases the DOWN latch and then retracts the gear into the nose wheel well. One latch locks the gear in the fuly extended position only. A steel



1. L. H. Door Actuating Rod
2. Nose Wheel Door UP Latch
3. L. H. Door Actuating Arm
4. L. H. Door UP Latch Release Cable *(Figure 606, Item 11)*
5. Nose Wheel Doors Actuating Cylinder
6. Nose Wheel Doors Actuating Arm
7. Connecting Link Assembly
8. Nose Wheel Gear UP Latch Emergency Release Cable
9. Nose Wheel Gear UP Latch Release Bar
10. UP Latch Release Adjusting Screw (Located inside Link)
11. Nose Wheel Gear UP Latch Hook
12. Switch (Nose Wheel Gear Latched Up)
13. Nose Wheel Door Mechanism DOWN Latch Release Lever
14. Nose Wheel Door UP Latches Release Cable *(Figure 606, Item 56)*
15. Arm Assembly
16. R. H. Door UP Latch Release Cable *(Figure 606, Item 10)*
17. Connecting Link Turnbuckle
18. R. H. Door Actuating Arm
19. R. H. Door Actuating Rod

Figure 109—Nose Wheel Door Operating Mechanism and Nose Wheel Gear UP Latch Installed

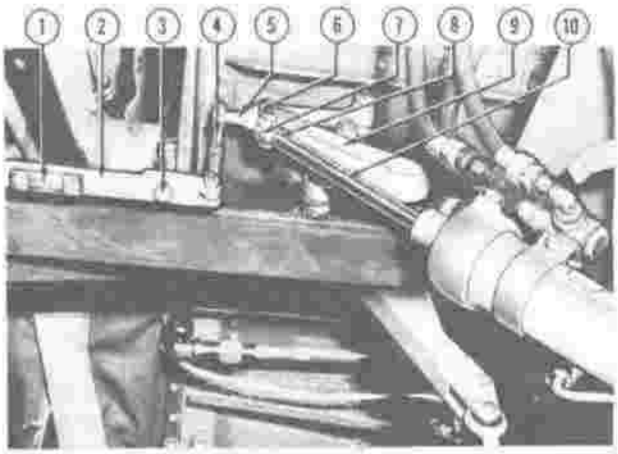
bungee *(7, figure 107)* composed of four leaf-type springs and a small latch are attached to the underside of the upper retracting link. This bungee and latch prevents the retracting links from moving until the DOWN latch plunger has completely unlocked the links. In this manner, any friction which would prevent the unlatching operation of the down latch mechanism is eliminated. The nose wheel gear is latched in the up position by a hook installed on the beam in the nose wheel well.

Note

On some airplanes the nose wheel doors are latched in the fully closed position by spring loaded latches *(2, figure 109)*. The latches are unlocked mechanically by the movement of the landing gear control lever to the "DOWN" position. A cable extends from this lever to a bell crank in the wheel well. From this bell crank a cable extends to each of the door UP lock latches *(2, figure 109)*. On other airplanes the nose wheel doors are held in the closed position by continuous hydraulic pressure in the nose wheel doors actuating cylinder and the air loads on the doors.

(b) REMOVAL AND DISASSEMBLY.

1. Support the airplane on a nose stand.



1. Striking Pad
2. Door Mechanism Down Latch Release Lever
3. Adjusting Bolt
4. Door Mechanism Down Latch Turnbuckle
5. Door Mechanism Down Latch
6. Door Mechanism Down Latch Roller Bearing
7. Actuating Cylinder Eyebolt
8. Actuating Cylinder Eyebolt Check Nut
9. Door Mechanism Actuating Arm
10. Nose Wheel Door Actuating Cylinder

Figure 110—Nose Wheel Door Operating Mechanism DOWN Latch Installed

2. Relieve hydraulic system pressure by operating the brakes.

3. Remove the bolt attaching the piston rod eyebolt to the clevis between the retracting arms.

4. Remove the screws attaching the latched down position switch to the upper retracting link and remove the switch wire clamp from the upper part of the link.

5. Remove the bolt that attaches the lower retracting link to the shock strut collar.

6. Remove the upper retracting shaft which goes through the two supports on each side of the nose wheel well and upon which the upper retracting link revolves. This is done by removing the bolt that locks the shaft to the right-hand support and then sliding the shaft out through the right-hand support.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Damaged parts must be replaced with new parts.

2. For hydraulic actuating cylinder and hydraulic selector valve information, refer to paragraph 14. *c.*, this section.

(d) ASSEMBLY AND INSTALLATION.—Reverse the procedure outlined in paragraph 5. *c.* (1) *(b)*, this section.

(e) ADJUSTMENT.—Refer to *figure 106* and to paragraph 5. *c.* (1) *(d) 25.*, this section.

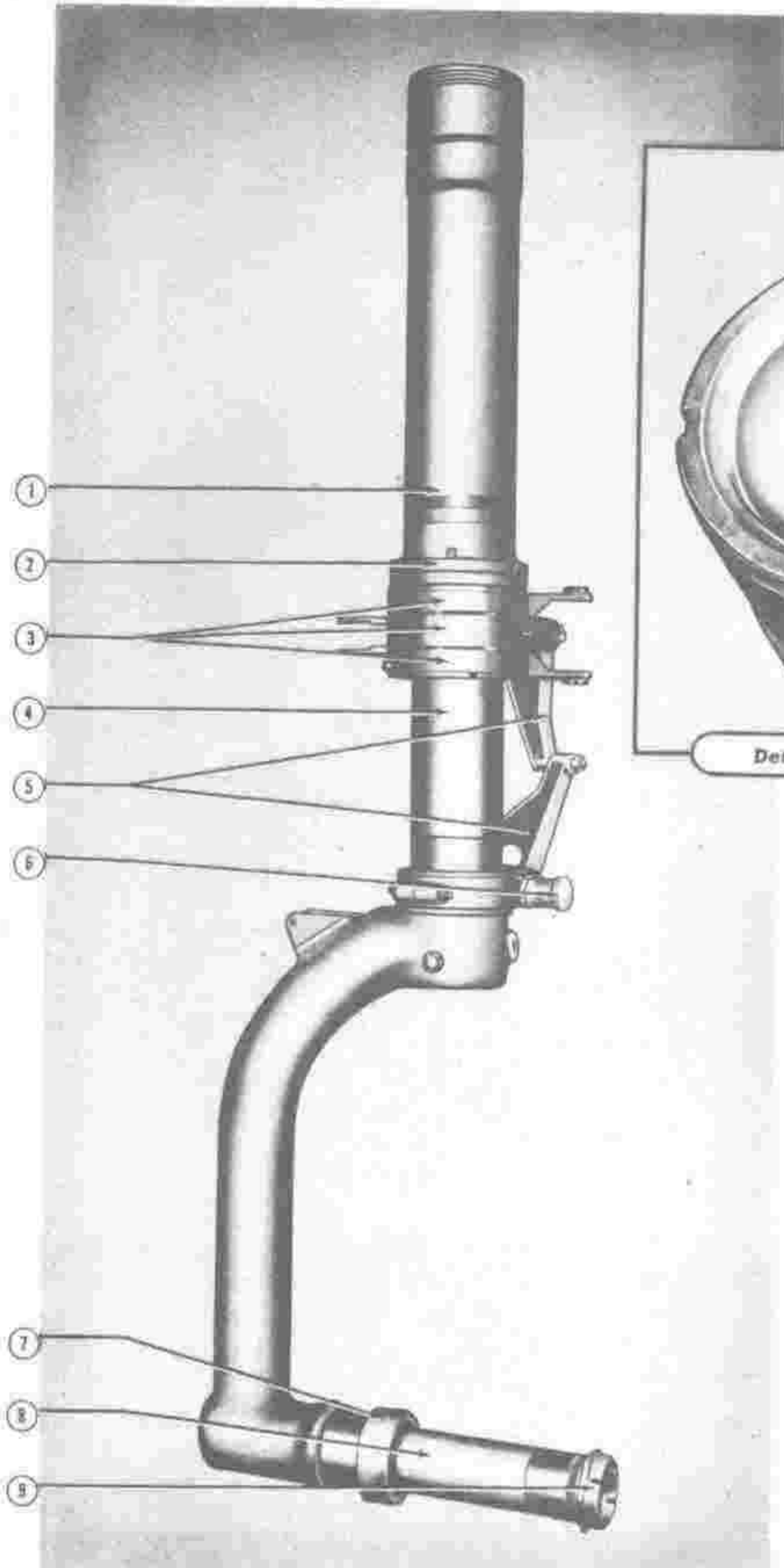
(f) TEST AFTER INSTALLATION.—Retract and extend the nose wheel gear several times to check mechanism for proper operation.

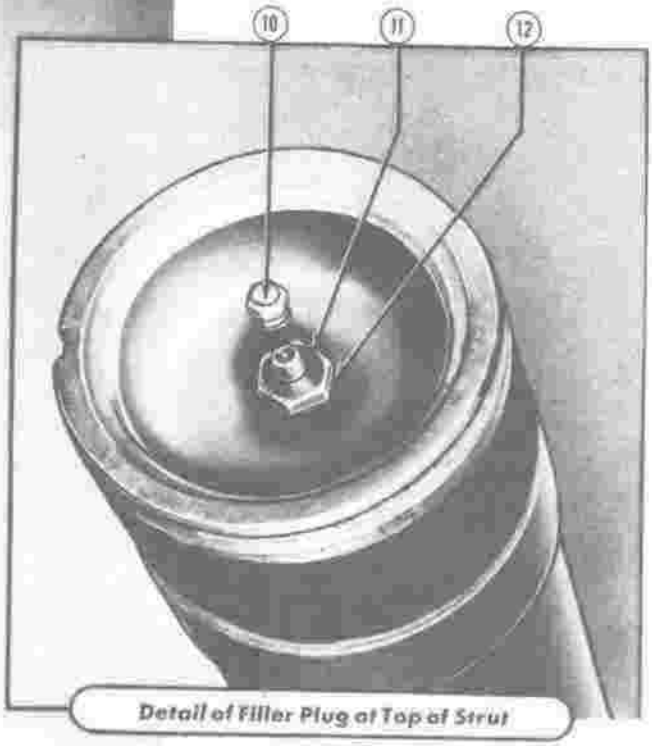
Note

With the down latch engaged, maximum offset at center bolt should not exceed values shown in *figure 108* if all parts are within specified tolerances.

(3) NOSE WHEEL SHOCK ABSORBER STRUT.

(a) DESCRIPTION.—Landing shocks on the nose wheel gear are partially absorbed by the oleo-pneumatic strut. A yoke *(3, figure 105)* around the top of the strut, bolts onto the side of the nose wheel well. Side braces *(1, fig. 105)* extend from the yoke to the strut collar. The strut is connected to the retracting shaft by the retracting link assembly *(7, fig. 105)*. A rotating arm *(5, fig. 105)* extends from the top of the strut and is controlled by a swivel assembly *(6, fig. 105)* attached to a bracket in the upper left-hand corner of the nose wheel well. The nose wheel shock strut and wheel are rotated 90 degrees during retraction so that the nose wheel lies flat in the nose wheel well.





Detail of Filler Plug at Top of Strut

1. Shock Strut Cylinder
2. Packing Nut
3. Snubber Collars
4. Shock Strut Piston
5. Restraining Links
6. Snubbing Pin and Collar Assembly
7. Nose Wheel Spacer
8. Axle
9. Nose Wheel Axle Nut
10. Air Valve Cap (Apply 15 to 25 inch-pounds Torque Preload)
11. Filler Plug and Air Valve Assembly
12. Gasket

NOTE
Fill shock strut with hydraulic fluid AAF Specification 3580 (Red Color).

Figure 111 — Nose Wheel Shock Strut Assembly

(b) REMOVAL.

1. Support the airplane on a nose stand.

2. Remove the bolt which attaches the rotating arm to the swivel mechanism.

3. Remove the bolt which attaches the lower retracting link to the shock strut collar.

4. Remove the bolts which fasten the strut to the side of the nose wheel well and remove the strut assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. TIGHTENING THE SHOCK STRUT PACKING.—If the packing gland is leaking as evidenced by fluid seepage, or the presence of air bubbles when soapy water is applied, tighten the packing nut as follows:

a. Release the air pressure in the strut by partially backing off the filler plug *(11, figure 111)* located at the top of the strut. Packing cannot be tightened properly under pressure.

Note

Air must be exhausted completely from the strut before removing the filler plug. Do NOT release the air pressure by depressing the air valve core or the valve will be damaged.

b. Remove the packing nut lock wire.

c. Loosen the packing nut about one turn and work piston up and down several strokes. Then tighten packing nut until snug but not too tight.

d. Replace the lock wire on the packing nut and inflate the nose wheel shock strut as instructed in paragraph 5. *b.* (3) *(c)* *3.*, this section.

2. FILLING THE SHOCK STRUT.—The nose wheel shock strut is filled with hydraulic fluid, AAF Specification 3580, at the filler plug, located at the top of the strut, by the same procedure as given for the main landing gear shock strut. Refer to paragraph 5. *b.* (3) *(c)* *2.*, this section.

3. INFLATING THE SHOCK STRUT.—Observe the same procedure as given for the inflation of the main landing gear shock strut in paragraph 5. (3) *(c)* 3., this section. The nose wheel shock strut also is inflated until the upper edge of the red line on the piston tube is $1\frac{7}{8} \pm \frac{1}{4}$ inches from the bottom of the packing gland nut when the airplane is supporting a full normal load. For other maintenance information about the nose wheel shock strut refer to paragraph 5. *b.* (3) *(c)* 4. through 7.

(d) INSTALLATION.—To install the nose wheel shock strut reverse the removal procedure given in paragraph 5. *c.* (3) *(b)*, this section.

(4) NOSE WHEEL, TIRE AND TUBE.

(a) DESCRIPTION.—A drop-center wheel is mounted on an off-center support which extends from the axle and is an integral part of the shock strut piston rod. A 36-inch, smooth contour, 10-ply tire and dual seal tube are mounted on the wheel.

(b) REMOVAL.

1. WHEEL ASSEMBLY.

a. Support the airplane on a nose stand.

b. Remove the dust plate (if installed) from the right side of the wheel by removing the Dzus fasteners.

c. Remove the cotter from the axle nut and remove the axle nut and washer from the axle.

d. Slide the nose wheel assembly from the axle.

e. Remove the bearing enclosure lock ring, bearing enclosure rings and felt grease retainers, and bearings from the wheel.

2. TIRE AND TUBE.

a. Deflate the dual seal inner tube by removing valve core and unscrewing valve core housing five complete turns. Removal of the core housing before tube is completely deflated will cause inner compartment to collapse, preventing further deflation.

b. In the event that the inner compartment is collapsed at any time, follow inflation procedure as given in paragraph 5. *c.* (4) *(c)* 2., this section and deflation as given in paragraph 5. *c.* (4) *(d)* 2., this section.

c. After the dual seal inner tube is completely deflated remove the nose wheel tire and tube by observing the procedure given in paragraph 5. *b.* (5) *(b)*, this section.

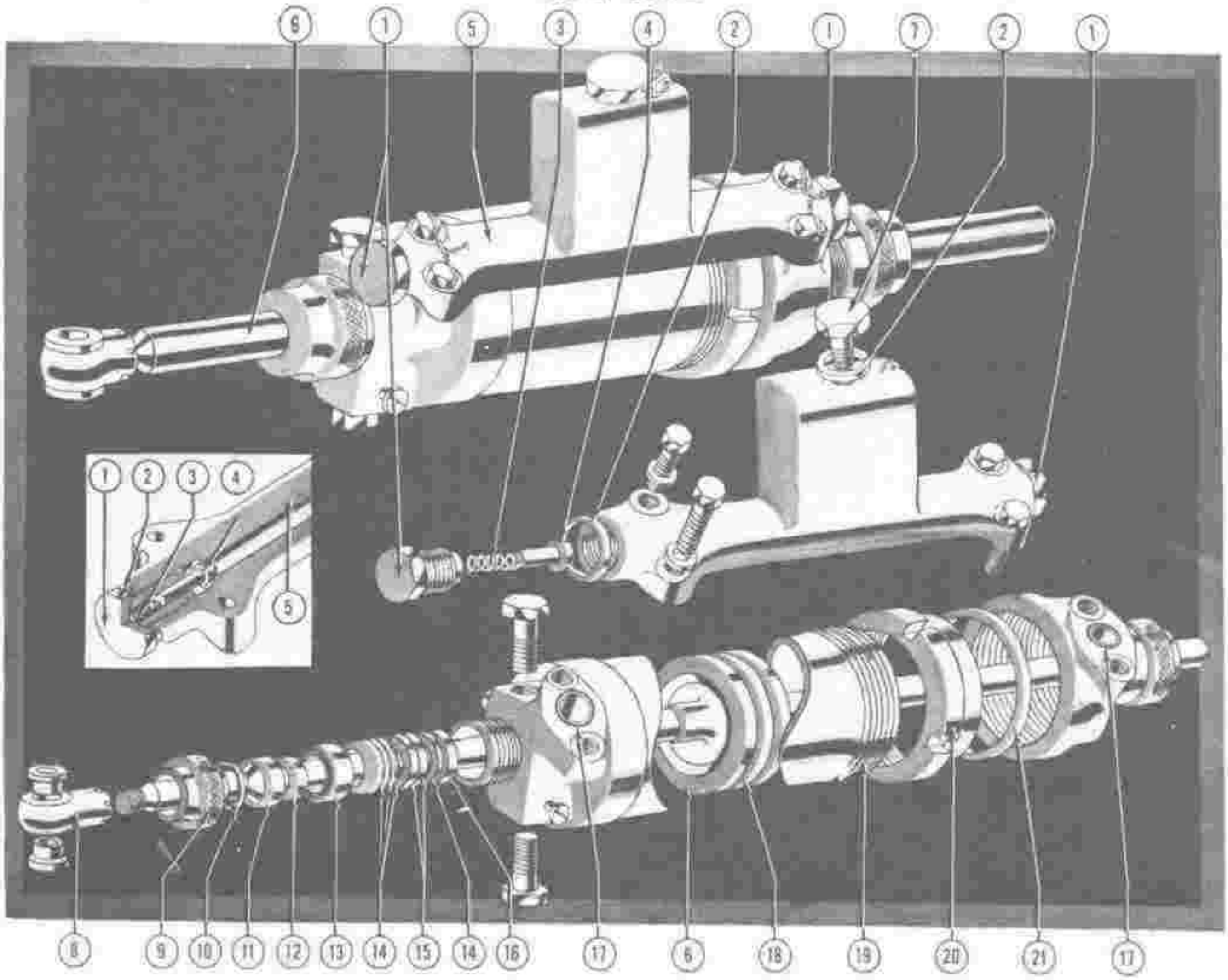
(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. WHEEL.—Maintenance for the nose wheel is the same as that given for the main wheels in paragraph 5. *b.* (4) *(c)*, this section.

2. TIRES AND TUBES.—Because of the tendency for tires with dual seal inner tubes to slip it is necessary to check inflation of the nose wheel tire frequently and with extreme care. Follow the procedure given in paragraph 5. *c.* (4) *(d)* 2., this section. For other maintenance information about tires and tubes refer to paragraph 5. *b.* (5) *(c)*, this section.

(d) INSTALLATION.

1. WHEEL ASSEMBLY.—To install the nose wheel assembly on the axle reverse the removal procedure given in paragraph 5. *c.* (4) *(b)*, this section.



1. Plug
2. Gasket
3. Spring
4. Poppet
5. Manifold Assembly (Reservoir)
6. Piston Assembly
7. Filler Plug
8. End Assembly (Includes Bushings)
9. Packing Nut
10. Lock Ring
11. Wiper
12. Washer
13. Ring
14. AN6225-16 Packing
15. Ring
16. Ring
17. Packing Cup
18. AN6227-34 Packing
19. Barrel Assembly
20. Nut
21. Cylinder Gasket

TEST PROCEDURE

TEST PORT	PISTON POSITION	TEST PRESSURE	MAX. LEAKAGE
AT RESERVOIR PLUG	EXTENDED	250 PSI	NONE

With Reservoir Filled Apply an Axial Force of 250 psi at Piston Rod End

Time for Complete Stroke Should be as Follows:

To Extend — 15 ± 2 Seconds To Retract 15 ± 2 Seconds

(Lever May Be Used to Apply Force)

Douglas Drawing No. 5122388

Figure 112—Nose Wheel Snubber

2. TIRE AND TUBE.—Special care is necessary in the installation and use of the dual seal inner tube. Because of the tube's stiffer construction which causes relatively less pressure against the tire head seat and greater weight of the tube, there is more of a tendency for the tire to slip on the rim upon impact with the ground. To eliminate one source of such slippage, before attempting to mount the nose wheel tire and tube, wash all lubricant off the inside of the casing with a cloth dampened in gasoline. Blow out the inside of the casing with air or otherwise make sure that the casing is perfectly dry before continuing with the installation. Install the nose wheel tire and tube as follows:

a. Remove core housing and deflate by hand pressure to facilitate insertion of tube into the casing. Place the tube in the casing.

b. Place the tire and tube on a horizontal plane with the valve down. Force wheel, with valve hole down, into the tire.

c. Invert assembly so valve and valve hole are up.

d. With valve in line with valve hole, force tube over wheel rim.

e. Place valve in valve hole and apply core housing. Screw down tight.

f. Apply second bead to wheel.

g. Check centering of valve in valve hole.

h. Unscrew core housing five full turns from seated position and inflate until both beads are seated on rim.

i. Deflate completely by removing valve core to allow tube to adjust and center itself. (This should be done regardless of type of tube.)

j. Replace valve core and inflate. Wait 30 seconds to allow pressure to equalize in the two chambers. Check inflation which should be 38 psi, measured with an accurate gage. Retighten valve core housing by screwing rubber barrel back tight, then twisting 180 degrees *by hand* to seat securely. *Do not use pliers.* Remove valve core and use spit test on valve tip to check for leakage.

k. Re-install valve core and cap.

l. Check inflation of dual seal tubes frequently and carefully.

(5) NOSE WHEEL SNUBBER.

(a) DESCRIPTION.—The nose wheel snubber is an independent hydraulic unit attached to the nose wheel strut. The manifold assembly located on top of the snubber is the fluid reservoir. Spring loaded poppets are seated in the manifold assembly and restrict the flow of fluid when snubbing pressure is applied. The snubber cylinder assembly incorporates a piston which moves with the wheel and builds up the snubbing pressure. This unit prevents wheel shimmy and restricts the wheel to 36 degrees of movment each side of center. A nose wheel snubber locking mechanism key is attached to the red streamer containing the nose wheel gear safety pin. When in the locked position, the key engages the snubber lock plunger until the red cap (chained to the lower torque arm) can be applied. When installed, this cap insures a positive engagement of the wheel and snubber for flight. When in the unlocked position, the nose wheel key disengages the snubber lock plunger. The plunger, in turn, releases the nose wheel from the snubber, allowing full caster 360 degrees for towing and handling. *(See figure 113.)*

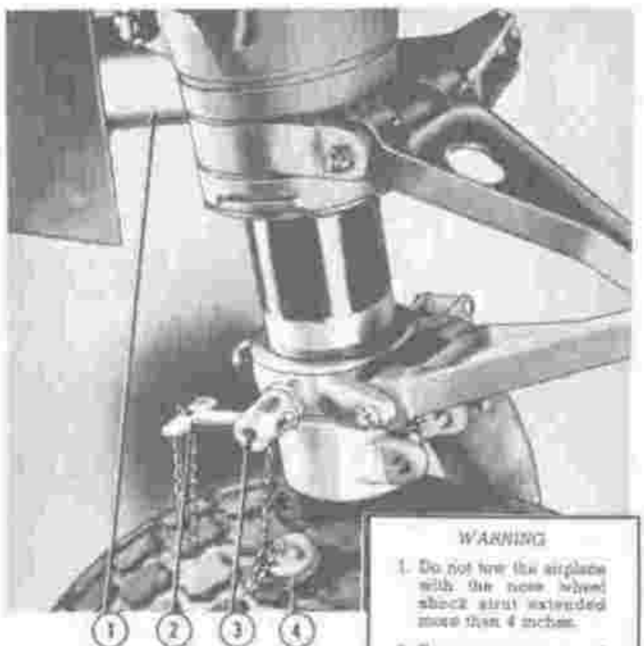
(b) REMOVAL.

1. Remove the bolt at the end of the snubber piston rod.

2. Remove the bolt at the top of the snubber cylinder and remove the snubber assembly from the nose strut collar.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check the snubber reservoir for proper amount of fluid periodically.

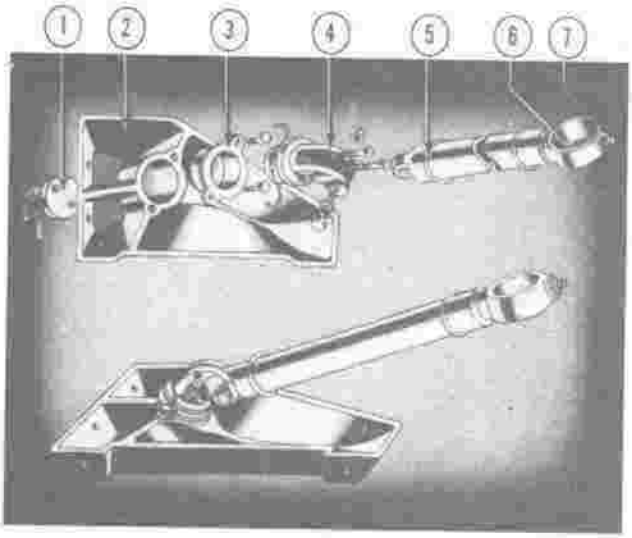


1. Nose Wheel Snubber
2. Lock Pin Key
3. Snubber Lock Pin
4. Lock Pin Engaging Cap Nut

WARNING

1. Do not tow the airplane with the nose wheel shock strut extended more than 4 inches.
2. Remove cap nut and fully engage key before towing the airplane.
3. Remove key and install cap nut after towing the airplane.

Figure 113—Nose Wheel Snubber Lock Pin (Shown Unlocked)



1. Washer
2. Support Fitting
3. Bearing
4. Swivel
5. Rotating Mechanism Link Assembly
6. Link Socket
7. Lubrication Fitting

Figure 114—Nose Wheel Rotating Mechanism

2. Bleed the snubber by moving the wheel to the limit of its travel in both directions two or three times. Refill with fluid and plug the reservoir. Maintain the hydraulic fluid (Specification AN-VV-O-366) level with the bottom of the reservoir filler hole. Whenever excessive leakage becomes evident, disassemble the snubber *(figure 112)* and replace the packing.

(d) INSTALLATION.—Reverse the procedure outlined in *(b)* above.

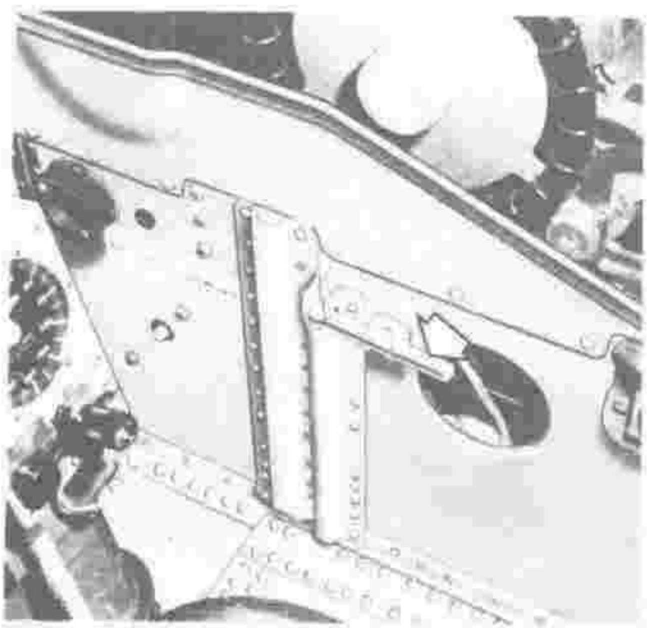


Figure 115—Nose Gear Emergency Release

(e) FILLING THE SNUBBER.

1. Fill the reservoir with hydraulic fluid (Specification AN-VV-O-366) to bottom of filler hole.

2. Remove all air bubbles by slowly extending and compressing the snubber piston fully several times.

3. Add hydraulic fluid to the snubber reservoir if necessary.

(f) TEST AFTER INSTALLATION.—Turn the nose wheel either side of center several times to check snubber operation. Refer to *figure 112* for fluid leak tests of the snubber assembly.

(6) NOSE WHEEL DOORS.—*(See figure 116.)*

(a) DESCRIPTION.—A left and right-hand side door is installed to cover the nose wheel well. These doors are linked to operate with the nose wheel gear, opening completely before the nose wheel gear begins extending and closing only after the nose wheel gear is completely retracted.

(b) REMOVAL AND DISASSEMBLY.

1. Remove the bolts from the door actuating rods.

2. Remove the hinge bolts which attach the doors to the nose wheel well structure. Remove the doors.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check for looseness of hinge bolts and actuating rod attaching bolts.

2. Check doors for freedom from binding or excessive over-travel.

(d) ADJUSTMENTS.—The nose wheel doors and gear are adjusted at the same time. See paragraph 5. *c.* (1) *(d)*, this section.

(e) ASSEMBLY AND INSTALLATION.—Reverse procedure outlined in paragraph 5. *c.* *(b)*, this section.

(f) TEST AFTER INSTALLATION.—Operate the nose wheel gear and check the doors for proper operation.

(8) NOSE WHEEL GEAR ROTATING MECHANISM.—A rotating mechanism *(figure 114)* is provided in the nose wheel well which turns the nose wheel and shock absorber strut 90 degrees while they are being retracted so that the nose wheel lies flat in the nose wheel well. The unit is attached at one end to a bracket in the left hand forward corner of the well and at the other to the rotating mechanism arm *(5, figure 105)* on the oleo strut.

d. TAIL SKID.—A tail skid is installed on the bottom of the aft fuselage section. This unit is riveted to the fuselage tail structure and is made of molded neoprene, capped by .125 sheet steel.

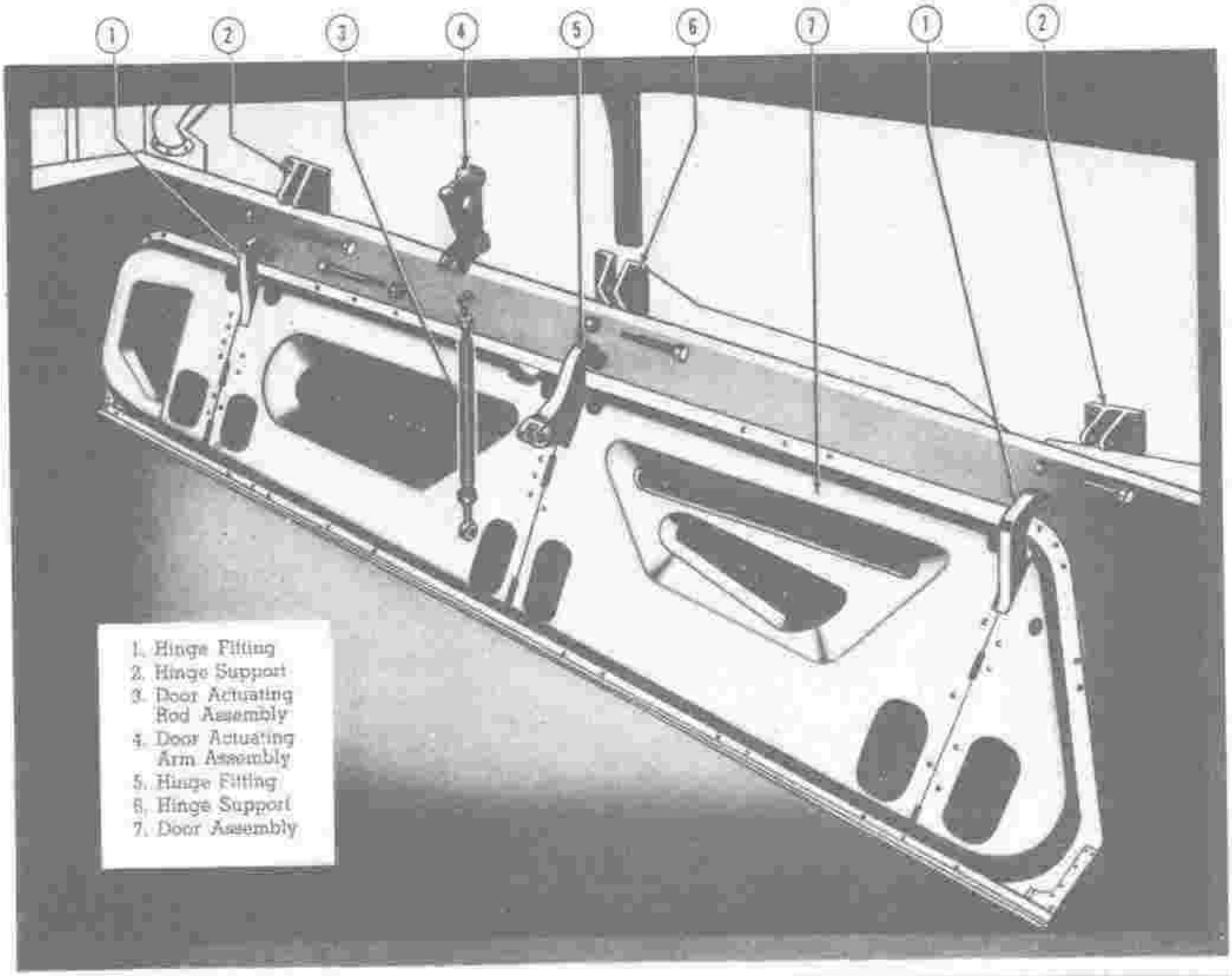


Figure 116—Nose Wheel Door

e. ALIGHTING GEAR TROUBLE SHOOTING LIST.

BRAKE TROUBLE SHOOTING

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Excessive brake pedal travel or insufficient braking action.	*a.* Normal wear of bronze discs.	*a.* As discs wear thinner, the brake piston must travel farther. This results in greater fluid displacement and requires adjustment in disc clearance as instructed in paragraph 5. *b.* (5) *(d)*, this section.
	b. Improper adjustment of clearance between discs.	*b.* Check clearance of discs as a unit. See paragraph 5. *b.* (5) *(d)* *c.*, this section.
	c. Fluid leak in the system.	*c.* If the pedal will gradually depress under pressure, there is a fluid leak in the system. Check the leak. If the piston seal is worn, shrunken or damaged, replace as specified, see paragraph 5. *b.* (4) *(c)* 2., this section.
	d. Air in the brake hydraulic lines.	*d.* A springy, rubbery action of the pedal may indicate air in the system. An excessive amount of air will permit the pedal to go full on under normal pressure. Bleed the system as instructed in paragraph 14. *e.* (2) *(d)* 1., this section.
	e. Lack of fluid in the hydraulic system reservoir.	*e.* Air will enter the system if the reservoir is allowed to go dry. Fill reservoir as instructed on name plate.

e. ALIGHTING GEAR TROUBLE SHOOTING LIST.—Continued

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
2. Dragging brakes.	*a.* Improper adjustment of clearance between discs.	*a.* Adjust clearance. See paragraph 5. *b.* (5) *(d)*, this section.
	b. Binding of brake piston.	*b.* Dust and dirt mixing with the hydraulic fluid at the brake piston may become gummy and cause sticking of brake piston. Remove and clean the brake as instructed in 5., this section.
	c. Dirt in the system.	*c.* Follow instructions outlined in paragraph 5. *b.* (5) *(c)* *2.* d., this section.
	d. Weak or broken brake piston return springs.	*d.* Replace with new springs.
	e. Dished or warped bronze or steel discs.	*e.* Return to a flattened condition and install.
	f. Rudder pedal linkage binding.	*f.* Check linkage and eliminate binding.
	g. Parking brakes applied.	*g.* Release the parking brake.

SHOCK STRUT TROUBLE SHOOTING.

CAUTION—RELEASE ALL AIR PRESSURE IN STRUT BEFORE DISASSEMBLING

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Air leaks.	*a.* Undue wear of valve core seat.	*a.* Work valve core up and down to find new seat. If this method fails, replace valve core.
	b. Deterioration of valve seat.	*b.* Screw valve core down. If this fails, replace valve core.
	c. Scratches or nicks in copper gasket.	*c.* Replace gasket.
	d. Improper assembly of valve core or valve body.	*d.* Tighten valve core or valve body.
2. Oil leaks.	*a.* Improper packing adjustment.	*a.* Tighten packing nut just enough to stop leakage.
	b. Deterioration of packing.	*b.* Replace packing.
	c. Improper assembly of packing.	*c.* Replace packing.
3. Improper taxiing characteristics.	*a.* Improper air inflation.	*a.* See name plate for instructions on inflation and oil quantity.
	b. Improper packing adjustment.	*b.* Back off packing nut to allow freedom of piston movement while retaining oil.
	c. Improper inflation of tire.	*c.* Inflate tire properly.
4. Rigid landing characteristics.	*a.* Over-inflation.	*a.* Inflate according to name plate instructions.
	b. Tight packing.	*b.* Back off packing nut to allow freedom of piston movements while retaining oil.
	c. Over supply of oil.	*c.* Fill according to instructions on name plate.
5. Hard landings due to failure of shock absorber.	*a.* Under inflation.	*a.* Inflate according to name plate instructions.
	b. Insufficient oil supply.	*b.* Fill according to instructions on name plate.

6. ENGINES

a. GENERAL.—Power for this airplane is furnished by two Pratt and Whitney R-2800-27 (or R-2800-71) Douglas-Wasp single-stage, two speed radial engines. Critical altitude is listed at 5700 feet for low blower operation, and 13,000 feet for high blower. Refer to AN01-40AJ-1 "Flight Operations" for tables of operating instructions. Engine accessories are reached through access doors in each nacelle. Easily removable anti-drag ring and electrically operated cowl flaps are installed. Engine controls including carburetor air, throttle, supercharger blower, carburetor air filter, and fuel mixture are manually operated from the pilot's compartment.

b. ENGINE ASSEMBLY.

(1) GENERAL.—Each double-row engine has eighteen cylinders, nine in each row, which produce 2000 brake horse-power at take-off. Cylinders are numbered consecutively in the direction of crankshaft rotation (clockwise when viewed from the rear looking forward) beginning with the top cylinder in the rear bank. Left and right directions are determined from behind the engine looking forward. The engine assembly consists of the engine proper and all engine accessories forward of the firewall.

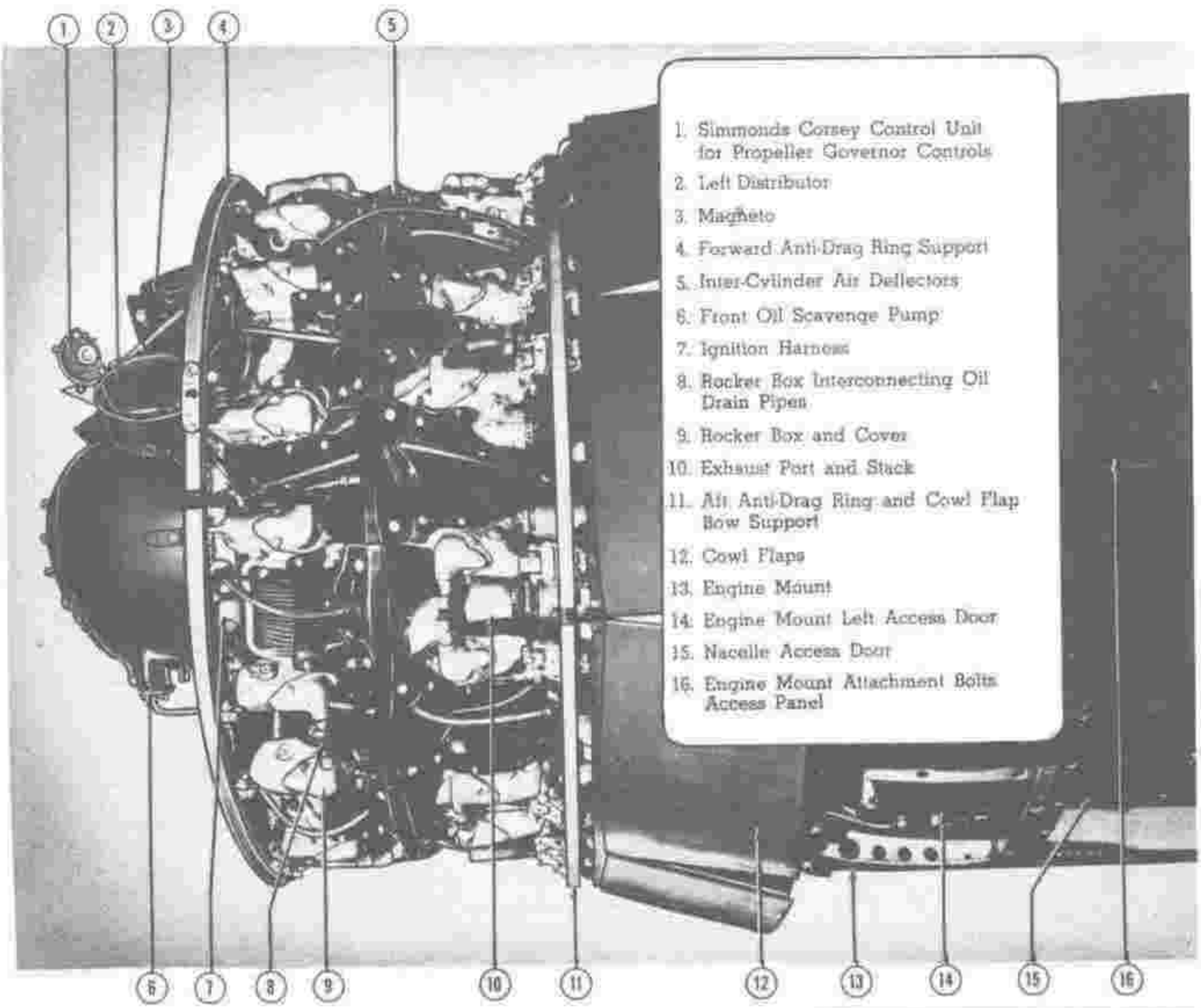
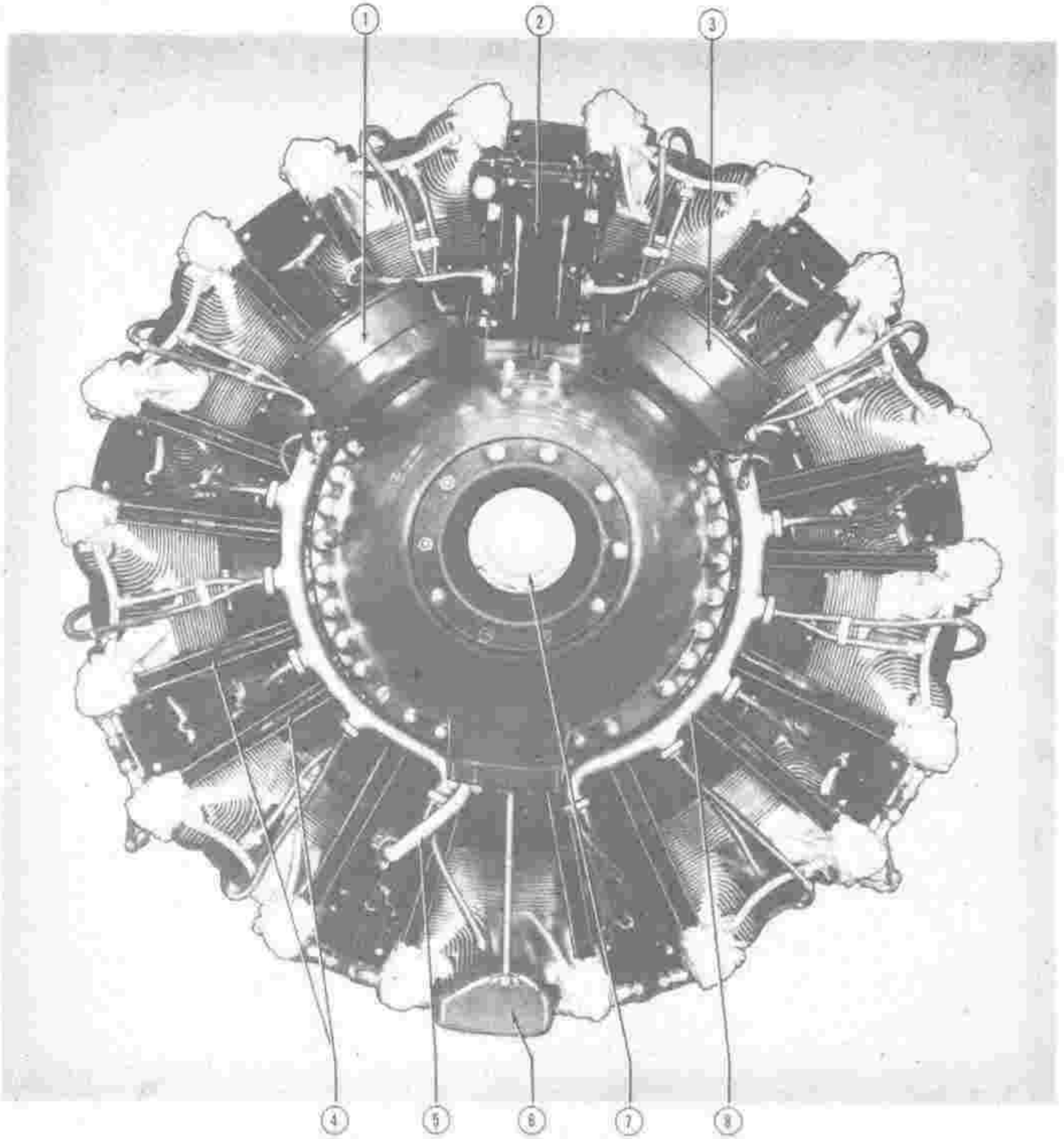
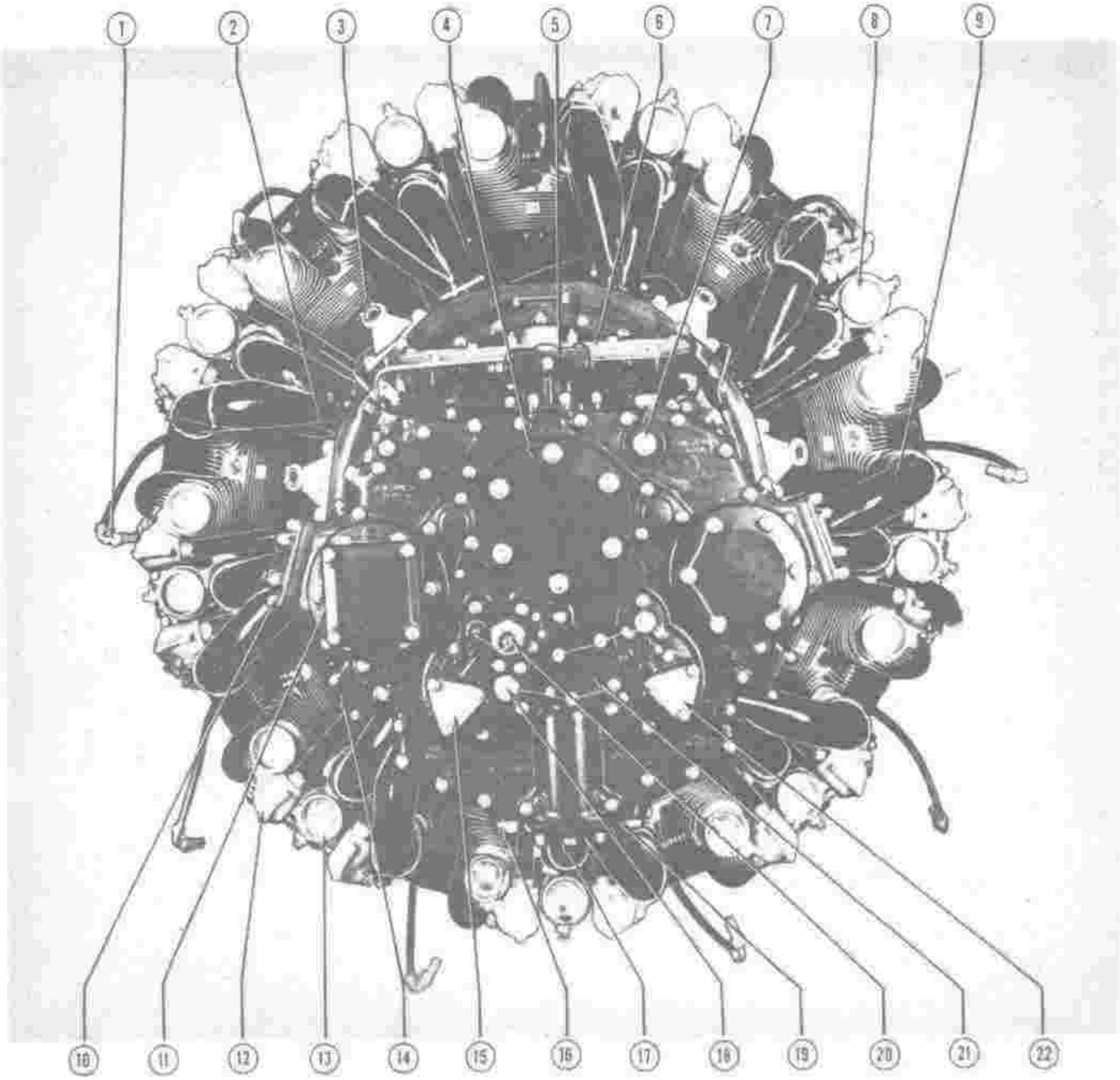


Figure 117—Engine Installed (Side View)



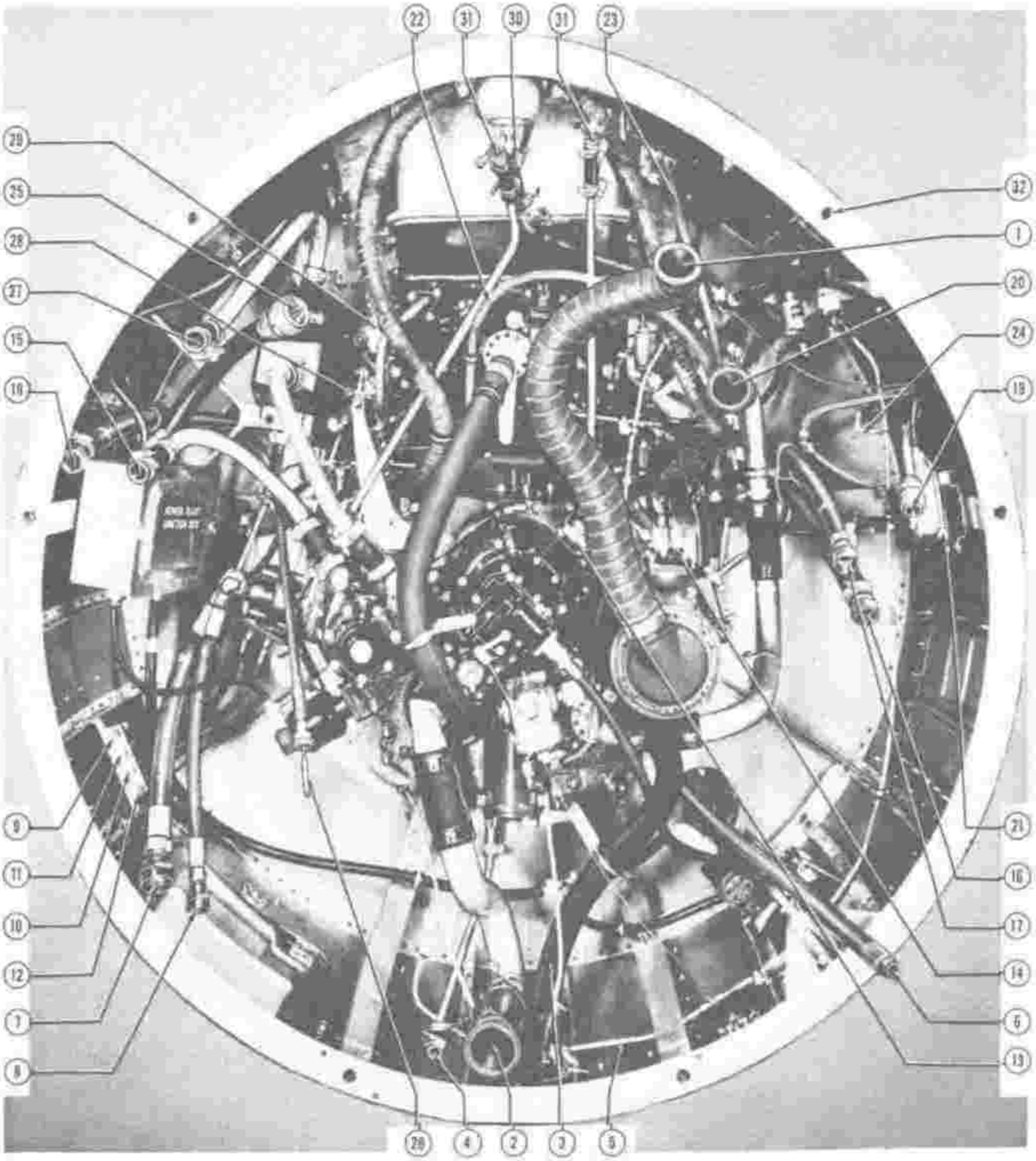
1. Right Distributor
2. Magneto
3. Left Distributor
4. Push Rod Cover Tubes
5. Oil Scavenge Line, Front Section to Blower Section
6. Rocker Box Drain Sump
7. Propeller Shaft
8. Ignition Harness

Figure 118 — Engine (Front View)



1. Spark Plug Lead Elbow
2. Primer Line
3. Engine Mounting Bracket
4. Starter Mounting Pad
5. Supercharger Low Speed Control
6. Carburetor Mounting Pad
7. Oil Tank Vent Connection
8. Exhaust Port
9. Intake Pipe
10. Hydraulic Pump Mounting Pad
11. Vacuum Pump Mounting Pad
12. Rocker Box
13. Rocker Box Interconnecting Pipes
14. Tachometer Drive Pad
15. Oil Inlet Pad
16. Rear Section Oil Drain Plug
17. Oil Pressure Screen Chamber Drain Plug
18. Oil Pressure Screen Chamber By-Pass Valve
19. Rear Section Scavenge Chamber Drain Plug
20. Compensating Relief Valves
21. Fuel Pump Drive Pad
22. Oil Outlet Pad

Figure 119 — Engine (Rear View)



1. Generator Blast Tube (Flexible Tube Not Shown)
2. Engine Oil — In Line
3. Fuel Supply Line
4. Supercharger Drain Line
5. Oil Dilution Line
6. Hydromatic Propeller Feathering Line
7. Hydraulic Supply Line
8. Hydraulic Pressure Line
9. Oil Pressure Transmitter Line
10. Fuel Pressure Gage Vent Line
11. Fuel Pressure Transmitter Line
12. Manifold Pressure Line
13. Starter Electrical Disconnect
14. Generator Electrical Disconnect
15. Vacuum Suction Line
16. Heat and Vent Exhaust Line
17. Heat and Vent Fuel Vapor Line
18. Heat and Vent Fuel Vapor Line
19. Ignition Disconnector Receptacle
20. Engine Oil — Out Line
21. Propeller Anti-Icer Line
22. Blower Control
23. Carburetor Airscoop Control
24. Thermocouple (Cylinder Head Temperature) Disconnector
25. Main Electrical Box Disconnector
26. Propeller Governor Control
27. De-Icer Pressure Line
28. Carburetor Throttle Control Rod
29. Carburetor Mixture Control Rod
30. Carburetor Vapor Vent Line
31. Oil Tank Vent Lines
32. Mount Bolt Hole (8 Holes)

Figure 120 — Quick Engine Change (Rear View of Engine)

(2) REMOVAL (QUICK ENGINE CHANGE).

(a) Remove the propeller as instructed in paragraph 10. *b.* (2), this section.

(b) Remove anti-drag ring cowling as instructed in paragraph 6. *b.* (14) *(b)*, this section.

(c) Remove access doors aft of the firewall which are held by Dzus fasteners.

(d) Remove the firewall center section which is also held by Dzus fasteners.

(e) Place a tail stand in position under the empennage.

(f) Drain the oil system as instructed in 12. *d.*, this section.

(g) Place the fuel container selector valve in the "OFF" position and drain the lines at the fuel strainer.

(h) Disconnect all electrical plugs at the firewall.

(i) Disconnect the two hydraulic lines at the firewall by unscrewing the self-sealing disconnect couplings. When unscrewed, these couplings cut off the flow of fluid immediately.

(j) Disconnect and cap all oil, fuel, and vacuum lines.

(k) Disconnect engine controls at firewall.

(l) Place the engine hoisting stand and equipment in position. Hook the sling cables to the engine hoisting eye brackets.

(m) Remove the four small oblong cover plates on the upper portion of the nacelle, aft of the engine mount.

(n) With the hoist slackened, remove the two lower engine mount bolts which are reached through the lower forward corner of each access door of each nacelle.

(o) With the hoist supporting almost the entire weight of the engine, unscrew the four remaining engine mount bolts and remove the engine.

(3) TOP OVERHAUL.—Refer to information pertaining to the component parts which comprise the engine assembly.

(4) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Check the table of recommended torque valves given at the end of this part. Engine mount attaching bolts should be tightened to a torque of 480-690 inch-pounds.

(5) CYLINDER GROUP.

(a) GENERAL.—The cylinder group includes the intake pipes, the valve assembly, cylinders, cooling air baffle and deflectors, and the piston assembly. The valve assembly includes the push rods and covers, the rocker box mechanism and the valves—the piston assembly includes pistons, piston pins, and rings. Only parts which may be removed on the field (TOP OVERHAUL) are considered.

(b) INTAKE PIPES.

1. DESCRIPTION.—Eighteen stainless steel intake pipes are connected by packing nuts to the outlet ports of the blower case and to the inlet ports of the cylinders.

2. REMOVAL.—Loosen the packing nuts at the blower section and at the cylinder end with the Intake Pipe Packing Nut Wrench; then remove intake pipes from the engine.

3. TOP OVERHAUL.—Intake pipes should be replaced.

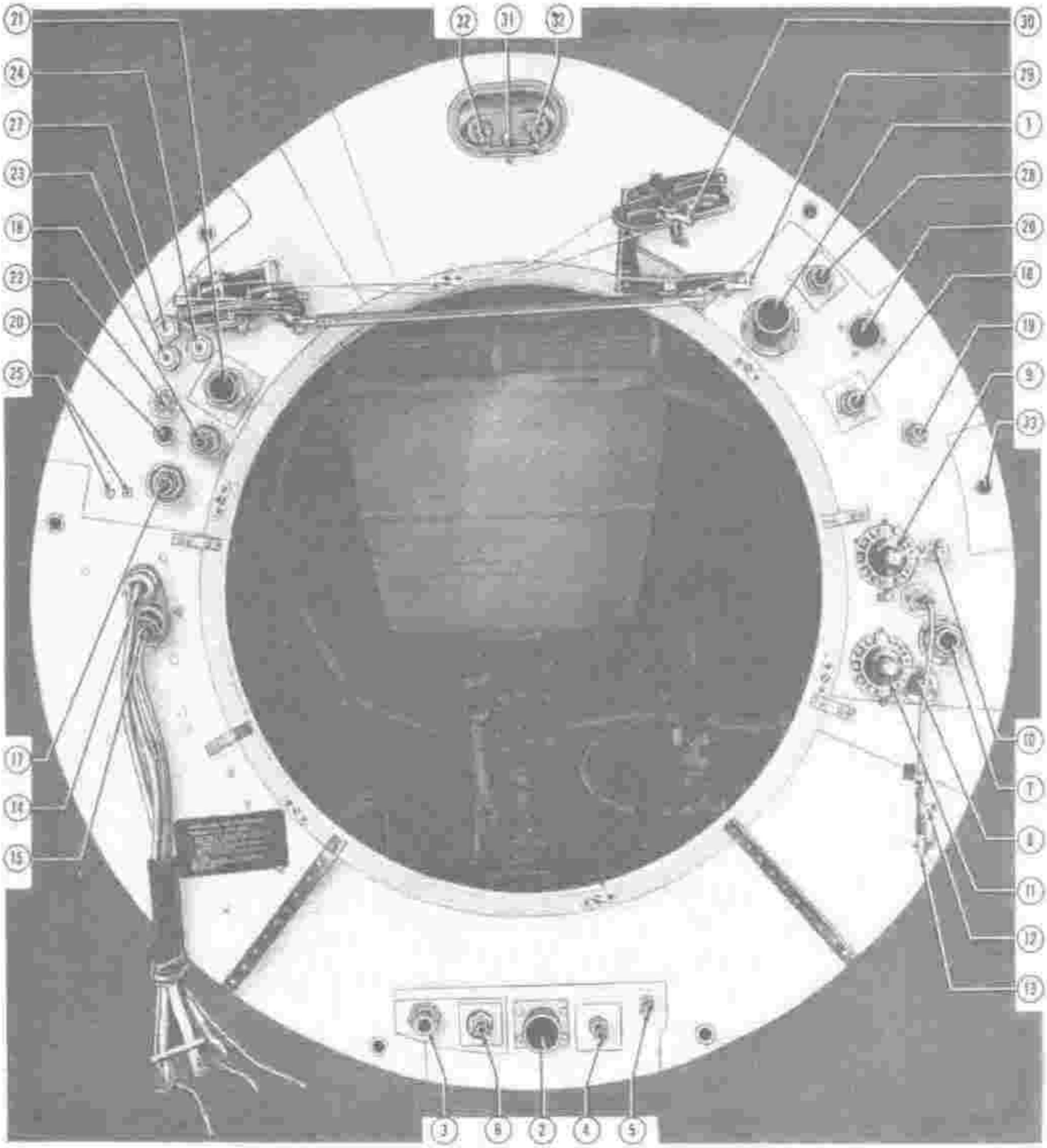
4. INSTALLATION.—Slip the packing and gland nut into place over the blower end of each intake pipe. Install the two rubber seal rings and spacer in place on the cylinder end of each intake pipe. The ring with the larger outer diameter should be placed just forward of the flange, and the one with the smaller outer diameter just to the rear of the flange. In order to prevent leaks around the seals, each pipe should be assembled as follows:

a. Set the pipe in place and tighten the nut at the blower case end one turn. Tighten the nut at the cylinder end of the pipe hand tight; loosen it, pull it back, and inspect the rubber seal rings to make certain that they are properly located inside the intake pipe coupling.

b. When properly located, thread the nut onto the coupling, and tighten it with the Intake Pipe Coupling Nut Wrench. Tighten the nut at the blower case end of the pipe. Care should be used during tightening to avoid damaging the pipe. Secure the coupling nuts with safety wire.

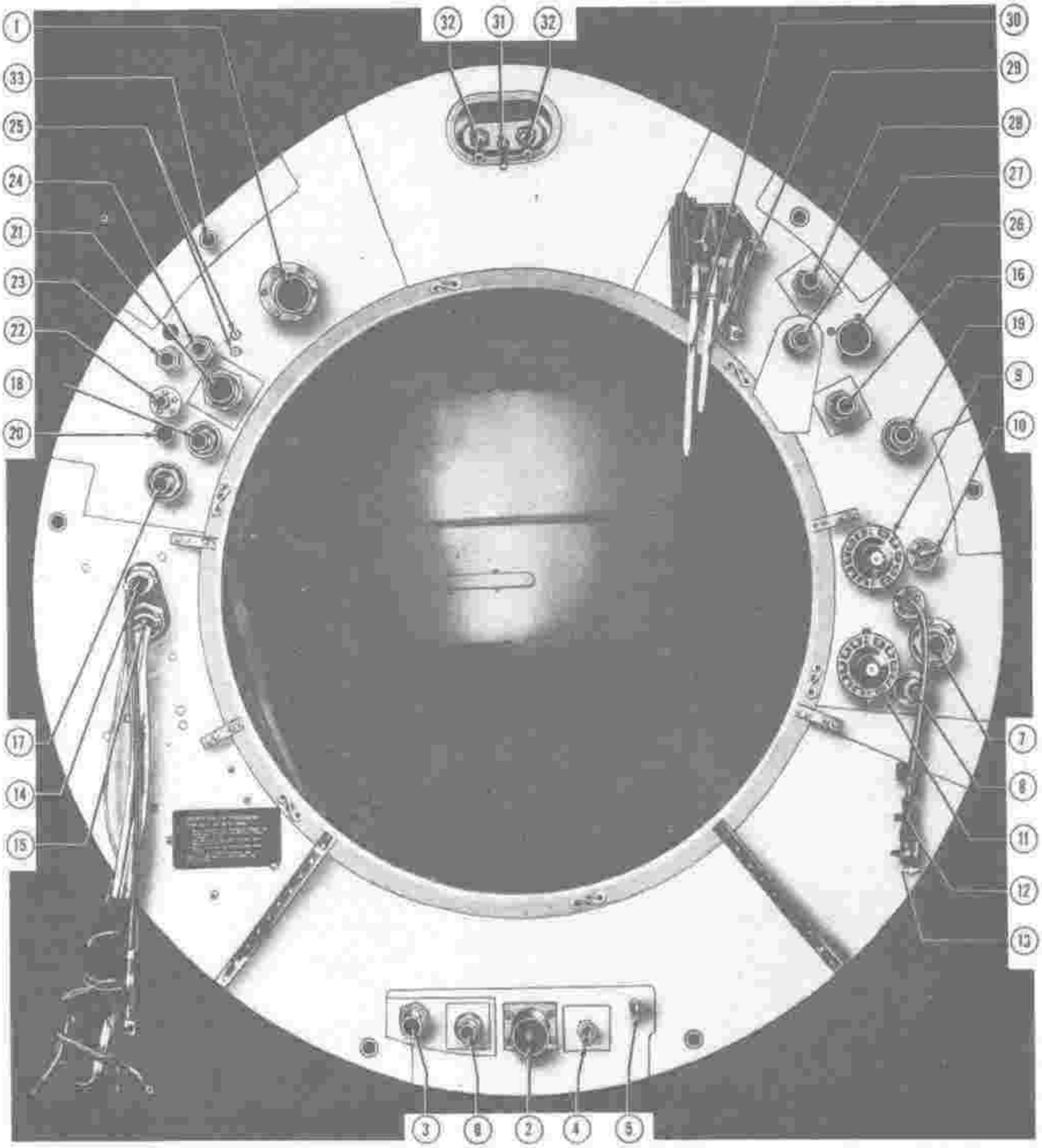
(c) VALVE ASSEMBLY.

1. GENERAL.—The valve assembly consists of the push rods and covers, the rocker box covers, rocker box arms, rocker box drain sump, and the valves. Only parts which may be removed on the field (TOP OVERHAUL) are considered.



1. Carburetor Blast Tube (Flexible Tube Not Shown)
2. Engine Oil — In Line
3. Fuel Supply Line
4. Supercharger Drain Line
5. Oil Dilution Line
6. Hydromatic Propeller Feathering Line
7. Hydraulic Supply Line
8. Hydraulic Pressure Line
9. Oil Pressure Transmitter
10. Fuel Pressure Gage Vent Line
11. Fuel Pressure Transmitter
12. Manifold Pressure Line
13. Drain Cock
14. Starter Electrical Disconnect
15. Generator Electrical Disconnect
16. Vacuum Suction Line
17. Heat and Vent Exhaust Line
18. Heat and Vent Fuel Vapor Line
19. Heat and Vent Fuel Vapor Line
20. Ignition Disconnect Receptacle
21. Engine Oil — Out Line
22. Propeller Anti-Icer Line
23. Blower Control
24. Carburetor Air Scoop Control
25. Thermocouple (Cylinder Head Temperature) Disconnector
26. Main Electrical Box Disconnector
27. Propeller Governor Control
28. De-Icer Pressure Line
29. Carburetor Throttle Control Rod
30. Carburetor Mixture Control Rod
31. Carburetor Vapor Vent Line
32. Oil Tank Vent Lines
33. Mount Bolt Hole (4 Holes)

Figure 121 — Quick Engine Change (L.H. Firewall)



1. Generator Blast Tube (Flexible Tube Not Shown)
2. Engine Oil — In Line
3. Fuel Supply Line
4. Supercharger Drain Line
5. Oil Dilution Line
6. Hydromatic Propeller Feathering Line
7. Hydraulic Supply Line
8. Hydraulic Pressure Line
9. Oil Pressure Transmitter
10. Fuel Pressure Gage Vent Line
11. Fuel Pressure Transmitter
12. Manifold Pressure Line
13. Drain Cock
14. Starter Electrical Disconnect
15. Generator Electrical Disconnect
16. Vacuum Suction Line
17. Heat and Vent Exhaust Line
18. Heat and Vent Fuel Vapor Line
19. Heat and Vent Fuel Vapor Line
20. Ignition Disconnector Receptacle
21. Engine Oil — Out Line
22. Propeller Anti-Icer Line
23. Blower Control
24. Carburetor Airscoop Control
25. Thermocouple (Cylinder Head Temperature) Disconnector
26. Main Electrical Box Disconnector
27. Propeller Governor Control
28. De-Icer Pressure Line
29. Carburetor Throttle Control Rod
30. Carburetor Mixture Control Rod
31. Carburetor Vapor Vent Line
32. Oil Tank Vent Lines
33. Mount Bolt Hole (6 Holes)

Figure 122 — Quick Engine Change (R.H. Firewall)

2. PUSH RODS AND COVER.

a. DESCRIPTION.—Tappers located in the front and rear main crankcase sections actuate the rocker arms by tubular aluminum alloy push rods which have steel ball end caps. The push rods are protected by removable two-piece oil tight push rod cover tubes held in place by a packing nut at each end. The push rod cover tubes telescope together at the center, the joints being covered with short rubber sleeves.

b. REMOVAL AND DISASSEMBLY.

(1) Remove the rocker box cover and rocker arms as instructed in paragraph 6. *b.* (5) *(c)* 3., this section.

(2) Loosen the push rod cover nuts and partially telescope the push rod cover tubes together.

(3) Turn the propeller shaft until the piston in the desired cylinder is at the top of its compression stroke (both valves closed).

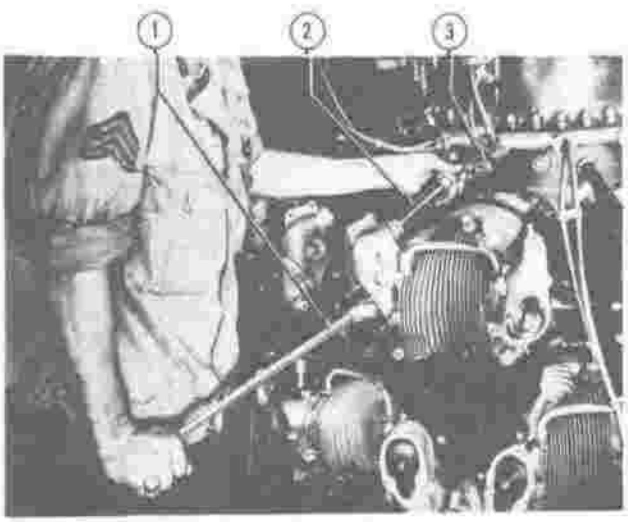
(4) Depress the valve springs with the rocker arm depresser and remove each push rod and cover.

c. TOP OVERHAUL.

(1) Examine push rod ball-ends for looseness and wear (a clear ringing sound when a push rod is dropped on a bench indicates that the ball-ends are tight).

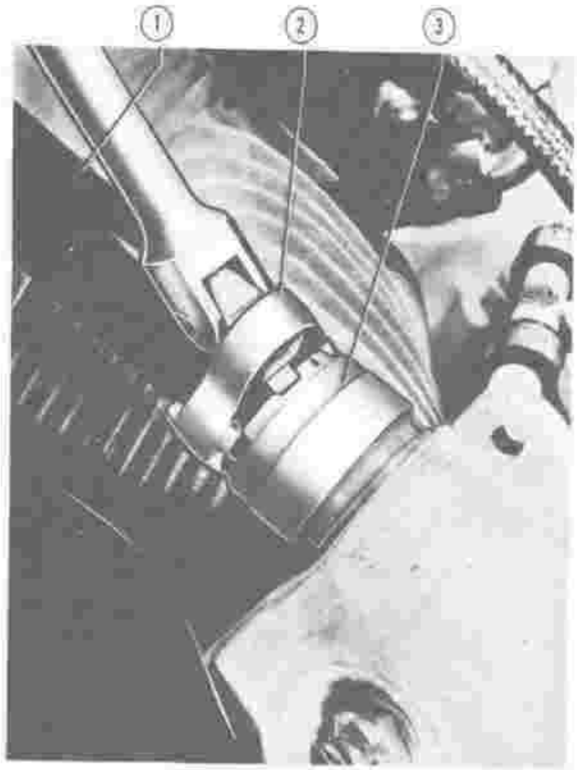
(2) Inspect for cracks.

(3) Test for straightness by rolling on a flat plate.



1. Rocker Arm Depressor
2. Push Rod Cover Tubes
3. Push Rod Socket

Figure 123 — Push Rod Cover Tube Removal



1. Push Rod Cover Tube
2. Push Rod Cover Tube Gland Nut Wrench
3. Push Rod Cover Tube Gland Nut

Figure 124 — Push Rod Cover Tube Gland Nut Removal

(4) Examine push rod covers for cracks, especially at the flange and telescoping ends. Inspect condition of the gland nuts.

Note

If any of the above conditions are extreme, replace the part.

(5) Look for evidence of oil leakage at the push rod cover tube packing nuts, but do not tighten nuts in excess of 75 inch-pounds of torque. Too much tightening will tend to nick the pipes and disturb the packing.

d. ASSEMBLY AND INSTALLATION.

(1) The push rod cover tube assembly consists of a larger and a smaller tube which telescope together with a rubber sleeve covering the joint. To prevent oil leaks at this joint, the smaller tube should be above the larger tube when the engine is installed.

(2) The following table indicates the proper positioning of the tube for each valve:

Small Tube Nearest Cylinder End		*Small Tube Nearest Crankcase End*	
No. 1	Intake	No. 5	Intake
No. 1	Exhaust	No. 7	Intake
No. 3	Intake	No. 7	Exhaust

Small Tube Nearest Cylinder End		*Small Tube Nearest Crankcase End*	
No. 3	Exhaust	No. 9	Intake
No. 17	Intake	No. 9	Exhaust
No. 17	Exhaust	No. 11	Intake
No. 5	Exhaust	No. 11	Exhaust
No. 15	Intake	No. 13	Intake
No. 2	Intake	No. 13	Exhaust
No. 2	Exhaust	No. 15	Exhaust
No. 4	Intake	No. 6	Intake
No. 4	Exhaust	No. 8	Exhaust
No. 16	Intake	No. 8	Intake
No. 16	Exhaust	No. 10	Intake
No. 18	Intake	No. 10	Exhaust
No. 18	Exhaust	No. 12	Intake
No. 6	Exhaust	No. 12	Exhaust
No. 14	Intake	No. 14	Exhaust

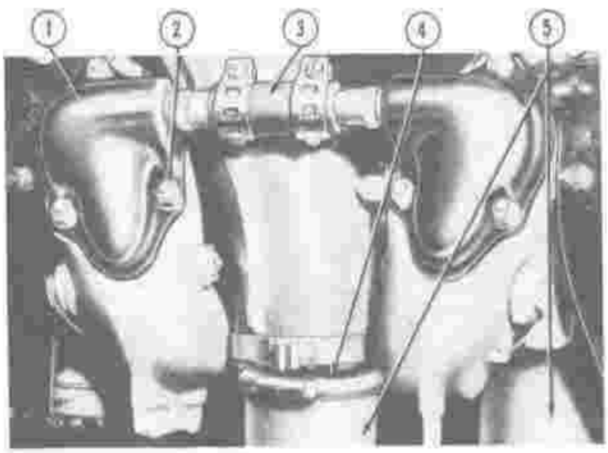
(3) Do not lubricate the tubes before telescoping them.

(4) Assemble each push rod and cover in its proper position with the numbered ball-end at the tappet end. Turn the crankshaft until the tappet which actuates the push rod may be pushed into its guide. Depress the rocker arm with the rocker arm depresser and fit the push rod cover in position. Tighten the push rod cover gland nut at the tappet guide end first; then the nut at the rocker arm end.

CAUTION

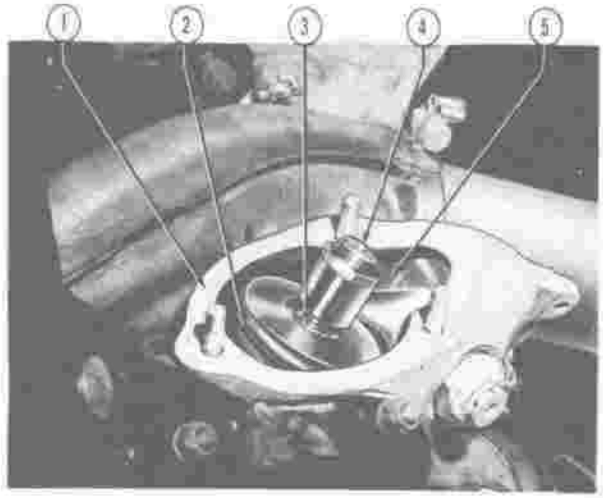
Tighten the nuts to a torque of 75-inch pounds. Excessive tightening may cause tappets to stick in their guides.

(5) The inner exhaust and intake push rod cover gland nuts at the tappet ends should be safety wired together in pairs; the gland nuts at the rocker arm ends must be safety wired to the adjacent rocker shaft nuts.



1. Rocker Box Cover
2. Rocker Box Cover Attaching Nut
3. Rocker Box Interconnecting Drain Pipes
4. Exhaust Stack Clamp (Pratt and Whitney Type)
5. Exhaust Stacks

Figure 125 — Rocker Box Covers and Exhaust Stack Installation



1. Rocker Box
2. Valve Spring
3. Valve Split Locks
4. Valve Adjusting Screw
5. Rocker Arm

Figure 126 — Rocker Arm and Valve Spring Installed

3. ROCKER BOX MECHANISM.

a. DESCRIPTION.—The rocker arms are supported on double row ball bearings in housings cast integral with the cylinder heads. Rocker housing covers are secured by studs and elastic stop nuts. The rocker arms are equipped with valve clearance adjusting screws and lock nuts, the action of the rocker being transmitted to the end of the valve stem through a half-ball and socket in the lower end of each adjusting screw.

b. REMOVAL AND DISASSEMBLY.

(1) ROCKER BOX COVERS.

(a) Unscrew the inner push rod cover gland nuts of the rear bank with the cover gland nut wrench P.W.A. 1600. This allows the oil to drain from the rear bank rocker boxes.

(b) Remove the elastic stop nuts on the rocker box cover.

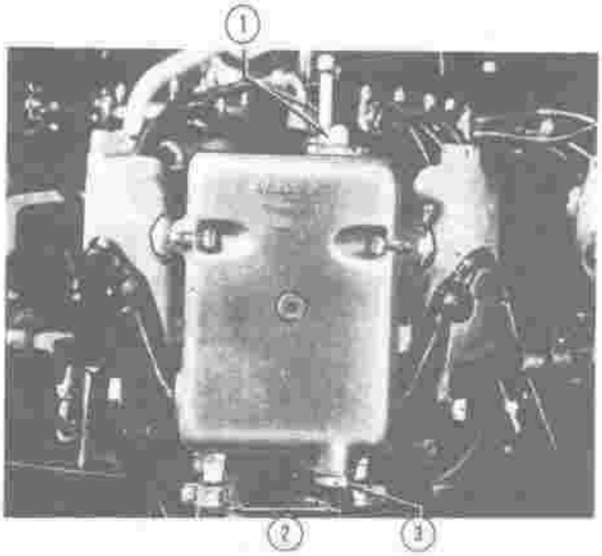
(c) Remove the rocker box covers in pairs with the connecting inter-cylinder scavenge pipes first from the rear bank, and then from the front bank.

(2) ROCKER ARMS.

Note

Be certain that the valve is closed before attempting to remove a rocker arm.

(a) Remove the cap and gasket from the large end of the rocker shaft and the nut and



1. Outlet Line to Front Oil Scavenge Pump
2. Inlet Lines
3. Drain Sump Plug

Figure 127 — Rocker Box Drain Sump

washer from the small end of the rocker shaft.

(b) Tap out the rocker shaft, using a suitable drift, and lift the rocker arm out of the box.

(3) ROCKER BOX DRAIN SUMP.

(a) Disconnect the oil suction pipe that connects the sump to the front scavenge pump.

(b) Remove drain sump plug, drain oil, and replace plug.

(c) Loosen the clamps which secure the two rubber hose connections.

(d) Remove the pipes attached to the reduction gear housing and blower section.

(e) Remove the two fillister head screws which secure the rocker box drain sump to the rocker shafts of number 10 cylinder.

(f) Remove the two plugs at the rear of the rocker housings on number 10 cylinder, and unscrew the two hollow studs using the Rocker Box Drain Sump Support Nut Wrench.

CAUTION

Remove the brass washer, the rubber seal and the steel washer around the hollow stud carefully.

(g) Remove the sump together with the attached number 11 exhaust and number 9 intake rocker box covers.

c. TOP OVERHAUL.

(1) If the movement of the rocker arm bearing on its axis permits a tilt in excess of .015 inch, replace the bearing.

(2) Since the exhaust rocker bearings are subject to greater wear, it is advisable to shift exhaust and intake bearings whenever wear becomes apparent. If only part of a new set of rocker arms are installed, always put them in the exhaust rocker shafts.

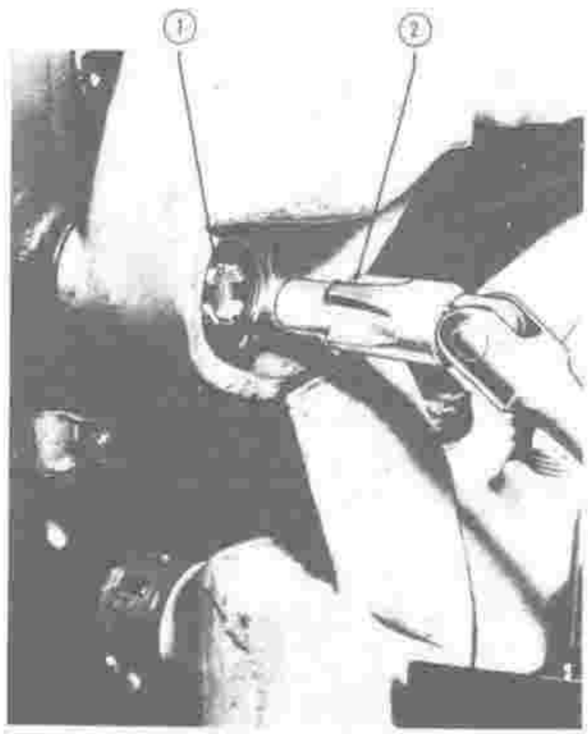
(3) Examine the push rod ball sockets for looseness and wear. Replace any socket that has a flat area in excess of 1/32 inch width.

(4) Check the valve adjusting screw assemblies for burred threads. Inspect the half-ball for unusual wear, looseness in its socket, nicks, or a pitted condition. Inspect the screw for cracks.

(5) Face the rocker box covers on a lapping plate with a small amount of lapping compound. This insures that the cover bears evenly on the gasket and prevents oil leakage. Wash the covers thoroughly to remove all traces of the lapping compound.

d. ASSEMBLY AND INSTALLATION.

(1) Align the oil holes in the rocker bearings with the oil passages in the rocker arms. Press the bearings into the rocker arms using an arbor press.



1. Rocker Box Drain Sump Support Nut
2. Rocker Box Drain Sump Support Nut Wrench

Figure 128 — Rocker Box Drain Sump Support Nut Removal

(2) Rotate the inner race of the rocker bearing so that the filling notches (if present) are 180° apart; then install the rocker arms in the cylinders, and install the rocker shafts. Drive the shafts into position with a suitable drift.

(3) Install the necessary gaskets, oil seals, and steel washers and secure the shafts in place with the nuts. The proper procedure for tightening rocker shaft nuts is to tighten snugly (approximately 35 in.-lbs.) and then turn to the next cotter pin hole.

(4) Place a new rocker box gasket in position.

(5) Install the rocker box cover, tightening the nuts to a torque of 75 inch-pounds.

(6) Reverse the procedure outlined above for installation of the rocker box drain sump. Exercise extreme care in getting proper alignment of the washers and rubber seal in order to prevent oil leakage.

e. ADJUSTMENTS.

(1) VALVE CLEARANCE.—No inspection or adjustment of the valve mechanism is necessary between overhauls except in an emergency.

(a) Adjust valve clearances in the same sequence as the firing order of the cylinders. Start with Cylinder No. 1.

(b) Back off the valve clearance adjusting screws several turns to insure that all clearances are loose.

(c) Using the top dead center indicator, place the piston of No. 11 cylinder on exact top dead center of its exhaust stroke. Turn the crankshaft in the direction of normal rotation for all timing procedures.

(d) Using two rocker arm depressers, (PWA 455), relieve the valve spring load on tappets 7 and 15.

Note

Never depress any valve that is not at least half opened. This will prevent the push rod from becoming accidentally disengaged from the rocker arm socket.

(e) The procedure above allows the cam to slide over so that it is in contact with the cam bearing adjacent to the cylinder whose valve clearance is being set *(figure 130)*.

(f) Adjust the valve clearance to .060-inch cold clearance.

CAUTION

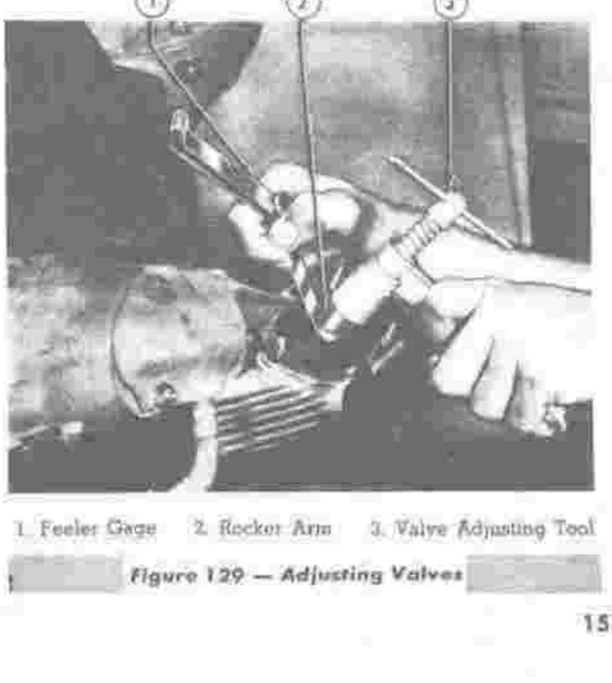
Do not tighten valve adjusting screw locknuts excessively. The recommended torque is 275 inch-pounds.

(g) Adjust all valves in this manner in the order shown in *figure 130*.

(h) Turn the propeller shaft two revolutions with the propeller shaft turning bar, and recheck all clearances in the same order. If clearances vary more than .005 inch from the correct amount, they must be reset.

Note

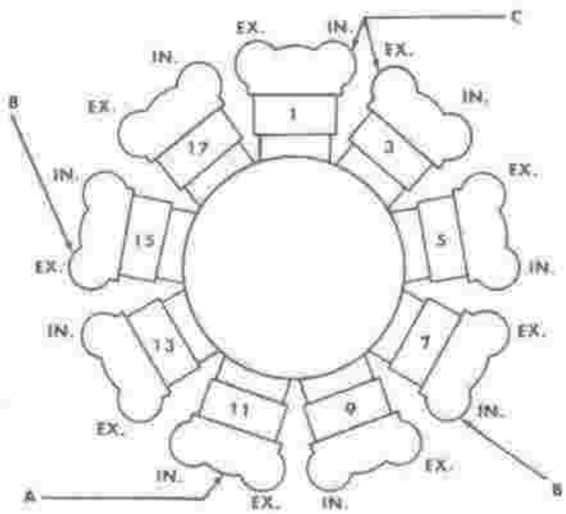
After all the valve clearances have been properly adjusted, not more than 5 threads or less than 1½ threads of any adjusting screw will be showing above the lock nut. There should be at least .031-inch clearance between the edge of the outer valve spring washer and the rocker arm with the valve in the closed position. This clearance may be checked by passing a .031-inch diameter wire between the rocker arm and the outer valve spring washer. If it is necessary to increase this clearance, grind the flat face of one or both of the push rod ball end spacers enough to obtain the correct clearance, providing that the proper positioning of the adjusting screw can be maintained. Do not grind either spacer to less than .060-inch thickness. If it is impossible to obtain a clearance of at least .031-inch and, at the same time, to maintain the proper positioning of the adjusting screw, the radius on the under side of the rocker arm should be checked with the rocker arm template gage, and ground to the correct contour. The spacers should be ground in the previously described manner if more than five threads of the valve adjusting screws show above the lock nut. If less than 1½ threads of the adjusting screws show above the lock nut, replace one or both of the push rod ball end spacers with a thicker spacer. Install spacers with the curved surface toward the ball end, and use only one spacer under each ball end.



1. Feeler Gage 2. Rocker Arm 3. Valve Adjusting Tool

Figure 129 — Adjusting Valves

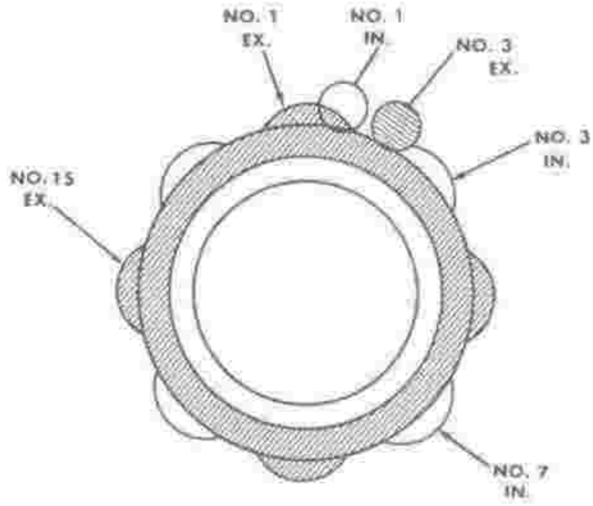
REAR VIEW OF R-2800-REAR BANK



A—SET TO TOP DEAD CENTER ON EXHAUST STROKE

B—MOMENTARILY DEPRESS THESE VALVES SIMULTANEOUSLY

C—SET THESE VALVE TAPPETS



REAR CAM AND TAPPETS (REAR VIEW)

LOADED TAPPETS (ON CAM LIFTS)

TAPPETS TO BE SET (INTAKE)

TAPPETS TO BE SET (EXHAUST)

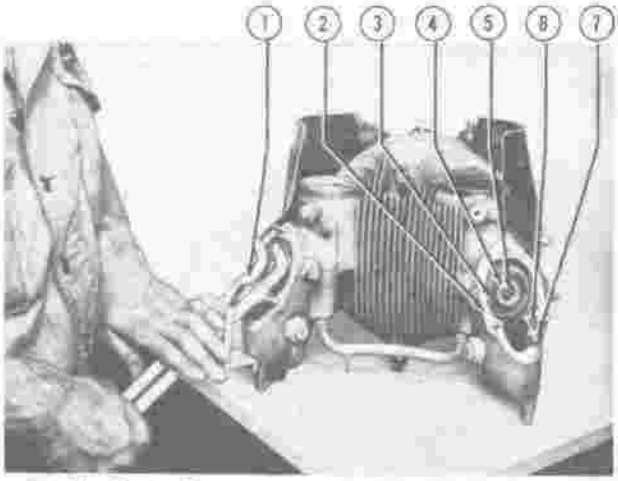
TABLE FOR ADJUSTING VALVE CLEARANCES ON R-2800 ENGINES

TO SET VALVE		SET THIS PISTON ON TOP DEAD CENTER ON THE EXHAUST STROKE	RELIEVE PRESSURE ON THESE TAPPETS	
IN.	EX.	CYLINDER No.	IN.	EX.
1	3	11	7	15
12	14	4	18	8
5	7	15	11	1
16	18	8	4	12
9	11	1	15	5
2	4	12	8	16
13	15	5	1	9
6	8	16	12	2
17	1	9	5	13
10	12	2	16	6
3	5	13	9	17
14	16	6	2	10
7	9	17	13	3
18	2	10	6	14
11	13	3	17	7
4	6	14	10	18
15	17	7	3	11
8	10	18	14	4

Fig. 130—Instructions for Adjustment of Valve Clearances

4. VALVES.

a. DESCRIPTION.—One inlet and one exhaust valve is installed in each cylinder. The exhaust valves are of hollow head and stem design and are sodium cooled with a seating face of stellite. Two concentric valve springs secured to the stems by split cone locks and washers are used at each valve. The "B" series engines have heavy inlet valve springs which are not interchangeable with the exhaust valve springs.



1. Valve Spring Compressor (PWA 459)
2. Rocker Box
3. Valve Spring
4. Valve Split-Lock
5. Valve
6. Rocker Arm
7. Valve Adjusting Screw

Figure 131 — Valve Spring Compressor

b. REMOVAL AND DISASSEMBLY.—This operation *must be done* with the cylinder removed from the engine. (See paragraph 6. *b.* (5) *(c)* 3., this section.

(1) Place the cylinder over a wooden block which has the same contour as the inside of the cylinder head.

(2) Compress the valve springs with the valve spring compressor. Remove the split locks which hold the outer valve spring washer in position.

(3) Lift out the valve springs and washers.

(4) Remove the cylinder from the block and lift out the valves. Do NOT let the valves fall out and strike the cylinder wall.

(5) Place the valves in a rack or otherwise protect them during overhaul to insure correct reassembly.

c. TOP OVERHAUL.

(1) Check the exhaust valves with the valve radius stretch gage by holding the edge of the gage against the stem of the valve, and the curvature of the gage against the radius of the valve head. A clearance of 1/32 inch between the gage and the valve is cause for valve replacement.

(2) Valves which have creases, or show signs of swelling or drawing where the head joins the stem must be replaced.

(3) Inspect the lock grooves for wear, galling, or burns.

(4) Inspect the valve heads for excessive pitting or erosion.

(5) Examine the valve springs for cracks, rust, or pit marks.

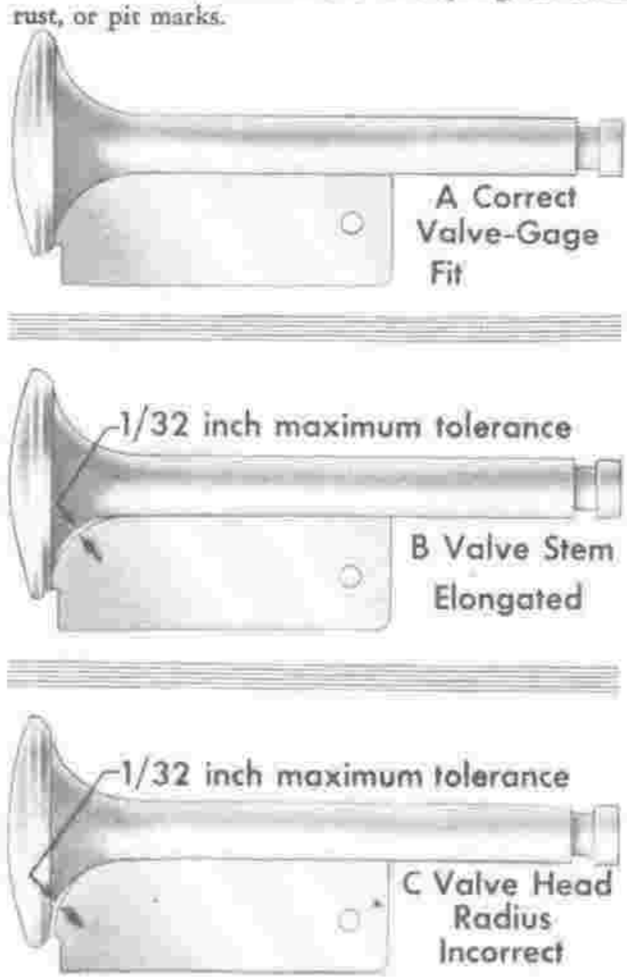


Figure 132—Valve Radius Stretch Gage

d. ASSEMBLY AND INSTALLATION.—This operation must be done with the cyliuders removed from the engine.

(1) Clean and oil the valve stems and guides before installing them in the cylinders.

(2) Place each valve in position and set the cylinder over a dome-headed wooden block to hold the valves in place during assembly of the valve springs.

(3) Place the lower valve spring washer, the inner and outer valve springs, and the upper valve

spring washer in position. Compress the valve springs with the valve spring compressor (PWA-459) and install the split cone locks which hold the valve, springs, and washers in place.

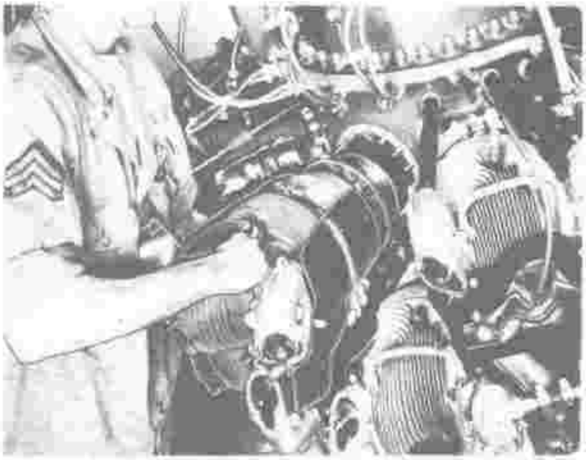
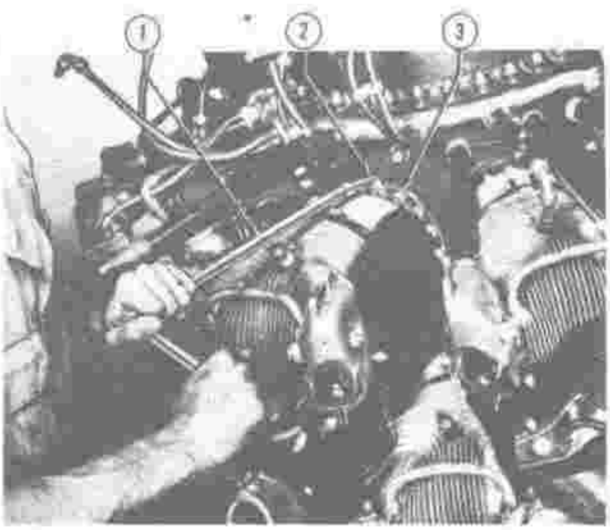


Figure 133—Cylinder Removal

(d) CYLINDERS.

1. DESCRIPTION.—The cylinder barrels are machined from steel forgings and have an aluminum sleeve with deep integral cooling fins shrunk onto the central portion. The heads are machined from aluminum alloy castings, having closely spaced cooling fins and integral rocker housing. Each cylinder has one inlet and one exhaust valve, the inlet valve seating on a bronze insert, and the exhaust on a steel insert. The cylinder-head also incorporates bronze inlet and exhaust valve guides, bronze bushings for two spark plugs, and four steel inserts for supporting the two rocker arm shafts.



1. Extension 2. Hold Down Nut Wrench 3. Hold Down Nut

Figure 134 — Hold Down Nut Removal

2. REMOVAL AND DISASSEMBLY.

a. Remove all anti-drag ring cowling which would interfert with the necessary work on the engine. (See paragraph 6. *b.* (14) *(b)*, this section.)

b. Remove all front spark plug lead elbows from the spark plugs and remove the spark plugs with the spark plug wrench. Remove the rear spark plug elbow and rear spark plug from the cylinder to be removed.

c. Turn the propeller shaft with the propeller shaft turning bar until the piston of the cylinder to be removed is on top center of the compression stroke. Remove No. 8 and 13 master rod cylinders last. Remove the circular clamps which fasten the exhaust piping to the cylinder.

d. Remove the rocker box covers and the rocker arms as instructed in paragraph 6. *b.* (5) *(c)*.

e. Remove all primer lines which are fastened to the intake pipes. Unscrew packing nuts which secure intake pipes to the blower section and unions at the cylinder inlet ports, using intake pipe coupling nut wrench (PWA-1786).

f. Remove the push rods and push rod cover tubes as instructed in paragraph 6. *b.* (5) *(c)* 3. b., this section.

g. Remove the small cap plates from the cylinder head deflector and lift out the braided ignition wire conduit and rubber grommet from the slots in the cylinder head deflector. Remove the elastic stop nuts holding the head deflector and remove the head deflector. Remove the clamps which hold the braided ignition wire conduits to the cylinder. Remove the small deflector baffle plates between adjacent front and rear row inter-cylinder deflectors by unfastening the retaining screws.

CAUTION

If the master rod cylinder is to be removed, to hold the master rod in the center of the crankcase opening so it cannot turn to either side upon removal of the cylinder. This may be done by blocking the master rod. If the master rod is permitted to move sideways, the bottom ring on some of the other pistons will come out of the cylinders and may seriously damage the pistons and skirts of these cylinders.

h. Remove the cylinder hold-down nuts using wrenches PWA-2394, PWA-2396, or PWA-2400 with suitable handles. Remove cylinder.

i. Cover the openings in the crankcase and blower sections to prevent the entrance of foreign material.

Note

If several cylinders are to be removed, the master rod cylinder must be removed last and installed first. The master rod cylinder on the front bank of cylinders is No. 8, and on the rear bank it is No. 13.

5. TOP OVERHAUL.

a. If two or more center head fins are cracked the entire length, the cylinder should be discarded. Small cracks in the head fins are not cause for rejection.

b. Examine the following parts for cracks:

(1) Inside surface of the cylinder head.

(2) Inlet and exhaust ports.

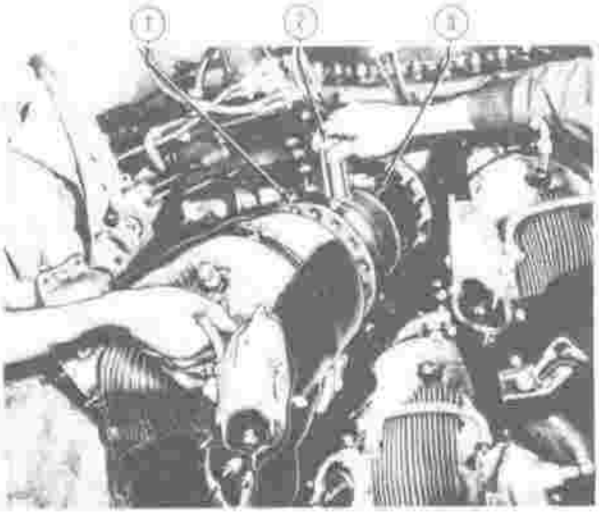
(3) Strengthening rib on the front of the valve housing.

(4) Heavy flange at base of cylinder head.

(5) Inside of rocker box walls for cracks and valve spring chafing.

(6) Cylinder barrel for cracks and scoring.

c. Check the cylinder hold down flange for flatness, squareness, and trueness with the cylinder barrel flange surface plate, using Prussian Blue dye. An uneven seating surface may be corrected by lapping the flange on the cylinder barrel flange lapping fixture, provided the flange is not uneven or distorted more than .005 inch.



1. Cylinder 2. Piston Pin 3. Piston

Figure 135 — Installing Cylinder

4. ASSEMBLY AND INSTALLATION.

a. Install the rocker arms as described in 6. *b.* (5) 3. c., this section.

b. Install the valves as instructed in paragraph 6. *b.* (5) 4. d., this section.

c. Install and tighten the cylinder hold-down nuts. The torque indicating handle wrench (PWA-2239) will be used, whenever possible, to tighten the nuts to a torque of 450 in.-lbs.; with PWA-2394, PWA-2396, or PWA-2400 wrenches.

CAUTION

When using a wrench with a plain handle, do not tighten the nuts excessively as the studs may be stretched or broken.

d. Fit the proper seals on each end of the intake pipe and insert the pipe in the blower. Screw the packing nut in the blower loosely, then screw the upper packing nut on the union of the cylinder inlet port, and tighten with PWA-1786 wrench.

e. Depress the valves and install push rods and covers. Apply a torque of 75 in.-lbs. for tightening the cover gland nuts. Each push rod is marked with its position and will be installed according to the markings. The markings are on the tappet ends of the push rods.

Note

The two-piece telescoping push rod cover tubes must be installed so that the smaller diameter tubes are fastened to the rocker boxes of the cylinders above the horizontal centerline of the engine and to the tappet guides for cylinders below the horizontal centerline of the engine.

CAUTION

Be sure the rubber oil seal rings are in the grooves provided at the tappet guide and rocker box connections for each push rod cover tube. Do not tighten these connections excessively because the seal may be cut or damaged, causing leakage.

f. Adjust the valve clearance in accordance with the procedure described in paragraph 6. *b.* (5) *(c)* 4. *e.*, this section. Install new rocker box cover gaskets. Install the covers in pairs as they were removed. Secure the covers with elastic stop nuts.

g. Install all spark plugs and connect spark plug leads to the spark plus. Install all primer lines, oil pipes, etc.

h. Fasten the exhaust piping to the exhaust port of the cylinder with the circular clamps and replace the anti-drag ring cowling sections.

Note

The preceding installation instructions are based on the assumption that the connecting rod assembly was not moved after cylinder removal and that the piston is on the top dead center of the compression stroke of the cylinder being installed.

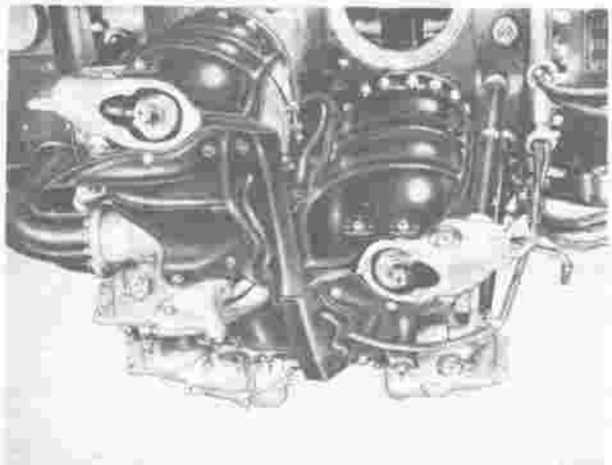


Figure 136—Inter-Cylinder Air Deflectors

(e) COOLING AIR BAFFLES AND DEFLECTORS.

1. DESCRIPTION.–Pressure type air deflectors are installed between the rocker housings on each cylinder head and between adjacent front and rear row cylinders. The baffles have air blast tubes which cool the rear spark plugs and ignition leads on each row of cylinders.

2. REMOVAL AND DISASSEMBLY.

a. Remove the top plate from each cylinder inter-ear air deflector by unfastening the two Dzus fasteners.

b. Lift out the ignition wire conduit and the split grommet from its slot in each deflector.

c. Unscrew the nuts securing the deflectors and lift them from the cylinder heads.

d. Remove the wing nuts and spring fasteners which secure the deflector extension plates to the bottom of each front row deflector.

3. TOP OVERHAUL.

a. Check the inter-cylinder and inter-ear drain pipes for security of attachment. To avoid excessive tightening in order not to crack the cylinder head, see the table of recommended torque values See Section IX.

b. Replace damaged or bent pipes in the following manner:

(1) Cut through the old pipe adjacent to each pipe connector.

(2) Back out the threaded pipe connector with a suitable wrench.

(3) Coat the new connectors with thread lubricant and screw into place.

Note

Rear row connectors must be screwed in until the front face of the connector is ½ inch from the front face of the cylinder head base. Front row connectors must be screwed in until they are seated firmly.

4. ASSEMBLY AND INSTALLATION.–Reverse the REMOVAL AND DISASSEMBLY procedure.

(f) PISTON ASSEMBLY.

1. DESCRIPTION. – The pistons are machined from aluminum alloy forgings and are of the full skirt type. They have a domed head with recesses in the top to provide clearance for the valve heads when the piston is at the top of its stroke. Three compression rings, a dual oil control ring, and an oil scraper ring are installed in the three top grooves, the fourth groove, and the bottom groove in the order mentioned. The master cylinder pistons are the only exception incorporating a straight-sided compression ring in lieu of the scrape ring in the bottom groove, for better lubrication of master cylinder pistons. The compression rings are wedge type and are fitted into grooves correspondingly profiled.

Figure 137—Piston Pin Removal

2. REMOVAL AND DISASSEMBLY.

a. Turn the propeller shaft until the piston in the cylinder to be removed is on dead center.

b. Remove cylinder as instructed in paragraph 6. *b.* (5) *(d)* 2., in this section.

c. Push the piston pin in and remove the piston.

CAUTION

When the cylinder is being removed, make certain that the piston pin does not fall out.

d. If difficulty is experienced in pushing out piston pin, remove pin with the piston pin pusher (PWA-2302).

e. Place articulated rod support slings over each rod and over the cylinder mounting studs on either side to prevent the articulated rods from striking the crankcase.

CAUTION

Remove master cylinder last and install master cylinder first. The throw of the master rod from its center line to either side of the crank case is sufficient to permit the bottom ring of the opposite piston to drop below the cylinder barrel inside the power section.

f. Remove all piston rings with piston ring expander pliers. Tag the rings to show from which pistons and grooves they have been removed.

3. TOP OVERHAUL.

a. Inspect piston pins for scoring, cracks, excessive wear, and rust pitting.

b. It is permissible to continue the use of chromium plated compression rings in service if the plating is in good condition and there is no evidence

Figure 138—Piston Ring Removal

of appreciable wear or loss of tension. Dual oil control and oil scraper rings which show no appreciable wear or loss of tension may also be continued in service. The unplated compression rings used in the second and third grooves of each piston should be replaced after each overhaul.

4. ASSEMBLY AND INSTALLATION.

a. WITH RING COMPRESSORS.

(1) Install piston rings with the piston ring expanding pliers (see paragraph 6., *b.*, (5), *(f)*, 4., a., this section).

(2) An oil scraper ring is installed in

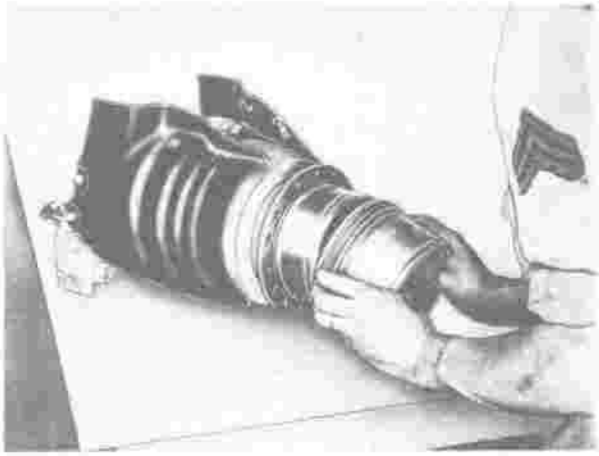


Figure 139—Installing Piston Into Cylinder

the bottom groove of the piston with the beveled side up. (Master cylinder pistons use the straight compression ring in this location.)

(3) Dual oil control rings are installed in the fourth ring groove with the serrated side of *both rings* placed downward.

(4) Install wedge-type compression rings in the three upper grooves, with a chrome-plated ring in the top groove.

(5) Turn the crank shaft with the crankshaft turning bar until the master rod of the rear bank (No. 13) is approximately at its top center position.

(6) Fit the rubber oil seal around the radius under the hold down flange of No. 13 cylinder.

(7) Insert the correct piston pin through No. 13 piston and the bushing in the master rod. The piston pin must be well oiled before insertion.

Note

Each piston and piston pin will bear the same number as that of the cylinder in which they are installed. Each cylinder is numbered on the forward side of the hold down flange; each piston is numbered on one of the piston pin bosses and each piston pin is numbered on one of the plugs at the end of the pin and installed with the number toward the outside of the engine.

(8) Install pistons and piston pins in the same positions from which they were removed.

(9) Coat the cylinder walls, pistons, and rings with a generous amount of oil.

(10) Stagger the ring gaps around the circumference of the piston.

(11) Lock the piston ring clamp over the piston and rings. Slide the cylinder over the piston and into place against its mounting pad.

(12) Fasten the cylinder to the crankcase with several nuts. Install the remaining pistons and cylinders of the rear bank in the same manner.

b. WITHOUT RING COMPRESSOR.

(1) In an emergency, pistons may be installed in a cylinder barrel without the use of a ring compressor. With the cylinder on the bench and the piston rings properly fitted for side and gap clearance and ready for installation, place the cylinder in position by turning it so it will rest on the rocker boxes, front side down.

(2) Turn the piston so that the cylinder number on the bottom edge of the skirt will be toward the nose of the engine. As the front of the cylinder is placed in a down position on the bench, the piston is also held in position with the number down.

(3) Next arrange the spacing of the ring gaps. The ring gaps should be spaced as far apart as possible and not in line with the piston pin hole. A satisfactory arrangement is to place the gap of the top compression ring about twenty degrees from the piston pin hole, the gap on the second ring one hundred eighty from the first and the third at ninety. The gaps of the dual oil control rings, both rings being installed in one groove, should be one hundred eighty degrees apart and out of line with the compression gaps as far as possible.

(4) While installing the piston, the thumbs should be kept inside the piston skirt at all times, one on each side, with the fingers on the outside of the piston. Holding the piston in this position, the rings are installed one at a time. With the fingers, the half of the top compression ring opposite the gap is held in its groove flush with the piston wall. The piston is then placed in a cocked position in the cylinder barrel, with part of the ring being held flush with the piston wall in its groove, inside the cylinder wall. With the thumbs remaining inside the piston skirt, move one hand to the piston ring gap and compress the balance of the ring in the groove by placing one finger on each side of the gap. Now bring the piston to a straight position in the cylinder barrel and the top ring is installed.

(5) The same procedure is used on each ring, cocking the piston for each additional ring the same as on the first, placing fingers on each side of ring gap and straightening piston in cylinder. The dual oil control rings, though both are in the same groove, are installed one at a time.

Note

Caution must be used when moving the fingers around the piston as a severe cut can be suffered if fingers are slid around the piston ring instead of picking them up when moving to another location on the piston.

(6) With the rings installed up to the piston pin hole, the cylinder assembly is then ready to be installed on the engine. The entire assembly is placed in position over the rod, the piston pin inserted and the cylinder pushed down to the scraper ring which can easily be installed by a similar method as used on the others, cocking the piston by letting the cylinder down over one side of the ring, compressing at the gap, pushing cylinder over ring and into position on mounting pad of power section.

(6) ENGINE OIL UNITS.

(a) GENERAL.—Engine oil units include the front oil scavenge pump, the main oil scavenge pump, the engine oil pressure pump, the temperature compensating oil relief valve, the low pressure oil relief valve, the oil screen by-pass valve, the thermostat, and the oil screen and plugs. A description of each component part follows.

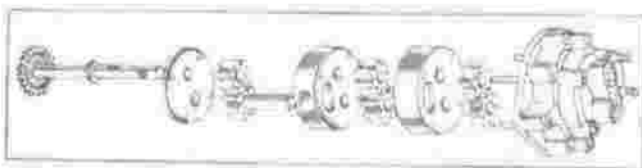


Figure 140—Front Scavenger Pump (Exploded)

1. FRONT OIL SCAVENGE PUMP.

a. DESCRIPTION.—The front oil scavenge pump is a three-section unit located in the bottom of the front nose section. This pump scavenges the front cam compartment drain oil, the reduction gearing drain oil, and the oil collected in the rocker drain sump. The scavenged oil from all three sections is forced through an external pipe connecting with cored passages in the blower and intermediate rear sections which in turn connect through an internal pipe to a passage at the discharge side of the main scavenge pump.

b. REMOVAL AND DISASSEMBLY.

(1) Remove the nuts securing the front oil scavenge pump to the reduction gear housing. Pull the pump from the housing with the oil pump puller (PWA 2151-11).

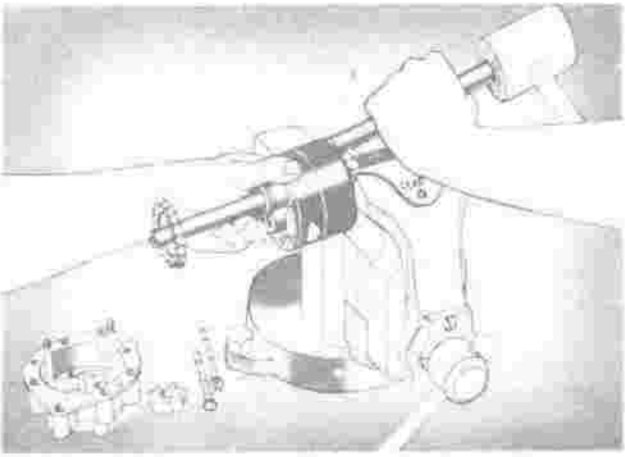


Figure 141—Front Scavenger Oil Pump Assembly

CAUTION

Be sure to turn the propeller shaft so that the oil pump drive gear clears the pinion shafts and pinion cage bolts.

(2) Remove the four bolts holding the various sections of the pump together (two of these bolts are loose—two are dowel type and must be drifted out).

(3) With a light fibre drift, tap the oil pump cover from the pump lower body.

(4) Remove these parts in the following order:

(a) Lower set of gears and key on the drive shaft.

(b) Lower body.

(c) Middle set of gears with key on the drive shaft.

(d) Upper body.

(e) Upper set of gears together with the keys on the drive shaft.

(f) Oil pump plate. If trouble is encountered in removing the gears, grasp the gear on the drive shaft in a lead-jawed vise and tap the bottom of the body gently.

CAUTION

Never tap the lower end of the drive shaft as this may cause the keys to embed in the adjacent section of the pump body.

c. TOP OVERHAUL.

(1) Examine the oil pump bodies for scoring and wear.

(2) Make sure the gears turn freely and smoothly, and show no signs of rubbing.

(3) Inspect the drive and idler shafts for roughness and wear.

(4) Check the fit of all keys in keyways.

d. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

Figure 142—Rear Scavenger Oil Pump (Exploded)

7. MAIN OIL SCAVENGE PUMP.

a. DESCRIPTION. — A two-section main scavenge pump is located in the right rear face of the rear section to scavenge oil from the main sump and the bottom portion of the rear section. Both sections discharge scavenged oil into the oil outlet passage, which is part of the main scavenge pump.

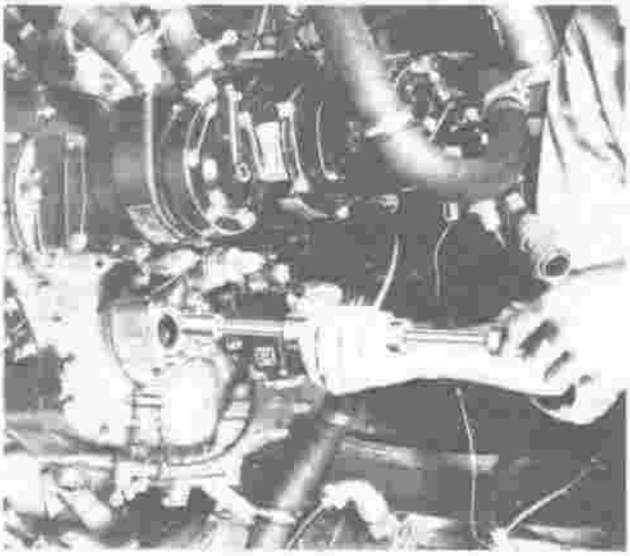


Figure 143—Oil Pressure Pump Removal With Puller

b. REMOVAL AND DISASSEMBLY.

(1) Remove the nuts and washers holding the main oil scavenge pump in place.

(2) Pull out the pump with the oil pump puller (PWA 2151-11).

(3) Remove the drive gear retainer screw located in the side of the rear section of the pump.

(4) Unscrew the nuts and washers from the two right (dowel) bolts and remove the bolts.

(5) Unscrew the nuts from the two studs that hold the various sections of the pump together. Remove the rear section of the pump.

(6) Disassemble in the following order:

(a) Lower body.

(b) Seal ring.

(c) Lower set of gears.

(d) Key on the drive shaft.

(e) If difficulty is experienced in removing the gear keyed to the drive shaft, use the oil pump gear puller (PWA 2569).

c. TOP OVERHAUL.

(1) Examine the main oil scavenge pump bodies for scoring and wear.

(2) Make sure the gears turn freely and smoothly and show no signs of rubbing.

(3) Inspect the drive and idler shafts for roughness and wear.

(4) Check the fit of all keys in keyways.

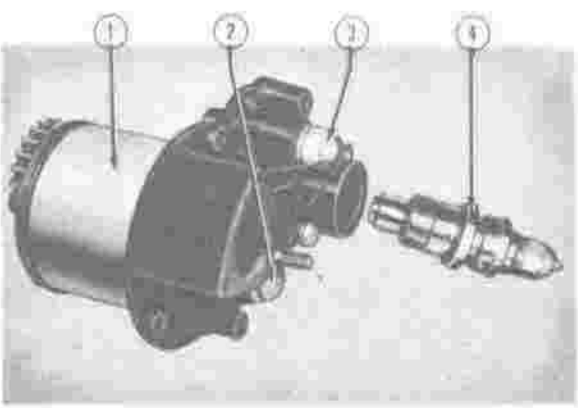
(5) Make sure that the oil seals are properly seated.

(6) Examine the oil return check valve for proper seating. Check the condition of the threads.

d. ASSEMBLY AND INSTALLATION.—Reverse REMOVAL AND DISASSEMBLY procedure.

3. ENGINE OIL PRESSURE PUMP.

a. DESCRIPTION. — Oil is circulated through the engine by a gear type pressure pump located in the left rear face of the rear section. The oil pressure pump provides mounting bosses for the inlet oil connection, the temperature compensating high pressure oil relief valve, the low pressure oil relief valve, the oil screen by-pass valve, and the thermostat, together with their connecting cored passages.



1. Oil Pressure Pump
2. Thermostat
3. Low Pressure Relief Valve
4. High Pressure Relief Valve

Figure 144 — Oil Pressure Pump

b. REMOVAL AND DISASSEMBLY.—Refer to paragraph 6. *b.* (6) *(a) 1.* b. *(1)* through *(5)*, this section.

(1) Remove the body, the oil seal rings, and the idler gear in that order.

(2) Clamp the oil pump pressure gear in a soft-jawed vise and remove the pump drive gear retainer screw.

(3) Withdraw the pump drive gear and the end plate.

(4) The idler shaft remains in the end plate.

c. TOP OVERHAUL.—Refer to paragraph 6. *b.* (6) *(a) 1.* c., this section.

d. ASSEMBLY AND INSTALLATION.

(1) Place the two leather oil seals in the drive-shaft and idler shaft recesses of the pump outer cover.

(2) Insert the oil seal in the driveshaft recess of the oil pump and plate.

(3) Insert the oil pump drive shaft and gear in the end plate and place the idler gear on the bronze shaft.

(4) Assemble the pump body in position over the gears and end plate and install the body in the cover plate.

(5) When the gears turn freely and the oil seals are properly seated, insert the through bolts in position and install nuts and washers on all four body bolts.

(6) Tighten and safety uniformly but not excessively.

(7) Install the oil pump drive gear on the end of the drive shaft and secure it.

(8) Assemble the two oil seal rings in the groove on the O.D. of the pump.

e. ADJUSTMENT.—If the oil pressure, after starting, does not register on the gage almost immediately, the engine should be stopped and an investigation made of the cause. With the compensating type of oil pressure relief valve, initial cold starting oil pressures may reach as high as 400 psi. If the oil pressure as the running progresses is less than 50 psi at 1450 rpm or 70 psi at 2150 rpm, the pressure should be immediately increased. The pressure should be adjusted later on (if necessary), by means of the adjusting screw on the main oil pressure relief valve, to 80-90 psi at 2400 rpm with the inlet temperature at 140°-167°F (66°-75°C). The rear section oil pressure should be adjusted to 25-40 psi by means of the low pressure relief valve adjustment. If the fuel pressure is not within the desired range of 17±-psi at 1000 rpm and above, it should be adjusted by means of the fuel pressure relief valve.

4. TEMPERATURE COMPENSATING OIL RELIEF VALVE (HIGH PRESSURE).

a. DESCRIPTION.—Oil is by-passed to the compensating piston of the high pressure relief valve when its temperature is greater than 104 degrees Fahrenheit. The oil passes over a thermostat which opens up when the proper temperature is reached and sends the oil to this relief valve.

b. REMOVAL AND DISASSEMBLY.

(1) Remove the acorn cap.

(2) Remove the cap which contains the adjusting screw, lock nut, gasket, spring, and piston, using the compensating relief valve cap wrench (PWA 978).

(3) Remove the plunger from the body.

(4) Unscrew the relief valve housing from the rear side of the oil pressure pump using the housing wrench (PWA 977).

(5) Remove the valve body with the body wrench (PWA 1604).

c. TOP OVERHAUL.

(1) Insert the plunger in the relief valve body and check for proper seating by applying Prussian Blue dye.

(2) If necessary, lap the plunger with fine lapping compound.

CAUTION

Do not disturb the setting of the adjusting screw. However, it may be necessary to alter the setting of the screw during the first engine run-in to obtain the desired oil pressure.

d. ASSEMBLY AND INSTALLATION.

(1) Install the gasket and housing on the rear side of the oil pressure pump with the compensating relief valve housing wrench.

(2) Install the piston, spring, gasket, and the cap which contains the adjusting screw, and lock nut in that order, using the compensating relief valve cap wrench (PWA 978).

(3) Install the gasket and the acorn cap on the assembly.

5. LOW PRESSURE OIL RELIEF VALVE.

a. DESCRIPTION.—The low pressure oil relief valve by-passes excessive low pressure oil to the inlet side of the oil pressure pump.

b. REMOVAL AND DISASSEMBLY.

(1) Remove the acorn cap and gasket from the rear section of the oil pressure pump.

(2) Remove the housing, valve, and spring from the forward side of the pump.

(3) Remove the valve from its housing.

c. TOP OVERHAUL.

(1) Examine piston for smoothness and proper seating.

(2) Make sure the relief valve spring is free from cracks and burrs and has sufficient pressure.

d. ASSEMBLY AND INSTALLATION.

(1) Reverse the REMOVAL AND DISASSEMBLY procedure.

6. OIL SCREEN BY-PASS VALVE.

a. DESCRIPTION.—The oil screen by-pass valve is provided to allow oil to by-pass the oil screens, thus preventing stoppage of the flow of oil to the engines if the screens should become clogged.

b. REMOVAL AND DISASSEMBLY.—Remove the cover, gasket, spring, and valve, and remove valve and the by-pass body strainer from the rear side of the oil pressure pump.

c. TOP OVERHAUL.

(1) Examine the pistons for smoothness and proper seating.

(2) Make sure the by-pass valve spring is free from cracks and burrs and has pressure of three to four pounds for 1-3/8 inch spring.

d. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

7. THERMOSTAT.

a. DESCRIPTION.—The thermostat serves to by-pass oil into the temperature compensating high pressure oil relief valve whenever the oil temperature reaches 104 degrees Fahrenheit.

b. REMOVAL AND DISASSEMBLY.—Remove the two fillister head screws from the rear section of the oil pressure pump, and carefully tap out the thermostat.

c. TOP OVERHAUL.—Thermostats will be replaced rather than repaired.

d. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

8. OIL SCREENS AND PLUGS.

a. DESCRIPTION.—Oil screens which require periodic cleaning and maintenance are the oil pressure screen in the bottom central portion of the rear section and the two oil scavenge screens. Drain sump plugs must also be inspected for the presence of metal chips or any foreign material which would indicate a failure or some unsatisfactory condition in the engine.

b. REMOVAL.

(1) Unscrew the following oil drain plugs:

(a) Rear of the rocker box drain sump.

(b) Bottom rear of main oil sump.

(c) Bottom of oil pressure screen chamber in the rear section.

(2) Remove the two drain plugs on either side of the oil pressure screen chamber on the bottom of the rear section.

(3) Remove the small oil screen from the scavenge chamber above and forward of the right plug.

(4) Unscrew the oil drain plug from the scavenge chamber at the lower left side of the intermediate rear section, and remove the oil scavenge screen assembly.

(5) Remove the nuts which secure the oil pressure screen cover to the bottom of the rear section.

(6) Remove the cover and withdraw the screen assembly.

c. TOP OVERHAUL.

(1) Examine the screen for being out of shape, splits in the solder joints, or other damage.

(2) Check the fit of the screen in the recess in the rear case.

(3) Examine the sump drain plugs, the oil pressure screen and the two oil scavenge screens for the presence of metal chips, or any foreign material which would indicate a failure or some unsatisfactory condition in the engine.

(4) Install a new oil screen cover gasket each time the oil pressure screen cover is removed.

(5) Install new gaskets on oil plugs after each removal.

d. INSTALLATION.

(1) Screw the check valve assembly and gasket in position in the rear section and tighten with the check valve seat wrench (PWA 1600).

(2) Assemble the oil screen cover plate and gasket in position and secure with washers and nuts.

(7) ENGINE-DRIVEN FUEL PUMP.—Refer to paragraph 11., *i.*, this section.

(8) ENGINE-DRIVEN VACUUM PUMP.—Refer to paragraph 13., this section.

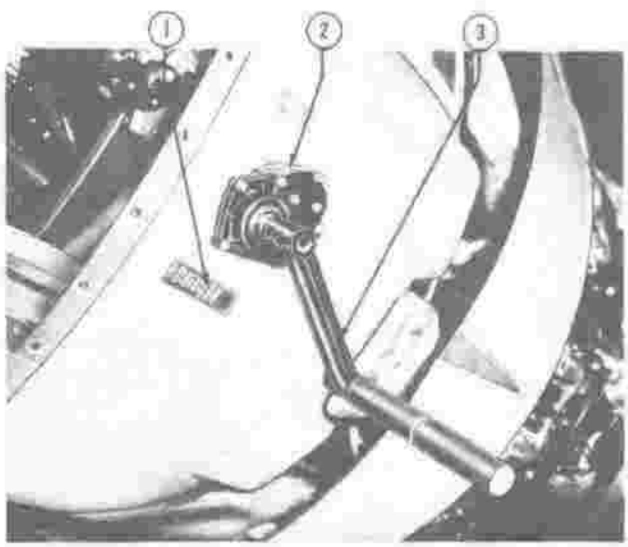
(9) ENGINE-DRIVEN HYDRAULIC PUMP.—Refer to paragraph 14., *b.*, (2), this section.

(10) ENGINE-DRIVEN TACHOMETER GENERATOR.—Refer to paragraph 15., this section.

(11) STARTING SYSTEM.

(a) GENERAL.—The engines may be started electrically or, in emergency, by a handcrank.

1. ENGINE STARTER (ELECTRICAL).—Refer to paragraph 15., this section.



1. Access Door to Starter Cable 2. Gear Box 3. Hand Crank

Figure 145 — Starter Hand Crank

2. STARTER HANDCRANK AND GEAR BOX.—A starter hand crank and gear box are stowed in the outboard side of the left nacelle and are operated through an access hole on the right-hand side of the engine mount. A flexible tube connects the starter with a bracket on the engine mount, into which the hand crank fits. An access door beside the gear box provides a handle which connects by cable to the starter.

(12) PRIMING PLUMBING SYSTEM.

(a) DESCRIPTION.—In order to facilitate engine starting, gasoline is often injected directly (without carburetion) into certain cylinders by means of an electrically operated priming system. Refer to paragraph 11., *u.*, this section and also paragraph 15., this section. Only the following top cylinders are affected: Number 2, 4, 16, and 18 in the front bank and number 1, 3, 15, and 17 in the rear bank.

(b) REMOVAL.—Disconnect all primer lines at the primer distributor and at the cylinders to which they are attached. Unfasten the clamps holding them to the intake pipes and blower section and withdraw each primer line. Remove the primer distributor from No. 1 cylinder intake pipe.

(c) TOP OVERHAUL.—Primer lines will be replaced rather than repaired. See section VIII.

(d) INSTALLATION.—Reverse the REMOVAL procedure.

(13) EXHAUST SYSTEM.

(a) DESCRIPTION.—Exhaust gases are expelled from the engine by nine ejector type stacks. The stacks are attached to the exhaust ports by Pratt & Whitney scissor clamps and cantilever from the engine. No supports are used.

(b) REMOVAL AND DISASSEMBLY.

1. Remove the stacks by disconnecting the scissor clamps at the exhaust ports.

2. Pull the stacks from the engine exhaust ports.

(c) TOP OVERHAUL.

1. Examine the stacks for cracks or excessive burning.

2. Check all clamps for tightness and proper fit.

3. Cover small cracks, holes or other damage by welding.

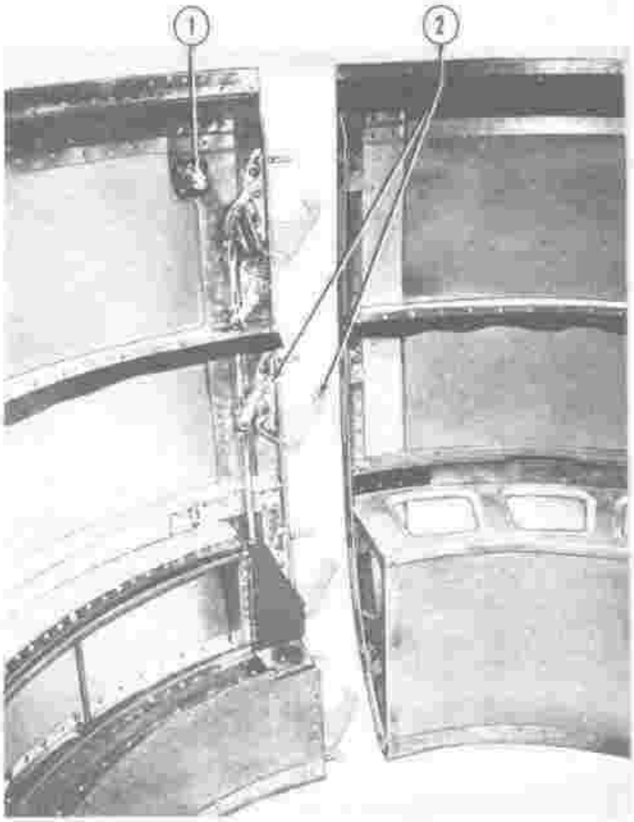
(d) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

(14) ANTI-DRAG RING COWLING.

(a) DESCRIPTION.—The anti-drag ring cowling is composed of an upper and a lower segment mounted on "D" shaped anti-drag ring cowl flap bow supports. The upper segment is bolted at the top, forward of the carburetor air duct elbow and latch locks into the lower segment.

(b) REMOVAL AND DISASSEMBLY.—The anti-drag cowling for each engine is interchangeable.

1. Turn the slotted lock socket on the left-hand side of the anti-drag ring cowling with a spark plug wrench to release the latching mechanism. This lock screw head is painted red, and is located near the aft end of the cowling.

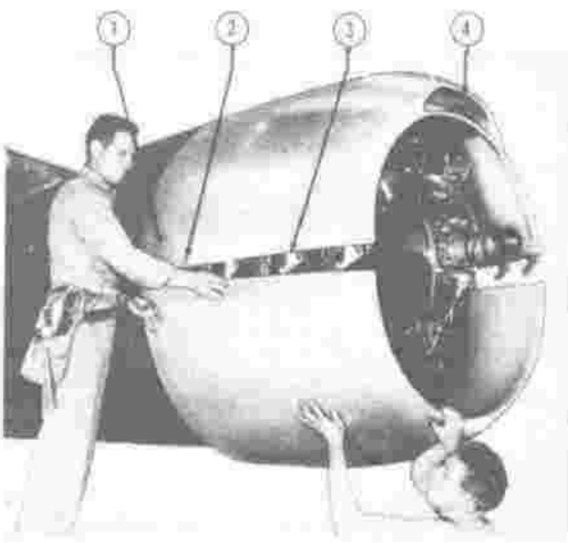


1. Latch Lock 2. Latch Mechanism

Figure 146 — Anti-Drag Ring Latch

Note

The latching mechanism is in locked position when the lock screw slot is parallel to the red line painted on each side of the screw head.



1. Latch Lock Screw
2. Latch Mechanism Operating Nut
3. Latch
4. Ram Scoop

Figure 147 — Anti-Drag Ring Installation

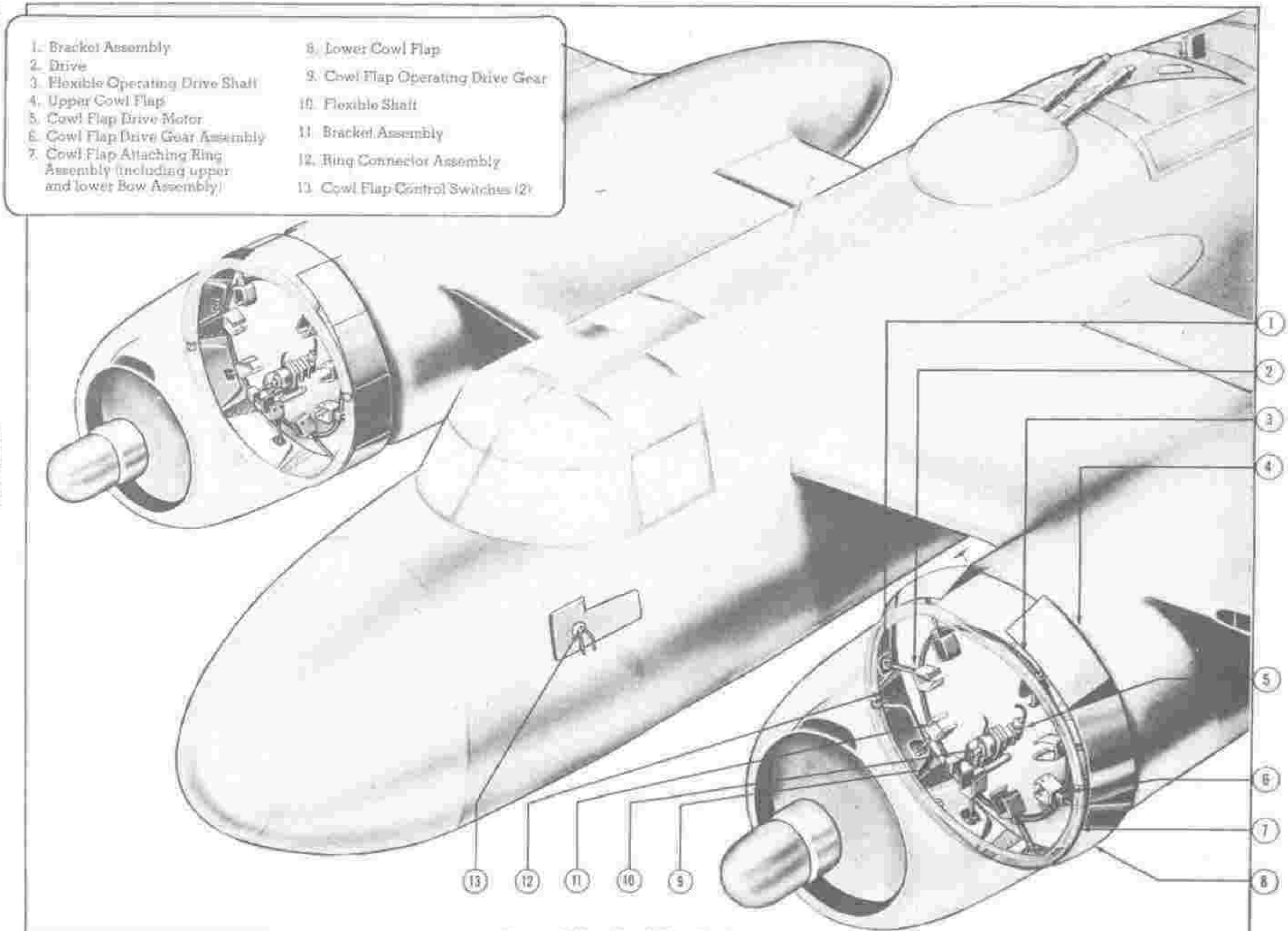


Figure 148 — Cowl Flap System

2. Turn the ⅞-inch hex nut (locking lever) with the cowl flaps closed until the mechanism has reached its full travel.

3. Unlock the right-hand side in the same manner, and remove the lower cowling segment.

4. Open the cowl flaps and disconnect the two toggle bolts which are located at the top of the anti-drag ring cowling, forward of the carburetor air duct elbow.

5. Close the cowl flaps. Unlatch the anti-rotational stop pins which are located above the horizontal center line on the inside of the forward support bow.

6. Remove the upper section of the anti-drag ring cowling.

(c) TOP OVERHAUL.

1. Check for cracks or other damage.

2. Make sure that both cowling sections are fastened securely.

(d) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

(15) ENGINE COWL FLAPS.

(a) DESCRIPTION.—Eight overlapping cowl flaps are installed for each engine. They are attached by hinges to the aft cowl bow support. The bow support is bolted to the rocker boxes of the engine by brackets. The cowl flaps are designed to operate within thirteen angular degrees with a tolerance of plus or minus one degree. In the closed position the aft edge of the cowl flap must be 1/16 inch from the highest obstruction. In the open position this same dimension should be approximately 5½ inches. An electric drive motor is attached to the lower right-hand side of the engine mount. The motor is connected by a flexible drive shaft to the main operating drive gear box. The operating drive gear box is in turn connected by flexible shafts to eight individual drive gear boxes, each of which moves a flap. The electric motor is operated by the cowl flap switch on the pilot's main electrical control panel. This electric motor is geared for an output of 375 to 415 revolutions per minute. Each thirty revolutions of the output drive shaft will move the flaps one degree of angular travel. Cowl flap load is greatest in the closed position under any flight conditions.

(b) REMOVAL AND DISASSEMBLY.—Reverse the INSTALLATION procedure.

(c) TOP OVERHAUL.

1. Check the assembly for cracks or other damage.

2. Check the installation for tightness and security of mounting.

3. Replace the flexible drive shafts for the individual gear boxes and for the operating drive gear box whenever the serrated ends show excessive wear.

4. Replace the Lord mountings on each of the eight cowl flap drive shaft ends whenever they are excessively worn.

5. When backlash or excessive wear in the gear boxes makes it impossible to adjust the cowl flaps to the specified travel (twelve to fourteen angular degrees, or approximately 3 inches) replace parts as necessary.

6. For maintenance of the electric motor, refer to paragraph 15. *b.* (6), this section.

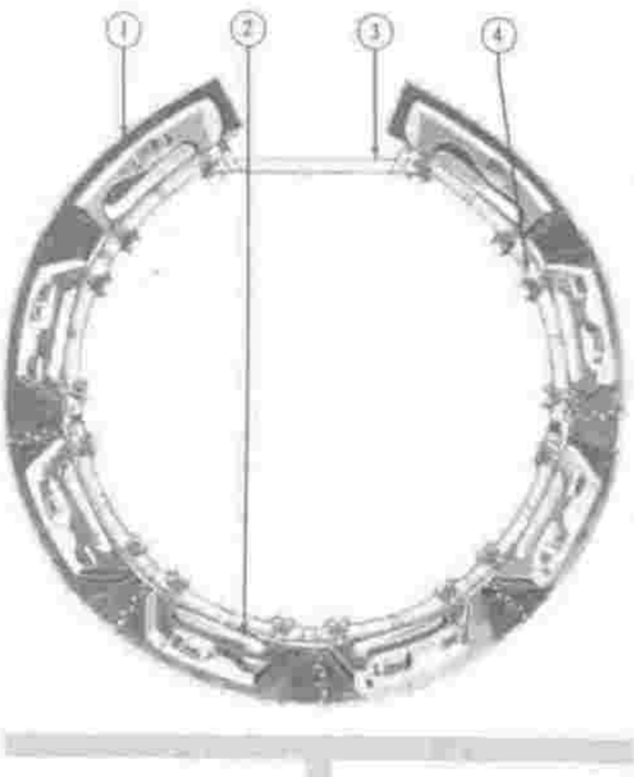
Note

Factory lubrication is intended to last the life of the unit. The gear boxes are packed with approved, low temperature grease.

(d) ASSEMBLY AND INSTALLATION.

1. Bolt the brackets to the rocker boxes.

2. Mount the cowl flap electric drive motor in the lower right hand side of the engine mount.



1. Upper Cowl Flap
2. Lower Cowl Flap
3. Bow Ring Support
4. Hinge Assembly

Figure 149 - Cowl Flap and Bow Ring Support Assembly

3. Mount the cowl flap operating drive gear box onto the bracket provided.

4. Mount each of the eight individual cowl flap drive gear boxes onto the brackets provided. The brackets are bolted onto the Lord engine mounts.

5. Connect all units with the proper flexible drive shafts.

6. Attach the upper bow ring assembly to the engine by bolting the brackets to the rocker boxes.

7. Connect the lower bow ring to the upper bow ring by the bow ring connectors. Attach the lower ring to the engine as described above.

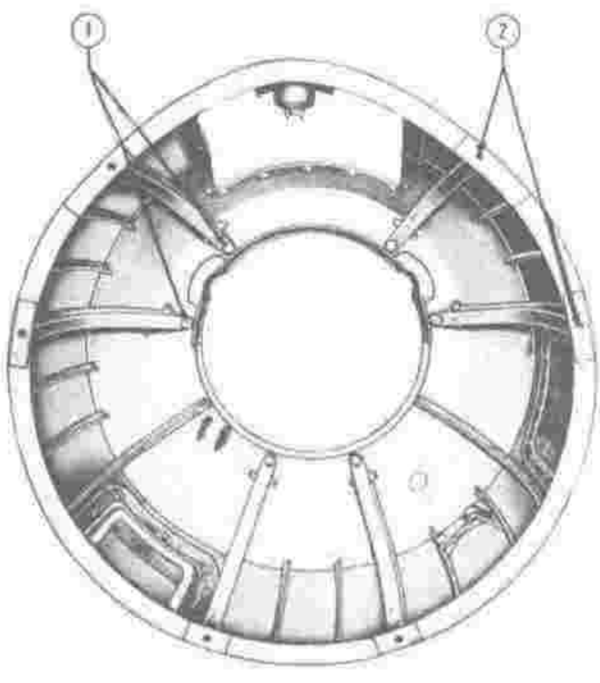
8. Attach the cowl flaps to the bow ring by bolting the hinges to the ring brackets.

9. Connect the jack shafts on the cowl flap drive gear boxes to the bracket provided on the flap.

(e) ADJUSTMENTS.

1. Adjust the individual jackscrews until the trailing edge of the flap is 1/16 inch from the highest obstruction in the closed position and 5½ inches from the highest obstruction in the opened position. The jackscrew is adjusted by turning it to the right to shorten the distance and to the left to lengthen the distance.

2. The three inch travel of the flaps is controlled by a limit switch within the gear box. The switch is not adjustable. The flap travel can be regulated by the jack shafts only.



1. Engine Mount Points 2. Nacelle Mount Points

Figure 150 — Engine Mount

(16) ENGINE MOUNT.

(a) DESCRIPTION.—The engine mount consists of eight forged al. alloy ribs which are stress-covered with a stainless steel skin. The engine is bolted onto the spun aluminum alloy ring at the forward end of the mount through six Lord Company or Pratt & Whitney rubber shock mounts.

(b) REMOVAL AND DISASSEMBLY.

1. Remove the engine as instructed in paragraph 6., *b.*, (2), this section.

2. Disconnect the neoprene sleeve which extends from the carburetor to the air duct elbow, and remove the elbow by disconnecting the Dzus fasteners which hold it to the anti-drag ring cowling.

3. Disconnect the oil lines at the engine, and place covers over the exposed oil ports.

4. Remove the vacuum lines, and plug the vacuum pump ports.

5. Remove and cap all other lines which are connected to the engine.

6. Disconnect the cowl flap flexible actuating shaft from the electric drive motor.

7. Disconnect and remove the propeller auxiliary feathering pump and pump lines.

8. Remove the engine-driven hydraulic pump.

9. Remove the nuts from the studs located at the top of the carburetor and remove the carburetor from the engine. Immediately after removing the carburetor, place a cover plate over the engine carburetor spacer. Extreme care should be taken to prevent any foreign material from falling into the blower section.

10. Disconnect and remove the tachometer cable from the engine.

11. Remove the cotter pins and the three nuts which are located at the end of each forged rib.

12. Remove the bonding from each forged rib and remove the engine mount from the engine. Be careful not to strike any accessory parts.

(c) TOP OVERHAUL.

1. Check the engine mount for damages, cracks, distortions, or other structural defects.

2. Check bolt holes for elongation or other damage.

3. Replace engine mount if repair is necessary.

Note

If it is necessary to replace a Lord shock mount, the entire engine must be removed.

(d) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Follow torque instructions given in section IX.

(17) ENGINE FIRE SEAL.

(a) DESCRIPTION.—The engine fire seal *(figure 151)* is an all metal baffle mounted on the engine blower case, separating the cylinders from the accessory section.

(b) REMOVAL AND DISASSEMBLY.

1. Remove the bolts that secure the seal to the engine.

2. Remove the fireseal.

(c) TOP OVERHAUL.—Damaged fireseals will be replaced whenever possible.

(d) INSTALLATION. – Reverse the DISASSEMBLY procedure.

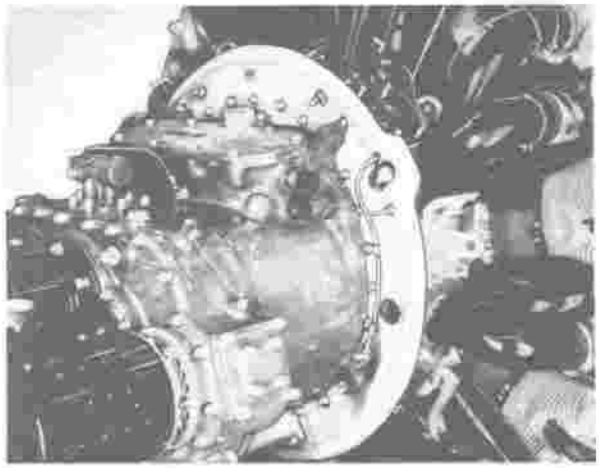


Figure 151—Engine Fire Seal

e. ENGINE SECTION TROUBLE SHOOTING CHART.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Engine fails to start.	*a.* Inadequate fuel supply.	*a.* Check selector valve position and fuel quantity.
	b. Overpriming.	*b.* If overprimed, cut switch and open the throttle full. Turn the propeller in the direction of normal rotation not less than two revolutions.
	c. Underpriming.	*c.* Reprime. If still underprimed, check priming system for leaks.
	d. Incorrect mixture and throttle setting. Idle adjustment too rich or too lean.	*d.* Adjust controls as instructed in paragraph 7. *c.* (4), this section.
	e. Leaking carburetor flange gasket.	*e.* Remove carburetor and replace gasket.
	f. Fuel flow restricted due to presence of water or foreign matter in carburetor strainer.	*f.* Clean the carburetor strainer as instructed in paragraph 7. *c.* (3), this section.
	g. Insufficient fuel pressure.	*g.* See fuel system trouble shooting chart, paragraph 11., this section.
	h. Air leaks from faulty packing or looseness at intake pipe connection.	*h.* Replace packing or tighten gland nut.
	i. Damaged intake pipes.	*i.* Replace pipes.
	j. Water in carburetor.	*j.* Remove drain plug at base of fuel control unit.
	k. Mixture control in idle cut-off.	*k.* See section III, paragraph 3., for starting instructions.
	l. Air in regulator unit.	*l.* Remove vent plug in top of regulator chamber of carburetor and pump until fuel comes out.
	m. Diaphragm failure in carburetor.	*m.* Replace diaphragm as instructed in T.O. No. 03-10BA-3.
	n. Loose electrical connections.	*n.* Tighten connections.
	o. Magneto breaker points which are dirty, pitted or at improper gap when opened or which fail to open.	*o.* Clean points as instructed in paragraph 8. *b.*, this section, and 8. *c.*, this section. Reset gap as instructed in T.O. No. 05-5DA-9 or 05-5DC-1 and -2.
	p. Moisture, oil, or dirt on spark plug terminals or electrodes.	*p.* Remove plugs from engine. Dry, clean and replace.
	q. Burned ignition wires and burned or chafed insulation.	*q.* Replace ignition wiring.

c. ENGINE SECTION TROUBLE SHOOTING CHART.–Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	r. Low electrical output of magnetoes or induction vibrators.	*r.* High tension leads of these units when operated at normal starting speed should be disconnected and held 1/4 to 3/8 inch from a grounded surface. If the spark which arcs this gap is weak, the units are functioning improperly. Replace units.
	s. Valves or ignition out of time.	*s.* See paragraph 8. *b.* 3., and 8. *c.* (4), this section, for magneto timing. If vlaves are out of time an engine overhaul will be necessary.
	t. Sticking valves.	*t.* Depress valve several times with PWA valve compressor and lubricate with light lubricating oil (AXS777). This is only a temporary measure and must be followed by a top overhaul in which the sticking valve is cleaned or replaced. See paragraph 6. *b.* (5) *(c)*, this section.
	u. Broken valve springs.	*u.* See paragraph 6. *b.* (5) *(c)*, this section.
	v. Incorrect valve clearance adjustment.	*v.* Adjust clearance as instructed in paragraph 6. *b.* (5) *(e)*, this section.
2. Low engine power.	*a.* Incorrect grade of fuel.	*a.* For correct types of fuel to use in these airplanes refer to stencils on the airplane.
	b. Improper setting or operation of carburetor.	*b.* Adjust carburetor as instructed in paragraph 7. c. (4), this section.
	c. Throttle controls out of adjustment.	*c.* Check throttle linkage for freedom of movement to extreme positions.
	d. Inadequate fuel pressure to carburetor.	*d.* See fuel system trouble shooting chart, paragraph 11, this section.
	e. Ice formation on carburetor venturi or air screen.	*e.* Place the carburetor hot air control in the HOT position. Use carburetor anti-icing system.
	f. Air leaks in intake pipes, carburetor mounting flange, or carburetor body gaskets.	*f.* Locate leak. Stop leaks in intake pipes by tightening gland nuts or replace packing. Replace leaking carburetor gaskets.
	g. Faulty ignition.	*g.* Test the ignition by running momentarily on each magneto with the propeller in low pitch position. In switching from both magnetoes to one, the normal drop-off should not exceed 100 rpm at the cruising rpm and manifold pressure. When switching from one magneto to the other the change in rpm should not be more than 30 or 40. **CAUTION** Continued running on one magneto may cause detonation or pre-ignition.
	h. If the drop in speed is in excess of either of the above mentioned limits, investigation should be made for the following conditions:	
	(1) Defective ignition wires or terminal sleeves.	(1) Replace.
	(2) Defective or fouled spark plugs.	(2) Replace.
	(3) Incorrect timing and operation of magnetos.	(3) See item 1. *s.*, above.
	i. Oil on magneto breaker points.	*i.* Clean points as instructed in paragraph 8. *b.*, this section, and paragraph 8. *c.*, this section.
	j. Improperly set valve clearances.	*j.* Reset valves as instructed in paragraph 6. *b.* (5) *(e)*, this section.
	k. Poor compression due to improperly seated valves or defective piston rings.	*k.* Remove valves. If worn unevenly or excessively reface and reseat. Remove pistons and install new rings. See paragraph 6. *b.* (5) *(f)*, this section.
3. Rough running.	*a.* Dirt, water, or foreign matter in the carburetor fuel passages or strainer.	*a.* Flush carburetor with clean gasoline. Do not use carbon tetrachloride or other carbon base solvents.

c. ENGINE SECTION TROUBLE SHOOTING CHART.—Continued.

TROUBLE	PROBABLE CAUSE	REMEDY
	b. Improperly operating fuel pump.	*b.* Refer to fuel system trouble shooting chart, paragraph 11., this section.
	c. Air leaks in the air intake system.	*c.* Check intake pipes for damage, and gland nuts for tightness. Inspect carburetor mounting gasket.
	d. Defective or improperly gapped spark plugs.	*d.* Clean, regap, or replace spark plugs as instructed in paragraph 8. *c.* (3), this section.
	e. Oil on magneto breaker points.	*e.* Clean points as instructed in paragraph.
	f. Broken or damaged ignition wires or connections.	*f.* Repair or replace.
	g. Improper timing and operation of magnetos.	*g.* Refer to item 1. *s.*, above
	h. Loose engine mounting bolts.	*h.* Tighten bolts.
	i. Cracked or broken members of the engine mount.	*i.* Replace mount.
	j. Faulty valve action due to improper clearance adjustment.	*j.* Adjust valve clearances as instructed in paragraph 6. *b.* (5) *(c)*, this section.
	k. Bent or worn push rods.	*k.* Straighten if possible, or replace.
	l. Broken valve spring.	*l.* Replace as instructed in paragraph 6. *b.* (5) *(c)*, this section.
	m. Sticking valves.	*m.* Depress valve several times with the PWA valve compressor and lubricate with light oil. (AXS 777). This is only a temporary measure and must be followed by a top overhaul in which the sticking valve is cleaned or replaced. See paragraph 6. *b.* (5) *(c)*, this section.
	n. Unbalance or improper tracking of the propeller.	*n.* Can be caused by nicks or other damage to blades. Replace propellers.
	o. Propeller not tight on propeller shaft.	*o.* Inspect splines for galling. Tighten retaining nut. See paragraph 10, this section.
	p. Propeller thrust nut not tight.	*p.* Examine hub rear cone for galling. Tighten thrust nut as instructed in paragraph 10., this section.
	q. Governor control faulty.	*q.* See paragraph 10., this section.
4. Detonation. (See introduction to trouble-shooting for definition.)	*a.* Excessive cylinder temperature.	*a.* See trouble shooting item No. 27., below.
	b. Low grade or octane of fuel.	*b.* See section III for servicing information.
	c. Mixture too lean.	*c.* Adjust mixture control as instructed in paragraph 7. *c.* (4), this section.
	d. Overspeeding engine.	*d.* Check governor control for malfunction or leakage. See paragraph 10., this section.
	e. Excessive blow-by.	*e.* Replace piston rings as instructed in paragraph 6. *b.* (5) *(f)*, this section.
5. Pre-ignition. (See introduction to trouble-shooting for definition.)	*a.* Prolonged detonation.	*a.* See trouble-shooting item No. 4 above.
	b. Excessively lean mixture.	*b.* Adjust mixture and idle controls as instructed in paragraph 7. *c.* (4), this section.
	c. Excessive cylinder temperature.	*c.* See throuble shooting item No. 27 below.
	d. "Feather-edged" valves or seats.	*d.* Grind valves and reface seats or replace valves.
	e. Excessive carbon deposits.	*e.* Remove and clean valves. See paragraph 6. *b.* (5) *(c)*, this section.
6. Low oil pressure.	*a.* For information regarding troubles to the oil system or any of its units which are not part of the engine, refer to Oil System Trouble Shooting Chart, paragraph 12, this section.	
	b. Clogged oil strainer screen.	*b.* Remove and clean screen. If metal particles are found in the screen or in the drain-plugs of the oil sumps, determine the cause before operating the engine any further.
	c. Improper seating of oil pressure relief valve.	*c.* Examine relief valve for uneven wear or pitting. Check valve stem and compensating piston for scoring or seizing. Wash and clean thoroughly—re-oil with engine oil.
	d. Faulty operation of main oil pump.	*d.* Remove and replace.

c. ENGINE SECTION TROUBLE SHOOTING CHART.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	e. Blow-by resulting from burned or scored pistons or weak piston rings.	*e.* Remove and replace pistons and piston rings as necessary. See paragraph 6. *b.* (5) *(f)*, this section.
	f. Excessively worn bushings or bearings which permit spillage of oil into front section main crankcase or accessory section.	*f.* Requires major overhaul.
7. Oil pressure too high.	*a.* Improperly operating oil pressure relief valve.	*a.* Check valve stem and compensating piston for presence of gum or other matter to prevent the valve from lifting. Wash and clean thoroughly—re-oil with engine oil.
	b. For troubles due to units of the oil system which are not part of the engine refer to Oil System Trouble Shooting Chart, paragraph 10., this section.	
	c. Thermostat control pressure relief valve stuck closed.	*c.* Clean needle valve.
	d. Oil temperature too low.	*d.* See trouble shooting item No. 8.
	e. Oil viscosity too high.	*e.* Warm oil.
8. Oil temperature too high.	*a.* Improper grade oil or insufficient supply.	*a.* See section III for proper grade oil and servicing of oil system.
	b. Oil diluted or dirty.	*b.* If contaminated, drain oil as instructed in paragraph 12. *b.*, this section.
	c. Poor compression caused by burned or scored pistons and weak piston rings.	*c.* Perform top overhaul work as instructed in paragraph 6. *b.* (5) *(f)*, this section.
	d. Excessive cylinder heat temperature.	*d.* See trouble shooting item No. 30 below.
	e. Partial or complete failure of bushings or master rod bearing (Inspect oil screen and drain plug of main oil sump for metal chips which indicate these conditions.)	*e.* Major overhaul required.
	f. Improper valve adjustment.	*f.* Adjust valve clearances as instructed in paragraph 6. *b.* (5) *(c)*, this section.
	g. Improper magneto timing.	*g.* Refer to item 1.
9. No oil pressure.	*a.* Damaged oil pressure line.	*a.* Replace line.
	b. Broken pump shaft.	*b.* Replace pump.
	c. No oil.	*c.* Check tanks and fill system as instructed in paragraph 12. *c.*, this section.
	d. Oil Seal or engine structural part damaged.	*d.* Change engine.
10. Fluctuating oil pressure.	*a.* Oil supply too low.	*a.* Add oil. See paragraph 12. *c.*, this section.
	b. Air leak in oil inlet line.	*b.* Tighten or replace connections or lines. Bleed lines.
	c. Air in oil pressure line or in line to gage.	*c.* Check lines for damage and fittings for looseness. Bleed oil pressure transmitter line and fill with compass fluid.
11. High oil consumption (characterized by excessive blue smoke when engine is hot and idling).	*a.* Burned or scored pistons and worn piston rings.	*a.* Perform top overhaul work as instructed in paragraph 6. *b.* (5) *(f)*, this section.
	b. Worn valve guides.	*b.* Replace.
	c. Viscosity too low.	*c.* See paragraph 12. *b.*, this section.
	d. Oil pressure too high.	*d.* See trouble shooting item No. 7, above.
	e. Oil temperature too high.	*e.* See trouble shooting item No. 8, above.
	f. Oil leakage anywhere in system.	*f.* Locate leakage. Tighten or replace fittings. Replace damaged line.
	g. Improper scavenge pump operation.	*g.* Repair or replace. See paragraph 6. *b.* (6) *(a)* 1. and 2., this section.

c. ENGINE SECTION TROUBLE SHOOTING CHART.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	h. Breather pipes clogged.	*h.* Clean out breather lines.
	i. Accessory drive oil seal leaks.	*i.* Replace oil seal.
12. Excessive vibration.	*a.* Propeller out of balance (not tracking properly) or not mounted correctly.	*a.* See paragraph 10., this section.
	b. Bent crankshaft.	*b.* Change engine. See paragraph 6. *b.* (2), this section.
	c. Engine mount bolts loose.	*c.* See torque chart section IX.
	d. Faulty engine mount bolts.	*d.* See torque chart section IX.
	e. Incorrect valve clearance setting.	*e.* Refer to paragraph 6. *b.* (5) *(c)*, this section.
	f. Mixture too lean or too rich.	*f.* See trouble shooting items No. 17 & 18, below.
	g. Detonation.	*g.* See trouble shooting item No. 4, above.
	h. Pre-ignition.	*h.* See trouble shooting item No. 5, above.
13. Engine fails to develop full power.	*a.* Faulty ignition units, shorting of ignition wires.	*a.* Inspect ignition units including switch, booster coil or induction vibrator, magnetos and spark plugs. Examine all ignition wiring for loose connections or leaks.
	b. Faulty carburetion.	*b.* Check linkage of throttle, mixture, carburetor hot air, and propeller pitch controls. See paragraph 9., this section. Check carburetor and carburetor adjustments as instructed in paragraph 7. *(c)* (4) this section.
	c. Improper valve clearance or ignition timing.	*c.* Refer to item 2., Trouble Shooting Chart.
	d. Air leak in induction system.	*d.* Check intake pipes for cracks or other damage. Check intake pipe packing and packing gland nuts for security.
	e. Fuel pressure too low.	*e.* See Trouble Shooting, paragraph 12, this section.
	f. Air scoop filter clogged.	*f.* Remove obstruction.
	g. Improper lubrication.	*g.* Check operation of pressure and scavenge pumps, oil thermostat and oil pressure relief valve. See paragraph 6. *b.* (6), this section.
	h. Propeller blade angle stop setting rings may be improperly installed.	*h.* Remove dome and check setting rings for proper indexing.
14. Intermittent misfiring.	*a.* Incorrect mixture.	*a.* See trouble shooting items Nos. 17 & 18.
	b. Low grade fuel.	*b.* See Section III, for servicing information.
	c. Water in fuel system.	*c.* Drain water through sumps on fuel tanks, also drain water from carburetor, fuel pump and fuel pressure lines to carburetor.
	d. Air leaks in induction system.	*d.* Check intake pipes for cracks or other damage. Check gland nuts for tightness and packing for general condition.
	e. Improper valve clearance.	*e.* Refer to item 2, Trouble Shooting.
	f. Defective spark plugs.	*f.* Replace faulty plugs.
	g. Defective ignition harness or wires.	*g.* Check wires for loose connections, breaks, burned or chafed areas. Replace if necessary.
	h. Defective magneto.	*h.* See trouble shooting item No. 28, below.
15. Misfiring at high rpm.	*a.* Defective magneto, or induction vibrator.	*a.* Check units as instructed in paragraph 8. b. (1) *(a)* 3., this section. Replace if necessary.
	b. Defective ignition harness or wiring.	*b.* Check wiring for loose connections, breaks, burned or chafed areas. Replace if necessary.
	c. Defective spark plugs.	*c.* Replace defective plugs.
	d. Mixture too lean.	*d.* Adjust mixture control as instructed in paragraph 7. *c.* (4), this section.
	e. Engine operating temperature too low.	*e.* See section III for servicing information.
	f. Restricted fuel flow.	*f.* See paragraph 12., this section.
	g. Engine overheated.	*g.* See trouble shooting item No. 26.
16. Rich mixture.	*a.* Fuel pressure too high.	*a.* See fuel system, paragraph 12, trouble shooting list.
	b. Mixture control setting too rich.	*b.* Adjust mixture control as instructed in paragraph 7, *c.* (4), this section.

c. ENGINE SECTION TROUBLE SHOOTING CHART.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	c. Partially clogged filter cartridge.	*c.* Remove obstruction. Remove and clean filter.
	d. Float level too high.	*d.* Replace carburetor. See paragraph 7. *b.*
	e. Jets loose or enlarged.	
	f. Air bleeds clogged.	
	g. Acceleration pump and valve leaking.	
17. Lean mixture.	*a.* Low fuel pressure.	*a.* See paragraph 12, this section.
	b. Mixture control set too lean.	*b.* Adjust mixture control as instructed in paragraph 7. *c.* (4), this section.
	c. Air leak or crack in induction system.	*c.* See trouble shooting item No. 20.
	d. Vapor lock due to overheated line.	*d.* See trouble shooting item No. 19.
	e. Insufficient warm air supply to carburetor.	*e.* Turn on carburetor hot air control.
	f. Jets too small.	*f.* Replace carburetor.
	g. Accelerator pump not operating properly.	*g.* Replace carburetor. See paragraph 7. *c.* (2), this section.
18. Excessive fuel consumption.	*a.* Leaks in lines or loose connections.	*a.* Check fittings and lines.
	b. Fuel pressure too high.	*b.* See paragraph 9, this section.
	c. Mixture control set too rich.	*c.* See trouble shooting item No. 17.
	d. Jets too large or loose in carburetor body.	*d.* Replace carburetor.
	e. Air bleeds clogged.	*e.* Clean out bleed lines.
	f. Float level too high.	*f.* Reset float.
19. Vapor lock.	*a.* Overheated fuel lines.	*a.* Determine cause of heating—see trouble shooting item No. 26. Bleed fuel lines, paragraph 12, this section.
	b. Vertical humps or short bends in lines.	*b.* Straighten out lines.

Note

This trouble is indicated by sudden stoppage of the engine, particularly in hot weather during take-off.

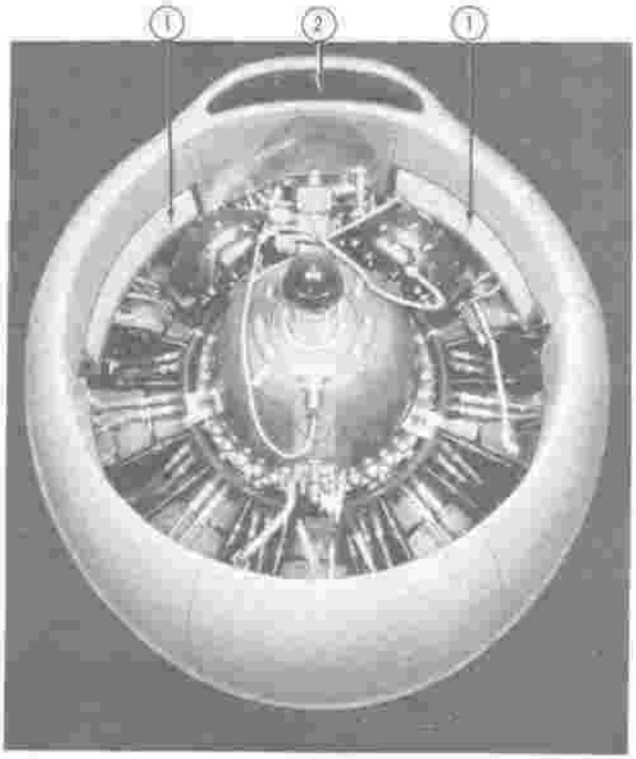
TROUBLE	*PROBABLE CAUSE*	*REMEDY*
20. Air leak.	*a.* Cracked induction housing.	*a.* Major overhaul. Replace housing.
	b. Leaking intake pipe flange or gland gaskets.	*b.* Inspect gland nut and packing. Tighten or replace.
	c. Leaking carburetor flange gasket.	*c.* Replace gasket.
	d. Worn throttle shaft or bushings.	*d.* Rework and replace parts as necessary.
21. Engine will not start or continue to run after starting.	*a.* Incorrect starting procedure used.	*a.* See section III, for service information.
	b. Insufficient fuel pressure.	*b.* See paragraph 11., Fuel System Trouble Shooting Chart, item No. 2.
	c. Idle adjustment too low.	*c.* Adjust carburetor as instructed in paragraph 7. *(c).* (4), this section.
	d. Air in regulator unit.	*d.* Remove vent plug in top of unmetered fuel chamber of regulator unit. Pump fuel until it stands level with plug opening.
	e. Check position of manual mixture control to see that control is not *in* idle cut-off position.	*e.* If position is wrong, re-rig control linkage.
	f. Main discharge nozzle sticking open.	*f.* Clean unit thoroughly or replace. Nozzles must hold a 3 pound pressure without leaking fuel.
22. Engine runs too rich or too lean at cruising power.	*a.* Fuel pressure low.	*a.* Check fuel pump and fuel pressure gage. Clean carburetor strainer.
	b. Foreign material in cruise jet.	*b.* Clean jet.
	c. Economizer needle leaking or sticking open.	*c.* Replace carburetor.
	d. Check automatic mixture control unit setting and bellows if carburetor is running rich or lean in automatic position at altitude.	*d.* Replace carburetor.

c. ENGINE SECTION TROUBLE SHOOTING CHART.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
23. Engine runs too lean at take-off or rated power but satisfactorily at cruising power.	*a.* Insufficient fuel pressure.	*a.* See paragraph 11., this section.
	b. Economizer valve is binding.	*b.* Remove fuel control unit cover body and check mechanism for freedom of movement. Clean parts thoroughly. If necessary, replace unit.
24. Engine runs too lean or too rich at altitude in automatic position, but satisfactorily at sea level.	*a.* Vapor separator float needle stuck in the closed position.	*a.* Remove strainer and inspect float for freedom of movement.
	b. Mixture control valve set in wrong position.	*b.* Check linkage to manual mixture control lever.
	c. Emergency full-rich valve plates open or leaking.	*c.* Remove valve cover on throttle body and see that slots in the plates are open only in full rich position and that plates do not leak. If necessary reface plates on a flat lapping plate.
	d. Automatic mixture control unit set incorrectly or operating faultily.	*d.* Replace carburetor. See paragraph 7. *c.* (2), this section.
25. Engine does not accelerate properly but runs satisfactorily with slow throttle movements.	*a.* Fuel inlet to acceleration pump clogged at the intake restriction, also mixture set too lean.	*a.* Remove pump cover, diaphragm, and examine.
	b. Discharge nozzle leaking.	*b.* Run engine up to high power and retard throttle rapidly several times to remove dirt from under the needle valve seat.
	c. Fuel leak into air chamber of regulator unit.	*c.* Remove air chamber drain plug.
	d. Accelerating pump not adjusted to give required travel.	*d.* Replace carburetor. See paragraph 7. *c.* (2), this section.
26. Overheating of engine.	*a.* Lean mixture.	*a.* See trouble shooting item No. 18.
	b. Viscosity of oil too low.	*b.* See paragraph 12, this section.
	c. Excessive blow-by.	*c.* Replace pistons or piston rings as instructed in paragraph 6. *b.* (5) *(1)*, this section.
	d. Air leak in the induction system.	*d.* See trouble shooting item No. 20, above.
	e. Detonation.	*e.* See trouble shooting item No. 4, above.
	f. Pre-ignition.	*f.* See trouble shooting item No. 5, above.
	g. Excessive manifold pressure.	*g.* See operating instructions, section III, paragraph 6.
27. Failure of dual ignition system.	*a.* Contact points pitted or dirty, also points that fail to open.	*a.* Clean and repair as instructed in paragraph 8. *b.* (1) *(a)* 4., this section.
	b. Loose terminals or other wiring connections.	*b.* Inspect and tighten connections.
	c. Broken accessory drive.	*c.* Replace magneto.
	d. Moisture in ignition harness.	*d.* Dry out harness.
28. Failure of one magneto.	*a.* Broken drive shaft or drive gear.	*a.* Replace magneto.
	b. Defective coil or condenser.	*b.* Replace defective unit.
	c. Dirty or defective breaker points.	*c.* Clean as instructed in paragraph 8. *b.* (1) *(a)* 4., this section, or 8. *c.* (3), this section.
29. Failure of spark plug.	*a.* Plug too hot or too cold for engine. Distortion of plug from improper installation. Tightening plug too tight when installing.	*a.* See paragraph 8 *e.* (3), this section.
	b. Insulator shorted.	*b.* Replace plug.
	c. Electrodes shorted by excessive oil or carbon deposits.	*c.* Clean.
	d. Cracked ceramic.	*d.* Replace plug.
30. Engine does not shut off in idle cut-off position.	*a.* Idle cut-off valve washer on mixture control needle not seating properly.	*a.* Remove plug on side of fuel control unit adjacent to cruise jet to see if washer seats in idle cut-off position. Check control rods for full travel. Check for burrs on metering jet.
	b. Economizer needle not seating properly.	*b.* Remove fuel control unit, cover body and check mechanism for freedom of movement.
	c. Regulator unit functioning improperly.	*c.* Check.

7. CARBURETOR FUEL-AIR INDUCTION SYSTEM.

a. GENERAL. – The carburetor fuel-air induction system consists of the carburetor, and the scoop (also air control gates, electric motor, and filters on some airplanes) installed on the upper portion of the anti-drag ring cowling, which conveys air to the carburetor. Refer to *figure 153.* Air may gain access to the carburetor directly through the scoop (ram-air position); through filters (non-ram air position); or over the engine for the purpose of pre-heating air in cold weather conditions.



1. Filter 2. Ram Scoop

Figure 152 — Ram Air Scoop

b. AIR SCOOPS.

(1) RAM TYPE AIR SCOOP.

(a) DESCRIPTION.–The air induction system consists of a scoop which extends from the leading edge of the anti-drag ring cowling to the carburetor. The first section of the scoop is sheet metal and is integral with the anti-drag ring cowling. The remaining part of the scoop is an elbow-shaped casting. Two flexible connections are used to absorb engine vibration, one between the anti-drag ring cowling and the elbow casting, and the other between the elbow casting and the carburetor. The elbow casting has a door which opens into the engine section through which warm air may enter.

(b) REMOVAL AND DISASSEMBLY.

1. Disconnect the neoprene sleeve which connects the carburetor to the air scoop elbow.

2. Remove the flexible connector between the anti-drag ring cowling and the intake elbow.

3. Remove the control linkage at the side of the elbow.

4. Remove the Dzus fasteners which secure the elbow to the anti-drag ring cowling and remove the elbow.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check the air scoop for security of attachment.

2. Check the control arm for freedom of movement.

3. For cable rigging information refer to *figure 74.*

(d) ASSEMBLY AND INSTALLATION.–Reverse the REMOVAL AND DISASSEMBLY procedure. See paragraph *(b)*, above.

(2) NON-RAM TYPE AIR SCOOP.

(a) DESCRIPTION.–In this type carburetor air induction system, a gate, installed in the aft part of the cowling scoop, prevents the direct passage of air to the carburetor. The air is diverted through the two filters, located at the top of the cowling, before entering the scoop which extends to the carburetor. This system, however, may be used also in the ram position. See paragraph 7. *b.* (1), this section.

(b) REMOVAL AND DISASSEMBLY.

1. The scoop is removed as described in paragraph 7. (1), *(b)*, this section.

2. The filters may be removed by releasing the applicable latches and sliding the filters from place.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–When possible replace all carburetor air induction system parts. Small holes in the scoop may be welded if necessary.

(d) INSTALLATION.–Reverse the REMOVAL AND DISASSEMBLY procedure.

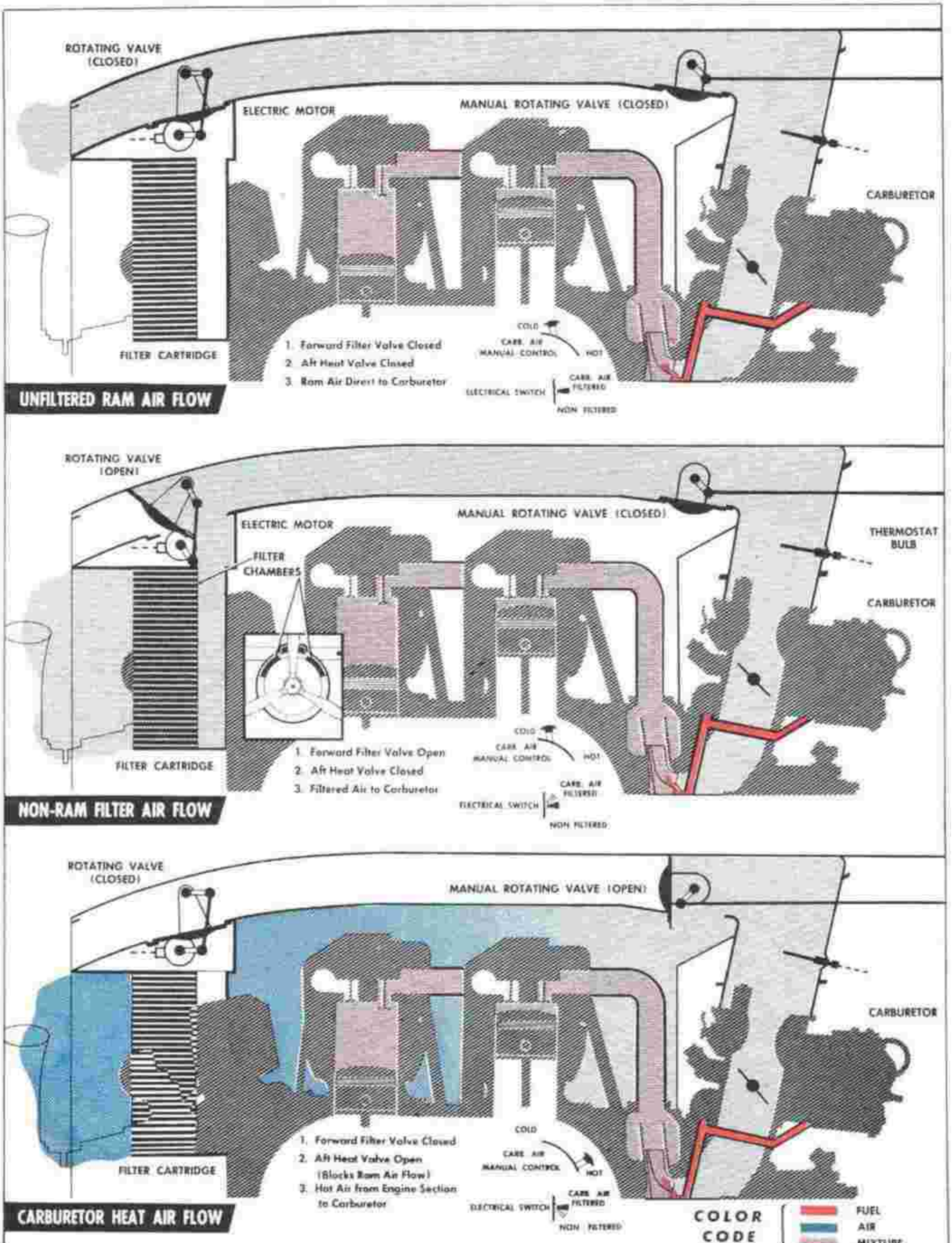
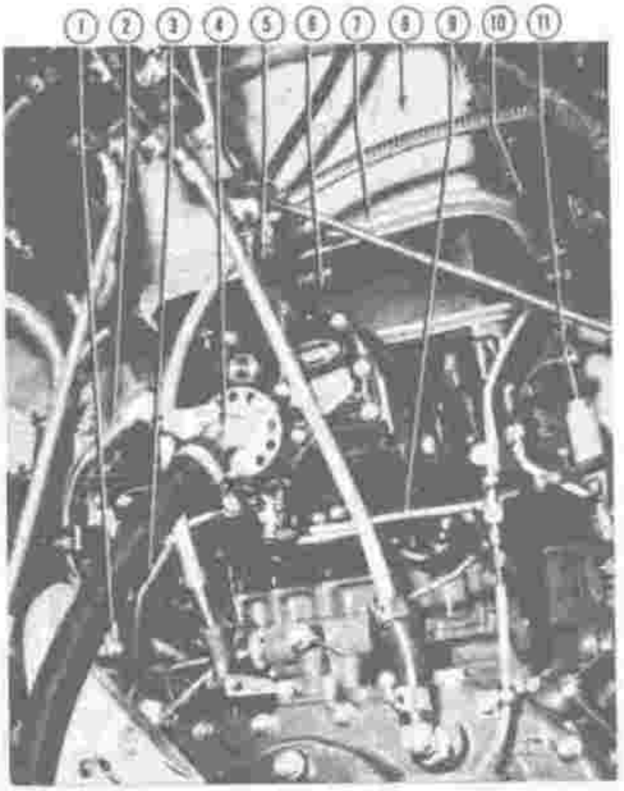


Figure 153—Carburetor Air Induction Systems

c. CARBURETOR.

(1) DESCRIPTION.—These engines are equipped with PT13G1 Bendix-Stromberg downdraft, injection carburetors *(figure 154.)* The carburetor is functionally divided into the following four parts: throttle unit, automatic-mixture-control unit, regulator unit and fuel control unit.

(a) THROTTLE UNIT.—Air is taken in through the air scoop and flows to the three barreled throttle unit. Each barrel contains a large venturi, a boost venturi (tubular restriction), and a group of small impact tubes around the top of the large venturi. The throttle valves control the amount of incoming air. The difference in air pressure between the impact tubes and the boost venturi throat is a measure of the volume of air entering the engine.



1. Carburetor Mixture Control
2. Fuel Line to Discharge Nozzle
3. Fuel Pressure Line
4. Inlet Line from Fuel Pump
5. Vapor Vent Line
6. Neoprene Sleeve
7. Neoprene Sleeve Clamp
8. Air Induction System Elbow Casting
9. Engine Priming Line
10. Clamp Tightening Screws
11. Throttle Control Mechanism

Figure 154 — Carburetor Installed

(b) AUTOMATIC MIXTURE CONTROL.—An automatic mixture control unit is mounted on the side of the throttle body and contains metallic bellows which are sensitive to changes of carburetor air pressure and temperature. The function of the unit is to correct the fuel-air ratio according to existing atmospheric conditions.

(c) REGULATOR UNIT.—The regulator unit has an air chamber and a fuel chamber. Each member is divided into two sections by diaphragms which are installed on the fuel poppet shaft. The incoming air pressure produces an air metering force which acts on the air diaphragm. This force moves the fuel poppet and the fuel diaphragm, permitting the flow of fuel to vary according to the mixture desired and the atmospheric condition of the air being used.

(d) FUEL CONTROL UNIT.—The fuel control unit contains fixed metering jets, the idle valve, the power enrichment valve, and a four position full mixture control selector valve.

(e) ACCELERATION PUMP.—A throttle actuated, piston type acceleration pump is installed on the throttle body. This unit causes the fuel poppet to admit more fuel into the engine blower housing and through the fuel slinger ring on the impeller shaft. This carburetor is also equipped with a throttle balance which reduces the tendency of the throttle valve to creep shut when the vacuum below the throttle valves is high.

(2) REMOVAL AND DISASSEMBLY.

(a) Remove the anti-drag ring cowling as instructed in paragraph 6. *b.* (14) *(b)*, this section.

(b) Disconnect the carburetor air scoop control.

(c) Disconnect the neoprene sleeve which extends from the carburetor to the air duct elbow.

(d) Remove the elbow by unfastening the Dzus fasteners which hold it to the engine mount.

(e) Disconnect the throttle and mixture control rods at the carburetor.

(f) Disconnect the main transfer line which is connected to the blower section.

(g) Disconnect all lines which are connected to the carburetor.

(h) Remove the nuts which secure the carburetor to the studs on the blower housing. Lift the carburetor off the spacer.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—The following maintenance operations can be performed in the field without the use of a flow bench or overhaul equipment. It is not advisable to perform any further work on carburetors between overhaul periods. All work on carburetors will be performed by carburetor specialists.

(a) Remove the fuel strainer bolt, cup, and strainer from the regulator body and clean the parts.

(b) Mixture control and idle linkage joints should be examined occasionally for play. Link bolts should be tightened securely and spring washers in place.

(c) The automatic mixture control unit may be removed for inspection or replacement. While this unit is removed, clean the needle valve. Replacement is necessary approximately every 250 hours.

CAUTION

When the control is removed, particular care must be taken not to change the position of the adjusting screw and lock nut.

(d) Keep the boost venturi clean at all times. Clean the impact tubes with pipe cleaners or a small wire.

(e) When making connections between the fuel pump and the carburetor, be sure to clean all sealing compounds off the ends of the connections. Use the sealing compound lightly on the threaded area only.

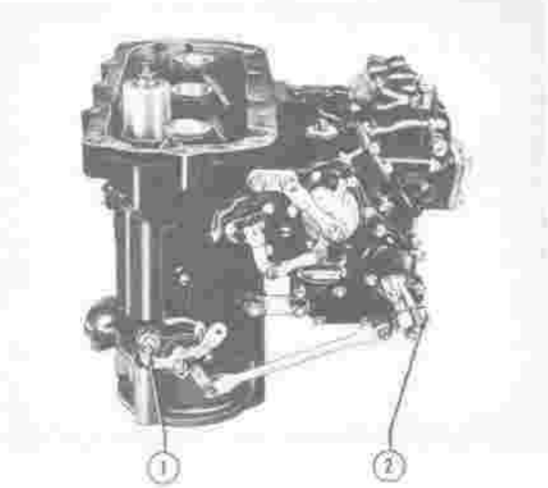
(f) Check for broken lockwires and consequent loosening of nuts and plugs.

(4) ADJUSTMENTS.—All adjustments with the exception of idle adjustment should be made at a major depot where a flow bench is available. Proceed with the idle adjustment as follows:

(a) If the engine is cold, run it at 1000 rpm until the oil inlet temperature reaches 60 degrees C. to 70 degrees C. (140 degrees F. to 158 degrees F.) and the cylinder head temperatures are normal: then run the engine at 2000 rpm long enough to clean the spark plugs. At this time the operation of the plugs should be checked by moving the magneto switch from "BOTH" to "LEFT" and to "RIGHT." If the decrease in rpm is normal, the idling of the engine may then be checked, and adjusted if necessary.

(b) The throttle stop position should first be set so that the engine will idle between 400 and 500 rpm. While the engine is idling, momentarily move the mixture control to "IDLE CUT-OFF" and carefully observe the engine rpm. Move the control back to automatic rich before the engine stops.

(c) If the engine rpm decreased immediately when the mixture control was moved to "IDLE CUT-OFF," turn the knurled adjusting screw one or two notches in a clockwise direction to enrich the mixture and again check the rpm when the control is moved to "IDLE CUT-OFF."



1. Idling Adjustment Screw 2. Throttle Adjustment Screw

Figure 155 — Carburetor (Left Side)

(d) If the engine rpm increased momentarily by more than 5 to 10 (never more than 15 or 20) rpm when the mixture control was moved to "IDLE CUT-OFF" lean the mixture slightly by turning the knurled adjusting screw one or two notches in a counterclockwise direction; then recheck the rpm when the control is moved to "IDLE CUT-OFF."

(e) Each time the adjustment is changed, the engine should be run up to 2000 rpm to clear the spark plugs before proceeding with the rpm check. The above procedure should be repeated until a momentary increase of between 10 and 20 rpm is noted when the mixture control is moved to "IDLE CUT-OFF." When this condition exists, the idling is satisfactorily adjusted. The final idling rpm should be between 500 and 650.

CAUTION

Never attempt to make an adjustment on the automatic units. These adjustments must be made on the flow bench.

(5) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

d. TROUBLE SHOOTING CHART. (See paragraph 6. *c.*, this section.)

8. IGNITION SYSTEM.

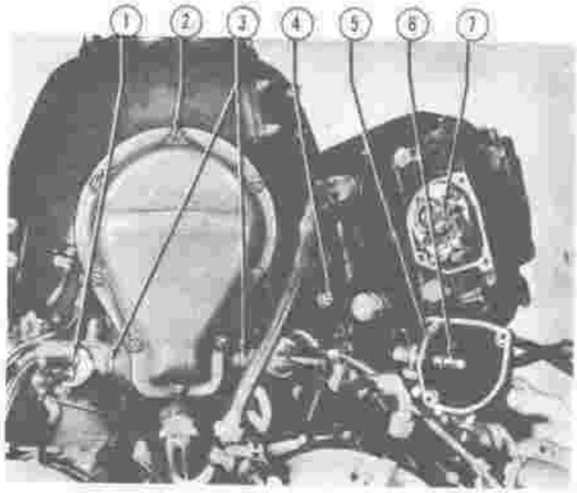
a. GENERAL.—Either Scintilla Magnetos, distributors, and ignition harness or General Electric Magnetos and Ignition Shielding are installed on A-26 engines. The two systems are interchangeable. Engines using the first named system are designated as R-2800-27, engines using the other type ignition system as R-2800-71.

b. SCINTILLA MAGNETOS, DISTRIBUTORS, AND IGNITION HARNESS (Used on R-2800-27 engines).

(1) GENERAL.—The ignition system is the magneto type and is completely independent of the airplane electrical system, except for the induction vibrator circuits. The system is completely shielded and has two major electrical disconnect plugs for each engine: one at each firewall and one at each wing disconnect location. The ignition wires are connected to terminal posts in the ignition junction box, the left and right firewall junction boxes, and the left and right power plant junction boxes. The ignition is furnished by a dual magneto, an induction vibrator, and twin distributors mounted separately on external pads on the front section of the engine housing, and controlled by two ignition switches located on the pilot's main electrical control panel. When the ignition switch is in the "ON" position and the starter is engaged, the current from the battery is supplied to the induction vibrator, causing it to produce a rapidly interrupted current. This current flows through the primary winding of the magneto coil, where, by induction, a high voltage is created in the secondary winding of the magneto coil. This produces a high tension voltage which is supplied to the spark plugs, through the magneto distributor rotor and distributor block electrodes, when the magneto contact points are open. The current causing the initial spark is timed for delivery in advance, and the sparks which follow gradually taper off into retard until the magneto contact points close, and the current by-passes to the ground connection. This action is repeated each time the magneto contact points are separated, sending the interrupted current again through the primary winding of the magneto coil, where the action, outlined above, again occurs. This action continues until the engaging starter is released and the engine is firing under the regular magneto spark.

Note

For wiring diagrams for the component part of the ignition system, refer to the WIRING DIAGRAM SECTION following paragraph 15, this section.



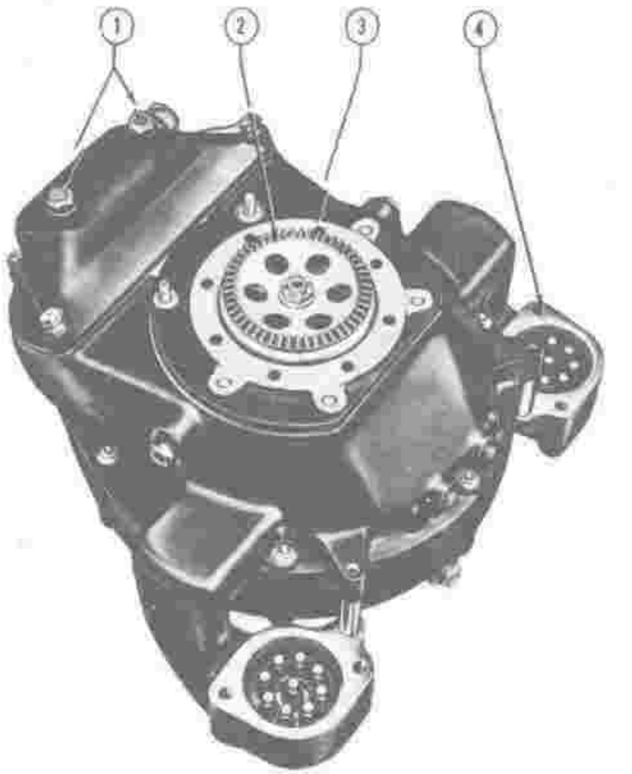
1. Ignition Harness
2. Distributor Cover Screws
3. Distributor Gland Nuts
4. Magneto Stud Bolts
5. Magneto Breaker Cam Cover
6. Plunger Type Cam Oiler
7. Magneto Breaker Cam

Figure 156 — Magneto and Distributor

(*a*) MAGNETO AND DISTRIBUTORS.

1. DESCRIPTION.—The type DF18RN Magneto (*7, figure 156*) is a double type, four-bolt flange mounted, eighteen cylinder magneto driven at 1⅛ engine crankshaft speed and mounted one on each engine. The high tension current from each coil within the magneto is conducted through two separate

Figure 157—G. E. Magneto Distributor (Top View)



1. Vent Plugs
2. Gear
3. Adapter Plate
4. Terminal Plug

Figure 158 — G.E. Distributor (Integral with G.E. Magneto, Bottom View)

breaker assemblies by means of an external cable to two separate distributors *(2, figure 156)*, each driven independently of the magneto at one-half engine crankshaft speed. The breaker on the left (Name Plate) side of the magneto is connected to high tension terminals "GR2" and "HT2" and supplies current to the right distributor. The breaker on the right side of the magneto is connected with high tension terminals "GR1" and "HT1" and supplies current to the left distributor. Individual high tension electrical cables then carry the current from the distributors to the spark plugs where discharge or spark occurs for ignition purposes. The left distributor supplies current to the rear spark plugs in all cylinders, and the right distributor supplies current to the front spark plugs. The two distributors and the ignition harness form a completely shielded unit to carry the current to the shielded spark plugs.

2. REMOVAL.

a. Disconnect the distributor connections *(figure 156)* from the magneto, using a pair of leather padded pliers.

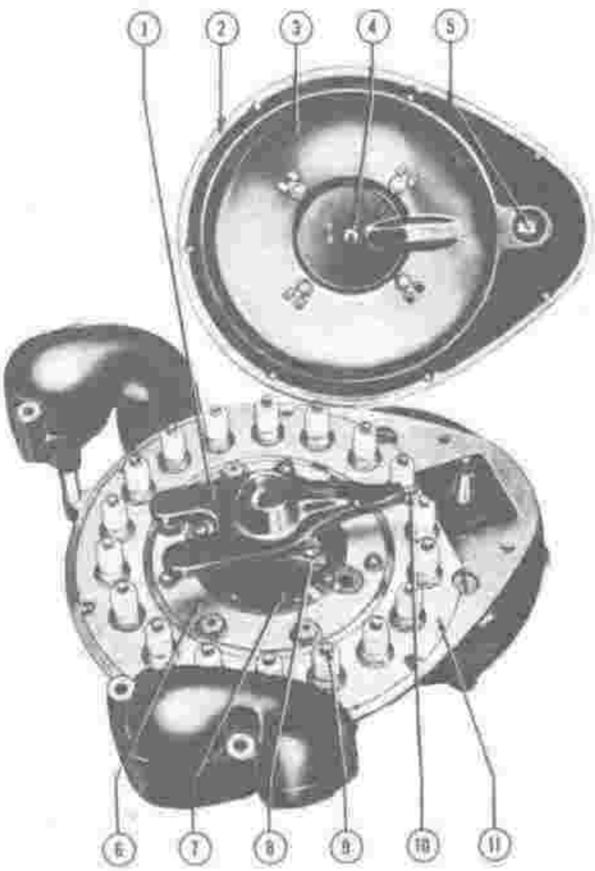
b. Remove the four nuts and washers *(4, figure 156)* holding the magneto in position and lift off the magneto.

c. Remove the distributor blocks as instructed in paragraph 8. *b.* (1) *(a)* 3. a. *(9)*, this section.

3. MAINTENANCE REPAIR OR REPLACEMENT.

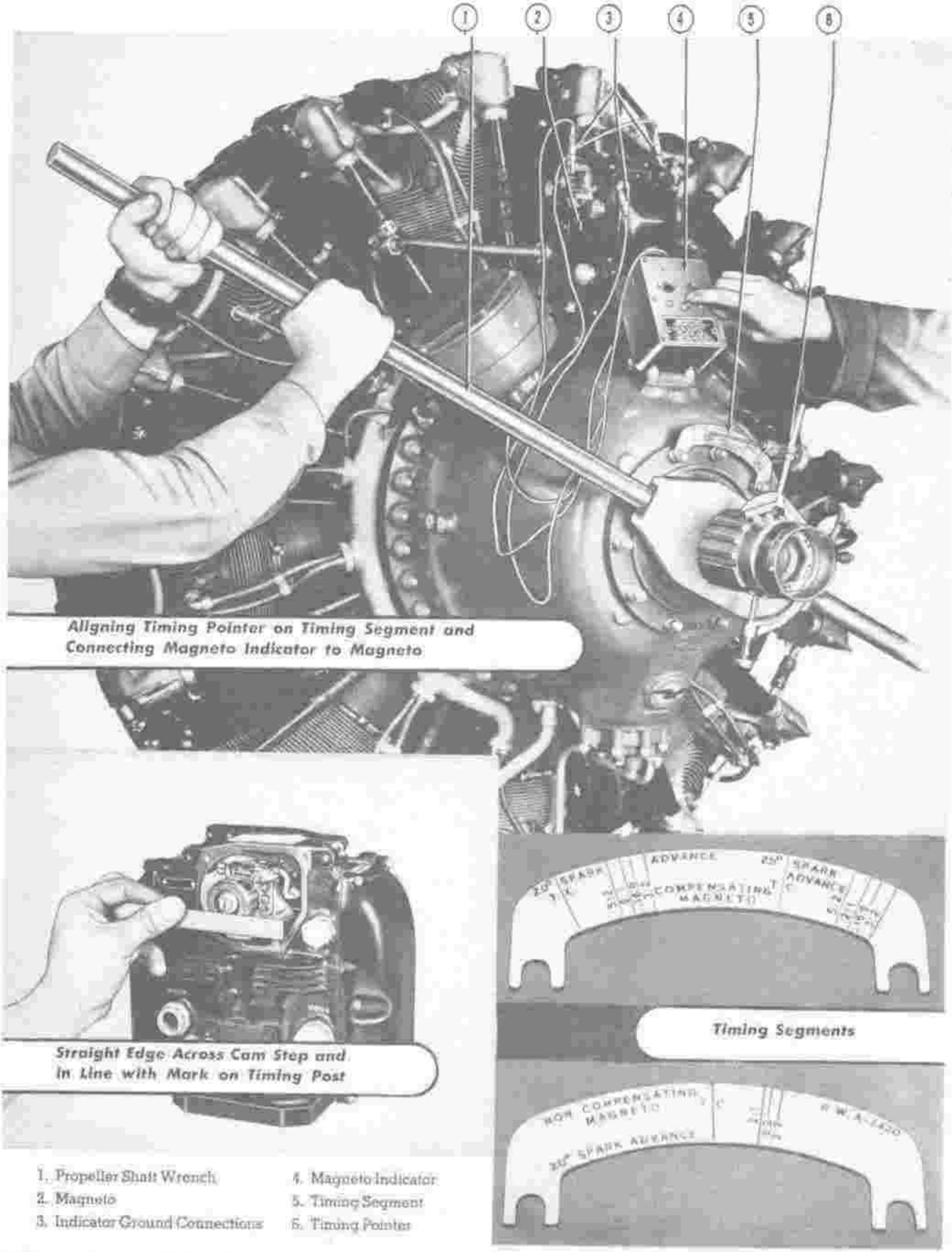
a. CHECKING IGNITION TIMING.—To check the ignition timing completely, the following three checks should be made. First, the magneto should be checked for timing, having its two breakers synchronized with their own timing marks. Second, the magneto should be checked for correct timing with the engine. Third, the distributors should be checked for timing with the engine. Before checking the timing of the ignition, the engine should have the proper timing indicators installed as described in the following paragraphs:

(1) Remove the front spark plugs from all cylinders and install top-center indicators (PWA-



1. Distributor Rotor
2. Cover
3. Electrode Shield Assembly
4. Carbon Button
5. Contract Point
6. Bracket Assembly
7. Eccentric Screws (3)
8. Distributor Rotor Support
9. Electrodes
10. Distributor Rotor Tip
11. Electrode Ring

Figure 159 — G.E. Distributor (Integral with G.E. Magneto, Open View)



Aligning Timing Pointer on Timing Segment and Connecting Magneto Indicator to Magneto

Straight Edge Across Cam Step and In Line with Mark on Timing Post

Timing Segments

1. Propeller Shaft Wrench
2. Magneto
3. Indicator Ground Connections
4. Magneto Indicator
5. Timing Segment
6. Timing Pointer

Figure 160 — Timing and Synchronizing Magneto

2537) in No. 1 cylinder spark plug hole, and locate No. 1 piston at the top center of its compression stroke. Attach the timing segment (PWA-2352) to two of the thrust cover studs and timing pointer (PWA-2353), to the propeller shaft or propeller hub so that the pointer aligns with the top center mark of the segment. Connect the two red wires of magneto indicator (PWA-2417) to the two ground connections of the magneto (GR1 and GR2) and ground the black wire to the engine.

Note

The breaker assembly on the left (Name Plate) side of the magneto connects with the ground and high tension connections "GR2" and "HT2," and the breaker assembly on the right side of the magneto connects with "GR1" and "HT1."

(2) Remove top-center indicator from No. 1 cylinder and the breaker covers on each side of the magneto. Turn the propeller shaft back in clockwise direction (as viewed from the front of the engine) approximately 90°, then forward in the normal direction of rotation, until the timing pointer is aligned with the correct spark advance mark of the timing segment for the R-2800-27 engine.

(3) At this position, a straight edge placed on the step of the breaker cam should align with the timing mark on the post of the breaker plate and both lights of the magneto indicator should go on, indicating the contacts have just opened. *(See figure 160.)*

Note

The contact points must always be adjusted to open at the proper position of the breaker cam in relation to the timing marks on the magneto, and not for any fixed clearance between the contact points.

(4) If the above check shows one or both contact points to be out of adjustment with the magneto timing marks, they should be adjusted as described in paragraph 7. *c.* (4), this section.

(5) When the foregoing is completed, time the magneto to the engine so that both the indicator lights go on when the pointer reaches the correct spark advance mark on the segment for the R-2800-27 engine. This may be done by loosening the four magneto stud nuts and rotating the magneto on its mounting pad, through the range allowed by the slots in its mounting flange *(figure 160)*, until the lights just go on and the pointer is on the correct spark timing mark. The direction of the final rotation of the magneto should, when setting the magneto to the engine, be in a clockwise direction.

Note

When timing the magneto to the engine, it should be noted that No. 1 cam lobe, which is marked with a dot, is opening the contact points.

(6) To check the timing of the distributors to the engine, unfasten the eight fillister head screws from the distributor cover plate and remove the cover plate. Remove the single fillister head screw located behind the distributor block and beneath the ignition wires. Loosen the two gland nuts which fasten the distributor housing to the manifold ring with a distributor gland nut wrench. With the top center indicator, the engine timing segment, and the engine timing pointer installed, rotate the propeller shaft until the piston in No. 1 cylinder is at the proper

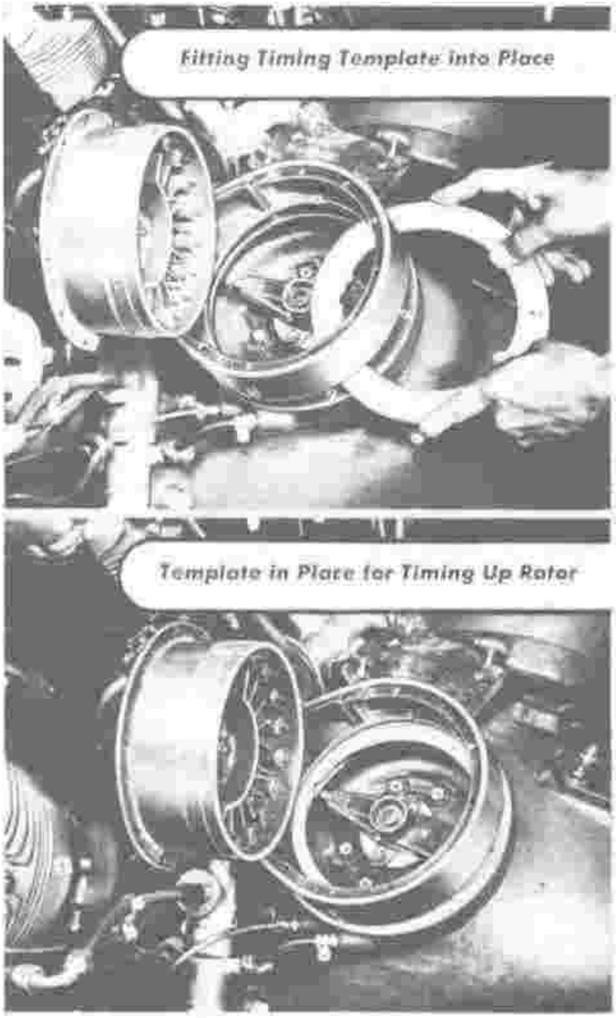


Figure 161 — Aligning the Distributor Rotor

specified advance position on the compression stroke. Pry the distributor body from the adapter sufficiently to reach in with a wire and lift out the rubber seal. NEVER try to remove the distributor body without first removing the seal. Fit the distributor timing template on the top surface of the adapter with the small pin in the rear threaded insert of the adapter face so that the timing projection is nearest the cylinders of the engine. The large electrode on the distributor rotor should align exactly with the timing projection on the template. *(See figure 161.)* Check each distributor separately.

(7) To correct any misalignment of the distributor rotor, loosen the two nuts which fasten it in position on the rotor plate; then rotate the distributor rotor within the range of the slots until the large electrode aligns with the projection on the timing template fitted to the top surface of the distributor adapter. Fasten the distributor rotor in position with the two retaining bolts, using care not to change the position of the rotor. If no timing template is available, merely position the distributor finger so that the TRAILING half of its high tension segment is over the No. 1 distributor head electrode.

(8) A recheck of the ignition timing should be made after any adjustment to the magneto or distributors. This recheck must be made by first reestablishing top-center position of No. 1 piston as previously described, and checking the timing pointer with the top-center mark on the timing segment. The propeller shaft will then be turned back in clockwise direction (as viewed from the front of the engine) approximately 90°, then forward in the normal direction of rotation, until the timing pointer is on the correct spark advance mark of the timing segment. At this position, both lights of the magneto indicator should light, the timing mark on the post of the breaker plate should align with a straight edge placed on the step of the magneto breaker cams, and the large electrode of the distributor finger must align with the projection of the distributor timing template. (This series engine has a spark advance of 20°.)

(9) Remove the four flat head screws holding the retaining plate to the distributor case and slightly lift the block. Reach in under the block with a wire hook and pull out the rubber sealing ring. Never attempt to pull the distributor block off without removing this ring. Pull the ring free of the block before raising the block any further. When the block is free from the case, it may be tilted back, using care not to chip or otherwise damage it. Care must be taken to see that the insulation of the ignition wires is not damaged, or the high tension lead broken.

b. CLEANING CONTACT BREAKER POINTS.—Unless the contact breaker points are oily, dirty, or badly pitted, do not disturb them. If it becomes necessary to clean the contact points, remove the breaker assembly, and clean the points with carbon tetrachloride or unleaded gasoline. Remove high spots with an oil stone or with 400 to 600 "Wet-or-Dry" paper (DO NOT USE EMERY CLOTH).

4. ADJUSTMENT OF CONTACT BREAKER POINTS.—If inspection shows that adjustment of the breaker contacts is necessary, loosen the two screws which fasten the movable contact support to the breaker plate. Adjust the movable contact support by means of the eccentric screw so that the points just begin to open on the No. 1 lobe of the respective cam when a straight edge coincides with the timing mark "M." Tighten the screw when the setting has been made and recheck the adjustment.

Note

The contact points must always be adjusted to open at the proper position of the breaker cam in relation to the timing marks on the magneto and not to any fixed clearance between the contact points.

5. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

c. GENERAL ELECTRIC IGNITION SYSTEM. (Used on engine model R2800-71.)

(1) GENERAL.—The General Electric Ignition system, consisting of two magnetos (type S18LG-P1) and an ignition shielding assembly (type P18HG-P1), is interchangeable with the Scintilla Magneto, distributor and ignition harness. Each magneto is a single self-contained unit with a built-in distributor assembly so that a separate externally mounted distributor assembly is not required. The magneto operates at one-half the crankshaft speed of the engine and gives 18 sparks per revolution of the magneto. The manifold of the ignition shielding assembly is of circular form. It is made in several sections connected together by ball and socket joints which make it possible to spread the manifold apart slightly for installation in the engine without removing the propeller. A special elastic impregnating gel is forced into the manifold around the conductors to exclude moisture and provide additional insulation. The leads are detachable from the manifold. Each lead comprises high tension ignition cable encased in a flexible braided jacket with appropriate terminals at each end for connection to the manifold and spark plug.

(2) REMOVAL.

(a) SPARK PLUG LEADS.—The removal pro-

cedure for the spark plugs is essentially the reverse of the INSTALLATION procedure.

(*b*) IGNITION SHIELDING ASSEMBLY.

1. Disconnect the detachable leads from the spark plugs and manifold.

2. Remove the brackets from the engine which fasten the manifold tubes in position.

3. Cut the safety wire and remove the screw holding the center section of the manifold to the bracket.

4. Loosen the four ball and socket joints which fasten the center section and manifold tubes to the manifold castings, using a harness spanner wrench M-8642253-G1. The manifold tubes can now be spread apart and the manifold removed from the engine.

5. Reconnect the detachable spark plug leads to the manifold outlets or pack the leads in a container with the manifold.

(*c*) REMOVAL OF MAGNETO.

1. Unfasten the six screws which hold the cover to the magneto housing. The cover may now be removed by tapping the lip on the cover with a screw-driver.

2. Remove the ground cable. Close the cable opening in the magneto housing with a piece of cloth to prevent entry of dust and dirt.

3. Remove the four bolts which fasten the magneto to the manifold.

4. Remove the two elastic stop nuts from the studs which project beneath the magneto through the adapter plate.

5. Cut the safety wire on the four bolts which fasten the magneto to the adapter plate and remove the bolts.

6. Remove the magneto from the engine.

7. Remove the gaskets, laminated shim, and adapter plate from the motor nose and fasten them to the magneto using the four hold-down bolts.

8. Replace the cover on the magneto.

9. Repeat steps one to eight, inclusive, for the other magneto.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—In general, damaged ignition systems should be replaced rather than repaired. For other information refer to AN 03-5DD-1.

(4) ADJUSTMENTS.

(*a*) TIMING MAGNETO WITHOUT TIMING LIGHT.

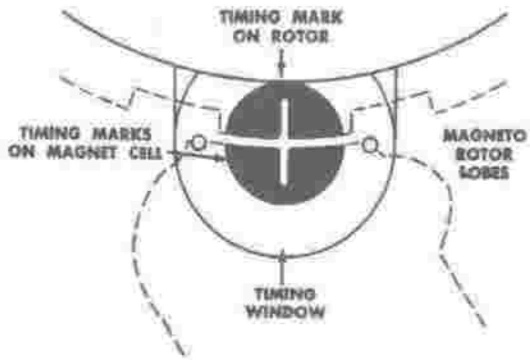


Figure 162 — Timing Marks as Seen Through No. 1 Timing Window

1. Set up the engine at the proper firing point on the *compression stroke of No. 1 cylinder* in accordance with the applicable engine Technical Order.

2. Put the magneto on the engine with the distributor finger as close to the No. 1 electrode as the gear mesh will allow.

3. Look through the No. 1 timing window in the breaker plate assembly. The magneto is correctly timed to the engine if the timing marks on the magneto rotor and magneto cells line up during the 1/32 movement of the magneto rotor allowed by the gear play. *(See figure 162.)*

4. To adjust timing of the magneto, shift the magneto-drive gear on the splined shaft in accordance with the following procedure:

a. The magneto drive gear has 51 teeth and is keyed to the shaft by 13 splines. If this gear

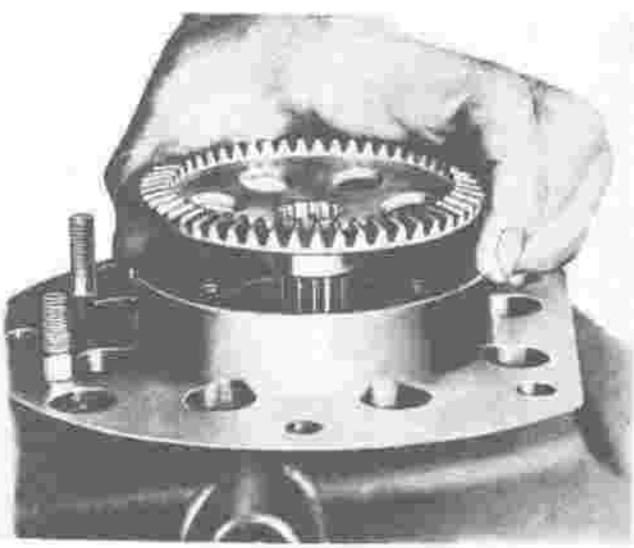


Figure 163 — Moving Gear to Advance Spark

is shifted on the shaft by one spline, the magneto-drive gear and the drive pinion on the engine will not mesh until the magneto shaft is turned slightly. This relation is the basis of timing procedure. Moving the gear one spline "clockwise" (looking at the gear end of the magneto) will retard the magneto by about 1/2 degree of magneto-shaft rotation, or about one degree of engine-crankshaft rotation. Moving the gear "counterclockwise" one spline will advance the magneto timing by the same amount.

b. To retard magneto, remove the drive gear from the shaft and shift the gear one spline in a "clockwise" direction (looking at the gear end of the magneto). To advance magneto, shift in a "counter-clockwise" direction. *Figure 163* shows how the gear is moved for advancing or retarding the magneto.

(5) TEST BEFORE INSTALLATION.

(a) INSPECTION AND TESTING OF MAGNETO HOUSING AND MAGNET CELLS.

1. Place a connector plug in each of the magnet terminal plugs and place the connector plugs under pressure by clamping with insulating plate. *(See figure 164.)* Using the Delco Ignition Tester (Model 724420), test between each electrode and the

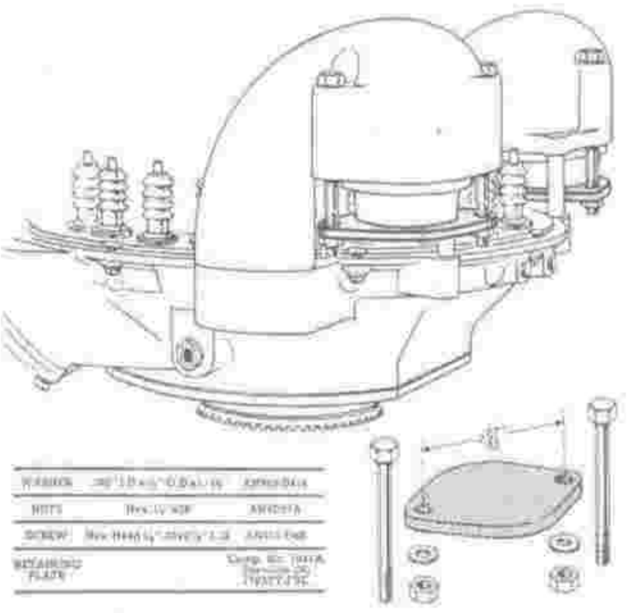
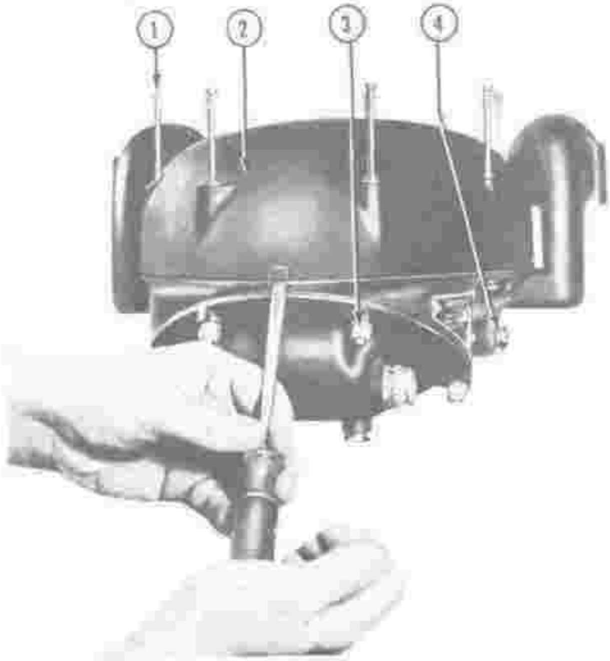


Figure 164 — Placing Connector Plugs Under Pressure

magneto housing at 12,000 volts (rms) for one minute. If any electrode fails this test, repeat with a new set of connector plugs to make certain that the magneto and not the plugs caused the failure. If the second test indicates that the magneto has failed, the housing must be discarded and returned to the factory for reworking.

2. Examine each electrode carefully for cracks or damage. If any electrode is defective, the housing must be discarded and returned to the factory for reworking.



1. Cover Bolt
2. Cover
3. Self-Locking Nut
4. Spline Nut

Figure 165 — Removing Cover by Tapping Against Lip

3. Test the magneto as follows:

a. Loosen the bolts *(See figure 165.)* and remove the cover from the magneto. The cover may be raised by tapping against the lip with a screw driver.

b. Mount the magneto on the magneto test stand. Connect the A-C ammeter across both breakers. (One terminal should be connected to the primary connector and the other to the magneto housing.) Place a piece of paper between the points of one breaker to open the circuit through the breakers.

c. Run the magneto at 400 rpm.

d. Read the ammeter. If the reading is less than 1.45 to 1.55 (rms) amperes, it indicates that the magneto needs remagnetizing on the magnet charger.

e. Remove paper between breaker points.

CAUTION

It is imperative that the magnet cells be placed in the charger with the "N" pole of the cell adjacent to proper pole of the charger. The poles of the magnet cells are shown on *figure 166*. The poles of both magnet cells are the same. Each magnet cell should be magnetized by closing the switch of the charger two or three times, 30 seconds each time. After magnetizing, keep the cells away from metal objects, metal work benches etc., which might act to reduce the magnetic charge.

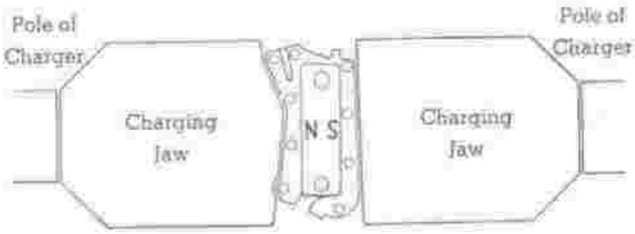


Figure 166 — Poles of Magnet in Relation to Charger

(b) INSPECTION AND TESTING OF ELECTRODE SHIELD.

1. Inspect the button in the center of the electrode shield. *(See figure 4, figure 159.)* If worn within 1/16 inch of its metal base, it must be replaced.

2. Inspect the contact in the electrode shield. If burned or dirty, clean with a piece of emery or crocus cloth held on the flat end of a pencil.

3. Install the electrode shield in the magneto cover and fasten with the four washers and screws. Using the Delco Ignition Tester (Model 7244420), test between the metallic cover and the rotor carbon button at 10,000 volts (rms) for one minute. If the electrode shield fails this test, it must be replaced.

4. If the electrode shield is satisfactory, lockwire the screws to the washers.

(c) INSPECTION AND TESTING OF DISTRIBUTOR ROTOR.

1. Inspect the distributor rotor for cracks or burns. If defective, it must be replaced.

2. Inspect the flat spring contact which engages the carbon button in the electrode shield for burns. Polish the burnished area. If necessary, lift the spring so that it is 3/8 inch high.

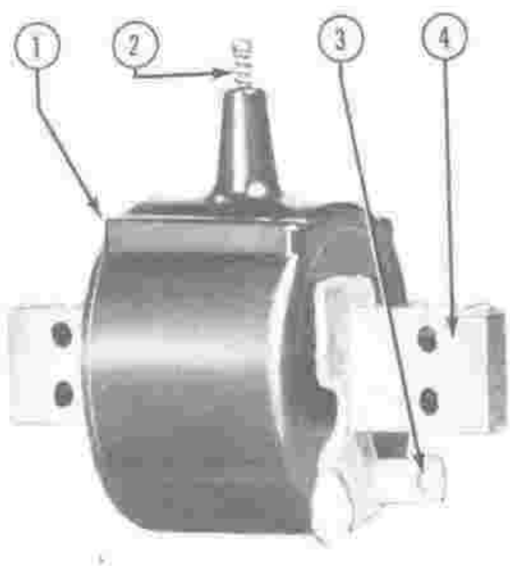
3. Test the distributor rotor at 10,000 volts (rms) between the metal support and the electrode tip. If insulation failure is evident, replace the rotor.

(d) INSPECTION AND TEST OF MAGNETO COIL.

1. Inspect the contact on the coil. If dirty or burned, clean with emery paper.

2. Use a "Supreme" Ohmmeter (model 542), or equivalent, and measure the resistance of the primary coil between the primary connector and the coil core. If the resistance is more than one ohm, the coil must be replaced. *(See figure 167.)*

3. Use a "Supreme" Ohmmeter (model 542), and measure the resistance of the secondary between the coil core and the coil contact. The reading must be between 15,000 ohms and 30,000 ohms. If the resistance falls outside these limits, the coil must be replaced.



1. Coil Assembly
2. Coil Contact
3. Primary Connector
4. Coil Core

Figure 167 — Primary Coil, Showing Primary Connector and Coil Core

(e) INSPECTION AND TEST OF BREAKER ASSEMBLY.

1. Check the primary condenser with a Biddle Insulation Tester. If the reading is less than ten megohms the condenser is defective and must be replaced.

2. Check the contact points on both the No. 1 and No. 8 breaker assemblies for proper opening. Check that the breaker contacts mate over a substantial portion of their area. Pitting of the contact itself is not detrimental to operation of the magneto as long as substantial areas of the contacts engage. However, if pitting has worn back the contact tips to the metal base, the No. 1 or No. 8 breaker assembly must be replaced.

3. Check the breaker-spring in the breaker arms with a spring scale. If the tension falls outside the 24 and 30 ounce limit, replace the breaker assembly. Unless the breaker tension is sufficient, the breakers may "bounce" or "flutter" at high speed causing improper operation of the magneto.

4. Check that the windows in the breaker plate are not broken or cracked. If so, replace the window by cutting and replacing the two drive pins holding the window in position.

5. Check that a sufficient amount of oil wick projects from the case to engage the cam when assembled. Place one drop of oil, Univis No. 48, (AAF Specification No. 3582) on the wick.

(f) INSPECTION AND TEST OF BALL BEARINGS.

1. Inspect the sealed bearing carried by the breaker plate to see that it turns freely. If bearing is damaged or rotates with difficulty, replace.

2. Inspect the bearing to see that it rotates freely, after the bearing carried by the housing has been washed in solvent. Lubricate the bearing with a small amount of grease to protect it while running test.

Note

Other information pertaining to ignition system tests may be found in AN 03-5DD-1.

Magneto Drive Adapter

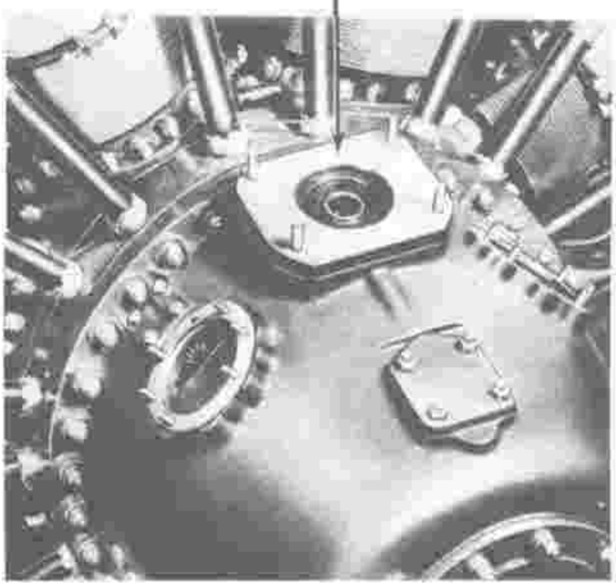


Figure 168 — P & W R-2800 Engine Nose, Ready for Installation of Ignition System

(6) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—For information pertaining to assembly of the ignition system refer to AN 03-5DD-1.

(b) INSTALLATION.

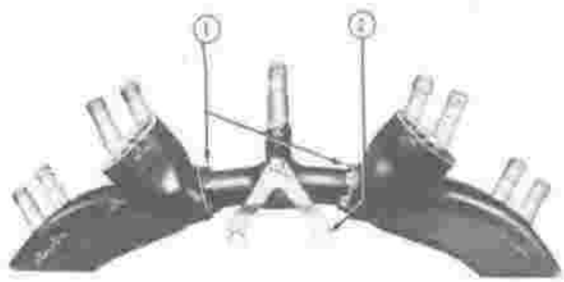
1. PARTIAL INSTALLATION OF MANIFOLD AND DRIVE COVER.

a. Check master-rod location on engine data plate to assure agreement with locations shown on magneto nameplate.

b. Remove the magneto-drive adapter *(See figure 168)* from the center mounting pad on the engine.

c. Place cloths in the three openings for the magneto-drive adapter and distributors to prevent articles from falling into nose.

d. Loosen the four ball and socket joints on opposite sides of the two castings of the manifold, using a harness spanner wrench M-8642253-G1.

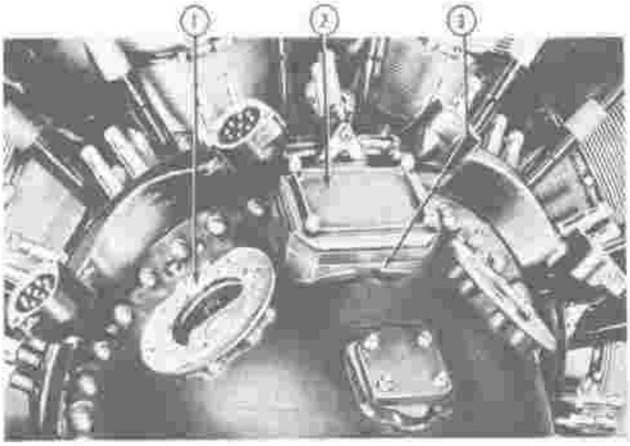


1. Ball and Socket Joints 2. "A" Bracket

Figure 169 — "A" Bracket on Ignition Shielding Assembly

e. Fasten the "A" bracket loosely to the center section of the ignition shielding assembly. *(See figure 169.)*

f. Spread the two halves of the ignition shielding assembly and mount the assembly on the engine nose with the arms of the bracket seated on the two studs back of the magneto mounting pad. It is not necessary to remove the propeller. Tighten the nuts holding the bolt to the engine.



1. Adapter Plate
2. Drive Cover
3. Magneto Drive Adapter

Figure 170 — Adapter Plate and Drive Cover Installed

g. Replace the double magneto - drive adapter (be sure to replace the gasket under it) and then install the drive-cover gasket and the drive-cover. Both of these are furnished with the ignition shielding assembly.

h. Fasten the drive-cover down with washers and elastic stop nuts on the four studs.

2. INSTALLING ADAPTER PLATE.

a. Remove cover from magneto and also remove the four bolts which hold the adapter plate to the magneto. The adapter plate and adapter plate gasket may now be removed.

b. Place the gasket on the distributor mounting pad on the engine, and install the adapter plate. Fasten the adapter plate with the eight cap screws and lock washers furnished in the installation kit accompanying the magneto and safety wire the screws. The nose will now appear as in *figure 170.*

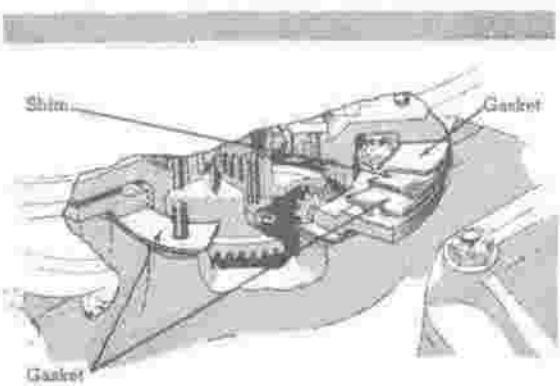


Figure 171 — Laminated Shim Between Two Magneto Gaskets

3. SETTING UP ENGINE.

a. Set up the engine at proper firing point on the *compression stroke of No. 1 cylinder* in accordance with the applicable engine Technical Order.

b. Determine the point of firing from the engine-data plate.

4. SETTING GEAR CLEARANCES.

a. Place the laminated shim between the two magneto gaskets on the magneto flange.

b. Set the magneto on the adapter plate. Make sure gears are in mesh. *(See figure 171.)*

c. Secure the magneto with the two opposite hold-down bolts, and check the gear clearance between the engine-drive pinion and the drive gear on the magneto by moving the distributor-rotor tip. There must be enough play or backlash in the gears to allow the distributor-rotor tip to be moved back and forth about 1/32 inch.

Note

Other information pertaining to installation of the ignition system will be found in the service publication AN 03-5DD-1 describing the 18-cylinder High Tension Ignition System as manufactured by General Electric.

(7) TEST AFTER INSTALLATION.

(a) When the engine has been warmed up, it should be run at 1900 rpm, and the magnet switch turned from "BOTH" to "L" and "R." With the switch at "L," the right-hand magneto is grounded so that the left-hand magneto alone is active in firing the engine. With the switch at "R," only the right-hand magneto is active. The engine should continue to run with the switch at "L" or "R."

(b) The engine speed will drop slightly from 1900 rpm when each magneto is operating alone. The maximum permissible drop in speed is 100 rpm for either magneto with about 70 rpm as the normal speed drop.

(c) If the engine speed drops more than 100 rpm when the magneto switch is turned to either "L" or "R" the timing of the magneto giving the high drop is probably faulty. The timing of the magneto to the engine should be rechecked. If one of the magnetos still gives a high drop, the internal timing of the magneto should be checked.

1. Electrical Connection to Magneto
2. Alternate Electrical Connection
3. Induction Vibrator
4. Radio Noise Filter

Figure 172 — Induction Vibrator and Radio Noise Filter

d. INDUCTION VIBRATORS.

(1) DESCRIPTION.—Two American Bosch type VJR-24B3 or (VJR-24B5, VJR-24B1 or G. E. type 70 G7) induction vibrators (*3, figure 172*) are mounted, one for each engine, on brackets forward of the fire-wall on the right-hand side of each engine mount. The induction vibrators are designed for use as an auxiliary source of ignition to facilitate starting of aircraft engines. There are two flexible conduits leading from two of the three outlets on the unit: a conduit attached to the "+" outlet, containing a wire leading to the starter switch, and a wire leading to the starter through the starter relay; a conduit attached to the "IGN. SW." outlet, containing a wire leading to the ignition switch, and a wire leading to the magneto. No attachment to the "MAG." outlet is necessary, because the internal contacts for the "IGN. SW." and "MAG." outlets are connected inside the unit. The induction vibrator automatically starts to function when the ignition switch is "ON" and the starter is engaged; it ceases to function when the starter is disengaged.

(2) REMOVAL.

(a) Remove top cover fastening nut with a 7/16 inch socket wrench and lift off cover.

(b) Trip lock spring on "IGN. SW." outlet and unscrew outlet nut. A gentle pull on cable will remove conduit attachment with springs.

(c) Remove terminal clip fastening screw inside the unit. Terminal clip may now be removed through the "+" cable outlet.

Note

If unit is B1 model, the positive cable fastening screw must be loosened and the positive cable removed.

(d) Remove the mounting bolts holding the unit to the bracket and remove the unit.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Maintenance is limited to minor external and connecting parts. A number of causes of so-called induction vibrator failures may result from faulty spark plugs, a defective switch cable or switch, damaged or incorrect external wiring, or a weak battery, or by having a contact spring that is made from a wire with less than .035 diameter. In order to be sure that the induction vibrator is faulty, leave the unit installed in the airplane, disconnect the conduits as instructed in paragraph 8, *d*, (2), this section, and test as follows: *(See figure 173.)*

(a) Connect a wire from "MAG." outlet to a standard six volt battery ignition coil. Ground the other side of the ignition coil.

(b) Connect a lead from the high tension terminal of the battery ignition coil to a spark gap having sharp points, and set apart at nine mm. Connect the other side of the spark gap to ground.

(c) Connect a wire from the positive side of a fully charged 12-volt storage battery through a single pole, single throw switch, and an ammeter having a range of 0 to 5 amperes, to the positive terminal post in the induction vibrator. Connect the negative side of the storage battery to ground.

Note

The induction vibrator is automatically connected to ground when the mounting bolts are in place.

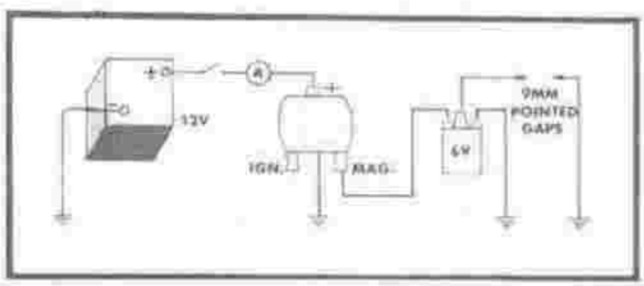


Figure 173 — Induction Vibrator Test

(d) When the switch from the storage battery to the induction vibrator is closed, the unit must supply an electric spark of sufficient intensity to jump the nine mm gap, without missing. The ammeter reading must be from 2.3 to 2.8 amperes.

(e) If the vibrator fails to pass this test, replace it.

Note

No lubrication of any kind is required on this unit.

(4) INSTALLATION. – Reverse removal procedure given in paragraph 8. *d.* (2), this section.

e. SPARK PLUGS.

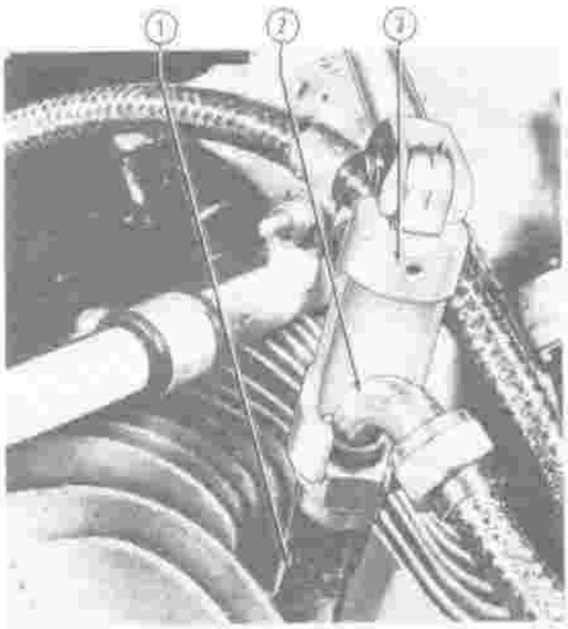
(1) DESCRIPTION.–Type C34S ceramic, long-reach, hot-running spark plugs are installed, two in each of the 18 engine cylinders, which transmit the spark for ignition purposes. Individual high tension cables connect the spark plugs with the distributors.

(2) REMOVAL.–*(See figure 174.)*

(a) Unscrew nuts on spark plug elbows.

(b) Remove ignition wire terminal sleeves from spark plugs.

(c) Remove spark plugs, using spark plug wrench (PWA-2254) and extension handle.



1. Spark Plug (C 34S)
2. Spark Plug Lead Elbow
3. Spark Plug Lead Elbow Wrench

Figure 174 — Spark Plug Lead Elbow Removal

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) CLEANING SPARK PLUGS.–Great care should be taken in handling ceramic spark plugs because rough handling or dropping may crack the ceramic, rendering them useless.

1. Nicks or burrs on the external threads may be chased with an 18 mm die. Do not attempt to disassemble the spark plugs.

2. Clean spark plugs with carbon tetrachloride or an unleaded gasoline. After cleaning, the spark plugs should be inspected for cracked ceramic.

(b) ADJUSTING SPARK PLUG GAPS.–The spark plug electrode gap should be .012 inch (.304mm). Special care should be taken that during this operation no pressure of any kind is exerted on the central electrode of the spark plug.

(4) INSTALLATION.

(a) Before installing spark plugs, fit the split rubber grommets and braided ignition wire conduits in their slots in the cylinder head deflectors; then fasten the braided ignition wire conduits to the inter-rear drain pipe on each cylinder head by means of the necessary clamps.

(b) Apply a small quantity of anti-seize compound, Specification AN-VV-C-566, on the threads of the spark plugs. Do not allow any of the lubricant to collect on the electrodes, because subsequent fouling of the spark plugs may result.

(c) Screw the spark plugs in the cylinder heads, using spark plug wrench (PWA-2254), and tighten to a torque of 350 to 360 in. pounds.

(d) Insert spark plug connectors in the spark plugs and fasten the braided ignition wire conduits to the spark plugs by means of the nuts on the spark plug elbows.

CAUTION

The spark plug connectors must be perfectly clean and dry when they are inserted in the spark plugs.

Note

Extreme care must be exercised to see that the barrel is not rotated with respect to the shell when checking the barrel assembly. All AN type elbows will be checked by using elbow wrenches Nos. 39A5279-1 and 39A-5279-2. Under no condition will the tightness of the elbow be determined by a twisting motion applied to the body of the elbow.

f. IGNITION SHIELDING.

(1) GENERAL.—The following information applies only to engines (R-2800-27) equipped with Scintilla Magnetos, distributors, and harness. General Electric ignition shielding installed on R-2800-71 engines, is discussed in paragraph 8. *c.*, this section.

(a) DESCRIPTION.—The ignition shielding is the Pratt & Whitney type, made up of braided metal conduits to carry the ignition wires from the spark plugs to the manifold ring. The manifold ring is a three-piece assembly and has two distributor adapters which house the distributor blocks. The ignition wires lead to each adapter, where they attach to their respective distributor blocks. Two short conduits, attaching at the manifold ring, carry high tension leads from each side of the magneto to each distributor.

(b) REMOVAL AND DISASSEMBLY.

1. Loosen the gland nuts on each side of both distributors *(3, figure 156)* with a distributor gland nut wrench (PWA-1217).

2. Remove the eight fillister head screws which secure each distributor cover to the body and the body to the adapter, and lift off the cover.

3. Remove the fillister head screw located behind the block and beneath the ignition wires. This screw fastens the body to the adapter.

4. Remove the four nuts securing the ignition harness to the crankcase, and the cap screw securing the manifold to the support bracket directly behind the magneto adapter.

5. Carefully withdraw the ignition harness and distributor blocks.

CAUTION

Extreme care should be taken during this operation not to damage the housing or the distributor blocks.

(c) REPLACEMENT—IGNITION WIRE.

1. If there are indications that an ignition wire is defective, determine which wire is defective by means of a continuity buzzer or other electrical test. When the defective wire is located, examine the spark plug connector for moisture, oil, dirt, cracking, or indications of flashover. If the connector is defective, replace it and recheck the wire; otherwise proceed with the following:

2. Remove the eight fillister head screws from the proper distributor cover plate and remove the cover plate.

3. Unfasten the four flat head screws in the distributor block retaining plate, remove the plate, and carefully lift the distributor block out of its housing.

4. Disconnect the faulty wire from the block.

5. Unscrew the union nut which fastens the electrical conduit carrying the defective ignition wire to the manifold. The defective wire can be manipulated from this opening.

6. Fasten an end of the new wire to the distributor end of the defective wire and pull the old wire out. At the same time, insert the new wire into the manifold, and then into the proper ignition wire conduit.

CAUTION

It is necessary to perform this operation carefully so as not to injure the protective coating on the wire.

7. Dust the new wire with talc or soapstone to prevent it from binding or seizing when being installed in the manifold. Do not use carbon tetrachloride or gasoline for cleaning the ignition harness.

8. When the new wire has been pulled through the manifold far enough, cut it off to the proper length at each end. Fasten the distributor contact insert to the distributor end of the new wire; then insert it in distributor block and fasten in place with locking screw.

9. Place spark plug connector on spark plug end of wire. Fasten manifold union nut in place; then replace distributor block in adapter and fasten in place.

(d) ASSEMBLY AND INSTALLATION.—Reverse REMOVAL AND DISASSEMBLY PROCEDURE.

g. IGNITION SWITCH UNIT.

(1) DESCRIPTION.—A type B-5 ignition switch unit, which incorporates a master ignition "ON-OFF" switch and an ignition switch for each engine, is installed on the pilot's main electrical control panel. The master ignition switch must be "ON" for the ignition switches to operate. Each ignition switch has four positions which control the four circuit conditions, "OFF," "L," "R," and "BOTH." When the switch is on "OFF," the circuits to the magneto are grounded out and are inoperative. When the switch is on "R" (right), current is supplied to the left side of the magneto to the right distributor which fires the front spark plugs in all cylinders. When the switch is on "L" (left), current is supplied to the right side of the magneto to the left distributor which fires the rear spark plugs of all cylinders. When the switch is on "BOTH," current is supplied to the magneto to both distributors, firing all the spark plugs.

(2) REMOVAL.

(a) Remove the screws securing the ignition switch unit to the main electrical control panel within the pilot's compartment.

(b) Remove the screws and lift off the access

door on the upper left-hand side of the fuselage, forward of the pilot's windshield on the outside of the airplane.

(c) Disconnect the ground wire from the ground stud on the bottom of the small panel to the left of the pilot's main electrical control panel.

(d) Pull the ignition switch unit with the conduit attached, through the access door opening to a convenient working position.

(e) Unscrew the conduit union nut, and slide it down on the conduit.

(f) Unscrew the lock nut on the switch side of the union, and slide it down the conduit.

(g) Remove the screws that secure the back-cover of the switch.

(h) Disconnect the wires from the terminals and remove the switch.

CAUTION

Be sure to ground the system when the switch is removed by pulling the ignition plug at either the wing disconnect fitting or the fire-wall disconnect fitting. When the wires are removed from the switch terminals, the magnetos are not grounded, and the engines are subject to starting if the propellers should be moved.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Replace faulty ignition switch units.

(4) TEST BEFORE INSTALLATION.—Apply test described in paragraph 8. *g.* (3), this section.

(a) Connect two test lamps to the switch.

(b) Connect a battery to both lamps.

(c) Connect one lamp (L) to both "L" terminals of the switch unit; connect the lamp (R) to both "R" terminals of the switch unit.

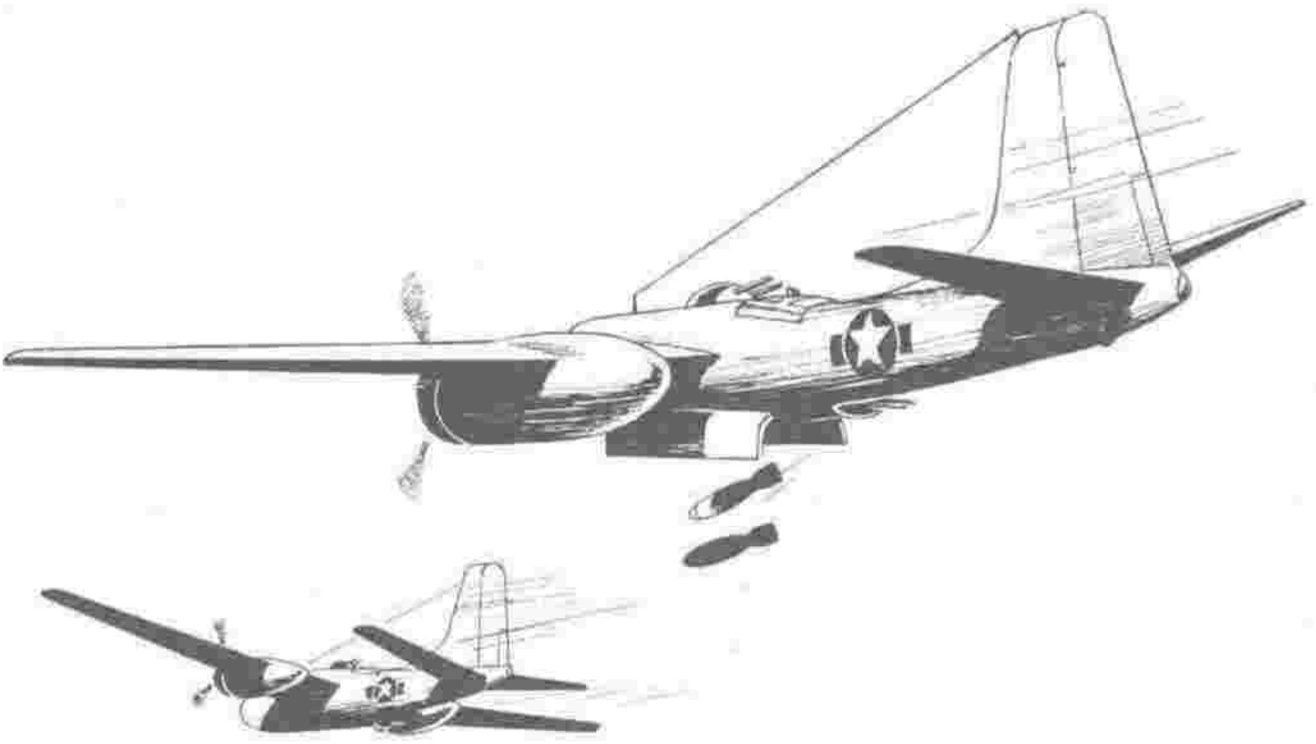
(d) With the master ignition switch in the "ON" position, and the "BOTH" position of the switch not being tested, the lamps should function as shown in the following table:

	Lamps	
Switch Position	*R*	*L*
BOTH	OFF	OFF
L	ON	OFF
R	OFF	ON
OFF	ON	ON

(e) With the switch in the "BOTH" position, push the master ignition switch to the "OFF" position. Both lamps should light.

(5) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL PROCEDURE, described in paragraph (2), above.

b. TROUBLE SHOOTING CHART.—(Refer to paragraph 6. *c.*, this section.)



9. ENGINE CONTROLS.

a. GENERAL.—The following engine controls are operated from the control pedestal in the pilot's compartment: throttle, fuel-air mixture, two-speed blower, air intake temperature, carburetor air filter, propeller rpm, and the oil cooler exit air door. The first five will be considered in this paragraph, while the propeller controls will be discussed in paragraph 10, this section, and the cooler in paragraph 12, this section. Standard cable controls are used, with the exception of the supercharger and the carburetor air regulator which are operated by Simmonds-Corsey push-pull rods attached to bellcranks in each nacelle. The control levers are arranged in three banks, and left and right engine levers are grouped together to facilitate operations of both engines.

b. THROTTLE.—*(See 2, figure 175.)*

(1) DESCRIPTION.—The throttle levers are in the second or main bank of controls. Increased throttle is obtained by loosening the control lock lever, which is located just to the right of the throttle control levers, and moving the throttle levers forward.

(2) REMOVAL AND DISASSEMBLY.

(a) Disconnect the cable linkage to the carburetor.

(b) Disconnect the cable linkage from the throttle lever.

(c) If complete removal is necessary, remove the pulleys and brackets which connect the cable to the engine section.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Check control for freedom of operation.

(b) Check positions of the control, both in the pilot's compartment and at the engine, to insure that they are coinciding properly in the compartment with the placards or marking.

(c) Oil the clevis joints and other bearing parts where this is desirable.

(4) ADJUSTMENTS.

(a) The throttle control is properly adjusted if the control lever on the carburetor strikes the positive stops when the control lever in the pilot's compartment is moved to its full open or full closed positions. If necessary, adjust as follows:

(b) If a major adjustment is necessary, loosen the nut which attaches the control lever to the carburetor throttle shaft.

(c) Place both the pilot's control lever and the carburetor lever in their full open positions.

(d) Tighten the control lever to the carburetor throttle shaft.

(e) To make a minor adjustment, disconnect the rigid control rod from the carburetor actuating arm on the carburetor.

(f) Place both the pilot's control lever and the carburetor lever in the full open position.

(g) If the control rod is found to be too short, loosen the lock nut on the rod end, and loosen the rod end until it can be attached to the control lever on the carburetor.

(h) Adjust the tension of the cables according to the chart shown in paragraph 3., this section.

(5) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

c. CARBURETOR MIXTURE CONTROL.

(1) DESCRIPTION.—The carburetor mixture (fuel-air) control levers *(2, figure 176)* are also located in the second or main bank on the pilot's control pedestal. They may be set in any of four positions: IDLE CUT-OFF, AUTO-LEAN, AUTO-RICH, or EMERGENCY RICH. Standard cable controls are installed.

(2) REMOVAL AND DISASSEMBLY.

(a) Disconnect the cable linkage at the mixture control lever on the pilot's control pedestal.

(b) Disconnect the cable linkage at the carburetor.

(c) If necessary, remove the pulleys and brackets which extend the cables from the control lever to the engine section.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 9. *b.* (3), above.

(4) ADJUSTMENTS.

(a) The carburetor mixture control is properly adjusted if the control lever on the carburetor strikes the stops when the control lever in the pilot's compartment is at either extreme of its travel.

(b) If any adjustments are necessary, follow the instructions outlined in paragraph 9. *b.* (4), above.

d. ENGINE BLOWER CONTROL.

(1) DESCRIPTION.—A two-speed, supercharger, blower system is controlled from the front bank of

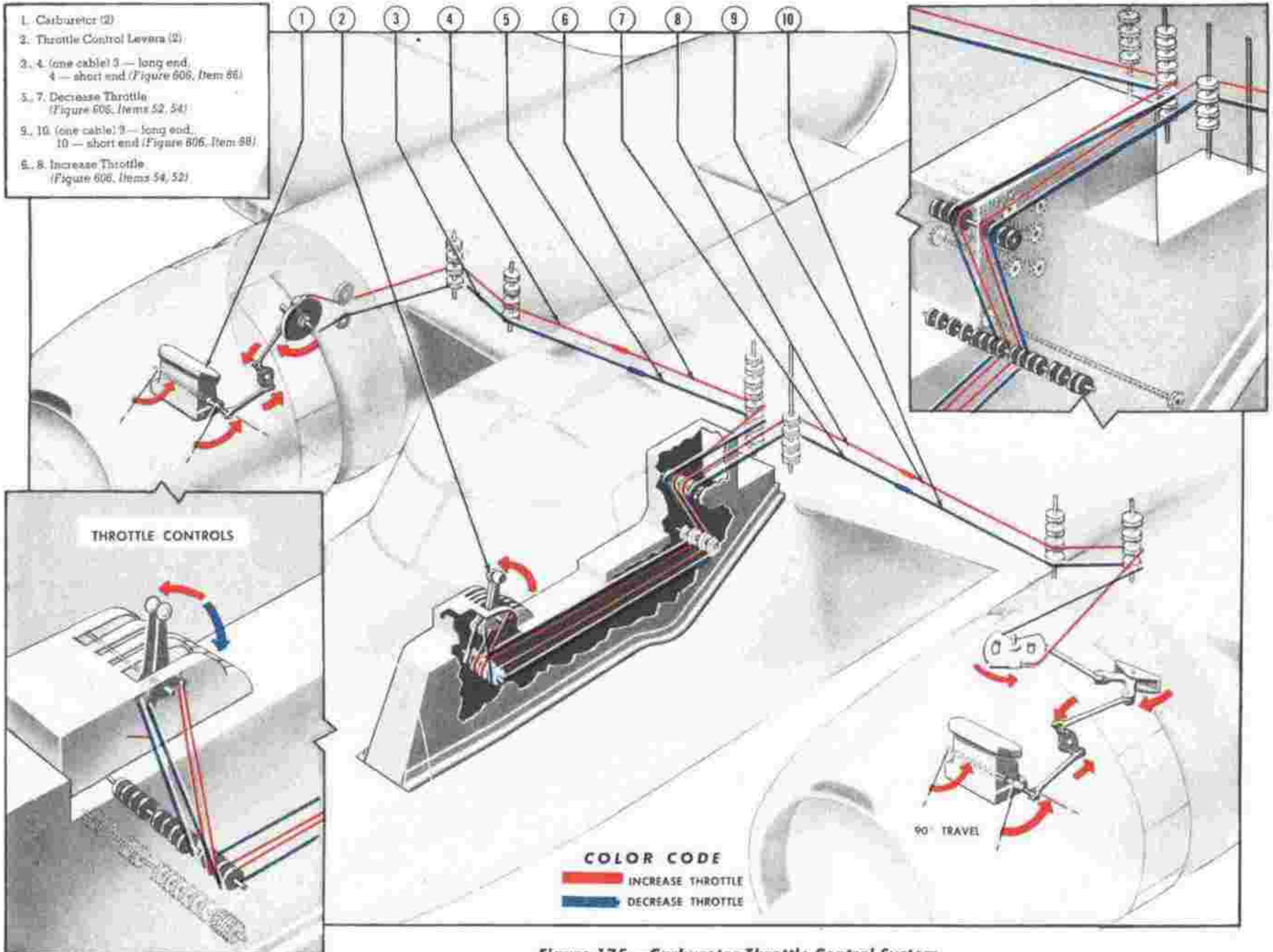


Figure 175 — Carburetor Throttle Control System

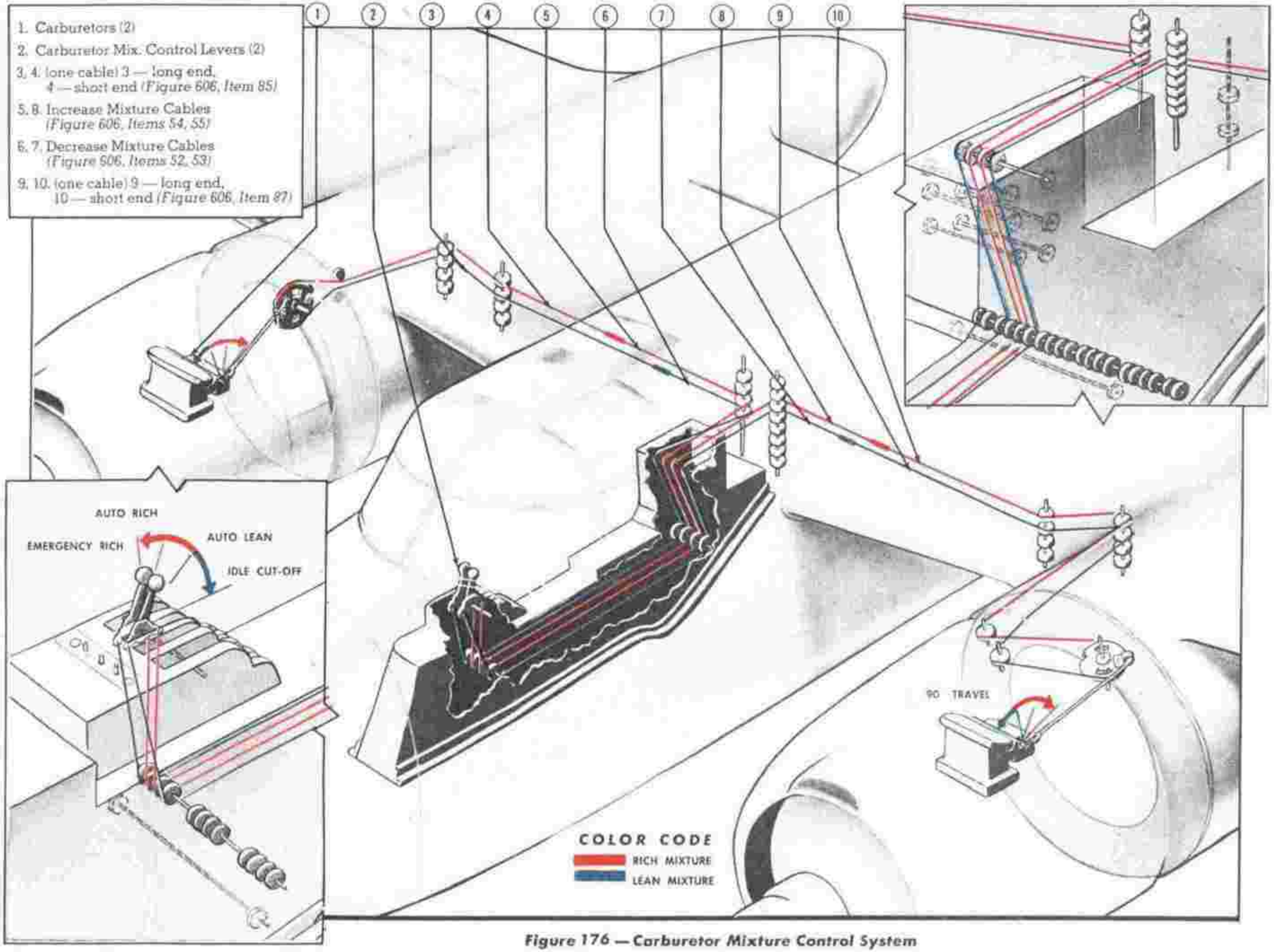


Figure 176 — Carburetor Mixture Control System

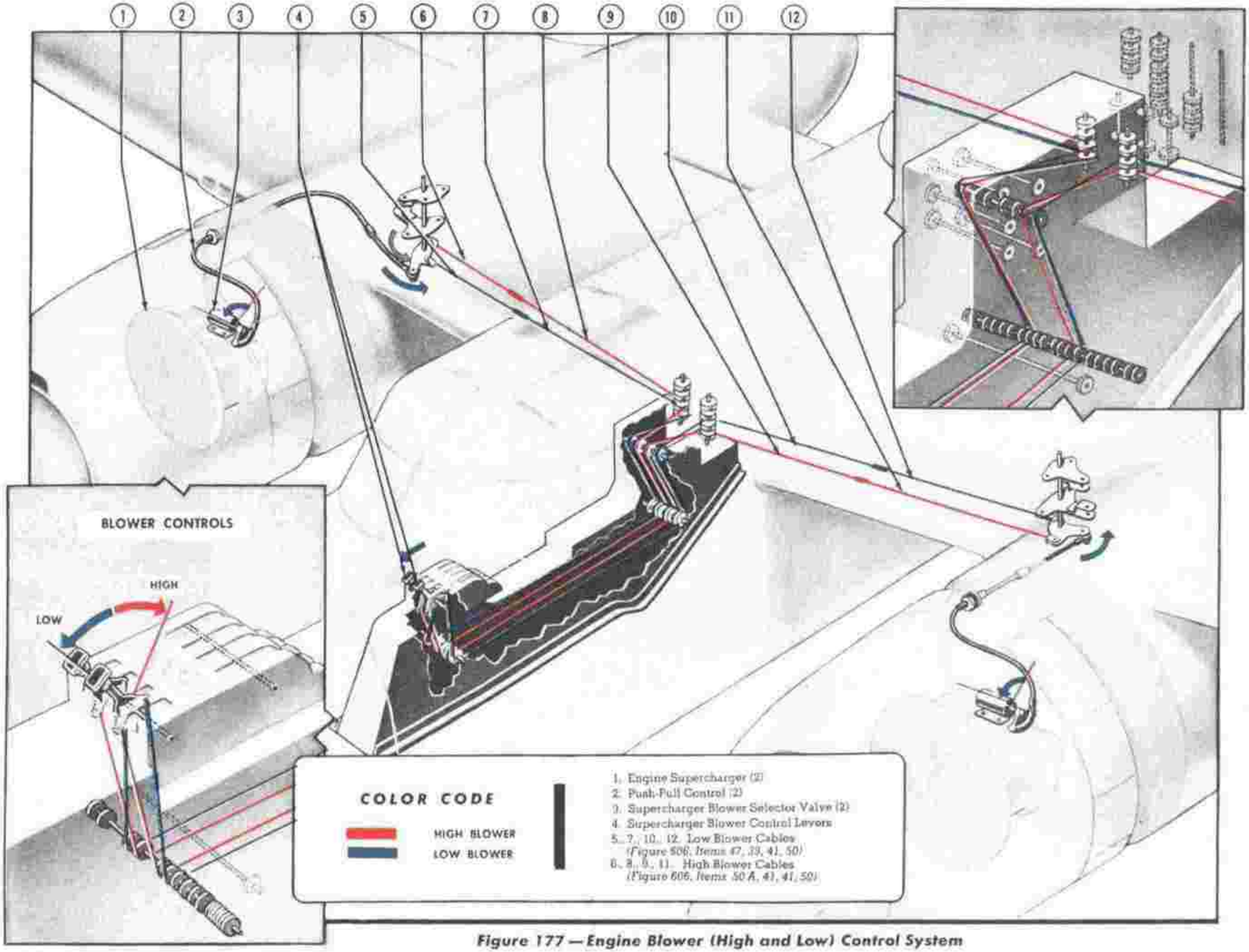


Figure 177 — Engine Blower (High and Low) Control System

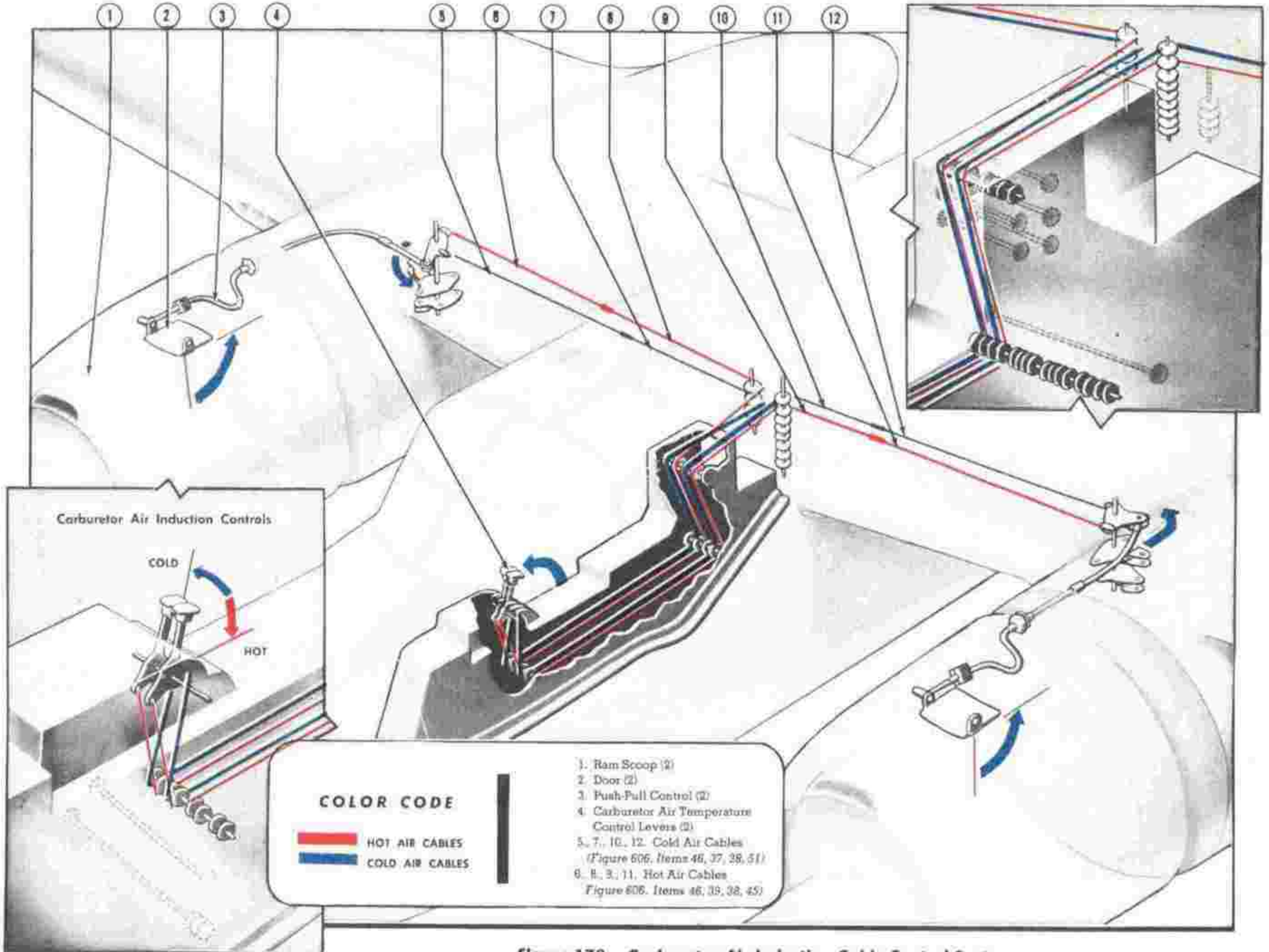


Figure 178 — Carburetor Air Induction Cable Control System

the pilot's control pedestal. When the control levers are full forward, they are in "HIGH BLOWER" position; when they are full aft, they are in "LOW BLOWER" position.

These controls employ Simmonds-Corsey push-pull controls, which consist of flexible tubing enclosing a series of alternating olive shaped and tubular shaped "beads" strung on flexible steel aircraft cable. They form a series of ball and socket joints; the olives and tubelets taking the force of the push stroke, the cable taking the pull force.

(2) MAINTENANCE REPAIR OR REPLACEMENT.–Damaged control members are to be replaced if adjustment as described in paragraph 9. *d.* (3), this section, proves unsatisfactory.

(3) ADJUSTMENTS.

(a) The blower control is properly adjusted if the mechanism on the blower strikes the low stop when the control lever in the pilot's compartment is in its full "LOW" position and the actuating arm of the Simmonds-Corsey control head is fully retracted. If necessary, adjust the control as follows:

(b) Disconnect the two bolts which support the Simmonds-Corsey control head to a bracket just aft of the carburetor.

(c) Disconnect the retaining nut which is on the blower control shaft and remove the control head. This automatically moves the unit to the "LOW BLOWER" position.

(d) Place the pilot's control in the "LOW BLOWER" position. Remove the cover of the control head to see whether the actuating arm is fully retracted.

(e) If the actuating arm in the control head is not fully retracted when the pilot's control lever is in the "LOW" position, disconnect the Simmonds-Corsey control head at the bell crank aft of the firewall and shorten the rod end as much as is necessary.

(f) If the 50-hour inspection, Section X, reveals the Simmonds-Corsey control unit to be in need of adjustment, proceed as follows:

1. Treat the linkage with Beacon M-285 or other lubricant conforming to specification AN-G-3a.

2. Screw the locking barrel along the terminal. Screw the sliding rod tight against the locking barrel.

3. Screw the sliding rod on the non-adjustable end of the linkage and open the inspection hole (under the spring clip) to see that it is screwed all the way on the fixed terminal.

4. Rotate the spring clips to close the inspection hole and finally connect the adjacent members of the control system.

(g) Reinstall the cover and the control head on the serrated blower control shaft, and secure them with the attaching bolts.

(h) Adjust the cable tension as instructed in cable rigging chart *(figure 74)*.

e. CARBURETOR AIR CONTROL.

(1) DESCRIPTION. – The carburetor air control levers are located on the rear bank of the pilot's control pedestal. When the levers are full forward, they are in the "COLD" position. When they are full aft, they are in the "HOT" position.

(2) MAINTENANCE REPAIR OR REPLACEMENT. – Refer to paragraph 9. *d.* (2), this section.

(3) ADJUSTMENTS.

(a) The carburetor air control is properly adjusted if the door in the air scoop elbow strikes the stops when the control lever in the pilot's compartment is moved from its full "HOT" or full "COLD" positions. If necessary, adjust the control as follows:

(b) Remove the four attaching bolts on the Simmonds-Corsey control head and remove the cover.

(c) Remove the actuating arm from the serrated disc with a screw driver.

(d) Place both the pilot's control lever and the carburetor air door in the "HOT" position.

(e) Install the actuating lever with the female serrations on the male serrated disc, and reinstall the cover of the control head.

(f) Adjust for the "COLD" position by turning the adjusting screw which is attached to the control head, just above the rigid control, to the left or right as required.

(g) Adjust the cable tension as instructed in *figure 74.*

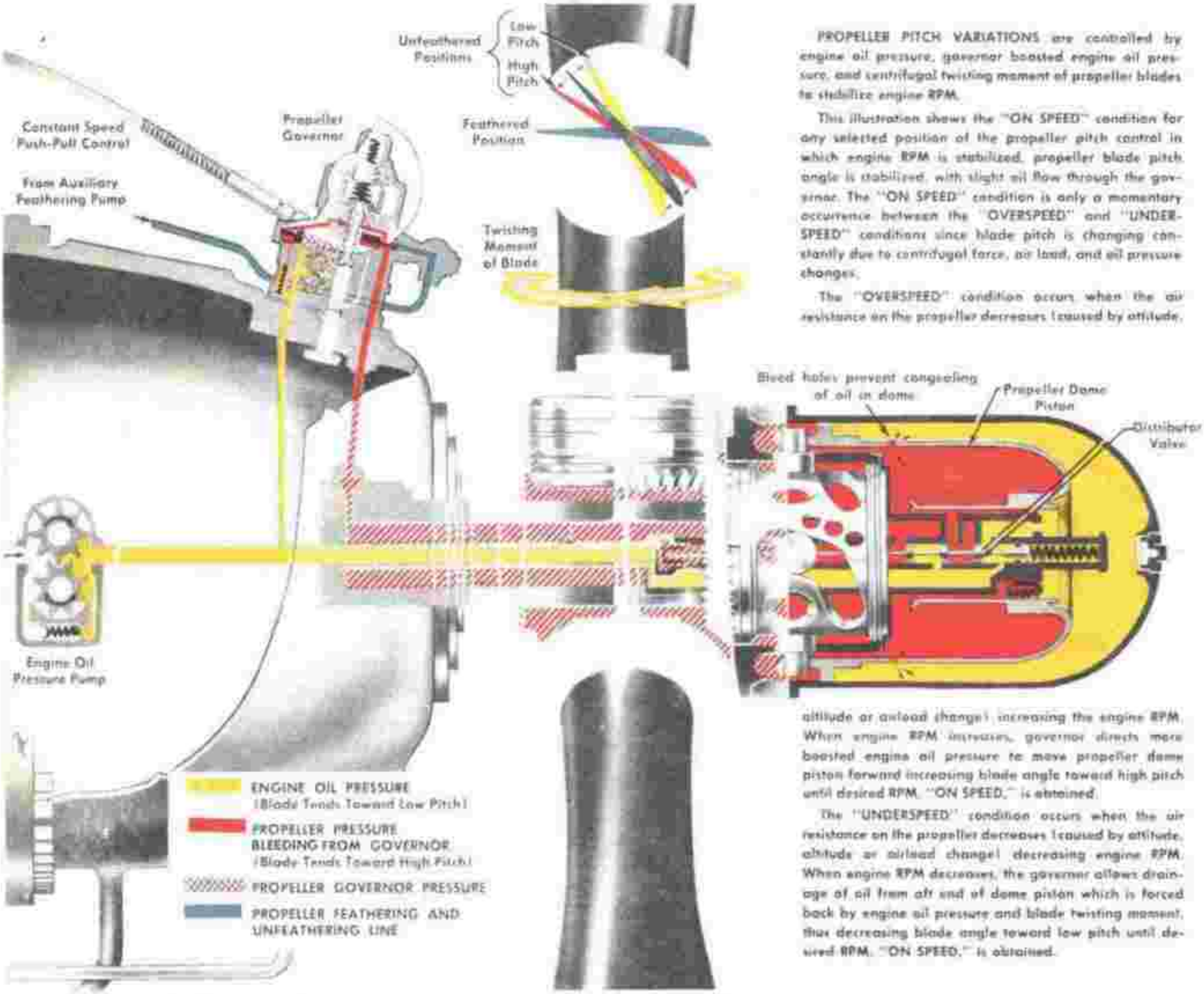
f. CARBURETOR AIR FILTER CONTROL.–Two air filters are installed in the top aft section of the cowling. When the electrical control is energized, a gate installed in the duct extending to the carburetor, prevents further passage of air, which enters through the filters and is by-passed to the carburetor. Refer to paragraph 7., this section. Refer also to paragraph 15., this section.

g. TROUBLE SHOOTING CHART. (See paragraph 6. *c.*, this section.)

10. PROPELLER AND PROPELLER CONTROLS.

a. GENERAL.—A Hamilton Standard Hydromatic propeller (*figure 180*) is mounted on the propeller shaft of each engine. This propeller is the full feathering type, model 23E50-505.

A Hamilton Standard Constant-Speed Control, Model 4G8-G23G or 4G8-G23G-1, is mounted on the propeller governor pad of the front (nose) section of each engine. The constant speed of each engine is maintained automatically by its constant-speed control (engine-driven propeller governor) which causes a continual change in propeller blade angle, through the constant-speed range of 1200 rpm minimum to 2700 rpm maximum, to meet the changing conditions of altitude, attitude and throttle setting. The change in blade angle is accomplished hydraulically by the



PROPELLER PITCH VARIATIONS are controlled by engine oil pressure, governor boosted engine oil pressure, and centrifugal twisting moment of propeller blades to stabilize engine RPM.

This illustration shows the "ON SPEED" condition for any selected position of the propeller pitch control in which engine RPM is stabilized, propeller blade pitch angle is stabilized, with slight oil flow through the governor. The "ON SPEED" condition is only a momentary occurrence between the "OVERSPEED" and "UNDERSPEED" conditions since blade pitch is changing constantly due to centrifugal force, air load, and oil pressure changes.

The "OVERSPEED" condition occurs when the air resistance on the propeller decreases (caused by attitude, altitude or airload change) increasing the engine RPM. When engine RPM increases, governor directs more boosted engine oil pressure to move propeller dome piston forward increasing blade angle toward high pitch until desired RPM, "ON SPEED," is obtained.

The "UNDERSPEED" condition occurs when the air resistance on the propeller decreases (caused by attitude, altitude or airload change) decreasing engine RPM. When engine RPM decreases, the governor allows drainage of oil from aft end of dome piston which is forced back by engine oil pressure and blade twisting moment, thus decreasing blade angle toward low pitch until desired RPM, "ON SPEED," is obtained.

PROPELLER FEATHERING is accomplished by directing engine oil under higher pressure from the propeller feathering pump through an external line through the governor, moving the piston to extreme forward position. This feathers the propeller by rotating the blades to the extreme high pitch angle.

In all oil flow conditions the oil displaced by piston movement is forced into the engine lubrication system either through the governor or the propeller shaft.

UNFEATHERING oil flow to the distributor valve is identical to that of feathering. When dome piston is in extreme forward position, and the auxiliary feathering pump again delivers pressure to the aft end of piston, extreme pressure is developed causing the distributor valve to reverse the oil pressure flow directing the pressure to the forward and moving the piston back. This decreases the blade angle toward low pitch until the constant-speed range is reached.

Figure 179 — Propeller Pitch (Engine RPM) Control Forces Diagram

constant-speed control through regulation of the flow of engine oil under pressure to and from the propeller.

Each propeller is equipped with a feathering system, powered with an individual electric motor-driven hydraulic pump *(figure 198)* installed on the mechanic's floor and electrically operated from the pilot's compartment. The feathering pump supplies oil under high pressure, independent of engine oil pressure, directed to the propeller for feathering or unfeathering the blades. Refer to paragraph 10. *d.*, this section. To feather the propeller means to place the blades in the full high pitch position of 90 degrees, measured at the 42 inch station, so that the blades lie directly in line of flight, acting as powerful brakes to stop rotation of the engine and at the same time reducing drag to a minimum.

b. PROPELLER.

(1) DESCRIPTION.—Each of the two Hamilton Standard, hydromatic, constant-speed control, full feathering propellers has the following general characteristics:

Diameter—12 feet 7 inches.
Number of blades—3.
Low pitch—28 degrees at the 42 inch station.
High pitch—90 degrees at the 42 inch station.
Constant speed range of 1200 rpm minimum—2700 rpm maximum.

Propeller reduction gear ratio—2-1.

Three fundamental forces interact to control the blade angle when the propeller is operating in the constant-speed or flight range. They are:

Centrifugal twisting moment of the blades toward low pitch which is utilized to decrease the blade angle.

Engine oil under normal engine-driven pump pressure which supplements the centrifugal twisting moment, thus insuring adequate control force toward low pitch at low propeller speeds.

Engine oil under boosted pressure from the propeller governor which moves the blades toward high pitch. Refer to paragraph 10. *c.* (1), this section, for a description of the constant-speed control governor.

(2) REMOVAL AND DISASSEMBLY.—The following procedure for removing the propeller from the propeller shaft is, in general, the reverse of the installation procedure.

(a) DOME ASSEMBLY REMOVAL.

1. Remove the dome breather hole nut lock wire and the dome breather hole nut; drain the oil from within the dome.

CAUTION

The dome is usually filled with engine oil. Some provision should be made to take care of this oil both at the removal of the dome breather hole nut and when the dome assembly is removed from the hub assembly.

2. Install the dome lifting handle in the dome breather hole. Take out the dome retaining nut lock screw cotter pin and remove the retaining nut lock screw.

3. Back off the dome retaining nut. This nut is attached to the dome and acts as a puller when the nut is unscrewed from the hub. Lift off the dome assembly using care not to damage the distributor valve assembly.

4. Remove the propeller retaining nut lock wire.

CAUTION

It is imperative that this lockwire be removed before unscrewing the distributor valve from the propeller shaft in order to prevent shearing of the distributor valve housing locking splines.

5. Back off the propeller retaining nut two or three turns to relieve any compressive effect on the propeller shaft, then, using the composite wrench and adapter, remove the distributor valve from the propeller shaft.

(b) HUB AND BLADES ASSEMBLY REMOVAL.

1. Install the propeller sling. *(2, figure 180.)*

2. Unscrew the propeller retaining nut.

Note

The propeller hub snap ring, front split cone, and propeller retaining nut are so arranged inside the spider that, as the propeller retaining nut is backed off the propeller shaft, the forward edge of the front split cone will contact the hub snap ring and force the propeller hub and blades assembly off the rear cone.

3. Cover the propeller shaft with a thread protector cap.

4. Remove the hub and blades assembly from the propeller shaft.

5. Cover the propeller shaft until installation of the propeller.

(c) DISASSEMBLY.—Disassembly of propellers other than the accessory disassembly incidental to removal is to be done only at a repair depot.

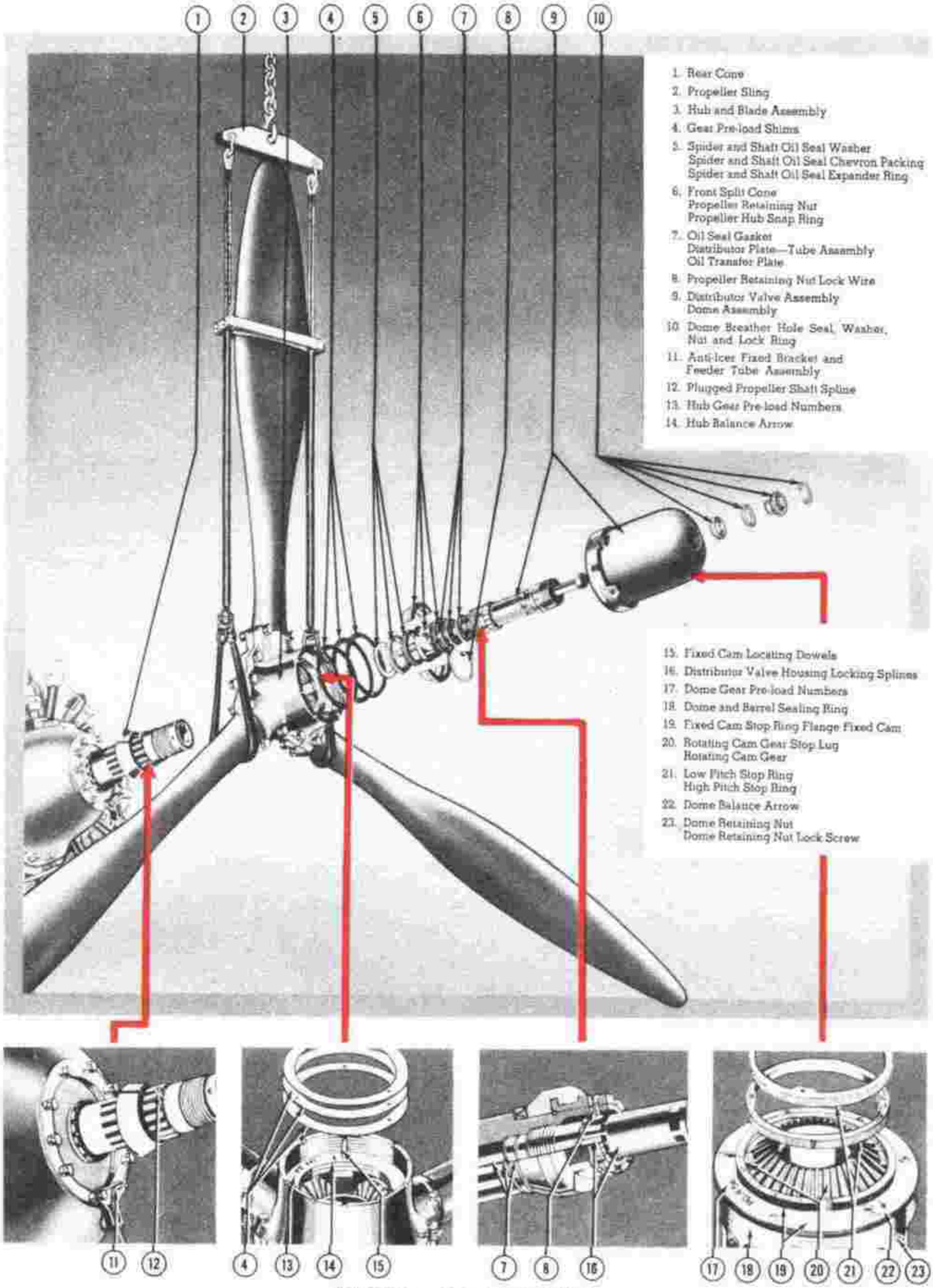


Figure 180 — Propeller Installation

CAUTION

Any operation pertaining to propeller maintenance is to be performed only by trained personnel.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—All propeller maintenance repair or replacement is to be done at a repair depot by trained personnel.

(4) ADJUSTMENT.—All propeller maintenance adjustment is to be done at a repair depot by trained personnel.

(5) TEST BEFORE INSTALLATION.—The test before installation of propellers or propeller parts is to be done at a repair depot by trained personnel.

(6) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—Assembly of propellers other than the necessary assembly incidental to installation is to be done only at a repair depot.

(b) INSTALLATION.

1. GENERAL.

a. Hydromatic propellers as prepared for installation on the A-26B engine propeller shaft, consist of three sub-assemblies: the hub and blades assembly, the dome assembly, and the distributor valve assembly.

b. Certain smaller attaching parts are also included with the hub and blades assembly at installation. These parts are the rear cone, the spider and shaft oil seal assembly, the front split cone, the propeller retaining nut lockwire.

c. The attaching parts included with the dome assembly are the dome breather hole nut and the dome breather hole nut lock wire. The dome assembly is locked in the hub assembly by the dome retaining nut lock screw and cotter pin.

d. The attaching parts which are used at the installation of the distributor valve assembly include the valve housing and oil transfer plate gasket, the valve housing oil transfer plate, and the oil transfer plate and shaft gasket.

e. To insure proper balance, the sub-assemblies of any one propeller will be kept together as a complete propeller unit.

f. The distributor valve assemblies of the same types are interchangeable.

g. Dome assemblies are interchangeable, if previously checked with the hub assembly for balance and gear preload.

2. PREPARATION.

a. Before installing a propeller, all parts which are accessible without disassembling the unit will be examined for defects or damage, and checked for proper fittings. All corrosion and all raised points, nicks, burrs, galls, and scores on joining surfaces of attaching parts, will be carefully dressed off and the parts thoroughly cleaned prior to propeller installation.

CAUTION

Remove all small metal particles after any stoning or dressing of propeller parts. Use carbon tetrachloride or straight-run gasoline in order to protect the neoprene seals and packings. Do not use aromatic gasoline for cleaning a propeller.

b. Inspect the propeller shaft and threads for nicks, burrs, or defects. Dress down defects with a fine stone and polish with crocus cloth. Wash the shaft with gasoline and allow to dry thoroughly. Then apply a light film of clean engine oil to both the inside and outside of the propeller shafts.

c. The propeller hub splines, front split cone and cone seat will be coated with clean engine oil to provide lubrication and prevent corrosion. Rear cone and rear cone seat will be installed dry. Cup grease or semi-fluid oils will not be used for this purpose.

3. INSTALLATION PROCEDURE.

a. INSTALLATION OF ANTI-ICING EQUIPMENT.

(1) Remove the two bottom nuts and washers on the thrust bearing cover plate of the engine's front section. Install the anti-icer fixed bracket and feeder tube assembly *(11, figure 180)* onto the two engine studs against the spacers. Replace nuts (but not washers) by hand, leaving bracket loose enough for final clearance adjustment with installation of propeller slinger ring mounted on hub and blades assembly.

(2) Connect the anti-icing fluid supply pipe to the feeder tube assembly.

(3) After complete installation of the propeller on the engine, check to see that the feeder tube assembly will direct the flow of anti-icing fluid to the anti-icing slinger ring.

b. HUB AND BLADES INSTALLATION.

(1) On new engines, the propeller shaft wide spline is usually in the top dead-center position. Do not rotate the propeller shaft prior to propeller installation because this changes the position of the engine pistons in the cylinders. In case the engine is allowed to stand idle before the initial ground run-up, the portion of the cylinders wiped clean of protective coating by moving the pistons may begin to corrode.

(2) Install the rear cone on the shaft, moving it back until it contacts the propeller shaft thrust bearing nut. Keep the outside surfaces of the rear cone dry and free from oil. To prevent seizure of the propeller retaining nut or the distributor valve on the propeller shaft, apply a thin film of a recommended thread lubricant to the shaft threads.

(3) Cover the propeller shaft threads

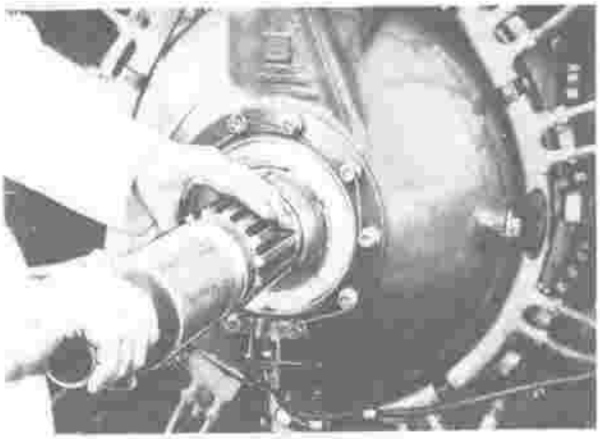


Figure 181—Installing Thread Protector

with a thread protector. Hoist the propeller hub and blades assembly, with the propeller blade up that is adjacent to the blank spline in the propeller spider. This will insure that the propeller blank spline is in line with the wide spline on the engine shaft, and that propeller blade clearance is provided for the work stand. Install the hub and blades assembly on the propeller shaft. While sliding the propeller assembly back on the shaft, tilt the feeder tube assembly to permit the feeder tube to clear the slinger ring attached to the rear of the propeller barrel.

Note

The threads of the propeller shaft may be easily damaged during installation of propeller hub and blade assembly. Care should be used during this operation; if available use a thread protection cap of the type that will allow the propeller hub to slide over it. After installing propeller hub and blade assembly on propeller shaft, remove thread protection cap.

(4) The spider and shaft oil seal rings *(5, figure 180)* consists of the spider and shaft oil seal

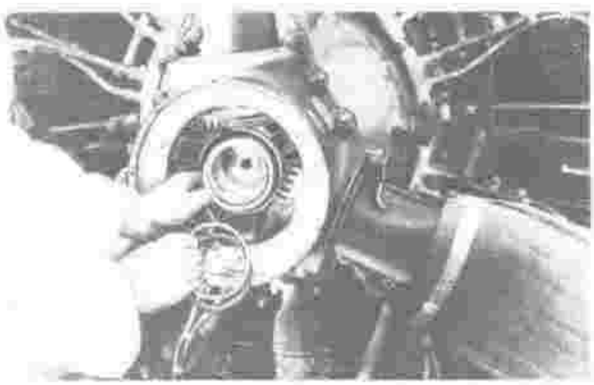


Figure 182—Installation of Spider and Shaft Oil Seal, Oil Seal Washer, and Oil Seal Expander Ring

washer, the spider and shaft oil seal, and the spider and shaft oil seal expander ring. These pieces are installed over the propeller shaft in that order to fit forward of the propeller spider splines. The spider and shaft oil seal (chevron type packing) is installed with "V" edge facing aft against the washer and groove wings facing forward. Use some blunt instrument which will not harm the seals to aid in properly seating this assembly.

(5) Apply a thin film of a recommended thread lubricant to the threads on the inner diameter of the propeller retaining nut. Keep the front split cone outside surface dry and free from oil. Then install the front split cone, consisting of two beveled half rings, on the propeller retaining nut. These parts are

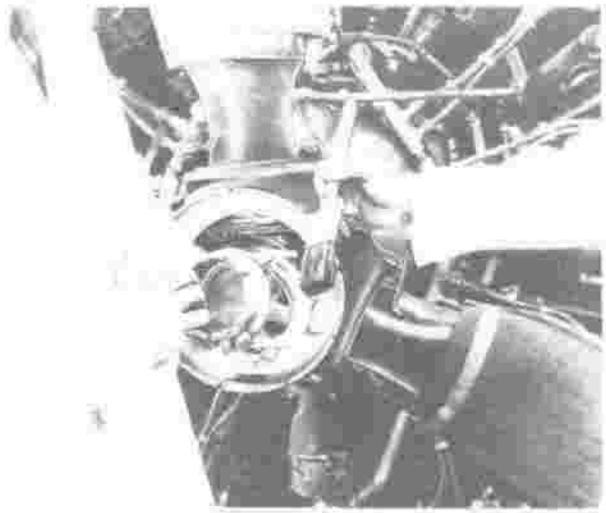


Figure 183—Application of Lubricant to the Retaining Nut and Front Cone

machined so that the annular groove incorporated inside the front split cone matches with the ledge at the base of the retaining nut. Turn the blades into reverse pitch so that the teeth position of the blade gear segments moves down into the hub. This will provide the necessary clearance to permit installation of the propeller retaining nut and the attached front cone halves.

Start the propeller retaining nut and the attached front cone onto the propeller shaft threads by hand.

CAUTION

The propeller retaining nut should advance on the threads without binding or catching. If it does not, recheck both the retaining nut and the propeller shaft threads for burrs, nicks, etc.

Tighten the propeller retaining nut on the shaft using the combination installation wrench in conjunction

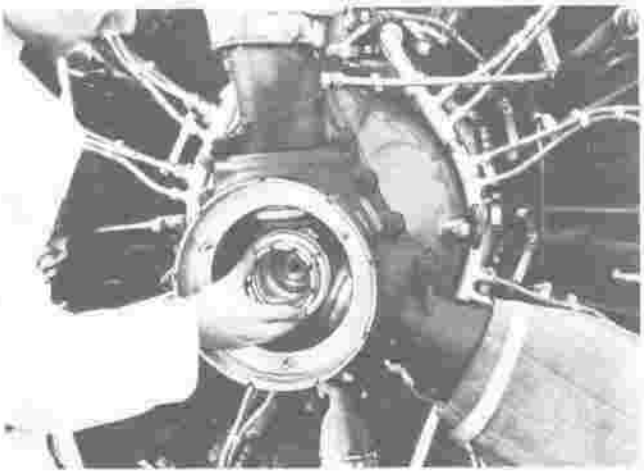


Figure 184—Installation of Propeller Retaining Nut—Start by Hand

with a bar 3 feet long. The required torque for this operation is 720 ft. lbs. which can be obtained by applying a force of approximately 180 pounds at the end of the 3 foot bar.

Note

The distance from the center of the wrench to the end of a 3 foot bar makes approximately the required 4 feet.

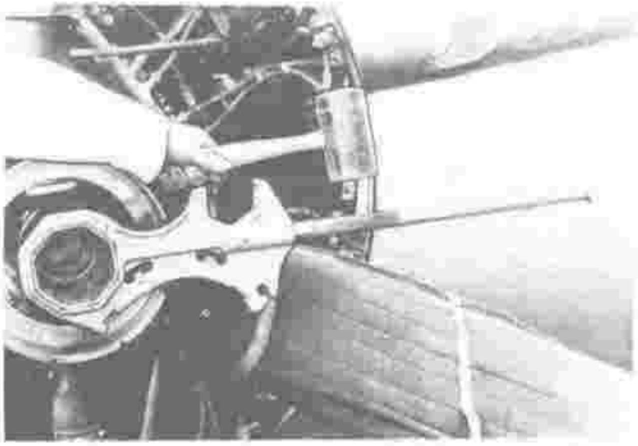


Figure 185—Tightening Retaining Nut With Composite Wrench, Adapter and Handle

In order to fully tighten the nut on the shaft, strike the bar close to the wrench with a hammer weighing about 2½ pounds while this force is being applied. Determine if one of the locking slots in the retaining nut is in alignment with one of the holes in the propeller shaft. If not, repeat the tightening operation until one slot and hole are in alignment. Spacing of the slots in the propeller retaining nut with respect to the holes in the propeller shaft is such that alignment of a slot and hole will occur at each 5° of rotation.

(6) Compress the hub snap ring and install it in the spider hub snap ring groove.

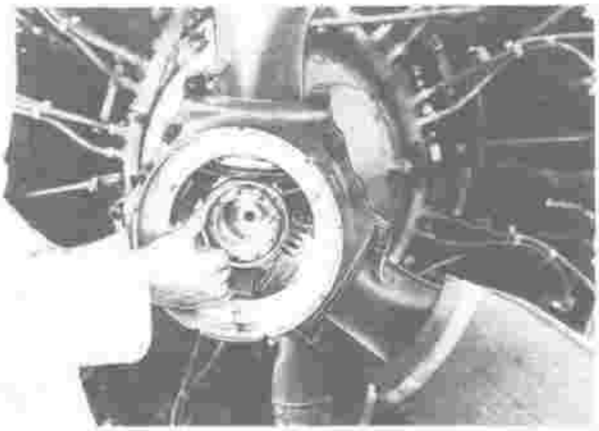


Figure 186—Installation of Hub Snap Ring Into the Spider Hub Snap Ring Groove

c. DISTRIBUTOR VALVE INSTALLATION.

(1) Check to be sure that the copper gasket (distributor plate to engine shaft oil seal) and the distributor plate engine parts *(7, figure 180)* are in place against the adapter flange inside the propeller shaft.

Note

Before installing the distributor valve on a new engine, remove the gasket and distributor plate inside the propeller shaft. Wash these two engine parts clean, coat with engine oil and install them in the shaft. The oil seal gasket fits against the adapter flange. The distributor plate is installed with its rear shoulder in the central hole of the gasket.

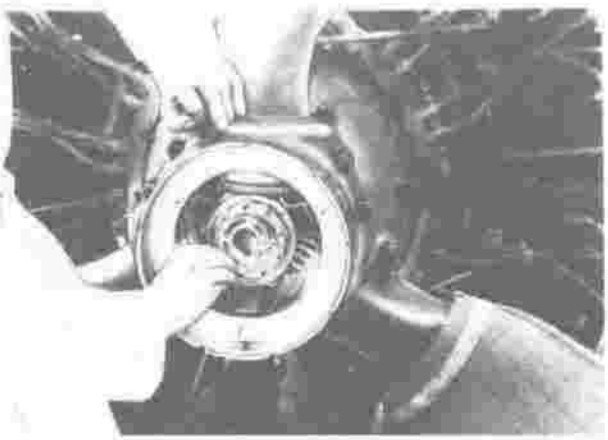


Figure 187—Installation of Oil Transfer Plate and Shaft Oil Seal Gasket—Engine Furnished Parts Previously Installed

(2) Install the oil transfer plate and shaft oil seal gasket *(7, figure 180)*. this gasket fits over the raised central shoulder and onto the smooth face of the distributor plate (engine part). This 1/32 inch copper gasket is furnished by the propeller manufacturer while another is furnished by the engine manufacturer as a spare.

(3) Check the valve housing oil transfer plate on the base of the distributor valve to be sure that it is the solid center type, and that the copper gasket is included between the oil transfer plate and the housing. These parts are installed with a snap fit onto dowels in the rear end of the valve housing.

(4) Apply a thin film of a recommended thread lubricant to the threads on the base of the distributor valve. Screw the valve into the propeller shaft by hand.

CAUTION

The valve should advance into the propeller shaft smoothly and easily. If binding is noticed, remove the valve and check the threads of the propeller shaft and the housing for burrs, damaged threads, etc.

(5) Tighten the distributor valve into the propeller shaft using the composite wrench, using adapter 41B1862. The use of this adapter will permit equal application of torque force on all sides of the valve housing and will prevent the crushing effect encountered when using only the composite wrench. Apply a force of approximately 100 pounds at the end of the one foot bar and, while this force is being maintained, strike the bar near the wrench one light blow with a hammer weighing not more than 2½ pounds. Repeat this tightening operation until one of the slots on the distributor valve housing is in alignment with the same hole in the propeller shaft to which a slot in the propeller retaining nut was previously lined up.

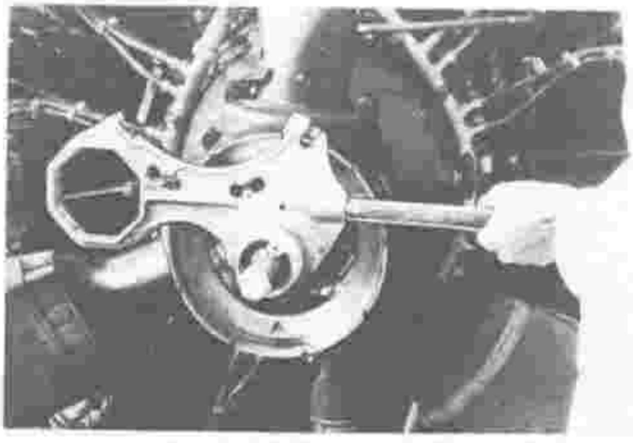


Figure 188—Tightening Distributor Valve by Using Composite Wrench

CAUTION

Under no conditions should the valve housing be backed off even slightly in order to obtain slot and hole alignment. If this alignment cannot be obtained without exceeding the specified torque, remove the distributor valve and reinstall it using either a new oil transfer plate and shaft gasket, or reduce the thickness of the first gasket by lapping it slightly. This caution applies as well to the installation procedure.

(6) Install the propeller retaining nut lock wire with its head placed through the retaining nut slot, propeller shaft hole, and into the distributor valve housing slot (spline groove). Pin head of lockwire should lead in direction of rotation of propeller shaft, while tail end of lockwire should trail. Snap this lockwire AS ILLUSTRATED into position in the lockwire groove provided for it in the retaining nut.

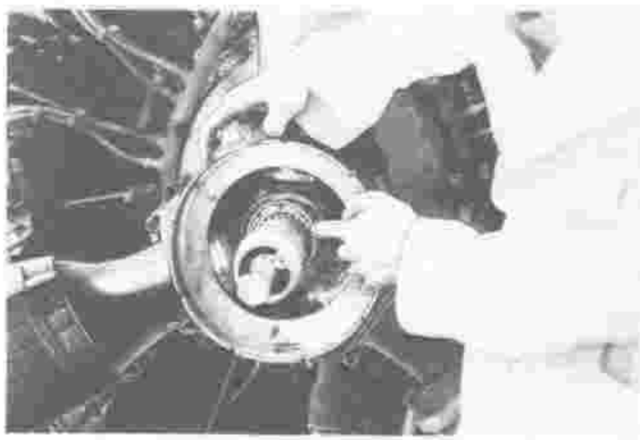


Figure 189—Installation of Retaining Nut Lockwire —Tail to Follow Direction of Finger

(7) Turn each propeller blade by hand to the high pitch angle position (90° or full feathering) against the stop pins. This will place all blade gear segments in proper position for alignment with rotating cam gear in propeller dome.

d. DOME ASSEMBLY INSTALLATION.

CAUTION

When installing the dome assembly, it is ABSOLUTELY ESSENTIAL that the rotating cam gear in the dome be meshed with the blade gear segments in the proper angular relationship, and the following steps should be carried out to insure correct meshing.

Prior to dome installation, check the low and high pitch stop rings in the base of the fixed cam to make certain the dome operating range is correctly set for the installation. To reset these rings, lift out the uppermost stop ring which is the high angle stop ring and

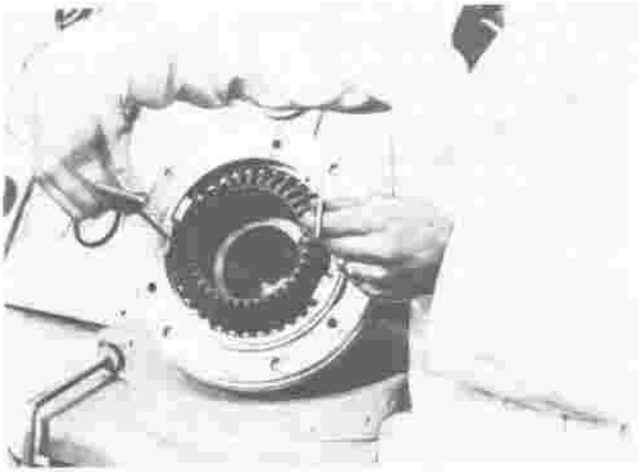


Figure 190—Lifting Out Stop Rings

marked "SET TO HIGH PITCH" on one lug, and "ASSEMBLE THIS STOP LAST" on the other lug. Then lift out the lower stop ring which is the low angle stop ring and marked "SET TO LOW PITCH" on one lug, and "ASSEMBLE THIS STOP FIRST" on the other lug. These rings can best be taken out by inserting 10-24 screws in the tapped holes which are incorporated in the stop lug portion of each ring. In order to insure that the stop rings will not fall out of the dome during installation, it is permissible to "SPRING" the stop rings to a slightly out of round shape so as to provide sufficient friction to hold them against their own weight. Such "SPRINGING" shall not be greater than will permit installation of the rings by hands alone.

Reinstall low pitch stop ring *(lower 21, figure 180)* to full low angle limit by inserting it so that the arrow on the stop ring coincides with the 28 degree mark (indicating the degrees of blade angle at the 42-inch reference station) stamped on the fixed cam stop ring flange. To insert the low pitch stop ring, it may be necessary to rotate the cam gear *(20, figure 180)* a small amount in a counterclockwise direction to permit inserting the stop ring without interfering with the stop lugs on the gear. It will be noticed that this rotation causes the piston in the dome assembly to move forward.

Reinstall the high pitch stop ring to the full high angle limit by inserting it on top of the low pitch ring so that the arrow on the high pitch stop ring coincides with the 90° mark on the fixed cam stop ring flange.

The stop lug on the rotating cam gear marked "SET WITHIN GRADUATIONS," must lie within the graduated arc of the stop ring flange on the base of the fixed cam after the stop rings have been installed.

(1) Install the required number of pre-load shims over the fixed cam locating dowels in the hub assembly.

(2) Move the rotating cam gear in the dome assembly until the cam stop lugs contact the high pitch stop ring; in this position, the dome piston will be moved into the extreme forward position.

(3) Install the dome lifting handle in the dome breather hole at the extreme forward end of the dome assembly.

Figure 191—Installing Dome Lifting Handle in Breather Hole

(4) The dome assembly is initially installed in the hub assembly with the correct number of pre-load shims in place BUT WITHOUT THE DOME AND BARREL SEAL. Lift the dome assembly into position and install it over the fixed cam locating dowels in the hub assembly. Make certain that the balance arrow etched on the base of the fixed cam coincides at installation with the arrow stamped on the dome and barrel shelf of the outboard barrel half. Extend the arrow with a pencil mark to a point directly outward on the retaining shoulder of the barrel so as to insure proper installation, if gear preload shims cover the arrow on the hub. Lift the dome assembly into position and align it to match the dome hole arrow to the hub dowel arrow; in this position the rotating cam gear and the blade gear segments are now in proper alignment to mesh correctly.

Note

If there are no arrows marked, the propeller is so balanced that the dome may be installed in any position, being perfectly balanced in both hub and dome assemblies.

(5) Install the propeller dome assembly by sliding it straight on over the end of the distributor valve assembly. Make sure that the oil seal rings on the valve assembly properly enter into the sleeve inside the piston.

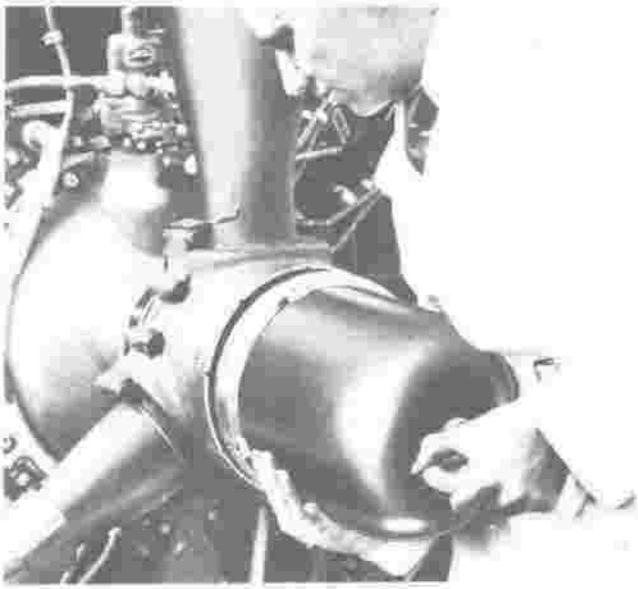


Figure 192—Starting Propeller Dome Assembly

(6) While installing, rotate the dome assembly in a counterclockwise direction until the fixed cam locating dowels in the barrel dome shelf enter the correct dowel holes in the fixed cam.

CAUTION

Do not rotate the dome assembly in a clockwise direction to align dowels and holes, because if the gear teeth should engage, this will tend to move the stop lugs on the rotating cam gear AWAY FROM THE FULL HIGH PITCH ANGLE POSITION, thus allowing the gears to mesh incorrectly.

(7) Start the dome retaining nut into the hub assembly by hand-turning the dome retaining nut, and then attach the composite wrench and insert a wrench bar. Remove the dome lifting handle. Tighten the dome retaining nut using a maximum torque of 720 ft. lb. (180 pounds at 4 feet radius). While this force is being applied, strike the bar near the wrench with a hammer weighing approximately 2 1/2 pounds. Continue this tightening operation until the dome assembly seats on the dome-barrel shelf and one of the lock screw lugs on the dome retaining nut is in line with a half circle groove in the barrel retaining shoulder. Mark the position of the dome retaining nut with respect to the barrel by drawing a pencil line through the center of the aligning lock screw lug and half circle groove.

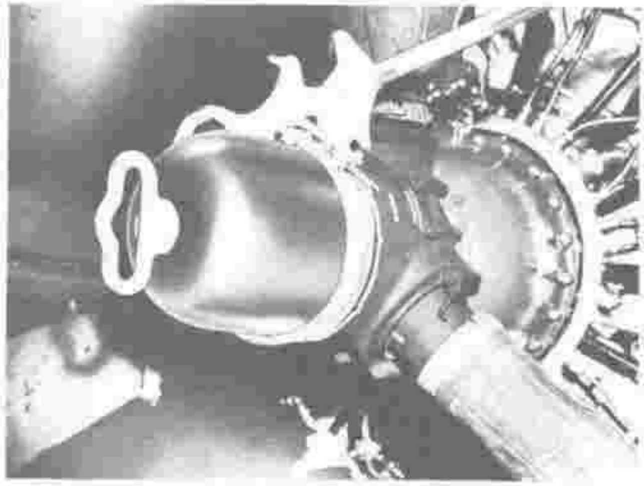


Figure 193—Tightening Dome Retaining Nut with Composite Wrench—3 Ft. Handle

Note

With the dome assembly properly seated in the barrel, the front face of the dome retaining nut will be approximately flush with the front edge of the barrel retaining shoulder. Tightening of the dome reteaining nut, in addition to the fastening the dome unit to the hub, serves to apply the preloading force to the gears, and to compres the dome and barrel seal. Failure to tighten the dome unit securely in the hub will result in elongation or failure of the dome shell retaining screws, and oil leakage around the dome retaining nut.

(8) Remove the dome assembly. Install the dome and barrel seal on the outer perimeter of the fixed cam base just aft of the dome retaining nut. This seal is installed with the tapered end facing away from the dome retaining nut. Reinstall the dome assembly as before and apply sufficient torque force to the dome retaining nut to bring it to the position previously marked.

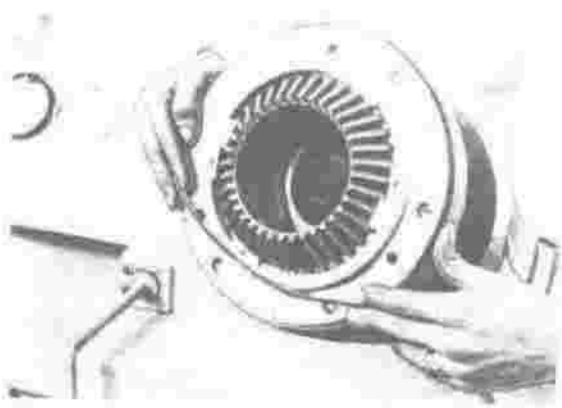


Figure 194—Installation of Dome and Barrel Seal

(9) Install the dome retaining nut lock screw in the dome retaining nut and safety this screw with a 1/16" x 1/2" steel cotter pin.

(10) Install the dome breather hole seal in the dome breather hole at the outboard end of the dome assembly. This seal is inserted with the tapered portion facing into the dome. Next insert the dome breather hole washer over the seal.

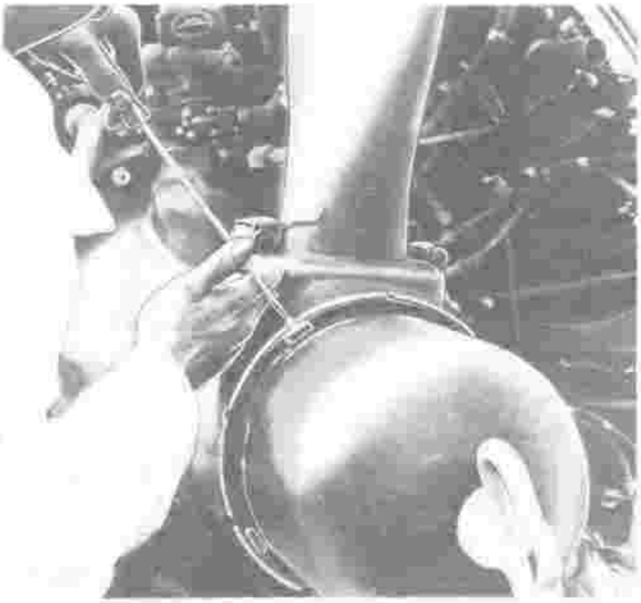


Figure 195—Installation of Dome Retaining Nut Lock Screw

(11) Install the spinner dome breather hole nut in the dome breather hole and tighten it with a torque force of approximately 40 foot pounds. Continue this tightening operation until one of the holes in the spinner dome breather hole nut is aligned with a slot in the dome shell.

(12) Snap the dome breather hole nut lockwire into the dome shell groove.

(13) Check propeller installation by inspection of blade angles as follows:

(a) Using suitable blade turning levers, shift the propeller blades first into the full low pitch position and then into the full high pitch position and check the blade angles either by the index line on the shank of the blades and the graduation on the barrel blade bore, or by a protractor at the reference station. These angles should be the same as the low and high pitch settings of the stop rings. This check will insure that the correct relationship between the blade gear segments and the cam gear has been obtained.

(b) If this check for correct blade angles reveals any blade incorrectly positioned, remove the dome assembly. Twist each blade by hand into

Figure 196—Changing Blade Pitch

full high pitch position against the stop pins. Check the position of the two stop rings in the dome assembly. Turn the rotating cam gear in the dome to full high pitch stop. Reinstall the dome assembly as described, and recheck the blade angles.

(7) TEST AFTER INSTALLATION.

(a) Prior to feathering and unfeathering a propeller for test after installation, the engine should be started and the propeller operated under constant-speed control as described in paragraph c. (7), below. CONSTANT SPEED CONTROL—TEST AFTER INSTALLATION. This will insure that the dome and barrel are filled with engine oil and that all parts of the propeller are fully lubricated.

(b) FEATHERING AND UNFEATHERING TESTS.

1. Complete the ground test of governing action. With the engine operating at approximately 1500 rpm and 22" Hg. manifold pressure, depress the propeller feathering control switch push-button. When the propeller has reached the full-feathered position, the control switch will release automatically, and the engine speed will have decreased to approximately 500 rpm.

2. After the feathering test has been satisfactorily completed, again depress the propeller feathering control switch, and hold it down while the propeller is being unfeathered until the engine speed increases to approximately 1000 rpm.

3. Release the propeller feathering control switch push-button. The engine will return to the control of the governor.

CAUTION

To avoid overloading the engine sump, do not repeat the feathering and unfeathering test until the engine has run for at least two minutes at approximately 1000 rpm.

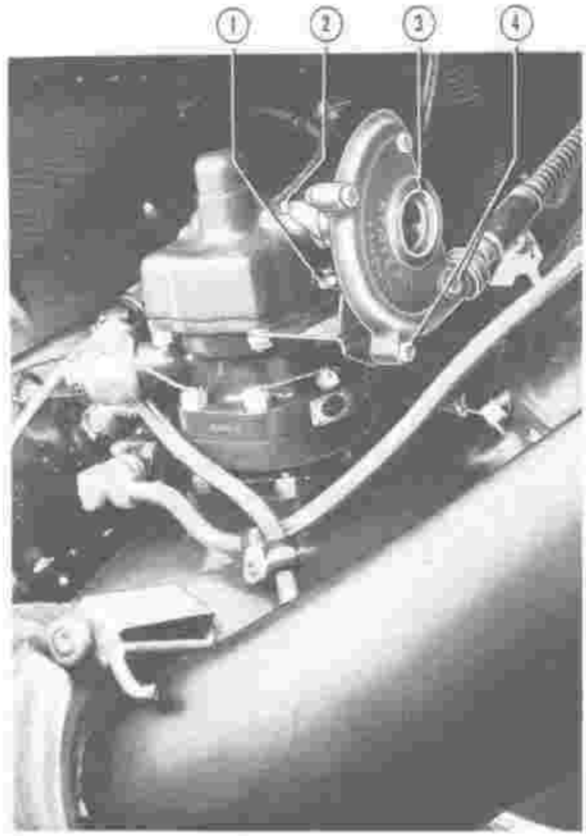
4. The above method of testing the feathering operation with the engine running has several important advantages not attainable when feathering is carried out with the engine stationary. They are: (1) It is not necessary to drain the engine sump after each feathering cycle in order to avoid loading the engine with oil since the engine scavenge pump returns the excess oil to the container. (2) The oil is hot and the propeller feathers and unfeathers faster and on a lower pump pressure, thereby reducing the load on the electrical system. (3) The hot oil and rotating engine parts allow a lower engine back pressure during feathering and unfeathering. (This back pressure is caused by the displacement of approximately three quarts of propeller oil into the engine lubricating system when the propeller is feathered or unfeathered.) (4) The feathering test is made with oil of relatively lower viscosity which approaches more closely the conditions under which the propeller would be feathered in flight.

c. CONSTANT-SPEED CONTROL UNIT (PROPELLER GOVERNOR).

(1) DESCRIPTION.

In conjunction with the hydromatic propeller, the constant-speed control is an automatic device used to maintain the engine rpm constant at any engine speed selected by the pilot within the governing range. Driven by the engine, the constant-speed control functions to regulate the flow of oil to the propeller, changing the blade angle to hold the engine speed constant for each new set of flight conditions. Thus, the engine speed is set and controlled independently of engine power; engine speed being governed by the constant-speed control, while engine power is governed by the throttle. With the hydromatic propeller, the constant-speed control will permit the engine to develop any selected power at any selected engine speed. The engine power and speed will be maintained until the throttle and the propeller governor control levers are readjusted to a new operating rpm.

A Hamilton Standard Constant-Speed Control is mounted on the propeller governor pad of the front (nose) section of the engine. This unit is a double capacity hydromatic propeller governor of the flyball type and is engine-driven. Once set, this governor automatically maintains constant engine rpm by controlling the propeller blade angle within the constant-speed range of 1200 rpm minimum to 2700 rpm for take-off, to meet varying conditions of altitude, attitude and throttle setting. The minimum rpm at which the governor will control the propeller blade angles is set at 1200 rpm by an adjusting screw in the head of the governor. The maximum rpm of the governing range is set at 2700 rpm by an external high rpm



1. HIGH RPM Stop Screw
2. HIGH RPM Stop Arm
3. Serrated Radian Bushing
4. Radian Mounting Bolts

Figure 197 — Constant Speed Control (Propeller Governor) Flexible Shaft Attachment

stop arm on the control head. Adjustment of the two governors, to control rpm of the engines, is made from the engine rpm controls (propeller governor controls) installed on the forward upper structure of the pilot's control pedestal *(figure 199)*. The controls are marked, in the extreme rear position "DECREASE" (signifying minimum rpm or constant-speed high pitch limit range) and in the extreme forward position "INCREASE" (high rpm or low pitch range).

The governor boosts engine oil pressure to the pressure required for moving the blades toward high pitch. Also the governor meters to or drains from the aft end of the propeller piston the quantity of oil required to set and maintain the proper blade angle as necessary to allow the engine to run at constant rpm regardless of the altitude of the airplane.

The functions performed by the constant-speed control are governed by the various component parts within the housing. The speeder spring, located in the head of the governor acts as an adjustable tension balance for the engine-driven flyballs, balancing or counteracting the centrifugal force exerted by these flyballs at varying engine speeds. Flyball centrifugal force actuates a pilot valve, lifting the pilot valve against the speeder spring. As the speeder spring and flyball forces balance, or one overrides the other, so the pilot valve meters the oil flow through suitable ports in the drive gear shaft to or from the aft end of the propeller piston.

Engine oil pressure is received and boosted by a small engine-driven gear type booster pump within the constant-speed control. This pump furnishes sufficient oil pressure to the aft end of the propeller piston to move the propeller toward the high pitch limit of the constant-speed range. The booster pump is not used to move the blades toward low pitch; this movement is accomplished by normal engine oil pressure and centrifugal twisting moment of the blades. The governor drive gear shaft is splined at one end to fit the engine drive coupling in the engine pad. This hollow shaft drives both the booster pump and the flyball assembly, while the pilot valve fits inside the shaft.

A low pressure relief valve responds to pump pressure and pilot valve positions and all oil, not actually required to shift the propeller blades, is returned to the inlet side of the pump. A high pressure (dump) relief valve is permanently set to limit the booster pump delivery from 330 to 350 psi oil pressure above engine oil pressure. Within the governor body, a high pressure transfer valve in the feathering oil pressure passage acts as a shuttle valve to disconnect the governor booster pump oil flow to the propeller feathering and unfeathering operations.

On the base, a differential pressure cut-out switch is connected to the governor oil pressure outlet passage to the propeller. Upon completion of the feathering operation, 500 psi oil pressure developed by the feathering pump actuates a plunger within the switch. The automatic plunger movement breaks the feathering electrical circuit to stop the pump. For further information on the electrical function of this switch, refer to paragraph 15., this section.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. Remove anti-drag ring cowling described in paragraph 6. *b.* (14) *(b)*, this section.

2. Mark the relationship between the serrated bushing on the governor shaft and the index mark on the end of the governor shaft, and between the bushings and the serrated disk carrying the stop arm, in order that the control may be reassembled in the same manner to avoid unnecessary adjustment.

3. Disconnect the control head.

4. Disconnect the feathering pump high pressure connection in the body of the governor unit.

5. Disconnect the electrical control wire from the pressure cut-out switch on the base of the governor.

6. Unscrew the mounting stud nuts which secure the governor unit to the engine pad, and remove the governor.

(b) DISASSEMBLY.—The constant-speed control governor is to be disassembled only at a repair depot.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) MAINTENANCE REPAIR.—The constant-speed control governor is to be repaired only at a repair depot.

(b) REPLACEMENT.—Replace all faulty governors.

(4) ADJUSTMENTS.—Any internal adjustment of the constant speed control governor is to be made at a regular depot. For instructions regarding adjustment of maximum rpm, see paragraph 10. *e.* (2) *(d)*, this section.

(5) INSPECTION BEFORE INSTALLATION.

(a) Check that the oil control plugs in the governor body and base are installed in B-B holes, as the governor drive on the engine rotates in a clockwise direction. The plug hole in the body may be seen through the hole in the base.

(b) Make certain that the governor drive gear shaft turns freely before it is assembled on its drive coupling on the engine.

(6) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY. — Assembly of the constant-speed control governor is to be done at a repair depot.

(b) INSTALLATION.

1. Install the governor on the engine pad and place the nuts on the mounting studs fingertight. Remove the governor head from the body and check the drive gear shaft for backlash and freedom of movement while tightening. It is essential that these nuts be evenly tightened. The securing nuts should not be drawn down excessively, because to do so may cause the displacement of the gasket in the vicinity of the mounting studs and result in warping the governor base.

Note

For installation and adjustment of the governor control, see paragraph 10. *e.* (2) *(b) & (f)*, this section.

CAUTION

Make certain that the governor drive gear shaft turns freely before it is assembled on its drive coupling on the engine.

2. Install Simmonds-Corsey head as follows:

a. Place the RPM control lever in the extreme "DECREASE" position.

b. Turn the constant speed control governor shaft to the low rpm position.

c. Install the Simmonds-Corsey control head on the governor shaft by fitting serrations over serrations of corresponding attaching bushing. If adjustment is necessary refer to paragraph 10. *e.* (2) *(d)*, this section.

(7) TEST AFTER INSTALLATION.

(a) Before testing the constant-speed control, the propeller should be inspected to check the correct blade angles. This test is necessary to insure the correct relationship between rotating cam gear and blade gear segments. This test will usually be performed after the installation of the propeller.

Note

Do not use the feathering pump to move the blades to low pitch position in order to check the blade angles. If oil pressure is used for this purpose before checking the blade angles, serious damage may result to the mechanism due to improper installation.

(b) Set the engine RPM (propeller governor) control *(figure 199)* in the pilot's compartment to the "INCREASE" (Maximum rpm, low pitch) position, and then start the engine and warm it up in accordance with the engine operating instructions. When the engine is started, the forward end of the propeller dome cylinder will fill with engine oil at normal engine-pump pressure. This pressure, in conjunction with the blade centrifugal twisting moment, will hold the blades against the low pitch stops.

With the propeller blades in full low pitch, and the actual engine rpm lower than that for which the propeller governor is set, the engine rpm will vary directly with engine horsepower output.

Note

Horsepower varies with rpm and manifold pressure. Rpm is controlled by the propeller governor through change of blade pitch; manifold pressure is controlled by the throttle. In the condition stated above, with the blades in full low pitch, the propeller acts as a fixed pitch propeller and engine horsepower is governed by the throttle which in this case controls rpm as well as manifold pressure.

(c) After completing the engine warm-up period, advance the throttle to some intermediate engine speed, for example, 1500 rpm. Move the engine rpm control to the extreme "DECREASE" position. At this control setting, the engine will turn faster than the speed for which the governor is set, and the governor will supply oil pressure to the aft end of the propeller piston. In 35 to 45 seconds, when the aft end of the dome cylinder has been filled with oil, the propeller blades will move toward a higher pitch and the engine rpm will drop down to the minimum propeller governor setting.

(d) After the forward and aft ends of the dome cylinder have been filled with oil according to the procedures outlined above, move the engine rpm control several times between the "DECREASE" and the intermediate settings to eliminate trapped air from the propeller system.

d. AUXILIARY FEATHERING PUMP ASSEMBLY.

(1) DESCRIPTION.—When it is necessary to stop engine rotation in flight, in case of engine failure or testing conditions, the powerful braking effect of the propeller in the feathered conditions is employed. Feathering the blades to the full high pitch position of 90 degrees at the 42 inch station so that the blades lie in the direction of flight prevents windmilling and reduces drag to a minimum. Since the engine-driven oil pump and the engine-driven governor are inoperative when the engine stops, an auxiliary source of power is provided for feathering and unfeathering the propeller.

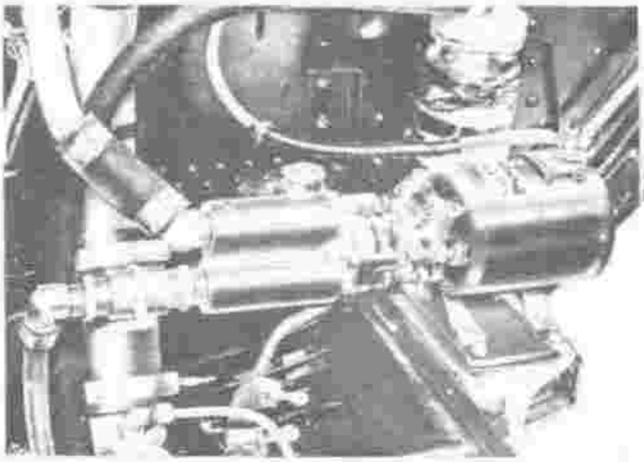


Figure 198—Propeller Feathering Pump and Motor

This power unit is an individual electric motor-driven hydraulic pump assembly *(figure 198)*, one for each propeller, mounted below the oil tank in the nacelle. The electric drive motor is controlled by the propeller feathering control switch button in the pilot's compartment. The electric motor is described in paragraph 15., this section. The auxiliary feathering pump takes oil supplied from the oil container and pumps this oil under high pressure to the propeller governor housing where this pressure actuates the high pressure transfer valve to disconnect the propeller governor from the system. The transfer valve is actuated to allow high pressure oil from the feathering pump to flow through the governor base and through the passage in the front (nose) section to the propeller shaft and then through the distributor valve to the propeller dome cylinder. This route from the governor to the propeller dome is the same as that used to conduct oil from the governor booster pump during constant speed operation.

Feathering is started by depressing the propeller feathering control switch push-button which holds in automatically. During the feathering operation, high pressure oil is pumped to the aft end of the propeller piston, moving the piston forward to feather the blades while forcing the engine oil forward of the piston to drain into the engine crankshaft, just as in constant-speed operation. When the piston has reached its full forward travel, feathering the blades to 90 degrees, the accumulated oil pressure within the feathering pump lines and the aft end of the dome cylinder reaches 500 psi and actuates the differential pressure cut-off switch on the base of the governor; this action opens the propeller feathering circuit and stops the pump.

Considerably greater oil pressure is required for the unfeathering operation than for the feathering, in order to open the distributor valve in the propeller shaft to redirect the oil flow within the dome cylinder. The only movement of the distributor valve is produced during unfeathering operation by the high pressure of 600 psi or more. However, at 500 psi, the pressure cut-out switch is actuated and breaks the feathering electrical circuit, automatically releasing the feathering control switch in the pilot's compartment which stops the feathering pump motor. For this reason, the feathering control switch must be HELD DOWN MANUALLY to produce sufficient pressure for unfeathering.

During the unfeathering operation in flight with engine dead, high pressure oil from the feathering pump at first flows to the aft end of the propeller piston. When the pressure builds up to 600 psi it actuates the distributor valve which redirects the pump pressure into the forward end of the dome cylinder while oil in the aft end is now directed into the engine crankshaft for drainage. Pressure in the forward end of the propeller dome forces the piston aft, unfeathering the blades. In flight, the blades immediately windmill and crank the engine. When the engine reaches the desired speed for starting, approximately 1000 rpm, the feathering control switch must be released to stop the feathering pump. The distributor valve returns to its normal position and the transfer valve in the governor closes to shut off the feathering pump line thus permitting the governor to resume its normal automatic control of engine speed when the engine is now started.

The pump is a fixed clearance type with a positive displacement of .141 cu. inches. The total weight including motor is approximately 11 pounds. The pump itself consists essentially of a pair of closely meshed steel gears contained within a housing, mounted on the end of a 24-volt motor. The housing is made up of a heat treated aluminum alloy body. The body contains 2 removable lead bronze bushings. Two removable bushings are also located in the cover. The parts are accurately machined to provide the proper clearance for the gears to turn freely with a minimum of fluid pressure loss.

The intake port and discharge port are located in the cover. A pair of small drilled holes provide communication between the intake port, gear shafts, and seal chamber in order to relieve pressure at the end of the shafts and in the seal chamber. The oil pressure relief valve, set at 1200 psi, is located in the cover. It is arranged to by-pass fluids from the discharge port back to the intake port when the discharge pressure exceeds the pressure adjustment.

A seal is provided to keep the fluid within the pump, to prevent air being drawn into the pump.

(2) REMOVAL.

(a) Remove the access doors from the left-hand side of the nacelle. *(See 3, figure 9.)*

(b) Drain the oil from the engine system through the "Y" oil drain valve which is accessible through a cover plate *(27, figure 6)* in the bottom of the nacelle.

(c) Drain the 1½ gallons of reserve oil from the oil tank through the plug beneath the tank sump.

(d) Remove the oil lines from the pump and drain them into the container.

(e) Disconnect the electric plug from the motor.

(f) Disengage the bolts which secure the motor to the mechanics floor.

(3) DISASSEMBLY. — The feathering pump should be disassembled only at a repair depot.

(4) MAINTENANCE REPAIR OR REPLACEMENT.

(a) MAINTENANCE REPAIR.—The hydraulic feathering pump and electric motor assembly is to be repaired only at a repair depot.

(b) REPLACEMENT.—Replace all damaged or worn pump and electric motor assemblies.

(5) ADJUSTMENTS.—Any adjustment of the hydraulic feathering pump and electric motor assembly is to be made at a repair depot.

(6) TEST BEFORE INSTALLATION.—The hydraulic feathering pump and electric motor assembly is tested before being shipped from the factory. Consequently, a test before installation is not necessary.

(7) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—The feathering pump should be assembled only at a repair depot.

(b) INSTALLATION.—Reverse of REMOVAL AND DISASSEMBLY procedure.

(8) TEST AFTER INSTALLATION.—For complete procedure, refer to paragraph *b.* (7), this section, PROPELLER, TEST AFTER INSTALLATION.

e. PROPELLER CONTROLS.

(1) PROPELLER FEATHERING CONTROL SWITCH.—A push-button control switch *(figure 352)* is provided for each propeller feathering system. These switches are installed on the forward upper structure of the pilot's control pedestal. Further description of these switches will be found in paragraph 15. *d.* (11) *(c)*, this section.

(2) ENGINE RPM CONTROLS (PROPELLER GOVERNOR CONTROLS).

(a) DESCRIPTION.—Each of the two constant-speed control units (propeller governors) can be manually adjusted from the pilot's compartment. Adjustments are made with the engine RPM controls installed on the forward upper structure of the pilot's control pedestal. The purpose of these controls is to control the engine speed within the constant-speed range of 1200 rpm minimum to 2700 rpm take-off speed. The function of these controls is to adjust the propeller governor, i. e., to increase or decrease the compression applied to the speeder spring within the governor head, thus regulating the flow of oil from the governor to the propeller to affect a change of blade angle, in this way constant-speed control governing only the engine RPM.

It should be clearly borne in mind that with the constant-speed control, governing only the engine RPM controls (propeller governor controls) can regulate engine speed. These controls do not regulate blade pitch. The abbreviation "RPM" designates these controls and their extreme positions are marked as follows: the forward control position is "INCREASE" signifying high rpm or low pitch range; the aft control position is "DECREASE" signifying low rpm or constant-speed high limit range. The control system incorporates pulleys and cables from the control pedestal to the bellcrank in each nacelle. A push-pull control mechanism connects each bellcrank to the respective propeller governor.

The push-pull control mechanism consists of two main parts: the casing and the core. The casing in each nacelle is rigid from the bellcrank to the firewall, flexible from the firewall to the governor. The casing sections are connected by couplings at the firewall. The core consists of an arrangement of olives and tubelets, threaded on a cable. In the "PULL" operation, tension is borne by the cable; in the "PUSH" operation, compression is borne by the linkage of olives and tubelets. At the governor, this mechanism ends in a control head mounted on the serrated disc of the propeller governor shaft. An external high rpm stop arm, attached to the control head, limits the movement within the control head when the stop arm strikes the high rpm adjustable stop bolt threaded through a boss in the governor head. This stop arm is set to limit the high rpm developed by the engine while controlled by the propeller governor. The stop arm functions to limit the amount of compression that can be applied to the speeder spring by the engine RPM control.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.—Disconnect control linkages *(figure 197)* at the propeller governor and at the engine RPM control in the pilot's compartment. Remove in an orderly manner.

2. DISASSEMBLY.—The propeller controls are disassembled when removed.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Faulty control parts should be replaced rather than repaired.

(d) ADJUSTMENTS.

1. When installing the control on a replacement governor, install the serrated bushing on the governor shaft in the same relationship to the index mark on the end of the governor shaft as existed on the governor removed. Also adjust the stop arm disc in the previous relationship to the serrated bushing on the governor shaft. This will avoid unnecessary adjustment of the controls.

2. To obtain small changes in the maximum rpm setting, turn the stop screw on the governor head clockwise to decrease rpm, or counterclockwise to increase rpm.

3. To obtain larger changes in the maximum rpm setting, loosen the nut on the end of the governor shaft and shift the disc carrying the stop arm to a serration placing the stop arm farther away from the stop screw on the governor head to increase rpm, or nearer the stop screw to decrease rpm. As each serration on the stop arm disc changes the setting of the arm by 15 degrees, this results in a change of approximately 114 rpm in the governor setting.

CAUTION

If the engine fails to develop take-off rpm at take-off manifold pressure and with the propeller control in full increase rpm position, check whether the engine rpm drops slightly when the manifold pressure is slightly reduced. If the rpm does not change, the governor is controlling the propeller, but the governor is not set for take-off rpm due to

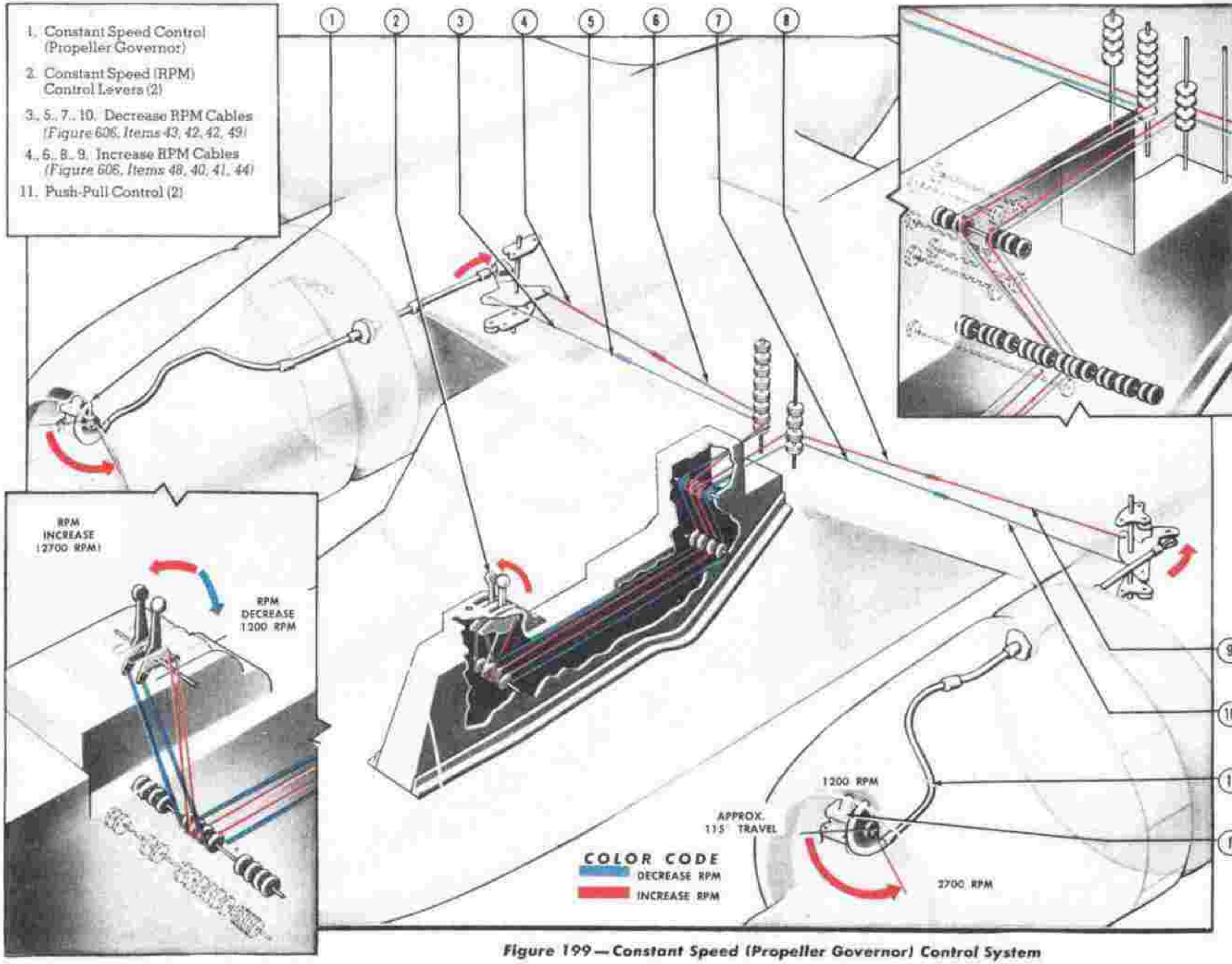


Figure 199—Constant Speed (Propeller Governor) Control System

improper adjustment of the high rpm stop on the control, or improper operation or rigging of the controls. If the engine rpm drops when the manifold pressure is slightly decreased, the governor is in the underspeed condition but the blades are against the low pitch stops and cannot go to a lower angle. DO NOT ATTEMPT TO INCREASE THE RPM BY ADJUSTING THE GOVERNOR MAXIMUM RPM STOP UNDER THESE CONDITIONS, AS THIS WILL NOT INCREASE THE RPM ON THE GROUND AND CAN CAUSE DANGEROUS OVERSPEEDING IN FLIGHT. Check the engine for any condition causing loss of power, and check the minimum blade angle.

4. The propeller control lever in the cockpit should be adjusted so that when the stop arm on the control is against the stop screw on the governor, the cockpit lever is ⅛ inch from its full forward position. To obtain this adjustment, change the relationship between the serrations on the bushings on the governor shaft and the outer part of the control required.

CAUTION

When making this adjustment, take care not to loosen the nut on the governor shaft allowing the relationship between the radial serrations on the bushings on the governor shaft and the disc carrying the stop arm to change. This would result in changing the rpm setting of the governor.

5. If it is necessary to install a replacement governor without information on the previous adjustment of the controls, proceed as follows:

a. Place the propeller control in the cockpit in full decrease rpm position.

b. Install the disc carrying the stop arm and the serrated bushing on the governor shaft. Turn the governor shaft clockwise to the full extent of its travel. Set the stop arm so that the arm is approximately 110 degrees away from the stop screw when the draft is in its full clockwise position.

c. Install the outer part of the control head over the serrated bushing on the governor shaft, keeping the governor shaft turned fully clockwise.

d. The above procedure gives a trial setting. Run the engine and adjust the stop screw on the governor head and the stop arm on the control described above to set the stop for take-off rpm.

e. Adjust the control as described above so that the cockpit lever is ⅛ inch from its full forward position when the stop arm on the control is against the stop screw.

(e) TEST BEFORE INSTALLATION. – The control parts are not tested before installation.

(f) ASSEMBLY AND INSTALLATION.–Reverse the REMOVAL AND DISASSEMBLY PROCEDURES.

(g) TEST AFTER INSTALLATION.–The engine RPM control (lever and cable linkage) is tested in conjunction with the test of the constant-speed control unit. Refer to paragraph 10. *c.* (7), this section. The propeller feathering control switch push-button is tested in conjunction with the test of the hydraulic feathering pump and electric drive motor assembly.

f. PROPELLER AND CONTROLS TROUBLE SHOOTING LIST.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Inability to attain take-off rpm on the blocks.	*a.* Wrong setting of governor and incorrect rigging of control system.	*a.* Reset governor and rerig system.
	b. Improper adjustment of low pitch stop ring in propeller dome assembly.	*b.* Reset stop ring.
	c. Low engine power.	*c.* See engine manual.
	d. Erroneous reading on tachometers, manifold pressure gage.	*d.* Calibrate instruments.
2. Overspeeding on take-off.	*a.* Wrong setting on governor control.	*a.* Reset and rerig.
	b. Insufficient exercise of propeller mechanism prior to take-off.	*b.* Move engine rpm control through constant-speed range with engine running.
	c. Backlash in engine rpm control.	*c.* Rerig control system.
	d. Too rapid throttle opening.	*d.* Advance throttle slowly.

f. PROPELLER AND CONTROLS TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	e. Poor or incorrect gaskets between distributor valve and propeller shaft; and between governor base and engine mounting pad.	*e.* Install new gaskets.
	f. Sticky governor pilot or relief valve.	*f.* Remove governor and forward to overhaul depot.
	g. High engine transfer ring leakage.	*g.* Remove engine and forward to overhaul depot.
	h. Erroneous reading tachometers, manifold pressure gage.	*h.* Replace defective instrument.
3. Poor synchronization.	*a.* Ignition trouble.	*a.* Check with ignition tester or megger.
	b. Poor carburetion.	*b.* Consult engine carburetor manual.
	c. Backlash in governor control system.	*c.* Rerig control system.
	d. Sluggish pilot valve.	*d.* Remove governor and forward to overhaul depot.
	e. Sluggish governor relief valve.	*e.* Remove governor and forward to overhaul depot.
	f. Sticky piston action in propeller dome assembly.	*f.* Remove dome shell. Clean and lubricate piston gasket. If piston contact area of dome is scored, polish with wet and dry 300 emery.
	g. Loose piston gasket.	*g.* Tighten piston gasket nut.
	h. Variation in engine transfer ring leakage.	*h.* Replace defective instrument.
4. Leakage.	*a.* At crankshaft breather.	
	(1) Incomplete engine scavening or excessive blow-by.	(1) Consult engine manual.
	(2) Loose distributor valve.	(2) Tighten distributor valve or engine shaft extension.
	(3) Leaky gaskets.	(3) Replace gaskets.
	b. Dome Breather Hole.	
	(1) Damaged seal.	(1) Replace seal.
	(2) Loose dome breather hole nut.	(2) Tighten nut.
	(3) Washer missing.	(3) Install washer.
	c. Interference between breather pipe in propeller shaft and distributor valve oil transfer plate fillet.	*c.* Rework fillet.
	d. Dome Retaining Nut.	
	(1) Damaged seal.	(1) Replace seal.
	(2) Loose nut.	(2) Tighten nut.
	e. Blades.	
	(1) Damaged packing or molded chafing ring.	(1) Replace packing and molded chafing ring by split type chafing ring.
	f. Barrel Half Seals.	
	(1) Damaged seals.	(1) Replace seals.
	(2) improper closure of barrel half.	(2) Remove burrs from parting surfaces of barrel half.
	g. Barrel Spider Packing.	
	(1) Damaged packing.	(1) Replace packing.
	h. Rear Cone.	
	(1) Damaged spider shaft oil seal.	(1) Replace seal.
	(2) Spider shaft oil seal washer installed improperly.	(2) Install in proper sequence—washer, seal, ring.
	(3) Spider shaft oil seal washer missing.	(3) Install washer.
	i. General.	
	(1) Engine thrust plate seal.	(1) Consult engine manual.

f. PROPELLER AND CONTROLS TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
5. Roughness.	*a.* Spark plugs or ignition.	*a.* Replace spark plugs—check wiring.
	b. Propeller unbalance.	*b.* Check balance (effects will be greater at high rpm).
	c. Blade angles vary.	*c.* Correct angles—(effects will be greater at high rpm).
6. Failure to Feather.	*a.* Batteries low.	*a.* Recharge batteries.
	b. Faulty electrical system.	*b.* Check power and control circuits of feathering pump.
	c. Failure of pushbutton to remain engaged.	*c.* Check wiring or low pressure setting of cutout switch.
	d. Failure to remain unfeathered. (1) Pushbutton fails to disengage.	*d.* Reset cutout switch.
	e. Incorrect high pitch stop ring settings.	*e.* Reset stop ring.
	f. Sheared coupling in feathering pump.	*f.* Replace coupling.
	g. Restricted oil supply to feathering pump.	*g.* Check feathering pump inlet lines for foreign material, and bleed line.
	h. Excessive leakage.	
	(1) Improper distributor valve installation.	(1) Check for tightness or interference.
	(2) Poor or incorrect gaskets between distributor valve and propeller shaft and between governor base engine mounting pad.	(2) Install new gaskets.
	(3) Engine transfer rings.	(3) Replace defective engine.
	i. Defective feathering pump.	*i.* Replace pump.
7. Failure to Unfeather.	*a.* Batteries low.	*a.* Recharge batteries.
	b. Faulty electrical system.	*b.* Check power and control circuits of feathering pump.
	c. Excessive leakage.	
	(1) Engine transfer rings.	(1) Replace defective engine.
	(2) Improper distributor valve installation.	(2) Check tightness or interference.
	(3) Poor or incorrect gaskets between distributor valve and propeller shaft and between governor base engine mounting pad.	(3) Install new gaskets.
	d. Sheared coupling in feathering pump.	*d.* Replace coupling.
	e. Restricted oil supply to feathering pump.	*e.* Check feathering pump inlet lines for foreign material and bleed line.
	f. Defective feathering pump.	*f.* Replace pump.

11. FUEL SYSTEM.

a. GENERAL. *(See figure 200.)*—The fuel system includes five self-sealing fuel cells, an engine-driven fuel pump mounted on each engine, electrically operated fuel booster pumps on each fuel tank, fuel level transmitters in each tank with fuel quantity indicators in the pilot's compartment, two cable controlled fuel tank selector valves, one cable-controlled cross-feed and bomb bay fuel tank(s) selector valve, two fuel strainers, two fuel pressure transmitters and a dual fuel pressure indicator, drain cocks, engine priming and oil dilution solenoid valves, and the necessary lines and fittings. Provisions are made for the installation of a non-self-sealing long range tank in the bomb bay. The normal fuel system capacity is 925 U. S. gallons (771 Imperial gallons) which is increased by 675 U. S. gallons (562 Imperial gallons) by installation of the long range tank. Normal fuel pressure is 17 $\pm$ 1 psi with the engines operating at 2000 rpm.

b. FILLING THE FUEL SYSTEM.

(1) All fuel delivery hose must be metal-lined or bonded between the nozzle and the fittings on the opposite end. In addition, one end of a flexible bonding wire or cable shall be attached permanently to the discharge nozzle. When a fuel tank is filled, attach the free end of the bonding wire to a convenient, uninsulated metallic part of the airplane to insure an electrical bond between the tank and the delivery hose. DO NOT attach the bonding wire near the filler neck of the tank. A standard test clip may be used on the free end of the bonding wire for conveniently attaching or removing the wire. The bonding wire must be attached before removing the tank filler cap and must not be disconnected until the filler cap has been reinstalled.

CAUTION

Filling of the fuel tanks should be accomplished in the open air and care must be taken to avoid spilling fuel. All precautions against fire must be observed. Fuel trucks must be equipped with a suitable static ground chain.

(2) Care must be taken while filling the fuel cells to prevent damage to the tank filler necks. The discharge nozzle must be held and must not be placed in the filler neck without support.

(3) The main (nacelle) fuel cells are located in each nacelle and have a capacity of 300 U. S. gallons 249.8 Imperial gallons). The filler wells are located on the aft outboard corner of each tank and are accessible from the top side of the nacelle. *(See 6, 14, & 22, figure 7.)* An overflow drain line at the filler well allows excess fuel to be discharged to the ground.

(4) The auxiliary (wing) fuel cells are located in the wing between the nacelles and fuselage and have a capacity of 100 U. S. gallons (83.3 Imperial gallons). The filler wells are located immediately inboard of each nacelle and are accessible from the top side of the wing. An overflow drain line at the filler well allows excess fuel to be discharged to the ground.

(5) The auxiliary (bomb bay) fuel cell is installed in the top forward section of the bomb bay and has a capacity of 125 U. S. gallons (104.1 Imperial gallons). The filler well is located at the top, left-hand side of the fuselage. An overflow drain line at the filler well permits excess fuel to be discharged to the ground. When the long range tank is installed in the bomb bay the combined capacity of the auxiliary (bomb bay) cell and long range tank is 800 U. S. gallons (666.4 Imperial gallons). The same filler well is used for filling either the auxiliary (bomb bay) cell alone or the bomb bay cell and long range tank combined. *(See 6, figure 7.)*

c. DRAINING THE FUEL SYSTEM.

(1) GENERAL.—Drain cocks are installed in all fuel cells, both fuel strainers, and booster pumps, and a drain plug is installed in the long range tank to facilitate complete drainage of the fuel system or drainage of accumulated moisture from the fuel container sumps. *(See figure 202.)*

(2) DRAINING THE COMPLETE SYSTEM.

(a) Open the deflector plating at the bottom of both nacelles by releasing the fasteners.

(b) Place a suitable container beneath the drain elbows in the fuel strainers.

(c) Place the cross feed and bomb bay tank(s) selector valve in the "OFF" position.

(d) Place both fuel tank selector valve controls in the "MAIN ON" positions.

(e) Place the corresponding booster pump switches in the "HIGH BOOST" position.

(f) Place the booster pump switches and selector valve controls in the "OFF" position, after the main cells and lines have been drained.

(g) Open the drain cock on the bottom of each main cell and allow the residual fuel to drain into a container. Close the drain cock after the fuel has drained.

(h) Place both fuel tank selector valve controls in the "AUXILIARY ON" positions.

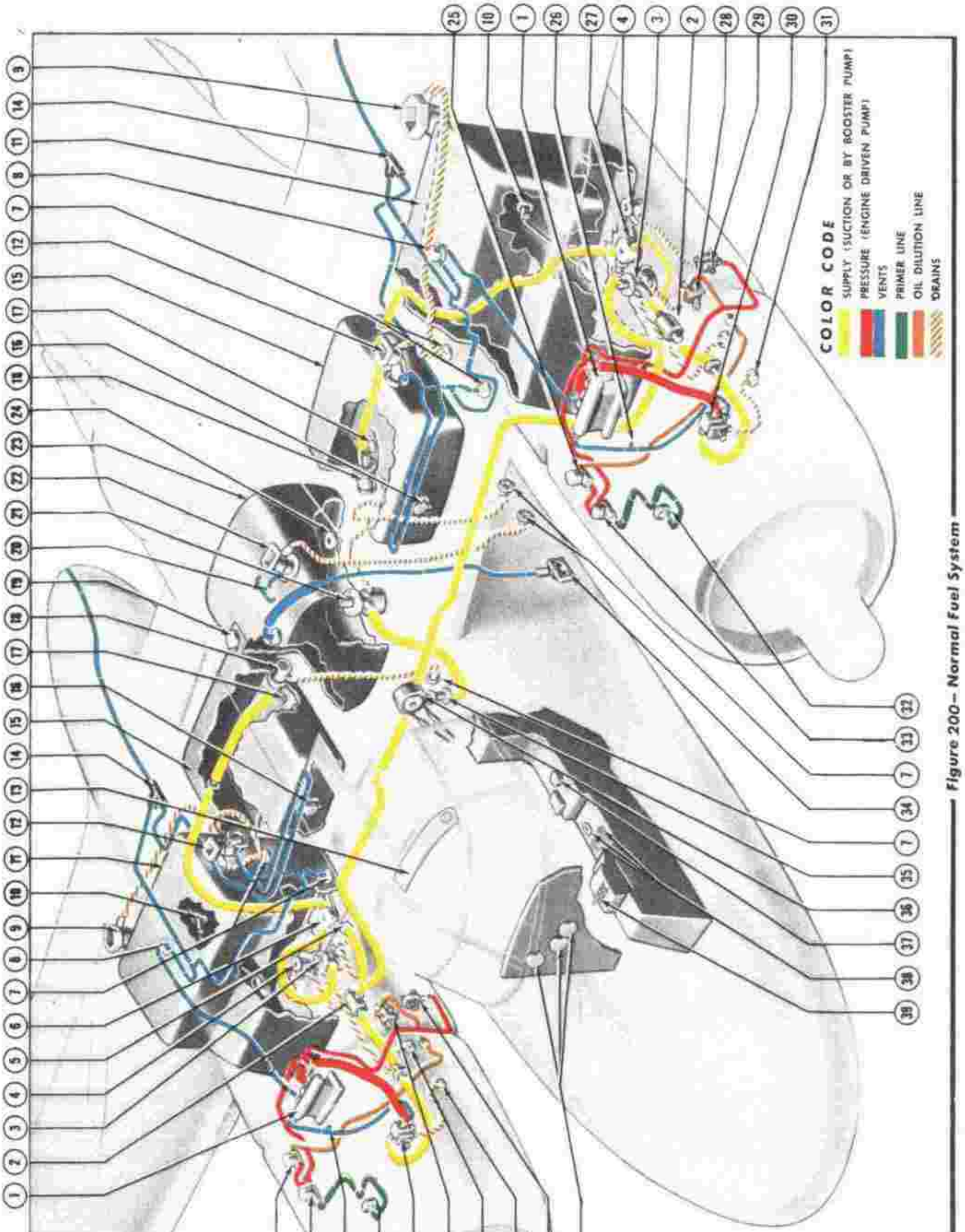


Figure 200— Normal Fuel System

KEY TO FIGURE 200

1. Carburetor
2. Fuel Strainer *(Figure 222)*
3. Main (Nacelle) Fuel Cell Booster Pump
4. Main Fuel Cell Drain Cock
5. Coupling (Check Valve on Some Airplanes)
6. Right Hand Fuel Tanks Selector Valve
7. Flanges
8. 2126545 Vent and Vapor Return Fitting, 1128988 Gasket
9. Main (Nacelle) Fuel Cell Filler Wells
10. Fuel Level Transmitters (Main Fuel Cells)
11. Main (Nacelle) Fuel Cells *(Figures 206 & 207)*
12. Auxiliary (Wing) Fuel Cell Filler Wells
13. Engine Primer and Oil Dilution Control Switches *(Figure 205)*
14. Manifold Fitting
15. Auxiliary (Wing) Fuel Cells
16. Fuel Level Transmitters (Wing Fuel Cells)
17. Auxiliary (Wing) Fuel Cell Draink Cocks
18. Auxiliary (Wing) Fuel Cell Booster Pumps
19. Fuel Level Transmitter Bomb Bay Cell (Located on Bottom of Cell on Some Airplanes)
20. Vent Fitting (Tee must be Capped when Long Range Tank is Not Installed)
21. Bomb Bay Cell Fuel Booster Pump
22. Bomb Bay Fuel Cell Filler Well
23. Auxiliary (Bomb Bay) Fuel Cell *(Figures 211 & 212)*
24. Bomb Bay Fuel Cell Drain Cock
25. Oil Dilution Solenoid Valve
26. Fuel Pressure Gage Vent Line Connection
27. Left Hand Fuel Tanks Selector Valve
28. Oil System "Y" Drain Cock
29. Fuel Pressure Transmitter *(Figure 241)*
30. Type G9 Engine Driven Fuel Pump
31. 1202421 Flange
32. Engine Primer Distributor (On Engine)
33. Engine Primer Solenoid Valve
34. 5150303 Vent Fitting
35. 2206737 Coupling (Check Valve on Some Airplanes)
36. Cross-Feed and Bomb Bay Tank(s) Selector Valve *(Figure 221)*
37. Long Range Tank Fuel Indicator *(Figure 205)*
38. Fuel Tank Selector Valve Controls *(Figure 205)*
39. Fuel Booster Pump Selector Switches *(Figure 205)*
40. Fuel Pressure Gage and Fuel Level Indicators *(Figure 205)*
41. 2193828 Flange
    1193826 Gasket

(i) Place the corresponding booster pump switches in the "HIGH BOOST" positions.

(j) Place the booster pump switches and selector valve controls in the "OFF" positions, after the auxiliary (wing) cells and lines have drained.

(k) Open the drain cocks on the auxiliary (wing) cells *(7, figure 202)* and allow the residual fuel to drain into a container. Close the drain cocks after the fuel has drained.

(l) Be sure the cross-feed and bomb bay tank(s) selector valve still is in the "OFF" position.

(m) Place containers beneath the bomb bay cell drain cocks on the booster pump and bottom of the cell *(9 & 10, figure 202)*.

(n) Open the drain cocks and allow the bomb bay cell to drain. Close the drain cocks after the fuel has drained.

(o) If the long range tank is installed both the bomb bay cell and long range tank may be drained by removing the drain plug in the long range tank and opening the drain cock on the booster pump. Replace the drain plug and close the drain cock after the fuel has drained into suitable containers.

(3) DRAINING ACCUMULATED MOISTURE.

(a) Open the drain cocks on the fuel cells, booster pumps, and fuel strainers, and remove the drain plug from the long range tank. *(See 5, figure 215.)* When the water has been drained from the tanks, close all drain cocks, replace the drain plug in the long range tank, and replace all lock wire.

(b) Accumulated moisture must be drained from the fuel tanks before and after each flight and at frequent intervals when the airplane is inactive. Frequent draining of water from the fuel tanks aids in preventing water from being drawn into the fuel lines or freezing during cold weather operations. Local stoppage of fuel lines caused by ice particles may be eliminated by heating the lines with a heater that does not employ an open flame.

(c) The fuel tanks should be serviced at the end of each flight to eliminate air spaces in the tanks in which condensation of moisture can occur.

d. FUEL SYSTEM CONTROLS AND INSTRUMENTS. *(See figure 205.)*

(1) CONTROLS.

(a) FUEL TANK SELECTOR CONTROLS.—The fuel tank selector controls are located on the pedestal in the pilot's compartment *(figure 205)* and operate the tank selector valves and cross-feed and bomb bay tank(s) selector valve by means of cables. One tank selector valve controls the left hand main and auxiliary tanks and one controls the right hand main and auxiliary tanks. The cross-feed and bomb bay tank(s) selector valve controls fuel cross feed and selection of fuel from the bomb bay cell alone or in combination with the long range tank. For complete information about the selector valves and controls refer to paragraph 11. *k.*, this section.

(b) FUEL BOOSTER PUMP SELECTOR SWITCHES.—Three switches are installed on the control pedestal, one for the booster pumps in each wing fuel system and one for the bomb bay tank booster pump. Each switch has two positions "LOW BOOST" and "HIGH BOOST." The "LOW BOOST" position sets up the circuit for normal operation of the booster pump while "HIGH BOOST" position sets up the circuit for increased booster pump operation, which is controlled by the booster pump rheostats. For complete information about the fuel booster pump selector switches refer to paragraph 15. *d.* (5), this section.

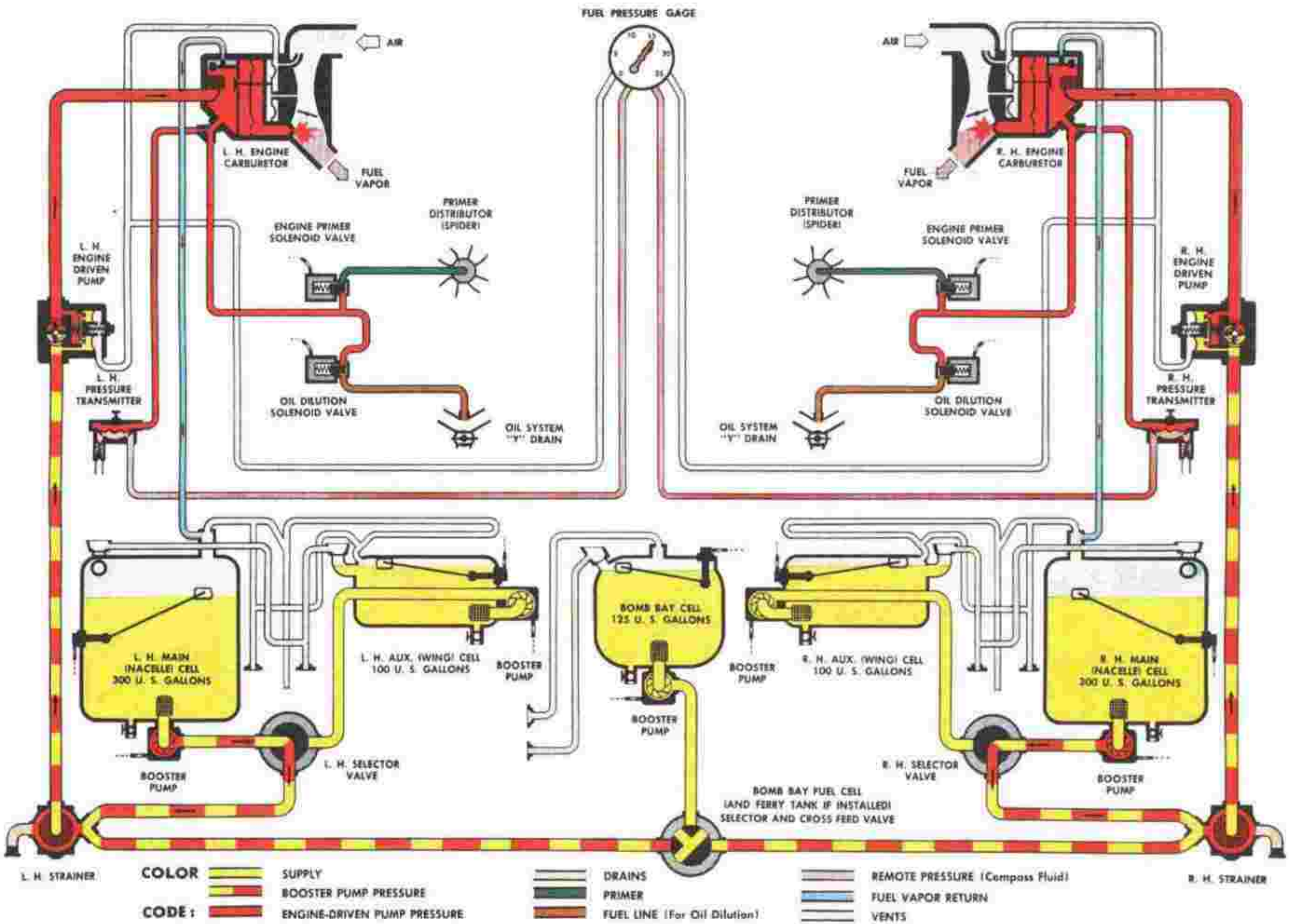
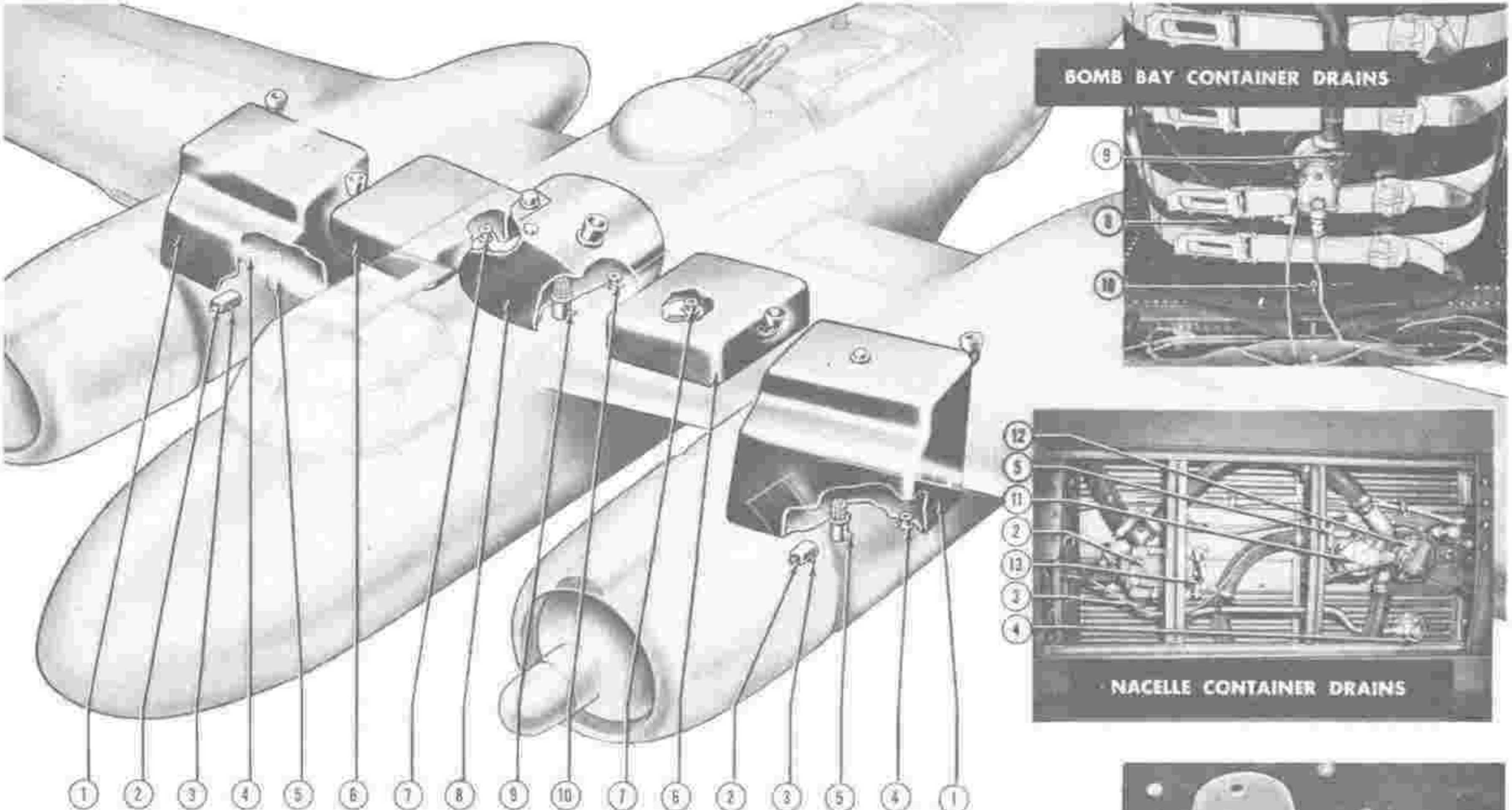
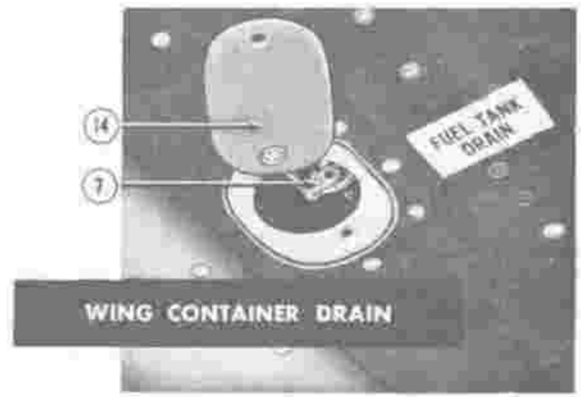


Figure 201 —Fuel System Flow Diagram





1. Main (Nacelle) Fuel Cell
2. Fuel Strainer
3. Fuel System Main Drain
4. Main Cell Drain Cock
5. Main Cell Booster Pump Drain Cocks
6. Auxiliary (Wing) Fuel Cell
7. Wing Cell Drain Cock
8. Auxiliary (Bomb Bay) Fuel Cell
9. Bomb Bay Cell Booster Pump Drain Cock
10. Bomb Bay Cell Drain Cock
11. Main Cell Booster Pump
12. Selector Valve Assembly
13. Fuel Strainer Drain Cock
14. Wing Cell Drain Cock Access Door

Figure 202—Fuel System Drains

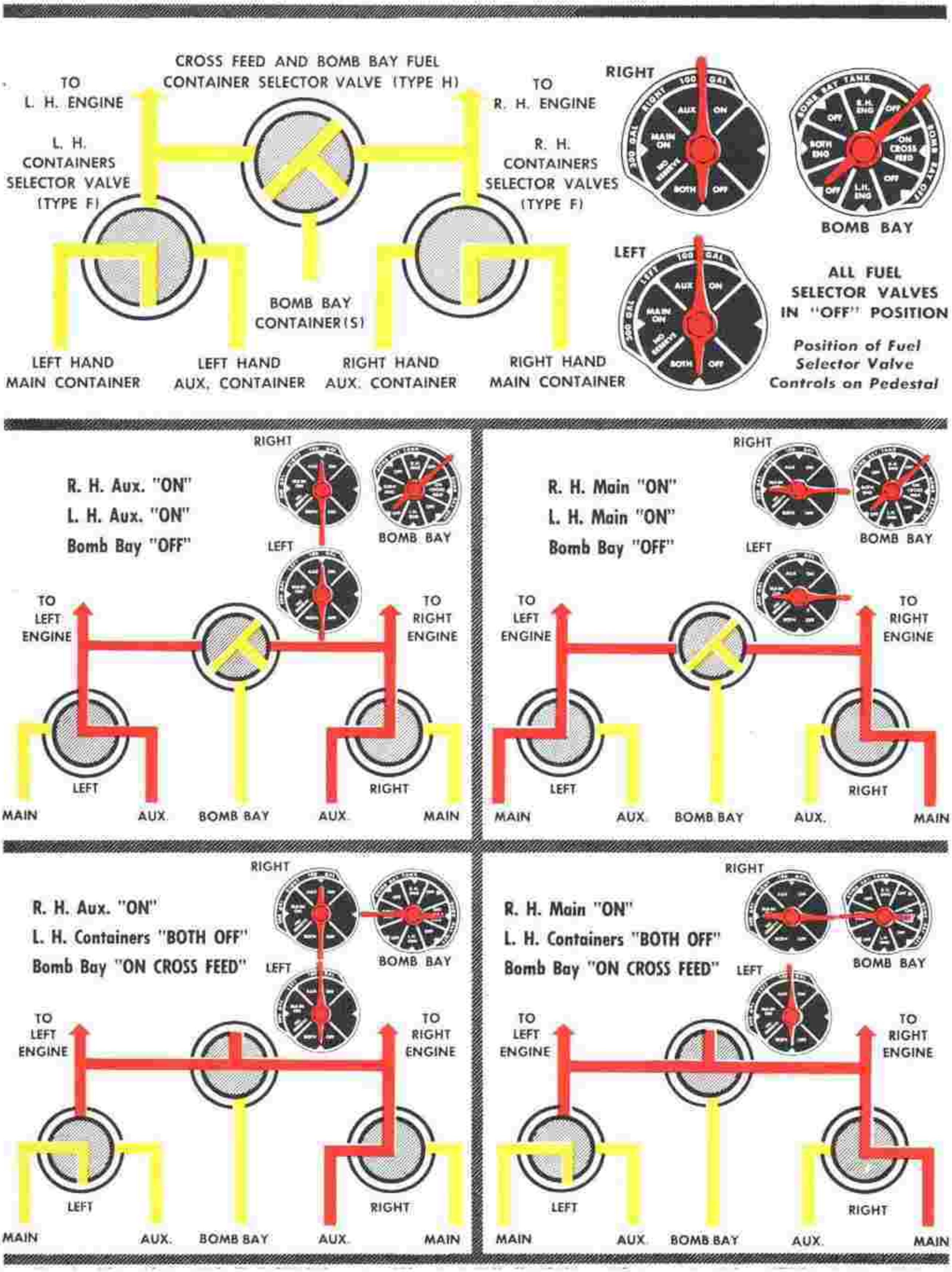


Figure 203(Sheet 1 of 2) — Alternate Positions of Fuel Container Selector Valves

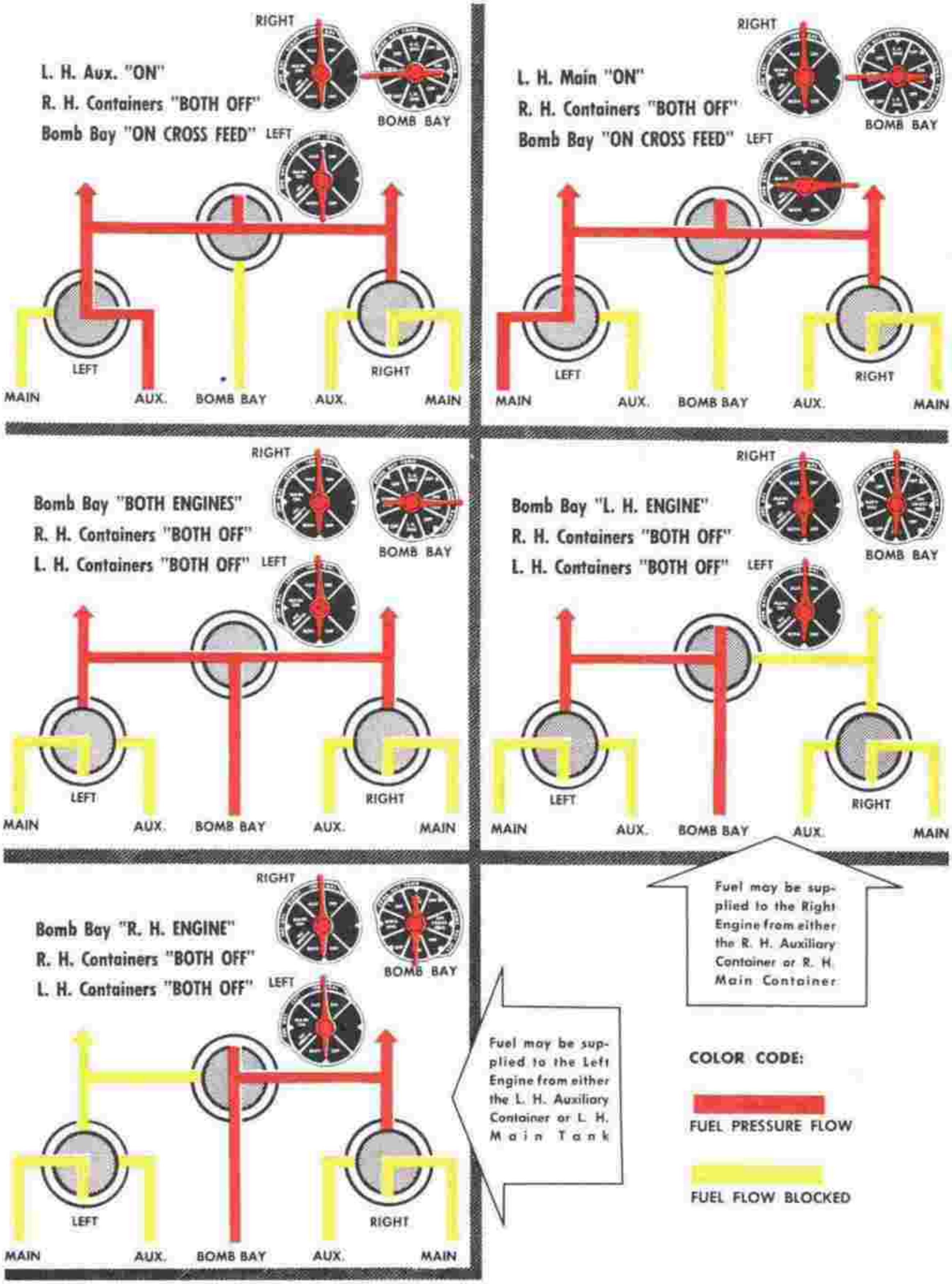


Figure 203(Sheet 2 of 2) — Alternate Positions of Fuel Container Selector Valves

FUEL TANK SELECTOR VALVE CONTROLS

FUEL BOOSTER PUMP SELECTOR SWITCHES

	Desired Transfer	L.H. Selector Control Position	R.H. Selector Control Position	Cross Feed Bomb Bay Control Position	L. H. Booster Pumps Switch	R. H. Booster Pumps Switch	Bomb Bay Booster Pump Switch
1.	L.H. Main to R.H. Main	MAIN ON	MAIN ON	ON CROSS FEED	HIGH BOOST	OFF	OFF
2.	L.H. Main to R.H. Auxiliary	MAIN ON	AUX. ON	ON CROSS FEED	HIGH BOOST	OFF	OFF
3.	L.H. Main to Bomb Bay	MAIN ON	BOTH OFF	L.H. ENG.	HIGH BOOST	OFF	OFF
4.	L.H. Main to L.H. Auxiliary	FOLLOW PROCEDURES 1 AND 6, OR 2 AND 8, OR 3 AND 10.					
5.	R.H. Main to L.H. Main	MAIN ON	MAIN ON	ON CROSS FEED	OFF	HIGH BOOST	OFF
6.	R.H. Main to L.H. Auxiliary	AUX. ON	MAIN ON	ON CROSS FEED	OFF	HIGH BOOST	OFF
7.	R.H. Main to Bomb Bay	BOTH OFF	MAIN ON	R.H. ENG.	OFF	HIGH BOOST	OFF
8.	R.H. Main to R.H. Auxiliary	FOLLOW PROCEDURES 5 AND 2, OR 6 AND 14, OR 7 AND 12.					
9.	Bomb Bay to L.H. Main	MAIN ON	BOTH OFF	L.H. ENG.	OFF	OFF	HIGH BOOST
10.	Bomb Bay to L.H. Auxiliary	AUX. ON	BOTH OFF	L.H. ENG.	OFF	OFF	HIGH BOOST
11.	Bomb Bay to R.H. Main	BOTH OFF	MAIN ON	R.H. ENG.	OFF	OFF	HIGH BOOST
12.	Bomb Bay to R.H. Auxiliary	BOTH OFF	AUX. ON	R.H. ENG.	OFF	OFF	HIGH BOOST
13.	L.H. Auxiliary to R.H. Main	AUX. ON	MAIN ON	ON CROSS FEED	HIGH BOOST	OFF	OFF
14.	L.H. Auxiliary to R.H. Auxiliary	AUX. ON	AUX. ON	ON CROSS FEED	HIGH BOOST	OFF	OFF
15.	L.H. Auxiliary to Bomb Bay	AUX. ON	BOTH OFF	L.H. ENG.	HIGH BOOST	OFF	OFF
16.	L.H. Auxiliary to L.H. Main	FOLLOW PROCEDURES 13 AND 5, OR 14 AND 17, OR 15 AND 9.					
17.	R.H. Auxiliary to L.H. Main	MAIN ON	AUX. ON	ON CROSS FEED	OFF	HIGH BOOST	OFF
18.	R.H. Auxiliary to L.H. Auxiliary	AUX. ON	AUX. ON	ON CROSS FEED	OFF	HIGH BOOST	OFF
19.	R.H. Auxiliary to Bomb Bay	BOTH OFF	AUX. ON	R.H. ENG.	OFF	HIGH BOOST	OFF
20.	R.H. Auxiliary to R.H. Main	FOLLOW PROCEDURES 17 AND 1, OR 18 AND 13, OR 19 AND 11.					

CAUTION—Fuel transfer is to be accomplished only when the airplane is on the ground and when the engines are not operating. Observe fuel quantity indicators closely to prevent overflow of fuel.

Figure 204 — Fuel Transfer Chart

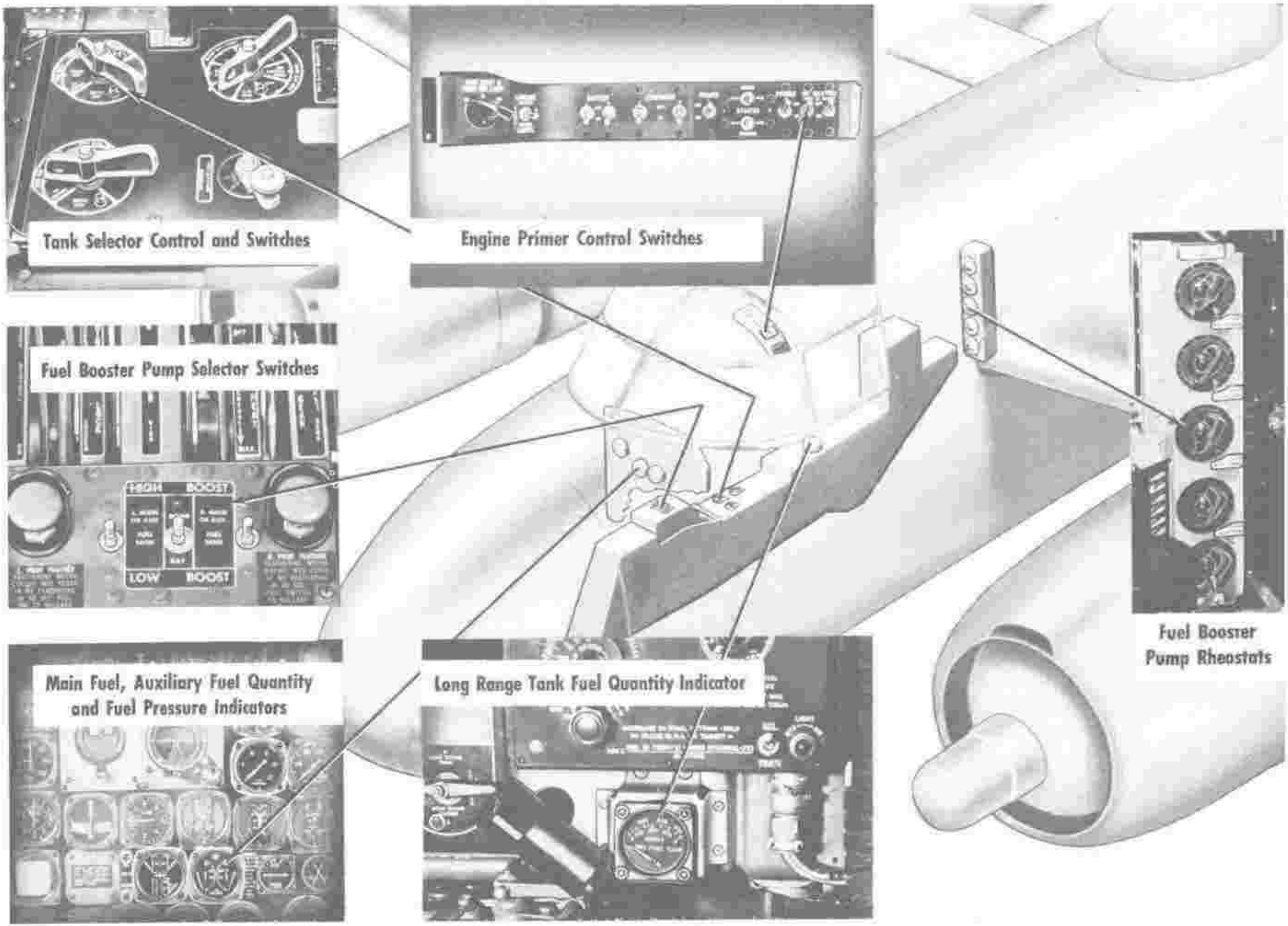


Figure 205 — Fuel System Instruments and Controls

(c) FUEL SELECTOR SWITCHES.—Two rotary type fuel selector switches are installed on the control pedestal. A lever is attached to the fuel tank selector valve control shaft and rotates with the shaft in conjunction with the three positions of the selector valve control, "MAIN ON," "AUX ON," and "BOTH OFF." Each fuel selector switch is wired to the corresponding booster pump selector switch. When the booster pump selector switch is in either the "LOW BOOST" or "HIGH BOOST" position, the booster pumps in the wing fuel system are operated automatically by the selector valve control. The bomb bay tank(s) booster pump has no fuel selector switch and is controlled directly by the booster pump selector switch on the pedestal, independently of the setting of the cross feed and bomb bay tank(s) selector valve control. For complete information about the fuel selector switches refer to paragraph 15. *d.* (5) *(d)*.

(d) FUEL BOOSTER PUMP RHEOSTATS.—Five rheostats are installed on the control pedestal behind the pilot's seat and regulate the speed of the booster pumps in the "HIGH BOOST" position. For complete information about the fuel booster pump rheostats refer to paragraph 15. *d.* (5), *(d)*, this section.

(e) ENGINE PRIMER AND OIL DILUTION SWITCHES.—Priming of the engines and dilution of the engine oil are controlled by electrical switches located on the pilot's overhead electrical panel. For complete information about these switches refer to paragraph 15. *d.* (2) *(c)*, and 15. *d.* (7), this section.

(2) INSTRUMENTS.

(a) FUEL PRESSURE INDICATOR.—A dual fuel pressure indicator is installed on the pilot's main instrument panel to indicate the fuel pressure at each carburetor. Normal fuel pressure is 17 $\pm$ 1 psi. A fuel pressure transmitter is installed on each firewall. For complete information about the fuel pressure indicating system refer to paragraph 13. *f.* (6), this section, and *figure 241*.

(b) FUEL LEVEL TRANSMITTERS.—A fuel level transmitter is installed in each fuel tank and consists of a float arm, gears, adjusting screw, and electrical receptacle. Each transmitter is wired to the proper fuel quantity indicator in the pilot's compartment. For complete information about the fuel level transmitters refer to paragraph 15. *d.* (12) *(f)*, this section.

(c) FUEL QUANTITY INDICATORS.—Three fuel quantity indicators are installed in the pilot's compartment. A dual indicator, located on the main instrument panel, indicates the fuel quantities in the left and right main (nacelle) cells. The auxiliary fuel quantity indicator, also located on the main instrument panel, indicates the fuel quantities in the auxiliary (wing and bomb bay) cells. The long range tank (ferry fuel) fuel quantity indicator is located on the control pedestal.

e. FUEL TANK SELECTION.—Refer to *figure 203* for schematic diagrams of fuel flow to the engines and combinations of alternate fuel tank selector valve control settings.

f. FUEL SYSTEM ADJUSTMENTS.

(1) FUEL PRESSURE.—Refer to paragraph 11. *i.* (5), this section.

(2) FUEL BOOSTER PUMP RHEOSTATS.—Refer to paragraph 15. *d.* (5) *(b)*, this section.

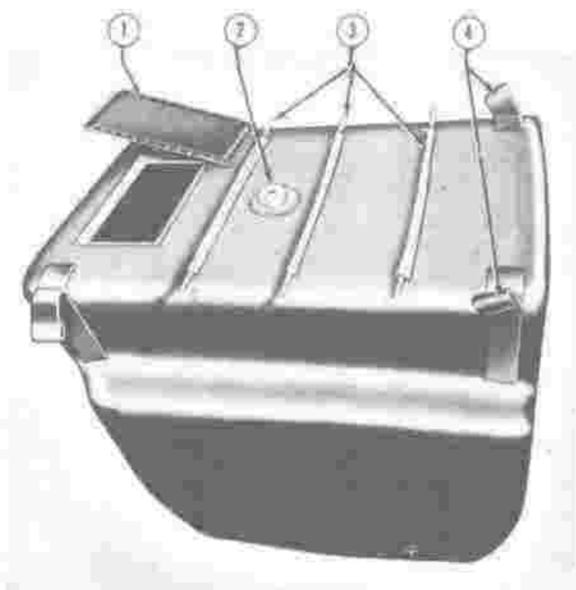
(3) FUEL QUANTITY TRANSMITTERS AND INDICATORS.—Refer to paragraph 15. *d.* (12), this section.

g. FUEL TRANSFER.—Check valves were installed in the fuel lines *(figure 200)* on some airplanes and transfer of fuel from one tank to another is not possible. On other airplanes the check valves were removed from the fuel system and transfer of fuel is possible if the engines are not running. To transfer fuel from tank to tank observe the procedures given in *figure 204*.

h. FUEL CELLS AND TANKS.

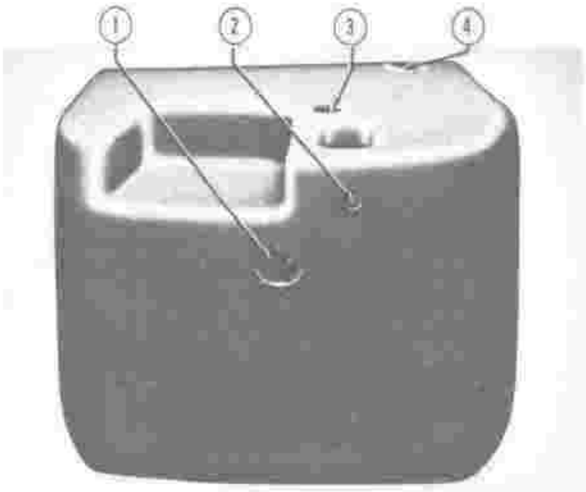
(1) MAIN (NACELLE) FUEL CELLS.
(See figures 206 & 207.)

(a) DESCRIPTION.—The self-sealing main fuel cells are installed in each nacelle between the wing spars and have a fuel capacity of 300 U. S. gallons (249.8 Imperial gallons). The filler well is located at the aft outboard corner of the cell and may be reached through an access hole on the top of the wing. A fuel level transmitter is installed on the aft side of the cell.



1. Access Cover
2. Vent and Carburetor Vapor
3. External Stiffeners
4. Hoisting Straps

Figure 206—Main (Nacelle) Fuel Cell (Top View)



1. Opening for Fuel Booster Pump
2. Opening for Drain Cock
3. Opening for Fuel Level Transmitter
4. Opening for Filler Well

Figure 207 — Main (Nacelle) Fuel Cell (Bottom View)

A fuel booster pump and drain valve are installed on the bottom of the cell. The carburetor vapor vent line is connected to the fitting at the top of the cell and the vapor return flow from each carburetor to the corresponding main fuel cell may reach a maximum of 10 gallons an hour. Drain and vent lines are provided on each main cell. Internal and external stiffeners aid in maintaining the proper contour of the cell. Rubber padding and fabric panels are installed on the surrounding wing structure to protect the cell against chafing.

(b) REMOVAL.

1. Drain all fuel from the main cell as instructed in paragraph 11. *c.*, this section.

2. Remove the lower half of the engine cowl as instructed in paragraph 6. *b.* (14) *(b)*, this section.

3. Install a jack and support stand under the rocker arm boxes in the forward bank of engine cylinders *(figure 27)*. It is necessary to support the engine because the wing is weakened when the large stress panel is removed.

4. Remove the oil tank filler well access cover and remove the screws that attach the filler well to the oil tank nacelle fairing. Remove the screws along the outer edges of the oil tank fairing and remove the fairing.

5. Remove the nuts and bolts that secure the forward portion of the nacelle fairing to the brackets on the wing front spar.

6. Remove the wing hoisting hook access cover on the top of the nacelle *(figure 11)*. From the nacelle wheel well use a socket wrench and extension to remove the bolts that attach the nacelle fairing to the stress panel.

7. Remove the screws that attach the nacelle fairing to the filler well and filler well retainer. Remove the screws at the outer edges of the nacelle fairing and remove the fairing.

8. Remove the access cover from the stress panel. Remove the bolts that attach the brackets on the stress panel to the fuel cell. Remove the fuel cell cover.

Note

The bolts with the heads painted red attach the fuel cells to the stress panel brackets. The bolts with unpainted heads attach the fuel cell cover to the cell.

9. Disconnect the vent lines at the wing front and rear spars. Disconnect the vent lines from the fitting on the stress panel. Remove the screws that attach the flange assembly and gasket to the stress panel and remove the flange assembly.

10. Remove the screws at the outer edges of the stress panel and remove the stress panel.

11. Disconnect the drain line from the synthetic rubber filler well. Disconnect the grounding jack. Remove the screws that attach the filler well to the filler neck and remove the filler well.

12. Remove the screws that attach the filler neck and mounting ring to the fuel cell. Hold the mounting ring through the access hole in the cell while removing the screws. Remove the filler neck and mounting ring.

13. Disconnect the electrical wiring from the fuel level transmitter at the forward end of the main landing gear wheel well. Remove the screws that attach the fuel level transmitter to the mounting flange and carefully remove the transmitter.

CAUTION

Care must be observed to prevent damage to the float arm and float when the transmitter is removed from the fuel cell.

14. Remove the screws that attach the fuel level transmitter mounting ring to the support flange and remove the mounting ring through the cell access hole.

15. Remove the fuel cell drain valve from the bottom of the cell by removing the attaching screws.

16. Disconnect the electrical wiring at the disconnect plug on the fuel booster pump. Remove the screws and nut that attach the booster pump to the support casting and remove the booster pump. Remove the screws from the booster pump mounting ring and remove the mounting ring through the fuel cell access hole.

17. Remove the screws that attach the plugged heater outlet fitting on the front wall of the fuel cell (right-hand cell only) and remove the fitting.

18. Open the slide fasteners and remove the external stiffeners from the top of the cell. Carefully loosen the sides of the fuel cell from the surrounding nacelle structure and lift the cell from the nacelle by means of the hoisting straps.

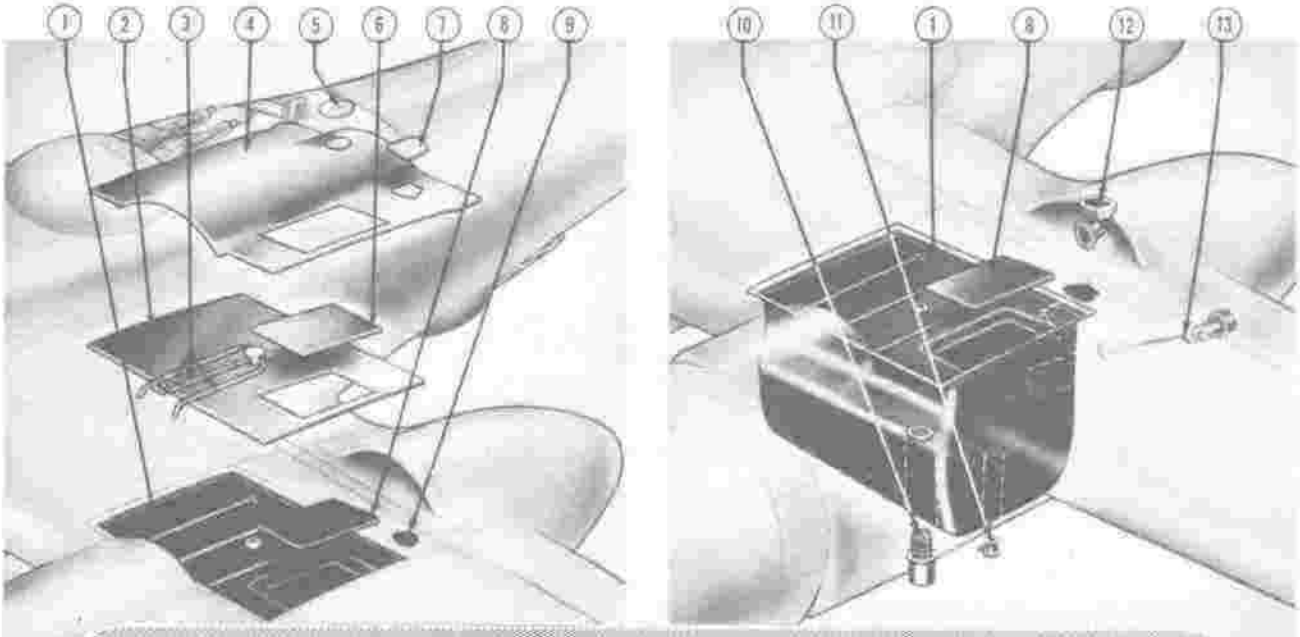
(c) MAINTENANCE REPAIR OR REPLACEMENT.—The majority of all self-sealing fuel cell damage can be attributed to improper installation, that is, structural damage to the cell itself; damaged or torn inner liner; separation of plies; damaged or loosened fittings; excessive scuffing of either interior or exterior ply of the cell; high torque on the attaching bolts or screws, or the action of deteriorating solvents. Inner liner failure will permit gasoline to come into contact with the sealant material causing localized swelling. The same condition will result if the exterior of the cell is exposed to gasoline for a prolonged period of time. Fitting failure is followed by the loss of fuel, frequently resulting in swollen spots. All fitting failures or damage require immediate corrective action. Further information on fittings may be found in T.O. No. 03-10J-4.

1. INSPECTION OF REPAIRABLE CELLS.

a. Inspect the interior of the cell for loose areas between the plies of material, blistered areas, or spots where cements have failed (loss of adhesion). Be especially careful to note any raised areas or looseness around the bases of fittings.

b. Inspect for breaks in the outside covering, especially on the binding strips around the edges of the cell. A scuffed area will permit spilled gasoline to penetrate the retainer and cause swelling of the sealant layer.

c. Check all protruding fittings by GENTLY FLEXING them in all directions to reveal any cracks or torn places. Check metal inserts or washers to determine damage caused by pressure or excessive torque. Check threads in metal inserted fittings to see



REMOVAL OF FAIRING AND ACCESS DOORS

1. Main (Nacelle) Fuel Cell
2. Stress Panel
3. Vent and Carburetor Vapor Return Lines
4. Nacelle Fairing
5. Wing Hoist Fitting Access Door
6. Stress Panel Access Door
7. Filler Well Access Door
8. Cell Access Cover

REMOVAL OF CELL FITTINGS AND EQUIPMENT

9. Filler Well Access Hole
10. Fuel Booster Pump
11. Cell Drain Cock
12. Filler Well and Filler Neck Casting
13. Fuel Level Transmitter

NOTE—Disconnect fuel lines and electrical wiring before removing cell. Hoist cell by means of hoisting straps on cell.

Figure 208 — Removal of Main (Nacelle) Fuel Cell

that they are not stripped or damaged. Insure that the tapped hole is not filled with anything that will cause bolts or screws to bottom prematurely.

d. Examine the interior of the cell with a vaporproof light. If gasoline has penetrated the lining, a swollen or soft area will be the first indication. The hole in the lining may be so small as to be almost invisible, but the swelling will be quite prominent if the hole has been of long standing.

WARNING

Gasoline vapors are toxic and should not be inhaled for a prolonged period of time.

e. A loose area, whether raised or flat, between the inner liner and the first ply of the sealant, is not harmful if it does not exceed one inch in diameter. Such an area or blister is generally a manufacturing imperfection caused by trapped air, solvent, or moisture during the manufacture of the cell.

f. Examine, with a mirror if necessary, all sides of the cell for cracks or folds. It is difficult to determine whether an apparent defect is actually a harmful crack or a harmless fold in the inner liner. If in doubt close all fitting openings in the cell and fill it with gasoline. It is imperative that the cell is placed in a temporary crate of appropriate size and shape. Drain the cell after 48 hours and look for swollen areas directly behind the doubtful fold. If no swollen area is present, the fold may be considered harmless and the cell may be used if no other defects are found.

2. INSPECTION OF CELLS INSTALLED IN THE AIRPLANE.

a. Obviously, a detailed inspection as outlined above is not practical for cells installed in the airplane, and frequent inspections requiring the removal of the cells are not desirable. However, during preflight inspection as many as possible of the above items should be observed through the available access openings.

b. At 30 day intervals, or in connection with every second 100-hour inspection, whichever is first, the following inspections are to be made:

(1) Drain the self-sealing fuel cells as instructed in paragraph 11 *c.*, this section, and drain the oil tanks as instructed in paragraph 12. *d.*, this section. Prior to placing the airplane back in service, refill the cells and compare the quantity of fuel or oil required to fill each cell to the normal capacity with the original capacity as stencilled on the filler caps or covers. If the capacity of the cell is less than 95 percent of the original capacity, the cells must be inspected to determine the cause of the reduced capacity.

Note

This inspection may be made conveniently by conducting it at the end of a flight and before the fuel cells or oil tanks are serviced.

(2) Visually inspect cells, fittings, and connections through the access holes as much as possible without actually removing the cells from the airplane.

c. TWELVE MONTH INSPECTION.—At the end of each 12 month service, inspect thoroughly the interior of the cells for any indication of failure such as those listed in paragraph 11. *b. (c)*, this section. This will be accomplished through access holes, or if necessary, by the removal of the cells from the airplane. If evidence of deterioration is found, the cells will be repaired or replaced in accordance with the instructions contained in the No. 03-10J-series Technical Orders. Serviceable cells may be reinstalled.

3. DISPOSITION OF CELLS.

a. Repair of self-sealing cells in which the self-sealing layers are swollen excessively will not be attempted. In all instances where the swollen area is larger than 25 square inches, replace the cell.

b. Cells damaged mechanically by shell fragments or gunfire, cells leaking at seams and cells having swollen or deteriorated areas may be repaired in accordance with the instructions contained in No. 03-10J-series Technical Orders. The defective cells removed, if considered repairable, will be forwarded to Air Service Commands, air bases, sub-depots, depot groups, or depots, for repair, and will be tagged with a "Repairable Part Routing Tag," AAF Form 50. Swollen areas should be outlined on the exterior with a light colored paint and sufficient wording used to indicate the nature of the damage or failure. This is necessary because repairmen have difficulty finding the damage after the swollen area dries out and the cell returns to normal size.

c. Prior to installation of replacement cells, a thorough inspection will be made for any damage to the cell because of sabotage or mishandling in transit.

(d) INSTALLATION.—To install the main (nacelle) fuel cells reverse the REMOVAL procedure given in paragraph 11. *b. (b)*, this section.

Note

Screws holding fittings to the self-sealing cell are to be tightened to 20-30 inch-pounds torque and screws are not to be tightened after initial installation.

(e) TESTS AFTER INSTALLATION.—Fill the main (nacelle) fuel cell with fuel as instructed in paragraph 11. *b.*, this section. Check the entire installation for fluid leaks. Check the operation of the fuel booster pump and fuel quantity indicator.

(2) AUXILIARY (WING) FUEL CELLS.
(See figure 209.)

(a) DESCRIPTION.—The auxiliary (wing) self-sealing fuel cells are installed in each wing between the two wing spars and between the main (nacelle) fuel cell and the fuselage. Each wing fuel cell has a fluid capacity of 100 U.S. gallons (83.3 Imperial gallons). The filler wells are located on the outboard sides of the cells and are accessible from the top of the wing. The wing cells fuel booster pumps are installed on the inboard sides of the cells. An internal line conducts fuel from the booster pump to the outlet fitting on the outboard side of the cell. A fuel level transmitter is installed on the front of the cell. Condensed moisture may be drained from the cell by means of a drain cock on the bottom of the cell *(7, figure 202)*. Overflow drain lines and vent lines *(figure 200)* are provided for the cell.

(b) REMOVAL.

1. Drain the auxiliary wing fuel cell as instructed in paragraph 11. *c.*, this section.

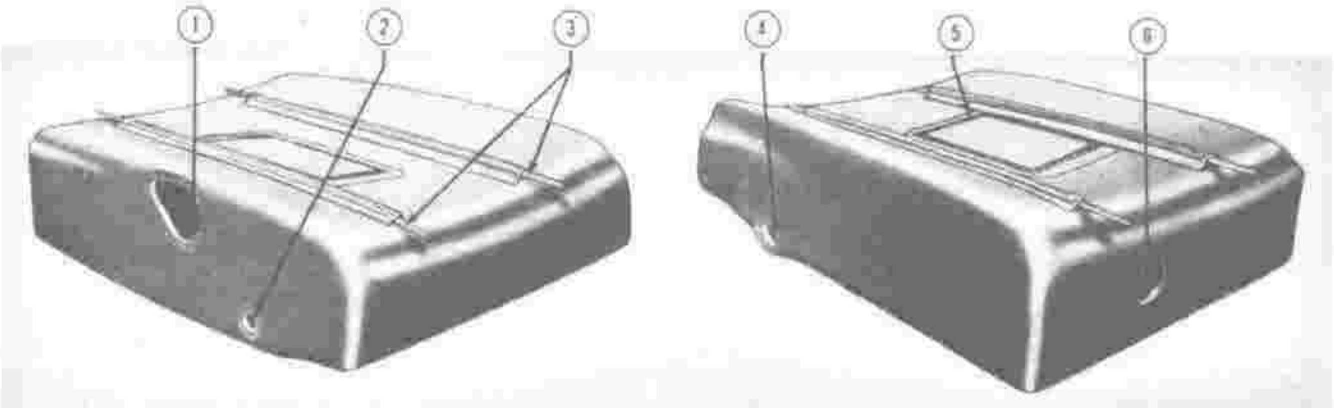
2. Remove the lower half of the engine cowl as instructed in paragraph 6. *b.* (14) *(b)*, this section.

3. Place a support stand and jack under the rocker arm boxes in the forward row of cylinders *(figure 27)* to support the engine. Removal of the wing stress panel weakens the wing and the engine must be supported.

4. Remove the wing nose upper section inboard of the nacelle by removing the attaching screws.

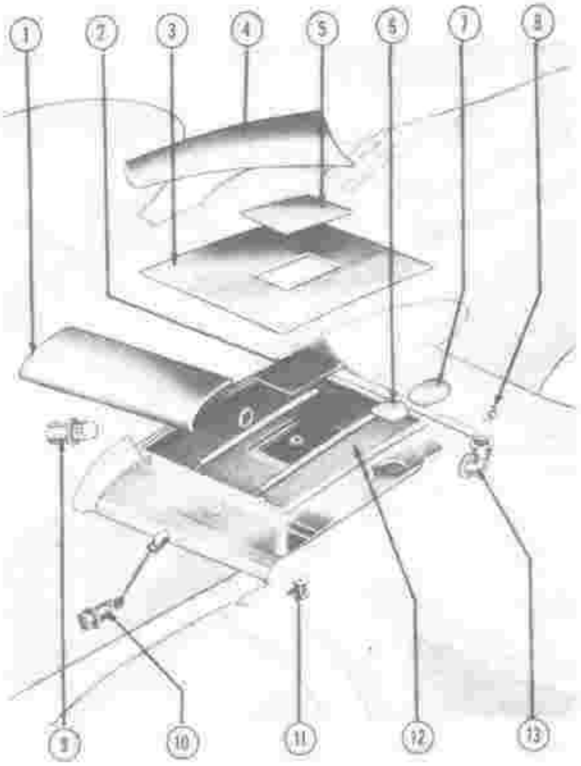
5. Remove the stress panel access cover by removing the attaching screws.

6. Remove the bolts that attach the stress panel brackets to the wing fuel cell. Remove the wing fuel cell access cover.



1. Opening for Filler Well
2. Opening for Internal Line
3. External Stiffeners
4. Opening for Fuel Booster Pump and Internal Line
5. Access Cover
6. Opening for Fuel Level Transmitter

Figure 209 — Auxiliary (Wing) Fuel Cell (Top View)



1. Wing Removable Nose Section
2. Cell Access Cover
3. Stress Panel
4. Fairing
5. Stress Panel Access Door
6. Filler Well Access Door
7. Access Door
8. Cell Internal Outlet Fitting
9. Fuel Booster Pump
10. Fuel Level Transmitter
11. Drain Cock
12. Auxiliary (Wing) Fuel Cell
13. Filler Well and Filler Neck Casting

NOTE—Disconnect fuel lines and electrical wiring before removing cell. Hoist cell by means of hoisting straps on cell.

Figure 210 — Removal of Auxiliary (Wing) Fuel Cell

Note

The bolts with heads painted red attach the stress panel brackets to the wing fuel cell. The bolts with unpainted heads attach the access cover to the fuel cell.

7. Remove the screws along the outer edges of the stress panel and remove the stress panel.

8. Remove the filler well access cover and the access cover immediately aft of the filler well. Disconnect the filler well overflow drain line. Remove the screws that attach the filler well to the filler neck and wing structure and remove the filler well.

9. Disconnect the vent line from the filler neck fitting. Remove the filler cap and grounding jack. Remove the screws from the filler neck and remove the filler neck through the wing cell access hole.

10. Disconnect the internal line fittings inside the wing cell and remove the line. Disconnect the outlet fitting on the outside of the cell. Remove the screws that attach the fitting to the cell and remove the fitting through the wing cell access hole.

11. Disconnect the electrical wires and fuel lines from the fuel booster pump inside the bomb bay.

12. Remove the screws that attach the fuel booster to the mounting ring inside the cell. Remove the booster pump and gasket. Remove the mounting ring through the fuel cell access hole.

13. Disconnect the electrical wiring from the fuel level transmitter. Remove the screws that attach the transmitter to the mounting flange and remove the transmitter and gasket. Remove the screws from the mounting flange and remove the flange through the fuel cell access hole.

14. Remove the wing cell drain cock access door on the under side of the wing. Unscrew the drain cock from the wing cell.

15. Open the slide fasteners and remove the stiffeners from the top of the wing fuel cell.

16. Loosen carefully the wing fuel cell from the surrounding structure and lift the cell from the wing by means of the hoisting straps.

(c) MAINTENANCE REPAIR.—See paragraph 11. *b.* (1) *(c)*, this section.

(d) INSTALLATION.—Reverse the REMOVAL procedure.

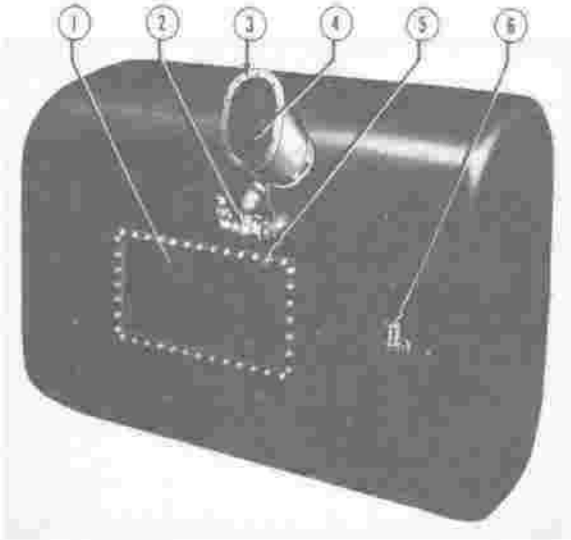
Note

Screws holding fittings to self-sealing cells are to be tightened to 20-30 inch-pounds torque, and the screws are not to be tightened after initial installation.

(e) TESTS AFTER INSTALLATION.—Fill the wing cell with fuel. Check the operation of the fuel booster pump. Check the fuel quantity indicator for proper operation. Check the entire wing fuel cell installation for evidence of fluid leakage.

(3) AUXILIARY (BOMB BAY) FUEL CELL. *(See figure 211 & 212.)*

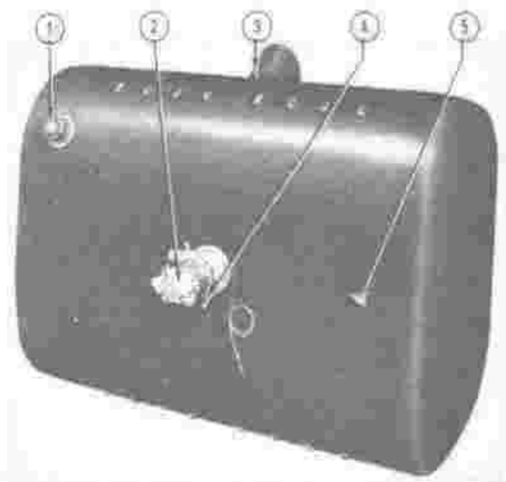
(a) DESCRIPTION. — A self-sealing fuel cell with a usable capacity of 125 U. S. gallons (104.1 Imperial gallons) is installed in the upper forward end of the bomb bay. The bomb bay cell filler well is accessible on the top, left-hand side of the fuselage. The bomb bay cell is hung from chocks in the bomb bay by four strap assemblies. One strap assembly at the forward end of the cell and one at the aft end of the cell prevent swaying of the bomb bay cell. A fuel booster pump and a fuel drain cock are installed on the bottom of the cell. The fuel supply line from the



1. Access Cover
2. Tee (Connector for Long Range Tank Vent Lines)
3. Filler Well
4. Filler Cap
5. Grounding Jack
6. Vent Fitting

Figure 211 — Auxiliary (Bomb Bay) Fuel Cell (Top View).

booster pump is connected to the cross-feed and bomb bay fuel tank(s) selector valve, which is located above the pilot's compartment slanting floor at the forward end of the bomb bay. The fuel level transmitter is installed at the top of the bomb bay cell on some airplanes and at the bottom of the cell on other airplanes. Drain and vent lines are provided on the cell *(figure*



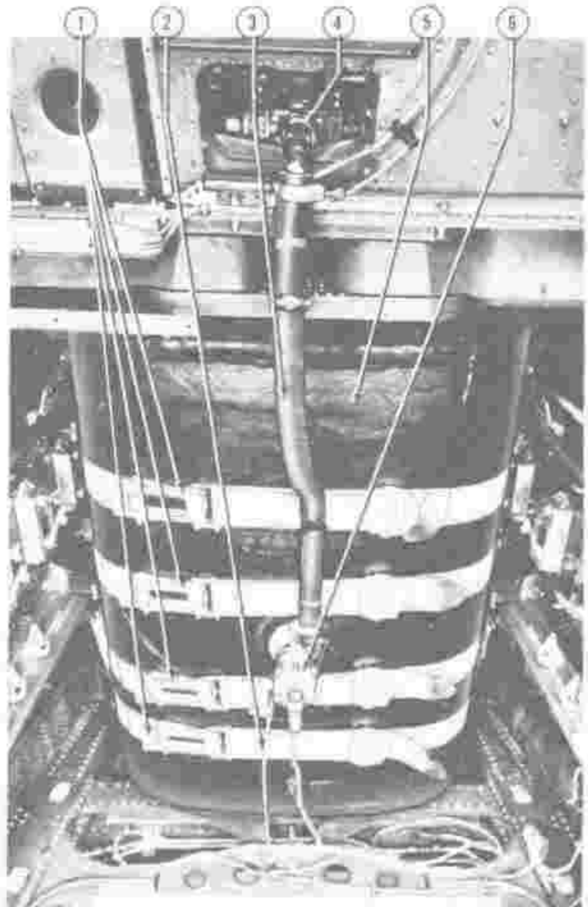
1. Fuel Level Transmitter (Located on top of Cell on Some Airplanes)
2. Fuel Booster Pump
3. Connection for Overflow Drain Line
4. Elbow (Top Connect Gland Drain Line)
5. Drain Cock

Figure 212 — Auxiliary (Bomb Bay) Fuel Cell (Bottom View)

200.) The bomb bay fuel cell does not interfere with the carrying of 500 or 1000 pound bombs, or torpedoes.

(b) REMOVAL.

1. Drain the bomb bay cell as instructed in paragraph 11. *c.*, this section. Disconnect the hose from the cross feed and bomb bay tank(s) selector valve and drain the fuel in the hose.



1. Supporting Strap Assemblies
2. Fuel Booster Pump Gland Drain Line
3. Fuel Supply Line
4. Cross Feed and Bomb Bay Tank(s) Selector Valve
5. Bomb Bay Fuel Cell
6. Fuel Booster Pump

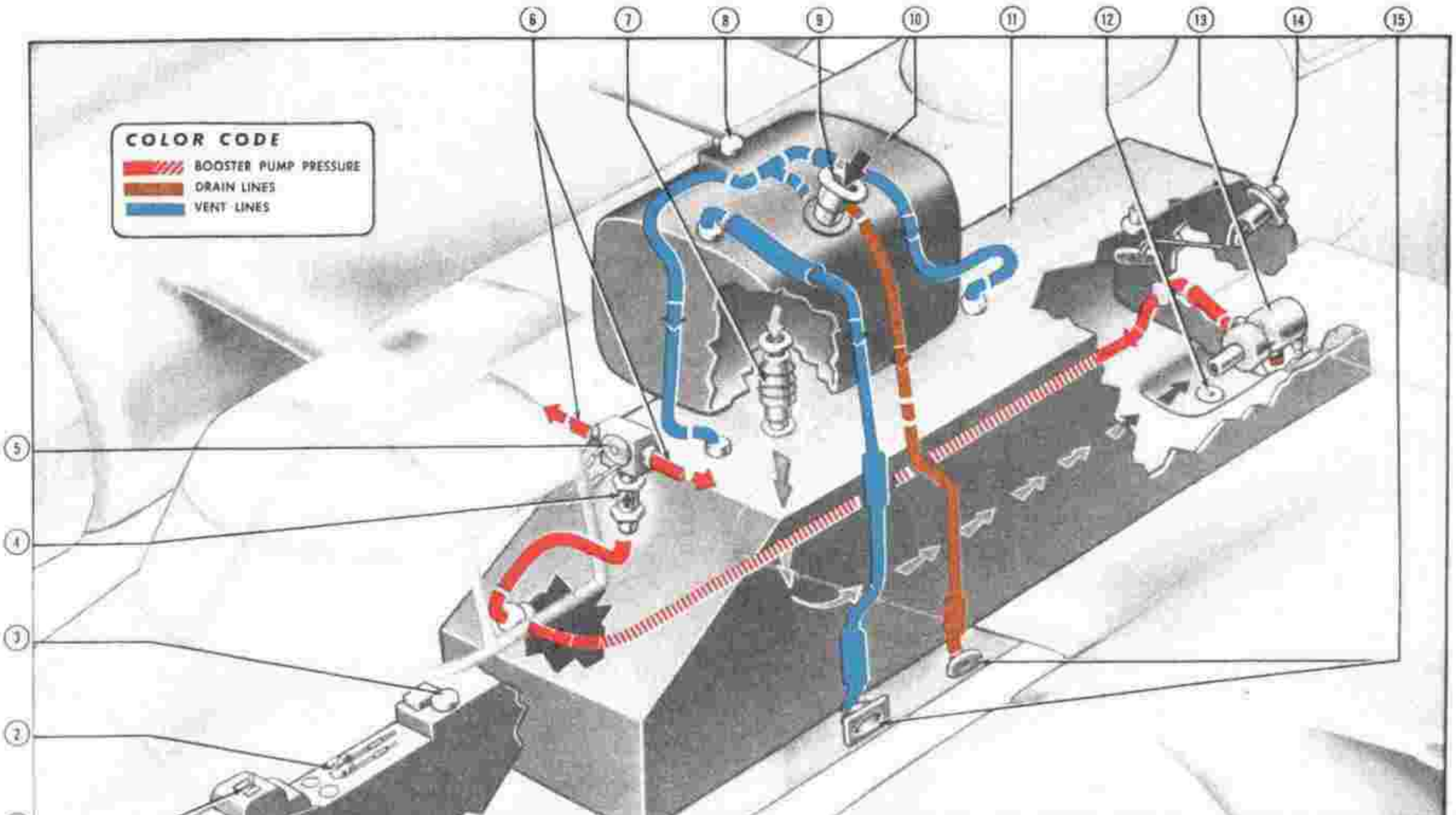
Figure 213 — Auxiliary (Bomb Bay) Fuel Cell Installed (Looking Aft)

Note

Make certain that the cross feed and bomb bay tank(s) selector valve control in the pilot's compartment is in the "OFF" position.

2. Disconnect the fuel supply line from the booster pump and cross feed and bomb tank(s) selector valve and remove the hose.

3. Disconnect the booster pump gland drain line at the pump and at the elbow on the wing rear spar.



1. Bomb Bay Fuel Booster Pump Selector Switch (*Figure* 205)
2. Cross Feed and Bomb Bay Tank(s) Selector Valve Control (*Figure* 205)
3. Long Range (Ferry) Fuel Quantity Indicator (*Figure* 205)
4. Coupling (Check Valve on Some Airplanes)
5. Cross Feed and Bomb Bay Tank(s) Selector Valve
6. Normal Fuel System Cross Feed Lines (*Figure* 200)
7. Connector Between Auxiliary (Bomb Bay) Fuel Cell and Long Range Tank (*Figure* 215)
8. Bomb Bay Cell Fuel Level Transmitter (Located on Bottom of Cell on Some Airplanes)
9. Bomb Bay Cell Filler Well (Used to Fill Long Range Tank and Bomb Bay Cell)
10. Auxiliary (Bomb Bay) Fuel Cell (*Figures* 211 and 212)
11. Long Range Fuel Tank (*Figure* 215)
12. Long Range Tank Drain Outlet (*Figure* 202)
13. Fuel Booster Pump (Removed from Bomb Bay Cell and Installed on Long Range Tank)
14. Long Range Tank Fuel Level Transmitter
15. Vent and Drain Fittings

Figure 214 — Long Range Fuel System

4. Remove the filler well access cover on the top of the fuselage. Disconnect the filler well overflow drain line. Remove the filler cap. Remove the screws that attach the filler well and remove the filler well. Disconnect the grounding jack.

5. Disconnect the vent hose from the vent line through the access hole in the top of the fuselage.

6. Disconnect the electrical wiring from the fuel level transmitter and fuel booster pump.

7. Remove the cotter keys on the bomb bay cell aft strap buckles. Open the buckles and free the straps from the cell.

8. Remove the cotter keys from the bomb bay cell cradle strap buckles. Support the cell and open the buckles to free the straps from the cell. Carefully remove the bomb bay fuel cell from the bomb bay.

(c) INSTALLATION.—To install the bomb bay cell reverse the removal procedure.

(d) TESTS AFTER INSTALLATION.—Fill the bomb bay cell with fuel as instructed in paragraph 11. *b.* Check the entire installation for fluid leaks. Check the operation of the fuel booster pump and fuel level transmitter and fuel quantity indicator.

(4) LONG RANGE (FERRY) TANK.

(a) DESCRIPTION.—The long range tank is constructed of welded steel and is not self-sealing. The tank is installed in the bomb bay and has a capacity of 675 U.S. gallons (562 Imperial gallons). When the long range tank is installed, the booster pump is removed from the auxiliary (bomb bay) cell and installed on the long range tank. A flexible connector is installed on the pump outlet of the bomb bay cell and inlet of the long range tank. The same hose that connected the bomb bay cell booster pump to the cross feed and bomb bay tank(s) selector valve is used to connect the long range tank outlet to the valve. The long range tank is hung in the bomb bay by means of shock mounts bolted to supports on the tank and in the bomb bay. The fuel booster pump is mounted on the aft end of the tank and the fuel is supplied to the tank outlet through a removable internal line in the tank. The long range tank is filled by means of the bomb bay cell filler well. Fuel is supplied to the engines from the combination of long range tank and bomb bay auxiliary cell in exactly the same manner as from the auxiliary (bomb bay) cell alone. *(See figure 203.)*

(b) REMOVAL.

1. Open the bomb bay doors as instructed in paragraph 14. *d.* (10), this section, and install safety stops in the bomb bay doors operating linkage *(figure 269).*

2. Drain the fuel from the bomb bay tanks as instructed in paragraph 11. *c.*, this section.

3. Remove the bomb bay filler well and filler cap through the hole in the top of the fuselage.

4. Disconnect the long range tank vent hoses from the tee fitting at the auxiliary (bomb bay) cell inlet fitting. Cap the open ends of the tee fitting with rubber caps and hose clamps.

CAUTION

Make certain that the tee fitting is capped if the airplane is to be operated without the long range tank. If the tee fitting is left open, fuel will be discharged into the bomb bay and create a serious fire hazard.

5. Disconnect the hose from the long range tank outlet.

6. Disconnect the electrical wiring from the fuel level transmitter and fuel booster pump at the disconnect plugs.

7. Remove the access cover from the bottom of the long range tank. Reach through the access hole and remove the nuts and washers from the bolts of the connector collar at the tank inlet.

8. Support the long range tank and remove the bolts from the shock mounts. Remove the long range tank from the airplane.

9. If the airplane is to be operated without the long range tank, observe the following instructions:

a. Remove the flexible connector, sleeve, collar, clamps, and gasket from the bomb bay auxiliary cell booster pump outlet by removing the attaching screws.

b. Remove the fuel booster pump from the long range tank. Remove the gland drain from the booster pump and install plug in the opening.

c. Install booster pump on the bomb bay auxiliary cell and install elbow and booster pump gland drain line as shown in *(2, figure 213).*

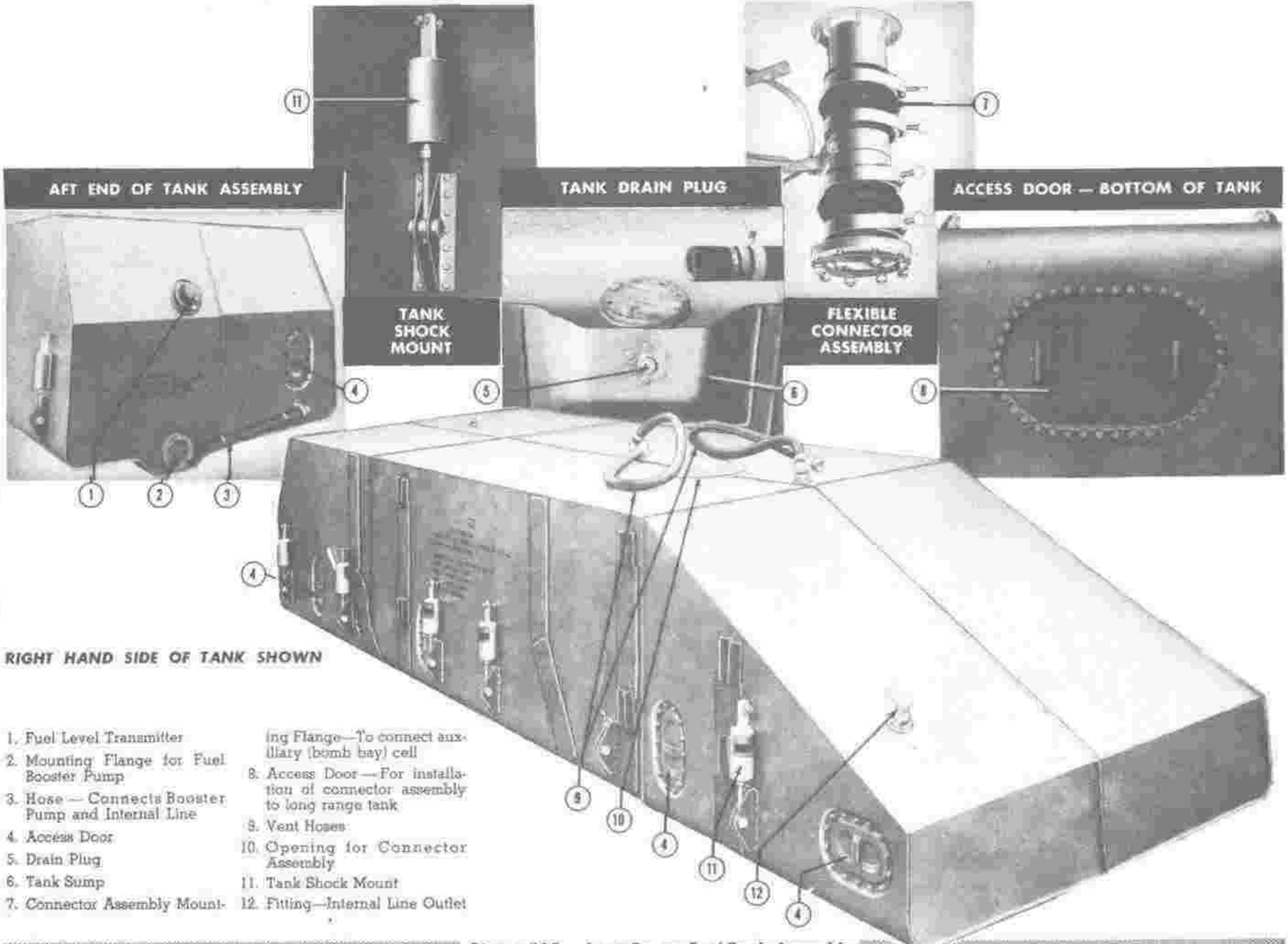
d. Connect the hose to the cross-feed and bomb bay tank(s) selector valve to the outlet port of the fuel booster pump.

e. Install the auxiliary (bomb bay) cell filler well and filler cap.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Repairs may be made to the tank by approved welding procedures.

CAUTION

The tank must be free from gasoline fumes



1. Fuel Level Transmitter
2. Mounting Flange for Fuel Booster Pump
3. Hose — Connects Booster Pump and Internal Line
4. Access Door
5. Drain Plug
6. Tank Sump
7. Connector Assembly Mounting Flange—To connect auxiliary (bomb bay) cell
8. Access Door — For installation of connector assembly to long range tank
9. Vent Hoses
10. Opening for Connector Assembly
11. Tank Shock Mount
12. Fitting—Internal Line Outlet

Figure 215 — Long Range Fuel Tank Assembly

to eliminate the fire hazard while welding. To make certain that all gas-vapor is out of the tank, let it remain open in a cool dry open area for several days. At about 24 hour intervals check with an Explosive Vapor Tester. When the tester indicates no explosive vapor, welding may be accomplished. As a further precaution against explosion, close all tank outlets but one and force carbon dioxide gas into the tank to approximately 2 psi pressure. Keep the gas in the tank while welding.

(d) INSTALLATION.

1. Douglas drawing 5202252, Installation of the Bomb Bay Ferry Tank, is stowed in a box containing the publications that accompany the airplane. Refer to this drawing when installing the long range tank.

2. Drain the bomb bay auxiliary fuel cell as instructed in paragraph 11. *c.,* this section.

3. Disconnect the gland drain line and elbow from the bomb bay cell booster pump. Disconnect the gland drain line from the left-hand auxiliary (wing) cell booster pump drain line at the tee. Cap or plug the open end of the tee.

4. Disconnect the hose at the booster pump outlet and remove the booster pump from the bomb bay cell.

5. Install the fuel booster pump in the long range tank. Install the line that connects the booster pump and internal line in the tank. Install the fuel level transmitter. Install the elbow in the tank outlet fitting. Connect the vent hoses and elbows to the tank.

6. Install the connector, sleeve, collar assembly, clamps and gasket on the bomb bay cell booster pump outlet.

7. Remove the bomb bay cell filler well and filler cap through the hole in the top of the fuselage.

8. Before the long range tank is raised into position, lower cords or ropes through the hole in the top of the fuselage to each of the vent hoses.

9. Fasten the ropes to the vent hoses. Pull the hoses into place as the tank is raised into position in the bomb bay. Remove the caps from the tee fitting at the bomb bay cell inlet fitting and install the vent hoses.

10. When the long range tank is in the proper position, there is adequate clearance between the tank and the bomb bay doors when the bomb bay doors are closed.

11. Install the shock mount units to the hooks on the fuselage and supports on the long range tank.

12. Install the gland drain line on the fuel booster pump and stow the plug and elbow taken from the pump. When the bomb bay doors are closed, the gland drain line should extend ½ inch below the bottom of the door.

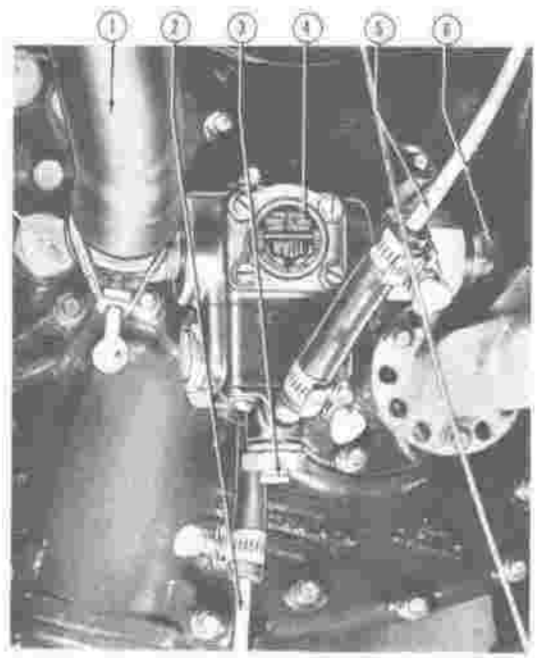
13. Install the bomb bay cell filler well and filler cap.

14. Connect the electrical wiring to the long range tank fuel level transmitter and fuel booster pump.

(e) TEST AFTER INSTALLATION.—Fill the long range tank and bomb bay cell with fuel as instructed in paragraph 11. *b.,* this section. Check the booster pump for proper operation. Check the long range fuel quantity indicator *(figure 205)* for proper indication. Check all lines and fittings on the long range tank for evidence of fluid leakage.

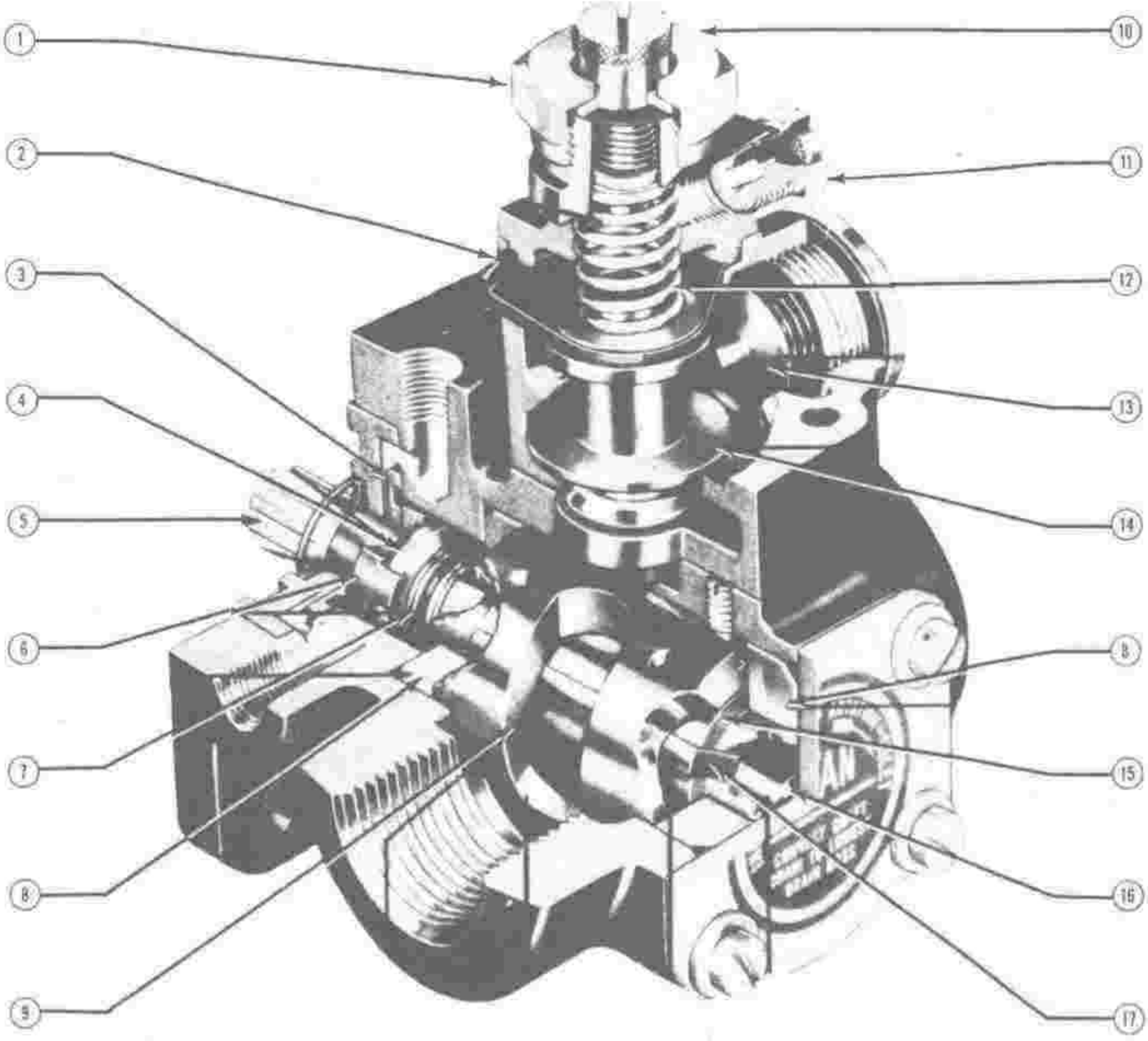
i. ENGINE-DRIVEN FUEL PUMP.
(See figures 216 & 217.)

(1) DESCRIPTION.—Any type G-9 engine-driven fuel pump may be installed on the accessory drive section of each engine to furnish fuel under pressure to the carburetors. The pumps are of the rotary vane, positive displacement type. The rotor and vanes revolve inside a cylindrical pumping chamber bored in



1. Fuel Pressure Line (Pump to Carburetor)
2. Pump Drain Line
3. Fuel Pressure Adjusting Screw
4. Type G-9 Engine-Driven Fuel Pump
5. Vent Line (Pump to Carburetor)
6. Fuel Supply Line to Pump

Figure 216—Engine-driven Fuel Pump Installed



1. Lock Nut
2. Diaphragm
3. Rear Bearing Seal
4. Packing
5. Drive Shaft
6. Rotating Metal Seal
7. Spring
8. Rotor Bearings
9. Liner
10. Pressure Adjusting Screw
11. Vent Plug (Removed when Vent Line to Carburetor is Installed)
12. Relief Valve Spring
13. By Pass Valve
14. Relief Valve
15. Rotor
16. Pin
17. Vanes

Figure 217 — Typical Type G-9 Engine-Driven Fuel Pump (Candler-Hill)

the liner. The rotor is mounted eccentrically to the liner bore in such a manner that the rotor almost touches the liner at one point. Thus there is a crescent shaped space between the rotor and the liner bore, and as the vanes sweep this space they create a pumping action which draws fuel in through the intake port and forces it out through the discharge port. The pumps will operate equally well in either direction of rotation, but reversing the rotation reverses the fuel flow and necessitates turning the relief valve housing 180 degrees. The function of the relief valve is to regulate the discharge pressure. The relief valve is held closed by a spring which can be set at the desired tension by the pressure adjusting screw to obtain 17±1 psi discharge pressure. Since the pump usually is pumping more fuel than can be used, the relief valve allows the excess fuel to flow to the intake side of the pump and maintain the proper discharge pressure. The by-pass valve allows fuel to bypass the pumping mechanism when the engine-driven pump is inoperative and the fuel booster pumps are operating. The diaphragm in the engine-driven pump is vented to the carburetor to maintain the relative relationship of the air pressure and fuel pressure in the carburetor. The drive coupling of the pump has a safety shear section to protect the engine in the event of jamming of the pump. *(See figure 218.)*

(2) REMOVAL.

(a) Place the fuel booster pump selector switches in the "OFF" positions.

(b) Place the fuel tank selector valve controls in the "BOTH OFF" position. Place the cross-feed and bomb bay tank(s) selector valve in the "OFF" position.

(c) Open the deflector plating at the bottom of each nacelle.

(d) Remove the drain plug from the elbow in the fuel strainer to allow the fuel in the supply line to the engine-driven fuel pump to drain.

(e) Remove the large access panels from the lower sides of the nacelles *(3, figure 9)* and remove the center section of the firewall.

(f) Disconnect the two main fuel lines, the diaphragm vent line and drain line from the engine-driven fuel pump.

(g) Remove the safety wire and nuts and remove the engine-driven pump from the mounting pad on the engine.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Inspect the pump and fittings at each 25-hour inspection for evidence of leaks. Be certain that the pump mounting nuts are tight and properly safetied.

(b) The most probable cause of faulty pressure regulation is foreign matter lodged under the relief valve. Remove the relief valve housing and carefully wash the relief valve assembly in a suitable cleaning fluid. Reinstall the valve assembly on the pump. Make certain there is no stoppage in the diaphragm vent line to the carburetor.

(c) If the safety shear section of the pump drive coupling is sheared, install a new or serviceable pump. If the pump is damaged or is not functioning properly, install a new or serviceable pump.

Note

Fuel pumps are removed for overhaul at the time engines are removed for overhaul. Fuel

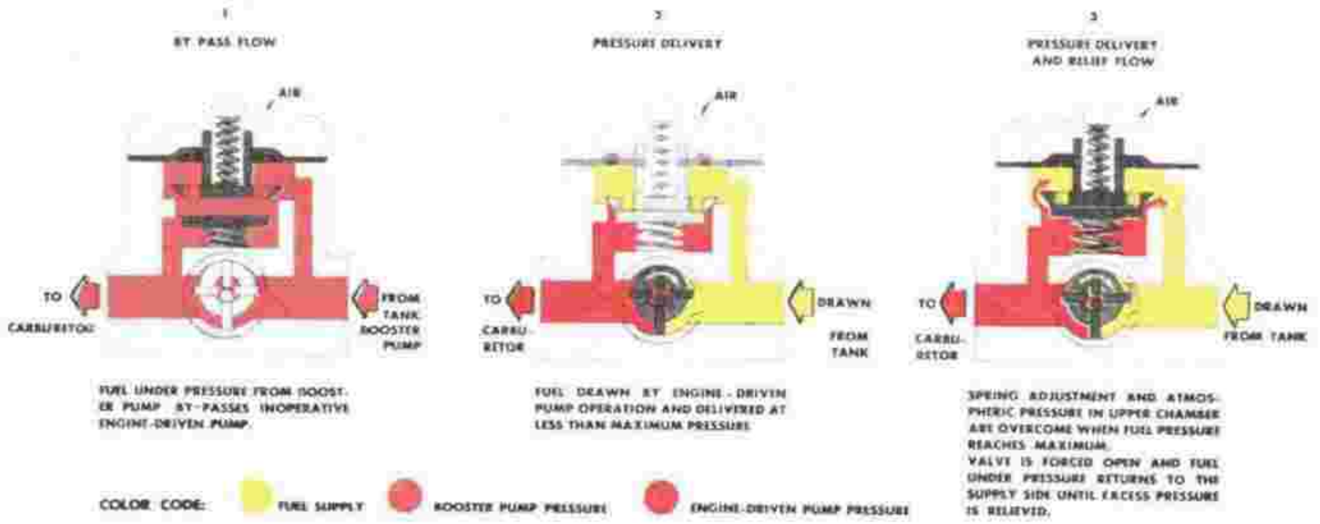


Figure 218—Engine-Driven Fuel Pump Operation

pumps that have been operated less than 100 hours since their last overhaul may be reinstalled. Pumps removed for overhaul will be forwarded to the control depot.

(4) INSTALLATION.

(a) Determine the direction of rotation of the pump drive coupling and be sure the relief valve assembly is installed on the pump correctly as instructed by the name plate.

(b) Test the pump for freedom of operation by turning the drive coupling with the fingers. If the drive shaft does not turn freely, wash the pump thoroughly with clear gasoline to remove any foreign material.

(c) See that the mounting pad on the engine is clean and smooth and that the gasket between the pad and pump mounting flange is in good condition.

(d) Place the gasket and the pump mounting flange over the mounting studs. Be sure the drive shaft registers perfectly with the engine driver. The pump flange should go down against the mounting pad freely by hand. Support the pump and tighten the nuts uniformly, then safety with lock wire.

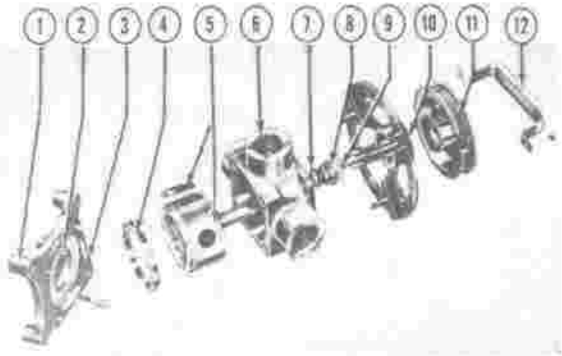
(e) Install fittings and lines to the proper ports and check for any leakage. Replace the drain plug in the fuel strainer.

(f) Install access covers and panels.

(5) ADJUSTMENTS.—If it is necessary to adjust the fuel pressure, loosen the lock nut enough to allow the adjusting screw *(3, figure 216)* to turn. Turn the adjusting screw clockwise to increase pressure, or counterclockwise to decrease pressure. When the lock nut is tightened and a fuel pressure indication of 17±1 psi is obtained, safety the lock nut with safety wire.

j. FUEL BOOSTER PUMPS.
(See figure 342)

(1) DESCRIPTION.—A fuel booster pump is installed on each of the five self-sealing fuel cells. When the long range tank is installed, the booster pump is removed from the bomb bay cell and installed on the long range tank to serve both bomb bay cell and the long range tank. The booster pumps are electric motor driven centrifugal type pumps and provide boosting (pumping of vapor free fuel under pressure to the engine-driven fuel pumps at high altitude to prevent fuel system failure because of vapor lock), fuel system pressure for priming and engine starting, an emergency fuel pump in the event of engine-driven pump failure, and provide a means of fuel transfer from tank to tank for ground operations. Three fuel booster pump selector switches *(figure 205)* are located on the control pedestal. When the main or auxiliary booster pump selector switches are in the "LOW BOOST" or "HIGH BOOST" position, operation of the booster pumps is controlled automatically by the fuel selector



1. Valve Mounting Base
2. Indexing Roller
3. Gasket
4. Ring
5. Valve Plug and Seal Assembly
6. Valve Body
7. Packing
8. Nut
9. Pin
10. Support and Bearing Assembly
11. Drum Assembly (Cable Removed)
12. Guard

Figure 219—Typical Fuel Selector Valve

switches, which are operated by the fuel tank selector valve controls on the pedestal. The bomb bay tank(s) fuel booster pump is controlled directly by the selector switch *(figure 205)*, independently of the setting of the cross-feed and bomb bay tank(s) selector valve control on the pedestal. Five rheostats *(figure 205)* control the speed of the booster pumps in the "HIGH BOOST" position. These rheostats are pre-set on the ground and MUST NOT be adjusted in flight. When the booster pumps are not operating, fuel is drawn through the booster pumps by the engine-driven fuel pumps.

(2) REMOVAL.—Refer to paragraph 15. *d.* (5) *(b) 3.*, this section.

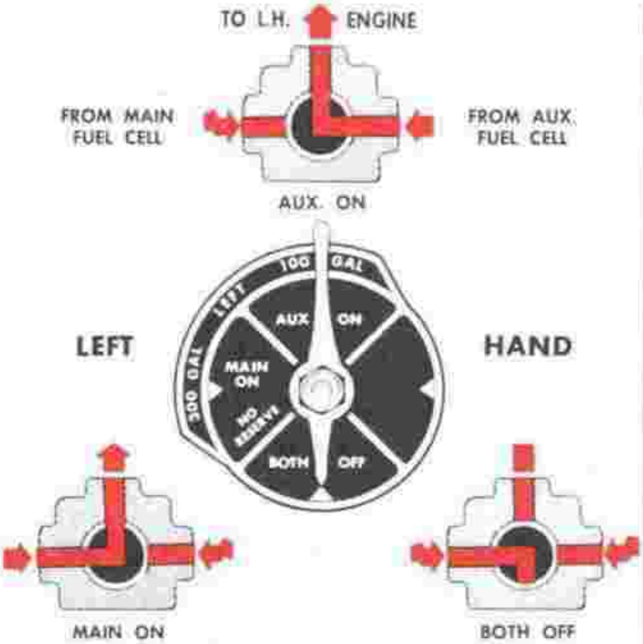
(3) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 15. *d.* (b) *4.*, this section, for maintenance repair instructions.

(4) ADJUSTMENTS.—To adjust the fuel booster pump rheostats refer to paragraph 15. *d.* (2) *2.*, this section.

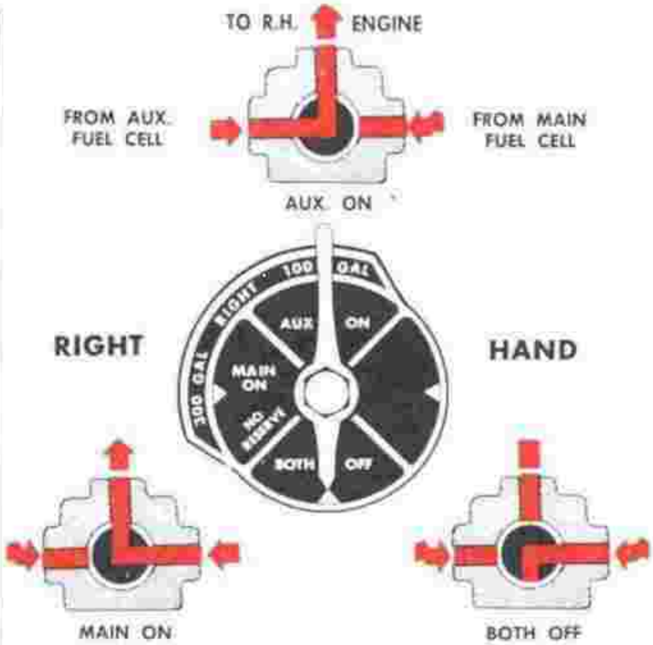
(5) INSTALLATION.—Refer to paragraph 15. *d.* *(b) 6.*, this section.

k. FUEL SELECTOR VALVES AND CONTROLS.

(1) DESCRIPTION.—Three cable-controlled fuel selector valves are installed on the airplane to select fuel from the fuel system tanks. The selector valve controls are located on the control pedestal in the pilot's compartment *figures 220 & 221*. The right-hand main (nacelle) and auxiliary (wing) fuel cells are selected by means of the right-hand fuel tank selector valve, located on the bottom of the right-hand nacelle *(figure 220)*. The left-hand main (nacelle) and auxiliary (wing) cells are selected by means of the left-hand fuel tank selector valve, located on the bottom of the



RELATION OF PEDESTAL CONTROL TO LEFT HAND SELECTOR VALVE PORTS



RELATION OF PEDESTAL CONTROL TO RIGHT HAND SELECTOR VALVE PORTS

NOTES: 1. Rig cables and pedestal controls in "MAIN ON" position and make certain the valve ports are aligned as shown in all positions of the pedestal control.

2. Access to cable turnbuckles is obtained by removing upper panels of the wing removable nose sections between the fuselage and nacelles.

3. Refer to figure 74, to obtain the proper cable tension.

1. R.H. Selector Valve
2. R.H. Drum and Cable Assembly (Figure 606, Item 23)
3. R.H. Control Handle, Drum and Cable Assembly (Figure 608, Item 19)
4. L.H. Control Handle with Drum and Cable Assembly (Figure 608, Item 18)
5. Cable Turnbuckles
6. L.H. Selector Valve
7. L.H. Drum and Cable Assembly (Figure 606, Item 24)

COLOR CODE

ON CABLES — OFF CABLES

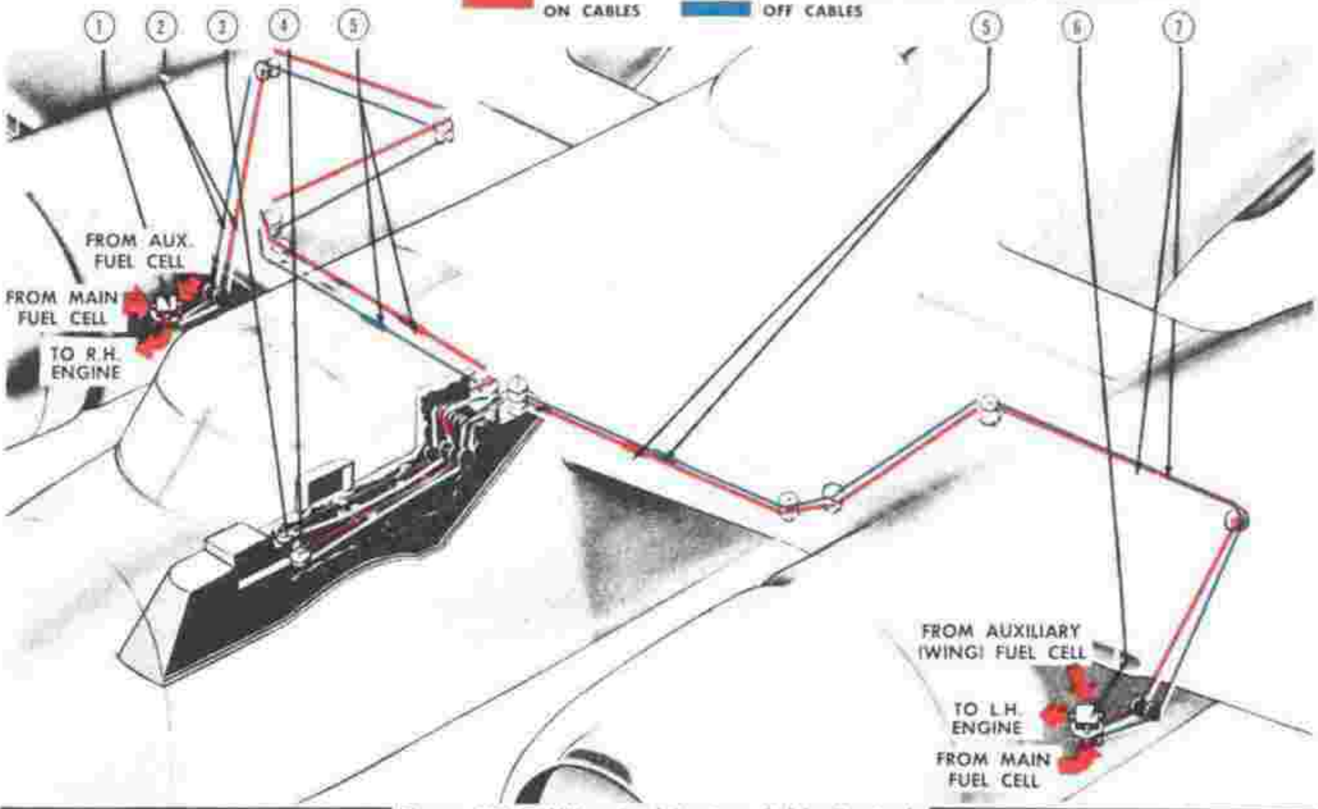
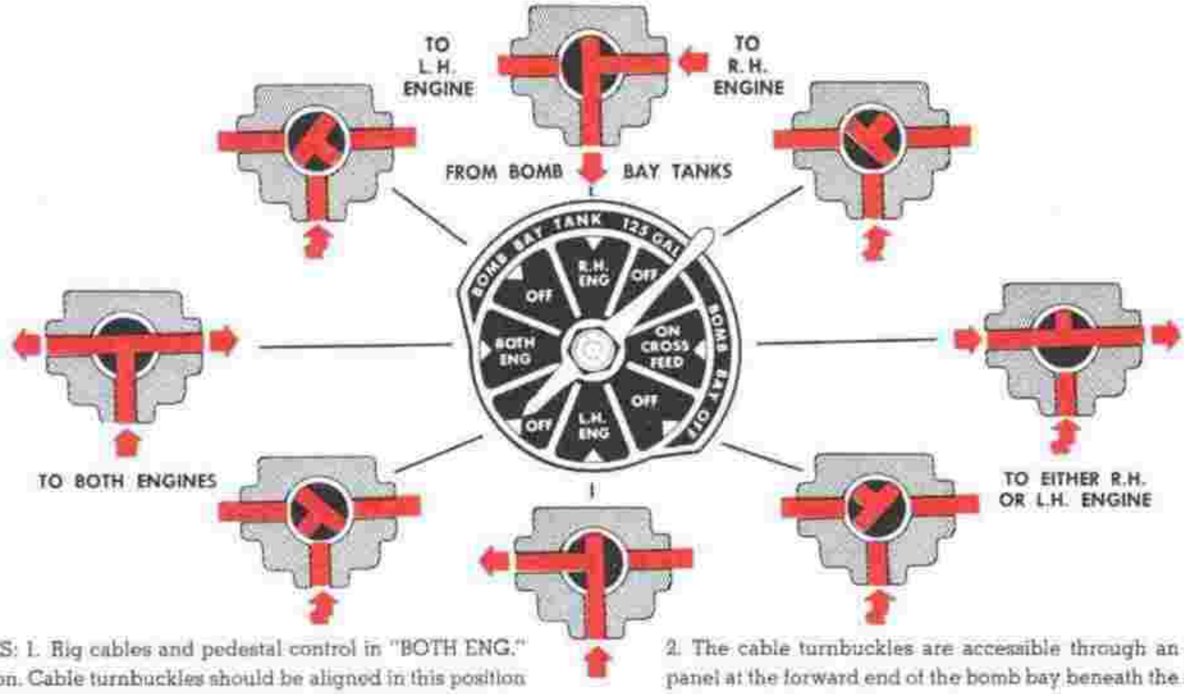


Figure 220 — Wing Fuel System Cable Controls



NOTES: 1. Rig cables and pedestal control in "BOTH ENG." position. Cable turnbuckles should be aligned in this position within 7/8 ± 1/8 inch. Make certain the valve ports are aligned as shown in all positions of the pedestal control.

2. The cable turnbuckles are accessible through an access panel at the forward end of the bomb bay beneath the aft end of the control pedestal.

3. Refer to figure 74 to obtain the proper cable tension.

1. Control Handle 2. Drum and Cable Assembly *(Figure 606, Item 12)* 3. Cross Feed and Bomb Bay Tank(s) Selector Valve 4. Drum and Cable Assembly — On Selector Valve *(Figure 606, Item 15)* 5. Cable Turnbuckles

RELATION OF PEDESTAL CONTROL TO SELECTOR VALVE PORTS

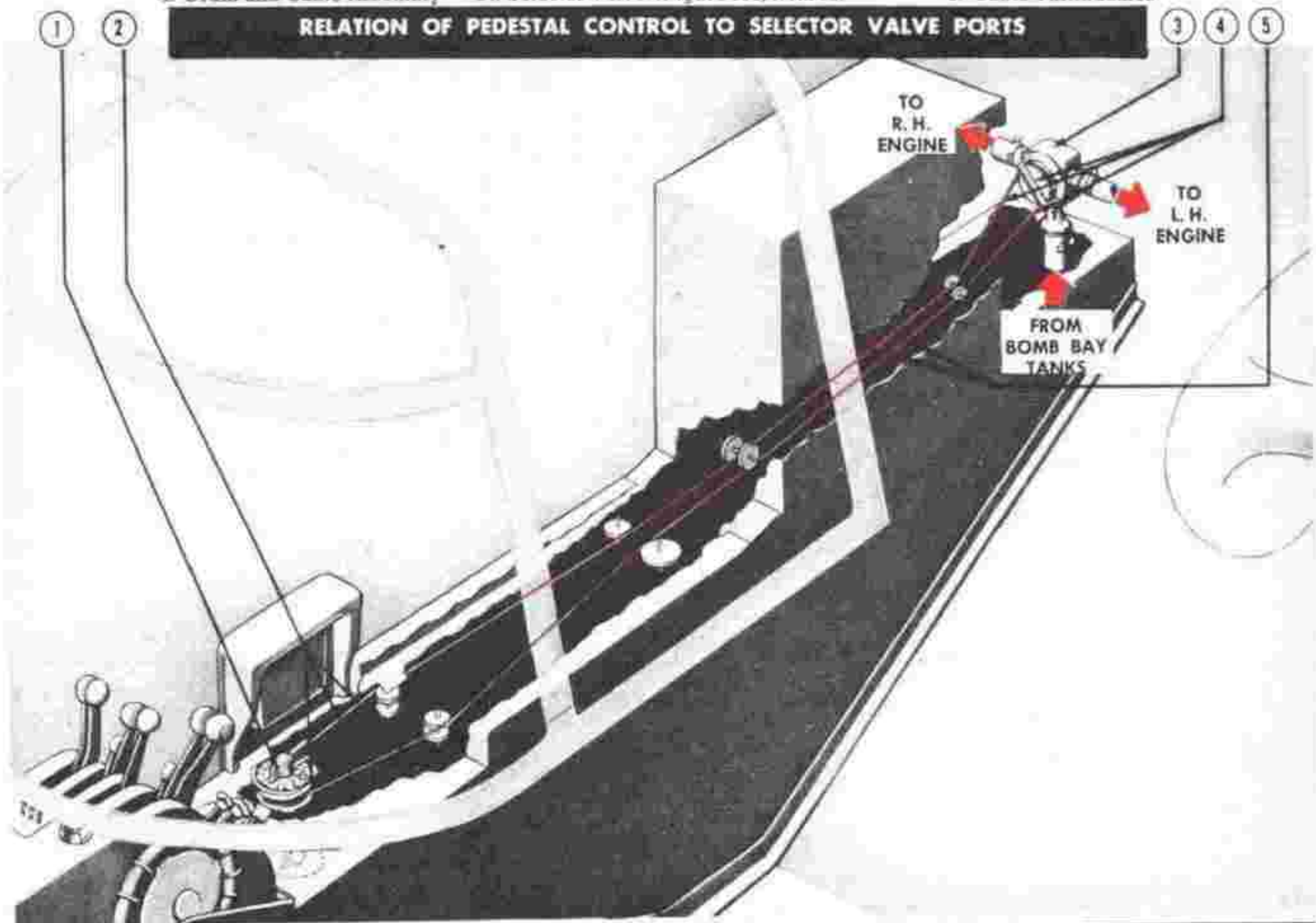


Figure 221 — Cross Feed and Bomb Bay Tanks Selector Valve Cable Controls

left-hand nacelle. The cross-feed and bomb bay tank(s) selector valve, located at the aft end of the control pedestal, controls the cross-feeding of fuel or selection of fuel from the auxiliary (bomb bay) cell alone or combined bomb bay cell and long range tank. *(See figure 221.)* For alternate settings of the fuel tank selector valve controls and schematic diagrams of fuel flow to the engines refer to *figure 203*. The fuel tank selector valves are type "F" valves with two ports in the valve plug. The cross-feed and bomb bay tank(s) selector valve is a type "H" valve with three ports in the valve plug. The three valves are of similar construction *(figure 219)* with the exception of the valve porting arrangement.

Note

When setting the fuel tank selector valve controls always make the setting by "click" or "feel" and not solely by the markings on the valve control indicator plate. Because of wear in the cables and operating mechanism, the selector valves may not always have the ports fully open or closed when the control handle is turned to the prop~r "ON" and "OFF" positions marked on the indicator plate. When the spring loaded indexing plate in the valve engages the friction release mechanism, the valve ports are properly aligned. A decided "click" can be heard when the plate engages when the engines are not operating or can be felt through the control handle when the engines are operating.

(2) REMOVAL.

(a) RIGHT OR LEFT-HAND FUEL TANK SELECTOR VALVE.

1. Drain the main (nacelle) and auxiliary (wing) fuel cells as instructed in paragraph 11. c., this section.

2. Remove the pulley guard by removing the attaching bolts.

3. Remove the pin that secures the valve shaft to the drum and cable assembly. Remove the drum from the valve shaft, loosening the cable turnbuckles *(5, figure 220 & 5, figure 221)* if necessary.

4. Remove the nuts and bolts that attach the support assembly to the valve and remove the support assembly.

5. Disconnect the fuel lines from the valve assembly.

6. Remove the bolts that attach the valve assembly to the support and remove the valve assembly.

(b) REMOVAL OF CROSS-FEED AND BOMB BAY TANK(S) SELECTOR VALVE.

1. Place both right and left-hand fuel tank selector controls in the "BOTH OFF" positions. Place the cross-feed and bomb bay tank(s) selector valve control in the "BOTH ENG." position.

2. Drain the bomb bay tank(s) as instructed in paragraph 11. *c.*, this section.

3. Disconnect the supply hose to the bomb bay cell from the coupling or check valve in the cross feed valve and allow the fuel in the cross-feed lines to drain.

4. Remove the screws from the access doors to the selector valve at the forward end of the bomb bay.

5. Disconnect the cross-feed lines from the selector valve.

6. Loosen the cable turnbuckles *(5, figure 221)*. Remove the bolts that attach the valve assembly to the mounting bracket and remove the valve and drum and cable assembly from the airplane.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) The fuel selector valves, controls and cables must be inspected periodically for any binding and dragging, which if found must be eliminated by inspecting the alignment of pulleys, cables and valve assemblies.

(b) If any of the fuel selector valves are damaged or not functioning properly, new parts must be installed.

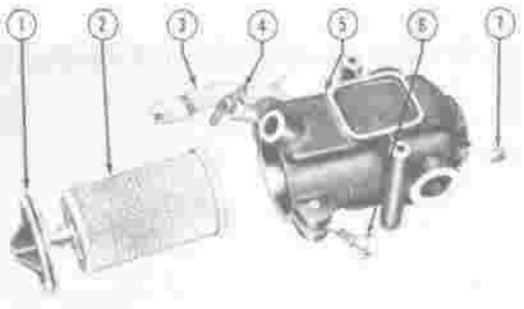
CAUTION

Whenever fuel selector valves are removed or replaced, the reassembly and installation of parts must be checked carefully to insure that the valve ports open to the tank positions indicated by the control handle on the pedestal. *(See figure 221.)*

(4) INSTALLATION.—Reverse the REMOVAL procedure and refer to *figures 220 and 221* for correct alignment of the selector valves with the controls on the pedestal.

l. FUEL STRAINERS.
(See figure 222.)

(1) DESCRIPTION.—A wire mesh type fuel strainer *(figure 222)* is installed in each fuel supply line between the engine-driven fuel pump and tank selector valve and is located on the bottom of the nacelle, immediately forward of the main (nacelle) cell booster pump *(2, figure 202)*. The fuel strainer filters foreign material from the fuel before the fuel enters the engine-driven fuel pump. A drain cock is installed on the bottom of each strainer to facilitate the drainage of condensed moisture from the strainer. A drain plug in



1. Cap
2. Strainer Assembly
3. Clamp Assembly
4. Drain Cock
5. Body
6. Nut, Bolt, and Washer
7. Plug

Figure 222 — Fuel Strainer Assembly

an elbow in the strainer is removable for complete drainage of the main (nacelle) and auxiliary (wing) cells. Refer to paragraph 11. *c.*, this section, for draining instructions.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. Place the booster pump selector switches on the pedestal in the "OFF" position.

2. Place the fuel tank selector valve controls in the "BOTH OFF" positions and the cross-feed and bomb bay tank(s) selector valve control in the "OFF" position.

3. Open the deflector plating at the bottom of the nacelles.

4. Remove the drain plugs from the fuel strainer elbows and drain the fuel from the strainers and fuel supply lines.

5. Disconnect the fuel lines from the fuel strainers.

6. Remove the bolts that attach the fuel strainers to the support brackets and remove the strainers from the airplane.

(b) DISASSEMBLY.—The fuel strainer is disassembled by unscrewing the wing nut, swinging back the hinged arm, and removing the cover and screen assembly. *(See figure 222.)*

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) The screens in the strainers must be cleaned periodically in a suitable cleaning fluid. Inspect the screens for damage and replace with new parts if necessary.

(b) Examine the top cover gasket and be sure it is in good condition. If in doubt, install a new gasket.

(c) Check the drain cock and drain cock outlet for damage or corrosion. Badly corroded parts must be replaced with new parts.

(d) If the fuel strainer assembly is cracked or otherwise damaged, install a new part.

(4) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—To assemble the fuel strainer refer to *figure 222* and reverse the DISASSEMBLY procedure.

(b) INSTALLATION.—To install the fuel strainer refer to *(2, figure 202)* and reverse the REMOVAL procedure.

(5) TEST AFTER INSTALLATION.—Inspect the fuel strainers for fluid leakage with normal pressure in the fuel system.

m. CARBURETORS. — Down draft, injection carburetors are installed on each engine. The carburetors are discussed fully as an engine accessory and for complete information about the carburetors refer to paragraph 7., this section.

n. ENGINE PRIMING AND OIL DILUTION SOLENOID VALVES.

(1) DESCRIPTION.—Two electrically operated solenoid valves *(figure 200)* are installed on the right side of each engine mount to control the flow of gasoline to the engine priming distributors, and to the oil system "Y" drains for dilution of the engine oil. The engine priming and oil dilution solenoid valves are controlled by momentary contact switches on the pilot's overhead electrical panel. Normally the valves are in the closed position, with the valve plunger held against the valve seat by the valve spring. When the control switch is placed in the "ON" position, the valve solenoid is energized, lifting the plunger and allowing fuel from the fuel pressure gage line to flow through the valve either to the priming distributor or oil "Y" drain. When the control switch is released, the valve solenoid is deenergized and the spring returns the plunger to the closed position.

Note

When priming the engines, the fuel booster pumps must be operating to supply fuel pressure to the solenoid valves. For correct priming procedure refer to section III. The engines must be operating to accomplish dilution of the engine oil. Refer to section III, 3. *g.* (2), for correct oil dilution procedures.

(2) REMOVAL.

(a) Place the booster pump selector switches on the control pedestal in the "OFF" position.

(b) Place the fuel tank selector valve controls

on the pedestal in the "BOTH OFF" position Place the cross feed and bomb bay fuel tank(s) selector valve in the "OFF" position.

(c) Remove the access panel *(3, figure 9)* from the lower right-hand side of the nacelle.

(d) Remove the center section of the firewall.

(e) Disconnect the lines leading to the engine priming and oil dilution solenoid valves.

(f) Disconnect the electrical wiring from the solenoid valves.

(g) Remove the bolts that attach the solenoid valves to the support brackets and remove the valves.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Inspect the oil dilution solenoid valves for leakage every 25 hours by observing the following procedure:

(a) Remove the access panel *(3, figure 9)* on the lower right-hand side of the nacelle. Remove the center section of the firewall.

(b) Remove the plug that fits in the bottom of the dilution solenoid valve.

(c) Start the engine as instructed in section III, 3. *f*.

(d) If leakage through the plug hole is less than 10 drops a minute, the solenoid valve is operating satisfactorily. Stop the engine as instructed in section III, and reinstall the plug.

(e) If leakage through the valve is more than 10 drops a minute, stop the engine, and reinstall the plug. Start the engine and place the proper oil dilution switch in the "ON" and "OFF" positions for 10 five second periods. Stop engine and remove the valve plug. Start the engine and if leakage through the valve is less than 10 drops a minute, the valve is operating satisfactorily. If leakage still is greater than 10 drops a minute, proceed with the following instructions:

(f) Using a steel rod or finger, raise the valve plunger several times, allowing the plunger to spring back on the valve seat. This will produce better seating of the plunger on the seat.

(g) Start the engine. If leakage through the valve still exceeds 10 drops a minute, replace the valve assembly with a new part and forward the defective valve to the control depot. If leakage is less than 10 drops a minute, reinstall the plug in the valve. Install the firewall center section and access panel.

(h) Overhaul and special inspection of the solenoid valves is to be performed yearly or as necessary according to the instructions in T.O. No. 03-15-11.

(4) INSTALLATION. – To install the engine priming or oil dilution solenoid valves reverse the REMOVAL procedure.

o. FUEL SYSTEM CHECK VALVES.

(1) DESCRIPTION.—Check valves were installed in the fuel tank and cross-feed selector valves on some airplanes to prevent back flow of fuel into the fuel tanks and leakage in the fuel tank selector valves. In airplanes with check valves installed, fuel transfer between tanks was not possible. The check valves were removed from the fuel system on other airplanes and on these airplanes fuel transfer between tanks is possible for ground operations. Refer to *figure 204* for fuel transfer procedures.

(2) REMOVAL.

(a) Place the fuel booster pump selector switches in the "OFF" position.

(b) Place the fuel tank selector valve controls in the "BOTH OFF" positions and the cross-feed and bomb bay tank(s) selector valve control in the "OFF" position.

(c) Open the deflector plating at the bottom of the nacelles.

(d) Remove the drain plug from the fuel strainers elbows and drain the fuel in the lines.

(e) Disconnect the hoses from the check valves and unscrew the check valves from the fuel tank and cross-feed selector valves.

(3) MAINTENANCE REPAIR OR REPLACEMENT. – A damaged or defective check valve should be replaced with a new check valve or the check valve may be replaced with a suitable coupling. Check valves with a red "O" have been modified into couplings by removing the poppet, hinge pin and spring.

p. FUEL SYSTEM LINES AND FITTINGS.

(1) DESCRIPTION.—Self-sealing hose and metallic lines are used in the fuel system. Metal, threaded unions, and hoses and hose clamps are utilized to join the fuel lines. The color banding of fuel lines is red.

(2) REMOVAL.

(a) Drain the fuel from the lines before removal.

(b) Disconnect hose clamps on hose connections or unscrew nuts from metal unions. Remove the lines.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) All fuel system lines and fittings should be inspected frequently to detect fluid leaks, cracks in tubes or hoses, damaged fittings, and security of line supports.

(b) Any lines or hoses with cracks, deep scratches and other defects must be replaced with new parts. Refer to section VIII for tubing fabrication information.

(c) Replace defective hose clamps or other fittings with new parts.

(4) INSTALLATION.—To install lines or hoses reverse the REMOVAL procedure. Check for fluid leaks after the line is installed.

q. FUEL SYSTEM TROUBLE SHOOTING CHART.

TROUBLE	PROBABLE CAUSE	REMEDY
1. No fuel pressure indication when starting engines.	a. Booster pump selector switches and fuel tank selector valves controls not in proper position.	a. Refer to section III.
	b. Booster pumps fail to operate.	
	(1) Wiring connected improperly.	(1) Connect wiring properly. Refer to wiring diagram index which follows paragraph 15.
	(2) Loose or high resistance in booster pump connections.	(2) Clean and tighten connections.
	(3) Dirty commutator.	(3) Clean and smooth commutator as instructed in paragraph 15. d. (5) (b) 4., this section.
	(4) Brushes binding in brush holders.	(4) Remove and clean as instructed in paragraph 15. d. (5) (b) 4., this section.
	(5) Damaged booster pump.	(5) Replace pump.
2. No fuel pressure indication.	a. Lack of fuel in tanks.	a. Fill the fuel tanks.
	b. Defective fuel pressure indicator.	b. Check fuel pressure indicator as instructed in paragraph 13. f. (3), this section.
	c. Fuel selector valve controls not in proper position.	c. Place controls in proper position.
	d. Broken, damaged, or disconnected fuel lines or fittings.	d. Check all fuel lines and fittings for leaks. Make necessary replacements.
	e. Clogged fuel strainers.	e. Remove and clean strainers as instructed in paragraph 11. l. (2), this section.
	f. Engine-driven fuel pump fails to pump.	
	(1) Foreign matter holding the relief and bypass valves open.	(1) Remove and clean valve assembly as instructed in paragraph 11. i. (2) & (3), this section.
	(2) Drive coupling sheared.	(2) Replace engine-driven fuel pump.
	(3) Leak in intake lines to engine-driven pump.	(3) Examine intake lines for leaks and repair lines and fittings as necessary.
	(4) Relief valve diaphragm ruptured.	(4) Replace engine-driven fuel pump.
3. Low fuel pressure.	a. See 1. b. above.	
	b. See 1. d. above.	
	c. See 1. e. above.	
	d. See 1. f. above.	
	e. Leaking or damaged fuel selector valves.	e. Replace defective selector valves.
	f. Improper adjustment of engine-driven fuel pump relief valve.	f. Adjust the relief valve as instructed in paragraph 11. i. (5), this section.
4. High fuel pressure.	a. Improper adjustment of engine-driven fuel relief valve.	a. Adjust the relief valve as instructed in paragraph 11. i. (5), this section.
	b. Defective fuel pressure indicator.	b. Check fuel pressure indicator as instructed in paragraph 13. f. (4) (b), this section.
5. Fluctuating fuel pressure indication.	a. Engine-driven fuel pump relief valve sticking.	a. Remove and clean relief valve assembly as instructed in paragraph 11. i. (2) & (3), this section.
	b. Obstruction in intake lines to engine-driven fuel pump or clogged fuel strainer.	b. Check intake lines and remove any obstructions. Clean strainer as instructed in paragraph 11. l. (2), this section.
	c. Vent line from engine-driven fuel pump to carburetor clogged.	c. Remove and clean line.
	d. Fuel tank vent lines obstructed.	d. Clean lines by blowing out with compressed air.

12. OIL SYSTEM.

a. GENERAL.—Two independent engine oil systems *(figure 223)* are installed on the airplane to supply oil for the necessary lubrication of the internal parts of each engine. The oil tank also supplies oil to the propeller feathering pump. Oil from the self-sealing oil tank is supplied by gravity through the oil inlet line to the gear-type oil pressure pump, located in the engine rear section, and the oil pressure pump forces the oil through the engine to the moving engine parts. The engine drain oil is scavenged by two separate, gear-type pumps and returned to the oil temperature regulator, then to the temperature accelerating well (hopper) in the oil tank. The oil tank has two vent lines connected to the rear engine section and an overflow drain line from the filler well. Oil temperature is regulated by means of the electrically controlled exit flap (oil cooler door). The normal oil inlet temperature is 60 degrees to 75 degrees C (140 degrees to 153 degrees F) with limits of 40 degrees to 100 degrees C (104 degrees to 212 degrees F) permissible. Normal oil pressure is 75 psi with operating limits of 60-100 psi permissible. Minimum permissible oil pressure when the engine is idling is 25 psi. An oil dilution system is provided to prevent congealing of the engine oil during airplane layovers in cold weather and to facilitate cold engine starting.

b. OIL SYSTEM INSTRUMENTS AND CONTROLS. *(See figure 225.)*

(1) OIL PRESSURE INDICATOR.—A dual oil pressure indicator is installed on the main instrument panel in the pilot's compartment. An oil pressure transmitter is installed on the firewall and is connected to the engine rear section and the oil pressure indicator. Refer to paragraph 13. *f.* (5), this section, and *figure 242* for complete information about the oil pressure indicating system.

(2) OIL TEMPERATURE INDICATOR.—A dual oil temperature indicator is installed on the pilot's main instrument panel. An oil temperature bulb is installed in each oil container sump and each oil temperature bulb is wired to the oil temperature indicator. For complete information about the oil temperature indicator, refer to paragraph 13. *e.* (4), this section.

(3) OIL COOLER DOOR SWITCHES.—The oil cooler doors are controlled by two electrical switches installed on the forward side of the step on the control pedestal in the pilot's compartment (located on the pilot's main electrical control panel on earlier airplanes). The switches have three positions: "OPEN," "CLOSE," and "OFF."

(4) OIL COOLER DOORS POSITION INDICATOR.—An electrically operated dual oil cooler doors position indicator is installed on the pilot's main instrument panel. A transmitter is installed adjacent to each oil cooler door and the transmitters are wired to the indicator so that changes in the positions of the oil cooler doors are registered by the position indicator. For complete information about the oil cooler door switches and position indicator refer to paragraph 13. *e.* (14), this section.

(5) OIL DILUTION SWITCHES.—The oil dilution solenoid valves are controlled by two momentary contact switches located on the pilot's overhead electrical panel. For complete information about the oil dilution switches refer to paragraph 15. *d.* (7), this section.

c. FILLING THE OIL SYSTEM.

(1) The oil container filler well access door is located at the top of the nacelle aft of the leading edge of the wing. Remove the cover by releasing the Dzus fasteners. *(See 3, figure7.)*

(2) The filler well is designed so that a funnel is not needed when the oil container is serviced. Open the filler cap.

(3) The normal capacity of the oil container is 30 U.S. gallons (25 Imperial gallons) as indicated by the "N" mark on the measuring stick, located in the filler fitting.

(4) Use oil Specification AN-VV-O-446, Grade 1120 to fill the container for normal operation. For cold weather operation use oil Specification AN-VV-O-446, Grade 1100A.

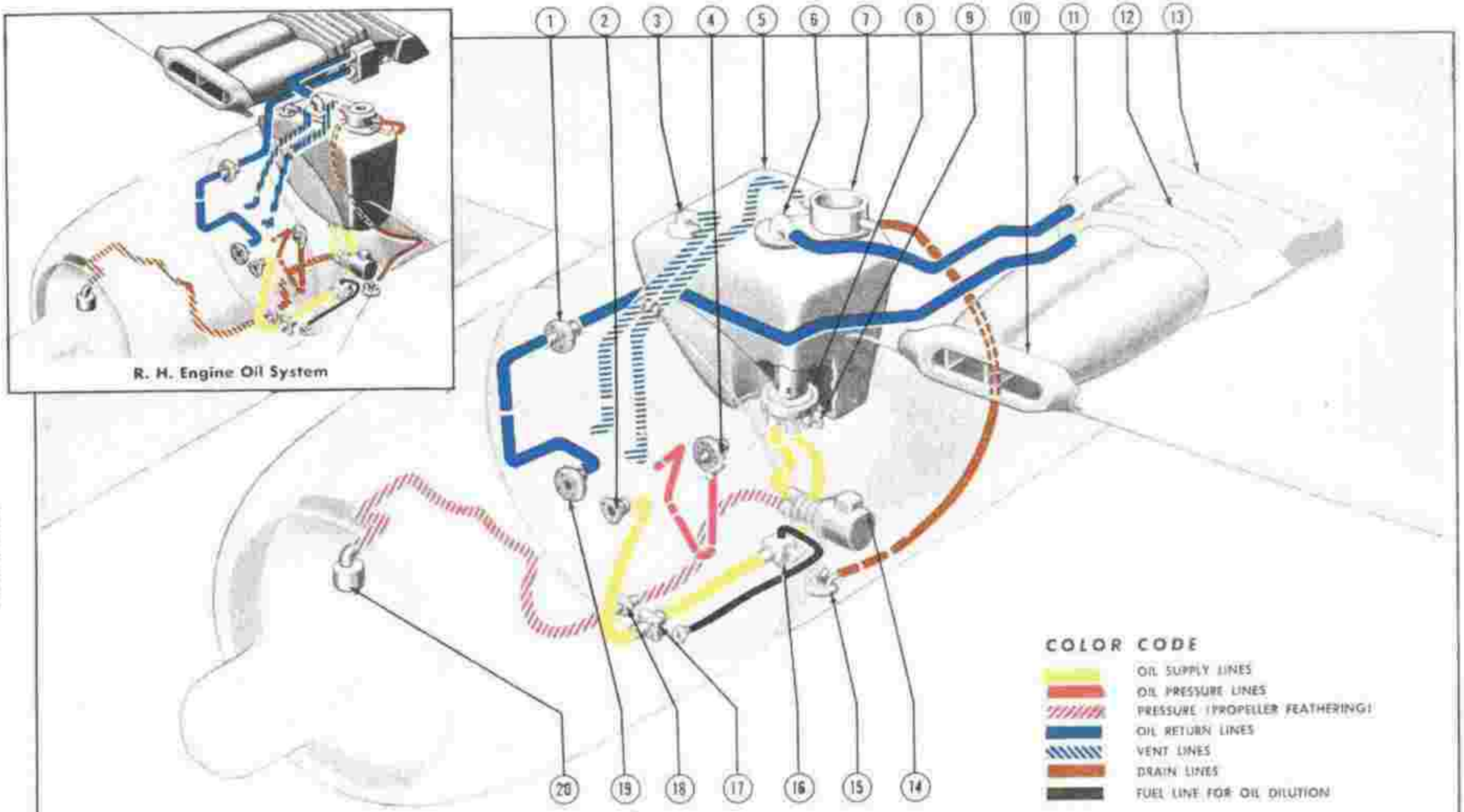
(5) Move the propeller manually five or six complete revolutions to draw oil into the inlet line and engine. Check the oil level and add oil if necessary to increase the level to the "N" mark on the measuring stick.

(6) Secure the filler cap and install the filler well access cover.

CAUTION

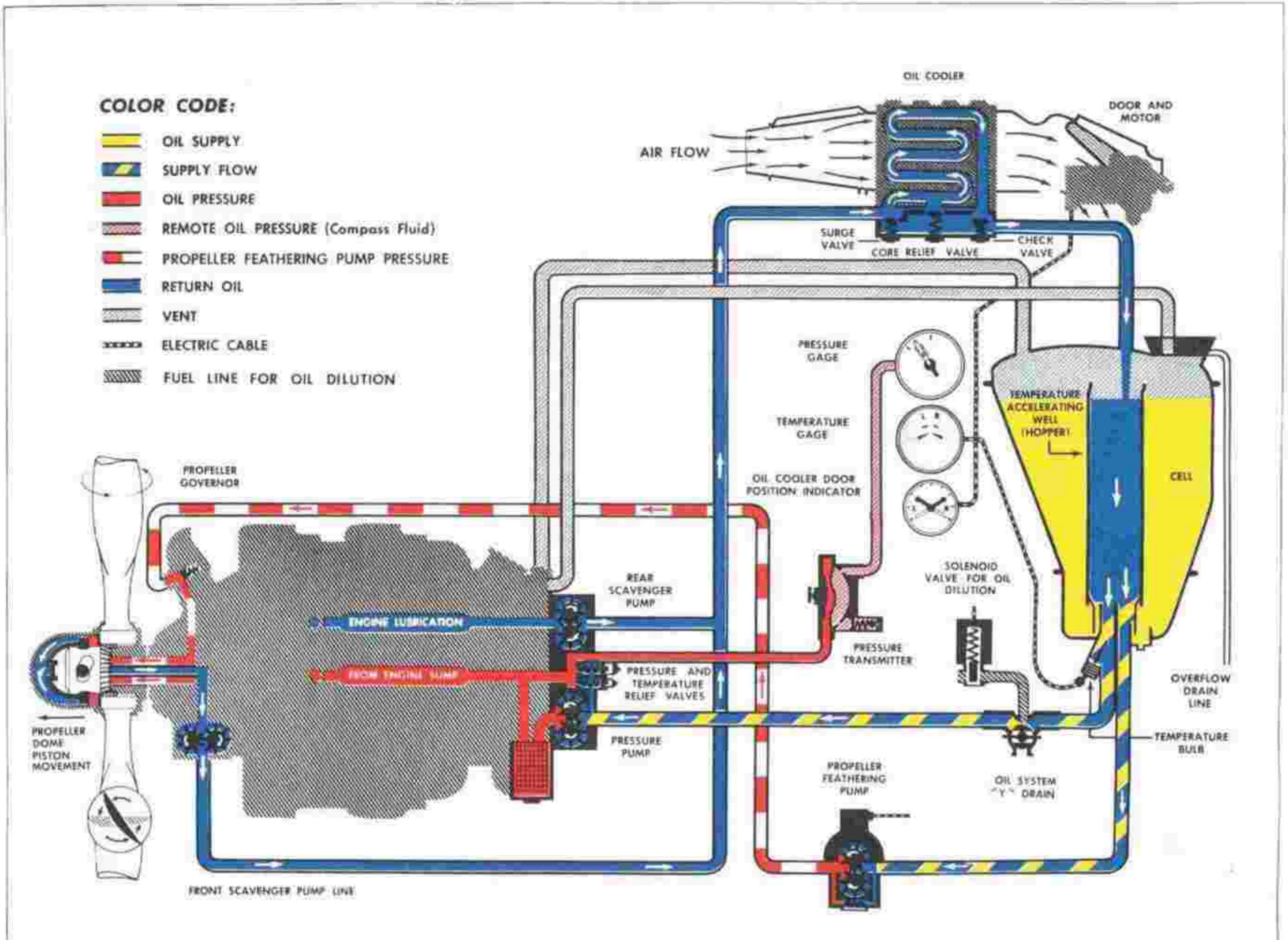
Care must be exercised to prevent the entrance of foreign material into the oil container during the filling operation to avoid damage to the engine parts.

d. DRAINING THE OIL SYSTEM.—Each oil system may be drained by means of two drain cocks and a drain plug *(figure 227)*. The "Y" drain cock is installed in the oil supply line aft of the firewall. The



1. Connector on Fire Wall
2. 2123201 Elbow (Oil Inlet)
3. Vent Fitting on Oil Tank
4. Oil Pressure Transmitter
5. Oil Tank Assembly
6. 4192860 Oil Tank Inlet Fitting—L.H.
   4123739 Oil Tank Inlet Fitting—R.H.
   1125908 Gasket
7. Oil Tank Filler Well
8. Oil Temperature Accelerating Well (Hopper)
9. Oil Tank Sump Drain Cock
10. Oil Cooler Air Scoop
11. Core Relief and Surge Protection Valve
12. Oil Cooler Assembly
13. Oil Cooler Door (Inside Aft Air Duct)
14. Propeller Feathering Pump
15. 2193628 Drain Fitting
16. "Y" Drain Cock
17. 2205648 Connector
18. Union
19. 2105060 Fitting (Oil Outlet)
20. Propeller Governor

Figure 223 — Engine Oil System



–Normal Engine Oil Flow and Propeller Feathering Oil Flow

"Y" drain cock, which is auto-locking and does not require the use of lock wire, may be reached by means of an access panel on the lower side of the nacelle forward of the deflector plating and stencilled "OIL Y DRAIN." All oil, except that in the oil container sump and oil cooler may be drained through the "Y" drain. The oil container sump is drained by means of a drain cock installed in the tank outlet fitting. This drain cock is accessible through the panel on the left side of the nacelle. Drain plugs are installed on the bottom of the oil coolers and are accessible through a cover stencilled "OIL COOLER DRAIN."

Note

Prior to engine starting during cold weather, the oil tank sump drain and "Y" drain should be operated and checked for the presence of ice or congealed oil. If ice or congealed oil is present, which will be shown by no flow of oil at these drains, thawing may be accomplished by using a "heat gun" or other heater without an open flame. Close the drains as soon as water is drained or oil begins to flow. Drain condensed moisture from the oil tank

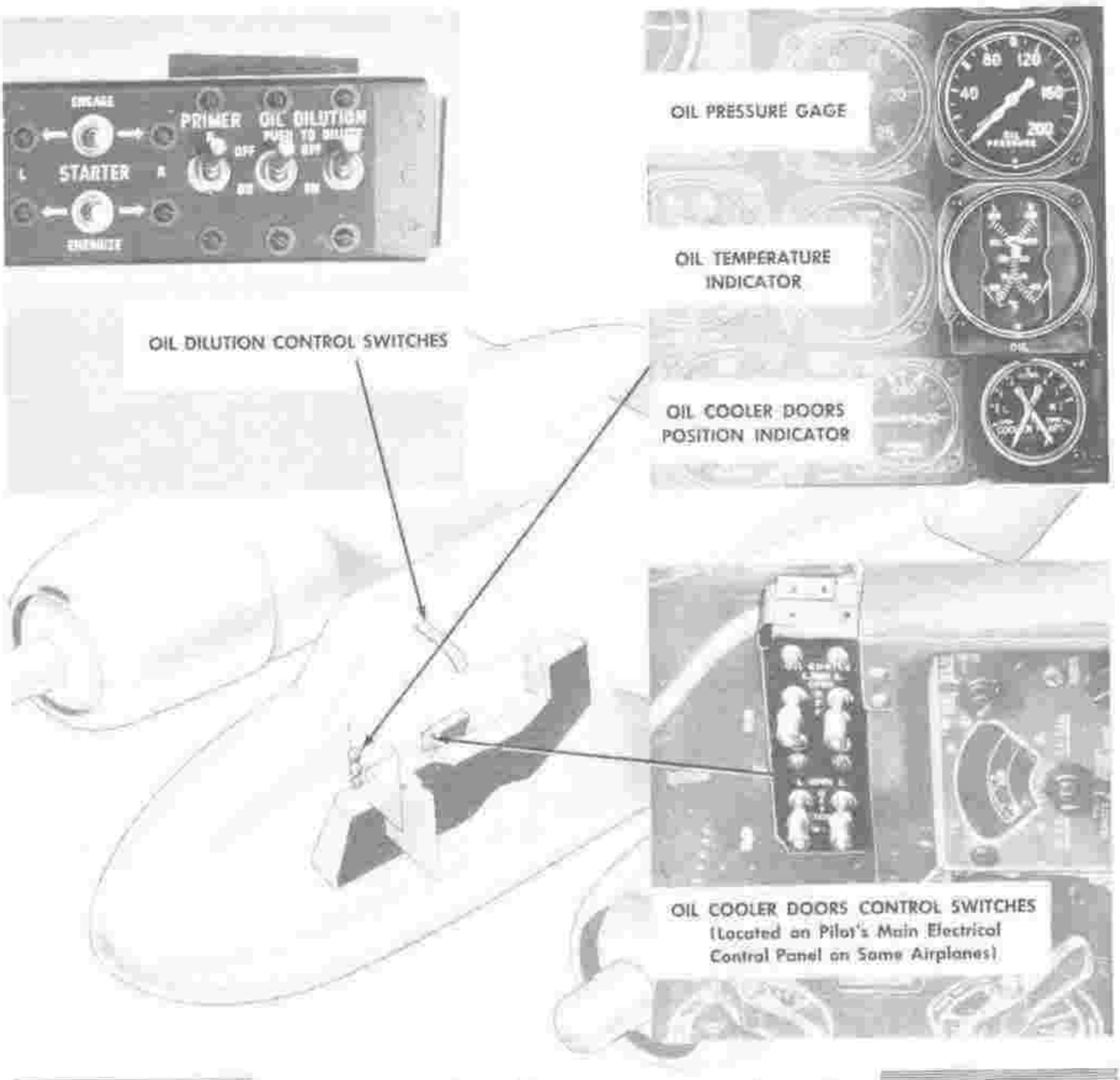


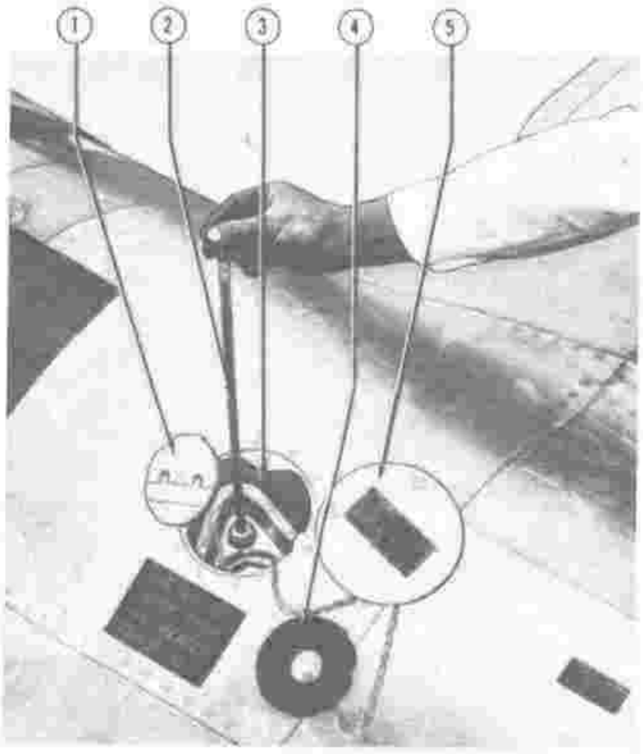
Figure 225—Engine Oil System Instruments and Controls

sump drain and "Y" drain after every flight in cold weather. The drain plugs in the oil coolers will be replaced with drain cocks in Modification Centers on northbound airplanes.

(1) The time of inspection of oil tank sumps for possible accumulation of water will depend greatly upon local ground temperatures and operating conditions. In areas where ground temperatures are at or below the freezing point 0 degrees C (32 degrees F) or may drop to or below that point during the time an airplane on flying status is to remain inactive for more than one hour, open the oil tank sump drain cock to drain off any accumulation of water approximately one hour AFTER the last flight has been made.

Note

This time is important since the greatest condensation of moisture takes place during the cooling period of the oil tank. If no water or oil runs out of the sump drain cock, make an immedate inspection of the tank to determine the reason and take the necessary corrective action prior to the next flight of the airplane.



1. Filler Cap
2. Measuring Stick Assembly
3. Filler Well
4. Immersion Heater Adapter
5. Filler Well Access Cover

Figure 226—Measuring Oil Level in Oil Tank

(2) In areas where it is known that ground temperatures will remain constantly above the freezing point 0 degrees C (32 degrees F) inspect the oil tank sump for accumulated water at each 25-hour inspection or once each seven days, whichever is first.

e. OIL SYSTEM ADJUSTMENTS.

(1) To adjust the oil system pressure refer to paragraph 12. *b.* (1), this section.

(2) To adjust the oil cooler door mechanism refer to paragraph 12. *b.* (4) *(e)*, this section.

f. CLEANING THE OIL SYSTEM.—To prevent contamination of the oil systems with dirt, metal particles, and other foreign materials, drain and thoroughly flush and clean the oil lines and oil tanks after each engine change as follows:

(1) Disconnect the oil lines, remove the hose connections and inspect for any trapped debris. Thoroughly flush and clean each oil system with kerosene, Specification No. VV-K-211.

(2) During the flushing operation disconnect the oil outlets at the bottom of the oil tank hoppers and pour kerosene through the tank until all traces of dirt and debris have been eliminated.

(3) At each fourth engine change or at the discretion of the local engineering officer at any intermediate engine change and at all changes made necessary by an internal engine failure of such an extent that metal particles are circulated through the oil system, remove the oil tanks as instructed in paragraph 12. *g.* (8), this section. Clean and flush the tank with hot kerosene and shake the tank violently during the cleaning operation.

CAUTION

When using kerosene in the cleaning operation, precautions against fire must be observed.

g. OIL TANK. *(See figures 228 & 229.)*

(1) GENERAL.—Each oil tank, installed between the firewall and wing front spar in each nacelle, consists of a self-sealing cell in a metal shell, oil temperature accelerating well (hopper), the necessary inlet and outlet fittings, oil level measuring stick, and filler cap. The oil tank has a total capacity of 39 U. S. gallons (32.5 Imperial gallons) with 30 U. S. gallons (25 Imperial gallons) as the useable oil capacity as indicated by the "N" mark on the measuring stick. A 1.25 U. S. gallons (1.04 Imperial gallons) quantity of reserve oil is maintained by a standpipe in the oil tank sump to supply the propeller feathering pump during an emergency when the engine has been stopped because of a depleted supply of oil. The remaining space in the oil tank is for expansion of the oil.

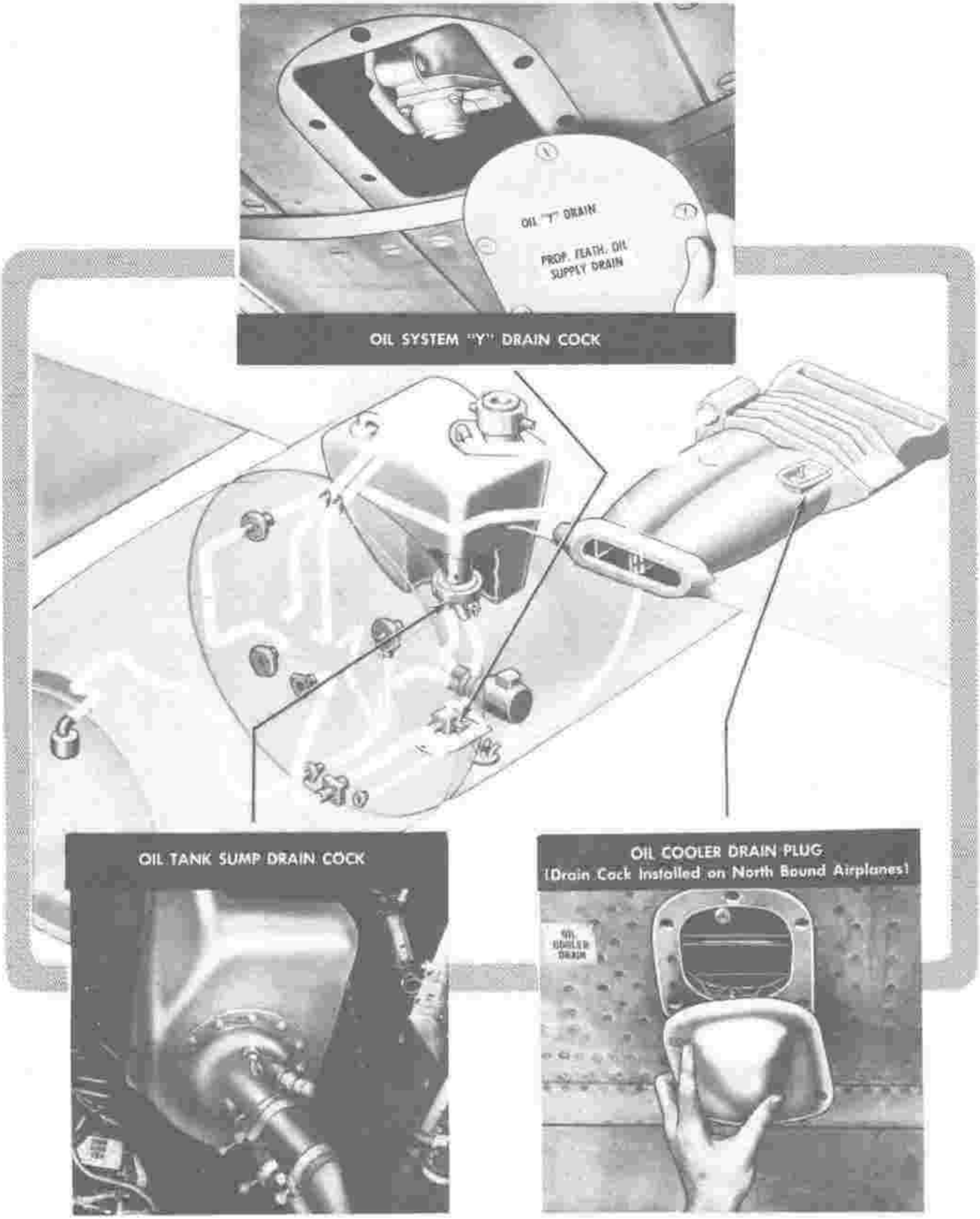


Figure 227—Engine Oil System Drains

(2) SELF-SEALING CELL.—The oil tank self-sealing cell is constructed of an inner liner of oil resistant snythetic rubber, an inner liner of sealing material, and an outside covering or retainer. When the cell is punctured, the sealant comes into contact with the oil and swells to several times its original size. This swelling action, plus a mechanical closing action due to the construction characteristics of the cell, seals the injury and prevents leakage. The cell includes a vent elbow to connect the forward vent line.

(3) OIL TANK SHELL.—The oil tank shell is constructed of aluminum alloy and consists of two parts which are bolted together.

(4) OIL TEMPERATURE ACCELERATING WELL (HOPPER).—The hopper is a metallic tube installed in the oil tank to partially isolate a small quantity of the oil supply. The smaller quantity of oil within the hopper flows to the engine, and oil returning from the engine is introduced into the hopper and immediately flows again to the engine. With the hopper type tank the engine oil is warmed quickly, since the entire oil supply is not being drawn into the engine. The bulk oil in the tank flows into the hopper gradually through holes at the top and bottom of the hopper.

(5) INLET FITTING.—The inlet fitting, located at the top of the oil tank, is a casting that receives the filler cap and provides bosses for the return line elbow, rear vent line connection, overflow drain line connection, and oil level measuring stick, which screws into a tube assembly. The synthetic rubber filler well is attached to the inlet fitting and the oil tank fairing.

(6) OUTLET FITTING.—The outlet fitting, located on the bottom of the tank, provides outlets to the oil supply line and propeller feathering line, and bosses for installation of a drain cock and oil temperature bulb. The outlet fitting is designed with a standpipe to provide a reserve supply of oil available only to the propeller feathering pump.

(7) USE OF OIL IMMERSION HEATERS.—The oil tank filler cap permits the use of oil immersion heaters and a wooden adapter ring is provided to hold the flexible lead of the heater and to provide a seal against the entrance of foreign material into the oil tank. The adapter ring is stowed on the under side of the oil tank filler well access cover. Oil immersion heaters provide a means of heating the oil in the tanks during airplane layovers when low temperatures are encountered and heated hangar space is not available. Normally immersion heaters are not necessary when the oil is properly diluted. The use of immersion heaters will not assist in starting a cold engine or in providing fluid oil in the inlet lines to the engines. If it is necessary to use immersion heaters observe the following procedure:

(a) Use 250 watts—115 volts heaters.

(b) Remove the filler well access cover and filler cap. Place the adapter ring in the filler opening.

(c) Wipe off the heater assembly to prevent foreign material from getting into the oil tank.

(d) Place the heater in the tank and adjust the adapter on the heater lead so that the heating element is approximately two inches from the bottom of the tank. Be sure the heater is covered with oil. Install the heaters after the engines have been stopped and before the oil has cooled.

(e) Plug the heater lead into an external 110 volt circuit. Never connect the heaters to the airplane batteries or use a higher voltage than 110 volts.

(f) It is not necessary to operate the heaters continuously to maintain fluid oil in the tanks. Prior to starting the engines, remove the heaters and install the filler caps and access covers.

Note

Keep clean the space between the heating element and the perforated shield. Prevent the heater from touching the ground.

(8) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. Remove the access panels on the lower side of the nacelle *(3, figure 9)*.

2. Remove the oil "Y" drain cock access door and drain the main oil supply into a clean container after opening the "Y" drain cock. After the oil has drained, close the "Y" drain.

3. Drain the oil in the oil tank sump into a clean container by opening the sump drain cock. Close the drain after the oil has been drained.

4. Disconnect the oil supply line and propeller feathering supply line from the oil tank by loosening the hose clamps.

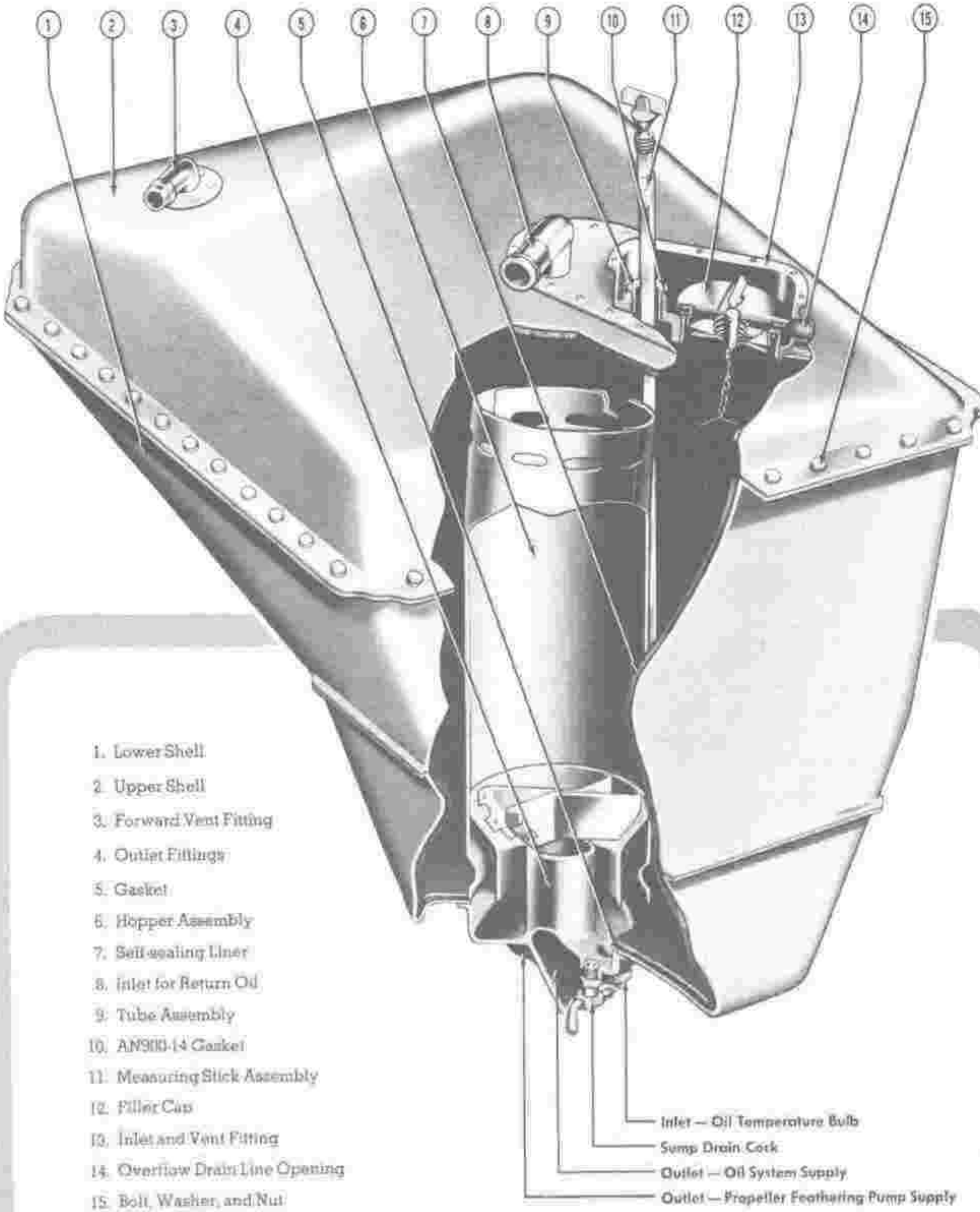
5. Disconnect the electrical wiring from the oil temperature bulb.

6. Remove the oil tank filler well access door on the top of the nacelle by releasing the Dzus fasteners. Remove the screws that attach the filler well to the oil tank fairing. Remove the oil tank fairing.

7. Disconnect the oil return line, the two vent lines, and the overflow drain line.

8. Remove the bolts that attach the oil tank forward and aft flanges to the firewall and to the wing front spar.

9. Lift the oil tank by the inboard and outboard flanges and remove the tank carefully from the nacelle.



1. Lower Shell
2. Upper Shell
3. Forward Vent Fitting
4. Outlet Fittings
5. Gasket
6. Hopper Assembly
7. Self-sealing Liner
8. Inlet for Return Oil
9. Tube Assembly
10. AN900-14 Gasket
11. Measuring Stick Assembly
12. Filler Cap
13. Inlet and Vent Fitting
14. Overflow Drain Line Opening
15. Bolt, Washer, and Nut

Note: Screws holding fittings to self-sealing cell are to be tightened to 20 to 30 inch-pounds. Screws are not to be tightened after initial installation.

Figure 228—Oil Tank Assembly

CAUTION

Do not lift the oil tank by its fittings.

(b) DISASSEMBLY.

1. Remove the inlet fitting and filler well from the top of the oil tank.

2. Remove the hopper through the filler opening.

3. Remove the outlet fitting from the bottom of the oil tank.

4. Remove the bolts that attach the upper and lower sections of the oil tank shell and remove the upper section.

5. Remove the self-sealing cell from the lower section of the shell.

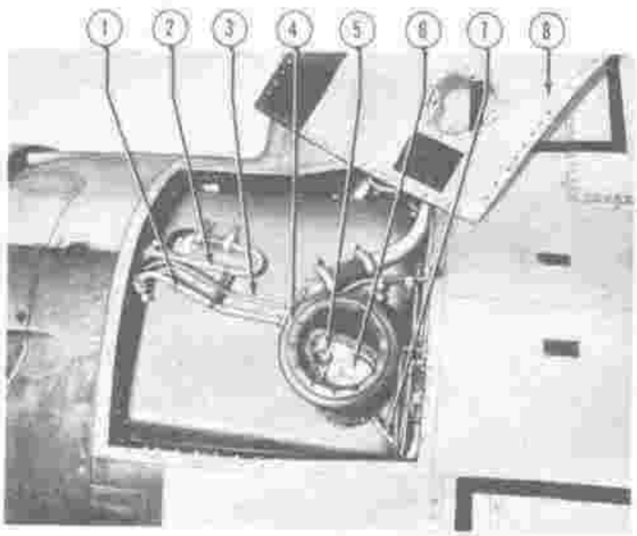
CAUTION

Observe care in removing the self-sealing cell if the metallic shell is damaged to prevent tearing the cell on sharp metal edges of the shell injury.

(9) MAINTENANCE REPAIR OR REPLACEMENT.

(a) CLEANING.—Clean the oil tank at each fourth engine change as instructed in paragraph 12. *f.*, this section.

(b) SELF-SEALING CELL.—Refer to paragraph 12. *g.* (2), this section.



1. Oil Tank Rear Vent Line
2. Oil Tank Forward Vent Line
3. Carburetor Vapor Return Line (Fuel System)
4. Oil Tank Filler Well
5. Measuring Stick Assembly
6. Filler Cap
7. Overflow Drain Line
8. Fairing

Figure 229 — Oil Tank Installed (Nacelle Fairing Removed)

(c) OIL TANK SHELL.—If the oil tank shell or hopper is damaged, install new parts. If the inlet and outlet fittings and gaskets are damaged, replace with new parts.

(10) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—To assemble the oil tank refer to *figure 228* and reverse the disassembly procedure given in paragraph 12. *g.* (8), this section.

Note

Screws holding fittings to the self-sealing cell are to be tightened to 20-30 inch-pounds torque and the screws are not to be tightened after the initial installation.

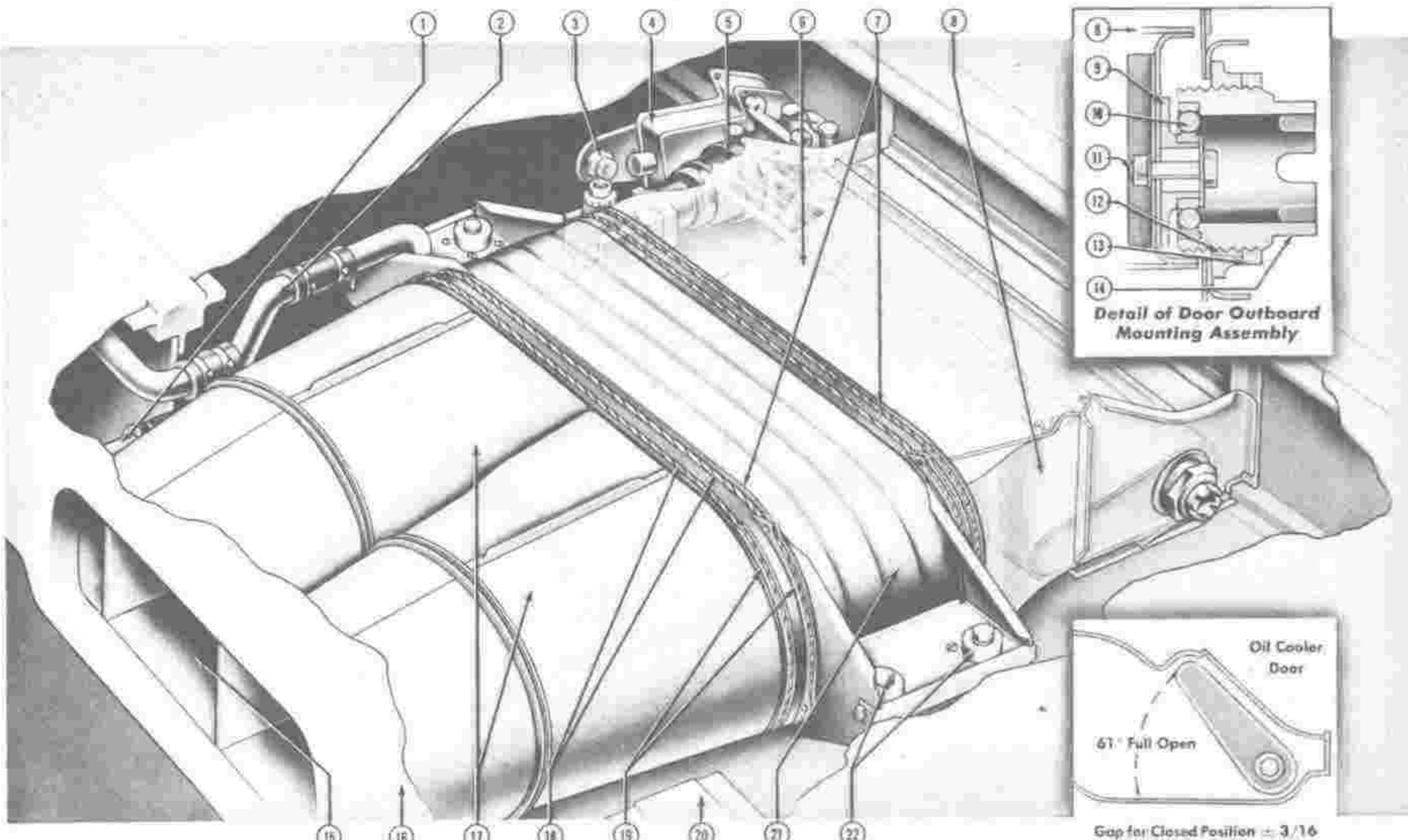
(b) INSTALLATION.—To install the oil tank reverse the removal procedure given in paragraph 12. *g.* (8), this section.

h. OIL TEMPERATURE REGULATOR. *(See figure 230.)*

(1) GENERAL.—The oil temperature regulator installation consists of the oil cooler, control valves, air ducts, and the oil cooler door operating mechanism. The oil temperature regulator functions to maintain the oil supply at the temperature most desirable for engine operation. The oil cooler is installed in the wing outboard of the nacelle. The air intake scoop is installed in the wing leading edge and two ducts are located forward of the cooler. A single aft duct terminates on the under surface of the wing. An oil cooler door (exit flap) is installed in the aft duct and is actuated by an electric motor to control the flow of air through the oil cooler. The hot oil returning from the engine is introduced into the oil cooler and the oil temperature is reduced by the flow of air through the cooler before the oil returns to the oil tank. However, if the oil is cold and the oil pressure is high, the control valves allow the oil to by-pass the cooler and return directly to the oil tank. Oil temperature is regulated by observing the oil temperature indicator *(figure 225)* and operating the oil cooler door by means of the oil cooler door switch, to the position necessary to maintain the proper oil temperature. The oil cooler doors position indicator and oil cooler door switches are located in the pilot's compartment *(figure 225)*. Each oil cooler door switch has three positions "OPEN," "CLOSE," and "OFF."

(2) OIL COOLER.

(a) DESCRIPTION.—The oil cooler for each engine oil system is installed in the wing between the front and rear spars outboard of the nacelle. *(See figure 230).* The cooler consists of a shell and outer warming jacket and control valve mounting flange, fabricated as an integral unit, and the core assembly. The core, honey-comb-like in external appearance, is a bundle of copper tubes arranged in such a uniform manner that oil can pass over the outside wall of each



1. Oil Line to Cooler
2. Oil Line from Cooler
3. Oil Cooler Door Position Transmitter
4. Actuator Follow-up Unit
5. Oil Cooler Door Actuator
6. Aft Air Duct
7. Seal and Channel
8. Oil Cooler Door
9. Collar Assembly
10. Bearing
11. Bolt and Washer
12. Collar
13. Lock Nut
14. Retainer Assembly
15. Oil Cooler Air Scoop
16. Air Scoop Nose Structure
17. Forward Air Ducts
18. Cables
19. Clamps
20. Front Wing Spar
21. Oil Cooler Assembly
22. Shock Mounts

Adjustment of Oil Cooler Door

Set mechanism stops in drive unit for full travel of 63°, starting with the above minus tolerance of no gap. Set limit switches follow-up actuator unit for full travel to 61°, starting with the above minus tolerance of no gap. Set for full travel to 60°, starting with nominal gap dimension of 3/16 inch.

Figure 230 Oil Temperature Regulator Installation (L.H. Wing)

tube while cold air is flowing along the inside wall. Hot oil flowing around the tubes continually transfers heat to the air flowing through the tube. Because the hexagonal ends of the tubes are bonded together with solder, the core of the cooler actually becomes a leakproof container through which air (through tubes) and oil (surrounding the tubes) circulates freely. This cooling action lowers the temperature of the oil to a degree suitable for normal engine operation. To prevent a channeling of the oil from one end of the core to the other, with consequent partial cooling of oil, a series of baffles divide the core bundle into compartments with openings at alternate ends. Thus the oil is forced to traverse all the tubes in one compartment before passing into the next. The baffles also furnish strength to withstand thermal stresses and hydraulic pressures in the core. The "free-flow" warm-up of oil in the core is accomplished by spacing the tubes and baffles so that low pressure flow paths are set up for the oil.

(b) REMOVAL.

1. Remove the stressed panel, located on the under surface of the wing and stencilled "OIL COOLER ACCESS."

2. Remove the drain plug, or open the drain cock if installed, and drain the oil in the cooler into a clean container.

3. Remove cables and clamps that clamp the rubber seals to the oil cooler and the air ducts. Move the seals so that they will not interfere with the removal of the cooler.

4. Disconnect the hoses leading to the control valve assembly by loosening the hose clamps.

5. Remove the four bolts and washers that attach the cooler to the wing and carefully remove the cooler from the airplane.

6. Remove the shock mounts and brackets from the cooler.

7. Remove the screws that attach the control valve assembly to the cooler and remove the control valve assembly.

8. The cooler is constructed as an integral unit and is not to be disassembled.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check the hose connections at the inlet and outlet lines of the cooler. Replace damaged or deteriorated hoses.

2. Check for oil leakage around the control valve and base casting. Check for leakage where the core joins the shell and base casting.

3. Check mounting straps and clamps for correct tension.

4. Check core tubes for obstructions to air flow. If the core is dirty, blow out with compressed air. If the dirt cannot be removed with an air blast the cooler must be removed and cleaned according to instructions in T. O. No. 03-15-17.

5. Check for collapsed tubes in core by looking through core face. Check core face for surface leaks and outlet ducts for oil splatter from damaged tubes. If the core tubes are damaged or leaking, install a new or serviceable cooler, or the tubes may be replaced according to instructions in T. O. No. 03-15-17.

6. Check the air ducts, inlet scoop, and exit for obstructions and any damage.

7. Clean the oil cooler at each normal engine change or prior to making any solder repairs. In the event of an engine change resulting from an engine failure that releases metal particles into the oil system, the oil cooler must be rebuilt if it is to be used for future engine operation. Remove the oil cooler and tag with AAF form No. 50 marked "METAL-REBUILD" and forward to the control depot. Refer to T. O. No. 03-15-17 for proper cleaning and repair procedures.

(d) TESTS BEFORE INSTALLATION.

1. Attach an air hose to the inlet connection of cooler. Plug all other openings in the cooler.

2. Submerge cooler in a water tank with water covering the core face. Apply 100 to 105 psi air pressure and check for any air bubbling from the cooler core face indicating leaky tubes in cooler.

(e) INSTALLATION.

1. Before installing the oil cooler, make certain that the shock mounts are in good condition. Replace any damaged or deteriorated mounts with new parts.

2. Installation is the reverse of the REMOVAL procedure given in paragraph 12. *b.* (2) *(b)*, this section. Also refer to *figure 230*.

(3) CONTROL VALVE ASSEMBLY.
(See figure 231.)

(a) DESCRIPTION.—The control valve assembly contains a core relief and surge protection valve, external warming jacket relief valve, and core check valve to protect the oil cooler from excessive oil pressures resulting from cold oil. The core protection valve has its opening to the inlet port of the cooler, and has a small atmospheric vent in the cap. The external warming jacket relief valve is under the center of the valve assembly. The core check valve is at the outlet port of the cooler. The entire valve assembly is attached to the cooler by means of screws. In normal operation the oil returning from the engine flows into the lower chamber of the inlet port, then

KEY TO FIGURE 231

1. Guide Nuts
2. Gaskets
3. Warming Jacket Relief Valve Spring
4. Check Valve Spring
5. Warming Jacket Relief Valve Poppet
6. Check Valve Poppet
7. Valve Seats
8. Valve Housing Assembly
9. Outlet Port
10. Inlet Port
11. Gasket
12. Surge Protection and Core Relief Valve Poppet
13. Valve Guide
14. Spacer
15. Packing
16. Packing Retainer
17. Nut
18. Surge Protection and Core Relief Valve Spring
19. Vented Guide Nut
20. Mounting Screw

into the common inlet of the external warming jacket and the core of the cooler, through the core under the check valve, and then to the outlet port. If the pressure drop in the core exceeds 30 psi, the external warming jacket relief valve is lifted and the oil bypasses around the jacket of the cooler. If the pressure in the system exceeds 45 psi, the core relief valve is lifted to allow the oil to bypass directly from the inlet to the outlet port of the valve. If the system pressure becomes even greater, the guided valve is moved higher, pulling up the core protection valve which finally closes off the oil cooler from the remainder of the system. The core check valve prevents back flow of oil into the core when the surge valve has lifted, bypassing the oil over the check valve into the outlet port of the control valve assembly.

(b) REMOVAL.

1. To remove the control valve assembly refer to paragraph 12. *b.* (2) *(b)*, this section.

2. If emergency disassembly of the valve is attempted refer to *figure 231*.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check for leaks around control valve and oil cooler base casting. Leakage may be caused by a damaged gasket or loosened attaching screws. Check the oil line hose connections.

2. If the control valve assembly is damaged or is not operating properly, replace the valve with a new or serviceable part.

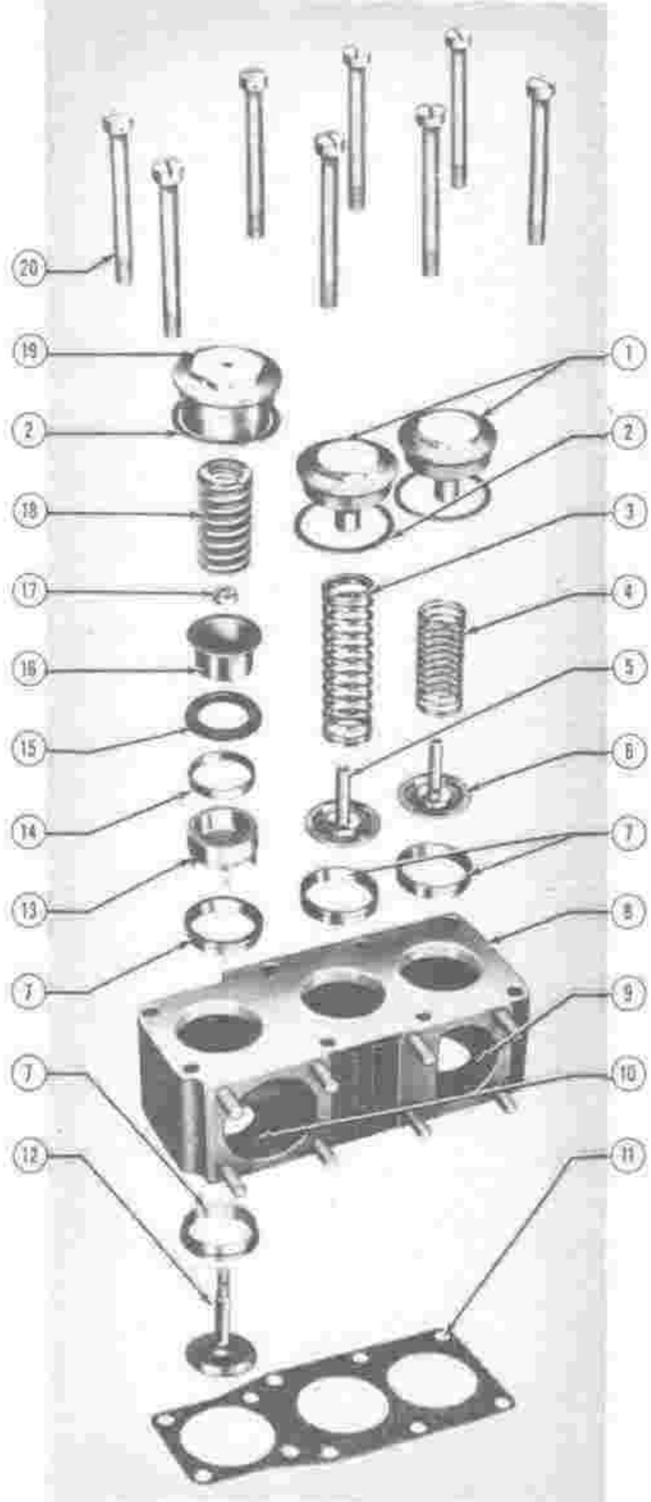


Figure 231—Oil Temperature Regulator Control Valve (Disassembled)

(d) INSTALLATION.—Installation is the reverse of the removal procedure as given in paragraph 12. *b.* (2) *(b)*, this section.

(4) OIL COOLER DOOR AND OPERATING MECHANISM. *(See figure 230.)*

(a) DESCRIPTION.—The oil cooler door (oil cooler duct exit flap) controls the flow of air through the oil cooler and air duct installation. The oil cooler door actuator consists of a gear box with torque drive and electric motor with magnetic brake on which is mounted the automatic follow-up and limit switch box unit, and the oil cooler door position transmitter. The motor provides power to open and close the oil cooler door. The follow-up switch allows the motor to operate until the oil cooler door reaches the desired position: the limit switches stop the motor when the oil cooler door is in the extreme open or closed position. The drive shaft of the actuator fits into a splined collar on the oil cooler door which is supported on the opposite side by a collar which fits into a bearing assembly. The cooler door is controlled by a switch in the pilot's compartment *(figure 225)*. The switch has three positions, "OPEN," "CLOSE," and "OFF." For further description of the oil cooler door actuator and switch box refer to paragraph 15. *d.*.(8) *(c)*, this section.

(b) REMOVAL.

1. Remove the access panel on the upper surface of the wing outboard of the nacelle and stencilled, "OIL COOLER DOOR CONTROLS."

2. Disconnect the electrical connections at the oil cooler door actuator and switch box.

3. Remove the bolts that attach the actuator and switch box assembly to the wing structure. Remove the actuator by sliding the drive shaft out of the splined collar on the oil cooler door.

4. Remove the bolt and washer that secure the oil cooler door outboard collar in the retainer and bearing assembly.

5. Cut the lockwire, loosen the lock nut, and unscrew the retainer and bearing assembly until the door outboard collar is free.

Note

It is not necessary to remove the retainer and bearing assembly.

6. Remove the oil cooler door through the oil cooler duct exit by tilting the door and sliding it through the opening.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. For repairs to the oil cooler actuator and switch box refer to paragraph 15. *d.* (8) *(b)*, this section.

2. Check the oil cooler door mechanism for tightness and security of mounting bolts every 50 hours.

3. Check the oil cooler door bearing collars, spacers, and outboard bearing for evidence of wear. Replace damaged parts with new parts.

4. If the oil cooler door is damaged, replace with a new part.

5. Excessive end play in the oil cooler door may be eliminated by tightening the outboard retainer and bearing assembly.

(d) INSTALLATION.—Refer to *figure 230* and reverse the REMOVAL procedure given in paragraph 12. *b.* (4) *(b)*, this section. When installing the oil cooler door, make certain the door has end clearance in its full range of movement.

(e) ADJUSTMENTS.—To adjust the oil cooler door and actuator refer to *figure 230* and paragraph 15. *d.* (8) *(b) 4*, this section.

i. OIL DILUTION SYSTEM—DESCRIPTION.—An oil dilution system is provided for each engine oil system to dilute the engine oil with gasoline to prevent congealing of the oil when the airplane is inactive during cold weather. An oil dilution valve is installed on the right side of each engine mount *(figure 200)* and is controlled by an electrical switch in the pilot's compartment *(figure 225)*. When the dilution switch is placed in the "ON" position the solenoid valve is opened and fuel under pressure from the fuel pressure line *(figure 200)* is injected into the oil inlet line at the "Y" drain valve *(figure 200)*. The diluted oil is circulated through the engine and is returned to the hopper in the oil tank. The dilution switch returns to the "OFF" position when released. When it is necessary to dilute the oil in anticipation of a cold engine start (temperature below 5 degrees C—41 degrees F) observe the procedure given in section III. For other information about the oil dilution solenoid valve refer to paragraph 15. *d.* (7) *(b)*, this section.

j. PROPELLER FEATHERING SYSTEM.—The oil tank supplies oil to the propeller feathering pump, which furnished oil under high pressure to the propeller governor for feathering of the propeller. The propeller feathering pump is mounted beneath the oil tank in the nacelle *(figure 223)*. The propeller feathering supply line is connected to the outlet fitting of the oil tank. A 1.25 U. S. gallons (1.04 Imperial gallons) reserve supply of oil in the oil tank sump is available only to the propeller feathering pump when the engine has been stopped because of a depleted supply of oil. For complete information about the propeller feathering system refer to paragraph 10. *e.* (1), this section.

k. OIL SYSTEM LINES.
(See figure 223.)

(1) DESCRIPTION.—Most of the rigid lines in the oil system are made of aluminum alloy. Hoses and hose clamps are used to connect the lines. Bronze tubing and metal fittings are utilized in the propeller feathering system. Color banding of oil lines is yellow. For general tubing fabrication information refer to section VIII.

(2) REMOVAL.—Removal of oil system lines is accomplished either by loosening the hose clamps or by unscrewing nuts on the tubing collars when metal lines and fittings are used.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Check the oil system lines and connections frequently for evidence of oil leakage. Replace lines that are damaged. Replace damaged or deteriorated hoses and hose clamps with new parts.

(4) INSTALLATION.—For tubing fabrication and installation information refer to section VIII.

l. OIL SYSTEM TROUBLE SHOOTING CHART.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Low Oil Pressure.	*a.* High oil temperature	*a.* See item No. 2
	b. Excessive oil foaming (1) High altitude operation (2) Excessively hot oil (3) Oil supply depleted	*b.* Check oil in tank. If excessive foaming is evident, drain system and fill with new oil.
	c. Leak, congealed oil, or air in oil pressure gage line; leak or air in oil pressure transmitter line.	*c.* Inspect lines and fittings for leaks. Bleed air from lines or thaw congealed oil. Refill pressure gage line with compass fluid.
	d. Leaking oil dilution solenoid valve.	*d.* Refer to paragraph 15. *d.* (7), this section.
	e. Faulty engine parts or operation (1) Oil pressure pump (2) Screens (3) Oil pressure relief valve (4) Excessive engine operating clearness.	*e.* See engine section trouble shooting chart in paragraph 6. *c.*, this section.
2. High Oil Temperature	*a.* Operating at excessively high manifold pressure.	*a.* Operate engines at recommended manifold pressure.
	b. Insufficient oil supply	*b.* Check oil level in tanks. If supply is abnormally low, check lines and fittings for leaks.
	c. Oil cooler doors not operating properly.	*c.* Check operation of oil cooler doors.
	d. Damaged or restricted oil cooler core.	*d.* Replace cooler if damaged. Restrictions in the core may be removed by use of compressed air, or by removing and cleaning with solvent.
	e. Congealed oil in coolers.	*e.* Close oil cooler doors until core thaws and normal oil flow resumes.
	f. Defective core relief and surge protection valve.	*f.* Replace valve with new port.
	g. Diluted or dirty oil.	*g.* Check oil at tank or at drain cock. If oil is dirty, drain system and fill with fresh oil. If oil is *diluted*, check dilution solenoid valve as instructed in item 1. *d.*
3. Loss of Oil (High Oil Consumption)	*a.* Oil temperature too high	*a.* See item No. 2.
	b. Oil pressure too high	*b.* See item No. 4.
	c. Leaks in system	*c.* Check lines and fittings for leaks.
	d. Oil viscosity too low	*d.* Check dilution solenoid valve as instructed in item No 1. *d.*
	e. Faulty engine parts or operation	*e.* See engine trouble shooting chart in paragraph 6. *c.*, this section.
	f. Clogged breather lines from engine blower case.	*f.* Clean out breather lines.

l. OIL SYSTEM TROUBLE SHOOTING CHART—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
4. High Oil Pressure	a. Low air temperature (Oil too viscous)	*a.* Warm oil supply with ground heaters
	b. Defective gage or pressure transmitter.	*b.* Refer to 13. *f.* (4) *(b)*, this section.
	c. Improper operation of oil pressure relief valve.	*c.* Refer to engine section trouble shooting chart in paragraph 6.
5. No Oil Pressure	*a.* Defective gage or pressure transmitter.	*a.* Refer to 13. *f.* (4) *(b)*, this section.
	b. Damaged oil inlet lines or gage lines.	*b.* Inspect lines and fittings for damage, causing leakage.
	c. Defective oil pressure pump.	*c.* See engine trouble shooting chart in paragraph 6.
	d. Air lock in oil inlet line.	*d.* Prime line pre-oil engine.
6. Delay in Oil Pressure Indication (Stop engine if no oil pressure is indicated within 30 seconds)	*a.* Loose or leaking connections.	*a.* Check connections for tightness.
	b. Excessive viscosity (Pump forcing air into oil system)	*b.* Warm oil supply with ground heater.
7. Fluctuating Oil Pressure Indication	*a.* Insufficient oil supply	*a.* Check oil level in tanks. If supply is abnormally low, check lines and fittings for leaks. If supply is normal, check operation of oil pump. See engine trouble shooting chart in paragraph 6. *c.*
	b. Air in pressure gage or pressure transmitter lines.	*b.* Bleed air from lines. Refill pressure gage lines with compass fluid.
	c. Oil viscosity too high.	*c.* Warm oil supply with ground heater.

13. INSTRUMENTS

a. GENERAL.—Most of the instruments used on this airplane are installed on a shock-mounted panel located in the pilot's compartment forward of the control column. The instrument panel is illuminated by two fluorescent lamps attached to the instrument panel shield. On airplanes equipped with the bombardier nose (A-26C) a small instrument panel is provided for the bombardier. Engine instruments are the dual indicating type, actuated by remote electrical transmitters, low pressure fluid transmitters, or by direct reading. Instruments which indicate altitude, airspeed and rate of climb operate from direct atmospheric pressures supplied through the pitot-static tube, located on the tip of the vertical stabilizer. Flight instruments of the gyroscopic type are vacuum-actuated, operating by suction furnished by either one of two engine-driven vacuum pumps. The majority of the engine and position indicators are actuated electrically. Two exceptions are the fuel and oil pressure indicators operated by means of pressure transmitters located in the engine sections. A third exception is the engine manifold pressure gage, which provides a direct indication. All indications are transmitted either by means of aluminum alloy tubing and flexible hoses, or by electrical wiring. An auxiliary airspeed line, not connected to any equipment, is installed in the fuselage aft section and the vertical stabilizer on some airplanes. The line was provided for possible future installation of a wing flap maneuvering control.

b. INSTRUMENT PANEL.

(1) DESCRIPTION. — A shock-mounted instrument panel is installed in the pilot's compartment and in the bombardier nose if installed. These panels are attached to the airplane structure by means of six Lord vibration absorbers installed in four places.

(2) REMOVAL.

(a) Disengage the electrical cables and flexible lines from the instruments.

(b) Label all the instrument connections to facilitate replacement.

(c) Remove the panel by disengaging the bolts from the vibration absorbers which secure the panel in position.

(d) Cap all lines and instruments so that dirt cannot enter.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—A cracked or broken instrument panel shall be replaced.

(4) INSTALLATION.

(a) Support the panel in place while inserting the bolts through the vibration absorbers. Tighten the bolts evenly.

(b) Remove the caps from the lines and apply a coat of thread lubricant compound to the threads. Then connect the lines to the respective instruments according to the labels. Use short-handled line wrenches and do not put excessive strain on the fittings. Make certain that the panel rides clear of all surrounding structure.

(c) Connect the electrical plugs on the back of the instruments.

(5) TEST AFTER INSTALLATION.—Check panel vibration, which should not exceed an .004 inch amplitude.

c. PITOT-STATIC INSTRUMENTS AND EQUIPMENT. *(See figure 254.)*

(1) GENERAL.—The pitot-static instruments and equipment consist of the airspeed indicator, the altimeter, the rate of climb indicator, the pitot-static tube and the connecting lines.

(2) OPERATIONAL TESTS.

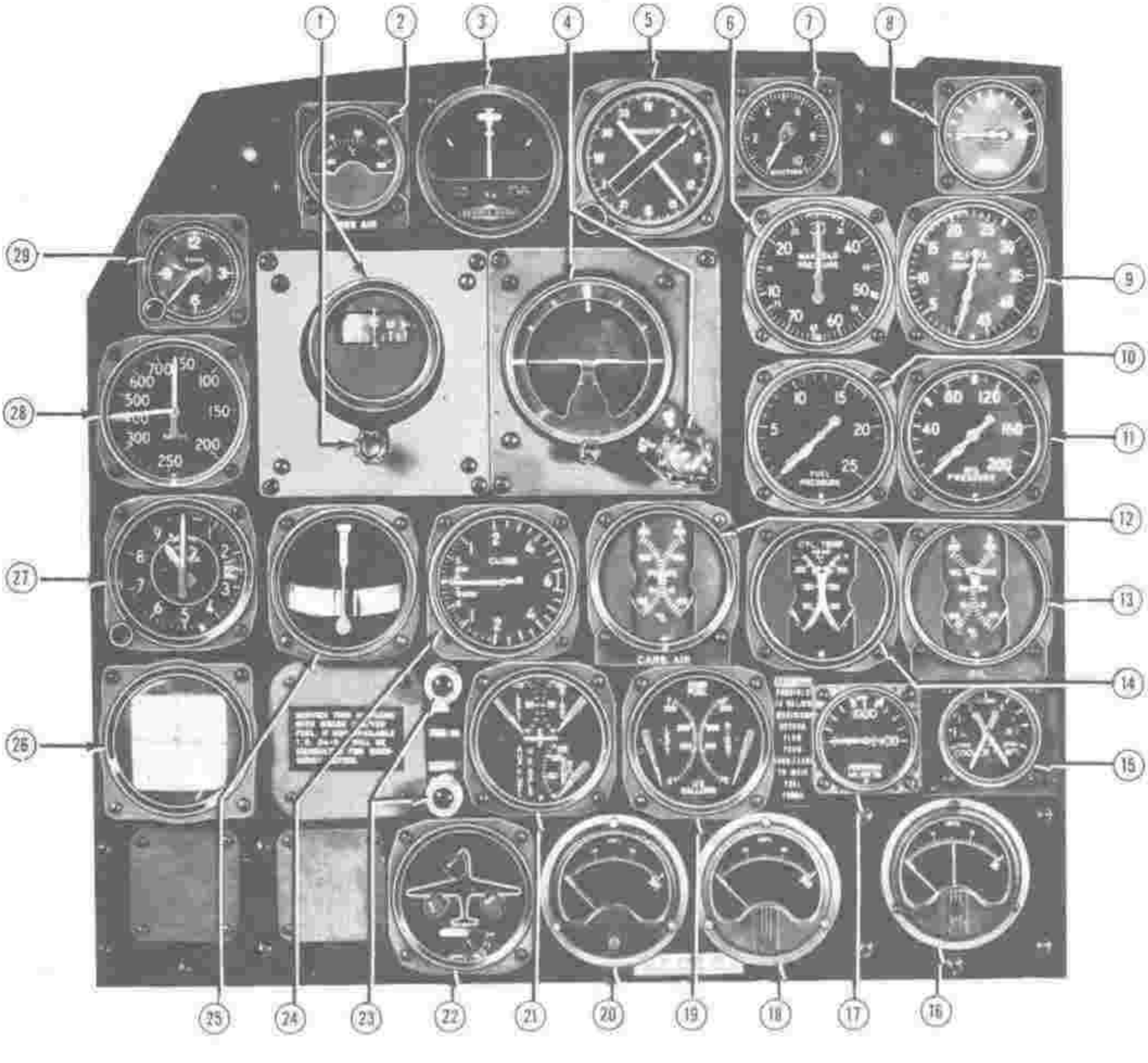
(a) PITOT-STATIC INSTRUMENTS. — Improper operation of a pitot-static instrument may be due to (1) a faulty mechanism, (2) a leaking case, (3) a leaking line or connection, or (4) foreign material in the pitot-static tube or connecting lines.

(b) If the pointer of the airspeed indicator, the altimeter or the rate of climb indicator fails to respond, the source of the trouble frequently may be traced to a stoppage in the pitot-static tube or the connecting lines. Disconnect the instruments involved and clean the lines and tubes by applying air pressure at the panel ends of the lines. If this fails to overcome the trouble, install a new instrument.

(c) If the pointer of the airspeed indicator or the rate of climb indicator oscillate, or if the altimeter reading is too high, the source of the trouble frequently may be traced to leakage of air in the instrument cases or connecting lines. If tests show that an instrument case is leaking, remove the instrument and install a new one. If tests show that the instrument itself functions properly, test the lines and connections for leaks.

CAUTION

These tests should be made only by persons familiar with the delicate nature of the instruments. Test pressures must be applied and released slowly and gently to avoid damaging the instruments.



1. Directional Gyro (Turn) Indicator and Setting Knob.
2. Outside (Free) Air Temperature Indicator
3. Radio Compass Left-Right Indicator
4. Gyro Horizon (Flight) Indicator and Caging Knob
5. Remote Magnetic Compass Indicator
6. Manifold Pressure Gage (Dual)
7. Suction Gage
8. De-Icer System Pressure Gage
9. Tachometer Indicator (Dual)
10. Fuel Pressure Gage (Dual)
11. Oil Pressure Indicator (Dual)
12. Carburetor Air Temperature Indicator (Dual)
13. Oil Temperature Indicator (Dual)
14. Cylinder Head Temperature Indicator (Dual)
15. Oil Cooler Door Position Indicator (Dual)
16. Voltmeter
17. Hydraulic Pressure Gage
18. R. H. Engine Ammeter.
19. Main Fuel Quantity Gage
20. L. H. Engine Ammeter
21. Auxiliary Fuel Quantity Gage
22. Landing Gear and Wing Flap Indicator
23. Landing Gear Warning Lamps
24. Rate of Climb Indicator
25. Bank and Turn Indicator
26. Tell-Tale Indicator
27. Altimeter
28. Airspeed Indicator
29. Clock

Figure 232—Instrument Panel

1. AIRSPEED INDICATOR CASE LEAK TEST.

a. Disconnect the STATIC line as close to the indicator as possible and attach a rubber tubing to the instrument end.

b. Put the other end of the tubing in the mouth and softly take in breath until the pointer reaches 200 mph. Then pinch off the tube.

c. If the pointer descends faster than five mph, a leak in the instrument case is indicated and the instrument must be replaced. If no case leak is indicated, test the connecting lines for leaks.

2. PITOT PRESSURE (AIRSPEED) LINE LEAK TEST.

a. Seal the pitot pressure drain holes in the pitot-static tube with tape.

b. Attach a rubber tube to the pitot pressure (airspeed) opening at the end of the pitot static tube, making sure that the connection is air tight.

c. Blow GENTLY into the tube until the airspeed indicator is caused to read 150 mph. Then pinch off the source of pressure.

CAUTION

Do not apply suction to the pitot-pressure (airspeed) opening of the pitot static tube.

d. During a one minute period the indicator pointer should not change appreciably from the 150 mph reading. The indicator case must be tapped with the fingers during the test to overcome the effects of friction on the pointer.

e. If the pointer indication varies by more than 10 mph, check the lines for cracks or faulty connections.

3. ALTIMETER CASE LEAK TEST.

a. Disconnect the line (static pressure) from the altimeter.

b. Connect a length of rubber tubing to the altimeter vent and by blowing gently, decrease the altitude indication by only 500 feet.

c. Pinch off the tube and watch the pointer for 10 seconds. Tap the indicator case to eliminate friction. The indication should not change by more than 20 feet.

d. If the change is more than 20 feet during the 10 second period, a case leak is indicated and the altimeter must be replaced.

4. RATE OF CLIMB INDICATOR CASE LEAK TEST.

a. Set the indicator pointer to zero by means of the adjusting knob on the face of the instrument.

b. Disconnect the static line from the instrument and attach a rubber tubing to the inlet on the instrument case.

c. GENTLY AND SLOWLY apply a suction which will cause the pointer to read 2,000 feet per minute ascent, and then pinch the tube. The pointer then should return to zero and stay there as long as the tube is pinched off.

d. If the pointer rotates past zero, an air leak in the instrument is indicated and another instrument should be installed. Be sure to tap the instrument case while making the test to overcome friction in the pointer shaft.

5. STATIC PRESSURE LINE LEAK TEST.

a. Connect a mild source of suction to the static opening of the pitot static tube. (A rubber tube may be used by splitting one end and binding it to the pitot-static tube.)

b. Set the altimeter pointers to zero.

c. Slowly apply SUCTION to the static line until the altimeter pointers indicate an altitude of 1,000 feet. Then pinch off the tube and tap the instrument case to overcome friction in the pointer.

d. In one minute the indication of the altimeter pointers should not change by more than 150 feet.

e. If the change in the position of the altimeter pointers exceeds 150 feet, check the lines for cracks or loose connections.

CAUTION

Do not apply air pressure to the static pressure lines when the instruments are connected.

(3) REMOVAL OF INSTRUMENTS.

(a) Remove the access door *(7, figure 7)* to the instruments, located on the upper left-hand side of the fuselage, forward of the windshield.

(b) Remove the individual instruments from the back of the panel by disengaging the flexible lines and removing the four bolts which secure each instrument to the panel. The bolts are of various lengths and should be kept with the instruments.

(c) Label the instrument connections for location if more than one instrument is removed.

(d) Cap the lines.

(4) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged or faulty instruments shall be

replaced. Before removing an instrument which is believed to be defective, it should be subjected to a test to make certain that the difficulty lies in the instrument, and is not due to leaky or clogged lines, or a damaged pitot tube. Refer to Operational Test paragraph 13. *e.* (2), this section.

(5) ASSEMBLY AND INSTALLATION OF INSTRUMENTS.

(a) Reverse the REMOVAL procedure.

(b) Apply a coat of thread lubricant compound to the threads before connecting the lines to the instruments.

(c) Check the flexible connecting hoses, and replace them if they have hardened or deteriorated.

(6) AIRSPEED INDICATOR.—The airspeed indicator, one on pilot's instrument panel and one on bombardier's instrument panel (if installed), records the speed of the airplane as it travels through the air. The instrument is actuated by impact and static pressures supplied by the pitot-static tube, the difference between the pressures being the means of measurement. Scale range on the dial is from 0 to 700 miles per hour. The instrument is automatic in operation and no external adjustments are provided.

(7) ALTIMETER.

(a) The altimeters (one on the pilot's instrument panel and one on the bombardier's instrument panel, if installed), compute the altitude of the aircraft in reference to a preselected location on the ground, and also the altitude above sea level. The altimeter is connected to the static line of the pitot-static tube and is operated by changes in the existing atmospheric pressure. Devices on the dial consist of an altitude scale, a barometric scale with an index marker, two reference markers, and three pointers. A knob on the front of the instrument is used prior to take-off to set the pointers to zero, or to a pressure specified by the pilot.

(b) ADJUSTMENT.—The altimeter pointers may be set to zero or the existing barometric pressure by means of a setting knob which protrudes from the front of the instrument. This adjustment is made by the pilot.

(8) RATE OF CLIMB INDICATOR.

(a) DESCRIPTION.—The rate of climb indicator is used to indicate a gain or loss in the altitude of the airplane while it is in flight. In level flight, the pointer is horizontal. In rate of climb, the pointer rotates upward from the zero position; in rate of descent, the pointer rotates downward from the zero position. A zero setting screw protrudes from the front of the instrument. The instrument consists principally of an indicator, a thermos chamber and a diaphragm. It is actuated by the differential between the atmospheric static pressure, supplied by a line from the pitot-static tube, and the pressure within the thermos chamber.

(b) ADJUSTMENT.—When the rate of climb indicator does not properly indicate zero, the pointer may be adjusted by means of a screw located on the front of the instrument. Tap the instrument with the finger while making the adjustment.

(9) PITOT-STATIC TUBE. *(See figure 233.)*

(a) DESCRIPTION.—The pitot-static tube provides the means of actuation for airspeed indicator, the altimeter, and the rate of climb indicator. The tube is installed on the leading edge of the vertical stabilizer, at the top. Two connecting lines extend through the fuselage to the instrument panel. An electrical heater, controlled from the pilot's main electrical control panel, is used to prevent icing of the pitot-static tube. Designed to be used only when freezing conditions are encountered in flight, the heater may be turned on momentarily for checking purposes while the airplane is on the ground. For further information on the heater refer to paragraph 15. *d.* (9) *(b)*, this section.

(b) REMOVAL.

1. Disconnect and cap the two pitot-static tube lines through the access hole located just below the tube.

2. Remove the neoprene fillet cemented to the stabilizer plating and the pitot-static tube by applying non-leaded gasoline to the base of the fillet and working the fillet loose.

Figure 233 - Pitot Static Tube

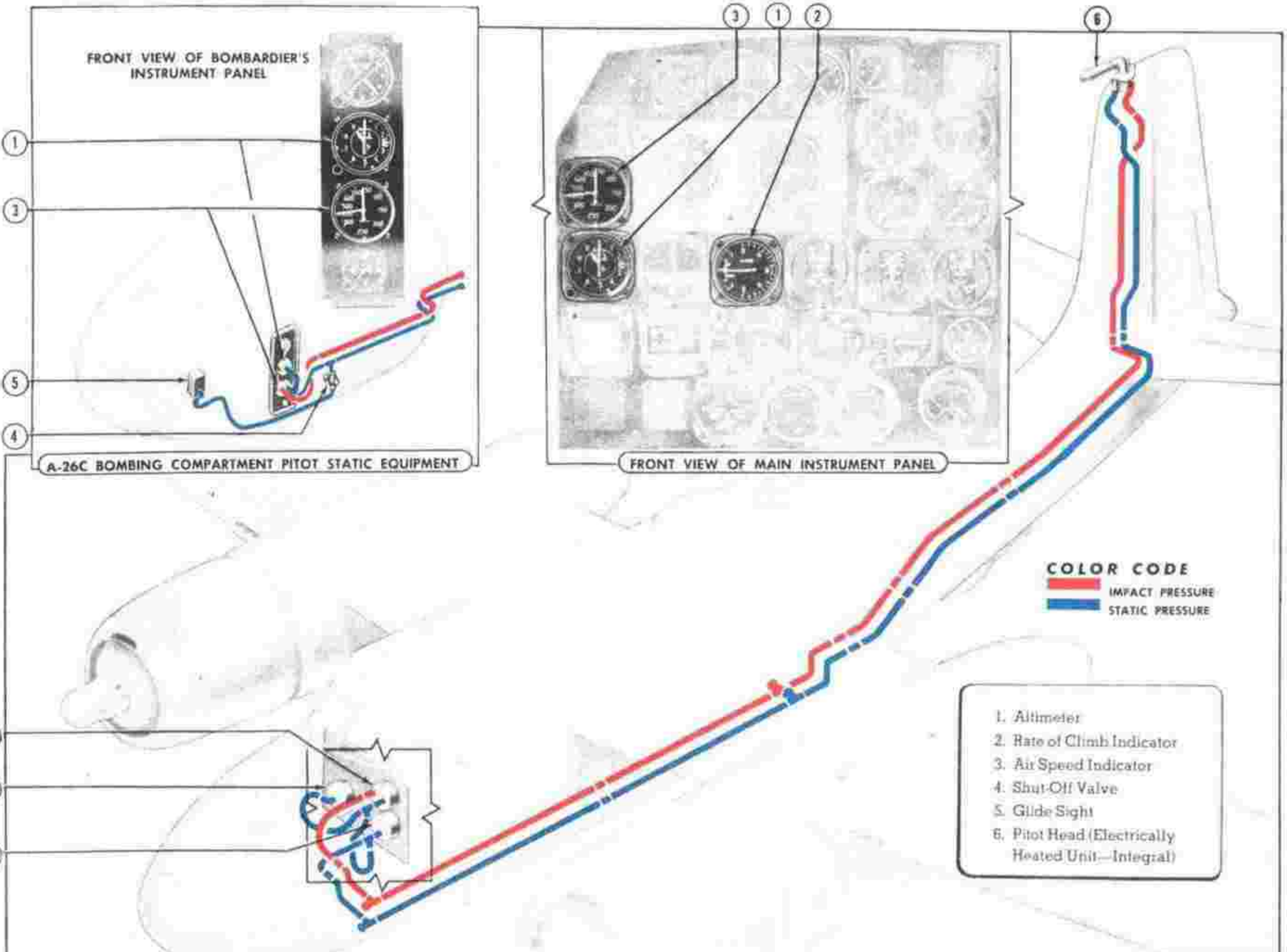


Figure 234 — Pitot Static Instrument System

3. Remove the two screws and disconnect the heater element wires from the base of the pitot-static tube. Lift the tube from the tip until the lines are clear.

(c) MAINTENANCE REPAIR.—A damaged pitot-static tube, or a tube with a burned out heating unit, shall be replaced.

(d) INSTALLATION.

1. Place the tube in position; remove the caps from the lines, apply a thread lubricant compound to the threads, and connect the lines to the pitot-static tube.

2. Insert the screws which secure the tube to the bracket and tighten them.

3. Connect the heating element wires.

4. Cement the neoprene filler to the stabilizer plating with neoprene cement, preferably DuPont Fairprene No. 1 or 4. Apply a thin, even coat to both surfaces and allow to dry from 20 to 45 minutes (or until the solvent odor and the sheen are gone). A better bond will be obtained if the metal surface is first primed with cement primer, preferably 624 N, manufactured by B and D Chemical Co., or equivalent.

(10) LINES. *(See figure 234.)*—Aluminum alloy tubing is used to carry static and dynamic air pressures from the pitot-static tube to the pitot-static instruments. The tubing is held in place at definite points by means of clips and clamps which reduce vibration. The actual connection to the instruments is made with short lengths of flexible composition hose, installed to reduce instrument panel vibration. Drain tees *(figure 234)* are provided in each line. Lines repair and replacement instructions may be found in Section VIII.

d. VACUUM-ACTUATED INSTRUMENTS AND EQUIPMENT. *(See figure 235.)*

(1) GENERAL.—The vacuum operated instruments installed in the airplane, and associated equipment, consist of a bank and turn indicator, a gyro horizon indicator, a directional gyro indicator, a suction gage, two engine-driven vacuum pumps, two suction relief valves, a vacuum pump selector valve, an air filter and connecting lines. The terms "vacuum" and "suction" are used interchangeably to signify reduced air pressure.

(2) REMOVAL OF INSTRUMENTS.

(a) Remove the access door to the instruments, located on the upper left-hand side of the fuselage, forward of the windshield.

(b) Remove the individual instruments from the panel by disengaging the flexible lines and removing the four bolts which secure each instrument to the panel. As the bolts are of various lengths they should be kept with the instruments to which they belong.

(c) Label the instrument connections for location if more than one instrument is removed.

(d) Cap the lines.

(3) ADJUSTMENT.—See adjustment of the suction relief valve below.

(4) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged or defective vacuum instruments shall be replaced. Improper operation of the gyro instruments usually is caused by excessive vibration, or an improper supply of vacuum and these possibilities should be checked before the instrument is removed from the airplane. Following are system tests which should be made before a supposedly defective vacuum instrument is removed from the airplane.

(5) BANK AND TURN INDICATOR.

(a) DESCRIPTION.—The bank and turn indicator is a "two-in-one" instrument, used principally during conditions of poor visibility. It helps the pilot to keep the airplane laterally level while flying straight, and to bank at the proper angle when turning. The instrument consists of a gyro-actuated indicator and a simple form of pendulum.

(b) MAINTENANCE REPAIR.

1. Check the vacuum being supplied to the instrument by attaching a portable suction gage to the inlet on the bottom of the case. The desired vacuum at the inlet is 1.9 inches of mercury. Minimum vacuum required for operation is 1.08 inches of mercury and the maximum is 2.05.

2. If the vacuum is below minimum or above maximum, check the adjustment of the control valve located on the vacuum instrument manifold. This valve functions to restrict the suction supplied to the bank and turn indicator. If the control valve is dirty, it should be removed and cleaned with solvent.

3. If insufficient vacuum is being supplied to the control valve, check the vacuum pump for proper operation and the vacuum lines for air leaks.

(c) TEST AFTER INSTALLATION.—The pointer must set at zero, with a tolerance of ± 1/64 inch, when the gyro is not spinning. When the airplane is in the normal horizontal position, the ball should rest at the zero position with a tolerance of ± .008 inch if the instrument is tapped gently.

(6) GYRO HORIZON INDICATOR.

(a) DESCRIPTION.—The gyro horizon (flight) indicator establishes an artificial horizon by means of a gyro-actuated horizon bar and a fixed miniature airplane. A pointer attached to the dial also indicates the degree of bank. A caging knob is provided on the front of the instrument so that it can be made inoperative during violent maneuvers.

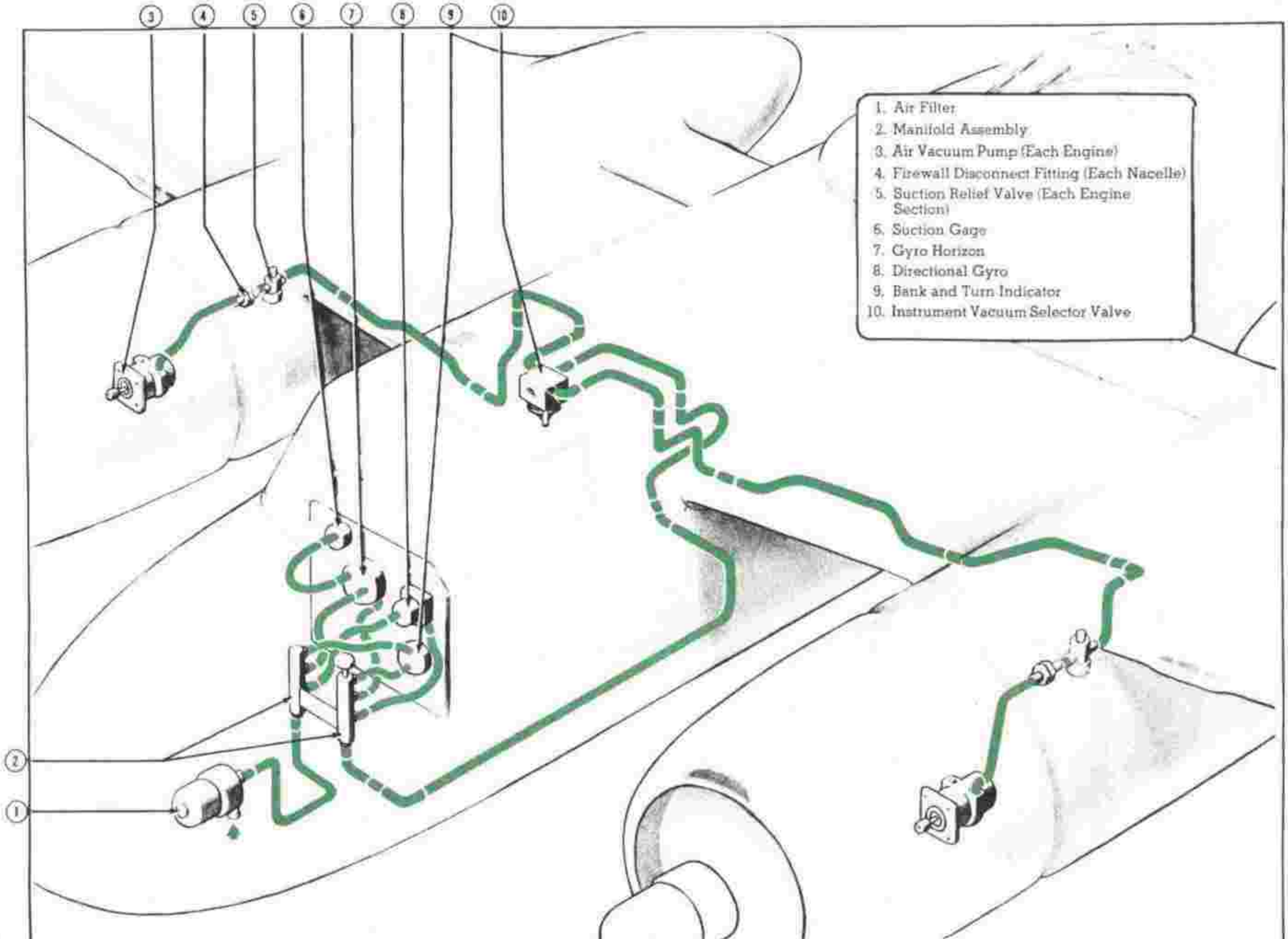


Figure 235— Vacuum Instrument System

(b) MAINTENANCE REPAIR.

1. Check the vacuum being supplied to the instrument concerned by connecting a portable suction gage to the alternate connection on the instrument. The vacuum required is from 3.5 to 4.2 inches of mercury.

2. If abnormal or subnormal vacuum is being provided, check the suction relief valve *(figure 239)* for proper adjustment and operation. The relief valve, located in the nacelle forward of the firewall, is used to regulate the vacuum supplied by the vacuum pump, as well as to supply air to the pump if a line becomes clogged.

3. If sufficient pressure is being supplied to the suction relief valve, check the vacuum pump for proper operation and the lines for air leaks.

(c) TEST AFTER INSTALLATION. – After the engines have been running for 10 minutes or more, and the suction is shut off, the gyro in the gyro horizon indicator should coast at least eight minutes but not more than sixteen minutes. The gyro rotations can be detected by placing the ear to the cover glass. When the engines are running, the horizon bar should hold steady after one and one-half minutes.

(7) DIRECTIONAL GYRO INDICATOR.

(a) DESCRIPTION.–The directional gyro (turn) indicator establishes a fixed reference on flight direction. It consists of a gyroscope, a graduated circular card on which the relative movement of the airplane is shown, and a caging knob used to set the gyro assembly on the desired heading.

(b) MAINTENANCE REPAIR.–See paragraph *(b)* above.

(c) TEST AFTER INSTALLATION.

1. The test given for the gyro horizon indicator (paragraph 13. *d.* (6)), also is applicable for the directional gyro indicator.

2. Improper operation of the directional gyro indicator frequently is caused by excessive vibration or improper vacuum, and these factors should be checked before the instrument is removed from the airplane. Instrument panel vibration should not exceed .004 inch amplitude.

(8) SUCTION GAGE.

(a) DESCRIPTION.–The suction gage, which is connected by a line to the gyro horizon indicator, shows the amount of suction supplied to the vacuum operated instruments. It consists mainly of a pressure-sensitive diaphragm, a dial calibrated in inches of mercury, and a pointer. Desired amount of suction is four inches of mercury.

(b) TEST AFTER INSTALLATION.–Check the suction gage for proper operation while the engines are running.

(9) AIR FILTER. *(See figure 236.)*

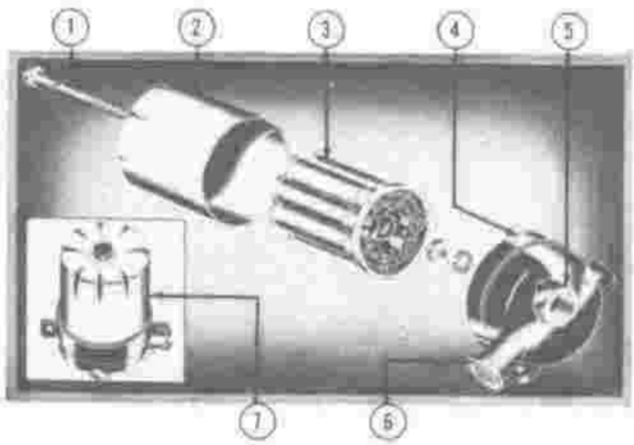
(a) DESCRIPTION.–The air filter is connected to the air intake port of the vacuum system, and is designed to remove from the air all the foreign substances which might damage the sensitive instruments. The filter is installed on the forward end of the control pedestal in the pilot's compartment and can be serviced without removing the outer case from the mounting bracket. The air filter is supplied in more than one shape and design, but operation is the same and maintenance requirements are similar. The air filter illustrated in *figure 236* contains a cylindrical diffusing screen and seven tubular elements through which the air must pass before it reaches the vacuum-operated instruments.

(b) REMOVAL.–Disconnect the line at the fitting and remove the two attaching bolts. Cap the line. For disassembly of the air filter, refer to the following maintenance repair instructions.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Damaged or defective air filters shall be replaced. Cleaning of the air filter, or replacement of the filtering elements is required after 25 hours of operation. To disassemble and clean the filter proceed as follows:

1. Disconnect the flexible hose from the filter outlet.

2. Cap the hose.



1. Disassembly Bolt
2. Filter Case
3. Filtering Elements (Diffusing Screen Not Shown)
4. Filter Head
5. Outlet Port
6. Inlet Screen
7. AN5822-1 Air Filter

Figure 236 — Air Filter

3. Loosen the bolt on the bottom of the filter and remove the filter head.

4. Remove the lock nut and nut from the bolt and pull out the filter assembly.

5. Slide off the cylindrical diffusing screen which covers the filter elements.

6. Apply low pressure compressed air to the open ends of the filter elements to loosen dirt deposits. Also direct the air along the filaments from each end. Do not apply the air pressure at right angle to the filter.

7. Using a clean cloth, wipe off any remaining dust on the elements and in the case. Also wipe the head, especially the outlet port and the inlet screen.

8. After the diffuser and elements have been reassembled in the case, the puller nut should be installed loosely by hand and then locked in place with lock nut.

(10) ENGINE - DRIVEN VACUUM PUMPS. *(See figure 237.)*

(a) DESCRIPTION.—Two engine-driven vac-

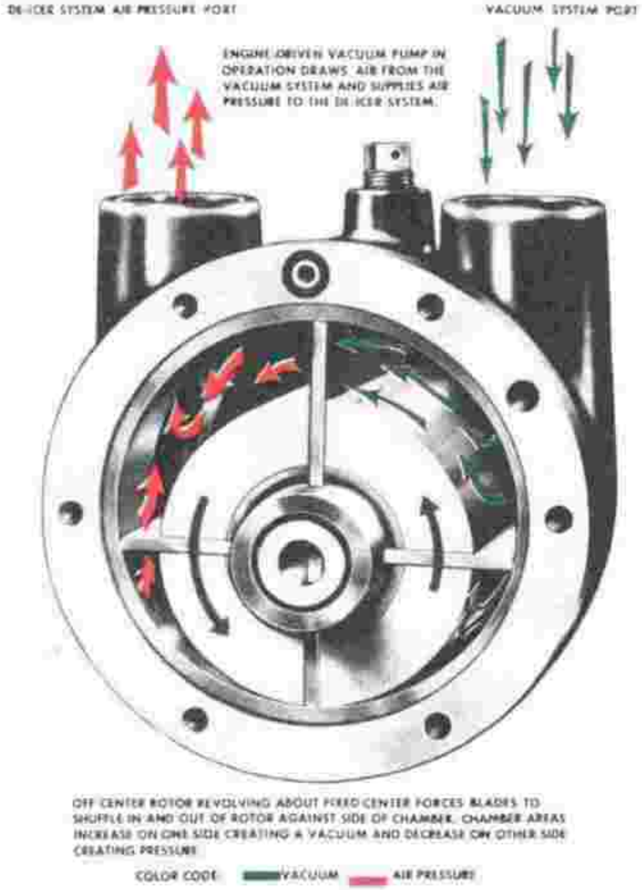


Figure 237 — Typical Vacuum Pump

uum pumps supply the suction required to operate the gyroscopic instruments, and the air pressure required to operate the wing and tail de-icing system. The pumps, installed on the lower left-hand side of each engine, are of the rotary, four vane, positive displacement type. Each pump consists essentially of a cast aluminum housing containing a tempered sleeve in which an offset rotor with four moving vanes is driven by means of a spring coupling mated with the engine drive gear. Rated capacity is 17 cubic feet of free air per minute at 2250 rpm with 4.2 inches of mercury inlet suction, and 16 inches of mercury outlet pressure. Ratio of the pump rpm to the engine rpm is 5 to 3. Both pumps operate continuously with the engines. They are automatically lubricated.

(b) REMOVAL.

1. Remove the left-hand access door on the nacelle, or the removable center section of the firewall.

2. Loosen the clamps and remove the two flexible hoses attached to the pump.

3. Remove the four safety-wired nuts which attach the pump to the engine.

4. Pull the pump away from the engine.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged or defective engine-driven vacuum pumps shall be replaced. For emergency repair see *figure 237.*

(d) TEST AFTER INSTALLATION.—Check vacuum provided by the pumps. The vacuum recorded on the suction gage should be 4.2 inches of mercury.

(11) VACUUM PUMP SELECTOR VALVE. *(See figure 238.)*

(a) DESCRIPTION.—While the two vacuum pumps run continuously with the engines, suction from only one of the pumps is utilized to operate the vacuum-actuated instruments. The vacuum pump selector valve, installed in the pilot's compartment aft of the pilot's seat, makes it possible for the pilot to switch the source of suction from one pump to the other in event of an engine failure. Under normal operation, the suction from the alternate pump is used to draw air from the de-icer system so that the de-icer boots will "hug" the wings and the stabilizers. When the de-icer system is operating, the same source of suction helps to deflate the boots.

(b) REMOVAL.

1. Disconnect the four vacuum lines and cap them.

2. Remove the four bolts which secure the valve to the bracket. Remove the valve.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—A damaged or defective vacuum pump selector valve shall be replaced. For emergency repairs see *figure 238.*

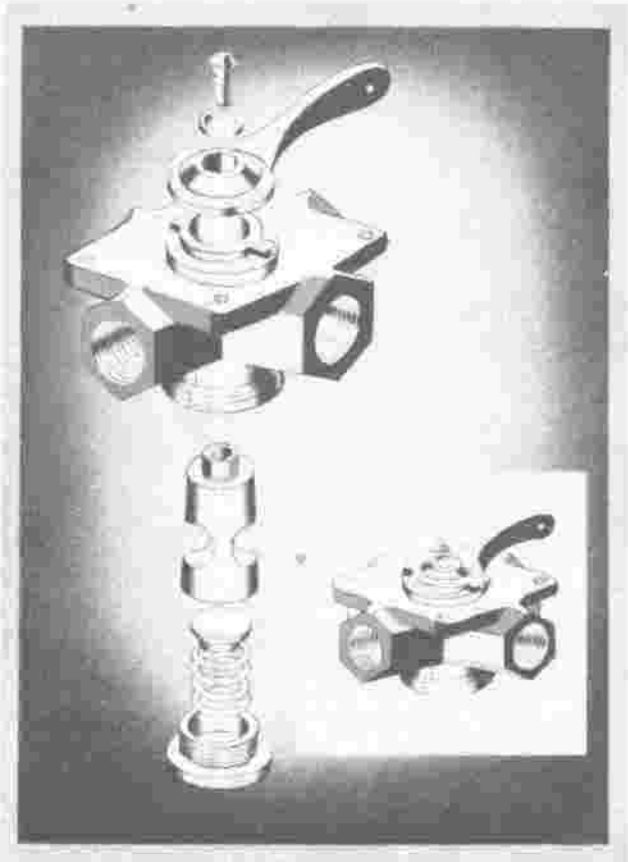


Figure 238—Vacuum Pump Selector Valve

(12) VACUUM MANIFOLD ASSEMBLY. *(See figure 235.)*

(a) DESCRIPTION. – The vacuum manifold assembly, mounted on a bracket in the pilot's compartment forward of the instrument panel, provides a simple means of distribution of vacuum to and from the vacuum-actuated instruments. The manifold assembly is a casting consisting of two leak-proof chambers, each containing four ports. An adjustable needle-valve is mounted on the casting, and is connected into the line which extends to the bank and turn indicator. The valve is used to restrict the vacuum from four inches of mercury to two inches.

(b) REMOVAL.

1. Remove the instrument panel access door on the top of the fuselage.

2. Disconnect the lines and the two bolts which attach the assembly to the bracket.

3. Remove the assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–A damaged or leaking vacuum manifold assembly shall be replaced.

(13) SUCTION RELIEF VALVE. *(See figure 239.)*

(a) DESCRIPTION.–A suction relief valve is installed in each of two lines extending from the vacuum pumps to the selector valve. Located in each nacelle forward of the firewall, the relief valves provide a means of controlling the amount of suction supplied. Each valve automatically supplies air to the vacuum pump in event that a line becomes clogged. The suction relief valve is the spring-loaded, disc type and has an adjustment screw.

(b) REMOVAL.

1. Remove access door from left-hand side of the engine mount.

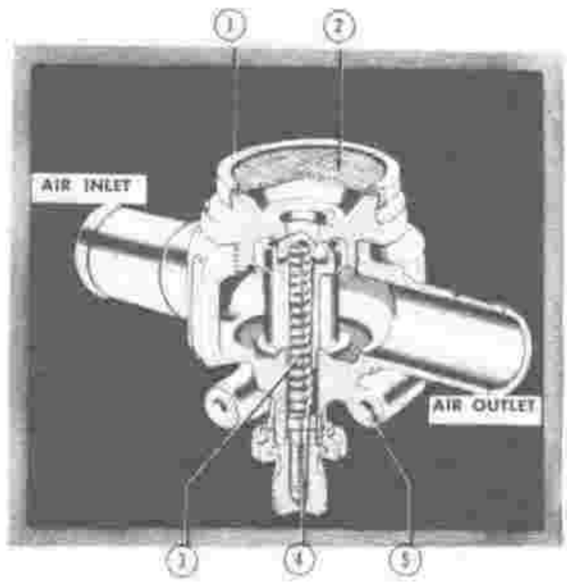
2. Disconnect the lines and cap them.

3. Remove the clamps from the two hose connections to the valve.

4. Slide off the hose and remove the valve.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. At regular engine overhaul periods, remove the valve seat from the valve body *(figure 239)* and take out the bakelite disc. Inspect the disc and correct any slight wear by passing it lightly over a flat oil stone. If the wear is excessive, replace the disc.



1. Type B-8 (2V-216-B) Suction Relief Valve
2. Valve Screen
3. Spring
4. Adjustment Screw
5. Mounting Lugs

Figure 239—Suction Relief Valve

2. When reassembling the valve, note condition of the gaskets and replace them if necessary. Make certain that the valve seat and the lock nut are fastened with safety wire.

(d) ADJUSTMENTS.—To increase the suction supplied to the vacuum instruments, loosen the lock nut on the suction relief valve and turn the adjusting nut clockwise. To decrease the suction, turn the nut counter-clockwise. The relief valve should be adjusted to supply a vacuum of 4.2 inches of mercury to the instruments.

(14) LINES. *(See figure 235.)*—Aluminum alloy tubing is used in the vacuum instrument system. The tubing is held in place at certain points by means of clips and clamps which reduce vibration. The actual connection to the instruments is made with short lengths of composition hose, installed to reduce instrument panel vibration. For replacement and maintenance of lines see Section VIII.

e. ELECTRICALLY OPERATED INSTRUMENTS.

(1) GENERAL.—The electrically operated instruments consist of the cylinder temperature indicator (thermocouple thermometer), the tachometer, the oil temperature indicator, the oil cooler door position indicator, the carburetor air temperature indicator, the fuel level gages, the tell-tale indicator, the remote magnetic compass indicator, the landing gear and flap position indicator, the radio compass left-right indicator, the outside air temperature indicator, the ammeters and the voltmeter. Because these instruments and related equipment are electrical in nature, all information other than a general description will be found in paragraph 15, this section. An exception is the radio compass left-right indicator, described in paragraph 15. *b.* (12) *(j)*, this section.

(2) CYLINDER HEAD TEMPERATURE INDICATOR (THERMOCOUPLE THERMOMETER). *(See 14, figure 232.)*—The dual cylinder head temperature indicator records the temperature of each of the air cooled engines. The instrument is actuated by electrical impulses set up in iron-constantan thermocouples located at the number 14 cylinders. Two zero-setting screws are provided on the front of the instrument for temperature adjustments.

(3) TACHOMETER. *(See 9, figure 232.)* — The tachometer measures the speed of the engine crank shafts in revolutions per minute. The dual indicator is actuated by an electrical generator attached to the tachometer drive of each engine.

(4) OIL TEMPERATURE INDICATOR. *(See 13, figure 232.)*—The dual oil temperature indicator records the temperature of the lubricating oil used in each engine. The indicator is connected electrically to sensitive resistor bulbs located in the oil container sumps.

(5) CARBURETOR AIR TEMPERATURE INDICATOR. *(See 12, figure 232.)*—The dual carburetor air temperature indicator shows the temperature which exists in the throat of the carburetor on each engine. The indicator is connected electrically to a resistor bulb installed in the intake duct of each carburetor.

(6) FUEL LEVEL GAGES. *(See 19 & 21, figure 232.)*—The fuel level gages indicate the quantity of fuel contained in each of the five containers normally installed in the airplane, and for the bomb bay ferry tank when installed. One dual indicator, installed on the instrument panel, shows the quantity in each of the main fuel containers installed in the nacelles. Another multiple indicator on the instrument panel shows the quantity in each of the two auxiliary fuel containers installed in the wings, and for the bomb bay (fuselage) container. A third indicator mounted on the control pedestal in the pilot's compartment shows the fuel quantity in the ferry tank when it is installed in the bomb bay. Each indicator is actuated electrically by means of float arms installed in each fuel container, and remote indication transmitters.

(7) TELL-TALE INDICATOR. *(See 26, figure 232.)*—The Douglas tell-tale indicator, located on the instrument panel and remotely controlled by the gunner at the sighting station, is installed to inform the pilot of the direction which the turret guns face in relation to the empennage; the outline of the empennage from a view looking aft is described on the dial of the instrument. When the turret AC power is turned on by the gunner a green dot appears on the dial. When the turrets are operated the green dot indicates the direction the guns face in relation to the tail section. A cathode ray tube is the source of the green dot.

(8) REMOTE MAGNETIC COMPASS INDICATOR. *(See 5, figure 232.)*—The remote magnetic compass indicator shows the direction the airplane is heading with reference to the earth's magnetic field. A rotating reference marker and setting knob are provided to help keep the airplane on a pre-selected course. The indicator is connected electrically to the magnetic compass transmitter, mounted on the vertical stabilizer.

(9) LANDING GEAR AND WING FLAP POSITION INDICATOR. *(See 22, figure 232.)* — The landing gear and wing flap position indicator keeps the pilot informed on the position of the main landing wheels, the nose wheel and the wing flaps. Red warning spots appear on the indicator when any part of the landing gear is not locked in the "UP" or the "DOWN" position. The wing flap position indicator is calibrated to show the ¼, ½, ¾ or "DOWN" position of the flaps. The instrument is actuated electrically by remote indication transmitters mounted near the units.

(10) RADIO COMPASS LEFT-RIGHT INDICATOR. *(See 3, figure 232.)*—The radio compass left-right indicator operates in conjunction with the radio compass to show the direction of an incoming radio signal in relation to the course of the airplane. The indicator is connected electrically to the radio compass, which is installed in the fuselage aft of this lower turret.

(11) OUTSIDE (FREE) AIR TEMPERATURE INDICATOR. *(See 2, figure 232.)*—The outside air temperature indicator records the temperature which exists outside the airplane. The indicator is connected electrically to a resistor bulb located in a well on the lower left-hand side of the fuselage near the junction of the nose section.

(12) AMMETERS. *(See 18 & 20, figure 232.)*—Two ammeters are installed on the pilot's instrument panel. The instruments measure the direct current produced by the generators installed on each engine. For all other information concerning this instrument refer to paragraph 15. *d.* (12), this section.

(1) VOLTMETER. *(See 16, figure 232.)*—A voltmeter is installed on the pilot's instrument panel. The instrument measures hte voltage produced by the electrical generators installed on each engine. For all other information concerning this instrument refer to paragraph 15. *d.* (12), this section.

(14) OIL COOLER DOORS POSITION INDICATOR. *(See 15, figure 232.)*—A dual oil cooler door position indicator is installed on the pilot's instrument panel. The indicator is actuated by electrical transmitters linked to the electrical drive unit of each oil cooler door. Door positions indicated on the dial of the indicator are open, closed and three intermediate points.

f. PRESSURE INSTRUMENTS.

(1) GENERAL.—The pressure-type instruments and associated equipment consist of a dual fuel pressure indicator, a dual oil pressure indicator, fuel and oil pressure transmitters, an engine manifold pressure gage, an engine manifold pressure gage line drain control, a hydraulic fluid pressure gage, a de-icer air pressure gage, an air pressure gage, and the pressure lines.

(2) REMOVAL.—The removal procedure is the same as for all other instruments located on the instrument panel. See paragraph 13. *c.* (3), this section.

CAUTION

When removing or installing a fuel or oil pressure transmitter, do not remove or loosen the flange screws used in the assembly of the transmitter. These screws have been set to a definite torque (25 to 30 inch-pounds) and may leak if disturbed.

(3) FILLING FUEL, OIL PRESSURE INSTRUMENT LINES. *(See figure 240.)*—To replace the compass fluid (Spec. AN-VV-C-551) in the fuel and oil pressure instrument lines and transmitters proceed as follows, using a portable filling gun or the master gage unit from the C-1 instrument field set:

(a) Center the diaphragm within the transmitter by loosening the lock nut which secures the thumbscrew on the front of the instrument, and gently pushing in on the thumb-screw until the pressure plate rests against the diaphragm; then turn the thumbscrew clockwise with the fingers until the pin engages in the slot.

(b) Remove the cap from the lower check valve on the back of the transmitter (the valve is black and marked "F"), and connect the filling gun.

(c) Remove the cap from check valve "B" near the indicator and connect a bleed line, venting it into a suitable vessel.

(d) Using a maximum pressure of 25 pounds per square inch, slowly force the compass fluid into the system, continuing until bubbles no longer come through the bleed line. (The end of the bleed line must be immersed in the fluid in the vessel so that the bubbles will show.)

(e) Remove the filling and bleed lines and replace the caps. Loosen the thumbscrew on the transmitter, pull the thumbscrew outward as far as it will go, and then tighten thumbscrew locknut. Connect the fuel or oil pressure line to the fitting on the base of the instrument. Check the indicator for zero setting. If there is an indication on the gage, with no pressure being applied at the transmitter, reset the pointer to zero by means of the setting screw located inside the case of the indicator.

(4) FUEL PRESSURE INDICATOR. *(See 10, figure 232.)*

(a) DESCRIPTION.—The dual fuel pressure indicator shows the fuel pressure which exists at the carburetor inlet of each engine. The indicator, which contains a metal bellows assembly, is actuated by compass fluid pressure which is transmitted through lines from the fuel pressure transmitters *(figure 241)* mounted in each engine section.

(b) MAINTENANCE REPAIR OR REPLACEMENT.

1. LOW OR ABSENT PRESSURE INDICATION.

a. If the oil pressure indication is low or absent, the trouble ordinarily may be traced to compass fluid leaks in the connecting lines or to a faulty

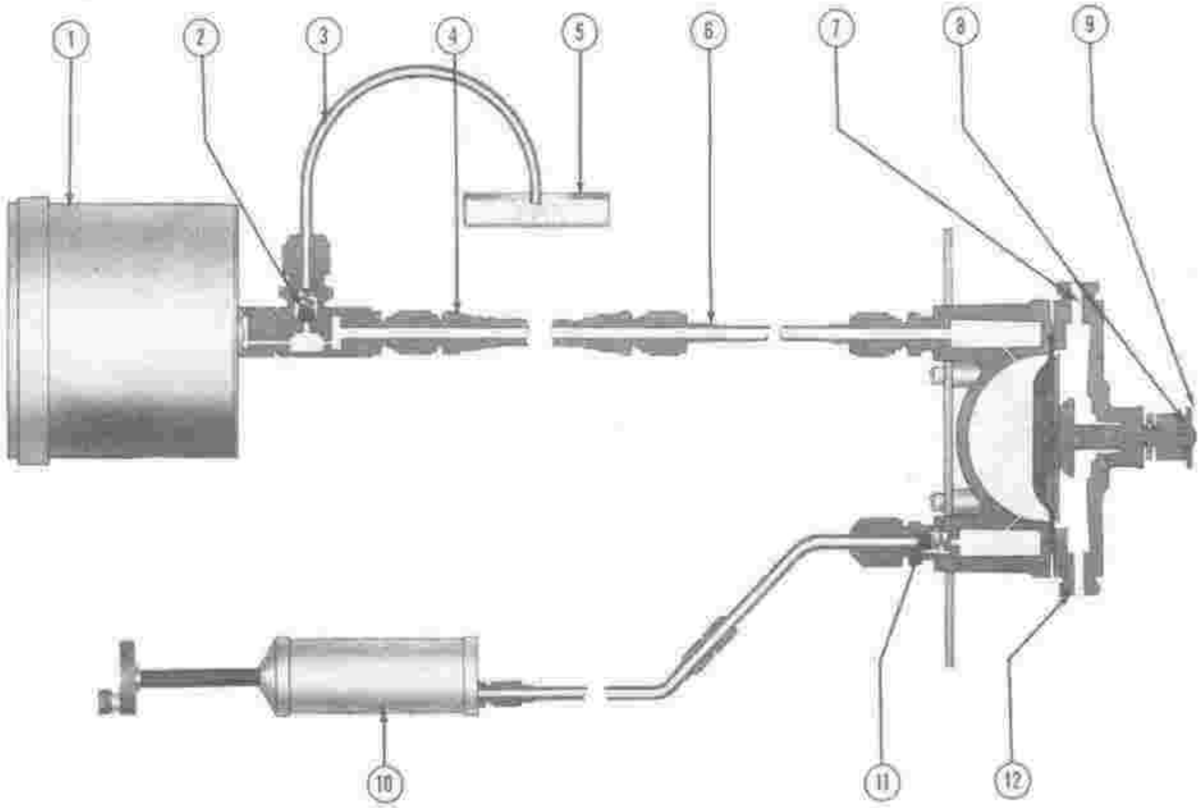


Figure 240 — Filling Procedure for Oil and Fuel Pressure Indicator Systems

indicator. Make a careful visual inspection of the lines and connections. If a leaking connection is discovered, drain the remaining compass fluid from the line. Take the leaky connection apart and inspect the flaring on the tube for cracks, distortions or dirt. Correct all cracks or distortions immediately.

b. If there is no leakage visible to the eye, make the following air pressure test for gradual leakage in the lines or indicator case:

(1) Drain the compass fluid from the lines.

(2) With the oil pressure indicator properly connected, disconnect the instrument line at the transmitter.

(3) Install a suitable air valve at the transmitter end of the instrument line. (A Schrader valve is recommended.)

(4) Attach to the valve an air pressure source equipped with a pressure regulator.

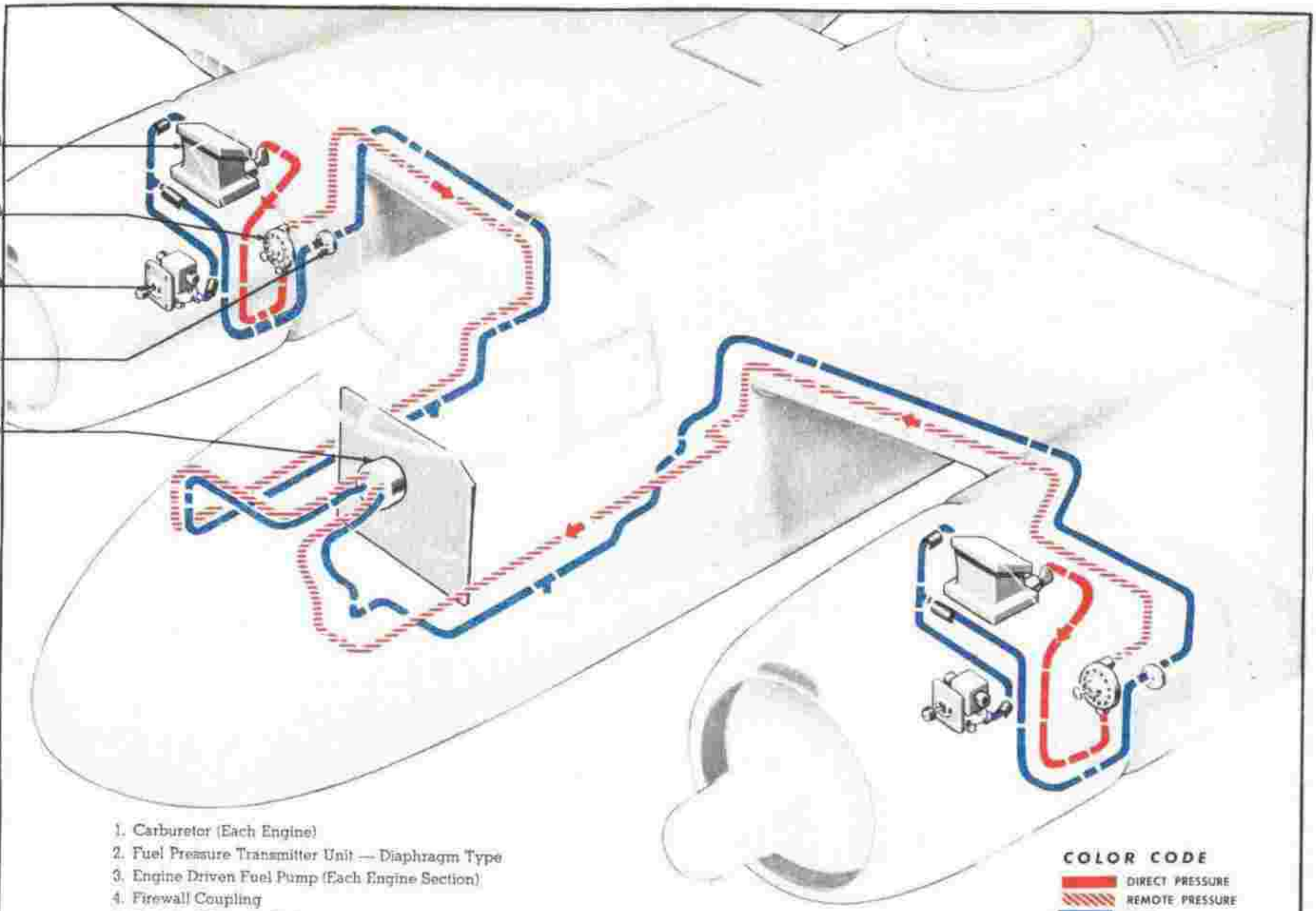
(5) Apply an air pressure of 160 pounds psi as indicated on the oil pressure indicator. Do not exceed 160 pounds.

(6) Maintain the air pressure for one-half hour. If the indicator shows a pressure drop, check lines and connections for leaks, using a brush and soap suds.

c. If no leaks can be found in the lines, it may be assumed that the oil pressure indicator is defective. Install a new indicator.

2. SLUGGISH INDICATION.

a. If the indicator pointer responds very slowly to the engine oil pressure, the difficulty frequently may be traced to a broken diaphragm in the



1. Carburetor (Each Engine)
2. Fuel Pressure Transmitter Unit — Diaphragm Type
3. Engine Driven Fuel Pump (Each Engine Section)
4. Firewall Coupling
5. Dual Fuel Pressure Indicator

Figure 241— Fuel Pressure Instrument System

transmitter. Damage of this kind will allow the engine oil to enter the compass fluid lines. To overcome the difficulty it will be necessary to drain the compass fluid and oil from the indicator end of the line and install a new transmitter. Then refill the system with compass fluid as described below.

b. A sluggish indication occuring in extremely cold weather (below 14 degrees F.) may be caused by the congealing of engine oil in the line which extends from the engine to the transmitter. To overcome the difficulty, proceed as follows every 25 hours, or after four flights:

(1) Remove the cap from the top of the oil pressure transmitter.

(2) Connect a filling gun containing hydraulic fluid (Specification AN-VV-O-366) to the transmitter and fill the transmitter and the line to the engine with the fluid.

(3) Replace the cap on the top of the transmitter.

(c) TEST AFTER INSTALLATION.—Disconnect the pressure line at the corresponding transmitter, apply an air pressure to the line which will give at least one-half of the scale reading on the indicator, and then close the source of the pressure at a point within two inches of the connection. During a period of one minute, the pressure indication of the pointer should not change. If a change in the indication occurs, and it is not due to a leakage in the lines, fittings or transmitter, remove the indicator and replace it with a serviceable instrument.

(5) OIL PRESSURE INDICATOR.
(See 11, figure 232.)

(a) DESCRIPTION.—The dual oil pressure indicator shows the pressure at which the lubricant is being forced to the engine bearings and the various other points of the lubricating system. The indicator, which contains a bourdon tube, is actuated by compass fluid pressure which is transmitted through lines from the oil pressure transmitters mounted in each engine section.

(b) MAINTENANCE REPAIR.—See paragraph 13. *f.* (4) *(b)*, above.

(c) TEST AFTER INSTALLATION.—See paragraph 13. *f.* (4) *(c)*, above.

(6) FUEL AND OIL PRESSURE TRANSMITTERS.—*(See figures 241 & 242.)*

(a) DESCRIPTION.—The fuel and oil pressure transmitters are manufactured to the same specification. Each transmitter consists of two chambers separated by a flexible synthetic rubber diaphragm. One side of the diaphragm is subjected to the fuel or oil pressure, as the case may be, and the other side transmits the pressure to the indicator through the medium of the compass fluid within lines. The oil and fuel pressure transmitters are mounted on the outboard side of the firewall in each nacelle.

(b) REMOVAL.

1. FUEL PRESSURE TRANSMITTER.

a. Remove the access door located on the left hand side of the engine mount.

b. Remove the connecting lines on the forward and aft sides of the firewall.

c. Remove the four bolts which attach the transmitter to the forward side of the firewall.

d. Remove the transmitter.

2. OIL PRESSURE TRANSMITTER.

a. Remove the access door located on the right-hand side of the engine mount.

b. Remove the line connected to the engine accessory case.

c. Disconnect the four bolts which secure the transmitter to the mounting bracket.

d. Remove the transmitter.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged or defective fuel and oil pressure transmitters shall be replaced.

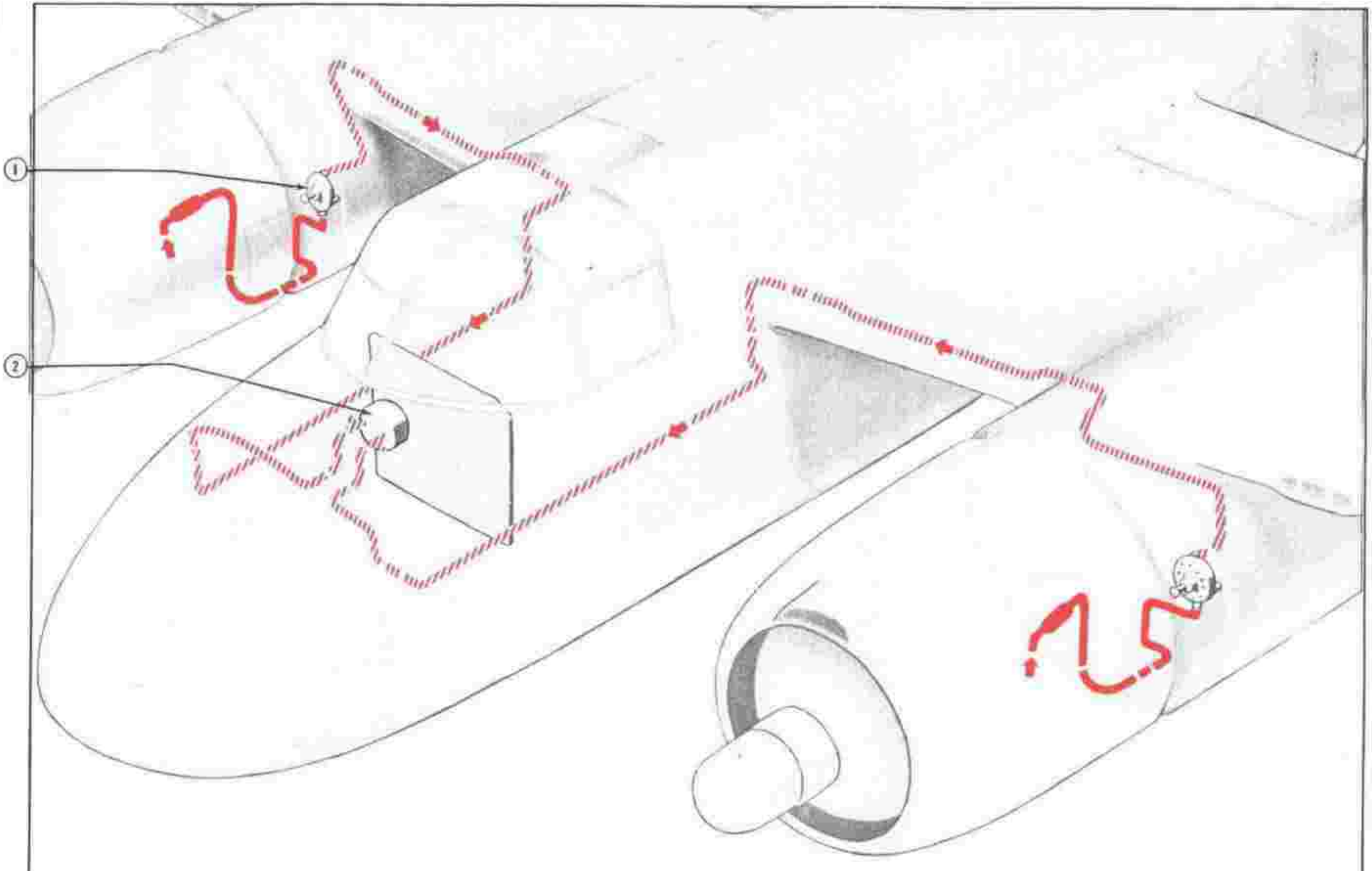
(d) ADJUSTMENTS.—No adjustments are provided on the fuel and oil pressure transmitters other than a means of setting the diaphragms when the pressure systems are being refilled with compass fluid. See paragraph 13.

(e) TEST AFTER INSTALLATION.—After the line to the instrument has been refilled with compass fluid, the transmitter and system may be tested for proper operation by disconnecting the engine pressure line at the transmitter and installing an air valve on the engine side of the transmitter. Apply suitable air pressure through a pressure regulator to give at least one-half scale indication on the instrument panel gage. If no pressure drop can be detected on the indicator within 30 minutes, the system is satisfactory for operation. If air leakage occurs, check connections and retest.

CAUTION

Never apply air pressure to the transmitter when the transmitter and the line are empty of compass fluid.

(7) ENGINE MANIFOLD PRESSURE GAGE.
(See 6, figure 232.)



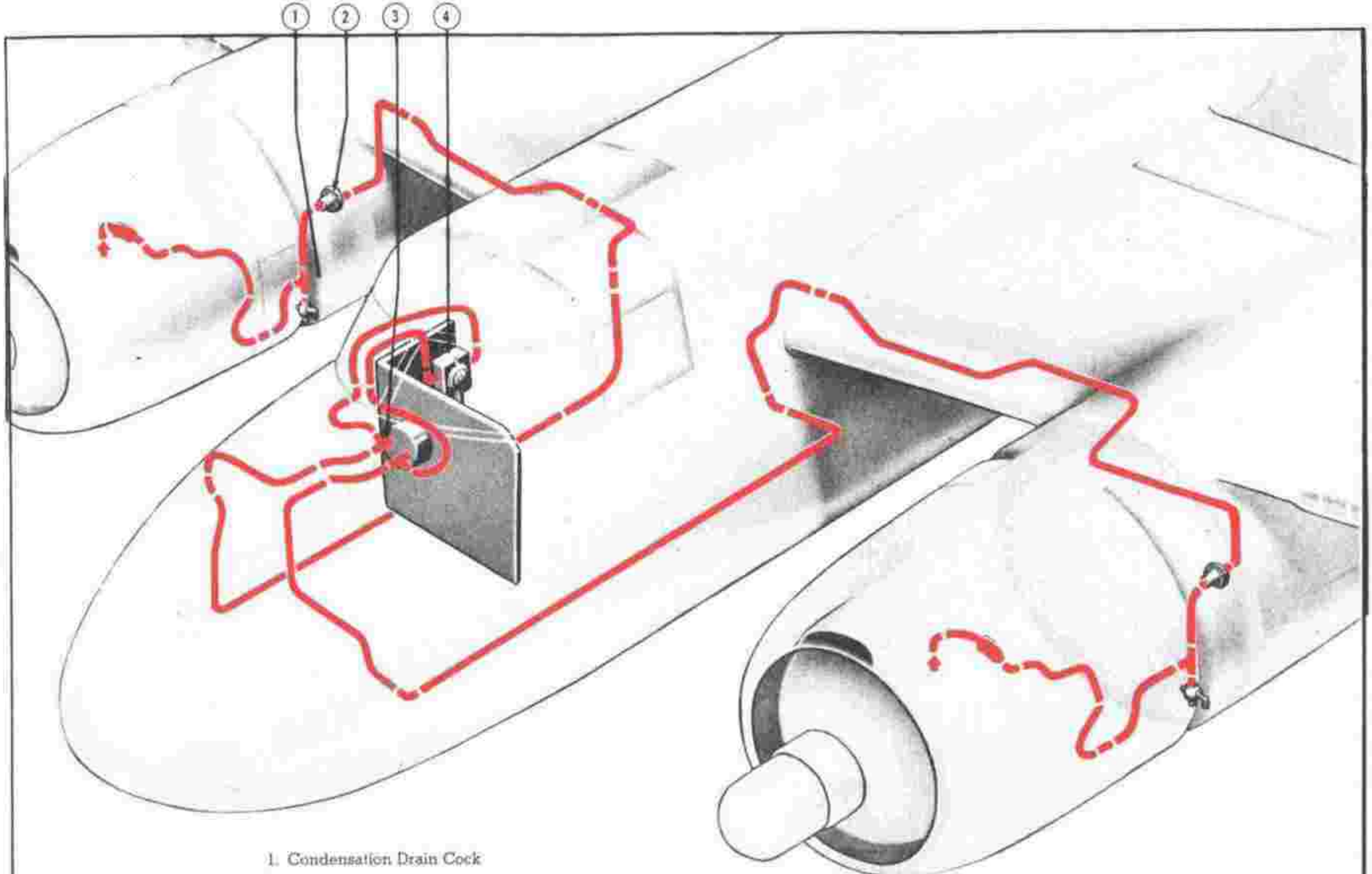
1. Oil Pressure Transmitter — Diaphragm Type (Each Engine Section)
2. Oil Pressure Indicator — Dual

COLOR CODE

DIRECT PRESSURE

REMOTE PRESSURE

Figure 242 – Oil Pressure Instrument System



1. Condensation Drain Cock
2. Firewall Connection
3. Manifold Pressure Gage — Dual
4. Manifold Pressure Gage Drain Control

Figure 243 — Manifold Pressure Instrument System

(*a*) DESCRIPTION.—The dual manifold pressure gage is connected to the intake manifold of each engine and guides the pilot in his use of the supercharger. Lines extend directly from each engine to the gage, which contains two bellows assemblies. When the engines are inoperative, the gage indication should correspond with the local barometric pressure. The dial is calibrated in inches of mercury.

(*b*) MAINTENANCE REPAIR OR REPLACEMENT.

1. A damaged or defective engine manifold pressure gage shall be replaced.

2. To test the engine manifold pressure gage for case air leaks, disconnect the manifold pressure line at the gage and apply an air pressure which will give a scale reading of 50 inches of mercury. If the pressure indication drops in a one minute period, the instrument shall be replaced.

(*c*) TEST AFTER INSTALLATION.

1. The engine manifold pressure gage may be tested for case leaks by first disconnecting the line to the gage at the engine end, and then applying air pressure until the indicator shows 50 inches of mercury. Maintain the air pressure for at least a minute, during which time there should be no change in the reading.

2. The damping adjustment in the instrument is checked by suddenly releasing the air pressure after the gage reaches 50 inches of mercury. The indicator should reach 32 inches of mercury in not less than one second, or more than two seconds.

(8) ENGINE MANIFOLD PRESSURE GAGE LINE DRAIN CONTROL. *(See figure 243.)*—This control is used to clear moisture from the engine manifold gage lines prior to takeoff. The control, which is a simple valve and lever assembly, is mounted on the instrument panel glare shield and is connected to the pressure lines extending from the manifold at each engine. The control is so arranged that when the valve is opened, air is permitted to enter the lines and the moisture is sucked back into the engine manifold. In order that the moisture will not be blown into the pilot's compartment, the engine should always be idling at 800 rpm or less when draining the lines. The valve is opened for a period of approximately 30 seconds.

(9) HYDRAULIC FLUID PRESSURE GAGE. *(See 17, figure 232.)*—The hydraulic fluid pressure gage records the pressure which exists in the hydraulic system. The gage is located on the pilot's left-hand control panel and is connected to the left-hand brake pressure supply line. For all other information on the instrument, refer to paragraph 14., this section.

(10) DE-ICER AIR PRESSURE GAGE. *(See figure 232.)*—The de-icer air pressure gage measures the air pressure delivered to the de-icing system from the exhaust of the engine-operated vacuum pumps. The gage is located on the pilot's left-hand control panel. For all other information on the instrument, refer to paragraph 20., this section.

(11) AIR PRESSURE GAGE. *(See figure 288.)*—The air pressure gage, which is connected to the air bottle in the pilot's compartment, indicates the air pressure which is available for emergency application of the brakes. The gage is located near the top of the pilot's enclosure, aft and right of the pilot's seat. For all other information concerning the gage, refer to paragraph 14., this section.

(12) LINES. (See Section VIII.)—Aluminum alloy tubing is used in the fuel, oil and manifold pressure instrument systems. The tubing is held in place at certain points by means of clips and clamps which reduce vibration. Actual connection with the instruments is made with short lengths of flexible hose. Drain tees are provided in the fuel pressure vent line. Drain cocks are installed in the manifold pressure lines at the firewall, on some airplanes. When the airplane is parked in a cold area, the drain cocks should be opened to permit drainage of moisture which condenses in the line after the engines have cooled. Close the drain cock before starting the engines.

g. CLOCK.
(See 29, figure 232.)

(1) GENERAL.—A clock is mounted on each of the pilot's and bombardier's (when installed) instrument panels in the same manner as the instruments. The clock consists of an aluminum case containing an eight-day movement. A winding and setting knob is provided on the front of the clock, and a rate adjustment is provided on the back.

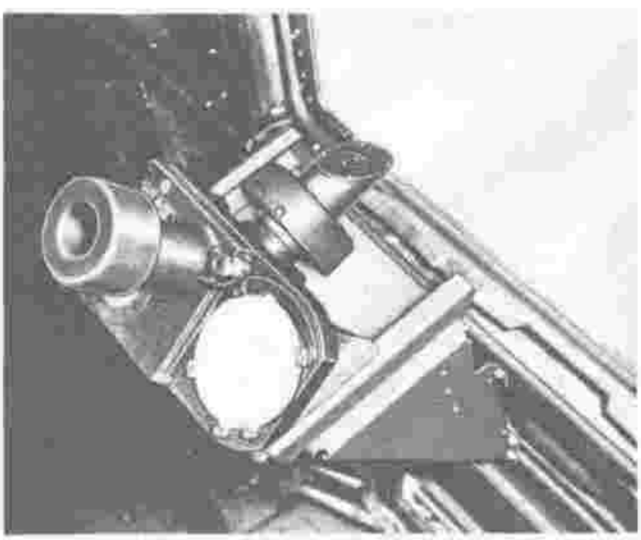


Figure 244—Driftmeter

(2) REMOVAL. – Remove the four bolts which attach the clock to the instrument panel and remove the clock.

(3) MAINTENANCE REPAIR OR REPLACEMENT.–A damaged or defective clock shall be replaced.

(4) ADJUSTMENT.–The clock shall be set to correspond with the master clock in the control tower.

h. DRIFT METER. *(See figure 244.)*–A Type B-5 drift meter is installed on the right wall of the pilot's compartment on some airplanes. The drift meter is used by the navigator (gun loader) to measure the angle between the navigational heading of the airplane and its actual path over the ground. The drift meter also may be used to determine ground speed.

i. ASTRO-COMPASS.–A type A-1 astro compass is mounted on the under side of the entrance latch of the pilot's compartment on certain airplanes. The instrument is used to provide the navigator with a true heading of the airplane, and to swing the magnetic compass and correct its reading during flight.

j. INSTRUMENT TROUBLE SHOOTING LIST.

BANK AND TURN INDICATOR

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Pointer fails to respond.	*a.* Leaky or clogged line.	*a.* Repair, clean, or replace line. See section VIII.
	b. Clogged air filter.	*b.* Clean filter. See paragraph 13. *d.* (9) *(c)*, this section.
	c. Oil thickened by cold.	*c.* Replace instrument.
	d. Valve at manifold clogged.	*d.* Clean valve.
	e. Vacuum pump selector valve not fully open.	*e.* Open vacuum pump selector valve.
	f. Dirt in mechanism.	*f.* Replace instrument.
2. Incorrect sensitivity.	*a.* Too much or too little vacuum.	*a.* See remedies above. Readjust the control valve on manifold.
	b. Air filter clogged.	*b.* Clean filter. See paragraph 13. *d.* (9) *(c)*, this section.
3. Pointer vibrates.	*a.* Excessive vibration in instrument panel.	*a.* Check mounting of panel. Replace rubber shock absorbers if worn or deteriorated.
	b. Damping screw misadjustment.	*b.* Replace instrument.
	c. Lack of oil.	*c.* Lubricate at 100 hour Inspection.
	d. Defective mechanism.	*d.* Replace instrument.
4. Pointer does not set at zero.	*a.* Defective mechanism.	*a.* Replace instrument.
	b. Pointer sits incorrectly on staff.	*b.* Replace instrument.
	c. Sensitivity spring adjustment pulls pointer off zero.	*c.* Replace instrument.

DIRECTIONAL GYRO INDICATOR

1. Excessive drift in card.	*a.* Excessive vibration.	*a.* Check panel shock mountings and replace if necessary.
	b. Improper suction.	*b.* Adjust suction relief valve. See paragraph 13. *d.* (13) *(d)*, this section.
	c. Engine-driven vacuum pump failure.	*c.* Replace pump. See paragraph 13. *d.* (10), this section.
	d. Air filter clogged.	*d.* Clean air filter. See paragraph 13. *d.* (9) *(c)*, this section.
	e. Leak in vacuum line.	*e.* Locate leak and repair line. See Section VIII.
	f. Vacuum pump selector valve not fully open.	*f.* Open vacuum pump selector valve.
	g. Defective mechanism (worn or dirty pivots and bearings).	*g.* Replace instrument.

j. INSTRUMENT TROUBLE SHOOTING LIST.—Continued.

TROUBLE	PROBABLE CAUSE	REMEDY
2. Caging mechanism works hard.	*a.* Lack of oil.	*a.* Lubricate external part of shaft with instrument oil.
3. Pendulum ball doesn't center.	*a.* Instrument out of alignment on panel.	*a.* Correct the alignment.

GYRO HORIZON INDICATOR

TROUBLE	PROBABLE CAUSE	REMEDY
1. Horizon bar fails to respond.	*a.* Instrument caged.	*a.* Uncage instrument.
	b. Air filter dirty.	*b.* Clean filter. See paragraph 13. *d.* (9) *(c)*, this section.
	c. Vacuum below required 3.5 inches Hg.	*c.* Adjust suction relief valve. See paragraph 13. *d.* (13) *(d)*, this section.
	d. Air leak in vacuum line or connection.	*d.* Locate and repair leak. See section VIII.
	e. Vacuum pump selector valve not fully open.	*e.* Open vacuum pump selector valve.
	f. Failure of engine-driven vacuum pump.	*f.* Replace engine-driven vacuum pump. See paragraph 13. *d.* (10) *(c)*, this section.
2. Horizon bar fails to settle.	*a.* Excessive vibration.	*a.* Check panel mountings and replace if defective.
	b. Insufficient vacuum.	*b.* Adjust suction relief valve. See paragraph 13. *d.* (13) *(d)*, this section.
	c. Defective mechanism.	*c.* Replace instrument.
3. Horizon bar oscillates.	*a.* Gyro not completely uncaged.	*a.* Uncage gyro.
	b. Air filter dirty.	*b.* Clean filter. See paragraph 13. *d.* (9) *(c)*, this section.
	c. Excessive vacuum.	*c.* Adjust suction relief valve. See paragraph 13. *d.* (13) *(d)*, this section.
	d. Excessive vibration.	*d.* Check panel mountings and replace if necessary.

SUCTION GAGE

TROUBLE	PROBABLE CAUSE	REMEDY
1. Excessive error at zero.	*a.* Loose pointer.	*a.* Replace gage.
	b. Seasoning of diaphragm.	*b.* Replace gage.
2. Scale error excessive.	*a.* Improper calibration.	*a.* Replace gage.
3. Pointer calibration excessive.	*a.* Rough seat in suction relief valve.	*a.* Adjust or replace suction relief valve.

FUEL, OIL PRESSURE INDICATORS

TROUBLE	PROBABLE CAUSE	REMEDY
1. Excessive pointer oscillation.	*a.* Defective mechanism.	*a.* Replace instrument.
2. Jerky movement of pointer.	*a.* Defective mechanism.	*a.* Replace instrument.
3. Sluggish operation of pointer.	*a.* Foreign material in connecting lines.	*a.* Clean connecting lines.
	b. Oil congealed in line to engine due to extreme cold.	*b.* Fill line with low viscosity fluid. See paragraph 13. *f.* (3), this section.

j. INSTRUMENT TROUBLE SHOOTING LIST.—Continued.

TROUBLE	PROBABLE CAUSE	REMEDY
4. Limited or no pointer movement.	*a.* Leak in lines or connections.	*a.* Locate and repair leak. See section VIII.
	b. Insufficient compass fluid.	*b.* Refill lines with fluid. See paragraph 13. *f.* (3), this section.
	c. Defective instrument.	*c.* Replace instrument.
	d. Defective transmitter.	*d.* Replace transmitter.
5. High reading.	*a.* Faulty instrument.	*a.* Replace instrument.

ENGINE MANIFOLD PRESSURE GAGE

TROUBLE	PROBABLE CAUSE	REMEDY
1. Excessive pointer oscillation.	*a.* Instrument needs adjustment.	*a.* Replace instrument.
2. Jerky movement of pointer.	*a.* Trouble in instrument.	*a.* Replace instrument.
3. Sluggish pointer.	*a.* Foreign material in connecting lines.	*a.* Clean lines by means of manifold pressure gage line drain. See paragraph 13. *f.* (8), this section.
4. Limited pointer movement.	*a.* Loose pointer.	*a.* Replace instrument.
	b. Leak in line or connections.	*b.* Locate leak and repair line. See section VIII.
5. High or low reading.	*a.* Instrument needs adjustment.	*a.* Replace instrument.
6. Excessive error at existing barometric pressure.	*a.* Pointer shifted.	*a.* Replace instrument.

ALTIMETER

TROUBLE	PROBABLE CAUSE	REMEDY
1. Instrument fails to function.	*a.* Clogged static line connection.	*a.* Disconnect all instruments from static connection line and blow through tubing.
	b. Defective mechanism.	*b.* Replace instrument.
2. Rough operation, excessive friction.	*a.* Dirty or defective mechanism.	*a.* Replace instrument.
3. Reading high.	*a.* Static line leaks.	*a.* Check static line for leak. See section VIII and make necessary repairs.
	b. Pitot tube out of alignment.	*b.* Line up pitot tube.

RATE OF CLIMB INDICATOR

TROUBLE	PROBABLE CAUSE	REMEDY
1. Pointer off zero.	*a.* Shift in mechanisms.	*a.* Reset pointer by means of adjustment screw. Tap lightly while making adjustment.
2. Pointer cannot be reset to zero.	*a.* Broken pivot.	*a.* Replace instrument.
3. Pointer fails to respond.	*a.* Obstruction in static line.	*a.* Disconnect all instruments connected to static line, open line drain plug, and blow line clear.
4. Indication incorrect.	*a.* Case air leak.	*a.* Replace instrument.
	b. Friction due to dirty pivots and jewels.	*b.* Replace instrument.
	c. Pitot tube damaged.	*c.* Replace tube. See paragraph 13. *c.* (8), this section.
5. Pointer oscillates.	*a.* Air leak in static line.	*a.* Disconnect all instruments from line, check lines and instruments for leaks. See section VIII.

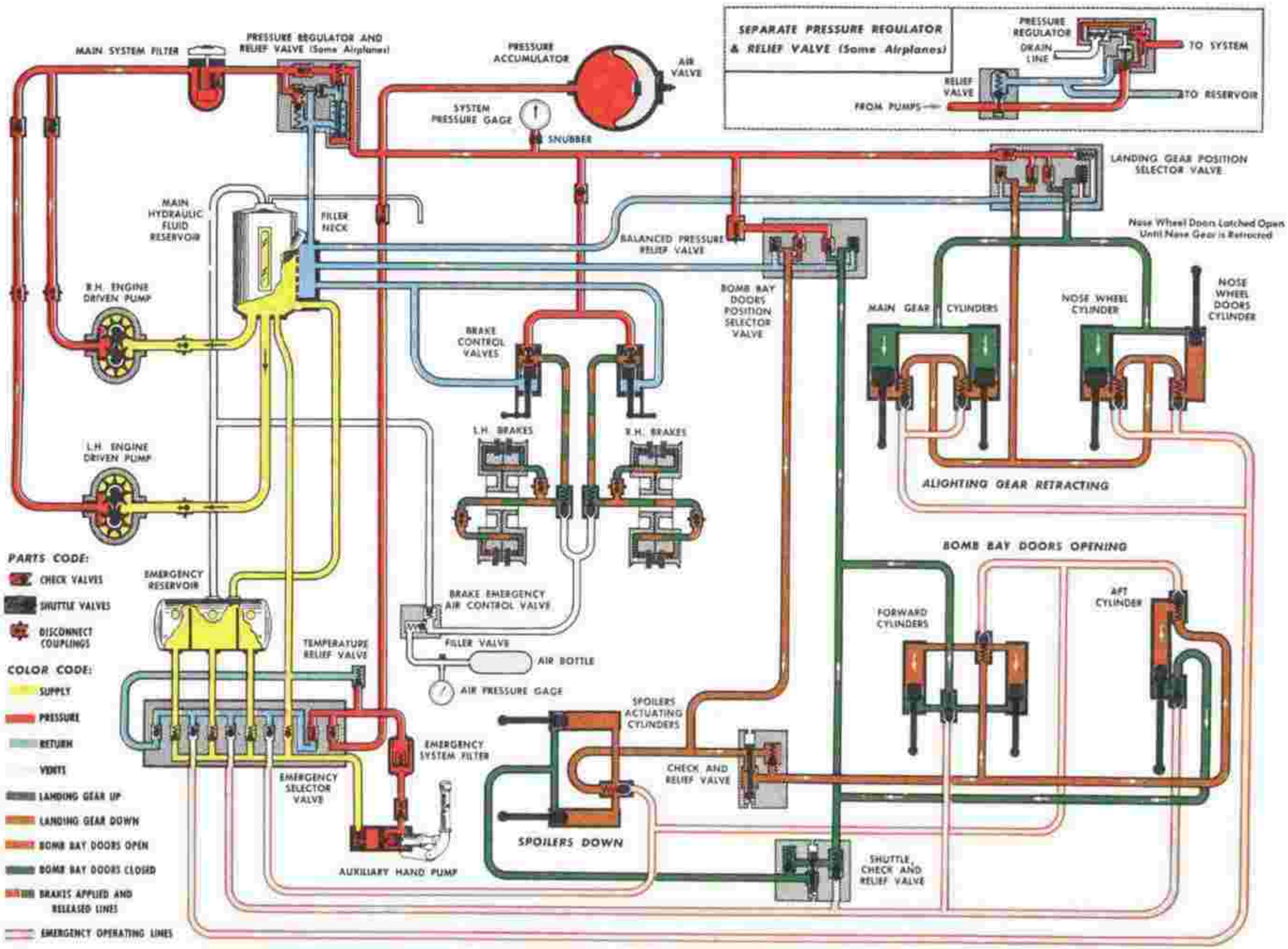


Figure 245 — Hydraulic Fluid Flow System

14. HYDRAULICS

a. GENERAL. – A pressure-accumulator type hydraulic system *(figure 245)* is installed in the airplane to operate the retractable tricycle alighting gear, the brakes, and the bomb bay doors and bomb bay spoilers. The entire hydraulic system contains approximately eight U.S. gallons (6.66 Imperial gallons) of hydraulic fluid, Specification AN-VV-O-366. During normal operation fluid pressure is supplied by two engine-driven hydraulic pumps. An emergency hydraulic system is installed to extend the alighting gear, and to open and close the bomb bay doors and spoilers. A pressure bottle type brake emergency air system is installed to operate the brakes if the main hydraulic system is not functioning.

b. SUPPLY, PRESSURE, AND RETURN HYDRAULIC SYSTEM. *(See figure 246.)*

(1) GENERAL.–The main hydraulic system fluid reservoir *(10, figure 246)* which has a capacity of 1.75 U.S. gallons (1.46 Imperial gallons), supplies fluid by gravity to the two engine-driven hydraulic pumps *(2, figure 246)*. The fluid under pressure from the engine-driven pumps flows through disconnect couplings *(3, figure 246)* and check valves *(8, figure 246)* into a filter *(9, figure 246)* and then to the hydraulic system pressure regulator *(12, figure 246)* which is set to maintain a system operating pressure of 850 to 1000 psi. Check valves prevent the back flow of hydraulic fluid from the system to the engine-driven pumps should the engines fail. From the pressure regulator, the fluid flows to the hydraulic system pressure accumulator *(14, figure 246)* and then to the systems. If the pressure regulator fails to operate properly and the system pressure exceeds 1250 ± 25 psi, the system pressure relief valve by-passes the excess fluid to the main hydraulic system reservoir. The entire system operating pressure may be relieved by applying toe pressure to and releasing the rudder-brake pedals *(figure 247)* until the hydraulic system pressure gage indicates zero. The operating pressure is indicated on the hydraulic system pressure gage *(5, figure 246)* located on the left side of the instrument panel in the pilot's compartment on some airplanes, and on the main instrument panel on other airplanes.

CAUTION

As long as the hydraulic units are operating properly they should not be removed from the airplane, regardless of the period of service. Disassembly of any of the units should be undertaken only when absolutely necessary. It is a safe rule that if a hydraulic unit is operating satisfactorily, LET IT ALONE. If damage to a unit is suspected, test it in the airplane before removing it for disassembly.

(2) ENGINE-DRIVEN HYDRAULIC PUMPS. *(See figures 248 and 249.)*

(a) DESCRIPTION.–One gear-type engine-driven, pressure-loaded pump is mounted on the accessory drive section of each engine. The pump will operate in either direction of rotation. The pumping action is accomplished by the rotation of a pair of closely meshed precision steel gears supported on bronze bearings within a closely fitted housing. When the gear teeth separate on one side, the resultant tooth space is filled by hydraulic fluid drawn from the inlet port. The fluid is carried around to the opposite side where the teeth mesh again, and then displaced into the pressure port. This action produces a positive flow of fluid under pressure into the outlet port of the pump. The pump cover is provided with four spring-loaded, ball-type check valves. Working in combination, one set of two check valves operates to provide suitable lubrication throughout the pump, and the other set provides a means of pressure loading the cover bearings to compensate for wear on the bearings and to provide more efficient operation in cold weather. The drive gear of the pump is turned by a drive shaft which engages the engine accessory drive. The drive shaft is provided with a safety shear section to protect the engine accessory drive if pump failure is caused by excessive load or jamming of parts. Each pump supplies sufficient pressure to operate the hydraulic system, but the actuation of the hydraulic units will be slower if only one engine-driven pump is operative.

(b) REMOVAL.

1. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

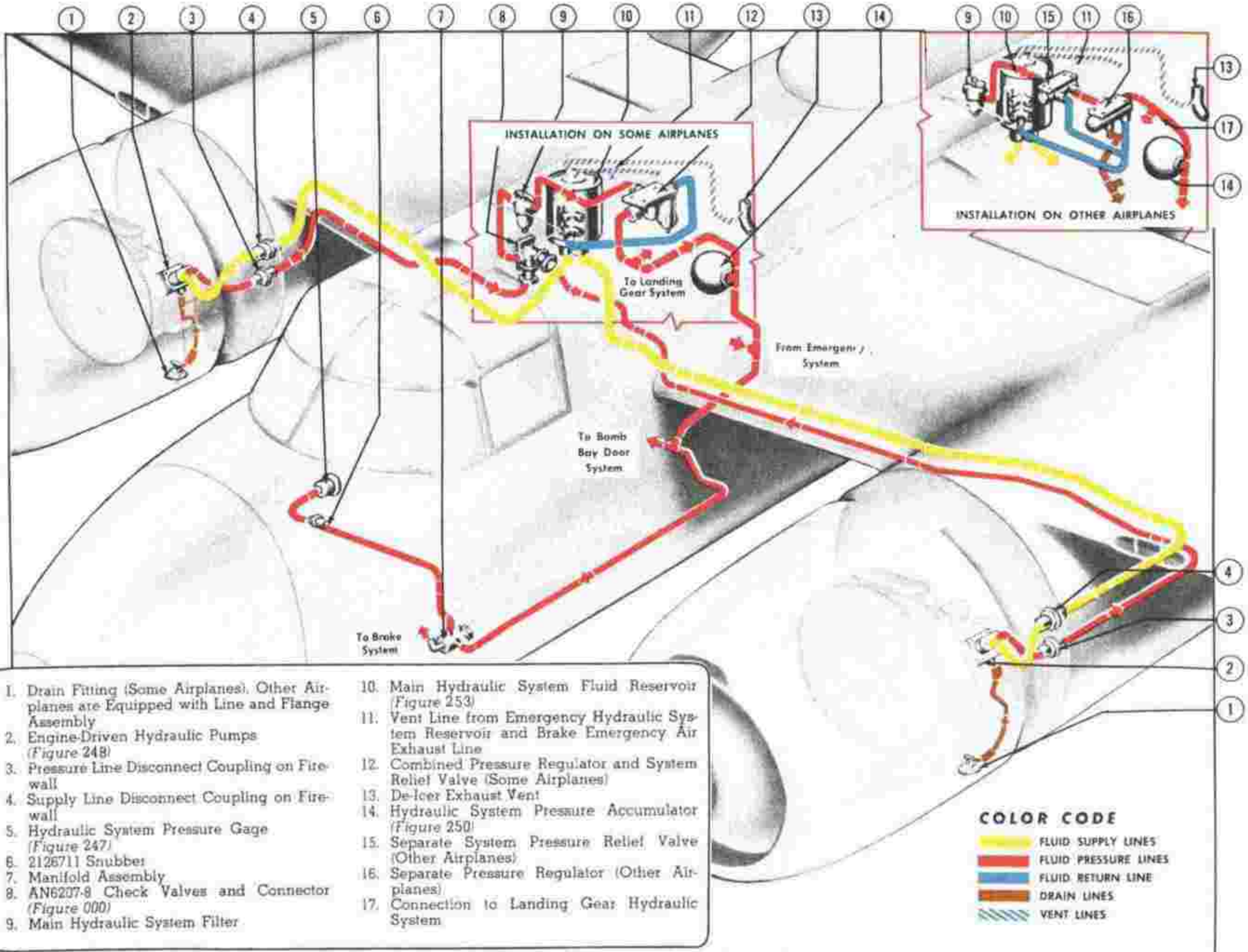
2. Remove the access door *(3, figure 9)* on the outboard side of the left nacelle and the inboard side of the right nacelle.

3. Disconnect and cap the hydraulic hoses at each pump. Disconnect the engine-driven pump drain line.

4. Cut the safety wire, remove the nuts that attach each pump to the engine mounting pad studs and then remove the pump and gasket from the mounting pad.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. The fluid circulating through the pump during normal operation provides ample lubrication for all requirements; therefore, no special lubrication is required.



1. Drain Fitting (Some Airplanes). Other Airplanes are Equipped with Line and Flange Assembly
2. Engine-Driven Hydraulic Pumps (*Figure 248*)
3. Pressure Line Disconnect Coupling on Firewall
4. Supply Line Disconnect Coupling on Firewall
5. Hydraulic System Pressure Gage (*Figure 247*)
6. 2126711 Snubber
7. Manifold Assembly
8. AN6207-8 Check Valves and Connector (*Figure 000*)
9. Main Hydraulic System Filter
10. Main Hydraulic System Fluid Reservoir (*Figure 253*)
11. Vent Line from Emergency Hydraulic System Reservoir and Brake Emergency Air Exhaust Line
12. Combined Pressure Regulator and System Relief Valve (Some Airplanes)
13. De-Icer Exhaust Vent
14. Hydraulic System Pressure Accumulator (*Figure 250*)
15. Separate System Pressure Relief Valve (Other Airplanes)
16. Separate Pressure Regulator (Other Airplanes)
17. Connection to Landing Gear Hydraulic System

Figure 246— Hydraulic Supply, Pressure, and Return System

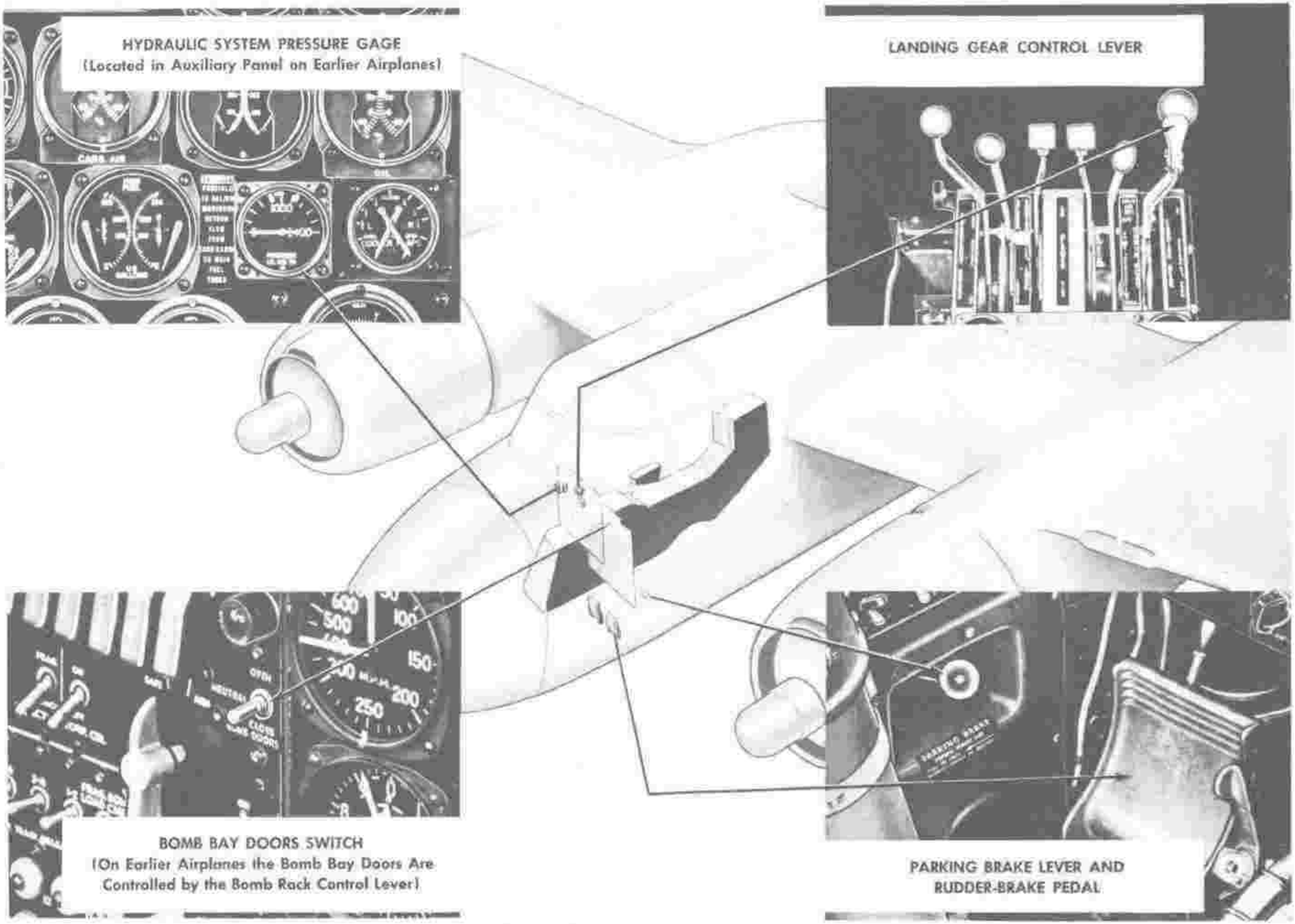
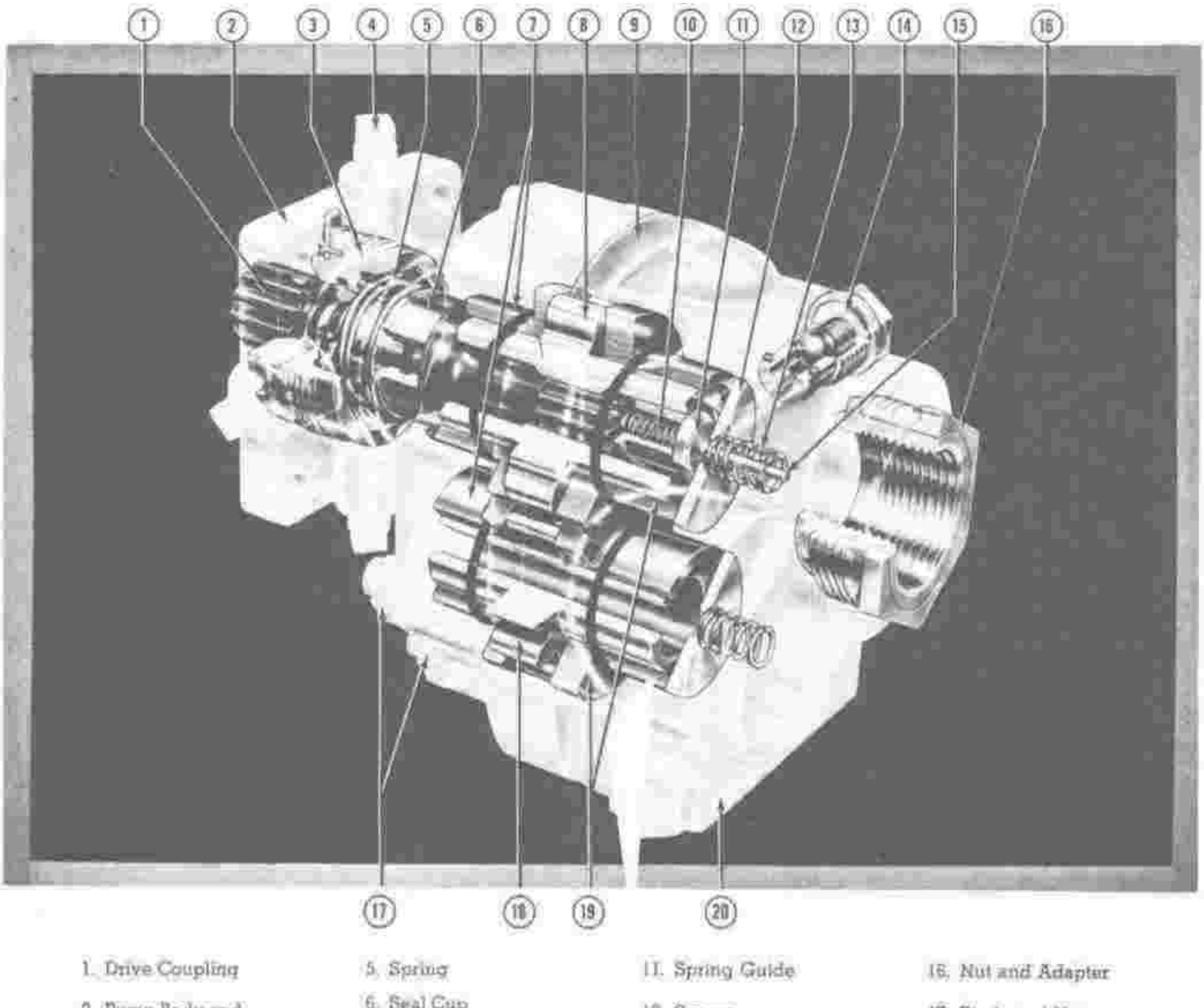


Figure 247—Hydraulic System Controls and Instruments

2. Loss in pump capacity may be caused by foreign material becoming lodged under the ball check valves. The ball check valves should be removed by removing the valve retainers from the cover. Wash the ball checks in clear gasoline and reassemble the ball check valves.

3. The pump will not function properly if there is any air in the system. Bleed the lines to ensure that they are free from entrapped air. The lines may be bled by operating all units to the full extent. Bleed the brakes according to the procedure outlined in paragraph 14. *e.* (2) *(d) 1,* this section.

4. Loss of capacity may also be caused by air being drawn through the seal into the pump. The mating spline of the engine accessory drive may be slightly burred or rusted or have an accumulation of grease which prevents the spline on the pump coupling drive from entering the engine drive spline to full depth. This will force the bronze seal disc away from the seal surface of the drive shaft and allow air to be drawn into the pump. Before the pump is mounted, the engine mounting pad and drive should be carefully checked to be certain they are clean. A small portion of clean grease should be placed on the pump drive spline before it is installed on the engine.



1. Drive Coupling
2. Pump Body and Mounting Flange
3. Drive Coupling Seal Assembly
4. Plug
5. Spring
6. Seal Cup
7. Body Bushings
8. Drive Gear
9. Cover Gasket
10. Drive Coupling Spring
11. Spring Guide
12. Spacer
13. Spacer Spring
14. Check Valve Assembly
15. Pin
16. Nut and Adapter
17. Studs and Nuts
18. Driven Gear
19. Cover Bushings
20. Pump Cover

Figure 248—Typical Engine-driven Hydraulic Pump (Pesco)

5. Leakage exceeding the maximum limit of five drops per minute from the drain port requires examination of the seal rings or seal surfaces for damage, or for particles of dirt which may be embedded in them. If the seal surfaces are rough or scored, or if the seal rings are swollen or torn, replace them with new parts.

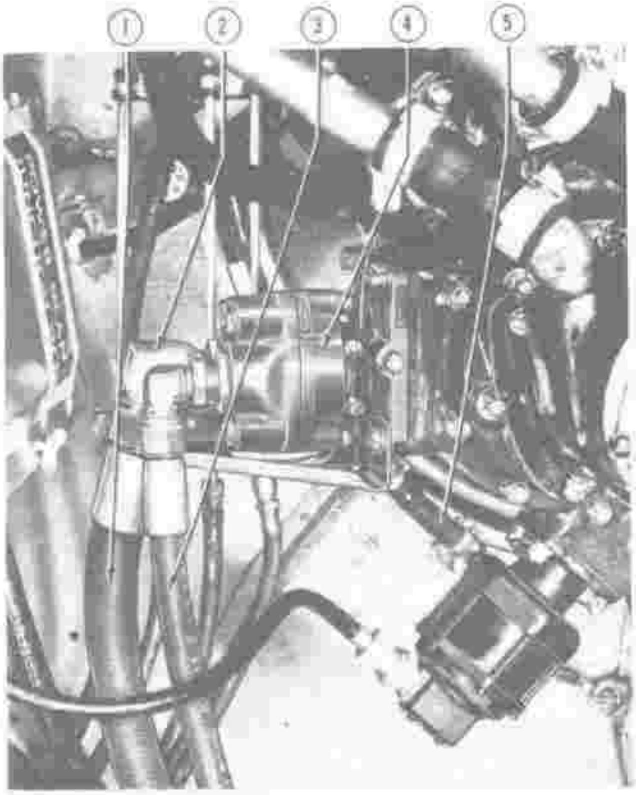
6. Sheared pump drive coupling or damaged pump requires replacement. Disassembly and major repair of the engine-driven pumps should be undertaken only at depots where adequate tools and testing facilities are available.

(d) INSTALLATION.

1. Before installing a new pump, flush the pump with hydraulic fluid (Spec. AN-VV-O-366).

2. Clean the engine mounting pad. Check the engine drive to see that the spline is free from nicks, burrs, rust, or accumulated grease.

3. Turn the pump coupling with the fingers to test for freedom of operation.



1. Hose Assembly (Supply)
2. 2126774 Elbow
3. Hose Assembly (Pressure)
4. Engine-Driven Hydraulic Pump
5. Pump Drain Line

Figure 249—Engine-driven Hydraulic Pump Installed

Note

The coupling tension springs of the bushings cause a close fit of the gears. Do not reject a pump merely because it appears to be too tight.

4. Apply a thin coating of lubricant, Specification AN-G3, to the splines of the pump drive coupling. Also apply a thin coating of the same lubricant to all male pipe threads, taking care to keep first (leading) thread free from grease.

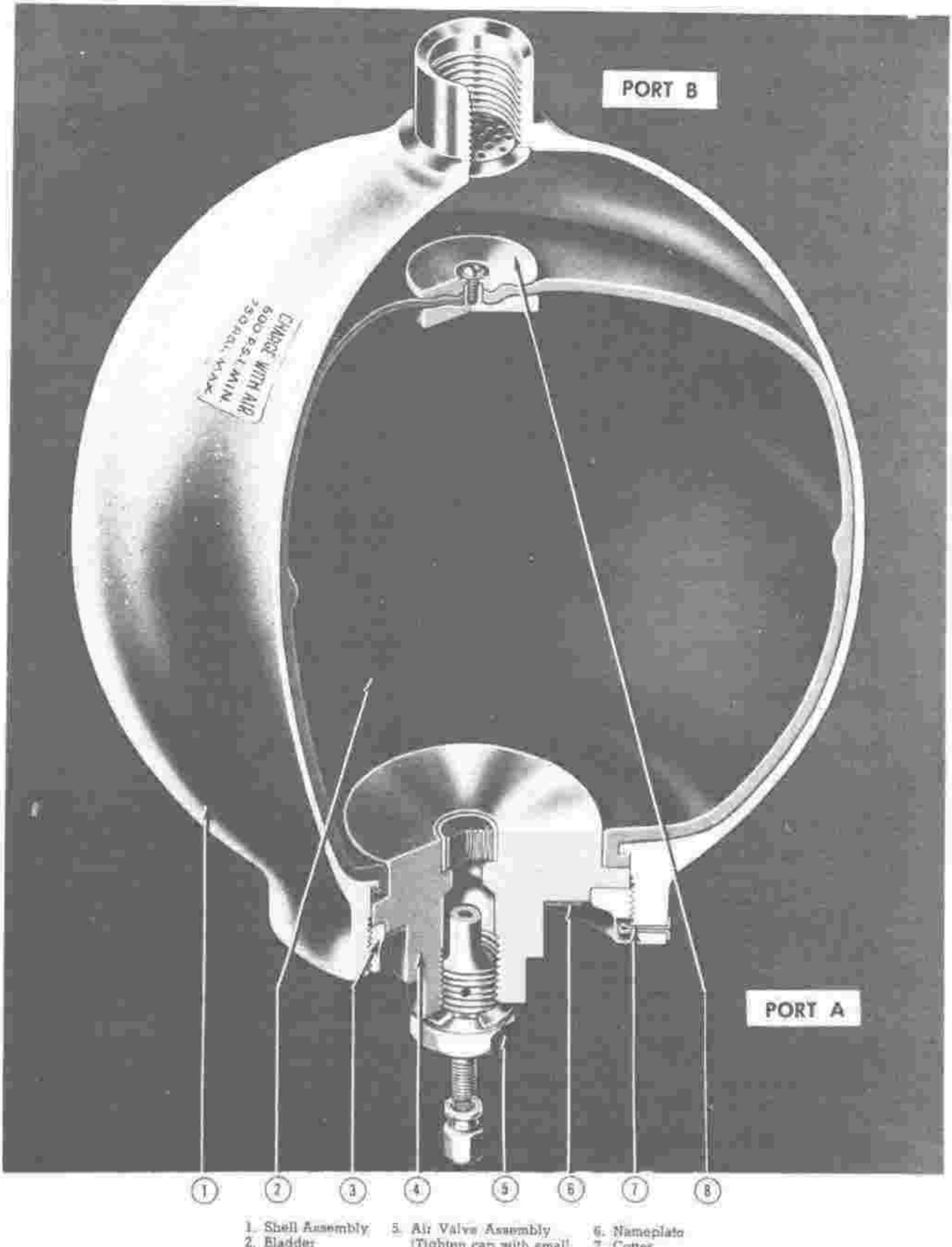
5. Reverse the procedure outlined in REMOVAL to install the pump on the engine mounting pads.

6. Test the pump suction lines and fittings from the reservoir for leaks. Tighten all connections and eliminate air leaks so that a suction of 20 inches (50.8 cm) Hg can be maintained for at least five minutes. Make certain that all flexible hoses are installed without twisting and are properly supported.

7. After installation of the engine-driven pumps is complete, bleed the entire hydraulic system. Use the hand pump to fill the hydraulic lines and units before the system is put in operation. Bleeding must be done thoroughly to eliminate air in the hydraulic system.

(3) HYDRAULIC SYSTEM PRESSURE ACCUMULATOR. *(See figure 250.)*

(a) DESCRIPTION.—The hydraulic system pressure accumulator is a spherical welded steel container that is used essentially to store energy to provide an instantaneous supply of high pressure fluid when actuation of hydraulic units cause fluid demands beyond the capacity of the engine-driven hydraulic pumps. The accumulator also acts as a surge chamber or shock absorber for excessive loads thrown on the hydraulic system. The accumulator is supported by two brackets, located on the canopy in the pilot's compartment *(12, figure 252)*. When the accumulator is charged initially with dry, clean air at a pressure of 600-750 psi, the flexible synthetic rubber bladder, which separates the air and hydraulic fluid in the accumulator, is fully extended against the walls of the accumulator shell. As hydraulic fluid from the hydraulic system pressure regulator flows into the accumulator, the bladder is forced down compressing the air in the bladder. When the accumulator is fully charged with hydraulic fluid, the bladder is in the shape of a "U." When actuation of hydraulic units lowers the system pressure, the compressed air forces the bladder outward which expells the hydraulic fluid from the accumulator, supplying an instantaneous supply of high pressure fluid to the hydraulic system. The total volume of the accumulator is 200 cubic inches. However, with 750 psi air charge and hydraulic system pressure at the lower limit (850 psi) only 24 cubic inches of fluid is available in the accumulator.



1. Shell Assembly
2. Bladder
3. Retainer
4. Cap Assembly
5. Air Valve Assembly (Tighten cap with small wrench to torque of 15-25 inch-pound
6. Nameplate
7. Cotter
8. Stop Assembly

Figure 250 — Hydraulic System Pressure Accumulator

HYDRAULIC SYSTEM PRESSURE ACCUMULATOR

Douglas Drawing No. 4123727 — Bendix Aviation Ltd. No. 403714

TEST PROCEDURE		
TEST PRESS.	PORTS PLUGGED	MAX. LEAKAGE
750 psi air press.–Port A	None	Observe leakage by gage in 10 min. None allowed
1250 psi oil press.–Port B 750 psi air press.–Port A	None	External – None

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines at the tee fitting in the accumulator.

c. Remove the screws and collars that attach the pressure accumulator to the mounting brackets and remove the accumulator.

2. DISASSEMBLY.

a. Release the air pressure in the accumulator by backing off the air valve with a box wrench. DO NOT release the air pressure by depressing the air valve core.

b. Remove the retainer ring and cap assembly with service tool K33601. Hold the accumulator shell with a strap wrench when removing the retainer ring.

c. Remove the bladder by collapsing it to the inside with a smooth piece of wood. Grasp the fold of the bladder firmly and pull outward, twisting at the same time. DO NOT attempt to pry out the bladder with a sharp instrument or tool or the bladder may be punctured.

d. It is not necessary to remove the stop and washer on the bottom of the bladder unless the bladder has been damaged, necessitating replacement, or unless there is evidence of oil leakage through the stop and washer to the inside of the bladder.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check the air charge in the pressure accumulator every 25 hours by observing the following procedure:

a. Obtain system pressure (850-1000 psi) with the engines operating or by operating the hydraulic hand pump with the emergency hydraulic system selector valve in the "SYSTEM" position.

b. Slowly relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals. The last hydraulic system pressure gage indication before a sudden drop to zero is the accumulator air charge and should be 600-750 psi.

2. If the pressure accumulator is damaged, leaking or is not functioning properly, install a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.–Refer to *figure 250* for leak tests of the pressure accumulator

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.

(See figure 250.)

a. Install the washer and stop on the bottom of the bladder. Make certain the screw is in tight to prevent air leaking from inside the bladder. Stake the screw lightly in two places.

b. Install the bladder assembly in the shell. Make certain the bladder is fitted all around the inside of the shell and that the lip on the top of the bladder is over the shoulder on the inside of the shell.

c. Place the cap assembly in the top of the accumulator, making certain that the lip of the bladder is not pushed down inside or distorted in any way. Push the cap against the bladder, and seat with a slight rocking motion.

d. Screw in the retainer ring, holding the cap in place. The retainer ring should be turned until it bottoms against the cap and then tightened with service tool K33601. When sufficiently tight, the top of the ring should be approximately 1/16 inch below the rim of the shell assembly.

Note

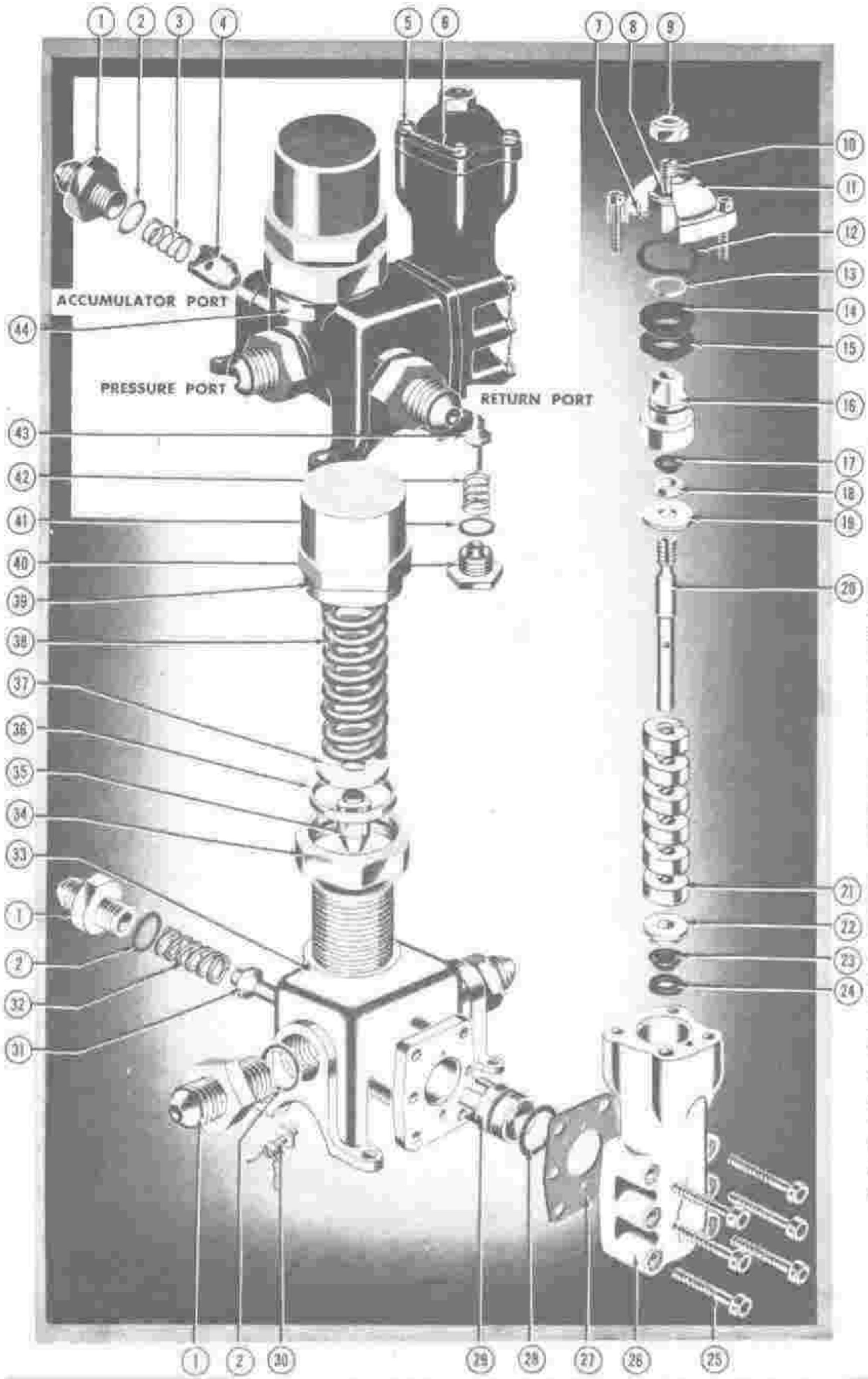
In cold weather tighten the ring an additional ¼ turn.

e. Install the air valve assembly, making certain that the gasket is in good condition. Tighten the valve cap with a small wrench to a torque of 15-25 inch-pounds. Finger tightness of the cap will not hold pressure consistently.

2. INSTALLATION.–To install the pressure accumulator refer to *12, figure 252* and reverse the removal procedure given in paragraph 14. *b.* (3) *(b) 1,* this section.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the pressure accumulator as instructed in this paragraph 14. *b.* (3) *(b) 1,* this section.



1. Coupling
2. AN6227-13 Packing
3. Check Valve Spring
4. Check Valve Poppet
5. Cap Screw
6. Lock Wire
7. Plate and Screws
8. AN6227-6 Packing
9. Nut
10. Pin-Driver
11. Pilot Cap
12. AN6227-21 Packing
13. Snap Ring
14. Adapter
15. Leather Packing
16. Piston
17. AN6227-5 Packing
18. Washer
19. Washer
20. Piston Rod
21. Spring
22. Retainer
23. Packing
24. Adapter
25. Screw
26. Housing —Pilot Valve
27. Gasket
28. AN6227-12 Packing
29. Piston
30. Screw, Washer, and Lock Wire
31. Poppet
32. Spring
33. Valve Body
34. Lock Nut
35. Relief Valve Poppet
36. Seal
37. Spring Stop
38. Spring—Relief Valve
39. Cap—Relief Valve
40. Guide
41. AN902-5 Gasket
42. Spring
43. Pilot Poppet
44. Nameplate

Douglas Drawing No. 5122202
Bendix Aviation Ltd. No. 401507

Figure 251—Hydraulic System Pressure Regulator and Relief Valve (Some Airplanes)

HYDRAULIC SYSTEM PRESSURE REGULATOR AND RELIEF VALVE (SOME AIRPLANES)

Douglas Drawing No. 5122202 Bendix Aviation Ltd. No. 401507

TEST PROCEDURE			
TEST PRESSURE	PORTS PLUGGED	MAXIMUM LEAKAGE	
		INTERNAL	EXTERNAL
1000 psi–Accumulator Port	Pressure Port	1 drop/min. at Return Port	None
1000 psi–Pressure Port	Accumulator Port	1 drop/min. at Return Port	None
1000 psi–Return Port	Press. & Accum. Ports		None
Relief valve must relieve 6 gals./min. at 1250 ± 25 psi max.			

2. Clean the inside of the shell thoroughly with solvent or clean hydraulic fluid to remove any foreign material that might be discharged into the hydraulic system.

3. Inspect the bladder thoroughly for evidence of rupture, cracking, holes, which necessitate replacement.

4. Examine the shell for cracks at the welds, or evidence of wear. Check the threads in the shell for wear. A damaged shell must be replaced.

5. Examine the air valve assembly and replace any damaged parts with new parts.

6. Reassemble the pressure accumulator as instructed in paragraph 14. *b.* (3) *(b) 1.*, this section, and test for leaks as instructed in *figure 250.*

(4) HYDRAULIC SYSTEM PRESSURE REGULATION.

(a) GENERAL.—Two types of hydraulic system pressure regulators are used on this airplane. On some airplanes the hydraulic system pressure regulator and system pressure relief valve are combined in one integral unit. On other airplanes the pressure regulator and system relief valve are separate units. The differences in the line routing of the two installations are shown in *figure 246.*

(b) COMBINED PRESSURE REGULATOR AND SYSTEM RELIEF VALVE. *(See figure 251.)*

1. DESCRIPTION.—The pressure regulator and system relief valve is installed on the pilot's compartment canopy inboard and above the main hydraulic system reservoir. The pressure regulator and relief valve functions to maintain the hydraulic system pressure between 850-1000 ± 20 psi and to by-pass fluid to the reservoir when the upper limit is reached, thereby relieving the load on the engine-driven hydraulic pump, which operates continuously. This is accomplished by means of the pilot valve assembly, which may be adjusted to operate at the desired cut-in and cut-out pressure. As pressure increases from the pressure port to the accumulator port, the pressure is exerted on the back of a piston in the pilot valve. When the pressure increases to 1000 ± 20 psi, a poppet in the bottom of the pilot valve is forced open by action of the piston and piston rod and the fluid is by-passed to the return port to the reservoir, relieving the load on the engine-driven hydraulic pump. When the pressure in the pressure accumulator decreases to 850 ± 20 psi by actuation of any of the hydraulic system units, the regulator, by means of closing of the internal poppets, allows the engine-driven pumps to recharge the system pressure. An integral check valve prevents flow of fluid from the accumulator port to the return port. The relief valve on the top of the valve body contains a spring-loaded poppet which is adjusted to open at 1100 psi and to allow full flow to the reservoir at 1250 ± 25 psi maximum.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

(2) Disconnect and cap the hydraulic lines leading to the pressure regulator and relief valve asssembly.

(3) Remove the screws that attach the regulator assembly to the mounting bracket and remove the regulator.

b. DISASSEMBLY.—When disassembly of the pressure regulator and relief valve assembly is attempted refer to *figure 251.* Disassembly of the regulator should be done only where adequate repair and testing facilities are available.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. At the 25-hour inspection period check the pressure regulator for evidence of external fluid leakage, especially at the couplings, the pilot valve cap, the relief valve tap, and the gasket between the pilot valve housing and valve body. Also check the cut-in and cut-out pressure of the regulator.

b. If the pressure regulator and relief valve assembly is damaged or is not operating properly it should be replaced with a new or serviceable part.

4. ADJUSTMENTS.

a. Adjustment for cut-out pressure is the only one necessary as this adjustment also regulates the cut-in pressure. With the engines operating the hydraulic system pressure should remain at 850-1000 $\pm$ 20 psi. If the system pressure is not within these limits, relieve the hydraulic system pressure and adjust the driver pin screw in the pilot valve to obtain the desired pressure range.

Note

It is preferable to adjust the driver pin screw when there is no pressure on the regulator to avoid damage to the screw-driver head of the pin.

b. The relief valve is adjusted by means of the large cap. Tightening the cap increases the hydraulic system relief pressure setting; unscrewing the cap decreases the relief pressure setting. The relief valve should be adjusted to open at 1100 psi and allow full flow to the reservoir at 1250 $\pm$ 25 psi.

5. ASSEMBLY AND INSTALLATION.

a. ASSEMBLY.—To assemble the pressure regulator and relief valve assembly refer to *figure 251*.

Note

Make certain the drive on the bottom of the driver pin is engaged in the slot in the top of the piston rod. To facilitate replacing the cap on the pilot valve, the piston rod should be screwed into the piston until almost flush with the top of the piston.

b. INSTALLATION.—To install the pressure regulator and relief valve assembly reverse the REMOVAL procedure.

6. TESTS AFTER INSTALLATION.—Refer to *figure 251* for fluid leak tests of the pressure regulator and relief valve assembly.

7. MAJOR OVERHAUL.

a. Remove and disassemble the pressure regulator and relief valve assembly as instructed in 2., above.

b. Inspect the packing on the couplings. If there is any evidence of wear or leakage, replacement is necessary.

c. Carefully inspect all the poppets for evidence of wear or leakage. If leakage is apparent, the poppet may be reseated by placing a soft brass punch against the back of the poppet when it is on the seat and tapping LIGHTLY with a small hammer. If the poppet is badly worn or grooved and leakage persists, replacement is necessary.

CAUTION

Under no circumstances should these poppets be lapped into the seats.

d. Inspect all springs. If any springs are broken, replacement is necessary.

e. Inspect the threads on the driver pin, the piston rod, piston, and the nut of the pilot valve. If threads are stripped or too worn to allow adjustment of the pilot valve, replacement is necessary.

f. Inspect the piston and packing for scoring and scratching. Replace worn or scored packing.

g. Check the honed cylinder surface for scores or scratches. If the cylinder wall is scored deeply, allowing fluid leakage, replacement is necessary.

h. Inspect the retainer and packing in the pilot valve for wear. Inspect the piston and seal in the valve body for evidence of wear. If the seal is worn or scored, replacement is necessary.

i. When repairs have been completed, assemble and test the pressure regulator and relief valve assembly as instructed in *figure 251*.

(c) SEPARATE PRESSURE REGULATOR.

1. DESCRIPTION.—An AN 6206-1 pressure regulator and AN 6200-8AB relief valve are installed on some airplanes. The separate pressure regulator is similar to the pilot valve of the pressure regulator and relief valve assembly and is set to cut in at $800 {}^{+50}_{-0}$ psi and to cut out at $1000 {}^{+50}_{-0}$ psi. The separate pressure regulator has four ports, a pressure inlet port, a port to the pressure accumulator, a return port to the reservoir, and a drain port as shown. The separate pressure regulator is located on the pilot's compartment canopy *(16, figure 246.)*

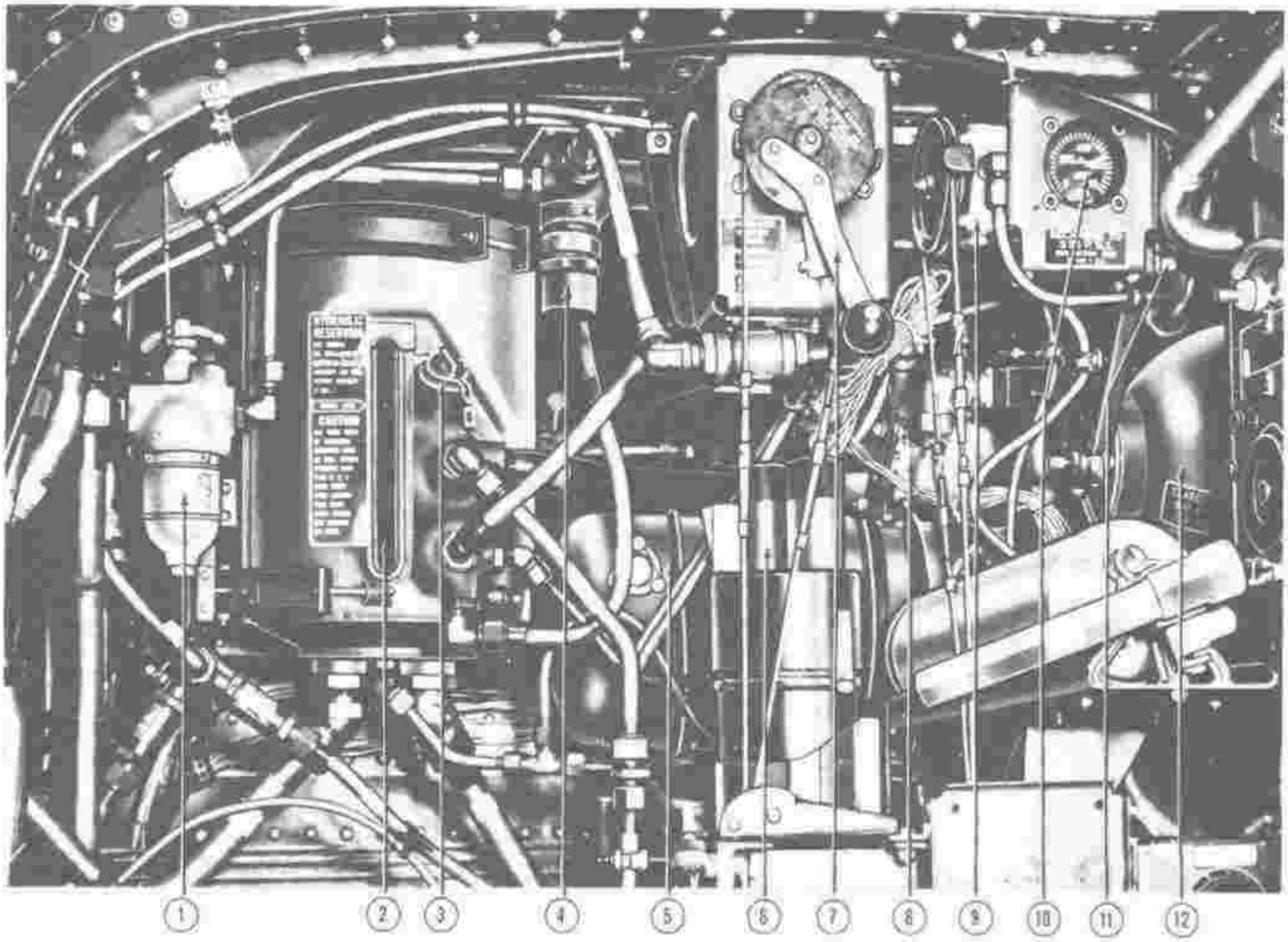
2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder brake pedals until the hydraulic system pressure gage indicates zero.

(2) Disconnect and cap the hydraulic lines leading to the pressure regulator.

(3) Remove the screws that attach the pressure regulator to the mounting bracket and remove the pressure regulator.



1. Main Hydraulic System Filter
2. Sight Gage—Main Hydraulic System Reservoir
3. Filler Neck—Main Hydraulic System Reservoir
4. Hydraulic System Pressure Regulator and Relief Valve (Some Airplanes)
5. Emergency Hydraulic System Fluid Reservoir
6. Solenoid Operated Bomb Bay Doors Position Selector Valve
7. Landing Gear Position Selector Valve Auxiliary Control Lever
8. Brake Emergency Air Bottle
9. Brake Emergency Air Control Valve
10. Brake Emergency Air Pressure Gage
11. Brake Emergency Air Filler Valve
12. Hydraulic System Pressure Accumulator

Figure 252—Hydraulic System Equipment Installed in Pilot's Compartment (Looking Aft)

b. DISASSEMBLY. — Disassembly of the pressure regulator should not be attempted in the field.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Check the pressure regulator at the 25-hour inspection period for evidence of fluid leakage. Also check the cut-in and cut-out adjustment of the pressure regulator. If the pressure regulator is damaged or is not operating properly, replacement is necessary.

4. ADJUSTMENTS.—The cut-out pressure of the pressure regulator is made by means of a screw head driver in one end of the pressure regulator. If the hydraulic system pressure range is not 800 to 1000 $^{+\,50}_{-\,0}$psi, relieve the system pressure and adjust the regulator by turning the screw-head driver either in or out. When the proper adjustment is obtained, tighten the lock nut on the screw-head driver.

5. INSTALLATION.—To install the pressure regulator, reverse the REMOVAL procedure.

(d) SEPARATE PRESSURE RELIEF VALVE.

1. DESCRIPTION.—The AN 6200-8AB pressure relief valve is installed in conjunction with the AN 6206-1 pressure regulator on some airplanes. The separate pressure relief valve is installed in the engine-driven hydraulic pump pressure line between the main hydraulic system filter and the pressure regulator, and is located on the pilot's compartment canopy. The pressure relief valve has three ports, a pressure inlet, an outlet to the pressure regulator, and an outlet to the main hydraulic system reservoir. The spring loaded poppet in the pressure relief valve is adjusted to open at 1125 psi minimum and allow full flow to the reservoir at 1250 psi maximum. *(See 15, figure 246.)*

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

(2) Disconnect and cap the hydraulic lines leading to the pressure relief valve.

(3) Remove the screws that attach the valve to the mounting bracket and remove the pressure relief valve from the airplane.

b. DISASSEMBLY.—Disassembly of the pressure relief valve should not be attempted in the field.

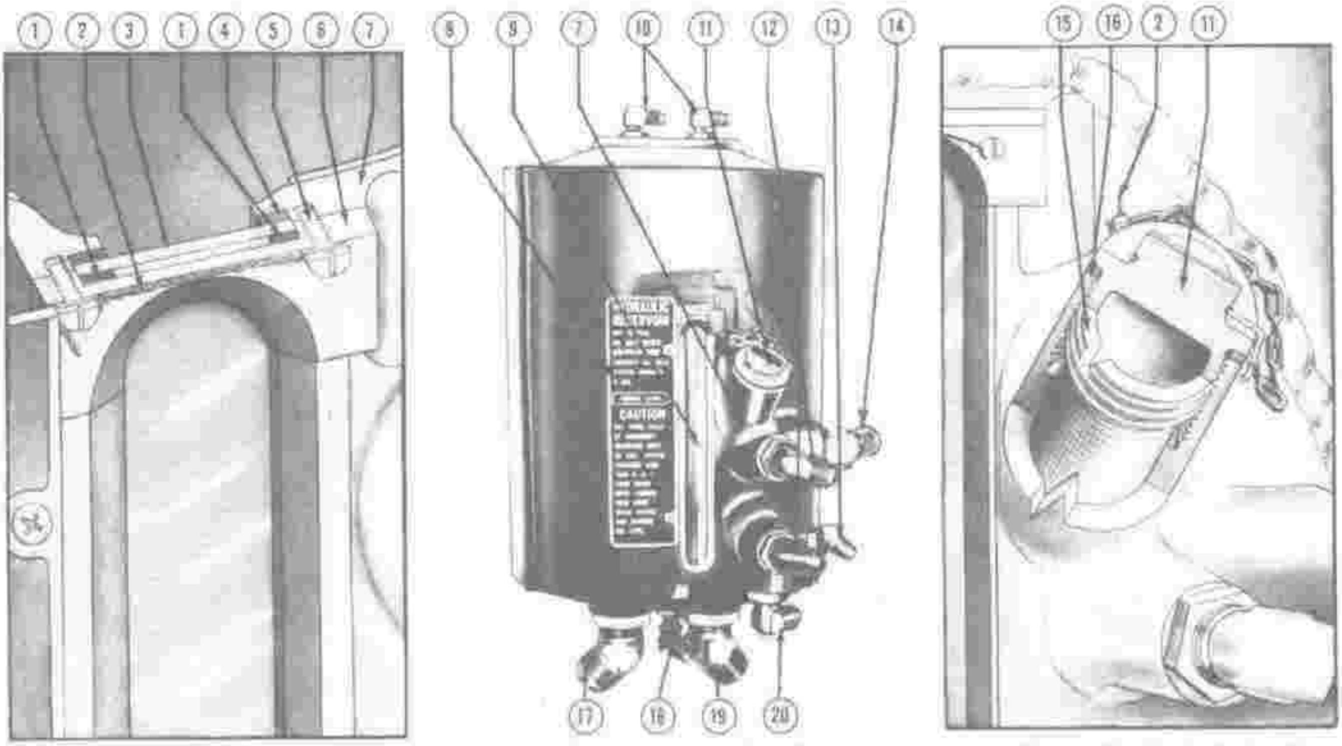
3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Inspect the pressure relief valve for evidence of fluid leakage at the 25-hour inspection period.

b. If the pressure relief valve is damaged or is not functioning properly, replacement is necessary.

4. ADJUSTMENTS.—Adjustment of the pressure relief valve is made by tightening or loosening the end cap. Tightening the cap increases the system pressure relief setting; loosening the cap decreases the system pressure relief setting. Adjust the valve to open at 1125 psi minimum and to allow full flow to the reservoir at 1250 psi maximum.

5. INSTALLATION.—To install the pressure relief valve reverse the REMOVAL procedure.



Detail of Sight Gage Assembly — Complete Reservoir Assembly — Detail of Filler Neck Assembly

1. Wedge
2. Lock Wire
3. Transparent Panel
4. Gasket
5. Screw
6. Sight Gage Cap
7. Segment
8. Instruction Plate
9. Sight Gage Assembly
10. Vent Fittings
11. Filler Cap and Chain Assembly
12. Fitting (Brake or Landing Gear Return)
13. Fitting (Bomb Bay Door Return)
14. Fitting (Emergency Reservoir Supply)
15. Strainer Assembly
16. Gasket
17. Fitting (R. H. Engine-Driven Pump Supply)
18. Fitting (Hand Pump Supply)
19. Fitting (L. H. Engine-Driven Pump Supply)
20. Fitting (Pressure Regulator Return)

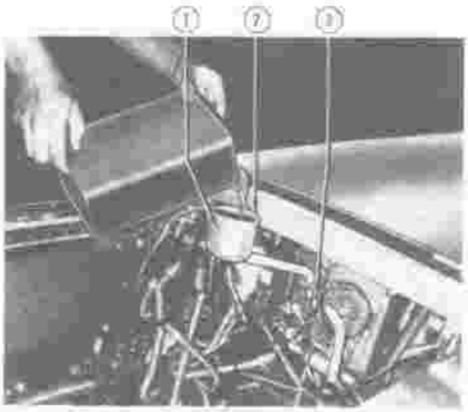
Douglas Drawing No. 5122204

Figure 253 — Main Hydraulic System Fluid Reservoir

(5) MAIN HYDRAULIC SYSTEM FLUID RESERVOIR. *(See figure 253.)*

(a) DESCRIPTION.—The main hydraulic system fluid reservoir is a welded aluminum container supported by straps at the rear of the pilot's compartment and has a fluid capacity of 1.75 U.S. gallons (1.46 Imperial gallons). The main reservoir supplies fluid to the main system and to the emergency hydraulic fluid reservoir *(figure 287)*, and incorporates a sight gage *(9, figure 253)* for determining the fluid level. An instruction plate for filling the fluid reservoir is attached to the reservoir beside the sight gage.

1. FILLING THE RESERVOIR.—Use hydraulic fluid (Specification AN-VV-O-366) only and observe the following procedure:



1. Funnel Assembly
2. Hole for Hook on Filler Funnel
3. Reservoir Filler Neck

Figure 254—Filling The Hydraulic System Reservoirs

a. Remove the reservoir filler cap and use the hydraulic reservoir funnel *(figure 254)* to pour the fluid into the main reservoir at the filler opening until all three cells of the emergency hydraulic system reservoir *(figure 290)* are filled, and the fluid approaches the normal level mark on the main reservoir. Make certain all foreign material is removed from the top of the supply container before hydraulic fluid is poured into the filler funnel.

Note

The hydraulic reservoir funnel is attached to clips on the radio equipment shelf aft support, located behind the pilot's seat. To use the funnel, place the spout into the filler opening. Hook the funnel into the hole provided in the canopy support. It is not necessary to hold the funnel while pouring hydraulic fluid into the reservoir.

b. Either attach a hydraulic test stand or operate the engines to maintain 1000 psi system operating pressure. The test stand should be connected at the firewall self-sealing disconnect couplings.

c. With the landing gear down and the bomb bay doors open, bleed the system and recheck the fluid level. Add more fluid if necessary and then replace the filler cap.

CAUTION

Every precaution must be observed in the handling of hydraulic fluid to prevent contamination. The storage containers must be kept sealed; all handling equipment must be kept clean and should be used for hydraulic fluid only. Leakage, poor functioning of hydraulic units, and excessive wear of parts are often caused by contaminated fluid. Do not mix different types of hydraulic fluid because the resulting mixture may cause the packing to seize, deteriorate, and clog the actuating cylinders so that they will fail to operate. Do not expose hydraulic fluid to the air any more than is absolutely necessary. The fluid will absorb dust and grit from the air and this becomes a serious menace. Fluid that has been exposed to dust contamination, or which has been used previously, should be filtered before using. Filtering will remove the sludge from used fluid, as well as all metal flakes and grit. Hydraulic fluid may be strained effectively by using fine wire mesh as a strainer. The filtered fluid should be placed in clean containers, properly marked to identify the contents, then sealed until required for use.

(b) REMOVAL.

1. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

2. Disconnect and cap all hydraulic lines at the reservoir.

3. Remove the bolts, bend back the straps and remove the main hydraulic system reservoir.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Small holes or cracks in the reservoir may be welded by approved welding procedures.

2. Fluid leaks may develop at the outlets of the reservoir. If moderate tightening of the elbow nuts will not stop the fluid leakage, install new gaskets or fittings.

3. Leakage of fluid around the sight gage may require replacement of the gasket or the panel. Procedure follows:

a. Cut the lockwire and remove the screws which attach the sight gage cap to the reservoir; then remove the cap.

b. Remove the four wedges which press the plexiglas panel against the gasket.

c. Remove the panel and gasket and replace them with new parts if defects are discovered.

d. To reassemble the sight gage panel, first install the gasket. Slide in the plexiglas panel. Install the four wedges to seal the panel. Reinstall the sight gage cap and safety the screws.

4. Clean the reservoir strainer assembly by the following procedure:

a. Unscrew the filler neck cap.

b. Unscrew the strainer assembly in the filler neck with a piece of strap iron of the proper width and thickness to fit into the slots in the strainer assembly.

c. Clean the strainer with clear gasoline. Small holes or tears in the brass screen may be soldered.

d. After thoroughly cleaning the strainer, install the strainer assembly and filler cap. Install a new filler cap gasket if the original gasket shows evidence of deterioration.

5. If the reservoir is damaged badly, replace it with a new reservoir assembly.

(d) TEST BEFORE INSTALLATION.—Apply 10 psi with all outlets plugged to test for fluid leaks. No fluid leaks are permissible.

(e) INSTALLATION.—Installation of the main hydraulic system reservoir is the reverse of the REMOVAL procedure.

(6) MAIN HYDRAULIC SYSTEM FILTER.

(a). DESCRIPTION.—A Purolator unit *(figure 255)* is employed to filter the fluid in the main hydraulic system. The filter is located at the right of the main hydraulic system fluid reservoir in the rear of the pilot's compartment *(1, figure 252)*. Cleaning of the fluid is accomplished by a metal edge filter element. Cleaning of the filter element is accomplished without disassembly by rotating the cleaning handle at the top of the filter four or five times in a clockwise direction. the filter four or five times in a clockwise direction. A drainable sump is located at the bottom of the filter to catch foreign particles. The filter has a capacity of 12 gallons per minute and incorporates two fluid pressure relief valves set at 28 to 30 psi differential to bypass the fluid if the filter element clogs. The filter operates during cleaning unless the sump is being drained.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the system operating pressure by applying toe pressure and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines at the filter.

c. Remove the attaching screws and remove the filter from the airplane.

2. DISASSEMBLY.
(See figure 255.)

a. Clamp the filter upside down in a vise, using the square boss on top the head of the filter.

b. Unscrew the case from the head. Remove the cleaning handle by removing the handle lock nut.

c. Use a wide bit screw driver to remove the relief valve seats from the filter head.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. The filter should be thoroughly cleaned every 100 hours by observing the following instructions:

a. Relieve the system operating pressure by applying toe pressure to and releasing the rudder brake pedals until the hydraulic system pressure gage indicates zero.

b. Turn the cleaning handle *(1, figure 255)* four or five times in a clockwise direction. This turns the filtering element against stationary blades, and foreign particles are scraped into the drainable sump.

c. Remove the drain plug from the filter and allow dirt and hydraulic fluid to drain out into a container.

d. Install a new gasket and insert drain plug.

e. Increase the fluid pressure in the system, and inspect the drain plug for fluid leaks. If no fluid leakage is observed, replace drain plug safety wire.

f. Clean the emergency system filter when the main system filter is cleaned.

2. This self-cleaning filter requires no maintenance other than periodic draining of the sump. However, the filtering element may become clogged with foreign materials, and it may be necessary to disassemble the filter and clean the element.

3. To disassemble the filter, refer to paragraph 14. *b.* (6) *(b)* 2., this section. To clean the filtering element, submerge the element in clear gasoline or fuel oil, and wash with a soft, lint-free cloth or a soft hair brush. DO NOT USE WIRE BRUSH OR SCRAPER. Wash out the inside of the head and case by submerging in clear gasoline or fuel oil, and using a soft, lint-free cloth or soft hair brush.

Note

It is extremely important that the filter is functioning efficiently. Dirty fluid will cause operating troubles in the hydraulic system and excessive wear of parts in the hydraulic units.

4. A damaged filter should be replaced with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to *figure 255* for leak tests.

(e) ASSEMBLY AND INSTALLATION.

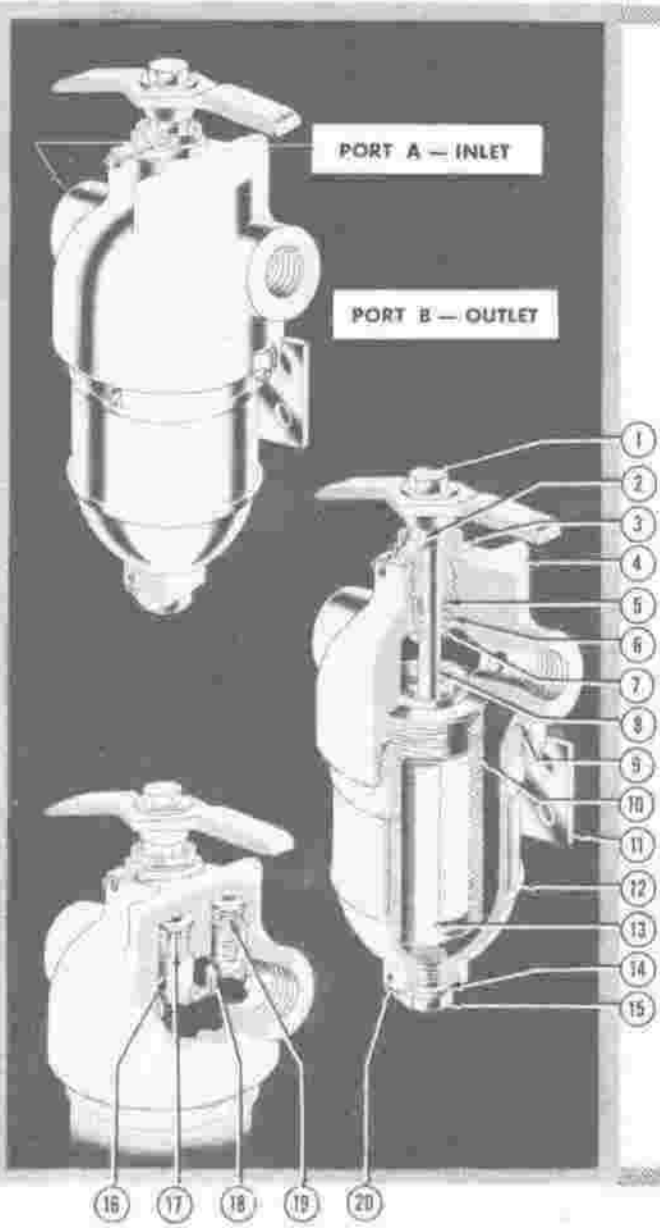
1. ASSEMBLY.—To assemble the filter, refer to *figure 255.*

2. INSTALLATION.—To install the filter, reverse the REMOVAL procedure.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the main hydraulic system filter as instructed in paragraph 14. *b.* (6) *(b) 2.,* this section.

2. Inspect relief valve spring guides for evidence of wear which may cause the spring to stick. Inspect the springs for breaks. Check the relief valve pistons for wear on the seats which may cause leakage or wear on the sides of the pistons which might cause sticking.



1. Cleaning Handle Assembly
2. Nut
3. Packing Plug
4. Head
5. AN-6225-3 Packing
6. Packing Support
7. Retainer Cap
8. Drive Shaft Retainer
9. AN-6230-6 Case Packing
10. Filter Element
11. Bracket and Nameplate
12. Case
13. Knife and Frame Assembly
14. Drain Plug Gasket
15. Drain Plug
16. Relief Valve Piston
17. Spring Guide
18. Relief Valve Seat
19. Relief Valve Spring
20. Lock Wire (3 Places)

TEST PROCEDURE		
TEST PRESS.	PORTS PLUGGED	MAX. LEAKAGE
1500 psi– Port A	Port B	2 drops in 12 hrs.– External
Relief valves should open at 28-30 psi pressure differential if element clogs.		

Douglas Drawing No. 4123160
Purolator Products Type G-159 J-11

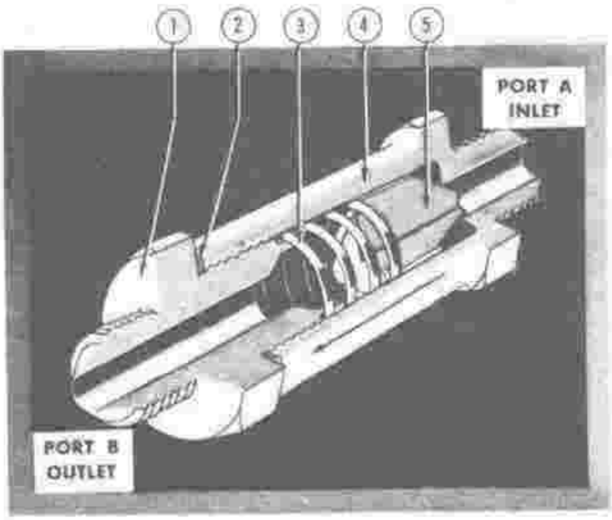
Figure 255—Main Hydraulic System Filter

3. Inspect the edges of the cleaning knives for wear that will prevent proper cleaning of the element. Inspect the filtering screen on the element assembly for wear caused by the cleaning knives as this wear will allow dirt to pass through the filtering screen.

4. Clean the filtering element, head, and case thoroughly by submerging in clear gasoline or fuel oil, and washing with soft, lint-free cloth. DO NOT USE WIRE BRUSH OR SCRAPER.

5. Install new packing and gaskets.

6. When the repairs to the filter are completed, assemble the filter and test for leaks as instructed in *figure 255*.



1. Connector
2. Gasket
3. Spring
4. Valve Body
5. Poppet

NOTE
Arrow on valve body indicates direction of fluid flow through the check valve.

TEST PROCEDURE			
TEST PRESS.	PORTS PLUGGED	MAX. LEAKAGE INTERNAL	MAX. LEAKAGE EXTERNAL
1500 psi–Port B	None	None	None
5 psi–Port B	None	1 drop in 2 min.	None

Figure 256—Typical Fluid Check Valve

(7) HYDRAULIC FLUID CHECK VALVES.

(a) DESCRIPTION. — Hydraulic fluid check valves are incorporated in the main hydraulic system to maintain the flow of fluid in one direction only in critical lines. *(See figures 246 and 282.)* The check valve consists of spring-loaded plastic poppet with a conical end which seats on the aluminum alloy valve body and a connector that retains the poppet spring. The check valve allows free flow of fluid in one direction but no flow in the opposite direction. An arrow on the side of the valve body indicates the direction of flow. Fluid flow through the poppet end of the valve unseats the poppet. Flow in the opposite direction immediately seats the poppet and prevents any further back flow.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines at the check valve.

c. Unscrew attaching clip (if any) and remove the check valve.

2. DISASSEMBLY.—Refer to *figure 256* if disassembly of the check valves is attempted.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Inspect the line connections and connector end of the valve body for leakage. No other maintenance or lubrication is necessary.

2. The check valve should be replaced if it is damaged or not functioning properly.

(d) TEST BEFORE INSTALLATION.—Refer to *figure 256*, for fluid leak tests of the check valves.

(e) INSTALLATION.—To install a check valve, reverse the REMOVAL procedure.

(8) HYDRAULIC SYSTEM PRESSURE GAGE. *(See figure 247.)*

(a) DESCRIPTION.—The Bourdon-tube type hydraulic system pressure gage is located on the left side of the instrument panel in the pilot's compartment on some airplanes and on the main instrument panel on other airplanes, and indicates pressure from 0 to 2000 psi. The gage is connected to the brake pressure line. The line to the gage includes a snubber which prevents damage to the gage by fluid surges in the hydraulic system.

(b) REMOVAL.

1. Remove the instrument panel access door *(7, figure 7)*.

2. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

3. Disconnect and cap the hydraulic line or hose leading to the gage.

4. Remove the screws attaching the gage to the instrument panel and remove the gage.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If a gage is damaged or is not functioning properly, a new or serviceable gage will be installed. Repair of the gage should be made only at depots by qualified personnel.

(d) INSTALLATION.—To install the hydraulic system pressure gage reverse the REMOVAL procedure.

(9) SELF-SEALING DISCONNECT COUPLINGS.

(a) DESCRIPTION. — Self-sealing disconnect couplings *(figure 257)* to facilitate service and maintenance are provided at the hydraulic connections on the firewall and at the brake units. The couplings consist of two parts connected by a union nut. When the union nut is unscrewed, the coupling valves are seated by springs to prevent the loss of hydraulic fluid and the introduction of air into the lines. When the union nut is tightened, the valves allow free flow of the hydraulic fluid. The firewall couplings are provided with a mounting flange, while the brake couplings are attached to the brake units with hollow bolts.

(b) REMOVAL.

1. Relieve the system operating pressure by applying toe pressure and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

2. Disconnect and cap the hydraulic lines leading to the couplings.

3. To remove the firewall couplings, remove the attaching screws. To remove the brake couplings, remove the attaching hollow bolts.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—A damaged coupling should be replaced with a new or serviceable part.

(d) TEST BEFORE INSTALLATION.—Refer to *figure 257* for leak tests.

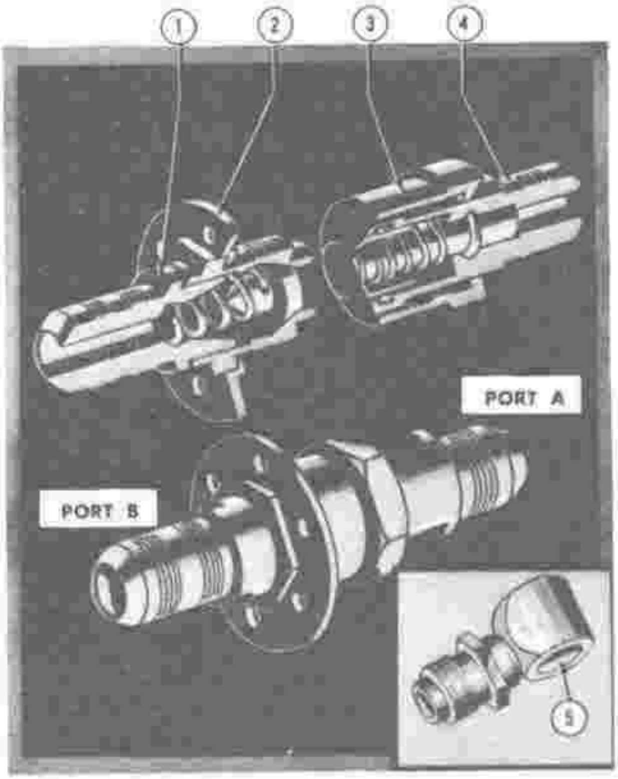
(e) INSTALLATION.—To install the self-sealing couplings, reverse the REMOVAL procedure.

Note

When installing the brake disconnect couplings, preload the attaching bolts to 540 inch-pounds wrench torque. If this torque does not give a satisfactory seal, install new seal washers.

c. LANDING GEAR HYDRAULIC SYSTEM. *(See figure 258.)*

(1) GENERAL.—The landing gear hydraulic system consists of the hydraulic units necessary to operate the main landing gear, nose wheel gear, and nose wheel doors. The operation of this system is controlled by the landing gear position selector valve *(9, figure 258)* located on the canopy in the pilot's compartment. The landing gear control lever is located on the forward right-hand side of the pilot's control pedestal and actuates the landing gear position selector valve and nose wheel door "UP" latches by means of cables. When the control lever is moved to the "UP" position, the selector valve directs fluid pressure to the main landing gear, nose wheel gear, and nose wheel door actuating cylinders. The main landing gear and nose wheel gear actuating cylinder pistons extend, and the nose wheel door actuating cylinder piston retracts. The displaced fluid is returned to the fluid reservoir through the landing gear DOWN lines and selector valve as the



1. Bulkhead Fitting End Half
2. Mounting Flange
3. Nut
4. Coupling Half Gasket Seal Fitting End
5. Brake Coupling Half 15 Banjo Swivel End

TEST PROCEDURE	
TEST PRESSURE	MAX. LEAKAGE
5 psi—Port A—Valve Disconnected	10 drops / hr.
5 psi—Port B—Valve Disconnected	10 drops / hr.
1500 psi—Port A—Port B Plugged	External—None

Figure 257—Typical Self-sealing Disconnect Coupling

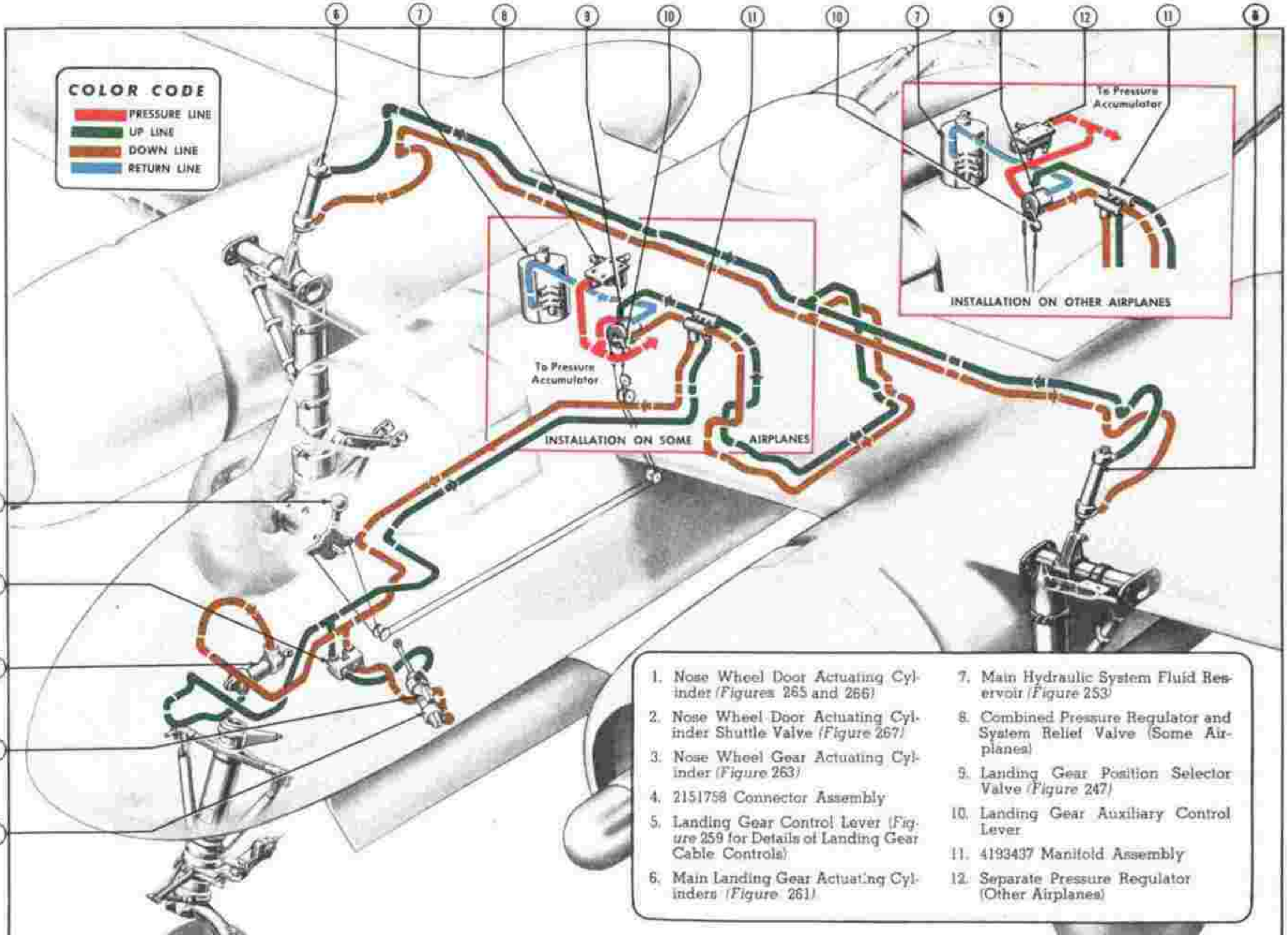


Figure 258 — Landing Gear Hydraulic System

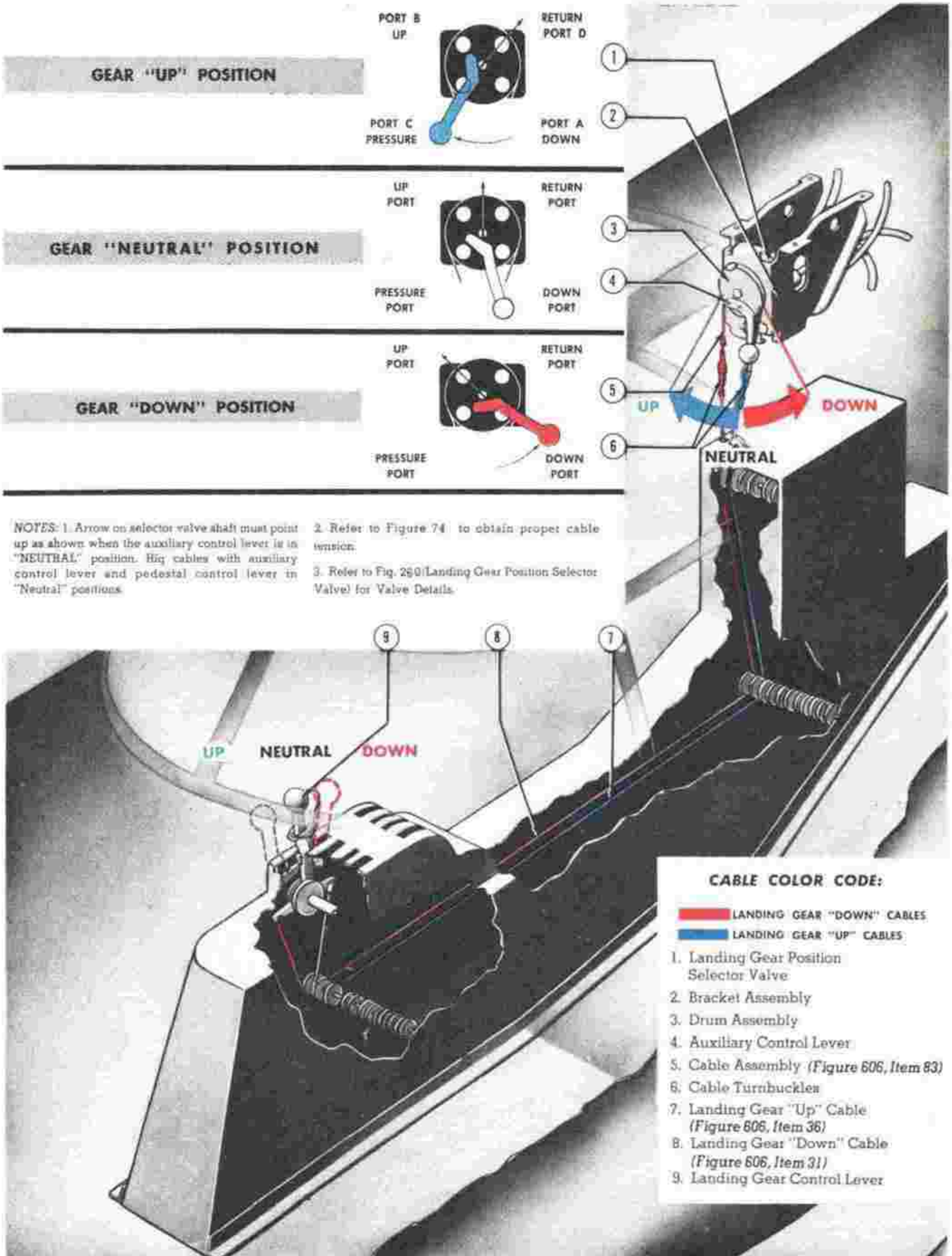
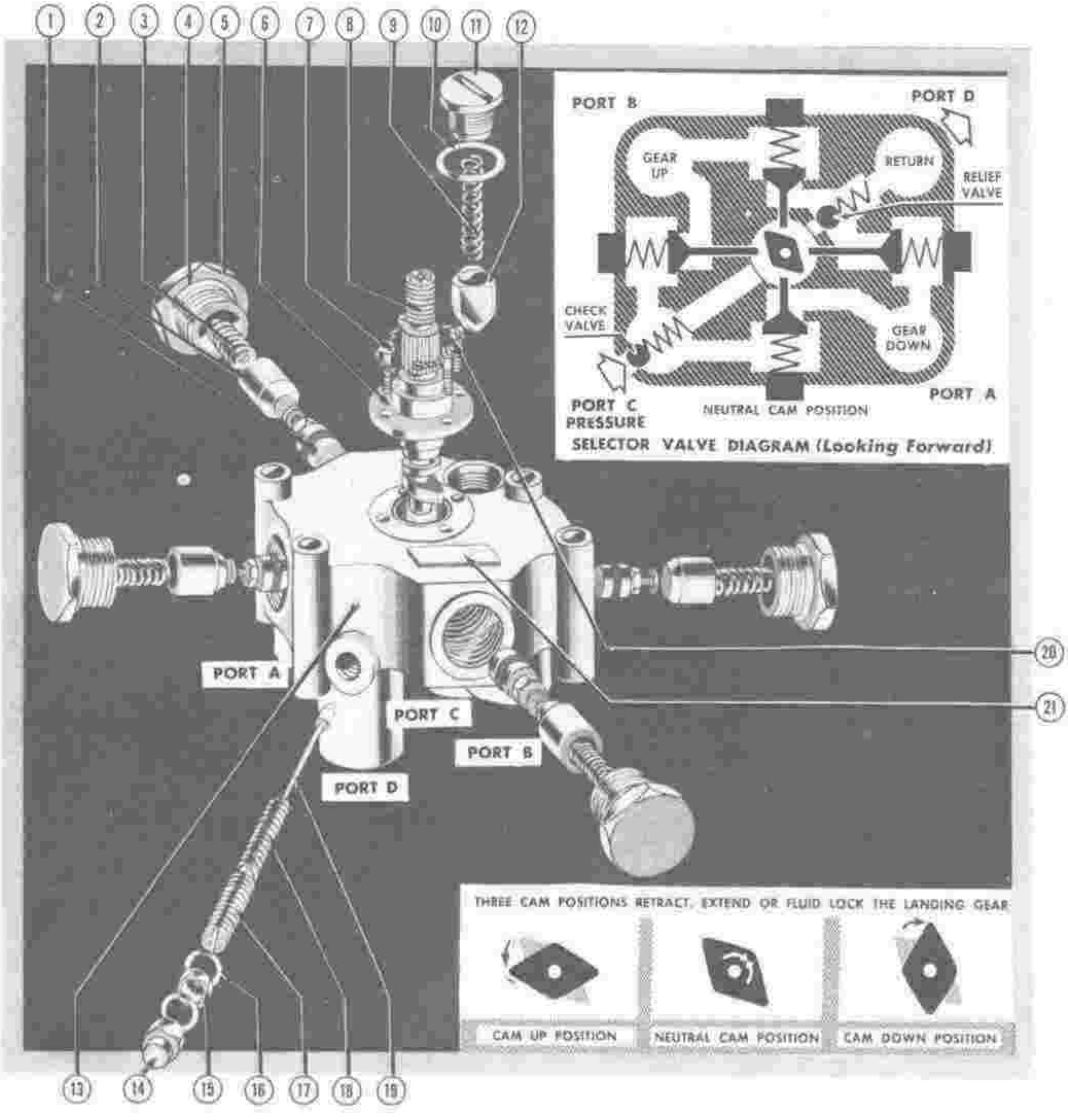


Figure 259 — Landing Gear Position Selector Valve Cable Control System



1. Piston Assembly
2. Poppet
3. Spring
4. AN900-12 Gasket
5. Cap
6. Bearing
7. Screw
8. Control Shaft
9. Spring
10. Packing
11. Plug
12. Check Valve
13. Body Assembly
14. Cap
15. Lock Nut
16. AN900-5 Gasket
17. Set Screw
18. Spring
19. Needle
20. Lock Wire
21. Nameplate

Douglas Drawing No. 4196938

Figure 260—Landing Gear Position Selector Valve

LANDING GEAR POSITION SELECTOR VALVE

Douglas Drawing No. 4127438

Bendix Aviation Ltd. No. 401481

TEST PROCEDURE					
				MAX. LEAKAGE	
TEST	TEST PRESSURE	PORTS PLUGGED	HDLE. POS.	INTERNAL	EXTERNAL
1	1500 psi–Port C	A, B, and D	3		None
2	1300 psi–Port C	A and B	2	Relief valve must relieve at 1250 ± 50 psi	None
	WARNING: Do not exceed 4 drops / sec. flow through relief valve.				
3	1000 psi–Port C		2	10 drops / hr. each at Ports A and B. 10 drops / hr. at Port D	None
4	1000 psi–Port A		1	Leakage found at Port D in Test 3 plus 10 drops / hr.	None
5	1000 psi–Port B		3	Leakage found at Port D in Test 3 plus 10 drops / hr.	None
6	100 psi–Port B	D and A	3	10 drops / hr.	None

landing gear retracts. When the landing gear is extended, the flow of fluid and direction of piston action is reversed. After the landing gear has been retracted, the control lever should be moved from the "UP" position to the "NEUTRAL" position. For complete information about the mechanical operation of the landing gear refer to paragraph 5. *b.*, this section. When the airplane is on the ground, a solenoid detent pin prevents the landing gear position selector valve handle from being moved from the "DOWN" position to the "UP" position. The retraction release switch is installed on the left main landing gear shock strut cylinder above the torque arm. A cam on the torque arm opens the switch when the torque arm is compressed; that is, when the landing gear is bearing the weight of the airplane. Opening the switch opens the circuit to the selector valve solenoid, de-energizing the solenoid pin which springs forward and prevents movement of the landing gear control lever to the "UP" position. Refer to paragraph 15. *d.* (13) *(e)*, this section for complete information about the solenoid detent pin assembly and the landing gear signal system.

Note

When extending the landing gear, move the control lever on the pedestal from the "NEUTRAL" to the "DOWN" position in a continuous movement taking no longer than two seconds to move the lever. DO NOT actuate the control lever by a series of light taps.

(2) LANDING GEAR POSITION SELECTOR VALVE AND CABLE CONTROLS.

(See figures 259 and 260.)

(a) DESCRIPTION.—The landing gear position selector valve is attached to a bracket on the canopy in the pilot's compartment *(figure 259)*. This poppet type valve has four ports; a pressure port, return port, an UP port and a DOWN port. When the control lever is moved to the "DOWN" position, a cam assembly on the valve shaft opens two of the poppet valves, one connecting the pressure port to the DOWN line and the other connecting the return port to the UP line. When the control lever is moved to the "UP" position, the other two poppet valves are opened, one connecting the pressure port to the UP line and the return port to the DOWN line. When the lever is in the "NEUTRAL" position, all four poppet valves are closed. The valve unit has an integral check valve to prevent flow of fluid from the cylinder ports to the system pressure port, and an integral fluid pressure relief valve which by-passes fluid to the reservoir when pressure in the landing gear hydraulic system increases to 1250 ± 50 psi. The cable controls consist of a drum and cable assembly installed on the valve shaft with cables connecting to the control lever on the pedestal. Another cable is attached to the control lever to release the nose wheel door up latches when the control is moved to the "DOWN" position on some airplanes.

(b) REMOVAL AND DISASSEMBLY.

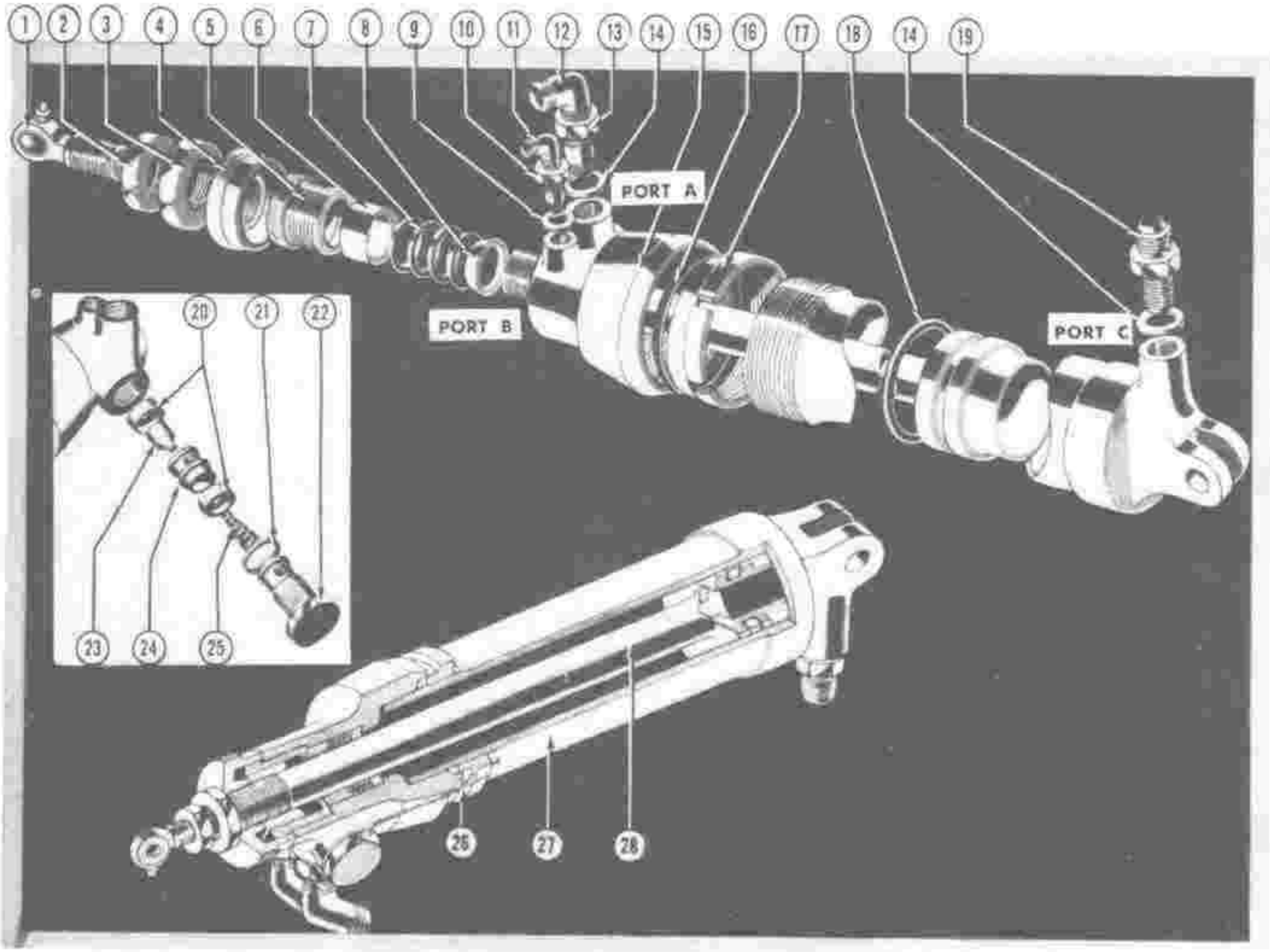
1. REMOVAL.

a. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the four hydraulic lines leading to the landing gear position selector valve.

c. Loosen the cable turnbuckles *(figure 259)* and remove the pulley with cable attached from the valve shaft.

d. Remove the screws attaching the valve to the bracket and remove the valve.



1. Rod End Assembly (Includes 116500-9A-028G Bushing)
2. Nut
3. Nut
4. Stop Nut
5. Packing Nut
6. Ring
7. AN6225-22 Packing (4 Required)
8. Ring
9. AN902-4 Gasket
10. Lock Nut
11. Elbow
12. Elbow
13. Lock Nut
14. AN902-8 Gasket
15. Cylinder End
16. Gasket
17. Nut
18. AN6227-38 Packing
19. Union
20. Seats—Shuttle Valve (Emergency Substitute Part may be made from AN6226-9)
21. Washer
22. Plug—Shuttle Valve
23. Cone—Shuttle Valve
24. Spacer—Shuttle Valve
25. Spring—Shuttle Valve
26. Lock Wire
27. Barrel Assembly
28. Piston Assembly

TEST PROCEDURE

TEST PRESS.	PISTON POS.	MAX. LEAKAGE	
		EXTERNAL	INTERNAL
1500 psi–Port A	Retracted	2 drops in 12 hrs.	10 drops / hr.
1500 psi–Port B	Retracted	2 drops in 12 hrs.	10 drops / hr.
1500 psi–Port C	Extended	2 drops in 12 hrs.	10 drops / hr.
Friction Pressure – 25 psi max.			

Douglas Dwg. No. 5122377

Figure 261—Main Landing Gear Actuating Cylinder

2. DISASSEMBLY.—Refer to *figure 260* if disassembly of the landing gear position selector valve is attempted.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the landing gear position selector valve is damaged or is not functioning properly, replace it with a new or serviceable part.

(d) ADJUSTMENTS.

1. If the valve has been disassembled, the flat head screws *(1, figure 260)* on the pistons must be adjusted so that the control shaft *(8, figure 260)* may rotate 20 degrees in the "NEUTRAL" position—that is, between the closing of one pair of poppets and the opening of the opposite pair. Install the valve pulley so that as much of the 20 degrees as possible is usable in extending the gear.

2. The relief valve is set to by-pass fluid to the reservoir at 1250 ± 50 psi. Place the emergency hydraulic system selector valve in the "SYSTEM" position and operate the hydraulic hand pump until the hydraulic system pressure gage indicates 1250 ± 50 psi.

a. If the hydraulic pressure gage indicates more than 1250 ± 50 psi, the set screw *(17, figure 260)* located under the return port should be turned out.

b. If the gage indicates less than 1250 ± 50 psi, turn the adjusting screw in.

(c) To adjust the cable controls refer to *figure 259.*

(e) TESTS BEFORE INSTALLATION.—Refer to *figure 260* for leak tests.

(f) INSTALLATION.—To install the valve, reverse the REMOVAL procedure. Adjust the cable controls as shown on *figure 259.*

(3) MAIN LANDING GEAR ACTUATING CYLINDERS.
(See figure 261.)

(a) DESCRIPTION.—Each main landing gear actuating cylinder is attached at the cylinder end to the landing gear retracting link support, and at the piston end to the main landing gear strut retracting arm. When the landing gear is retracted, fluid is forced into the cylinder upper port *(figure 258)*, extending the piston and retracting the gear. As the piston is actuated, the excess fluid is forced out of the cylinder lower port *(figure 258)*, and then back to the fluid reservoir through the landing gear DOWN line and position selector valve. When the landing gear is extended, the fluid flow and piston actuation is reversed. The main landing gear cylinders have integral shuttle valves *(23, figure 261)* which close the main hydraulic fluid ports when the emergency DOWN lines are being used.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Install ground safety pins on the two main landing gear assemblies and on the nose gear. *(See figure 91.)*

b. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

c. Disconnect and cap the three hydraulic hoses leading to the main landing gear actuating cylinder.

d. Remove the bolt attaching the piston rod eyebolt to the retracting link support and remove the cylinder.

e. Remove the bolt that attaches the cylinder head to the retracting link support and remove the main landing gear actuating cylinder.

2. DISASSEMBLY.

a. A suitable clamp must be used to prevent distorting the cylinder barrel when this part is clamped in a vise during disassembly. Great care must be exercised in clamping the cylinder barrel because the thin barrel walls are easily dented or distorted. A clamp may be made of two pieces of hardwood with the two halves encircling the entire length of the barrel. Use of this type of clamp assures that the clamping pressure is evenly distributed over the entire outside barrel surface. Place the cylinder barrel with clamp in a vise and tighten the vise until the cylinder is held securely.

b. To disassemble the main landing gear actuating cylinder, refer to *figure 261* and observe the following precautions:

(1) Use a spanner wrench (service tool K27705) to loosen the cylinder head packing retainer nut.

(2) Use a strap wrench to loosen the knurled nuts on the piston rod and cylinder.

(3) DO NOT GRIP the piston rod with a pair of pliers, because the rod will be scratched and damaged, and cause damage to the piston rod packing.

(4) DO NOT USE a screw driver or other sharp pointed tool to pry out the piston rod packing.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Very little maintenance is required of the actuating cylinders during normal operation, other than occasional tightening or replacement of packing. If the actuating cylinders are not functioning properly, and disassembly is necessary, observe the following instructions:

1. After the cylinder has been disassembled, wash all parts of the cylinder in clean hydraulic fluid.

2. If moderate tightening of the packing nuts *(figure 261)* does not stop external fluid leakage, new packing *(figure 261)* must be installed. Attempts to stop fluid leakage by excessive tightening of the packing results in rapid wear of the packing.

3. Internal leakage should be remedied by installing a new packing *(18, figure 261)* on the piston.

4. Inspect all wearing surfaces on the piston, piston rod and cylinder walls for evidence of scratches and abraded areas. Light scratches and abrasions should be buffed out carefully. Long deep scratches may cause considerable fluid leakage, and parts with such damage should be replaced.

5. All packing removed during disassembly must be replaced with new packing, although fluid leakage has not been observed. Packing in service for some time, takes a permanent "set" to surrounding parts and will not seal properly when removed and reinstalled.

CAUTION

When new packing is installed, make certain that the rings are of the approved type and same part number as originally used, and they should be thoroughly inspected. Soak the packing in hydraulic fluid (Specification AN-VV-O-366) or equivalent for approximately 24 hours before installation. Packing should not be installed if swelling occurs after it has been soaked in hydraulic fluid because swelling indicates that the ring is not made of oil resistant synthetic rubber. Great care must be observed when installing packing rings over and through threaded surfaces in order to avoid shearing or scraping the edges of the rings. Place a cap over the end of the threaded piston rod, or tube, slightly larger than the packing rings in the threaded opening in the cylinder head. Install one ring at a time. Push the rings together with a suitable blunt tool. DO NOT USE a screw driver or other sharp tool to press packing rings into position.

6. Inspect the integral shuttle valve *(figure 261)* to determine if the steel cone is properly seated. If the cone or seats are pitted, scored, or worn excessively, new parts should be installed. Check the spacer, spring, plug, and gasket for evidence of excessive wear. Install new parts if necessary.

7. Inspect the general condition of all remaining parts of the cylinder, and install new parts if inspection reveals defects. Check bushings or bearings for evidence of excessive wear.

(d) ADJUSTMENTS.—To adjust the main landing gear actuating cylinders with the landing gear retracting mechanism, refer to paragraph 5. *b.* (2) *(e).*, this section.

(e) TESTS BEFORE INSTALLATION.—Refer to *figure 261* for fluid leak tests.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the cylinder, refer to *figure 261.*

Note

Install all packing rings with care to avoid damaging the edges of the rings.

2. INSTALLATION.—To install the main landing gear cylinders, reverse the REMOVAL procedure.

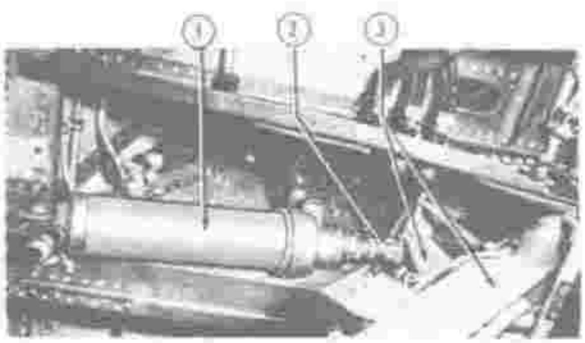
Note

The locknut on the main landing gear actuating cylinder should be tightened to a torque of 1300-1500 inch pounds.

(g) MAJOR OVERHAUL.—Follow the same procedure as given in MAINTENANCE REPAIR OR REPLACEMENT.

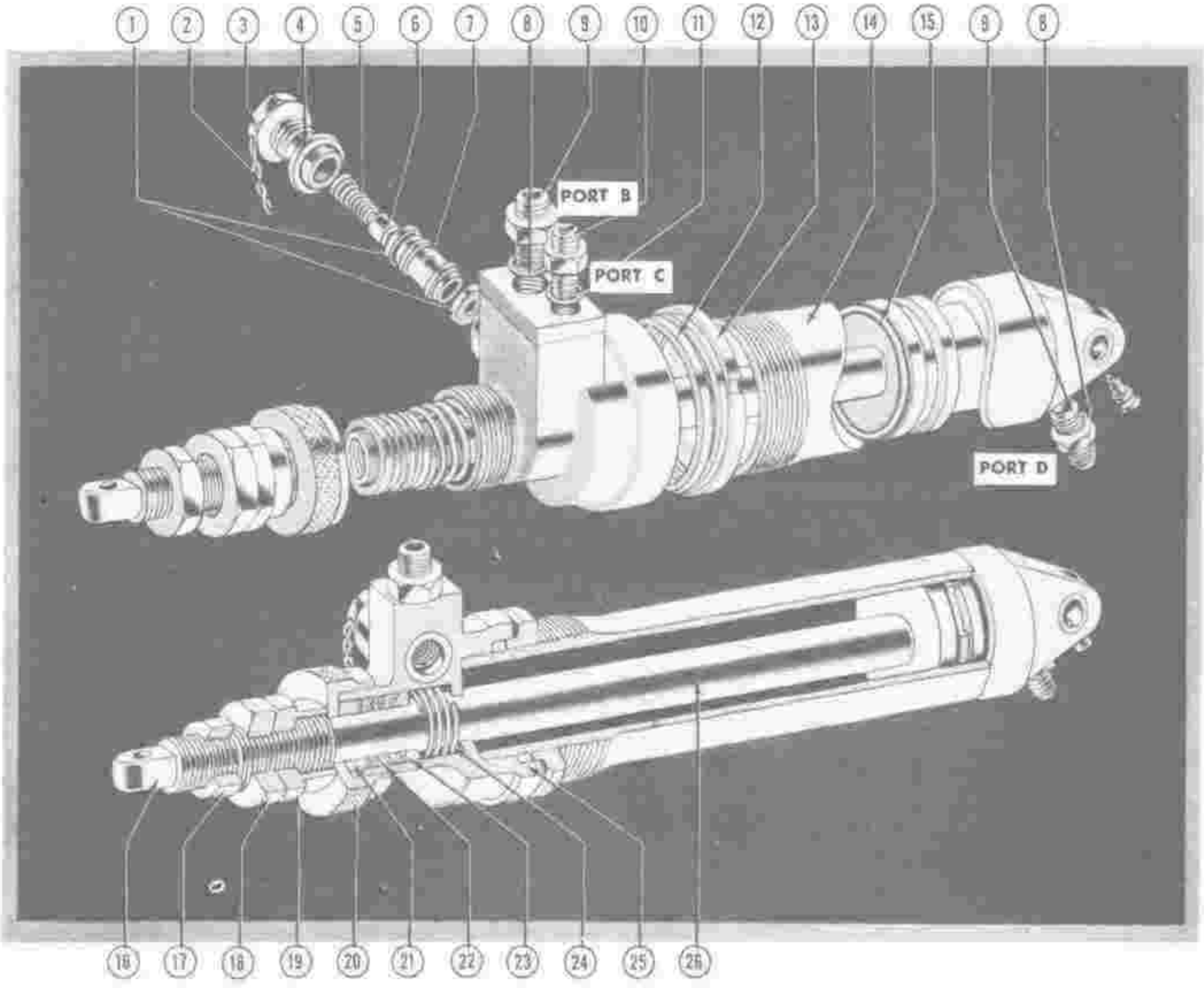
(4) NOSE WHEEL GEAR ACTUATING CYLINDER.
(See figures 262 and 263.)

(a) DESCRIPTION.—The nose wheel gear actuating cylinder is located in the center of the forward section of the nose wheel well. The cylinder end is attached to a bracket in the forward section of the nose wheel well. The piston end is attached to a lever on the upper shaft assembly of the nose wheel gear retracting link. When the nose wheel gear is extended or retracted, the action of the hydraulic fluid is identical to, and simultaneous with that of the main landing gear actuating cylinder. A mechanical latch *(figure 109)* holds the nose wheel gear in the retracted position until the nose wheel doors reach the fully opened position. At this point, the link assembly, which connects the nose wheel door mechanism, releases the



1. Nose Wheel Gear Actuating Cylinder
2. Clevis
3. Nose Wheel Gear Retracting Mechanism

Figure 262—Nose Wheel Gear Actuating Cylinder Installed



1. Seat (Emergency Substitute Part may be made from AN6225-4)
x2. Lock Wire
3. Plug—Shuttle Valve
4. Gasket
5. Spring—Shuttle Valve
6. Cone—Shuttle Valve
7. Spacer—Shuttle Valve
8. AN902-6 Gasket
9. Union
10. Union
11. AN902-4 Gasket
12. Gasket
13. Nut
14. Barrel Assembly (Includes 116500-9A-024G Bushing)
15. AN6227-36 Packing
16. Bolt
17. Nut
18. Lock Nut
19. Stop Nut
20. Packing Nut
21. Ring
22. AN6225-22 Packing (4 Required)
23. Ring
24. Spring
25. Cylinder Head
26. Piston Assembly

TEST PROCEDURE			
		MAX. LEAKAGE	
TEST PRESSURE	PISTON POS.	EXTERNAL	INTERNAL
1500 psi—Port B	Retracted	2 drops in 12 hrs.	10 drops / hr.
1500 psi—Port C	Retracted	2 drops in 12 hrs.	10 drops / hr.
1500 psi—Port D	Extended	2 drops in 12 hrs.	10 drops / hr.
Friction Pressure – 25 psi max.			

Fig. 263—Nose Wheel Gear Actuating Cylinder

mechanical latch, thus allowing the nose wheel gear to extend. When the nose wheel is retracted, a mechanical latch *(figure 264)* is provided to prevent the nose wheel doors from closing until the nose wheel is fully retracted. When the nose wheel gear reaches the fully retracted position, it releases the latching mechanism, allowing the doors to close. The nose wheel gear actuating cylinder has an integral shuttle valve *(figure 263)* that closes the main hydraulic fluid port when the emergency DOWN line is being used. For complete information about the nose gear and nose wheel doors operating mechanism refer to paragraph 5. *c.*, this section.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Install ground safety pins *(figure 91)* on the nose wheel gear and main landing gear.

b. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

c. Disconnect and cap the three hydraulic lines leading to the cylinder.

d. Remove the bolt which attaches the piston rod eyebolt to the link between the retracting arms.

e. Remove the bolt which attaches the cylinder head to the support on the floor of the pilot's compartment.

f. Remove the nose wheel gear actuating cylinder.

2. DISASSEMBLY.—Refer to *figure 263* for disassembly procedure.

CAUTION

Do not clamp the cylinder barrel in a vise, but provide a suitable clamp as instructed in paragraph 14. *c.* (3) *(c)*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to maintenance repair instructions for main landing gear cylinders paragraph 5. *c.* (3) *(c)*, this section.

(d) ADJUSTMENTS.—Refer to paragraph 5. *c.* (1) *(e)*, this section, to adjust the nose wheel gear actuating cylinder with the nose wheel gear operating mechanism.

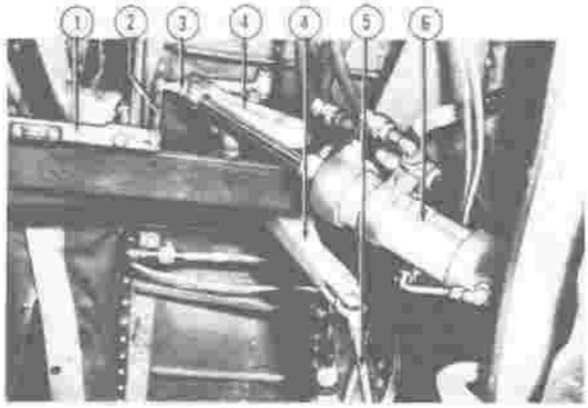
(e) TESTS BEFORE INSTALLATION.—Refer to *figure 263* for fluid leaks.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the nose wheel gear actuating cylinder refer to *figure 263*.

CAUTION

Use great care in installing the packing in the cylinder. Refer to paragraph 14. *c.* (3) *(f)* *2.*, this section.



1. Nose Wheel Doors DOWN Latch Operating Lever
2. Nose Wheel Doors DOWN Latch Actuating Rod
3. Nose Wheel Doors DOWN Latch
4. Nose Wheel Doors Operating Arms
5. Nose Wheel Door Actuating Rod
6. Nose Wheel Doors Actuating Cylinder and Shuttle Valve Assembly (See Figures 265 and 266)

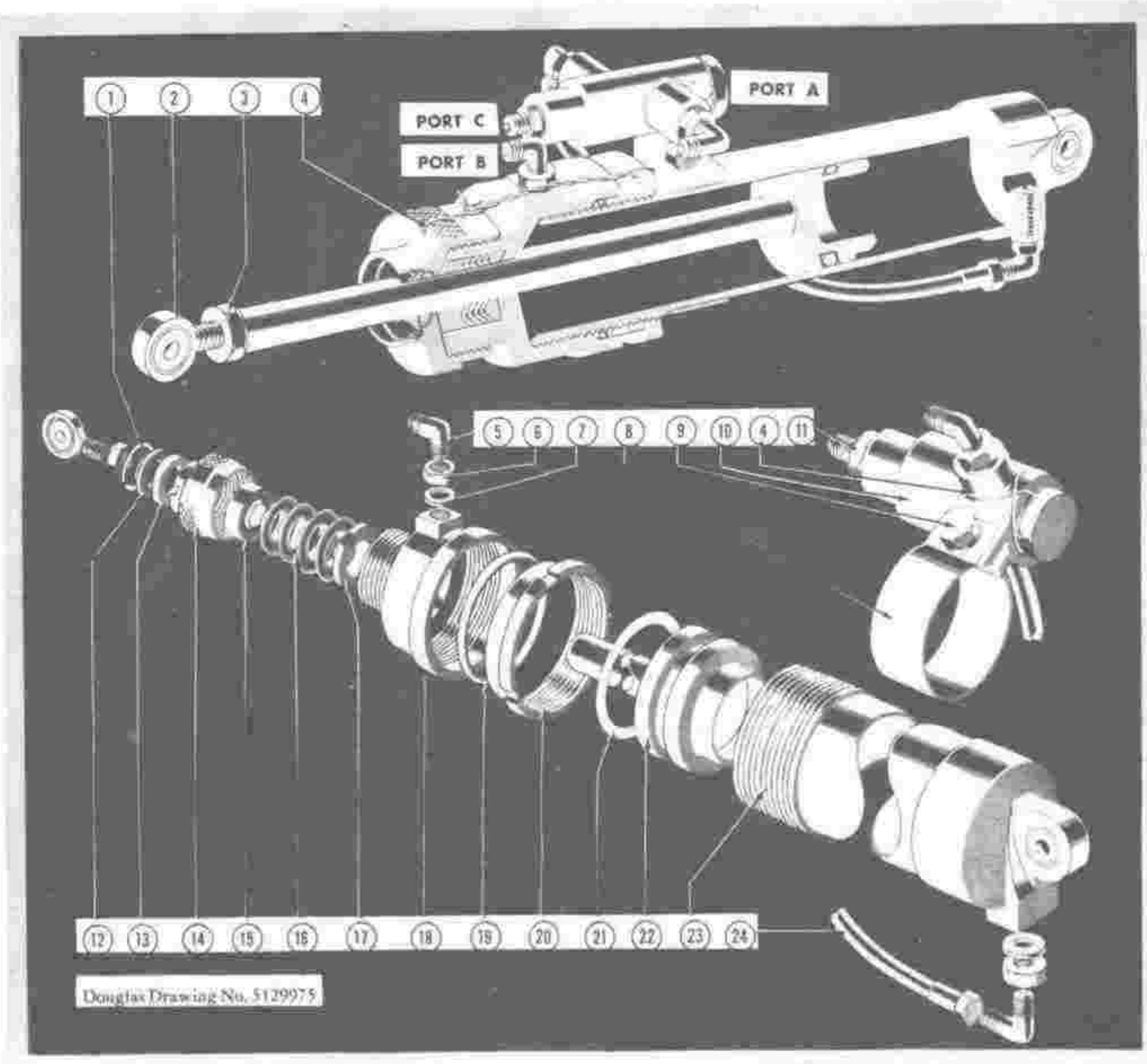
Figure 264—Nose Wheel Door Actuating Cylinder Installed

2. INSTALLATION.—To install the nose gear actuating cylinder reverse the REMOVAL procedure. The locknut on the nose wheel actuating cylinder should be tightened with a torque of 1300-1500 inch-pounds.

(g) MAJOR OVERHAUL.—Follow the same procedure as given in MAINTENANCE REPAIR OR REPLACEMENT.

(5) NOSE WHEEL DOOR ACTUATING CYLINDER.
(See figure 264.)

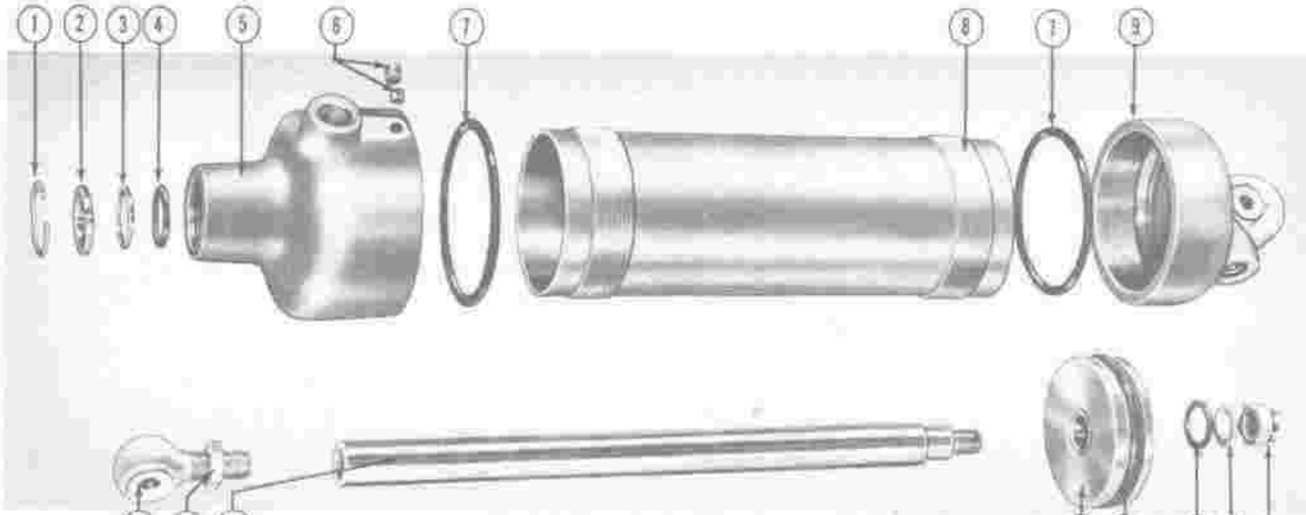
(a) DESCRIPTION.—The nose wheel door actuating cylinder is located on the left side of the nose wheel well. It is attached to a support at the cylinder end, and to an actuating lever at the piston end. The actuating cylinder piston extends and opens the nose wheel doors after the nose wheel gear is extended. The piston retracts to close the doors after the nose wheel gear has been retracted. A mechanical latch system permits the nose wheel gear to extend only after the nose wheel doors have opened completely, and the doors to close only after the nose wheel gear is fully retracted. Two types of nose wheel door actuating cylinders have been used on the airplane, one cylinder being larger than the other. The differences in the two cylinders may be seen by comparing *figure 265* and *figure 266*. For complete information about the nose wheel door operating mechanism refer to paragraph 5. *c.* (6), this section.



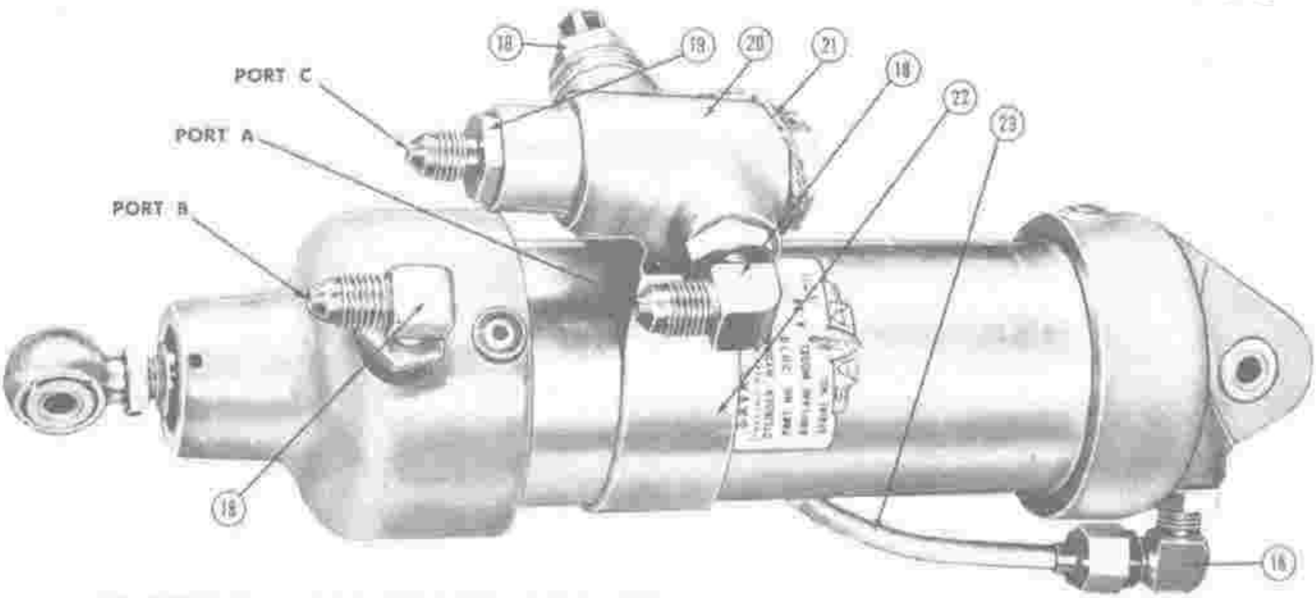
1. Lock Ring
2. Bolt Assembly
3. Lock Nut
4. Lock Wire
5. Elbow (3 Required)
6. Nut (3 Required)
7. AN902-4 Gasket (4 Required)
8. Clamp
9. Bolt, Nut, and Washers
10. Shuttle Valve (*See figure 267.*)
11. Union and Gasket
12. Wiper
13. Felt
14. Packing Nut
15. Ring
16. AN6225-14 Packing (4 Required)
17. Ring
18. Cylinder Head
19. Gasket
20. Nut
21. AN6227-27 Packing
22. Piston Assembly
23. Barrel Assembly
24. Tube Assembly

TEST PROCEDURE			
		MAX. LEAKAGE	
TEST PRESSURE	PISTON POS.	EXTERNAL	INTERNAL
1500 psi–Port A	Extended	2 drops in 12 hrs.	10 drops / hr.
1500 psi–Port B	Retracted	2 drops in 12 hrs.	10 drops / hr.
1500 psi–Port C	Extended	2 drops in 12 hrs.	10 drops / hr.
Friction Pressure – 25 psi max.			

Figure 265—Nose Wheel Door Actuating Cylinder (Some Airplanes)



NOSE WHEEL DOOR ACTUATING CYLINDER (Douglas Drawing No. 4207061)



NOSE WHEEL DOOR ACTUATING CYLINDER AND SHUTTLE VALVE ASSEMBLY (Douglas Drawing No. 4207091)

1. Lock Ring
2. AN6231-3 Wiper
3. Spacer
4. AN6227-12 Piston Rod Packing
5. Cylinder Head
6. Lock Screw and Plug
7. AN6230-6 Packing
8. Cylinder Barrel
9. Cylinder End
10. Piston Rod End
11. Check Nut
12. Piston Rod
13. Piston
14. AN6227-30 Packing
15. AN6227-10 Packing
16. Washer
17. Nut and Cotter
18. Elbow, Nut and Gasket
19. Union, Nut and Gasket
20. Shuttle Valve (*Figure 267*)
21. Lock Wire
22. Clamp
23. Tube Assembly

TEST PROCEDURE		
TEST PRESSURE	PISTON POSITION	MAXIMUM LEAKAGE
1500 psi at Port A	Extended	2 drops in 12 hours – external 10 drops an hour – internal
1500 psi at Port B	Retracted	2 drops in 12 hours – external 10 drops in an hour – internal
Packing Friction Pressure – 25 psi maximum		

Figure 266—Nose Wheel Door Actuating Cylinder Assembly (Some Airplanes)

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Install ground safety pins on the nose wheel gear and main landing gear. *(See figure 91.)*

b. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

c. Disconnect and cap the three hydraulic lines leading to the nose wheel door actuating cylinder.

d. Remove the bolt attaching the piston rod eyebolt to the connecting arms.

e. Remove the bolt attaching the actuating cylinder to the left side of the nose wheel well. wheel well.

f. Remove the actuating cylinder from the airplane.

2. DISASSEMBLY—Refer to *figures 265 & 266* for disassembly procedure. Use service tool K26419 to loosen the lock nut on the smaller nose wheel door actuating cylinder on some airplanes.

c. MAINTENANCE REPAIR OR REPLACEMENT.—Refer to maintenance repair instructions for the main landing gear cylinders in paragraph 14. *c.* (3) *(c)*, this section. These instructions all apply with the exception of the repair on the integral shuttle valve. The nose wheel door actuating cylinder does not include an integral shuttle valve.

(d) ADJUSTMENTS.—Refer to paragraph 5. *c.* (1) *(d)*, this section, for adjustment of the nose wheel doors and operating mechanism with the nose wheel door actuating cylinder.

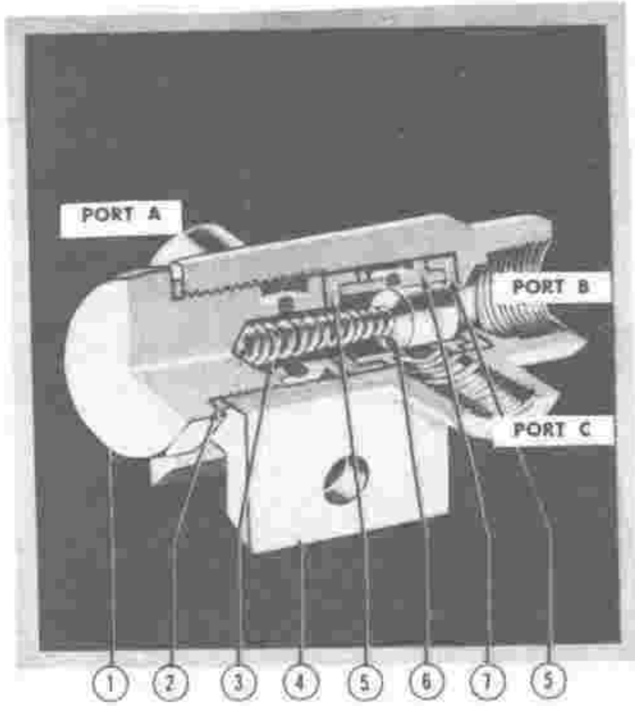
(e) TESTS BEFORE INSTALLATION.—Refer to *figures 265 and 266* for fluid leak tests of the nose wheel door actuating cylinder.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the nose wheel door actuating cylinder, refer to *figures 265 and 266*. Apply 95-100 inch-pounds wrench torque when tightening the lock nut on the piston rod of the nose wheel door actuating cylinder.

2. INSTALLATION.—To install the nose wheel door actuating cylinder reverse the REMOVAL procedure.

(g) MAJOR OVERHAUL.—Follow the same procedure as given in MAINTENANCE REPAIR OR REPLACEMENT, *(c)*, above.



1. Plug
2. Washer
3. Spring
4. Body
5. Seat (Emergency Substitute Part may be made from AN6226-2)
6. Cone
7. Spacer

TEST PROCEDURE			
PORT PLUGGED	TEST PRESS.	MAX. LEAKAGE	
		INTERNAL	EXTERNAL
Port C	1500 psi–Port A	None–Port B	None
Port C	1500 psi–Port B	None–Port A	None

Douglas Drawing No. 4129449

Figure 267—Nose Wheel Door Actuating Cylinder Shuttle Valve

(6) NOSE WHEEL DOOR ACTUATING CYLINDER SHUTTLE VALVE. *(See figure 267.)*

(a) DESCRIPTION.—A shuttle valve is clamped to the nose wheel door actuating cylinder, and functions to close the emergency hydraulic system DOWN line during normal operation of the main hydraulic system. The spring-seated cone in the shuttle closes the main DOWN line port when the emergency hydraulic system is used.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve system operating pressure by applying toe pressure and releasing rudder-brake pedals until pressure gage indicates zero.

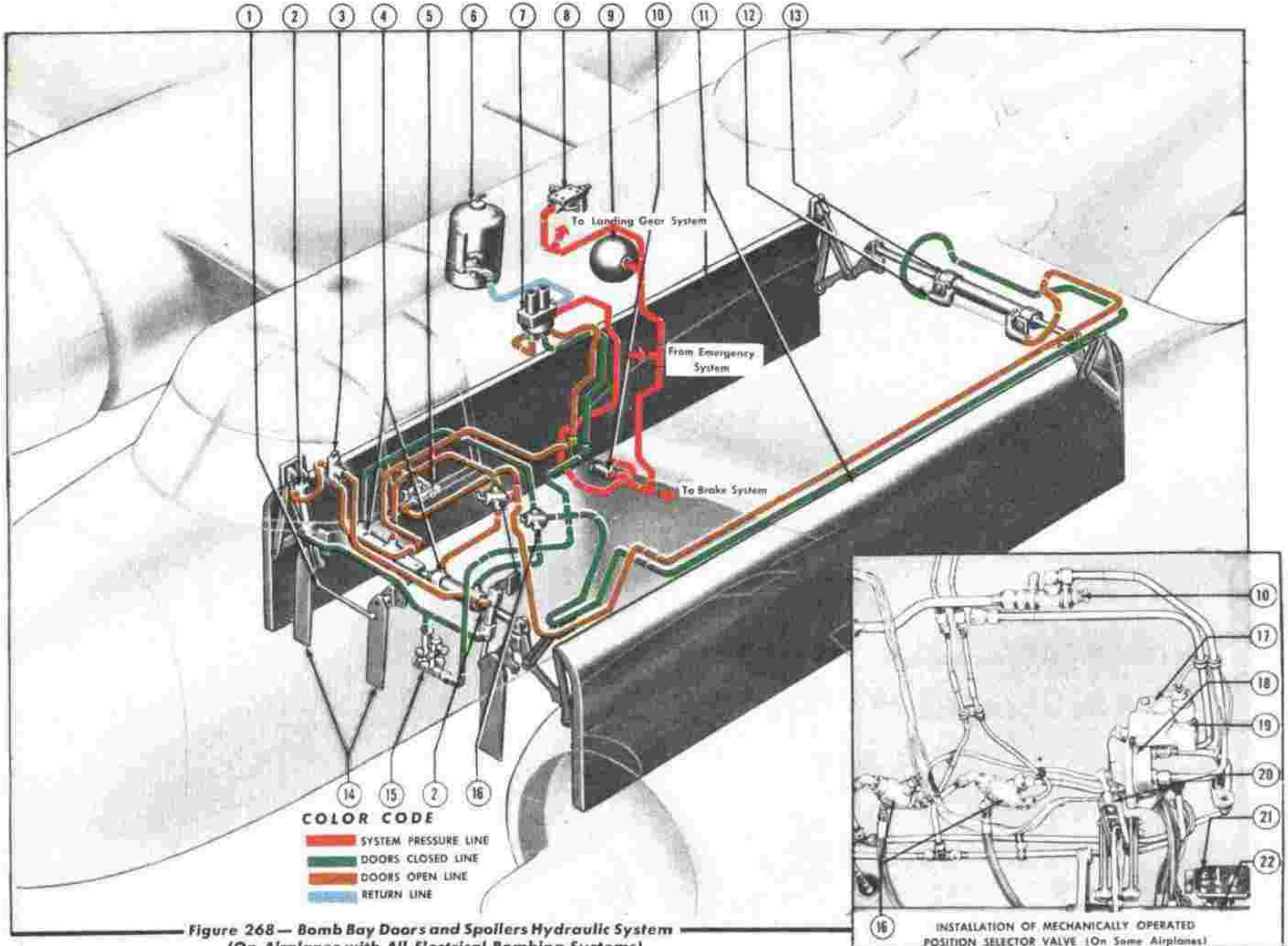


Figure 268 — Bomb Bay Doors and Spoilers Hydraulic System (On Airplanes with All-Electrical Bombing Systems)

KEY TO FIGURE 268

1. Center Spoiler Plate Actuating Rod
2. Bomb Bay Spoilers Actuating Cylinders
3. Bomb Bay Spoilers Actuating Cylinders Shuttle Valve
4. Bomb Bay Door Forward Actuating Cylinders (*Figure 273*)
5. Combination Check and Pressure Relief Valve
   Check Valve Opens at 3 to 7 psi
   Relief Valve opens at 825 ± psi Minimum
   Reseats at 525 psi Minimum
6. Main Hydraulic System Fluid Reservoir (*Figure 253*)
7. Bomb Bay Doors and Spoilers Position Selector Valve
8. Hydraulic System Pressure Regulator (*Figure 251*)
9. Hydraulic System Pressure Accumulator (*Figure 250*)
10. Balanced Pressure Relief Valve (*Figure 280*)
11. Bomb Bay Doors (*Figure 281* for Details of Bomb Bay Doors Operating Mechanism)
12. Bomb Bay Doors Aft Actuating Cylinder Shuttle Valves (*Figure 276*)
13. Bomb Bay Doors Aft Actuating Cylinder (*Figure 275*)
14. Bomb Bay Spoiler Plates
15. 2207579 Restrictor Union
    Combination Shuttle, Check, and Pressure Relief Valve
    Shuttle Valve Opens at 25 to 30 psi
    Check Valve Opens at 3 to 7 psi
    Relief Valve Opens at 825 ± 25 psi Minimum
    Relief Valve Reseats at 700 psi Minimum
16. Bomb Bay Doors Forward Actuating Cylinders Shuttle Valves (*Figure 274*)
17. Mounting Bracket
18. Mechanically Operated Bomb Bay Doors Position Selector Valve (*Figure 272*)
19. Solenoid Assembly—Bomb Bay Doors Locking
20. Valve Operating Levers
21. Bomb Bay Doors Lock Control Switch
22. Torque

b. Disconnect the hydraulic lines leading to the shuttle valve.

c. Unbolt the attaching clamp.

d. Remove the shuttle valve from the airplane.

2. DISASSEMBLY.—Refer to *figure 267* when disassembly of the shuttle valve is attempted.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—The only maintenance necessary with this valve will be to prevent external fluid leaks at the plug and internal fluid leaks of the spring seated cone. Internal fluid leaks will cause sluggish operation of the actuating cylinder.

1. If moderate tightening fails to stop leakage at the plug, replace the gasket or plug.

2. Check the steel cone for corrosion, roughness or pitting, and install a new cone if defects are apparent. Replace the valve seats if worn or scored.

3. Replace worn or fatigued spring with a new spring.

(d) TESTS BEFORE INSTALLATION.—Refer to *figure 267* for leak tests of the shuttle valve.

(e) ASSEMBLY AND INSTALLATION.

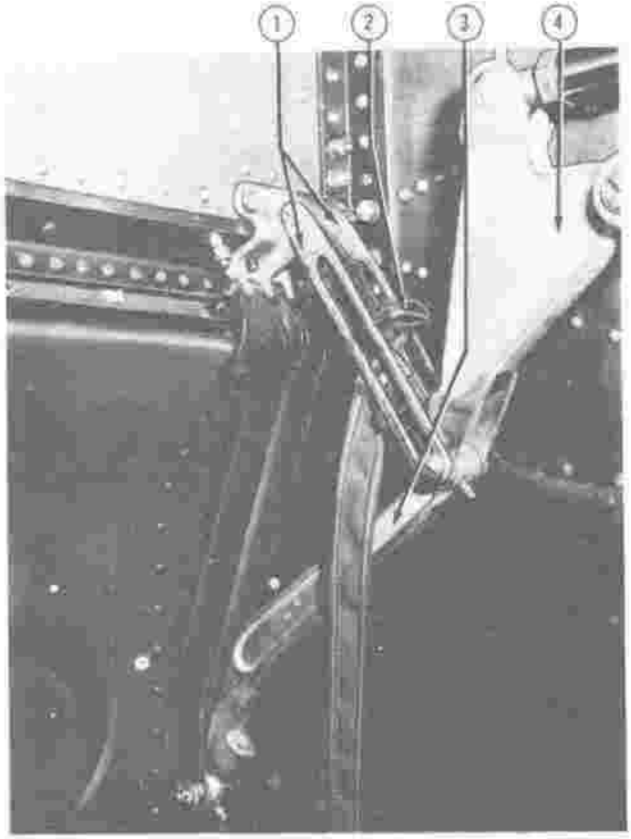
1. ASSEMBLY.—To assemble the shuttle valve reverse the DISASSEMBLY procedure and refer to *figure 267*.

2. INSTALLATION.—To install the shuttle valve reverse the REMOVAL procedure.

(f) MAJOR OVERHAUL.—Follow the same procedure as given in MAINTENANCE REPAIR OR REPLACEMENT, *(c)*, above.

d. BOMB BAY DOORS AND SPOILERS
(*See figure 268.*)

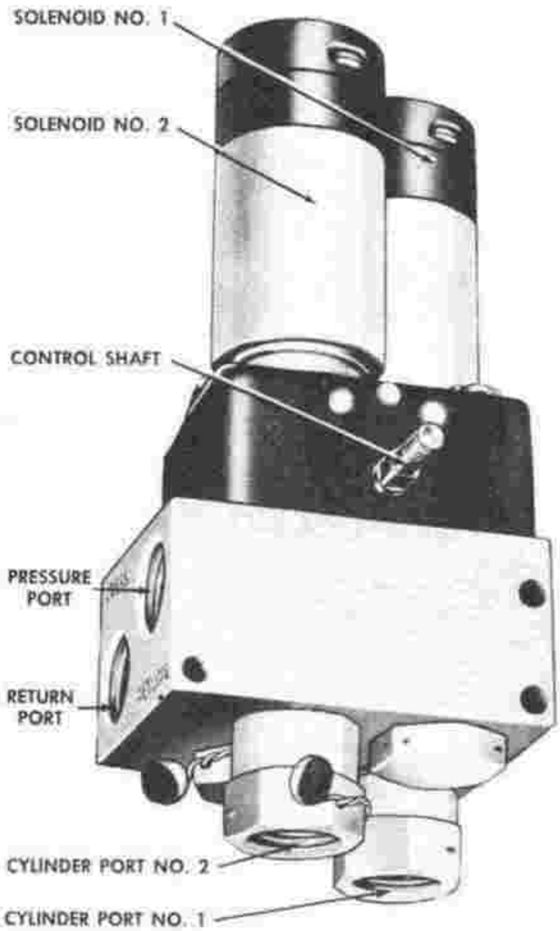
(1) GENERAL.—The opening and closing of the bomb bay doors and the extension and retraction of



1. Sliding Stop Links
2. Safety Stop and Streamer Assembly
3. Bomb Bay Door Actuating Arm
4. Bellcrank

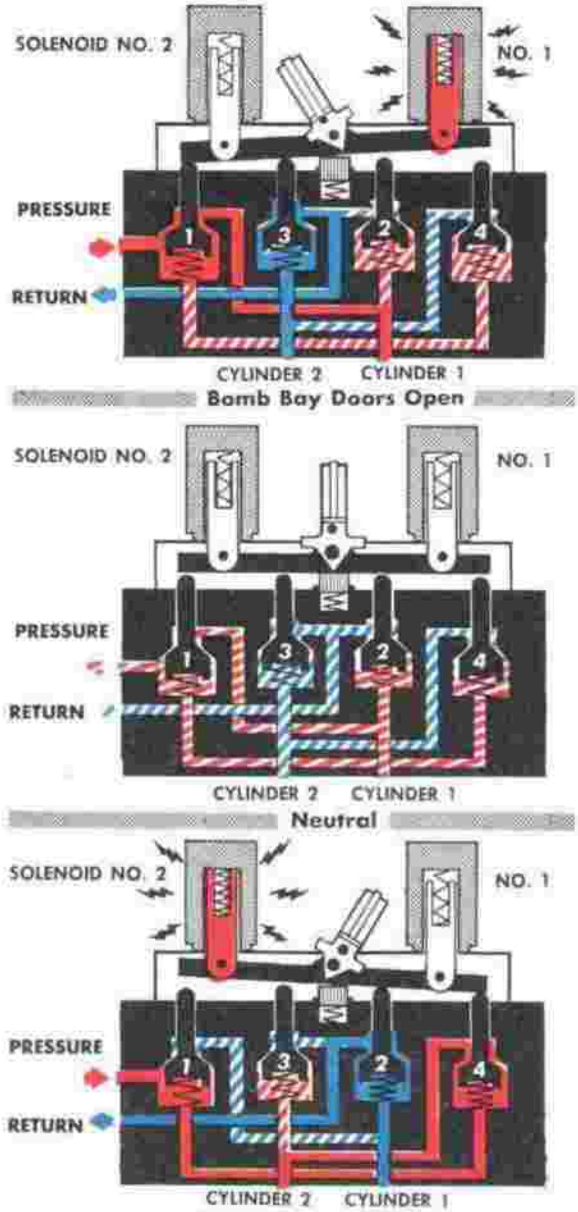
Figure 269—Bomb Bay Door Safety Stop Installed

Douglas Drawing No. 4204376 — D11735 Adel Precision Products Inc.—4V4032 The Aerodraulics Co.



Cylinder Port No. 1 open to pressure and Cylinder Port No. 2 open to return when Solenoid No. 1 is energized

Cylinder Port No. 2 open to pressure and Cylinder Port No. 1 open to return when Solenoid No. 2 is energized



Bomb Bay Doors Closed
VALVE DIAGRAMS

TEST PROCEDURE

Solenoid Energized	*Test Pressure*	*Ports Plugged*	*Allowable Internal Leakage*	*Remarks*
None	1000 psi at Pressure Port	None	10 Drops an Hour at Cylinder No. 1 and Cylinder No. 2 Ports	Test Poppets 1 and 4
No. 1	1000 psi at Pressure Port	Cyl. No. 1 and Cyl. No. 2	Leakage from Cylinder No. 1 in First Test Plus 10 Drops per Hour at Return Port	Test Poppet 3
No. 2	1000 psi at Pressure Port	Cyl. No. 1 and Cyl. No. 2	Leakage from Cylinder No. 2 in First Test Plus 10 Drops per Hour at Return Port	Test Poppet 2

Figure 270 — Solenoid Operated Bomb Bay Doors Position Selector Valve (Some Airplanes)

the bomb bay spoilers is accomplished by actuation of hydraulic cylinders. Two pressure relief valve assemblies are installed to obtain the proper operating sequence of the spoilers and the bomb bay doors. One pressure relief and check valve assembly is installed in the bomb bay door OPEN line to prevent flow of fluid to the bomb bay doors actuating cylinders until the spoilers have been extended completely. The other pressure relief, shuttle, and check valve assembly is installed in the bomb bay doors CLOSED line to prevent flow of fluid to the spoilers actuating cylinders until the bomb bay doors have closed. Another pressure relief valve is installed in the pressure line to the bomb bay doors position selector valve to prevent the reduction of pressure to the brakes when the bomb bay doors are operated. Two types of selector valves have been used. On airplanes with electrical bomb release and mechanical salvo system the bomb bay doors position selector valve is installed on the underside of the slanting floor of the pilot's compartment at the forward end of the bomb bay. On these airplanes the selector valve is controlled by means of levers and cables by the bomb rack control lever *(figure 523)*. On airplanes with the all electrical bombing system the solenoid operated selector valve is installed on the aft end of the control pedestal and controlled by a switch on the main electrical control panel in the pilot's compartment. *(See figures 247 and 288.)*

Note

On airplanes with electrical bomb release and mechanical salvo the bomb bay doors can be locked in the closed position by a solenoid assembly *(19, figure 268)* on the position selector valve so that crew members may walk safely across the bomb bay doors when the airplane is in flight. This solenoid is controlled by toggle switches *(21, figure 268)*, in the forward bomb bay near the access door to the pilot's compartment and in the aft bomb bay near the gunner's access door.

(2) BOMB BAY DOORS POSITION SELECTOR VALVE.

(a) GENERAL.—Two types of bomb bay door position selector valves have been used in the airplane. One selector valve is controlled mechanically and is installed on airplanes with electrical bomb release and mechanical salvo systems. The other selector valve is controlled electrically and operated by means of solenoids and is installed on airplanes with all electrical bombing systems.

(b) ELECTRICALLY OPERATED BOMB BAY DOORS POSITION SELECTOR VALVE.

(See figure 270.)

1. DESCRIPTION.—Two solenoids are installed on this poppet-type selector valve to operate the valve. The solenoids are controlled by an electrical switch on the pilot's main electrical control panel *(figure 247)*. The valve has four ports; a pressure port, a return port, and two ports connected to the bomb bay doors and spoilers actuating cylinders. When the control switch is moved to the bomb bay doors "OPEN" position, one of the solenoids is energized and opens the poppets which connect the pressure port to the bomb bay doors OPEN line and the return port to the bomb bay doors CLOSED line. When the switch is moved to the bomb bay doors "CLOSE" position, the other solenoid is energized and it opens the poppets which connect the pressure port to the bomb bay doors CLOSED and the return port to the bomb bay doors OPEN line. The valve is installed on the aft end of the control pedestal and includes a handle on the valve shaft to operate the valve manually in the event of an electrical failure.

2. REMOVAL.

a. Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines leading to the valve. Disconnect the electrical wiring.

c. Remove the bolts that attach the valve to the mounting bracket and remove the valve assembly.

d. Disassembly of the valve should not be attempted in the field.

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the bomb bay doors position selector valve is damaged or is not functioning properly, it should be replaced with a new or serviceable part.

4. TESTS BEFORE INSTALLATION.—Refer to *figure 270* for fluid leak tests of the selector valve.

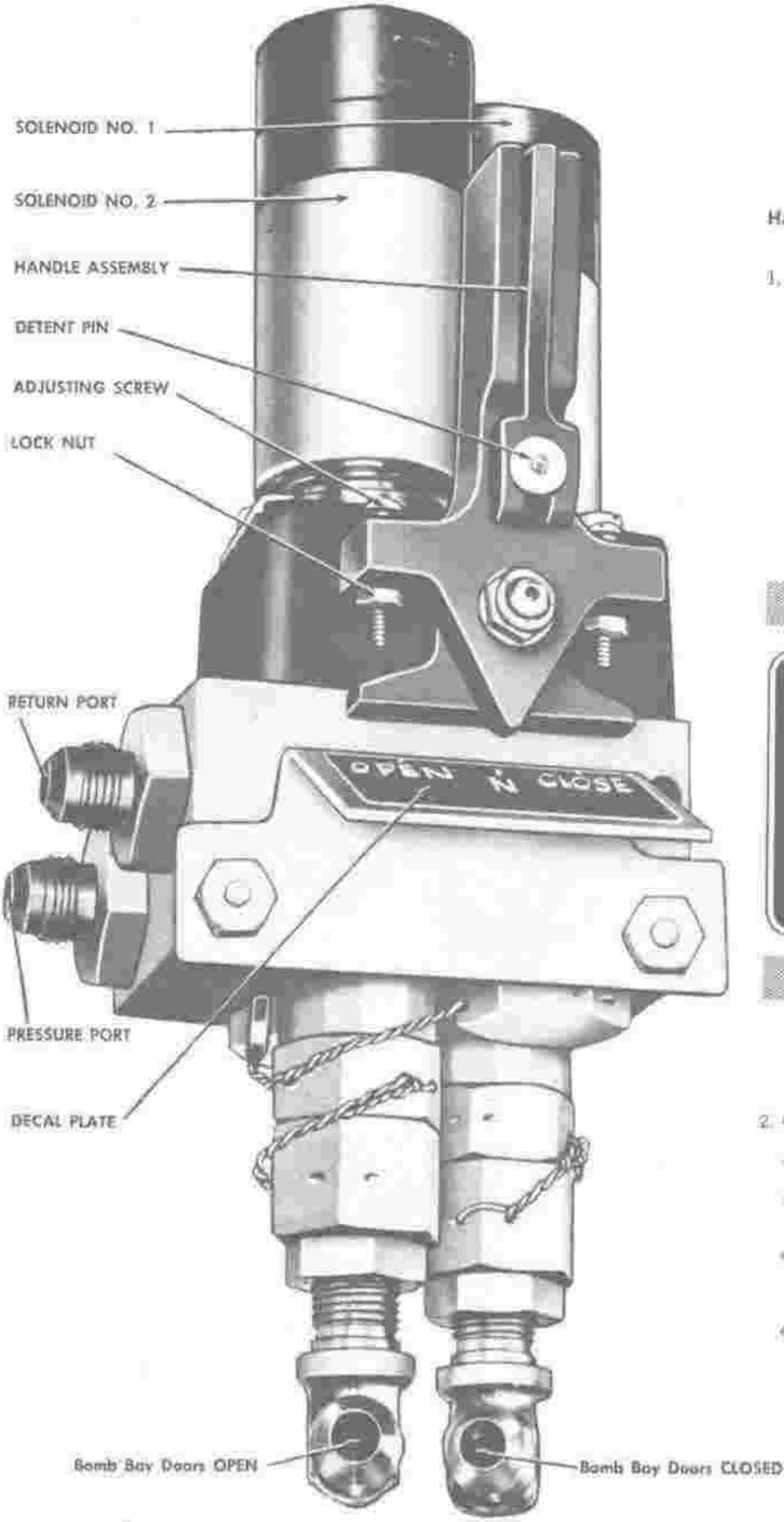
5. ADJUSTMENTS.—To adjust the handle on the valve assembly refer to *figure 271*.

6. INSTALLATION.—To install solenoid operated selector valve, reverse the REMOVAL procedure as given in *2* above.

(c) MECHANICALLY OPERATED BOMB BAY DOORS POSITION SELECTOR VALVE.

(See figure 272.)

1. DESCRIPTION.—This four way, poppet type selector valve is located on the under side of the slanting floor at the forward end of the bomb bay. When the bomb rack control lever is moved to the "DOORS OPEN" position, two of the poppet valves are opened; one connecting the pressure port to the bomb bay doors OPEN line and the return port to the



HANDLE ADJUSTMENT PROCEDURE

1. *OPEN POSITION*

   a. Energize Solenoid No. 2.

   b. Place handle in OPEN position with detent pin engaged.

   c. Adjust right hand screw to obtain .002 clearance between screw and clutch.

   d. Tighten lock nut.

2. *CLOSE POSITION*

   a. Energize Solenoid No. 1.

   b. Place handle in CLOSE position with detent pin engaged.

   c. Adjust left hand screw to obtain .002 clearance between screw and clutch.

   d. Tighten lock nut.

Figure 271 — Adjustment of Auxiliary Manual Control on Solenoid Operated Bomb Bay Doors Position Selector Valve

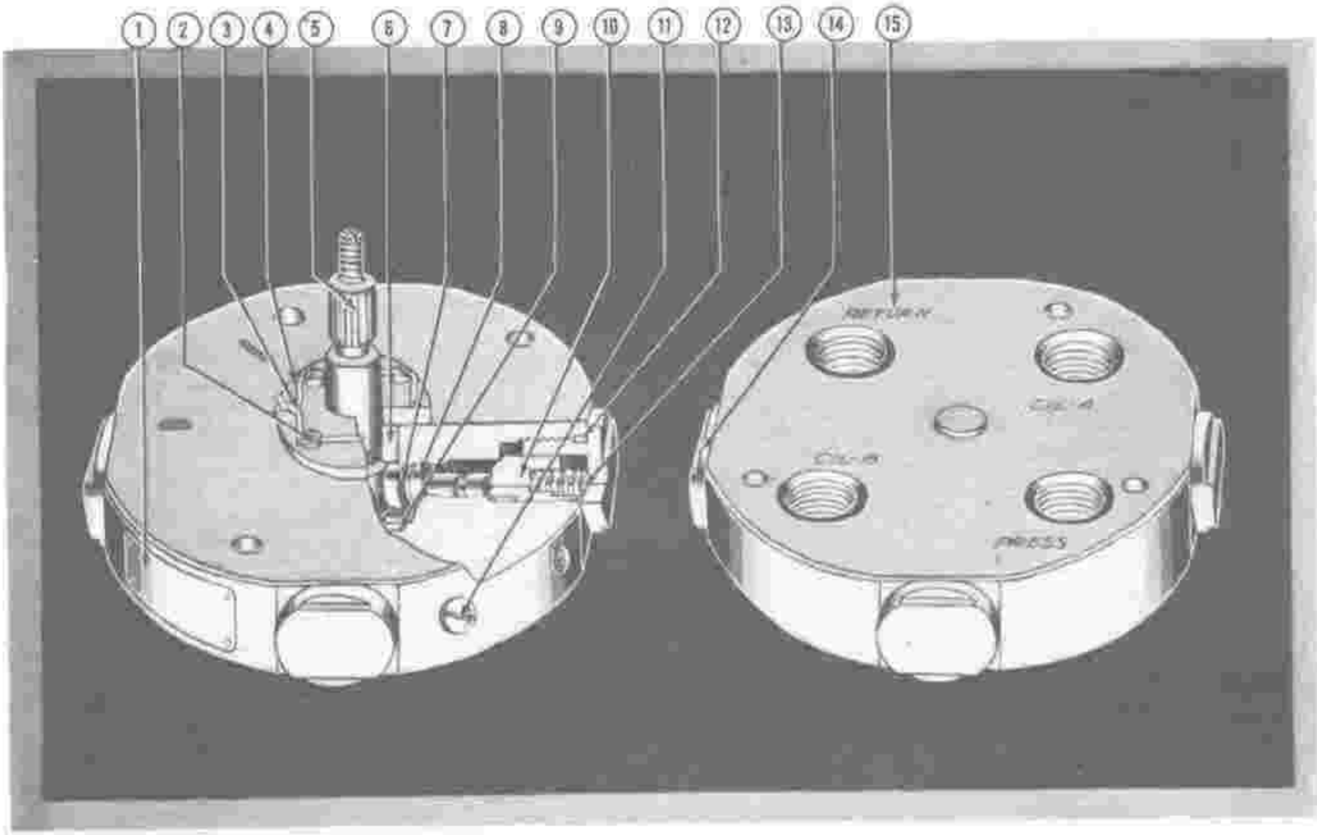
bomb bay doors CLOSED line. The displaced fluid is returned to the fluid reservoir through the position selector valve. When the bomb rack control lever is moved to the "DOORS CLOSE" position, the action described above is reversed. The valve mechanism consists of four identical spring loaded plastic poppet assemblies actuated by a camshaft. The poppets are arranged radially about the camshaft in the aluminum alloy valve body. The valve unit is connected by linkage and cables to the bomb rack control lever. When the valve is in the neutral position, all four poppets are closed. *(See 18, figure 268.)*

2. REMOVAL.

a. Be certain that the landing gear control lever in the pilot's compartment is in the "DOWN" position.

b. Check the emergency selector valve control handle on the pilot's control pedestal to see that it is in the "SYSTEM" position.

c. Place the bomb rack control lever or bomb bay doors switch located in the pilot's compartment in the "DOORS OPEN" position.

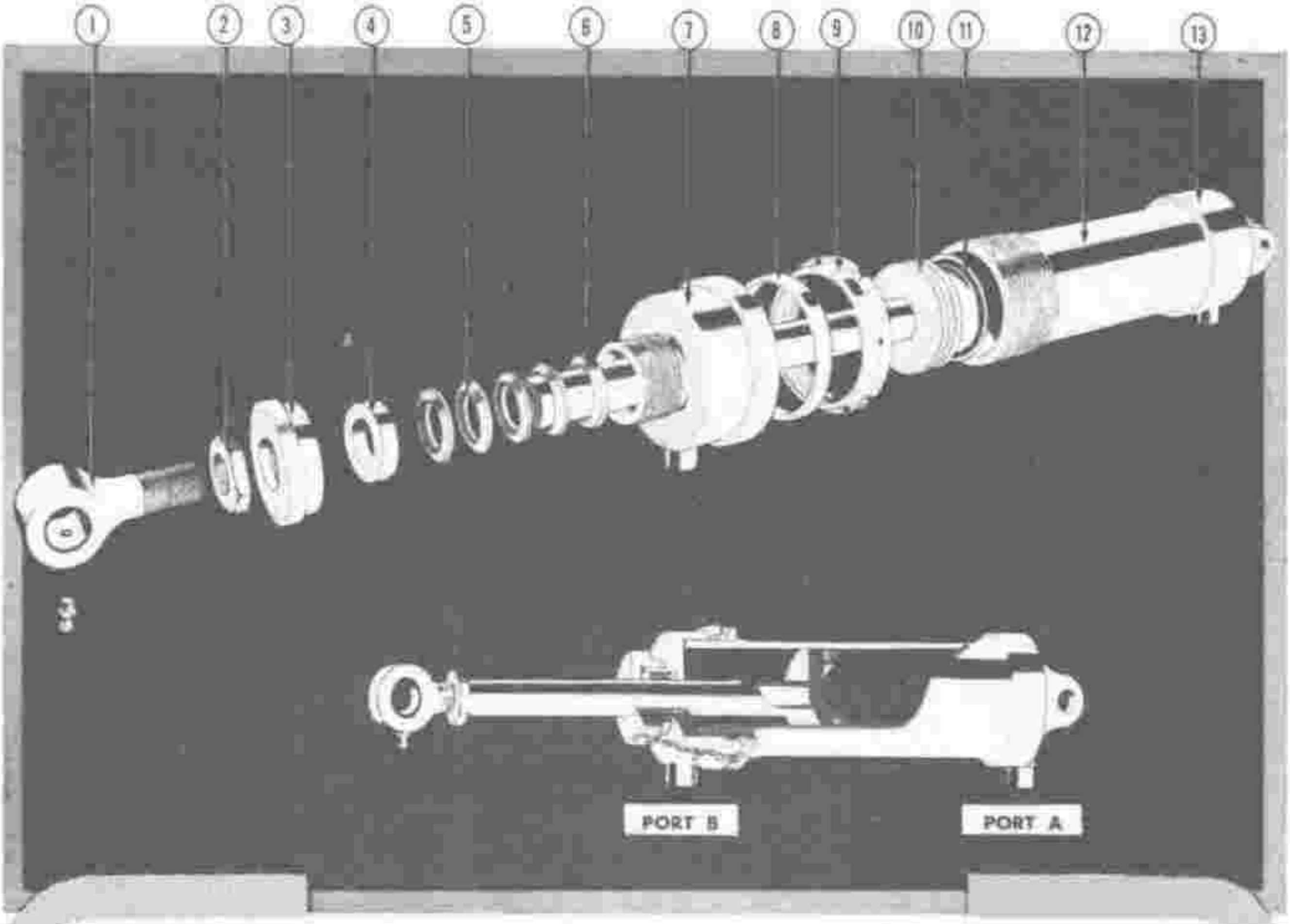


AN6213-1 SELECTOR VALVE

1. Nameplate
2. Screw
3. Lock Wire
4. Plate
5. Camshaft
6. Bearing
7. AN6227-4 Packing
8. Piston
9. Washer
10. Poppet
11. Pipe Plug
12. AN902-8 Gasket
13. Spring
14. Cap
15. Body

Figure 272—Mechanically Operated Bomb Bay Doors Position Selector Valve (Some Airplanes)

TEST PROCEDURE			
TEST PRESS.	PORTS PLUGGED	HANDLE POSITION	MAX. LEAKAGE
1500 psi–Cyl. A Port	Press., Return, and Cyl. B Ports	Any Position	External–None



1. Bolt Assembly (Includes 118500-9A-24G Bushing)
2. Lock Nut
3. Packing Nut
4. Ring
5. AN6225-20 Packing (4 Required)
6. Ring
7. Cylinder End
8. Gasket
9. Packing Nut
10. Piston Assembly
11. AN6227-32 Packing
12. Barrel
13. Cylinder Head

TEST PROCEDURE			
TEST PRESS.	PISTON POS.	MAX. LEAKAGE	
		EXTERNAL	INTERNAL
1500 psi–Port B	Retracted	2 drops in 12 hrs.	10 drops / hr.
1500 psi–Port A	Extended	2 drops in 12 hrs.	10 drops / hr.
Friction Pressure – 25 psi max.			

Douglas Drawing No. 5122207

Figure 273—Bomb Bay Doors Forward Actuating Cylinder

d. If the bomb bay doors do not open fully, operate the hydraulic hand pump *(figure 288)* until the doors are opened completely.

CAUTION

To prevent the possibility of the bomb bay doors closing, four safety stops *(figure 269)* should be fitted in the sliding links at the door connections. These safety stops are located in the miscellaneous equipment roll *(figure 585)* on the outboard side of the left nacelle.

e. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

f. Remove the armor plate at the forward end of the bomb bay.

g. Disconnect and cap the hydraulic lines at the bomb bay door position selector valve.

h. Unfasten the operating levers from the valve control shaft.

i. Remove the bolts that attach the valve to the valve bracket. Remove the valve.

j. If disassembly of the valve is attempted refer to *figure 272.*

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the bomb bay doors position valve is damaged or is not functioning properly, it should be replaced with a new or serviceable part.

4. TESTS BEFORE INSTALLATION.—Refer to *figure 272* for fluid leak tests.

5. INSTALLATION.—To install the valve, reverse the REMOVAL procedure, given in 2., above.

(3) BOMB BAY DOOR FORWARD ACTUATING CYLINDERS.
(See figure 273.)

(a) DESCRIPTION.—The two bomb bay door forward actuating cylinders are located at the forward end of the bomb bay. Each cylinder is attached to a bracket assembly at the cylinder end and to the bomb door operating linkage at the piston end. To open the bomb bay doors, fluid pressure is applied at the inboard ports *(figure 268)* of each cylinder. The pistons extend, and the displaced fluid flows back to the fluid reservoir through the bomb bay door position selector valve. The action is reversed when the bomb bay doors are closed.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

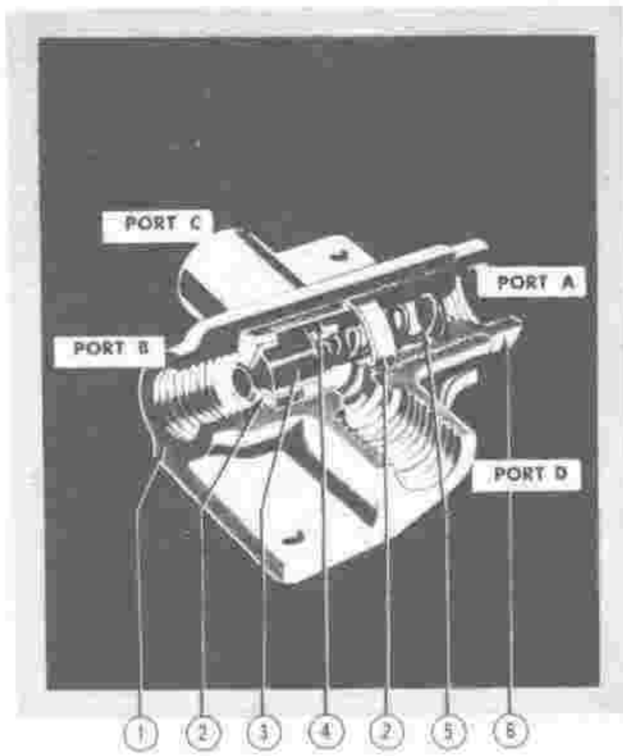
a. Follow the same procedure as outlined in BOMB BAY DOOR POSITION SELECTOR VALVE, paragraph 14. *d.* (2) *(b) 2.*, this section, and in addition:

b. Disconnect and cap the hydraulic hoses at each actuating cylinder.

c. Remove the bolts attaching the cylinders to the brackets and the bomb bay door linkage. Remove the cylinders.

2. DISASSEMBLY.—Refer to *figure 273* for disassembly procedure.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to instructions on main landing gear cylinders, except for instructions for integral shuttle

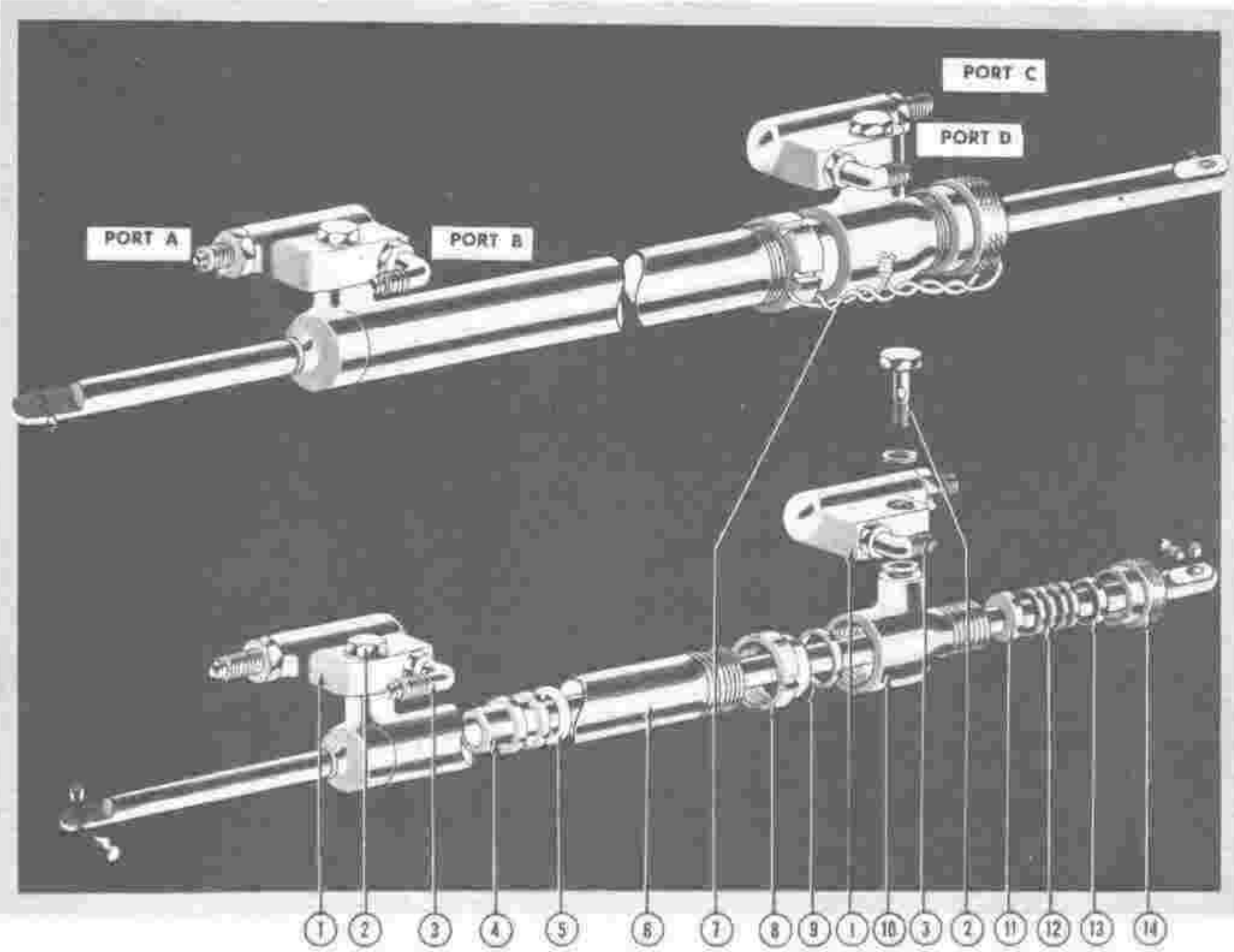


1. Body
2. Seat (Emergency Substitute Part may be made from AN6228-4)
3. Cone
4. Spacer
5. Spring
6. End Fitting (Apply 420 inch-pounds Torque Preload)

TEST PROCEDURE			
TEST PRESS.	PORTS PLUGGED	MAX. LEAKAGE	
		INTERNAL	EXTERNAL
1500 psi–Port A	Ports C and D	None	None
5 psi–Port A	Ports C and D	2 drops in 12 hrs.	None
1500 psi–Port B	Ports C and D	None	None

Douglas Drawing No. 2150744

Figure 274—Bomb Bay Doors Forward Actuating Cylinder and Spoilers Actuating Cylinder Shuttle Valve



1. Shuttle Valve Assembly *(See figure 276.)*
2. Bolt and AN901-6C Gaskets
3. Elbow, Lock Nut, and AN902-4 Gasket
4. Piston Assembly (Includes 116500-6B-23G Bushing)
5. AN6227-25 Packing
6. Barrel Assembly (Includes 116500-6B-23G Bushing)
7. Lock Wire
8. Packing Nut
9. Gasket
10. Cylinder End
11. Ring
12. AN6225-20 Packing (4 Required)
13. Ring
14. Packing Nut

TEST PROCEDURE			
		MAX. LEAKAGE	
TEST PRESS.	PISTON POS.	EXTERNAL	INTERNAL
1500 psi–Port A	Extended	2 drops in 12 hrs.	10 drops / hr.
1500 psi–Port B	Extended	2 drops in 12 hrs.	10 drops / hr.
1500 psi–Port C	Retracted	2 drops in 12 hrs.	10 drops / hr.
1500 psi–Port D	Retracted	2 drops in 12 hrs.	10 drops / hr.
	Friction Pressure – 25 psi max.		

Douglas Drawing No. 5122208

Figure 275—Bomb Bay Doors Aft Actuating Cylinder

valve repair. The bomb bay door forward actuating cylinders do not have integral shuttle valves.

(d) ADJUSTMENTS.—Refer to BOMB BAY DOOR ADJUSTMENTS, paragraph 14. *d.* (11) *(d)*, this section, for adjustment of the bomb bay door forward actuating cylinders with the bomb bay door mechanism.

(e) TEST BEFORE INSTALLATION.—Refer to *figure 273* for fluid leak tests of the bomb bay door forward actuating cylinders.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the forward bomb bay door actuating cylinders, refer to *figure 273.*

CAUTION

Use care when installing the packing rings in the actuating cylinder to avoid damage to the rings.

2. INSTALLATION. — To install the cylinders reverse the REMOVAL procedure and refer to *figure 281.*

(g) MAJOR OVERHAUL. — Follow the same procedure as given in MAINTENANCE REPAIR OR REPLACEMENT above.

(4) BOMB BAY DOORS AFT ACTUATING CYLINDER. *(See figure 275.)*

(a) DESCRIPTION.—The bomb bay doors aft actuating cylinder, located at the rear of the bomb bay, is attached at each end to the bomb bay door linkage. Since the cylinder is movable, it functions in conjunction with either or both of the forward actuating cylinders. When the bomb bay doors are opened, hydraulic pressure is applied at the cylinder end, extending the piston. The excess fluid is returned to the fluid reservoir through the bomb bay doors CLOSED line and bomb bay door position selector valve. When the doors are closed, the fluid flow and piston movement is reversed.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Follow the same procedure as outlined under BOMB BAY DOOR POSITION SELECTOR VALVE, paragraph 5. *d.* (13) *(e)*, this section.

b. Cap the four hydraulic hoses at the cylinder.

c. Remove the bolts attaching the cylinder to the bomb bay door linkage. Remove the cylinder.

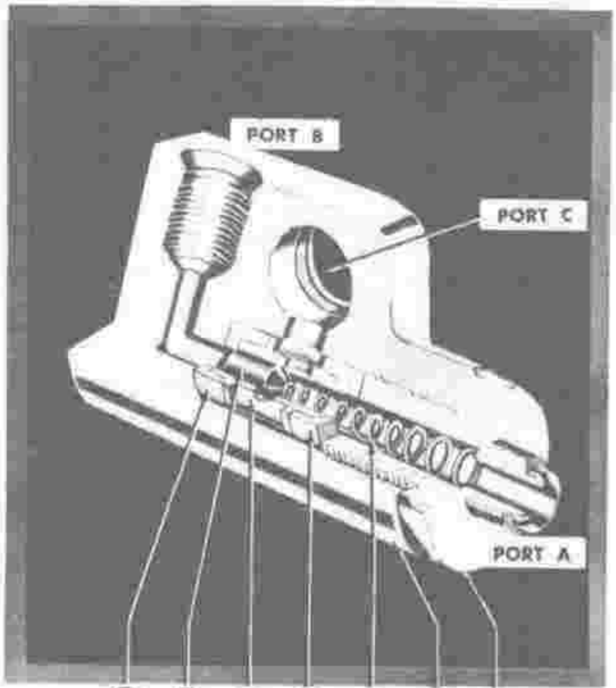
2. DISASSEMBLY.—Refer to *figure 275* for disassembly procedure.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to instructions MAIN LANDING GEAR ACTUATING CYLINDER, paragraph 14. *c.* (3) *(c)*, this section, except for procedure concerning the integral shuttle valve. The bomb bay door aft actuating cylinder does not have an integral shuttle.

(d) ADJUSTMENTS.—Refer to paragraph 14. *d.* (10) *(e)*, this section for adjustment of the bomb bay door aft actuating cylinder with the bomb bay door operating mechanism.

(e) TESTS BEFORE INSTALLATION.—Refer to *figure 275* for fluid leak tests of the bomb bay door aft actuating cylinder.

(f) ASSEMBLY AND INSTALLATION.

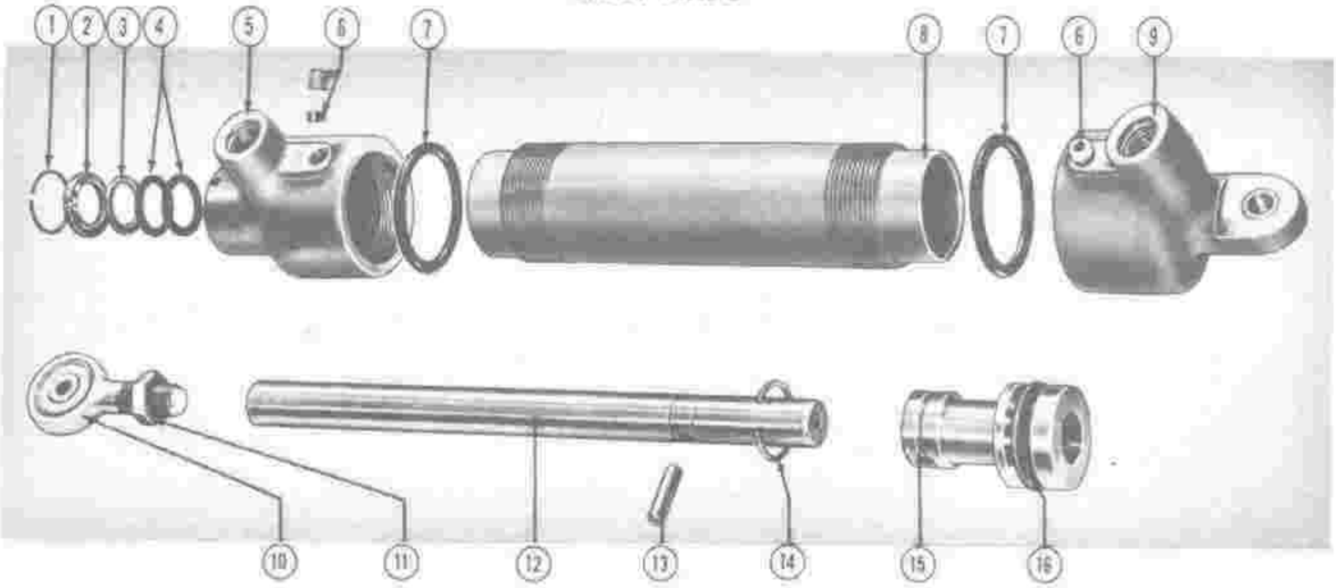


1. Seat
2. Cone
3. Spacer
4. Spring
5. Body
6. Connector (Apply 420 inch-pound Torque Preload)

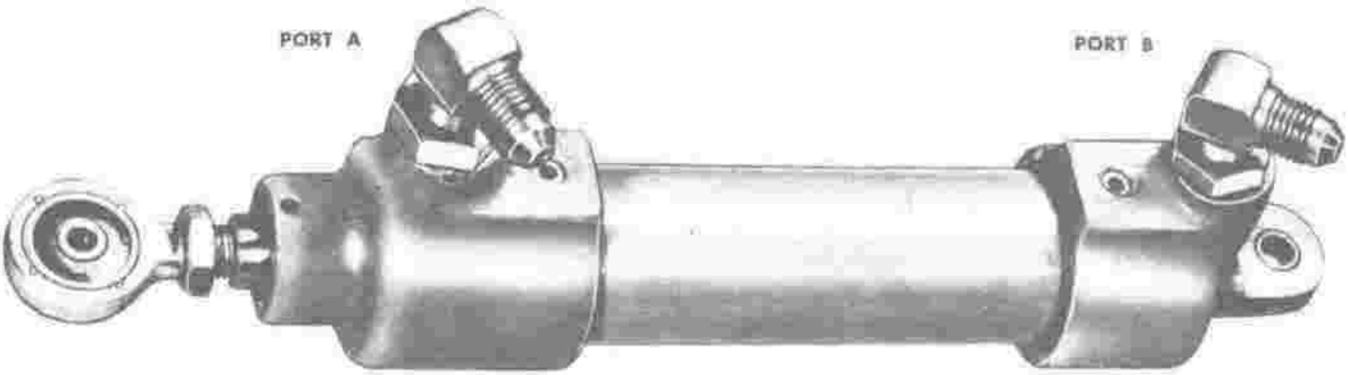
TEST PROCEDURE			
TEST PRESS.	PORTS PLUGGED	MAX. LEAKAGE INTERNAL	MAX. LEAKAGE EXTERNAL
1500 psi—Port B	Port C	None at Port A	None
1500 psi—Port A	Port C	None at Port B	None
5 psi—Port A	Port C	2 drops in 12 hrs at Port B	None

Douglas Drawing No. 3129383

Figure 276—Bomb Bay Doors Aft Actuating Cylinder Shuttle Valve



1. Lock Ring
2. Wiper
3. Spacer
4. Piston Rod Packing
5. Cylinder Head
6. Lock Screw and Plug
7. Cylinder Head or End Packing
8. Cylinder Barrel
9. Cylinder End
10. Piston Rod End
11. Lock Nut
12. Piston Rod
13. Pin
14. Lock Ring
15. Piston
16. Piston Packing



TEST PROCEDURE		
TEST PRESSURE	PISTON POSITION	MAXIMUM LEAKAGE
1500 psi at Port A	Extended	2 drops in 12 hours – external 10 drops an hour – internal
1500 psi at Port B	Retracted	2 drops in 12 hours – external 10 drops in an hour – internal
Packing Friction Pressure – 25 psi maximum		

Douglas Drawing No. 4206319

Figure 277—Bomb Bay Spoilers Actuating Cylinder

1. ASSEMBLY.—To assemble the bomb bay doors aft actuating cylinder refer to *figure 275.*

CAUTION

Use care in installing the packing rings in the cylinder.

2. To install the bomb bay doors aft actuating cylinder, reverse the REMOVAL procedure.

(5) BOMB BAY SPOILERS ACTUATING CYLINDERS.
(See figure 277.)

(a) DESCRIPTION.—The bomb bay spoilers are actuated by two small cylinders, located in the aft section of the nose wheel well. The cylinder assemblies are attached at the cylinder ends to brackets in the nose wheel well and at the piston ends to the spoiler plates. When the actuating cylinder pistons extend, they force the spoiler plates into the airstream. When the actuating cylinder pistons retract, they pull the spoiler plates up into a slot in the bottom of the fuselage between the nose wheel well and the bomb bay.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines leading to the bomb bay spoilers actuating cylinder.

c. Remove the attaching bolts and nuts and remove the actuating cylinders.

2. DISASSEMBLY.—If disassembly of the spoilers actuating cylinder is attempted, refer to *figure 277.*

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 14. *c.* (3) *(c)*, this section.

(d) TESTS BEFORE INSTALLATION.—Refer to *figure 277* for fluid leak tests of the spoilers actuating cylinder.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the cylinders refer to *figure 277.*

2. INSTALLATION.—To install the spoilers actuating cylinders reverse the REMOVAL procedure.

(6) COMBINATION PRESSURE RELIEF AND CHECK VALVE.
(See figure 279.)

(a) DESCRIPTION.—The combination pressure relief and check valve assembly is installed in the bomb bay doors and spoilers OPEN line to obtain the proper opening sequence of the spoilers and bomb bay doors. The valve is located on the pilot's compartment slanting floor at the forward end of the bomb bay. When the bomb bay doors are opened, fluid under pressure flows to the spoilers actuating cylinders but is prevented from flowing to the doors actuating cylinders by the pressure relief valve. When the spoilers actuating cylinders have extended the spoilers, the fluid pressure increases in the doors OPEN line until the pressure relief valve opens and allows fluid to flow to the doors actuating cylinders, which open the bomb bay doors. The check valve is provided in the valve assembly so that fluid returning to the reservoir may by-pass the pressure relief valve when the bomb bay doors and spoilers are closed. The pressure relief valve is adjusted to open at 625 ± 25 psi and to reseat at 525 psi. The check valve opens at 3 to 7 psi.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Follow the procedure outlined in paragraph 14. *d.* (10) *(b)*, this section.

b. Disconnect and cap the hydraulic lines leading to the valve assembly.

c. Remove the screws that attach the valve assembly to the slanting floor and remove the valve from the airplane.

2. DISASSEMBLY.—Refer to *figure 279* if disassembly of the combination pressure relief and check valve is attempted.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the valve assembly is damaged or is not functioning properly, replace it with a new or serviceable part.

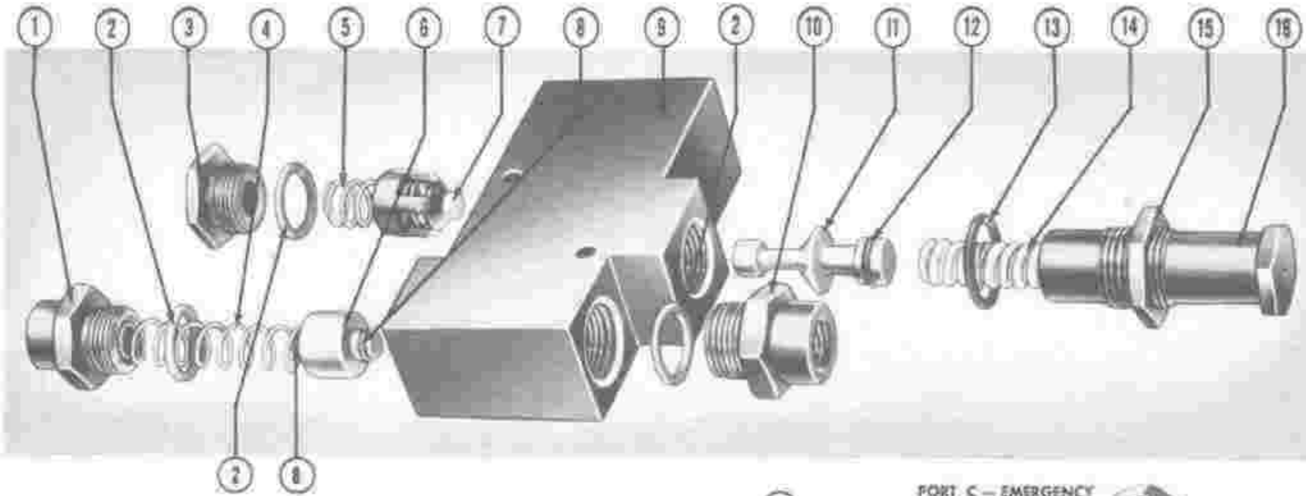
(d) ADJUSTMENTS.—The pressure relief valve is adjusted by means of the adjusting cap *(11, figure 279).* Tighten the cap to increase the pressure relief setting or loosen the cap to decrease the pressure relief setting. Adjust the pressure relief valve to open at 625 ± 25 psi and to rseat at 525 psi. When the proper adjustment is obtained, tighten the lock nut on the adjusting cap.

(e) TESTS BEFORE INSTALLATION.—Refer to *figure 279* for fluid leak tests of the combination pressure relief and check valve.

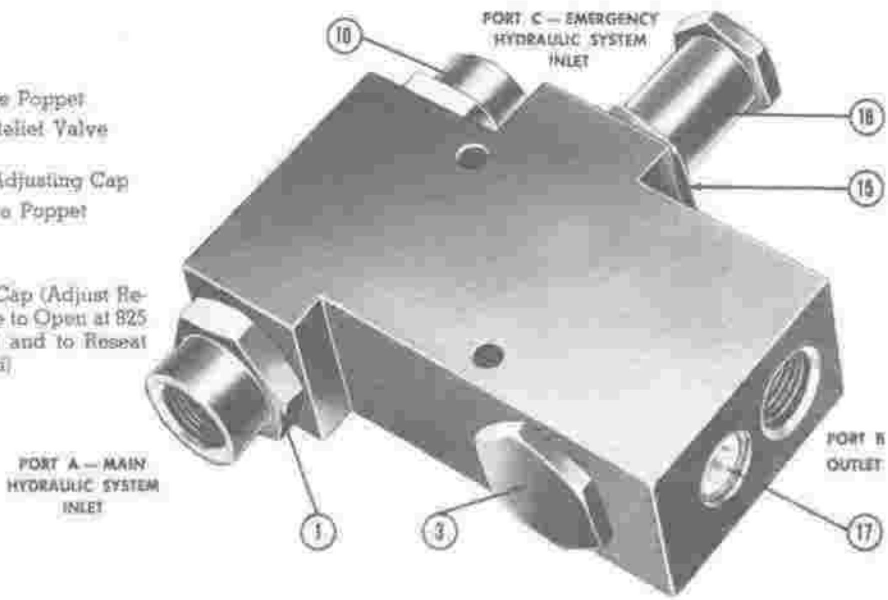
(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the valve refer to *figure 279.*

2. INSTALLATION.—To install the valve reverse the REMOVAL procedure.



1. Fitting (Main Hydraulic System Port)
2. Gasket
3. Plug—Check Valve
4. Shuttle Valve Spring
5. Check Valve Spring
6. Shuttle Valve Poppet
7. Check Valve Poppet
8. Packing—Shuttle Valve Poppet
9. Valve Body
10. Fitting (Emergency Hydraulic System Port)
11. Relief Valve Poppet
12. Packing—Relief Valve Poppet
13. Packing—Adjusting Cap
14. Relief Valve Poppet Spring
15. Lock Nut
16. Adjusting Cap (Adjust Relief Valve to Open at 825 ± 25 psi and to Reseat at 700 psi)
17. Plug

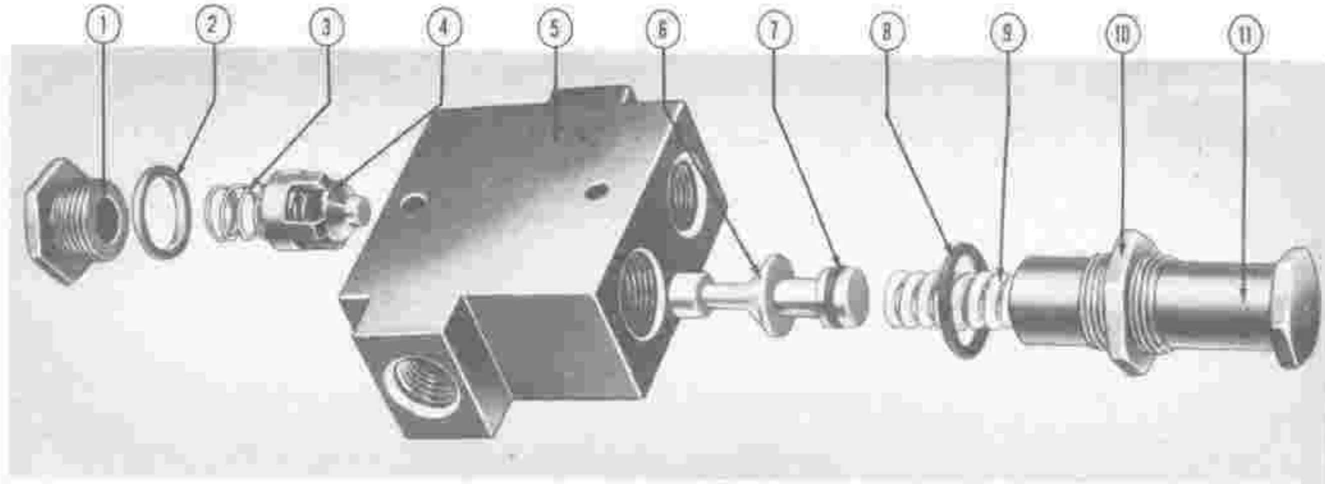


TEST PROCEDURE

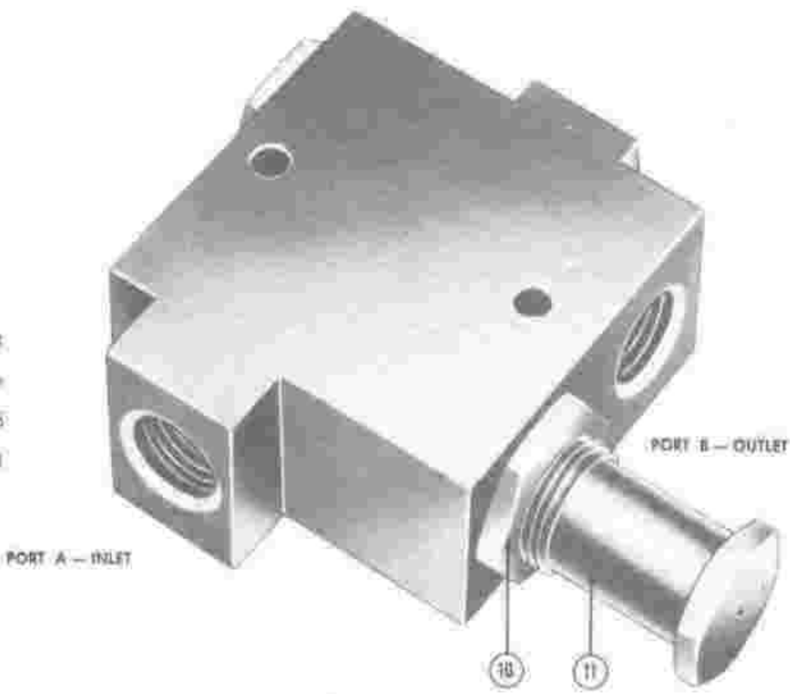
TEST PRESSURE	PORTS PLUGGED	MAXIMUM LEAKAGE		PURPOSE OF TEST
		Internal	External	
1500 psi at Port A	Ports B and C	None	2 Drops in 12 Hours	Proof Pressure
775 psi at Port A	None	None	2 Drops in 12 Hours	Seal of Poppets (Relief and Check)
Drop Pressure from 900 to 700 psi at Port A	None	None after 1 Minute	2 Drops in 12 Hours	Reseat Pressure (Relief Valve)
5 psi at Port A	None	1 Drop in 2 Minutes at Port B	2 Drops in 12 Hours	Static Test (Check Valve)
3 to 7 psi at Port B	None	Fluid Should Relieve at Port A	2 Drops in 12 Hours	Opening Pressure (Check Valve)
5 psi at Port A	Port B	1 Drop an Hour at Port C	2 Drops in 12 Hours	Static Test (Shuttle Valve)
1500 psi at Port A	Port B	None	2 Drops in 12 Hours	Seat of Shuttle Valve at Port C
Manually unseat shuttle poppet and apply 6 psi at Port C	Port B	1 Drop an Hour at Port A	2 Drops in 12 Hours	Static Test (Shuttle Valve)
1500 psi at Port C	Port B	None	2 Drops in 12 Hours	Seat of Shuttle Valve at Port A

Douglas Drawing No. 4207096

Figure 278—Combination Pressure Relief, Check, and Shuttle Valve



1. Plug
2. Plug Gasket
3. Check Valve Spring
4. Check Valve Poppet
5. Valve Body
6. Poppet—Pressure Relief
7. Poppet Packing
8. Adjusting Cap Packing
9. Pressure Relief Valve Spring
10. Lock Nut
11. Adjusting Cap (Adjust Pressure Relief Valve to Open at 625 ± 25 psi and to Reseat at 600 psi)



TEST PROCEDURE

TEST PRESSURE	PORTS PLUGGED	MAXIMUM LEAKAGE		PURPOSE OF TEST
		Internal	External	
1500 psi at Port A	Port B	None	2 Drops in 12 Hours	Proof Pressure
575 psi at Port A	None	None	2 Drops in 12 Hours	Seal of Poppets (Relief and Check)
Drop Pressure from 700 to 525 psi at Port A	None	None After 1 Minute	2 Drops in 12 Hours	Reseat Pressure (Relief Valve)
5 psi at Port A	None	1 Drop in 2 Minutes	2 Drops in 12 Hours	Static Test (Check Valve)
3 to 7 psi at Port B	None	Fluid Should Relieve at Port A	2 Drops in 12 Hours	Opening Pressure (Check Valve)

Douglas Drawing No. 4207095

Figure 279 — Combination Pressure Relief and Check Valve

(7) COMBINATION PRESSURE RELIEF, CHECK, AND SHUTTLE VALVE.
(See figure 278.)

(a) DESCRIPTION.—The combination pressure relief, check, and shuttle valve is installed in the bomb bay doors CLOSED line to obtain the proper closing sequence of the bomb bay doors and spoilers. This valve is similar to the combination pressure relief and check valve except that it includes a shuttle valve for the emergency hydraulic system connection. This valve is installed in the nose wheel well. When the bomb bay doors are closed the pressure relief valve prevents the flow of fluid to the spoilers actuating cylinders until after the bomb bay doors have closed and the bomb bay door actuating cylinders have bottomed. The check valve is provided so that fluid returning to the reservoir can by-pass the pressure relief valve when the bomb bay doors are opened. The shuttle valve closes the emergency hydraulic system port when the main hydraulic system is used and closes the main hydraulic system port when the emergency hydraulic system is used. The pressure relief valve opens at 825 ± 25 psi and reseats at 700 psi. The check valve opens at 3 to 7 psi and the shuttle valve operates at 25 to 30 psi.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines leading to the valve assembly, located in the nose wheel well.

c. Remove the screws that attach the valve to the bracket and remove the valve from the airplane.

2. DISASSEMBLY.—If disassembly of the valve is attempted refer to *figure 278.*

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the combination pressure relief, check and shuttle valve is damaged or is not functioning properly, replace it with a new or serviceable part.

(d) ADJUSTMENTS.—Adjustment of the pressure relief valve assembly is made by means of the adjusting cap *(16, figure 278).* Tightening the cap increases the pressure relief setting; loosening the cap decreases the pressure relief setting. The relief valve must be adjusted to open at 825 ± 25 psi and to reseat at 700 psi. When the correct adjustment is obtained, tighten the lock nut on the adjusting cap.

(e) TESTS BEFORE INSTALLATION.—Refer to *figure 278* for fluid leak tests of the combination pressure relief, check, and shuttle valve.

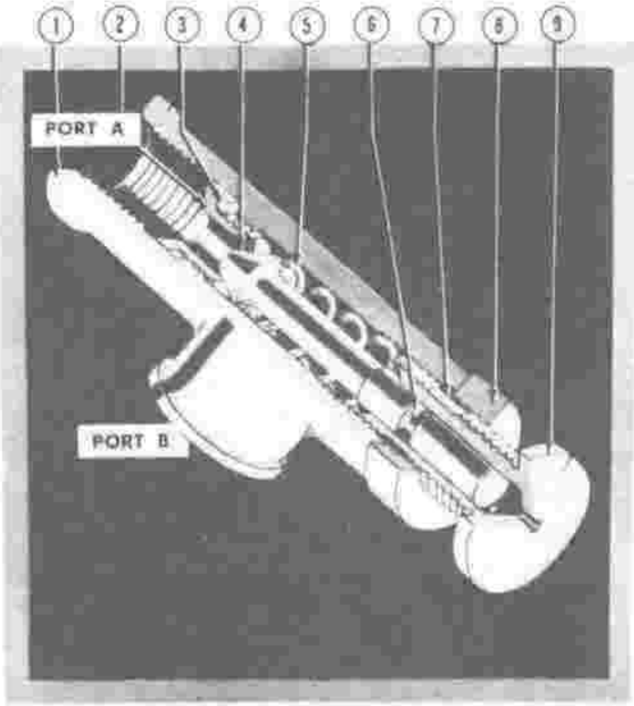
(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—Refer to *figure 278* to assemble the valve.

2. INSTALLATION.—To install the valve reverse the REMOVAL procedure.

(8) BALANCED PRESSURE RELIEF VALVE.
(See figure 280.)

(a) DESCRIPTION.—The balanced pressure relief valve, which prevents the reduction of fluid pressure to the brakes when the bomb bay doors are operated, is installed in the pressure line to the bomb



1. Valve Body
2. Poppet Seat
3. Washer
4. Piston—Poppet
5. Spring
6. AN6227-1 Packing
7. AN902-6 Gasket
8. Lock Nut
9. Adjusting Retainer

TEST PROCEDURE			
TEST PRESS.	PORTS PLUGGED	MAX. LEAKAGE INTERNAL	MAX. LEAKAGE EXTERNAL
1500 psi–Port A	Port B		2 drops in 12 hrs.
300 psi–Port A	None	.25 to .50 gals. /min. at Port B	2 drops in 12 hrs.
Drop press. from 750 psi to 400 psi at Port A	None	.25 to .50 gals. /min. at Port B	2 drops in 12 hrs.

Douglas Drawing No. 4196958
Interstate Aircraft and Engineering Corp. No. B13-300.

Figure 280—Balanced Pressure Relief Valve

bay doors position selector valve and is located on the slanting bulkhead in the forward end of the bomb bay. The valve consists of a poppet-piston held against a steel seat by a spring and adjustable adapter. The valve is adjusted to open at 600 psi and to reseat at 570 psi. The valve will relieve three gallons of hydraulic fluid a minute with 750 psi at the inlet port. A small hole is drilled through one wall of the steel seat to provide a passage for expansion of the hydraulic fluid. This hole allows passage of 1/4 to 1/2 gallon per minute of hydraulic fluid when the poppet is seated. THIS SEEPAGE OF OIL SHOULD NOT BE REGARDED AS MALFUNCTION OF THE VALVE.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Follow the same procedure as outlined in paragraph 14. *d.* (2) *(c)* 2., this section.

b. Disconnect and cap the hydraulic lines leading to the valve.

c. Remove the clips attaching the valve to the slanting floor and remove the valve from the airplane.

2. DISASSEMBLY.—Refer to *figure 280* if disassembly of the balanced pressure relief valve is attempted.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the balanced pressure relief valve is damaged or is not functioning properly, it should be replaced with a new or serviceable part.

(d) ADJUSTMENTS.—This valve is adjusted and tested at the factory and should not require further adjustment. However, if adjustment is required, proceed with the following instructions: Loosen the lock nut with a 3/4 inch crescent type wrench. To increase the pressure required to open the poppet, tighten the adjustable retainer *(9, figure 280)*; to decrease the required pressure, loosen the retainer. Adjust the valve to open at 600 psi and to reseat at 570 psi. When the proper adjustment has been obtained, tighten the lock nut on the adjustable retainer.

(e) TESTS BEFORE INSTALLATION.—Refer to *figure 280* for fluid leak tests of the balanced pressure relief valve.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—Refer to *figure 280* to assemble the valve.

CAUTION

When assembling the valve, do not tighten the elbow too tightly in the outlet port. A maximum of one-half of the gasket groove width of the elbow should be installed below the face of the outlet. Tightening the elbow to below the recommended depth will cause interference with the working parts of the valve.

2. INSTALLATION.—To install the balanced pressure relief valve, reverse the REMOVAL procedure, paragraph 14. *d.* (8) *(b)*, this section.

(9) SHUTTLE VALVES.
(See figures 274 and 276.)

(a) DESCRIPTION. — Five shuttle valves are installed in the bomb bay doors and spoilers hydraulic system, two for the bomb bay door forward actuating cylinders, two for the bomb bay aft actuating cylinder, and one for the bomb bay spoilers actuating cylinders. The bomb bay door forward actuating cylinders and bomb bay spoilers actuating cylinders shuttle valves are identical and have four ports, one for the main hydraulic system line, one for the emergency hydraulic system, and two ports to the lines to the actuating cylinders. The bomb bay door aft actuating cylinders have three ports, one for the main hydraulic system line, one for the emergency hydraulic system line, and one to the actuating cylinder. The bomb bay door aft actuating cylinder shuttle valves are attached to the cylinder ports by hollow bolts, which provide the passage into the cylinder. The bomb bay door forward actuating cylinder shuttle valves are located on the slanting floor at the forward end of the bomb bay. The shuttle valve mechanism consists of a spring-loaded cone that slides within a spacer and seats against synthetic rubber seats. Normally the spring-loaded cone closes the emergency hydraulic system port. When the emergency hydraulic system is used, the shuttle valve closes the main hydraulic system port.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines leading to the shuttle valve.

c. Remove the attaching screws or bolt and remove the shuttle valve.

2. DISASSEMBLY.—The shuttle valve may be disassembled by unscrewing the connector and removing the spring, cone, spacer, and seats.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Internal fluid leaks because of improper seating of the steel cone, will cause sluggish operation of the actuating cylinder. If disassembly and repair of a shuttle valve is attempted observe the following procedure:

1. Inspect cone and seats for scoring or wear. New parts must be installed when an inspection reveals defects in the cone and seats.

2. Inspect the spring for evidence of wear or fatigue. Install new spring if necessary.

3. Inspect the remaining valve parts for wear, cracks, or other defects, installing new parts when and where necessary.

4. Install new gaskets, if there is evidence of external leakage.

(d) TESTS BEFORE INSTALLATION.—Refer to *figures 274 and 276* for leak tests of the shuttle valves.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the shuttle valves refer to *figures 274 and 276* and reverse the DISASSEMBLY procedure.

Note

Apply wrench torque of 420 inch-pounds (maximum) when installing the connector which retains the spring-loaded cone, seats, and spacer.

2. INSTALLATION.—To install the shuttle valves reverse the REMOVAL procedure.

(f) MAJOR OVERHAUL.—Follow the same procedure as given in MAINTENANCE REPAIR OR REPLACEMENT, *(c)* above.

(10) BOMB BAY DOORS AND OPERATING MECHANISM.
(See figure 281.)

(a) DESCRIPTION.—The bomb bay doors are riveted aluminum alloy structures which form the lower surface of the center portion of the fuselage when closed. The doors are supported at each end by the bellcranks and actuating arms, and by five hinges along the bomb bay structure. Power to operate the bomb bay doors is obtained from the two forward hydraulic actuating cylinders and the aft actuating cylinder. The movement of the actuating cylinder pistons is transmitted through bellcranks to the operating arms, which are attached to the bomb bay doors. Sliding links provide stops to limit the travel of the doors and operating mechanism. The two forward actuating cylinders are attached to the bomb bay structure. The aft actuating cylinder is attached at both ends to the aft operating mechanism and is not attached to the bomb bay structure.

(b) REMOVAL.

1. With the bomb bay door control and the emergency hydraulic system selector valve control in the DOORS OPEN position, operate the hydraulic hand pump to open the bomb bay doors.

2. When the bomb bay doors have been opened completely, install safety blocks in the sliding links as shown in *figure 269.*

3. Remove the bolts that attach the actuating arms, bellcranks, and sliding links.

4. Remove the bolts from the bomb bay door hinges and remove the doors.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Inspect the bellcranks, actuating arms, sliding links, and hinges for wear, cracks, and other defects. Damaged parts must be replaced with new or serviceable parts.

2. For repair to the bomb bay doors refer to AN 01-40 AJ-3.

(d) INSTALLATION.—To install the bomb bay doors and operating mechanism reverse the REMOVAL procedure.

(e) ADJUSTMENTS.—The bomb bay doors are properly adjusted in the CLOSED position when they press tightly and evenly against the rubber seal around the edge of bomb bay. To properly adjust the doors, proceed as follows:

1. With the bomb bay doors open, disconnect the actuating arms from each door.

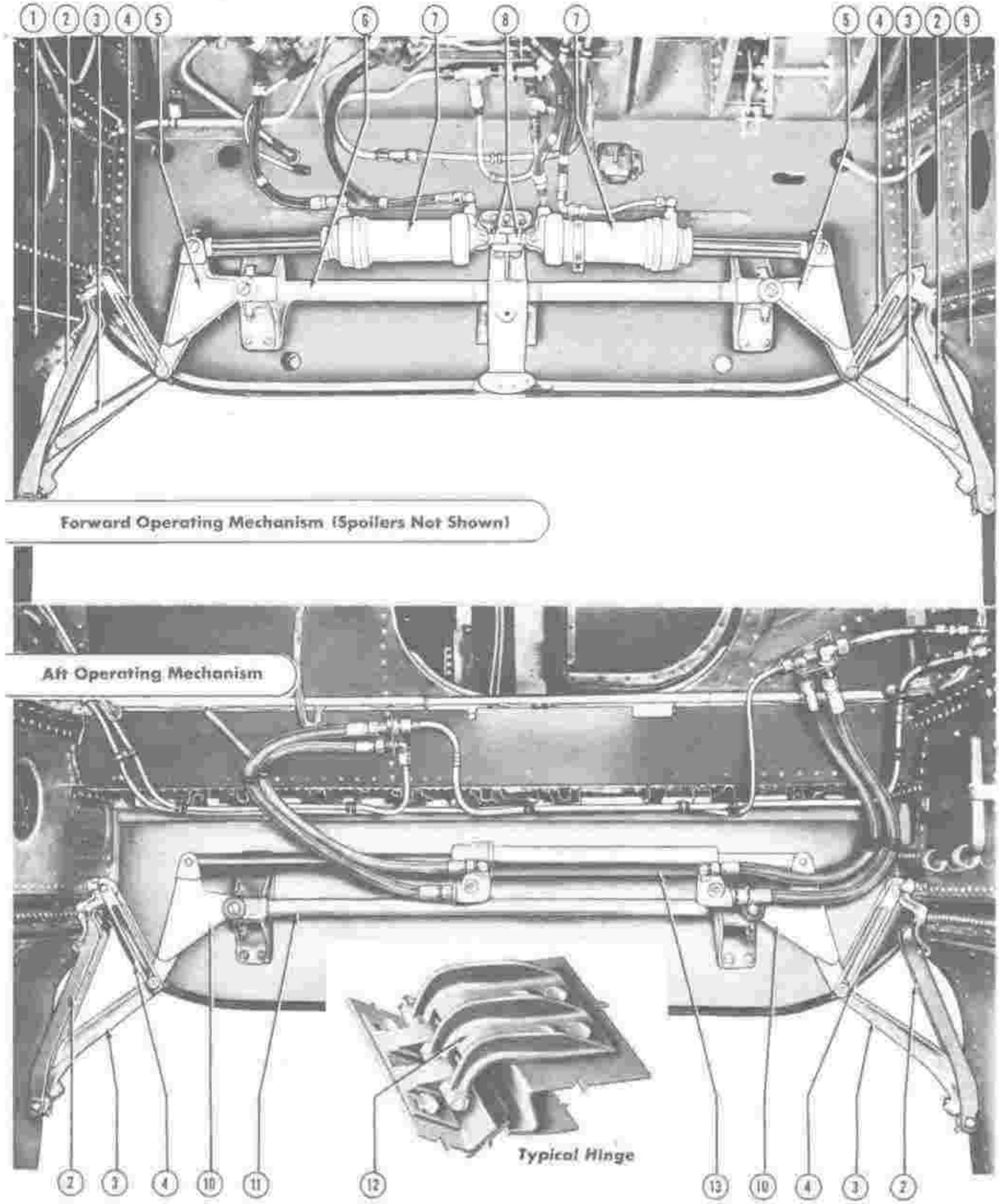
2. Adjust each forward actuating cylinder eyebolt to bring the bellcranks against the sliding link stops at both open and closed extreme positions.

3. If the actuating cylinder positions retract fully before they are stopped by the sliding links, proceed as follows: disconnect the piston rods at the bellcranks, loosen the locknuts, and shorten the piston rods until the sliding links strike the stops.

4. Check the travel of the aft actuating cylinder to make certain that the bellcranks are stopped at both ends of travel by the sliding link stops.

5. While the actuating mechanism remains in the CLOSED position, raise and adjust one bomb bay door at a time. The eyebolts which are screwed into the ends of each actuating arm, are adjusted (either in or out) to permit the bomb bay door to press tightly against the rubber seal about the edge of the bomb bay when the doors are closed.

6. After the actuating arms have been properly adjusted, pre-load the eyebolt check nut on the bomb bay door forward actuating cylinders with 1212 inch-pounds wrench torque. Operate the actuating cylinders to the OPEN position and connect the actuating arms to the doors with the attaching bolts.



1. L. H. Door Assembly
2. Hinge
3. Actuating Arm
4. Sliding Stop Links
5. Forward Bellcranks
6. Bracket Assembly
7. Forward Actuating Cylinders
8. Link Assemblies
9. R. H. Door Assembly
10. Aft Bellcranks
11. Bracket Assembly
12. Hinge (18 Required)
13. Aft Actuating Cylinder

Figure 281—Bomb Bay Doors Operating Mechanism

(11) BOMB BAY DOOR SPOILERS AND OPERATING MECHANISM.
(See figure 268.)

(a) DESCRIPTION.—The bomb bay spoilers are mounted in a slot in the bottom of the fuselage between the nose wheel well and the bomb bay. Three plate assemblies are provided to extend into the air stream and break up the air stream into the bomb bay when the bomb bay doors are open. Two pressure relief and check valve assemblies are installed in the bomb bay doors and spoilers hydraulic lines to obtain the proper operating sequence of the spoilers and doors. The spoilers extend completely before the bomb bay doors open, and the bomb bay doors close completely before the spoilers retract. The right and left hand spoiler plates are actuated directly by the bomb bay spoilers actuating cylinders, located in the aft end of the nose wheel well. The center spoiler plate is actuated by means of a rod assembly that links the center plate to the right hand spoiler plate. The operation of the bomb bay doors and spoilers is controlled by the bomb bay doors control.

(b) REMOVAL.

1. Open the bomb bay doors.

2. Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

3. Remove the bolts that attach the bomb bay spoilers actuating cylinders to the right and left hand spoiler plates.

4. Remove the rod that links the center and right hand spoiler plates.

5. Remove the bolts that attach the spoiler plates to the mounts and remove the spoiler plates.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Inspect the spoiler plates and mounts periodically for wear, and general condition and security. Replace any damaged parts with new or serviceable parts.

(d) ADJUSTMENTS.—The bomb bay spoiler plates should be adjusted to be flush with the bottom of the fuselage in the retracted position and to open 90 ± 1 degrees.

(e) INSTALLATION.—To install the bomb bay spoilers reverse the REMOVAL procedure.

e. BRAKE HYDRAULIC SYSTEM.
(See figure 282.)

(1) GENERAL.—Multiple-disc brake units, actuated hydraulically, are employed on this airplane. Two brake units are installed in each main landing gear wheel. Each wheel may be braked separately. Application of toe pressure on the rudder-brake control pedals opens the pressure ports of each power brake control valve. Hydraulic fluid under pressure flows directly to the brake actuating cylinders (integral with the brake) to produce the necessary braking effect. The brake control valves *(1, figure 282)* admit pressure to the brake actuating cylinders in direct proportion to the force applied to the rudder-brake pedals. When the brake pedals are released, the fluid returns to the reservoir through the brake lines and power brake valves. A check valve *(6, figure 282)* is installed near the left-hand brake control valve to maintain pressure in the brake control valves in the event of leaks in the brake pressure line. Self-sealing disconnect couplings are provided at the wheels to facilitate removal of the brake units or the wheels. A parking brake is provided and is operated by depressing the rudder-brake pedals fully, and by pulling back the parking brake lever *(figure 247)* located on the lower left side of the pilot's compartment.

(2) POWER BRAKE CONTROL VALVES.
(See figure 283.)

(a) DESCRIPTION.—The two power brake control valves are bolted to supports, located immediately forward of the rudder-brake pedals. The power brake control valve consists of a body that has a pressure port, a brake port and a return port; an extension lever that operates the piston in the valve body; the piston assembly which is sealed at both ends by synthetic rubber packing cups; an upper valve that controls the flow of fluid from the pressure port to the brake port, and a lower valve that controls the flow of fluid from the brake port to the return port. The power brake valve is designed to allow a pressure flow of fluid to the brakes when toe pressure is applied to the rudder-brake pedals. When the brakes are applied, the extension lever raises the piston in the valve body, closing the lower valve and opening the upper valve; and fluid flows from the pressure port to the brake port, actuating the brakes. Pressure increases in the brake port and on the head of the piston and the piston is forced downward. This pressure on the piston deflects the extension lever giving a "load feel" on the rudder-brake pedals. When toe pressure on the rudder-brake pedals is released, the valve piston returns to its normal position, closing the upper valve and opening the lower valve, which permits the fluid to flow from the brake port to the return port, releasing the main wheel brakes.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Remove the instrument panel access door *(7, figure 7)*.

b. Relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

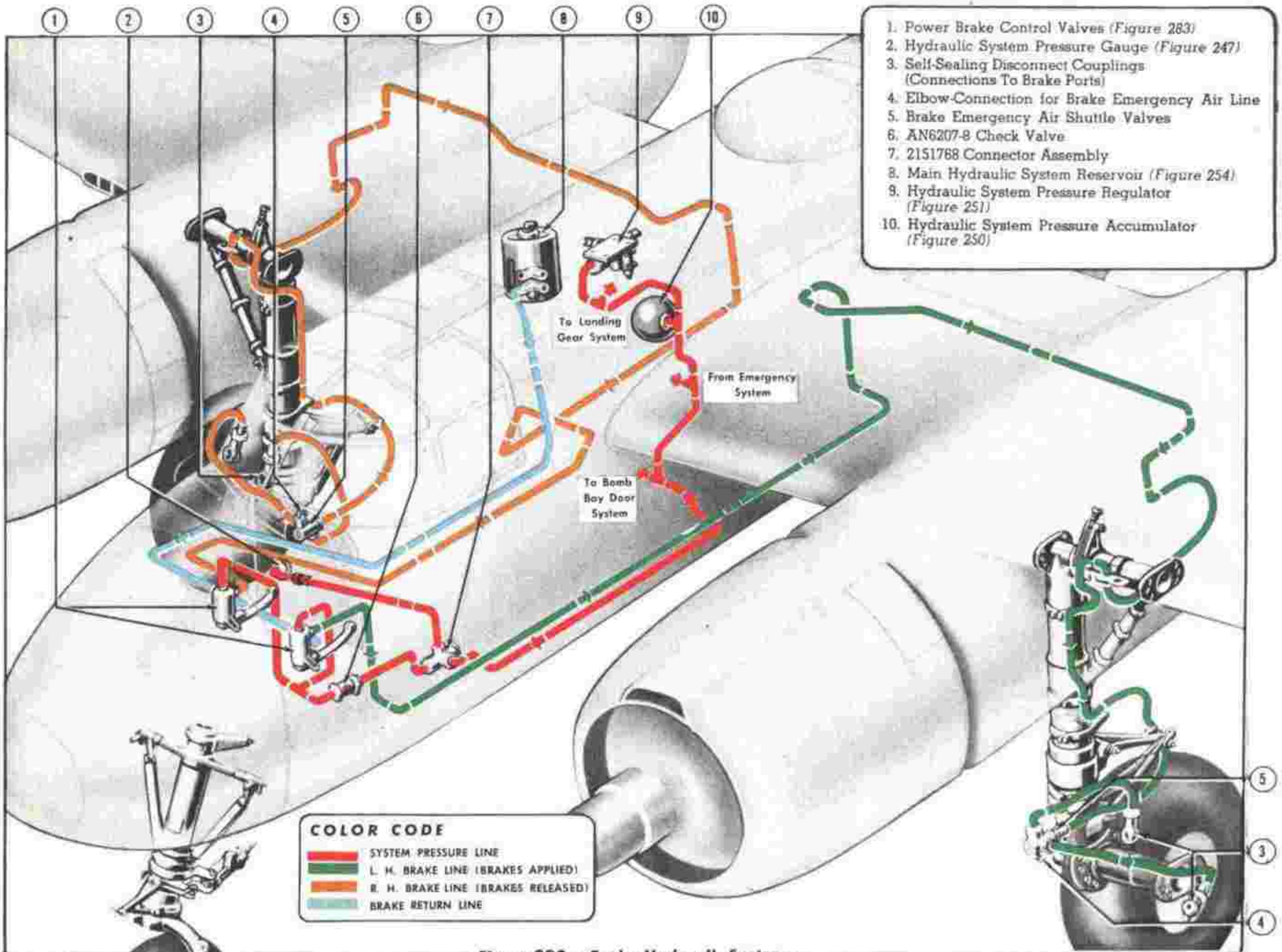
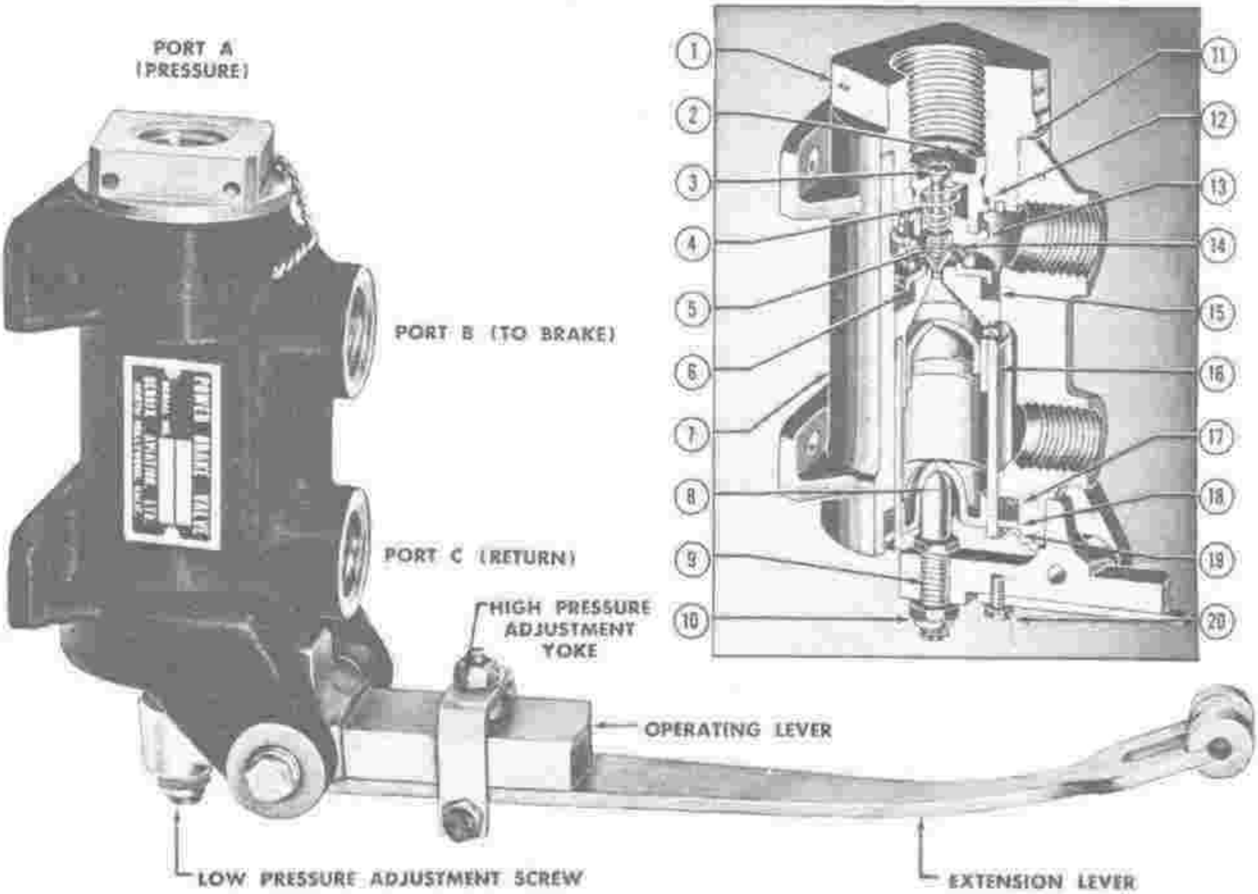


Figure 282— Brake Hydraulic System



1. Adapter
2. Upper Valve Seat
3. Upper Valve
4. Spring
5. Lower Valve
6. Packing Cup Retainer
7. Valve Body
8. Push Rod
9. Screw
10. Lock Nut
11. Gasket
12. Packing
13. Spring
14. Cotter
15. Piston Packing Cup
16. Piston Assembly
17. Cylinder Packing Cup
18. Packing Cup Support
19. Lock Ring
20. Bolt, Washer and Lock Wire

TEST PROCEDURE

TEST PRESSURE	PORTS PLUGGED	MAX. LEAKAGE	
		INTERNAL	EXTERNAL
1500 psi–Port A	None	1 drop in 15 min. at Ports B or C	None
450 psi–Port B with piston held in open position by screwing in bottom adjusting screw	Port A	1 drop in 15 min. at Port C	None
100 psi at Port C with piston actuated 25 times	Ports A and B		None

Douglas Dwg. No. 5123539

Bendix Aviation Ltd. No. 401332

Figure 283—Power Brake Control Valve

c. Disconnect and cap the hydraulic lines leading to each brake valve.

d. Remove the bolt that attaches the brake valve extension lever to the rudder-brake pedal mechanism.

e. Remove the bolts that attach the brake valves to the supports and remove the valves.

2. DISASSEMBLY.—Refer to *figure 283* when disassembly of the brake valve is attempted.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Inspect the power brake valves for evidence of fluid leakage at the valve ports and around the end of the piston at the 25-hour inspection period.

2. If the power brake valve is damaged or is not functioning properly, replace it with a new or serviceable part.

(d) ADJUSTMENTS.

1. TO BLEED THE BRAKES.—Both sides of each wheel must be bled, making a total of four bleeding operations that must be performed. Observe the following procedure for each of the bleeding operations:

a. Remove the cap screw *(figure 284)* and washer from the bleeder port in the brake. Insert bleeder hose *(figure 284)*. Place the free end of the hose in a clean receptacle.

b. With the emergency hydraulic system selector valve in the "SYSTEM" position, operate the hydraulic hand pump until the hydraulic system pressure gage indication is approximately 800 psi.

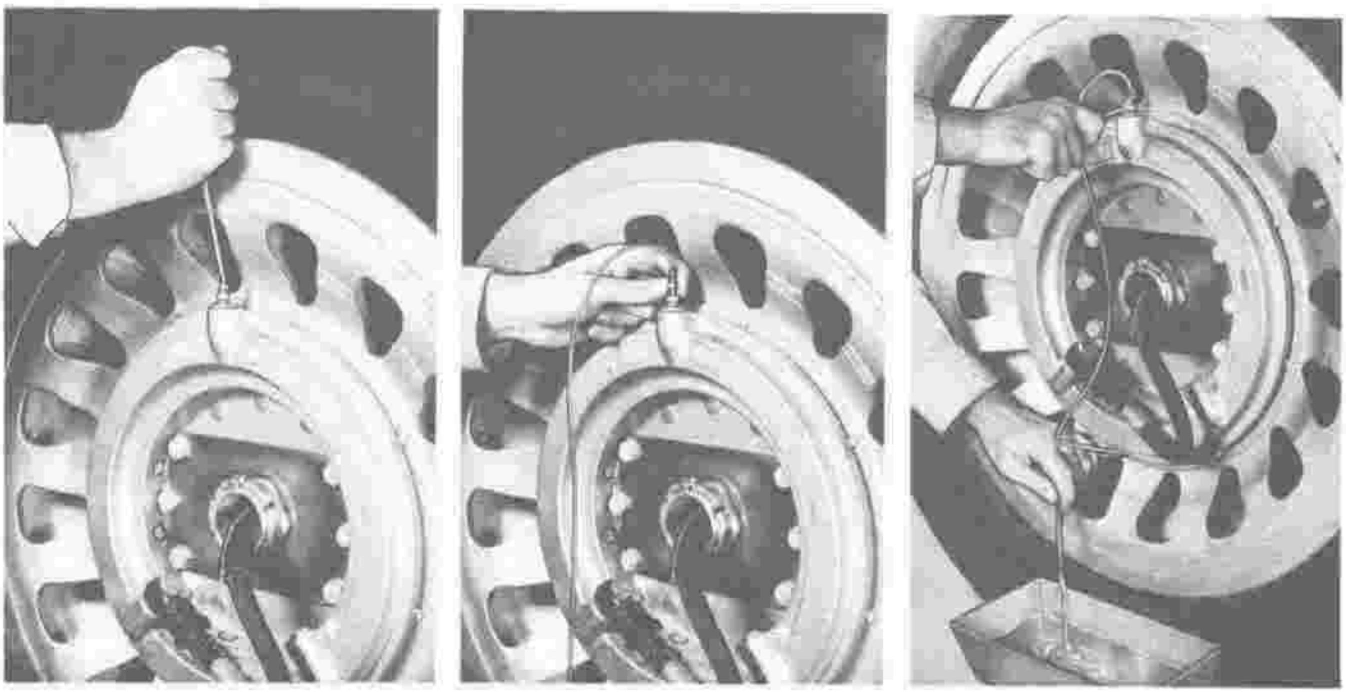
c. Set the parking brake by applying toe pressure on the rudder-brake pedals and pulling back the parking brake lever *(figure 247)*. Open the bleeder valve *(figure 284)*.

d. Allow hydraulic fluid to flow from the bleeder hose until clear, bubble-free fluid is observed.

e. Close and lock the bleeder valve. Remove the bleeder hose and replace the cap screw and washer. Release the parking brake by applying toe pressure to the rudder-brake pedals.

CAUTION

Maintain an ample supply of hydraulic fluid in the reservoir during the bleeding operation. If any hydraulic fluid spills on the tires, wipe it off immediately.



1. With 850-1000 psi in hydraulic system set the parking brake. Remove cap screw and washer from brake bleeder valve.

2. Install standard bleeder hose in brake bleeder valve.

3. Open bleeder valve and allow hydraulic fluid to flow until clear, bubble free fluid is obtained. Close bleeder valve, remove bleeder hose, and reinstall cap screw and washer.

Figure 284 —Brake Bleeding Procedure

2. TO ADJUST THE CONTROL VALVES.—Bleed all four brakes as instructed above. Each brake valve must be adjusted separately with 850-1000 psi pressure in the hydraulic system, by the following procedure:

a. Install an extension line and 500 psi pressure at the bleeder port of each inboard brake. *(See figure 285.)*

b. With the brakes released, tighten the low pressure adjusting screw *(figure 283)* directly under the valve body until the pressure gage indicates 60-80 psi.

c. Back off the adjusting screw until the gage pressure stops dropping. Back off an additional half turn. Lock the screw with the jam nut.

Note

The gage will not drop to zero because of static pressure of the fluid in the lines. Probably there will be five to eight psi pressure indicated on the gage.

d. Depress the rudder-brake pedals fully with the rudder pedals locked in their neutral position. Observe the pressure indication on the gage. The correct reading should be 300 ± 20 psi with the brakes in the FULL ON position. If the pressure is low, move the operating lever adjustment yoke *(figure 283)* away from the valve, tighten the yoke, and depress the brake pedals again. If the pressure is high, move the yoke toward the valve to decrease the pressure at the brakes.

CAUTION

The brakes must be applied to the FULL ON position. The parking brake cannot be substituted for the above as the yoke must be tight when testing for pressure.

e. Repeat the above high pressure adjustment procedure until the correct pressure is indicated on the gage.

f. With the parking brakes ON, the brake pressure should be 225 ± 25 psi. There should be no interference or external leakage of fluid.

(e) TEST BEFORE INSTALLATION.—Refer to *figure 283* for leak tests of the power brake valves.

(f) INSTALLATION.—To install the power brake valves, reverse the REMOVAL procedure.

(g) MAJOR OVERHAUL.

1. Remove and disassemble the power brake valve as instructed in paragraph 14. *e.* (2) *(b)*, this section.

2. Inspect the piston packing cups for scoring or other evidence of leakage. If they are scratched or scored, install new packing cups.

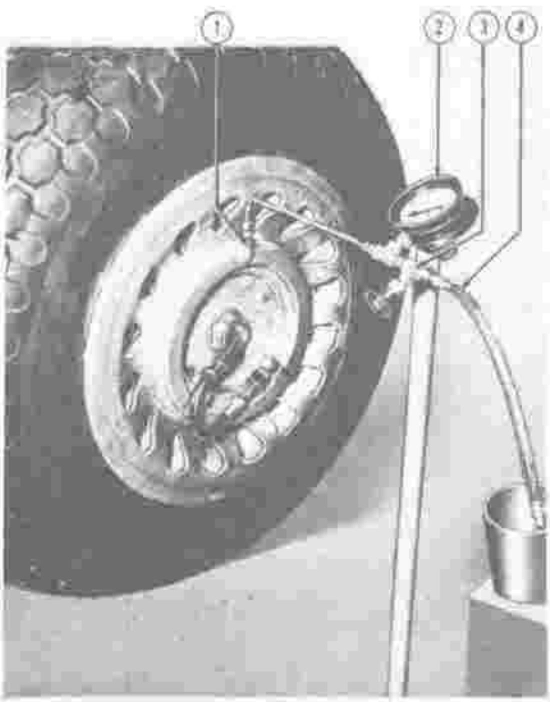
3. Inspect the valve seat, the upper and lower valves, and the valve seat on the piston assembly. If these valves are leaking, they may be reseated by lapping with a fine lapping compound as follows:

a. Apply lapping compound to the valves and seats. The piston assembly should be placed in the valve body and the valves assembled in the valve seat. Thread the valve seat into the adapter and screw the adapter into the body.

b. Lap the upper valve by turning with a screw driver while the valve is on the seat. The lower valve may be lapped by depressing the extension lever until the upper valve is lifted off seat approximately .010 inch. The lower valve then is seated on the piston assembly. Hold the extension lever in this position and turn the upper valve from the outside with a screwdriver to lap in the lower valve.

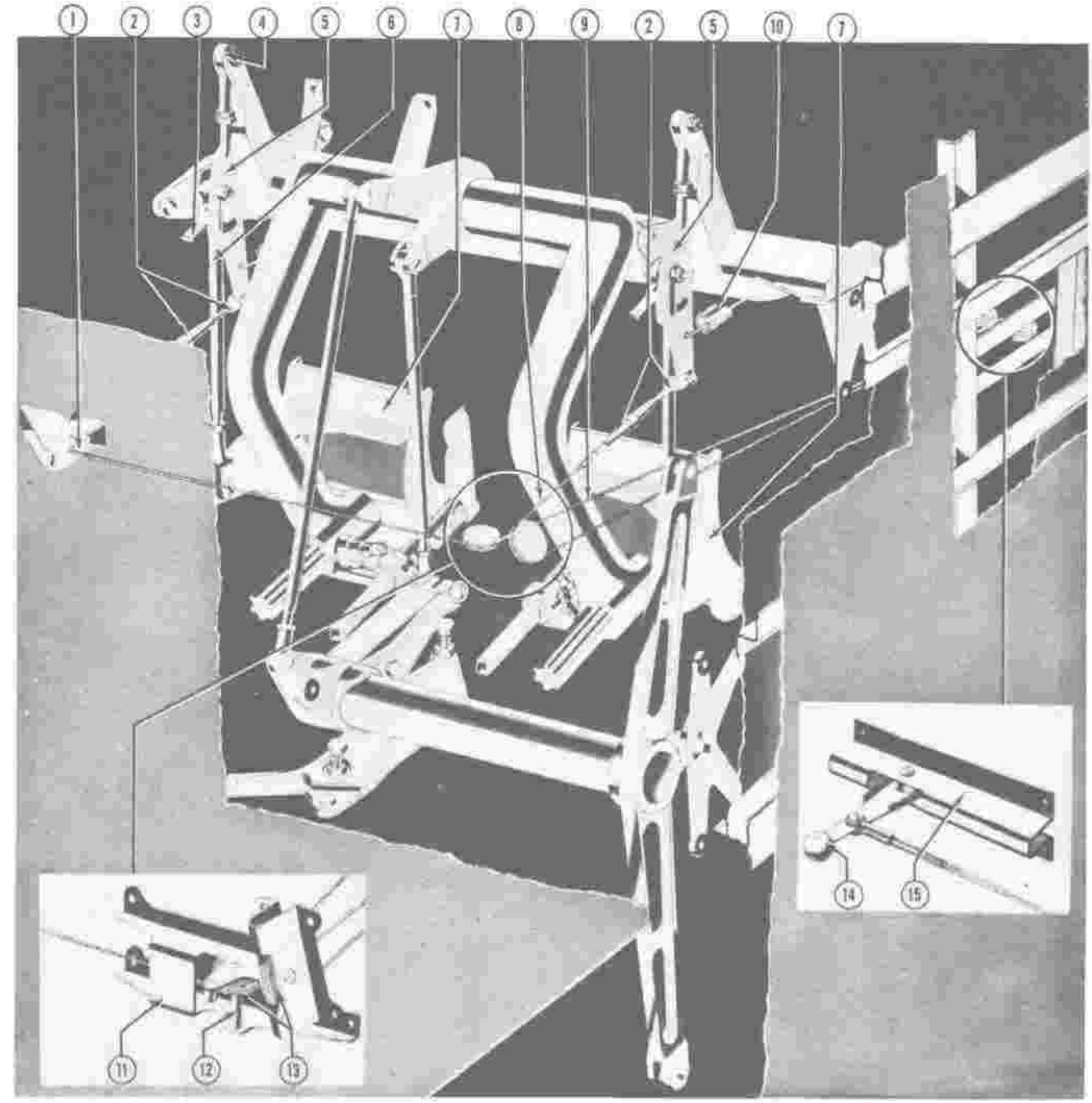
c. After lapping the valves, disassemble the unit and wash all parts thoroughly in clear gasoline to remove all traces of lapping compound.

4. Reassemble the power brake valve and test for leaks as instructed in *figure 283.*



1. Brake Bleeder Valve
2. Hydraulic Fluid Pressure Gage
3. Shut-Off Valve
4. Bleeder Hose

Figure 285—Installation of Pressure Gage for Adjustment of Power Brake Control Valve



1. Bracket and Pulley Assembly
2. Turnbuckle and Fork
3. Brake Valve Extension Lever
4. Bearing
5. Locking Plate
6. Rod Assembly
7. Rudder-Brake Pedals
8. L. H. Parking Brake Cable *(Figure 606, Item 14)*
9. R. H. Parking Brake Cable *(Figure 606, Item 30)*
10. Spring
11. Bracket Assembly
12. Spacer
13. Pulleys
14. Parking Brake Control Lever
15. Bracket

Figure 286—Parking Brake Mechanism

(3) BRAKE ACTUATING CYLINDERS.
(See figure 99.)

(a) DESCRIPTION. – Each wheel brake has two annular ring pistons, backed up by two synthetic rubber seals. Toe pressure applied on the rudder-brake pedals permits hydraulic fluid pressure to act on the rubber seals which in turn force the annular ring pistons against the brake discs. This pressure results in friction between the rotary and the stationary discs *(figure 99)* in the brake unit, producing effective braking of the airplane. When the brakes are relieved by releasing the rudder-brake pedals, the pistons are forced back to their normal position by leaf springs *(figure 99)* and the hydraulic fluid returns to the reservoir through the brake control valves and brake lines.

(b) REMOVAL AND DISASSEMBLY.
(Refer to figures 97 and 98.)

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Refer to paragraph 5. *b.* (4) *(c)*, this section.

(d) ADJUSTMENTS.–Refer to paragraph 5. *b.* (4) *2.* *(d)*, this section.

(e) ASSEMBLY AND INSTALLATION.–Refer to paragraph 5. *b.* (4) *(2)* *(e)*, this section.

(4) SELF-SEALING DISCONNECT COUPLINGS.
(See figure 257.)

(a) DESCRIPTION. – Self-sealing disconnect couplings are provided on the inboard and outboard side of each brake unit to facilitate removal of the wheels or brakes. No fluid leakage occurs when connecting or disconnecting these couplings. For all other information about these couplings, refer to paragraph 14. *b.*, this section.

(5) PARKING BRAKE.
(See figure 286.)

(a) DESCRIPTION.–A parking brake is installed in the airplane to lock the brakes when the airplane is parked. To operate the parking brake, the rudder-brake pedals are depressed fully by toe pressure, and the parking brake control lever *(figure 247)*, located on the left side of the pilot's compartment forward of the bomb rack control lever, is pulled back. Release the pedals before releasing the control lever. The rudder-brake pedals and power brake control valves are held in the "ON" position by a slotted plate, which is controlled by cables to the parking brake control lever. Apply toe pressure on the rudder-brake pedals to release the parking brake.

(b) REMOVAL.–To remove the parking brake cables, control lever, and locking plate remove the attaching bolts. *(See figure 286.)*

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Inspect the parking brake installation periodically for condition and security. Check for any binding of the cables and pulleys. Replace any worn or damaged parts with new parts. To adjust the cable tension refer to *figure 74*.

(d) INSTALLATION.–To install the parking brake refer to *figure 286*.

KEY TO FIGURE 287

1. Emergency Hydraulic System Filter and Check Valve
2. Nose Wheel Door Actuating Cylinder *(Figures 265 and 266)*
3. Nose Wheel Door Actuating Cylinder Shuttle Valve
4. Nose Wheel Gear Actuating Cylinder *(Figure 261)*
5. Hydraulic Hand Pump *(Figure 289)*
6. Emergency Hydraulic System Temperature Relief Valve *(Figure 284)*
7. Emergency Hydraulic System Selector Valve *(Figure 288 for Details of Cable Controls)*
8. Main Landing Gear Actuating Cylinders
9. AN6207-4 Check Valve
10. Main Hydraulic System Fluid Reservoir *(Figure 253)*
11. Tee (Connection for Brake Emergency Air Exhaust Line)
12. Emergency Hydraulic System Fluid Reservoir *(Figure 290)*
13. De-Icer Exhaust Vent
14. Bomb Bay Door Forward Actuating Cylinder Shuttle Valves *(Figure 274)*
15. Bomb Bay Spoilers Actuating Cylinders Shuttle Valve *(Figure 274)*
16. Combined Check, Shuttle, and Pressure Relief Valve Assembly *(Figure 278)*
17. Bomb Bay Door Aft Actuating Cylinder Shuttle Valves *(Figure 278)*
18. Bomb Bay Door Aft Actuating Cylinder *(Figure 275)*
19. Landing Gear DOWN Supply Line From Emergency Reservoir
20. Bomb Bay Doors and Spoilers OPEN
21. Bomb Bay Doors CLOSED Supply Line
22. Bomb Bay Doors OPEN Supply Line
23. Bomb Bay Doors and Spoilers CLOSED Operating Line
24. Supply Line from Main Hydraulic System Reservoir
25. Landing Gear DOWN Operating Line
26. Hand Pump Pressure Line
27. Drum and Cable Assembly
28. Pressure Line to Main Hydraulic System
29. Hand Pump Supply Line
30. Return Line
31. Mounting Bracket

f. EMERGENCY HYDRAULIC SYSTEM.
(See figure 287.)

(1) GENERAL.–The emergency hydraulic system is installed in the airplane to extend the landing gear and open and close the bomb bay doors and spoilers when the main hydraulic system is inoperative. The emergency hydraulic system reservoir furnishes fluid to the hydraulic hand pump, which furnishes pressure for the system. Fluid under pressure from the hand pump flows to the emergency hydraulic system filter and check valve assembly to the emergency hydraulic system selector valve which has four positions. A relief valve is included in the system to relieve excess fluid pressure caused by thermal expansion.

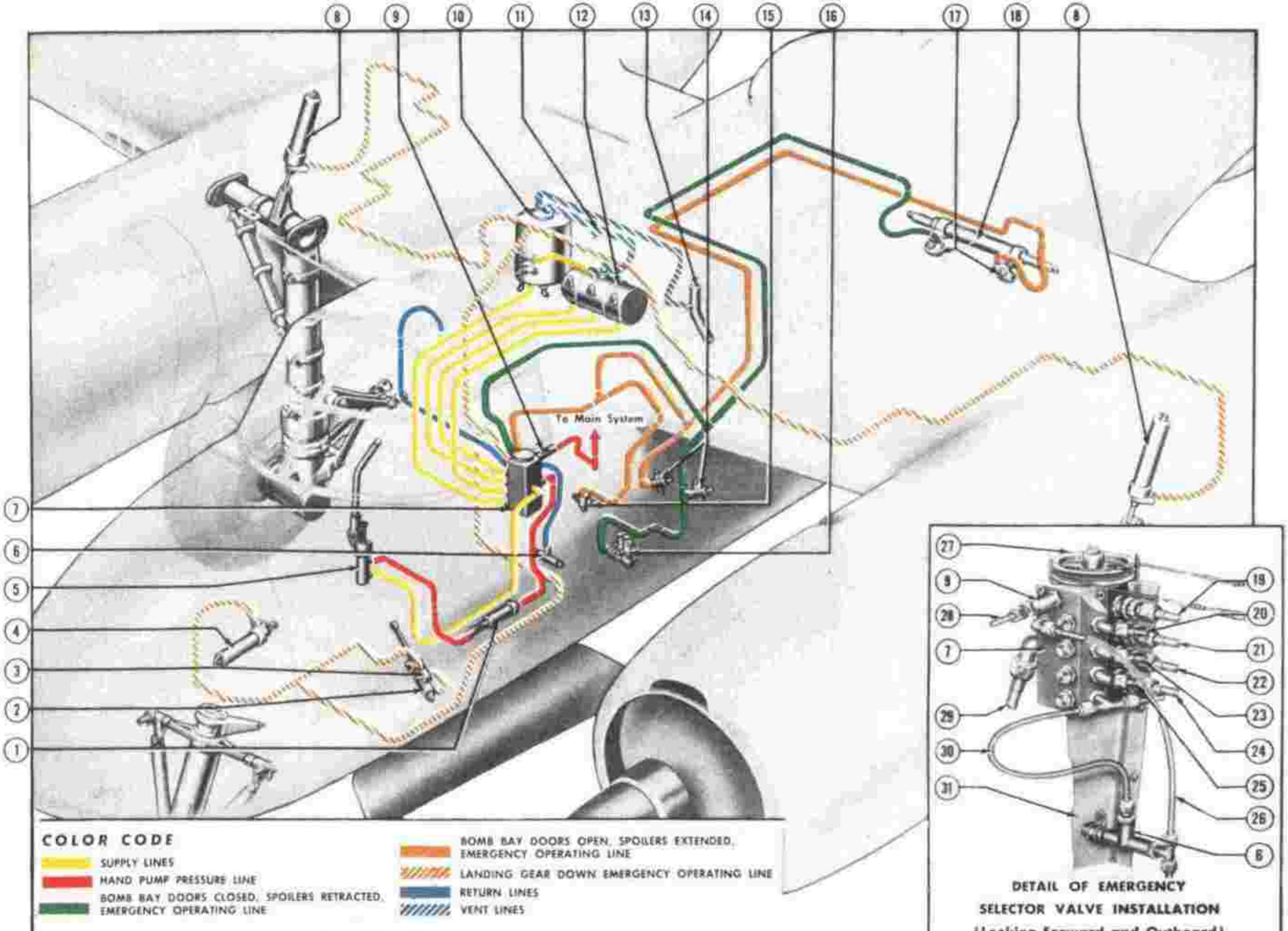


Figure 287– Emergency Hydraulic System

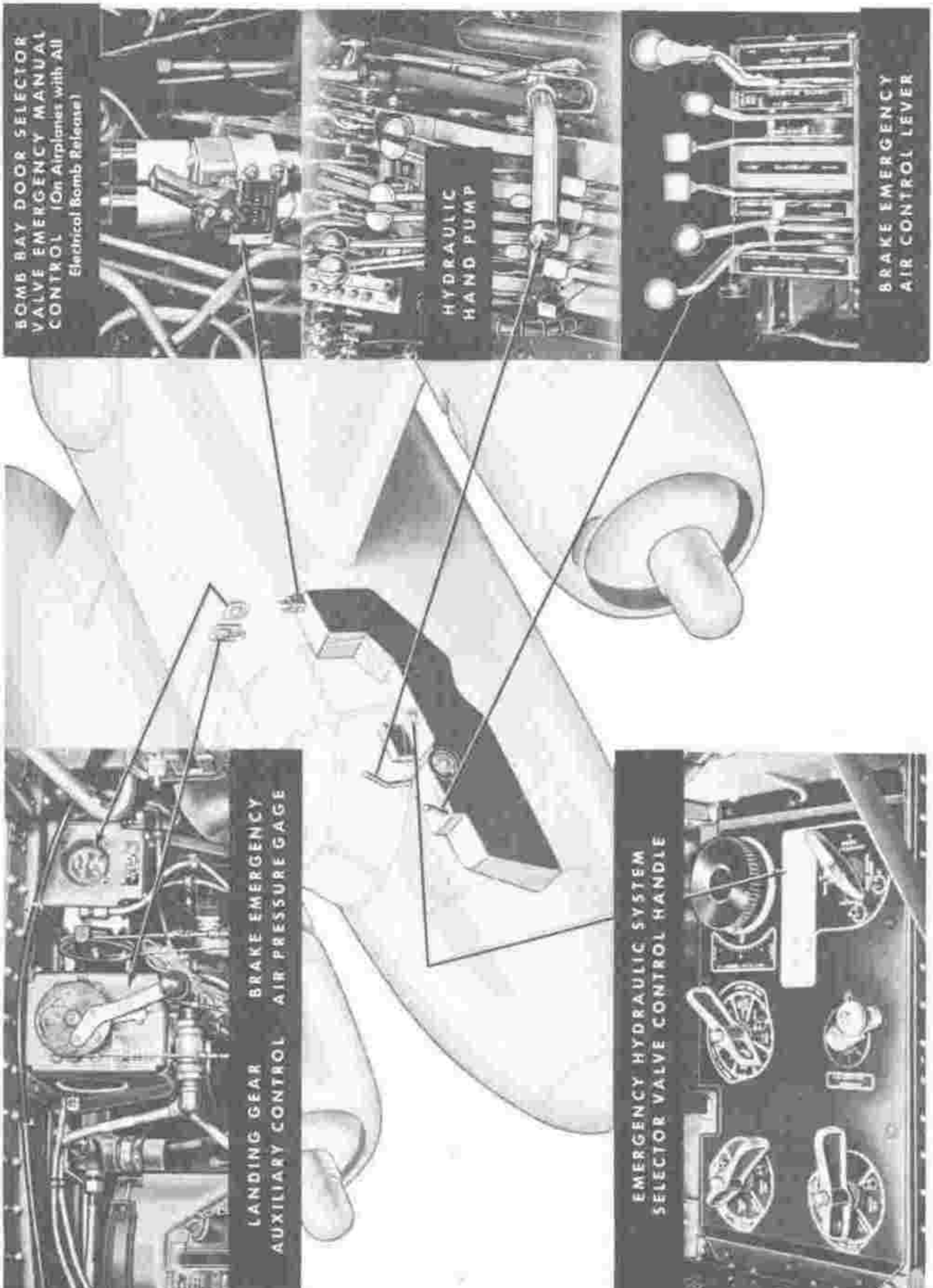


Figure 288—Hydraulic System—Emergency and Auxiliary Controls and Instruments

Note

The corresponding main hydraulic system selector valve first must be set for the desired operation; then, the emergency position selector valve must be set to actuate the desired mechanism. Because the emergency system utilizes main hydraulic lines as return lines, the corresponding main position selector valves must be set for the same operations as the emergency position selector valve; otherwise the excess fluid could not return to the reservoir and emergency operation would be impossible. When an emergency hydraulic system operation is completed, return the emergency system selector valve control handle to the "SYSTEM" position. In the "SYSTEM" position fluid is supplied to the hydraulic hand pump from the main hydraulic system reservoir and fluid under pressure from the hand pump is utilized to increase pressure in the main hydraulic system pressure accumulator.

(2) HYDRAULIC HAND PUMP.
(See figure 289.)

(a) DESCRIPTION.—The double-acting piston-type hydraulic hand pump is mounted on the right side of the pilot's control pedestal. *(See figure 288.)* The hand pump serves two functions: (1) to supply pressure for the main hydraulic system when it is not convenient to operate the engine-driven hydraulic pumps, (2) to supply pressure for the emergency hydraulic system in opening or closing the bomb bay doors and spoilers, and extending the landing gear. The pump has a capacity of 1.25 cubic inches per cycle minute. When the pump is operated, hydraulic fluid is sucked in on only one stroke, but is displaced under pressure on both strokes because of the check valve and accompanying passages contained within the piston head. Handle movement is limited to approximately 65 degrees.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the two hydraulic lines leading to the hand pump.

c. Remove the two bolts attaching the brackets to the pump assembly and remove the pump assembly.

2. DISASSEMBLY. — If disassembly of the hand pump is attempted, refer to *figure 289.*

(c) MAINTENANCE OR REPLACEMENT.

1. The pump requires no internal lubrication because all working parts operate in oil. Occasional lubrication of the link pivots is required. Refer to the lubrication chart in Section III. Inspect the hand pump tube connections periodically for evidence of fluid leakage.

2. If the hydraulic hand pump is damaged or is not operating properly, it should be replaced with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to *figure 289* for fluid leak tests.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the hydraulic hand pump refer to *figure 289.*

2. INSTALLATION. — To install the hydraulic hand pump, reverse the REMOVAL procedure.

(3) EMERGENCY HYDRAULIC SYSTEM FLUID RESERVOIR.
(See figure 290.)

(a) DESCRIPTION.—The emergency hydraulic system fluid reservoir is a welded aluminum container located inboard of and below the main hydraulic system fluid reservoir, which supplies fluid to the emergency system reservoir. The emergency fluid reservoir is divided into three separate cells, with each cell having a bullseye inspection window. The fluid in the emergency fluid reservoir cannot be drawn out by the engine-driven pumps so that a fluid supply is available to the hydraulic hand pump, should the main system reservoir be damaged. One cell of the emergency system fluid reservoir supplies fluid to open the bomb bay doors, the second cell supplies fluid to extend the landing gear, and the third cell supplies fluid to close the bomb bay doors. Openings at the top of the emergency system reservoir cell partitions permit filling of the reservoir.

(b) REMOVAL.

1. Relieve the system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

2. Disconnect and cap all the hydraulic lines at the emergency reservoir.

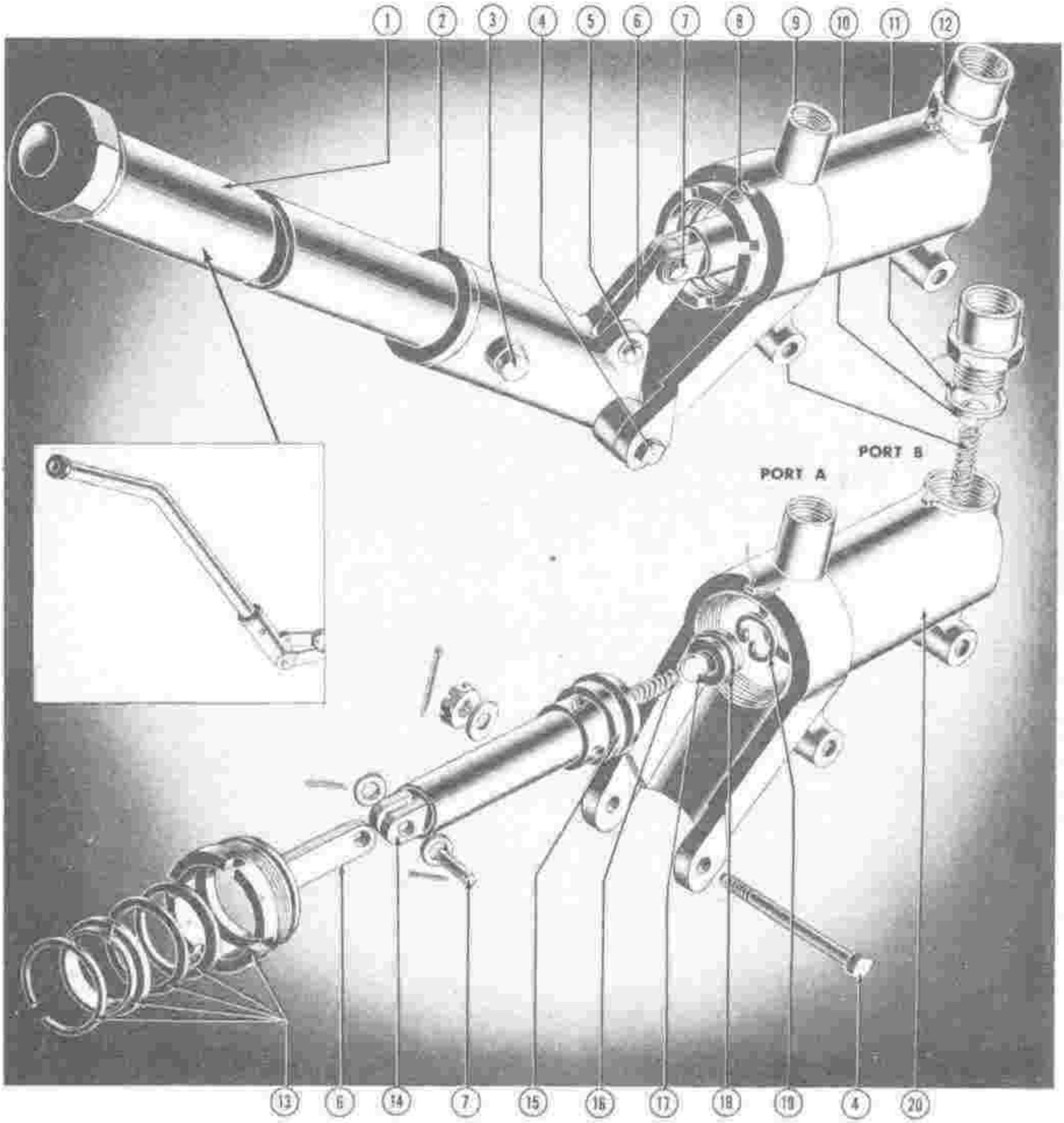
3. Remove the bolts, bend back the straps, and remove the reservoir.

4. The reservoir cannot be disassembled.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Small holes or cracks in the emergency hydraulic system reservoir can be welded.

2. If moderate tightening will not stop fluid



1. Handle Assembly
2. Handle Socket
3. Bolt, Nut, and Washer
4. Bolt or Shaft, Washer, and Cotter
5. Pin, Washers, and Cotters
6. Link
7. Pin, Washers, and Cotters
8. Lock Wire
9. Spring
10. Ball
11. AN902-8 Gasket
12. Fitting
13. Gland Assembly (Includes AN6227-17 Packing)
14. Piston Assembly
15. AN6227-16 Packing
16. Spring
17. Ball
18. AN6227-9 Packing
19. Lock Ring
20. Pump Body

Douglas Drawing No. 5123561

Adel Precision Products Inc. D10007-4

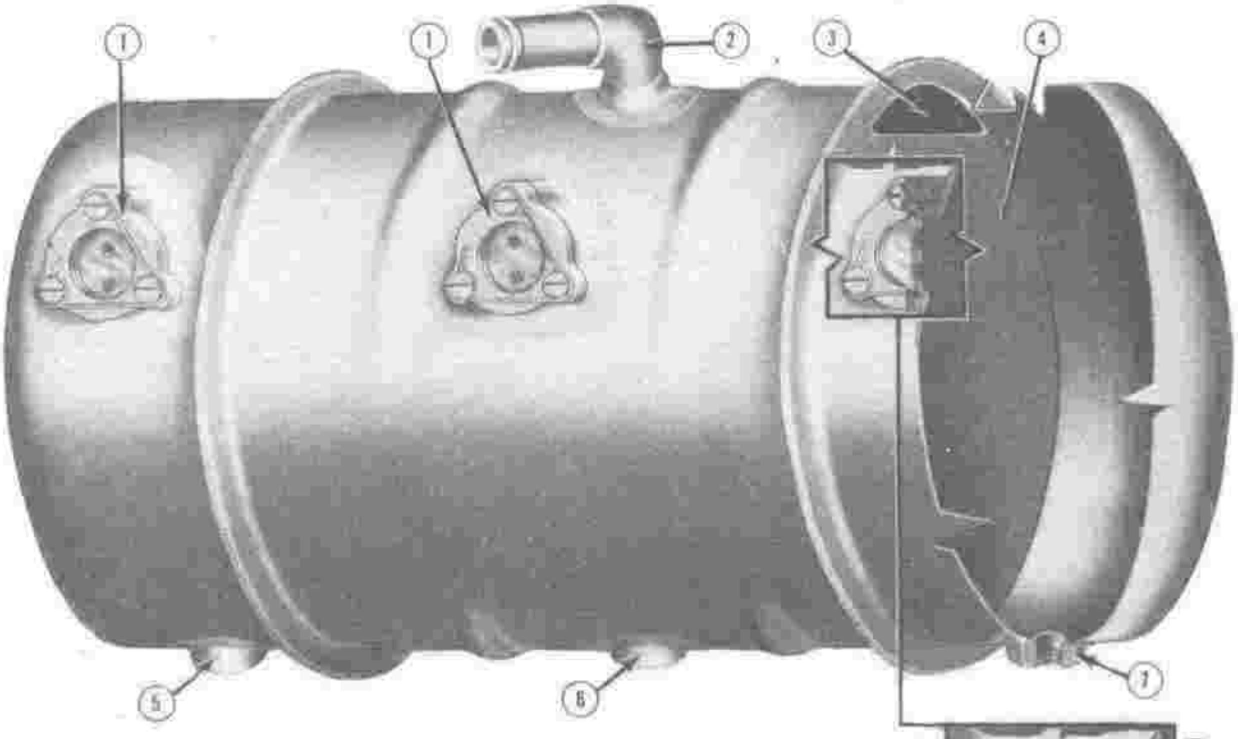
Figure 289—Hydraulic Hand Pump

HYDRAULIC HAND PUMP

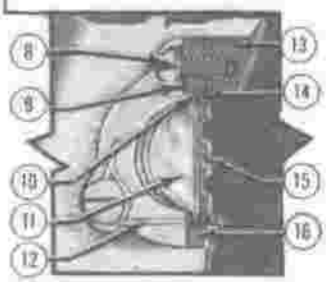
Douglas Drawing No. 5123561

Adel Precision Products Inc. D10007-4

TEST PROCEDURE					
PORT A	PORT B	POSITION	LOAD APPLIED 18" HANDLE	EXTERNAL LEAKAGE	MAX. HANDLE CREEP
Pump Against Relief Valve Set at 1250 psi	Connect To Reservoir	Operate Slowly	1080 in.-lbs.		
Plugged	Connect To Reservoir	Piston Extending	1080 in.-lbs.	2 drops / hr.	1½ in. / hr.
Plugged	Connect To Reservoir	Piston Retracting	1080 in.-lbs.	2 drops / hr.	1½ in. / hr.



1. Bullseye Window Assembly
2. Vent and Inlet Fitting
3. Opening in Bulkhead to Permit Fitting of Cell
4. Bulkhead
5. Outlet Boss (Bomb Bay Doors Closed)
6. Outlet Boss (Landing Gear Down)
7. Outlet Boss (Bomb Bay Doors Open)
8. Screw
9. Washer
10. Bullseye Gasket
11. Bullseye Window
12. Lock Wire
13. Bullseye Boss
14. AN6227-15 Packing
15. Bullseye Disc
16. Bullseye Cover

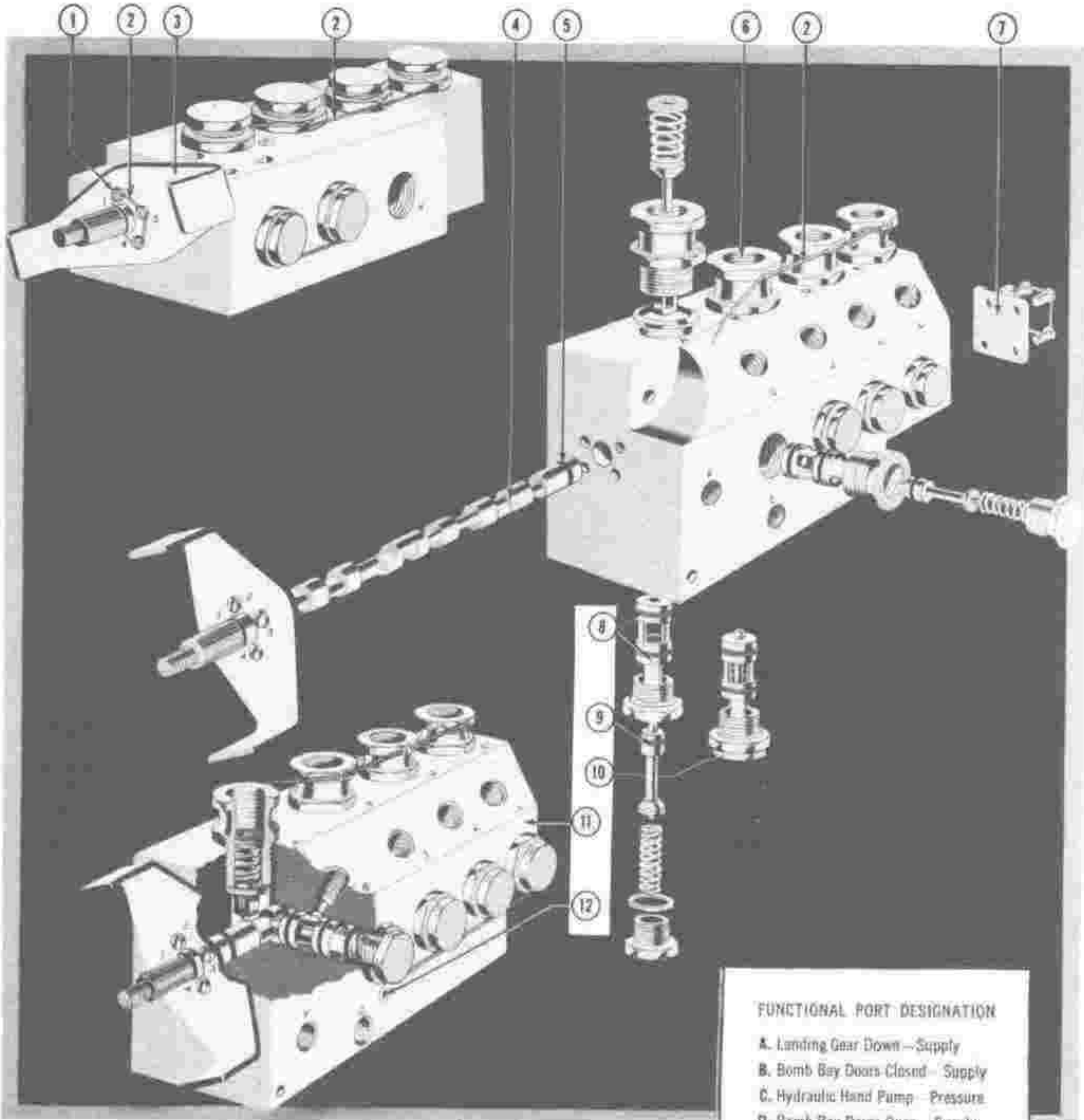


DETAIL OF WINDOW ASSEMBLY

NOTE — Some window assemblies include cover gasket and spacer instead of AN6227-15 Packing

Douglas Drawing No. 5128374

Figure 290 — Emergency Hydraulic System Fluid Reservoir



FUNCTIONAL PORT DESIGNATION

A. Landing Gear Down—Supply
B. Bomb Bay Doors Closed—Supply
C. Hydraulic Hand Pump—Pressure
D. Bomb Bay Doors Open—Supply
E. System—Reservoir Supply
F. To System
G. Bomb Bay Doors Open—Pressure
H. Hydraulic Hand Pump—Supply
J. Bomb Bay Doors Closed—Pressure
K. Landing Gear Down—Pressure
L. Vent

1. Screws
2. Lock Wire
3. Pulley Guard
4. Cam Shaft
5. AN6227-7 Packing
6. Cartridge Assembly
7. Bracket
8. AN6227-9 Packing
9. AN6227-1 Packing
10. Cartridge Assembly
11. Valve Body
12. Plug

Douglas Drawing No. 5128486
Adel Precision Products Corp. D10005

Figure 291—Emergency Hydraulic System Selector Valve

EMERGENCY HYDRAULIC SYSTEM SELECTOR VALVE

Douglas Drawing No. 5128486

Adel Precision Products Inc. D10005

TEST PROCEDURE				
TEST PRESSURE	PORTS PLUGGED	HANDLE POS.	MAX. LEAKAGE INTERNAL–2 DROPS / MIN.	MAX. LEAKAGE EXTERNAL
1500 psi–Port B	H	1	At Port A	None
1500 psi–Port D	H	1	At Port A	None
1500 psi–Port E	H	1	At Port A	None
1500 psi–Port A	H	2	At Port B	None
1500 psi–Port C	J	2	At Each Port F, J, K, and L	None
1500 psi–Port C	G	4	Total At Ports F, J, K, and L	None
1500 psi–Port C	F	3	At Port J	None

leaks at the outlet connections, replace gaskets or fittings.

3. Fluid leaks may develop at the bullseye inspection windows, observe the following procedure:

a. Cut the lockwire; remove the screws and washers attaching the bullseye cover to the bullseye boss. Replace worn washers.

b. Inspect the molded neoprene gasket for deterioration, and install new gasket if necessary.

c. Inspect the bullseye plexiglas window and replace it if it is damaged.

4. If the emergency fluid reservoir is badly damaged, it should be replaced with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.–Apply 10 psi with all outlets plugged to test for leaks. No leakage is permissible.

(e) INSTALLATION. – To install the emergency hydraulic system reservoir reverse the REMOVAL procedure.

(4) EMERGENCY HYDRAULIC SYSTEM SELECTOR VALVE AND CABLE CONTROLS. *(See figures 291 and 292.)*

(a) DESCRIPTION. – This poppet-type valve is located in the left-hand aft section of the pilot's compartment. It is controlled by cables which are connected to a handle on the control pedestal. The emergency hydraulic system selector valve controls the opening and closing of the bomb bay doors, extending of the landing gear, and increasing pressure in the accumulator. To operate any of the emergency systems, the main hydraulic system selector valves first must be set for the same operation as the emergency selector valve. During normal operation when the main hydraulic system is functioning, the emergency hydraulic system selector valve should remain in the "SYSTEM" position.

Note

When changing the emergency selector valve from "BOMB DOORS OPEN" to "BOMB DOORS CLOSED," the valve should remain in the "SYSTEM" position for approximately five seconds to allow pressure in the bomb bay doors and spoilers system to be dissipated.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

b. Loosen the cable turnbuckle, remove the two bolts, and remove the pulley with the cable in place.

c. Disconnect and cap all hydraulic lines leading to the valve.

d. Remove the three bolts which attach the valve to the bracket and remove the valve.

2. DISASSEMBLY.–Refer to *figure 291* if disassembly of the emergency hydraulic system selector valve is attempted.

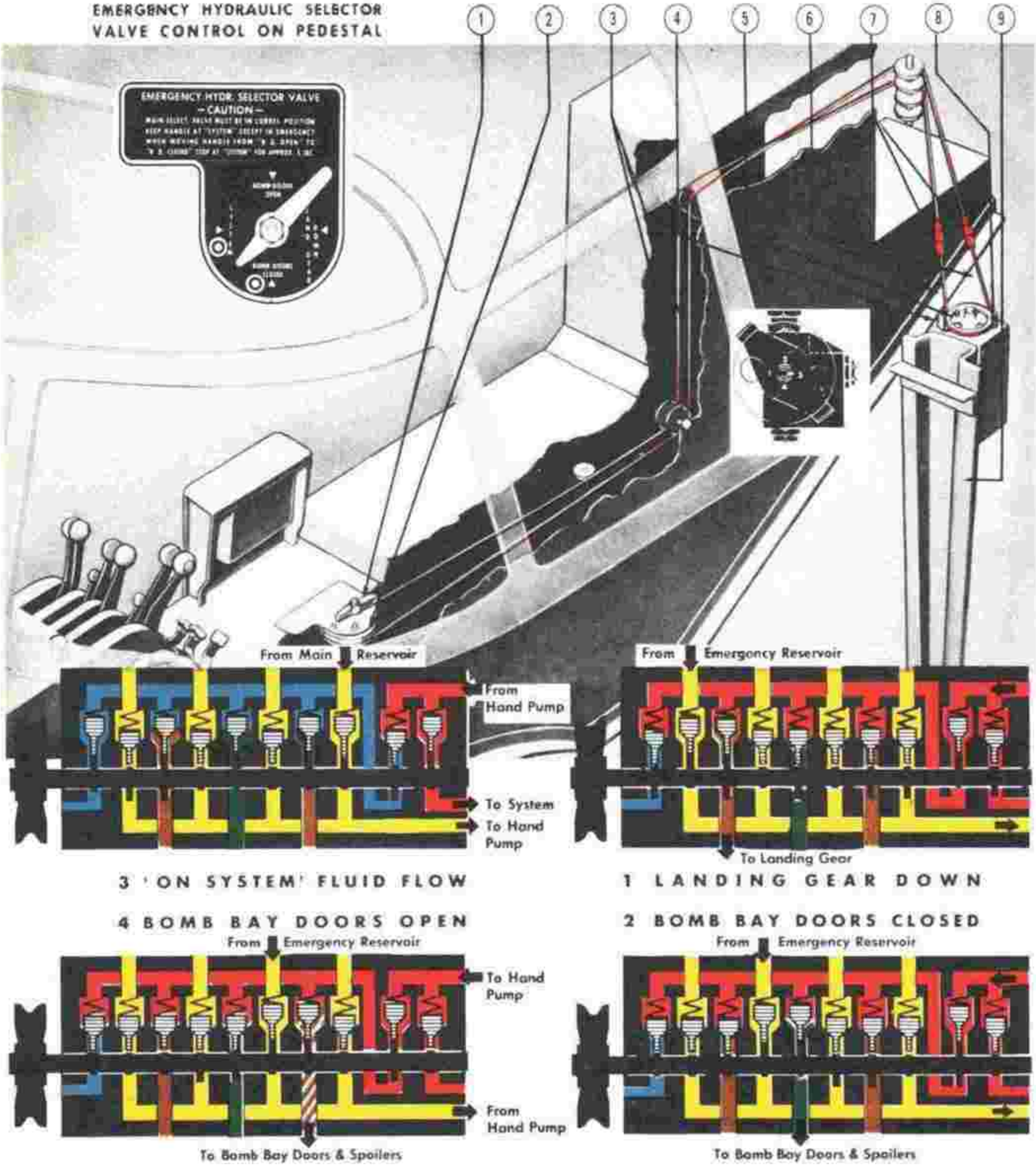
(c) MAINTENANCE REPAIR OR REPLACEMENT.–If the emergency hydraulic system selector valve is damaged or is not operating properly, replace it with a new or serviceable part.

(d) ADJUSTMENTS. – To adjust the valve, cables and cable control refer to *figure 292.*

(e) TEST BEFORE INSTALLATION.–Refer to *figure 291* for fluid leak tests.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.–Refer to *figure 291* for assembly procedure.



NOTES:

1. Rig cables with the pedestal control in "ON SYSTEM" position and mark on selector valve shaft pointing aft at No. 3 on pulley guard as shown.

2. Refer to Figure 74 to obtain correct cable tension.

1. Pedestal Control
2. Pedestal Control Pulley
3. Pedestal Cable Assembly *(Figure 606, Item 13)*
4. Pulley Guard
5. Selector Valve Pulley
6. Valve Cable Assembly *(Figure 606, Item 16)*
7. Cable Turnbuckles
8. Emergency Hydraulic Selector Valve
9. Bracket Assembly

SUPPLY — PRESSURE — RETURN — LANDING GEAR DOWN — BOMB BAY DOORS OPEN — BOMB BAY DOORS CLOSED

Figure 292—Emergency Hydraulic Selector Valve Cable Control System

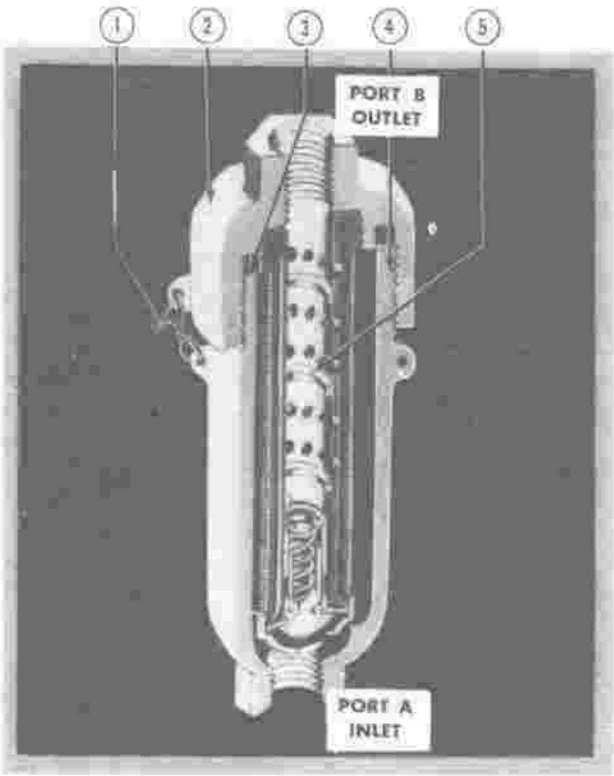
2. INSTALLATION.—To install the emergency hydraulic system selector valve, reverse the REMOVAL procedure.

(5) EMERGENCY HYDRAULIC SYSTEM FILTER. *(See figure 293.)*

(a) DESCRIPTION.—This filter is located in the emergency hand pump pressure line on the left side of the nose-wheel well. The unit filters the supply of emergency hydraulic system fluid and must be disassembled to be cleaned. A pressure relief valve is incorporated in the metal-edge type filter element, and is set at 28 to 30 psi pressure differential to bypass the fluid if the filter clogs. The filter has a capacity of 1.5 gallons a minute at a maximum pressure differential of 10 psi.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.



1. Lock Wire
2. Head
3. Case Packing
4. Case
5. Element Assembly (Includes Relief Valve Assembly)

TEST PROCEDURE		
TEST PRESSURE	PORTS PLUGGED	MAX. LEAKAGE
1500 psi—Port A	Port B	External—None
Relief valve must open at 28-30 psi to bypass fluid if element clogs		

Douglas Drawing No. 2123260
Purolator Products Type G-166M-3

Figure 293—Emergency Hydraulic System Filter

a. Relieve the system operating pressure by applying toe pressure to and releasing the rudder brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines leading to the filter and check valve assembly.

c. Remove the screw and clip which attach the filter to the side of the nose-wheel well. Remove filter. Remove the check valve from the inlet port of the filter.

2. DISASSEMBLY.—Refer to *figure 293* for disassembly procedure.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. CLEANING.—Remove and disassemble the filter as instructed above. Unscrew the filter element from the head. Clean the filter element with a soft bristle brush (DO NOT USE METAL BRUSH) and wash it in solvent. Blow air through reverse side of filter element. The filter should be disassembled and cleaned every 100 hours.

Note

This filter should be cleaned at the same time as the main hydraulic system filter.

2. Install new case packing if there is evidence of external leakage.

3. If the emergency hydraulic system filter is damaged, it should be replaced with a new or serviceable part.

(d) TEST BEFORE INSTALLATION.—Refer to *figure 293* for leak tests of the emergency hydraulic system filter.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the emergency hydraulic system filter refer to *figure 293.*

2. INSTALLATION.—To install the filter, reverse the REMOVAL procedure.

(6) HYDRAULIC FLUID CHECK VALVES. *(See figure 256.)*

(a) DESCRIPTION. — Hydraulic fluid check valves are installed in the emergency hydraulic system to prevent the fluid from reversing its normal direction of flow in certain lines. One check valve *(figure 287)* is located in the hand pump pressure line at the inlet port of the emergency system filter, while one is located at the emergency selector valve in the connecting line from the valve to the line to the main hydraulic system pressure accumulator. A check valve and pressure relief valve assembly is installed in the bomb bay doors OPEN line. The check valves consist of spring-loaded plastic poppets seating on the aluminum alloy valve body.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero.

b. Remove valves from the airplane after disconnecting and capping hydraulic lines at the valves.

2. DISASSEMBLY.—Refer to *figure 256* for disassembly procedure.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If a check valve is damaged or is not functioning properly, replace it with a new or serviceable part.

(d) TEST BEFORE INSTALLATION.—Refer to *figure 256* for leak tests.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—Refer to *figure 256* for assembly procedure.

2. INSTALLATION.—Installation is the reverse of REMOVAL above.

(7) EMERGENCY HYDRAULIC SYSTEM TEMPERATURE RELIEF VALVE.
(See figure 294.)

(a) DESCRIPTION.—This valve is located on the same bracket that supports the emergency selector valve in the pilot's compartment, and functions to relieve fluid pressure in the emergency hydraulic system caused by thermal expansion. The valve is installed in the pressure line from the hydraulic hand pump to the emergency hydraulic selector valve with excess fluid being returned to the reservoir. The valve relieves fluid at the rate of three cubic inches a minute at a maximum pressure of 1300 psi. The valve consists essentially of a spring-loaded steel ball resting upon a hardened steel valve seat in an aluminum alloy body.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve system operating pressure by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

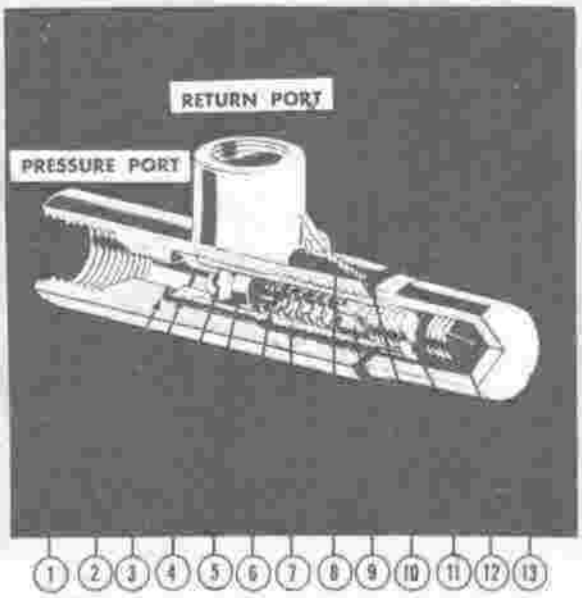
b. Disconnect and cap the hydraulic lines at the valve.

c. Remove the clip and screw which attach the valve assembly to the bracket and remove the valve assembly.

2. DISASSEMBLY.—Refer to *figure 294* if disassembly of the valve is attempted.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Leaks may develop because of faulty seating or the valve ball because of wear or by foreign particles lodging under the ball. Foreign particles may be dislodged by the following procedure:

1. Raise the system pressure by operating the hydraulic hand pump and continue the pumping to force a considerable volume of fluid to flow through the valve. This fluid flow should dislodge any particles holding the valve open, particularly if the valve body is lightly tapped at the same time with a rubber hammer. If this fails to remedy the trouble, the valve must be removed from the airplane and disassembled and cleaned.



1. Valve Body
2. Crush Washer
3. Ball Seat
4. Ball
5. Spring Seat (Ball End)
6. Spring
7. Bushing
8. Lock Wire
9. Spring Seat (Adjusting End)
10. Crush Washer
11. Lock Nut
12. Adjusting Screw
13. Cap

NOTE

Valve opens at 1170 psi minimum and reseats at 1100 psi. Valve allows flow at rate of 3 cubic inches a minute at maximum pressure of 1300 psi.

TEST PROCEDURE			
TEST PRESS.	PORTS PLUGGED	MAX. LEAKAGE	
		INTERNAL	EXTERNAL
1160 psi–Pressure Port	None	None at Return Port	None
1500 psi–Pressure Port	Return Port		None

Douglas Drawing No. 4193465 Aircraft Accessories Corp. No. 51023

Figure 294—Emergency Hydraulic System Temperature Relief Valve

2. If the temperature relief valve is not functioning properly or is damaged, it should be replaced with a new or serviceable part.

(d) ADJUSTMENTS.

1. MINOR ADJUSTMENT. – Remove cap *(13, figure 294)*, loosen lock nut *(11, figure 294)* and turn the adjusting screw *(12, figure 294)* IN to increase the pressure, and OUT to decrease the pressure. Tighten the lock nut after adjustment; replace dust cap and safety wire.

2. MAJOR ADJUSTMENT.–If the correct position of the adjusting screw has been lost, as in disassembly, the valve can be adjusted by turning the adjusting screw in until the spring is almost completely compressed. Then increase the system pressure to 1300 psi with the hydraulic hand pump. Turn the adjusting screw out until the temperature relief valve opens, as indicated by a pressure drop. Tighten the locknut, raise the system pressure again as a check, and make final minor adjustment as may be required.

(e) TESTS BEFORE INSTALLATION.–Refer to *figure 294* for leak tests.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY. – To assemble the temperature relief valve refer to *figure 294*.

2. INSTALLATION.–To install the temperature relief valve, reverse the REMOVAL procedure.

(g) MAJOR OVERHAUL.

1. Remove and disassemble the temperature relief valve as instructed in paragraph 14. *f.* *(7)* *(b)*, this section.

2. Thoroughly wash all parts in clean hydraulic fluid.

3. Inspect the valve ball for roughness or corroded surfaces. Replace the ball if there is evidence of roughness or corrosion.

4. Check the condition of valve seat. A valve seat that is slightly worn can be reconditioned by carefully lapping with extra-fine grinding compound. Select a short length of steel tubing that has an inside diameter slightly smaller than the valve ball outside diameter. Force a ball firmly into the end of this tube so that slightly more than one-half of the ball extends from the tube. Lap the ball to the seat, using a combined tapping and rotary motion to avoid "ringing" the valve seat. After a smooth, true seat is obtained, the seat and valve body should be carefully washed in clear gasoline to remove every trace of grinding compound.

Note

The ball used for grinding MUST NOT be used in the valve, and a new ball must be installed when reassembling the valve.

5. If the valve seat cannot be satisfactorily reconditioned by lapping, it should be replaced. Both valve seat and valve ball should be replaced at the same time, because it is impossible to obtain a satisfactory seal when a new seat is used with an old ball, or when a new ball is installed without first lapping the old seat to a true surface.

6. Inspect all remaining parts for wear and make necessary replacements. Assemble the valve and tests for fluid leaks as instructed in *figure 294*.

g. BRAKE EMERGENCY AIR SYSTEM.
(See figure 295.)

(1) GENERAL. – An independently operated brake emergency air system consisting of an air bottle *(11, figure 295)*, pressure gage *(8, figure 295)*, control valve *(6, figure 295)*, shuttle valves *(2, figure 295)*, and necessary fittings, provides a means of applying the brakes when the hydraulic system is not functioning. Air pressure is directed to the brakes without using the rudder-brake pedals. The air bottle contains sufficient air under pressure for three applications of the brakes. The brake emergency air system shuttle valves *(2, figure 295)* close the brake hydraulic system lines when the air system is utilized. The pressure gage is attached to a bracket at the left of the landing gear position selector valve on the canopy in the pilot's compartment. The brake air control valve also is attached to the bracket and is controlled by cables attached to a control lever on the pilot's control pedestal *(3, figure 295)*. The control lever has three positions, "NEUTRAL," "ON," and "RELEASE."

CAUTION

The brakes must be bled (see paragraph 14. *e.* (2) *(d)* *1.*, this section) after each use of the air system as the brake hydraulic system will not operate properly when air is entrapped in the hydraulic lines.

(2) BRAKE AIR BOTTLE.
(See 11, figure 295.)

(a) DESCRIPTION.–The cylindrical steel air bottle, located aft of the emergency hydraulic system fluid reservoir, contains 67 cubic inches of compressed air at an initial pressure of 575 psi. The bottle is connected to a manifold block which also is the connection for the brake air control valve, air pressure gage, and air filler valve for charging the bottle. To charge the air bottle, use a booster pump, high pressure air pump, or large air bottle and charge the bottle until the pressure gage indicates 575 psi. Charge the bottle at the air valve in the manifold block to the left of the air pressure gage. *(See 10, figure 295.)* The air bottle should be recharged when the pressure decreases to 450 psi.

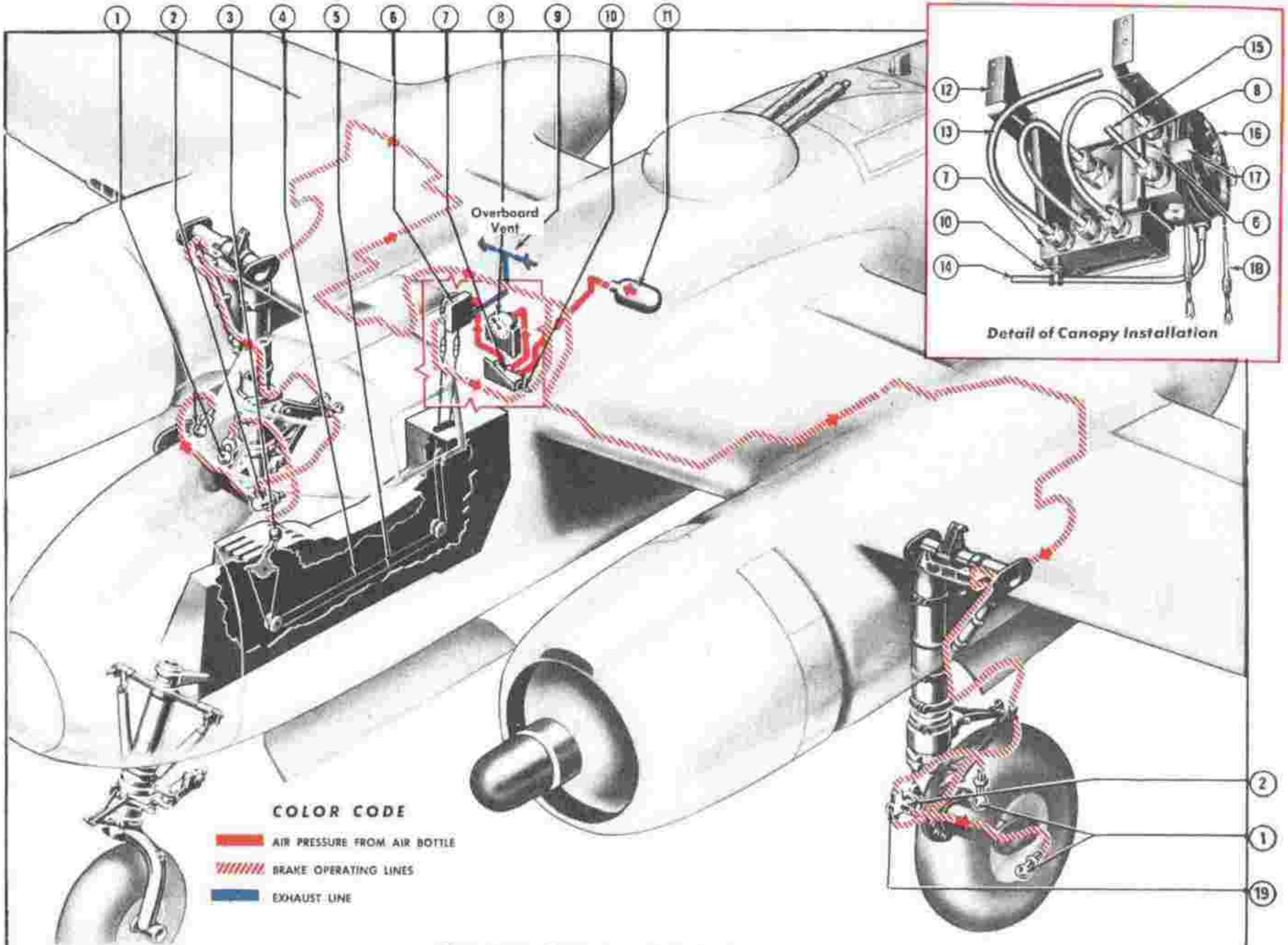


Figure 295 — Emergency Air Brake System

KEY TO FIGURE 295

1. Self Sealing Disconnect Couplings
2. Brake Emergency Air Shuttle Valve
3. Brake Emergency Air Control Lever (*Figure 288*)
4. Brake Emergency Air Cable
5. Brake Emergency Air Cable
6. Brake Air Control Valve (*Figure 295*)
7. 4151285 Manifold Assembly
8. Brake Air Pressure Gage
9. Tee in Vent Line from Emergency System Reservoir to Main System Reservoir. (On Some Airplanes the Brake Air Exhaust Line Is Connected to the Vent Line From the Main System Reservoir to the De-Icer Exhaust Vent)
10. Air Bottle Filler Valve Assembly
11. Brake Air Bottle (Recharge to 575 psi when the Air Pressure Decreases to 450 psi)
12. Mounting Bracket Assembly
13. Pressure Line From Air Bottle
14. Brake Operating Line
15. Exhaust Line
16. Pulley
17. Pulley Guard
18. Brake Air Control Valve Pulley Cable
19. Connection for Brake Hydraulic Line (*Figure 282*)

(*b*) REMOVAL.

1. Relieve the pressure in the air bottle by backing off the air valve in the manifold block.

2. Disconnect the line to the bottle.

3. Unbolt the strap assembly holding the bottle, and remove the bottle.

4. The only disassembly possible is to remove nut, connector and gasket.

(*c*) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check for leaking connections by applying a thin neutral soap solution to the air bottle connection. If tightening fails to stop the air leak, replace the connection and gasket.

2. If the bottle is damaged or inspection reveals deep scratches, cracks or serious defects, a new bottle should be installed.

(*d*) TEST BEFORE INSTALLATION.—Apply 675 psi pressure at inlet. There should be no external leakage.

(*e*) INSTALLATION.—To install the air bottle, reverse the REMOVAL procedure.

(3) BRAKE AIR CONTROL VALVE AND CABLE CONTROLS.
(*See figures 296 and 297.*)

(*a*) DESCRIPTION. — This two-way valve, mounted on a bracket to the left of the landing gear position selector valve on the canopy of the pilot's compartment, controls the air pressure to apply the brakes. The valve has three ports, one to the brake operating line, one to the exhaust line, and one to the air pressure supply line. Two poppets, actuated by a cam assembly, control the flow of air through the valve. The valve is controlled by cables attached to a lever on the pilot's control pedestal (*figure 288*).

(*b*) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the air pressure by backing off the air valve in the manifold block.

b. Disconnect the three lines leading to the brake air control valve.

c. Remove the drum and cable assembly from the control shaft of the valve.

d. Remove the screws that attach the valve to the bracket and remove the valve.

2. DISASSEMBLY.—Refer to *figure* 296 if disassembly of the brake air control valve is attempted.

(*c*) MAINTENANCE REPAIR.—If the valve is damaged or not functioning properly, it should be replaced with a new or serviceable part. Inspect the cable controls periodically for general condition and security. Replace damaged parts with new parts.

(*d*) ADJUSTMENTS.—If the valve has been disassembled, the set screws in the piston assemblies should be adjusted to obtain a minimum poppet lift of .032 inches, and a shaft rotation of four to nine degrees on each side of the neutral position of the control shaft before the poppets are opened. Refer to *figure 297* for proper rigging of the cable controls.

(*e*) TESTS BEFORE INSTALLATION.—Refer to *figure 296* for leak tests.

(*f*) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the brake air control valve refer to *figure 296*.

2. INSTALLATION.—To install the brake air control valve, reverse the REMOVAL procedure.

(4) BRAKE AIR PRESSURE GAGE.
(See figure 288.)

(a) DESCRIPTION.—The brake air pressure gage, attached to a bracket on the canopy in the pilot's compartment, indicates pressure from zero to 750 psi, and indicates the air pressure available in the air bottle to apply the brakes in an emergency.

(b) REMOVAL.

1. Relieve the air pressure by backing off the air valve in the manifold block.

2. Disconnect the line to the air pressure gage.

3. Remove the attaching screws and remove the valve.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the air gage is damaged or is not functioning properly, replace with a new or serviceable gage. Repairs to the air gage will be accomplished only at depots by qualified personnel.

(d) INSTALLATION.—To install the air pressure gage, reverse the REMOVAL procedure.

(5)BRAKE EMERGENCY AIR SHUTTLE VALVES.
(See figure 298.)

(a) DESCRIPTION.—The brake emergency air shuttle valves are attached to the inboard end of each main landing gear axle, and close the brake hydraulic lines when the brake emergency air system is being used. The spring-seated steel cone within the valve normally closes the air pressure port when the brake hydraulic system is being operated.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve hydraulic system pressure by applying and releasing the rudder-brake pedals until the hydraulic system pressure gage indicates zero.

b. Disconnect and cap the hydraulic lines leading to the shuttle valve.

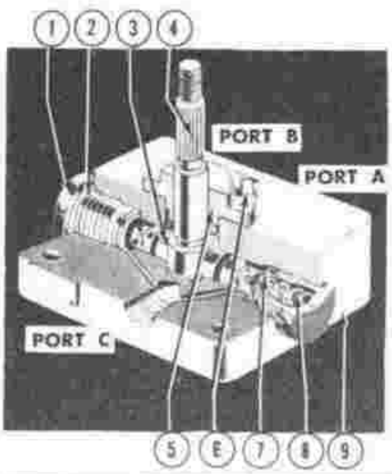
c. Remove the bolts attaching the valve support to the main landing gear axle.

d. Disconnect the union from the shuttle valve.

e. Remove the three screws attaching the shuttle valve to the valve support, and remove the valve.

2. DISASSEMBLY.—Refer to *figure 298* when disassembly of the shuttle valve is attempted.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—To prevent internal leaks and consequent



1. Cap
2. AN900-11 Gasket
3. Piston Assembly (Includes AN6227-4 Packing)
4. Control Shaft
5. Bearing
6. Screws and Lock Wire
7. Poppet
8. Spring
9. Valve Body

Douglas Drawing No. 4128185
Bendix Aviation Ltd. No. 402246

TEST PROCEDURE				
TEST PRESS.	HDLE POS.	PORTS PLUGGED	MAX. LEAKAGE INTERNAL	MAX. LEAKAGE EXTERNAL
650 psi air press. at Port A	#3	C	None at Port B	None
650 psi air press. at Port A	#2		None at Port C	None

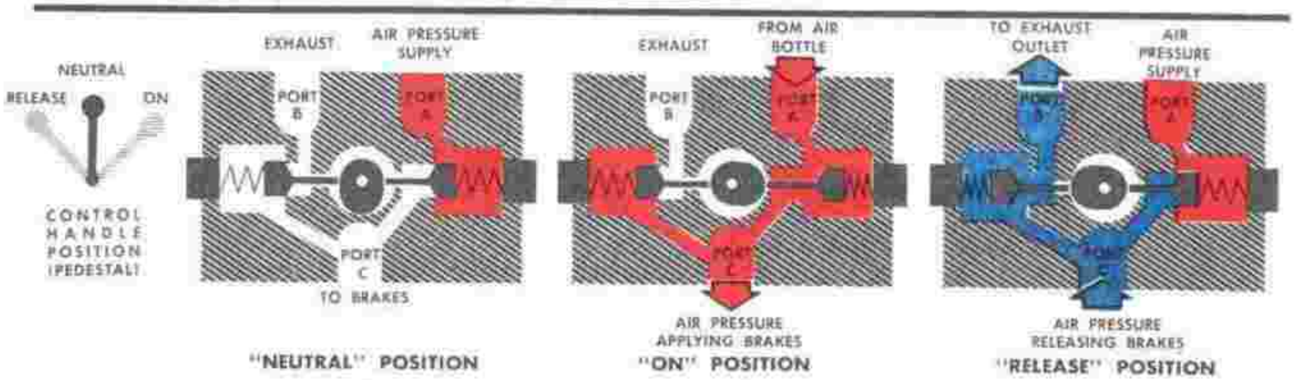
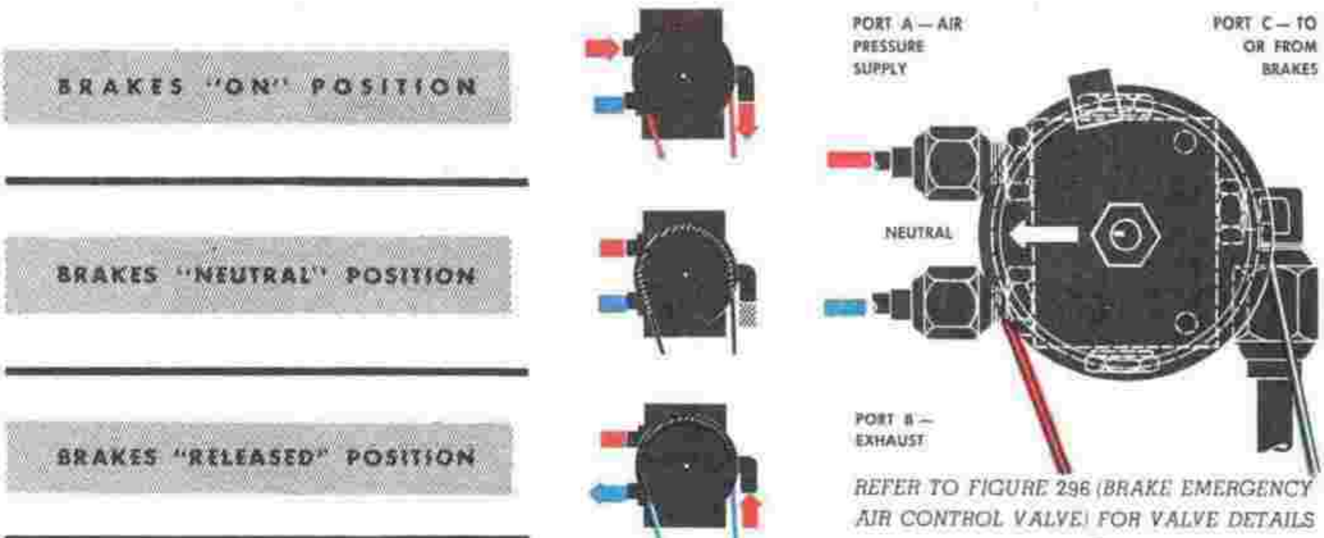


Figure 296—Brake Emergency Air Control Valve

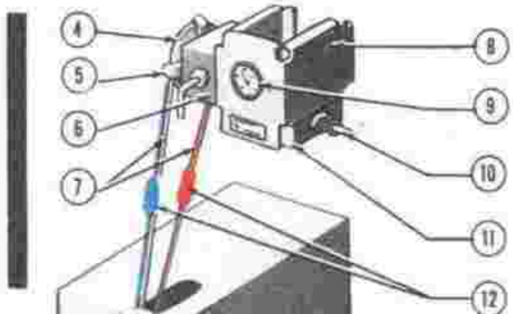


1. Brake Emergency Air Control Lever
2. Brakes "ON" Cable (*Figure 606, Item 35*)
3. Brakes "RELEASE" Cable (*Figure 606, Item 35*)
4. Pulley
5. Pulley Guard
6. Brake Air Control Valve
7. Valve Pulley Cable Assembly (*Figure 606, Item 84*)
8. Bracket Assembly
9. Air Pressure Gage
10. Air Filter Valve Assembly
11. Manifold Assembly
12. Turnbuckles

—NOTES—

a. Reg. cables with brake emergency air control lever in "Neutral" position and mark on brake air control valve shaft pointing directly aft as shown.

b. Refer to Figure 74 to obtain proper cable tension.



Cable Color Code: BRAKES APPLIED BRAKES RELEASED

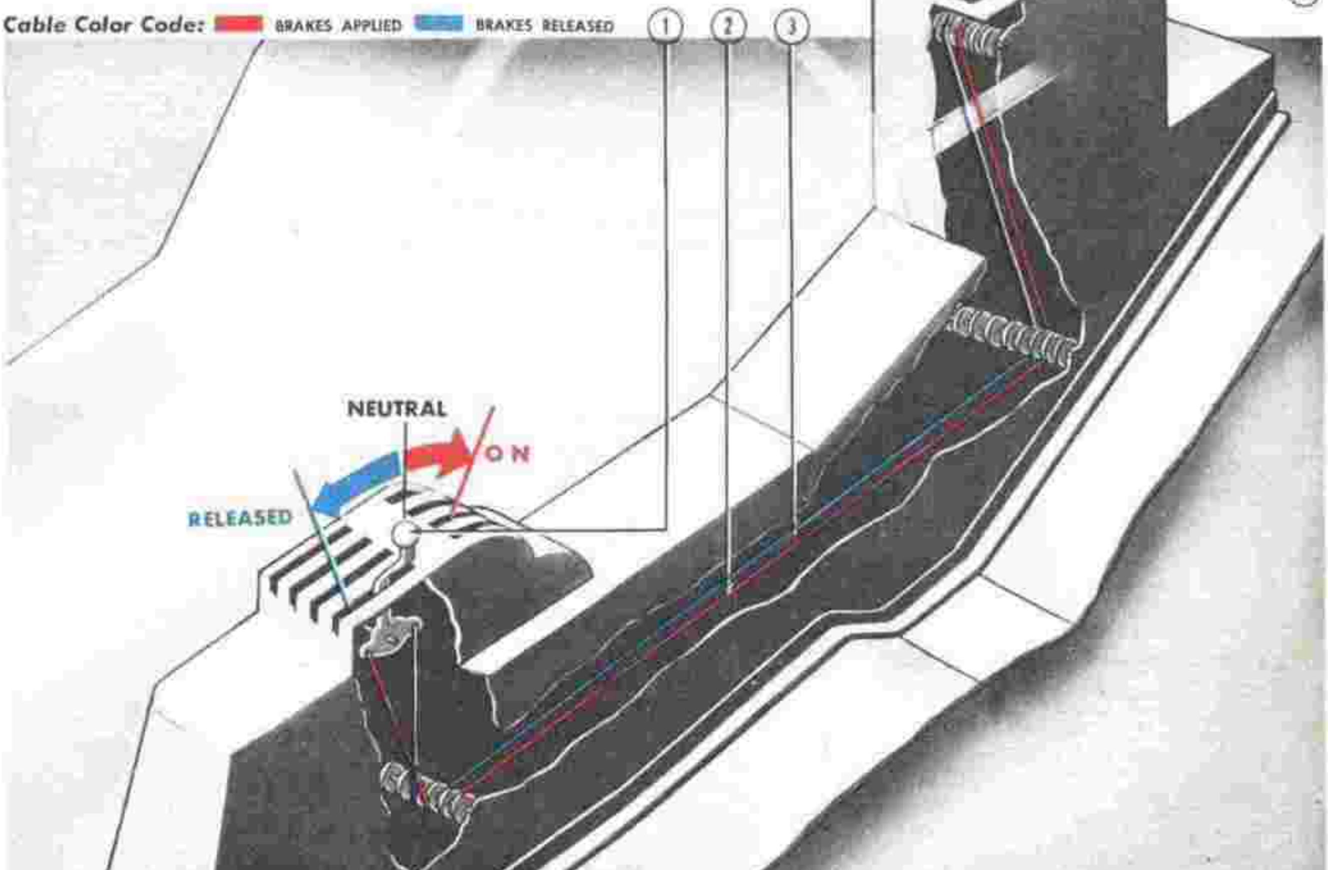


Figure 297 — Brake Emergency Air Control Valve Cable Control System

sluggish or spongy action of the brakes will be the primary maintenance problem in connection with the shuttle valve.

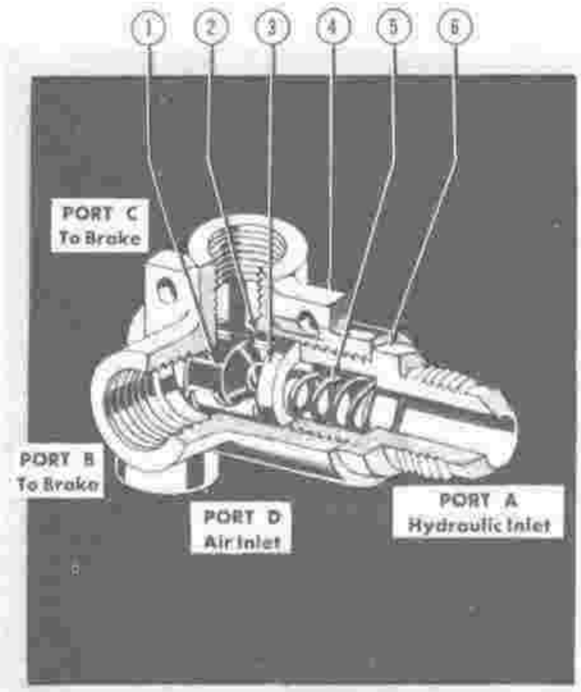
1. After disassembly of the valve, wash all parts in clean hydraulic fluid.

2. Inspect the steel cone and seats for evidences of pitting, corrosion, and other defects. New seats and cone should be installed if inspection reveals excessive wear.

3. Check the spring for evidence of fatigue or wear, and install new spring if necessary.

4. Inspect the remaining parts for wear, cracks, and other defects and make necessary replacements.

(d) TESTS BEFORE INSTALLATION.—Refer to *figure 298* for leak tests of the shuttle valve.



1. Cone
2. Spacer
3. Seat—2 Required (Emergency Substitute Part may be made from AN6226-9)
4. Body
5. Spring
6. Connector (Apply 420 inch-pounds Torque Maximum) and Lock Wire

TEST PROCEDURE			
TEST PRESS.	PORTS PLUGGED	MAX. LEAKAGE INTERNAL	MAX. LEAKAGE EXTERNAL
700 psi—Port A	Ports C and D	None at Port B	None
700 psi—Port B	Ports C and D	None at Port A	None

Douglas Drawing No. 4127548

Figure 298—Brake Emergency Air Shuttle Valve

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the shuttle valve refer to *figure 298.*

2. INSTALLATION.—To install the shuttle valve, reverse the REMOVAL procedure.

(6) TEST OF THE BRAKE EMERGENCY AIR SYSTEM.

(a) By means of a booster pump, a high pressure air pump, or a large air bottle, fill the brake emergency air bottle until the air pressure gage indicates 575 psi.

(b) With the foot brakes off, apply the brakes by placing the brake air control lever in the "ON" position. Keep the lever in the "ON" position for 15 minutes.

(c) After an initial pressure drop to 375 ± 25 psi the air pressure should remain constant.

(d) The wheels should be locked. Check them by attempting to roll the airplane forward or backward.

(e) After the initial pressure drop, any definite decrease from the constant pressure indicates an air leak in the system.

(f) If an air leak is present, locate it by applying a thin, neutral soap solution to all connections in the brake air system.

(g) Tighten any leaking connections, and test again with soap solution. If a connection still leaks air, replace it with a new connection.

(h) Relieve the air pressure on the brakes by placing the control lever in the "RELEASE" position. Air pressure in the emergency line will be exhausted to the atmosphere. Return the control lever to the "NEUTRAL" position and recharge the air bottle to 575 psi.

(i) The brakes now must be bled in accordance with the instructions in paragraph 14. *e.* (2) *(d),* this section.

b. TUBING AND FLEXIBLE HOSES.

(1) TUBING.—52SO aluminum alloy tubing is used throughout the hydraulic system in this airplane. AN-type end fittings are used on the hydraulic lines.

(a) REMOVAL OF LINES.—All hydraulic lines in the airplane may be removed by first relieving the system operating pressure and unscrewing the fittings at the ends of the lines. Attaching clips or clamps also must be removed. The ends of exposed lines must be capped to prevent dust and grit from entering the hydraulic fluid. Do not use rubber plugs to seal exposed lines. Rubber plugs may be shredded by the threads, and rubber particles will be circulated through the hydraulic system.

(b) INSTALLATION.—Before installation all lines and fittings should be blown out with clean, dry air. Apply thread lubricant sparingly. Great care must be observed in properly tightening the nuts. Over-tightening may completely cut off or severely damage the tube flare. The line will blow out if the nut is not tightened sufficiently. Carefully observe the wrench-torques given in Section VIII.

(c) FABRICATION.—Refer to Section VIII for general information on the fabrication of tubing.

(2) FLEXIBLE HOSES.—Approved, winterized, flexible hoses are installed on the movable parts in the hydraulic system.

CAUTION

Hydraulic actuating cylinders should not be handled by the hoses, or allowed to hang loosely from these hoses. Flexible hose should not be bent to a radius less than nine times its outside diameter. Do not install a flexible hose so that it is subjected to a twisting load. On all flexible hoses, there is a stripe running the entire length of the hose to determine any twisting after installation. A hose should not be stretched tightly between two fittings. About 5 to 8 percent of the total length of the hose must be allowed for slack to prevent the hose from being pulled out of the fittings when it is subjected to pressure. Hose must be protected against chafing, where necessary, by a suitable cover or boot.

i. CLIPS, CLAMPS, AND MISCELLANEOUS FITTINGS.

(1) CLIPS AND CLAMPS.—The hydraulic lines are held in place by clips and clamps which are placed at definite intervals to reduce line vibrations. The cushion clips and clamps are tightened sufficiently to hold the lines firmly. These line supports are bonded to the airplane in order that there shall be no vibrations and subsequent static electric charges generated that will interfere with the airplane's radio. These supports provide a vibration-absorbing cushion for the lines to eliminate fatigue and mechanical damage at the attachment point.

Note

It usually is desirable to slightly tighten the clips after a few hundred hours of service to compensate for initial displacement or cold flow of the cushioning material. When this service is not done, it is possible under adverse conditions for moisture to condense or otherwise reach the bonding material with attendant corrosive action and high resistance.

(2) MISCELLANEOUS FITTINGS.—Several types of multiple connectors are used in this airplane. Since these connectors have no moving parts, they require little maintenance except occasional tightening of unions or replacing of gaskets to prevent fluid leakage.

j. COMPLETE HYDRAULIC SYSTEM TEST.

(1) GENERAL.

(a) Support the airplane on wing and nose stands in flying attitude according to the instructions in Section III.

(b) With zero pressure in the hydraulic system, charge the pressure accumulator to 600-750 psi air pressure.

Note

When charging the accumulator with air, the air pressure should not indicate on the hydraulic system pressure gage. If pressure is indicated on the hydraulic pressure gage *(figure 247)*, relieve the hydraulic system pressure by applying toe pressure to and releasing the rudder-brake pedals.

(c) Fill the hydraulic reservoir *(figure 254)* with hydraulic fluid (Specification AN-VV-O-366). Use filler funnel. The hydraulic reservoir sight gage should indicate FULL according to the instruction plate on the reservoir.

(d) Connect a motor-driven hydraulic test stand pump to the firewall disconnect couplings at either the right or left nacelle firewalls. The test stand pump should deliver five gallons a minute at 1000 psi, in order to operate the hydraulic units at their correct speeds.

(e) Operate all hydraulic units repeatedly to their full extent until all air is driven from the hydraulic system. Operate units slowly to prevent overflowing of the reservoir by foamy oil. If necessary, refill the fluid reservoir according to the instruction plate on the reservoir.

(2) HYDRAULIC SYSTEM PRESSURE REGULATOR.—Check operation of the hydraulic fluid pressure regulator. The regulator should "cut-in" at 850 $\pm$ 20 psi and "cut-out" at 1000 $\pm$ 20 psi.

(3) HYDRAULIC SYSTEM PRESSURE CHECK.

(a) Check all fluid reservoir to engine-driven pump line connections individually for loose fittings.

(b) Place the landing gear control lever in the "DOWN" position. Place the bomb bay doors control in the "DOORS OPEN" position. Operate the hydraulic hand pump to raise the system pressure to 1100 psi. The system pressure should not drop below 1000 psi in five minutes.

(c) With ground safety pins installed on the main landing gear and nose gear, place the landing

gear control lever in the "UP" position. Place the bomb bay doors control in the "CLOSED" position. Operate the hydraulic hand pump to raise the system pressure to 1100 psi. The system pressure should not drop below 1000 psi in five minutes.

(4) LANDING GEAR.

(a) Adjust the main landing gear according to the instructions outlined in paragraph 5. *b.* (1) *(d)*, this section.

(b) Adjust the nacelle doors according to the instructions given in paragraph 5. *b.* (6) *(d)*, this section.

(c) Adjust the nose wheel and nose wheel doors according to the instructions in paragraph 5. *c.* (6) *(d)*, this section.

(d) Place the left and right battery switches *(figure 323)* "ON." Depress the retraction release switch *(figure 364)* on the left hand main landing gear shock strut. The solenoid plunger detent pin at the landing gear position selector valve should not permit movement of the position selector valve auxiliary handle to the "UP" position. With the landing gear latched down, and the landing gear position selector valve in the "DOWN" or the "NEUTRAL" position, the instrument panel indicator should show all three gears in the DOWN position.

(e) Retract the landing gear to the latched "UP" position. The landing gear should retract and lock in 12 seconds maximum. The nacelle doors should close completely and fair (fit flush) with the fuselage. There should be no interference. The landing gear and flap position indicator or indicator lamps should show all three gears in the "UP" position. A red lamp *(figure 232)* on the pilot's instrument panel should light when the throttle is "CLOSED."

(f) Place the landing gear control lever in the "DOWN" position. The landing gear should extend and lock in 12 seconds maximum. A green lamp on the pilot's instrument panel should light.

(g) External fluid leakage in the landing gear actuating cylinders should not exceed one drop in five pressure applications.

(h) The nose wheel shock strut and the main landing gear shock struts should be filled with hydraulic fluid and inflated with air in accordance with the instruction plate on the shock strut. Refer to paragraph 5. *c.* (3) *(c) 2. and 3.*, this section.

(i) The nose wheel snubber reservoir should be full of hydraulic fluid (Specification AN-VV-O-366) according to the instructions in paragraph 5. *c.* (5) *(e)*, this section.

(5) BOMB BAY DOORS.

(a) With the bomb racks empty, place the bomb bay doors control *(figure 247)* in the "DOORS OPEN" position. The bomb bay doors should open completely in four seconds maximum. A red lamp *(figure 232)* in the pilot's compartment should light. There should be no interference, and external fluid leakage of any cylinder should not exceed one drop in five pressure applications.

(b) Place the bomb bay doors control in the "DOORS CLOSED" position. The bomb bay doors should close completely in four seconds maximum. The red lamp in the pilot's compartment no longer should be lighted. There should be no interference or external leakage.

(c) With the bomb bay doors control lever (on some airplanes) in the "NEUTRAL" position, place the bomb bay door lock switch (on some airplanes) located in the forward end of the bomb bay in the "LOCKED" position. Check switch in the aft end of the bomb bay the same way. It should be impossible to move the bomb bay door selector valve in either direction. A red lamp on the switch panel should light when either of the lock switches is in the "LOCKED" position.

(6) WHEEL BRAKES (HYDRAULIC PRESSURE).

(a) Adjust the brakes in accordance with paragraph 5. *b.* (4) *(d)*, this section.

(b) Adjust the power brake control valves in accordance with the instructions given in paragraph 5. *e.* (2) *(d)*, this section.

(7) EMERGENCY HYDRAULIC SYSTEM. *(See figure 287.)*

(a) Place the emergency hydraulic system selector valve control handle and bomb bay doors control in the "BOMB DOORS OPEN" position. Operate the hydraulic hand pump to raise the pressure to 1100 psi. The bomb bay doors should open with approximately 60 strokes of the hydraulic hand pump. The pressure should not drop below 1000 psi in five minutes. There should be no interference or external fluid leaks.

(b) Place the emergency hydraulic system selector valve control handle and bomb bay doors control in the "BOMB DOORS CLOSED" position. Operate the hydraulic hand pump to raise the pressure to 1100 psi. The bomb bay doors should close with approximately 50 strokes with the hand pump. The pressure should not drop below 1000 psi in five minutes. There should be no interference or external fluid leaks.

(c) Place the emergency selector valve control handle in the "LANDING GEAR DOWN" position

and landing gear control lever in the "DOWN" position. Operate the hydraulic hand pump to raise the pressure to 1100 psi. The landing gear should extend with approximately 170 strokes with the hand pump, and the pressure should not drop below 1000 psi in five minutes. There should be no interference or external fluid leaks.

(8) WHEEL BRAKES (EMERGENCY AIR PRESSURE).

(a) With an initial air charge of 575 psi in the brake emergency air bottle, place the brake emergency air control lever in the "ON" position. The air pressure gage should indicate 375 ± 25 psi. There should be no external leakage of air.

(b) Place the emergency brake control lever in the "RELEASE" position. The air pressure on the brakes will exhaust to the atmosphere. There should be no external leakage of air. When the test is completed, return the brake emergency air control lever to "NEUTRAL" position.

(c) Bleed the brakes in accordance with instructions outlined in paragraph 14. *e.* (2) *(d) 1.*, this section. Recharge the brake emergency air bottle to 575 psi.

k. HYDRAULIC SYSTEM TROUBLE SHOOTING CHART.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Engine-driven pumps fail to deliver normal pressure.	*a.* Loose or faulty connections at the pumps.	*a.* Tighten loose connections or install new connections if necessary.
2. Engine-driven pumps fail to deliver fluid.	*a.* Loose or faulty connections at the pumps.	*a.* Tighten loose connections or install new connections if necessary.
	b. Incorrect direction of rotation.	*b.* Mount the pump correctly on the engine drive according to instructions outlined in paragraph 14. *b.* (2) *(d)*, this section.
	c. Pump drive shaft sheared by overloading.	*c.* Install new pump.
	d. Air lock in pump.	*d.* Bleed system.
3. Oil leakage at pressure accumulator cap.	*a.* Retainer insufficiently tightened.	*a.* Tighten retainer.
	b. Damaged bladder.	*b.* Install new bladder.
4. Line hammer.	*a.* Loss of air pressure in pressure accumulator.	*a.* Check for air leaks and damaged bladder.
	b. Low air pressure in accumulator.	*b.* Charge accumulator to correct pressure (600-750 psi) and check air valve for leakage.
	c. High air pressure in accumulator.	*c.* Bleed air valve to obtain correct pressure (600-750 psi).
5. Frequent loading and unloading of pressure regulator.	*a.* See 4. *a.* through *c.*, above.	*a.* See 4. *a.* through *c.*, above.
6. Sudden pressure drop when system is operated.	*a.* See 4. *a.* through *c.*, above.	*a.* See 4. *a.* through *c.*, above.
7. Loss of air pressure in pressure accumulator.	*a.* Leaks at accumulator air valve.	*a.* Install new air valve core, gasket, or both.
	b. Punctured or torn bladder.	*b.* Install new bladder in pressure accumulator.
8. Sluggish response of pressure accumulator.	*a.* Oil screen in accumulator clogged.	*a.* Clean the oil screen with a soft bristle brush.
9. Fluid leaks at packing nut of hydraulic hand pump.	*a.* Packing nut insufficiently tightened.	*a.* Tighten packing nut.
	b. Pump packing rings sheared during assembly, or packings are worn or deteriorated.	*b.* Install new packing rings with care.

k. HYDRAULIC SYSTEM TROUBLE SHOOTING CHART.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
10. Hydraulic hand pump fails to deliver pressure.	*a.* Piston head packings leaking because of shearing during assembly or deterioration and excessive wear.	*a.* Install new packings with care.
	b. Ball in piston head check valve does not seat properly.	*b.* Reseat the ball. If ball cannot be properly seated because of condition of seat and ball, lap seat with extra fine grinding compound. Install new ball.
11. Actuating cylinder operates sluggishly.	*a.* Internal fluid leaks because of worn piston sealing ring.	*a.* Install new sealing ring.
	b. Internal fluid leaks of shuttle valve.	*b.* Check cone in shuttle valve for proper seating. Replace cone or seats if damaged. and replace cone or seats.
12. Actuating cylinder leak at piston rod or at cylinder head joint.	*a.* Packing retaining nut insufficiently tightened.	*a.* Tighten packing retaining nut moderately.
	b. Packing rings worn or deteriorated.	*b.* Install new packing rings with care.
13. Emergency air brake handle applied, but brakes are not applied and air pressure is unchanged.	*a.* Mechanical failure in the cable system from pilot's emergency brake control handle to air control valve.	*a.* Inspect system for mechanical failure or maladjustment. Repair, replace, or readjust mechanical parts where necessary.
14. Emergency air brakes respond, but indicated air pressure continues to drop as long as brake handle is held in the "ON" position.	*a.* External fluid leaks in emergency air brake system.	*a.* Repair or replace parts and fittings where leakage occurs.
	b. Air leaks through the hydraulic system at the shuttle valves.	*b.* Inspect shuttle valves for proper seating of cone, and repair if necessary.
15. No pressure is indicated by the emergency brake air pressure gage.	*a.* No air pressure in the air bottle.	*a.* Charge bottle to 575 psi and observe air pressure gage for evidence of leaks in air control valve. If valve is leaking, remove, disassemble, and repair.

15. ELECTRICAL SYSTEM.

a. GENERAL DESCRIPTION.—The airplane electrical installation is a single wire, ground return system powered by two engine-driven generators connected in parallel with two storage batteries. One battery is installed in each nacelle. Primary distribution of power is made through an aluminum bus bar installed in the fuselage and the wing. Units and systems which are electrically controlled and operated include the engine starter, engine primer, cowl flaps, fuel booster pumps, carburetor air filter doors, oil dilution valves, oil cooler doors, remote indicating instruments, lamps, wing flaps, alighting gear position indicators and safety mechanisms, fuel-air mixture heaters, propeller anti-icer pump, de-icer distributor valve, propeller feathering pump, all-electric bomb release mechanisms, turrets, cannon and machine gun firing mechanisms, gun heating units, cameras, alarm bell, interphone, and radio. The interphone system and radio equipment are discussed in paragraph 16., COMMUNICATIONS, this section. The electrical installation also includes wiring provisions for the installation of a bombardier nose. The various electrical circuits on the airplane are illustrated in simplified form in *figures 431-487*. For detailed wiring diagrams refer to the INDIVIDUAL ELECTRICAL CIRCUIT DIAGRAM BOOK supplied with the airplane.

Note

The ignition system is discussed in paragraph 8., this section.

b. SOURCES OF POWER.

(1) BATTERY SYSTEM.

(a) GENERAL.—The battery system consists of two 24-volt batteries connected in parallel, each controlled by a battery disconnect relay. Each battery is equipped with an individual forced air vent system to carry battery fumes from the airplane and a battery "ON-OFF" switch located in the pilot's compartment. Each battery switch closes the individual battery circuit through the disconnect relay. Included also in each battery circuit are external power receptacle provisions for the attachment of power from a battery cart when the airplane is on the ground. The battery circuit is provided with a disconnect plug at each forward wing disconnect location and is attached to three bus bars: the upper electrical control bus bar, the left-hand wing main bus bar, and the two battery cart bus bars. For a simplified wiring diagram of the battery system, refer to *figure 433*.

(b) BATTERY.
(See figure 299.)

1. DESCRIPTION. — The two 24-volt, 34 ampere-hour storage batteries installed in this airplane are located in each nacelle, forward of the fuel container and outboard of the oil container. The batteries are mounted on retractable racks which allow stowage of the batteries in the top of the nacelles, but permit them to be lowered into a convenient position for servicing. Each battery rack rides on two vertical rails secured to the bulkhead immediately forward of the fuel container. The racks may be locked in either the upper or lower position on the rails by means of two spring loaded pins beneath the rack. A bungee shock cord is secured to the bulkhead and the rack to carry some of the battery weight when it is being lowered or raised. The battery is connected to the generator disconnect relay by a bus bar and grounded by means of a special stud attached to the nacelle structure outboard of each battery. The batteries are vented by means of an air inlet on the outboard side of each battery. Air passes through the battery and exhausts to the outside of the airplane. A drain trap which contains a neutralizing agent is provided in the vent system to retain and neutralize any electrolyte that may overflow from the batteries.

2. REMOVAL.

a. The battery switch on the pilot's overhead electrical control panel should be "OFF" before lowering or removing the battery.

b. The batteries may be easily lowered as follows into a convenient position for servicing:

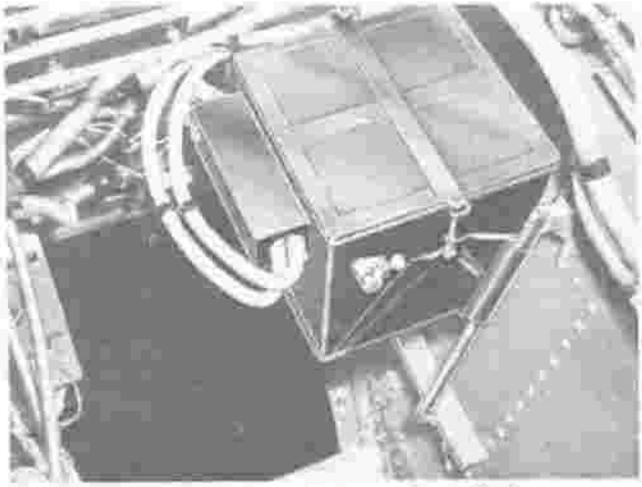


Figure 299 — Battery Installed

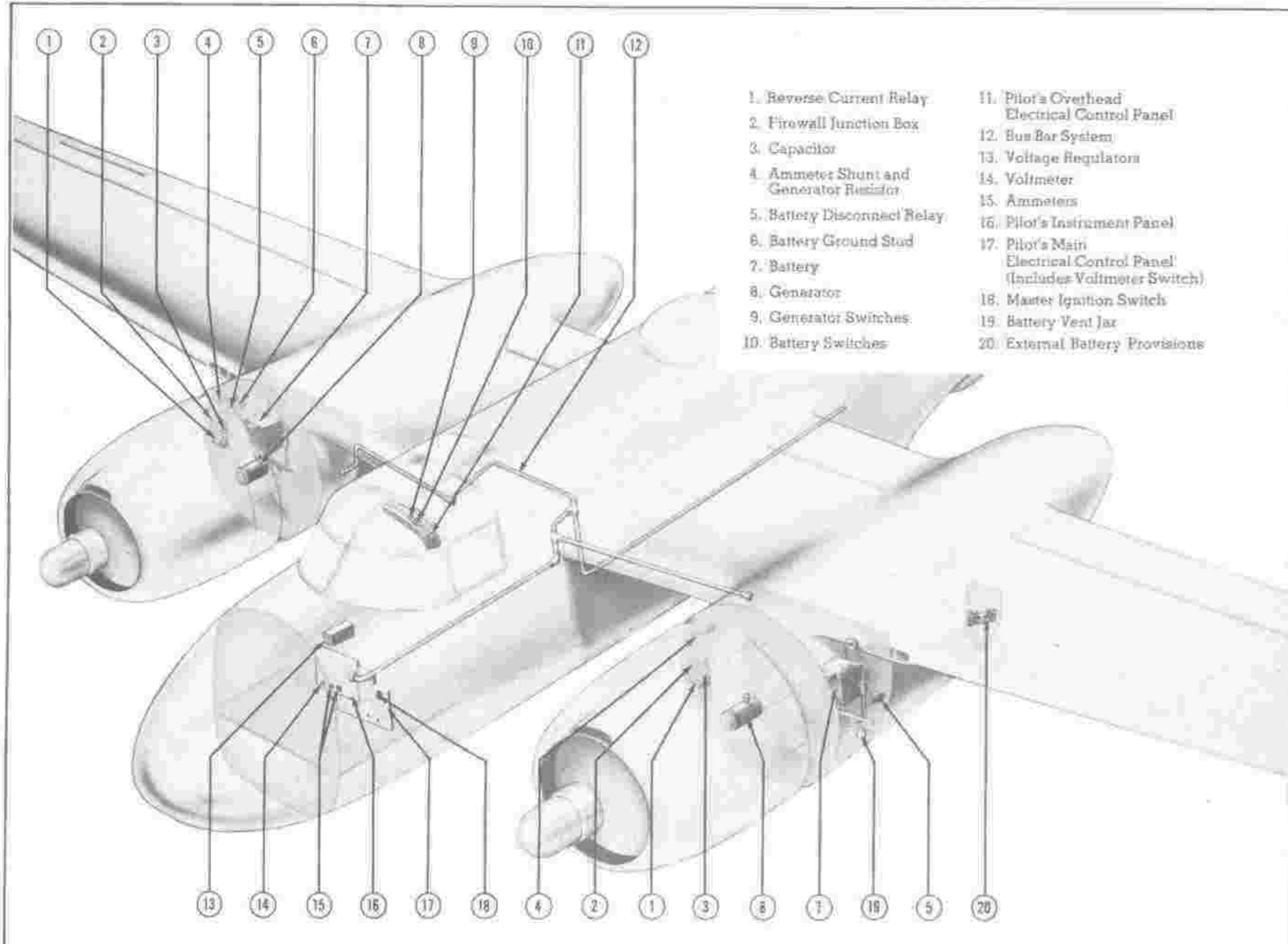


Figure 300 — Power System — Electrical

(1) Remove the nacelle inboard access door and the nacelle outboard access door, both of which are located just aft of the firewall in the lower part of the nacelle. These doors are removed by detaching the fasteners which secure them.

(2) Allow the battery to slide down on the support rails by releasing the pins which hold it in the upper position. To do this, grasp the two handles of the pins with one hand and squeeze them together until the pins are pulled from the upper locking holes in the support rails. This allows the battery, the descent of which is retarded by a bungee cord attached to the wall of the nacelle, to be lowered until the pins catch in the lower locking holes of the support rails.

c. With the battery in the lowered position, it may be removed from the airplane as follows:

Note

Be sure the battery switch in the pilot's compartment is "OFF."

(1) Remove the terminal box cover from the front of the battery by removing the two wing bolts which secure it.

(2) Disconnect the two battery leads.

(3) Disconnect the vent tubes from each side of the battery by loosening the clamps and slipping the tubes from the battery vent plugs.

(4) Loosen the two wing nuts that bear against the holddown strap on the top of the battery, and push the bolts from the slots in the strap.

(5) Lift the battery carefully from the rack.

WARNING

Before lifting the battery from the rack, make sure that both locking pins are secured in the lower latching holes of the support rails. When the battery is lifted from the rack, the bungee cord may snap the rack up, injuring the operator if this caution is not observed.

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the battery terminals are corroded, remove the corrosion by brushing the affected areas thoroughly with a wire brush and then applying to the terminals a neutralizing solution of baking soda and water. When the bubbling has stopped, wash the solution off with water. Always keep vent caps in place during cleaning, after which they should be examined to make sure the gas escapes holes are clear.

Note

When airplane is to be idle for more than one week, remove the battery and turn it in to battery room for storage where it will be kept fully charged.

4. TEST BEFORE INSTALLATION.

a. Check specific gravity of each cell with a hydrometer Fed. Spec. GG-H-941, returning the electrolyte to the cell from which it was removed. Remove the battery from the airplane if the specific gravity is below 1.240 or above 1.310.

b. Check level of electrolyte in battery cell. The electrolyte level must not be allowed to get below the top of the plates. If it is necessary to add water to the battery, use clean drinkable water or distilled water as follows:

(1) Fill the self-leveling syringe (in the type D-1 battery servicing kit) with water and insert it into the cell.

(2) Hold the syringe in a vertical position regardless of level of battery and fill the cell.

(3) Withdraw excess water back into the syringe until air is sucked in through hole in syringe tip. This will leave the electrolyte at the proper level.

CAUTION

Do not add water to higher than 3/8 inch above the protector as too much water above the protector will cause the electrolyte to leak out the vents when the airplane is in operation.

5. INSTALLATION.—Reverse the procedure described in REMOVAL, above. Refer to battery system wiring diagram for correct attachment of terminals.

Individual ELECTRICAL CIRCUIT WIRING DIAGRAM BOOK supplied with the airplane for correct attachment of terminals. Also see *figure 316,* in this section.

Note

Place the lead terminal on the battery terminal first; then the lock washer, the plain washer, and the wing nut—in that order. Replace any corroded washers.

(c) BATTERY DISCONNECT RELAY.
(See 5, figure 300.)

1. DESCRIPTION.—One type B-4 battery disconnect relay is secured to the outboard wall of each nacelle aft of the firewall and adjacent to the battery. The relay is designed to provide a means of remotely controlling each battery circuit by the operation of the battery switches in the pilot's compartment. The relay consists of a holding coil which, when opened or closed by operation of the battery switch, causes the opening or closing of the main contacts connecting the battery circuit to the airplane bus bar.

2. REMOVAL.

a. Slide the rubber contact covers over the terminals onto the heavy leads.

b. Disconnect the leads.

c. Remove the screws holding the relay to the nacelle stringer and remove the relay.

3. MAINTENANCE REPAIR OR REPLACEMENT.—When properly installed and operated, this relay should require little or no attention between overhaul periods.

a. In the event that the circuit controlled by this relay becomes inoperative, connect a heavy jumper cable across the two heavy contact studs to determine whether or not the switch is at fault. If this is the case, replace the unit.

b. No lubrication is required at any time.

4. ADJUSTMENT FOR USE AFTER STORAGE.—Prior to installing the unit after removal from storage, the relay should be given the following test: With the switch in a horizontal position, connect the coil terminals to a variable d-c supply. Connect a 0-50 scale voltmeter across the coil terminals. A test lamp should be connected across the heavy switch terminals to indicate the closing of the switch. The voltmeter reading, when the switch closes, must be 18 volts or less at room temperature. After the switch has been tested for closing voltage, gradually reduce the voltage from this closing voltage and note voltage at which switch opens. This voltage must not be more than 7 volts. If none of these values can be obtained, replace the relay.

5. INSTALLATION.—Reverse the REMOVAL procedure.

6. TEST AFTER INSTALLATION.—After installing a new battery disconnect relay and before each flight, the relays should be checked as follows: Turn one battery switch "ON" and note deflection on cockpit electrical instruments. Turn the battery switch "OFF" and note if the instruments return to the normally "OFF" position. Apply this test to the other battery switch. If the instruments do not show that the battery is properly connected and disconnected, the relay should be removed and checked.

(d) BATTERY SWITCH.

1. DESCRIPTION. — Two type B-5A "ON-OFF" battery switches, one for each battery, are mounted in the pilot's overhead electrical control panel (*figure 323*). The battery switch circuit is grounded by connection to a ground stud on the fire control panel.

2. REMOVAL.

a. Disconnect the two wires at the back of the switch.

b. Remove the two screws holding the switch to the panel.

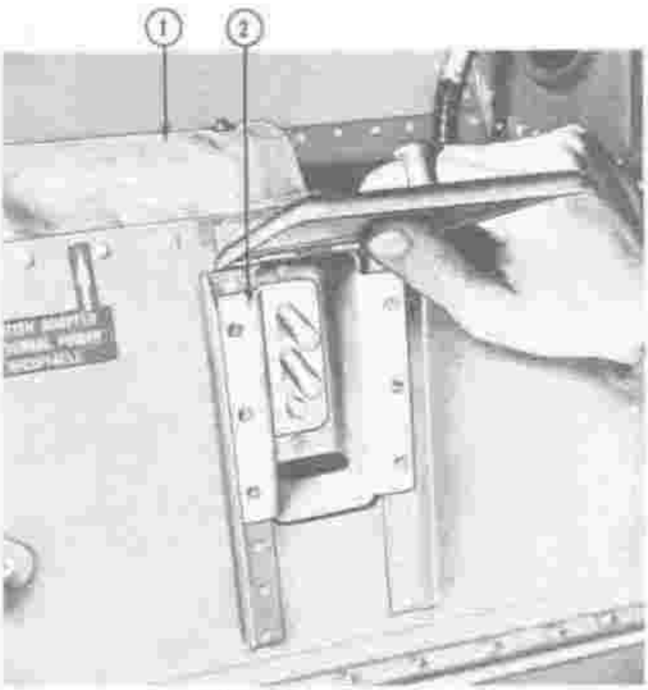
c. Lift the switch from the panel.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement rather than repair will be necessary, except for tightening any loose connections.

4. INSTALLATION.—Reverse procedure as described in REMOVAL, above.

(e) EXTERNAL POWER RECEPTACLE PROVISIONS. (*See figure 301.*)

1. DESCRIPTION.—The provisions for power from a battery cart to the regular battery circuit while the airplane is on the ground consist of the following: A ground power receptacle in a metal box; a type B-4 battery disconnect relay, such as is used in the regular battery system; and a British adapter held in a cloth case. All three of these units are mounted side by side on a panel on the outboard side of the left-hand nacelle wheel well. The battery disconnect relay is connected to the ground power receptacle by a small bus bar. The ground power receptacle is connected by another small bus bar to a ground stud.



1. British Adapter
2. Ground Power Receptacle

Figure 301 — External Power Provisions

The British adapter is available to be placed on the AAF type receptacle when needed by the service personnel.

Note

Do not exceed 28.5 volts when using an external power supply in order to reduce the possibility of damage to radio or the other electrical equipment caused by excessive voltages. When using an external power supply, be sure the battery switches in the pilot's compartment are "OFF."

2. REMOVAL.

a. GROUND POWER RECEPTACLE.

(1) Disconnect the bus bar attached to one of the terminals; disconnect the leads from the other terminals.

(2) Remove the four screws and nuts holding the receptacle box to the panel and the receptacle to the box.

(3) Remove the receptacle.

b. BATTERY DISCONNECT RELAY.

(1) Disconnect the bus bar attached to one of the terminals.

(2) Slide the rubber contact covers over the terminals onto the two heavy leads.

(3) Disconnect the leads.

(4) Remove the two bolts holding the relay to the panel and remove the relay.

c. ADAPTER.—The British adapter may be removed by pulling from case and untying knots in the rawhide holding the adapter to the panel.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. GROUND POWER RECEPTACLE.—Replacement, rather than repair, will be necessary.

b. BATTERY DISCONNECT RELAY.—Refer to paragraph 15. *b.* (1) *(c)*, this section.

c. ADAPTER.—Replacement, rather than repair, will be necessary.

4. ADJUSTMENTS.—BATTERY DISCONNECT RELAY.—Refer to paragraph 15. *b.* (1) *(c) 4.*, ADJUSTMENT FOR USE AFTER STORAGE, this section.

5. INSTALLATION.—Reverse the REMOVAL procedure.

6. TEST AFTER INSTALLATION.—After installing a new battery disconnect relay and before each flight, the relay should be checked by plugging in a battery cart and noting instruments deflection. Disconnect the battery cart and note if the instruments return to the normally "OFF" position. If the instruments do not show that the battery cart is properly connected and disconnected, the battery disconnect relay is not operating properly or the polarity of the battery cart is reversed.

(f) BATTERY VENT SYSTEM.

1. DESCRIPTION.—The battery vent system consists of vent lines and a one pint glass jar containing moistened sodium bicarbonate. A line carrying air under pressure comes from the intake ducts of the oil cooler system and enters the inboard side of each battery. The glass jar is attached to the battery rack on the outboard side, with a line leading to it from the battery and a line from it joining the oil overflow line near the bottom of the nacelle. Air is forced through the battery and into the jar which contains felt pads saturated with a solution of sodium bicarbonate (baking soda) to neutralize the acid fumes picked up in the battery. The neutralized fumes are ejected from the jar into the oil overflow line and to the outside of the airplane.

Figure 302 — Battery Vent Jar

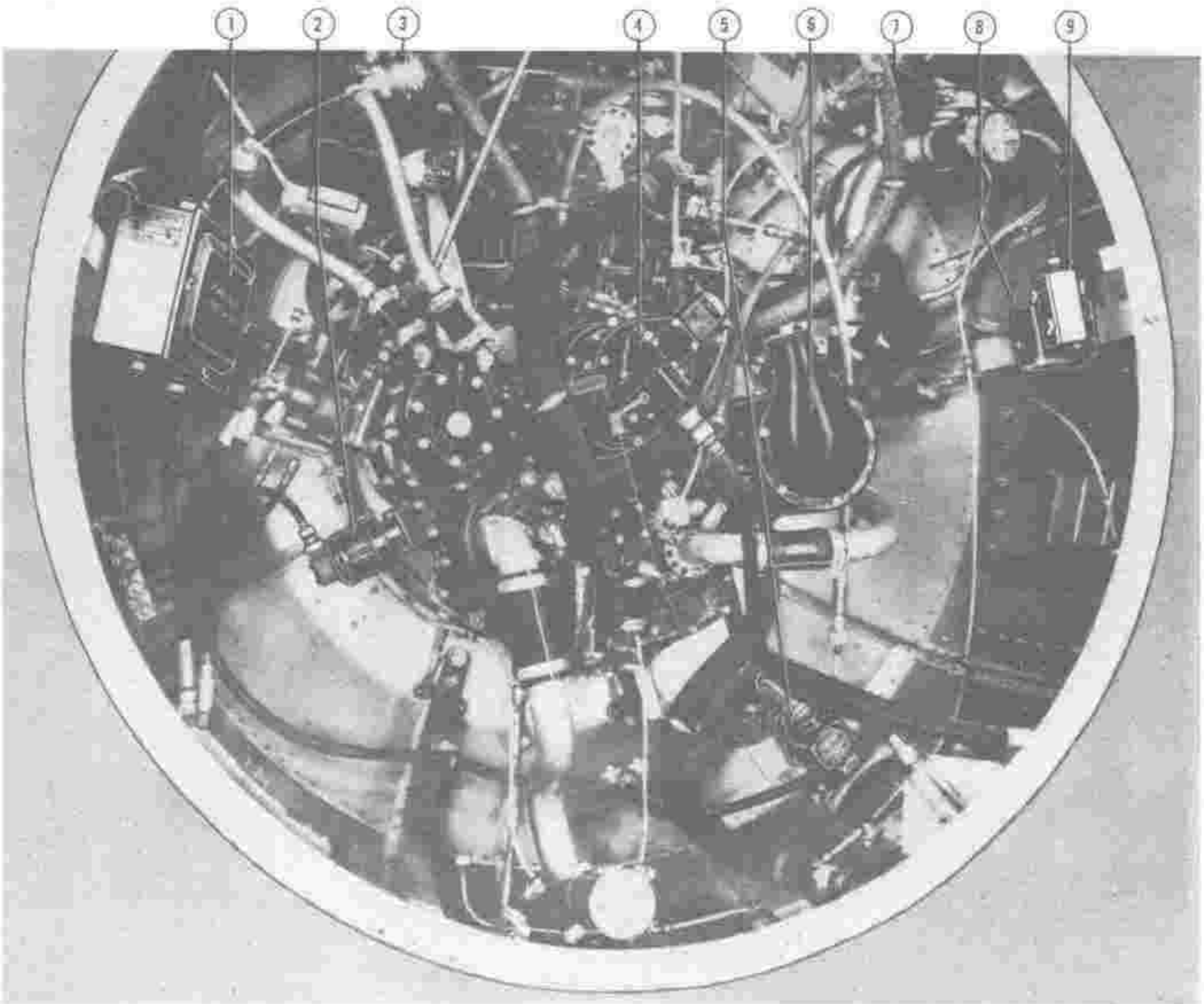
2. REMOVAL.—Any of the hose sections may be removed by loosening the clamps at the ends of each section and pulling the hose from the metal fitting. The jar may be removed by pulling on the metal latch clip that holds together the two halves of the wire retainer band and then unscrewing the cap from the jar.

3. MAINTENANCE REPAIR OR REPLACEMENT. – Replacement, rather than repair, will be necessary.

4. INSTALLATION. – Reverse REMOVAL procedure.

(2) GENERATOR SYSTEM.
(See figure 300.)

(a) GENERAL.–The generator system is the source of power for operating the electrical equipment on the airplane and for charging the two 24-volt storage batteries. The two generators in the system are connected in parallel, directly driven by the airplane engines and controlled by the two generator switches in the pilot's compartment. Each generator circuit includes a voltage regulator and a reverse current relay. The voltage regulators are used to maintain a constant voltage output of the generator and in equalizing the generator load of the two generators. A generator resistor is incorporated in the system to



1. Power Plant Junction Box
2. Tachometer Generator
3. Junction Box Receptacle
4. Starter
5. Cowl Flap Motor
6. Generator
7. Oil Dilution Solenoids
8. Induction Vibrator
9. Radio Noise Filter

Figure 303—Power Plant Electrical
View Looking Forward from Firewall

achieve the voltage drop necessary for the voltage regulator operation. The reverse current relay operates to close the main line circuit at a given generator voltage and to open the circuit at a given reverse current (when the battery voltage exceeds approximately 26 volts), thus preventing the battery from burning out the generator. A capacitor is wired through the switch relay to eliminate interference to radios. Adjustment of the voltage regulators and current control switch relays must be made by qualified personnel only. Two ammeters and one voltmeter are installed in the pilot's compartment to measure the current and the voltage in the circuit. A 200 ampere circuit breaker is included in the wire from the generator to the "GEN" terminal of the reverse current relay and is installed in the firewall junction box. Wires from the generators are connected through terminal posts in each firewall junction box. The system is provided with two major disconnect plugs: the voltage regulator disconnect plug and the plug at the aft wing disconnect location. For the wiring diagram of the generator system, refer to *figure 431*.

(b) GENERATORS.
(See figure 303.)

1. DESCRIPTION.—The two Type P-1, 200 ampere, 28.5 volt generators are bolted to the generator drive pads on the accessory case of each engine. When used with the voltage regulators, the generators will operate at required capacity for an engine speed range of from 2500 to 4500 rpm. Direction of rotation is left-hand (counterclockwise), facing the shaft extension. The generator is of compound wound design and connected in parallel with the generator of the other engine. It is provided with forced ventilation from a two-inch, duct leading from the oil cooler nose to an air connector covering the commutator end of the generator. A special resilient coupling inside the mounting flange reduces rotational shocks on both the engine and the generator.

2. REMOVAL.

a. Unscrew the shield coupling at the plug and remove the plug from the receptacle.

b. Disconnect the cooling duct at the air connector on the commutator (aft) end of the generator.

c. Remove the mounting bolts securing the generator to the engine.

d. Remove the generator by sliding it aft until the splined generator drive shaft is clear of the engine drive fitting.

CAUTION

Support the generator when removing it; do not allow the weight of the generator to bear on the drive shaft, thus bending it.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. FLASHING THE GENERATOR FIELD. —If the generator fails to build up voltage, it may be caused by reversed magnetism or loss of residual magnetism. In either case, the generator field should be flashed as follows:

(1) Turn both generator switches "OFF," run the engines at 1800 rpm.

(2) Remove the voltage regulator (of the generator to be flashed) from the mounting base.

(3) Take a wire No. 18 or larger and connect one end to any positive battery source.

(4) Take the other end of the wire and momentarily touch the NUT of the "A" terminal of the voltage regulator.

CAUTION

Do not touch the threads of the voltage regulator terminal as they will be damaged by arcing.

b. REPLACEMENT OF BRUSHES.—If the generator brushes are worn, they should be replaced.

(1) The carbon brushes may be removed from the rocker-ring assembly (on the commutator end of the generator) by merely lifting the springs and removing the screws fastening the shunt to the brush-holder.

(2) Replace with new brush.

Note

Never pull the brush out by the brush pigtail (wire screwed into the brush). A simple hook made of a bent wire to remove spring pressure will facilitate the removal and replacement of brushes.

(3) New brushes should be seated as described in the following paragraphs.

c. SEATING THE BRUSHES. — Remove the cover band and use one of the following methods:

(1) METHOD A. — Hold an abrasive stone against the commutator during rotation for several seconds. The stone will disintegrate and carry the powder under the brushes, consequently seating them. The dust should then be blow out of the generator with compressed air.

(2) METHOD B.—Wrap a strip of No. 000 sandpaper around the commutator, sanded side out. Make sure that the sandpaper conforms to the contour of the commutator and that the brushes press firmly on the sandpaper; then pull the sandpaper in the direction of armature rotation.

d. SMOOTHING THE COMMUTATOR.

(1) If the commutator is rough, slightly burned, glazed, or corroded, smooth it by holding a piece of No. 000 sandpaper against it while the generator is operated.

(2) Move the sandpaper back and forth along the length of the commutator to avoid excessive sanding in any one place.

(3) Blow all dust from the generator with dry compressed air.

Note

If the commutator is very rough, it will be necessary to remove the generator and turn the commutator down.

e. LUBRICATION.—No lubrication of the generator is required between overhaul periods. If oil is noted in the generator, the latter must be removed and the engine oil seal checked for leakage.

4. ASSEMBLY AND INSTALLATION.—Reverse the procedure as described in paragraph *2.* REMOVAL, above. Be sure that all nuts are tightened and cotter keyed. If a stud type connection is used, be sure that all leads are covered by insulating tubing and separated from each other.

5. FINAL TEST AFTER INSTALLATION.

a. Start the engines (generator switches "ON") and run at 2500 rpm. If the generator does not build up a 28 volt reading on voltmeter or indicate the correct polarity (voltmeter attempts to read backwards), flash the generator field as described in a., above. If the generator will not build up properly after being flashed, check the resistance between the "A" terminal of the generator and any ground with an ohmmeter. If the resistance is much more than two ohms, the generator must be checked for oil or corrosion on the commutator, corroded connector plug, improperly seated or binding brushes, or weak spring tension on brushes.

b. Take both ammeter readings. If there is more than 10 amperes difference between the two readings, parallel the voltage regulators as described in paragraph 15. *b.* (2) *(c)* *4.* b., this section.

(c) VOLTAGE REGULATORS.

1. DESCRIPTION.—Two generator voltage regulators, one for each generator, are mounted together on the floor of the pilot's compartment next to the right-hand outboard wall. They are covered by shields slotted for ventilation. The regulators control the generator voltage by varying the resistance in the field circuit of the generators and balance the loads of the two generators by means of the paralleling (equalizing) coil in each regulator. If only one generator is

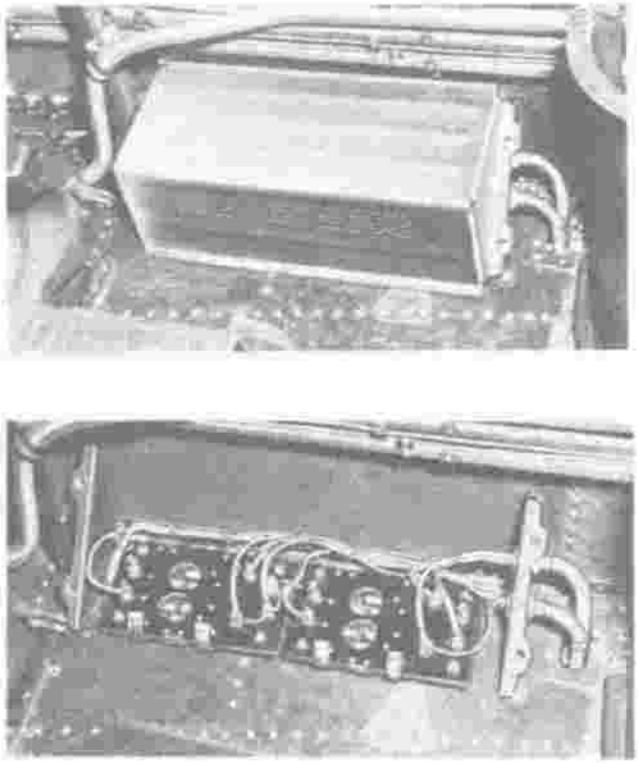


Figure 304 — Voltage Regulator Mounting and Shield

operated, the paralleling coils are protected as both generator switches must be "ON" before the paralleling coils of the regulators are connected.

2. REMOVAL.

a. Remove the shield assembly covering the regulators by releasing the stud fasteners on each end.

b. Lift the two spring clips which hold the regulator to the base.

c. Tilt the regulator forward and lift it from the base.

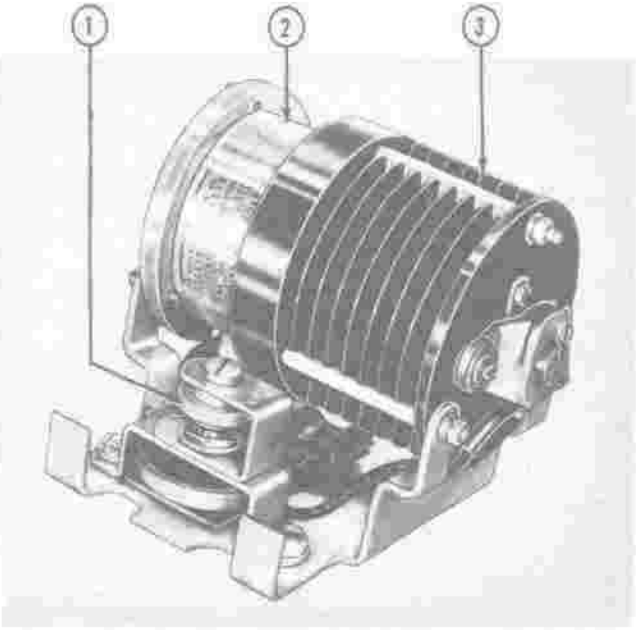
3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Check for burned contact fingers (reeds). If such is found, replace the regulator.

b. No oil or grease should be used on any part of the regulator.

c. Internal disassembly and repair will be accomplished at service depots.

d. Whenever a voltage regulator is replaced, the new regulator must be adjusted for proper voltage and for paralleling as described in paragraph *4.* ADJUSTMENTS, following.



1. Adjusting Knob
2. Solenoid Case
3. Carbon Pile Housing

Figure 305 — Carbon Pile Voltage Regulator

CAUTION

Always use both regulators of the same make and type on one airplane. If one regulator is removed, replace with the same make and type as the other regulator.

4. ADJUSTMENTS.—Voltage regulator adjustment and paralleling is done preferably during flight in order to prevent overheating of the engines and to adjust during regular flight conditions. If the adjustments are made on the ground, the cylinder head temperature indicators must be watched carefully to prevent the engines from overheating. If the critical ground operating temperature of 232°C (450°F) is reached, the engines must be shut down and allowed to cool.

Note

Any adjustments of the voltage regulators must be made by qualified personnel only.

a. ADJUSTMENT OF VOLTAGE REGULATORS FOR PROPER VOLTAGE.

(1) With both generator switches "OFF," start both engines and warm them up as described in AN 01-40AJ-1 (FLIGHT OPERATION INSTRUCTIONS.)

(2) Run the engine at 1500 rpm until the voltage regulators are hot (approximately 15 minutes).

(3) Increase the speed of the engine whose voltage regulator is being tested to 1800 rpm; idle the other engine at 1000 rpm.

(4) Using a precision voltmeter, connect the negative terminal of the voltmeter to any convenient ground and connect the positive terminal of the voltmeter to the "B" terminal of the voltage regulator base.

(5) The voltmeter should give a reading of 28 volts; correct voltage by turning adjusting knob. Turn the knob clockwise to increase, counterclockwise to decrease.

(6) Reduce the engine speed to 1000 rpm and repeat the operation for the other voltage regulator. Adjust both regulators to 28 volts.

b. ADJUSTMENT OF VOLTAGE REGULATORS FOR PARALLELING.

(1) With the engines running and the voltage regulators hot, turn the generator switches "ON."

(2) Turn on enough electrical equipment to total from 50 to 100 amperes on both ammeters.

(3) Increase the speed of both engines to 1800 rpm and note the ammeter reading for each generator. If not more than 10 amperes difference is noted in the ammeter readings, no further regulator adjustment will be made.

(4) If the generators are out of parallel by more than 10 amperes, turn the adjusting knob of the voltage regulator corresponding to the ammeter with the highest reading *one notch* in a counterclockwise direction to decrease generator output. Recheck the ammeters. If the same ammeter is still higher than the other, turn the adjusting knob of the same voltage regulator one more notch counterclockwise.

Note

Decreasing the output of one generator will increase the output of the other generator. By adjusting one voltage regulator, it is possible to bring the two generators into almost perfect equalization.

(5) Take a voltmeter reading at any convenient point in the main bus bar system. The bus bar between the two starter switches on the over head control panel may be used. This reading must be between 28 and 28.5 volts.

(6) If the system voltage is not between 28 and 28.5 volts, turn adjusting knobs of both voltage regulators one notch in direction necessary to correct system voltage (counterclockwise to decrease, clockwise to increase).

5. INSTALLATION.

a. Check the condition of the mounting base contact fingers by pressing on them, before installing the voltage regulators. If they are weak or broken, replace contact finger or mounting base.

b. Place the clips on the bottom of the regulator in the slotted brackets on the base. Then, while holding the regulator up with the left hand, place the thumb of the right hand on the NUT WHICH SECURES THE NAME PLATE AT THE TOP FRONT OF THE REGULATOR and place the fingers beneath the base. Squeeze with the hand until the spring clip on the base falls into the catch on the regulator. There are two clips so the operation must be repeated at the other end of the regulator.

c. Secure the left-hand clip first, and the installation will be easier.

d. Be sure that the spring clips have settled all the way into the trough of the catch.

CAUTION

When installing the G. E. regulator, do not press on the name plate for this will bend and damage the resistor housing. Press on the nuts at either end of the name plate.

e. Install the other regulator in the same manner.

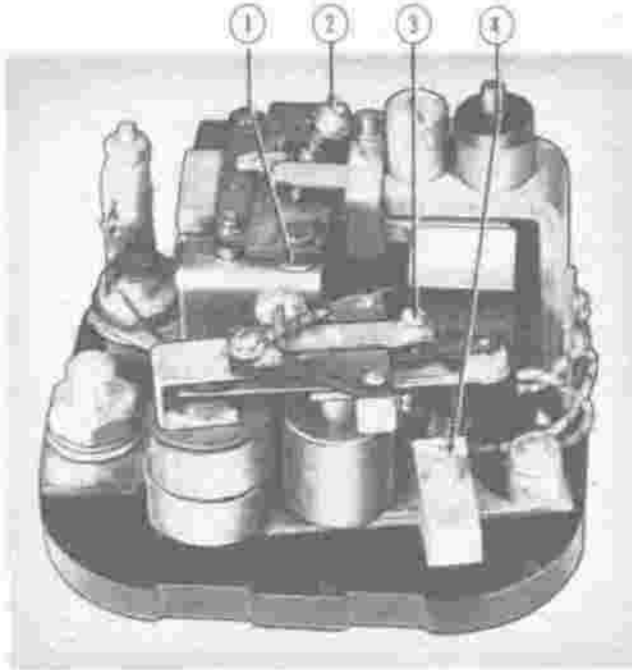
f. Install the shield assembly over the regulators and fasten the four studs.

Note

Always use two voltage regulators of one type and make on one airplane.

(d) REVERSE CURRENT RELAY.

1. DESCRIPTION.—A generator current control switch relay is fastened to the bottom of each firewall junction box *(figure 332)*. The terminals of the relay are connected as follows: "GEN."—to the generator and voltage regulator; "NEG."—to a ground stud in the firewall junction box and through a coil to the "SW." terminal; "SW." to the generator switch; "BAT."—to ground through the capacitor and to the main bus bar. The relay operates to connect the generator to the main bus bar when the generator voltage reaches 26 or 27 volts, and to disconnect it from the main bus bar when a minimum of 4 and a maximum of 16 amperes reverse current flows from the battery to the generator. That is, if the generator voltage becomes lower than that of the battery, the relay will open to prevent the battery from supplying power to the generator and burning out the generator.



1. Main Contactor
2. Spring Adjustment Screw
3. Reverse Current Adjustment Screw
4. Cut-in Adjustment Screw

Figure 306 — General Electric Reverse Current Relay

2. REMOVAL.

a. Remove the firewall junction box cover by releasing the four fasteners.

b. With the main battery switch "OFF," disconnect the wires from the "GEN.," "BAT.," "SW.," and "NEG." terminals at the relay.

c. Remove the screws at the base of the relay and lift it from the junction box.

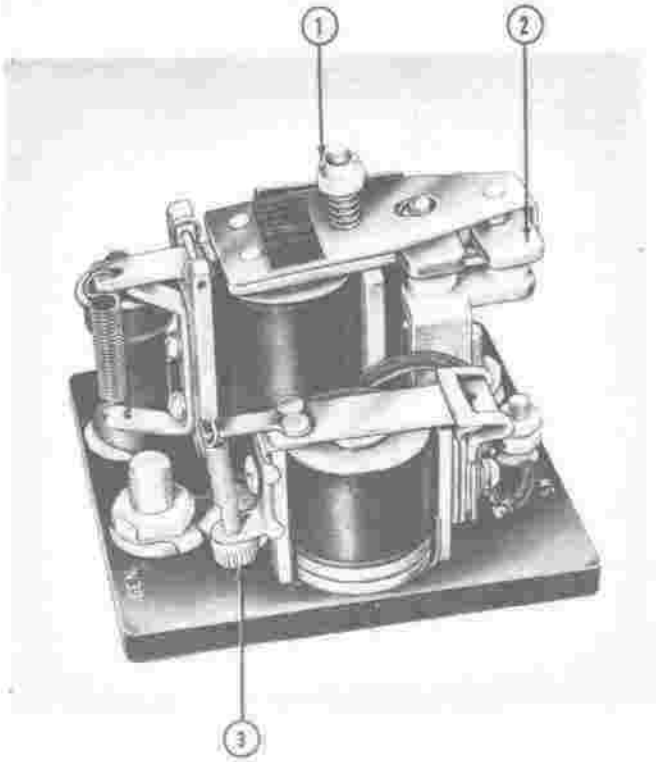
3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Internal disassembly and repair will be accomplished at service depots.

b. Whenever a reverse current relay is replaced by a new or reconditioned unit, the new relay unit must be adjusted for correct closing voltage as described in paragraph *4*, ADJUSTMENTS, following.

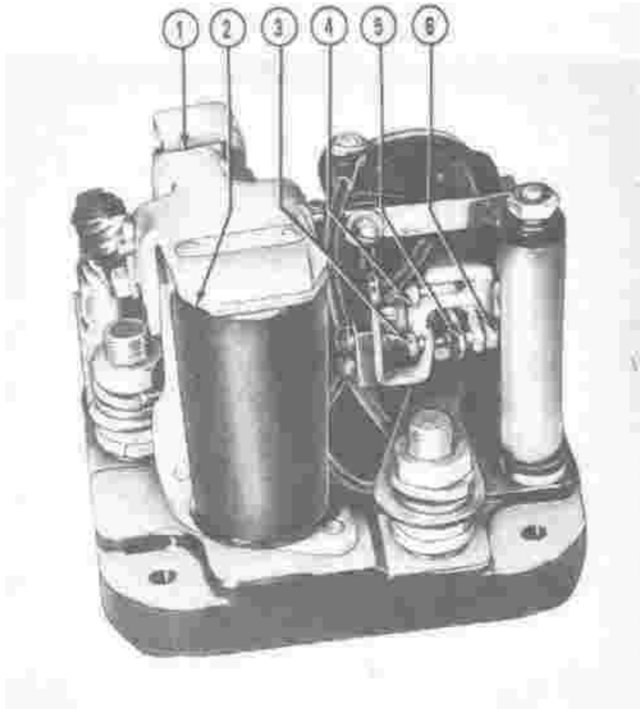
c. Use no lubrication of any kind on either the bearings or the contacts.

4. ADJUSTMENTS.—After both voltage regulators have been completely adjusted as in paragraph 15. *b.* (2) *(c) 4.*, this section, adjust the current control switch relay as follows:



1. Reverse Current Adjustment Nut
2. Main Contactor Contacts
3. Voltage Adjustment Screw

Figure 307 — Leece-Neville Reverse Current Relay



1. Main Contactor Contacts
2. Magnetic Contactor
3. Contact Screw
4. Armature Spring Adjusting Screw
5. Relay Contacts
6. Stop Screw

Figure 308 — Westinghouse Reverse Current Relay

WARNING

Never close the reverse current relay manually by pressing the contacts together, as serious damage to the relay, the electrical system, and to the personnel may result.

a. Connect the positive terminal of a portable precision voltmeter to the "GEN." terminal of the reverse current relay and ground the negative terminal to the airplane structure.

b. Connect a low-reading ammeter in the line between the generator and the "GEN." terminal of the reverse current relay.

c. If the test is being made in place on the airplane, be sure to disconnect all heavy loads so as not to damage the ammeter.

Note

The relay has been calibrated, under conditions corresponding to service, to close contacts at 26 to 27 volts. A bench test of the relay, without vibration, may show a setting as much as 1.0 volt higher.

d. Turn on the generator switch and gradually raise the generator speed.

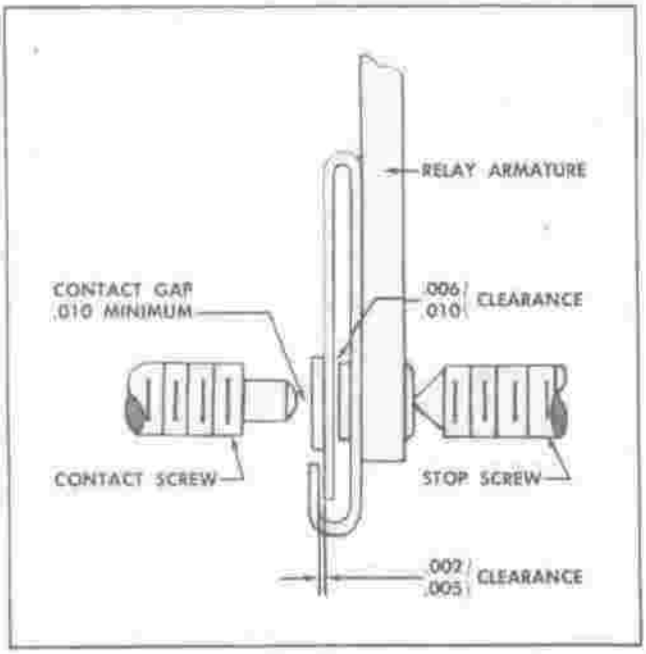


Figure 309—Reverse Current Relay Contact Adjustment

e. Read voltage at which the main contactor *(figure 309)* closes. This voltage is ideally 26.6 volts, but may be permitted to vary between 26 and 27 volts.

Note

There will be a voltage drop just after the contact closes. The highest voltage observed before the contacts close is to be considered the closing voltage.

f. If the closing voltage is less than 26 volts or more than 27 volts, adjust the stop screw *(figure 309)*. Screwing this inward lowers the voltage at which the contact will close.

g. Lower the generator speed and read the reverse-current when the relay contact opens. This should not be over 16 amperes at 25 to 26 volts.

h. If the reverse-current when the relay contact opens is more than 16 or less than 4 amperes, adjust the hex-head contact screw *(figure 309)*. Screwing this inward lowers the reverse-current setting.

i. After these adjustments are made, check the gap between the relay contacts. This must be at least .010 inch. In addition there must be a clearance of .006 to .010 inch inside the U-shaped contact spring, allowing that much contact wipe before it goes solid.

j. If the contact gap is less than .010 inch, back out the stop screw a quarter turn and weaken the spring adjustment *(figure 309)* to compensate and obtain the same voltage setting. Raise the voltage slowly while watching the relay contact. It must move briskly when the correct closing voltage is reached and not drift or hesitate. If the latter condition exists, there is excessive friction or else the adjustment of the armature spring adjusting screw *(figure 309)* is too far toward the right.

k. Repeat procedure for reverse-current relay in the other firewall junction box.

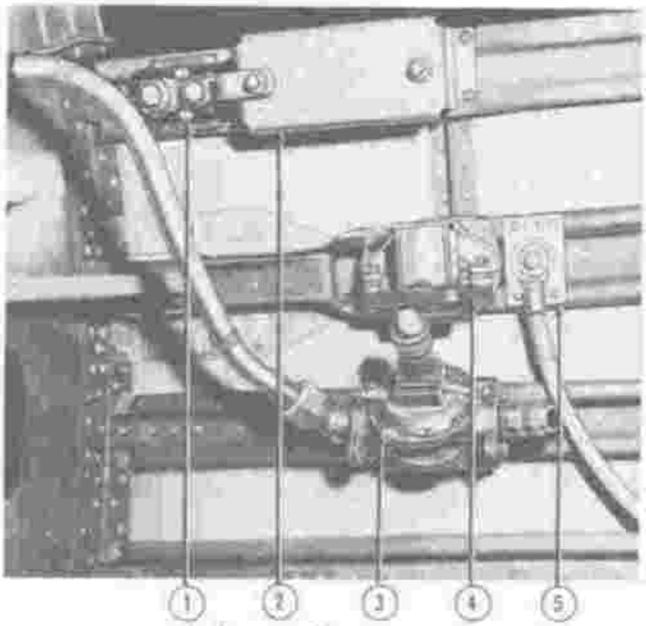
5. INSTALLATION.—Reverse procedure described in *2.* REMOVAL, preceding.

6. FINAL TEST AFTER INSTALLATION.—Check and adjust relay as described in paragraph *4.*, ADJUSTMENTS, preceding.

(e) GENERATOR RESISTORS.

(See 2, figure 310.)

1. DESCRIPTION.—A two grid generator resistor is installed in series with the negative lead of each generator and mounted on a bracket aft of each firewall. The negative end of the generator resistor is connected to the positive end of the ammeter shunt by a small bus bar. The positive end of the resistor is grounded. The generator voltage paralleling action of the two voltage regulators is dependent upon a voltage drop in the generator circuit between ground and the negative ("E") terminal of each generator. The generator resistor is included to achieve this voltage drop.



1. Ammeter Shunt
2. Generator Resistor
3. Ducting Heater Fuel Air Mixture Shut-off Solenoid Valve
4. Battery Disconnect Relay
5. Battery Ground Stud

Figure 310 — Electrical Equipment—Outboard Side of Right-hand Nacelle

2. REMOVAL.

a. Disconnect the resistor from the bus bar on one end and the ground connection at the other.

b. Remove the screws and nuts holding the resistor base (next to the bus bar) to the stringer and lift out the resistor and bracket.

c. Remove resistor from bracket.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening loose connection.

4. INSTALLATION. — Reverse REMOVAL procedure described in paragraph *(b)* above.

Note

The installation between the "E" terminal of the generator and its generator resistor must always be exactly the same as the similar installation for the other generator in order to allow the paralleling coils of the voltage regulators to correctly balance the output of the two generators.

(f) GENERATOR CONTROL SWITCH.

1. DESCRIPTION.—Two "ON-OFF" generator control switches, one for each generator, are located on the pilot's overhead control panel *(figure 323.)*

2. REMOVAL.

a. Disconnect the two wires at the back of the switch.

b. Remove the two screws holding the switch to the panel.

c. Lift the switch from the panel.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening loose connections.

4. INSTALLATION.—Reverse procedure described in *2.* REMOVAL, above.

(g) CAPACITOR.

1. DESCRIPTION.—A class B., 5 mfd. capacitor is connected to the main bus bar system between each battery and the battery terminal of each current control switch. One capacitor is installed in each firewall junction box *(figure 332)* and connected to the "BAT." terminal of the reverse current relay. The addition of the capacitor to the electrical system dampens interference to the radios.

2. REMOVAL.

a. Disconnect wires from capacitor.

b. Remove screw holding capacitor to junction box and remove capacitor.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

4. INSTALLATION.—Reverse REMOVAL procedure.

(h) AMMETERS.

1. DESCRIPTION.—Two type E-1 ammeters are installed on the pilot's instrument panel *(figure 232)* and are used to measure direct currents from 0 to 300 amperes. Included in the ammeter circuit is an ammeter shunt and connecting cable from shunt to ammeter. The ammeter shunt is mounted to a plate just aft of the firewall (next to the generator resistor, *(1, figure 310)*. A lead from the positive (aft) end of the shunt goes to the positive terminal of the ammeter; a lead from the negative (forward) end of the shunt goes to the negative terminal of the ammeter. The generator negative lead is connected to the negative end of the shunt; the resistor bus bar is connected to the positive end of the shunt. The shunt is a resistor which directs through the ammeter a small but proportioned amount of the current present in the generator negative lead. The millivolt drop across the shunt varies in proportion to the current (in the generator lead). As the millivolt drop changes, the current through the ammeter changes and the pointer moves over the scale in proportion to the current in the shunt.

2. REMOVAL.

a. AMMETER.

(1) Disconnect the two leads from the back of the ammeter.

(2) Remove the three mounting screws holding the ammeter to the panel and remove the ammeter.

b. AMMETER SHUNT.

(1) Disconnect the three leads connected to the shunt.

(2) Disconnect the resistor bus bar from the aft end of the shunt.

(3) Remove the ammeter shunt bracket from stringer.

(4) Remove the screws and nuts holding the shunt to the plate and remove shunt.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Maintenance will consist of minor repairs that do not require disassembly, such as:

a. Replacement of broken cover glass of the ammeter.

b. Adjustment of ammeter pointer to zero.

c. Tightening or replacement of leads.

d. Replacement of the ammeter or shunt.

4. ADJUSTMENT OF THE AMMETER POINTER.

a. Be sure there is no current flowing through the ammeter or shunt.

b. Adjust the zero corrector screw on the front of the ammeter, while lightly tapping the instrument, so that the pointer is exactly on zero.

c. After once making this adjustment, it will be unnecessary to change it unless the screw is accidentally moved.

5. INSTALLATION.

a. Reverse REMOVAL procedure.

b. All connections must be clean and tight for correct instrument readings.

(i) VOLTMETER.

1. DESCRIPTION.—One type B-1 voltmeter is installed on the pilot's instrument panel *(figure 232)*, and is used to measure direct current voltages. The voltmeter is connected by one lead to a ground stud and by another to a type B-9A voltmeter switch located on the pilot's electrical control panel. This toggle switch has two positions: "L," which connects the voltmeter into the left-hand generator circuit; and "R" which connects the voltmeter into the right-hand generator circuit.

2. REMOVAL.

a. VOLTMETER.—Remove the electrical wiring and the attaching screws.

b. VOLTMETER SWITCH.—Remove the electrical wiring and attaching screws.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. VOLTMETER.—Same as that for ammeters, paragraph 15. *b.* (2) *(b)* *3.*, this section.

b. VOLTMETER SWITCH.—Replacement, rather than maintenance, will be necessary except for tightening any loose connections.

4. ADJUSTMENTS—VOLTMETER.

a. The upper screw on the voltmeter can be turned to set the reference pointer at the indication desired.

b. The lower screw is the zero corrector screw and may be adjusted, while lightly tapping the voltmeter, so that the pointer indicates exactly zero.

Note

This adjustment must be made with the current shut off.

5. INSTALLATION.—Reverse the REMOVAL procedure. All wiring must be installed in accordance with the proper wiring diagram.

c. POWER DISTRIBUTION.

(1) BUS BAR SYSTEM.
(See figure 300.)

(a) DESCRIPTION.—The bus bar is fabricated of aluminum and is covered with flexible insulating tubing. The bar is routed from each nacelle, through the leading edge of the wing, to the fuselage, where it extends forward to a point a few inches forward of the main electrical control panel, and aft to the gunner's compartment. The bus bar is fabricated in five sections which are bolted together. At connecting points the bar is protected by rubber covers. To disconnect any section of the bus bar, make sure that the battery switches are turned off; then slide the cover back and remove the bolt or bolts.

(b) REMOVAL.

1. FUSELAGE BUS BAR.

a. Remove the dural deflecting plate which protects the bus bar on the left side of the fuselage by removing the screws. The aft section bus bar is accessible from the bomb bay.

b. Remove the clips which attach the bus bar to the fuselage.

c. Disconnect the bolts at the attaching points and wire junctions.

d. Remove the bus bar.

2. WING BUS BAR.

a. Remove the flush head screws which attach the removable nose section of the wing to the wing structure, and remove the nose section.

b. Remove the clips which attach the bus bar to the nose ribs.

c. Disconnect the bolts at the bar attaching points and wire junctions.

d. Remove the bus bar.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—When new sections of bus bar are not available, breaks in the airplane bus bar may be spliced with a piece of aluminum having a minimum electrical conductivity of 60 percent, or with a length of No. 00 cable. Splice the bus bar as follows:

1. Peel back the insulation on the bus bar and drill two 17/64 inch matching holes in the bar and the splice.

2. Insert two AN4-7A bolts and attach elastic stop nuts, torquing them to a tension of not more than 40 inch-pounds.

3. Clean the contacting surfaces of the splice and bus bar with emery cloth. Remove abrasive and metal particles with a clean cloth.

4. Apply an even coat of petrolatum to the contact surfaces and the holes.

5. Wire brush the entire electric contacting areas thoroughly, working through the petrolatum coating.

6. Install the splice on the bus bar, using AN4-7A bolts. Tighten the elastic stop nuts evenly.

7. Remove excess petrolatum with a dry cloth.

8. Wrap the splice with Flaminol tape, or equivalent.

(2) WIRING.

(a) DESCRIPTION.—The wiring system on this airplane is centralized for connection to power at the main bus bar. Power is supplied to the airplane electrical system by direct wire connections to the main bus bar in the fuselage from the pilot's distribution panel bus bar, wing flap drive relay, turret control box, and gunner's relay box; direct wire connections to the main bus bar in each wing are from the battery disconnect relay, propeller feathering relay, cowl flap relay, and nacelle relay box bus bar. All the wiring forward of the firewall except the starter and generator wiring is enclosed by conduit. The ignition and voltage regulator wiring is carried in conduit aft from the firewall through the wing to units in the fuselage. The wing bomb release control wiring is not in conduit except that portion which extends from the wing to the bomb racks. Wires that are not carried in conduit are grouped in bundles of not more than twenty wires to a bundle except in the fuselage armored tunnel and the armored leading edge of the wing. The wiring for the individual circuits of the airplane electrical system is presented in the form of simplified diagram in *figures 431-487* inclusive. When equipment is to be removed or replaced, refer to the INDIVIDUAL ELECTRICAL CIRCUIT WIRING DIAGRAM BOOK supplied with the airplane.

(b) IDENTIFICATION OF WIRE.

1. Each wire bears an identification number at 1 inch intervals along the first six inches at each end and at intervals not greater than 15 inches along the remainder of its length.

2. Wires 15 inches or less in length bear identification numbers at one inch intervals only.

3. The wire identification number consists of the wire numbers followed by the gage size of the wire.

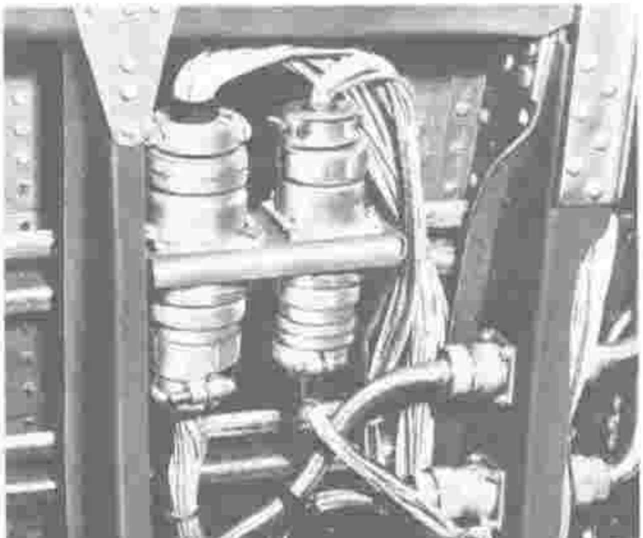


Figure 311 — Wing Forward Electrical Disconnect Plugs

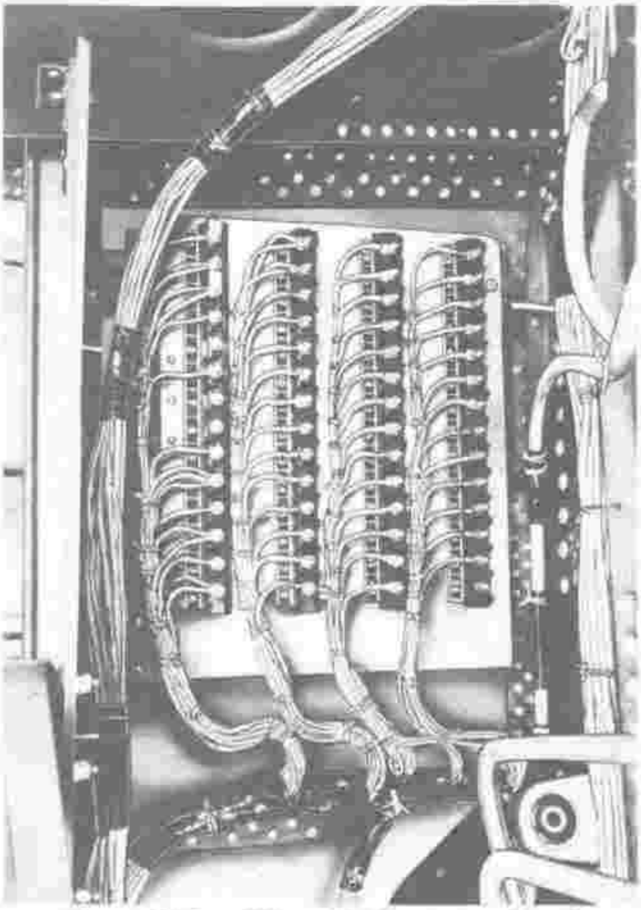


Figure 312 — Wing Aft Disconnect Panel

4. An arrow is used to indicate the direction in which the number is to be read.

5. On unshielded wire Nos. 20 to 4, the identification consists of the number stamped on the outer covering of the wire; unshielded wires larger than No. 4 carry numbers covered with transparent tape.

6. On shielded wire, the identification consists of ¾ inch lengths of insulating tubing, or transparent cellulose tape bearing the identification number placed over the wire at 15 inch intervals.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. SPLICING.

a. Splicing is made in standard types of

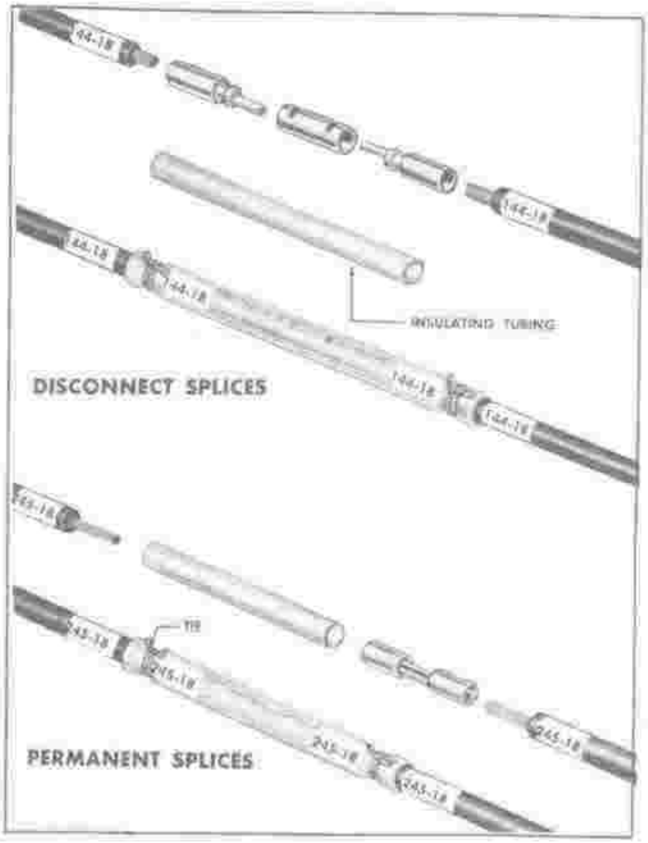


Figure 313 — Splices

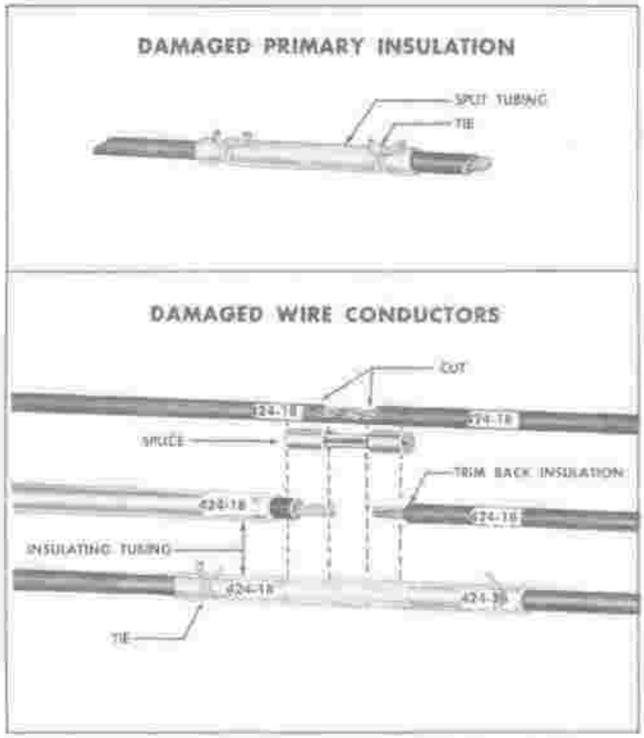


Figure 315 — Wire Repair

flexible stranded copper wire, sizes 10 to 22 inclusive. (Refer to the splicing table below.)

b. Splices, when made in bundles, should be staggered.

c. Splices should be used in accessible wiring tunnels or in open wiring.

d. Splices should be installed in such a manner as to allow the splice wires to follow the same routing as would have been used for unspliced wires.

2. WIRE REPAIR.

a. If necessary to replace terminals, select proper terminal for wire size from list below. Connect terminals as shown in the following drawing.

Note

Burndy terminals may be staked on either the top or the bottom. Stakon terminals should be staked on the top "hump" side.

WIRE GA.	THOMAS & BETTS		AMP	BURNDY	INSULATING TUBING			
					SURCO AMERICAN		IRVOLITE	
	Permanent	Disconnect			I.D.	WALL	I.D.	WALL
22 20 18	AA AA AA	A57 A57 A57	30956	YSV 18	.133 .138 .148	.018 .018 .018	.133 .148 .148	.016 .016 .016
16 14	BB BB	B57 B57	30954	YSV 14	.177 .196	.018 .020	.186 .208	.020 .020
12 10	CC CC	C58 C58	30934	YSV 10	.234 .234	.020 .020	.234 .234	.020 .020

Figure 314 — Splicing Chart

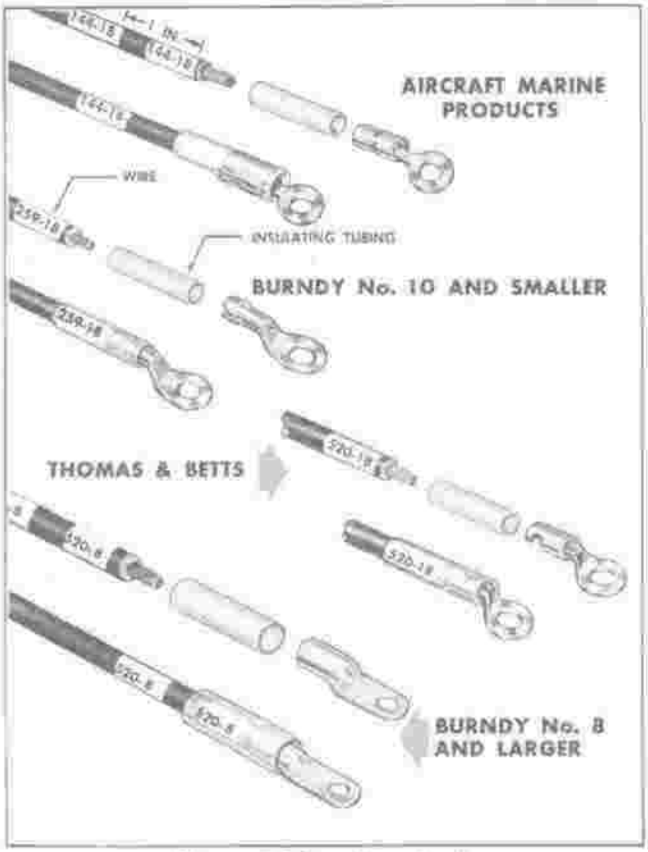


Figure 316 — Terminals

b. Select the proper connector and tubing for a damaged wire from the splicing list above.

c. Trim the insulation back on wire for a distance equal to the shank length of the connector being used.

d. Slip the tubing over the wire.

e. Attach the connector to the bare end of the wire.

f. Slide the tubing over the terminal extending equally beyond the splice and marking tape.

g. Using a piece of No. 7 or No. 9 cord, tie a knot around each end of the tubing covering the splice.

h. Thermocouple leads must never be shortened although they may appear to be too long; these wires have been calibrated to a definite length. The removal of any portion would cause inaccuracies in the instrument reading.

Note

If thermocouple wires are damaged, they may be tin solder-spliced if the break is in an area

WIRE GAGE	THOMAS & BETTS (STAKON)	AIRCRAFT MARINE PROD. (AMP)	BURNDY	STUD SIZE	INSULATING TUBING
22	A88G			#4	
20	A33G	31096	YAV 18-H5	#6	
18	A77G	31270	YAV 18-H1	#8	
	A36G	30997	YAV 18-H	#10	
	A73G			3/8	
16	B33G	30991	YAV 14-H5	#6	
14	B77G	30992	YAV 14-H1	#8	
	B36G	30993	YAV 14-H	#10	
	B73G			3/8	
12	C77	31117	YAV 10	#8	
10	C26	31118	YAV 10	#10	
	C71	31127	YAV 10-T1	1/4	
	C73			3/8	
8	D26		YAV 8C-L	#10	
	D71		YAV 8C-L1	1/4	
6	E71		YAV 6C-L	1/4	
4	F71		YAV 4C-L	1/4	
	F73		YAV 4C-L1	3/8	
2			YAV 2C-P	3/8	
			YAV 2C	3/8	
0			YAV 25	3/8	
00			YAV 26	3/8	

Figure 317 — Terminal Chart

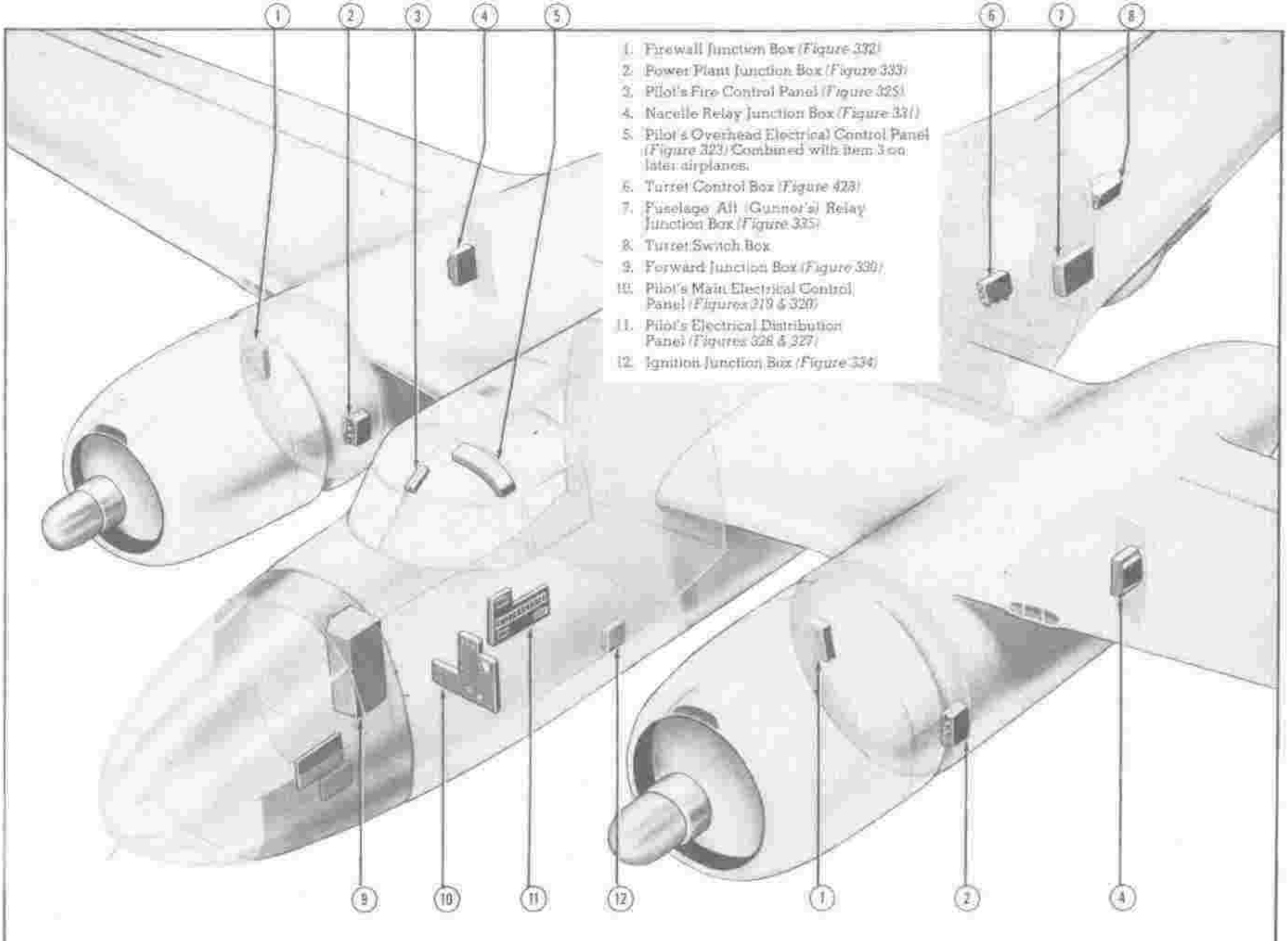


Figure 318 — Electrical Control Panels and Junction Boxes

which is not subject to severe changes in temperature. In areas subject to severe temperature changes, such as the engine section, the splices should be silver soldered.

i. Due to the high voltage carried in the high tension wires, they cannot be repaired but must be replaced.

(3) STATIC GROUND.—A static ground assembly, consisting of a length of wire and a flexible cable with soldered ends, is attached to the nose wheel strut by a clamp. When the airplane is on the ground, the cable must make contact with the ground to remove any accumulation of static electricity and to return the airplane to ground potential. A pre-flight check should be made to make certain that the cable and wire assembly is making proper contact with the ground. If the cable is worn sufficiently to prevent proper contact, it must be replaced.

(4) CONTROL PANELS. *(See figure 318.)*—Electrical control panels installed on the airplane consist of the pilot's main electrical control panel, the pilot's electrical distribution panel, the pilot's overhead electrical control panel, and the pilot's fire control panel. Most of the electrical control units are installed on these panels. The voltmeter and the ammeter *(16, 18, 20, figure 232)* are mounted on the pilot's instrument panel. The cowl flap control switches and oil cooler door control switches *(figure 341)* are located on the control pedestal step. The suit heat rheostat is located on the control pedestal structure.

(a) PILOT'S MAIN ELECTRICAL CONTROL PANEL. *(See figures 319, 320, 321, 322.)*

1. DESCRIPTION.—The pilot's main electrical control panel is located forward of the pilot's seat and is attached to the fuselage structure by four bolts which are accessible in the pilot's compartment. Access to the back of the panel is gained by removing the instruments access door or by removing the four bolts and pulling the panel aft into the pilot's compartment. The wiring is long enough for this purpose. Equip-

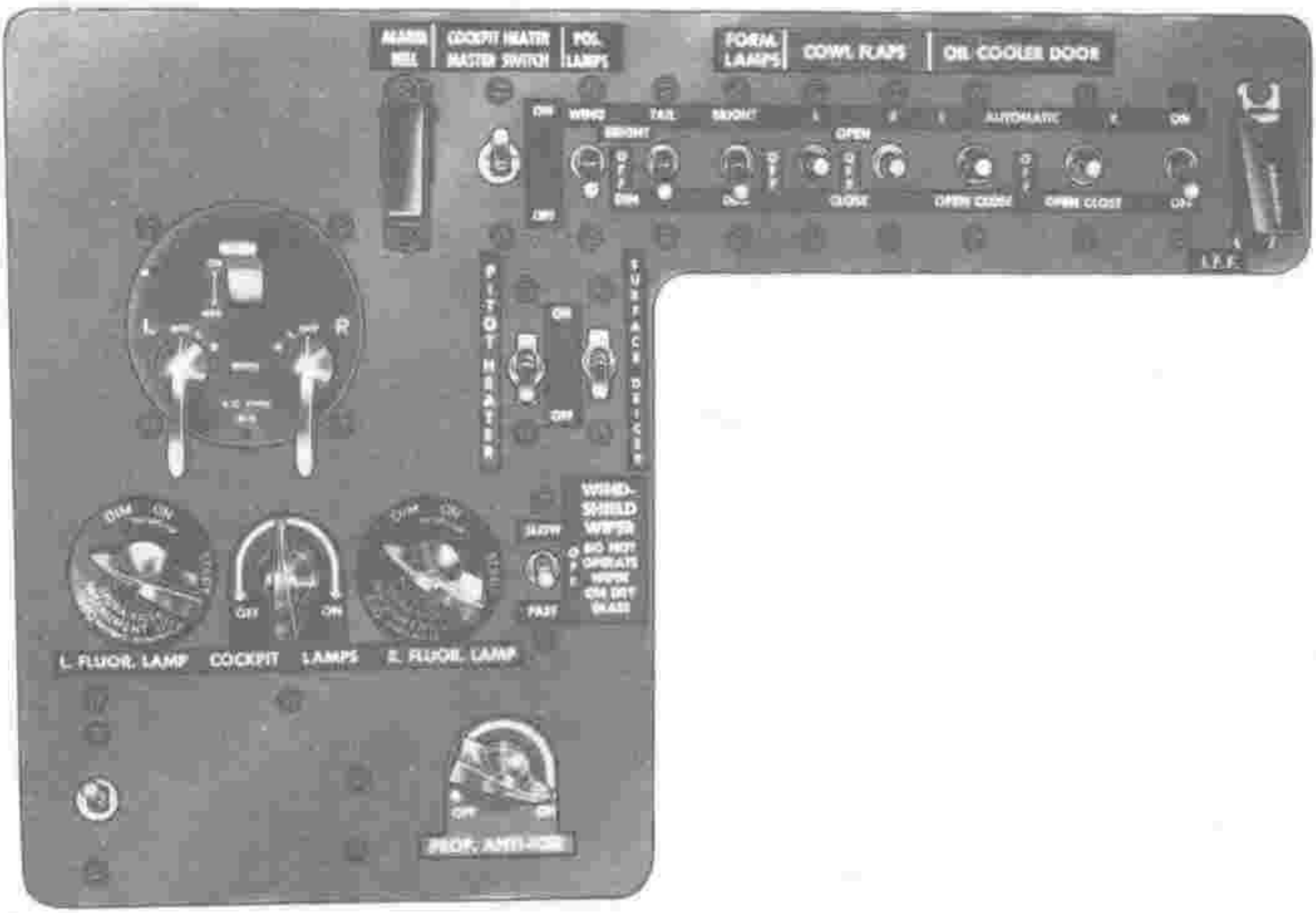


Figure 319 — Pilot's Main Electrical Control Panel—Front (some airplanes)

ment installed on the panel consists of bombing controls and various other switches, lamps, and rheostats.

2. REMOVAL.

a. Disconnect the electrical wires.

b. Remove the four attaching bolts.

c. Remove panel by pulling it aft.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(b) PILOT'S OVERHEAD CONTROL PANEL. (See figure 323.)

1. DESCRIPTION. — The pilot's overhead electrical panel is mounted on the enclosure structure above the control column. The panel contains the

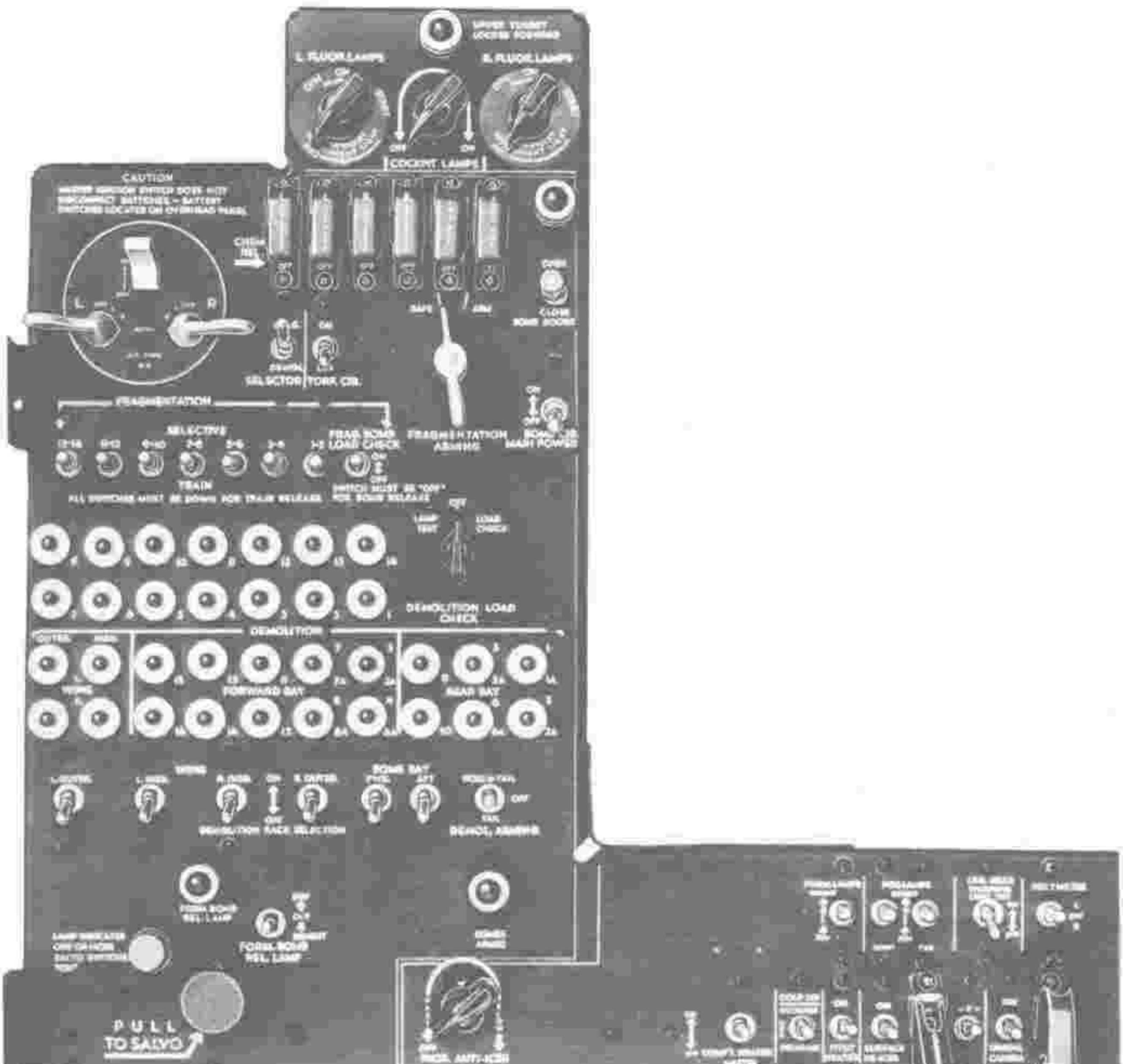


Figure 320 — Pilot's Main Electrical Control Panel—Front (some airplanes)

following units: the gun sight and torpedo director lamp rheostat, the landing lamp switch, two battery switches, two generator switches, two oil dilution switches, two engine primer switches, and two engine starter switches.

2. REMOVAL.

a. Remove the four screws which attach the panel to the enclosure structure.

b. Disconnect the electrical wiring and remove the panel.

3. MAINTENANCE REPAIR OR REPLACEMENT. — Replacement, rather than repair, will be necessary.

(c) PILOT'S FIRE CONTROL PANEL.
(See figure 325.)

1. DESCRIPTION.—The pilot's fire control panel is located on the pilot's enclosure structure above

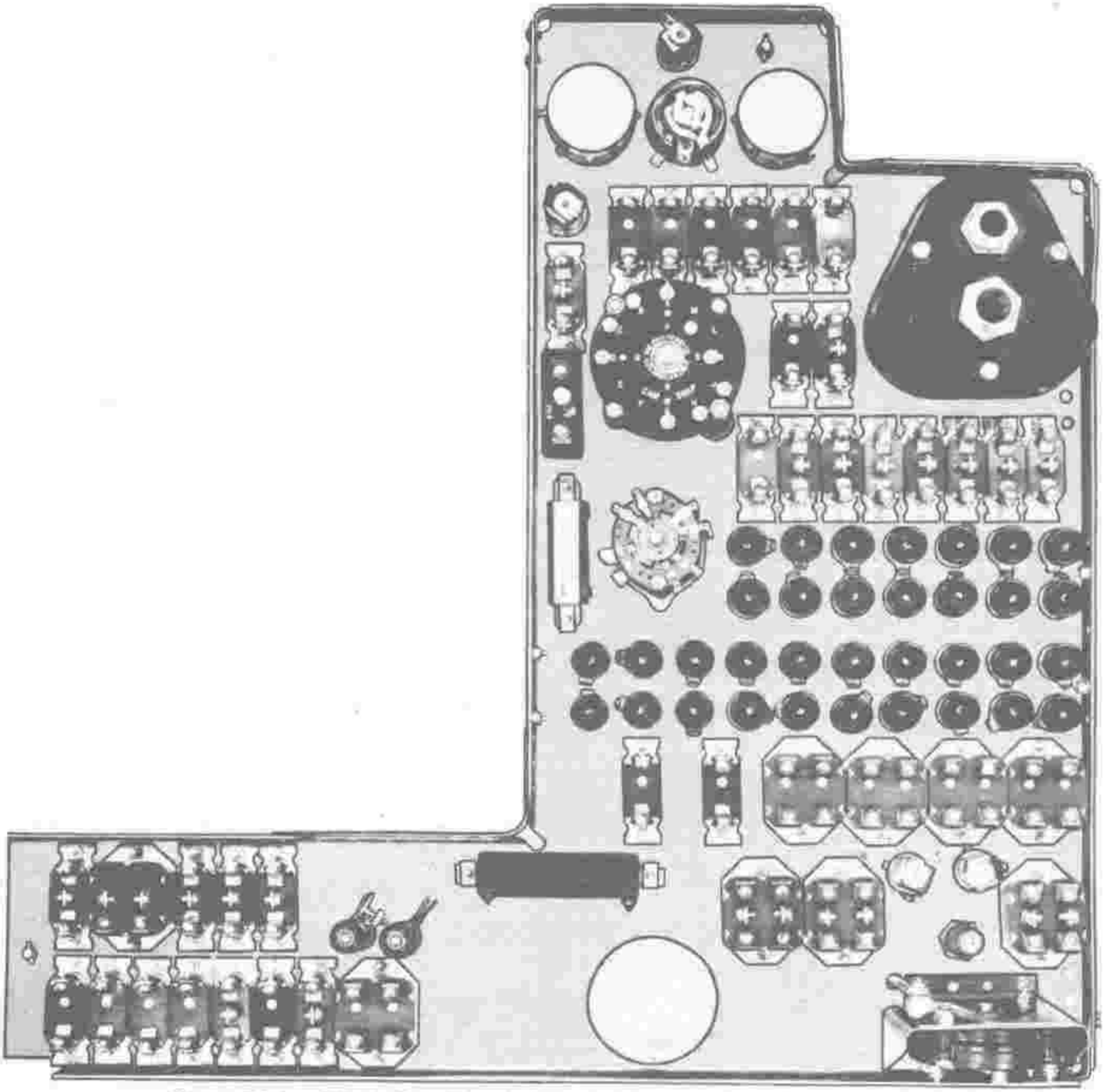


Figure 321 — Pilot's Main Electrical Control Panel—Rear (some airplanes)

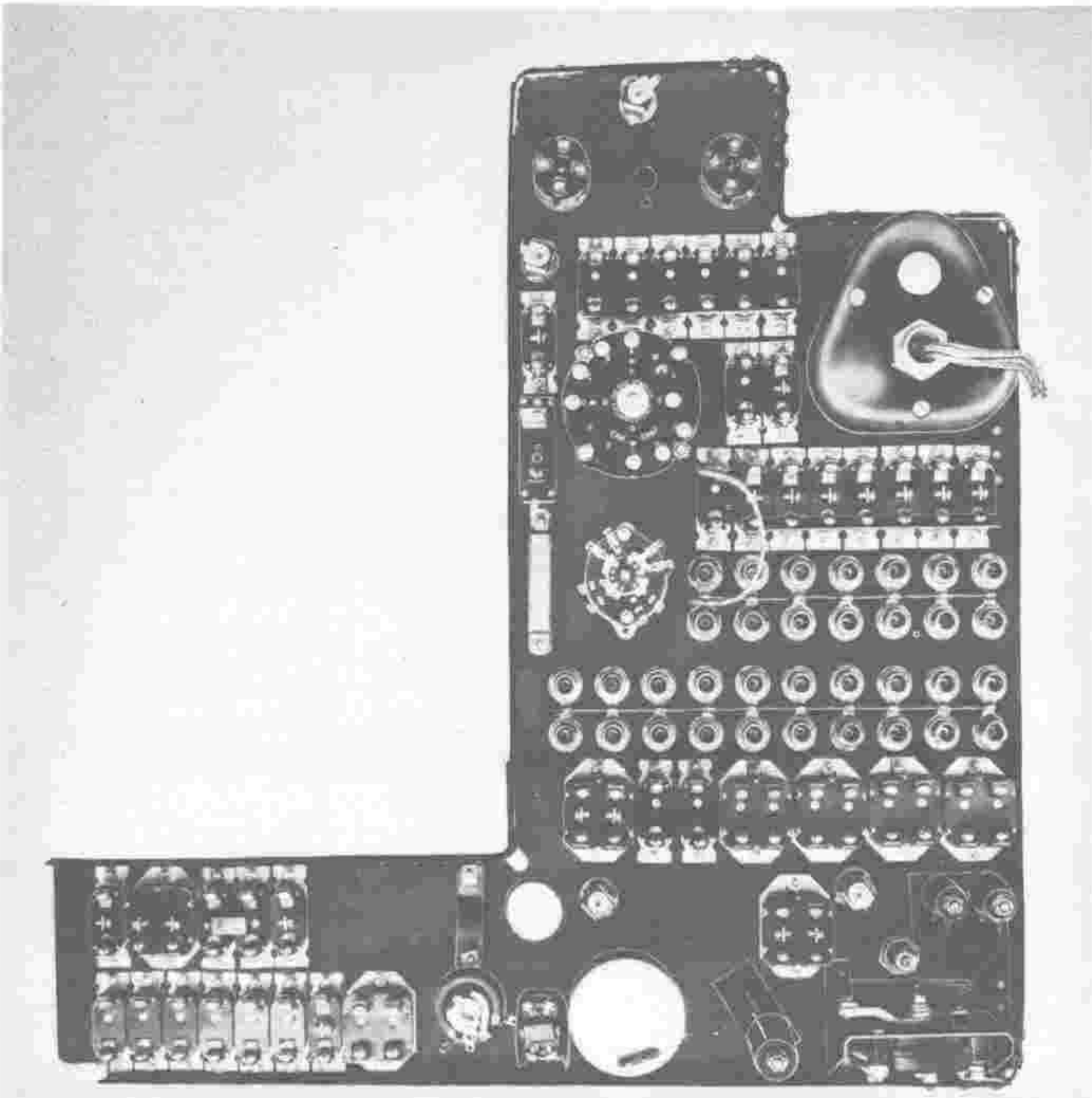


Figure 322 — Pilot's Main Electrical Control Panel—Rear (some airplanes)

Figure 323 - Overhead Electrical Control Panel

Figure 324 — Pilot's Auxiliary Electrical Panel (some airplanes)

and aft of the instrument panel. The panel contains the following units: master gun safety and camera switch, 75mm cannon switch, 37 mm cannon switch, .50 caliber nose gun switch, .50 caliber wing guns switch, upper turret guns switch, and gun heater switch.

2. REMOVAL.

a. Remove the screws which attach the panel to the enclosure structure.

b. Disconnect the electrical wiring and remove the panel.

c. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(d) PILOT'S ELECTRICAL DISTRIBUTION PANEL. *(See figures 326 & 327.)*

1. DESCRIPTION.—The pilot's electrical distribution panel is mounted on the left side of the pilot's compartment, adjacent to the pilot's seat, and is hinged to allow access to the back. A No. 0 cable is attached to the panel for transmission of the main line current. The panel contains circuit breaker switches.

Note

Circuit breaker switches are installed in the electrical system at all points which require protection against overloading. The circuit breakers differ from fuses in that they may be restored to service temporarily in the event of a flight emergency. Ordinarily, circuit breakers which are found to be in the "OFF" position should not be turned to "ON" until the circuit has been checked and the indicated defect has been corrected. In emergency the pilot may hold a circuit breaker switch "ON" to complete a circuit, even though it may be dangerous to the circuit or equipment. As soon as the switch is released, it will return to the "OFF" position, unless burned out.

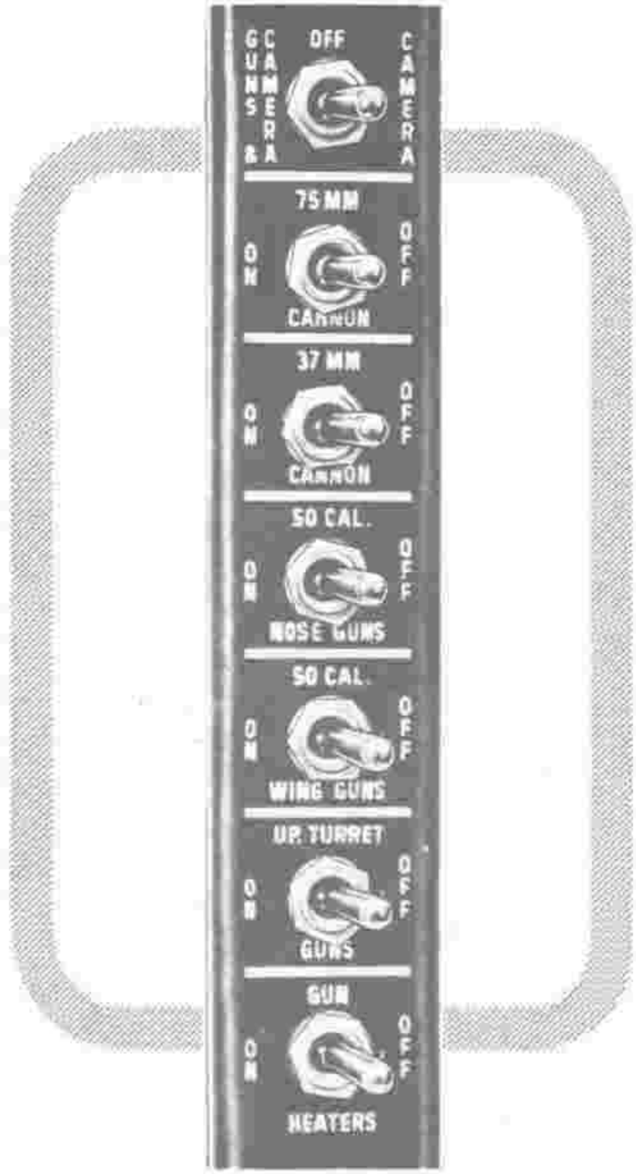


Figure 325 — Fire Control Panel

2. REMOVAL.

a. Remove the attaching bolts and the hinge pin.

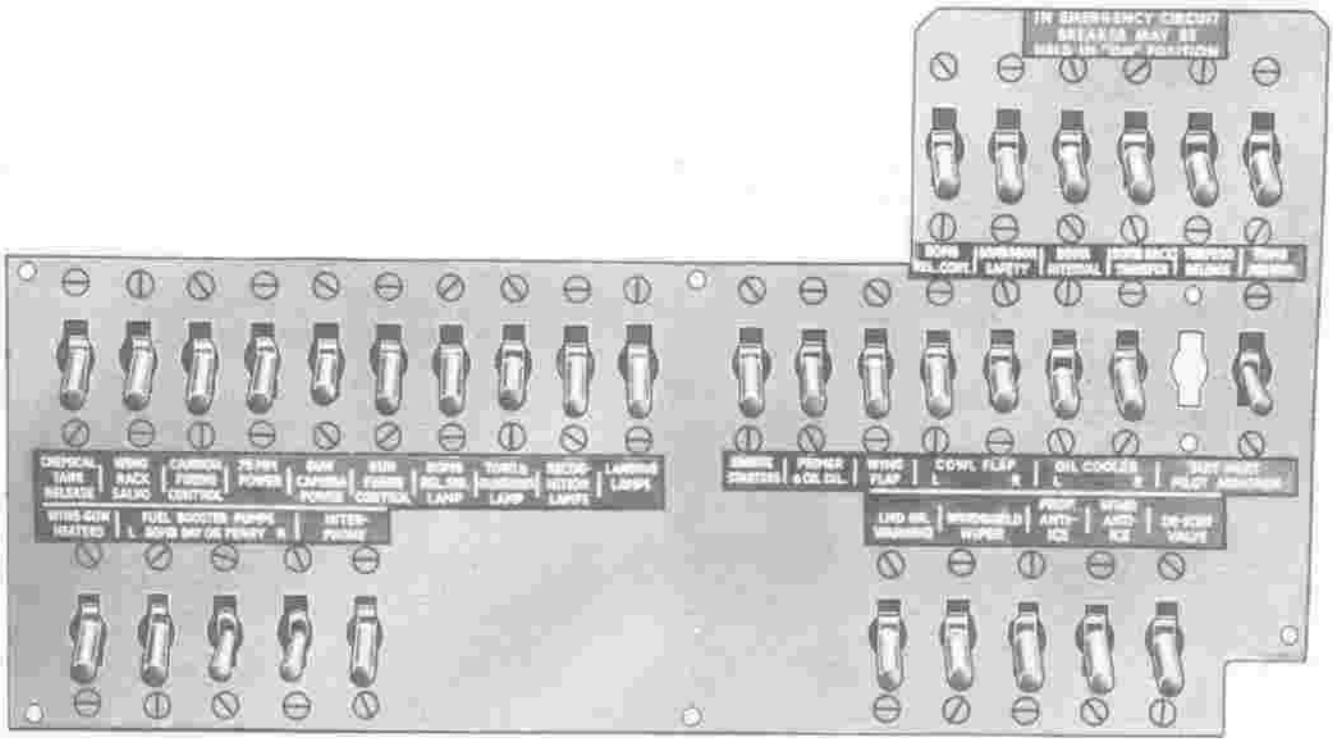


Figure 326 — Pilot's Electrical Distribution Panel (some airplanes)

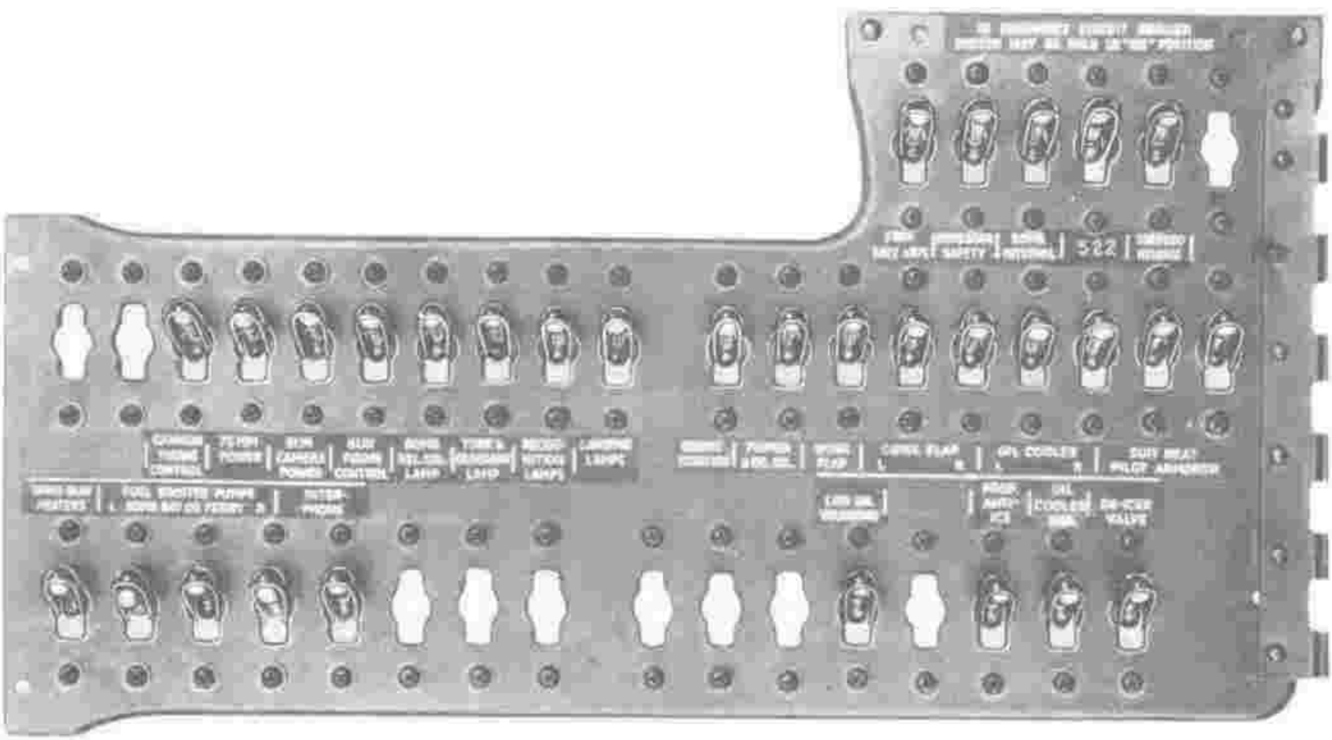
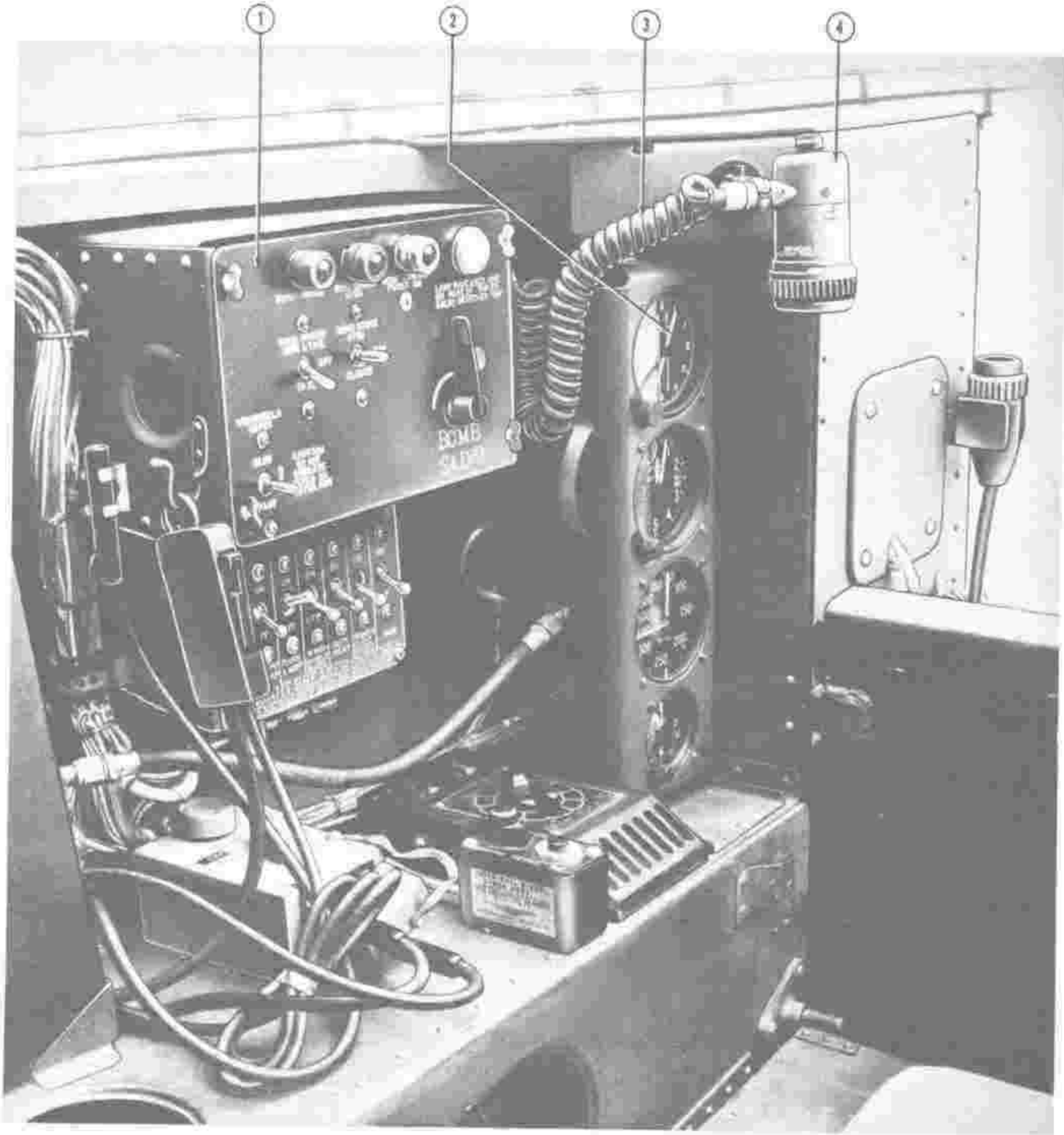
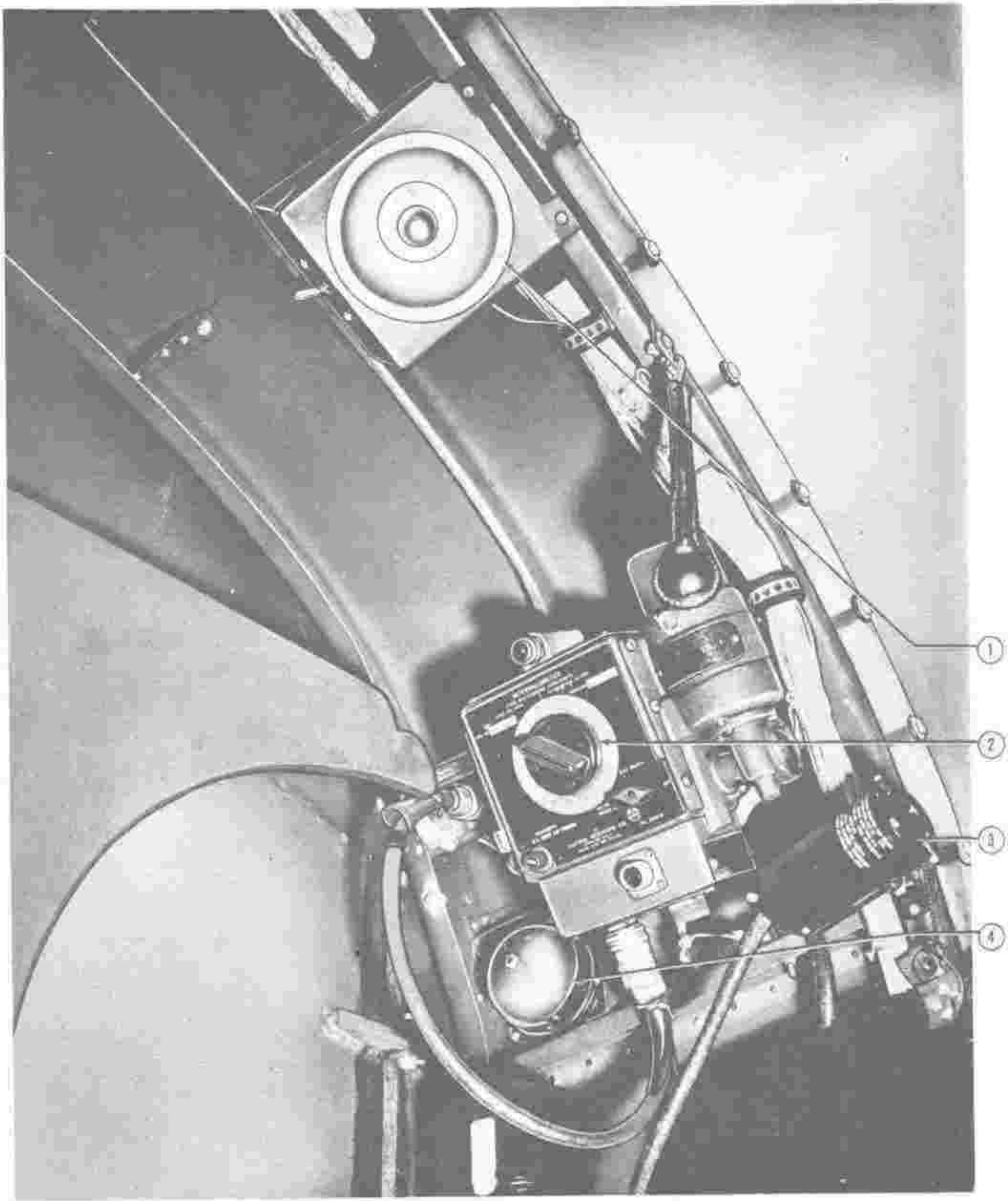


Figure 327 — Pilot's Electrical Distribution Panel (some airplanes)



1. Electrical Control Panel
2. Remote Magnetic Compass Indicator
3. Fluorescent Lamp Extension Cord
4. Fluorescent Lamp

Figure 328—Bombardier Nose Electrical Equipment (Forward)



View Looking Outboard and Aft

1. Dome Lamp
2. Camera Intervalometer
3. Cockpit Lamp
4. Alarm Bell

Figure 329 — Bombardier Nose Electrical Equipment — Aft

b. Disconnect the electrical wiring and remove the panel.

3. MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary.

(5) JUNCTION BOXES. *(See figure 318.)*–Junction boxes are installed in each engine section, in each nacelle, in the fuselage forward of the instrument panel, in the gunner's compartment, and in the bomb bay. The junction boxes house several kinds of electrical equipment, including relays, circuit breakers, terminal strips, and ground studs.

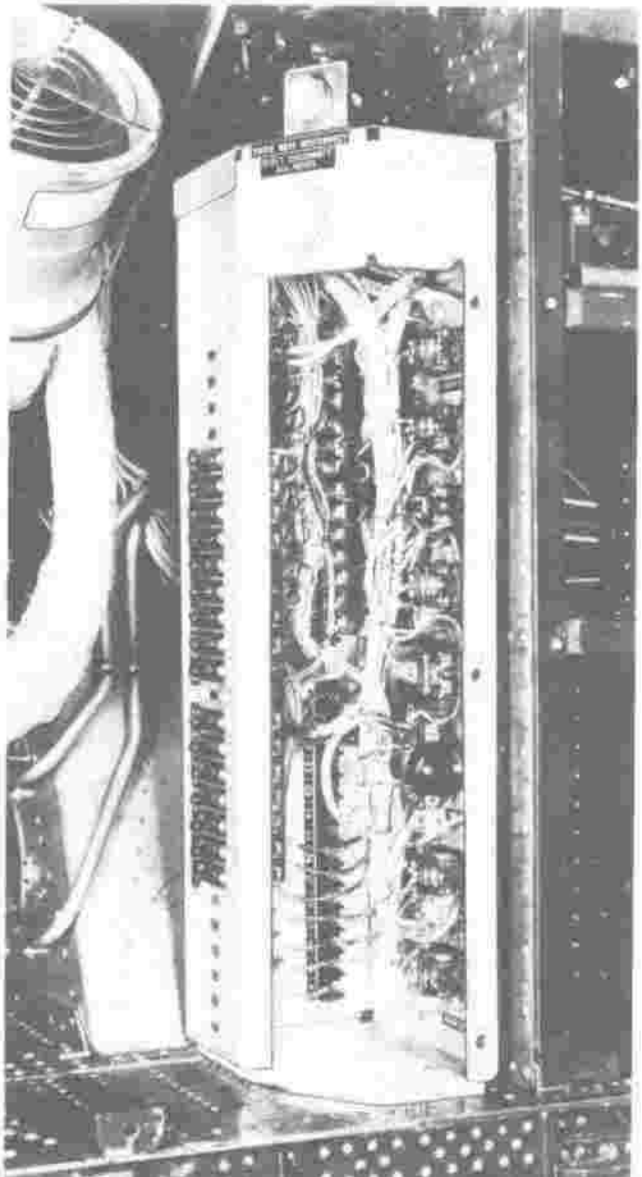


Figure 330 — Forward Junction Box

(a) FORWARD ELECTRICAL JUNCTION BOX. *(See figure 330.)*

1. DESCRIPTION. – The forward electrical junction box is located in the fuselage, forward of the istrument panel. The junction box contains circuit breakers for the following circuits: the pilot's fluorescent instrument lamps, pilot's cockpit lamps, formation lamps, position lamps, orientation camera, pitot tube heater, pilot's recirculating heater, pilot's ducting heater, pilot's heat control, landing gear and flap position indicator, ferry tank fuel level gage, auxiliary tank fuel level gage, main tank fuel level gage, carburetor air temperature indicator, pilot's outside air temperature indicator, and oil temperature indicator. The junction box contains the following relays: torpedo release, cannon firing, camera transfer, recirculating heater, ducting heater, fragmentation bomb release, demolition bomb release, bomb door safety and landing gear warning signal relay. The junction box also contains terminal strips, ground studs and two electrical disconnect receptacles, one for the electrical disconnect plug for all noses, and one for the electrical disconnect plug for the bombardier nose radio, if installed. A bus bar system, connected by wire to the fuselage main bus bar system, is provided in the junction box for connection to power.

2. REMOVAL.

a. Access to the forward junction box is gained through the nose access door *(24, figure 6)* by releasing the lock and opening the door.

b. Disconnect the electrical plug or plugs at the top of the box.

c. Release the Dzus fasteners and remove the cover plate from the side of the junction box.

d. Disconnect the electrical wiring.

e. Remove the attaching screws and remove the junction box.

3. MAINTENANCE REPAIR OR REPLACEMENT. – Replacement, rather than repair, will be necessary.

(b) NACELLE RELAY JUNCTION BOXES. *(See figure 331.)*

1. DESCRIPTION.–The nacelle relay junction boxes are located on the outboard side of each nacelle, and are accessible from the wheel wells. Each junction box contains three relays: the .50 caliber gun heater relay, the landing lamp relay, and the .50 caliber wing gun firing relay. There are four circuit

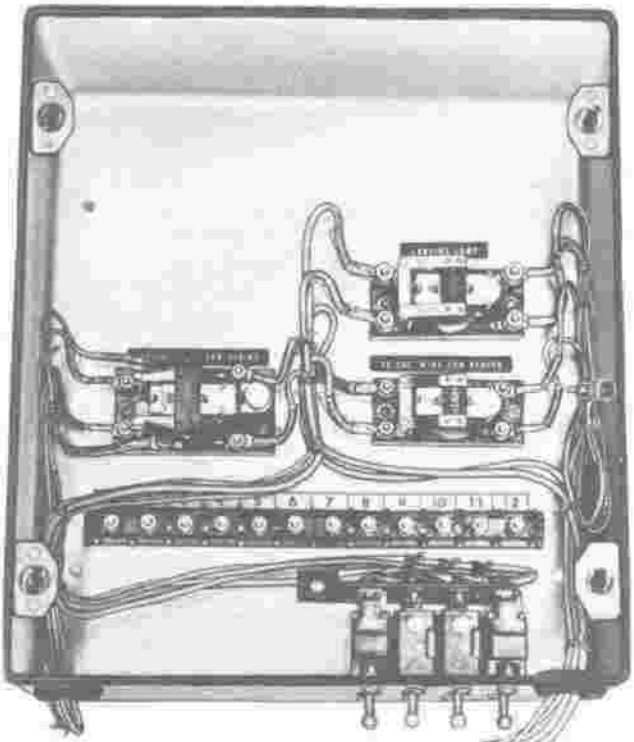


Figure 331 — Nacelle Relay Junction Box

breakers in each box. These are the gun heater circuit breaker, two wing gun circuit breakers, and the landing lamp circuit breaker. There is also a bus bar, a terminal strip and one ground stud. The nacelle junction box bus bar is connected to the main wing bus bar through a 90 ampere manual reset circuit breaker mounted aft of each firewall.

2. REMOVAL.

a. Release the Dzus fasteners and remove the cover plate.

b. Disconnect the electrical wiring.

c. Remove the attaching screws and remove the junction box.

d. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(c) FIREWALL JUNCTION BOXES. *(See figure 332.)*

1. DESCRIPTION.—A junction box is located on the aft side of each firewall. Each firewall junction box contains one generator reverse current control relay, the generator circuit capacitor, the circuit breakers for the cowl flap motor circuit, the generator circuit, the alarm bell circuit (in left firewall junction box only), and the recognition radio (F.) detonator

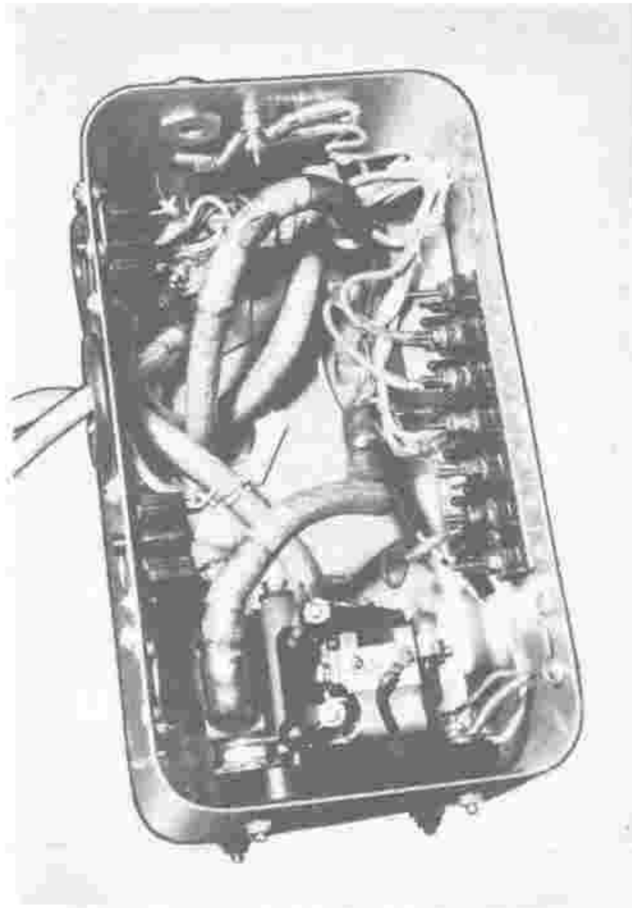


Figure 332 — Firewall Junction Box

circuit (in right firewall junction box). Each junction box also contains a terminal strip and one ground stud.

2. REMOVAL.

a. Access to the junction box is gained by releasing the Dzus fasteners and removing the inspection plate on the under side of the nacelle.

b. Remove the front cover plate of the junction box by releasing the Dzus fasteners.

c. Disconnect the electrical wiring.

d. Remove the attaching screws and remove the junction box.

(d) POWER PLANT JUNCTION BOXES. *(See figure 333.)*

1. DESCRIPTION.—A power plant junction box is located on the left hand side of the accessory section of each engine. Each junction box contains a cowl flap electrical drive relay, three terminal strips, and one ground stud.

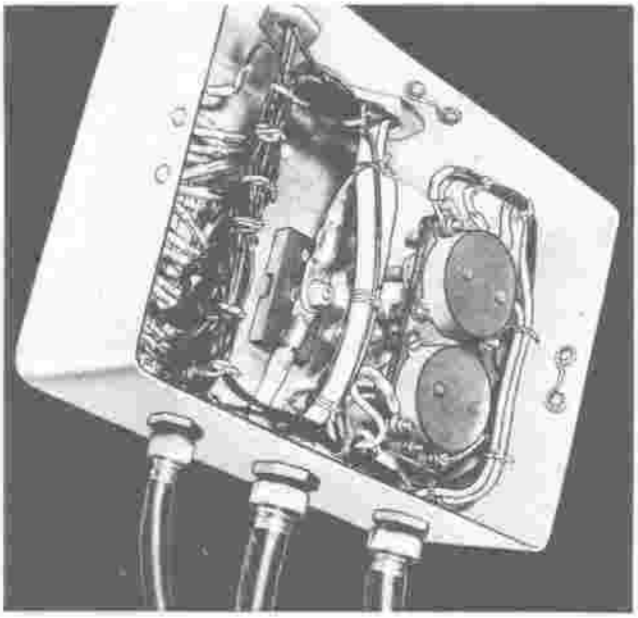


Figure 333 — Power Plant Junction Box

2. REMOVAL.

a. Remove the two access doors aft of the firewall by releasing the Dzus fasteners.

b. Remove the firewall center section by releasing the Dzus fasteners.

c. Remove the cover plate from the junction box by releasing the Dzus fasteners.

d. Disconnect the electrical wiring.

e. Remove the bolts which attach the junction box to the longeron and remove the junction box.

3. MAINTENANCE REPAIR OR REPLACEMENT. – Replacement, rather than repair, will be necessary.

(e) IGNITION JUNCTION BOX.
(See figure 334.)

1. DESCRIPTION.–The ignition junction box is located on the left side of the nose wheel well. The junction box contains one terminal strip.

2. REMOVAL.

a. Release the Dzus fasteners and remove the cover plate.

b. Disconnect the electrical wiring.

c. Remove the attaching screws and remove the junction box.

3. MAINTENANCE REPAIR OR REPLACEMENT. – Replacement, rather than repair, will be necessary.

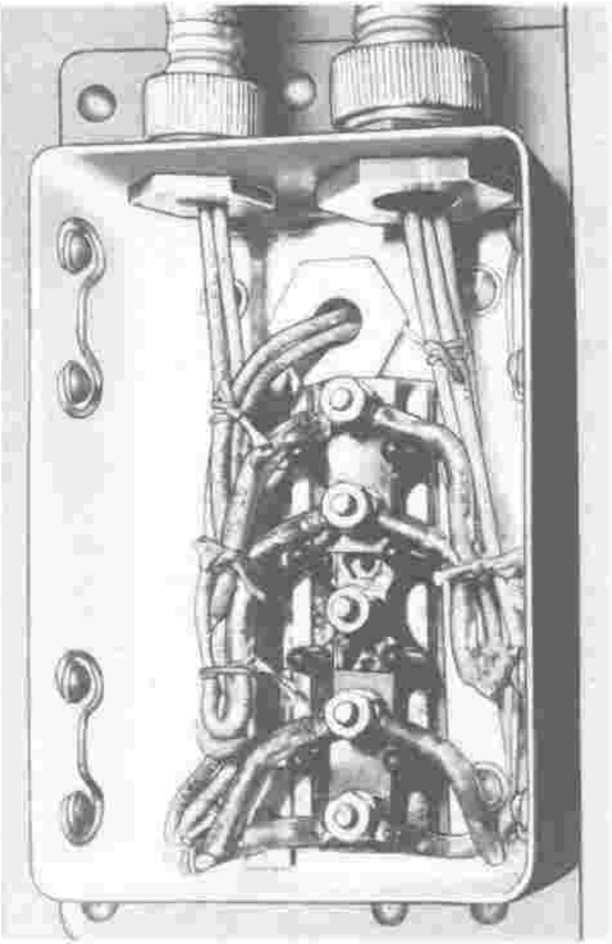


Figure 334 — Ignition Junction Box

(f) GUNNER'S RELAY JUNCTION BOX.
(See figure 335.)

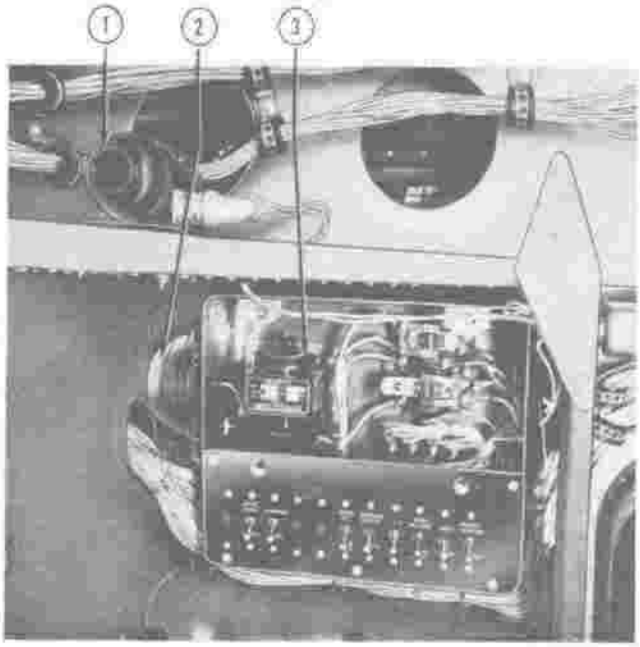
1. DESCRIPTION.–The gunner's relay junction box is located in the aft, left corner of the gunner's compartment. The junction box contains circuit breakers for the following circuits: interphone, gunner's lamp, bomb bay dome lamp, gunner's heater, identification radio, bomb release signal, aft main heater, and aft recirculating heater. There are three relays: the Agastat bomb release signal time delay relay, the aft recirculating heater relay, and the aft main heater relay. There is one terminal strip and a ground stud. The alarm bell is attached to the left side of the box.

2. REMOVAL.

a. Release the Dzus fasteners and remove the cover plate.

b. Disconnect the electrical wiring.

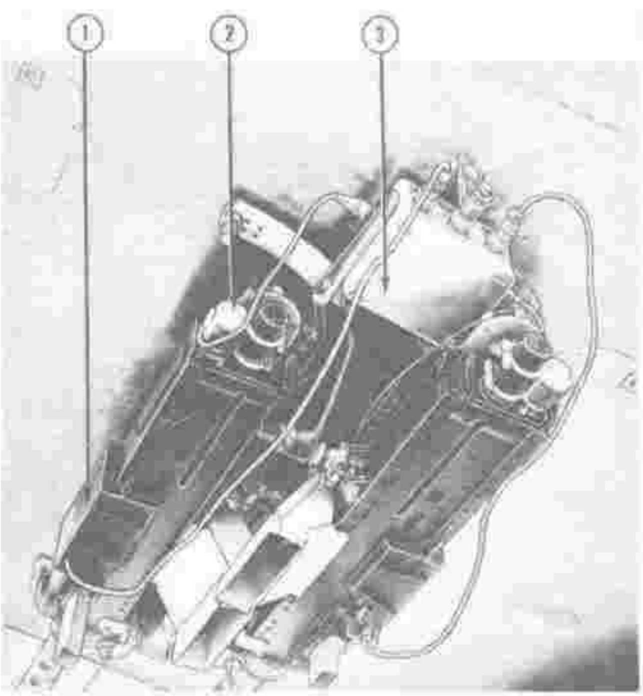
c. Remove attaching screws from the junction box and remove the box.



1. Remote Compass Inverter
2. Alarm Bell
3. Agastat Bomb Release Signal Time Delay Relay

Figure 335 — Fuselage Aft (Gunner's) Relay Box

* * *



1. Gun Heater
2. Type G-11 Gun Solenoid
3. Wing Gun Junction Box

Figure 336 — Wing Gun Electrical Equipment

3. MAINTENANCE REPAIR OR REPLACEMENT. — Replacement, rather than repair, will be necessary.

(*g*) TURRET JUNCTION BOX.—All turret equipment is described in paragraph (13), this section.

(*h*) WING GUN JUNCTION BOX.
(*See 3, figure 336.*)

1. DESCRIPTION.—A wing gun junction box is installed on each airplane equipped with wing guns. The junction box is attached to the aft end of the wing gun mount casting. The junction box contains a terminal strip.

2. REMOVAL.

a. Release the Dzus fasteners and remove the cover plate.

b. Disconnect the electrical wiring.

c. Remove attaching screws and remove the junction box.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(*i*) BOMB SALVO RELAY JUNCTION BOX.
(*See figure 337.*)

1. DESCRIPTION.—A bomb salvo relay junction box is installed on airplanes equipped with an all-electric bombing system. The box contains two dual wing bombs salvo relays, two fuselage bomb salvo time delay relays, and a terminal strip. The junction box is located on a shelf attached to the aft bulkhead of the bomb bay.

2. REMOVAL.

a. Remove the Dzus fasteners which hold the cover plate.

b. Disconnect the electrical wiring.

c. Remove the four screws which attach the box to the shelf.

3. MAINTENANCE REPAIR OR REPLACEMENT. — Replacement, rather than repair, will be necessary.

(6) MOTORS.—Electric motors are used to operate units in several systems on the airplane. Information concerning these motors will be found with the descriptions of the units with which they are connected. The following general information may be used in servicing and inspecting the motors except when noted otherwise in the text.

(*a*) GENERAL CHECK.

1. Check security of mounting.

2. Clean and tighten all external connections and replace any defective wiring.

3. Check bearings for wear. Lubricate in accordance with instructions on the motor. Sealed bearings should not be lubricated, but should be replaced as a unit when defective.

(b) BRUSH REPLACEMENT.—Brushes should be removed and inspected at least every 500 hours of airplane operation. When brushes are worn to approximately 1/16 inch from the brush holder, they will be replaced.

1. Remove the armature from the motor.

2. Apply a strip of No. 000 sandpaper to the commutator with water soluble glue (no overlap). Do not use coarse sandpaper or emery cloth.

3. Restore the armature to the case and install new brushes.

4. Turn the armature ½ to ¾ of a revolution. This will be sufficient to seat the new brushes.

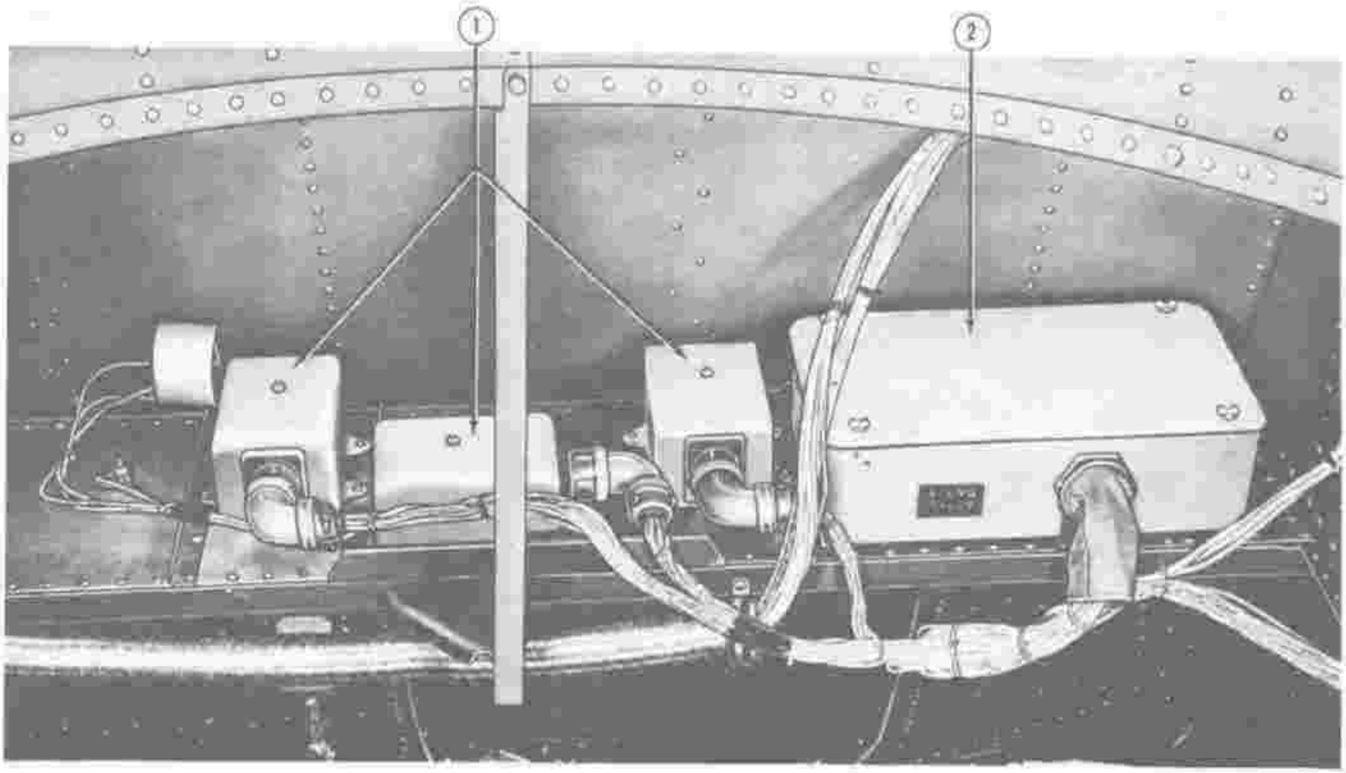
5. Remove the sandpaper and glue with a damp cloth. Clean the armature, commutator, brush rigging, and motor frame with carbon tetrachloride or compressed air, or both. It is very important that all carbon dust be removed.

6. If the commutator is slightly rough or dirty, smooth and polish it evenly with No. 000 sandpaper. If the commutator is very rough, it must be turned down in a lathe.

d. ELECTRICALLY OPERATED EQUIPMENT.

(1) ENGINE STARTER SYSTEM.

(a) GENERAL.—The engine starting system consists of two engine starters controlled by two starter switches in the pilot's compartment. The switches, one the "ENERGIZE" switch for both starters and the other the "ENGAGE" switch for both starters, are spring-loaded in the open position. When the "ENERGIZE" switch is closed by pushing it to either the left or right starter, the flywheel of the starter revolves, reaching a maximum of 20,000 rpm in 15 seconds. When the "ENGAGE" switch is pushed to the same starter, the solenoid meshing device in the starter is actuated and the energy of the revolving flywheel, in combination with the torque exerted by the motor, turns over the engine. Closing the "ENGAGE" switch also energizes the induction vibrator in the ignition system. Provisions are made for the emergency hand-cranking and engaging of the starter; the hand crank is stowed in the right-hand nacelle. A small hinged door in the lower right-hand side of each engine mount is labeled at one end "TO OPEN—PUSH," and at the other end "PULL TO START." A cable is at-



1. Demolition Bomb Rack Selector Relays (RS-2)
2. Fuselage and Wing Bomb Salvo Relays (two each)

Figure 337— Bombing Relays

tached from one end of the door to the manual engaging fitting on the starter. Beneath the other end of the door is a hole through which the hand-crank extension and starter crank shaft is to be inserted. The hinge fitting on the door is elongated to allow a 5/8" pull on the engaging cable. At the starter, a spring is fitted over the engaging cable to assure the disengagement of the starter when pull is no longer exerted on the cable. The starter circuit has a major disconnect plug at both the right-hand and left-hand wing disconnect locations; the circuit is protected by a 15 ampere circuit breaker on the pilot's distribution panel. The wires from the starter are connected to terminal posts in each firewall junction box; the "ENGAGE" switch is wired to the starter through the induction vibrator for each engine. For a simplified wiring diagram of the engine starter system, refer to *figure 434.*

(b) ENGINE STARTER.
(See 4, figure 303.)

1. DESCRIPTION.—One combination inertia and direct cranking starter is installed on the aft end of each engine. Each starter is furnished with a motor and internal solenoid meshing device. The motor is of the series interpole type and is set in this installation for counterclockwise rotation. Each motor assembly includes a flywheel and is removable as a unit from the starter proper. The brushes are set against the motor commutator which is energized, through the type B-8 starter relay, by operation of the starter switch in the pilot's compartment to the "ENERGIZE" position. The jaw meshing solenoid is put into operation through the induction vibrator when the starter switch is operated to the "ENGAGE" position. The starter body consists of a gear case and a steel base, both incorporating the shaft, meshing solenoid, gears, and hand-crank adapter. The driving mechanism from the motor flywheel to the clutch consists of three gear reductions.

2. REMOVAL.

a. Disconnect the electrical wires.

b. Disconnect the meshing cable from the starter.

c. Remove the clamp which secures the meshing cable to the starter.

d. Remove the bolts securing the meshing cable support to the starter.

e. Remove the bolts securing the starter to the engine, and remove the starter.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. If the hand-cranking of the starter is difficult, realign the crank extension and lubricate the crank bearing (around the hand-crank door on the engine mount) with engine oil, grade 98, Specification AN-VV-O-446.

b. If motor fails to operate because of loose and high resistance connections, clean and tighten connections.

c. If motor fails to operate because the brush holders are binding, remove the pivot pins, clean and lubricate, and install.

4. TEST BEFORE INSTALLATION.

a. Operate the solenoid and check the jaw travel for a minimum of 9/16 inch.

b. Apply run-down test as described in TEST AFTER INSTALLATION, below.

5. INSTALLATION.

a. Before installing a new starter, it should be prepared for use as follows:

(1) Remove the shipping cover from the starter jaw. The jaw should have twelve teeth cut for clockwise rotation as viewed from the motor end of the starter.

(2) The starter should be equipped with a concentric handcrank adapter which is slotted for clockwise rotation.

(3) The starter motor is reversible and, in this installation, should be set for counterclockwise rotation as viewed from the motor end of the starter. If it is necessary to reverse the motor, follow the procedure outlined on the underside of the motor cover plate.

(4) Before installing a new starter, it should be tested according to the procedure outlined in TEST AFTER INSTALLATION, below.

b. If the engine pad to which the starter is to be mounted is extremely rough, substitute a solid, soft annealed, aluminum gasket 1/32-inch thick for the asbestos gasket.

c. Wipe the mounting flange and gasket clean.

d. The mounting flange of the starter is provided with 24 mounting holes that permit location of the starter crank extension at 15 degree intervals. The position of the starter on the engine mounting pad should be chosen before the mounting bolts are installed.

e. Align the center line of the crank adapter with the center line of the brass bearing on the lower right-hand side of the engine mount beneath the hand-crank door.

f. After selecting the correct position, insert the mounting bolts and tighten them.

g. Insert the crank in the starter to make sure the brass bearing and the crank adapter are properly aligned; safety the mounting bolts.

h. Install the starter engaging cable assembly on the starter. The center line of the starter engaging cable support should be aligned with the center line of the hand-crank adapter. Make certain the engaging cable has sufficient slack to permit full retraction of the starter jaw.

i. Connect the electrical receptacle.

6. FINAL TEST AFTER INSTALLATION.

a. Accelerate the starter by the motor or by hand to full speed two or three times. Record the run-down time each time.

Note

The starter motor should accelerate from 0 rpm to 20,000 rpm in 15 seconds or less.

b. If the run-down time is less than four minutes, the starter should be removed and forwarded to an overhaul base for cleaning, relubrication, and test.

(c) STARTER SWITCH.

1. DESCRIPTION.—Two type B-11 spring-loaded starter switches are installed on the pilot's overhead control panel *(figure 323)*. One switch is labeled "ENGAGE" and the other "ENERGIZE." Each switch has three positions: "L" for the left engine starter, "R" for the right engine starter, and a straight forward OFF position. The "ENERGIZE" switch connects power to the starter motor through the starter relay; the "ENGAGE" switch connects power to the jaw meshing solenoid of the starter through the induction vibrator. Both starter switches are wired to a circuit breaker switch on the pilot's distribution panel. The circuit breaker switch breaks the circuit to the bus bar when the current exceeds 10 amperes and may be reset by the pilot.

2. REMOVAL.

a. Disconnect the wires at the back of the switch.

b. Remove the two screws holding the switch to the panel.

c. Lift the switch from the panel.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary except for tightening loose connections.

4. INSTALLATION.—Reverse procedure as described in paragraph 2. REMOVAL, above.

(d) STARTER RELAY.
(See figure 338.)

1. DESCRIPTION.—The type B-8 starter relays are installed one aft of each firewall and connected in the starter circuit to the "ENERGIZE" starter switch. When this switch is turned on, the starter relay is actuated, connecting the circuit between the airplane bus bar and the starter motor.

2. REMOVAL. — Disconnect electrical wires, remove screws attaching relay to nacelle wall, and remove relay.

3. MAINTENANCE REPAIR OR REPLACEMENT. — Replacement, rather than repair, will be necessary.

4. INSTALLATION.—Reverse procedure as described in REMOVAL, above.

(2) ENGINE PRIMER CONTROL.

(a) GENERAL.—The engine primer control system consists of a solenoid valve operated by an "ON-

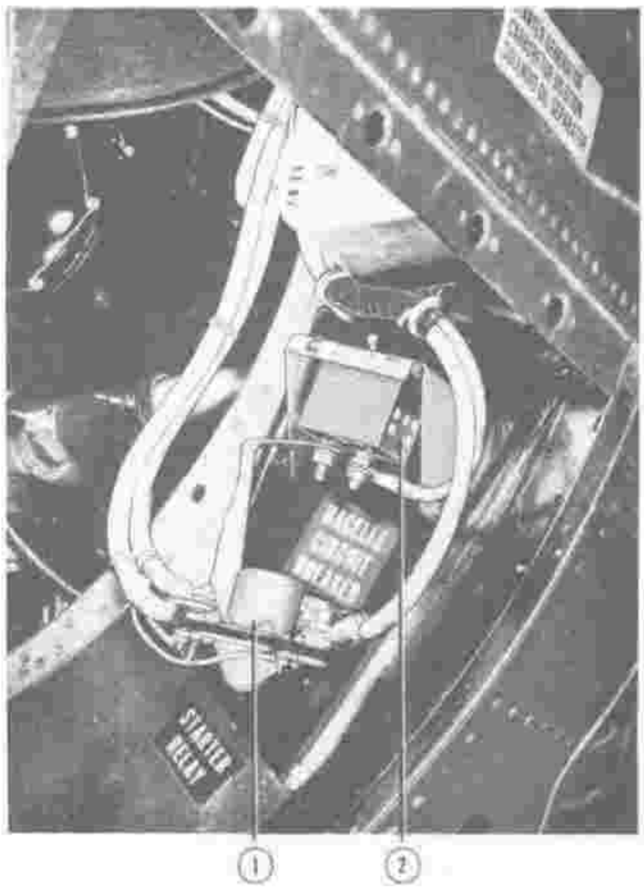


Figure 338 — (1) Starter Relay and (2) Nacelle Relay Box Circuit Breaker

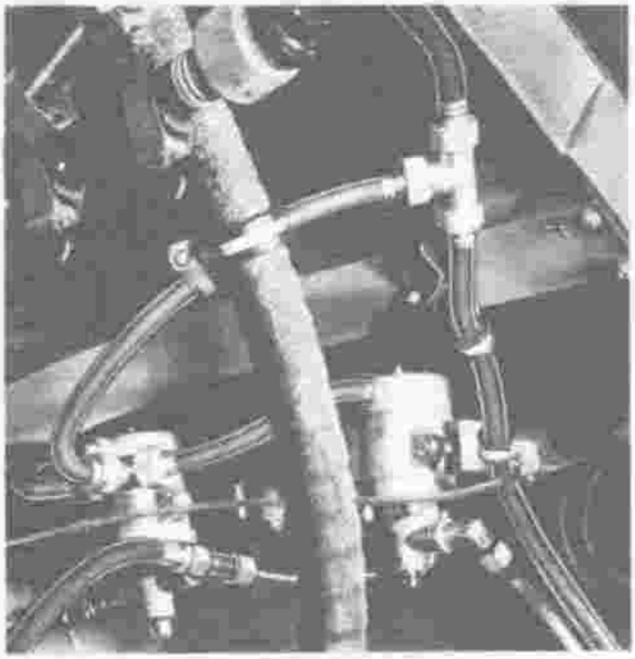


Figure 339 — Oil Dilution and Engine Primer Solenoid Valves

OFF" switch for each engine. The solenoid valve opens the lines between the fuel supply and the engine primers distributor. The engine primer control circuit has two major disconnect plugs for each engine: one at each firewall and one at each forward wing disconnect location. The wire from each solenoid valve is connected to a terminal post in each power plant junction box; the system is protected by a circuit breaker installed in the pilot's distribution panel. For a wiring diagram of the primer control circuit, refer to *figure 455.*

(b) SOLENOID VALVE.
(See figure 339.)

1. DESCRIPTION.—One solenoid valve is installed on the upper right-hand wall of each engine accessory section. The valve is an electrically-operated solenoid valve, controlled by operation of the spring-loaded engine primer switch in the pilot's compartment. The valve is connected to the fuel supply and the engine priming distributor; the electrical connection is connected from the primer switch to the internal terminal post. Operation of the engine primer switch unseats the ball in the valve and allows fuel to flow through the valve, through the priming distributor, directly to the engine cylinders. The words "IN" and "OUT" are clearly cast on the bosses to show the direction of flow through the valve. As soon as the switch is released, the valve is returned to the normal closed position.

2. REMOVAL AND DISASSEMBLY.

a. Disconnect and cap the two flexible lines from the valve.

b. Remove the locknut at the end of the valve and lift off the cover assembly exposing the terminals.

c. Disconnect the wire at the terminal.

d. Release the clamps holding the valve to the bracket.

e. Remove the solenoid valve.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair will be necessary, except for tightening loose connections.

4. INSTALLATION.—Reverse procedure as described in REMOVAL, above.

(c) ENGINE PRIMER SWITCH.

1. DESCRIPTION.—Two spring-loaded type B-6B "ON-OFF" engine primer switches, one for each engine, are installed on the pilot's overhead control panel *(figure 323).* These switches are wired through the oil dilution switches to a circuit breaker switch on the pilot's distribution panel. The circuit breaker switch breaks the circuit to the bus bar when the current exceeds 10 amperes and may be reset by the pilot.

2. REMOVAL.

a. Disconnect the wires at the back of the switch.

b. Remove the two screws holding the switch to the panel.

c. Lift the switch from the panel.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary except for tightening loose connections.

4. INSTALLATION.—Reverse procedure as described in REMOVAL, above.

(3) WING FLAPS ELECTRICAL.

(a) GENERAL.—The wing flaps are electrically operated by means of an electrical drive unit and gear box controlled by a dual relay and switch. The switch is linked to the wing flap control lever on the control pedestal. The control switch is connected to power through a five ampere circuit breaker switch on the pilot's distribution panel; the relay is directly connected to the main fuselage bus bar. For a wiring diagram of this system, refer to *figure 439.*

(b) WING FLAP ELECTRICAL DRIVE UNIT.
(See figure 340.)

1. DESCRIPTION.—The wing flap electrical drive unit is mounted on the aft wall of the frame dividing the bomb bay and consists of a reversible, 24 volt d-c, compound motor with an output shaft and gear box. The motor incorporates an overload protective switch, a torque limiting clutch, and a quick-stopping device. Two limit switches R-RL2-A38 are mounted on the side of the gear box and are controlled by cams linked to the main shaft. The switches are marked "A" and "C"; switch "A" opens the motor circuit when the flaps move to the full down position, and switch "C" opens when the flaps move to the full up position. The wing flap transmitter for the position indicator in the pilot's compartment is mounted on the main gear box. For further information on the wing flap drive unit, refer to paragraph 3, MOVABLE SURFACES AND SURFACE CONTROLS, this section.

2. REMOVAL.

a. MOTOR.

(1) Disconnect the electrical plug from motor.

(2) Remove cover plate from side of gear box by removing screws.

(3) Remove nuts and bolts attaching motor to gear box and remove motor.

b. LIMIT SWITCHES.

(1) Remove cover from side of gear box (above emergency hand crank shaft engaging unit) by removing screws.

(2) Disconnect wire connections at switches.

(3) Remove attaching screws and remove switches.

c. CURRENT CUT-OFF SWITCH.

(1) Remove cover from top of emergency hand crank shaft engaging unit by removing screws.

(2) Disconnect wire connections at switch.

(3) Remove attaching screws and remove switch.

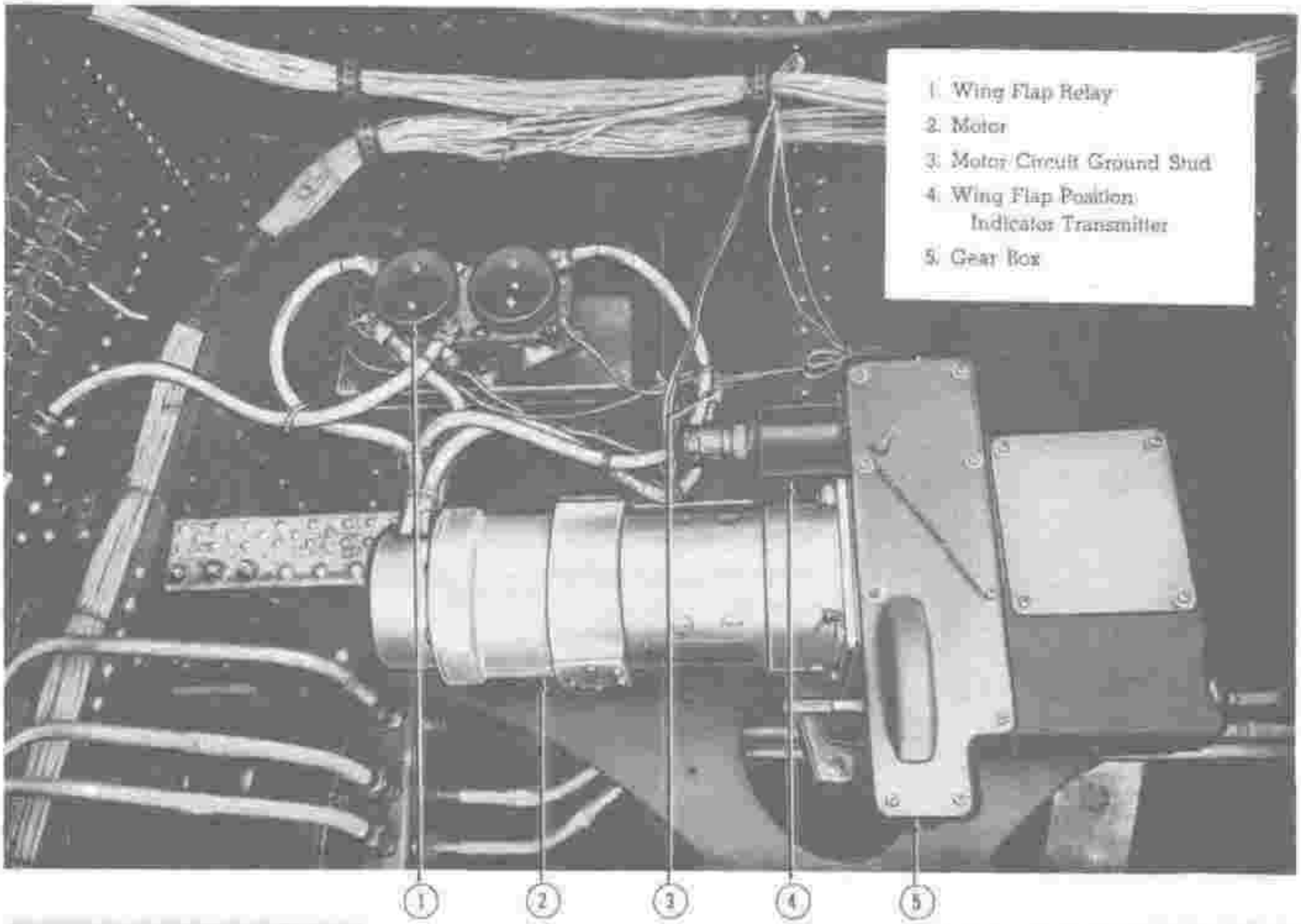


Figure 340 — Wing Flap Electrical Drive Installation

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MOTOR.—Refer to paragraph 15. *c.* (6) *(a)*, this section. No lubrication of the motor is necessary between overhaul periods.

Note

A thermal protector is built into the motor. If the motor is overheated by an overload, a bimetal disk in the protector will open temporarily, breaking the current. Before replacing a motor, check operation of the thermal protector in the motor housing.

b. SWITCHES.—Replacement, rather than repair, will be necessary.

4. ADJUSTMENTS.—Refer to paragraph 3, MOVABLE SURFACES AND SURFACE CONTROLS.

5. INSTALLATION.—Reverse procedure as described in paragraph 2, REMOVAL, above.

(c) WING FLAP RELAY.
(See 1, figure 340.)

1. DESCRIPTION.—One dual type C-2 Leach relay is installed on a bracket under the flap drive unit on the aft side of the frame dividing the bomb bay. The relay operates to connect the motor to power when the wing flap control switch in the pilot's compartment is operated; the relay is de-energized by operation of the limit switches, the current cut-off switch, and the pilot's control switch.

2. REMOVAL.

a. Disconnect the electrical connections.

b. Remove the screws attaching the relay to the support bracket and remove the relay.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 15. *c.* (6) *(a)*, this section.

4. INSTALLATION. – Reverse REMOVAL procedure.

(d) WING FLAP CONTROL.

1. DESCRIPTION.—The rotary contact switch for the control of the wing flaps is linked to a control lever *(figure 49)* on the control pedestal. The switch unit consists of a rotary lever making contacts between two contact points and a circular band which is connected to power. The lever has three positions: "LANDING" ("K" contact point), "NEUTRAL" (or "OFF"), and "FLAPS UP" ("M" contact point). When the lever is moved to one of these positions, the relay is energized, the motor is connected to power, and the flaps are driven through the gears until they reach the set position.

2. REMOVAL.

a. Remove the center cover assembly of the control pedestal as described in paragraph 3. *c.* (2), this section.

b. Disconnect electrical wires at flap control switch.

c. Remove the pin and nut attaching the control clevis to the switch arm.

d. Remove nut on pin holding switch.

e. Slide pin out far enough to release switch and remove switch.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement of switch unit, rather than repair, will be necessary.

4. INSTALLATION.—Reverse procedure as described in REMOVAL, above.

(4) COWL FLAP ELECTRICAL.

(a) GENERAL.—The cowl flap control for each engine system consists of an electrical drive unit operated by the action of a control switch in the pilot's compartment through a dual relay. According to the selection of the switch, the electrical drive is operated to open or close the cowl flaps through a main gear box, a coordinating gear box, and a gear box for each cowl flap unit. Refer to paragraph 6, ENGINE, this section for further information on the cowl flaps. Each control switch is wired to power through a five ampere circuit breaker switch in the pilot's distribution panel; the relay is wired to power through a circuit breaker in the firewall junction box.

(b) COWL FLAP ELECTRICAL DRIVE UNIT.
(See 5, figure 303.)

1. DESCRIPTION.—One cowl flap electrical drive unit is installed on each engine mount in the lower right-hand side, looking forward. The unit consists of a reversible, series wound motor designed to operate on 28 volts, a shunt clutch coil for the motor, limit switches, and a gear box. The motor has an integral thermal overload switch which opens the motor circuit if the motor should overheat. The shunt clutch coil actuates a clutch between the motor and the gear box. By disconnecting the gear box from the motor as soon as the current to the motor is stopped, the clutch eliminates the motor over-travel effect on the cowl flaps. Two micro-limit switches are installed inside each gear box to stop the motor when the cowl flaps reach the full open or full closed position. The motor and the gear box are connected to the gear boxes for the flaps by a flexible shaft which passes through a fire seal directly forward of the drive unit to the coordinating gear box.

2. REMOVAL.

a. Disconnect the electrical conduits at the motor and limit switch unit.

b. Remove the bolts attaching the unit to the support bracket.

c. Disconnect the flexible shaft and remove the drive unit.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Refer to paragraph 15. *c.* (6), this section.

b. The limit switches will be replaced, rather than repaired.

Note

Check operation of the thermal overload switch built into the motor housing before replacing the motor.

4. INSTALLATION.–Reverse procedure as described in REMOVAL, above.

Note

Synchronize the cowl flaps with the drive unit as instructed on the instruction plate mounted on the forward side of the firewall. This instruction plate reads as follows:

5. INSTRUCTIONS FOR SYNCHRONIZING COWLING FLAPS WITH DRIVE.

a. Adjust individual jack screws so straight line projections of flaps clear nacelle ⅜ inch at firewall, Sta. 93.

b. Run drive in closing direction until limit switch shuts motor off.

c. Install flexible shafting between gear boxes and drive.

Note

Flaps will open 13° between limit switches. Limit switches are in drive unit and are not adjustable.

(c) COWL FLAP RELAYS.

1. DESCRIPTION.–One dual relay is installed in each power plant junction box *(figure 333)*. The relay connects the electrical drive unit to power when the cowl flap switch in the pilot's compartment is turned "ON"; the relay is de-energized by operation of the limit switches, the motor overload switch, and the pilot's control switch.

2. REMOVAL.

a. Disconnect the electrical wires at relay; disconnect ground wire at ground stud.

b. Remove the screws attaching the relay to the junction box and remove the relay.

3. MAINTENANCE REPAIR OR REPLACEMENT.–Maintenance is confined to cleaning of contacts.

4. INSTALLATION. – Reverse REMOVAL procedure.

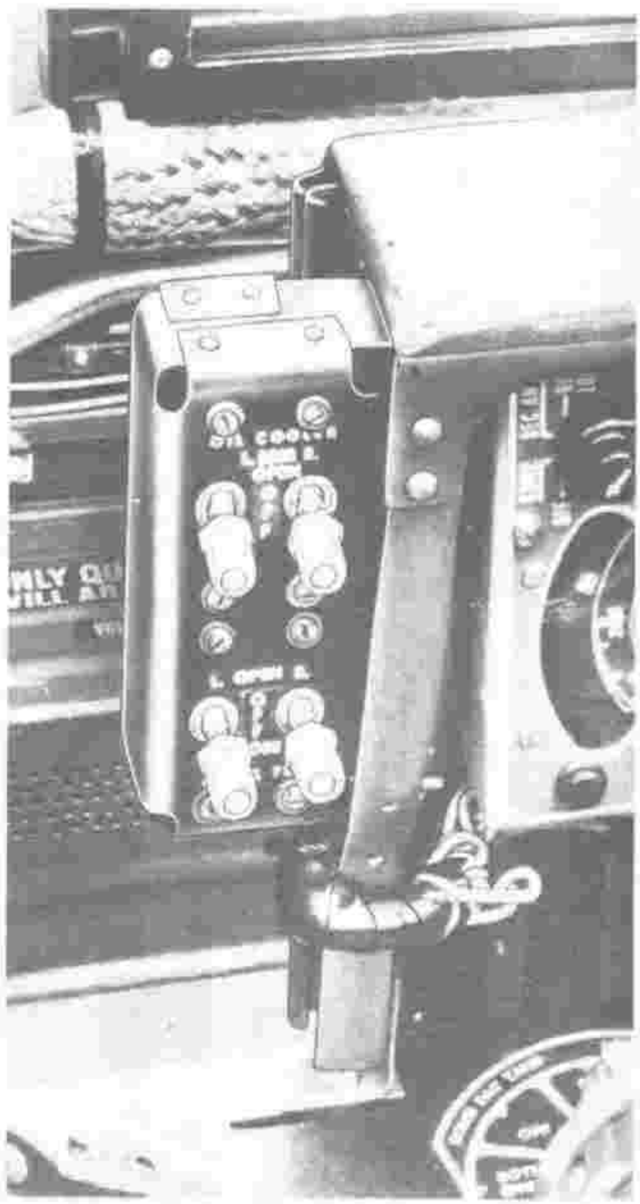


Figure 341 — Oil Cooler Door and Cowl Flap Switches

(d) COWL FLAP SWITCHES.
(See figure 341.)

1. DESCRIPTION.—Two type B-9A toggle switches, one for each engine cowl flap system, are installed on the control pedestal. Each switch has three positions: "OPEN," "CLOSE," and "OFF." When the switches are in either "OPEN" or "CLOSE," the cowl flap electrical drive unit is energized to open or close the cowl flaps.

2. REMOVAL.—Disconnect electrical wiring and remove the attaching screws.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(5) FUEL BOOSTER PUMP ELECTRICAL.

(a) GENERAL.—Each fuel container in the fuel system has a booster pump installed. These are electrically operated by means of the three fuel booster pump selector switches and the two fuel selector switches in the pilot's compartment. The fuel booster pump rheostats are pre-set on the ground to regulate the amount of added boost for emergency operation. The booster pump electrical system has a major disconnect plug in each forward wing disconnect location, and a plug at the forward and aft control pedestal disconnect location. The system is protected by three 20 ampere circuit breakers on the pilot's distribution panel, one for each wing wiring and one for the bomb bay wiring. For a simplified wiring diagram of this system, refer to *figure 438.*

(b) FUEL BOOSTER PUMP.

1. DESCRIPTION. — Five electrically operated fuel booster pumps are installed in the fuel system. A pump is installed on each of the two main (nacelle) fuel containers, on the bomb bay fuel container, and on the auxiliary (wing) containers. The booster pumps are of the centrifugal type, driven by electric motors and performing the following functions: (1) boosting (pumping) of vapor free fuel to the engine-driven fuel pump at high altitude to prevent fuel system failure due to vapor lock; (2) fuel system priming and pressuring prior to engine starting, during landings, and during take-offs; (3) operation as an emergency fuel pump in the event of engine pump failure. The pumps are controlled by the selector switches in the pilot's compartment. Five rheostats, also in the pilot's compartment, are included in the circuit and are pre-set to maintain a desired speed of the booster pumps in emergency operation.

2. REMOVAL.

a. Drain the fuel from the system as described in paragraph 11, FUEL SYSTEM.

b. Disconnect the electric wiring at the disconnect plug.

c. Remove the fuel line from the pump (nacelle and bomb bay container pump only).

d. Disconnect the drain line.

e. Remove the screws attaching the pump to the container and remove the pump.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Maintenance will be limited to exterior cleaning, replacement of seal parts, and replacement of brushes. When the booster pump requires any other repairs, it should be replaced and the used unit sent to a depot for overhaul. Lubrication is limited to replacement of grease-sealed bearings when necessary and the use of threadlube on all threaded and tenon fits.

b. If the seal parts are allowing a leakage from the seal drain, disassemble as shown in *figure 342,* and inspect seal parts *(10, 11, 12, 13, figure 342.)*

c. If seal cushion *(within 10, figure 342)* is sticking to shaft or there is dirt between the cushion and the shaft, clean parts thoroughly or if necessary, replace with new cushion.

Note

In reassembly, put a drop of oil on the shaft so cushion is certain to slide down and seat firmly on rotating seal.

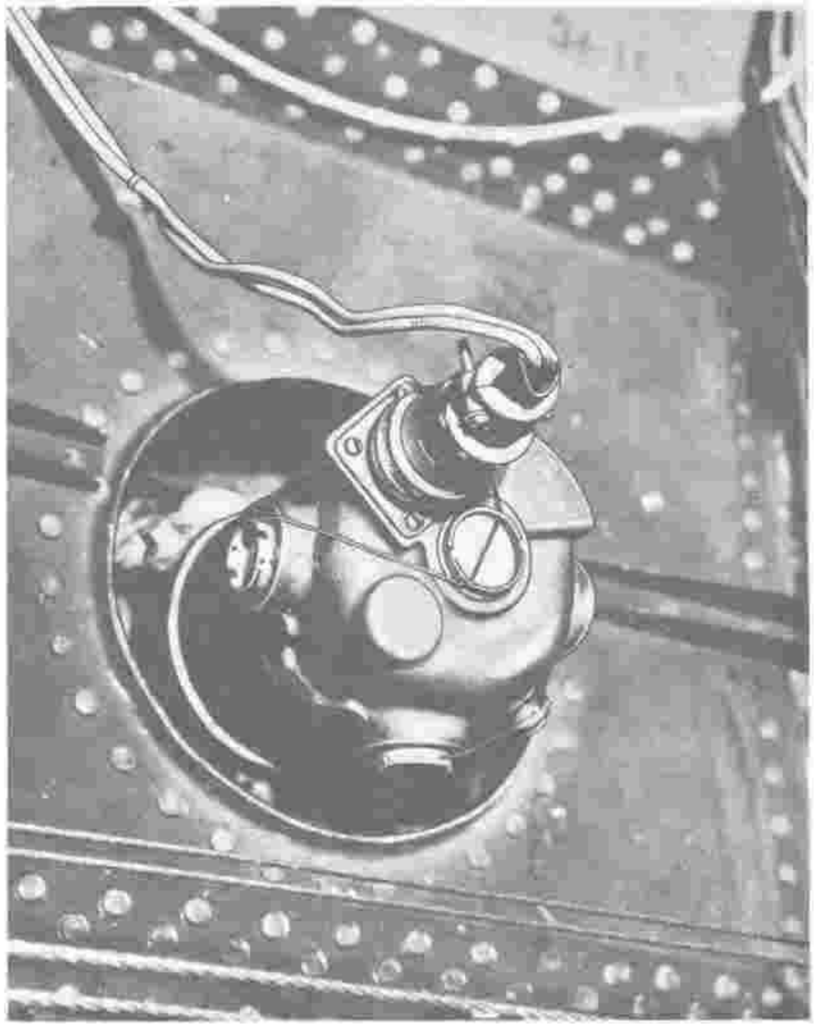
d. Dirt on sealing faces of rotating or stational fuel seals should be cleaned out thoroughly.

e. Damaged seal cushion, cracked fuel seals, or improperly seated seal gasket should be replaced.

f. The maximum permissible wear of the brushes is down to a length of 5/16 inch from a new length of ½ inch. The brushes should be replaced before the maximum wear limit is reached in order to assure correct operation. In replacing the brushes, use the following instructions.

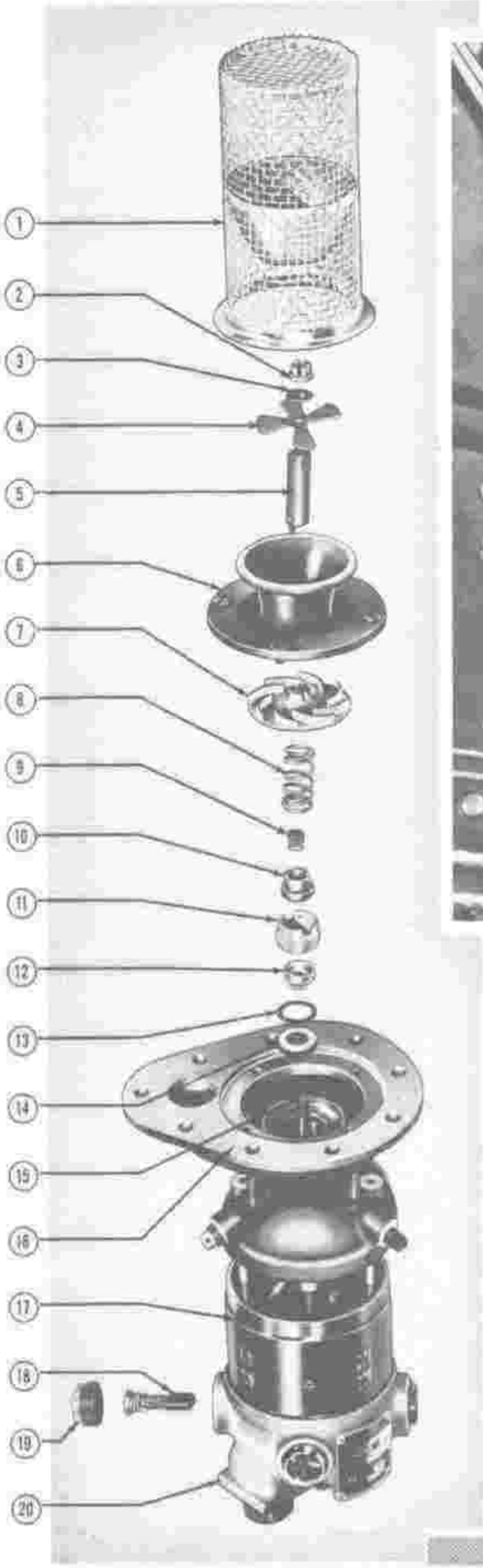
(1) Unscrew the brush cover nuts *(19, figure 342)* and brush holder cap screws *(18, figure 342)* to get at brushes.

(2) Remove brush assembly *(18, figure 342)* and insert new brush, replacing brush holder cap screws and cover nuts.



Installed

1. Screen
2. Nut
3. Washer
4. Auxiliary Propeller
5. Impeller Sleeve
6. Throat
7. Impeller
8. Spring
9. Spring
10. Diaphragm Seal Assembly
11. Seal Nut
12. Shaft Slinger
13. Seal Gasket
14. Retaining Washer
15. Armature Assembly
16. Pump End Frame Assembly
17. Frame and Coil Assembly
18. Brush and Nut Assembly
19. Brush Cover Nut
20. Commutator End Frame Assembly



Exploded View

Figure 342—Typical Fuel Booster Pump

Note

When replacing a worn brush, the new brush should have the same radius of curvature on the end as the commutator. Normally, spare brushes are supplied in this form, but if they are not it will be necessary to sand the face of the brush to the form of the commutator with a strip of No. 000 sandpaper. Pumps with new brushes should be run for two hours under load to seat brushes.

5. TEST BEFORE INSTALLATION.—Before installing the booster pump, it is necessary to wash the impeller chamber *(within 16, figure 342)* with clean fuel and to test the impeller for freedom of rotation. USE FINGERS ONLY FOR THIS TEST. The slightest catch at any point in complete revolution indicates the presence of harmful foreign matter. If rewashing the chamber fails to remove the obstruction, take off the impeller *(7, figure 342)* and clean the back of it. If the trouble still persists, the unit should be turned over to the service depot and replaced with a new pump.

6. INSTALLATION.—Reverse procedure as described in REMOVAL.

(c) FUEL SELECTOR SWITCHES. *(See figure 343.)*

1. DESCRIPTION.—Two rotary type fuel selector switches are installed on the control pedestal in the pilot's compartment, one for each wing fuel system. A lever attached to the fuel container selector valve control shaft rotates with the shaft and makes the desired switch point contacts. Each switch has three positions: "MAIN," "AUX." and "OFF." Each switch has two internal plates; one connected to the circuit by turning its fuel booster pump selector switch to the normal "LOW BOOST" position; the other connected to the circuit by turning its fuel booster pump selector switch to the "HIGH BOOST" position. The normal "LOW BOOST" position operates the respective fuel booster pump; the "HIGH BOOST" position gives a variable added boost, controlled by its pre-set fuel booster pump rheostat. The bomb bay fuel booster pump is directly controlled by its fuel booster pump selector switch.

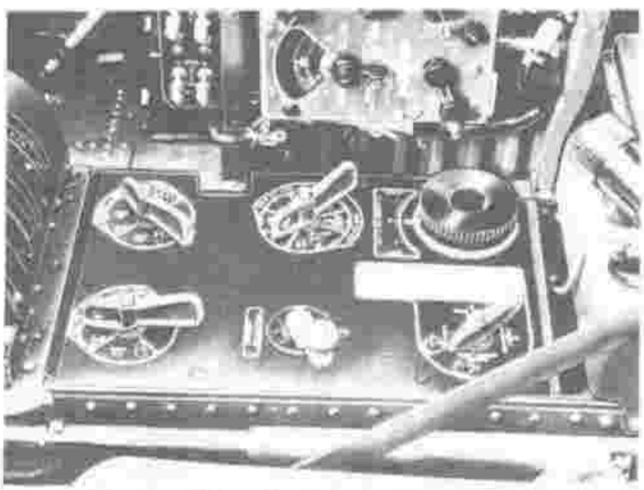


Figure 343 — Fuel Selection Controls

2. REMOVAL.

a. Remove the center cover assembly of the control pedestal as follows:

(1) Remove the handles from the controls on the cover by removing the nut which secures each control handle to its shaft.

Note

The cover over the aileron trim tab control nut will have to be pried from the center with a sharp instrument.

(2) Remove the machine screws around the edge of the cover and remove the cover.

b. Remove the nuts and screws holding the switch to the control casting.

c. Lift the switch off the lower end of the serrated control shaft.

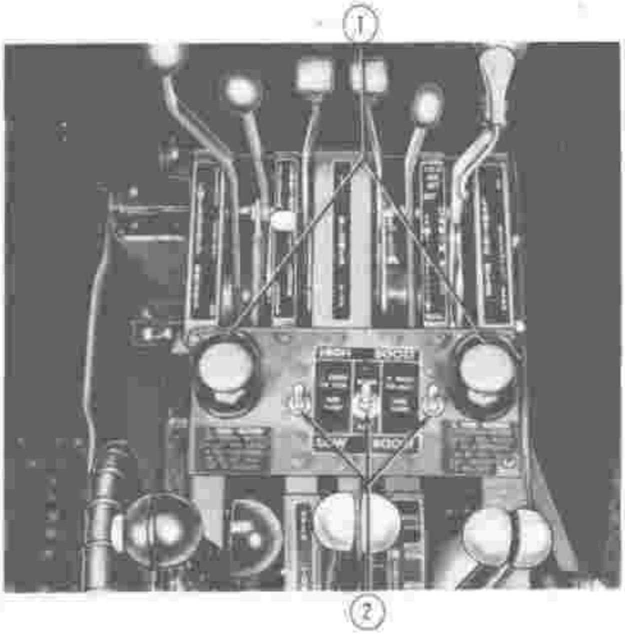
d. Disconnect the wires from the switch terminals and remove the switch.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening loose connections.

4. INSTALLATION. — Reverse REMOVAL procedure.

(d) FUEL BOOSTER PUMP SELECTOR SWITCHES. *(See figure 344.)*

1. DESCRIPTION.—Three type C-2 fuel booster pump selector switches are installed on the control pedestal, one for each wing fuel system and one for the bomb bay container. Each switch has two positions: "LOW BOOST" and "HIGH BOOST." The "LOW BOOST" position sets up the circuit for normal action of the booster pump; the "HIGH BOOST" position sets up the circuit for emergency added action of the booster pump, controlled by the fuel booster pump rheostats. Refer to FUEL SELECTOR SWITCHES, above, for the combined action of these switches with the fuel selector switches.



1. Propeller Feathering Control Switches
2. Full Booster Pump Selector Switches

Figure 344—Electrical Controls Forward Control Pedestal

2. REMOVAL.

a. Remove the propeller feathering knobs and nuts.

b. Remove the screws holding the cover assembly to the control column structure.

c. Lift up the cover assembly and remove the wires from the terminals.

d. Remove the screws holding the switch to the cover assembly and remove the switch.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

4. INSTALLATION. – Reverse REMOVAL procedure.

(*e*) FUEL BOOSTER PUMP RHEOSTATS. (*See figure 345.*)

1. DESCRIPTION.—Five rheostats, one for each fuel container booster pump, are installed on a support panel which is riveted to the control pedestal behind the pilot's seat. These rheostats regulate the amount of boost which will be added to the booster pumps when the fuel booster pumps selector switches are turned to the "HIGH BOOST" position. The switches are pre-set on the ground with engines inoperative, as described in paragraph 15. *d.* (5) (*b*) 2., this section.

2. REMOVAL.

a. Remove the knob.

b. Disconnect the wires at the back of the rheostat.

c. Remove the rheostat.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening loose connections.

4. ADJUSTMENT.—If the fuel booster pumps fail to supply sufficient pressure in the HIGH BOOST position, adjust the speed of the fuel booster

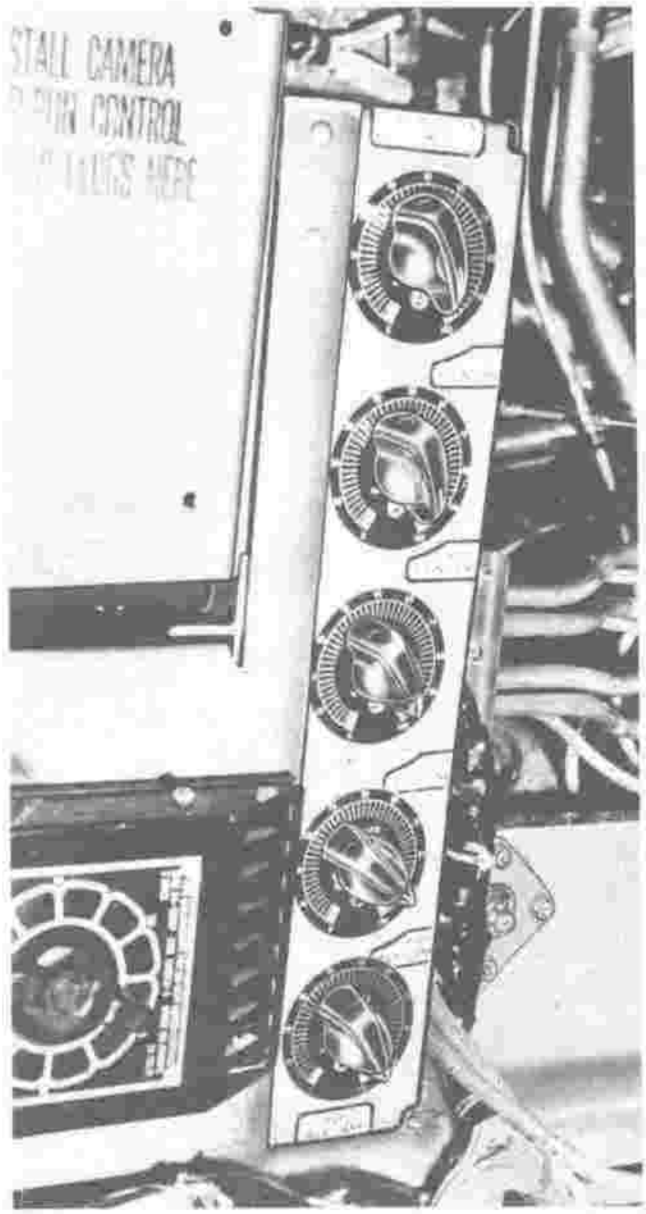


Figure 345 — Fuel Booster Pump Rheostats

pump electric motors by means of the rheostats installed adjacent to the control pedestal. Prior to flight, and with engines NOT OPERATING, adjust the speed of each pump motor to obtain a minimum fuel pressure of 18 pounds on the fuel pressure indicator. If the pressure exceeds 18 pounds, no harm will result. The combined pressure of the engine pumps and the booster pump when in HIGH BOOST must not exceed 24 pounds.

(6) CARBURETOR AIR FILTER ELECTRICAL.

(a) GENERAL.—A door located in the lower surface of each carburetor air scoop is provided to direct the incoming air either through the scoop from the forward opening (non-filtered) or through the filter then into the scoop. This door is operated by an electric motor located adjacent to the door and controlled by a switch on the main electrical control panel. The system also includes limit switches (integral with motor) and a circuit breaker located on the pilot's electrical distribution panel. The motor and door operations are illustrated in *figure 346*. For a complete description of the air induction system refer to paragraph 7., this section.

(b) MOTORS.

1. DESCRIPTION.—A conventional type 24V motor is located below the forward door in each carburetor air scoop. These motors are equipped with limit switches which break the electrical circuit when the limits of the door travel have been reached.

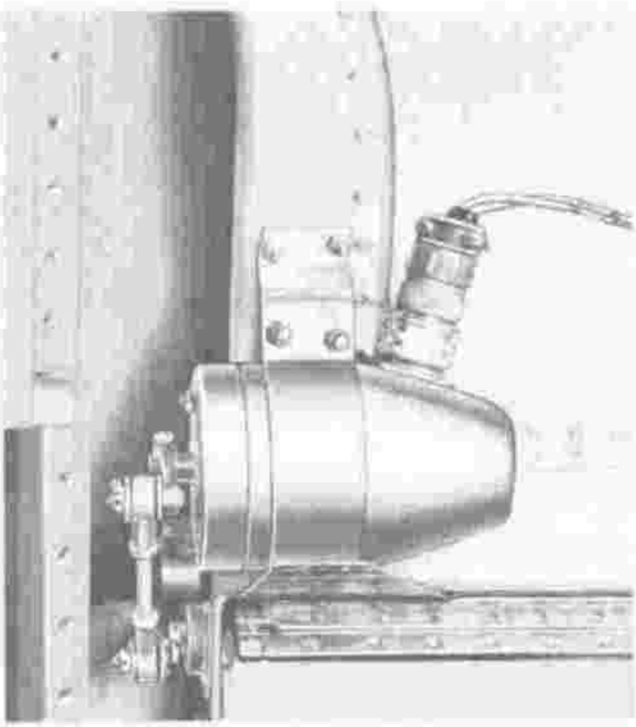


Figure 346 — Carburetor Air Filter Door Mechanism

2. REMOVAL.

a. Loosen the upper half of the engine cowling. Disconnect the electrical plug from the motor before lifting the cowling from the airplane.

b. Disconnect attaching bolts.

c. Slide motor away from actuating arm to free the splined shaft.

3. MAINTENANCE REPAIR.—General motor repair procedure is described in paragraph 15. *c.* (6), this section.

4. INSTALLATION. — Reverse REMOVAL procedure.

5. ADJUSTMENT.—The only adjustment on the motor is the opening positions of the limit switches. This adjustment must be made with the motor on the cowling with the door linkage connected. If the door travel is not correct when the limit switch stops the motor adjusts by turning the adjusting screw on the motor clockwise to increase the stroke of the arm and counterclockwise decreases the stroke.

(7) OIL DILUTION CONTROL.

(a) GENERAL.—The oil dilution control system consists of a solenoid valve, operated by an "ON-OFF" switch, for each engine. The solenoid valve opens the lines between the fuel supply and the oil system. The oil dilution control circuit has two major disconnect plugs for each engine: one at each firewall and one at the forward wing disconnect location. The wire from each solenoid valve is connected to a terminal post in each power plant junction box; the system is protected by a circuit breaker switch installed in the pilot's distribution panel. The control switches are located on the pilot's overhead control panel.

(b) SOLENOID VALVE.
(See figure 339.)

1. DESCRIPTION.—One solenoid valve is installed on the upper right hand wall of each engine accessory section. The valve is an electrically-operated solenoid valve, controlled by operation of the spring-loaded oil dilution switch in the pilot's compartment. Fuel is taken directly from the fuel pressure line and enters the oil system by means of an outlet on the "Y" oil drain valve. The primary use of the oil dilution solenoid is for cold weather starts. For further explanations, refer to paragraph 15. *d.* (2) *(b)*, this section. The engine primer solenoid valve is identical to this valve.

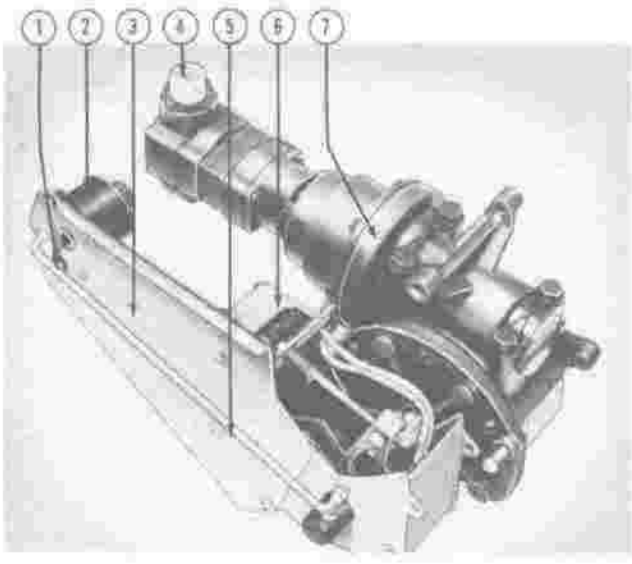
2. REMOVAL.—The removal procedure is the same as that for the engine primer solenoid valve. Refer to paragraph 15. *d.* (2) *(b)* 2., this section.

(8) OIL COOLER CONTROLS.

(a) GENERAL.—The control for each oil cooler door system consists of an electrical drive unit, to open and close the oil cooler door; a control switch in the pilot's compartment, for direct control of the door drive unit; a position indicator on the instrument panel and relays and resistors. The system has major disconnect plugs at each forward wing electrical disconnect location, and receives power through the pilot's control switch. Refer to paragraph 12, OIL SYSTEM for further information.

(b) OIL COOLER ELECTRICAL DRIVE UNIT. *(See figure 347.)*

1. DESCRIPTION.—The drive unit for the oil cooler doors consists of a 1/6 hp electric motor with a magnetic brake and thermal protection switch, a gear box with torque drive, and a switch box containing follow-up switches and limit switches. The drive unit is mounted to a bracket on the inboard side of each oil cooler duct; the switch box is mounted to the side of the drive unit. The motor provides power to open and close the oil cooler doors and is protected by a thermal switch which opens the circuit should the motor overheat. The follow-up switches allow the motor to operate until the oil cooler doors are in the desired position; the limit switches stop the motor when the oil cooler doors are in the extreme "OPEN" or "CLOSED" position.



1. Adjustment Screw—Position Transmitter Arm
2. Oil Cooler Door Position Transmitter
3. Bracket
4. Electrical Receptacle
5. Arm Assembly
6. Drive Assembly Follow-Up and Limit Switch Unit
7. Oil Cooler Door Drive Assembly

Figure 347—Oil Cooler Door Drive and Position Transmitter Assembly

2. REMOVAL.

a. DRIVE UNIT.

(1) Remove the access door on the top of the wing, outboard of the nacelle, by removing the screws.

(2) Disconnect the electrical connections at the motor and switch box.

(3) Loosen the bolt and remove the split lock nut at the inboard side of the gear box.

(4) Support the door and pull the serrated shaft of the drive unit inboard sufficiently to disengage it from the gear box.

(5) Remove the bolts which attach the drive unit to the bracket and remove the drive unit.

b. SWITCH BOX UNIT.

(1) Remove the bolts attaching the switch unit shield box to the drive unit and remove the shield box.

(2) Remove the bolts holding the cover of the shield box in place and remove the cover.

(3) Remove the bolts holding the bottom of the shield box and remove the bottom.

(4) Remove the cotter pin holding the spring on the limit switch adjustment bolts.

(5) Remove the limit switch adjustment bolts from the box.

(6) Remove the lock ring holding the insert in the electrical receptacle.

(7) Remove the lock ring holding the serrated shaft in the bracket.

(8) Drive the serrated shaft partly out of the bracket; remove the key and then drive the shaft completely out.

(9) Disconnect and remove the follow-up switch and both limit switches with their brackets; remove the micarta spacer and the limit switch actuating arm.

(10) Detach the switches from their brackets.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 15. *c.* (6), for general motor maintenance instructions. A cracked or damaged drive unit must be removed from the airplane and replaced. Before replacing a unit which apparently is not functioning correctly, be sure that damaged electrical wiring and connections are not at fault. If the micarta follow-up cam is worn more than .015 inch, it should be replaced. The limit switches should be replaced at intervals of 500 hours. The bearings are sealed and require replacement rather than lubrication.

4. ADJUSTMENTS.—The follow-up switch is pre-set at the factory and should not be changed. The limit switches are adjusted by turning the screw on the side of the switch box unit. This may be reset to give a total travel of the torque drive shaft of 61 degrees ± 5 degrees. Final adjustment must be made on the airplane as follows:

a. Open the oil cooler door 1/2 degree from its closed position (as determined by the fixed stop adjustment). Set the CLOSE limit switch to open the circuit and stop the door in this position.

b. Close the oil cooler door 1/2 degree from its open position (as determined by the fixed stop adjustment). Set the OPEN limit switch to open the circuit and stop the door in this position.

Note

Make certain that the limit switches and NOT the fixed stops determine the extreme positions of the doors.

5. INSTALLATION.—Reverse the REMOVAL procedure, 2., above.

6. FINAL TEST AFTER INSTALLATION.—Check operation of oil cooler doors with control switch in "OPEN," and "CLOSE," positions. With the control switch in "CLOSE," the doors should close to a position with a maximum allowable opening of 3/8 inch. With the control in "OPEN," the doors should travel a total of 61 degrees from the fully closed position.

Note

Insufficient travel of the doors may be adjusted by the limit switch adjusting screws on the side of the drive unit switch box.

(c) OIL COOLER DOOR SWITCHES. *(See figure 341.)*—Two three-way switches, one for each oil cooler door, are installed on the control pedestal. (On some of the airplanes the switches are located on the main electrical control panel.) Each switch has three positions: "OPEN" which operates the drive unit to open the oil cooler door, "CLOSE" which operates the drive unit to close the oil cooler door, and "OFF." Each switch is wired to power through a circuit breaker located on the pilot's distribution panel.

(d) OIL COOLER DOOR POSITION INDICATOR.—Refer to INSTRUMENTS ELECTRICAL, this paragraph.

(9) HEATING AND VENTILATING ELECTRICAL.

(a) GENERAL.—Each of the two independent heating systems (forward and aft) consist of a ducting heater, and a recirculating heater. The air is regulated for the ducting heaters by modulators; each recirculating heater has a motor and fan assembly attached to it. The fuel for the heaters is controlled by fuel shut-off valves at the supercharger blower case. The ducting heaters are prevented from operating when the airplane is on the ground by means of the heater safety switch. The heaters are controlled by means of the heater controls; the current is switched to the heaters and modulators by means of relays. Ventilation, with the heaters off, is provided by operation of the cold air control switches with the heater control at the cold air setting. The circuits in the forward heating system are wired to power through circuit protectors (25 ampere—Recirculating, 20-ampere—Ducting) in the forward junction box; the circuits in the aft heating system are wired to power through circuit breaker switches in the fuselage aft relay box. Both the pilot's and gunner's heating systems are controlled by the heater master switch on the pilot's main electrical control panel. On the A-26C airplane the forward recirculating heater is moved forward into the nose section. No additional wiring is required. For wiring diagrams of the two heating systems, refer to *figure 449.* Refer to paragraph 19, HEATING AND VENTILATING SYSTEM for further information.

(b) HEATERS. *(See figure 248.)*

1. DESCRIPTION.—Four 40,000 Btu, 24 volt heaters are installed, two in the forward and two in the aft section of the airplane. One of the two heaters in each section is a ducting heater and the other is a recirculating heater. Attached to each recirculating heater is a motor and fan assembly. Each heater contains a resistance igniter, a thermo-snap switch, and two overheat switches. Current flows to the heater through the igniter to the thermosnap switch. By means of a thermostatic blade this switch breaks the electrical circuit when the heater becomes sufficiently hot (approximately 55°C or 130°F). One overheat switch is located between the fins adjacent to the combustion chamber. This thermostatic switch opens the circuit to the fuel shut-off valve when the fins become overheated (approximately 163°C or 325°F). The other thermostatic overheat switch is located at the exhaust end of the heater and opens the circuit to the fuel shut-off valve when the exhaust duct becomes overheated (approximately 41°C or 285°F). When the heater cools sufficiently, these overheat switches and the thermo-snap switch will close the circuit to the valve.

2. REMOVAL AND DISASSEMBLY.

a. HEATER.—Refer to paragraph 19, HEATING AND VENTILATING SYSTEM.

b. IGNITER. *(3, figure 348.)*

(1) Remove igniter shield.

(2) Disconnect wires attached to igniter and remove.

c. THERMO-SNAP SWITCH. *(1, figure 348.)*

(1) Remove switch housing.

(2) Disconnect wires attached to switch and lift out switch.

d. FIN OVERHEAT SWITCH. *(4, figure 348.)*

(1) Remove switch housing.

(2) Disconnect the three connections of wires from the fin overheat switch shield.

(3) From the igniter end of the heater, cut the lock wire holding the overheat switch to the fin assembly and pull the switch and shield from the spring insert in the fin.

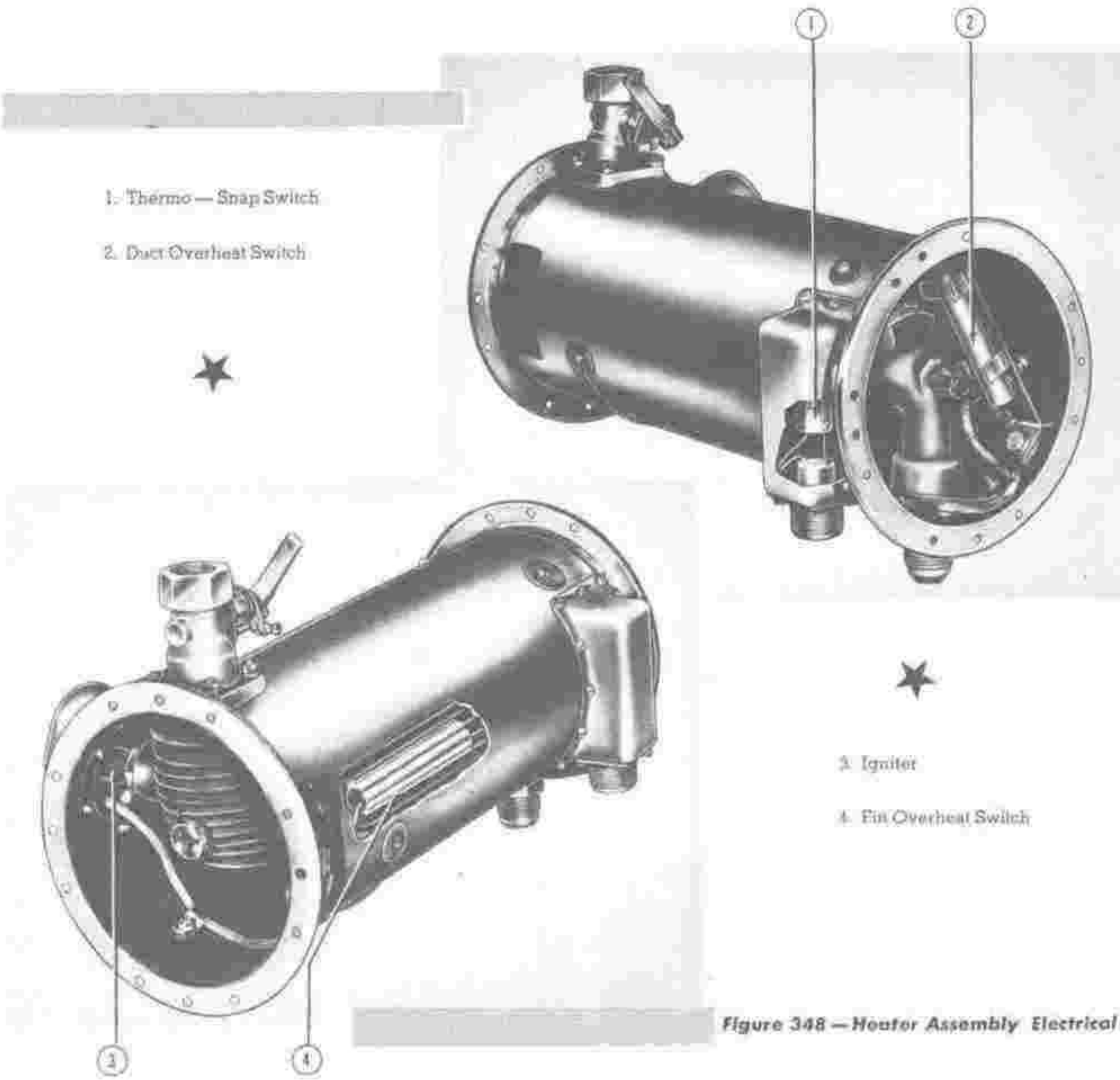


Figure 348—Heater Assembly Electrical

e. DUCT OVERHEAT SWITCH.
(2, figure 348.)

(1) Remove switch housing.

(2) Disconnect the wire from the duct overheat switch shield.

(3) From the switch end of the heater disconnect the other wire from the overheat switch.

(4) Disconnect the switch from the small mounting bracket and remove the switch and shield.

3. MAINTENANCE, REPAIR OR REPLACEMENT. – Refer to paragraph 19, HEATING AND VENTILATING SYSTEM.

4. TEST AFTER INSTALLATION.

a. Check current supply to heater by attaching one lead to voltmeter to "B" pole of the heater connector, and other lead to ground. Turn on the heater and observe reading of voltmeter. Voltage shown at this point must be at least 22 volts. If no reading is obtained, check for defective master switch or control switch.

b. Remove igniter cover and attach one lead of voltmeter to igniter terminal and other lead to ground.

(1) If required voltage is shown and igniter casing does not get warm, the igniter coil is defective and igniter must be replaced.

(2) If voltmeter does not give a reading, the thermo-snap switch is defective and must be replaced.

(c) MODULATORS. *(See figure 349.)*

1. DESCRIPTION.–Two temperature control modulators (air duct valve electric drive control assembly) are mounted one adjacent to each ducting heater in the forward and aft heating systems. Each modulator consists of a thermostat bulb connected to a switch and adjusted by a selector indicator, a small two-way, reversible motor controlled by two limit switches, three terminals marked "1," "2," and "3," condensers, and a torque drive shaft to be connected to the air regulator shutters on the heater. Terminal posts "1" and "3" are connected to the "INCREASE" and "DECREASE" positions of the cold air control switch; terminal post "2" is connected through the heater relay to power. When the heater control is turned on, the cold air control switch is inoperative and the modulator operates automatically through the heater, relay and terminal post "2." The fluid inside the thermostat bulb will expand or contract according to the temperature and, according to the setting on the selector indicator, will operate the switch to the motor, turning it in the direction needed to open or close the air regulator shutters. The limit switches will stop the motor when the shutters are in the full open or full closed position. Operation of the cold air control switch to the "INCREASE" or "DECREASE" position will operate the motor and open or close the shutters. Refer to paragraph 19, HEATING AND VENTILATING SYSTEM, for further information.

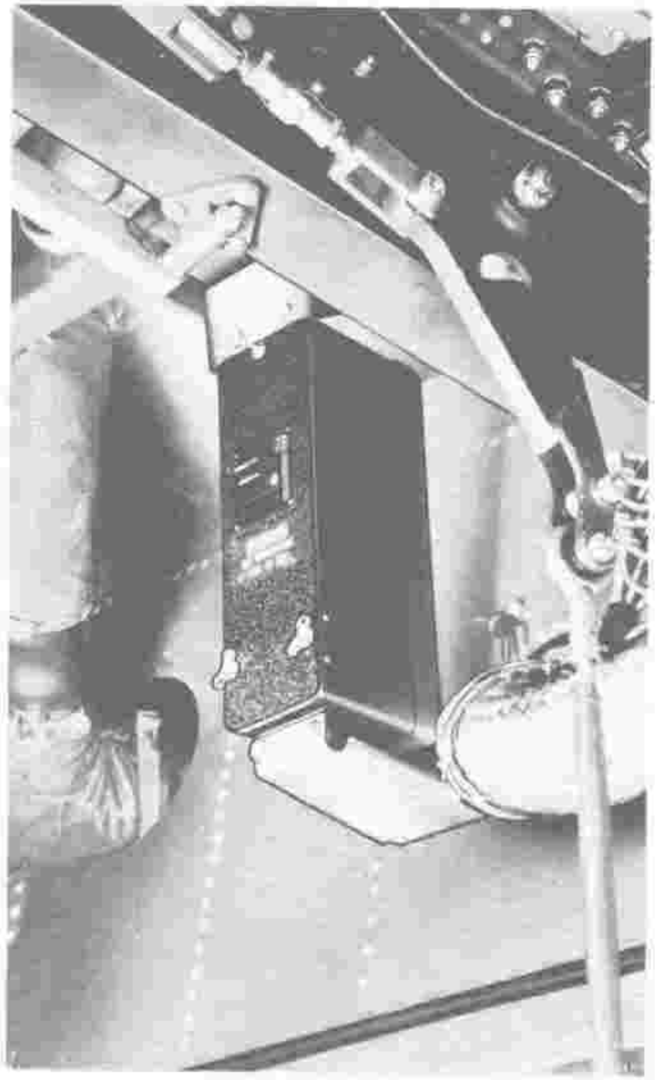


Figure 349 — Temperature Control Modulator (Forward)

2. REMOVAL AND DISASSEMBLY.

a. Remove modulator from airplane as described in paragraph 19, HEATING AND VENTILATING SYSTEM.

b. Disassemble unit as necessary for maintenance or replacement.

3. MAINTENANCE REPAIR OR REPLACEMENT.–If there appears to be failure of the modulator, the first procedure is to check for obvious mechanical breakage or damage. This is most likely to be in the thermal element, mounting brackets, Dzus fasteners, the output shaft, or gears. In case of breakage or failure, replacement of the modulator unit is recommended; however, if replacements are not available, the following emergency repairs may be made.

a. Replace thermal element if it is broken or damaged so that the liquid is leaking. This liquid has an appearance and odor somewhat similar to kerosene; any damage resulting in leakage cannot be repaired. Remove the thermal unit as follows:

(1) Remove the four screws through the mounting plate of the modulating unit.

(2) Lift the entire unit out of the case.

(3) Remove the four screws in the bottom holding the diaphragm of the thermal element to the modulator unit and remove the thermal element.

b. Replace the entire modulator unit, if contacts do not meet the following test:

(1) Check all wiring for broken wires or loose connections using diagram mounted on the lid of the modulator unit.

(2) Check circuits A-B and A-C by connecting power to A and to the case (ground) with the thermal element immersed in oil or air which can be raised to the temperature of the dial setting (200°).

(3) The contacts in the modulator unit should close the circuit A-B at temperatures of the thermal element below the dial setting; as the temperature reaches the dial setting, both circuits A-B and A-C should open; and, as the temperature goes above the dial setting circuit A-C should close.

c. If either the thermal element or the modulator unit is replaced, recalibrate the dial by loosening the two small screws and turning the dial plate until the dial setting corresponds to the temperature of the thermal element. It is necessary to calibrate at only one point as the dial and element have a straight line function.

d. Replace the condensers if the leads are broken at the case.

Note

The condensers are not essential to the operation of the modulator unit; they are connected across the contacts of the modulating unit and the limit switches to reduce sparking and prolong the life of the contacts.

e. Check the limit switches to see that they open the circuit at each end of the 90° movement of the output shaft. If the limit switches do not function properly, they can sometimes be adjusted by slightly bending the leaf springs. If not repairable in this way, replace the switches.

f. If the motor fails to operate when supplied with proper current, check the brushes and replace if badly worn. Brushes are accessible by removing the square cover located between the condensers and the terminal plate. New brushes should be fitted to the commutator with fine sandpaper.

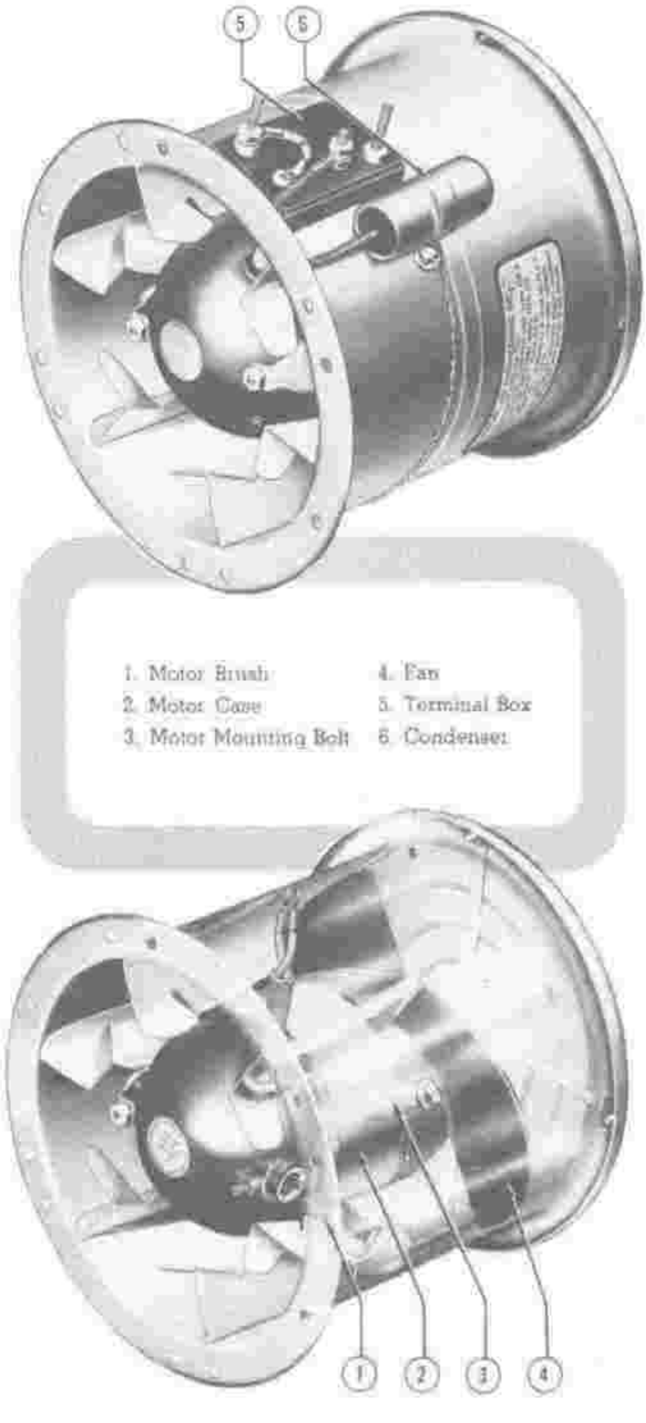


Figure 350 — Recirculating Heater Fan and Motor Assembly

(*d*) RECIRCULATING HEATER FAN AND MOTOR. *(See figure 350.)*

1. DESCRIPTION.—One 1/5 hp, two-brush motor and fan assembly is installed at the end of each recirculating heater. The motor and fan are held inside a two piece spun steel housing by means of three mounting screws. Outside the housing is a terminal box and a one mfd. radio noise filter condenser. Two wires connect from this terminal box, one to the recirculating heater and one to the heater relay. Attached to these same two terminals are wires to the motor and to the condenser.

2. REMOVAL AND DISASSEMBLY.

a. Remove the terminal box cover at the side of the fan and motor housing unit.

b. Disconnect the external connection wires.

c. Remove the bolts attaching fan and motor housing unit to the heater and remove the unit.

d. Disconnect the condenser terminal, loosen screw (motor mounting screw) in bracket, and remove condenser *(6, figure 350.)*

e. Loosen the motor mounting screws on the outside of the steel housing.

f. Disconnect wires connecting motor to terminal box and lift motor and fan unit from the housing.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary. Refer to paragraph 15. *c.* (6), this section, for maintenance of the motor.

4. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL procedure. The wire from the condenser and one wire from the airplane electrical system attach to the same terminal; the wire from the fan motor and the other wire from the airplane electrical system attach to the same terminal. Safety the condenser clamp screw (a lower motor mounting screw) with lockwire to the upper motor mounting screw on the top of the housing.

(*e*) GASOLINE-AIR MIXTURE SOLENOID VALVES (FUEL SHUT-OFF). *(See figure 310.)*

1. DESCRIPTION.—Four fuel shut-off solenoid valves are installed, two in each nacelle on the left and right walls. Each valve has a port connected to the engine supercharger blower case and a port connected to the fuel intake valve of the heater as well as an electrical connection to the heater through the thermo-snap and overheat switches. The solenoid valves in the left nacelle are connected to the forward and aft recirculating heaters; the solenoid valves in the right nacelle are connected to the forward and aft ducting heaters. When a heater is turned on, its solenoid valve operates through coil and diaphragms to allow a flow of fuel-air mixture to the fuel inlet of the heater; as soon as the circuit is opened, the valve shuts and cuts off the fuel flow to the heater.

2. REMOVAL.

a. Disconnect electrical connection.

b. Disconnect the two line connections at the valve.

Note

Be sure engines are off.

c. Remove the solenoid valve from its bracket.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

Note

The valve may be disassembled and the diaphragms or electrical coil unit replaced.

4. INSTALLATION.—Reverse REMOVAL procedure. Be sure the electrical connection is at the top. Be sure that no foreign material such as pipe compound gets inside the valve when installing connections.

5. TEST AFTER INSTALLATION.—Turn on the heater and check solenoid valve for clicking noise. Connect voltmeter to solenoid valve and ground, and check voltage. If voltage does not register, one of the overheat switches in the heater may need adjusting.

(*f*) RELAYS.

1. DESCRIPTION.—Two relays are installed in each of the two heating systems. The relays for the forward heating system are mounted in the forward junction box *(figure 330)*, the relays for the aft heating system in the fuselage aft relay box *(figure 335.)* Two relays are included in the main heater circuits, and close the circuit to the ducting heater and modulator when the heater control is in the "HEAT ON" position and the nose wheel doors are closed. Two other relays are included in the recirculating heater circuits and close the circuit to the recirculating heater and fan motor when the heater control is in the "MAXIMUM" position.

2. REMOVAL.–Remove screws attaching relay to side of junction box and lift out relay.

3. MAINTENANCE REPAIR OR REPLACEMENT.–The most important servicing item is keeping the contacts clean. All contacts will show burned spots, but these are not to be considered a fault unless they are excessive, in which case use a fine file to clean the contact surfaces. Never use sand or emery paper, as abrasive particles may stay in the contacting area, prevent proper contacting, and cause carbon deposits to form when the contacts open. All other worn parts will necessitate replacement of the relay or new parts if available.

4. INSTALLATION. – Reverse REMOVAL procedure.

(g) HEATER CONTROL.

1. DESCRIPTION. – Two rotary contact switch units are linked, one to the pilot's heater control lever and the other to the gunner's heater control lever. Each switch unit consists of a rotating lever making contacts between three contact arms and a circular band which is connected to power. As the heater control lever (or pointer in the gunner's compartment) is moved, the rotating lever in the switch unit moves, making contact with the arms. When the lever is in the "COLD AIR" position, contact is made energizing the cold air control switch. When the lever is in the "HEAT OFF" position, no contact is made. When the lever is in the "HEAT ON" position, contact is made energizing the main ducting heater. When the lever is turned toward the "MAXIMUM" position, contact is made energizing the recirculating heater.

2. REMOVAL. – Refer to paragraph 19, HEATING AND VENTILATING SYSTEM.

3. MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary.

(h) COLD AIR CONTROL SWITCH.

1. DESCRIPTION.–Two switches are installed, one in each heating system. The forward system switch is mounted in the main electrical control panel *(figures 319 & 320)*; the aft system switch on the right-hand wall of the gunner's compartment next to the aft heater control. Each switch has three positions, "INCREASE," "DECREASE," and "STOP," and is operative only when the heater control is in the "COLD AIR" position. The "INCREASE" position operates the motor on the modulator and opens the air regulator shutters on the heater; the "DECREASE" position reverses the motor and closes the shutters.

2. REMOVAL.

a. PILOT'S SWITCH.

(1) Remove the screws securing the switch to the panel.

(2) Remove the nuts attaching the panel to the fuselage and pull forward far enough to gain access to the back of the panel.

(3) Disconnect the switch wires at the back of the panel and remove the switch.

b. GUNNER'S SWITCH.

(1) Disconnect the wires at the back of the switch.

(2) Remove the screws holding the switch to the wall and remove the switch.

3. MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary.

4. INSTALLATION. – Reverse REMOVAL procedure.

(i) DUCTING HEATER SAFETY SWITCH. *(See figure 351.)*

1. DESCRIPTION.–One Micro switch with a type M-2 actuator is mounted on a bracket on the left-hand wall of the nose wheel well. The switch is included in the circuits of both ducting heaters and is operated by the left nose wheel door hinge. When the nose wheel doors are open, the switch is open and the ducting heaters cannot operate. When the nose wheel doors are closed, the switch is operated, completing the ducting heaters circuits, and allowing them to operate. This is to prevent overheating of the heater units when there is no air blast.

2. REMOVAL.

a. Remove nut holding switch actuator to bracket.

b. Remove screws holding switch to bracket and shield.

c. Remove switch.

3. MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary.

4. INSTALLATION. – Reverse the REMOVAL procedure.

(j) HEATER'S MASTER SWITCH.

1. DESCRIPTION.–One ON-OFF switch is installed on the pilot's main electrical control panel *(figures 319 & 320)* for master control of both heating systems in the airplane. The switch is wired to power through a 10 ampere circuit protector in the forward junction box.

2. REMOVAL.—Remove the wiring and the attaching screws.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

4. INSTALLATION. — Reverse the REMOVAL procedure.

(10) ICE ELIMINATION—ELECTRICAL.

(a) GENERAL. — Electrically operated units used in ice elimination consist of the propeller anti-icer pump and the de-icer distributor valve. Circuits for both units are wired to power through five ampere circuit breakers on the pilot's distribution panel. The anti-icer pump motor is controlled by a rheostat on the pilot's main electrical control panel. The de-icer valve motor is controlled by a switch on the same panel. For diagrams of the two circuits refer to *figures 461 & 462*. For other information on the systems refer to paragraph 20, this section.

(b) PROPELLER ANTI-ICER PUMP MOTOR. *(See figure 581.)*

1. DESCRIPTION.—A two-pole, series wound motor is installed in the propeller anti-icer pump located in the tail cone of the right nacelle. The motor drives the pump section through a 40:1 worm and wheel reduction.

2. REMOVAL.—Refer to paragraph 20, this section.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Unscrew the slotted brush cap screw and inspect the brushes.

b. Replace brushes before worn to a minimum length of 11/32 inch.

c. Brushes which are not provided with the correct curvature should be seated to the armature. Use #0000 sandpaper. Remove all sand particles.

d. Wipe brushes clean with a gasoline-moistened cloth.

(c) DE-ICER VALVE MOTOR. *(See figure 574.)*

1. DESCRIPTION.—The de-icer distributor valve, located in the top and aft section of the pilot's compartment, incorporates a 24-volt, shunt wound, .02 hp electric motor which runs the valve flywheel. The motor contains an overrun switch operated by the rotary distributor valve. The overrun switch opens only when the pressure port of the valve is in line

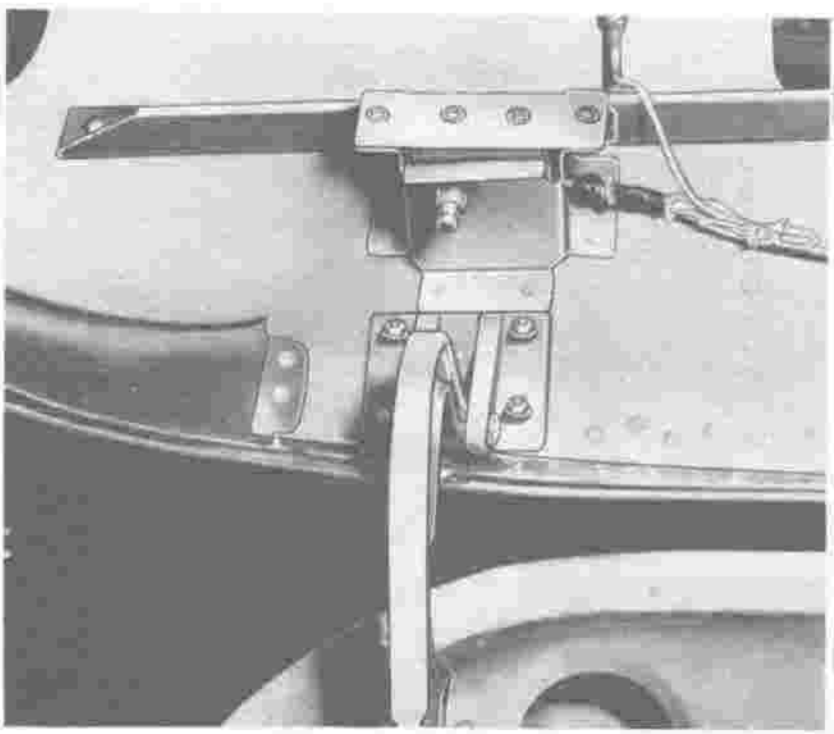


Figure 351 — Ducting Heater Safety Switch

with the exhaust port. The de-icer valve motor is controlled by a toggle switch on the pilot's main electrical control panel *(figures 319 & 320)*. The circuit is wired to power through a five ampere circuit breaker switch on the pilot's distribution panel. Refer to paragraph 20, ICE ELIMINATION SYSTEM, this section, for further information on this distributor valve.

2. REMOVAL.–Refer to paragraph 20, ICE ELIMINATION SYSTEM, this section.

3. MAINTENANCE REPAIR OR REPLACEMENT.–Refer to paragraph 15. *c.* (6), GENERAL MAINTENANCE FOR MOTORS.

(11) PROPELLER ELECTRICAL.

(a) GENERAL. – The propeller feathering pump is electrically operated by a motor which is controlled by the propeller feathering push button control switches in the pilot's compartment. Each propeller switch operates the pump through a relay which is connected to the wing bus bar system. The control switches are wired to power at the bus bar in the pilot's distribution panel. The circuit is provided with major disconnect plugs at each forward wing disconnect location. For the wiring diagram of the system, refer to *figure 437*.

Note

There are no circuit breakers or fuses in the propeller feathering circuit. If the propellers do not feather within 90 seconds, open the circuit by pulling the controls up.

(b) PROPELLER FEATHERING PUMP MOTOR. *(See figure 198.)*

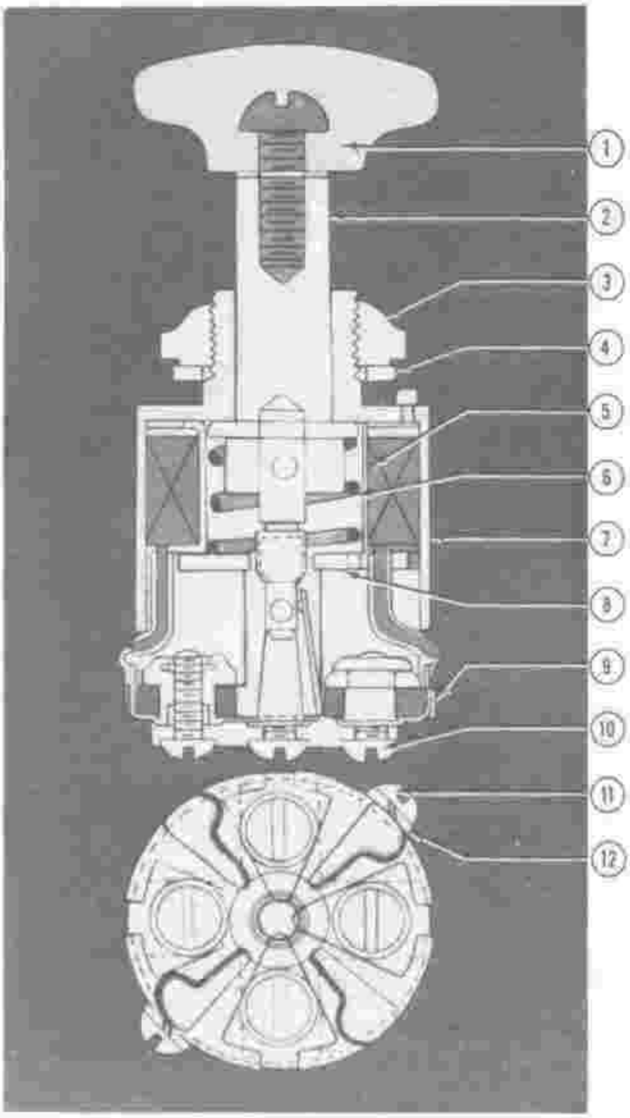
1. DESCRIPTION.–The high pressure propeller feathering pump is mounted on and driven by a 24-volt d-c series wound motor designed for intermittent duty and located in the engine section. The motor is designed for three minutes of operation out of 20 minutes when operating at its rated load. Refer to paragraph 10, PROPELLER AND PROPELLER CONTROLS, this section, for information on the pump.

2. REMOVAL.–Refer to paragraph 10, PROPELLER AND PROPELLER CONTROLS.

3. MAINTENANCE REPAIR OR REPLACEMENT.–Refer to paragraph 15. *c.* (6), this section.

(c) PROPELLER FEATHERING SWITCH. *(See figure 352.)*

1. DESCRIPTION.–Two push button control switches, one for each propeller, are mounted on the pilot's control pedestal, on some airplanes. On other airplanes the switches are located on the pilot's electrical control panel. The switch is used in conjunction with the propeller feathering pump motor relay and the pressure cut-out switch. When the switch is depressed, contact is made through the relay energizing the feathering pump motor. This contact is held by the holding coil inside the control switch unit until the pressure cut-out switch is opened.



1. Push Button Knob
2. Contact Pin Shaft
3. Retaining Nut
4. Lockwasher
5. Holding Coil
6. Compression Spring
7. Shell
8. Spring Seat
9. Brush Holder
10. Connection Lead Screw
11. Brush Holder Screw
12. Lockwasher

Figure 352—Propeller Feathering Push Button Control

Note

The propeller feathering motor circuit is not fused. If feathering does not occur within 90 seconds, pull the feathering button to break the circuit.

2. REMOVAL.—Refer to PROPELLER AND PROPELLER CONTROLS, paragraph 10, this section.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for emergency overhaul procedure. For emergency servicing, the following drawing *(figure 352)* and instructions may be used:

a. If contacts do not make proper contact, they may be bent into adjustment.

b. If shaft *(2, figure 352)* and contact pin stick and bind, lubricate with a few drops of oil, AAF Spec. 3561.

(d) PROPELLER FEATHERING MOTOR RELAY.

1. DESCRIPTION.—One relay is installed on the wall of each nacelle aft of the firewall. This relay, energized by the propeller feathering switch, energizes the propeller feathering pump motor.

2. REMOVAL.

a. Disconnect the wires at the terminals.

b. Remove the screws holding the relay to the stringer and remove the relay.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for emergency overhaul procedure. For emergency servicing, the following instructions may be used:

a. All type B-4 current relays are interchangeable. For example, in case of failure of the main battery disconnect relay, the propeller feathering motor relay may be removed and used in place of the damaged relay for emergency operation.

b. Slightly burned contact points may be filed apart with a fine file for temporary use only. Contact points, which have been burned and filed apart, will not carry the full current load. If the points are badly burned, the relay must be replaced.

(e) PROPELLER FEATHERING CUT-OUT SWITCH.

1. DESCRIPTION.—One pressure cut-out switch is mounted on the base of each propeller governor. The switch disconnects the propeller feathering switch and pump when the pressure builds up to 400 psi after the propeller reaches the full feathering position.

2. REMOVAL.

a. Disconnect the electrical plug.

b. Remove the screws attaching switch unit to the propeller governor base and remove the switch.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(12) INSTRUMENTS ELECTRICAL.

(a) GENERAL.—Electrically operated instruments on the airplane consist of the carburetor air temperature indicator, the cylinder head temperature indicator, the outside (free) air temperature indicator, the fuel quantity gages, the oil temperature indicator, the oil cooler doors position indicator, the wheel and flap position indicator, the remote magnetic compass indicator, and the tachometer. Instruments other than electrical are discussed in paragraph 13, this section. For the wiring arrangement of the electrical instruments refer to *figures 440-446*. Removal procedure is the same for all electrical instruments, involving the removal of the large access door in the fuselage forward of the windshield, the removal of the electrical plug from the back of the instrument, and the removal (from the pilot's compartment) of the four screws which attach the indicator to the pilot's instrument panel. Damaged or defective indicators shall be replaced.

(b) OIL COOLER DOORS POSITION INDICATOR. *(See 15, figure 232.)*

1. DESCRIPTION.—One dual oil cooler doors position indicator is installed on the pilot's instrument panel on some airplanes. The instrument is actuated electrically by means of two transmitters. One transmitter is mounted on each of the two oil cooler door drive assemblies. The circuit is wired to power through a circuit breaker installed on the pilot's electrical distribution panel. For a diagram of the electrical circuit, refer to *figure 447*. On other airplanes no oil cooler door position indicator is used due to installation of automatic control of the door.

2. REMOVAL OF TRANSMITTER.

a. Remove the drive unit access door.

b. Uncouple electrical plug connection from transmitter.

c. Unscrew the elastic stop nut from bolt on the linkage arm.

d. Slide linkage arm off shaft of transmitter.

e. Remove the four screws fastening the transmitter to the bracket assembly. Remove the transmitter.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(c) CARBURETOR AIR TEMPERATURE INDICATOR.—One dual carburetor air temperature indicator is installed on the pilot's instrument panel *(12, figure 232)*. The circuit is made up of wiring to a temperature sensitive bulb in the throat of each carburetor air scoop, grounded by connection to a ground stud in each power plant junction box, and wired to power through a five ampere circuit protector in the forward junction box. Two major disconnect plugs are provided in the wiring to each bulb, one at each forward wing and firewall disconnect locations. The indicator is calibrated from −70°C to +150°C for each engine; the cover glass is marked to indicate desirable and undesirable readings.

(d) CYLINDER HEAD TEMPERATURE INDICATOR (THERMOCOUPLE THERMOMETER).

1. DESCRIPTION.—One dual thermocouple thermometer is installed on the pilot's instrument panel *(14, figure 232)* on the bottom row. The indicator is connected by thermocouple leads through the thermocouple block at the firewall to thme thermocouple in cylinder No. 14. on each engine. The thermocouple is a brass gasket mounted under the spark plug in the cylinder. The instrument is calibrated from 0°C. to 350°C. for each engine; the cover glass is marked to indicate desired and undesired readings.

2. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, is necessary for both the indicator and the thermocouple. Thermocouple leads may be replaced by experienced personnel but exact lengths must be maintained and the cut ends must be soldered to the connector fittings.

3. ADJUSTMENT OF INDICATOR POINTER.

a. With the engine cold, place a check thermometer near the thermocouple. Set the instrument pointer to the temperature by means of the adjusting screw on the indicator face.

b. The indicator pointer may be adjusted by the following alternate method:

(1) Open the circuit at the thermocouple or by disconnecting the indicator.

(2) The temperature registered in the indicator should be the same as that of the pilot's compartment. Compare with check thermometer.

(3) If not the same, set pointer by means of adjusting screw on indicator face to agree with thermometer reading.

(e) OUTSIDE (FREE) AIR TEMPERATURE INDICATOR.—One outside air temperature indicator is installed on the pilot's instrument panel *(2, figure 232)*. The indicator circuit is made up of wiring to a temperature sensitive bulb installed in a concave support on the lower left-hand side of the fuselage aft of the nose section and wired to power through a five ampere circuit protector in the forward junction box. The indicator is calibrated from −70°C to +150°C for each engine; the cover glass is marked to indicate desired and undesired readings.

(f) FUEL LEVEL GAGES.

1. GENERAL.—Each fuel container installed in this airplane has a selsyn fuel gage system consisting of a transmitter unit and an indicator giving remote indication of the amount of fuel in the container. The transmitters *(figure 353)*, which change in type for different size and shape of container, are made up of a float arm, gears, adjusting screw, and electrical receptacle. The transmitter is electrically connected to the fuel level indicator in the pilot's compartment. Any change in the level of fuel in the container raises or lowers the float arm, registers in the transmitter unit, and activates a proportionate change of the pointer in the fuel level indicator. The adjusting screw is the means to check to see that the transmitter and the indicator are working together correctly.

2. MAIN FUEL GAGE.

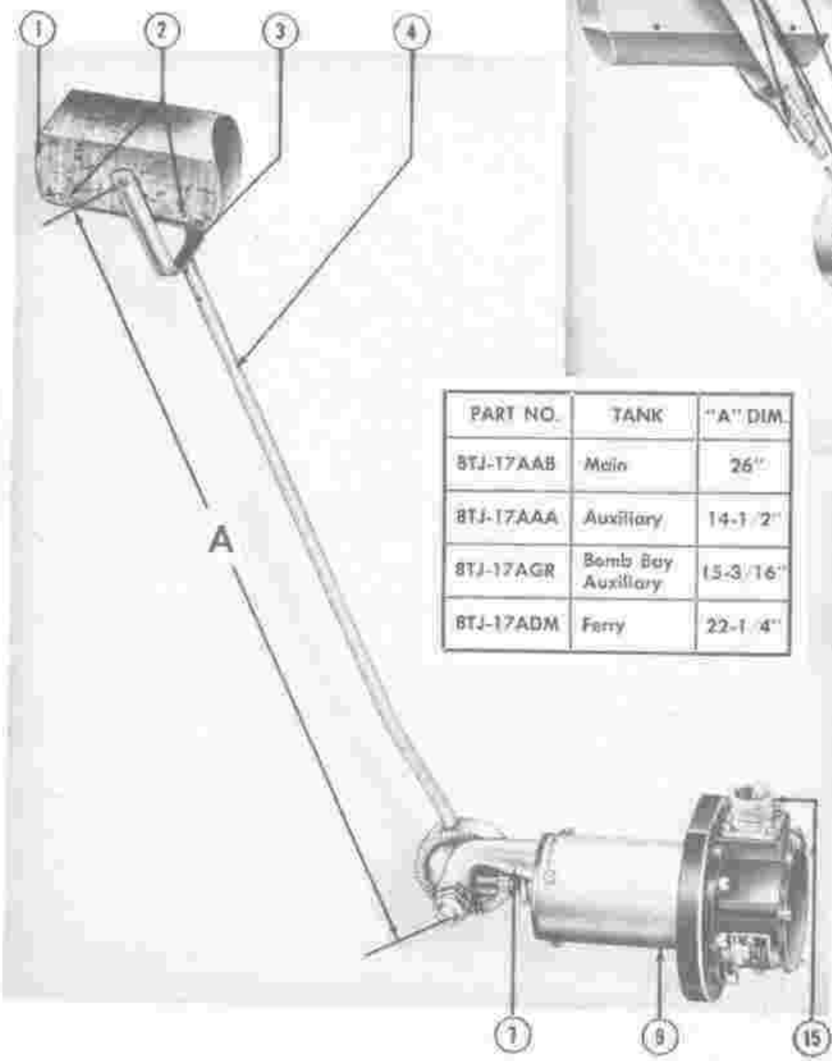
a. DESCRIPTION.—A dual fuel level indicator for the two main (nacelle) fuel containers is installed on the pilot's instrument panel. The circuit from the indicator is connected to a five ampere circuit protector in the forward junction box and to the fuel gage transmitter in each main (nacelle) fuel container. The indicator is calibrated from "EMPTY" to "FULL" (0 to 300 gallons) for each of the main (nacelle) fuel containers.

b. REMOVAL OF TRANSMITTER.

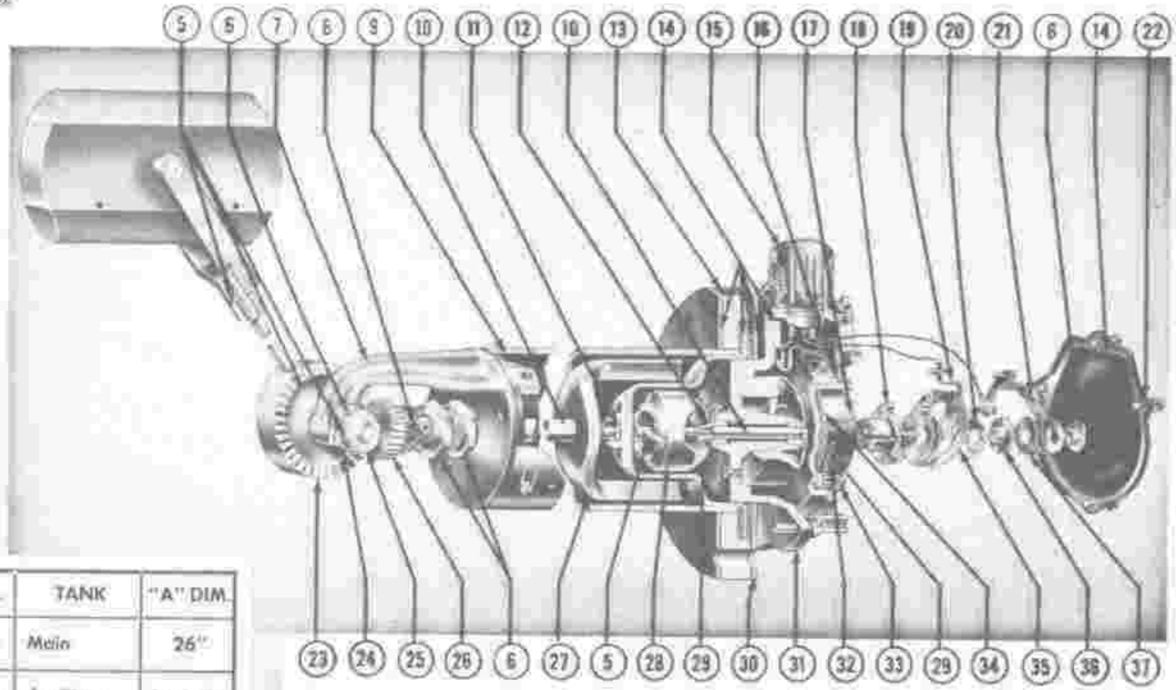
(1) Before removing the transmitter, be certain the fuel container is empty.

(2) Disconnect the plug at the electrical receptacle.

(3) Remove the screws holding the transmitter head to the container.



PART NO.	TANK	"A" DIM.
BTJ-17AAB	Main	26"
BTJ-17AAA	Auxiliary	14-1/2"
BTJ-17AGR	Bomb Bay Auxiliary	15-3/16"
BTJ-17ADM	Ferry	22-1/4"



1. Float
2. Counterweights
3. Float Bracket
4. Float Arm
5. Pin
6. Check Nut
7. Bearing Bracket
8. Setscrew
9. Tube and Shell Assembly
10. Shaft
11. Bearing
12. Spacer
13. Flange
14. Gaskets
15. Receptacle
16. Clamping Ring
17. Coil and Block Assembly
18. Lock Plate
19. Stationary Contact Assembly
20. Spring Washer
21. Warning Light Contact Assembly
22. Cover
23. Gear
24. Bushing
25. Float Arm Stud
26. Pinion
27. Float Magnet
28. Magnet
29. Spring
30. Flange Adapter
31. Case
32. Contact and Sector Assembly
33. Adjusting Pinion
34. Contact Ring
35. Brush Assembly
36. Spacing Nut
37. Warning Light Segment

Figure 353 — Fuel Level Gage Transmitter — Type TJ-17

(4) Pull the transmitter head and float-arm through the container opening.

c. ADJUSTMENTS–TRANSMITTER.

(1) EMPTY ADJUSTMENT.–Make sure that the container is empty and then remove the four cover screws of the transmitter head. Turn the adjusting screw marked "E" until the indicator reads exactly zero for that container.

Note

If it is not possible to obtain an empty adjustment by merely moving the adjusting screw, loosen the screw which holds the rotating brush and move the whole brush assembly until the indicator reads as close to zero as possible. Final adjustment can then be made by the adjusting screw.

(2) FULL ADJUSTMENT.–Move the float arm of the transmitter unit to the full position. Turn the adjusting screw marked "F" clockwise as far as it will go, and then turn the screw counterclockwise until the indicator reads exactly full for that container.

3. AUXILIARY FUEL GAGE.–A three-way fuel level indicator for the two auxiliary (wing) fuel containers is installed on the pilot's instrument panel. The circuit from the indicator is connected to a five ampere circuit protector in the forward junction box, to the fuel gage transmitter in each auxiliary (wing) fuel container, and to the fuel gage transmitter in the bomb bay fuel container. The circuit has a major disconnect plug at each forward wing disconnect location. The indicator is calibrated from "EMPTY" to "FULL" (0 to 100 gallons) for each of the two auxiliary (wing) containers and "EMPTY" to "FULL" (0 to 200 gallons) for the bomb bay container.

4. FERRY FUEL GAGE.–A fuel level indicator for use with the ferry (bomb bay) fuel tank, if installed, is installed on the control pedestal next to the bombing intervalometer. The circuit from the indicator is connected to a five ampere circuit protector in the forward junction box and to the fuel gage transmitter in the ferry (bomb bay) fuel tank, if installed. This fuel gage transmitter is grounded by connection to a ground stud. The indicator is calibrated from "EMPTY" to "FULL" (0 to 700 gallons).

(g) OIL TEMPERATURE INDICATOR.–One dual oil temperature indicator is installed on the pilot's instrument panel. The circuit consists of wiring to power through a five ampere circuit protector in the forward junction box and to the two oil temperature bulbs, one installed at the sump of each oil container. Each temperature bulb is grounded by connections to a ground stud in each firewall junction box. One major disconnect plug is provided in the wiring to the bulbs, one at each forward wing disconnect location. The indicator is calibrated from −70°C to +150°C; the cover glass is marked to indicate the desirable and undesirable temperatures.

(h) PITOT TUBE HEATER.–The airspeed tube installed on the upper tip of the vertical stabilizer is heated by the heating elements in the nose and rear of the tube. The circuit is grounded by connection to a ground stud in the vertical stabilizer structure, controlled by a toggle switch on the pilot's main electrical control panel, and connected to the power source through a 10 ampere circuit protector in the forward junction box.

(i) WING FLAP POSITION INDICATOR.–An indicator which shows the position of the wing flaps alone is installed on the pilot's instrument panel on some airplanes. On other airplanes a combined wing flap and landing gear position indicator is installed. On both types of instruments, the wing flap position indication is obtained by means of an electrical transmitter mounted on the wing flap actuator case in the bomb bay. The circuit is wired to power through a five ampere circuit breaker at the forward junction box. A diagram of the circuit used on airplanes equipped with the combined wing flap and landing gear position indicator will be found in *figure 446*. For information on landing gear position indication, refer to paragraph 15. *d.* (13) *(c)*, ALIGHTING GEAR ELECTRICAL, this section.

(j) REMOTE MAGNETIC COMPASS INDICATOR.

1. DESCRIPTION.–The remote reading compass system consists of an indicator located on the pilot's instrument panel, a transmitter mounted on a support on the right-hand wall of the aft fuselage section, and a 6 volt-ampere, 400 cycle inverter mounted on the upper shelf of the left-hand wall of the gunner's compartment. The system is a self-synchronous method of electrically transmitting voltages from a coil in the remotely located transmitter to a coil in the indicator. This permits the magnetic element of the compass (in the transmitter) to be installed in a place as free as possible from local magnetic disturbances. The inverter is used to convert the airplane system direct current to alternate current needed for operating the compass system and incorporates a filter which reduces to a minimum any radio frequency interferences caused by the inverter. The indicator dial is marked in two-degree gradations and incorporates the course setting pointer and the indicator hand. The course setting pointer is operated by an external adjusting knob located on the lower left-hand corner of the indicator.

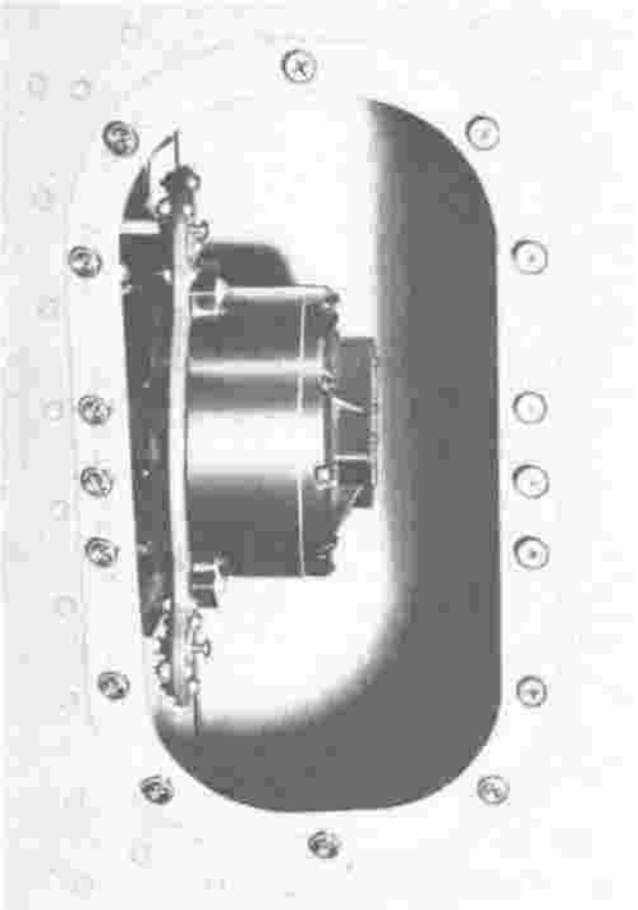


Figure 354 — Remote Magnetic Compass Transmitter Installed

2. REMOVAL.

a. TRANSMITTER.

(1) Disconnect electrical plug.

(2) Remove screws attaching transmitter to mounting plate.

(3) Lift transmitter from support and plate.

b. INVERTER.

(1) Disconnect electrical plug.

(2) Remove screws holding inverter to wall and remove inverter.

3. MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary.

Note

Inverter bearings do not require lubrication ordinarily except during major overhaul periods (every 1000 hours). At that time, bearings are to be washed in carbon tetrachloride, dried, and coated with grease (Andoc "C" or equivalent).

4. ADJUSTMENTS - COMPENSATION. – The remote indication magnetic compass (and any other compass which may be installed) must be compensated at the end of each 100 hours of flying time; at each change of engines or other equipment likely to affect the compass, and at least once in each three months' period. The compass may be compensated on the ground, using a compass base or a portable swinging compass, or it may be compensated in the air if a driftmeter or astro compass is installed on the airplane.

a. GROUND SWING IN THE FIELD.– The following procedure for compensation of the compass may be followed in the field without a prepared base and with equipment consisting of a swinging compass and a non-magnetic screwdriver:

(1) Obtain a swinging compass (a Pioneer Type B-16 compass which has been adapted for the purpose by removing the compensating assembly and installing a swinging compass sight, Stock No. 7800-725200). Also obtain a non-magnetic screwdriver, and a pilot's compass correction card, AAF Form No. 57.

(2) Remove from the clothing and person all objects which might exert a magnetic effect on the swinging compass.

(3) If a compass base, or rose, is not available, select a site which is remote from other airplanes, machinery, wires, buildings or other influences which might distort the compass readings. Check the suitability of the area with the handheld swinging compass by taking several bearings on one distant object from random positions. If all bearings are the same, the area is suitable.

(4) Neutralize the remote indicating magnetic compass transmitter (or any other compass which may be installed) by lining up the dots on the East-West and North-South adjustment screws with the dots on the case.

(5) Head the airplane magnetic East, within five degrees by its own compass.

(6) Take a position approximately 50 feet in front of the airplane and line up the sight of the swinging compass with the center strip on the pilot's windshield and the leading edge of the vertical stabilizer. (Other points on the centerline of the airplane may be used if desired.)

(7) Unless the poles of the swinging compass have been reversed (the reversed type is painted bright red) it will be necessary to add 180 degrees to each reading of the swinging compass to compensate for the opposed position in respect to the airplane.

(8) With engines running at sufficient rpm to show maximum charge on the ammeters,

	COMPENSATING SWING			RESIDUAL SWING		AIRCRAFT COMP.	DATE	
	ACTUAL HEADING	AIRCRAFT COMP.	DEV'N	ACTUAL HEADING	AIRCRAFT COMP.	C TO M		M TO C
N 000	005	001					000	
NE 045							045	
E 090	087	090					090	
SE 135							135	
S 180	176	180½					180	
SW 225							225	
W 270	265	273					270	
NW 315							315	
	(1)	(2)	(1) – (2)	(3)	(4)	(3) – (4)		(4) – (3)

If swinging compass used ahead of aircraft add or subtract 180 degrees

Coeff. C = $\frac{N-S}{2} = \frac{(\ \ )-(\ \ )}{2} =$

Coeff. B = $\frac{E-W}{2} = \frac{(\ \ )-(\ \ )}{2} =$

Coeff. A = $\frac{N+E+S+W}{4} = \frac{(\ \ )+(\ \ )+(\ \ )+(\ \ )}{4} =$

Figure 355 — Compass Correction Card No. 1

note the reading of the swinging compass (adding 180 degrees if necessary) in the "Actual Head" column on the correction card. Note the reading of the airplane compass in the "Aircraft Comp." column. *(See figure 355.)*

(9) Stop the engines and recheck the airplane compass reading.

(10) Head the airplane South and repeat the above procedure. If engine operation does not affect the reading of the airplane compass, it will not be mandatory to operate them during the remainder of the swing.

(11) Continue the swing on the other two cardinal headings, West and North, in order.

(12) By means of the figures placed in the first two columns on the correction card, calculate the deviation and its mathematical sign for each of

	COMPENSATING SWING			RESIDUAL SWING		AIRCRAFT COMP.	DATE	
	ACTUAL HEADING	AIRCRAFT COMP.	DEV'N	ACTUAL HEADING	AIRCRAFT COMP.	C TO M		M TO C
N 000	005	001	+4				000	
NE 045							045	
E 090	087	090	−3				090	
SE 135							135	
S 180	176	180½	−4½				180	
SW 225							225	
W 270	265	273	−8				270	
NW 315							315	
	(1)	(2)	(1) – (2)	(3)	(4)	(3) – (4)		(4) – (3)

If swinging compass used ahead of aircraft add or subtract 180 degrees

Coeff. C = $\frac{N-S}{2} = \frac{(\ \ )-(\ \ )}{2} =$

Coeff. B = $\frac{E-W}{2} = \frac{(\ \ )-(\ \ )}{2} =$

Coeff. A = $\frac{N+E+S+W}{4} = \frac{(\ \ )+(\ \ )+(\ \ )+(\ \ )}{4} =$

Figure 356 — Compass Correction Card No. 2

the four headings. Note the deviation and its sign in the column titled "Dev'n." *(See figure 356.)* The subtraction to be performed to obtain the figure for the deviation column is indicated at the bottom of the deviation column. If the number placed in the first column is larger than that in the second column, the deviation will carry the plus sign. If the number in the second column is the larger, the result will be a minus.

(13) Using the numbers placed in the deviation column, calculate coefficients A, B, and C in accordance with the algebraic formula stated at the bottom of the correction card. *(See figure 357.)* Coefficient A is the algebraic sum of deviations on North, East, South and West and divided by 4; that is,

Dev. on N + Dev. on E + Dev. on S. + Dev. on W.

	COMPENSATING SWING			RESIDUAL SWING		AIRCRAFT COMP.	DATE	
	ACTUAL HEADING	AIRCRAFT COMP.	DEV'N	ACTUAL HEADING	AIRCRAFT COMP.	C TO M		M TO C
N 000	005	001	+4				000	
NE 045							045	
E 090	087	090	−3				090	
SE 135							135	
S 180	176	180½	−4½				180	
SW 225							225	
W 270	265	273	−8				270	
NW 315							315	
	(1)	(2)	(1) – (2)	(3)	(4)	(3) – (4)		(4) – (3)

If swinging compass used ahead of aircraft add or subtract 180 degrees

Coeff. C = $\frac{N-S}{2} = \frac{(+4)-(-4\frac{1}{2})}{2} = +\frac{8\frac{1}{2}}{2} = +4\frac{1}{4}$ or $+4$

Coeff. B = $\frac{E-W}{2} = \frac{(-3)-(-8)}{2} = +\frac{5}{2} = +2\frac{1}{2}$

Coeff. A = $\frac{N+E+S+W}{4} = \frac{(+4)+(-3)+(-4\frac{1}{2})+(-8)}{4} = -\frac{11\frac{1}{2}}{4} = -3$

Figure 357 — Compass Correction Card No. 3

Coefficient B is the deviation on East minus (algebraically) the deviation on West, divided by 2; that is,

$$\frac{\text{Dev. on E}-\text{Dev. on W.}}{2}$$

Coefficient C is the deviation on North minus (algebraically) the deviation on South, divided by 2; that is,

$$\frac{\text{Dev. on N}-\text{Dev. on S.}}{2}$$

(14) Coefficient A shows the misalignment, if any, between the remote indicating compass transmitter and the cener line of the airplane. On the A-26B airplane coefficient A is reduced to a negligible figure when the transmitter is installed, and ordinarily no corrections will be necessary. However, the transmitter has slotted mounting holes which permit it to be turned slightly on the mounting table if necessary. Coefficient B determines the correction required

to compensate for horizontal magnetic disturbances (hard iron) located in the airplane forward and aft of the compass. Coefficient C determines the correction required to compensate for magnetic disturbances (hard iron) located in the airplane to the left and right of the compass.

Note

All computations are algebraic. The rule for addition in algebra is: Add all plus values, add all minus values, put down the sign of the larger value and find the difference. The rule for subtraction is: Change the sign of the number to be subtracted and add algebraically. The rule for division is: Like signs give plus and unlike signs give minus.

(15) With the airplane on the magnetic North heading, within five degrees by its own compass, add coefficient C algebraically to the compass reading on that heading to indicate what the instrument should read when compensated. Make the remote indicating compass indicate the compensated value by adjusting the N-S adjustment screw with a non-magnetic screwdriver. For example, if the airplane compass reads 1 degree and coefficient C is +4, the compass should be made to read 5 degrees. If the compass reads 1 degree and the coefficient is −4, the compass should be made to read 357 degrees.

(16) Turn the airplane to magnetic East, within five degrees by its own compass, and then add coefficient B algebraically to the compass reading on that heading to determine what the instrument should read when compensated. Make the compass indicate the compensated value by adjusting the E-W compensating screw on the transmitter with a non-magnetic screwdriver. For example, if the compass reads 90 degrees and coefficient B is +2½ degrees, the compass should be made to read 92½ degrees. If the compass reads 90 degrees and the coefficient is −2½, the compass should be made to read 87½ degrees.

(17) With the airplane on any heading, add coefficient A to the reading of the compass. Loosen the three mounting screws on the transmitter and revolve the transmitter until the indicator in the pilot's compartment gives the desired reading. The transmitter is turned clockwise if coefficient A is plus and counterclockwise if the coefficient is minus. After making the adjustment retighten the mounting screws.

(18) The correction of coefficients B and C, and possibly A, completes the compensation of the compass. However, a residual swing must be made to determine the deviations which continue to exist in the compass, but which cannot be overcome. The data obtained will be used by the pilot or navigator when determining headings.

(19) The residual swing will be made in the same way as the compensating swing, excepting that eight headings will be used. These are East, Southeast, South, Southwest, West, Northwest, North and Northeast. Readings from the airplane compass

	COMPENSATING SWING			RESIDUAL SWING		AIRCRAFT COMP.	DATE	
	ACTUAL HEADING	AIRCRAFT COMP.	DEV'N	ACTUAL HEADING	AIRCRAFT COMP.	C TO M		M TO C
N 000	005	001	+4	002½	001		000	
NE 045				040	043		045	
E 090	087	090	−3	095	094		090	
SE 135				136	134		135	
S 180	176	180½	−4½	185	184		180	
SW 225				222	225		225	
W 270	265	273	−8	275	276		270	
NW 315				317	316		315	
	(1)	(2)	(1) − (2)	(3)	(4)	(3) − (4)		(4) − (3)

If swinging compass used ahead of aircraft add or subtract 180 degrees

$$\text{Coeff. C} = \frac{N-S}{2} = \frac{(+4)-(-4\frac{1}{2})}{2} = +\frac{8\frac{1}{2}}{2} = +4\tfrac{1}{4} \text{ or } +4$$

$$\text{Coeff. B} = \frac{E-W}{2} = \frac{(-3)-(-8)}{2} = +\frac{5}{2} = +2\tfrac{1}{2}$$

$$\text{Coeff. A} = \frac{N+E+S+W}{4} = \frac{(+4)+(-3)+(-4\frac{1}{2})+(-8)}{4} = -\frac{11\frac{1}{2}}{4} = -3$$

Figure 358 — Compass Correction Card No. 4

and the swinging compass will be entered on the correction cards in the columns under the caption, "Residual Swing." *(See figure 358.)*

(20) Complete the form by filling in the last two columns from the data obtained in the residual swing. *(See figure 359.)* The entries for the left column are obtained by subtracting column 4 from column 3 for each heading, as indicated under the

	COMPENSATING SWING			RESIDUAL SWING		AIRCRAFT COMP.	DATE	
	ACTUAL HEADING	AIRCRAFT COMP.	DEV'N	ACTUAL HEADING	AIRCRAFT COMP.	C TO M		M TO C
N 000	005	001	+4	002½	001	+1½	000	−1½
NE 045				040	043	−3	045	+3
E 090	087	090	−3	095	094	+1	090	−1
SE 135				136	134	+2	135	−2
S 180	176	180½	−4½	185	184	+1	180	−1
SW 225				222	225	−3	225	+3
W 270	265	273	−8	275	276	−1	270	+1
NW 315				317	316	+1	315	−1
	(1)	(2)	(1) − (2)	(3)	(4)	(3) − (4)		(4) − (3)

If swinging compass used ahead of aircraft add or subtract 180 degrees

$$\text{Coeff. C} = \frac{N-S}{2} = \frac{(+4)-(-4\frac{1}{2})}{2} = +\frac{8\frac{1}{2}}{2} = +4\tfrac{1}{4} \text{ or } +4$$

$$\text{Coeff. B} = \frac{E-W}{2} = \frac{(-3)-(-8)}{2} = +\frac{5}{2} = +2\tfrac{1}{2}$$

$$\text{Coeff. A} = \frac{N+E+S+W}{4} = \frac{(+4)+(-3)+(-4\frac{1}{2})+(-8)}{4} = -\frac{11\frac{1}{2}}{4} = -3$$

Figure 359 — Compass Correction Card No. 5

(C to M) column. Entries for the right column (M to C) are obtained by subtracting column 3 from column 4.

(21) Complete the correction card by supplying the information required on the back. Detach the compass cards and insert them in the compass card holders on the airplane. Place the remainder of the form in a permanent file.

b. GROUND SWING ON PREPARED BASE.—To swing the airplane on a prepared compass base (rose) the airplane is turned to the desired heading as determined by the base. These magnetic headings are entered in the column "Actual Head (M)," and the airplane compass readings are entered in the column "Aircraft Comp." The procedure for swinging and compensating the compass on a prepared base is the same as that given for the field, excepting that it is not necessary to use a swinging compass.

c. AIR SWING.—Air swinging may be accomplished under calm weather conditions using the driftmeter or the astro compass.

(1) AIR SWING WITH DRIFTMETER.—When using the driftmeter, select a straight railroad, pipe line or the like, whose magnetic direction is known. Fly straight and level over the known landmark at normal cruising speed with landing gear retracted. Flying by reference to the directional gyro, align the airplane on a straight course approximately parallel to the landmark. Measure with the driftmeter the angle between landmark and the longitudinal axis of the airplane. From this angle and the known magnetic bearing of the landmark, the navigator can direct the pilot on a course bearing upon the cardinal magnetic headings, North, East, South and West. Land and calculate coefficients A, B, and C as described under the swinging compass method. Correct these on the ground using the swinging compass. Having corrected the coefficients, take off again and using the driftmeter as before, determine the magnetic headings on compass headings, North, Northeast, East, Southeast, South, Southwest, West, Northwest. Land and complete AAF Form No. 57. Detach the compass card and insert it in the compass card holder in the aircraft.

(2) AIR SWING WITH ASTRO COMPASS.—When using the astro compass, it is necessary that a celestial body whose altitude is preferably less than 45° be visible. Sufficient view of the ground to locate the aircraft within approximately 10 miles is also necessary. From the Air Almanac, prepare a graph of GMT against LHA for the selected flight area for a period covering that during which the swinging is to take place. The graph is drawn as a straight line between hours of GMT and LHA from the start to the finish of the swinging. Fly straight and level at normal cruising speed, landing gear retracted, over the area which the LHA's were calculated (within 10 miles) on compass headings, North, East, South and West (within 5°). Using the graph of LHA and the GMT, the aircraft's true heading is determined by the astro compass on each of the four heads. To these true courses, apply the local variation to obtain the magnetic heading. The average of a number of astro compass readings on each heading should be taken. Land and calculate coefficients A, B, and C and correct these on the ground as described under swinging compass method. Having corrected the coefficients, take off again and using the astro compass as before, determine the true heading on compass headings, North, Northeast, East, Southeast, South, Southwest, West, Northwest (flown to within 5°). Land, convert the true headings to magnetic by applying variations and complete AAF Form No. 57. Detach the compass card and insert in the compass holder in the aircraft.

5. INSTALLATION.—Reverse the REMOVAL procedure.

6. FINAL TEST AFTER INSTALLATION.—After the installation has been completed and thoroughly checked, switch on the rated power for the compass system with the engines not running. The indicator should read the approximate heading of the aircraft. With the rated power still on, start the engines. Slowly turn the airplane approximately 90 degrees and observe the indicator. Turn off the engines and note the indicator readings. Swing the aircraft approximately 90 degrees and note whether the hands of the indicator move in the direction of the new heading. If the hands fail to do so, the wiring is not continuous, or one of the compass units is defective. The wiring and the individual units of the system must be checked in accordance with the proper wiring diagram. *(See figure 445.)* This routine must be performed in a location that would be favorable for compensation, that is, a place as free as possible from local magnetic disturbances.

(k) TACHOMETER.

1. DESCRIPTION.—The tachometer system consists of a dual indicator mounted on the pilot's instrument panel and a generator transmitter *(figure 360)* mounted on each engine. The tachometer generator is mounted by means of an end shield on the left side of the engine housing just below the hydraulic pump and is connected to the crankshaft by means of reduction gears. When the engine shaft is rotated, the shaft of the tachometer generator rotates and produces three phase electric power which is transmitted to the synchronous motor inside the indicator unit. As the speed of the engine changes, the speed of the generator changes, causing a corresponding change in the speed

Figure 360 — Tachometer Generator

of the synchronous motor of the indicator. The indicator face is calibrated to indicate the revolutions per minute (0 to 4500) of the engine to which the tachometer generator is attached; there are two indicator pointers, one marked "L" and the other "R." Two major disconnect plugs are provided in the wiring to each generator: one at each firewall and forward wing disconnect locations. The wires are connected through terminal posts in each power plant junction box.

2. REMOVAL OF GENERATOR.

a. Disconnect the electrical plug.

b. Remove the four bolts holding the generator to the engine.

c. Slide the generator shaft free from the engine shaft and remove the generator.

3. MAINTENANCE REPAIR OR REPLACEMENT. — Replacement, rather than repair, will be necessary.

Note

When mounting the tachometer generator, it is first necessary to align the key on the generator shaft with the keyway on the engine shaft. The generator should be so positioned that its receptacle points in the direction which will permit electrical plug connection.

(13) ALIGHTING GEAR ELECTRICAL.

(a) GENERAL.—On some airplanes four alighting gear signal lamps are provided on the instrument panel. A green lamp is provided for each main landing gear and the nose wheel gear to indicate the safe latched DOWN position of each gear. A red lamp is provided to indicate any unsafe condition of the alighting gear when the throttles are closed to less than one-fourth segment. On other airplanes two alighting gear signal lamps, a green lamp for "SAFE" condition and a red lamp for "UNSAFE" condition, and a combined wheel and flap position indicator are installed on the instrument panel and position transmitters are installed on each main gear and the nose gear. Latch up and latch down switches are installed for each main gear and for the nose gear on all airplanes and are wired to the alighting gear signal lamps and to the throttle warning switch. A detent pin solenoid is installed on the landing gear position selector valve to prevent movement of the landing gear control lever to the "UP" position when the airplane is on the ground. The detent pin solenoid is actuated by the retraction release switch installed on the left-hand main landing gear shock strut. The alighting gear electrical circuits receive power from the distribution panel through a five ampere circuit breaker.

Note

On airplanes with the combined wheel and wing flaps position indicator a test switch is installed on the main electrical control panel to connect the signal lamps directly to power in order to test the lamps for proper operation. On these airplanes, power for the wheel and flap position indicator circuits is received from the forward junction box through a five ampere circuit breaker. A relay is installed in the circuits to the two alighting gear signal lamps. The relay is located in the forward junction box.

(b) ALIGHTING GEAR SIGNAL LAMPS.

1. DESCRIPTION.—Some airplanes are provided with four signal lamps for the alighting gear. These are installed on the instrument panel. A green lamp for each main gear and nose gear is installed to indicate the safe LATCHED DOWN position of the gears. When the alighting gear is extended and all these gears are latched down the green signal lamps are lighted, indicating the safe landing condition of the alighting gear. However, if the alighting gear is extended and one or more of the gears is not latched down and the throttle is closed to less than one-fourth segment, the red warning lamp is lighted, indicating an unsafe condition for landing. The green lamps of the gears which are not latched down, will not be lighted, indicating the unsafe gear or gears. On airplanes with a combined wheel and wing flap position indicator, two signal lamps are provided on the instrument panel. The green lamp is lighted when all three gears are latched down in the "SAFE" position for landing. The red lamp is lighted whenever any of the gears are not latched down and the throttle is closed to less than one-quarter segment. The unsafe gear may be determined by means of the wheel and wing flap position indicator on these airplanes.

2. REMOVAL.—The signal lamps may be removed by disconnecting the electrical wires and unscrewing the lamps.

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the signal lamps are not damaged or not functioning properly, replace them with new parts.

4. INSTALLATION.—To install the signal lamps reverse the REMOVAL procedure.

(c) ALIGHTING GEAR LATCH POSITION SWITCHES.

1. DESCRIPTION.—An UP and DOWN latch position switch is installed on each gear. The main landing gear DOWN latch position switch is installed on the upper retracting link while the UP latch position switch is installed on the main landing gear support. The DOWN latch position switch is actuated by a lever on the landing gear upper shaft and normally remains in the unlatched position. The switch is actuated to the "LATCHED" momentary contact position by the actuating lever. The UP latch switch includes a lever which is actuated by the main landing gear retracting link. The UP latch switch normally remains in the unlatched position and is moved to the

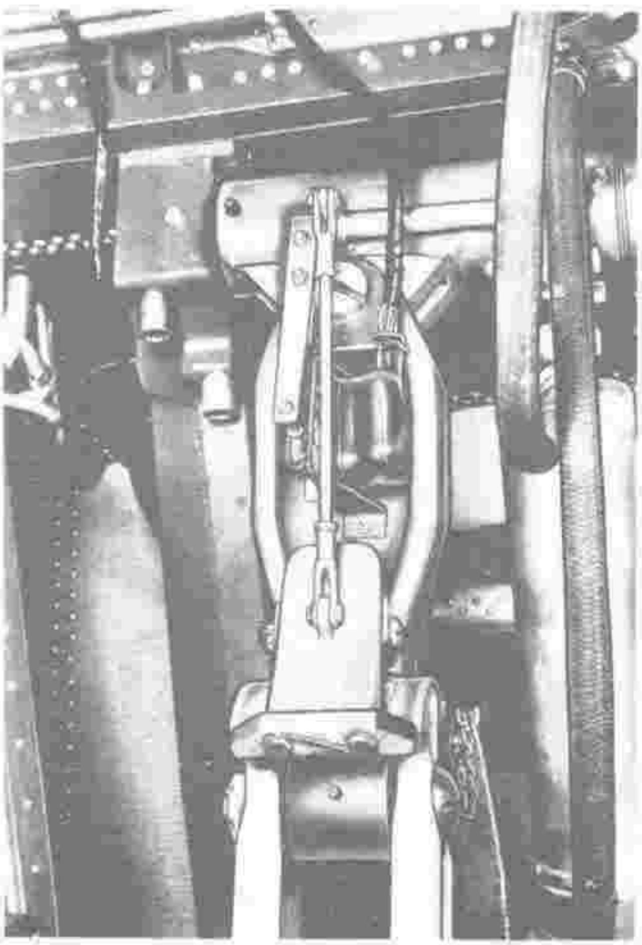


Figure 361 — Main Landing Gear Latch Switch

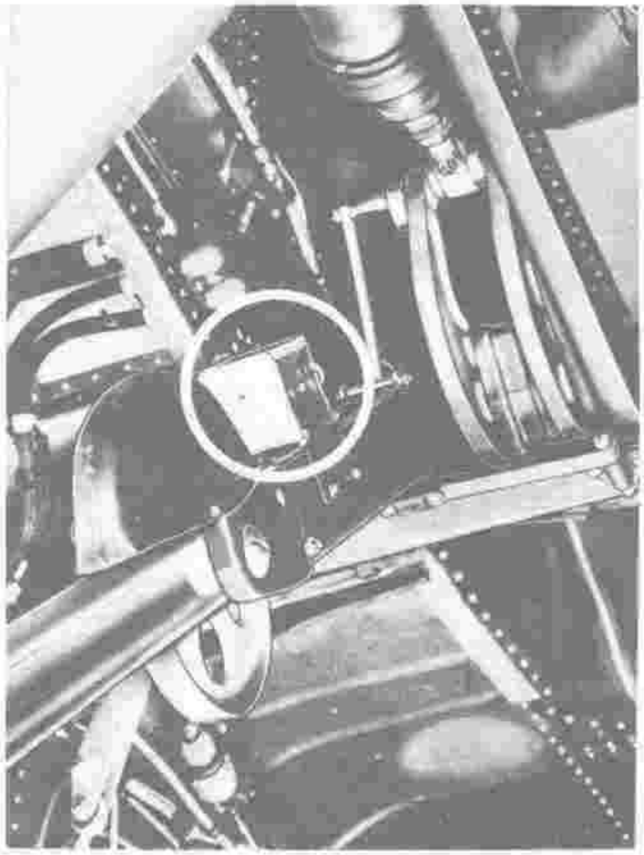


Figure 362 — Nose Wheel Gear Latched Down Switch

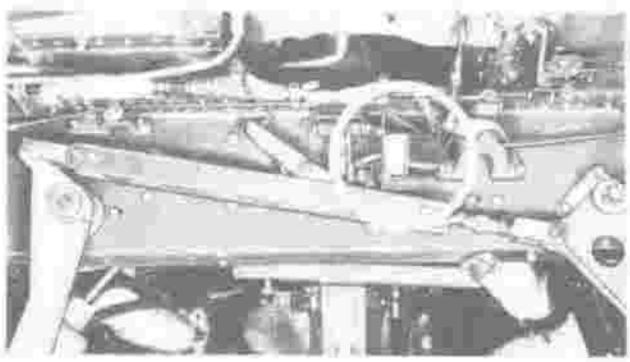


Figure 363 — Nose Wheel Gear Latched Up Switch

"UP" latch momentary contact position by the retracting link. The nose wheel DOWN latch position switch *(figure 362)* is installed on the nose gear upper retracting link and is actuated to the "DOWN" latch momentary contact position by a cam on the nose gear down latch plunger rod. The switch normally remains in the unlatched position. The nose wheel UP latch position switch *(figure 363)* is installed on the cross beam in the nose wheel well and is actuated by a screw on the nose wheel UP latch hook release lever to the "UP" latch momentary contact position. The switch normally remains in the unlatched position. When all three gears are latched down the LATCH DOWN position switches complete the circuits to the green signal lamp or lamps on the instrument panel. If the gears are latched up or in any unsafe condition for landing and the throttle is closed to less than one-fourth segment, the UP latch position switches complete the circuit to the red "UNSAFE" signal lamp on the instrument panel.

2. REMOVAL.—To remove any of the latch position switches, disconnect the electrical wires and remove the attaching screws.

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the alighting gear latch position switches are damgaed or not operating properly, replace them with new parts.

4. ADJUSTMENTS.

a. MAIN LANDING GEAR DOWN LATCH POSITION SWITCH.—With the landing gear down pressure applied to main landing gear actuating cylinder, turn clamp on shaft until it touches bolt on upper retracting link. Tighten clamp and adjust switch arm screw until DOWN latch circuit is closed and red signal lamp circuit is opened.

b. NOSE WHEEL DOWN LATCH POSITION SWITCH. — The nose wheel DOWN latch position switch must be adjusted so that the switch actuates from the green lamp indication to red lamp indication when the down latch travels $\frac{7}{32}$ inch from full latched to unlatched position. The cam actuator should be mounted on the down latch plunger sleeve so that the end of the sleeve is flush with the aft outside surface of the cam.

5. INSTALLATION.—To install the alighting gear latch position switches reverse the REMOVAL procedure.

(d) THROTTLE WARNING SWITCH.—The throttle warning switch which completes the alighting gear red signal lamp circuit when either or both of the throttle control levers are closed to less than one-fourth segment when any of the alighting gears are not latched down is installed in the forward end of the control pedestal. This double pole switch normally remains open until the throttles are closed to less than one-fourth segment and the throttle control levers actuate the switch to the closed position.

(e) LANDING GEAR POSITION SELECTOR VALVE SOLENOID DETENT PIN AND RETRACTION RELEASE SWITCH.—The landing gear position selector valve solenoid detent pin is installed to prevent accidental retraction of the alighting gear when the airplane is on the ground. When the airplane is on the ground, the retraction release switch, *(figure 364)* located on the left-hand main shock strut,

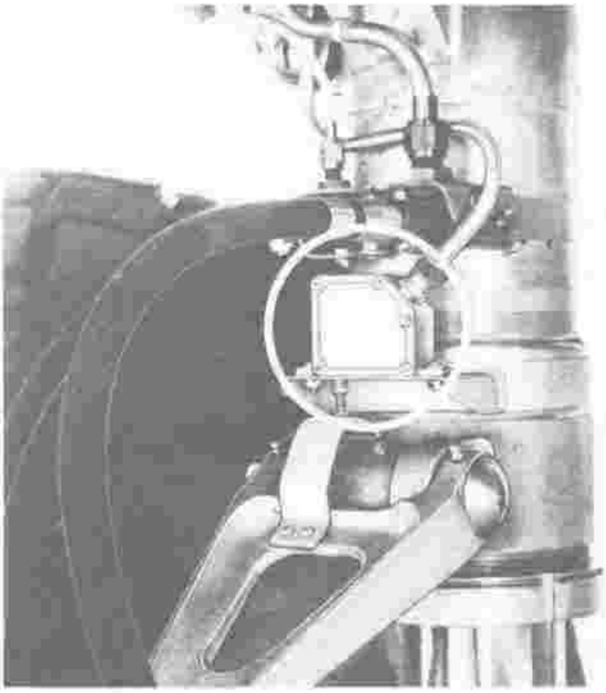


Figure 364 — Main Landing Gear Retracting Release Switch

is open and the solenoid detent pin is not energized. The spring loaded pin springs forward and the projecting pin prevents movement of the landing gear control lever to the "UP" position. When the airplane is in flight and the shock strut extends, a cam on the shock strut extension links closes the retraction release switch, energizing and retracting the solenoid detent pin. The landing gear control lever then can be moved to the "UP" position.

Note

The landing gear control lever always can be moved from the "UP" to the "DOWN" position.

(f) ALIGHTING GEAR POSITION TRANSMITTERS AND WHEEL AND WING FLAP POSITION INDICATOR.

1. DESCRIPTION.—One electrically operated wheel and flap position indicator is installed on the pilot's instrument panel on some airplanes. The indicator circuit consists of wiring to the power source through a five ampere circuit protector in the forward junction box and wiring to each of the four position transmitters, one for the wing flaps, one for the nose wheel, and one for each of the main wheels. The wing flap transmitter *(4, figure 340)* is mounted on the wing flap actuator case on the aft bomb bay bulkhead, and

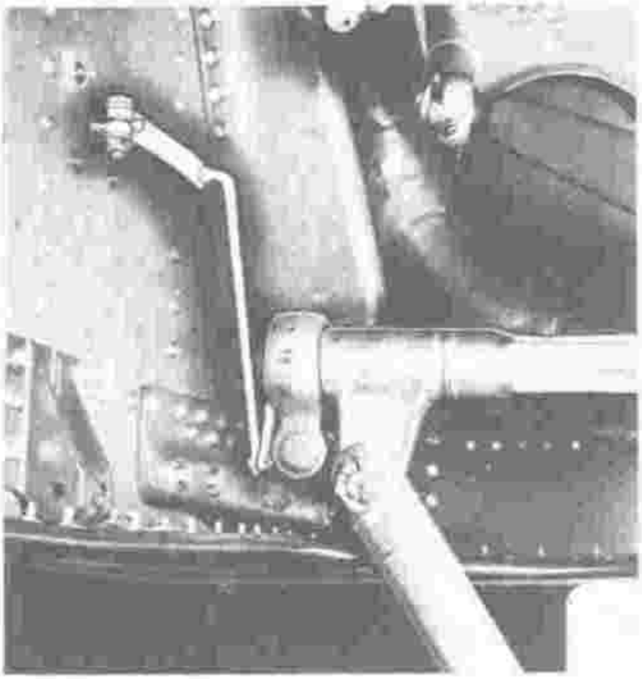


Figure 365 — Nose Wheel Position Indicator Transmitter

is directly connected to the indicator. The nose wheel transmitter *(figure 365)* is mounted on the wall in the nose wheel well, attached by a link and rod to the lever on the end of the wheel gear brace and connected through the nose wheel latch position switches to the indicator. The two main landing gear transmitters *(figure 366)* are located on the wall in each nacelle wheel well, attached by an arm and rod to the bolt at the shock strut cross shaft, and connected through the main landing gear latch position switches to the indicator. The transmitters are each driven by the linkage connected to the alighting gear or flap mechanism. The indicator face contains an outline of an airplane with small openings showing the positions of the wheels and flaps. When the wheels are not in a latched position, a small red warning tab is shown as well as the wheel position; when the wheels are latched up or down, the warning tab is not in view. When the instrument power is turned off or fails, the condition is indicated by rotation of the indicator points causing the word "OFF" to appear.

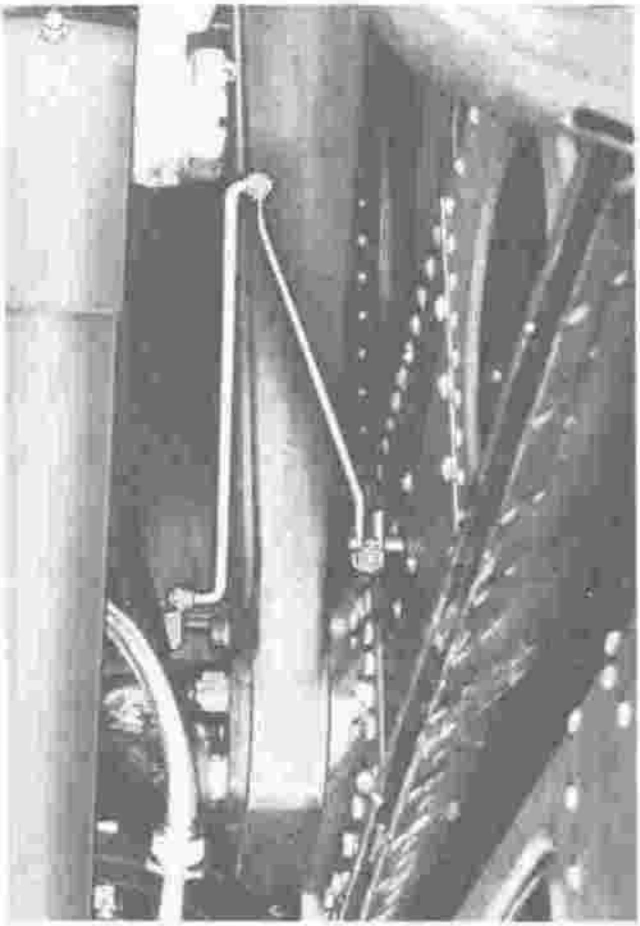


Figure 366 — Main Wheel Position Indicator Transmitter Arm

2. REMOVAL.

a. WING FLAP TRANSMITTER.

(1) Disconnect electrical plug from transmitter receptacle.

(2) Remove screws attaching transmitter and mount to the wing flap actuator case.

(3) Disconnect transmitter operating linkage from the transmitter shaft.

(4) Remove transmitter.

b. NOSE WHEEL TRANSMITTER.

(1) Disconnect electrical plug from the transmitter receptacle.

(2) Disconnect transmitter operating linkage from the link.

(3) Remove screws attaching transmitter to nose wheel well wall.

(4) Remove transmitter.

c. MAIN WHEEL TRANSMITTER.

(1) Disconnect electrical plug from transmitter receptacle.

(2) Disconnect transmitter operating linkage from arm.

(3) Remove screws attaching transmitter to web.

(4) Remove transmitter.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Maintenance should consist only of tightening loose connections and minor repairs that do not require disassembly, such as: replacing defective indicators, transmitters, or lines; replacing broken or loose cover glass in indicator; replacing or resetting pointer.

4. ADJUSTMENT — TRANSMITTER SHAFT AND POINTER.—Adjust the transmitter shafts on the drive linkages by loosening the shaft clamps and turning the shafts, by means of the screw driver slot provided, until the indicator pointer shows the proper wheel and flap positions. It may be necessary to jack up the airplane and operate the alighting gear to make the final adjustment or to distribute any minor error that might exist.

5. INSTALLATION OF TRANSMITTERS.—Reverse REMOVAL procedure, also note the following:

a. Connect the transmitter operating linkages to the transmitter shafts, using a collar and setscrew or a split bushing type clamp. Do not provide a positive method of engagement with the transmitter shaft; in the event of transmitter binding or jamming, the clamp or collar is expected to slip on the transmitter shaft, preventing mechanical damage to the transmitter or linkage. Slippage at a torque of about 20 foot-pounds is recommended.

b. From full-up to full-down, adjust the flap linkage to rotate the transmitter 90 degrees and the wheel linkages to rotate their respective transmitters 60 degrees.

(g) ALIGHTING GEAR SIGNAL LAMPS TEST SWITCH.—On airplanes with the combined wheel and wing flap position indicator a test switch is installed on the main electrical control panel. This switch connects the alighting gear "SAFE" and "UNSAFE" signal lamps directly to power in order to test the signal lamps for proper operation.

(14) LAMPS.

(a) GENERAL.—Lamps are used on the airplane for illumination, signalling, recognition, and navigation. A spare lamp box is located on the left wall of the pilot's compartment aft of the pilot's seat.

KEY TO FIGURE 367

1. Position Lamp (3 Places)
2. Formation Lamp (9 Places)
3. Landing Lamp (2 Places)
4. Dome Lamp (4 Places)
5. Extension Lamp
6. Bomb Bay Dome Lamp Switches
7. Bomb Release Signal Lamp
8. Recognition Lamp (3 Places)
9. Torpedo Director Sight Lamp (Integral with sight)
10. Gun Sight Lamp (Integral with sight)
11. Pilot's Instrument Panel Lamps (Fluorescent)
12. Pilot's Instrument Panel Lamps (Non-Fluorescent)
13. Bombardier's Dome Lamp
14. Bombardier's Cockpit Lamp
15. Bombardier's Fluorescent Instrument Lamp
16. Inter-Aircraft Signal Lamp Spare Filter Assembly
17. Recognition Lights Control Box
18. Inter-Aircraft Signal Lamp Extension Cord Receptacle (on Pilot's Suit Heat Rheostat)
19. Inter-Aircraft Signal Lamp
20. Spare Lamp Box

Simplified wiring diagrams of the various lamp systems will be found in *figures 450-460.* The removal procedure for most lamps and switches is the same, consisting of the removal of wires and attaching screws. Maintenance consists of the replacement of burned out or broken bulbs and the tightening of loose connections. On the A-26C airplane, several additional lamps are provided as illustrated in *figures 328 & 329.*

(b) BOMB BAY DOME LAMPS.—Two type A-9 dome lamp assemblies *(figure 367)* are installed in the bomb bay, one in the forward bomb bay ceiling and one on the right side of the aft bomb bay. Each lamp assembly incorporates a 28 volt, 21 c. p. type S-8 silver tip bulb with a single contact bayonet candelabra base. A type B-1B dome lamp switch for both lamps is provided in the bomb bay door warning lamp and switch assembly at each end of the bomb bay on the fore and aft bulkheads. Either switch reverses the condition of both lamps. The circuit is connected to power by means of a five ampere circuit protector in the aft relay junction box.

(c) INTERCALL SIGNAL LAMPS.—Two intercall signal boxes *(figure 368)* incorporating a key type signal switch and a lamp are installed, one for the pilot and one for the gunner. Each lamp includes a 28 volt, 3 c. p. type T-3¼ clear bulb with a single contact miniature bayonet base. The pilot's intercall signal box is located on a bracket on the left-hand side of the pilot's seat; the gunner's box is located on a bracket on the left-hand side of the gunner's compartment. Both lamps are wired to be on when either

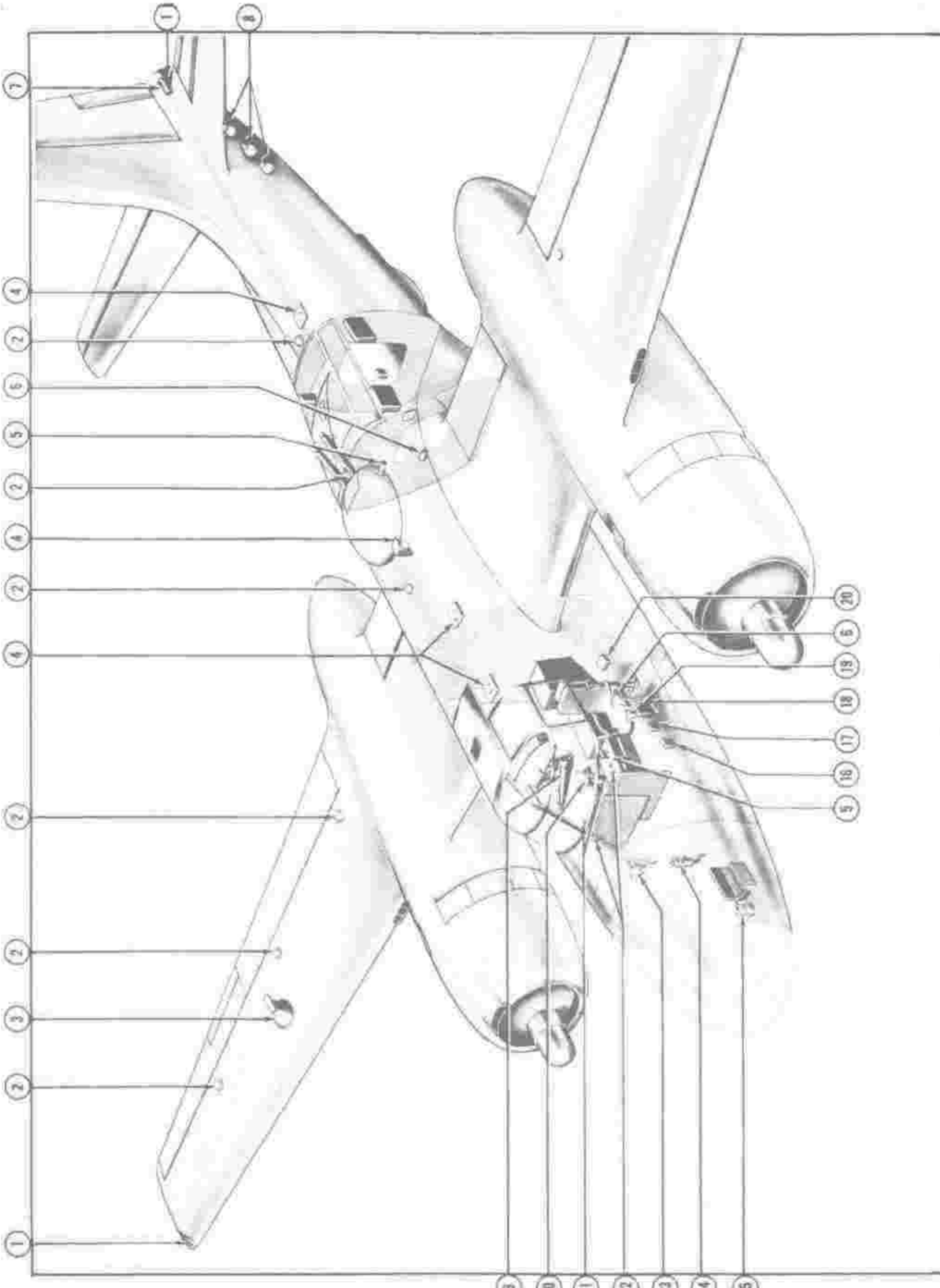


Figure 367 — Lamps

Figure 368 — Intercall Signal Box

signal switch is closed. Each box is connected to a ground stud; the circuit is connected to power through a five ampere circuit protector in the aft relay junction box.

(d) FLUORESCENT INSTRUMENT LAMPS. *(See figure 369.)*

1. DESCRIPTION.—Two fluorescent lamps are installed for illumination of the pilot's instrument panel, one to the left and the other to the right of the panel. On some airplanes, the lamps are operated by controls located on the main electrical control panel. Each control is marked with four positions: "START," "ON," "DIM," and "OFF," in this order from right to left. The lamp is started by turning the control knob to "START," holding it there for a few seconds, and then releasing. The brightness of the light may be reduced by turning the knob to "DIM." Visible blue light may be obtained by rotating the filter cap on the lamp to the right (viewed from the rear). On other airplanes resistors are provided in the lamp assemblies. The circuit is wired to power through a five ampere circuit protector in the forward junction box.

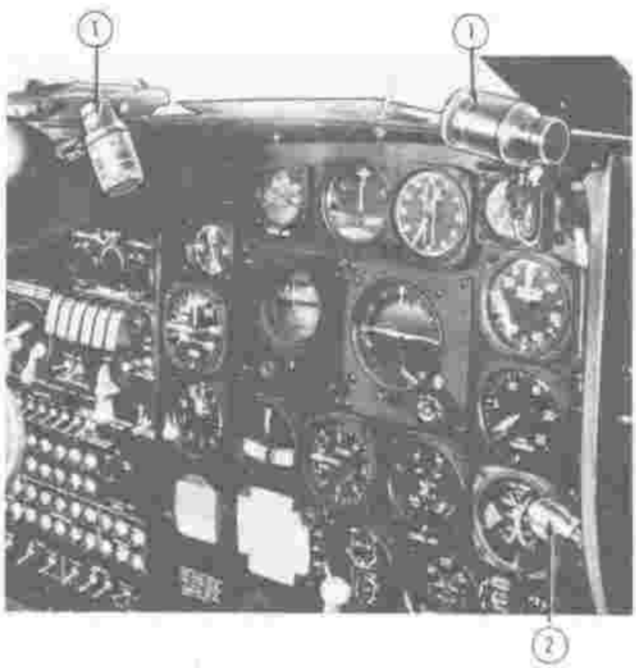
CAUTION

The ultra-violet rays from these lamp assemblies are harmless in any permanent form, but they should always be adjusted so that none of the radiation reaches the pilot's eyes. Radiation causes discomfort and temporary impairment of vision due to fluorescence of the eyeballs.

2. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary. For replacement of the lamp bulb:

a. Loosen the two screws on the sides of the lamp housing and remove the lamp housing from assembly.

b. The lamp bulb may then be removed and a new one inserted. The lamp will fit into the socket in one position only, due to the fact that the base pins are offset. Do not force the lamp bulb if it does not fit on the first trial.



1. Fluorescent Lamp
2. Cockpit Lamp

Figure 369— Pilot's Instrument Panel Lamps

(e) FORMATION LAMPS.—Nine type C-1 formation lamps *(figure 367)* are installed, three on the top of the fuselage and three on the top of each wing. Each lamp includes a 28 volt, 3 c.p., T-3¼ clear bulb with a single contact, miniature bayonet base. The lamps are operated in unison by a single type B-9A switch on the pilot's main electrical panel. The switch is wired through an adjustable resistor and has three positions: "OFF," "BRIGHT," and "DIM." The circuit is wired to power through a five ampere circuit protector in the forward junction box.

(f) GUNNER'S LAMPS.—One type C-4 extension lamp *(figure 367)* is mounted on the right-hand side of the gunner's compartment on the forward bulkhead. The lamp is operated and adjusted by the red knurled rheostat knob at the end of the lamp assembly, and by the red momentary switch button along the side. The lamp includes a 24 volt, 3 c.p., T-3¼ bulb with an s.c. min. bay. base. One type A-9 dome lamp assembly *(figure 367)* is installed in the ceiling of the aft section of the fuselage above the lower turret. The lamp includes a 28 volt, 21 c.p., type S-8 silver tip bulb with an s.c. bay. candel. base, and is controlled by a type B-5A "ON-OFF" switch AN3015 located along side of the dome lamp. Both the gunner's extension lamp and the aft compartment dome lamp are wired to power through a five ampere circuit breaker switch in the fuselage aft relay shield.

(g) GUN AND TORPEDO SIGHT LAMPS.

1. DESCRIPTION.—The type N-9 fixed gun sight is equipped with a Mazda No. 844, size G-9, 28 volt, 21-21 c.p. bulb *(figure 367)* with a d.c. bay. candel. base. The type B-2 torpedo director A.F. Spec. R-24789 is equipped with a 28 volt, 21 c.p., Mazda No. 307 frosted inside bulb *(figure 367)* with an s.c. bay candel. base. Either or both lamps are controlled by the type O-1C "Gun Sight and Torp. Dir." rheostat mounted on the pilot's overhead control panel. The circuit for one or both of these lamps is connected to power through a five ampere circuit breaker switch in the pilot's distribution panel. The gun sight lamp is connected to the rheostat by a single wire; the torpedo director lamp by a conduit covered wire.

(h) LANDING LAMPS.
(See figure 367.)

1. DESCRIPTION.—One type B-3 electrically retractable landing lamp assembly *(figure 370)* is mounted on the underside of each wing, approximately one-half the distance between the nacelle and wing tip. A heavy ground strap (jumper) is attached from the wing structure to the lamp assembly housing. The lamp housing includes actuating mechanism, a motor, a motor limit switch, a lamp switch, and the necessary electrical wiring. The lamp is a sealed beam reflector lamp holding one 24 volt, 600 watt clear bulb. The operation of the lamps is controlled by one switch on the pilot's overhead control panel and two relays installed one in each nacelle relay junction box. When the landing lamp switch is in the "EXTEND" position, the lamp motors operate the actuating mechanism which extends the lamps. The lamp switch lights the lamps when the units are lowered approximately 10 degrees; the motor limit switches open the motor circuits when the lamps are fully extended. When the landing lamp switch is in the "RETRACT" position, the operation is identical to that of extension except for the opposite movement of the units. Each lamp and relay circuit is connected to power through a 25 ampere circuit protector in each nacelle relay junction box; the landing lamp switch is connected to power through a 15 ampere circuit breaker switch in the pilot's distribution panel.

CAUTION

The landing lamps must not be extended at airplane speeds in excess of 190 mph.

2. REMOVAL OF LANDING LAMP ASSEMBLY.

a. Remove the screws from the outer rim of the lamp.

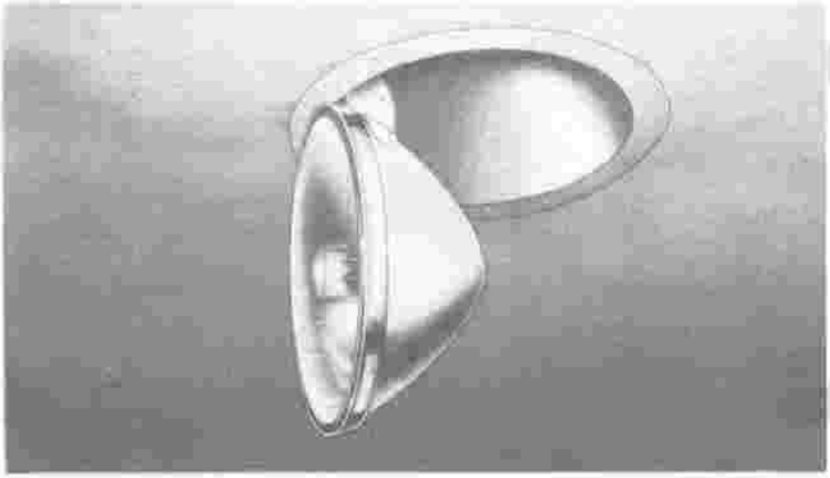


Figure 370 — Landing Lamp Extended

b. Pull lamp assembly from wing and disconnect electrical plug from motor.

c. Disconnect ground strap (jumper) from lamp assembly and remove lamp assembly.

(i) PILOT'S LAMPS.—One type A-9 dome lamp assembly *(figure 367)* is installed in the ceiling of the pilot's compartment. The type B-5A "ON-OFF" switch controlling this lamp is mounted along side the dome lamp. Two type A-7 cockpit lamps *(figure 369)* are installed one at each end of the instrument panel. One type C-4 extension lamp is installed on the control pedestal next to the bombing intervalometer. The lamp is operated and adjusted, in the "ON" position, by the red knurled rheostat knob at the end of the lamp assembly and by the red momentary switch button along the side. The extension lamp and both cockpit instrument lamps are controlled by the "COCKPIT LAMPS" rheostat on the pilot's main electrical control panel. All four of these lamps in the pilot's compartment are connected to power through a five ampere circuit protector in the forward junction box.

(j) POSITION LAMPS. *(See figure 367.)*

1. DESCRIPTION.—Two type A-9 position lamps are installed one in each wing tip. Each lamp is completely covered with the molded plexiglas tip *(7, figure 36)*. The lens in the left lamp is red; the lens in the right lamp is green. One type D-2 position lamp is installed in the tail cone *(figure 373)*, mounted inside the molded plexiglas cone (just below the tail cone signal lamp). Two type B-9A switches are provided on the pilot's main electrical control panel, one for the control of the wing lamps and the other for the tail lamp. Each switch has three positions: "DIM," "OFF," and "BRIGHT." The "DIM" position of the wing lamps switch is wired through a 15 ohm, 25 watt resistor. The "DIM" position of the tail lamp switch is wired through a 125 ohm, 7½ watt resistor. Both resistors are mounted on the back of the pilot's main electrical panel. Both lamp switches are wired to power through a five ampere circuit protector in the forward junction box.

2. REMOVAL.

a. WING TIP LAMP.

(1) Remove the plexiglas cover over the lamp by removing the screws attaching the cover to the wing tip structure.

(2) Remove the screws securing the lamp to its support.

(3) Lift the lamp out and disconnect the electrical plug from the neck of the lamp.

b. TAIL CONE LAMP.

(1) Remove the plexiglas cover over the lamp by removing the screws attaching the cover to the tail cone structure.

(2) Disconnect the electrical plug from the back of the lamp.

(3) Remove the screws securing the lamp to its support and lift out the lamp.

(k) RECOGNITION LAMPS. *(See figure 367.)*

1. DESCRIPTION.—Three type E-2 downward recognition lamps are located beneath the aft fuselage below the empennage structure. The lenses

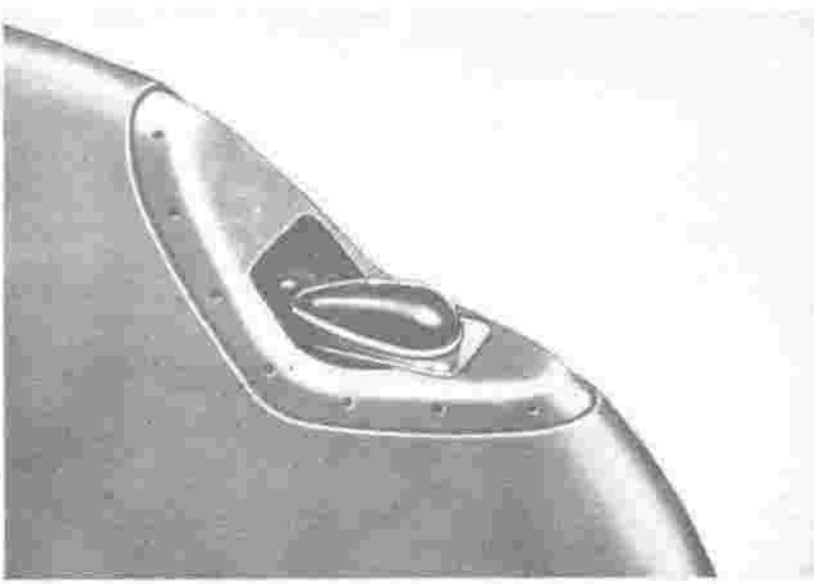
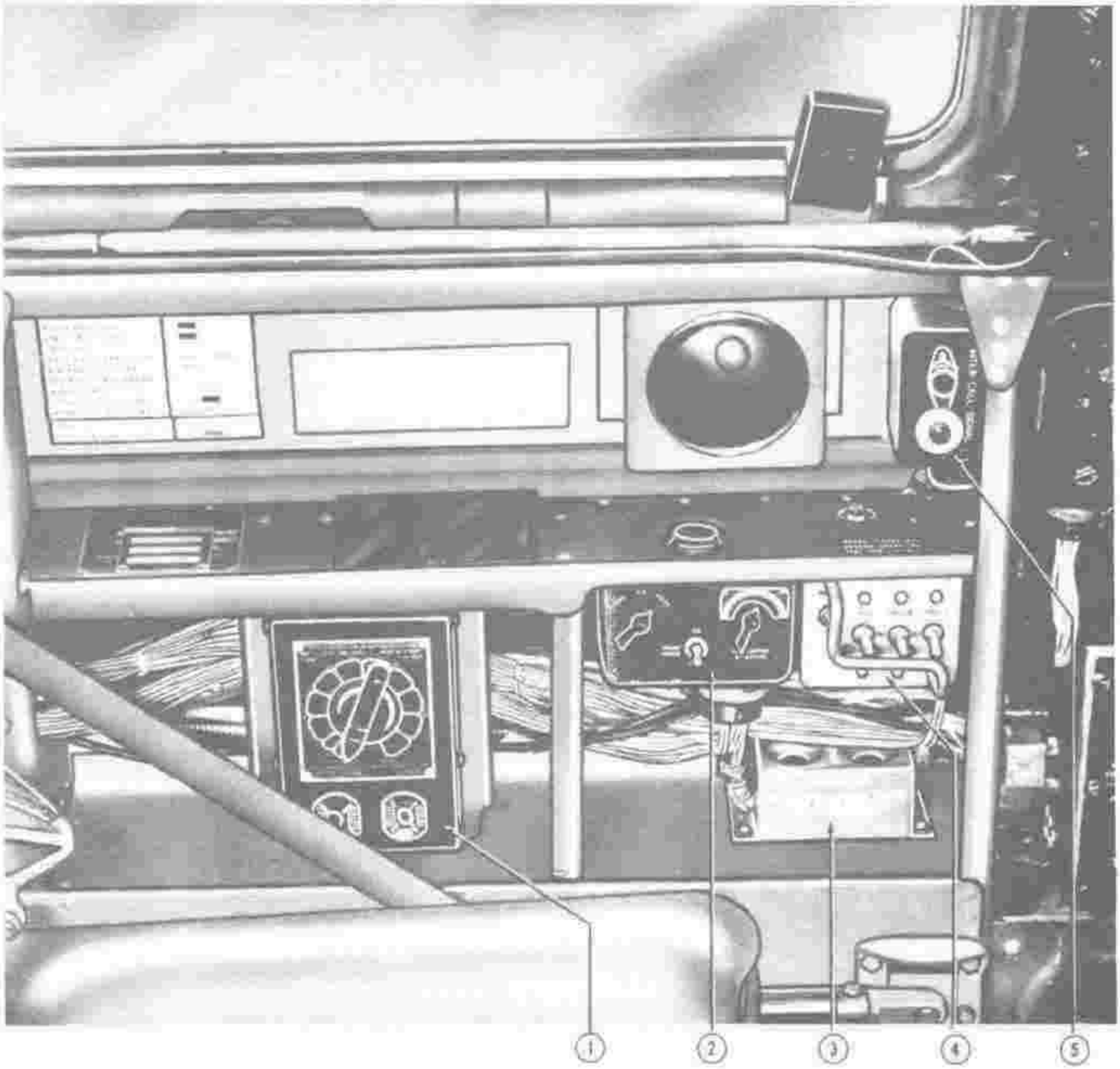


Figure 371 — Wing Tip Position Lamp

for the lamps, looking forward from the tail cone, are amber, green and red, respectively. One type E-1 upward recognition lamp protrudes through the top of the fuselage between the pilot's enclosure and the upper turret. These lamps are controlled by switches installed in a switch box *(4, figure 372)* located to the left of the pilot's seat next to the pilot's distribution panel. The four recognition lamp switches are protected by an S-shaped switch guard and have three positions: "STEADY" or down, "OFF" or straight forward, and "KEY" or up. When the switches are in the "KEY" or up position, the lamps may be operated intermittently for code signalling by means of a push button on the side of the switch box. When the switches are in the "STEADY" or down position, the lamps are turned on steadily and the push button is inoperative. The circuit is wired to power through a 15 ampere circuit breaker switch in the pilot's distribution panel.



1. Pilot's Suit Heat Rheostat
2. SCR-274-N Transmitter Control Box
3. Destructor Switch Box
4. Recognition Lamps Switch Box
5. Pilot's Intercall Signal Box

Figure 372—Electrical Equipment (Left Side of Pilot's Compartment)

2. REMOVAL.

a. DOWNWARD LAMPS.

(1) Remove the screws attaching lamp to fuselage.

(2) Pull lamp down away from fuselage, disconnect electrical plug, and remove lamp.

Note

A second man may disconnect the electrical plug from inside the aft fuselage section in order to recover the nuts from the screws holding the lamp to the fuselage.

b. UPWARD LAMP.

(1) From outside the airplane, one man must remove the screws attaching the lamp to the fuselage.

(2) From inside the bomb bay, a second man must disconnect the electrical connection and remove the lamp.

c. CONTROL SWITCH BOX.

(1) Remove the two screws on the extreme lower left and upper right corners of the switch box cover.

(2) Pull the cover away from the switch box.

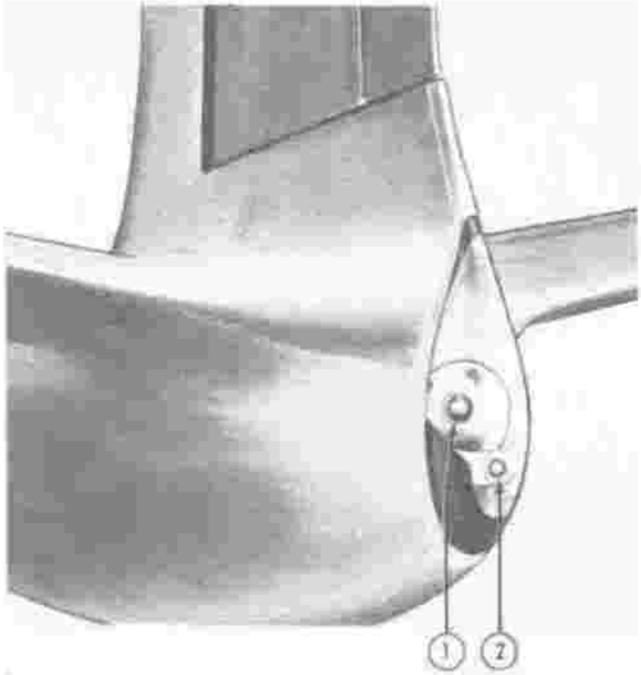
(3) Disconnect the wires at the back of the four switches.

(4) Remove the four screws (inside the box) holding the switch box to the bracket and remove the box.

(l) BOMBS ARMED LAMP. – One indicator lamp with an amber lens is mounted in the pilot's electrical control panel and lights when bombs have been armed in either the impact or delay condition.

(m) BOMB RELEASE SIGNAL LAMP (panel). –One indicator lamp with an amber lens is mounted on the pilot's auxiliary electrical control panel and lights when the bomb release signal lamp switch is turned on, to either the "DIM" or "BRIGHT" position.

(n) BOMB RELEASE SIGNAL LAMP (tail cone).–One type E-1 lamp is mounted to a bracket in the tail cone *(figure 373)* and is controlled by the bomb release signal lamp switch on the pilot's electrical control panel. The switch is wired through 15 ohm, 35 watt resistor mounted on the back of the auxiliary electrical panel and has two positions, "DIM" and "BRIGHT." The switch is also wired through the bomb rack safety relay which permits the tail cone signal lamp to light only when the bomb bay doors are open. The lamp assembly includes a solenoid which



1. Bomb Release Signal Lamp
2. Tail Cone Position Lamp

Figure 373 — Tail Cone Lamps

operates a red filter in front of the bulb for bomb signalling. The removal of this tail cone signal lamp is similar to that described in paragraph 15. *d.* (14) *(j)*.

(o) BOMB BAY DOORS OPEN LAMP.–One indictor lamp with a red lens is mounted on the pilot's electrical control panel and lights when the bomb bay doors are in the open position.

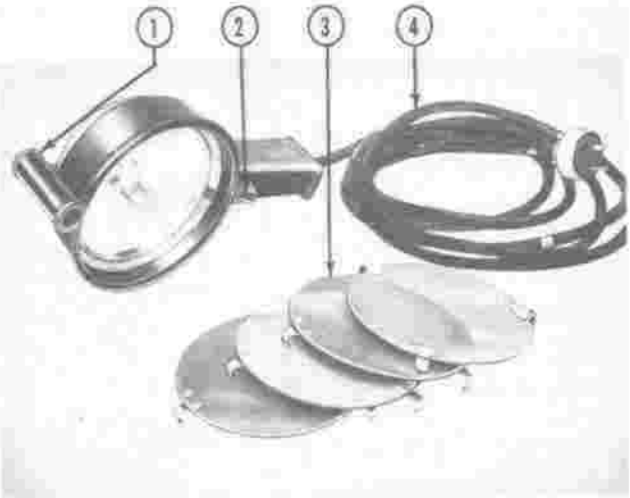
(p) BOMB BAY DOORS LATCHED LAMP (panel).–One indicator lamp with a green lens is mounted on the pilot's electrical control panel and lights when the bomb bay doors are locked in the closed position.

(q) UPPER TURRET LOCKED FORWARD LAMP.–One indicator lamp with an amber lens is mounted on the pilot's electrical control panel and lights when the upper turret is in the locked forward position.

(r) LANDING GEAR WARNING LAMPS.– Refer to paragraph 15. *d.* (13) *(b)*, this section.

(s) INTER-AIRCRAFT SIGNAL LAMP.
(See figure 374.)

1. DESCRIPTION.–One type C-3A lamp assembly is clipped to the floor beneath the pilot's seat. The unit includes a sealed beam projector lamp and extension cord (ten feet) hooked to the wall above the lamp assembly. A spare filter container is mounted to the left-hand wall next to the pilot's seat and contains four filters (neutral, green, red, and amber) to be



1. Aiming Sight
2. Trigger Operating Switch
3. Filters
4. Extension Cord

Figure 374 — Inter-Aircraft Signal Lamp

clipped on the lamp assembly to dim or color the light beam. The lamp cord is plugged into the spare receptacle in the pilot's suit heat rheostat box. The lamp is equipped with aiming sights on the top of the housing and is operated by means of a trigger switch on the handle.

2. REMOVAL AND DISASSEMBLY.

a. Remove the lamp unit from the floor by pulling from clips.

b. Loosen screws holding retaining band in place, disconnect electrical terminals to sealed beam bulb, and remove bulb.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace defective bulbs.

b. If necessary, the trigger travel may be adjusted by means of the screw (inside the plastic handle housing) which the trigger is pushed against.

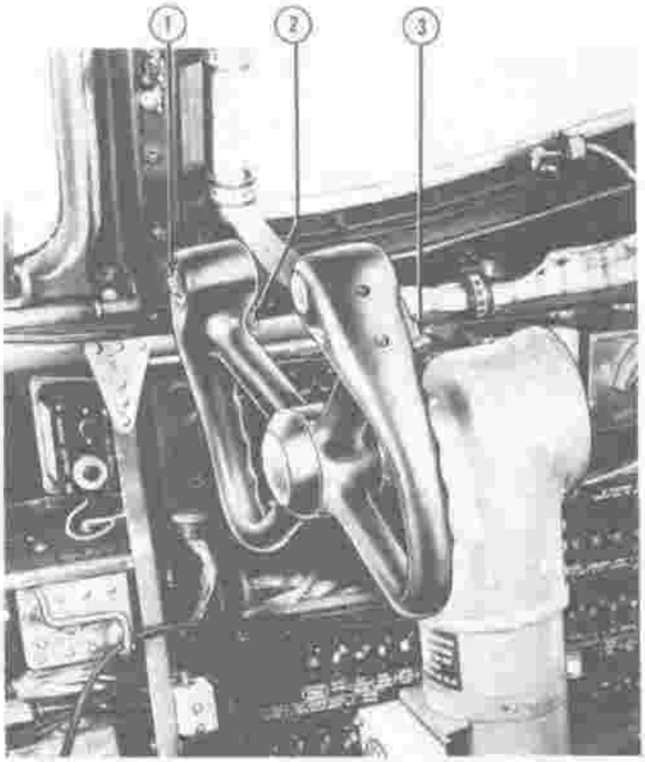
(15) BOMBING ELECTRICAL.

(a) GENERAL.—Bomb release is controlled electrically from the pilot's compartment on the A-26B airplane and from both the pilot's compartment and the bombardier nose on the A-26C airplane. Two bomb release systems have been used. On some airplanes, bomb release is electrical but the bomb bay doors are opened and closed by means of a manual control and the emergency salvo of bombs is accomplished mechanically. On other airplanes, all phases of bomb release are electrically controlled. A detailed wiring diagram of the bombing system used on the airplane will be found in the INDIVIDUAL ELECTRICAL CIRCUIT WIRING DIAGRAM BOOK supplied with the airplane. Simplified diagrams illustrating the basic circuits used in the all-electric bombing system will be found in *figures 466-475, 485 & 486.* For information on the maintenance of the mechanical equipment used in the bombing system, refer to paragraph 17, ARMAMENT. All of the electrical controls excepting the gunner's emergency switch are located in the pilot's compartment on the A-26B airplane. On the A-26C airplane, additional controls are provided in the nose to enable the bombardier to arm and release bombs selected by the pilot. *(See figure 486.)*

(b) ALL-ELECTRIC BOMBING SYSTEM.

1. GENERAL.—The all-electric bombing system installed on this airplane utilizes Type A-4 demolition bomb release units and R-1 fragmentation racks in the bomb bay and G-1750 (Type S-1 on some airplanes) bomb and chemical tank racks on the wing. Installation of the fragmentation bomb racks and wing bomb racks is optional. Features of the all-electric system are as follows:

a. The number of demolition bombs to be released, and the spacing may be predetermined by means of an intervalometer.



1. Bomb and Torpedo Release
2. Cannon Trigger
3. .50 Cal. Guns Trigger

Figure 375 — Control Wheel Switches and Triggers

b. A train of demolition bombs may be released by a single pressure on the bomb firing push button switch on the pilot's control wheel. (A separate switch is provided for the bombardier on the A-26C airplane.)

c. Demolition bombs in wing and fuselage may be released selectively or in train with nose or nose and tail armed or they may be salvoed instantly, either SAFE or ARMED, by means of a switch which also opens the bomb bay doors.

d. Fragmentation bombs may be released selectively or in train, in the ARMED condition only, by means of a continuous pressure on the bomb firing push button switch. They cannot be released by the salvo switch.

e. Chemicals carried in wing tanks may be fired by means of individual switches. The tanks themselves may be dropped by means of the same bomb firing push button switch used to release bombs.

f. Two torpedoes may be released from the bomb bay, either singly or in succession, by means of the same control wheel push button switch used to release bombs.

g. Bombs can be released from the fuselage only when the bomb bay doors are fully open. Bombs can be released from the upper racks only after the lower racks have been cleared.

h. Built-in features of the Type A-4 release insure the release of a full train of bombs from the fuselage. A bomb release receptacle installed at each bombing station maintains the circuit even though no bomb is installed.

i. While the bomb bay doors are operated hydraulically, they are controlled electrically. In event of an electrical failure, the doors also may be opened by means of a mechanical over-ride on the electrical control.

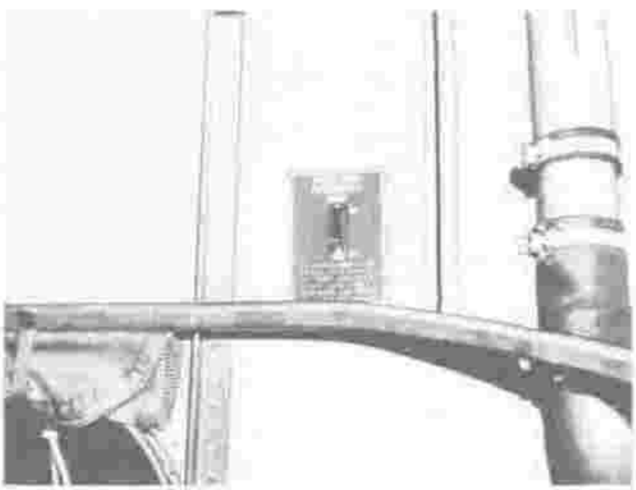


Figure 376 — Gunner's Emergency Exit and Bombs Salvo Switch

j. For an emergency escape through the bomb bay the gunner can open the bomb bay door and salvo the bombs by means of a guarded switch provided in his compartment.

k. A bomb release signal lamp is provided in the tail cone. A white light changes to red when bombs are released, and remains red for several seconds after the last bomb has been released. Then the light changes back to white.

l. Toggle switch circuit breakers are used in all bombing circuits excepting bomb salvo. The circuit breakers are located on the pilot's electrical distribution panel and in the forward junction box, where they may be reached in case it is necessary to close an opened circuit in emergency.

m. All bombing controls on the A-26B airplane, excepting the gunner's emergency exit switch, are located within easy reach of the pilot.

n. Additional controls are provided on the A-26C airplane which enable the bombardier to open the bomb bay doors, arm the bombs, and release them. The bombardier also is provided with a glide sight indicator and provisions are made for a bomb sight.

2. BOMB RACK OPERATIONAL CHECK (ALL-ELECTRIC SYSTEM).

a. CHECKING WING BOMB RACK OPERATION.

(1) Place bomb circuit main power switch in "ON" position.

(2) Place armament selector switch in "DEMOL." position.

(3) Cock all wing rack and fuselage bomb release units.

(4) Place individual wing rack switches in "ON" position.

(5) Place intervalometer sel-train switch in "TRAIN." Set intervalometer counter dial to six and the interval dial for slow release.

(6) With the bomb bay doors *closed* press the pilot's push button release switch. All four wing racks should release in the following order: Left Outboard, Right Outboard, Right Inboard, Left Inboard.

Note

The circuit should not transfer from the wing racks to the fuselage racks when the bomb bay doors are closed. If it does and any of the fuselage release units are operated, the safety switch in the aft bomb bay is faulty.

b. CHECKING WING & FUSELAGE BOMB RACK OPERATION.

(1) Open the bomb bay doors and re-cock all wing and fuselage bomb release units.

(2) Move bomb circuit main power switch to "ON" position.

(3) Place armament selector switch in "DEMOL" position.

(4) Move individual wing rack switches to "ON" position.

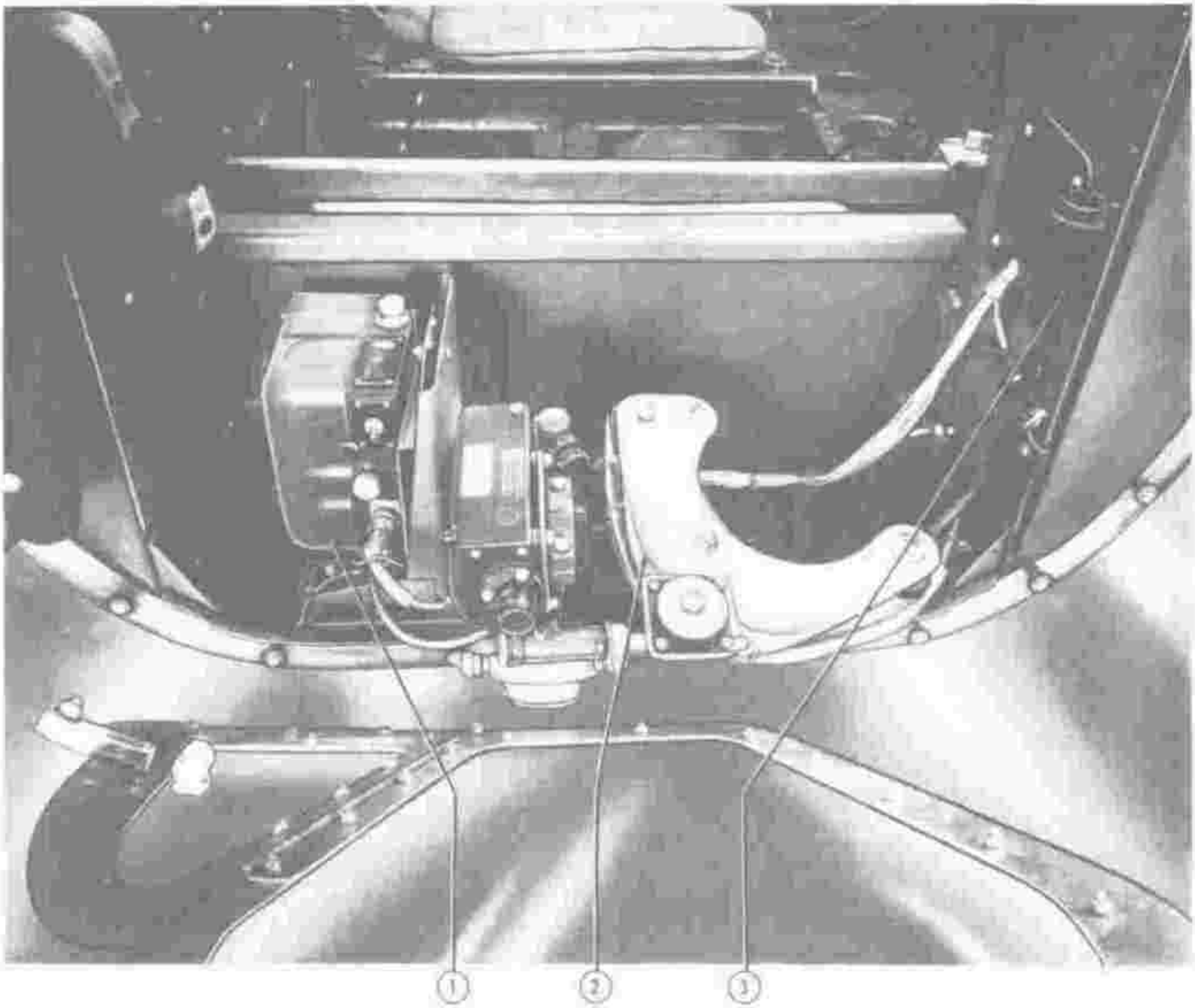
(5) Operate demolition lamp test and load check switches to check for proper operation.

(6) Place bomb release signal light switch in "DIM" or "BRIGHT" position.

(7) Place intervalometer SEL-TRAIN switch in "TRAIN" position, counter dial for number of racks being checked and interval control for slow release.

(8) Press pilot's push button release switch and check operation of racks as follows:

(a) All four wing racks should trip first.



View Looking Aft

1. Glide Sight Indicator
2. Bomb Sight Mount
3. Bomb Firing Push Button Switch

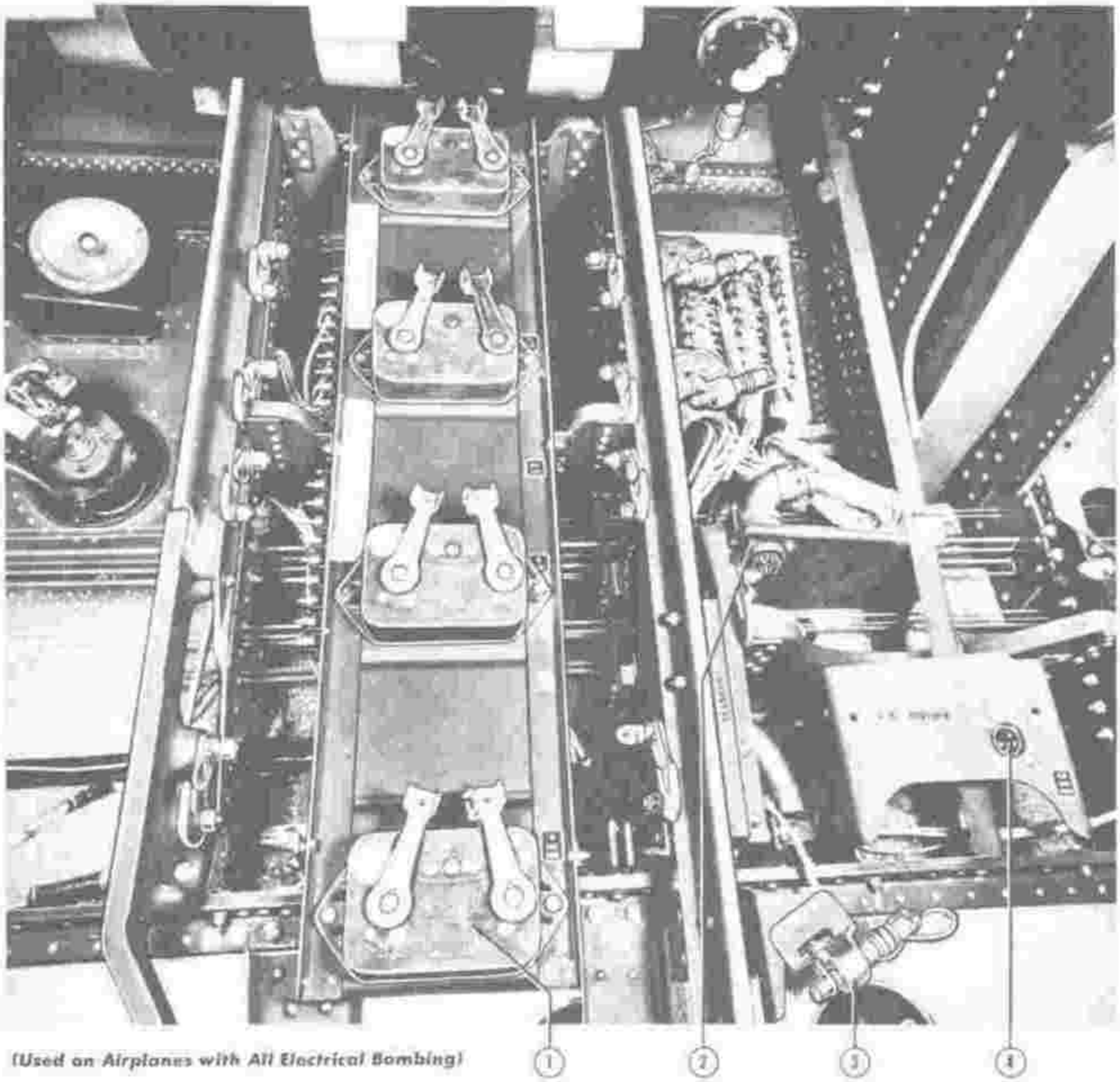
Figure 377 — Bombing Equipment — Bombardier Nose

(b) Circuit should then transfer to fuselage racks and trip each A-4 release unit.

Note

All of the bomb release units in the fuselage must be tripped before any of them are re-cocked in order to preserve the proper sequence of release. For example, if five releases should be fired and then re-cocked, the No. 6 release would be next to fire.

(c) Check operation of formation bombs release lamp in tail cone. The lamp should glow red for approximately five seconds after last bomb release has operated, and then be replaced by a white light.



(Used on Airplanes with All Electrical Bombing)

1. Type A-4 Bomb Release
2. Type B-1 Fragmentation Bomb Rack Plug Stowage
3. Type A-2 Bomb Arming Unit
4. Type A-1 Bomb Release Receptacle

Figure 378 — Fuselage Forward Demolition Bomb Rack

c. CHECKING WING & FUSELAGE DEMOLITION RACKS SALVO OPERATION.

(1) Turn bomb circuit main power switch "ON."

(2) Turn bomb selector switch to "DEMOL."

(3) Operate salvo switch on pilot's main electrical panel.

Note

This switch automatically opens the bomb bay doors.

(4) Repeat the salvo procedure, using the gunner's emergency exit switch for opening bomb bay doors and salvoing the bomb load.

3. ALL-ELECTRIC BOMBING CIRCUITS.—For purposes of description, the bombing system may be considered to consist of ten individual circuits. These circuits are described below, following discussion of electrical equipment common to all of the circuits.

a. CONTROL SWITCHES.

(1) DESCRIPTION.—Most of the control switches used in the all-electric bombing system are installed on the pilot's main electrical control panel. *(See figures 319 & 320.)* A gunner's emergency salvo switch *(figure 376)* is mounted on the right-hand side of the forward bulkhead in the gunner's compartment.

(2) REMOVAL.

(a) Detach the wires from the back of the switch.

(b) Remove the switch attaching screws. Lift the switch from the panel.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, excepting for tightening loose connections.

b. CIRCUIT BREAKERS.

(1) DESCRIPTION.—Toggle-switch type circuit breakers are used in the place of fuses in all parts of the bombing system excepting the salvo circuits. The circuit breakers differ from fuses in that they may be restored to service temporarily in the event of an emergency during flight. In such circumstances a pilot may elect to hold a circuit breaker switch "ON" to complete a circuit even though it may be dangerous to the circuit or equipment. As soon as the switch is released it will return to the "OFF" position. Ordinarily, circuit breakers found to be in the "OFF" position should not be turned "ON" until the circuit has been checked and the defect has been eliminated. Bombing system circuit breakers are installed on the pilot's electrical distribution panel, in the forward junction box, and in the gunner's aft relay box. It will be noted that several bombing circuits are wired through a 20 ampere circuit breaker switch located on the pilot's main electrical control panel.

(2) REMOVAL.—To remove a circuit breaker, disconnect the wires and remove the screws which attach it to the panel or junction box.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary if a circuit breaker has been burned out.

c. DEMOLITION BOMB RELEASE CIRCUIT. *(See figure 466.)*

(1) GENERAL.—This circuit enables the pilot to select bombs to be released by the intervalometer. (Refer to the INTERVALOMETER CIRCUIT, *figure 467.)* Selected wing or fuselage bombs are released in alternate rotation to insure an equal distribution of weight in the airplane. Power for the circuit is obtained by means of two connections to the distribution panel bus bar. One connection supplies power through the bomb circuit main power circuit break switch to the wing rack selector switches. Closing of these selector switches energizes two wing rack selector relays (RS-2). When the bomb firing push button is pressed, the selector relays automatically regulate the release of bombs from each wing through the G-1750 (Type S-1 on some airplanes) rack assembly. A second connection to the distribution panel bus bar supplies power through a ten ampere circuit breaker to the bomb bay door safety switches. When both of these safety switches have been closed by the opening of the doors the bomb door indicator lamp lights and power is furnished to the fuselage bomb rack selector switches. Closing of the selector switches energizes the bomb rack selector relay unit (RS-2) located in the bomb bay at the aft bulkhead. When the bomb firing push button release is pressed, the selector relay automatically regulates the release of bombs alternately from the aft and forward bomb bay release units. The release units are plugged into type A-1 receptacles provided on the back of each bomb rack station. The order of release of demolition bombs with all rack selector switches closed is as follows: L.O. wing, R.O. wing, R.I. wing, L.I. wing, or 1A R.H. aft, 4 or 4A L.H. forward, 2 or 2A L.H. aft, 3 or 3A R.H. forward, 5 or 5A R.H. aft, 8 or 8A L.H. forward, 6 or 6A L.H. aft, 7 or 7A R.H. forward, 9 R.H. aft, 12 L.H. forward, 10 L.H. aft, 11 R.H. forward, 14 L.H. forward, 13 R.H. forward, 16 L.H. forward, 15 R.H. forward.

(2) DEMOLITION BOMB RACK SELECTOR RELAYS.
(See figure 337.)

(a) DESCRIPTION.—Three Type RS-2 bomb rack selector relays are used to regulate the order of release of demolition bombs from the fuselage and wing. The relays are located in the bomb bay near the aft bulkhead. They are wired in series and automatically transfer the intervalometer impulses from one circuit to another.

(b) REMOVAL.

1. Disconnect the electrical plug.

2. Remove the four screws which attach the relay to the fuselage support.

3. Remove the relay.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Dirty contact points sometimes cause erratic operation of a bomb rack selector relay. To check the condition of the relay, remove the locknut which holds the cover in place. If the contacts are dirty, they should be carefully cleaned with carbon tetrachloride. No other repair of the relay should be attempted. A defective relay must be replaced. No lubrication is required.

(d) INSTALLATION.—Reverse the REMOVAL procedure.

(e) TEST AFTER INSTALLATION.

1. Break the d-c power source, either by turning off all rack selector switches, or by closing and reopening the bomb bay doors.

2. Cock one bomb release in each circuit and return all selector switches to "ON."

3. With the "SELECT-TRAIN" switch in "SELECT" position, trip the bomb release switch and check to see that each release trips in the proper sequence.

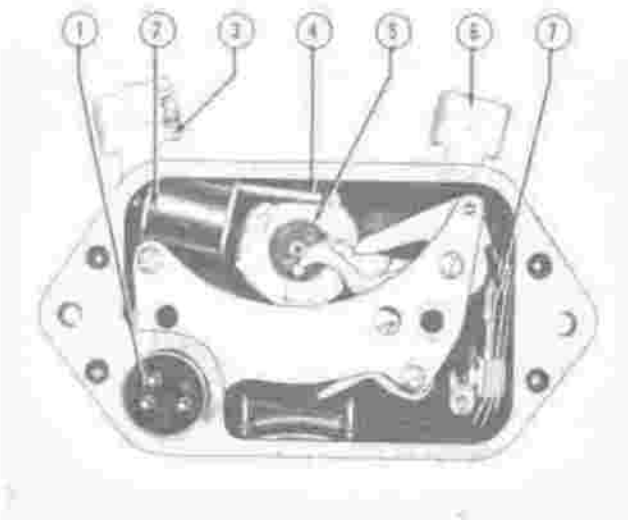
Note

When cocking the bomb releases be sure that all selector switches are "OFF." Random cocking of bomb releases when current is flowing into the rack selector relays may cause an erratic sequence of release.

(3) BOMB AND CHEMICAL TANK RACK ASSEMBLY. *(See figure 328.)*—Provisions are made for the installation of two G-1750 (Type S-1 on some airplanes) bomb and chemical tank, rack assemblies on each wing. For description and maintenance of the wing bomb racks refer to paragraph 17. *c.* (4), this section.

(4) BOMB RELEASE UNIT.
(See figure 379.)

(a) DESCRIPTION.—Type A-4 bomb release units are plugged into Type A-1 receptacles at all fuselage stations where bombs are to be carried. Each unit has an arming lever and a releasing lever which mate with arming and releasing levers on the bomb shackles. When the bomb firing switch is pressed, an impulse from the intermediate meter energizes a solenoid in the release unit. The solenoid in



1. Connector Plug
2. Salvo Locking Solenoid
3. Release Lever
4. Return Spring
5. Rotary Solenoid
6. Arming Lever
7. Transfer and Indicator Light Switches

Figure 379—Type A-4 Bomb Release

turn trips the arming lever, and a fraction of a second later, the release lever. Tripping of the bomb release lever causes the by-pass switch to open the circuit to the solenoid and close the circuit to the next bomb release. Each release unit is cocked by pulling the levers outward. The arming lever has to be cocked before the release lever. If bombs are released in an unarmed condition, the release lever only will operate. A rotary salvo solenoid within the unit accomplishes unarmed salvo release of bombs. A trip screw located on the face of the unit may be turned to trip the levers manually. If this measure is used to uncock a release unit the trip screw must be returned to its normal position. The release lever has a fixed ear and a hinged ear. The hinged ear may be moved with a screw driver or similar tool to permit emergency release of a bomb if the release unit has been damaged.

(b) REMOVAL.

1. Remove the two mounting screws and the safety wire.

2. Pull the release unit straight out from the receptacle.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. This unit must be kept free of oil, dirt, or any other foreign material. No lubrication is necessary.

2. If the spring on the hinged ear on the release lever is damaged or worn replace the spring. If necessary, replace the ear.

3. Clean any dirt or corrosion off of the electrical plug with emery cloth.

4. Keep internal switching contacts clean by using emery cloth.

5. Check for rough surfaces on lever ends of their corresponding trips. Polish roughened area with emery or crocus cloth.

(d) INSTALLATION. — Reverse the REMOVAL procedure. The releases are supplied as right-hand and left-hand units.

(e) TEST AFTER INSTALLATION.

1. Cock both levers of the release unit by pulling them outwards. Operate the bomb release controls as instructed in paragraph 1. *c.* (1) and (2), this section. Both levers should operate.

2. Cock all releases and set intervalometer for fastest train release. Operate controls again. All releases should trip.

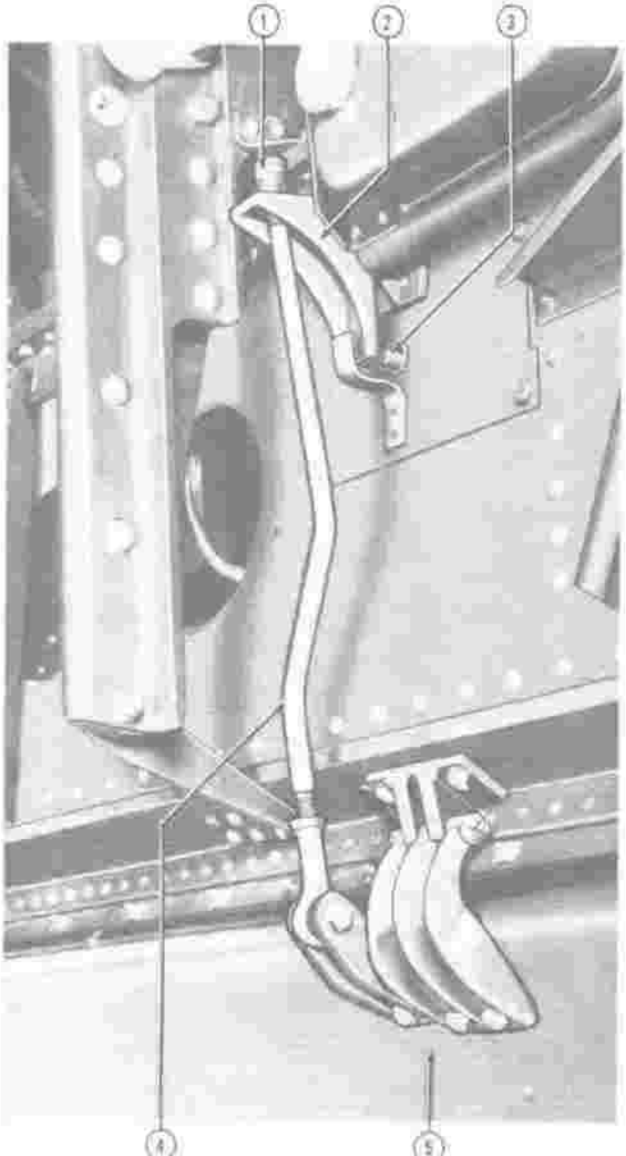
3. Cock releases. Open "BOMB CIRCUIT MAIN POWER" switch, press push button release. None of the units should operate.

4. Cock the release levers and close the salvo switch. All release levers should operate, but the arming levers should remain untripped.

5. Cock each unit and move the trip screw. Both levers should trip. Be sure to return the trip screw to its original position.

(5) BOMB BAY DOOR SAFETY SWITCHES.
(See figures 380 & 381.)

(a) DESCRIPTION.—Two bomb bay door safety switches are mounted on the lower fuselage structure in the bomb bay. Each switch is actuated by an arm and rod assembly which is attached to the bomb bay door. Both switches must be closed to complete the fuselage bomb release circuit.



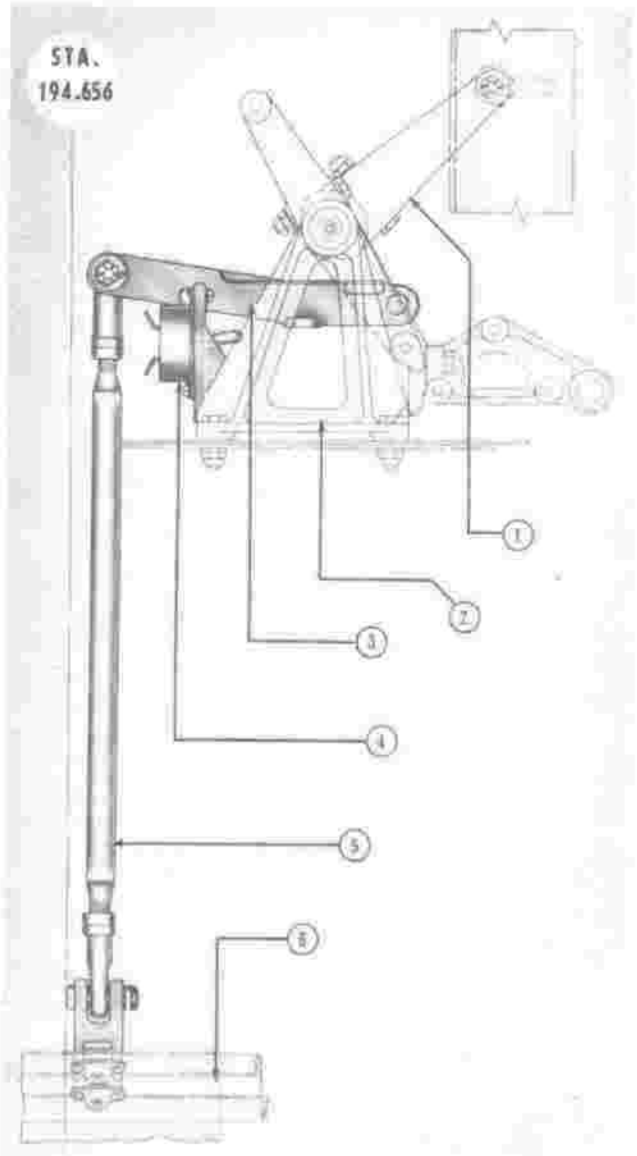
1. Adjustment Nuts
2. Tripping Lever
3. Switch
4. Actuating Rod
5. Bomb Bay Door

Figure 380 —Bomb Bay Door Safety Switch (Used on Airplanes with All Electrical Bombing)

(b) REMOVAL.

1. Detach the actuating rod by removing the two nuts and the spring at the top.

2. Remove the four screws from the switch mounting plate.



1. Bomb Rack Mechanical Salvo Mechanism
2. Bomb Rack Control Bellcrank Support
3. Switch Actuating Lever
4. Toggle Switch
5. Actuating Rod
6. Bomb Bay Door

Figure 381—Bomb Bay Door Safety Switch (On Airplanes with Mechanical Salvo)

3. Pull out the switch and disconnect the electrical wires.

4. Remove the switch.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(d) ADJUSTMENT.—If the bomb bay door safety switch fails to make proper contact, adjust the length of the actuating arm by loosening or tightening the two nuts on the top end of the rod. If necessary, an additional adjustment can be made by removing the switch and adjusting the nuts on the switch collar.

(6) BOMB RELEASE RECEPTACLE.
(See figure 382.)

(a) DESCRIPTION.—One type A-1 bomb release receptacle is provided on the back of each bomb rack station. The unit provides a convenient receptacle for the plug on the removable bomb release unit, and a skip switch to by-pass the electrical bomb release impulse around bomb stations where bomb releases are not installed. Normally closed, the skip switch is opened when the button which protrudes from the panel is depressed by the installation of the bomb release unit.

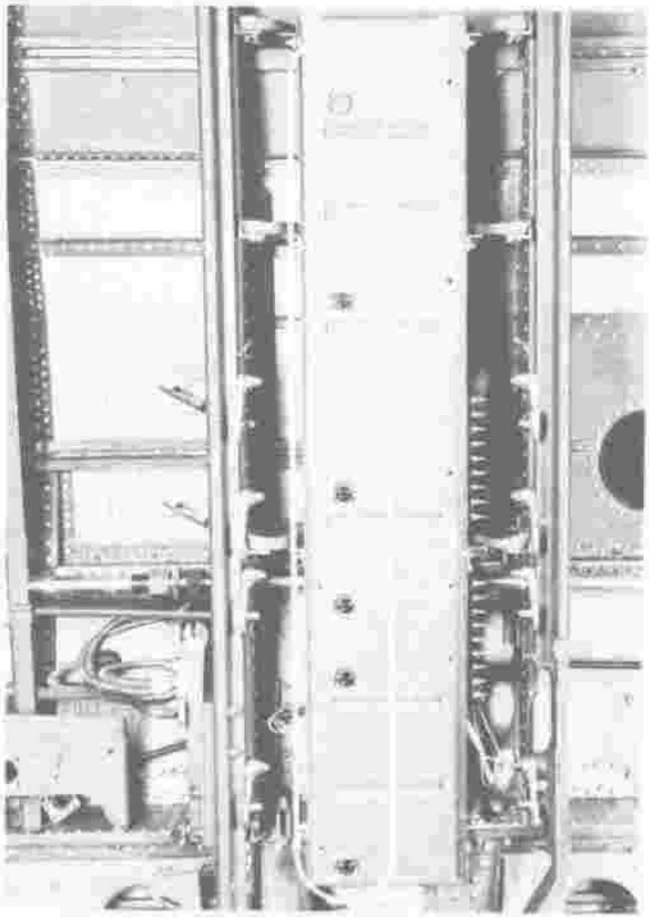


Figure 382 — Bomb Release Receptacle

(b) REMOVAL.

1. Remove the plug connected to the back of the receptacle.

2. Remove the four screws which attach the receptacle to the panel.

d. BOMB INTERVALOMETER CIRCUIT. *(See figure 467.)*

(1) GENERAL.—The bomb intervalometer circuit permits the release of a uniformly spaced pattern or train of demolition bombs. The pilot on the A-26B airplane, and also the bombardier on the A-26C airplane, needs to press the push button release switch only once to release from one to fifty bombs. Power is supplied from the distribution panel bus bar through a 15 ampere circuit breaker to the "C" terminal of the intervalometer. The "A" terminal of the intervalometer is connected to the demolition-fragmentation selector switch. The "B" terminal of the intervalometer furnishes power to the demolition bomb release relay in the forward junction box. This relay receives power from the forward junction box bus bar and transmits the power to the "D" terminal of the bomb rack selector relay unit (RS2) located in the bomb bay near the aft bulkhead. For continuation of wiring from this point, refer to the DEMOLITION BOMB CIRCUIT, *figure 466.*

Note

On some airplanes the demolition bomb release relay has been eliminated, along with the connection to forward junction box bus bar. Power is supplied from the intervalometer directly to the bomb rack selector relays.

(2) INTERVALOMETER. *(See figure 383.)*

(a) DESCRIPTION.—A type B-2A or B-3 intervalometer is mounted on the raised section of the control pedestal in the pilot's compartment and is controlled by an interval selector dial, a counter dial, and a train-selector switch on the face of the unit. Through a combination of relays, resistors, and capacitors, it furnishes the electrical impulses which operate the bomb releases on the bomb racks, generating either a single impulse or a series of accurately timed impulses. With the "Select-Train" switch in the "Select" position, one bomb will be released with each operation of the release switch; in the "Train" position one operation of the release switch will cause the intervalometer to release bombs until the counter on the "BOMBS TO BE RELEASED" knob reaches zero. This counter is set in advance to the desired number of bombs in the train to be dropped, and is returned to zero, one notch for each impulse, from the intervalometer, by a solenoid and ratchet arrangement. The desired ground spacing of the bombs in the train is obtained by setting the "GROUND SPEED-M.P.H." dial to line up with the desired "INTERVAL BETWEEN BOMBS-FEET" marking on the outer scale. The necessary time interval is automatically computed by the intervalometer, which upon operation of the release switch, drops a uniformly spaced train of bombs timed to land the distance apart selected on the dial. A train release may be stopped before the complete train has left the airplane by either moving the "SELECT-TRAIN" switch to "SELECT," or manually turning the counter knob immediately to zero. A train may be extended beyond the number of bombs originally selected by manually holding back the counter knob. A polarized jewel pilot light indicates when the bomb release circuit is ready to drop bombs. The polarizing feature allows the light to be dimmed or completely blacked out by rotating the jewel. The light is "ON" when "SELECT-TRAIN" switch is on "SELECT," but with the switch in "TRAIN" position, the light is "ON" only when the counter knob is displaced from zero. When not in use, leave the switch on "TRAIN" and the counter at zero to avoid unnecessary power drain by the pilot light. Failure of the light will not affect the operation of the unit.

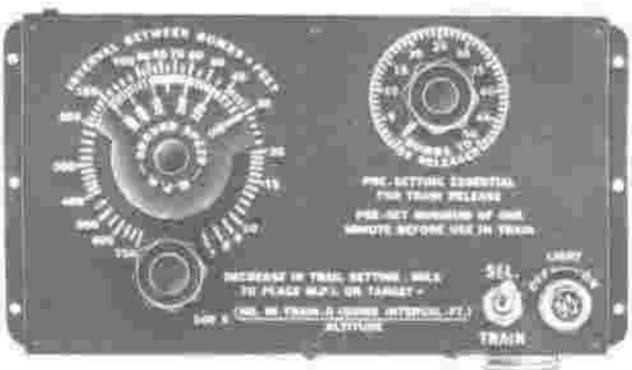


Figure 383 — Bombing Intervalometer

(b) REMOVAL.—Remove the electrical connections and the attaching screws.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. A damaged or defective intervalometer shall be replaced.

2. Replace a burned out pilot lamp. The pilot lamp jewel may be removed by turning the jewel holder counterclockwise.

3. No field lubrication is required.

(d) INSTALLATION. — Reverse the REMOVAL procedure.

(e) TEST AFTER INSTALLATION. —Set the "TRAIN-SELECT" switch to "SELECT" and cock at least two bomb releases. Depress the bomb release switch and check to see that only one release is tripped for each operation of the switch. Test the train operation by cocking 10 bomb releases and setting the counter knob to 10. With the "SELECT-

TRAIN" switch on "TRAIN" depress the bomb release switch and check to see that all 10 releases are tripped.

Note

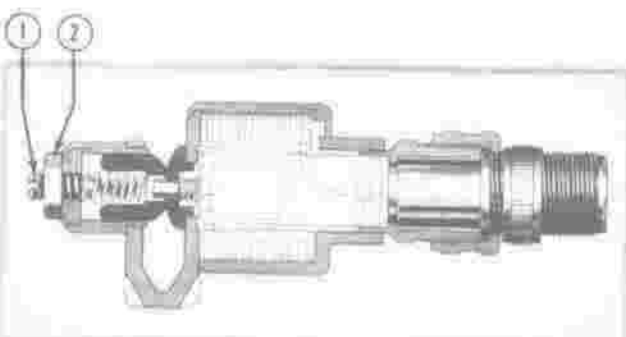
All group selector switches should be "ON" for this test.

e. BOMB ARMING CIRCUIT. *(See figure 468.)*

(1) GENERAL.–The bomb arming circuit serves to arm fuselage and wing demolition bombs. Power is supplied through the distribution panel bus bar and bomb circuit main power switch to the three-position bomb arming switch located on the pilot's electrical control panel. (A similar switch is also provided for the bombardier on the A-26C airplane.) When the bomb arming switch is placed in the TAIL position, the tails of all bombs mounted in wing racks are armed by the solenoids built into the rack assemblies. Tails of bombs mounted in bomb bay racks are armed automatically when the releases are cocked. When the bomb arming switch is placed in NOSE & TAIL position, the bomb arming solenoids (type A-2) arm the noses of bombs mounted in the bomb bay. If desired, the nose and tail of wing bombs then may be armed by closing the wing bomb rack selector switches. The BOMBS ARMED lamp on the pilot's electrical control panel (and in the bombardier nose on the A-26C) lights when the bombs are armed.

(2) BOMB ARMING CONTROL UNIT. *(See figure 384.)*

(a) DESCRIPTION. – A type A-2 bomb arming control unit on a type A-1 mount is installed at each bomb station to control the nose fusing of that bomb. Each control assembly is secured to a mount on the forward rail of each bomb station by a bolt. The nose arming wire swivel loop is retained in the unit by means of a spring actuated ball catch. When the demolition arming selector switch on the pilot's electrical panel is placed in the "NOSE & TAIL" position the solenoid within the unit is energized and the ball catch locks the arming wire. Otherwise, the arming wire slips free of the unit when the bomb is released, leaving the nose unarmed.



1. Adjusting Screw
2. Adjusting Screw Lock Nut

Figure 384 — Type A-2 Bomb Arming Control Unit

(b) REMOVAL AND DISASSEMBLY.

1. Disconnect the electrical plug at the forward end of the control.

2. Remove the bolts which attach the control unit to the support bracket on the bomb rail.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Any broken, bent or defective part of the arming control unit is cause for replacement.

2. NO lubrication is necessary. Lubrication might cause the unit to fail in extremely high or low temperatures.

(d) ADJUSTMENTS. – If the bomb arming unit fails the three pound or the four pound pull-out test as described below in TEST AFTER INSTALLATION, adjust as follows:

1. Loosen adjusting screw lock nut.

2. Turn tension adjusting screw clockwise to increase pull-out force on counterclockwise to decrease pull-out force.

3. After adjustment, tighten lock nut.

(e) ASSEMBLY AND INSTALLATION.–Reverse the REMOVAL procedure.

(f) TEST AFTER INSTALLATION. –Test the bomb arming control unit for the following load characteristics with a standard fuse arming wire and swivel loop; (.030 inch for 300 pound bomb; .064 inch for 500 to 1000 pound bombs). The unit MUST hold a three pound load with the solenoid de-energized.

f. DEMOLITION BOMB SALVO CIRCUIT. *(See figure 469.)*

(1) GENERAL.–By means of this circuit the pilot and gunner can salvo all demolition bombs instantaneously. On the A-26C airplane the bombardier also can salvo all demolition bombs. On some airplanes the pilot's salvo switch, and that of the bombardier, receive their power from the distribution panel bus bar while the gunner's salvo switch is connected to the gunner's relay junction box bus bar. On other airplanes, all salvo switches receive their power

directly from the battery. When a salvo switch is operated, power is furnished to the bomb bay door position valve solenoid, to the dual wing bomb salvo relays, to the fuselage bomb salvo relays, and to the bomb salvo indicator lamp. The fuselage bomb salvo relays operate after the bomb bay door safety salvo switches have been closed by the opening of the bomb bay doors. When the relays close, power is furnished to the wing rack and bomb bay bomb release units. Bombs can be salvoed in the SAFE or ARMED condition, depending on the position of the bomb arming switch. No circuit breakers are used in the bomb salvo circuits.

(2) DUAL WING BOMB SALVO RELAYS.

(a) DESCRIPTION.—Two dual wing bomb salvo relays are installed in the bomb salvo relay junction box *(figure 337)* located on a shelf in the bomb bay at the aft bulkhead. The four coils in the two relays actuate the four wing racks when the wing racks are installed on the wings.

(b) REMOVAL.

1. Remove the cover from the junction box.

2. Disconnect the wires from the relay.

3. Remove the four screws which attach the relay to the junction box.

4. Remove the relay.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Clean the contacts if the relay fails to function. If this fails to correct the difficulty, replace the relay.

(3) FUSELAGE BOMB SALVO RELAYS. *(See figure 337.)*

(a) DESCRIPTION.—Two time delay relays are installed in the bomb salvo relay junction box located on a shelf in the bomb bay at the aft bulkhead. Each relay contains a coil and an arrangement of copper slugs which delay the operation of the relay for one tenth of a second after the relay has been energized. This brief delay provides time for the electricity to reach the locking solenoid in the bomb release before power is applied to the salvo solenoid in the release. No provision is made to adjust the relay.

(b) REMOVAL.

1. Remove the cover from the junction box.

2. Disconnect the wires from the relay.

3. Remove the four screws which attach the relay to the junction box.

4. Remove the relay.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Clean the contacts if the relay fails to function. If this fails to correct the difficulty, replace the relay.

(d) TEST AFTER INSTALLATION.—Check the relay for correct operation by cocking all releases, closing bomb bay doors, and pulling the salvo switch. (The engines must be operating.)

(4) SAFETY SALVO SWITCHES.—Two bomb bay doors safety salvo switches are installed on the bomb bay doors on some airplanes. When a salvo is operated by a crew member, current is sent through the bomb bay door safety salvo switches to the fuselage salvo relays. The switches are identical with the bomb bay door safety switches described in paragraph 15., *d.*, (15), *(b)*, *3.*, c., *(5)*, this section.

g. DEMOLITION BOMB LOAD CHECK CIRCUIT. *(See figure 470.)*—This circuit enables the pilot to check the number of demolition bombs loaded on the airplane, ready for release. The check is made by means of a series of indicator lamps and a three-way, rotary blade, bomb load check switch with a normal position of OFF. When the switch is turned to the left, the lamps themselves are tested to make certain they are operating properly. When the switch is turned to the right, the lamps indicate the number of bombs loaded and ready for release in the wing and bomb bay racks. During bombing operations, the circuit may be used at will to determine the number of un-released bombs remaining in the wing and bomb bay racks. Circuit power is obtained from the pilot's distribution panel bus bar through the bomb circuit main power circuit breaker switch. The four lamps used to check the wing rack load are wired through resistors mounted on the back of the pilot's electrical control panel. *(See figures 321 and 322.)* The resistors are required because the wing rack shackles contain no internal resistance. The releasing solenoid in the A-4 releases provide the resistance required for the bomb bay load indication lamps.

h. BOMB RELEASE SIGNAL LAMP CIRCUIT. *(See figure 471.)*

(1) GENERAL.—The bomb release signal lamp circuit is used in flight to warn other airplanes in formation that bombs are being released. When the formation bomb release signal lamp switch is turned to "DIM" or "BRIGHT," power is furnished to an indicator lamp on the electrical control panel and a bomb release signal lamp in the tail cone.

The bomb release lamp normally emits a white light, but when bombs are released it changes to red and remains red for approximately five seconds after the last bomb of a train has been dropped. Power for operation of the lamps is supplied from the distribution panel bus bar through the bomb circuit main power circuit breaker switch and a double pole bomb release signal lamp switch which is wired through a resistor. Power for operation of the tail cone signal lamp mechanism is supplied from the gunner's relay junction box through a five ampere circuit breaker and an Agastat time delay relay. The Agastat is actuated by power supplied from the forward junction box bus bar when the demolition bomb release relay operates. Closing of the Agastat actuates a solenoid in the tail cone lamp assembly. The solenoid in turn raises or lowers a red filter on the lamp.

(2) BOMB RELEASE SIGNAL LAMP RELAY.

(a) DESCRIPTION.—An Agastat time delay relay controls the operation of the bomb release signal lamp in the tail cone. The relay consists of a coil and two switches, only one of which is used. The relay is located in the gunner's relay junction box.

(b) REMOVAL.

1. Disconnect the electrical wiring.

2. Remove the screws which attach the relay to the junction box.

3. Remove the relay.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, is advisable except for possible oiling of the small moving shaft and the resetting of the timing adjustment.

(d) ADJUSTMENT.—The time delay mechanism for this relay is adjusted for five seconds at the factory but may be readjusted for any reason, by turning the thumb screw on the face of the relay. Turning the screw clockwise will increase the time delay; turning the screw counterclockwise will shorten the time delay.

(3) BOMB RELEASE SIGNAL LAMP. *(See figures 319 & 320.)*—Refer to h. *(1)* above for description and maintenance of the bomb release signal lamp.

i. BOMB BAY DOOR SOLENOID CIRCUIT. *(See figure 472.)*

(1) GENERAL.—The bomb bay door solenoid circuit provides electrical control of the hydraulically operated bomb bay doors. When the BOMB DOORS switch on the pilot's electrical control panel is turned from the "NEUTRAL" position to "OPEN" or "CLOSE," it actuates one of two solenoid units built into the bomb bay doors position selector valve. The selector valve, *(figure 270)* located on the aft end of the control pedestal, also may be operated manually in the event of a failure in the electrical circuit. The bomb door solenoid circuit is wired to power at the distribution panel bus bar and is protected by the BOMB CIRCUIT MAIN POWER circuit breaker switch (20 amperes) located on the pilot's electrical control panel. This switch must be turned to the "ON" position to place the bomb door solenoid circuit in operation. On the A-26C airplane the circuit is wired so that the bombardier also can open and close the doors by means of a BOMB DOOR switch located on his electrical control panel.

(2) BOMB DOORS POSITION SELECTOR VALVE SOLENOIDS.

(a) DESCRIPTION. — Each solenoid unit mounted on the bomb doors position selector valve contains two coils, one large coil which operates the valve, and a small coil which holds the valve open. An internal switch in the solenoid cuts out the large coil if the BOMB DOORS switch is left on ("OPEN" or "CLOSE"). Normally the BOMB DOORS switch should be returned to the center position after the doors have been opened or closed.

(b) REMOVAL.

1. Disconnect the electric wiring from the top of the solenoids.

2. Remove the two screws and the retaining plate which attach the solenoids to the valve body.

3. Lift off the solenoids.

Note

If necessary, the valve operating shafts may be disconnected by removing the Allen set screws.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replace the solenoid unit if it overheats when the BOMB DOORS switch is left in the "OPEN" or "CLOSE" position. Overheating indicates that the internal switch in the solenoid has failed to operate.

j. CHEMICAL FIRING CIRCUIT. *(See figure 473.)*—The chemical firing circuit provides the means for electrical ignition of chemicals when they are carried in wing rack tanks. The circuit is wired to power at the distribution panel bus bar and is protected by the BOMB CIRCUIT MAIN POWER circuit breaker switch (20 amperes) located on the pilot's electrical control panel. Four of the six individual switches on the electrical control panel control the firing of chemicals in the tanks. The other two switches (right-hand) are not wired. The tanks themselves may be dropped from the wing racks by means of the same controls used to release demolition bombs. For other information about chemical tanks refer to paragraph 17, ARMAMENT.

k. TORPEDO RELEASE CIRCUIT. *(See figure 474.)*—This circuit makes it possible for the pilot to release two torpedoes from the bomb bay, either singly or in succession, by means of the same control wheel push button switch used to release bombs. Before the control wheel switch can be used, two other switches must be "ON." These are the BOMB CIRCUIT MAIN POWER circuit breaker switch, and the TORPEDO CIRCUIT switch, both located on the pilot's electrical control panel. When these switches are "ON," operation of the control wheel bomb release button switch actuates the torpedo release relay located in the forward junction box. Closing of the relay introduces bus bar power wired through a 10 ampere circuit breaker located on the pilot's distribution panel. This power supply actuates the Type A-4 torpedo release unit in the bomb bay. For other information or torpedo release, refer to paragraph 17, ARMAMENT.

l. FRAGMENTATION BOMB CIRCUIT. *(See figure 475.)*

(1) GENERAL.—When the fragmentation-demolition bomb selector switch is placed in the "FRAG" position and the fragmentation bomb rack selector switches are on "SELECTIVE" or "TRAIN," this circuit provides for the release of fragmentation bombs by means of the same bomb firing push button switch used to release demolition bombs.

With the opening of the bomb bay doors, the bomb bay safety switches are closed and power is furnished to the coil of the bomb bay door safety relay. The closing of this relay connects the coil on the fragmentation bomb release relay, preventing the release of bombs before the bomb bay doors are opened. The closing of the fragmentation bomb release relay supplies power from the forward junction box bus bar to the fragmentation bomb rack selector switches and the Type A-4 release units. The "FRAGMENTATION ARMING" switch, which obtains its power from the distribution panel bus bar, is utilized to arm certain types of fragmentation bombs. When the switch is closed, power is furnished to the Type A-1 bomb release receptacle and the Type A-4 bomb release unit.

Note

Some types of fragmentation bombs cannot be dropped unarmed even though the fragmentation arming switch is set in the "SAFE" position. A "FRAG LOAD CHECK" switch and indicator lamps are provided to determine the number of bombs mounted in the bomb bay. The load check switch must be "OFF" before bombs can be released.

(2) BOMB BAY DOOR SAFETY RELAY AND FRAGMENTATION BOMB RELEASE RELAY.

(a) DESCRIPTION.—One bomb bay door safety relay and one fragmentation bomb release relay are installed in the forward junction box. *(See figure 330.)* The relays are used only in the fragmentation bomb release circuits.

(b) REMOVAL.

1. Remove the electrical wiring.

2. Remove the screws which attach the relay to the junction box.

3. Remove the relay.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Service on the relays is confined to the cleaning of the contacts.

(c) ELECTRICAL RELEASE WITH MECHANICAL SALVO.

1. GENERAL.—On some airplanes the electrical bomb release system is used excepting for salvo, which is accomplished mechanically. The system utilizes Type A-2 bomb releases in the fuselage and the G-1750-500 bomb rack assemblies on the wings. The Type A-2 bomb release is plugged into a Type A-1 receptacle on most of the airplanes equipped with mechanical salvo. Some airplanes are equipped with the Type AX-5D switch box assembly in place of the A-1 receptacle. The electrical bomb release controls consist of toggle switches on the pilot's main electrical control panel *(figures 319 & 320)*, an intervalometer and a bomb firing push button switch on the pilot's control wheel. The mechanical salvo release system *(figure 322)* includes the bomb control lever, bell cranks, a torque tube, pulleys, cables connecting the fuselage and wing bomb stations, and a cam bar located behind each fuselage bomb panel. Mechanical salvo of fuselage and wing bombs is accomplished by placing the bomb lever in "SALVO" position. Wing bombs or chemical tanks also may be salvoed electrically without releasing fuselage bombs by means of a wing bomb salvo switch.

2. OPERATIONAL CHECK. (ELECTRICAL SYSTEM WITH MECHANICAL SALVO.)

a. Place bomb control lever and intervalometer in "SEL" position.

b. Cock levers on all A-2 release units installed.

c. Fire all stations by pressing push button release.

d. While making the preceding check, stop after the fifth release to check the operation of the bombs release signal lamp in the tail cone for white and red lighting. Refer to paragraph 1. *g.*, this section.

e. With racks cocked and bomb control lever in the "SEL" position, fire the racks and check sequence of release.

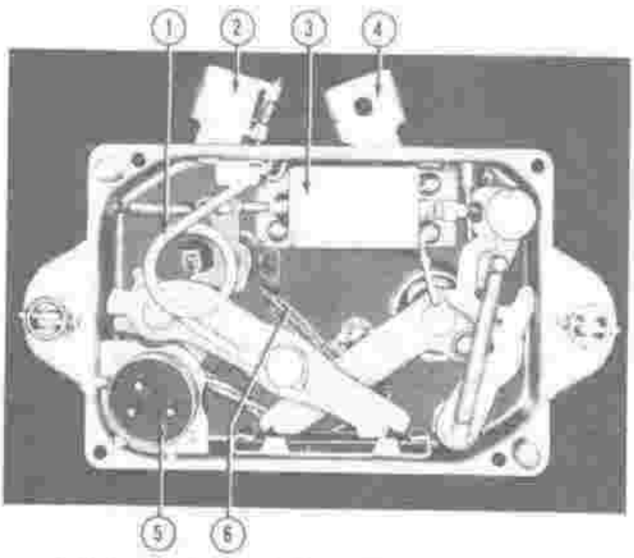
f. Cock all stations and pull the bomb control lever slowly from "SEL" to "SALVO" to check for sufficient overtravel (all stations should release).

g. Check bombs release signal indicator lamp for "BRIGHT" and "DIM" intensity of bombs release signal lamp.

h. Check bomb door safety switches at either end of the bomb bay and the bombs release safety switch installed on the bomb rack control bracket located behind the aft bomb bay panel for proper operation.

3. TYPE A-2 BOMB RELEASE MECHANISM.—(Used on airplanes with a mechanical salvo.)

a. DESCRIPTION.—The Type A-2 bomb release mechanism differs from the Type A-4 unit used in the all-electric bombing system in that it has a salvo coupling for mechanical release of bombs. Electrical operation is identical with the A-4 unit. The salvo coupling trips the release lever and the bombs are dropped in the safe condition if the armament selector switch is in the "TAIL" position. If the armament selector switch is in the "NOSE AND TAIL" position when bombs are salvoed, they are armed for impact explosion.



1. Release Spring
2. Release Lever
3. Solenoid
4. Arming Lever
5. Connector Plug
6. Transfer and Indicator Switch

Figure 285—Type A-2 Bomb Release Unit with Cover Removed

b. REMOVAL AND DISASSEMBLY.

(1) Be sure that the bomb bay doors are locked in the "OPEN" position with the bomb bay door link blocks.

(2) Depress the head of the push button at each end of the bomb release unit to retract the projecting prongs which hold the unit to the panel.

(3) Pull the unit straight out from the panel.

c. MAINTENANCE REPAIR OR REPLACEMENT.—Maintenance requirements for the A-2 bomb release unit is the same as that for the A-4 unit used in the all-electric bombing system. Refer to paragraph 15. *c.* *(4)* *(c)*, this section.

d. TEST AFTER INSTALLATION.

(1) Attach release units to all bomb positions and place the bomb control handle in the "SEL" position.

(2) Cock first the arming lever, then the release lever, on all units by pulling them outwards.

(3) Prepare for electrical release of bombs and push pilot's release button to see that both levers operate.

(4) Cock every alternate mechanism in the order of bomb release and push pilot's release button. See that all cocked releases operate.

(5) Cock the remaining units and check them in the same manner.

(6) With both the arming and the release levers cocked, place the pilot's bomb control handle in the "SALVO" position. Check to see that all release levers are tripped and that all arming levers remain untripped. The armament selector switch must be in the "TAIL" position.

(7) Replace any faulty units.

(16) TURRET ELECTRICAL.

(a) GENERAL.—The Model A-26B airplane is provided with a central fire control system which consists of an upper and a lower turret, both remotely controlled by one sighting station. Each turret mounts two caliber .50, type M-2 machine guns and one type

N-2 Gun Sight Aiming Point Camera and overrun control. The turrets are moved and the guns are fired electrically, by the gunner at the sighting station. The gun firing is harmonized with the gunner's line of vision through the upper or lower periscopes. A fifty degree field of vision is possible through either the upper or lower periscope head. On some airplanes a seventy degree sight is used. The sight is controlled in elevation by rotating the sighting handles about their horizontal axis, and in azimuth by manually rotating the entire sighting unit about its vertical axis. Switching of the sight from upper to lower periscope, or the reverse is accomplished automatically within the unit, allowing ten degrees of overtravel from upper sight to lower or lower to upper. The gunner may rotate the sighting station in any direction for scanning purposes (with AC power "ON") and when ready to fire bring the turret or turrets into correspondence with the sight by turning the desired turret power "ON." The guns in the upper turret have unlimited azimuth rotation, and operate between 0 degrees and +89 degrees zenith angle. The guns in the lower turret have unlimited azimuth rotation and operate from +5 degrees to −89 degrees nadir angle. This permits 5 degrees crossfire between the guns in the upper turret and the guns in the lower turret. The maximum turning or slewing speed of rotation of the guns in the turrets is 45 degrees per second in azimuth and 30 degrees per second in elevation. Maximum acceleration of the guns is 90 degrees per second in azimuth and 60 degrees per second in elevation. With the positioning remote control, every motion of the

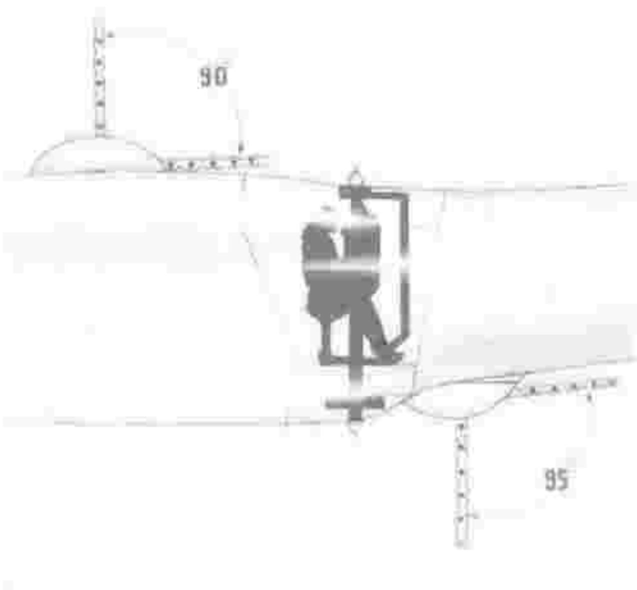
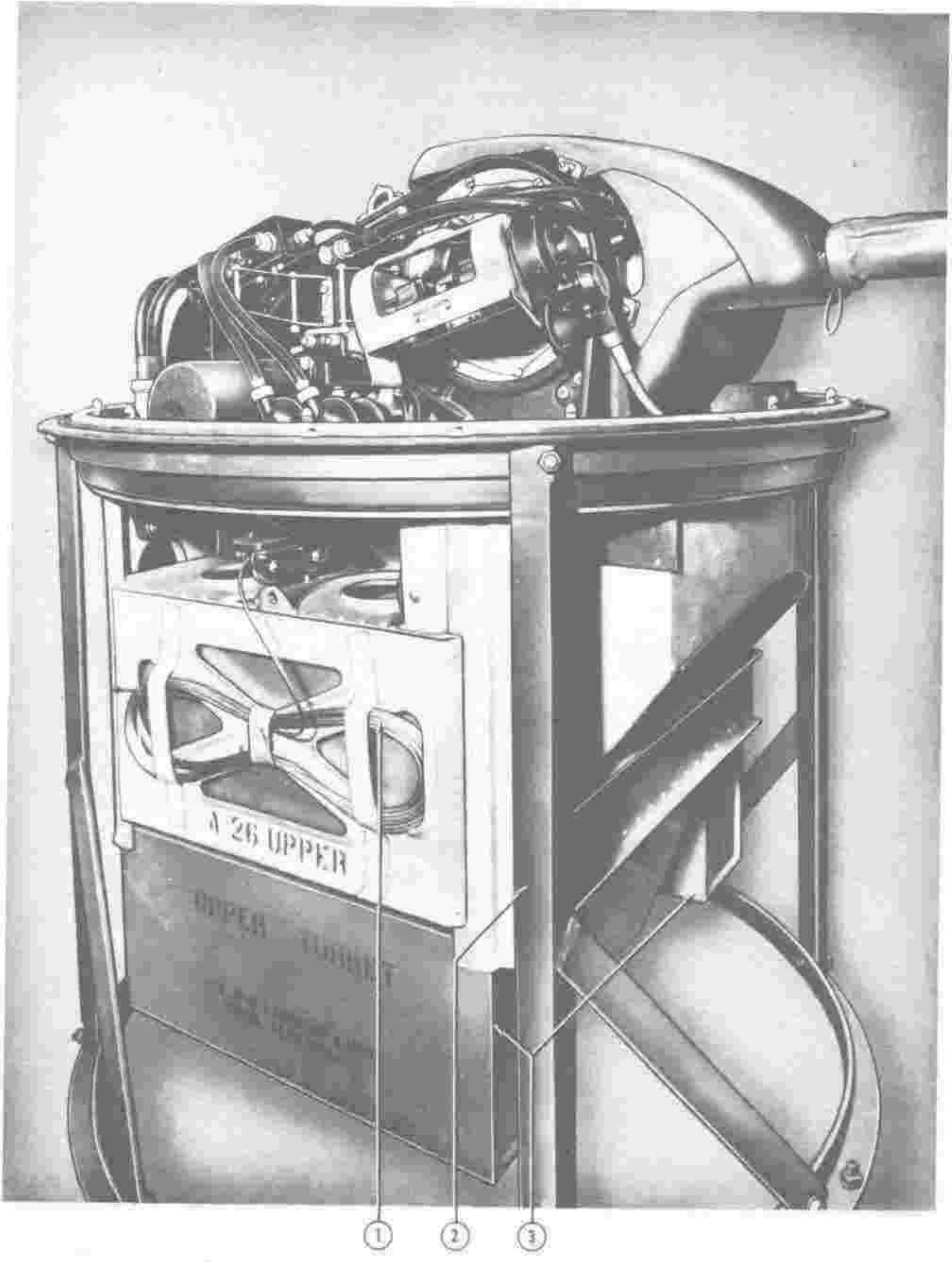


Figure 386 — Degree of Turret Gun Motion

sighting station within certain specified limits produces a similar motion of the turret. For positioning control it is necessary to have two separate systems; azimuth and elevation. The azimuth system controls rotation of the turrets in clockwise or counterclockwise directions in a horizontal plane. The elevation system controls the elevation and depressing of the guns in a vertical plane. The signal system uses two separate signal selsyns; a one-speed selsyn and a 31-speed selsyn. Positioning control requires the following major items: a dynamotor, operating on the 24-volt d-c airplane electrical system and generating 115-volt a-c, 400 cycle per second current necessary for the selsyns and amplifier; four selsyns on each turret and the sighting station; one servo-amplifier for each turret, to amplify and rectify the control voltage before sending it to the amplidyne motor-generator control field; one amplidyne motor-generator for each position (azimuth and elevation) of each turret, for amplification and quick response of the small voltages from the generator control field and connected directly to the turret drive motor armature; a drive motor for each system (azimuth and elevation) for each turret; a switch box, containing the control switches; a control box, cables, and other interconnecting electrical equipment. The operation procedure of the turret system is as follows: A movement of the control handle by the gunner, as he attempts to track the target with the optical system in the sighting station, causes the sighting station selsyns to change voltage. This movement of the selsyn generators and selsyn control transformers out of correspondence causes the error voltage set up in the control transformer to be transmitted to the amplifier where it is amplified and rectified. As the polarity of the selsyn output changes, the direction of the amplifier output in the amplidyne control field also changes. This flow of current in the control field which originated in the selsyn control transformer is greatly amplified in the amplidyne and sent to the drive motor armature. Since the drive motor field is continually energized during turret operation, the presence of current in the armature causes the drive motor armature to rotate. The motor drives the system until correspondence between the selsyns (and thus, between the sighting station and turret) is reached. At this point there is no longer an error voltage between the selsyns, and the system comes to rest unless the motion of the control handle is continued. The one-speed and 31-speed selsyns operate similarly, the one-speed selsyn taking care of large errors and the 31-speed selsyn taking care of the smaller remaining error.

(b) UPPER TURRET ASSEMBLY.

1. DESCRIPTION.—A General Electric, remotely controlled upper turret for two caliber .50 machine guns is illustrated in *figure* 387.



1. Ammunition Hoisting Cable (Superseded by Hoist) 2. Turret Stand 3. Ammunition Boxes

Figure 387 — Upper Turret

Figure 388 — Hoisting Upper Turret For Installation

a. RING ASSEMBLY.—The turret is supported by a ring assembly *(1, figure 388)* which provides for movement of the complete unit in azimuth. The saddle supports hold the guns and make possible gun movement in elevation.

b. DRIVE ASSEMBLIES.—Power for rotating the turret in azimuth is obtained from the azimuth drive assembly *(2, figure 389)*. (Refer to paragraph 12. *i.*, this section.) A similar drive assembly is provided for moving the guns in elevation. Each drive assembly consists of a drive motor, a -one and a -31 speed selsyn, a latching solenoid, and the necessary gearing. A latching solenoid assembly prevents movement of the turret in azimuth when turret power is OFF. This latch can be operated manually as shown in *figure 390*. The latching solenoid has a tapered detent pin which drops into the hold in the intermediate gear when turret power is turned OFF, and lifts when power is ON. The latching solenoid holds the turret in the stowed or strafing position. A similar solenoid on the elevation gearing locks the elevation power gear when the guns are in the stowed position and turret power is OFF. The elevation drive assembly is essentially the same as azimuth except for the addition of a clutch assembly designed to protect the gear train from excessive shock, such as the shock that occurs when the guns reach their limit of travel 'n elevation or depression.

c. COLLECTOR RING ASSEMBLY.—Control current is transmitted to the rotating turret by means of a collector ring assembly *(5, figure 392)* which

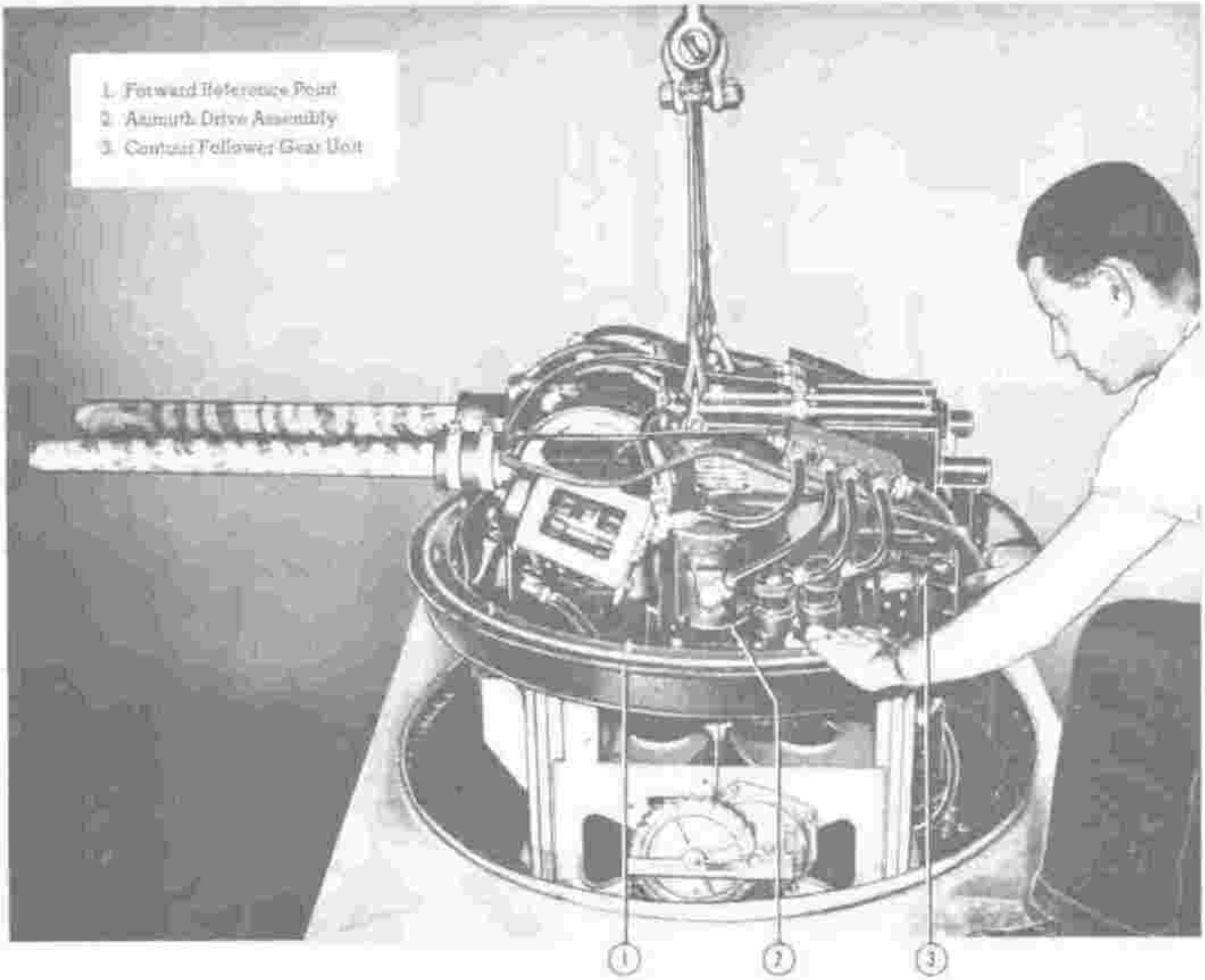
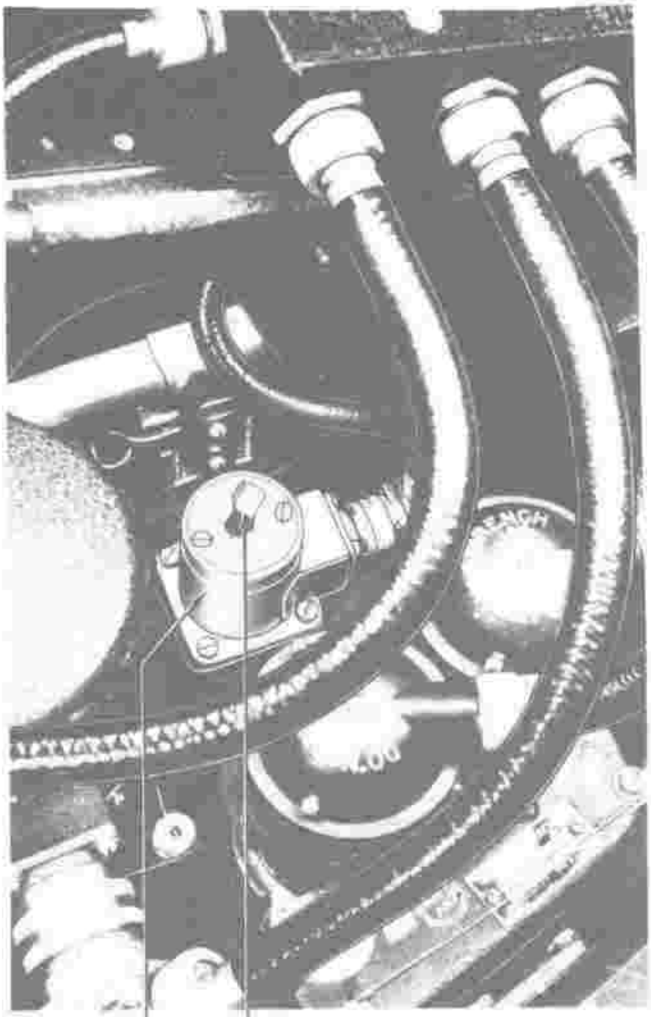


Figure 389—Lowering Upper Turret Into Position



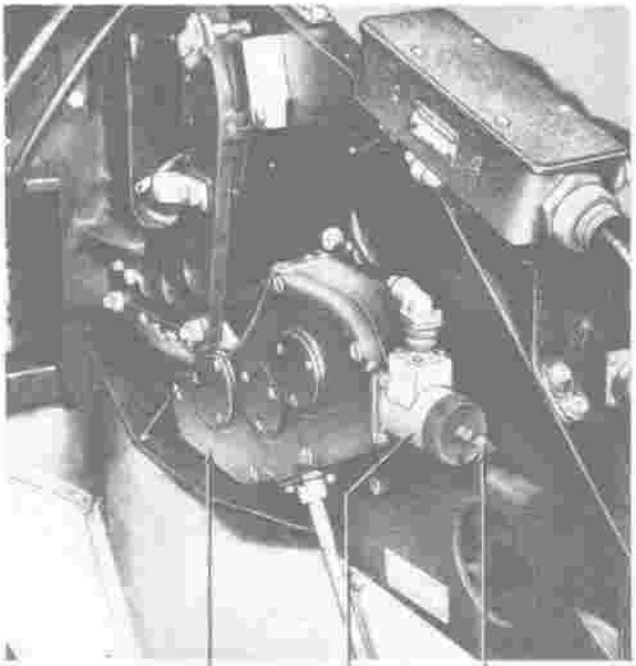
(1) (2)

1. Azimuth Latching Solenoid
2. Manual Release Lever (In Mounting Position)

Figure 390 — Azimuth Latching Solenoid

consists of 26 slip rings, a top plate, brush holders, brushes, and the necessary windings. Reverse gearing works against the drive gearing, causing the collector case and brushes to stand still while the slip rings rotate with the turret. The bottom plate of the collector case has one AN connector which is the only external electrical connection to the turret. The top plate has electrical connectors to supply power to other turret units.

d. FIRE INTERRUPTOR ASSEMBLY.—Interruption of machine gun fire in areas of wing and empennage surfaces, and propeller arcs is accomplished by a fire interruptor assembly *(5, figure 392)* built around the collector ring. The interruptor consists of a drum with cams (patterns of the areas to be protected) on the outer surface and a moving support which carries two switches. One switch is in series with the firing solenoid of each gun. The switches are arranged to move with reference to the cam drum in direct proportion to the movement of the guns in azimuth and elevation. This makes it possible to interrupt the fire of each gun individually.



(1) (2) (3)

1. Elevation Drive Assembly
2. Elevation Latching Solenoid
3. Manual Release Lever (In Unlatched Position)

Figure 391 — Elevation Latching Solenoid

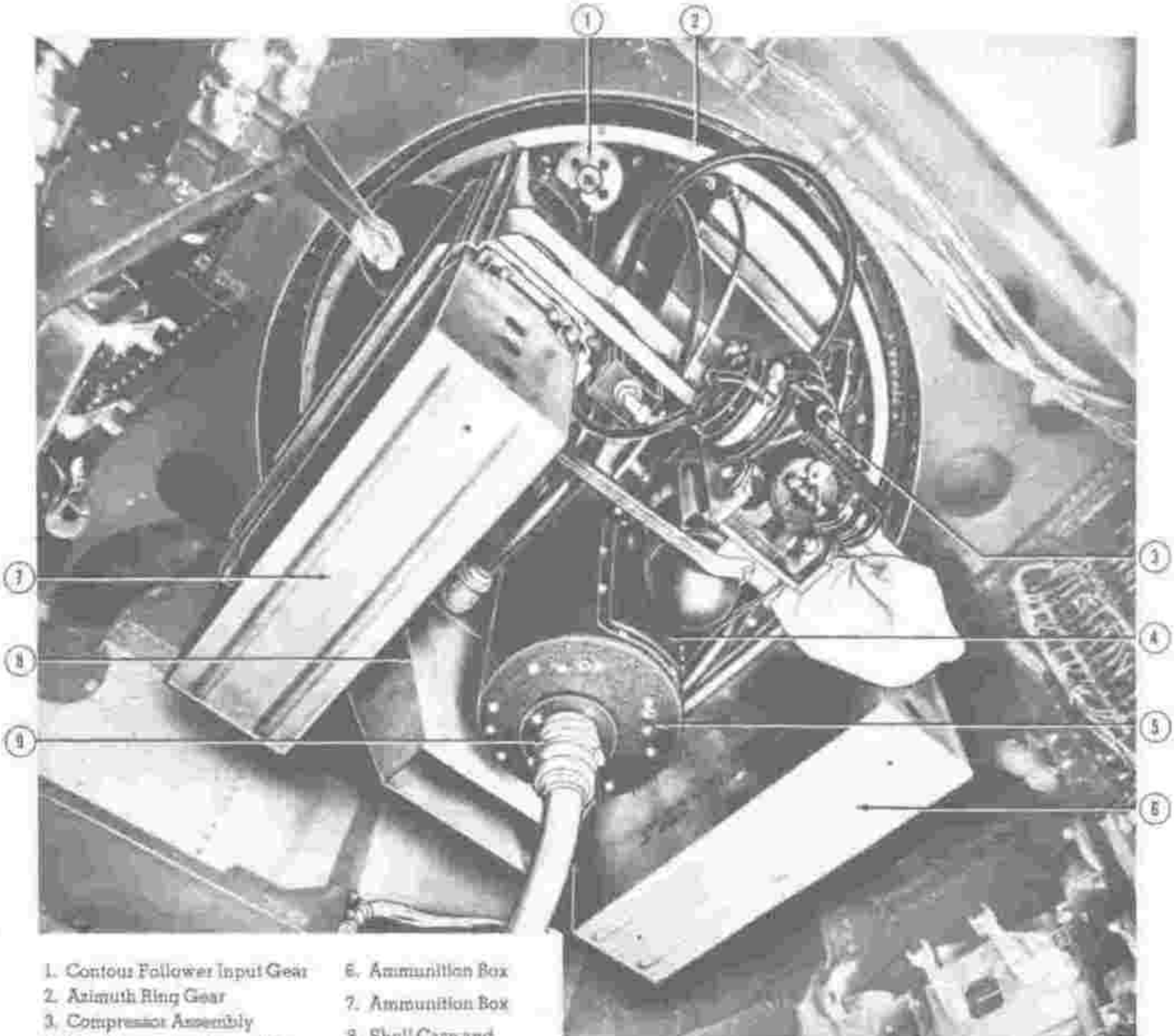
e. LIMIT STOPS AND SWITCHES.—Two limit stop assemblies which limit the travel of the guns in elevation are mounted on the right saddle support. *(See figure 393.)* The two stops are mounted in a fixed position and are engaged by a third stop which is mounted on the right hand side of the saddle. The stop on the saddle rotates as the guns are moved in elevation. An electrical limit switch *(figure 394)* mounted on the left saddle support operates to cut down 75 per cent of the elevation drive motor power and to open the firing circuit whenever guns are moved below horizontal. The switch is operated by a cam on the left hand side of the saddle. With the removal of approximately 75 per cent of the power applied to the elevation drive motor, the remaining power is of the proper polarity to hold the guns depressed against the stop.

f. CONTOUR-FOLLOWER. – Both upper and lower turrets are provided with contour-follower assemblies *(figure 395)* which prevents the guns from touching or damaging any part of the airplane structure as they are moved in azimuth or elevation. In addition, the contour-followers are provided with a built-in maneuver switch which interrupts the fire of the guns and reduces the elevation motor power approximately 9/10 when the guns approach these parts. Only enough power is provided to prevent the guns from being moved by the pressure of the air stream. On the upper turret the contour-follower prevents the guns from touching the structure by forcing them up both forward and aft. On the lower turret, the contour-follower prevents the guns from touching the structure by forcing the guns down in the forward direction only.

2. REMOVAL. – Reverse the INSTALLATION procedure given in *4.* below.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Check all gearing frequently for damaged gear teeth. Check bearings for freedom of operation.



1. Contour Follower Input Gear
2. Azimuth Ring Gear
3. Compressor Assembly
4. Fire Interrupter Access Door
5. Fire Interrupter and Collector Ring Assembly
6. Ammunition Box
7. Ammunition Box
8. Shell Case and Link Ejection Chute
9. Electric Connector

Figure 392 — Upper Turret Installed (View from Bomb Bay)

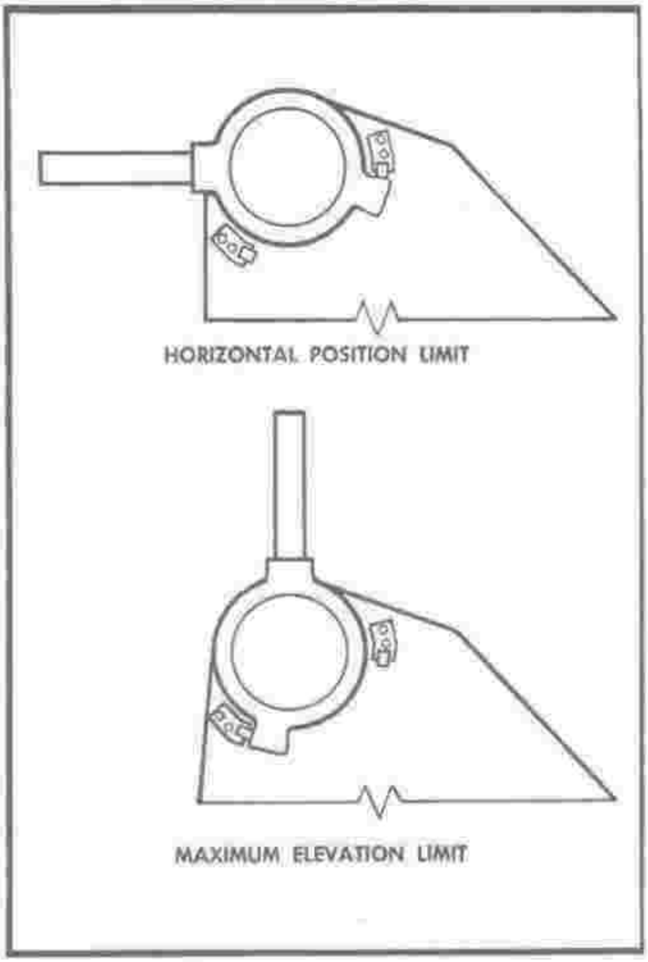


Figure 393 — Limits of Travel in Elevation

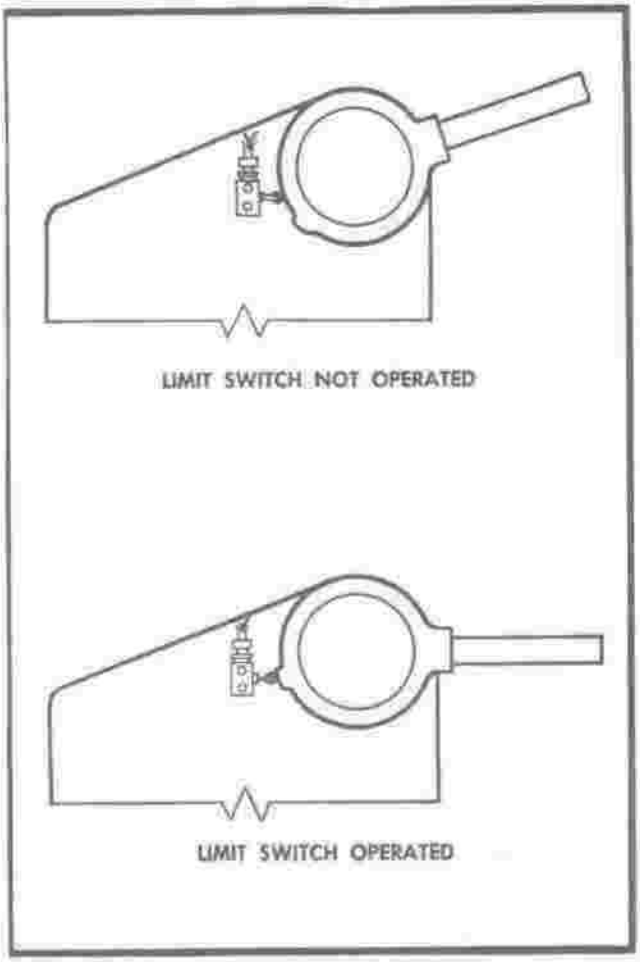


Figure 394 — Limit Switch Operation

b. For maintenance information check the following paragraphs on component parts of the turret and the Trouble Shooting Chart at the end of this section.

4. ASSEMBLY AND INSTALLATION.

a. With the turret dome removed, place the guns in a horizontal position.

b. Attach the hoist sling to the attaching points on the turret. *(See 6, figure 397.)*

c. The turret is mounted onto the airplane structure with 24 bolts. No shimming is necessary.

d. Lower the turret into position and line up six of the attachment bolts, equi-distant around the turret circumference.

e. Be sure to line up the point marked "FORE" on the turret with its forward matching point on the airplane.

f. Install one star washer under one of the mounting bolts for bonding purposes.

Note

Tighten all bolts from the upper (head) side of the bolt only.

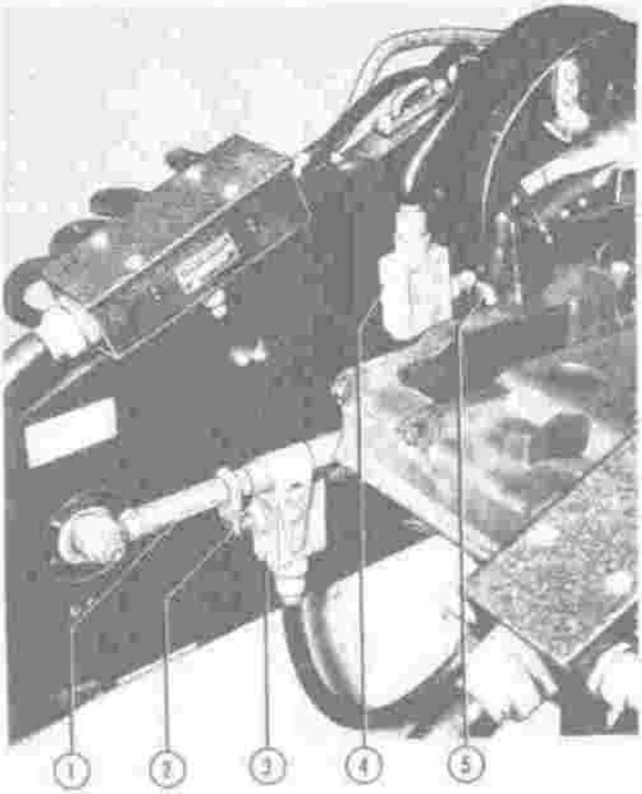
5. ADJUSTMENTS.

a. CALIBRATING FIRE INTERRUPTER.

(1) Move the turret in azimuth so that the index arrow on the inner ring is opposite the word "FORWARD" on the outer ring.

(2) Move the guns in elevation into the horizontal or "ZERO" position by placing the index mark on the elevation saddle support opposite the zero degree mark engraved on the saddle casting.

(3) Lock the turret and guns with the solenoid latches on the gear drives.



1. Contour Follower Rod
2. Stop
3. Maneuver Switch
4. Elevation Limit Switch
5. Cam

Figure 395 — Contour Follower

(4) Remove the access door on the collector-and-interrupter assembly *(4, figure 392)*.

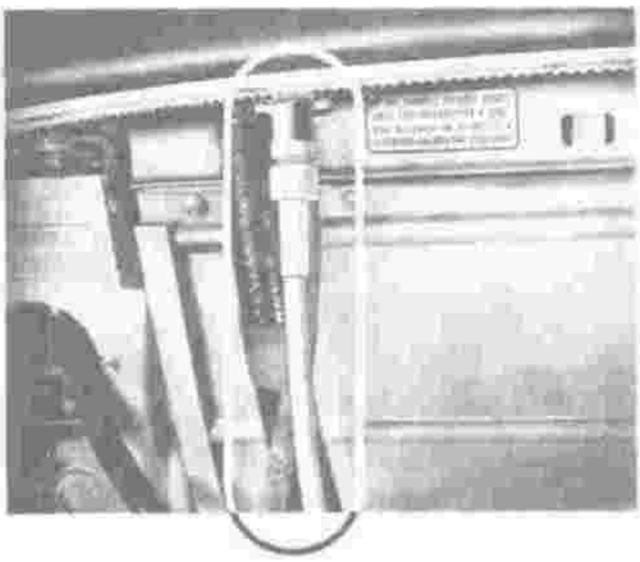


Figure 396 — Azimuth Interrupter Flexible Drive Shaft

(5) Check the cross marked "FORWARD" on the drum and make sure that it is centered in the sight hole on the switch carriage.

(6) If it is not centered, disconnect the flexible drive shafts from the azimuth collector driver and the elevation interruptor driver.

(7) Rotate the shafts until the sight hole and the cross marked "FORWARD" are aligned.

(8) Connect the flexible drive shafts to the azimuth and elevation collector-and-interrupter drivers without changing the position of the guns or of the collector drum and switch carriage.

(9) Unlatch the solenoids on the elevation and azimuth gear drives and move the guns in elevation and the turret in azimuth.

(10) Return the guns to the "FORWARD" point and the zero degree elevation point.

(11) Check the cross mark on the drum and the sight hole on the switch carriage to make sure they are properly centered. If not, repeat the complete calibrating procedure.

(12) Replace the access door when the adjustment is correct and completed.

Note

This same procedure can be followed with the guns in the "AFT" position if for any reason it is impossible or undesirable to use the "FORWARD" position. If the aft position is used the sight hole in the switch carriage should align with a cross on the opposite side of the drum which is marked "AFT."

b. ADJUSTMENT OF FIRE-INTERRUPTOR SWITCHES.—If the switches fail to open and close properly when the switch actuators come in contact with the cams on the surface of the drum, adjust as follows:

(1) Position the switch actuator on top of the steel cam surface.

(2) Back the adjusting nut until the switch is closed.

(3) Tighten the nut until the switch just opens and then give an additional 1/3 turn.

Note

The closing or opening of the switch is audible and can be determined easily "by ear."

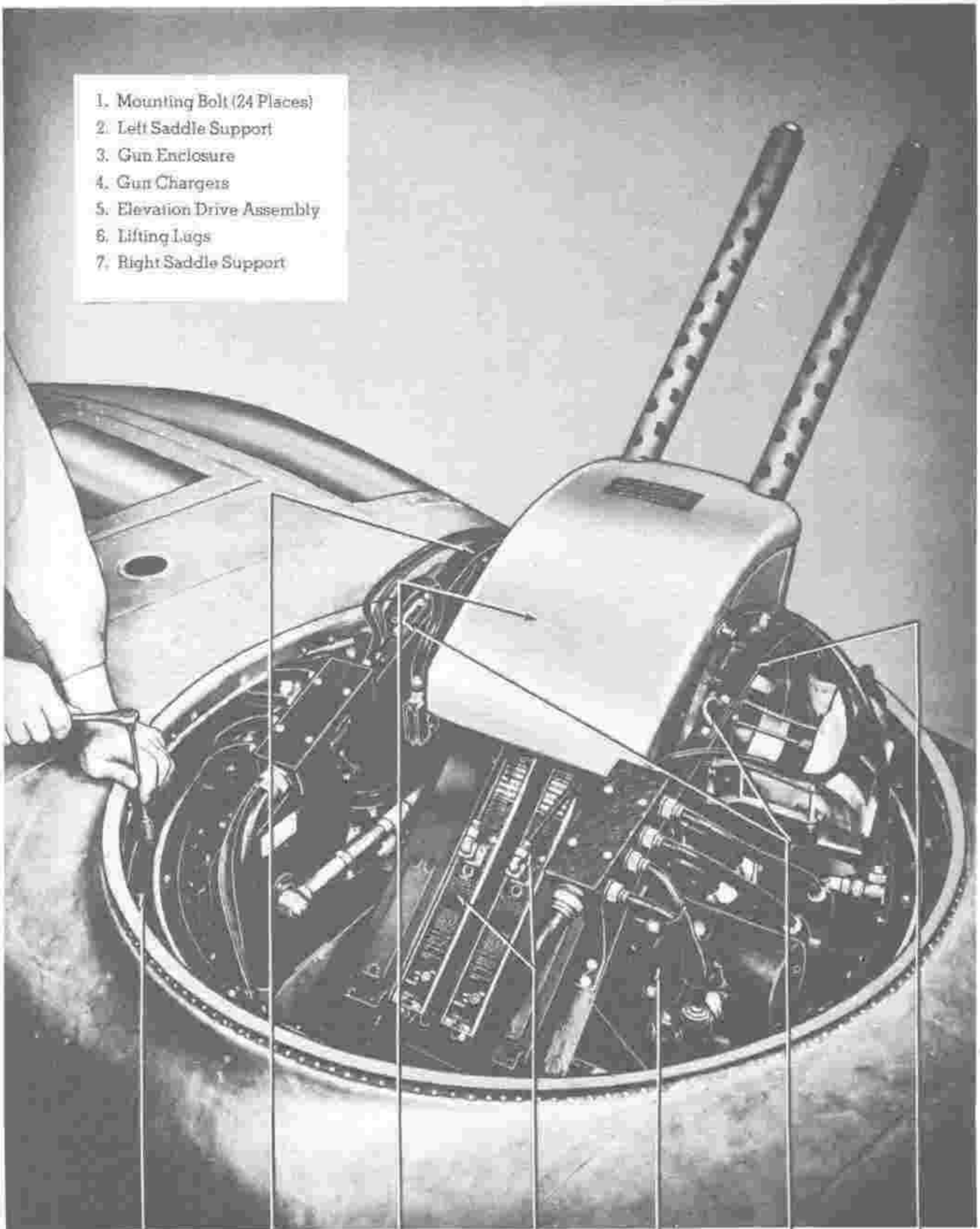
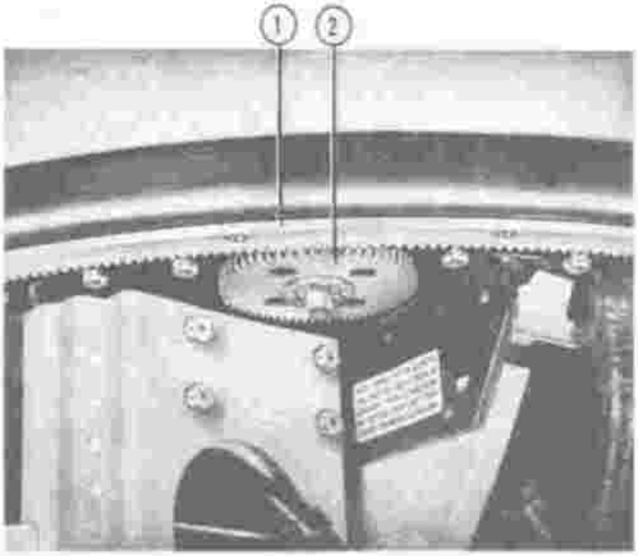


Figure 397—Upper Turret Installed



1. Azimuth Ring Gear
2. Contour Follower Input Gear

Figure 398 — Contour Follower Input Gear

c. CALIBRATING THE CONTOUR-FOLLOWER.—If the contour-follower has been calibrated properly the crank arm should be "dead center" towards the muzzle of the guns when the upper turret is in the "FORWARD" or "AFT" index points and the guns are in the horizontal or "ZERO" degree position. The crank arm for the lower turret should be in the same position with the turret in the "FORWARD" position only and the guns at an elevation of 28 degrees. If necessary, adjust as follows:

(1) With the turret at "FORWARD" index point and with the guns at "ZERO" degrees elevation (upper turret) or 28 degrees elevation (lower turret) unbolt the azimuth input gear. *(See figure 398.)*

(2) With this gear unmeshed with the azimuth ring gear, move the crank arm to the "dead center" position.

(3) Re-engage the input gear and the azimuth ring gear. Replace and tighten the bolt that holds this gear in place.

(4) Check the contour-follower by moving the turret, then returning it to the position noted above.

(5) Check the lower turret contour-follower operation by rotating the turret manually in maximum elevation. The guns should clear the structure if the contour-follower operates properly.

(c) LOWER TURRET. *(See figure 400.)*

1. DESCRIPTION.—The lower turret is substantially the same as the upper turret, with the following exceptions:

a. EJECTION CHUTE EXTENSION & DOOR ASSEMBLY.—Empty cases and links for lower turret guns are disposed of through an opening in the gun enclosure. A door assembly which is bolted to the bottom of the saddle opens automatically when the guns begin to fire and closes as soon as firing is stopped. The door assembly is operated by compressed air from the same bottle that operates the gun chargers. A slot enclosure assembly acts as a baffle to guide the empty cases and links from the door assembly down through the opening in the dome.

b. SADDLE ASSEMBLY.—In order to permit the guns to be installed upside down, the lower turret saddle must be inverted in the saddle support. The elevation gear sector is on the left-hand side of the saddle.

c. CONTOUR-FOLLOWER.—Link rod lengths for the lower turret contour follower are different because of the different contour followed. Lower turret guns may be elevated 5 degrees above horizontal except in the forward position where the guns are depressed to 28 degrees below horizontal.

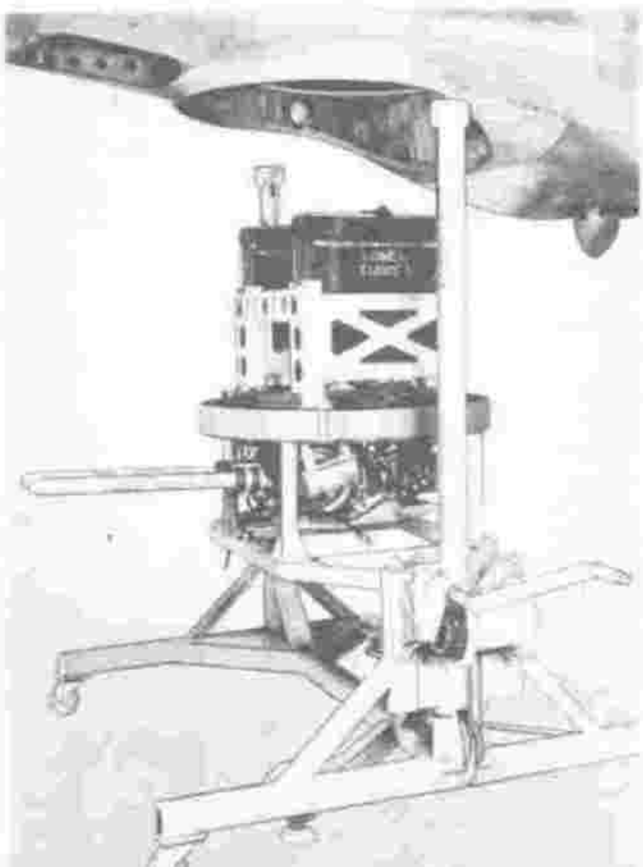
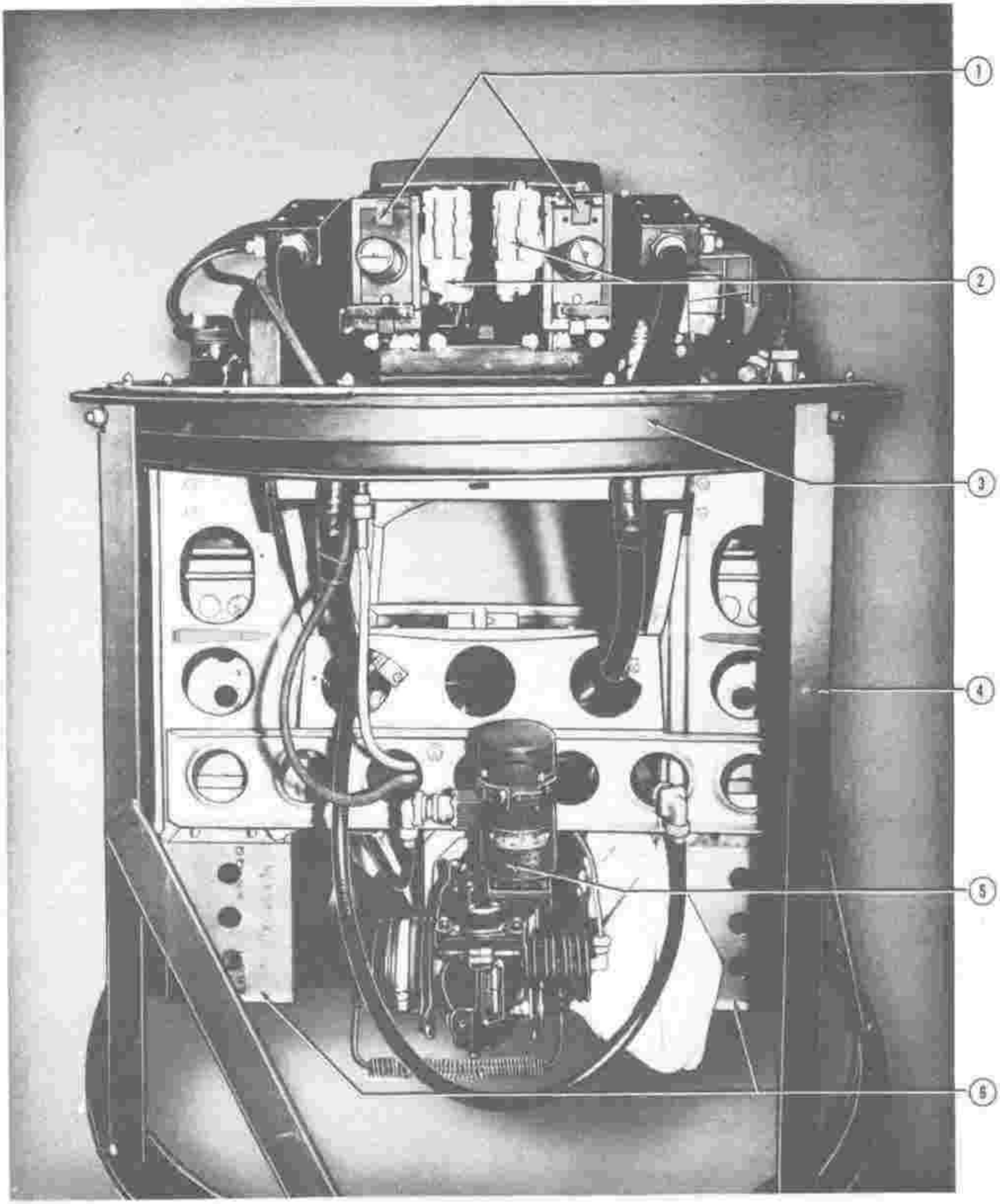


Figure 399 — Lower Turret in Place for Installation



1. Type M-2 Caliber .50 Machine Guns
2. Gun Chargers
3. Ring Assembly
4. Turret Stand
5. Compressor Assembly
6. Ammunition Boxes

★

Figure 400 — Lower Turret

d. COLLECTOR ASSEMBLY.—Lower turret collector assembly differs from the upper turret collector assembly in that it does not have an interrupter switch carriage, an elevation driver, an interrupter drum or cams, and has a slightly smaller cover.

2. REMOVAL.—Reverse the procedure outlined in ASSEMBLY AND INSTALLATION following.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Same as for upper turret.

4. ASSEMBLY AND INSTALLATION.

a. With the turret dome removed, place the gun in a horizontal position.

b. If the turret mounting ring has been damaged or removed, install a new ring by attaching it to the three mounting bosses. If this must be done, the ring must be leveled with the plane of the upper turret.

Note

Unless some structural damage is evident or unless the turret ring is known to have been moved, do not touch it.

c. Raise the turret into position *(figure 402).*

Note

Be sure that the "FORE" point marked on the turret is in the forward position.

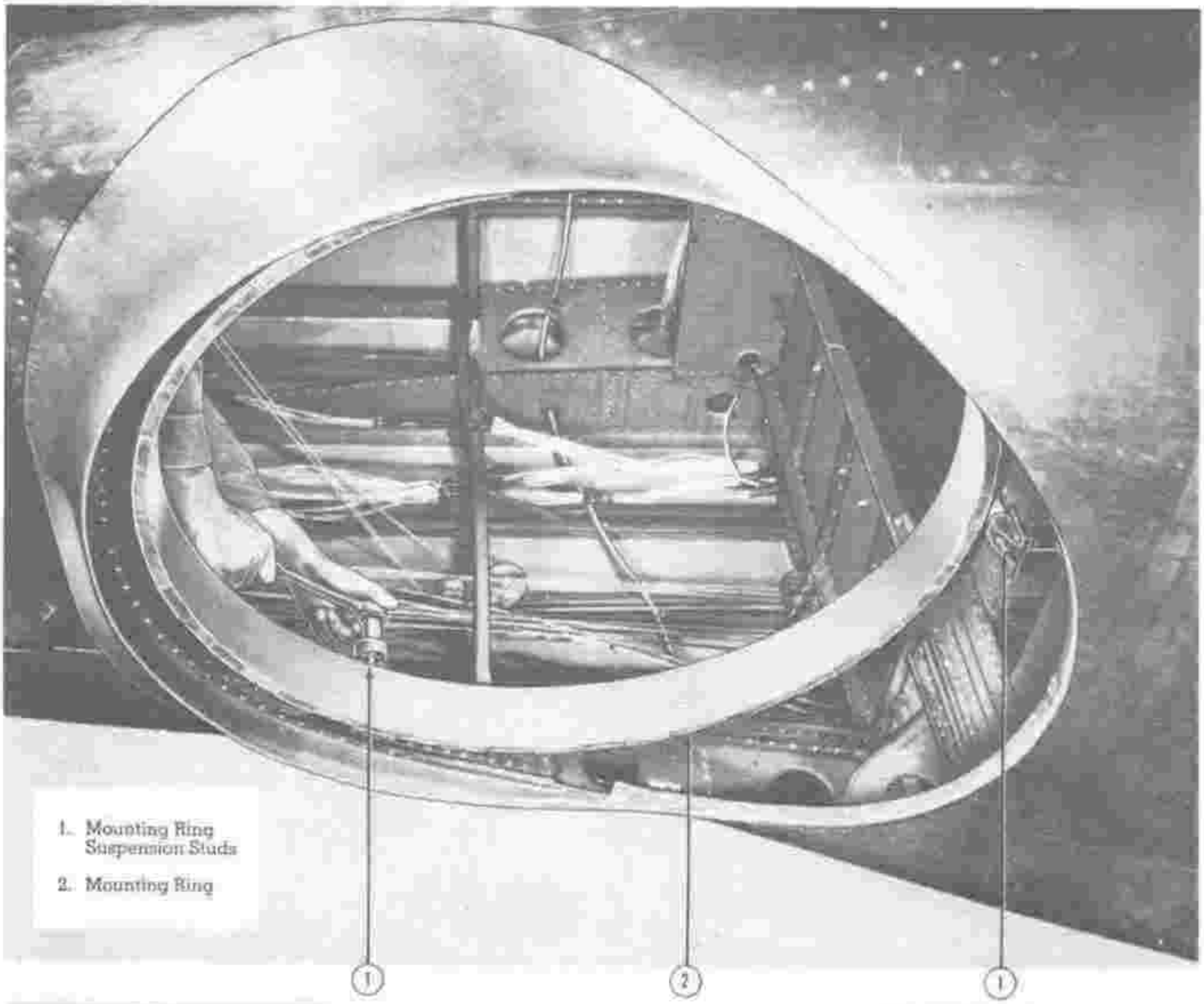


Figure 401 — Installing Lower Turret Mounting Ring

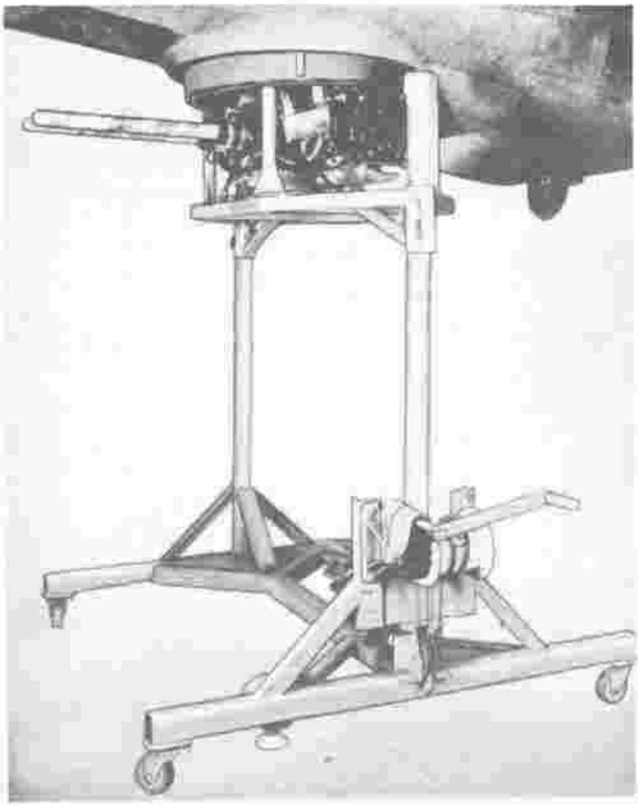


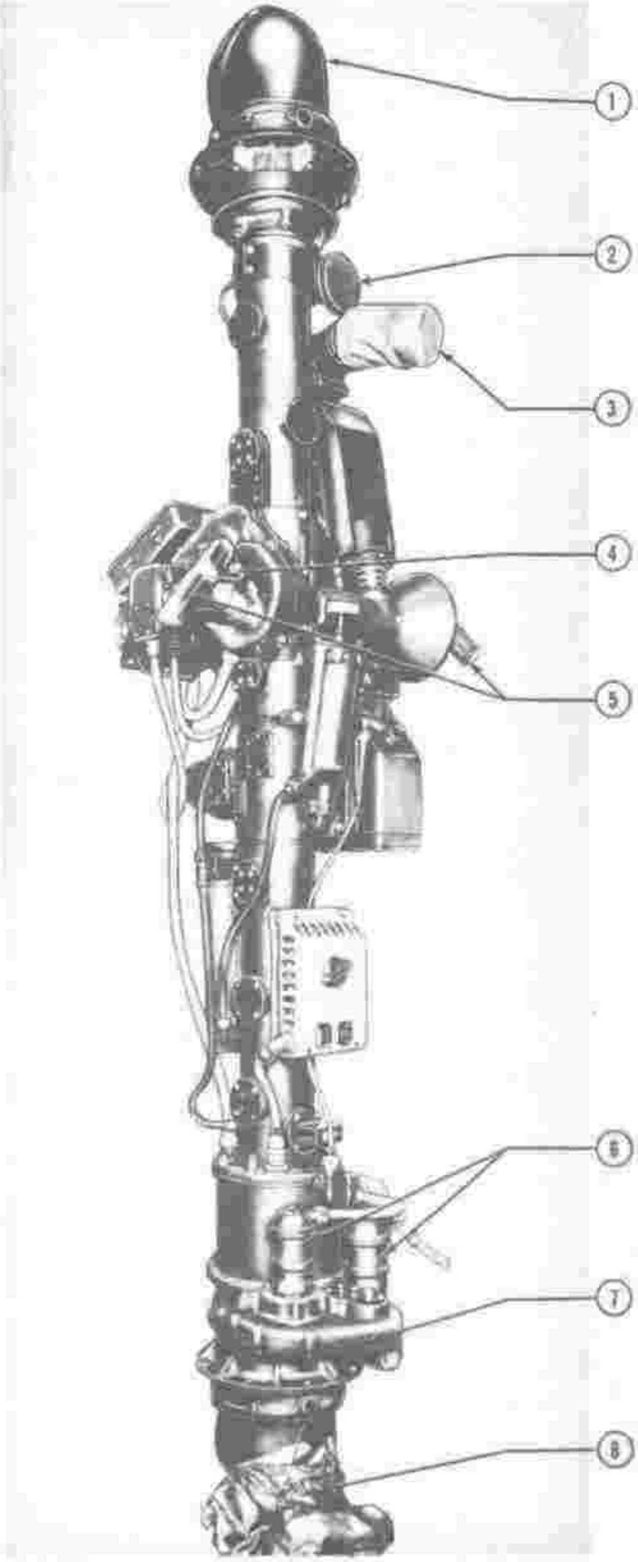
Figure 402 — Lower Turret Raised Into Position

d. Install bolts which attach turret to mounting ring. Use a star washer under the head of one of the bolts and always tighten from lower or head side.

5. ADJUSTMENTS.–CALIBRATING THE CONTOUR-FOLLOWER.–See paragraph 15, *b.* (12) *(b) 5.* c., this section.

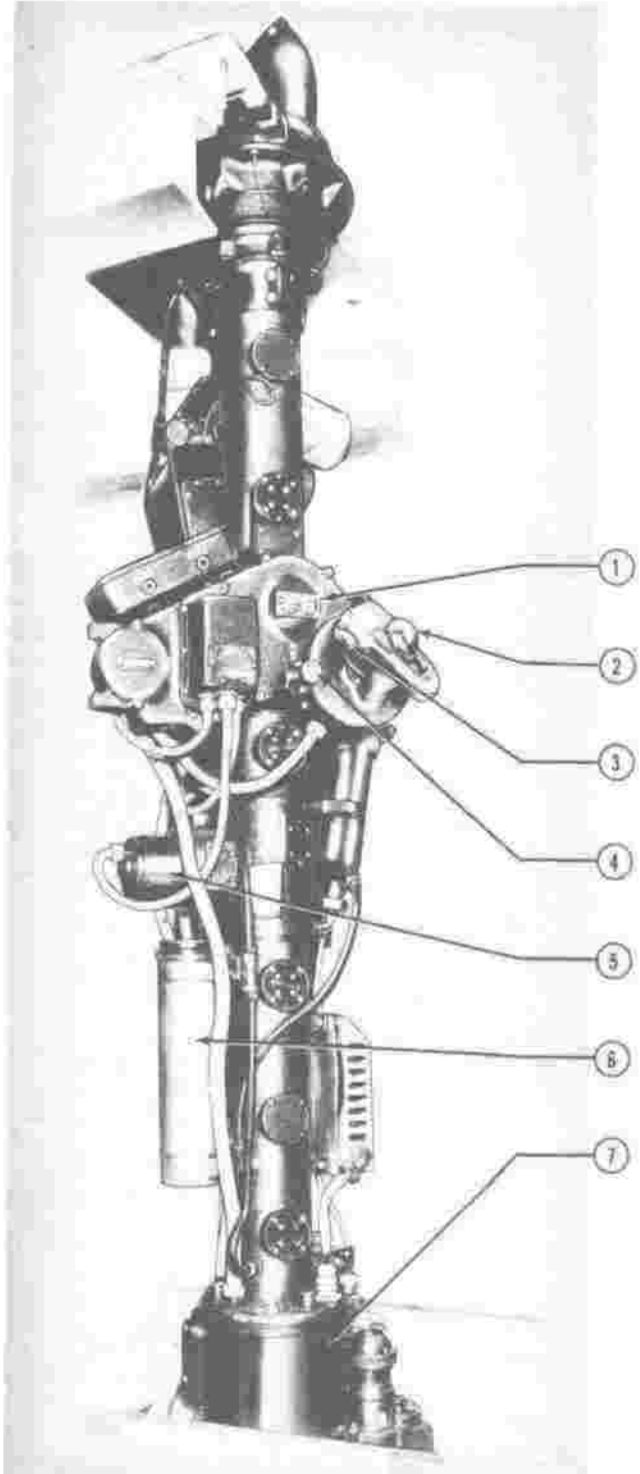
(d) SIGHTING STATION. *(See figures 403, 404 & 405.)*

1. DESCRIPTION. — A General Electric sighting station, with upper and lower periscopic heads, is installed in the gunner's compartment located midway between the turrets. Vision in azimuth is obtained by manually rotating the sight and in elevation by rotating elevation sighting handles located on the unit. The central casting of the station contains one fixed and one rotating prism. The change-over prism is rotated 90 degrees by the change-over motor so as to change the line of sight from the upper head to the lower head or vice-versa. A ten degree angle of over-travel on either side of horizontal is provided in order to eliminate the necessity of repeated changes of upper or lower sights. All system wires are brought into the sight through the AN connector on the azimuth unit. The azimuth selsyn wires go directly from the connector to the selsyns, while all other wires are attached to the brushes in



1. Upper Periscope Head
2. Gunner's Head Pad
3. Eye Piece
4. Gunner's Microphone Switch
5. Control Handles
6. Azimuth Selsyns
7. Azimuth Gear Box
8. Lower Periscope Head

Figure 403 — Sighting Station (View 1)



1. Elevation Unit
2. Action Switch
3. Turret Guns Firing Trigger
4. Elevation Gear Lock
5. Change-Over Motor
6. Dessicator Jar
7. Collector Assembly

Figure 404 — Sighting Station (View 2)

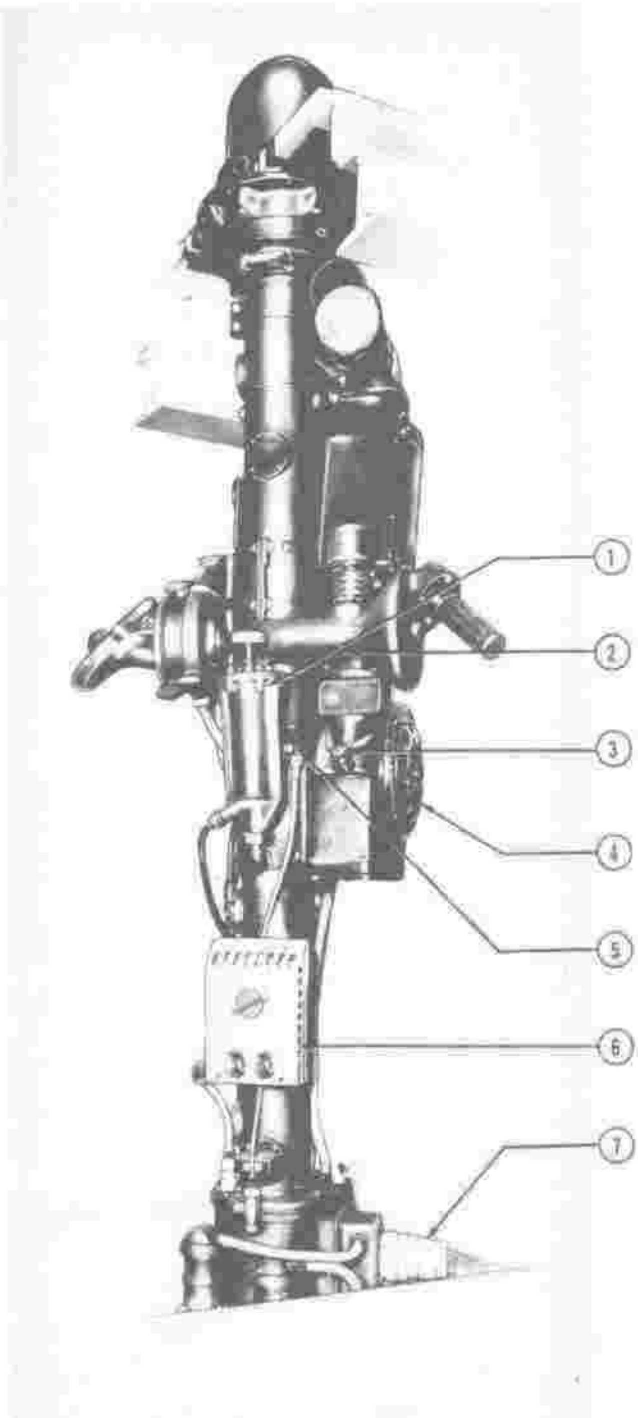
the azimuth unit and the electrical connection is made through slip rings to the parts above. The elevation selsyn wires and the suit heater wire #45 come directly from the slip rings to the selsyns, while the remaining wires go to the junction box. The firing and action circuits use only three wires, No. 43, 24, and 44. The prism change-over motor is operated from wire #43 and is controlled by micro-switches. When the line of sight is in the upper hemisphere, a cam in the elevation unit depresses one of the micro-switches, so that the motor rotates in the direction required to hold the changeover prism stationary. The line of sight is moved to the lower head by the gunner's movement of the sight which causes the cam to release the first micro-switch and close a second switch. This causes the prism change-over motor to rotate in the opposite direction tilting the change-over prism which transfers the line of sight to the lower head, the reticle lamps are each 3 volt lamps and operated in series with a 130 ohm resistor which reduced the 27 volts to 3 volts suitable for the lamps. The adjustable rheostat which controls the illumination of the reticle is also in series with the 130 ohm resistor. It permits a further regulation of the voltage on the lamps to make them dim or bright. A desiccating system is provided which removes the miosture from the optical system to prevent fogging and frosting at low temperatures or extreme temperature variations. This consists of a container of desiccant (anhydrous calcium sulphate) bearing the trade name "Drierite" and a hand-operated pump connected to the interior of the sight by tubing. The pump creates a positive circulation of air through the sight and desiccant. On some airplanes the desiccating system is electrically operated. Temperatures as low as —100 degrees F. can be encountered without the optical system becoming fogged or frosted when a desiccator is used. Means are furnished for spraying isopropyl (alcohol) fluid over the periscopic head windows. This system is operated by a hand pump located at the lower right-hand side of the gunner's compartment. The slip stream removes the ice or dirt after it has been softened by this fluid. The sighting station has an action switch and a firing trigger on the left-hand elevation handle. The action switch, when depressed, closes the control and firing circuits; the firing trigger starts the ammunition booster and fires the guns.

2. REMOVAL AND DISASSEMBLY.—Reverse the procedure outlined in 4. below.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

4. ASSEMBLY AND INSTALLATION.

a. Bolt the anti-rotation bar to the sighting station and to the bracket provided beneath the gunner's compartment floor. An access cover may be



1. Dessicator Hand Pump (Electrically Operated on Some Airplanes)
2. Elevation Selsyns (In Back of Control Handle)
3. Reticule Lamp Rheostat
4. Optical Filter Control
5. Azimuth Gear Lock
6. Gunner's Suit Heat Rheostat
7. Connector

Figure 405 — Sighting Station (View 3)

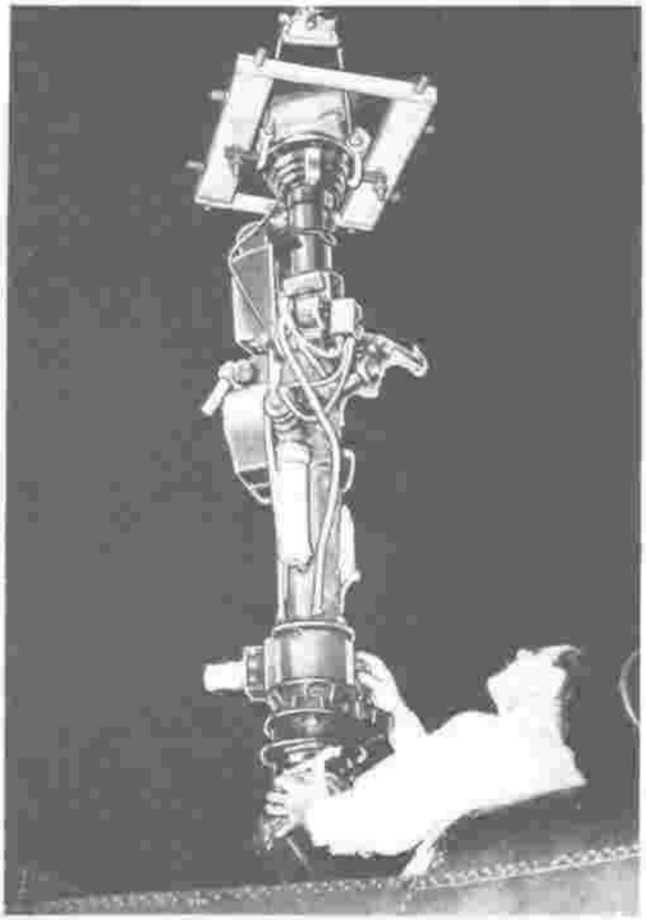


Figure 406 — Lowering Sighting Station Into Position

removed to reach the bar. Adjust the bar at the bracket until the sighting station fore index point is aligned with the forward index point on the structure.

b. With a lifting fixture attached *(figure 406)*, carefully hoist the sighting station into the gunner's compartment.

Note

Keep the station in an upright position at all times and exercise extreme care that the unit is not bumped at any time.

c. Place the seal around the lower part of the station (on the compartment floor).

d. With the unit in a perpendicular position, install the lower attaching bolts *(figure 407)*.

e. Place the gunner's compartment plexiglas enclosure in position over the upper periscope head.

f. Install upper and lower rubber seals.

g. Install upper attaching bolts *(figure 408)*.

Figure 407 — Installing Sighting Station Lower Attaching Bolts

(e) SELSYNS.

1. DESCRIPTION.—Four General Electric selsyns are used on each turret and on the sighting station. The selsyns on the turret are selsyn control transformers: a one-speed and a 31-speed selsyn for each movement of the turret (azimuth and elevation). The selsyns on the sighting station are selsyn generators: a one-speed and a 31-speed selsyn for each movement of the sighting station (azimuth and elevation). The selsyn generators transmit the voltage signal indicating the position of the sighting station. The selsyn control transformers receive this voltage signal and compare it with the voltage signal indicating the position of the turret. The voltage error, or difference between these voltage signals, is sent to the servo-amplifier for use in bringing the turret and sighting station into correspondence. Thus, the output of the selsyn control transformers is an electrical indication of the error in the correspondence between the turret and the sighting station. The polarity or phase of the output is an indication of the direction of error. The one-speed selsyns are used to transmit and correct the large errors in correspondence of the turret and sighting station positions; the 31-speed selsyns are used to transmit and correct the small remaining errors. (Refer to paragraph *(g)*, SERVO-AMPLIFIERS, below).

2. REMOVAL.

a. Disconnect electrical plug.

b. Remove attaching screws.

c. Lift selsyn from splined shaft connection.

3. MAINTENANCE REPAIR OR REPLACEMENT.—The selsyns should be replaced, rather than repaired, except when instrument trained personnel is available for proper overhaul.

Note

The selsyn rotors and stators cannot be separated as they form a balanced circuit. Replace the selsyn as a unit.

4. ADJUSTMENT.—ZEROING SELSYNS.

a. Selsyn control transformers.

(1) Position turret to aft and horizontal, and latch.

(2) Remove selsyn caps and make connections as shown in *A-1, figure 409.* Apply 115 volts, 400 cycles.

(3) Loosen selsyn clamps and rotate selsyns stator until the voltmeter indicates a minimum voltage.

(4) Remove connections and reconnect as shown in *A-2, figure 409*, using a voltmeter capable of reading 0.1 of a volt.

(5) Turn selsyn stator until voltmeter reads zero, being sure to turn in the direction that will reduce the voltage to zero. Tighten selsyn clamps, being sure that the voltmeter reading does not change.

b. Selsyn generators.

(1) Position sight to aft and horizontal, and latch.

(2) Remove selsyn caps and make connections as shown in *B-1, figure 409.* Apply 115 volts, 400 cycles.

(3) Loosen selsyn clamps and rotate stator until voltmeter indicates a minimum voltage.

(4) Remove connections and reconnect as shown in *B-2, figure 409*, using a voltmeter capable of indicating 0.1 of a volt.

(5) Turn stator until voltmeter indicates zero volts. Tighten selsyn clamps making sure that voltmeter reading does not change.

5. INSTALLATION.–Reverse procedure as described in paragraph 2., REMOVAL, above.

(f) DYNAMOTOR. (See figure 410.)

1. DESCRIPTION.–The General Electric dynamotor 5D21NJ3 is a combination motor-generator with a common magnetic field and a two-winding armature (rotor assembly), mounted in the fuselage, aft of the lower turret. It converts the 24 volts, d-c power of the airplane electrical system into a 115 volt, 400 cycle, a-c power for the operation of the selsyn systems and the servo amplifiers. The dynamotor is composed of a stator assembly, rotor assembly, commutator-end brush rigging, capacitor, and resistor.

2. REMOVAL.

a. Disconnect electrical plug.

b. Remove the bolts attaching the dynamotor to the frame and remove the dynamotor.

3. MAINTENANCE REPAIR OR REPLACEMENT.

Note

Commutator sparking should not cause alarm unless it is excessive. These machines are designed to permit pinpoint sparks, but a continuous roll of sparks which are bright and appear to be very hot cannot be tolerated. Occasional streamer sparks are permissible, as they are merely brush treatment shooting off as burning vapor.

a. REPLACING BRUSHES ON A-C END.

(1) Brushes should be replaced when they are worn to within 1/16 in. of the metal brush holder. It is desirable to change all of the brushes if one or two require replacement. This will make fewer

Figure 408 — Installing Sighting Station Upper Attaching Bolts

disassemblies necessary. The average operating life of the brushes is 75 dynamotor hours.

(2) The dynamotors have a steel plate across the upper part of the brush, against which the brush-mounting screw tightens. To remove the drive-motor brushes, loosen the brush-mounting screws.

(3) To install new brushes, insert new brushes and tighten the mounting screw. The lock washer under the head of the screw will lock the screw.

(4) Paint heads of screws with G.E. No. 1201 Glyptol insulating varnish or equivalent.

(5) Apply a strip of 00 sandpaper to the commutator with water-soluble glue and no overlap. Block brushes up, reassemble rotor to end shield, release brushes onto commutator, and turn rotor until brushes are sanded in to 80 percent fit (approximately 3/4 to one turn).

(6) Remove sandpaper and glue with a damp cloth. Thoroughly clean rotor, stator, and brush rigging with compressed air, carbon tetrachloride, or both. There will be much powdered carbon and dust deposited, and it is important that these be removed.

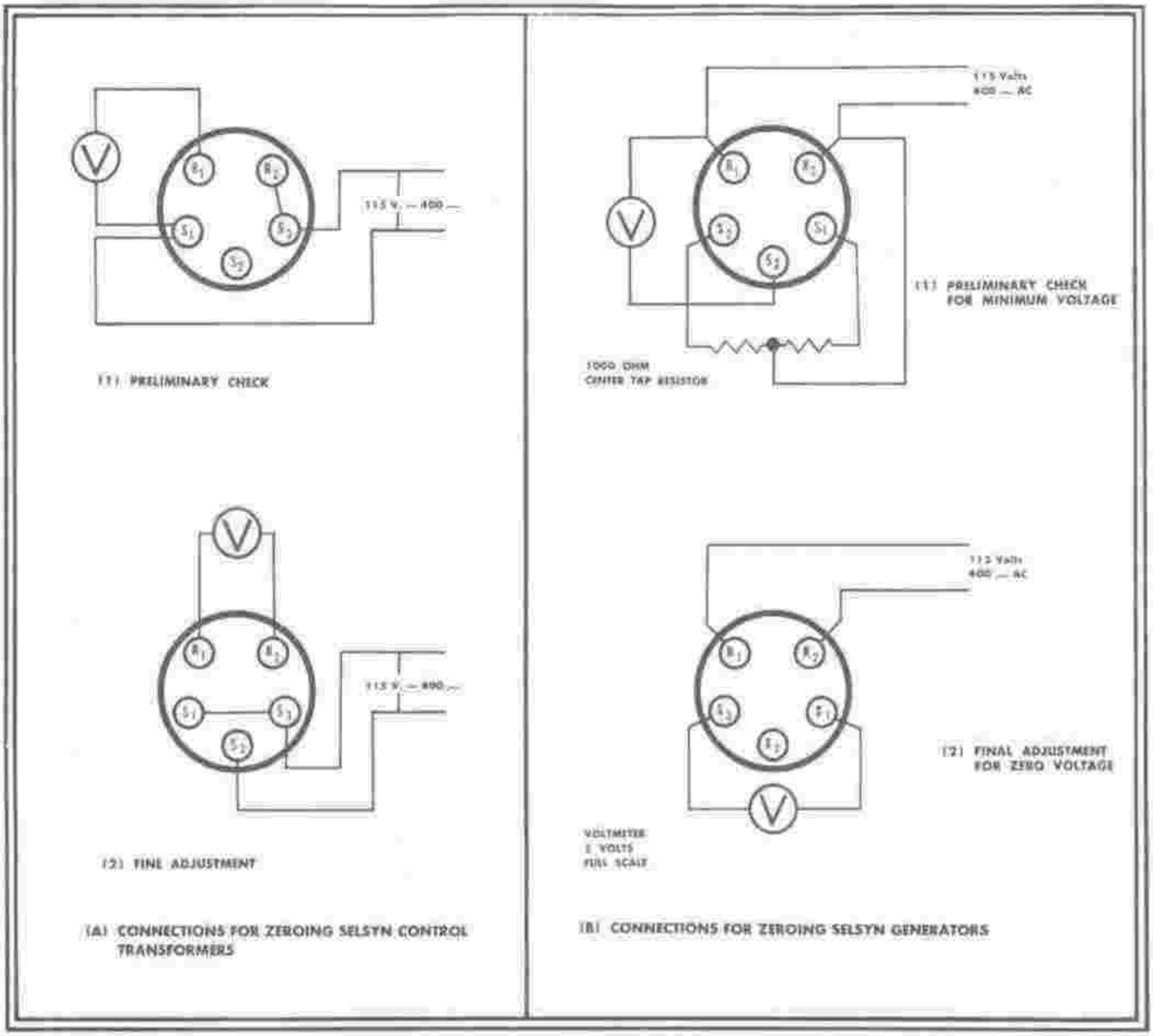


Figure 409 — Zeroing Selsyns

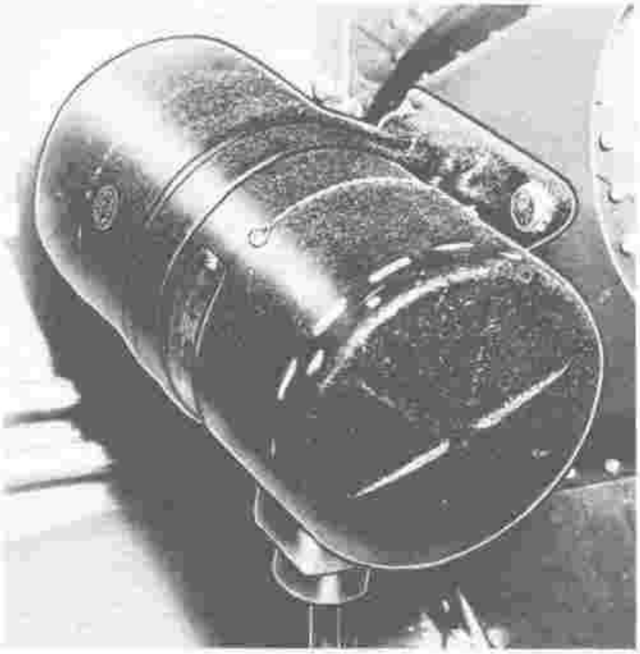


Figure 410 — Turret Dynamotor

(7) Run the machine at no load for an hour, to seat the brushes further. Use of brush-seating stones is not recommended.

(8) If brush yoke has not been moved, it should not be necessary to set a new brush position. Brush yoke position on the a-c end is of no importance.

b. REPLACING BRUSHES, D-C END.—This procedure is practically identical to brush replacing on the a-c end, except that the brushes need not be sanded nor run in for fit. The brushes are not interchangeable with those on the a-c end, and should not require replacement as often. If the yoke has been moved, reset the brush location as described in paragraph f., below.

c. COMMUTATOR AND COLLECTOR RINGS.

(1) Never oil or lubricate the commutator or rings.

(2) Occasionally it may be necessary to clean the commutator or rings. Touch them up lightly with 00 sandpaper. Never use emery cloth. Clean out all dust.

(3) If burning or pitting is severe, it is permissible to take a light lathe cut. Afterward it will be necessary to undercut the commutator mica 1/32 in.

(4) Commutator smoothness can be checked by lightly holding a small wood or other insulator stick on top of a brush while the dynamotor is running.

d. BEARINGS.

(1) The bearings are sealed with grease and need not be lubricated during the life of the machine.

(2) If the bearings are found to be binding, they must be removed from the shaft with a bearing puller and replaced, or the rotor assembly must be replaced. It is not necessary to rebalance after replacing bearings. When replacing bearings, exert force only on the inner race.

e. COILS.—Rewinding of rotor or field circuits is not recommended. The assemblies should be replaced.

f. RESETTING BRUSH LOCATION.—Brush location on the d-c end must be set if the brush yoke has been moved. The procedure is to connect selsyns and a servo-amplifier to the dynamotor, simulating actual load conditions. By cut and try, shift the brush yoke (normally against rotation) until the position of best sparking is obtained. Care must be taken to see that the brush yoke is not shifted too far against rotation, as the dynamotor will start backwards, overheat the armature, and throw solder. After the brushes have been shifted to a new position, the dynamotor should be started several times at reduced applied voltage (approximately ten volts if available) to make certain the dynamotor will run counterclockwise, viewed from the commutator end. If it does not, too much brush shift is indicated. Check to ascertain if, using rated input voltage, the frequency and output voltages are within allowable limits of 400 cycles, plus or minus ten percent, and 105 to 125 volts.

(g) SERVO-AMPLIFIERS. *(See figure 411.)*

1. DESCRIPTION.—The servo-amplifier contains electronic tubes and transformers necessary to amplify and rectify the control voltage before sending it to the amplidyne motor-generator control field. One amplifier is required for each turret. The servo-amplifier for the lower turret is located in the aft fuselage, aft of the lower turret; the servo-amplifier for the upper turret is located in the gunner's compartment on the forward right-hand wall. The amplifier has four 6L6 tubes, two 6N7GT tubes, and four neon-glow lamps. It has a power transformer and four grid transformers plus a number of resistors and capacitors.

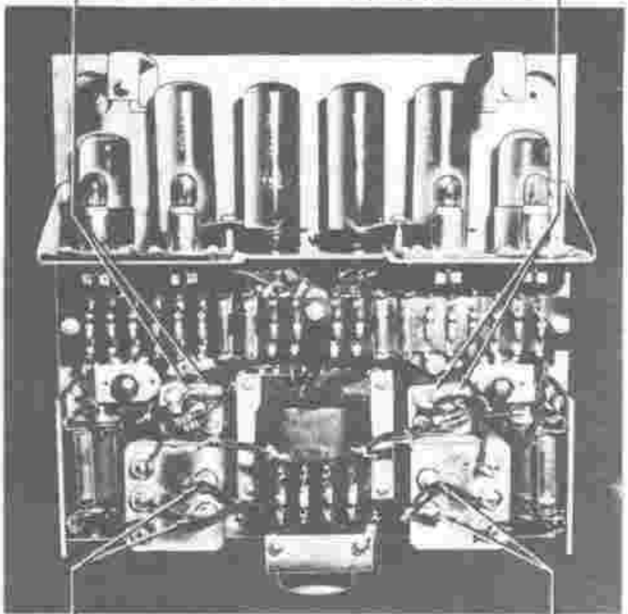


Figure 411—Turret Servo-Amplifier (Cover Removed)

The amplifier employed in this system has been designed to handle one-speed and 31-speed signals for both the elevation and azimuth systems. The azimuth system and elevation system are entirely separate in the amplifier. The only common connections are the main power transformer and ground. Since both azimuth and elevation systems of the amplifier are the same, only one will be explained and it may be assumed that the operation of the other is identical. Basically, the servo-amplifier is a two-stage electronic amplifier containing balanced circuits so arranged that it is polarity sensitive. That is, when a zero voltage signal is applied to the amplifier from the one-speed and 31-speed transformers, the beam-amplifier tubes carry equal anode currents and so does the duplex triode. When an a-c voltage signal is applied to the 31-speed transformer, which is in phase with the power supplied to the amplifier at the power transformer, these circuits are unbalanced. For example, the upper left tube may carry more current while the upper right tube carries less. If, however, the signal is opposite in phase as compared with the phase of the amplifier power supply, the unbalance would be reversed. That is, the upper left tube would now carry less current and the upper right tube more current. In addition to being polarity sensitive, the amplifier serves as a rectifier to provide the required d-c signals to the amplidyne fields. The vacuum tube energy is supplied from the 400-cycle a-c source, the dynamotor.

a. TWO SIGNAL SYSTEM. — Due to manufacturing imperfections within practical manufacturing tolerances, a selsyn is usually not more accurate than one-half a degree. Such an error is, of course, entirely too large to be tolerated in a gun sighting system. To avoid this, selsyns of two different speeds are used for control of each system (azimuth and elevation). The two-signal system is arranged so that for large errors the one-speed selsyn takes control and causes the turret motor to drive within three and one-half to four degrees of alignment. Then the 31-speed selsyn system comes in and takes control, driving the turret until the 31-speed selsyn system is within two or three degrees of correspondence which means that the gun position error is very small, being about one-thirty-first of that expected from a single-speed system where the selsyns revolve at the same speed as the sight. The actual error depends on acceleration, velocity, and wind loads on the guns. In practice it varies from zero to five degrees on the 31-speed selsyn which is equivalent to from zero to one-sixth of a degree at the guns. During the period of large errors mentioned above, the one-speed-output voltage of transformer T2S (in the servo-amplifier) increases until it breaks down the neon tube permitting a flow of current through the tubes. The voltage from T2S is much larger than the 31-speed voltage from T3S. The one-speed signal controls the output of the tubes from the time the neon tubes break down until the error is reduced to within the three and one-half to four degrees mentioned above. At this point the voltage from transformer T2S drops to a point where the tubes will no longer transmit the T2S voltage; then, the 31-speed signal from transformer T3S takes over and controls the system.

b. ANTI-HUNT CIRCUIT.—In the amplifier system between the selsyn control transformer and the amplidyne motor-generator there is an inherent tendency toward instability. This tendency is corrected by an anti-hunt feedback signal consisting of a carefully chosen function of the motor voltage. The purpose of the anti-hunt circuit is to minimize or eliminate hunting. This is accomplished in the following manner: The anti-hunt capacitor, located between the armature circuit and the amplifier circuit, permits rate of change of voltage on the motor armature circuit to be fed back into the amplifier circuit through resistor R1 and R2. The capacitor also acts to block the d-c voltage from the motor from being fed back to the amplifier during steady operation. As the guns swing close to correspondence, the driving signal diminishes, *diminishing* the output of the amplidyne and consequently lowering the voltage on the turret motor armature. This change of voltage is immediately interpreted by the amplifier as a negative signal before the guns have actually coasted beyond correspondence. Consequently, the amplifier anticipates what is going to happen and slows the guns down as they approach correspondence, thereby minimizing the overshooting and under certain conditions, eliminating it entirely.

2. REMOVAL.

a. Disconnect the electrical plug.

b. Remove the front cover, remove the attaching screws, and remove the servo-amplifier.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Repair, other than replacement of tubes or replacement of the entire unit, must be accomplished by trained personnel only. If the servo-amplifier is not functioning correctly, as determined by tests on its input and output, several quick checks can be made.

a. Feel all tubes to see if they are warm. All tubes except the flow tubes should feel warm when functioning. If tubes are cold, check input voltages.

b. If tube trouble is suspected, replace tubes. If no replacement tubes are available, shift tubes and note whether trouble follows tube or remains associated with the socket. Since duplicate channels are available, this check is usually effective for tubes.

c. If these preliminary quick checks do not reveal the trouble, carefully look over the circuit for evidence of damage or broken or loose connections. If the trouble is not disclosed by this inspection, trace the signals through electrically until the defect is disclosed. This may be done either with a cathode ray oscilloscope or analyzer. With zero signal, the following voltage should be observed:

VOLTAGE OBSERVATION POINTS (ZERO SIGNAL)

Left-hand Channel		*Right-hand Channel*	*Voltage*
	CD		*115 volts RMS AC 400 cycles*
2-3		29-30	0
4-5		31-32	0
6-7		33-34	0
10-11		37-38	0
17-18		43-45	75* volts aver. D-C
18-19		44-45	75* volts aver. D-C
	1-16		6.3 volts AC
21-20H		47-46H	6.3 volts AC
25-26		51-52	0
1-18		1-45	300 volts RMS A-C 400 cycles
1-20		1-46	350 volts RMS A-C 400 cycles
1-25		1-51	80* volts D-C aver. (amplidyne field disconnected)
			20* volts D-C aver. (amplidyne field connected)

Normal Operating Anode Currents (Zero Signal)

Tubes 1, 2, 6, 7	.020* amp. aver. D-C
Tubes 3, 8	.001* amp. aver. D-C
Tubes 4, 5, 9, 10	0* amp. aver. D-C

*These voltages and currents are approximate values only. The measured values will depend upon the method of measurement. In any case, points of symmetry in circuit can be compared, and trouble frequently located by this comparison.

d. Signal checks can be made by applying signal voltages of measured value and noting their effects on the circuit. Operation of the one-speed circuit can be detected visually by the appearance of a red glow discharge in tubes 4, 5, 9, 10.

e. If signal voltages are applied to either T2, T3, T4, or T5 primary and no corresponding voltages appear in the secondary check both primary and secondary windings for continuity with an ohmmeter. If the windings are defective, the transformer must be replaced.

4. ADJUSTMENTS.

a. SERVO-AMPLIFIER ADJUSTMENTS.—With zero input voltage to both the primaries of T2 and T3, and with zero input voltage to the anti-hunt terminals 2 and 3, the anode currents of tubes 1 and 2 should equal. This can be ascertained by comparing the voltage from points 25 to 1 and from 1 to 26. These should be equal. (Since these two voltages are opposite in polarity, the voltage across 25 and 26 should be zero.) If these two voltages are not equal, adjust R10 until balance can be made. If balance cannot be obtained, either tube 1, tube 2 or tube 3 may be defective, or the circuit is defective.

b. SYSTEM ADJUSTMENTS.—With the guns and sights locked in correspondence, the selsyns must be set on proper electrical zeros.

5. TEST AFTER INSTALLATION.

a. Turn on power switches in the following order:

(1) A-C power

(2) Turret power

b. Turret should come into alignment with sight, and should follow sight smoothly.

c. Check turret for proper direction of rotation in following the gun sight.

d. Check synchronizing through large angles by turning off the turret power, moving sight 90°, and then restoring the power to the turret. The turret should restore accurately to correct position within 2 seconds after first crossing the correspondence position.

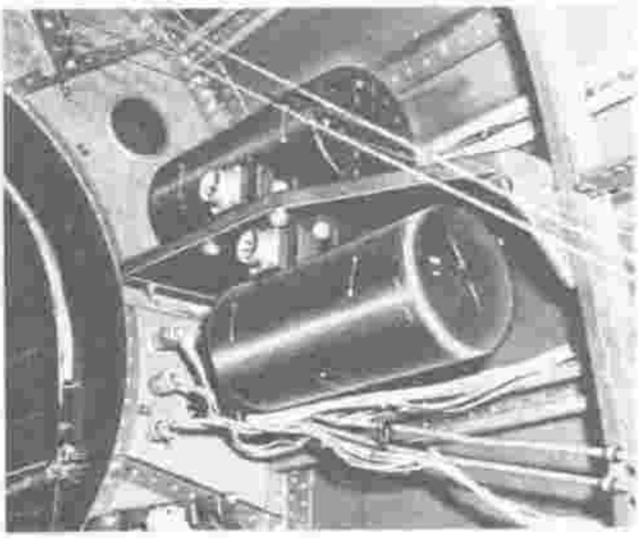


Figure 412 — Upper Turret Amplidynes Installed

e. Check for static accuracy by sighting on distant objects picked at random, and comparing with boresights in the guns.

f. Exert a force on the gun barrels and check for vibration and stiffness. A force of 100 pounds should not deflect the boresight more than about 10 mils (1/2 degree.)

g. Check the limit switches, fire interrupter, transfer switches and other details associated with the specific system. (See paragraph 15. *b.* (12) *(b) 1.* d. and e., this section.)

(b) AMPLIDYNE MOTOR-GENERATORS. *(See figure 412.)*

1. DESCRIPTION.—This unit is a special motor-generator with a very high amplification and quick response to small voltages in the generator-control field. The output is connected directly to the drive motor armature. One amplidyne motor-generator is required for each system (azimuth and elevation) of each turret. The two amplidynes for the upper turret are installed on the left-hand side of the aft fuselage above the lower turret. The two amplidynes for the lower turret are installed on the right-hand side of the aft fuselage above the lower turret. The amplidyne is similar to any ordinary separately-excited generator in the general shape of its characteristics and in that it is a rotating machine which converts mechanical energy into electrical energy; but it is unlike any rotating machine previously built in that the amount of excitation is very much smaller. In other words, the ratio of the power required to excite the control field of the power output is very much less than the corresponding ratio in conventional types of generators. Furthermore, the speed of response is such that a small change in the excitation will produce a corresponding change in the power output within a fraction of a second. Since the load resistance is reduced to zero by short-circuiting the brushes *(figure 413)*, very little voltage and thus a very small field current is required to produce a very high current and a resulting high armature flux. Since the field flux has to be built up only to a low value and since the resistance and reactance of the short-circuited armature is very small, full-load current may be obtained in an exceptionally short time. The armature-reaction flux is made use of by adding another set of brushes at right angles to those which are short-circuited. *(See figure 413.)* Replace safety wire, looping through hole in screw and around brush holder. The armature flux itself produces a voltage at these new brushes. This so-called cross axis-excited generator operates as follows: If a resistance load is placed across the new set of brushes, or "load axis" brushes of this machine, the "load current" which flows in the armature circuit (superimposed on the short-circuit current) causes a new magnetic flux to appear, and this flux opposes that of the original field winding. To overcome this by increasing the field excitation would destroy one of the advantages of the machine. Instead, a field coil is wound in series with the load brushes in such a position as to neutralize the load-axis-armature flux completely. With this winding, the amplidyne can be maintained even under full load with the following advantages: (1) Exceptionally small field currents required to produce full voltage; (2) The voltage builds up to its final value in an exceedingly short time.

2. REMOVAL.

a. Disconnect electrical plug.

b. Remove attaching bolts and remove amplidyne.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. REPLACING BRUSHES.

(1) Brushes should be replaced when they are worn to within 1/16 inch of the metal brush holder. It is desirable to change all brushes if one or two of them are worn to this extent. Such practice will require less frequent disassembly. The average brush life is 75 hours of amplidyne operation.

(2) Cut safetywire, loosen screws, and remove old brushes.

(3) Insert new brushes and adjust shim washers so that, when screws are snugly tightened, the safety wire holes will be aligned for safety wiring that will tend to tighten screws. *Do not tighten screws excessively, or brushes will break in compression.* Replace safety wire, looping through hole in screw and around brush holder.

(4) Prepare a thin strip of No. 00 sandpaper, from which most of the thick backing has been removed with a razor blade, and apply to the commutator with water-soluble glue, or mucilage, with no over-lap. Block brushes up, reassemble armature to end shield, release brushes onto sandpaper, and turn armature until brushes are sanded into as close a fit as possible (approximately ¾ to one turn). The brush fit is extremely important in the case of the generator end, because of its critical effect upon amplification. See paragraph 4. ADJUSTMENTS, below.

(5) Remove sandpaper and glue with a damp cloth. Thoroughly clean armature, commutators, both brush riggings, and field frame with compressed air, carbon tetrachloride, or both. There will be much carbon and dust deposited, and it is important that these be removed.

(6) Run the machine at light load for 5 hours, or at least until generator-end brushes have perfect fit. Use of brush-seating stones is *not* recommended.

(7) If brush yokes have not been moved, it should not be necessary to set a new brush position. If brushes have been moved, reset as described in paragraph 4. ADJUSTMENTS, below.

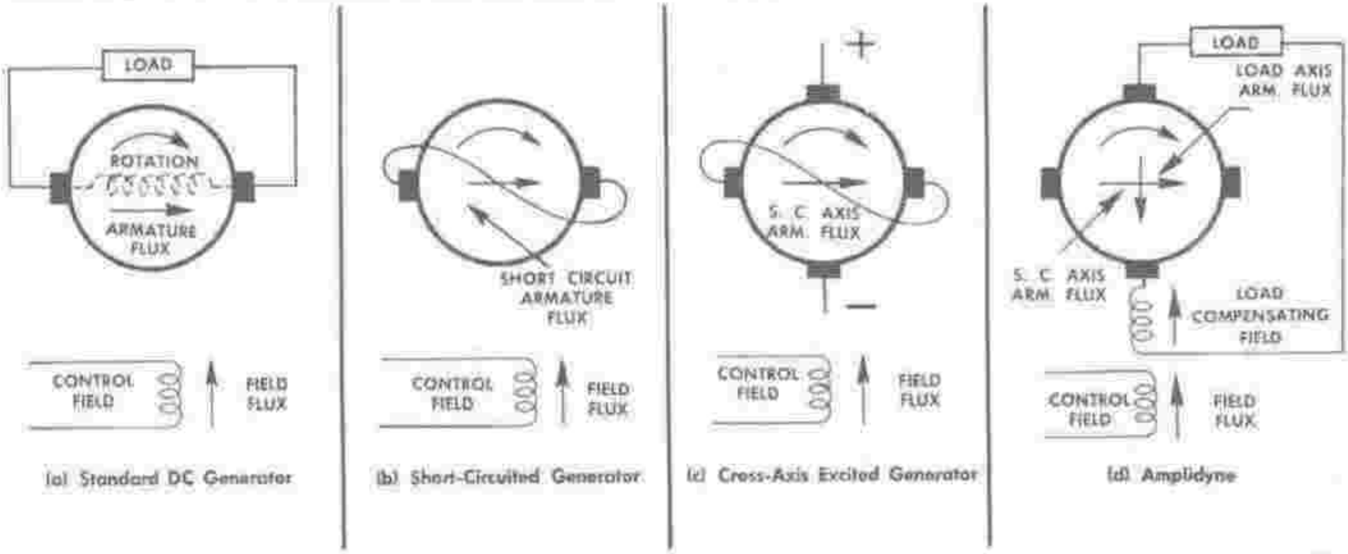


Figure 413—Amplidyne Theory of Operation

b. COMMUTATOR.

(1) Do not oil or lubricate commutator in any way.

(2) It may be necessary to clean the commutator by sanding lightly with No. 000 sandpaper. Do not use emery cloth. Blow out all dust afterward.

(3) If a commutator is badly scored or burned, it is permissible to take a light lathe cut. Following this, it will be necessary to undercut the mica 1/32 inch between segments, using a piece of hacksaw blade ground to proper thickness. After this, the machine must be run-in for several hours to reshape brushes.

(4) Resetting the brush position may be necessary.

Note

Commutator sparking should not cause alarm, unless it is excessive. The generator brushes are not set on the position of best commutation, and some sparking will occur.

c. BEARINGS.

(1) The bearings are sealed with grease, and should not be lubricated during the life of the machine.

(2) If bearings are found to be binding, they must be removed with a bearing puller and replaced, or the whole armature replaced. It is not necessary to rebalance after replacing bearings. Exert force on inner race only, when replacing bearings.

d. COILS.—Rewinding of faulty armatures or fields is not recommended. The assemblies should be replaced.

4. ADJUSTMENTS.—If the yokes have been moved since factory setting, the brush setting must be adjusted as follows:

a. MOTOR END.—Set the brush mechanism so that the retaining screws are in the center of the elongated slots. Move the brush yoke against the direction of rotation approximately 3/32 inch, measured on the outer diameter. Tighten retaining screws. If this is an unsatisfactory setting, shift the brush yoke until sparking is at a minimum when rated load is applied to the generator.

b. GENERATOR END.—These brushes should be shifted until 60 volts output can be obtained with 5 to 10 net millamperes in the control field. The output is open-circuit voltage, meaning to be measured with voltmeter across the terminals only. The test must be performed for both polarities of output.

5. INSTALLATION.—Reverse procedure described in paragraph *2.* REMOVAL, above.

(i) DRIVING MOTORS.

1. DESCRIPTION.—The General Electric drive motors are mounted on each turret, one for each gun position (azimuth and elevation). The turret assembly is mounted inside the stationary outer ring gear track; rotation of the azimuth drive motor causes rotation of the turret assembly inside the outer ring. The pinion gear driven by elevation drive motor is mated with a gear sector on the gun saddle; rotation of the elevation drive motor causes the guns to elevate or depress depending on the direction of rotation. The motor is composed of a stator assembly, rotor assembly, brush rigging assembly, commutator end shield, pulley end shield, connector end cover. The field of the motor is connected to the 24-volt d-c airplane electrical system and the armature is connected to the d-c output of the amplidyne generator. As long as there is an "error voltage" between the sighting station and the turret selsyns, the amplidyne produces an output to energize the drive motor armature and produce a change in the gun position. As soon as balance between the line of sight and the line of fire is restored, there is no further output from the amplidyne generator and the drive motor will stop.

2. REMOVAL.

a. Disconnect the electrical plug.

b. Remove the attaching screws, and lift the motor from the splined shaft.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. REPLACING BRUSHES.

(1) Brushes should be changed when they are worn to within 1/16 of an inch of the metal brush holder. The average life of the brushes is 75 hours of motor operation.

(2) Cut locking wire; unscrew and remove old brushes.

(3) Insert new brushes and adjust the washer shims so that when screws are tightened snug, the lockwire holes will be suitably aligned for a lockwire that will tend to tighten screw. *Do not tighten screws excessively or brushes will break in compression.* Replace lockwire, looping through hole in screw and around brush holder.

(4) Paint heads of screws with G.E. No. 1201 red Glyptol insulating varnish or equivalent.

(5) Apply a strip of 00 sandpaper to the commutator with water soluble glue and no overlap. Reassemble armature to end shield and turn armature until brushes are sanded to 70 percent contact (approximately ¾ to one turn).

(6) Remove sandpaper and glue with damp cloth. Thoroughly clean armature, commutator, brush rigging, and motor frame with carbon tetrachloride or air stream, or both. There will be much carbon dust deposited, and it is important that this be removed.

(7) If brush yoke has not been moved, it should not be necessary to set a new brush position. Setting brush position is covered in paragraph *4*, ADJUSTMENTS, below.

b. COMMUTATOR.—Do not oil or lubricate commutator in any manner. It may be necessary to clean the commutator by sanding lightly with 0000 sandpaper. Do not use emery cloth. If the commutator is badly scored or burned, it is permissible to take a light lathe cut. After this, it will be necessary to undercut the mica 1/32 inch between segments.

c. BEARINGS.—The bearings are sealed and are not to be lubricated during the life of the machine. If they are found to be binding, they must be removed with a bearing puller and replaced, or the whole armature replaced. When pressing on a new bearing, exert all force on the inner race.

d. COILS.—Rewinding of their field or armature coils is not recommended. The assemblies should be replaced.

Note

Commutator sparking under load should not cause alarm unless it is excessive. Turret motors are built to expect "pinpoint" sparking, but "streamer" sparking should not be tolerated.

4. ADJUSTMENTS — BRUSH SETTING.—Brush setting should be on electrical neutral. This is located by applying rated load to the motor and adjusting the brush yoke until the motor runs at the same speed in either direction with equal field currents and armature voltage. A flywheel wrapped with a string, or any kind of brake, can be used as load and a revolution counter can be used to measure speed. The field current should be measured frequently during the test because the resistance of the winding increases with temperature.

Note

If no means of loading the motor is available, the brushes may be set by "flashing." This consists of placing a milliammeter across the armature terminals, applying rated voltage to the motor field, and then breaking the field connection quickly and noting the deflection of the milliammeter. The brushes should be adjusted until this "flashing" gives no deflection of the meter. This will be the best brush position.

5. INSTALLATION.—Reverse the procedure described in paragraph *2.*, REMOVAL, above.

(j) MACHINE GUNS.

1. DESCRIPTION.—Two type M-2, caliber .50 machine guns are installed in each turret. Ammunition is fed to each gun from an ammunition box having a capacity of 500 rounds. Guns are charged automatically as described in paragraph 15. *d.* (16) *(k) 1.*, this section. Ammunition is lifted to the upper turret guns by an ammunition booster (paragraph 15. *d.* (16) *(k) 1.*, this section). A gun sight aiming point camera and a telltale indicator are installed to operate in conjunction with the turret guns.

2. REMOVAL.

a. UPPER TURRET.

(1) Open the dome access door and unlock the elevation latching solenoid located on the inside of the elevation saddle support.

(2) Position the guns at about 30 or 40 degrees elevation or depression and relatch the solenoid.

(3) Release the safety lock on the dome handle and turn the handle to release the dome, *figure 414*, and remove the dome.

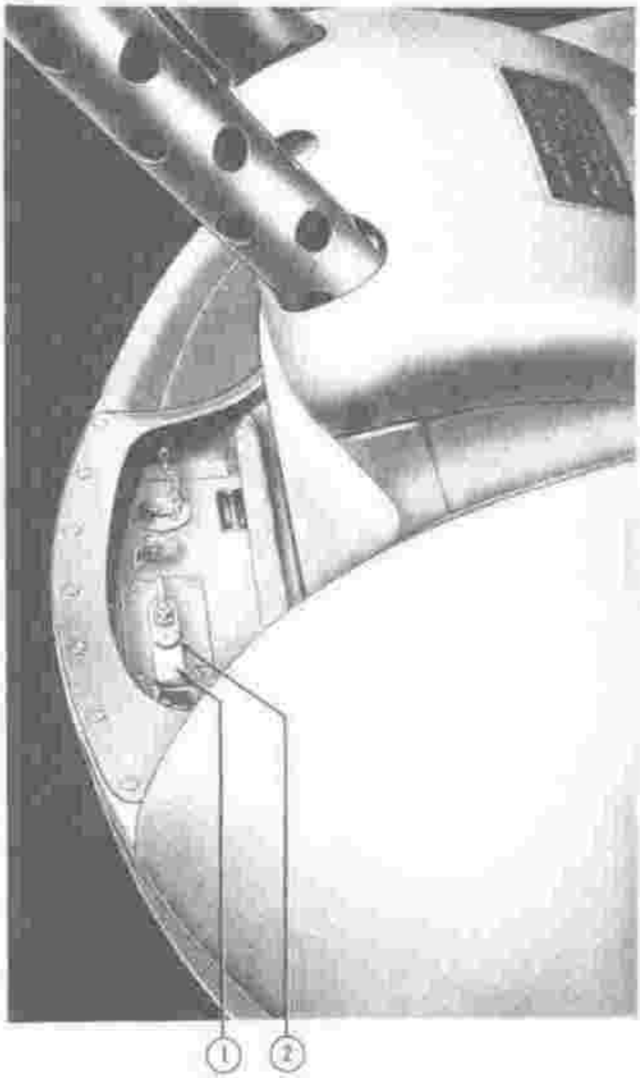
(4) Remove the gun enclosure by releasing the four gun-enclosure locks and sliding the gun-enclosure off the gun barrels. *(See figure 415.)* Remove the ammunition belts from the guns. Remove live rounds from the chambers of the guns.

(5) Shut off the gas supply by turning off the gun fire safety switches and opening the valve at the base of the pressure cylinder.

(6) Release the elevation latch solenoid. Position the guns in horizontal.

(7) Detach the electric and gas connections from the gun charger. If the gun which mounts the camera is being removed first, remove the camera as described in paragraph 15. *b.* (14) *(c) 2.*, this section.

(8) Cut the safety wire and loosen the trunnion bolts on the adapter of the gun. Lift the muzzle of the gun, disengaging the trunnion bolts from the front gun support.



1. Handle
2. Safety Lock

Figure 414 — Turret Dome Locking Handle

(9) Holding the muzzle of the gun up, push the gun back, disengaging the sliders of the slider-gun-mount assembly from the slider bushings in the saddle. Lift out the gun.

CAUTION

Be careful not to damage or distort the link chute when the gun is set down. It is better to remove the link chute by disengaging the pawl pin before setting the guns down.

b. LOWER TURRET.

(1) Open the dome access door and release the elevation latch solenoid. Position the guns about 30 or 40 degrees below the horizontal.

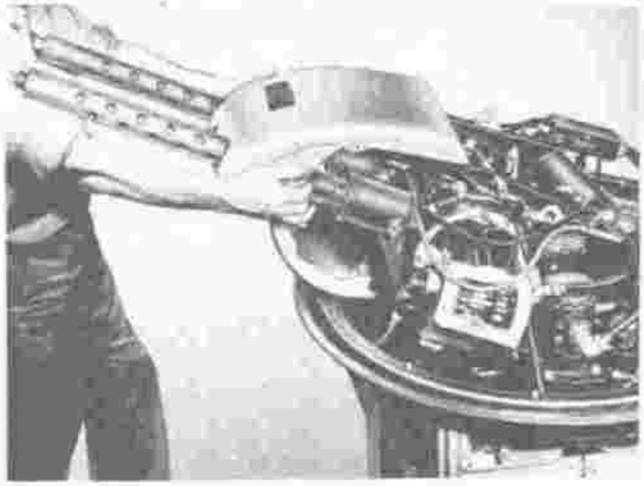
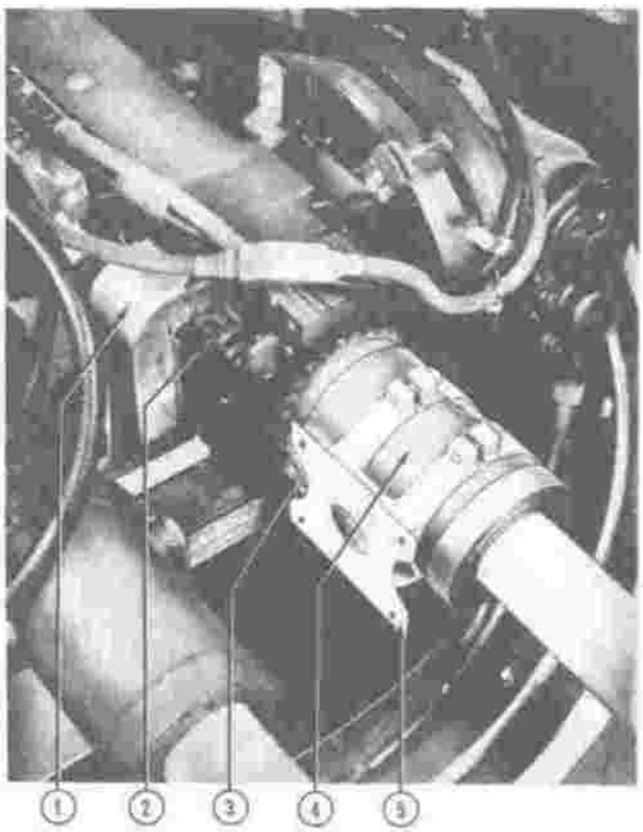


Figure 415 — Removing Gun Enclosure (Upper Turret — Lower Turret Similar)

(2) Release the safety lock on the dome handle and turn the handle to release the dome *(figure 414)*. Remove the dome. *(See figure 417.)*



1. Link Chute
2. Pawl Pin
3. Trunnion Bolt
4. Edgewater E-10 Recoil Adapter
5. G.S.A.P. Camera Mount

Figure 416 — Edgewater Recoil Adapter

(3) Remove the gun enclosure by first releasing the two Dzus fasteners and then the four locks.

WARNING

Remove the ammunition belts from the guns. Remove live rounds from the chambers of the guns.

(4) Detach the electric and gas connections from the gun charger. Depress the guns sufficiently to make the connections accessible. If removing the gun which mounts the camera, remove the camera as described in paragraph 15. *b.* (14) *(c) 2.*, this section.

(5) Position the guns about 45 degrees below horizontal.

(6) Loosen the trunnion bolts on the adapter of the gun. Lift the muzzle of the gun disengaging the trunnion bolts from the front gun supports.

(7) One man must hold the rear of the gun while another lifts the muzzle of the gun, pushes back, and remove the sliders of the slider-gun-mount assembly from the slider bushings of the saddle.

CAUTION

When sliding the guns back, the muzzle of the guns should be elevated so that the link chute does not jam against the spring of the door assembly.

(8) Slide the gun out muzzle-end first, being sure that the link chute does not jam against the spring of the door assembly.

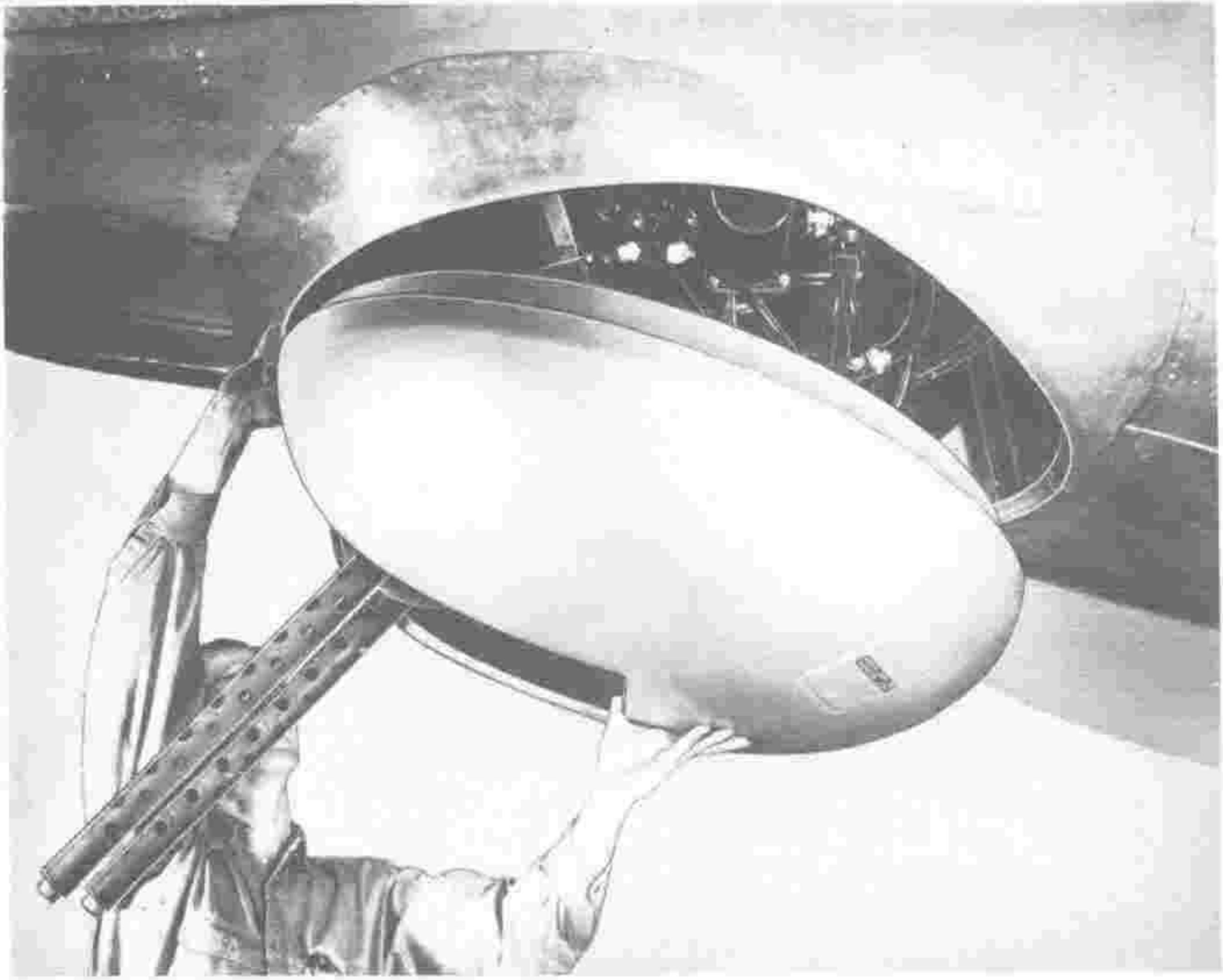


Figure 417 — Dome Removal (Lower Turret)

CAUTION

Be careful not to damage the link chute when the gun is set down. It is recommended that the link chute be removed by disengaging the pawl pin *(figure 416)* before setting the guns down.

3. MAINTENANCE REPAIR OR REPLACEMENT.—For cleaning, lubrication, and maintenance, refer to applicable technical manuals.

4. ASSEMBLY AND INSTALLATION.

a. PREPARING UPPER AND LOWER TURRET GUNS FOR INSTALLATION.—If the gun has not previously been used on an upper or lower turret, it must be prepared for installation as described below. An Edgewater E-10 recoil adapter, *(figure 416)* slider gun-mount assembly, and a link chute, are provided for use with each gun.

(1) Remove the original trunnion adapter by releasing the spring lock and unscrewing. Replace with an Edgewater, E-10 adapter, screwing the adapter on the barrel jacket with a spanner wrench.

(2) Remove the pawl pin and open the cover of the gun.

(3) Place the link chute on the inboard side of the gun, attaching it by forcing the pawl pin through the hole in the link chute. Lock the pawl pin in place with a cotter pin.

(4) Attach the slider-gun-mount assembly through the rear mounting holes of the gun as shown in *figure 418*.

(5) Mount the gun chargers on the guns as explained in paragraph 15. *b.* (12) *(k)* 4., this section.

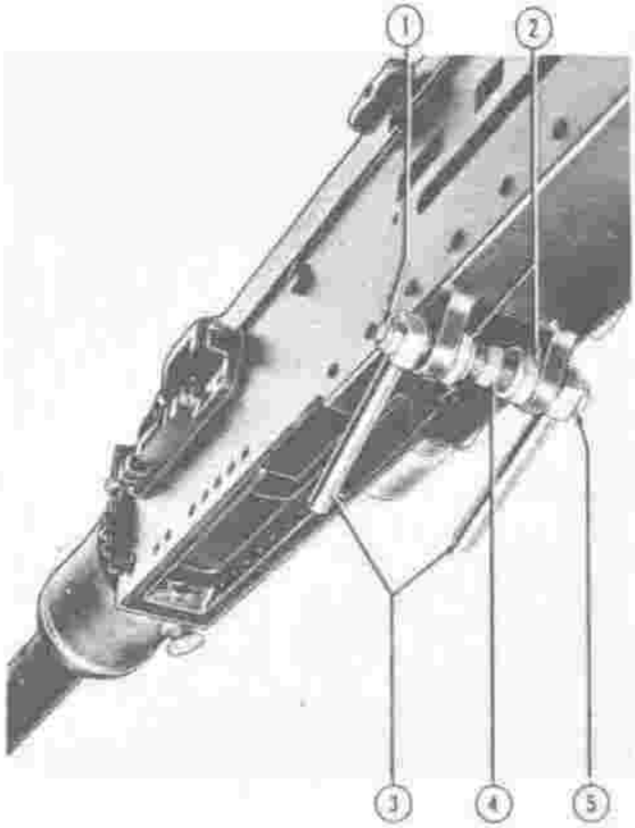
b. INSTALLING UPPER TURRET GUNS.

(1) Loosen and back out 3 or 4 threads of the trunnion bolts on the recoil adapter.

(2) Remove the dome as described above.

(3) Remove the gun enclosure as described above.

(4) Release the elevation latch solenoid and position the saddle of the turret in horizontal. One man holds up the barrel of the gun while another inserts the sliders of the slider-gun-mount assembly into the slider bushings of the saddle. Pull forward on the barrel of the gun until the trunnion bolts can be lowered into the front gun support. Make certain that the lower end of the link chute does not jam in the chute-extension opening in the saddle. Tighten and safety wire the trunnion bolts.



1. Self-locking Nut
2. Self-locking Nuts for Azimuth Adjustment
3. Slider Gun Mounts
4. Center Nut for Elevation Adjustment
5. Self-locking Nut

Figure 418 — Slider Gun Mount

(5) Make electric and gas connections to the gun charger. Both connections must be tight. Place soapy water on the gas hose connection and check for leaks by turning on the gun fire safety switch on the control box. Turn the switch off after checking.

CAUTION

Do not use a sealing compound on the gas hose connection to the gun charger.

(6) If it is the gun which mounts the camera that has been installed, install the camera as described in paragraph 17., ARMAMENT, this section.

(7) If only one gun has been replaced on the turret, align this gun with the other gun on the turret as described in paragraph 15. *b.* (13) *(j)* 5. a., this section. If both guns have been replaced, harmonize the turrets and sights as described in paragraph 15. *b.* (13) *(j)* 5. d., this section.

(8) Add the gun enclosure by fastening the four gun-enclosure locks.

(9) Release the elevation latch solenoid and position the guns about 30 or 40 degrees above horizontal. Put on the dome and fasten with the dome latch *(figure 414)*.

c. INSTALLING LOWER TURRET GUNS.

(1) Loosen and back out the trunnion bolts on the recoil adapter 3 or 4 threads.

(2) Release the safety lock on dome handle and turn the handle to release the dome. Remove the dome.

(3) Disengage the elevation latch solenoid and position the saddle of the guns about 45 degrees below the horizontal.

(4) Two men are needed to install lower turret guns. One man must hold the rear of the gun and guide it so that the link chute does not jam against the spring of the door assembly. The other man lifts up on the gun muzzle and slides the gun into the turret so that the slider-gun-mount assembly can be inserted into the slider bushings on the saddle support.

(5) Hold the muzzle of the gun up and pull forward to seat the sliders.

(6) Lower the gun and seat the trunnion bolts into the gun supports on the saddle.

(7) Tighten trunnion bolts *(figure 421)* and safety wire.

(8) Make electric and gas connections to the gun charger. Both connections must be tight. Place

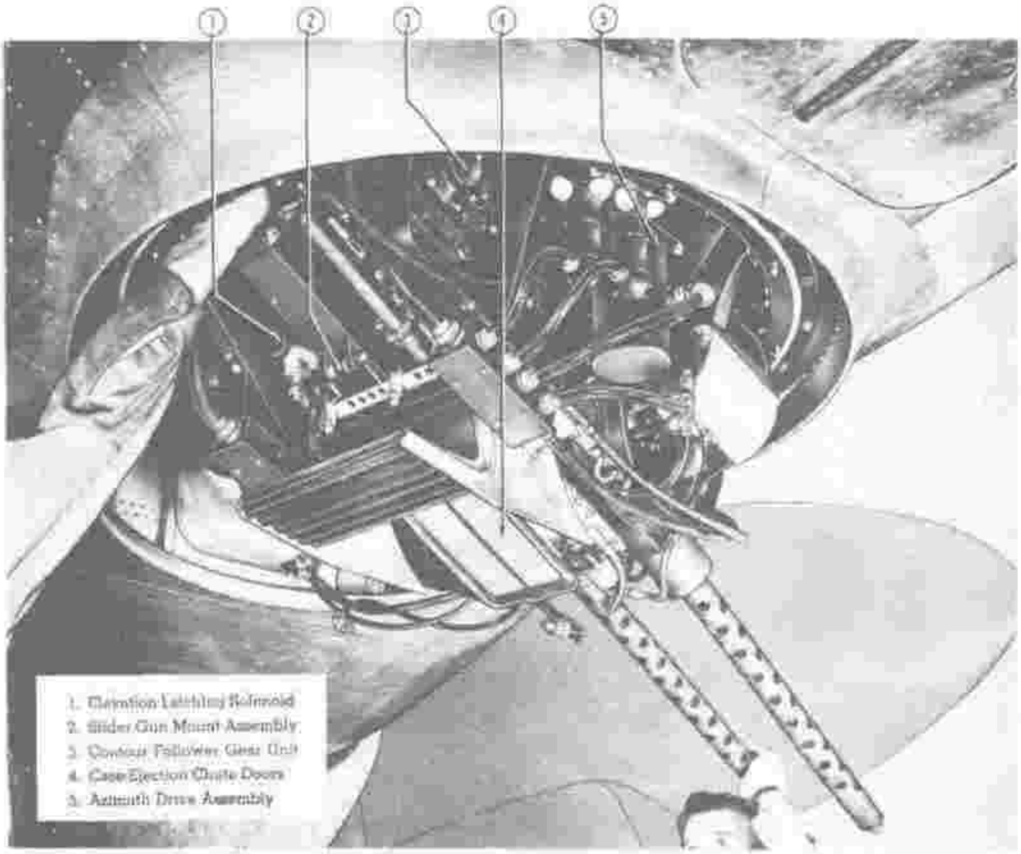


Figure 419 — Gun Installation (Lower Turret — View 1)

soapy water on the gas hose connections and check for leaks by turning on the gun fire safety switch. Turn off the gun fire safety switch on the control box.

CAUTION

Do not use a sealing compound on the gas hose connection to the gun charger.

(9) Install the camera as described in paragraph 17. *f.* (2) *(c)* 4., this section, if the gun on which the camera mounts has been put into place.

(10) If only one gun has been replaced on the turret, align this gun with the other gun on the turret as described in paragraph 15. *b.* (13) *(j)* 5. a., this section. If both guns have been replaced, harmonize the turrets and sights as described in paragraph 15. *b.* (13) *(j)* 5. d., this section.

(11) Add the gun enclosure, fastening the two Dzus fasteners and then four locks.

(12) Release the elevation latch solenoid and position the guns about 30 or 40 degrees below horizontal. Put on the dome and fasten with the dome latch.

5. HARMONIZING. — Before the Central Station Fire Control System will function properly, it must be harmonized so that the line of sight of the sighting station will be parallel to the bore axes of the guns on the turrets. Before harmonizing the system, it is necessary that the following conditions exist:

a. The vertical axes of the bottom turret and sighting station must be parallel to that of the upper turret.

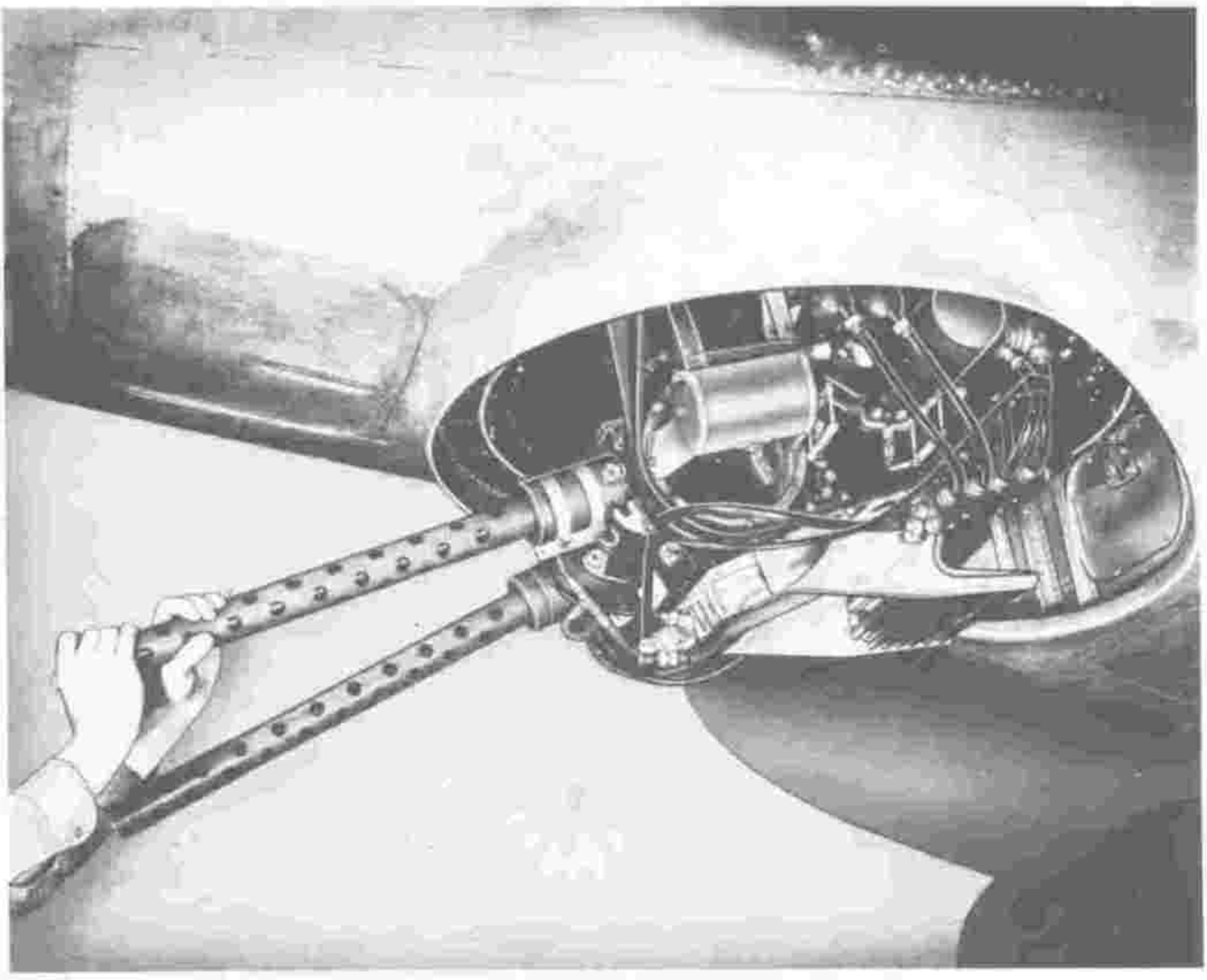


Figure 420 — Gun Installation (Lower Turret — View 2)

b. The bore axes of the guns must be parallel to each other and perpendicular to the horizontal axes about which the guns rotate in elevation.

c. The selsyns must be properly zeroid as outlined in paragraph (13) *(e) 4.*, and the output voltage of the selsyn control transformers to the servo-amplifier must be approximately zero when the line of sight of the sighting station is parallel to the gun bore axes of the turrets.

(1) GUN ALIGNMENT.—Gun alignment consists of making the bore axes of the guns on the same turret parallel, and is required before harmonizing the system.

(2) Insert a bore sight tool in the barrel of one of the guns.

(3) Position the turret so that the gun is bore sighted on the appropriate mark on the target. Lock the turret in azimuth and elevation.

(4) Place the bore sighting tool in the second gun and observe whether or not it is aligning as marked on the target. If the gun is not properly aligned, adjust it as follows:

(a) ELEVATION ADJUSTMENT.—Loosen all four self-locking nuts on the gun slider mount assembly on the rear of the gun *(figure 418)*. Turn the center nut *(4, figure 418)* until the gun is properly aligned in elevation. Tighten the two small self-locking nuts.

(b) AZIMUTH ADJUSTMENT.—Shift the gun in azimuth until it is aligned on the

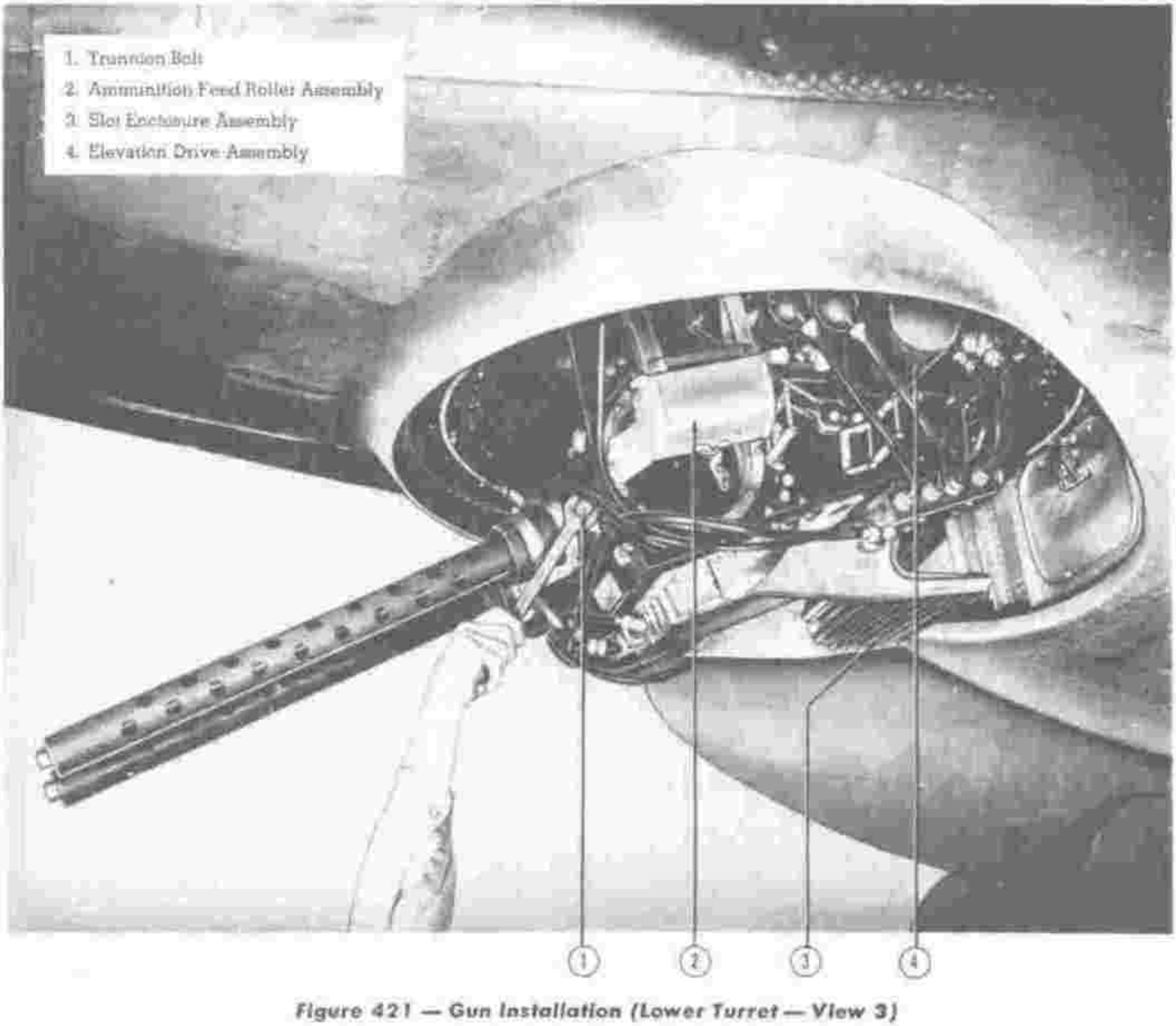


Figure 421 — Gun Installation (Lower Turret — View 3)

target mark by screwing the two large self-locking nuts in one direction or the other. *(See 2, figure 418.)* Then tighten the nuts to a snug fit. Do not overtighten.

(c) HARMONIZING ON A DISTANT OBJECT.—The preferred method in the field for a quick check of harmonization or for harmonizing after replacement of a turret or sight is a distant object preferably over one mile away. The distance will reduce the error due to parallax to one mile.

1. Locate a distant object at least one mile away, near the horizon.

2. Close the a-c power switch, the d-c turret power switches, and the action switch on the sight.

3. Operate both the upper and lower turrets in azimuth and elevation. Visually check that the turrets follow the sight in approximate correspondence. If they fail to, the zeroing of the selsyns on the turret and sight should be checked as outlined in ZEROING SELSYNS, paragraph (13) *(e) 4.*, this section.

4. Rotate the sight and turrets to the approximate location of the distant object and turn off the a-c and d-c switches.

5. Transfer the line of sight to the upper head of the periscope and align the line of sight and bore axis of one of the upper turret guns directly on the target. Latch the turret and sight in this position.

6. Close the a-c power switch to energize the selsyns system. (Do not close the turret power switches at this point.) Place a voltmeter, using a 10 volt scale, across terminals one and two of the azimuth 31-speed transformer T5 in the upper turret servo-amplifier. *(See figure 411.)*

7. Adjust the corresponding azimuth 31-speed selsyn control transformer on the upper turret until the voltage across terminals one and two of transformer T5 is zero.

8. Place a voltmeter, using a 10-volt scale, across terminals one and two of the azimuth one-speed transformer T4 in the upper turret servo-amplier. *(See figure 411.)*

9. Adjust the corresponding azimuth one-speed selsyn control transformer on the upper turret until the voltage is zero at transformer T4.

10. In turn, measure and adjust to zero the voltages across terminals one and two of the elevation 31 and one-speed transformers, T3 and T2 *(figure 411)* by adjusting the corresponding elevation selsyn control transformer on the upper turret in the same manner as was done for the azimuth system.

11. Transfer the line of sight to the lower head of the periscope.

12. Bore sight the guns of the upper turret on the target and latch the guns in position. Align the sight on its proper target.

13. Again place a voltmeter across terminals one and two of the azimuth and elevation 31 and one-speed transformers, T3 and T2, and adjust the corresponding lower turret selsyn control transformers so that the voltages obtained at the transformers are zero. Follow the procedure set forth in preceding paragraphs in adjusting the 31-speed selsyns before the one-speed selsyns.

14. Close the upper and lower turret power switches. If the system is not balanced properly, the turrets will move slightly due to a signal being impressed on the servo-amplifier.

15. Place a voltmeter across terminals one and two of the azimuth 31-speed transformer T5 in the upper turret servo-amplifier and adjust the potentiometer R27 to obtain a zero rating. This adjustment should realign the gun bore on the target points.

16. Repeat the operation of step (15) for the elevation 31-speed transformer T3. Adjust potentiometer R10.

17. Transfer the line of sight to the lower head of the periscope and repeat steps (15) and (16) on the lower turret servo-amplifier.

18. Check harmonizing of turrets and sight on two other points approximately 90 degrees and 180 degrees respectively from the original target.

(k) AUTOMATIC GUN CHARGERS.

1. DESCRIPTION.—The General Electric automatic gun charger is used with each caliber .50 M2 turret machine gun. The charger is controlled electrically. When the gunner closes the firing trigger, the gun either fires in the normal manner or, in the event that the gun fails to fire, the charger operates within 0.4 second to charge the gun. Should the gun fail to fire five or six times in succession, the charger will then stop operating, since it is assumed such continuous faulty operation is caused by something other than defective rounds. A reset button extending above the cover is used to reset the charger to operating condition. A timer, driven by an electric motor, controls the operation of the firing and charging solenoids. The timer stops operation of the charger if the gun does not fire within an interval of about four seconds.

2. REMOVAL.—Reverse the procedure outlined in INSTALLATION, paragraph (13) *(k)*. *4.*, this section.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Clean charger unit by removing it from the gun and wiping off oil, dirt, and grease with a cloth saturated with gasoline or naphtha. Do not use carbon tetrachloride.

b. No oil, grease, or lubrication of any kind should be applied to any part of the gun charger.

4. INSTALLATION.

a. REMOVE AMMUNITION BELT FROM GUN AND ANY LIVE ROUND FROM FIRING CHAMBER.

b. Check that rear slide of gun is set for operation on side of gun on which charger is to be installed. (Follow AAF procedure for changing rear slide.)

c. Check that mounting bar is on proper side of charger.

d. Remove stud from end of charger and insert in gun bolt.

e. Replace 0.025 inch diameter safety wire on screw which fastens spare stud to end of charger.

f. Withdraw sear-pin into mounting bar (nonfiring position) by turning sear-pin adjuster clockwise, as far as possible. Use a nail slipped through one of the holes in end of the sear-pin adjuster.

g. Remove safety pin from clamping bolt and loosen castle nut on bolt to end of bolt thread. Clamping bolt may now be extended beyond mounting bar for engagement with holding slot in side plate of gun. A clamping wedge on mounting bar cooperates with another slot in the gun side plate.

h. Apply charger to gun by first inserting head of clamping bolt in slot. Then fit clamping wedge on mounting bar into slot. The stud must extend through guide slot in wall of cylinder.

CAUTION

Mounting bar must rest flat against gun side plate at all times.

i. Tighten castle nut on clamping bolt to fit snugly and replace safety pin.

CAUTION

Do not tighten castle nut sufficiently to bend or deform side plate.

j. Fasten hose from pressure cylinder to nipple at end of charger. Check that connection is airtight by turning hand valve on pressure cylinder to admit air and listening for audible leakage.

CAUTION

Do not attach firing lead to electric connector on cover at this time.

5. TEST AFTER INSTALLATION.

a. FIRING ADJUSTMENT.

WARNING

Again check that ammunition belt has been removed from gun and that no live rounds are in gun chamber.

(1) Open hand valve on pressure cylinder.

(2) Insert screwdriver in SOCKET "C," identified on charger cover, resting end on bushing, and move handle toward muzzle of gun. This simulates action of the charging solenoid so that air enters the cylinder moving the piston to charge or cock the gun.

(3) Insert screwdriver in SOCKET "F," identified on charger cover, resting end of screwdriver against center of firing solenoid plunger. Move handle of screwdriver toward breech end of gun. This simulates action of the firing solenoid, and moves the sear-pin laterally into the gun to engage the sear slide and release the firing pin.

(4) If firing action is not accomplished, as evidenced by audible click when firing pin is released, turn sear-pin adjuster one notch counterclockwise, and repeat firing action by inserting screwdriver in SOCKET "F." Repeat one notch at a time until firing action is accomplished.

(5) Advance sear-pin adjuster counterclockwise two more notches (1/3 revolution) to make certain that firing action will continue.

(6) Connect electrical firing circuit by plugging in lead and screwing cap tight to connector on cover.

(7) Move reset-button projecting above cover to extreme end of slot away from START position.

(8) To check installation, fire gun electrically by closing firing key.

(9) Check timing of gun by inserting a gage between barrel extension and trunnion block of gun using a gage specified by and following the procedure recommended by the Army Air Forces.

b. CHARGER UNIT TEST.

(1) Apply 24 volts d-c to charger. Check that motor runs freely, sear-pin operates and timer motor circuit is opened in approximately four to eight seconds.

(2) Check seating of valve for air leakage as follows: Apply 1000 psi air pressure to charger and listen for leakage between valve and valve seat. If air leaks, check clearance between nut and charging plunger bushing. Clearance should be 0.015 inch. If air still leaks, a new valve assembly and valve compression spring should be installed.

(3) Check leakage between valve assembly and exhaust port when charger operates, as follows:

(a) Mount charger on spare gun.

(b) Apply 1000 psi air pressure and 24 volts d-c to charger.

(c) Block gun bolt by means of a two inch fiber plug, or equivalent, inserted between gun bolt and buffer.

(d) Set timer button to START position (indicated on charger cover) and operate charger electrically through firing key, keeping firing key depressed until timer-motor circuit opens. Fiber plug will prevent gun bolt from resetting timer switches so that tapered surface of valve will close exhaust port until timer-motor circuit opens in approximately four to eight seconds.

(e) Listen or feel for leakage of air through exhaust port during this period. A small amount of air may leak, but leakage should not be so excessive that the speed of the charging action is impaired.

(f) If leakage is excessive, measure the clearance between charging-plunger bushing and nut by means of a feeler gage.

(g) If clearance is over 0.015 inch, adjust to 0.015 inch by inserting a screwdriver into charging-plunger bushing and wedging nut so that both nut and bushing may be rotated on stem of valve.

(h) Again test leakage through exhaust port by following preceding paragraphs (d) and (e).

CAUTION

Excessive leakage may not be a valve defect. It may also be an electrical defect in the charging solenoid. Before proceeding, operate the valve manually at SOCKET "C." If manual operation produces no excessive leakage, check operation of charging solenoid at 24 volts, d-c.

(i) If leakage through exhaust port is still excessive, adjust the clearance between nut and charging-plunger bushing to 0.010 inch, but no less than 0.010 inch.

(j) Again test leakage through exhaust port by following preceding paragraphs (d) and (e).

(k) If leakage through exhaust port is still excessive, proceed as follows:

1. Unstake charging-plunger bushing from plunger.

2. Remove nut from stem of valve.

3. Remove valve and valve bushing from valve block.

4. Remove two of sealing washers. Each washer is 0.005 inch thick.

5. Reassemble valve and valve bushing on valve block, lubricating bushing threads with Parker Threadlube (AC 3751). Tighten bushing on block.

6. Thread charging-plunger bushing on plunger and stake.

7. Adjust clearance between nut and charging-plunger bushing to 0.015 inch.

c. TIMER OPERATION TEST.

(1) Mount charger on spare gun.

(2) Set timing of gun as slow as possible, following procedure recommended by the Army Air Forces.

(3) Apply 24 volts d-c and 1000 psi air pressure to charger.

(4) Fire gun with live ammunition. If charger ejects live rounds, adjust timer as follows:

Note

Ejection of live rounds means that the timer does not give the gun time to fire before operating charger. A time interval of approximately 0.2 to 0.4 second is required to see if the gun is going to fire, before the solenoid-switch lever arm engages the solenoid-switch lever to operate switch energizing the charging solenoid. If timer operates satisfactorily on a slowly-timed gun, it will always operate on a gun which is timed normally.

(5) Grip end of solenoid-switch lever just below the shaft with a pair of pliers. Move pliers in direction shown by the arrow so that the lever is bent adjacent to the shaft to move the end of the

lever a slightly greater distance from arm. Only a very slight adjustment is needed.

(6) Again check that charger does not eject live rounds.

(7) Remove ammunition belt and any live round from firing chamber. Also remove source of air pressure and firing lead from connector or charger.

(8) Remove drive spring from gun and position gun bolt "in battery." Move solenoid switch lever arm to operate solenoid switch by inserting screwdriver into cylinder and pushing the lever arm. Switch is now in position to energize charging solenoid.

(9) Manually move gun bolt back slowly until solenoid switch operates as evidenced by audible click.

(10) Measure position of gun extractor and see that it is within $\frac{1}{16}$ of the point where it drops to its lower position. If distance exceeds this, adjust timer as follows:

Note

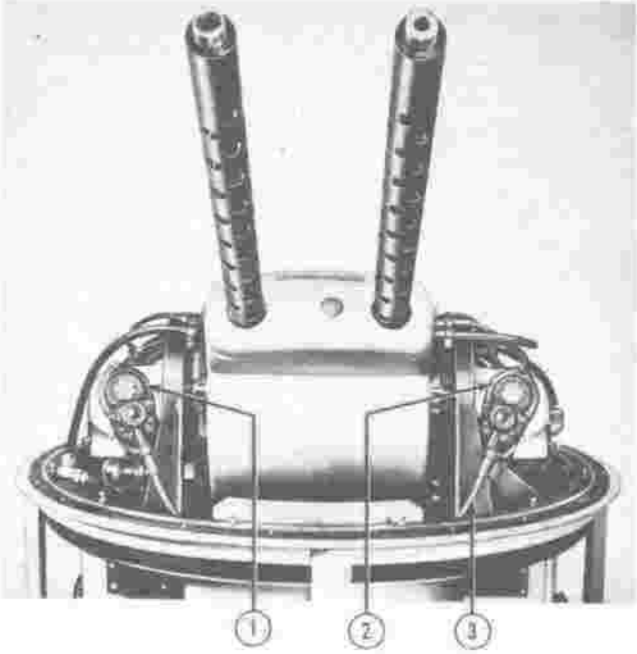
This check determines that charger will apply pressure to stud long enough to complete the charging cycle, so that gun bolt will insert the round which has been withdrawn from the ammunition belt into the firing chamber and not return it to jam the ammunition belt.

(a) With a pair of pliers, grip the end of lever just below the shaft. Move pliers to deform lever adjacent to the shaft so that the end of the lever is moved slightly nearer arm. Only a very slight adjustment is needed.

(b) Safety wire all screws on charger.

(l) AMMUNITION BOOSTER.
(See figure 422.)

1. DESCRIPTION.—The ammunition booster provisions provided on the upper turret include a sprocket wheel for each gun and a d-c series wound motor. The motor is used to drive both booster units by mounting the motor on one unit and driving the other through a flexible drive shaft. The booster is designed to insure continuous feed of the ammunition belt under condition of maximum drag on the belt. When the gunner depresses the firing trigger, the booster motor operates through a reduction gear and a free wheeling unit, to feed ammunition into the gun. The free wheeling unit makes it possible for ammunition to be drawn through the booster by rotating the sprocket wheel without rotating the motor and gear train. Thus, the firing of the gun is not interrupted by booster motor or drive failure.



1. Elevation Booster
2. Azimuth Booster
3. Flexible Drive Shaft

Figure 422 — Ammunition Booster Installation

2. REMOVAL AND DISASSEMBLY.

a. Remove retaining spring from end of lower feed guide that extends through hole in elevation feed bracket.

b. Withdraw pawl pin on machine gun far enough to free other end of lower feed guide.

c. Remove lower feed guide.

d. Remove two screws which secure upper feed guide to bearing retainer and elevation saddle support.

e. Remove upper feed guide.

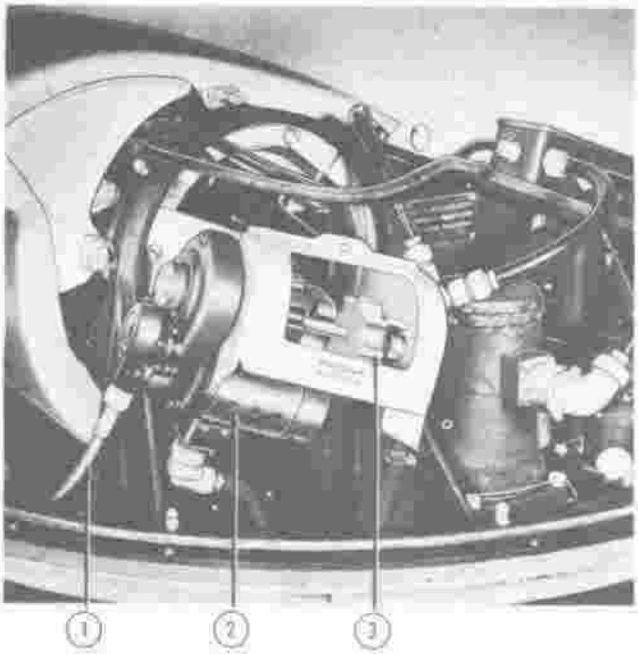
f. Remove flexible cable from elevation ammunition booster by unscrewing knurled nut and withdrawing flexible cable from output drive assembly.

g. Remove two screws which secure elevation ammunition booster to bearing retainer and elevation saddle support.

h. Remove elevation ammunition booster.

i. Loosen knurled nut which secures conduit assembly to AN connector on motor in azimuth ammunition booster and disconnect conduit assembly from motor.

j. Loosen knurled nut which secures conduit assembly to AN connector on interrupter and collector assembly and disconnect conduit from interrupter and collector assembly.



1. Flexible Drive Shaft
2. Booster Motor
3. Sprocket and Shaft

Figure 423 — Ammunition Booster Motor

k. Remove two clamps which secure conduit assembly to azimuth saddle support with two screws and lockwashers.

l. Remove two clamps which secure conduit assembly to ammunition frame assembly with a clip, three screws, three self-locking nuts, and one washer.

m. Remove conduit assembly.

n. Repeat steps a. through h. above, for azimuth ammunition booster.

o. Cut safety wire and remove two screws which hold a lower ammunition guide on each side of saddle.

p. Remove lower ammunition guides.

q. Cut safety wire and remove two screws which hold an upper ammunition guide on each side of saddle.

r. Remove upper ammunition guides.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replace faulty parts. Replace motor brushes when worn to within 1/8" of brush-holder. Run motor, cooled with a fan, for approximately two hours to properly seat new brushes.

4. ASSEMBLY AND INSTALLATION.

a. Replace upper ammunition guides on each side of saddle.

b. Secure each upper ammunition guide to saddle with two 1/4"–20 x 1/2" long fillister head screws.

c. Safety wire screws.

d. Replace lower ammunition guides on each side of saddle.

e. Secure each lower ammunition guide to saddle with two 1/4"–20 x 1/2" long fillister head screws.

f. Safety wire screws.

g. Place elevation booster in position on elevation saddle support.

h. Secure elevation booster to bearing retainer and elevation saddle support with two 1/4" x 20 x 1/2" long fillister head screw.

i. Reconnect flexible cable to elevation ammunition booster by inserting spline in output drive assembly and tightening knurled nut.

j. Repeat g., h., i., above for azimuth ammunition booster.

k. Thread conduit through proper openings in azimuth saddle support and ammunition frame between motor and interrupter and collector assembly.

l. Reconnect conduit to interrupter and collector assembly and tighten knurled nut.

m. Reconnect conduit to AN connector on motor in azimuth booster assembly and tighten knurled nut.

n. Replace two clamps which secure conduit to azimuth saddle support with two #8-32 x 5/16" long fillister head screws and two #8 lock washers.

o. Replace two clamps which secure conduit to ammunition frame assembly with clip, three #8-16 x 1/2" long fillister head screws, three #8-36 self-locking nuts, and one 0.172" I.D. x 0.3750" O.D. x 1/32" thick washer.

p. Replace upper-feed guides on each saddle support so that end of guide rod passes through proper hole in feed bracket of booster assembly.

q. Secure each upper feed guide to bearing retainer and saddle support with two 1/4"–20 x 1/2" long fillister head screws.

r. Insert ends of lower feed guides in proper holes in feed brackets.

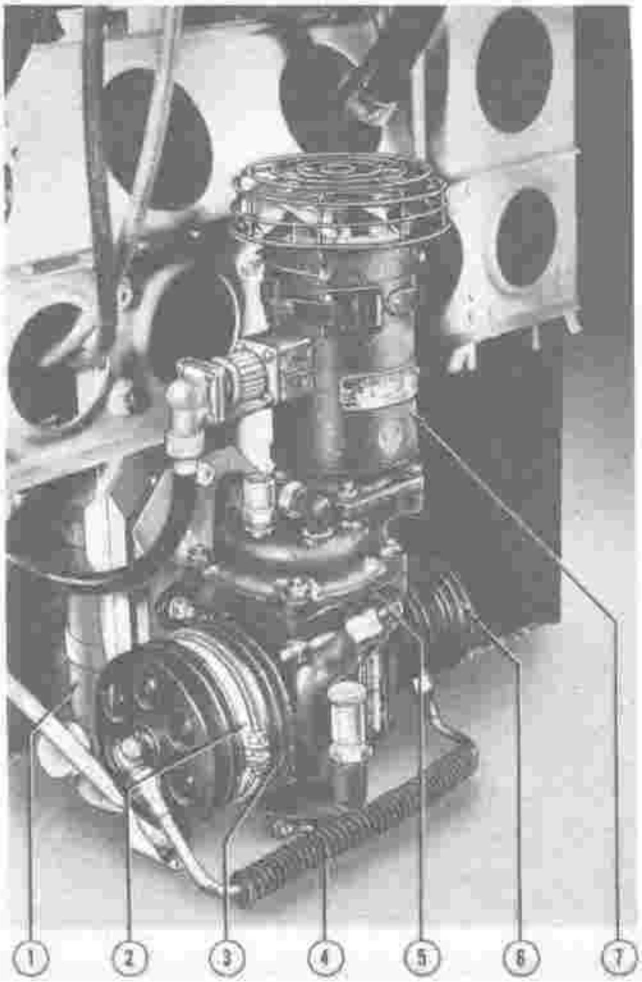
s. Replace retaining springs on ends of lower feed guides which extend through hole in feed bracket.

t. Withdraw pawl pin on machine guns far enough to insert lower feed guides in proper place.

u. Push pawl pins back into position so that they pass through holes in ends of lower feed guides and thus secure lower feed guides to machine guns.

(m) AIR COMPRESSOR SYSTEM. *(See figure 424.)*

1. DESCRIPTION.—The air compressor system, mounted on each turret, supplies compressed air to the two automatic gun chargers and consists of a compressor and motor, valve block, and pressure cylinder. The compressor has a low pressure cylinder and a high pressure cylinder and is driven by an electric motor, located on the top of the unit. Air is admitted and compressed in the low pressure cylinder, cooled in the intercooler line, further compressed in the high pressure cylinder, and sent out of the compressor to the valve block and pressure cylinder. The valve block assembly is a series of valves that control the flow of air from the compressor to the gun chargers. Also on the valve block is a pressure switch which opens to stop the compressor motor when the pressure in the pressure cylinder reaches approximately 1050 psi. When the pressure in the pressure cylinder drops to approximately 950 psi, the switch closes and the compressor motor starts. The air compressor system supplies compressed air at 1000 psi and is capable of completely refilling the pressure cylinder in four minutes at sea level and in 25 minutes at 40,000 feet altitude. The compressor is set for operation when the SHUT-OFF valve handle on the valve block is turned as far as possible in the counterclockwise direction. Do not leave the valve only part way open or closed, as in this position the valve will leak.



1. Pressure Cylinder and Switch Assembly
2. Air Inlet Filter
3. Low Pressure Cylinder
4. Intercooler Line
5. Compressor
6. High Pressure Cylinder
7. Drive Motor

Figure 424 — Turret Air Compressor

2. REMOVAL.

a. Disconnect the electrical connection to the motor.

b. Remove the bolts attaching the compressor and pressure cylinder to its shock mounting bracket and remove the units.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Clean out the compressor systems as follows:

(1) With the airplane's power supply off, pull up on the "BLOW OFF" valve handle and release all of the air.

WARNING

DO NOT BLOW COMPRESSED AIR AT ANY PART OF YOUR BODY.

(2) Remove the anti-freeze plug in the top of the valve block assembly.

(3) Pour in 1 oz. of ethleyne glycol (Prestone) anti-freeze.

(4) Replace the plug.

Note

The reason for the above procedure is to blow out the air, oil, water and anti-freeze which have collected during the last flight. The addition of the new anti-freeze is to prevent the moisture in the air, which will collect in the bottle during the next flight, from freezing. If the water were left in the bottle, it would freeze and the ice would plug up the end of the air inlet to the pressure cylinder, rendering the air compressor equipment useless.

b. To change the oil in the compressor:

(1) Place a can under the bottom oil plug, then cut the safety wire and remove the bottom oil plug.

(2) While the oil is draining out, remove the oil fill plug.

(3) After the oil is all drained out, replace the bottom oil plug.

(4) Add approximately 2 oz. of Univis 48 oil (Standard Oil of New Jersey) through the oil fill hole.

(5) Replace the oil fill plug and safety wire the two oil plugs together.

c. To clean the intake air filter:

Note

Under clean air conditions, this operation can be done every 25 hours.

(1) Remove the nut and bolt from the clamp assembly. With the bolt removed from the clamp assembly, the clamp and outside screen can be spread a little and then slipped off over the low pressure cylinder head. Unwrap the cotton gauze.

(2) Wash the outside screen, and the cotton gauze in kerosene. Let them dry; and evenly oil the outside and the inside screen and the cotton gauze.

(3) Rewrap the cotton gauze around the inside screen. Then slip the clamp and outside screen over the low pressure cylinder head into place. Replace the bolt and self-locking nut, and tighten clamp into position.

4. INSTALLATION.—Reverse procedure as described in paragraph *(b)*, REMOVAL, above.

5. TEST AFTER INSTALLATION.

a. Remove the power supply to the air compressor drive motor.

b. Release all of the air from the pressure cylinder by pulling up on the "BLOW-OFF" valve handle.

c. Remove the air line from the nipple in the "OUT" hole and connect a pressure gage with a range of 0 to 1500 psi.

d. Open the "SHUT-OFF" valve by turning the handle counterclockwise as far as possible.

e. The compressor should run no longer than four minutes at sea level or 25 minutes at 40,000 feet altitude.

f. The pressure in the pressure cylinder should be from 900-1100 psi at the time the compressor stops.

g. If these conditions are not met, replace the compressor assembly.

(u) TELLTALE INSTALLATION.

1. GENERAL.—The telltale installation consists of the telltale indicator TTS-1 on the pilot's instrument panel and the converter unit TTS-1, shock-mounted forward of the pilot's instrument panel. The converter unit converts the a-c signal from the 1-speed selsyns or the turret into a d-c potential needed to operate the indicator which shows an outline of the airplane empennage and a luminous spot indicating the gun position.

2. INDICATOR. *(See figure 425.)*

a. DESCRIPTION.—The indicator is a cathode ray oscilloscope, RCA #3 API/906-PI, housed in a triple magnetic shield. On the face of the instrument is a square decalcomania including a representation of the airplane empennage. Two horizontal lines represent the limit of fire of the turret guns. The upper line represents the upper limit of fire of the lower turret; the lower line represents the lower limit of fire of the upper turret. The shaded portion of the outline of the empennage indicates that area into which no turret guns can fire; the clear space within the outline indicates that area into which one gun can fire. A luminous spot appears on the indicator face to indicate the direction of fire of the turret guns. This spot moves around on the indicator face to show the corresponding movement of the turrets. When the guns are pointed in the aft hemisphere of rota-

Figure 425 — Tell-Tale Indicator

tion, the spot is round; when the guns are rotated to the forward hemisphere, a horn appears on the spot. The edge of the indicator face represents the maximum side fire or 90° rotation from the direct forward or aft position.

b. REMOVAL.

(1) Remove the left-hand cover plate forward of the windshield by removing the attaching screws.

(2) Detach the electrical connection at the end of the instrument tube housing.

(3) At the same time that the instrument housing forward of the instrument panel is being supported, the screws attaching the indicator to the instrument panel can be removed.

(4) Remove the attaching clamp and remove the indicator unit.

c. MAINTENANCE REPAIR OR REPLACEMENT.–If the cathode ray tube is damaged or burned out, remove the indicator from the panel and disassemble the mounting flange from the shield. The end of the tube is then accessible for a finger grip and may be pulled directly from its socket. Replace tube in the socket and reassemble mounting. If the tube should not have a marked decalcomania, one will have to be applied to the end. Any other damage will necessitate replacement of the indicator unit.

d. ADJUSTMENTS.–The indicator is adjusted through the converter controls. Refer to paragraph *(o)*, below.

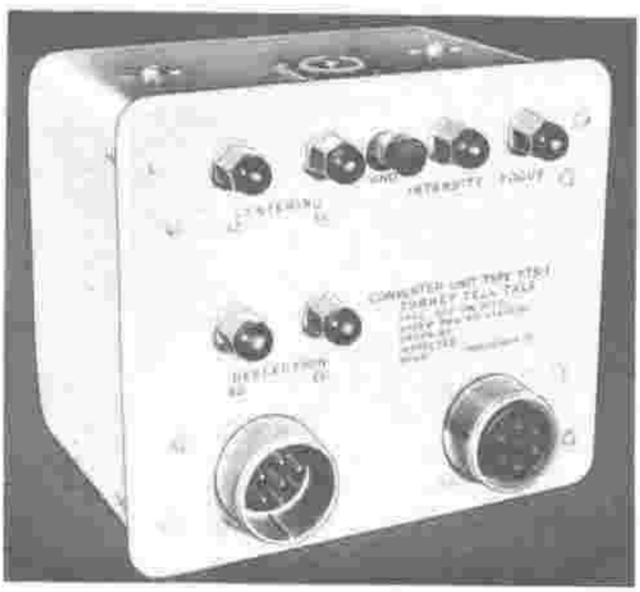


Figure 426 — Tell-Tale Converter (Front View)

e. INSTALLATION. – Reverse procedure as described in paragraph 2., REMOVAL, above.

(o) CONVERTER. *(See figure 426.)*

1. DESCRIPTION.–The converter is an electronic device which converts the a-c selsyn signal from the turret into a d-c potential which is applied to the deflection plates of the cathode ray tube in the indicator. The converter is connected to the turret 1-speed selsyns and to the indicator. Controls for adjusting intensity focus, centering and deflection in both azimuth and elevation are located on the face of the cover box. The adjustment knobs are provided with caps. On the side of the converter, inside the box, is a wiring diagram of the component parts. Each converter contains the following tubes: three 6H6 and one 2X2-879.

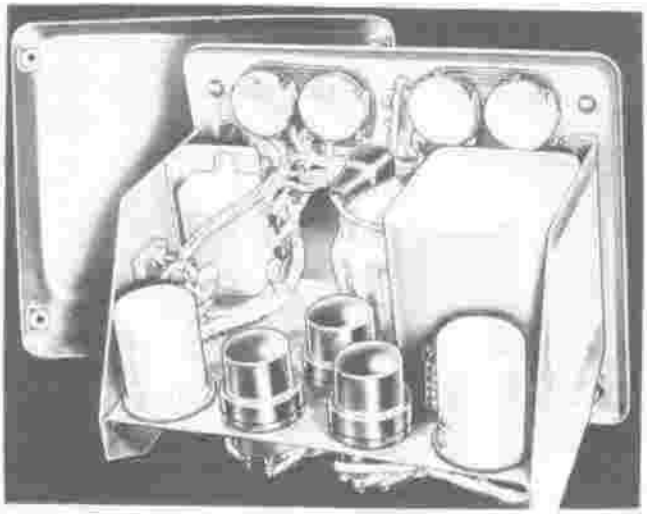


Figure 427 — Tell-Tale Converter (Rear View)

2. REMOVAL.

a. Remove the left-hand cover plate forward of the windshield by removing the attaching screws.

b. Detach the electrical connection.

c. Remove the front cover screws and pull forward, out of the converter box.

3. MAINTENANCE REPAIR OR REPLACEMENT.–The converter unit is to be regarded as a piece of radio equipment and is to be serviced by trained personnel only. The tubes inside the cover may be replaced; replace with tubes of the same number only. Any other damage will necessitate replacement of the entire unit.

4. ADJUSTMENTS.

a. Turn on the turret dynamotor and latch the sighting station in the aft position.

b. Adjust intensity control so that the spot appearing on the indicator is of satisfactory but not excessive brilliance.

CAUTION

If the intensity is adjusted too high, it might eventually burn a dead spot on the fluorescent screen of the cathode ray tube.

c. Adjust focus control so that the spot on indicator face is round and distinct.

d. Adjust azimuth centering control so that the spot is centered in azimuth.

e. Adjust elevation centering control so that the spot is centered in elevation (on lower horizontal line).

f. Swing guns in azimuth 90° from the aft position on each side and adjust the azimuth deflection control so that the spot on the indicator touches the edge of each side of the decalcomania.

g. Swing guns in elevation from 90° up to 90° down and adjust the elevation deflection control so that the spot on the indicator touches the top and bottom edges of the decalcomania.

Note

It may be necessary to recenter the spot in order to make the spot touch both edges of the decalcomania for full 180° swing while setting deflection. When the spot moves from edge to edge of the decalcomania in both azimuth and elevation with corresponding 180° movement of the guns, the spot should center when the guns are in the latched aft position. However, if the spot will not center due to the orientation of the turret selsyns, it is advisable to center the spot again as described in steps d. and e. above.

h. Swing turret into the forward hemisphere and check the indicator face for a horn appearing on the spot.

Note

If the spot on the indicator face moves in the opposite direction that the guns are moved, reversal of the pin connections "C" and "D" of the electrical connection from the converter to the turret will correct an azimuth reversal. Reversal of pin connections "E" and "F" will correct an elevation reversal.

5. INSTALLATION.—Reverse procedure as described in paragraph 2., REMOVAL, above.

Figure 428 — Turret Control Box

(p) TURRET CONTROL BOX. *(See figure 428.)*

1. DESCRIPTION.—The turret control box is mounted on the left wall of the gunner's compartment, looking forward. On the face of the control box are the following switches: A-C power, upper turret power, lower turret power, G. S. A. P. camera, upper turret guns fire, lower turret guns fire, and the upper turret transfer switch. The A-C power switch turns on the dynamotor which energizes the sighting station selsyn transmitter rotors and the servo-amplifier. The upper or lower turret power switches turn on the motor of the amplidyne motor-generator, allow the airplane generator to energize the fields of the turret drive motors, and direct power to the camera and gun fire switches. The upper and lower turret guns fire switches start the compressor motor. Three circuit breakers, included in the turret wiring, are mounted on the face of the switch box: A-C (dynamotor), UPPER (turret), and LOWER (turret).

2. REMOVAL.

a. Disconnect the electrical plugs.

b. Remove the screws attaching the switch box to the wall and remove the box.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

4. INSTALLATION.—Reverse procedure as described in paragraph 2., REMOVAL, above.

(q) TURRET CONTROL BOX.—The turret control box is mounted on the floor near the right wall of the aft fuselage, aft of the lower turret, and includes the relays and anti-hunt capacitors of the turret system.

(r) SPARE PARTS KIT.—A spare parts kit containing a spare desiccator, spare reticle lamps, and a reticle lamp wrench is located alongside the lower turret servo-amplifier on the right wall of the aft fuselage.

(s) GUN SIGHT AIMING POINT CAMERA AND OVER-RUN CONTROL.

1. DESCRIPTION.

a. G. S. A. P. CAMERA. — A mounting bracket is provided on the Edgewater adapter on one gun of each turret for the mounting of a Type N-4 G. S. A. P. gun camera. The camera is designed for taking motion pictures, using 16 mm film prethreaded into metal magazines. It operates each time the gun firing trigger is operated, serving to record hits on actual targets or to check smoothness in tracking targets during training operations. The camera is driven by a 24-volt constant speed electric motor mounted within the camera body. A manually set dial allows pre-selection of any one of three operating speeds of 16, 32, or 64 frames per second. A manually set footage dial indicates the amount of film remaining unexposed.

b. OVER-RUN CONTROL.—The over-run control is designed to keep the camera running from zero to three seconds after firing ceases, depending upon the manual setting of the time-control knob. If the over-run control is not to be used, it may be cut out by throwing the control cut-out switch to the "OFF" position. When the over-run control is used, the film exposed during the over-run may be identified from that exposed during firing, by the image of a retractile pointer which automatically moves into the aperature area from the upper left-hand corner when firing ceases and the over-run begins.

2. OPERATION AND SERVICE.—For operation and service instructions, refer to T.O. No. 10-10CA-1.

t. LUBRICATION. — Lubrication for turrets and sighting station should be made at each fifty-hour check.

1. UPPER AND LOWER TURRETS.

a. Elevation gear sectors *(figure 429)*. Apply a thin coat of lubricant, AAF Specification number AN-G-3. Do NOT lubricate in dusty climates.

b. Ring and input gears *(figure 398)*. Apply a thin coat of lubricant, AAF Specification number AN-G-3. Do NOT lubricate in dusty climates.

c. Slider gun mount *(figure 418)*. Apply a drop of oil, AAF Specification number 3582.

d. Jack for lower ejection doors. Apply a drop of oil, AAF Specification number 3582.

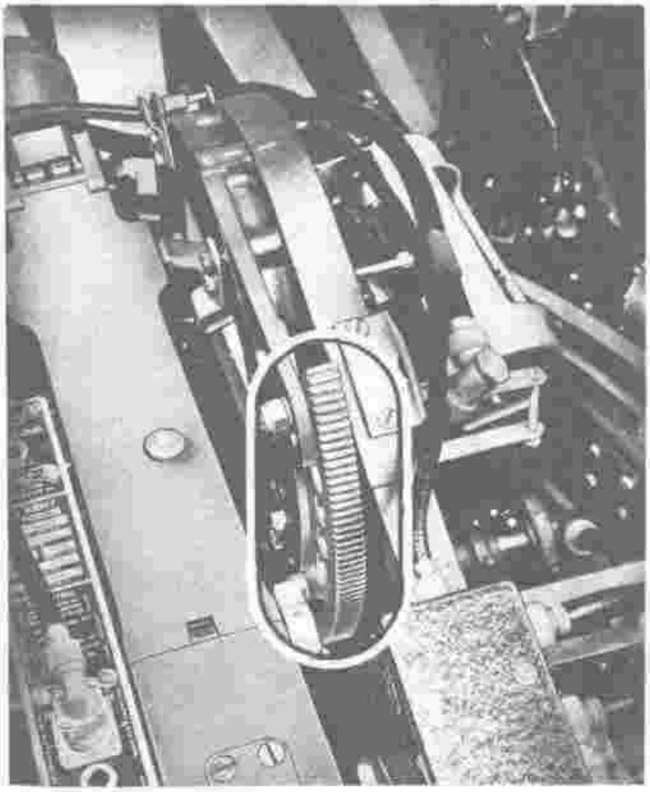


Figure 429 — Elevation Gear Sector

e. Compressor *(figure 424)*. Check oil level after each flight and add oil, if necessary, to raise the oil level to the threads in the standpipe. The oil used should be G. E. Spec. B50F50 (Number 11869 Standard Oil of Indiana). If oil of the specification is not available, any of the following may be substituted:

(1) Oil, Lubricating, Preservative Special Ordnance Dept., Spec. AXS-777. This is superior to all oils tested except B50F50.

(2) Oil, Lubricating, Aircraft Instrument, Gyro, AAF-3600. This oil is not as good at low temperatures as the first two oils.

(3) Oil, Hydraulic, Petroleum Base, Spec. AN-VV-O-366b. This can be used only in case of an emergency.

2. SIGHTING STATION. — Lubricate the stowing pins with a few drops of oil A.A.F. Specification number AN-G-3.

(17) GUNS ELECTRICAL.

(a) GENERAL.—Electrical circuits enable the pilot to fire all fixed guns installed on the airplane, and the upper turret guns when they are in the forward, latched position and the gunner has surrendered control. Heating of all fixed guns excepting the 75 mm cannon, is also controlled from the pilot's posi-

tion. The electrical circuits provide for the firing of fixed guns in any one of the following combinations:

Six caliber .50 machine guns in the nose.

One 37 mm cannon and either two or four caliber .50 machine guns in the nose.

Two 37 mm cannon in the nose.

One 75 mm cannon and two caliber .50 machine guns in the nose.

One 75 mm cannon and one 37 mm cannon.

Either four or eight caliber .50 wing machine guns.

Any nose combination plus all wing guns installed.

The upper turret guns and any other guns which may be selected.

(b) GUN CONTROLS.

1. DESCRIPTION.—The gun electrical controls consist of the master gun safety switch, the gun selector switches and the gun heater switch on the fire control panel, a cannon trigger and a machine gun trigger on the pilot's control wheel, and a turret transfer switch located in the gunner's aft relay box. This switch may be used to transfer control of the upper turret guns to the pilot when the guns are in the latched forward, horizontal position. Completion of the transfer is indicated by a red lamp located on the pilot's main electrical control panel. In addition to the controls, the guns electrical system includes relays, solenoids, heaters for all guns excepting the 75 mm cannon, bus bars, and circuit breakers for each circuit. For diagrams of each circuit, refer to *figures 476, 447, 448,* at the end of this section. Two fixed machine guns are provided in the nose of the A-26C airplane. These guns are fired electrically but no heaters are provided.

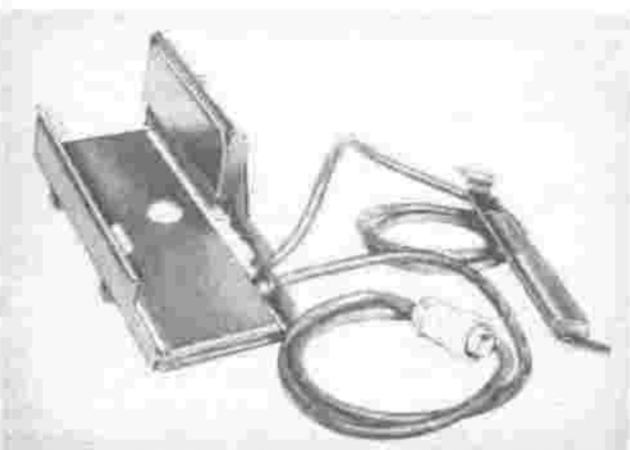


Figure 430 — Wing Gun Heater

2. REMOVAL.

a. SWITCHES AND RELAYS.—Remove the attaching screws and electrical wiring.

b. GUN HEATERS.

(1) Release the latching levers which hold the large resistance unit to the gun breach.

(2) Remove the screws which hold the small resistance unit to the oil buffer.

(3) Disconnect the electrical plug and remove the heater assembly.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary for all damaged or defective units.

(18) CAMERA ELECTRICAL.

(a) GENERAL.—The electrical installation for the camera equipment consists of the control switches and relays for the operation of the orientation camera, the G.S.A.P. camera in the nose, and the G.S.A.P. cameras in the turrets. For the wiring diagrams of these systems, refer to *figures 465, 479, 480.*

(b) ORIENTATION CAMERA.

1. DESCRIPTION.—The electrical provisions for the control of the orientation camera in the aft fuselage section consist of an "ON-OFF" toggle switch on the pilot's auxiliary electrical control panel, the bombing push button on the left end of the pilot's control wheel, and the electrical plugs for connection to the camera intervalometer, camera, and motor. When the orientation camera switch is "ON," the bomb selector switch is in the "FUS." position, and the bombing push button switch is closed, the orientation camera will operate alone through the bombing intervalometer and the camera intervalometer. If the bomb doors are open, the fuselage bombs selector switch is in the "DEMOL." position, and the arming is selected for the bombs. At the same time that the above mentioned switches are closed, the orientation camera will operate in conjunction with bomb release. The orientation camera switch is wired to power through a 20 ampere circuit protector in the forward junction box; the pilot's bomb push button switch is wired to power through a five ampere circuit breaker switch on the pilot's distribution panel. Provisions are made for installation of an orientation camera and a G.S.A.P. camera in the nose of the A-26C airplane. *(See figure 485.)*

2. REMOVAL AND MAINTENANCE.—Switches may be removed by removing attaching screws and electrical wiring. Refer to paragraph 18., PHOTOGRAPHIC EQUIPMENT, this section, for the removal and maintenance of the orientation camera equipment.

(c) G.S.A.P. CAMERA (NOSE).

1. DESCRIPTION.—The electrical provisions for the control of the G.S.A.P. camera, mounted in the fuselage nose, consist of the master gun safety and camera switch on the fire control panel, the wing gun tripper switch and the cannon trigger switch on the pilot's control wheel, and the gun camera relay in the forward junction box. When the safety switch is in the "CAMERA" position and either the wing gun or cannon trigger switch is closed, the camera will operate alone through the gun camera relay and the camera overrun control. When the safety switch is in the "CAMERA AND GUN" position and one or more of the guns have been selected, the camera will operate with the guns when they are fired.

Note

The guns cannot be fired unless the master gun safety and camera switch is in the "CAMERA AND GUNS" position.

The camera overrun control, the cannon trigger switch, and the wing gun trigger switch are wired to power through 10 ampere circuit breaker switches on the pilot's distribution panel.

2. REMOVAL AND MAINTENANCE.—Switches and relays may be removed by removing attaching screws and electrical wiring. Refer to paragraph 15. *b.* (2) *(c) 3.*, this section, for maintenance of relays. Refer to paragraph 17. *f.* (2) *(e)* 5. b., this section, for the removal and maintenance of the camera equipment.

(d) G.S.A.P. CAMERAS (TURRETS).—Provisions are made for the installation of a G.S.A.P. camera on each turret to operate in conjunction with the firing of the turret guns.

(19) MISCELLANEOUS ELECTRICAL.

(a) ALARM BELL. *(See figure 335.)*

1. DESCRIPTION.—One alarm bell is installed on the aft side of the fuselage aft relay box. The bell is controlled by the guarded type B-5A alarm bell switch on the pilot's main electrical control panel. The alarm bell circuit is connected to the left-hand engine battery disconnect relay through a 20 ampere circuit protector in the left nacelle firewall junction box and has a major disconnect plug at the forward wing electrical disconnect location. An alarm bell also is provided for the bombardier on the A-26C airplane.

2. REMOVAL.

a. BELL.—Remove the screws, disconnect the electrical wire, and remove the bell from the relay box.

b. SWITCH.—Same as described in paragraph 15. *d.* (17) *(b)* 2., this section.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening loose connections.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.*, REMOVAL, above.

(b) SUIT HEAT CONTROL.

1. DESCRIPTION.—One type Q-1A suit heat rheostat provided with two plug receptacles is installed for each crew member. The pilot's suit heat rheostat is located to the left of his seat, the gun-loader's to the left of his seat on the control pedestal, and the gunner's on the sighting station unit. Both plug receptacles of the pilot's and gun-loader's rheostats are connected to power through 20 ampere circuit breaker switches on the pilot's distribution panel; the gunner's rheostat is connected to power through the sighting station unit. In all three rheostats, only the receptacle for the suit heat plug is wired through the rheostat. On the A-26C airplane an additional suit heat rheostat is provided for the bombardier. *(See figure 485.)*

2. REMOVAL.

a. Disconnect the electrical wires.

b. Remove attaching screws and remove rheostat.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

4. INSTALLATION.—Reverse procedure as described in *2.*, REMOVAL, above.

(20) ELECTRICAL SYSTEM TROUBLE SHOOTING LIST—GENERAL.—Malfunctioning of an electrical device is usually the result of two general possibilities—the device itself (burned out, damaged mechanically, etc.) or that part of the circuit leading to or from the device. Continuity testing refers to checking for the existence of a complete electrical system between two points. The three main types of continuity testers are:

1. The portable dry cell tester, having a buzzer or a 3 volt lamp to indicate the completed circuit, is used to test circuits with the main circuit power off.

2. An ordinary lamp bulb (12 volt or 24 volt, according to airplane electrical system), with one lead from the center lamp contact and one ground lead attached to the lamp housing, can be used to test circuits with the main circuit power on.

3. A precision voltmeter is used to test circuits with the main circuit power on, by putting positive lead on circuit point and negative lead on any convenient ground.

The circuit should be tested at each terminal of the circuit. Between the last point at which voltage is indicated (or lamp goes on) and the first point at which zero voltage is indicated (lamp does not go on) there is an open circuit or a voltage drop caused by unit operation or short to ground. If the same voltage reading is obtained on the negative terminal of a unit as was obtained on the positive terminal, an open ground is indicated. If a small voltage reading is obtained on the negative terminal of the unit, a high resistance is indicated between the unit and ground,

e. ELECTRICAL TROUBLE SHOOTING LIST.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	GENERATOR	
1. Generator ammeter indicates no current; voltmeter indicates no voltage.	*a.* Defective ammeter connections, or defective ammeter; plus defective voltmeter connections, or defective voltmeter selector switch or defective voltmeter.	*a.* Check ammeter and voltmeter connections, and if necessary install new ammeter, new voltmeter selector switch, or new voltmeter as required.
	b. Generator polarity reversed: reverse-current relay will not close, voltmeter reversed with its pointer against stop at zero end of scale.	*b.* With engine running, with generator control switch "OFF," check polarity with a voltmeter connected between terminal B on voltage regulator base and metallic frame of airplane. If, to obtain positive reading on voltmeter, it is necessary to connect its negative terminal to terminal B on regulator base, polarity is reversed. Stop engine. Remove regulator from base, and flash generator field. **CAUTION** If the field is flashed without removing regulator from base, battery will be short-circuited by way of brushes, commutator, and regulator, and these may be damaged. Use portable battery with negative terminal connected to metallic frame of the airplane; or locate a point of positive battery voltage in a convenient terminal box, using voltmeter with negative terminal connected to frame of the airplane, and with its positive terminal connected to a test lead. Fasten a lead to positive terminal of portable battery, or to point of positive battery voltage, and touch other end of this lead briefly to terminal A on voltage regulator base. Replace voltage regulator on base. Start engine and bring to cruising speed. Put generator control switch "ON." The reverse-current relay should close, ammeter should indicate a current depending on battery charging current and on additional load on system, and the voltmeter should indicate normal voltage.
	c. Broken inner shaft; armature will not rotate properly, generator will not build up, reverse-current relay will not close.	*c.* With engine at standstill, disconnect ventilation tube. Loosen clamping screws, and remove air-blast cover. Pull the engine through by hand and check for failure of armature to turn smoothly. If inner shaft is broken, remove generator from engine and install a serviceable generator.

e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
2. Generator ammeter indicates no current; voltmeter indicates no voltage or low voltage.	*a.* Generator will not build up, and reverse-current relay will not close, due to open circuits or loose connections (especially in shunt field circuits), to a defective voltage regulator, or to generator defects (grease, oil, or dirt on brushes or commutator; insufficient spring pressure; loose connections in terminal box, at brush terminal screws, or elsewhere in generator; grounded, short-circuited, or open-circuited shunt field; grounded, short-circuited, or open-circuited armature).	*a.* With engine at standstill, and with generator control switch "OFF," check all power and control circuits, especially joints and connections. Double-check shunt field circuits. If open circuits or loose connections are found, make necessary repairs. Start engine, and bring to cruising speed. Put generator control switch "ON." Reverse-current relay should close, ammeter should indicate a current depending on battery charging current and on additional load on system, and voltmeter should indicate normal voltage. If external circuits are in good condition, or if trouble persists after fixing defective circuits, the regulator may be at fault or the generator may be defective. Stop engine. Put generator control switch "OFF." Remove regulator from base. Install a temporary connection between terminals A and B on regulator base. Connect a portable voltmeter, with its positive terminal connected to terminals A-B on regulator base, and with negative terminal connected to frame of the airplane. Start engine, and slowly increase its speed. If voltage builds up to approximately normal at less than cruising speed, regulator may be assumed defective. Stop engine. Remove temporary connection from regulator base. Install a new regulator. Start engine and bring to cruising speed. Check voltage with portable voltmeter, connecting positive terminal to terminal B on voltage regulator base, and its negative terminal to the metallic frame of the airplane. Adjust voltage regulator to hold 28.5 volts. Put generator control switch in the closed "ON" position. The reverse-current relay should close, the ammeter should indicate a current depending on battery charging current and on the additional load on the system, and the generator voltmeter should indicate normal voltage. If external circuits are in good condition, if voltage regulator is not defective, or if trouble persists after fixing defective circuits and after installing a serviceable regulator, the generator itself is probably defective. Remove generator from engine and install a serviceable generator.
3. Generator ammeter indicates no current; voltmeter indicates normal voltage.	*a.* Defective ammeter connections, or defective ammeter.	*a.* Check ammeter connections, and if necessary install new ammeter.
	b. Defective circuit breaker.	*b.* Install new circuit breaker.
	c. Reverse-current relay will not close due to defective conections, to defective generator control switch, or to defects in relay itself.	*c.* With its engine at standstill, and with generator control switch "OFF," check the connection from reverse-current relay to frame of the airplane, generator control switch circuits and generator control switch. If defects are discovered, make necessary repairs. Start engine and bring to cruising speed. Put generator control switch "ON." The reverse current relay should close, ammeter should indicate a current depending on battery charging current and on additional load on system, and voltmeter should indicate normal voltage. If there is nothing wrong with external circuits or generator control switch, or if trouble persists after correcting defects in these elements, the reverse-current relay is probably at fault. With engine running at cruising speed, put generator control switch in the "OFF" position. Check voltage, using a portable voltmeter with its

e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

TROUBLE	PROBABLE CAUSE	REMEDY
		positive terminal connected to terminal B on voltage regulator base, and with its negative terminal connected to the metallic frame of the airplane. Make certain all other generators are disconnected from the system, generator control switches "OFF," and that all batteries and other loads are disconnected from the system. Mark the existing voltage regulator adjustment. Readjust regulator to hold 26.5 volts. Adjust reverse-current relay so that it will just barely pick up at this voltage with generator control switch in the "ON" position. If the relay cannot be adjusted to pick up at the prescribed voltage, it is probably defective. Stop engine. Put generator control switch in the "OFF" position. Remove the defective relay, install a serviceable relay, and adjust it as described. With engine running at cruising speed, and with generator control switch in "OFF" position, reset voltage regulator, or readjust it to hold 28.5 volts. Reconnect batteries and a little additional load. Put generator control switch in the "ON" position. The reverse-current relay should close, the ammeter should indicate a current depending on battery charging current and on the additional load on the system, and the voltmeter should indicate normal voltage.
4. Generator ammeter indicates current; voltmeter indicates no voltage.	*a.* Defective voltmeter connections, defective voltmeter selector switch (if used), or a defective voltmeter.	*a.* Check voltmeter connections, and if necessary install new selector switch, new voltmeter, or both.
5. Generator ammeters indicate rapidly fluctuating current; voltmeter indicates normal or fluctuating voltage.	*a.* Reverse-current relay closes, reopens, recloses, reopens, etc. due to an improperly adjusted or defective relay, to an improperly adjusted voltage regulator or regulators, or to instability resulting from a rising generator voltage characteristic caused by incorrect brush setting.	*a.* With engine running at cruising speed, and with generator control switch "OFF," check voltage of one of generators using a portable voltmeter with positive terminal connected to terminal cap B on voltage regulator base, and negative terminal connected to frame of the airplane. Make certain all other generators are disconnected from system, generator control switches "OFF," and that all batteries and other loads are disconnected from system. Mark the existing voltage regulator adjustment. Readjust regulator to hold 26.5 volts. Adjust reverse-current relay so it will just barely pick up at this voltage with generator control switch "ON." Put generator control switch "OFF." Readjust voltage regulator to hold 28.5 volts. If relay cannot be adjusted, or if regulator cannot be adjusted to hold voltage steady at the prescribed value, stop engine, remove suspected device, install a serviceable replacement, and readjust as described. Repeat foregoing on each unit. With engines running at cruising speed, connect batteries and a little additional load. Put generator control switches "ON." Reverse-current relays should close and remain closed, ammeters should indicate currents depending on battery charging current and on additional load on system, and generator voltmeter should indicate normal voltage. If relays and regulators are properly adjusted and not defective, or if a reverse-current relay refuses to close and remain closed after installation and adjustment of serviceable relays and regulators, trouble may be due to incorrect brush setting. Check affected generator individually. With engine running at cruising speed, and with batteries and a little additional load connected to system (other generators disconnected), put generator control switch in "ON" position. If reverse-current relay closes, reopens, recloses, reopens, etc., remove generator from engine and install a serviceable generator.

e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
6. Generator ammeters indicate abnormally different currents; voltmeter indicates low voltage or normal voltage.	a. Improper load division due to defective circuits (especially, loose connections in shunt field or equalizer circuits, or loose or poorly made connections between generator negative terminals and the metallic frame of the airplane), improperly adjusted or defective voltage regulators, or a defective generator or generators. An abnormally low ammeter reading may indicate its generator is unable to carry load due to overheating caused by a dirty or defective ventilation tube, or dirty internal air passages; loose connections external to generator, at connector receptacle, in terminal box, at brush terminal screws, at brushes on the commutator, or elsewhere in generator; grounds or short circuits in armature, shunt field, compensating or commutating fields. An abnormally high ammeter reading may indicate its generator has a defective equalizer connection external to generator at connector receptacle, or in terminal box.	a. With engines at standstill, and with generator control switches "OFF," check all power and control circuits and especially the joints and connections. Double-check shunt field and equalizer circuits, from regulator to reverse-current relay, generator, and equalizer bus. Double-check circuits from generator negative terminals to frame of airplane, especially joints, which should be clean, tight, and of lowest possible resistance. If defective connections are found, make necessary repairs. Start engines, bring them to cruising speed. Connect batteries and as much additional load as possible. Put generator control switches "ON." The reverse-current relays should close, the ammeters should indicate currents within a 20-ampere spread, and voltmeter should indicate normal voltages. If external circuits are in good condition, or if trouble persists after fixing defective circuits, a regulator may be at fault, or a generator may be defective. With engine running at cruising speed, put its generator control switch "OFF," and check voltage of one of generators. Use a portable voltmeter with positive terminal connected to terminal B on regulator base, and with negative terminal connected to frame of airplane. Adjust voltage regulator to hold 28.5 volts. Repeat foregoing on each unit. Stop engines. Remove regulators which cannot be adjusted or which will not hold voltage steady at prescribed value. Install serviceable regulators, and adjust them as described. With all engines running at cruising speed, connect the batteries and as much additional load as possible to the system, and put all generator control switches in the "ON" position. The reverse-current relays should close. The ammeters should indicate currents within a 20-ampere spread, and the voltmeter should indicate normal voltages. When practicable, check load division in flight at maximum load and various speeds. If necessary increase voltage adjustment of regulators whose generators deliver low current and decrease voltage adjustment of regulator whose generators deliver high current. Adjust one notch at a time, meanwhile making certain that system voltage remains at the prescribed value. If external circuits are in good condition, if voltage regulators are properly adjusted and not defective, or if trouble persists after fixing defective circuits and after installing serviceable regulators, a generator or generators may be faulty. If a generator ammeter indicates abnormally low current, stop engine, put generator control switch in the "OFF" position, disconnect ventilation tube and check for dirt or defects which might cause overheating. If this does not disclose the cause of the trouble, remove generator from engine and install a serviceable generator. If a generator ammeter indicates abnormally high current, the trouble is probably in its equalizer circuit at connector receptacle, or in terminal box. Remove generator from engine and install a serviceable generator.

e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

BATTERY SYSTEM

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Battery will not hold its charge.	*a.* Battery is worn out.	*a.* Remove and send to service depot for capacity test.
	b. Charging rate not set right.	*b.* Check and correct the setting of the voltage regulator as described in paragraph 15. *b.* (2) *(c)* *4.*, this section.
	c. Discharge too great to replace.	*c.* Use of starter, etc., on the ground and other electrical equipment in air must be reduced. (Use external power source whenever possible for starting.)
	d. Standing too long (hot climate).	*d.* Battery will require removal and recharge if left in an unused airplane for one week or more, depending upon the temperature. For example, a fully charged battery will lose approximately 1/2 its charge in the following number of days for the temperatures given: 60°F. .... 90 days 80°F. .... 45 " 100°F. .... 14 " 120°F. .... 6 "
	e. Equipment left on accidentally.	*e.* Remove and recharge battery.
	f. Short circuit, or ground, in wiring.	*f.* Check wiring and correct trouble.
	g. Broken cell partition.	*g.* This is usually indicated by two or more adjacent cells running down continually, particularly if left standing a few days. Replace battery.
2. Battery life is short.	*a.* Overcharge.	*a.* This causes buckling of plates, shedding of active plate material, oxidation of grids, overheating, excessive loss of water and excessive gassing. Check and correct adjustment of voltage regulator as described in paragraph 15. *b.* (2) *(c)* *4.*, this section.
	b. Level of electrolyte below top of plates.	*b.* Keep electrolyte level 3/8 inch above the protector plate.
	c. Frequent discharges.	*c.* This is due to excessive use of starter and then recharging in the air which uses the battery excessively. Use external power sources where-ever possible to conserve the battery.
	d. Sulphated plates.	*d.* This occurs when the battery is left in a discharged or undercharged (1/2 or less) condition for a period of time, or electrolyte is not maintained at its proper level. Return to service depot for tests and overhaul.
	e. Improper storage.	*e.* Dry batteries stored in a damp location, or wet batteries stored for too long a period without charging, allow the plates to sulphate. Return to service depot for overhaul.
3. Cracked cell jars.	*a.* Hold-down loose.	*a.* Replace the battery and tighten hold-down clamps.
	b. Frozen battery.	*b.* This is caused by one of the following: (1) Adding water in cold weather without charging the battery sufficiently afterward to thoroughly mix the water with the electrolyte before allowing it to stand. (2) Allowing the battery to become discharged which permits it to freeze on account of its low specific gravity under these conditions. (3) Low specific gravity of the electrolyte caused by improper filling. Replace battery with fully charged one.

e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
4. Compound on top of battery melts.	*a.* Charging rate too high.	*a.* Check and correct setting of voltage regulator as described in paragraph 15. *b.* (2) *(c)* *4.*, this section.
	b. Electrolyte on top of cells.	*b.* Electrolyte on top of the cells caused by overfilling or improper operation of the ventilating system may short circuit the battery. The resulting heat will then soften the battery compound. To correct this condition, be sure the ventilating lines are clear, remove any electrolyte from the top of the battery and neutralize with Sodium Bicarbonate. Then wash the top of the battery thoroughly, charge and reinstall in the plane.
5. Electrolyte runs out of vent caps.	*a.* Too much water added to battery.	*a.* Remove excess with self-leveling syringe.
	b. Excessive charging rate.	*b.* Check regulating equipment involved.
6. Excessive corrosion inside container.	*a.* Overcharging.	*a.* Check and correct setting of voltage regulator as described in paragraph 15. *b.* (2) *(c)* *4.*, this section.
	b. Spillage.	*b.* Spillage is usually caused by overfilling, although in rare cases may be caused by cracked or melted sealing compound. Remove excessive electrolyte. Reseal if necessary.
	c. High charging rate.	*c.* Correct setting of regulating equipment involved.
	d. Vent lines leaking or clogged.	*d.* Clean out vent lines and replace any leaky hose.
	e. Improper venting.	*e.* Output hose not connected at lowest vent of battery. Relocate hose to drain from lowest vent in taxiing position.
7. Battery freezes.	*a.* Discharged battery. (See table below.)	*a.* Replace with fully charged battery.
	b. Water added and battery not charged immediately.	*b.* This is an important point. WATER SHOULD NEVER BE ADDED IN FREEZING WEATHER WHEN BATTERIES ARE TO BE LEFT STANDING BEFORE CHARGING. About a half hour charge will mix the water with the electrolyte. The freezing point will then be in accordance with the table given below.
	c. Leaking jar.	*c.* Water added and froze. Replace battery.
	d. Extreme cold. (See table below.)	*d.* In these cases it is almost always necessary to replace the battery, although in case of a partial freezing, thawing in a warm room may save it. It should be thoroughly checked before being used in an airplane.

Freezing Point

Specific Gravity	*Freezing Point*
1.300	−95° F.
1.275	−80° F.
1.250	−62° F.
1.225	−35° F.
1.200	−16° F.
1.175	− 4° F.
1.150	+ 5° F.
1.125	+13° F.
1.100	+19° F.

e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
8. Battery polarity reversed.	*a.* Battery connections reversed at charger. *b.* Battery connections reversed at airplane.	*a.* Such a battery should be slowly discharged completely and then charged correctly. *b.* Such a battery should be slowly discharged completely and then charged correctly.
9. Battery consumes excessive water.	*a.* Charging rate too high. *b.* Electrolyte runs out of vent caps.	*a.* Check and correct setting of voltage regulator as described in paragraph 15. *b.* (2) *(c)* *4.*, this section. *b.* Level of electrolyte too high. Adjust level to ⅜ inch above protector plate.
10. Battery will not come up on charge.	*a.* Battery worn out. *b.* Battery badly sulphated.	*a.* Replace with fully charged battery, send worn-out battery to service depot for testing. *b.* Caused by standing idle in discharged condition. Return to service depot for tests and overhaul.

FUEL BOOSTER PUMP

1. Seal leak.	*a.* Seal cushion sticking to shaft. Dirt between cushion and shaft or on sealing faces of fuel seals. *b.* Cracked fuel seals, damaged or loose cushion. *c.* Stationary fuel seal not seated firmly on seal gasket. *d.* Seal parts improperly assembled.	*a.* Clean parts. If necessary, replace cushion. *b.* Replace parts. *c.* Install new gasket. Seat it correctly before tightening down seal nut. *d.* Check with *figure 342.*
2. Discharge pressure too low.	*a.* Brushes not properly seated. *b.* Worn brushes. *c.* Brushes binding in brush holders.	*a.* Run pump under load for two hours. *b.* Replace brushes and seat correctly. *c.* Remove and clean with gasoline-moistened cloth.
3. Excessive current demand.	*a.* Brushes not properly seated.	*a.* Run pump under load for two hours.
4. Discharge pressure surges.	*a.* Screen clogged.	*a.* Clean out screen.
5. Pump failure.	*a.* Loose connections. *b.* Brushes binding in brush holders.	*a.* Check electrical and fuel connections. *b.* Remove and wipe clean with gasoline-moistened cloth.
6. Not enough pressure in HIGH BOOST position.	*a.* Motor lacks power.	*a.* Reset rheostats (on ground). Refer to paragraph 15. *d.* (5) *(b)* *2.*, Section IV.

OIL COOLER SYSTEM

1. Failure to operate.	*a.* Low battery, open circuit to pilot's compartment control, burned out motor, improper adjustment of limit switch or overtravel of actuator which has caused both limit switches to be operated, and loose electrical connectors.	*a.* Replace battery, replace burned out motor, readjust actuator, make all electrical connections tight.
2. Actuator operates in one direction only.	*a.* Burned out relay. Welded relay point. Open motor field. Flap jammed.	*a.* Replace relay box, replace actuator, readjust limit switch and/or linkage.
3. Actuator operating with combination of long and short steps in regular sequence.	*a.* Excessively worn follow-up cam.	*a.* Replace cam.
4. Over travel of end position.	*a.* Wrong setting of limit switch or defective braking relays or damaged limit switch.	*a.* Check wiring continuity and repair or replace.

POSITION INDICATORS

1. No reading with battery switch on.	*a.* Poor transmitter ground. *b.* Broken connection in indicator or transmitters. *c.* Battery trouble.	*a.* Check, repair, or replace. *b.* Replace parts. *c.* Repair or replace battery. See paragraph 15. *b.* (1), this section.
2. Poor scale adjustment.	*a.* Slippage of transmitter shaft. *b.* Faulty indicator mechanism. *c.* Battery voltage low.	*a.* Readjust and tighten. *b.* Replace. *c.* Repair or replace battery. See paragraph 15. *b.* (1), this section.
3. Pointer on scale but does not move with wheels and flaps.	*a.* Broken lead to transmitter. *b.* Broken lead in indicator or transmitter. *c.* Broken or loose transmitters driving linkage.	*a.* Repair lead. *b.* Replace parts. *c.* Repair and readjust.
4. Pointer fails to return to "OFF" when battery switch is turned off.	*a.* Short circuits in instrument switch. *b.* Faulty indicator.	*a.* Check and repair. *b.* Replace.

e. ELECTRICAL TROUBLE SHOOTING LIST—Continued.

TROUBLE	*REMEDY*	*PROBABLE CAUSE*
TURRET DYNAMOTOR		
1. Dynamotor won't run.	*a.* Improper or defective connector plug.	*a.* Check connector plug and socket prongs.
	b. Binding armature.	*b.* Rotate armature manually.
	c. Defective circuit wiring.	*c.* Check circuit continuity using known field and armature resistance. Remember that the two are in shunt. They may be tested individually by lifting brushes (and still not grounding them) or by removing the armature.
	d. D-C brushes improperly seated.	*d.* Check d-c brushes to see if they are seated properly and not cracked or broken. The brush spring is designed to give brush pressure of 4 to 6 psi
2. Dynamotor runs, but no a-c is generated.	*a.* Improper a-c circuit wiring.	*a.* Check a-c continuity. Check for defective connector plug, defective brushes or brush holders, dirty collector rings, open circuit in dynamotor internal wiring, open circuit in rotor winding.
3. Erratic or sluggish operation.	*a.* Improper brush position.	*a.* If dynamotor turns too fast at rated input and output, shift d-c brushes slightly with rotation; if frequency is too low, shift d-c brushes slightly against rotation.
4. Low output voltage. Note: A-C voltage at the servo-amplifier is critical and should not be permitted to rise above 125 volts or to fall below 105 volts rms.	*a.* Low input voltage.	*a.* Check input voltage (airplane electrical system). If input voltage is normal, and output voltage is still low, replace the dynamotor.
TURRET SERVO-AMPLIFIER		
1. Hunting continuously—hunting centered about position of correspondence.	*a.* Broken anti-hunt connection.	*a.* Repair connection.
	b. Reversed anti-hunt connections.	*b.* Correct connections.
	c. Anti-hunt capacitor too small.	*c.* Replace with condenser of greater capacity.
	d. 31-speed selsyn CT rotor leads reversed.	*d.* Correct connections.
2. Hunting continuously—hunting centered 180° from proper zero.	*a.* Reversed connections on output terminals of amplidyne generator.	*a.* Correct connections.
	b. Reverse connections (B & F) to control field of amplidyne generator.	*b.* Correct connections.
3. Hunting continuously—hunting about fixed point but incorrectly aligned.	*a.* Mis-alignment of 31-speed and one-speed selsyn zeros.	*a.* Zero selsyns. See paragraph 15. *d.* (16) *(e)*, this section.
4. Hunting continuously—hunting at certain positions only.	*a.* Open selsyn stator lead.	*a.* Correct connection.
	b. Reversed selsyn stator leads on one selsyn. (Remove one selsyn cap and check direction in which turret follows sight to determine which selsyn is reversed.)	*b.* Correct connections.
5. Turret rotates 180° from proper zero point, follows in direction of sight, but does not hunt. (Consider azimuth motion.)	*a.* Reversed turret motor field.	*a.* Correct connections.
	b. Reversed connections to turret motor armature.	*b.* Correct connections.
	c. Reversed connections (C & D) to primary of servo-amplifier power transformer.	*c.* Correct connections.
	d. Reversed connections (R1 & R2) to rotors of both 1-speed and 31-speed selsyn generators.	*d.* Correct connections.
	e. Reversed connections (R1 & R2) to both 1-speed and 31-speed CT rotors.	*e.* Correct connections.

e. ELECTRICAL TROUBLE SHOOTING LIST.–Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
6. Turret rotates in opposite direction from sight.	*a.* Reversed selsyn stator leads on both selsyns.	*a.* Correct connections.
7. Jumpy operation.	*a.* Open selsyn stator circuit.	*a.* Correct connections.
	b. Open selsyn rotor circuit, 31-speed selsyn set.	*b.* Correct connection.
	c. Binding on bearings, gears or turret rings.	*c.* Lubricate and/or readjust.
	d. Poor communication in amplidyne (brushes, commutator, or excessive vibration.)	*d.* Replace brushes. Clean commutator.
	e. Defective contact in one or more circuits, either in relays or connectors.	*e.* Clean out contacts.
	f. Minor mis-alignment of 31-speed and one-speed selsyns.*	*f.* Zero selsyns. See paragraph 15. *d.* (16) *(e)*, this section.
	g. Low a-c voltage.*	*g.* Check dynamotor. Replace if necessary.
8. Gun position independent of sight position in azimuth. Elevation motion correct.	*a.* Defective azimuth circuit wiring.	*a.* Correct connections.
	b. Defective azimuth amplidyne.	*b.* Replace amplidyne.
	c. Defective azimuth motor.	*c.* Replace motor.
	d. Defective azimuth channel in amplifier.	*d.* Repair or replace servo-amplifier.
9. Turret sluggish in response.	*a.* Supply voltage low, due to defective voltage regulator or generator.	*a.* Check voltage regulator and generator.
	b. Defective turret bearings.	*b.* Replace bearings.
	c. Defective amplidyne.	*c.* Replace amplidyne.
	d. Defective turret drive motor.	*d.* Replace motor.
	e. Defective servo-amplifier.	*e.* Replace servo-amplifier.
10. Bore-sight check indicates guns are not correctly aligned with sights.	*a.* Gun mounting adjustment incorrect in turret.	*a.* Bore-sight guns.
	b. Unbalance in servo-amplifier.	*b.* Balance servo-amplifier.
	c. Defective amplidyne field.	*c.* Replace amplidyne.
	d. Selsyns not zeroed correctly.	*d.* Zero selsyns. See paragraph 15. *d.* (16) *(e)*, this section.
	e. Change in mounting position of turret or sights.	*e.* Re-align mounting.
11. No response to action of sight.	*a.* Amplidyne not running.	*a.* Check amplidyne wiring. Replace defective amplidyne.
	b. Dynamotor not running.	*b.* Check dynamotor wiring. Replace defective dynamotor.
	c. Servo-amplifier connection disconnected.	*c.* Correct connection.
	d. Defective servo-amplifier.	*d.* Replace servo-amplifier.
	e. Defective action switch circuit.	*e.* Check circuit, correct connections, and replace defective units.
12. Erratic operation.	*a.* Loose connections.	*a.* Correct connections.
	b. Poor commutation, amplidyne or motor.	*b.* Clean commutator.
	c. Defective slip rings or brushes in turret or sight collector, dynamotor, or selsyns.	*c.* Replace brushes. Replace selsyns. Clean slip rings.
13. Operation accompanied by vibration of the drive motor and guns.	*a.* Too much sensitivity in amplidyne.	*a.* Adjust at amplifier or replace amplidyne.

*Jumpy operation due to these causes occurs when synchronizing from large angles of divergence between sight and guns.

e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	TURRET DRIVE MOTOR	
1. Motor won't run.	*a.* Improper or defective connection.	*a.* Check connector plug and socket.
	b. Turret jammed.	*b.* Check to see that turret is not jammed, or that the motor is not being required to exert excessive breakway torque.
	c. Binding armature.	*c.* Rotate the armature manually to see if a bearing or air gap is jammed.
	d. Incorrect or defective wiring.	*d.* Check circuit continuity with an analyzer. Between armature terminals should measure in the order of magnitude of 1 ohm or less; between field lead A and the frame should be approximately 12 ohms.
	e. Improper insulation resistance.	*e.* Check insulation resistance between the armature circuit and frame, and between the field circuit and the frame. If either is less than 1 megohm, the motor should be removed, cleaned, and further investigated.
	f. Improperly seated brushes.	*f.* Check brushes to see if they are seated properly and are not cracked or broken. The spring pressure may be checked by comparing with a motor that is functioning satisfactorily.
	g. Open or short-circuited windings.	*g.* Replace the winding.
2. Motor runs in wrong direction.	*a.* Incorrect wiring.	*a.* Check external circuits for proper wiring. Check internal motor wiring for proper rotation.
3. Erratic, sluggish operation.	*a.* Brushes and commutator.	*a.* Check brushes and commutator for proper contact and spring pressure. Clean commutator.
	AMPLIDYNE	
1. Amplidyne won't run.	*a.* Improper connection.	*a.* See that the proper d-c power is reaching the motor terminal and frame. Check for defective connector plug or socket.
	b. Binding armature.	*b.* Rotate the armature manually to see if a bearing or air gap is jammed.
	c. Incorrect or defective wiring.	*c.* Check internal circuit continuity with a circuit tester. Remember that the motor field and armature resistances are *in* parallel.
	d. Improperly seated brushes or dirty commutator.	*d.* Check motor brushes to see if they are seated properly and not cracked or broken. Brush spring pressure should be checked with that of a unit which functions properly. Check commutator for excessive dirt.
2. Erratic operation, discontinuous output saturation, no generator voltage.	*a.* Brushes, commutator or bearing.	*a.* Check brushes and commutator for proper contact and spring pressure. Clean commutator. Check for loose bearings.
	GUN CHARGER	
1. Charger fails to operate when firing key is closed.	*a.* Defective electric connection to charger.	*a.* Check firing lead and charger lead connected to shell of connector.
	b. Complete lack of gas pressure.	*b.* Check pressure supply.
	c. Defective timer operating switch.	*c.* Replace timer. Replace switch by overhauling timer.
2. Charger sluggish in operation.	*a.* Low pressure of gas or air.	*a.* Check pressure supply, which should be 1000 pounds.
	b. Gas leakage through exhaust port.	*b.* Check leakage through exhaust port.
	c. Gas leakage around piston assembly.	*c.* Replace piston assembly.
	d. Supports clamping cylinder too tightly.	*d.* Loosen screws slightly.
	e. Broken piston-spring.	*e.* Replace piston assembly.

c. ELECTRICAL TROUBLE SHOOTING LIST.–Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
3. Sear-pin moves but motor fails to operate.	*a.* Timer reset improperly. *b.* Motor mount binding motor too tightly. *c.* Broken lead to motor. *d.* Burned-out motor. *e.* Broken motor-brush.	a. Move timer reset-button to "START" position. *b.* Loosen screw holding motor in mount. *c.* Remove motor from charger and check leads to solenoid switch and shell of connector. *d.* Replace motor. *e.* Replace brush and pigtail assembly or brush mechanism.
4. Sear-pin fails to move but motor operates.	*a.* Binding in bell cranks. *b.* Defective solenoid switch. *c.* Burned-out (firing-solenoid) coil.	*a.* Insert screw driver in SOCKET "F" (indicated on charger cover) and check for free operation of bell cranks. *b.* Insert screw driver in cylinder and move solenoid-switch lever-arm to operate switch. If sear-pin fails to operate, switch may be defective. Before replacing switch, check (firing-solenoid) coil. *c.* Check (firing-solenoid) coil by disconnecting leads to shell of connector, applying voltage to charger and touching disconnected lead to shell to see if arc forms. If no arc forms, replace coil.
5. Motor operates but intake valve does not open.	*a.* Burned-out charging-solenoid coil. *b.* Insufficient friction between solenoid-switch button-arm and timer sleeve. *c.* Defective solenoid switch.	*a.* Check (charging-solenoid) coil by disconnecting lead from shell of connector, applying voltage to charger and touching disconnected lead to charger to see if arc forms. If no arc forms, replace coil. *b.* Insert screw driver in cylinder slot and move solenoid switch lever-arm to operate solenoid switch. If intake valve now opens, friction is insufficient and timer should be replaced. *c.* Replace timer. Replace switch by overhauling timer.
6. Charging solenoid operates but valve does not open.	*a.* Too much clearance between valve-stem nut and charging-plunger bushing.	*a.* Adjust clearance to 0.015 inch.
7. Gas leaks when gas pressure is first applied to block.	*a.* Defective valve. *b.* Weak or broken valve-compression spring. *c.* Loose or worn nipple.	*a.* Replace valve. *b.* Replace spring. *c.* Replace nipple.
8. Gas leaks when charger operates.	*a.* Improper seating of valve on exhaust port. *b.* Weak valve-compression spring. *c.* Leakage around piston assembly.	*a.* Adjust seating of valve. *b.* Replace spring. *c.* Replace piston assembly.
9. Charger continues to operate without stopping.	*a.* Defective timer operating-switch. *b.* Timer reset-button arm out of adjustment.	*a.* Replace timer. Replace switch by overhauling timer. *b.* Replace timer. Adjust reset-button arm by overhauling timer.
10. Sear-pin remains extended.	*a.* Dirt between sear-pin and mounting bar or in bell cranks. *b.* Broken solenoid spring.	*a.* Clean sear-pin and bell cranks. *b.* Replace solenoid spring.
11. Charger forces gun to eject live rounds of ammunition.	*a.* Solenoid-switch lever improperly set. *b.* Friction between solenoid-switch lever-arm and timer sleeve too great.	*a.* Replace timer. Adjust lever by overhauling timer. *b.* Replace timer.
12. Sear-pin operates but gun fails to fire.	*a.* Setting of sear-pin incorrect. *b.* Low voltage.	*a* Adjust sear-pin to timing of gun. *b.* Check voltage which should be 24 volts d-c.
13. Valve operates but gas does not enter charger.	*a.* Dust strainer in valve-block clogged.	*a.* Replace valve-block assembly.
14. Charges very fast but does not charge gun.	*a.* Stud not installed in gun bolt.	*a.* Install stud.
15. Charger stops operating too soon (in less than two seconds).	*a.* Friction between reset-button arm and timer shaft too low.	*a.* Replace timer.
16. Gun fails to cease firing when firing circuit is opened.	*a.* Solenoid spring is broken and linkage of bell crank is jammed preventing retraction of sear pin.	*a.* Replace solenoid spring and bellcrank assembly.

e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
	AMMUNITION BOOSTER	
1. Sprocket wheel will not rotate.	*a.* Faulty free wheeling assembly.	*a.* Replace free wheeling assembly.
2. Motor driven unit drives but other unit does not.	*a.* Broken flexible cable. *b.* Bevel gear not engaged on either shaft.	*a.* Replace flexible cable. *b.* Check that bevel gears are mounted on shafts.
3. Sprocket can turn backward.	*a.* Faulty brake assembly or wrong-hand brake assembled.	*a.* Replace brake assembly with one that prevents reverse rotation.
4. Motor fails to run.	*a.* Open electrical circuit. *b.* Burned out field coil. *c.* Broken brush.	*a.* Check electrical circuits both externally and internally. *b.* Replace motor. *c.* Replace brush.
5. Sprocket turns only in reverse direction.	*a.* Free wheeling assembly interchanged.	*a.* Replace free wheeling assembly with one which drives in proper direction.
6. Sprocket turns but ammunition belt not driven.	*a.* Worn sprockets. *b.* Ammunition guides bent sufficiently to impede belt.	*a.* Replace sprocket and shaft assembly. *b.* Bend guides sufficiently to allow ammunition belt to pass freely.
	BOMBING SYSTEM	
1. Bomb interval control fails to operate.	*a.* Bomb circuit main power switch not in "ON" position. *b.* Intervalometer or bomb bay door circuit breakers open. *c.* Insufficient voltage to operate the control. *d.* Failure to allow 1 minute warm-up after turning interval control on. *e.* Defective bomb interval control.	*a.* Turn switch on. *b.* Check circuit for trouble. *c.* Adjust voltage to 24-28 volts. *d.* Allow 1 minute for warm-up. *e.* Replace bomb interval control.
2. Bomb interval control continues sending impulses when counter reaches zero in train release.	*a.* Bad adjustment on contact spring attached to counter. *b.* Contact points attached to counter fail to open when counter reaches zero.	*a.* Replace interval control. *b.* Replace interval control.
3. Bomb interval control releases more stations than are set on the counter.	*a.* Two A-4 bomb rack releases operate on one impulse. *b.* Defective A-1 bomb release receptacle. *c.* Bad adjustment of counter. *d.* Weak ball detension spring permits counter to bounce back after reaching zero. *e.* Counter sticks.	*a.* Find defective release and replace. *b.* Replace the A-1 receptacle. *c.* Replace interval control. *d.* Replace interval control. *e.* Replace interval control.
4. Bomb interval control operates erratically.	*a.* Insufficient voltage. *b.* Infrequent use in extremely cold temperatures. *c.* Dirty contacts on rack selector relays.	*a.* Adjust voltage to 24-28 volts. *b.* Allow approximately 1 hr. for warm-up. *c.* Clean contacts.
5. The RS-2 rack selector relays do not operate correctly.	*a.* Bomb circuit main power switch not "ON." *b.* Rack selector switches not "ON." *c.* Type A-4 bomb release not cocked. *d.* Bomb bay door safety switches not completely in position for "doors open." *e.* Defective RS-2 rack selector relay. *f.* Lack of a ground on relay. *g.* Broken or disconnected wire between power source and B and C terminal. Broken or disconnected wire between E or F terminal and bomb release. *h.* Burned out or open circuit breaker.	*a.* Turn switch on. *b.* Turn all selector switches on. *c.* Cock several type A-4 bomb releases in the bomb bay. *d.* Make sure all bomb bay door safety switches are in correct position. *e.* Replace relay. *f.* Ground relay. *g.* Connect or replace wire. *h.* Replace circuit breaker or repair circuit.

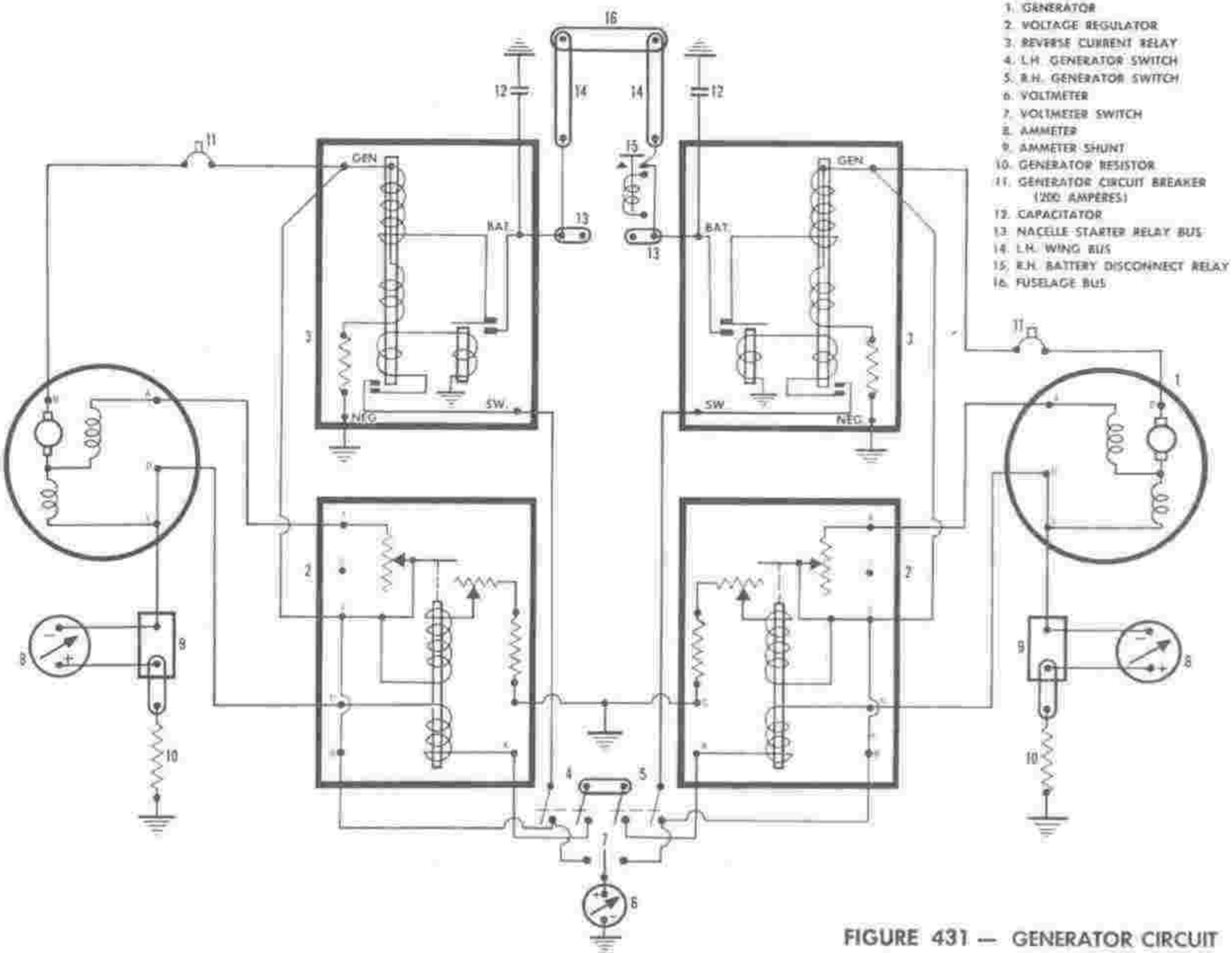
e. ELECTRICAL TROUBLE SHOOTING LIST.—Continued.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
6. Bomb release fails to transfer impulse to next release.	*a.* Defective type A-4 bomb release.	*a.* Make sure current enters A-4 release. If it enters the number 2 contact, and does not emerge from the number 3 contact, replace release.
	b. Defective A-1 bomb release receptacle.	*b.* Check receptacle for good contact.
	c. Break in the wiring between two circuits.	*c.* Check for breaks in the wiring between releases.
7. Current fails to pass through station on which there is no release.	*a.* Defective receptacle.	*a.* Adjust receptacle so that switch between number 2 and 3 contact is open when there is a release mated to the receptacle and closed when there is not a release mated to receptacle. Or replace receptacle.
	b. Break in wiring.	*b.* Check continuity of wiring from number 3 contact of previous release to number 2 contact of A-1 receptacle, through receptacle and out of number 3 contact to number 2 contact of next receptacle.
8. Bomb indicator light fails to indicate a cocked release.	*a.* Bomb circuit main power switch not "ON."	*a.* Turn switch on.
	b. Burned out indicator lamp.	*b.* Test lamp and replace if necessary.
	c. Defective indicator light switch.	*c.* Adjust indicator light switch. Replace if it cannot be repaired.
	d. Defect in A-4 bomb release.	*d.* Replace release.
9. Indicator lamp test switch fails to test lamps.	*a.* Bomb circuit main power switch not "ON."	*a.* Turn power switch on.
	b. Defective indicator light switch.	*b.* Adjust switch to obtain good contact to all indicator light circuits. Or replace.
	c. Burned out indicator light resistor on back of panel.	*c.* Replace resistor.
10. Releases fail to salvo bombs when salvo switch is closed.	*a.* Insufficient voltage to operate salvo circuit.	*a.* Adjust voltage regulator to obtain 28.5 volts.
	b. Bomb bay door safety switches not in "doors open" position.	*b.* Adjust bomb bay door switches.
	c. Salvo relays inoperative.	*c.* Check salvo relay coils to see that relays operate correctly. Clean contacts.
	d. Defective A-4 bomb release.	*d.* See that current flows to both number 1 and 2 contacts of A-4 release. If current is present and release fails to operate, replace release.
11. Bomb release trips both arming and releasing levers in salvo.	*a.* Defective salvo coil in A-4 release.	*a.* If current flows to number 1 circuit, and release fails to operate correctly, replace release.
	b. Defective indicator light switch.	*b.* If no current to number 1 contact of A-4 release, check indicator light switch for good contacts.
	c. Broken wire in circuit between indicator light switch and A-4 bomb release.	*c.* Replace or repair wire.
12. Bomb bay doors do not open when normal release of bombs is desired.	*a.* Bomb circuit main power switch not "ON."	*a.* Turn switch on.
	b. Bomb bay door position selector valve solenoid defective.	*b.* Operate manual override if doors open. Trouble is probably due to defective solenoid.
	c. Defective bomb circuit main power switch.	*c.* Replace switch.
13. Bomb racks will not operate on normal release.	*a.* Bomb circuit main power circuit breaker switch is "OFF" or burned out.	*a.* Turn switch to "ON" or replace.
	b. Wing or fuselage rack selector switches "OFF."	*b.* Turn switches to "ON."
	c. Fragmentation-demolition bomb selector switch not properly set.	*c.* Turn switch to correct position.
	d. Bomb firing push button switch not making proper contact.	*d.* Repair or replace switch.
	e. One or both bomb bay door safety switches does not make proper contact.	*e.* Adjust switch, replace if defective.
	f. Dirty contacts in demolition bomb release relay.	*f.* Clean contacts.
	g. Dirty contacts in rack selector relays.	*g.* Clean contacts.
	h. Defective A-4 release unit at station 1.	*h.* Replace release unit.
	i. Wires broken at terminal 2, station 1 bomb release receptacle.	*i.* Locate and repair broken wires.
	j. Intervalometer is defective.	*j.* Replace intervalometer.

ALPHABETICAL INDEX OF WIRING DIAGRAMS

NOTE

The following simplified wiring diagrams are intended to convey a basic understanding of the circuits used in the airplane electrical system. When actual maintenance information is desired, refer to the INDIVIDUAL ELECTRICAL CIRCUIT WIRING DIAGRAM BOOK provided with the airplane.



1. GENERATOR
2. VOLTAGE REGULATOR
3. REVERSE CURRENT RELAY
4. L.H. GENERATOR SWITCH
5. R.H. GENERATOR SWITCH
6. VOLTMETER
7. VOLTMETER SWITCH
8. AMMETER
9. AMMETER SHUNT
10. GENERATOR RESISTOR
11. GENERATOR CIRCUIT BREAKER (200 AMPERES)
12. CAPACITATOR
13. NACELLE STARTER RELAY BUS
14. L.H. WING BUS
15. R.H. BATTERY DISCONNECT RELAY
16. FUSELAGE BUS

FIGURE 431 — GENERATOR CIRCUIT

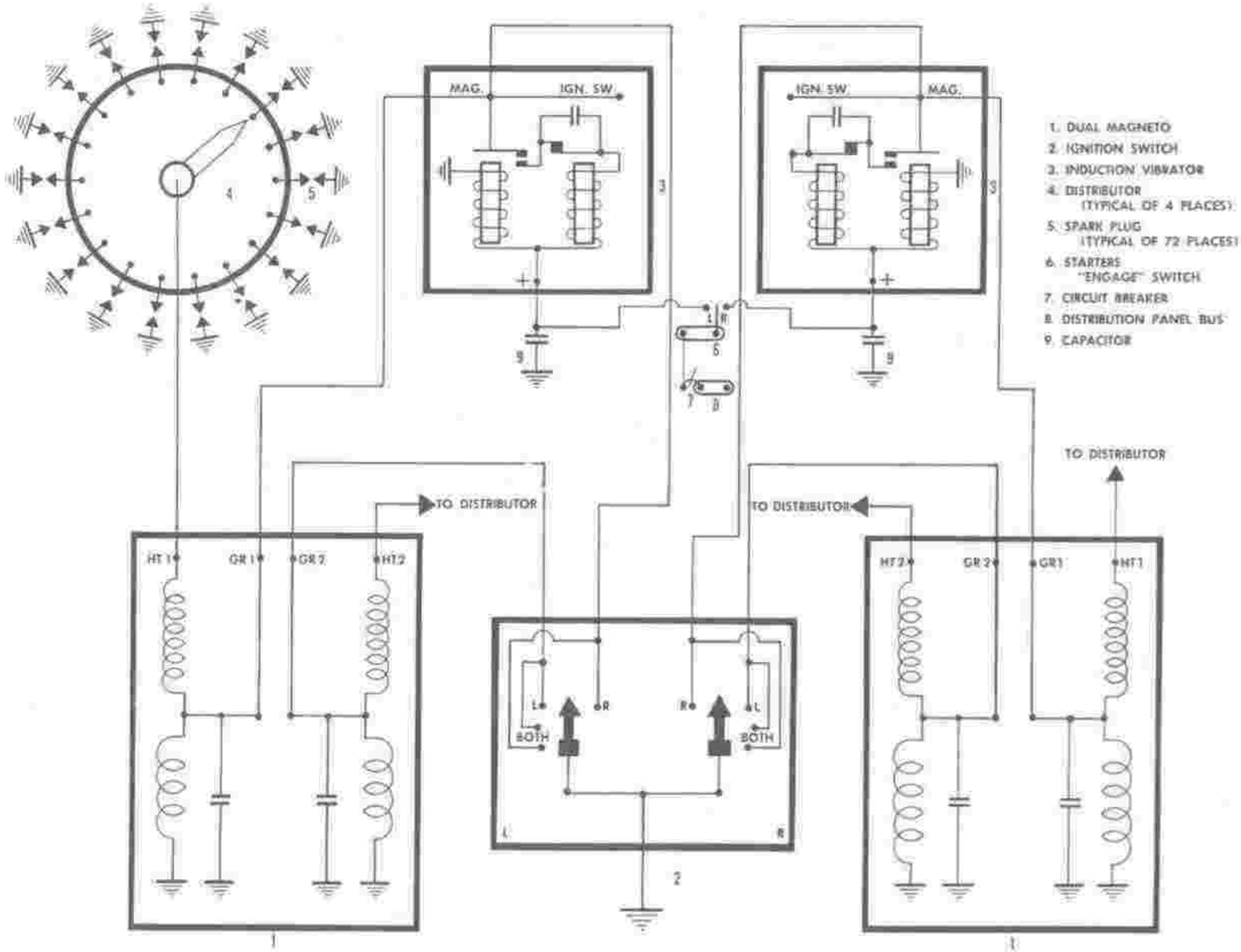
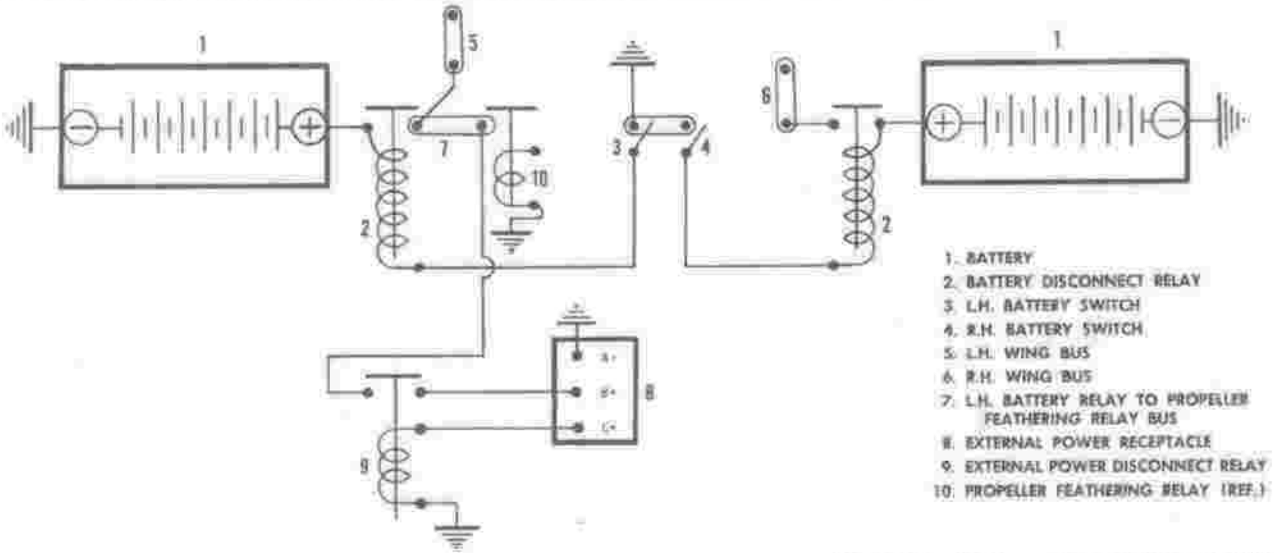
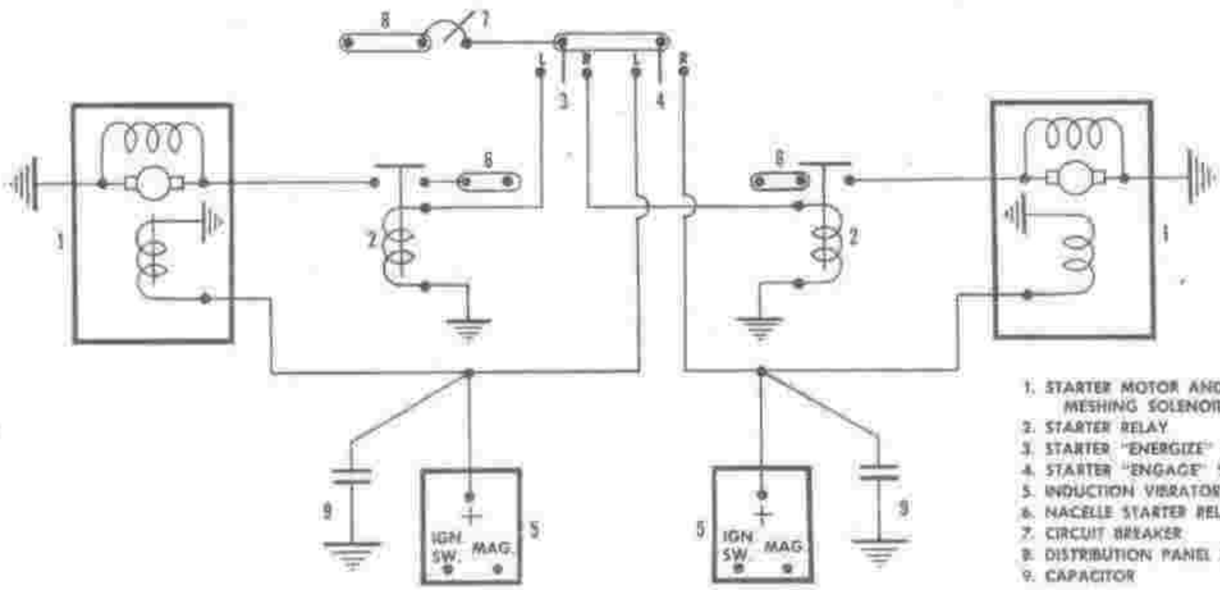


FIGURE 432 — IGNITION CIRCUIT



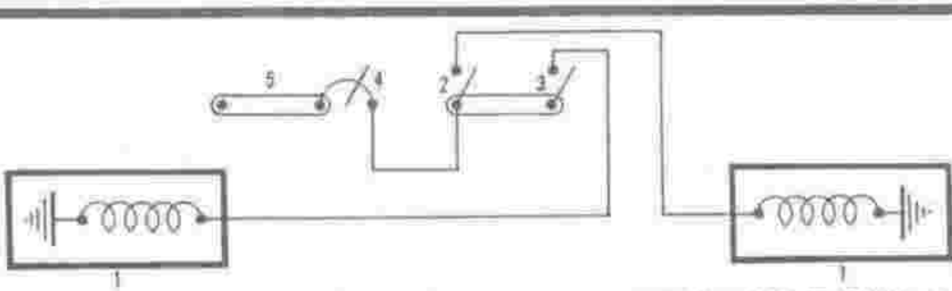
1. BATTERY
2. BATTERY DISCONNECT RELAY
3. L.H. BATTERY SWITCH
4. R.H. BATTERY SWITCH
5. L.H. WING BUS
6. R.H. WING BUS
7. L.H. BATTERY RELAY TO PROPELLER FEATHERING RELAY BUS
8. EXTERNAL POWER RECEPTACLE
9. EXTERNAL POWER DISCONNECT RELAY
10. PROPELLER FEATHERING RELAY (REF.)

FIGURE 433 — BATTERY CIRCUIT



1. STARTER MOTOR AND MESHING SOLENOID UNIT
2. STARTER RELAY
3. STARTER "ENERGIZE" SWITCH
4. STARTER "ENGAGE" SWITCH
5. INDUCTION VIBRATOR (REF.)
6. NACELLE STARTER RELAY BUS
7. CIRCUIT BREAKER
8. DISTRIBUTION PANEL BUS
9. CAPACITOR

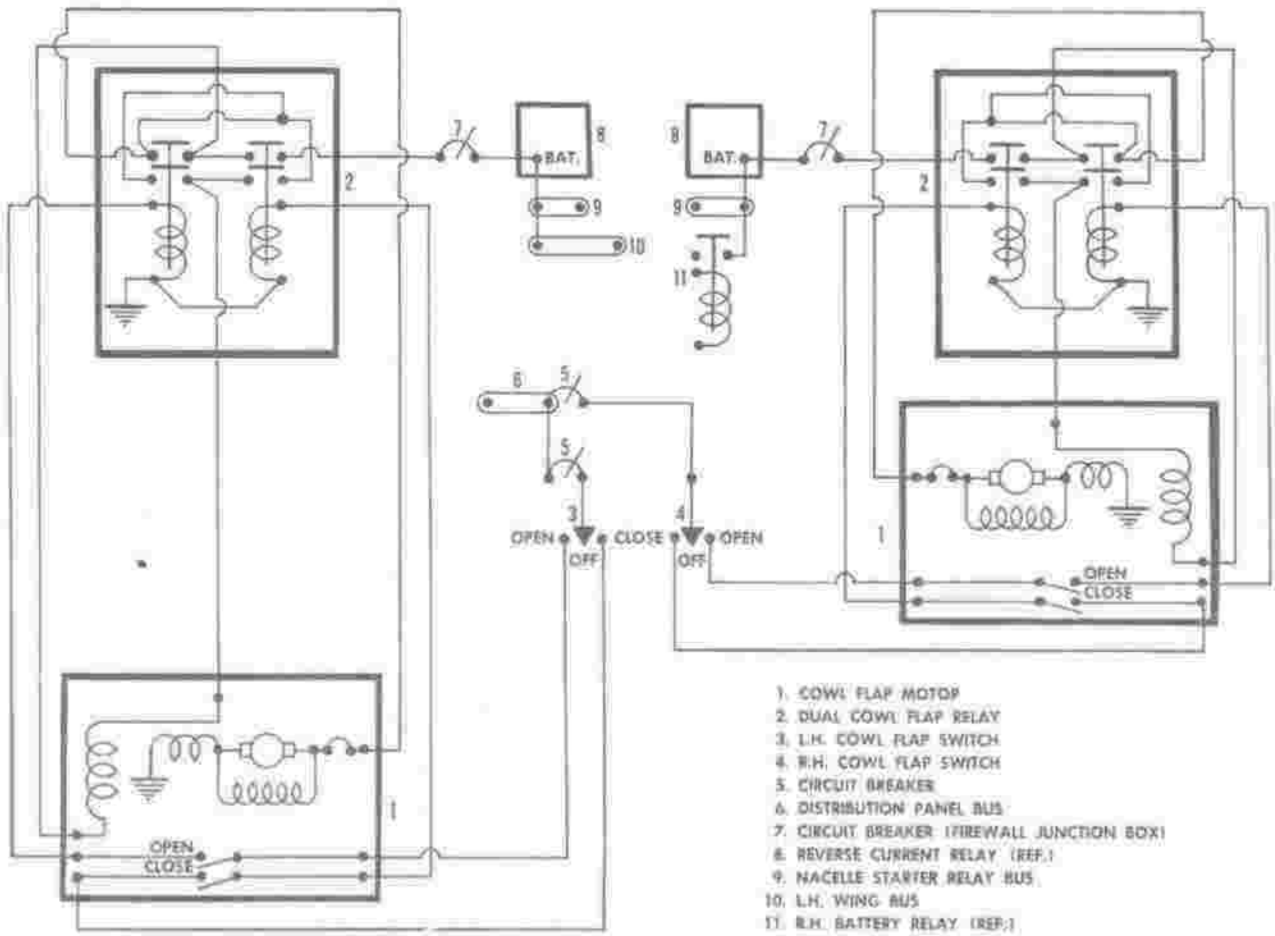
FIGURE 434 — STARTER CIRCUIT



1. OIL DILUTION (OR ENGINE PRIMER) SOLENOID*
2. L.H. SWITCH
3. R.H. SWITCH
4. CIRCUIT BREAKER
5. DISTRIBUTION PANEL BUS

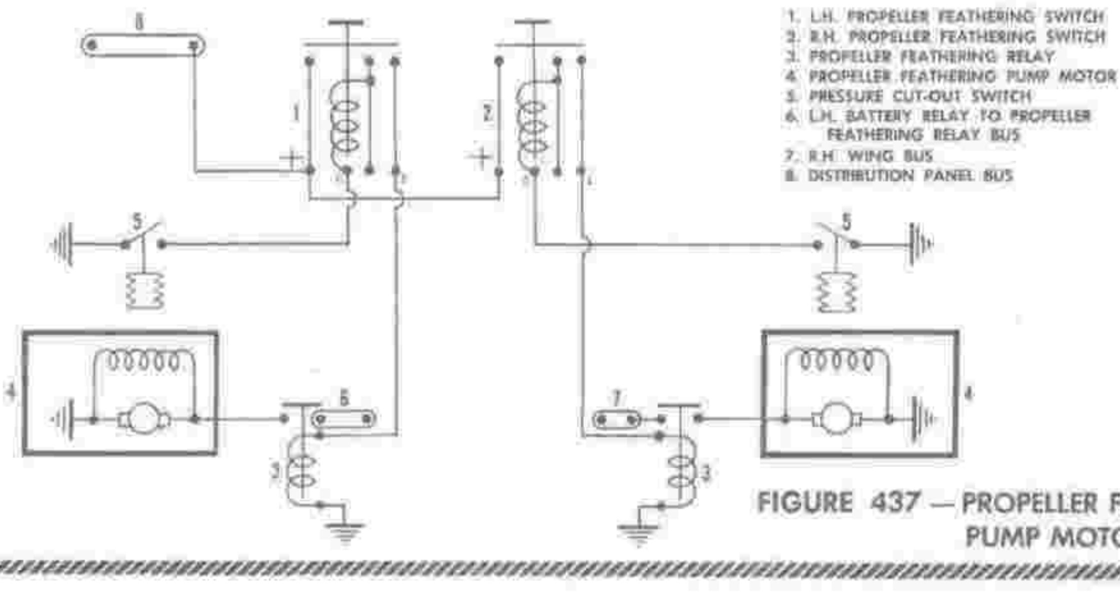
*The Engine Primer Solenoid Circuit is Identical to this Circuit.

FIGURE 435 — OIL DILUTION AND ENGINE PRIMER SOLENOID CIRCUIT



1. COWL FLAP MOTOR
2. DUAL COWL FLAP RELAY
3. L.H. COWL FLAP SWITCH
4. R.H. COWL FLAP SWITCH
5. CIRCUIT BREAKER
6. DISTRIBUTION PANEL BUS
7. CIRCUIT BREAKER (FIREWALL JUNCTION BOX)
8. REVERSE CURRENT RELAY (REF.)
9. NACELLE STARTER RELAY BUS
10. L.H. WING BUS
11. R.H. BATTERY RELAY (REF.)

FIGURE 436 — COWL FLAP MOTOR CIRCUIT



1. L.H. PROPELLER FEATHERING SWITCH
2. R.H. PROPELLER FEATHERING SWITCH
3. PROPELLER FEATHERING RELAY
4. PROPELLER FEATHERING PUMP MOTOR
5. PRESSURE CUT-OUT SWITCH
6. L.H. BATTERY RELAY TO PROPELLER FEATHERING RELAY BUS
7. R.H. WING BUS
8. DISTRIBUTION PANEL BUS

FIGURE 437 — PROPELLER FEATHERING PUMP MOTOR CIRCUIT

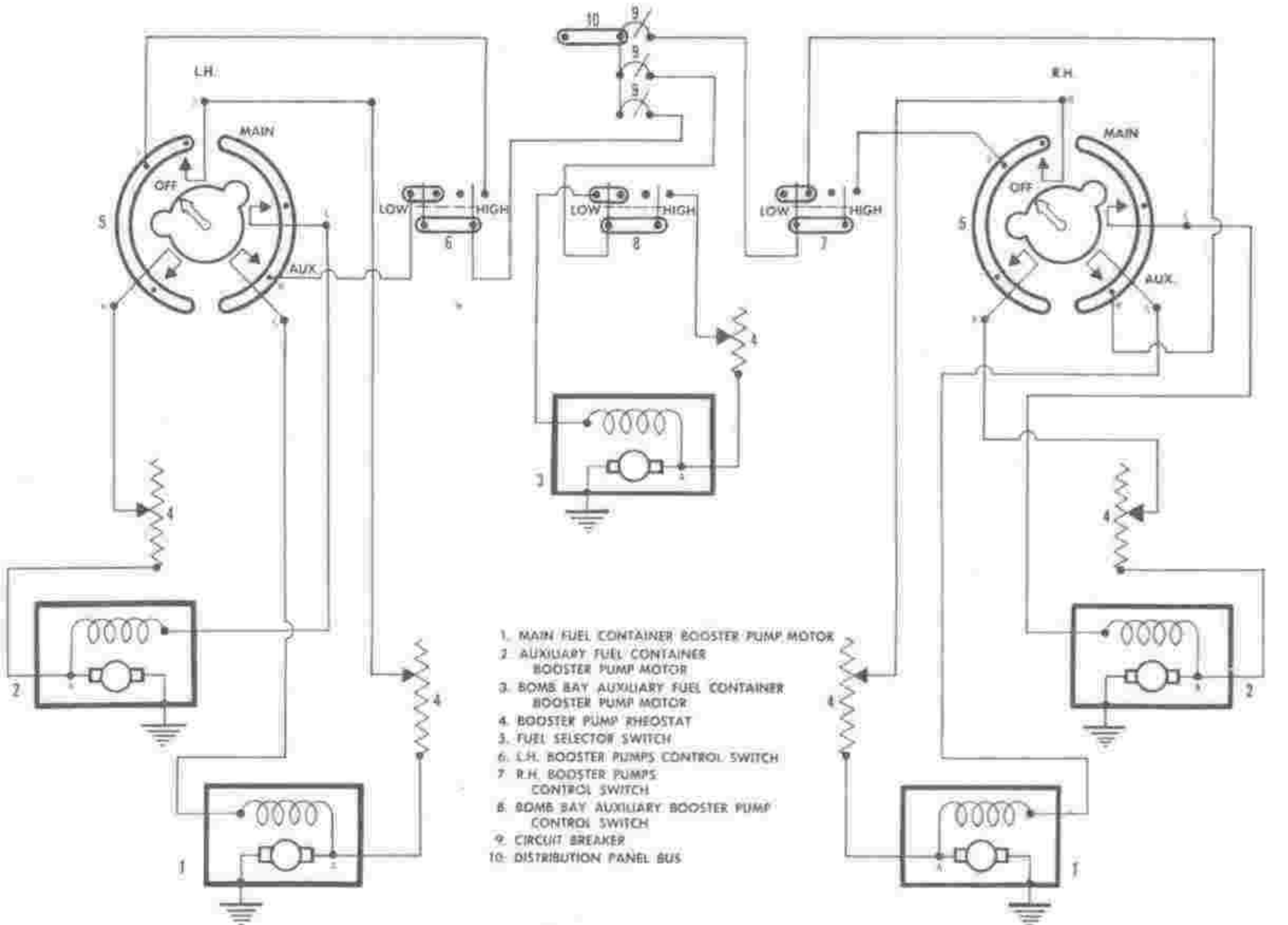
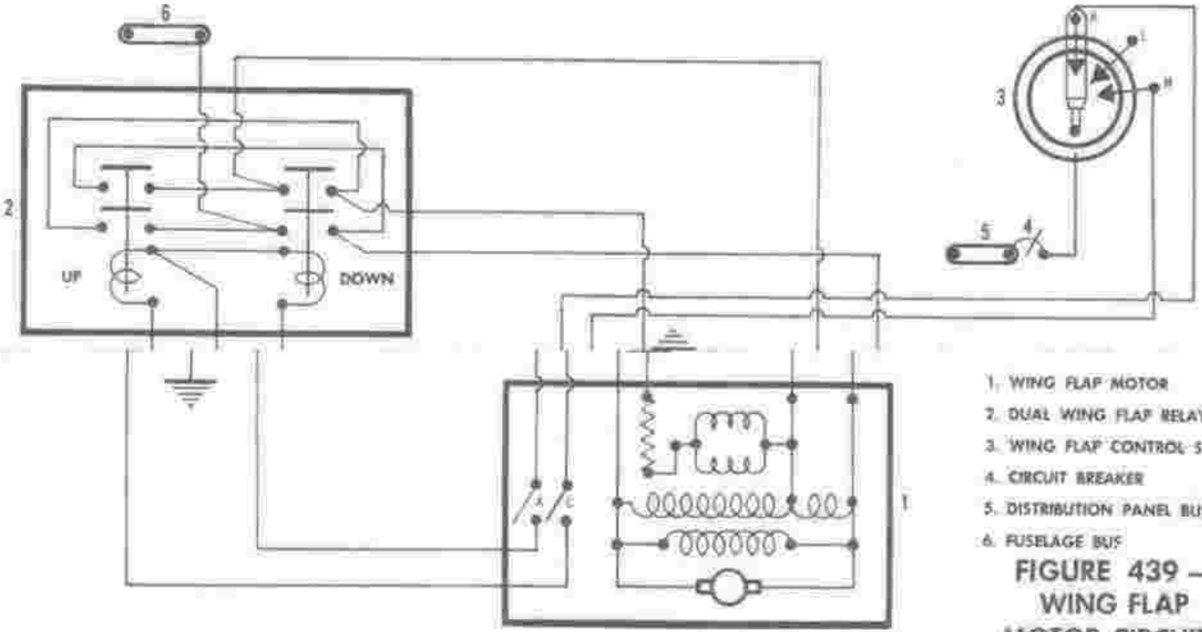
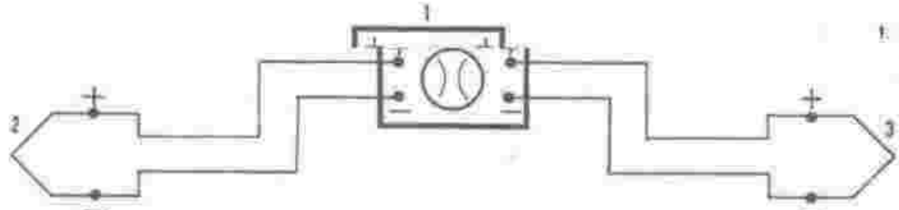


FIGURE 438 — FUEL BOOSTER PUMP CIRCUIT



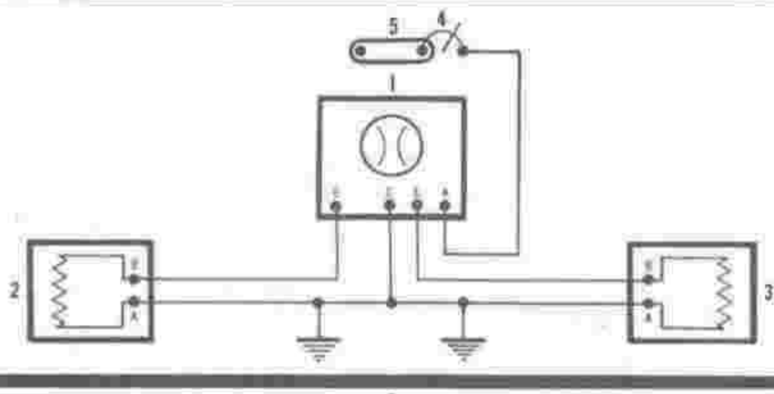
1. WING FLAP MOTOR
2. DUAL WING FLAP RELAY
3. WING FLAP CONTROL SWITCH
4. CIRCUIT BREAKER
5. DISTRIBUTION PANEL BUS
6. FUSELAGE BUS

FIGURE 439 — WING FLAP MOTOR CIRCUIT



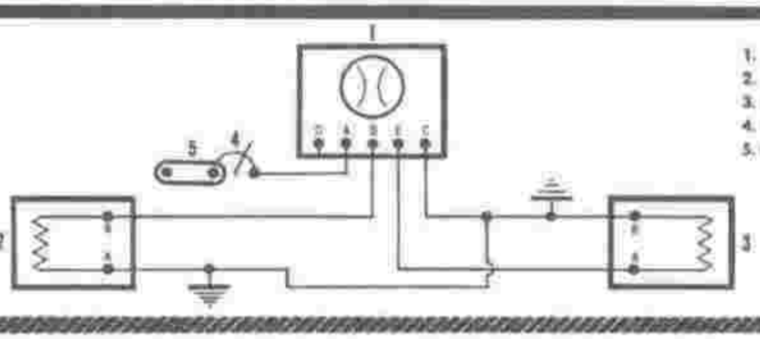
1. ENGINE TEMPERATURE INDICATOR
2. L.H. THERMOCOUPLE
3. R.H. THERMOCOUPLE

FIGURE 440 — ENGINE TEMPERATURE GAGE CIRCUIT



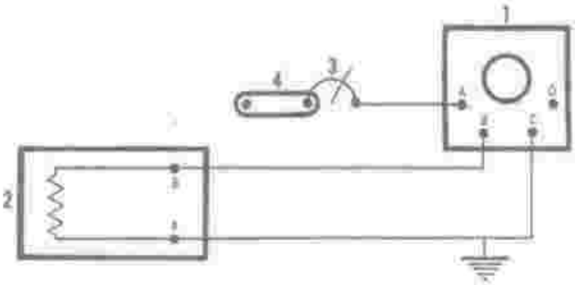
1. OIL TEMPERATURE INDICATOR
2. L.H. ENGINE RESISTANCE BULB
3. R.H. ENGINE RESISTANCE BULB
4. CIRCUIT BREAKER
5. FORWARD JUNCTION BOX

FIGURE 441 — OIL TEMPERATURE GAGE CIRCUIT



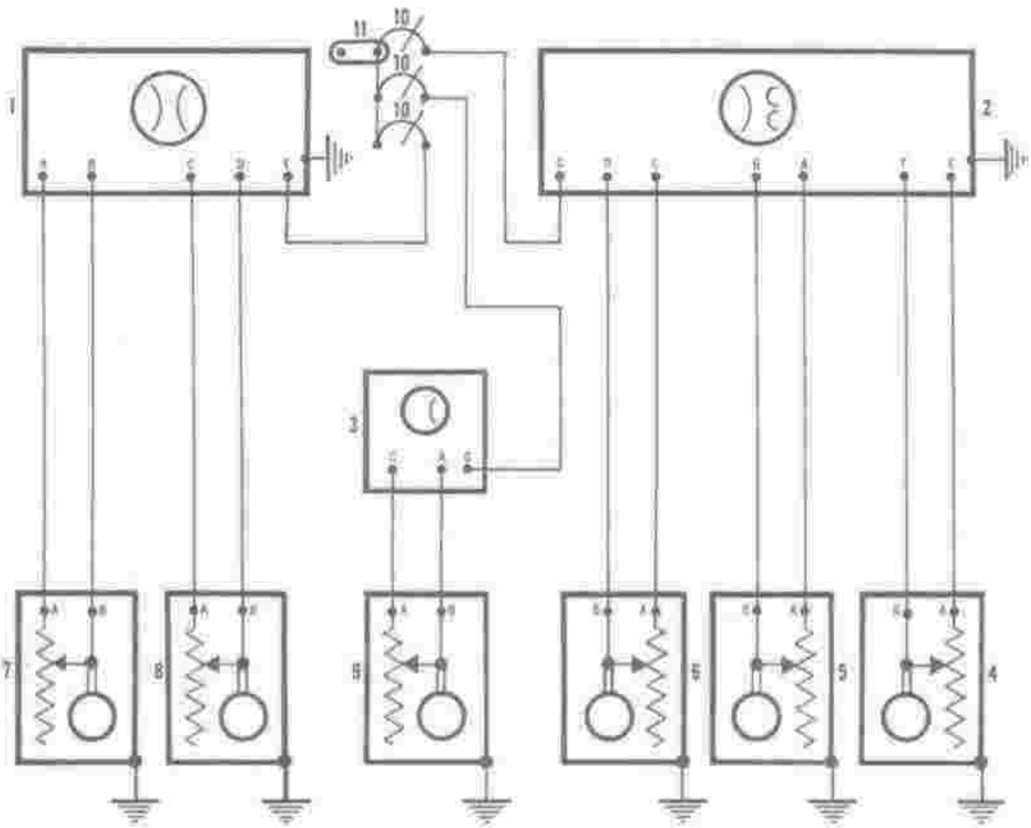
1. CARBURETOR AIR TEMPERATURE INDICATOR
2. L.H. ENGINE RESISTANCE BULB
3. R.H. ENGINE RESISTANCE BULB
4. CIRCUIT BREAKER
5. FORWARD JUNCTION BOX BUS

FIGURE 442 — CARBURETOR AIR TEMPERATURE GAGE CIRCUIT



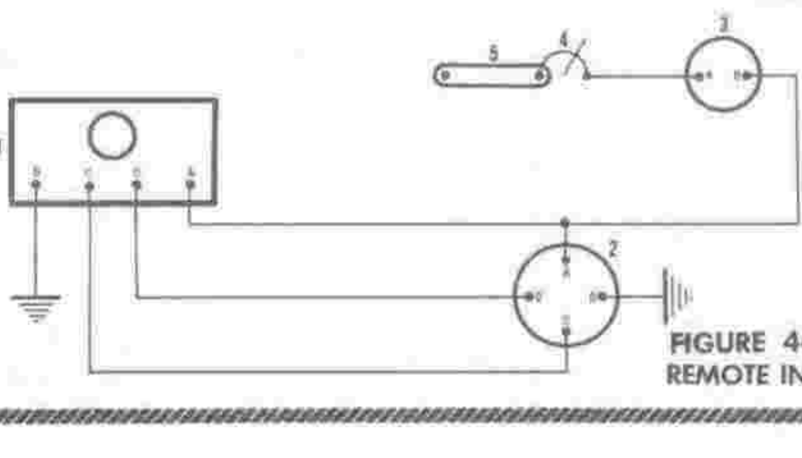
1. FREE AIR TEMPERATURE INDICATOR
2. RESISTANCE BULB
3. CIRCUIT BREAKER
4. FORWARD JUNCTION BOX BUS

FIGURE 443 — FREE AIR TEMPERATURE GAGE CIRCUIT



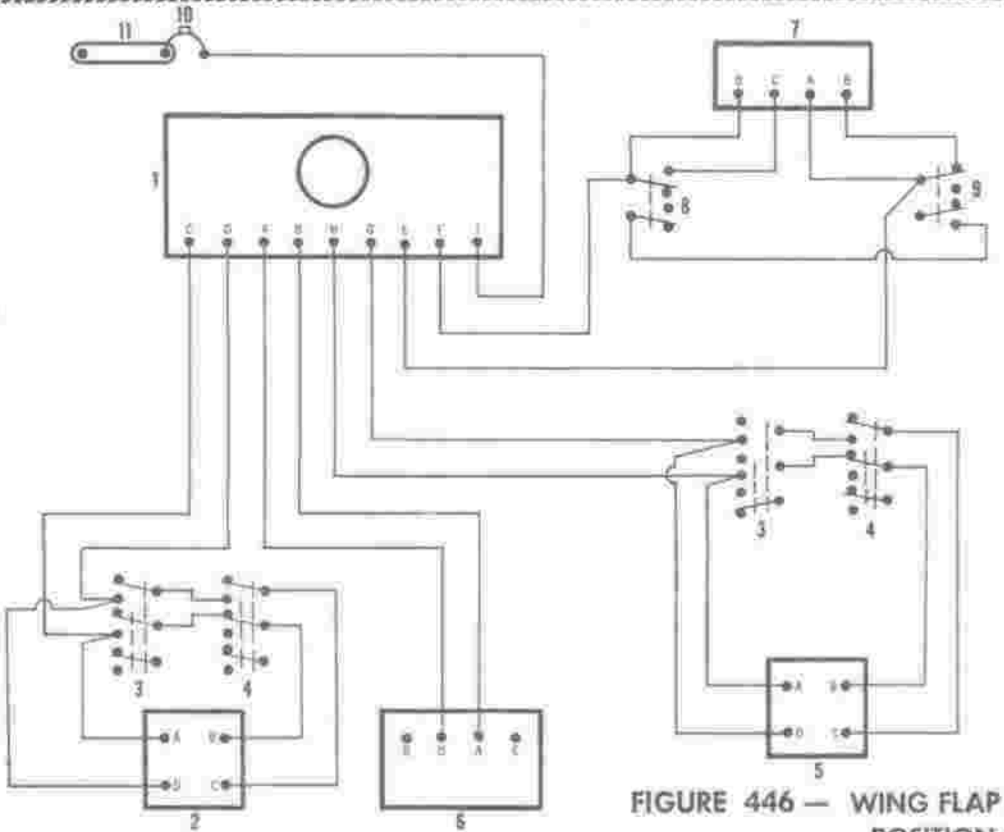
1. MAIN FUEL LEVEL INDICATOR (DUAL)
2. AUXILIARY FUEL LEVEL INDICATOR (THREE-UNITS)
3. FERRY FUEL LEVEL INDICATOR
4. L.H. AUXILIARY FUEL LEVEL TRANSMITTER
5. R.H. AUXILIARY FUEL LEVEL TRANSMITTER
6. BOMB BAY AUXILIARY FUEL LEVEL TRANSMITTER
7. L.H. MAIN FUEL LEVEL TRANSMITTER
8. R.H. MAIN FUEL LEVEL TRANSMITTER
9. FERRY FUEL LEVEL TRANSMITTER
10. CIRCUIT BREAKER
11. FORWARD JUNCTION BOX BUS

FIGURE 444 — FUEL LEVEL GAGE CIRCUIT



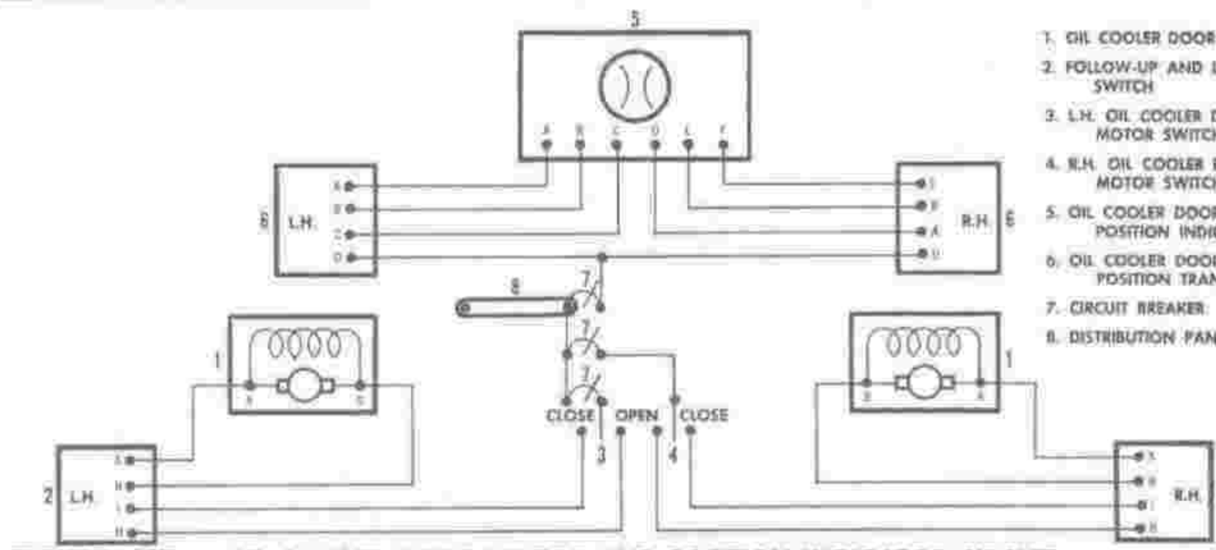
1. COMPASS INDICATOR
2. COMPASS TRANSMITTER
3. REMOTE INDICATING COMPASS INVERTER
4. CIRCUIT BREAKER
5. GUNNER'S RELAY JUNCTION BOX BUS

FIGURE 445 — REMOTE INDICATING COMPASS CIRCUIT



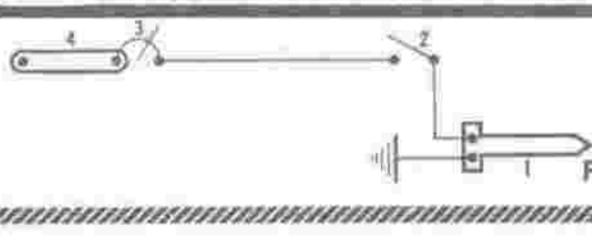
1. FLAP AND GEAR POSITION INDICATOR
2. L.H. LANDING GEAR POSITION TRANSMITTER
3. LATCHED DOWN SWITCH UNIT
4. POSITION TRANSFER SWITCH UNIT
5. R.H. LANDING GEAR POSITION TRANSMITTER
6. WING FLAP POSITION TRANSMITTER
7. NOSE GEAR POSITION TRANSMITTER
8. NOSE GEAR UP AND LATCHED SWITCH UNIT
9. NOSE GEAR DOWN AND LATCHED SWITCH UNIT
10. CIRCUIT BREAKER
11. FORWARD JUNCTION BOX BUS

FIGURE 446 — WING FLAP AND LANDING GEAR POSITION INDICATOR CIRCUIT



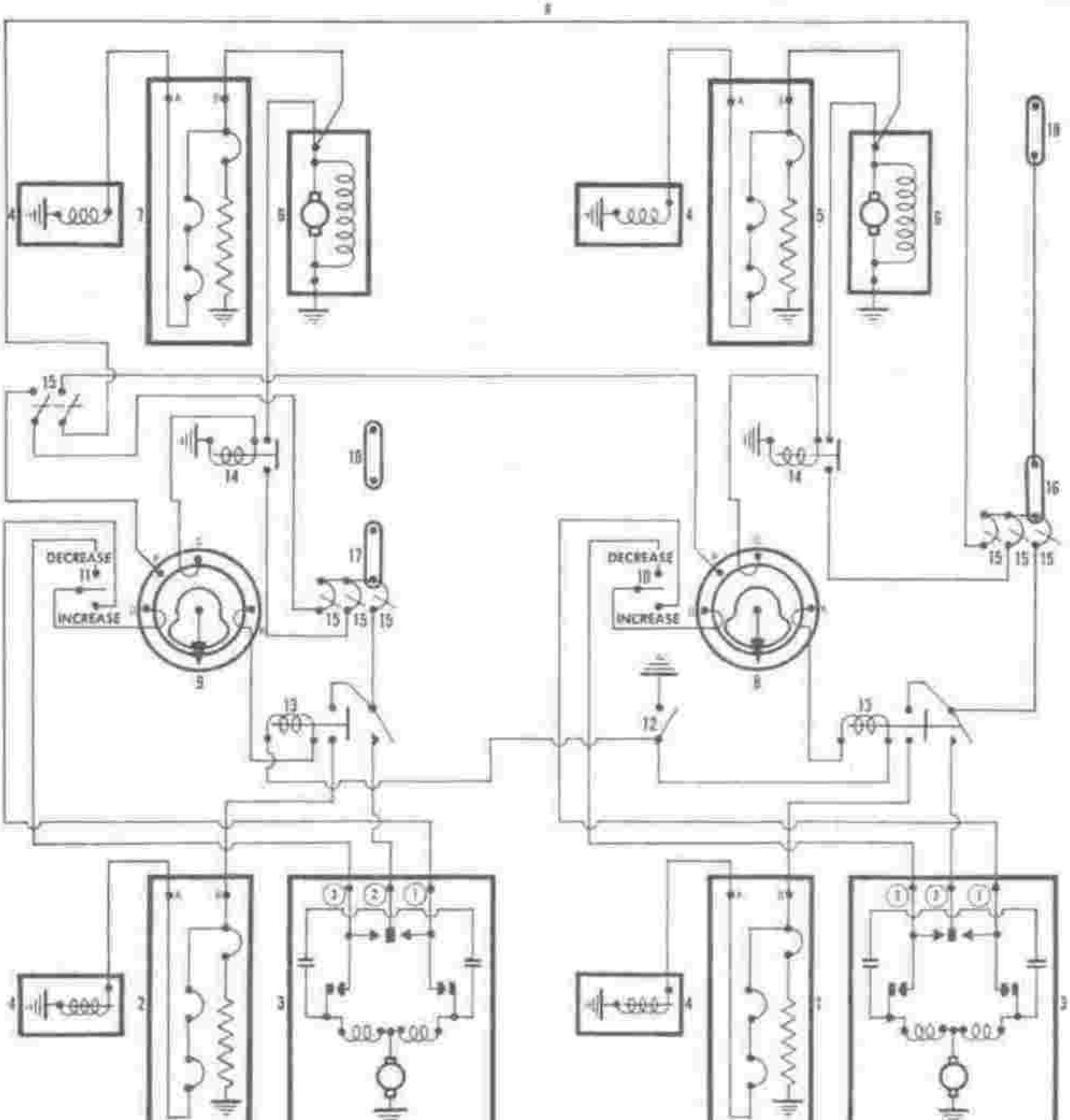
1. OIL COOLER DOOR MOTOR
2. FOLLOW-UP AND LIMIT SWITCH
3. L.H. OIL COOLER DOOR MOTOR SWITCH
4. R.H. OIL COOLER DOOR MOTOR SWITCH
5. OIL COOLER DOOR POSITION INDICATOR
6. OIL COOLER DOOR POSITION TRANSMITTER
7. CIRCUIT BREAKER
8. DISTRIBUTION PANEL BUS

FIGURE 447 — OIL COOLER DOOR MOTOR AND POSITION INDICATOR CIRCUIT



1. PITOT TUBE
2. PILOT'S PITOT TUBE HEATER SWITCH
3. CIRCUIT BREAKER
4. FORWARD JUNCTION BOX BUS

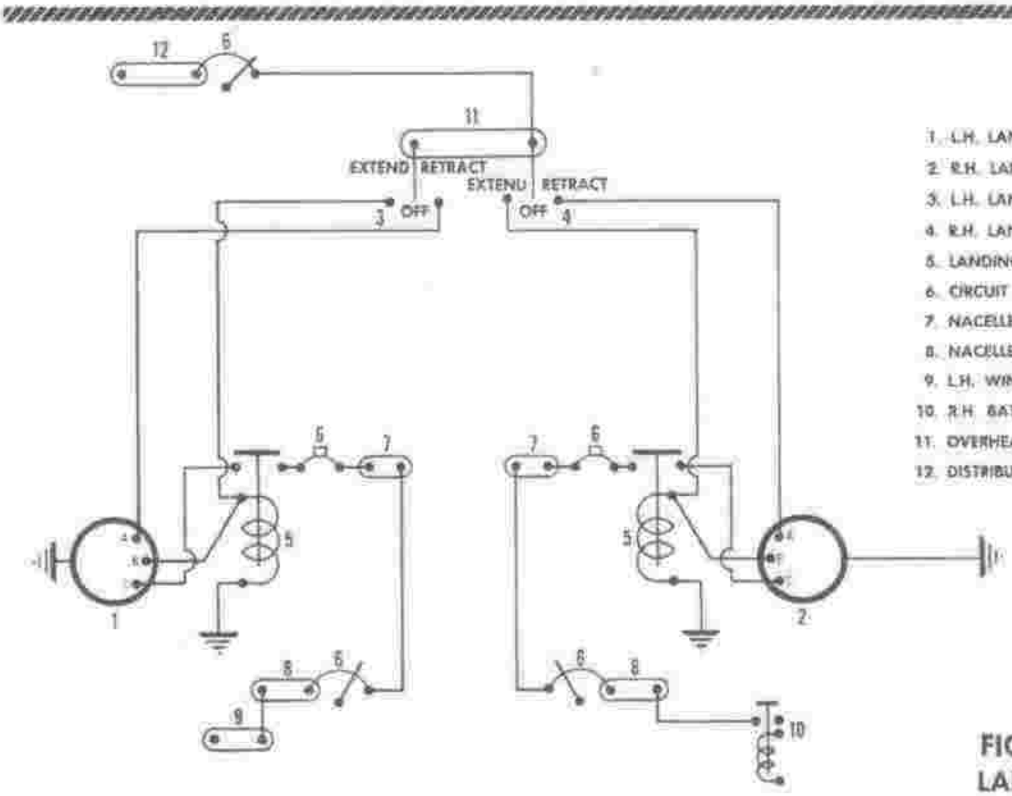
FIGURE 448 — PITOT TUBE HEATER CIRCUIT



1. AFT MAIN HEATER
2. FORWARD MAIN HEATER
3. MODULATOR UNIT
4. FUEL SHUT-OFF VALVE SOLENOID
5. AFT RECIRCULATING HEATER
6. RECIRCULATING HEATER MOTOR
7. FORWARD RECIRCULATING HEATER*
8. GUNNER'S AFT HEATERS CONTROL SWITCH
9. PILOT'S FORWARD HEATERS CONTROL SWITCH
10. GUNNER'S COLD AIR CONTROL SWITCH
11. PILOT'S COLD AIR CONTROL SWITCH
12. MAIN HEATER SAFETY SWITCH (NOSE GEAR TUNNEL)
13. MAIN HEATER RELAY
14. RECIRCULATING HEATER RELAY
15. CIRCUIT BREAKER
16. AFT RELAY BOX BUS
17. FORWARD JUNCTION BOX BUS
18. FUSELAGE BUS

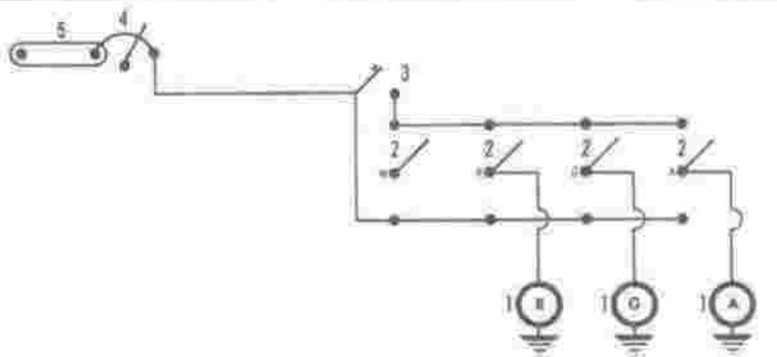
FIGURE 449 — HEATERS CIRCUIT

*On the A-26C Airplane this heater is moved forward to the Bombardier Nose. The same circuit and wiring is used.



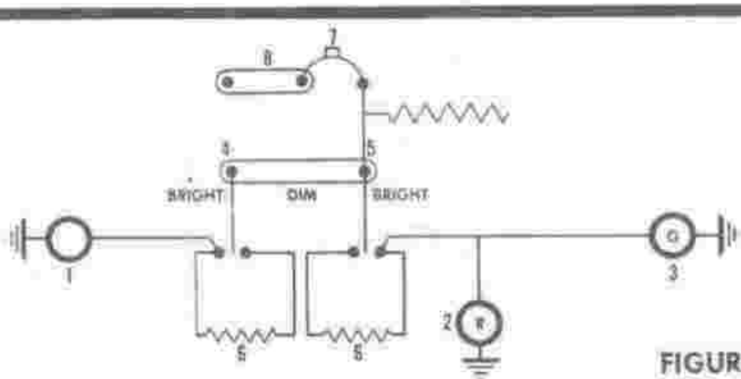
1. L.H. LANDING LAMP
2. R.H. LANDING LAMP
3. L.H. LANDING LAMP SWITCH
4. R.H. LANDING LAMP SWITCH
5. LANDING LAMP RELAY
6. CIRCUIT BREAKER
7. NACELLE RELAY JUNCTION BOX BUS
8. NACELLE STARTER RELAY BUS
9. L.H. WING BUS
10. R.H. BATTERY DISCONNECT RELAY
11. OVERHEAD CONTROL PANEL BUS
12. DISTRIBUTION PANEL BUS

FIGURE 450 — LANDING LAMPS CIRCUIT



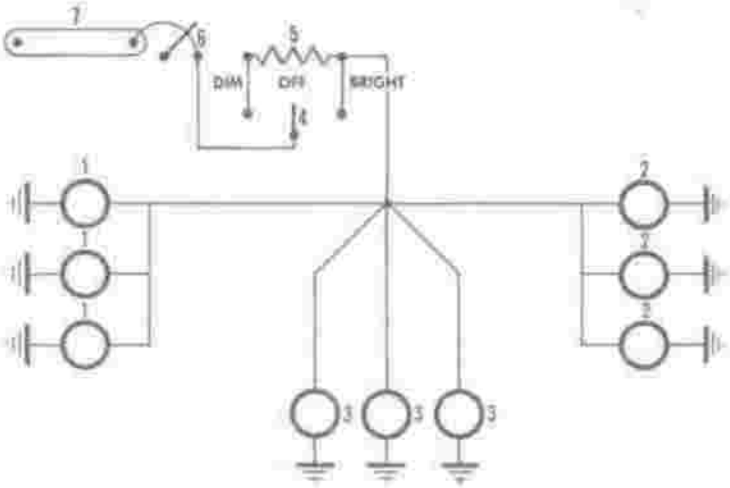
1. RECOGNITION LAMP
2. RECOGNITION LAMP SWITCH
3. RECOGNITION LAMP KEYING SWITCH
4. CIRCUIT BREAKER
5. DISTRIBUTION PANEL BUS

FIGURE 451 — RECOGNITION LAMPS CIRCUIT



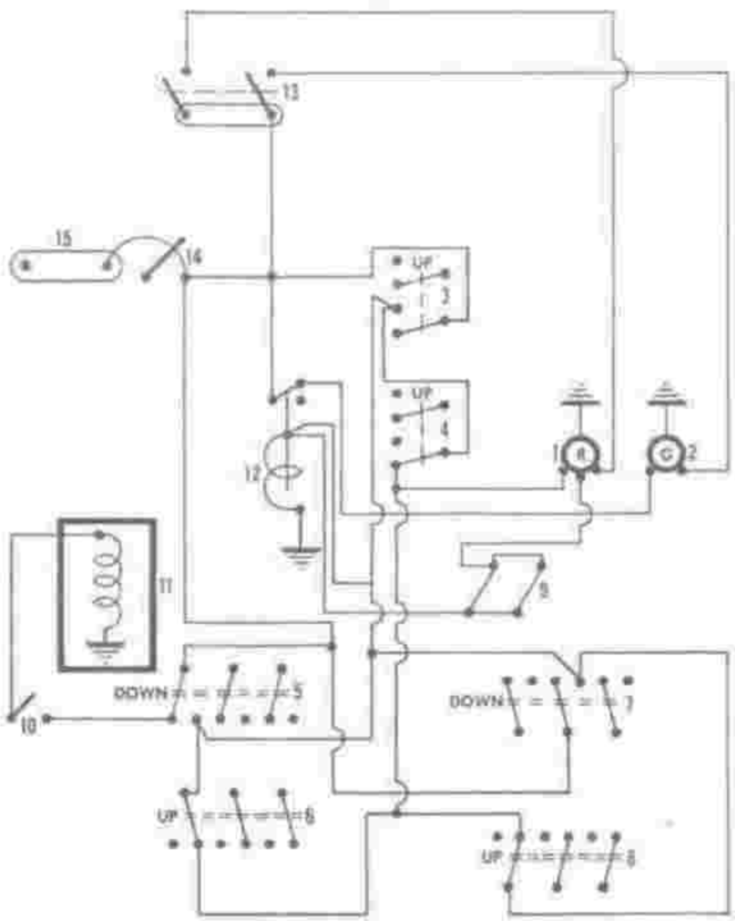
1. TAIL CONE POSITION LAMP
2. L.H. WING TIP POSITION LAMP
3. R.H. WING TIP POSITION LAMP
4. TAIL CONE POSITION LAMP SWITCH
5. WING TIP POSITION LAMP SWITCH
6. RESISTOR
7. CIRCUIT BREAKER
8. FORWARD JUNCTION BOX BUS

FIGURE 452 — POSITION LAMPS CIRCUIT



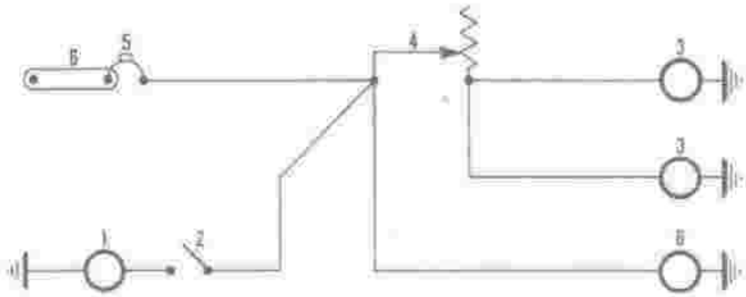
1. L.H. WING FORMATION LAMP
2. R.H. WING FORMATION LAMP
3. FUSELAGE FORMATION LAMP
4. FORMATION LAMPS SWITCH
5. RESISTOR
6. CIRCUIT BREAKER
7. FORWARD JUNCTION BOX BUS

FIGURE 453 — FORMATION LAMPS CIRCUIT



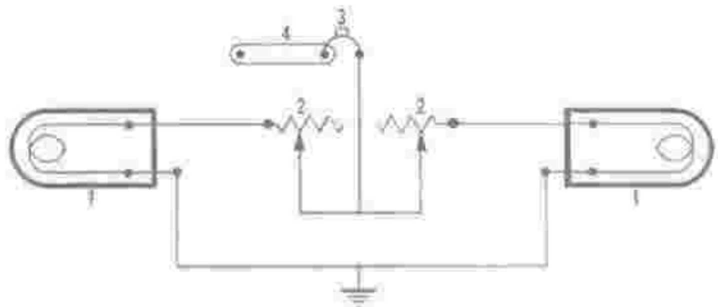
1. RED LANDING GEAR WARNING LAMP
2. GREEN LANDING GEAR WARNING LAMP
3. NOSE GEAR LATCHED DOWN SWITCH
4. NOSE GEAR LATCHED UP SWITCH
5. L.H. LANDING GEAR LATCH SWITCH
6. L.H. LANDING GEAR POSITION TRANSFER SWITCH
7. R.H. LANDING GEAR LATCH SWITCH
8. R.H. LANDING GEAR POSITION TRANSFER SWITCH
9. THROTTLE WARNING SIGNAL SWITCH
10. RETRACTION RELEASE SWITCH
11. LANDING GEAR SELECTOR SOLENOID
12. LANDING GEAR WARNING LAMPS RELAY
13. WARNING LAMPS TEST SWITCH
14. CIRCUIT BREAKER
15. DISTRIBUTION PANEL BUS

FIGURE 454 — LANDING GEAR WARNING LAMPS CIRCUIT



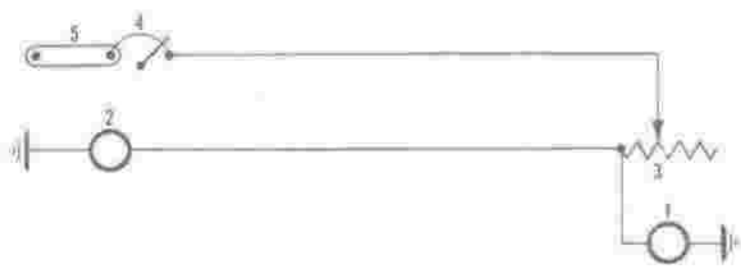
1. PILOT'S COMPARTMENT DOME LAMP
2. PILOT'S COMPARTMENT DOME LAMP SWITCH
3. COCKPIT LAMPS
4. COCKPIT LAMPS RHEOSTAT
5. CIRCUIT BREAKER
6. FORWARD JUNCTION BOX BUS

FIGURE 455 — PILOT'S COMPARTMENT LAMPS CIRCUIT



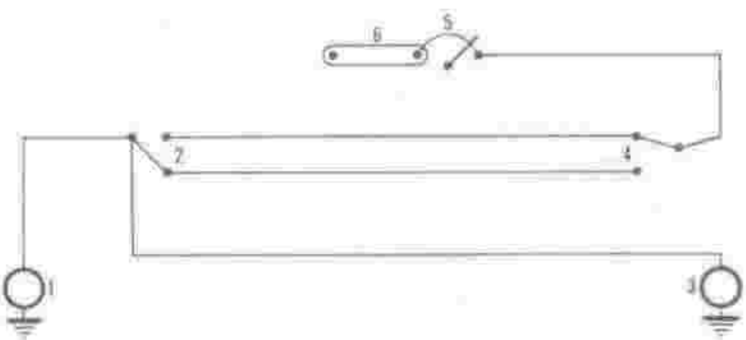
1. FLUORESCENT LAMP
2. FLUORESCENT LAMP RHEOSTAT
3. CIRCUIT BREAKER
4. FORWARD JUNCTION BOX BUS

FIGURE 456 — FLUORESCENT LAMPS CIRCUIT



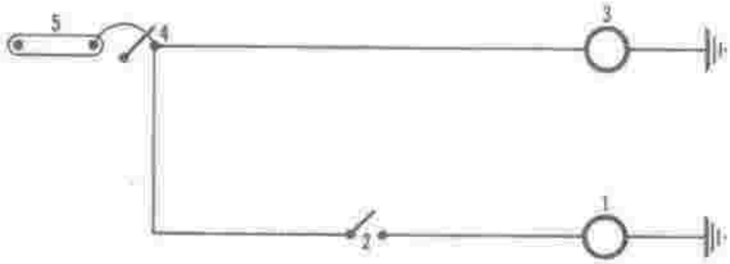
1. GUN SIGHT LAMP
2. TORPEDO DIRECTOR LAMP
3. GUN SIGHT AND TORPEDO DIRECTOR LAMPS RHEOSTAT
4. CIRCUIT BREAKER
5. DISTRIBUTION PANEL BUS

FIGURE 457 — GUN SIGHT AND TORPEDO DIRECTOR LAMPS CIRCUIT



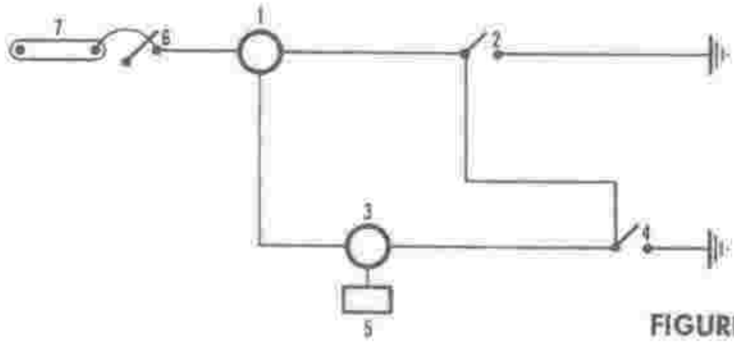
1. FORWARD BOMB BAY DOME LAMP
2. FORWARD BOMB BAY DOME LAMP SWITCH
3. AFT BOMB BAY DOME LAMP
4. AFT BOMB BAY DOME LAMP SWITCH
5. CIRCUIT BREAKER
6. GUNNER'S RELAY JUNCTION BOX BUS

FIGURE 458 — BOMB BAY DOME LAMPS CIRCUIT



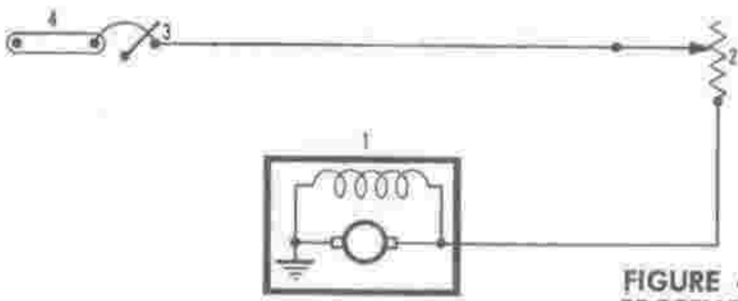
1. AFT FUSELAGE DOME LAMP
2. AFT FUSELAGE DOME LAMP SWITCH
3. GUNNER'S EXTENSION LAMP
4. CIRCUIT BREAKER
5. GUNNER'S RELAY JUNCTION BOX BUS

FIGURE 459 — GUNNER'S LAMPS CIRCUIT



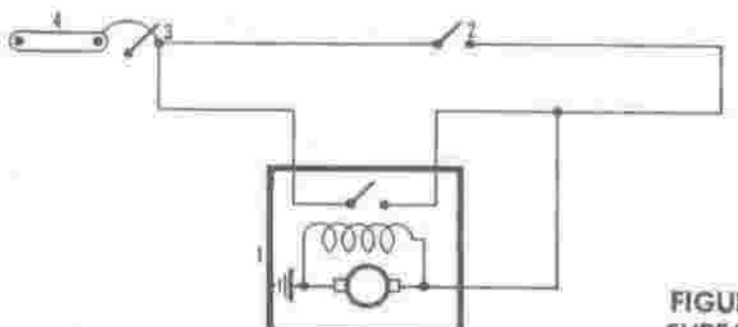
1. GUNNER'S INTERCALL SIGNAL LAMP
2. GUNNER'S INTERCALL SIGNAL LAMP KEYING SWITCH
3. PILOT'S INTERCALL SIGNAL LAMP
4. PILOT'S INTERCALL SIGNAL LAMP KEYING SWITCH
5. BOMBER NOSE DISCONNECT RECEPTACLE
6. CIRCUIT BREAKER
7. GUNNER'S RELAY JUNCTION BOX BUS

FIGURE 460 — INTERCALL SIGNAL CIRCUIT



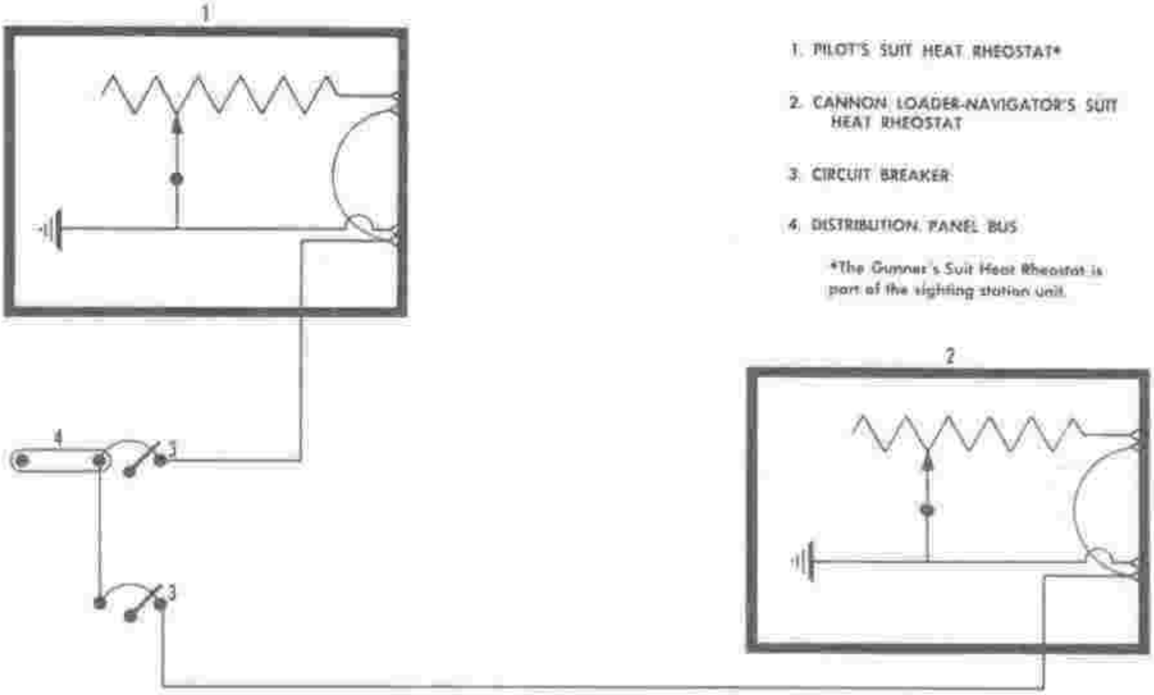
1. PROPELLER ANTI-ICER PUMP MOTOR
2. PROPELLER ANTI-ICER RHEOSTAT
3. CIRCUIT BREAKER
4. DISTRIBUTION PANEL BUS

FIGURE 461 —
PROPELLER ANTI-ICER PUMP MOTOR CIRCUIT



1. DE-ICER MOTOR UNIT
2. SURFACES DE-ICER SWITCH
3. CIRCUIT BREAKER
4. DISTRIBUTION PANEL BUS

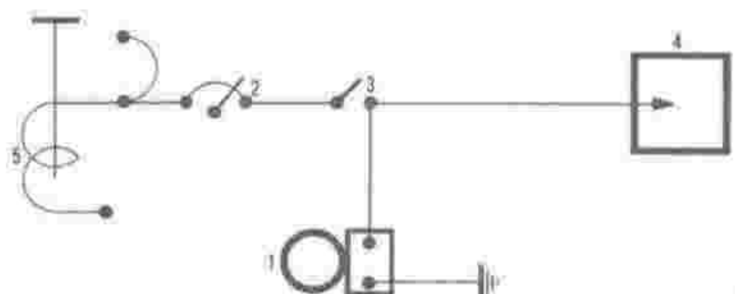
FIGURE 462 —
SURFACES DE-ICER PUMP MOTOR CIRCUIT



1. PILOT'S SUIT HEAT RHEOSTAT*
2. CANNON LOADER-NAVIGATOR'S SUIT HEAT RHEOSTAT
3. CIRCUIT BREAKER
4. DISTRIBUTION PANEL BUS

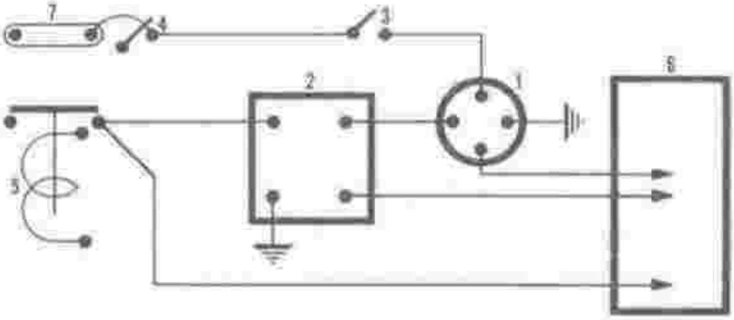
*The Gunner's Suit Heat Rheostat is part of the sighting station unit.

FIGURE 463 — SUIT HEAT RHEOSTATS CIRCUIT



1. ALARM BELL
2. CIRCUIT BREAKER
3. PILOT'S ALARM BELL SWITCH
4. BOMBER NOSE DISCONNECT RECEPTACLE
5. BATTERY RELAY (REF.)

FIGURE 464 — ALARM BELL CIRCUIT



1. ORIENTATION CAMERA
2. ORIENTATION CAMERA INTERVALOMETER
3. PILOT'S ORIENTATION CAMERA SWITCH
4. CIRCUIT BREAKER
5. DEMOLITION BOMB RELAY (REF.)
6. BOMBER NOSE DISCONNECT RECEPTACLE
7. FORWARD JUNCTION BOX BUS

FIGURE 465 — ORIENTATION CAMERA CIRCUIT

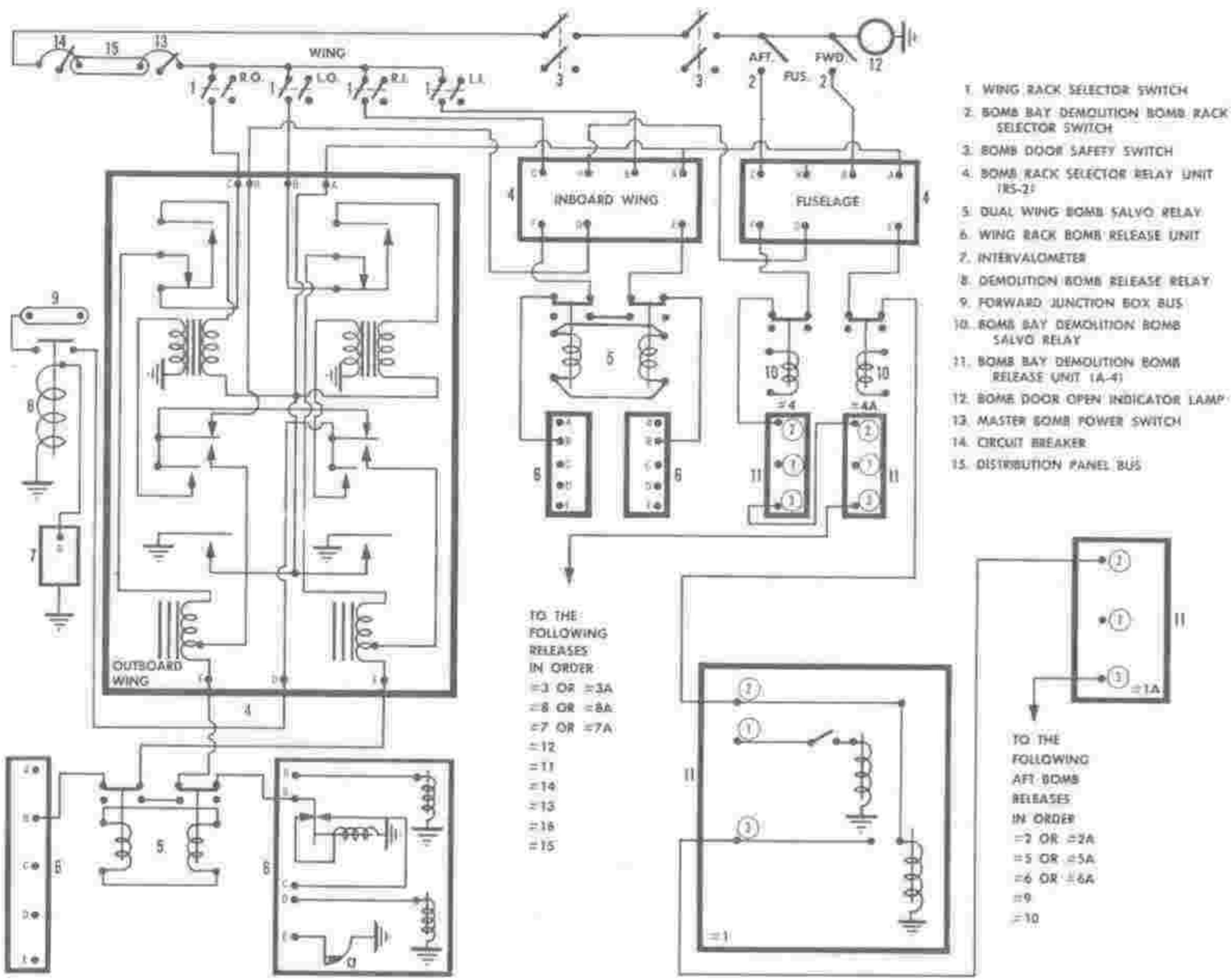
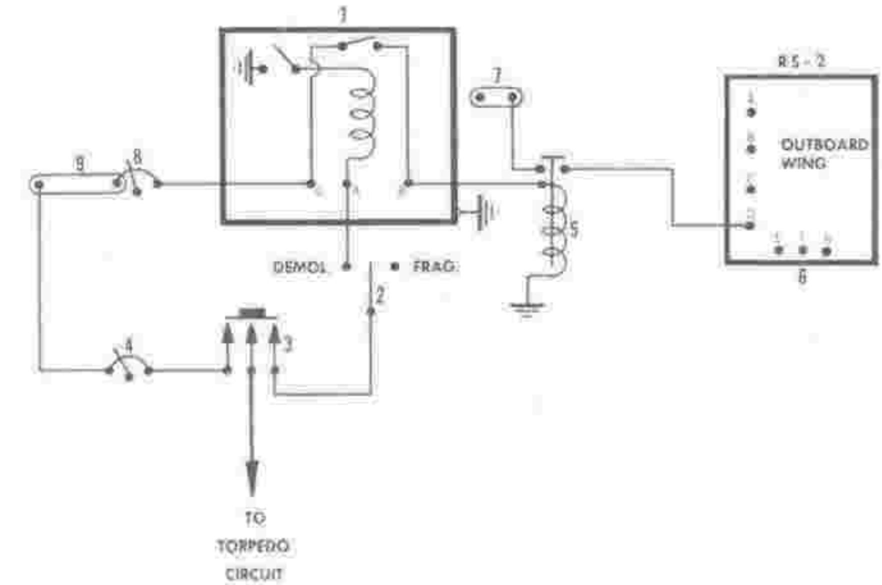
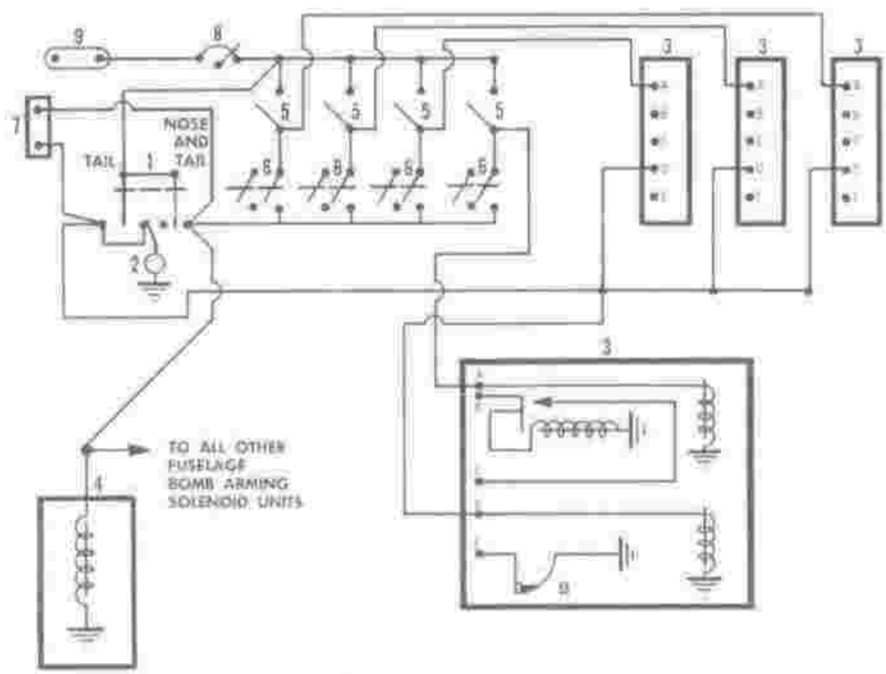


FIGURE 466 — DEMOLITION BOMB RELEASE CIRCUIT



1. BOMB INTERVALOMETER
2. FRAGMENTATION — DEMOLITION BOMB SELECTOR SWITCH
3. BOMB FIRING PUSH BUTTON SWITCH
4. MASTER BOMB POWER SWITCH
5. DEMOLITION BOMB RELEASE RELAY
6. BOMB RACK SELECTOR RELAY UNIT (RS-2)
7. FORWARD JUNCTION BOX BUS
8. CIRCUIT BREAKER
9. DISTRIBUTION PANEL BUS

FIGURE 467 — BOMB INTERVALOMETER CIRCUIT



1. DEMOLITION BOMB ARMING SWITCH
2. BOMBS ARMED INDICATOR LAMP
3. WING RACK BOMB RELEASE UNIT
4. BOMB BAY DEMOLITION BOMB ARMING UNIT
5. WING CHEMICAL RELEASE SWITCH*
6. WING BOMB RACK SELECTOR SWITCH
7. BOMBER NOSE DISCONNECT RECEPTACLE
8. MASTER BOMB POWER SWITCH
9. DISTRIBUTION PANEL BUS

*Shown for reference only

FIGURE 468 — BOMB ARMING CIRCUIT

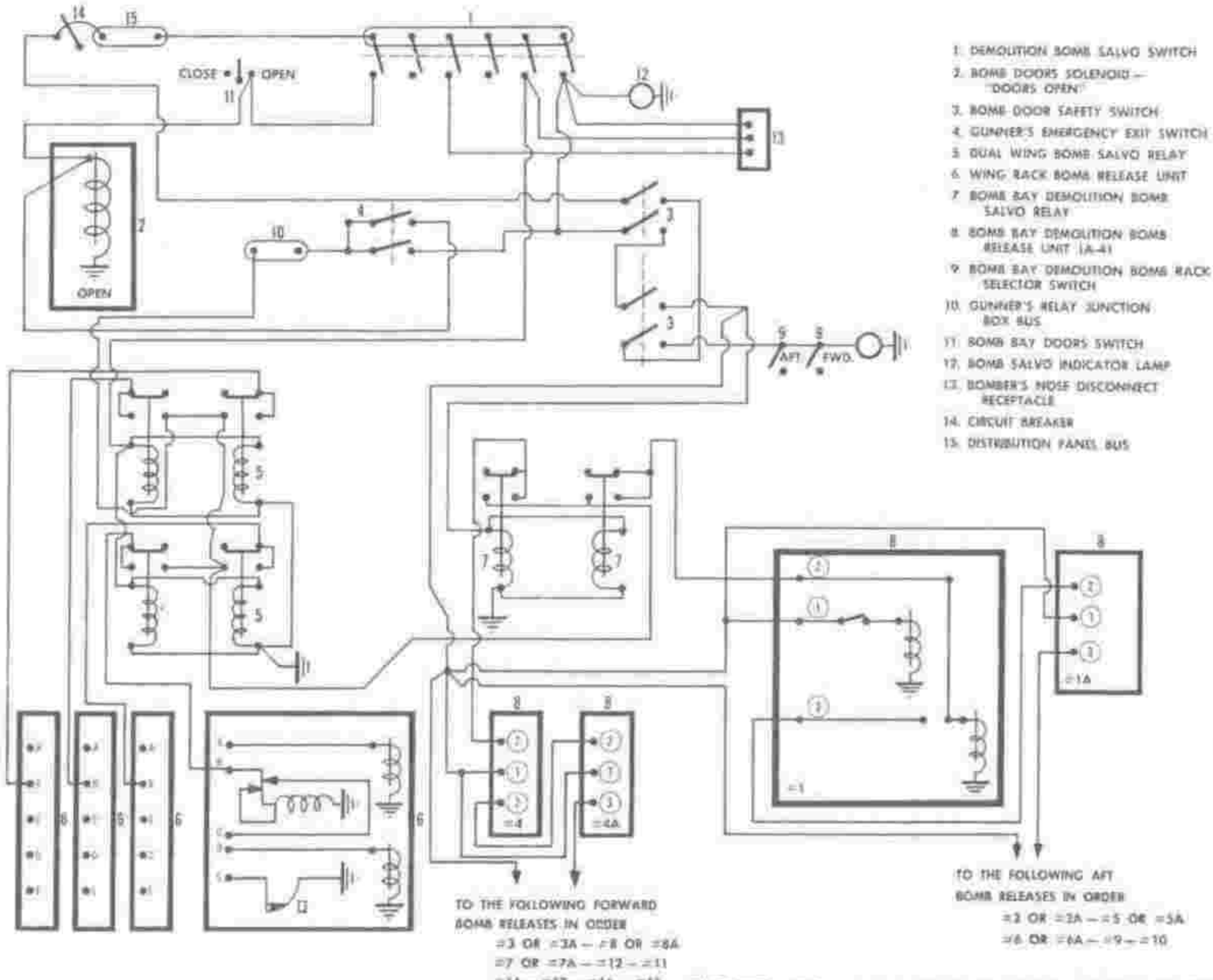


FIGURE 469 — DEMOLITION BOMB SALVO CIRCUIT

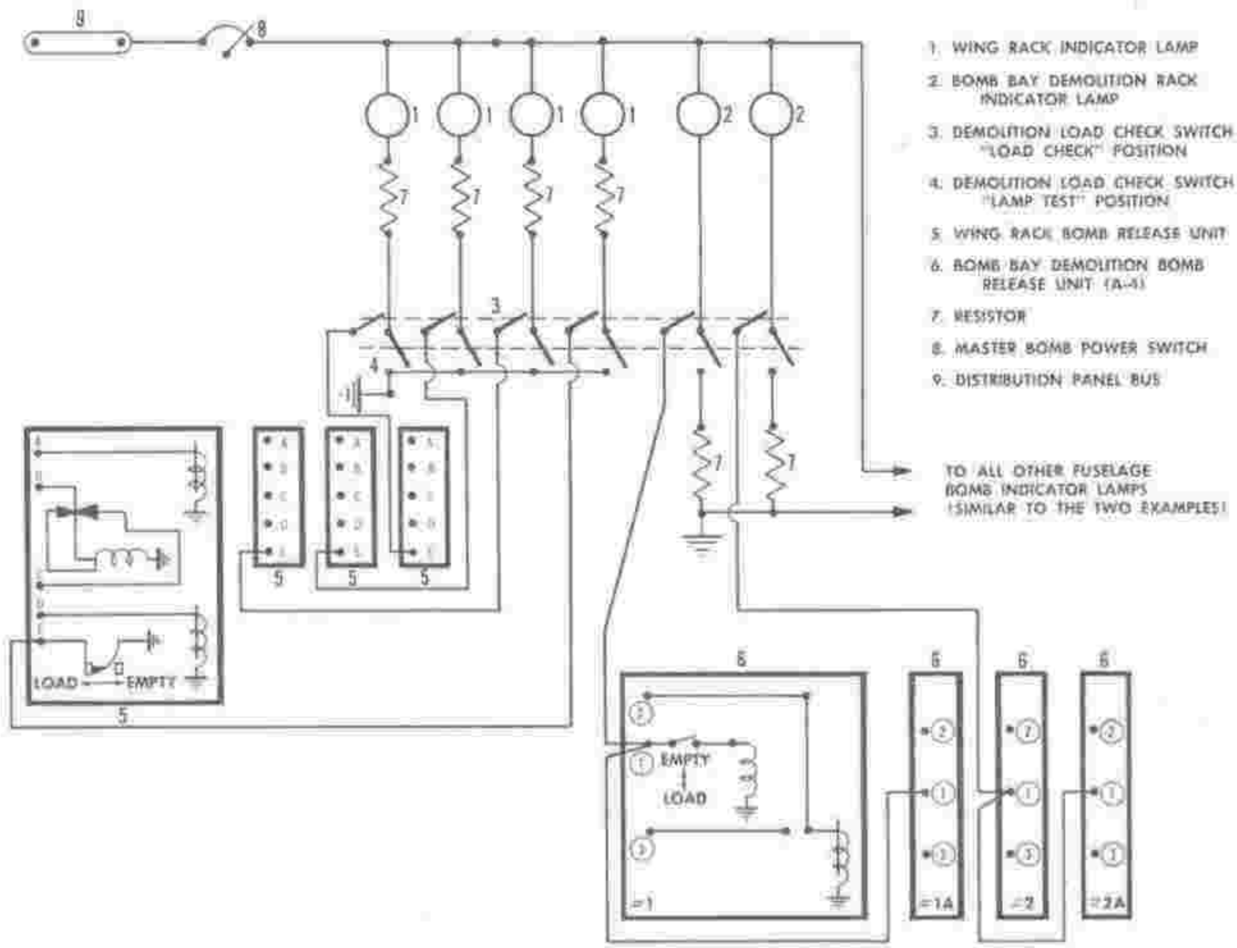
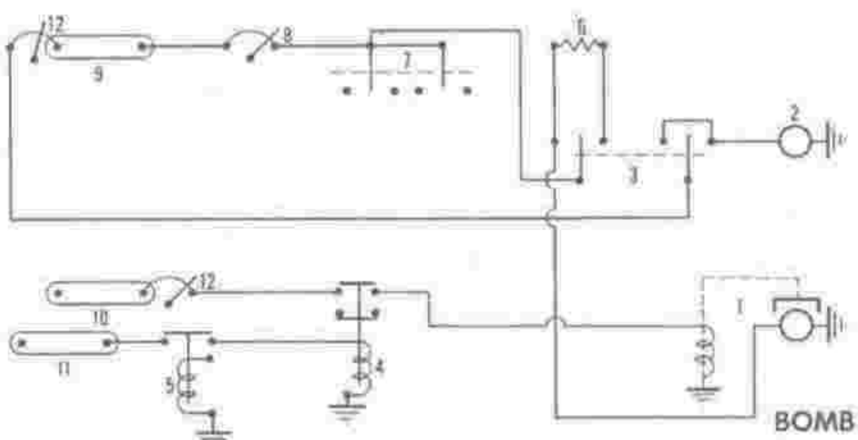
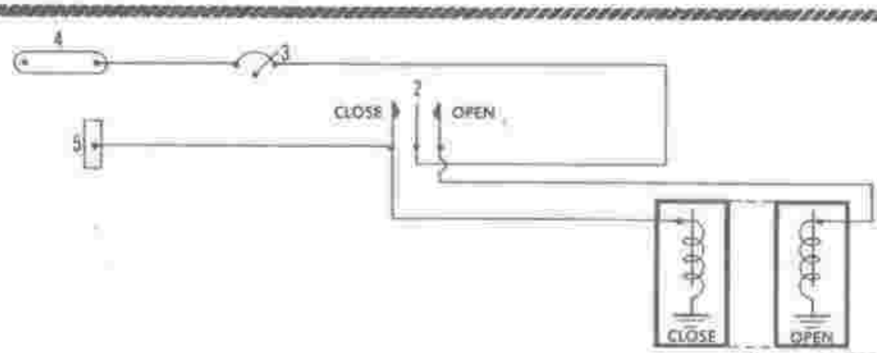


FIGURE 470 — DEMOLITION BOMB LOAD CHECK INDICATOR LAMPS CIRCUIT



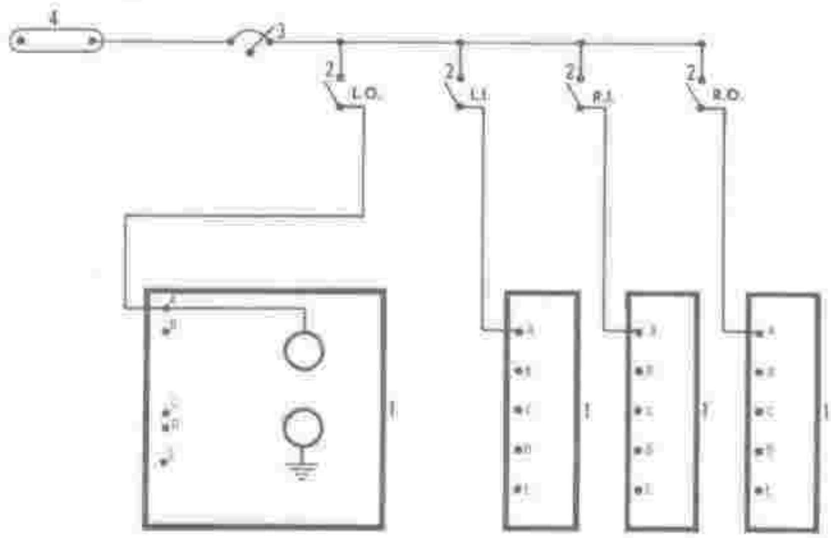
1. BOMB RELEASE SIGNAL LAMP (TAIL CONE)
2. BOMB RELEASE SIGNAL INDICATOR LAMP (PANEL)
3. BOMB RELEASE SIGNAL LAMP SWITCH
4. AGASTAT TIME DELAY RELAY
5. DEMOLITION BOMB RELEASE RELAY
6. RESISTOR
7. DEMOLITION BOMB ARMING SWITCH
8. MASTER BOMB POWER SWITCH
9. DISTRIBUTION PANEL BUS
10. GUNNER'S RELAY JUNCTION BOX BUS
11. FORWARD JUNCTION BOX BUS
12. CIRCUIT BREAKER

FIGURE 471 — BOMB RELEASE SIGNAL LAMP CIRCUIT



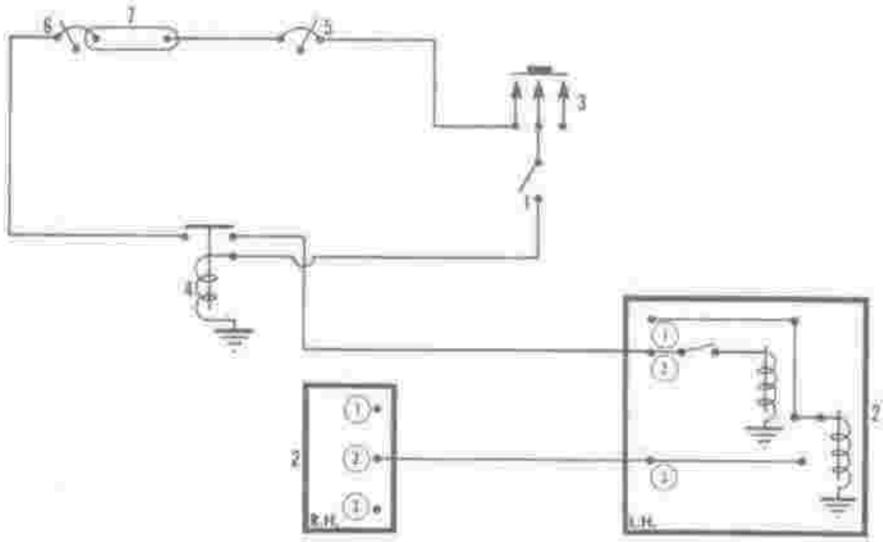
1. BOMB DOOR SOLENOID UNIT
2. BOMB DOOR SWITCH
3. MASTER BOMB POWER SWITCH
4. DISTRIBUTION PANEL BUS
5. BOMBER NOSE DISCONNECT RECEPTACLE

FIGURE 472 — BOMB DOOR SOLENOID CIRCUIT



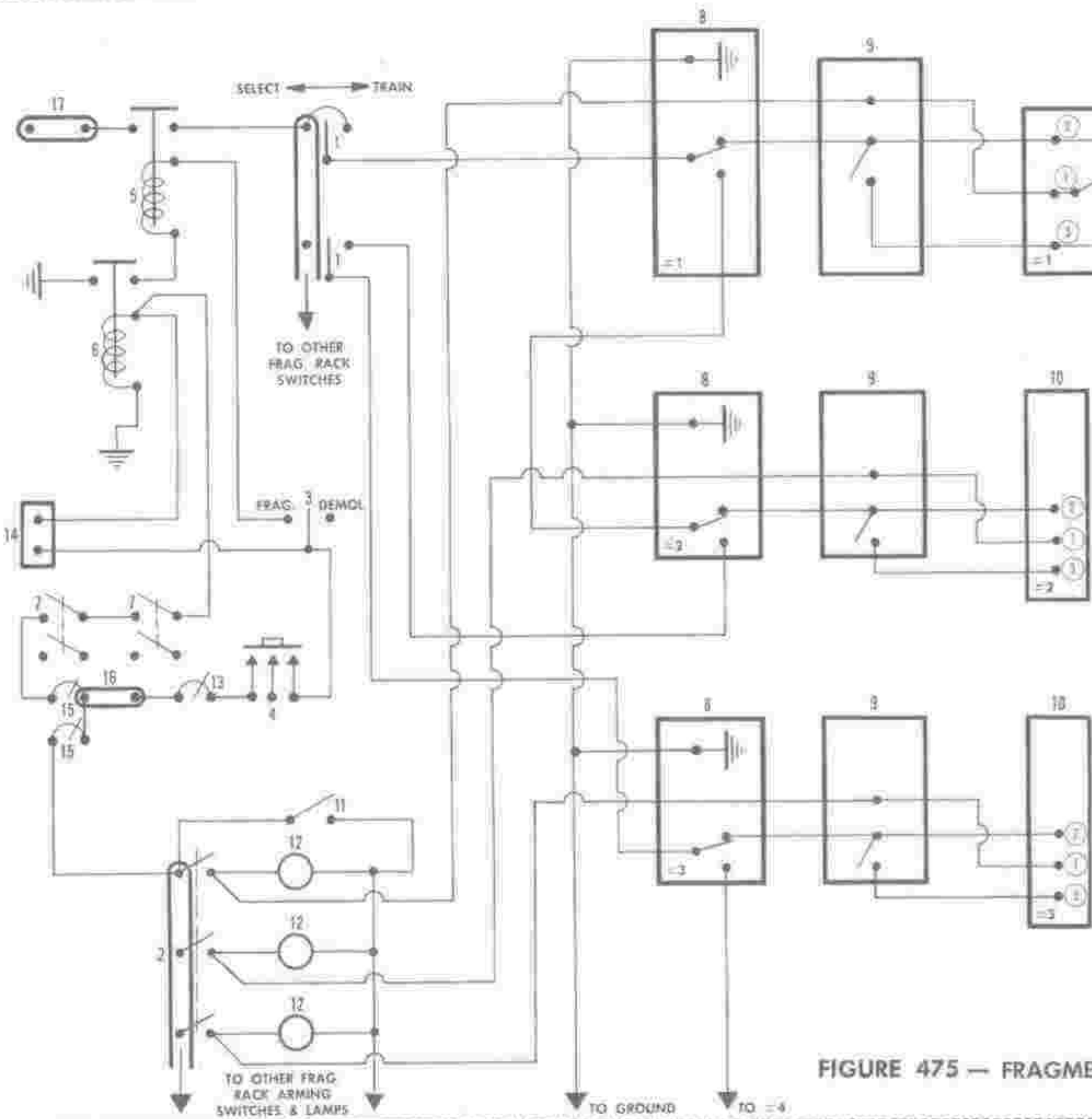
1. WING RACK CHEMICAL TANK RELEASE UNIT
2. CHEMICAL RELEASE SWITCH
3. MASTER BOMB POWER SWITCH
4. DISTRIBUTION PANEL BUS

FIGURE 473 — CHEMICAL FIRING CIRCUIT



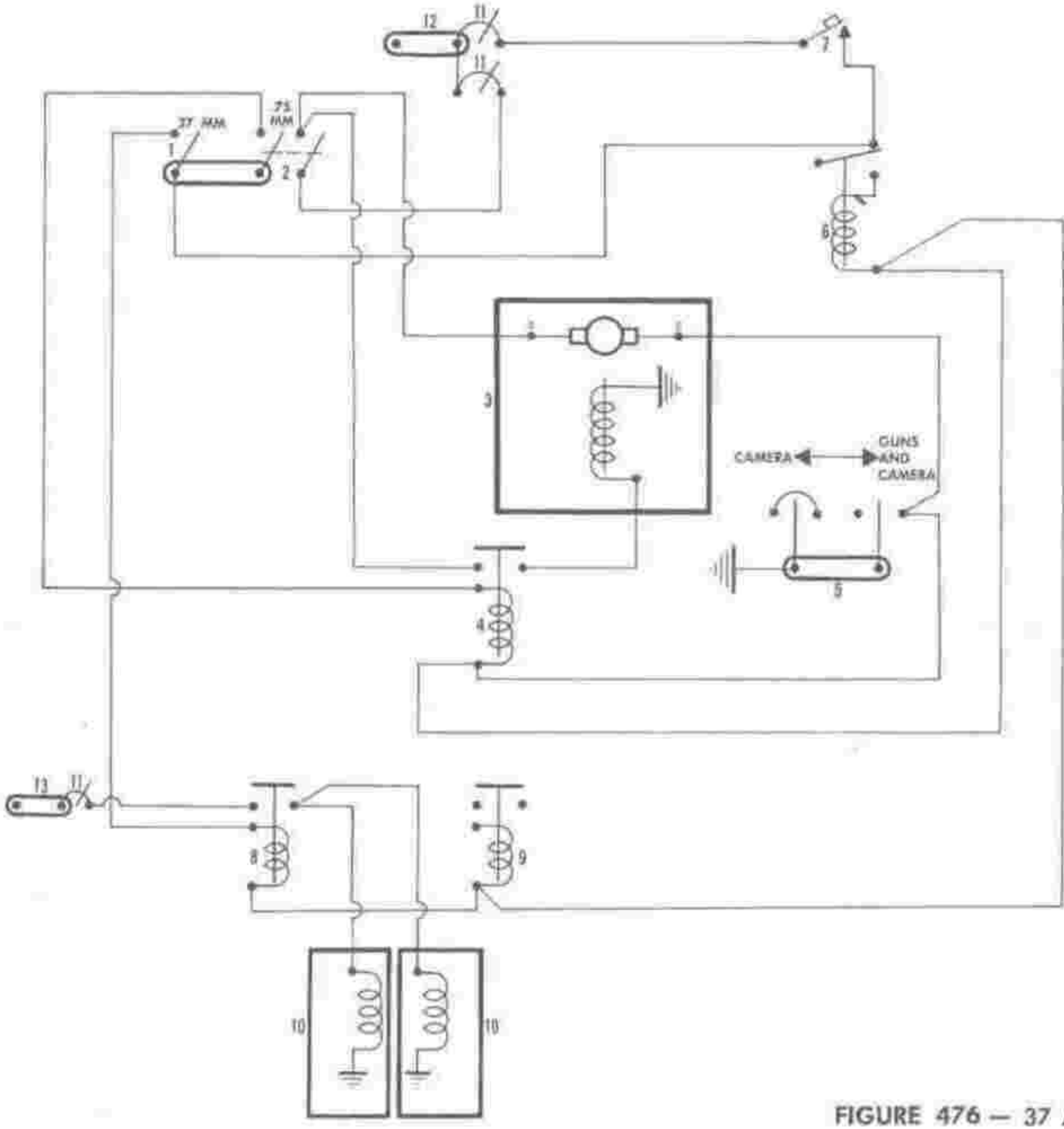
1. TORPEDO CIRCUIT SWITCH
2. TORPEDO RELEASE UNIT (A-4)
3. BOMB FIRING PUSH BUTTON SWITCH
4. TORPEDO RELEASE RELAY
5. MASTER BOMB POWER SWITCH
6. CIRCUIT BREAKER
7. DISTRIBUTION PANEL BUS

FIGURE 474 — TORPEDO RELEASE CIRCUIT



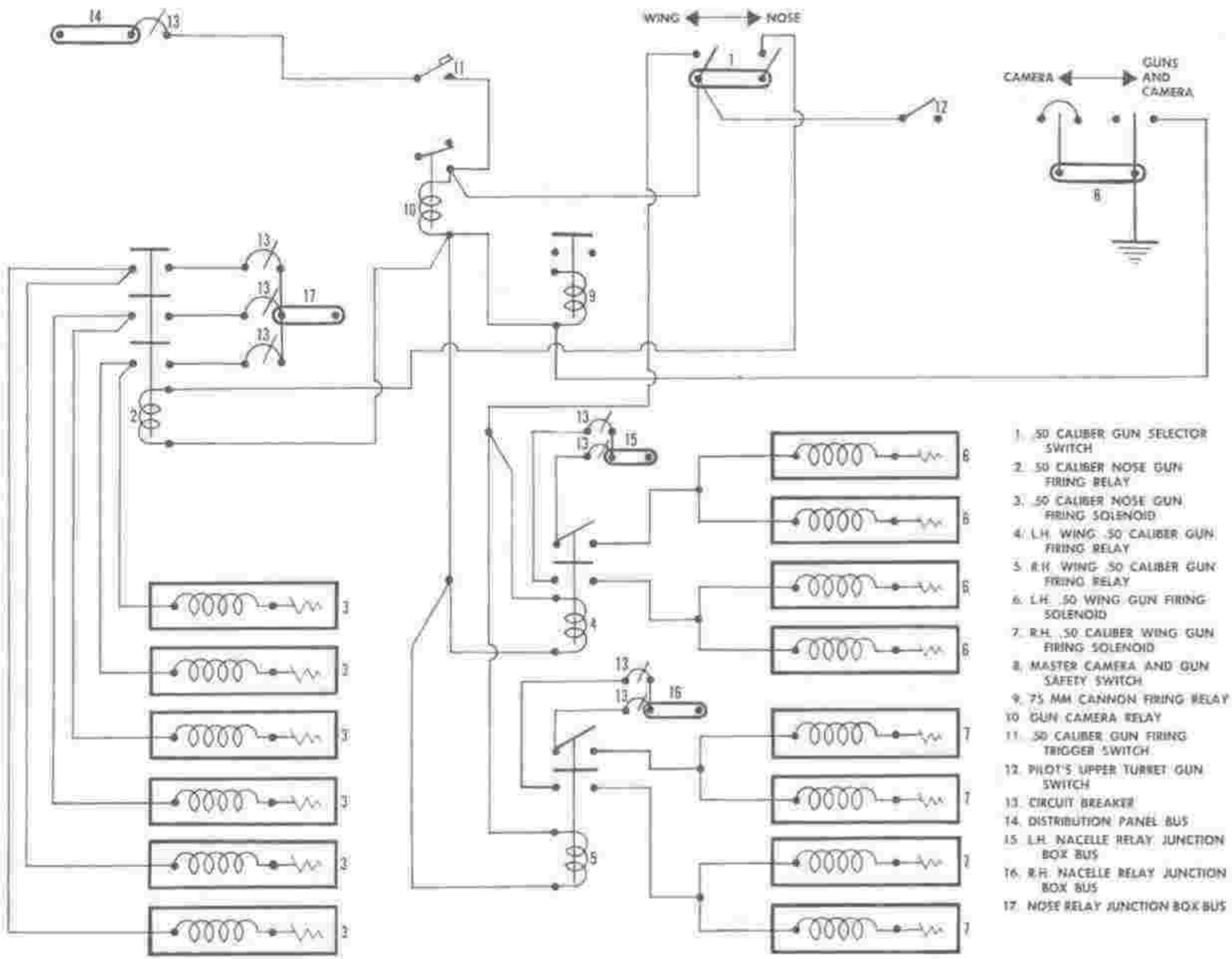
1. FRAGMENTATION BOMB RACK SELECTOR SWITCH
2. FRAGMENTATION ARMING SWITCH
3. FRAGMENTATION—DEMOLITION BOMB SELECTOR SWITCH
4. BOMB FIRING PUSH BUTTON SWITCH
5. FRAGMENTATION BOMB RELEASE RELAY
6. BOMB DOOR SAFETY RELAY
7. BOMB DOOR SAFETY SWITCH
8. SKIP STATION SWITCH
9. BOMB RELEASE RECEPTACLE (A-1)
10. BOMB RELEASE UNIT (A-4)
11. FRAGMENTATION BOMB LOAD CHECK SWITCH
12. FRAGMENTATION BOMB LOAD INDICATOR LAMP
13. MASTER BOMB POWER SWITCH
14. BOMBER NOSE DISCONNECT RECEPTACLE
15. CIRCUIT BREAKER
16. DISTRIBUTION PANEL BUS
17. FORWARD JUNCTION BOX BUS

FIGURE 475 — FRAGMENTATION BOMB CIRCUIT



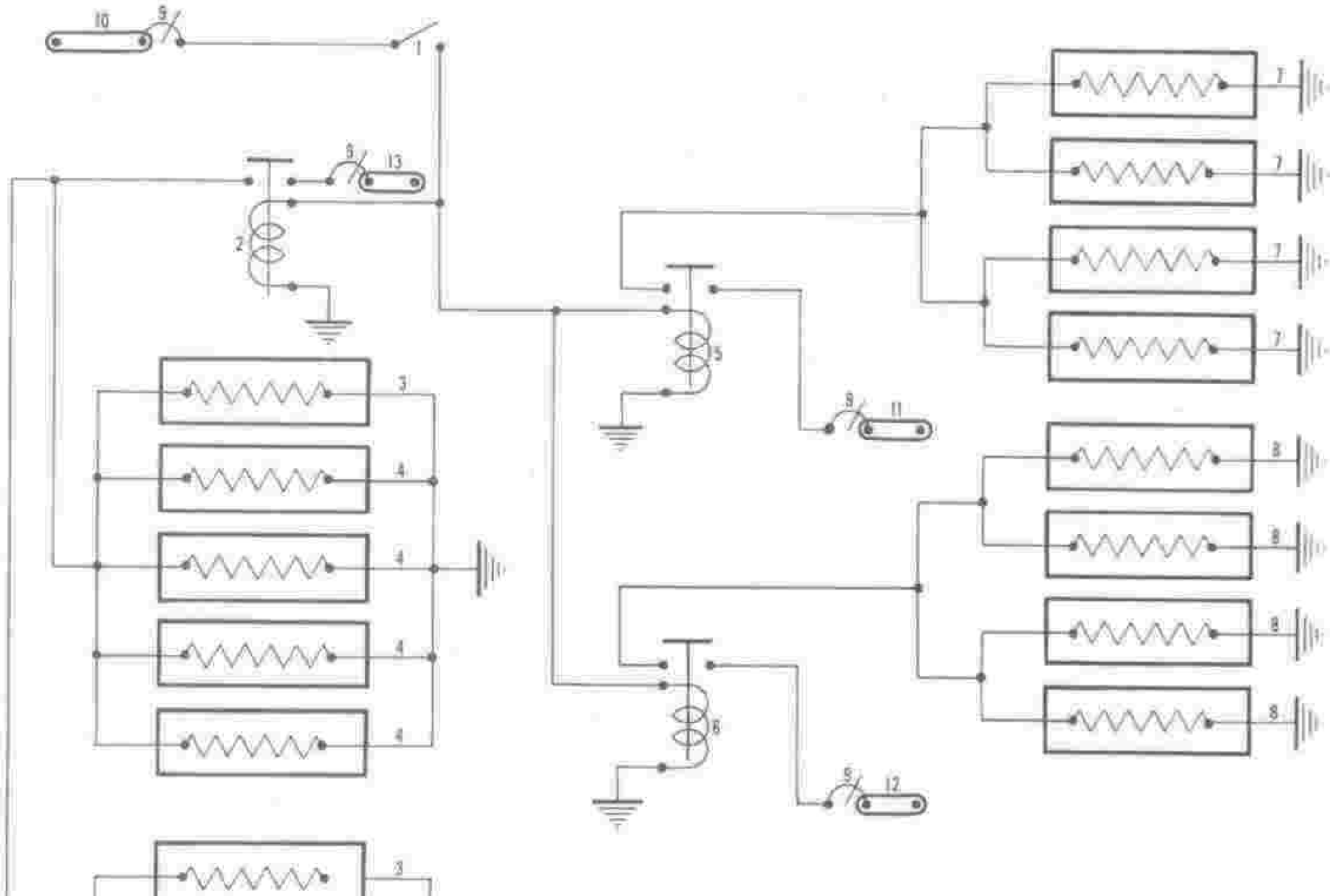
1. 37 MM CANNON SWITCH
2. 75 MM CANNON SWITCH
3. 75 MM CANNON FIRING MOTOR AND SOLENOID
4. 75 MM CANNON FIRING RELAY
5. MASTER GUN SAFETY AND CAMERA SWITCH
6. GUN CAMERA RELAY
7. CANNON FIRING TRIGGER SWITCH
8. 37 MM CANNON FIRING RELAY
9. .50 CALIBER GUN FIRING RELAY
10. 37 MM CANNON FIRING SOLENOID
11. CIRCUIT BREAKER
12. DISTRIBUTION PANEL BUS
13. NOSE RELAY JUNCTION BOX BUS

FIGURE 476 — 37 AND 75 MM CANNON CIRCUIT



1. .50 CALIBER GUN SELECTOR SWITCH
2. .50 CALIBER NOSE GUN FIRING RELAY
3. .50 CALIBER NOSE GUN FIRING SOLENOID
4. L.H. WING .50 CALIBER GUN FIRING RELAY
5. R.H. WING .50 CALIBER GUN FIRING RELAY
6. L.H. .50 WING GUN FIRING SOLENOID
7. R.H. .50 CALIBER WING GUN FIRING SOLENOID
8. MASTER CAMERA AND GUN SAFETY SWITCH
9. 75 MM CANNON FIRING RELAY
10. GUN CAMERA RELAY
11. .50 CALIBER GUN FIRING TRIGGER SWITCH
12. PILOT'S UPPER TURRET GUN SWITCH
13. CIRCUIT BREAKER
14. DISTRIBUTION PANEL BUS
15. L.H. NACELLE RELAY JUNCTION BOX BUS
16. R.H. NACELLE RELAY JUNCTION BOX BUS
17. NOSE RELAY JUNCTION BOX BUS

FIGURE 477 — .50 CALIBER GUN CIRCUIT



1. GUN HEATERS SWITCH
2. NOSE GUN HEATERS RELAY
3. 37 MM CANNON HEATER
4. .50 CALIBER NOSE GUN HEATER
5. L.H. WING GUN HEATERS RELAY
6. R.H. WING GUN HEATERS RELAY
7. L.H. WING .50 CALIBER GUN HEATER
8. R.H. WING .50 CALIBER GUN HEATER
9. CIRCUIT BREAKER
10. DISTRIBUTION PANEL BUS
11. L.H. NACELLE RELAY JUNCTION BOX BUS
12. R.H. NACELLE RELAY JUNCTION BOX BUS
13. NOSE RELAY JUNCTION BOX BUS

FIGURE 478 — GUN HEATER CIRCUIT

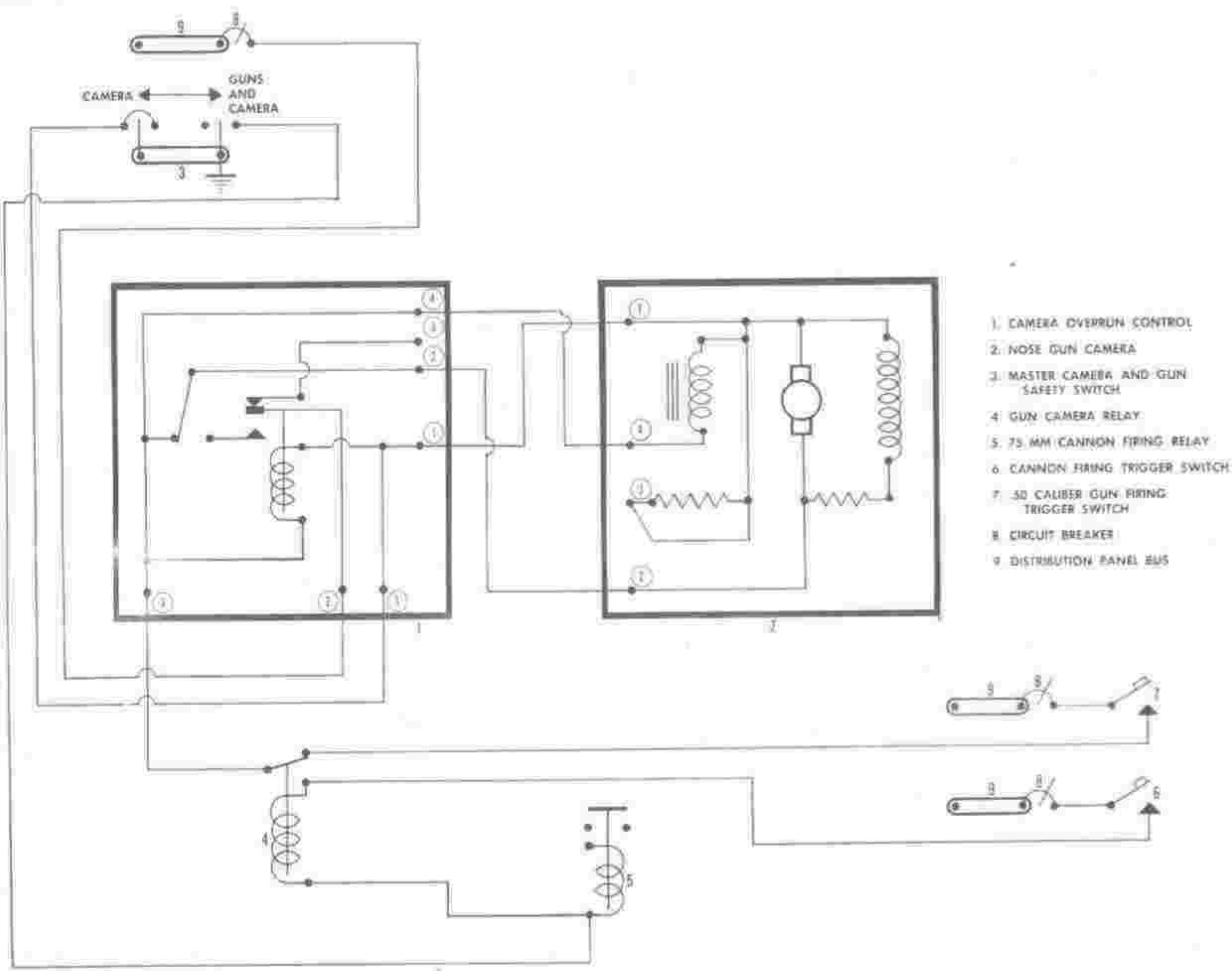


FIGURE 479 — NOSE GUN CAMERA CIRCUIT

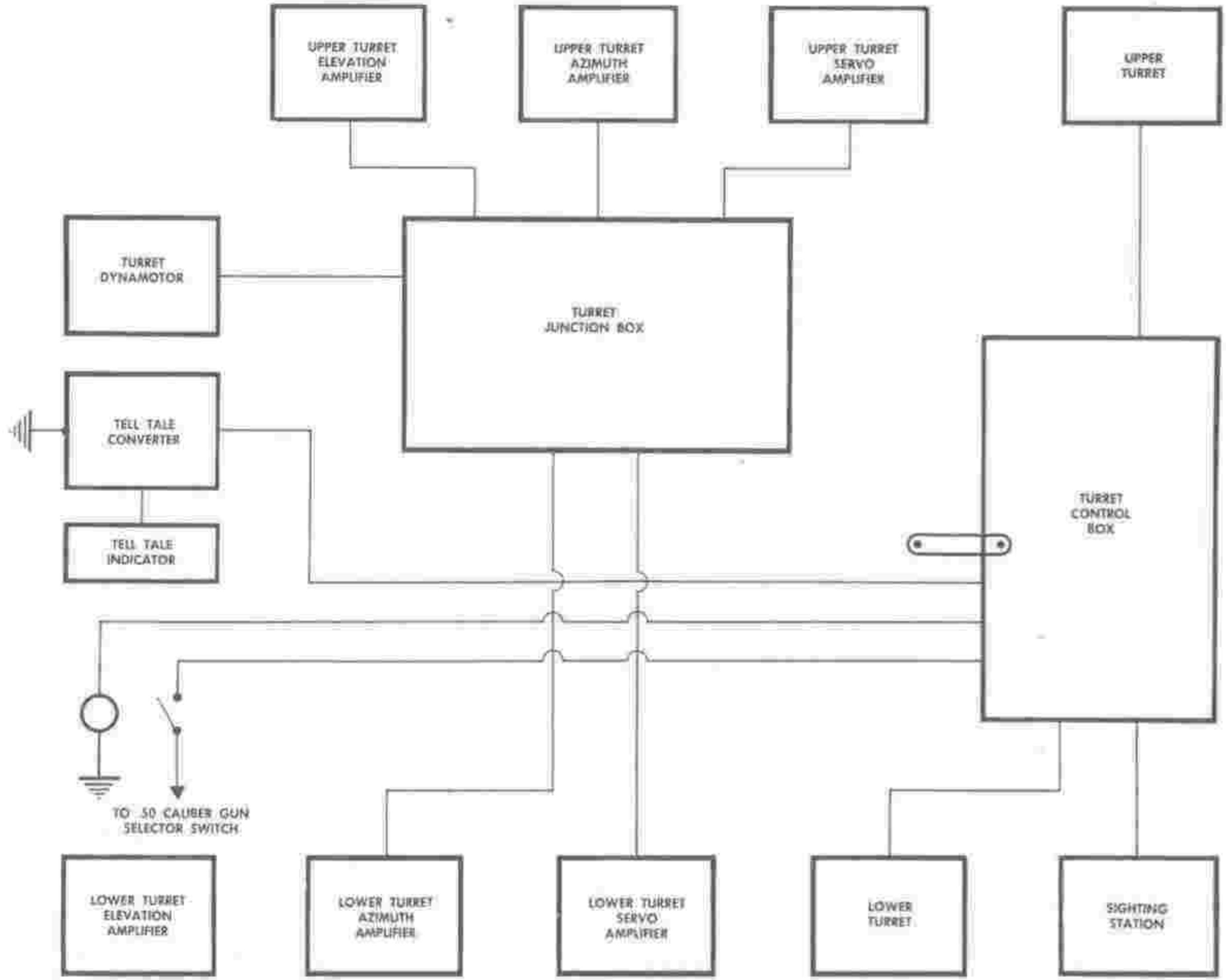


FIGURE 480 — TURRET SYSTEM CIRCUIT

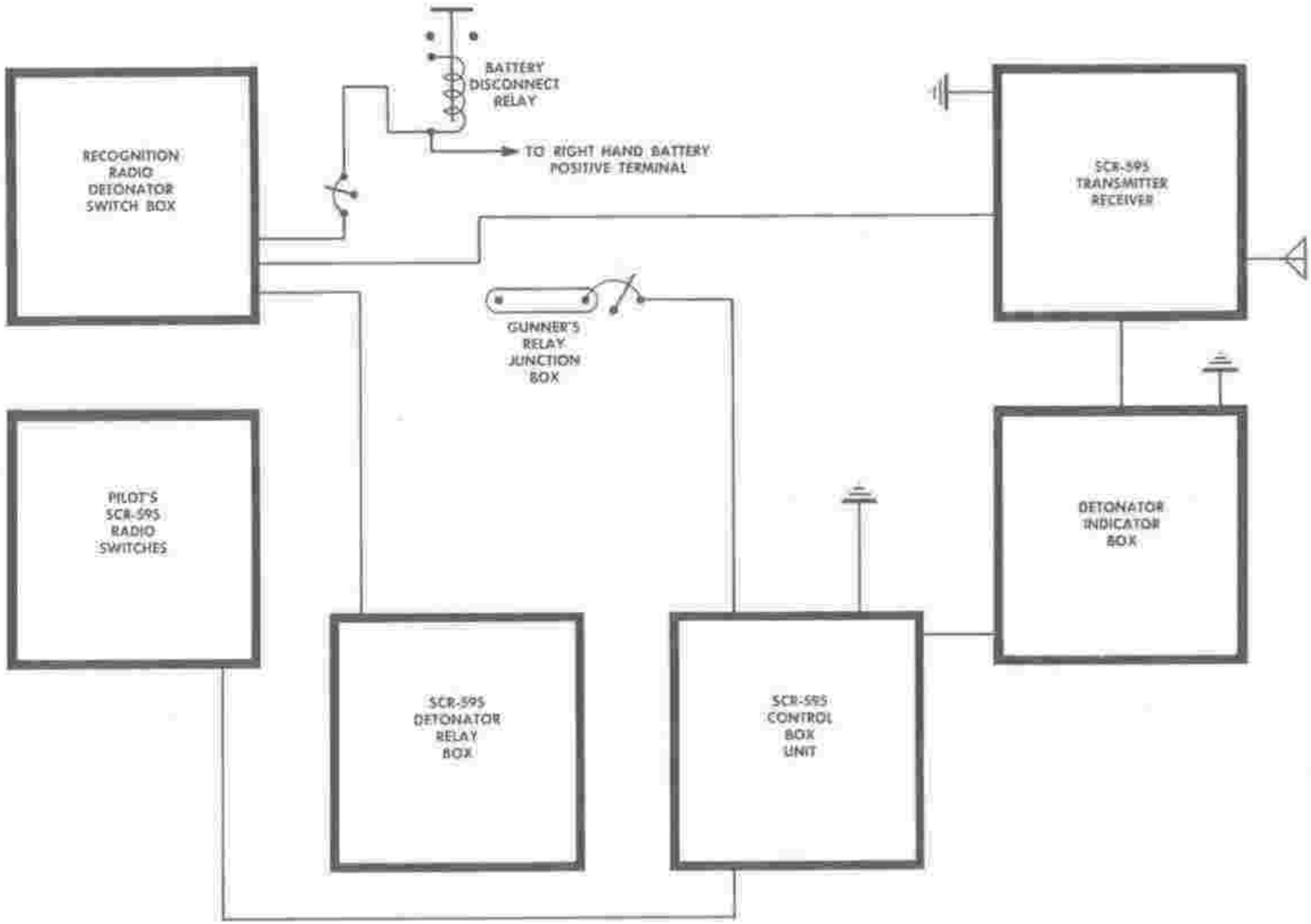


FIGURE 481 — RECOGNITION RADIO CIRCUIT

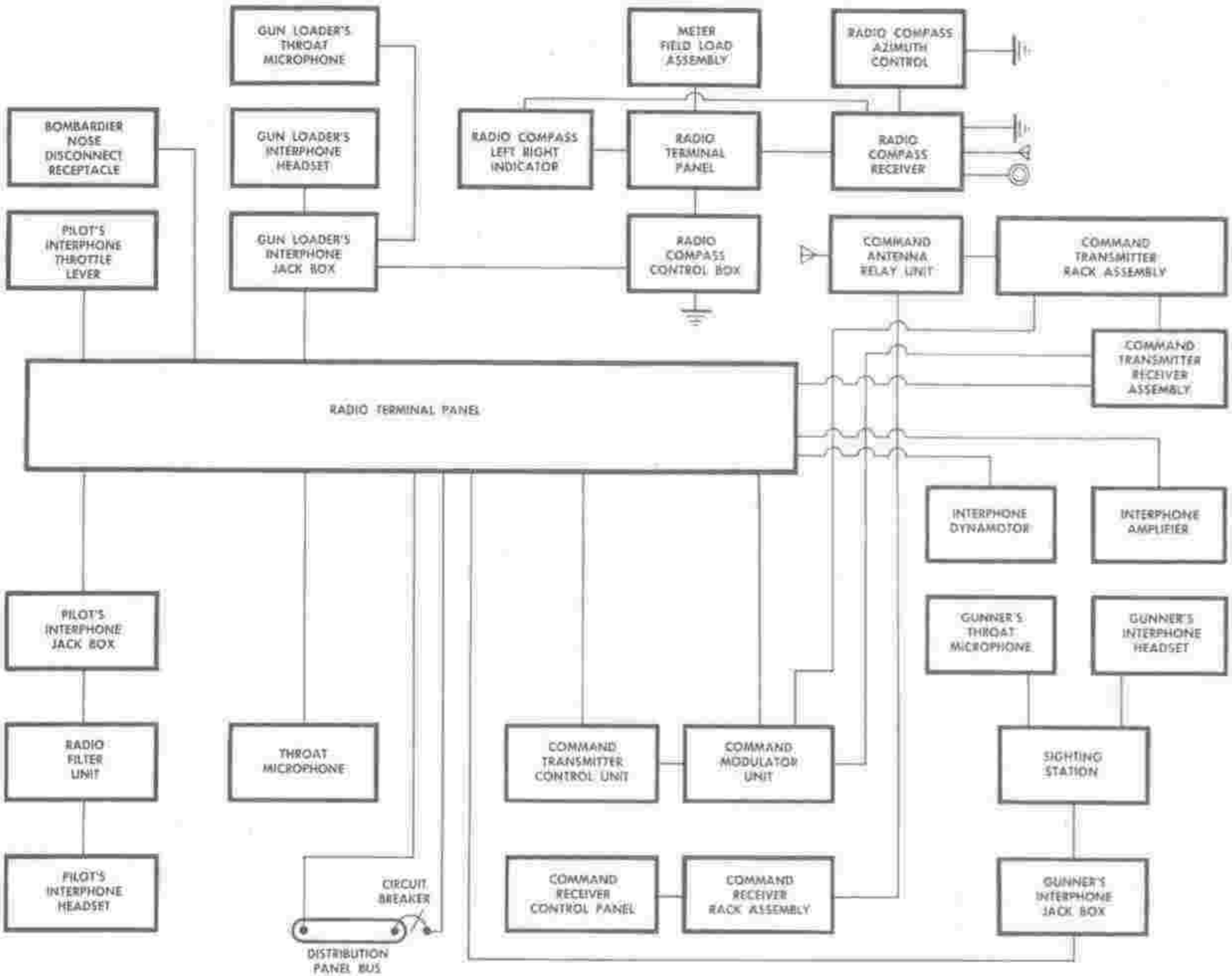


FIGURE 482 — COMMAND RADIO AND RADIO COMPASS CIRCUIT

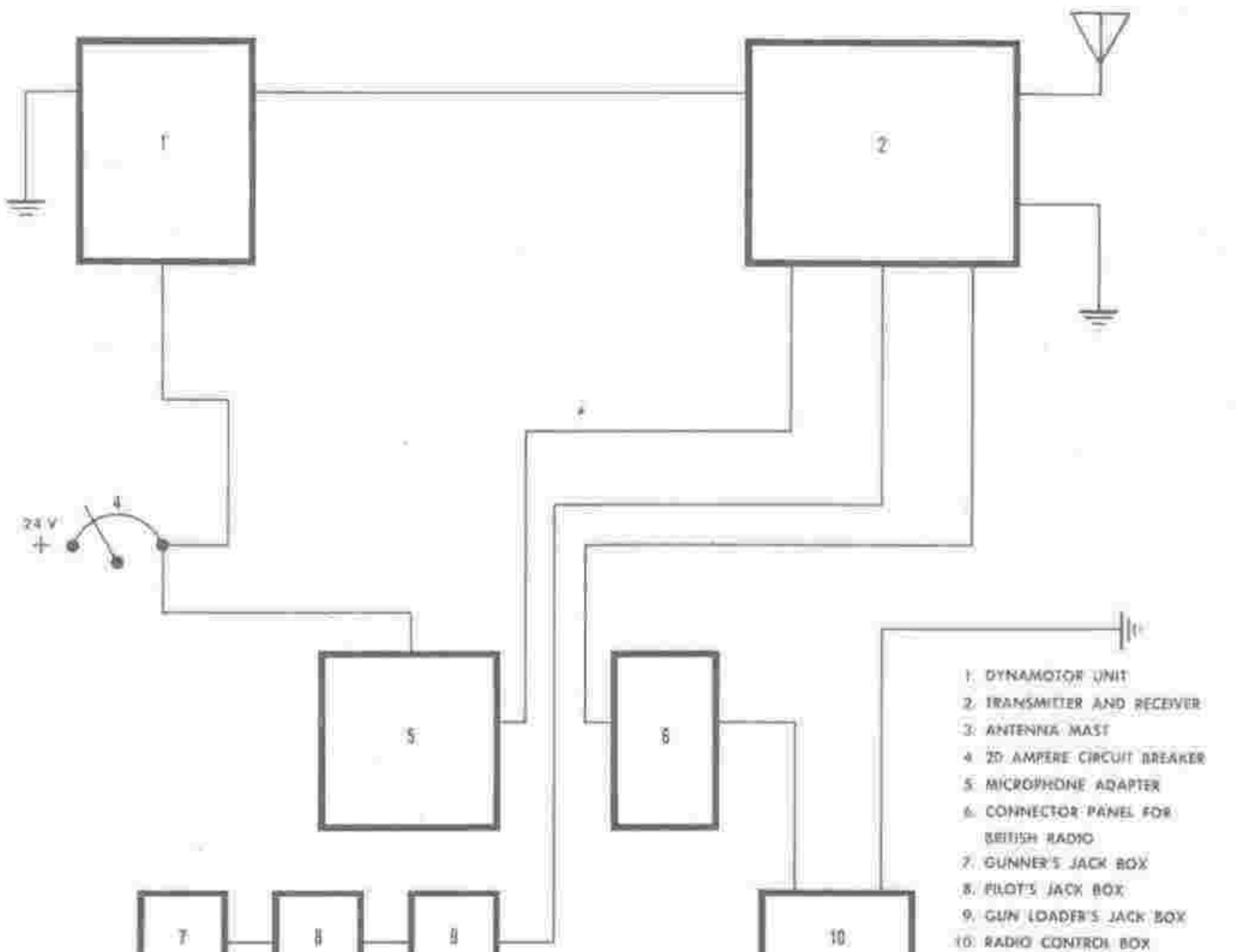


FIGURE 483
SCR-522 RADIO CIRCUIT

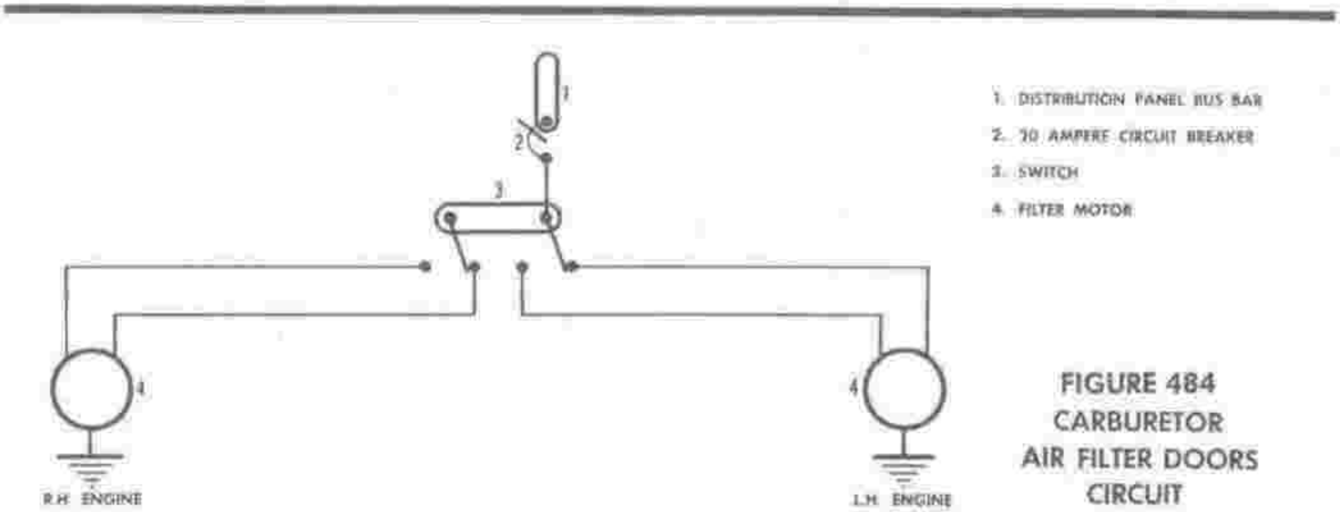
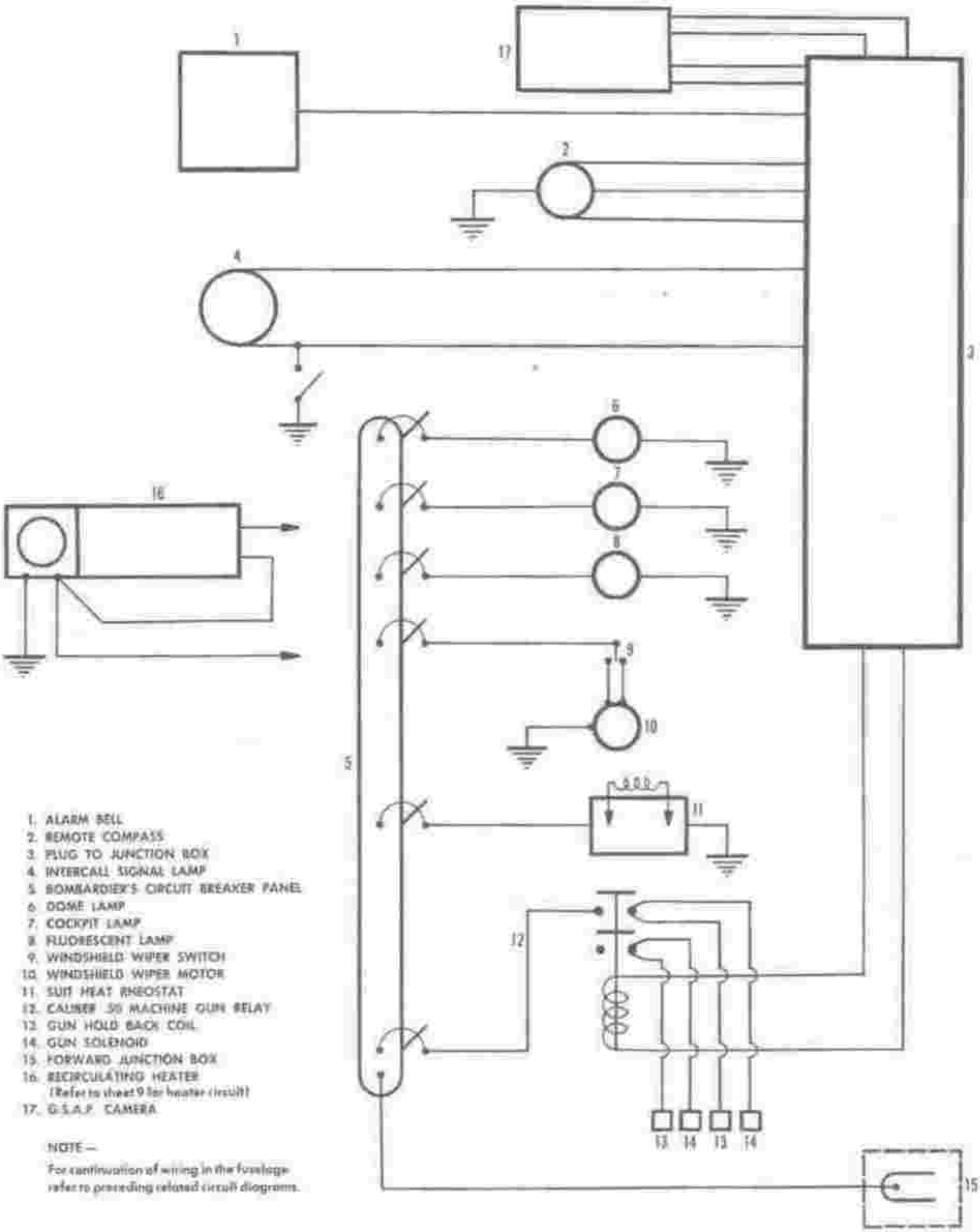


FIGURE 484
CARBURETOR
AIR FILTER DOORS
CIRCUIT

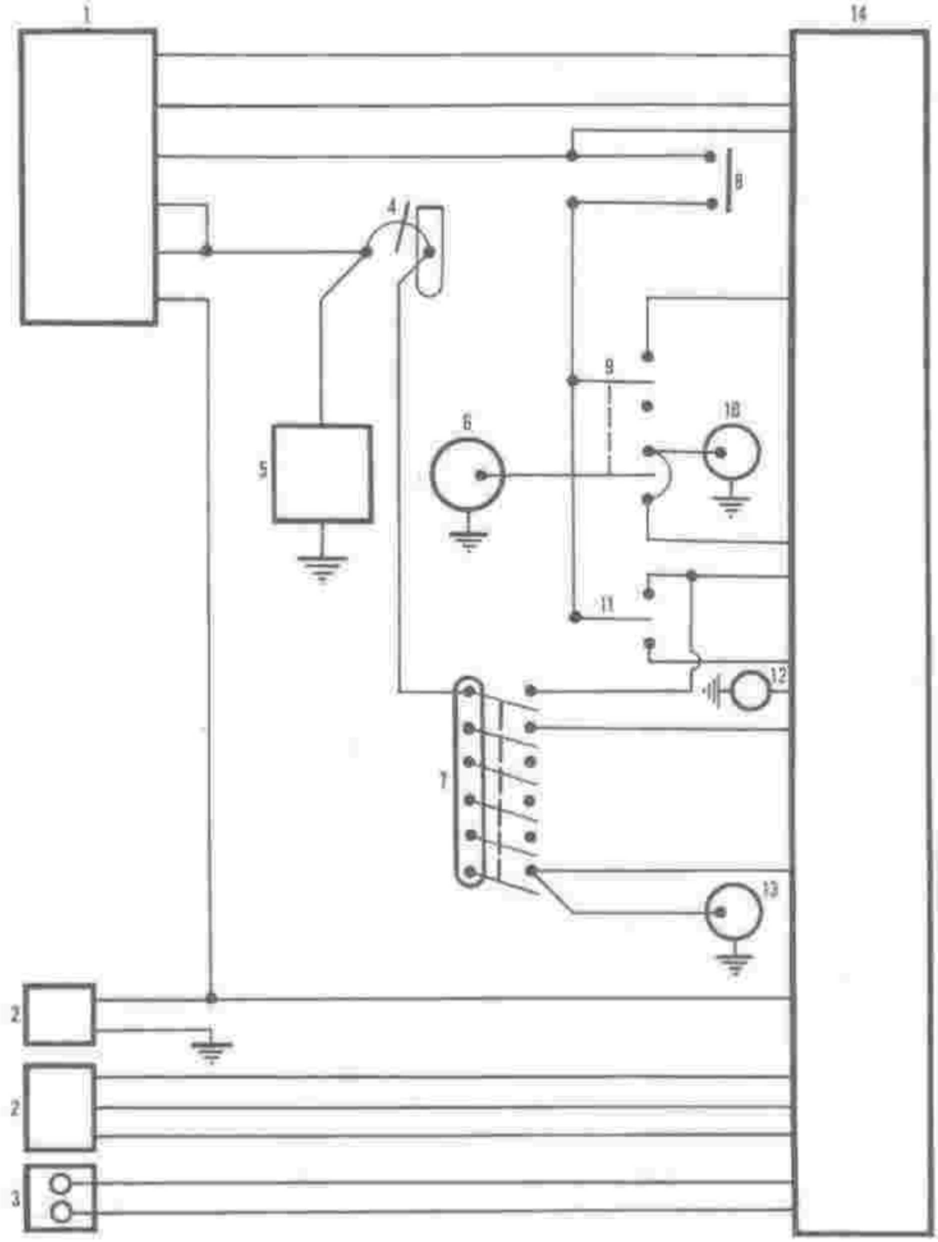


1. ALARM BELL
2. REMOTE COMPASS
3. PLUG TO JUNCTION BOX
4. INTERCALL SIGNAL LAMP
5. BOMBARDIER'S CIRCUIT BREAKER PANEL
6. DOME LAMP
7. COCKPIT LAMP
8. FLUORESCENT LAMP
9. WINDSHIELD WIPER SWITCH
10. WINDSHIELD WIPER MOTOR
11. SUIT HEAT RHEOSTAT
12. CALIBER .50 MACHINE GUN RELAY
13. GUN HOLD BACK COIL
14. GUN SOLENOID
15. FORWARD JUNCTION BOX
16. RECIRCULATING HEATER
    (Refer to sheet 9 for heater circuit)
17. G.S.A.P. CAMERA

NOTE —

For continuation of wiring in the fuselage refer to preceding related circuit diagrams.

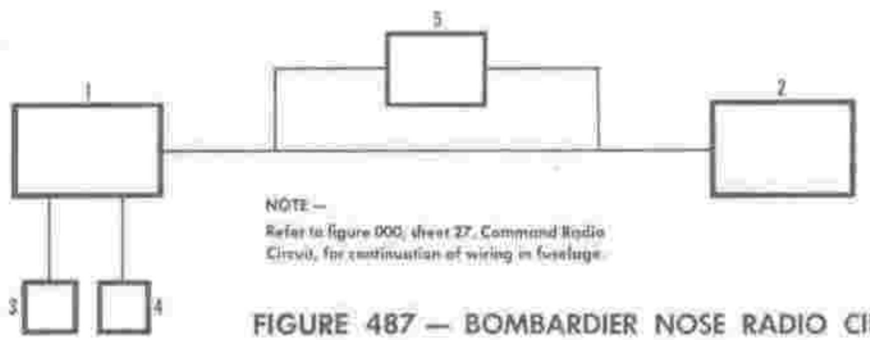
FIGURE 485 — BOMBARDIER NOSE ELECTRICAL SYSTEM (A-26C Airplane)



1. BOMB SIGHT
2. ORIENTATION CAMERA INTERVALOMETER RECEPTACLE
3. TERMINAL STRIP
4. BOMBARDIER'S SALVO CIRCUIT BREAKER
5. GLIDE ANGLE INDICATOR
6. BOMB POWER SIGNAL LAMP
7. SALVO SWITCH
8. BOMB RELEASE SWITCH
9. NOSE AND TAIL FUSING AND TAIL FUSING SWITCH
10. BOMBS ARMED SIGNAL LAMP
11. BOMB DOORS OPEN AND CLOSE SWITCH
12. BOMB DOORS OPEN SIGNAL LAMP
13. BOMB SALVO LAMP
14. PLUG TO JUNCTION BOX

NOTE —
Refer to Sheets 15, 16, 17, 18, 19 and 20, Bombing Circuit Diagrams, for continuation of wiring in the fuselage.

**FIGURE 486
BOMBARDIER NOSE
BOMB RELEASE SYSTEM
(A-26C Airplane)**



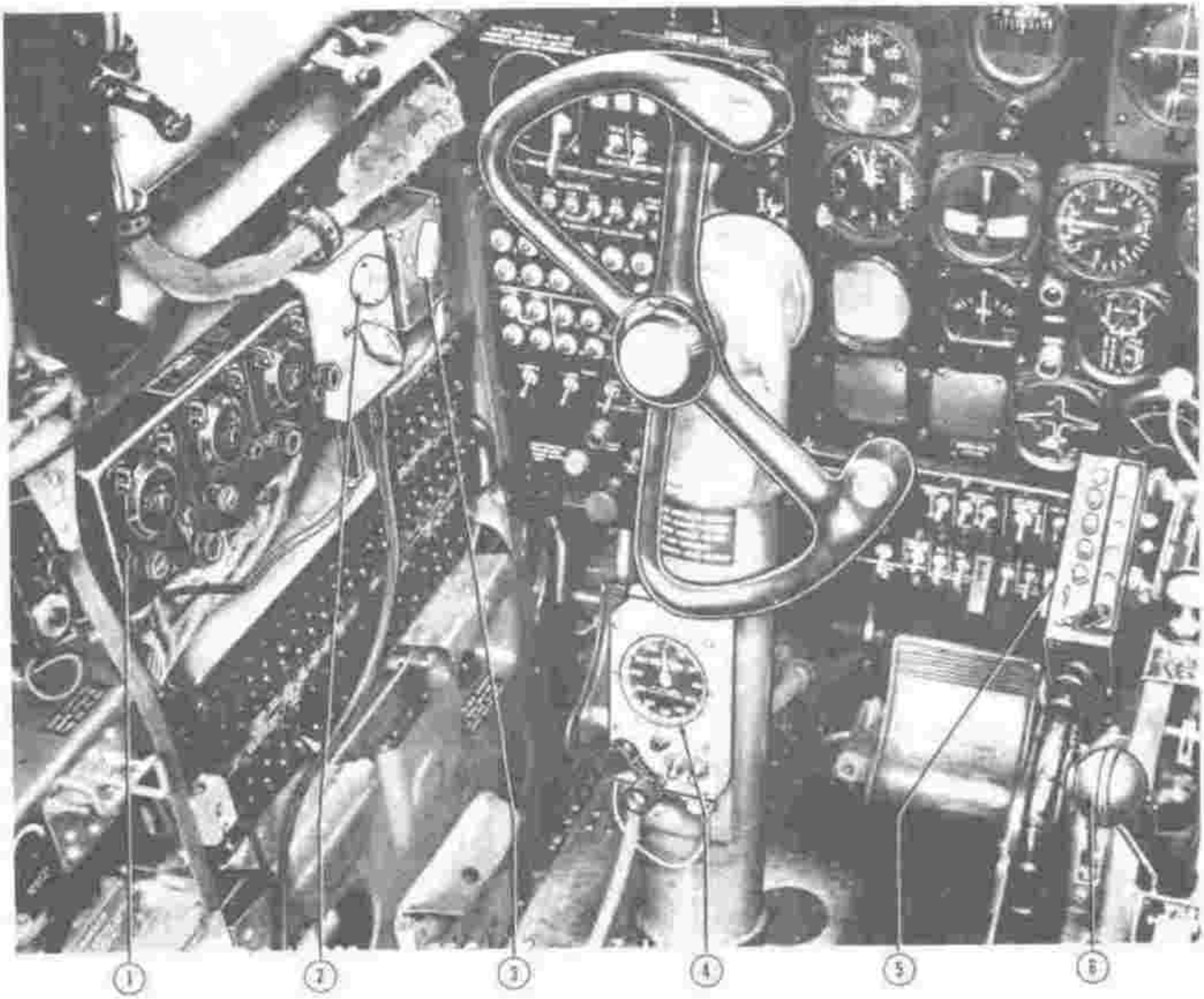
NOTE —
Refer to figure 000, sheet 27, Command Radio Circuit, for continuation of wiring in fuselage.

1. BOMBARDIER'S JACK BOX
2. PLUG
(To Bombardier Nose Disconnect Receptacle)
3. BOMBARDIER'S HEADSET
4. BOMBARDIER'S THROAT MICROPHONE
5. IMPEDENCE ADAPTERS

FIGURE 487 — BOMBARDIER NOSE RADIO CIRCUIT (A-26C Airplane)

16. COMMUNICATIONS EQUIPMENT

a. GENERAL.—The communications equipment installed in A-26B airplanes is as follows: Command Radio Set SCR-274-N used for airplane to airplane or airplane to station in short range operation; Radio Compass MN-26Y for navigation purposes; Radio Set SCR-595-A or SCR-695-A (IFF), identification, Friend or Foe, for recognition purposes; Interphone Equipment RC-36-A for crew member to crew member communication and for crew member participation in radio operations; and Radio Filter Equipment RC-198 for rejecting either radio range voice or code signals or for reception of both simultaneously. *(See figure 491.)* Additional communications equipment which may be installed is Command Radio Set SCR-522-A which provides for short range operation on four crystal controlled channels at very high frequencies.



1. SCR-274 Receiver Control Box
2. Pilot's Interphone Jack Box
3. Radio Filter Switch Box
4. Radio Compass Azimuth Control
5. SCR-522 Radio Control Box
6. Pilot's Microphone Switch

Figure 488 — Radio Controls — Pilot's Compartment

Refer to paragraph 15., ELECTRICAL SYSTEM, for the simplified wiring diagrams for these radio installations. For detailed wiring diagrams refer to the Individual Electrical Circuit Diagram Book, provided with the airplane.

b. COMMAND RADIO SET SCR-274-N.

(1) GENERAL.—The Radio Set SCR-274-N is a multi-channel aircraft radio receiving and transmitting equipment consisting of three receivers and dynamotors, three transmitters, a modulator and dynamotor unit, an antenna relay unit, antenna, and the radio remote control boxes. Power for this radio equipment is obtained by connection to the bus bar in the pilot's distribution panel. This radio equipment is used in conjunction with the head sets and throat microphones as described in paragraph 16. *e.*, INTERPHONE EQUIPMENT, this section.

WARNING

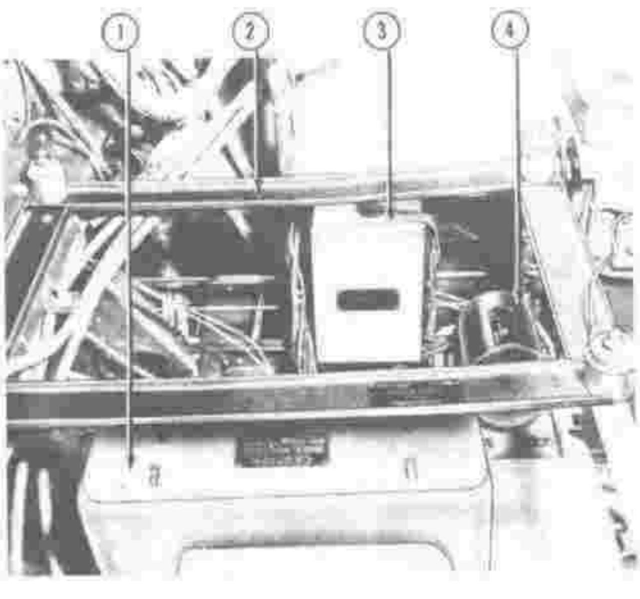
The Dynamotor DM-33-A on the modulator unit of this radio set generates 600 volts, d-c. This is sufficient to cause severe shock, or even death. Make absolutely certain that the dynamotor is not running before making any adjustment whatever except tuning up the transmitters.

Opening up the tube covers on the transmitters and modulator unit exposes the high voltage plate connections to the top caps of tubes VT-136. These covers should be safety wired in place at the time of installation. Do not attempt to connect or disconnect a transmitter or a power plug while Dynamotor DM-33-A is running. Do not depend alone upon hearing the dynamotor or upon observing the several switch positions to determine whether or not the dynamotor is running—feel it.

In tuning up the antenna circuit of the transmitters, be careful to avoid touching the antenna when the power is on, or severe, irritating burns will result. Warn anyone who may be working near the antenna of your intentions to turn on the power.

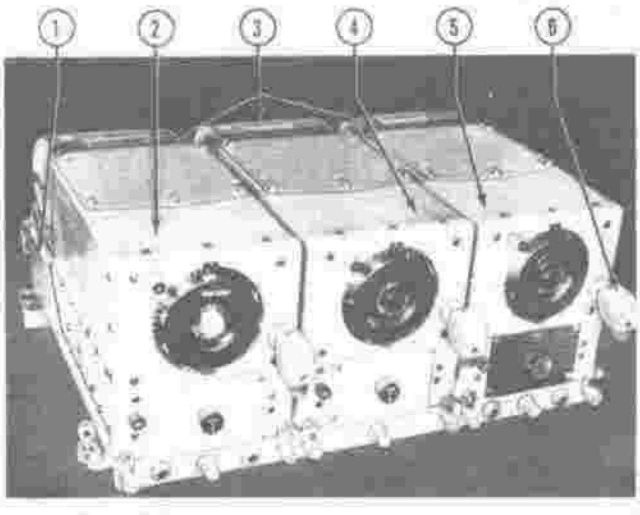
FIRE.—If the radio set compartment has been exposed to gasoline vapor, make certain that it is aired out well before turning on the power. The antenna must be installed as far as possible from any inflammable material such as fabric covering, canvas baggage compartments, etc., because of the possibility of sparking through this material to a grounded metal member beyond, and setting fire to the material.

The dynamotor DM-32-A on each of the receivers, generates 250 volts d-c. The danger of exposure to this voltage must not be ignored. Make certain that all dynamotors are "OFF" before performing any adjustment to the equipment other than antenna alignment.



1. SCR-274-N Dynamotors and Modulator Unit
2. SCR-274-N Receivers Mounting
3. Interphone Amplifier
4. Interphone Dynamotor

Figure 489 — Radio Equipment — Aft of Pilot's Seat



1. Rack, FT-220-A
2. Receiver BC-453-A
3. Dynamotors, DM-32-A
4. Receiver, BC-453-A
5. Receiver, BC-455-A
6. Coupling, MC-211-A

Figure 490 — SCR-274-N Radio Receiver Unit (Front View)

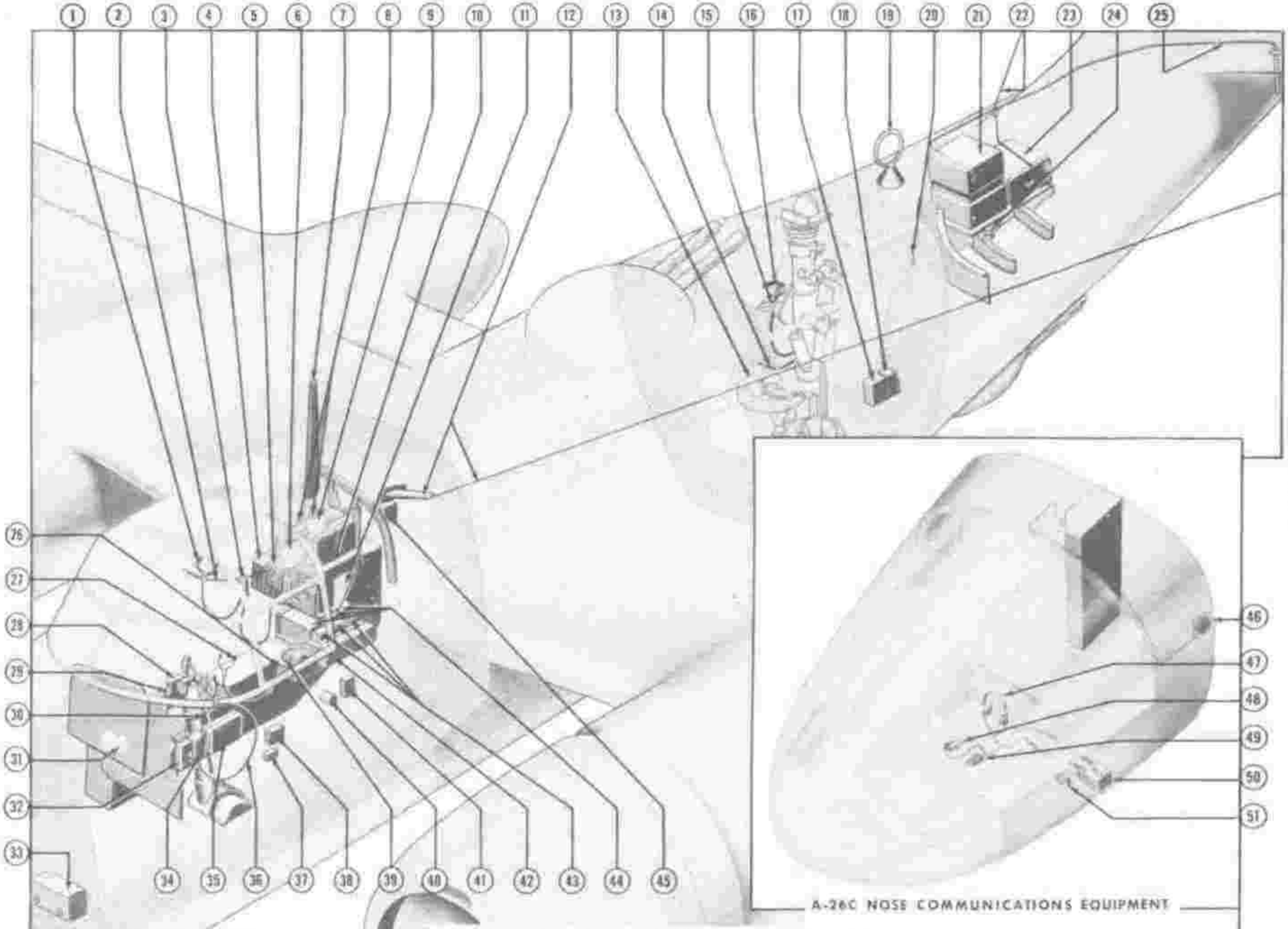


Figure 491 — Communications Equipment

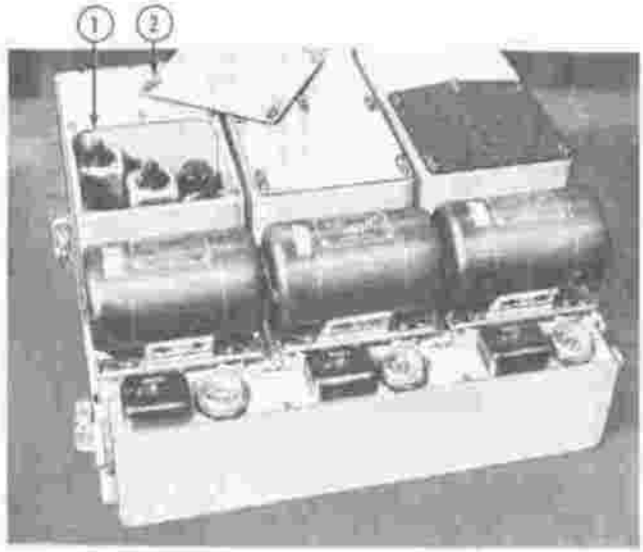
KEY TO FIGURE 491

1. Cannon Loader's Throat Microphone
2. Cannon Loader's Headset Cord
3. Cannon Loader's Microphone Switch
4. SCR-522 Radio Transmitter Receiver Assembly
5. Cannon Loader's Interphone Jack Box, BC-366 *(See Figure 513)*
6. SCR-522 Radio Connector Panel
7. SCR-522 Antenna Mast
8. SCR-274-N Transmitters, BC-457-A and BC-458-A *(See Figure 495)*
9. SCR-522 Radio Microphone Adapter
10. Transmitter Rack, FT-226-A
11. Transmitter Rack, FT-234-A
12. SCR-274-N Antenna *(See Figure 501)*
13. Gunner's Interphone Jack Box, BC-366 *(See Figure 513)*
14. Gunner's Headset Cord
15. Gunner's Microphone Switch
16. Gunner's Throat Microphone
17. SCR-595-A Selector Control Box, BC-965-A *(See Figure 508)*
18. SCR-595-A Power Control Box, BC-958-A *(See Figure 508)*
19. Radio Compass Loop Antenna, MN20-A *(See Figure 506)*
20. Inertia Switch Box, BC-706-A *(See Figure 511)*
21. SCR-595-A Receiver, C-( )—46AAQ
22. Radio Compass Sense Antenna *(See Figure 507)*
23. Radio Compass Receiver, MN-26Y *(See Figure 503)*
24. Destructor Circuit Indicator Box, BC-767 *(See Figure 509)*
25. SCR-595-A Antenna
26. SCR-274-N Transmitter Modulator, BC-456-A *(See Figure 497)*
27. Pilot's Throat Microphone
28. Radio Compass Remote Control Box, MN-28-C *(See Figure 504)*
29. Pilot's Microphone Switch
30. Radio Compass Azimuth Control, MN-52-A *(See Figure 505)*
31. SCR-522 Radio Control Box
32. Interphone Radio Filter Unit, RC-196 *(See Figure 515)*
33. SCR-522 Radio Dynamotor
34. Pilot's Interphone Jack Box, BC-366 *(See Figure 513)*
35. SCR-274-N Receiver Control Box, BC-450-A *(See Figure 494)*
36. Pilot's Headset Cord
37. Destructor Switch Box, BC-765 *(See Figure 510)*
38. SCR-274-N Transmitter Control Box, BC-451-A *(See Figure 499)*
39. SCR-274-N Transmitter Dynamotor, DM-33-A *(See Figure 497)*
40. Interphone Dynamotor, PE-86-( ) *(See Figure 514)*
41. Interphone Amplifier, BC-347 *(See Figure 489)*
42. Receiver Rack, FT-220-A
43. SCR-274-N Receiver Dynamotors, DM-32-A *(See Figure 496)*
44. SCR-274-N Receiver, BC-454-A, BC-453-A, and BC-455-A *(See Figure 490)*
45. SCR-274-N Antenna Relay Unit, BC-442-A *(See Figure 500)*
46. Bombardier's Alarm Bell
47. Bombardier's Headset
48. Bombardier's Throat Microphone
49. Bombardier's Microphone Switch
50. Interphone Jack Box
51. Intercall Signal Box

(2) SCR-274-N RECEIVING EQUIPMENT.

(a) GENERAL.—This receiving equipment consists of three receivers, three dynamotors, a receiver rack, a radio control box, antenna, and the necessary mountings, cords, and plugs.

(b) REMOVAL.—Carefully read WARNING, paragraph (1), above, before handling this equipment. Disconnect the tuning shaft cables antenna leads, ground wire, and electric plugs and release the snapslides from the mounts. Lift the receiver set from the airplane.



1. Tube Compartment
2. Cover

Figure 492 — SCR-274-N Radio Receiver Unit (Rear View)

(c) DISASSEMBLY.

1. Remove safety wires and unscrew knurled nuts in the rack in front of the transmitter far enough to unlock the receiver from the rack.

2. Slide the receiver from the rack (disconnecting it).

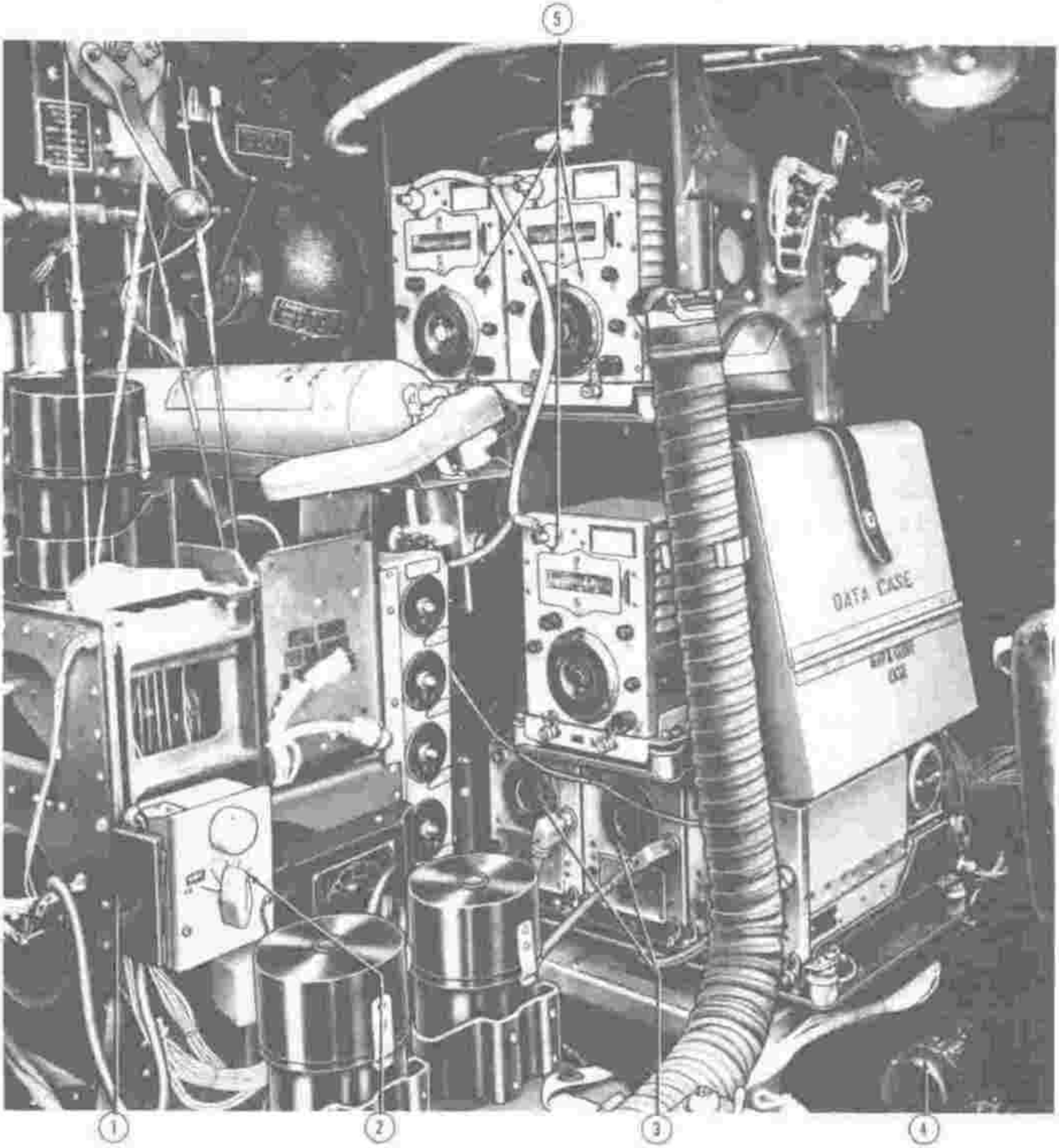
3. Unlock dynamotor from receiver by sliding snapslides away from studs.

4. Disconnect dynamotor from receiver by lifting it straight up from receiver.

5. Disconnect the three electrical cables and the three tuning shafts from the bottom of the control box.

6. Slide the snapslides from the studs to release the control box from the mounting.

(d) MAINTENANCE REPAIR OR REPLACEMENT.—Mechanical or electrical maintenance of any portion of the communication equipment will only be



1. Cannon Loader's Microphone Switch
2. Cannon Loader's Interphone Jack Box
3. SCR-274 Receivers
4. Interphone Dynamotor
5. SCR-274 Transmitters

★

Figure 493 — SCR-274 Radio Equipment Installed

accomplished by qualified personnel. All testing and repair will be made in accordance with the instruction book for the particular radio set. Replacement of the unit or individual tubes will be made whenever possible.

(e) ASSEMBLY AND INSTALLATION.—Reverse procedure as described in paragraph (2) REMOVAL, above, with the following precautions:

1. Carefully read WARNING, paragraph 16. *b.* (1), this section.

2. When attaching plugs, feel for the proper fit before using any considerable pressure on the plugs. The locking rings must be hand-tightened.

3. Make certain the units are locked in place by the snapslides and safety wired.

4. The correct tube must be inserted into its proper socket. Tubes must be inserted all the way into their sockets and all grid clips must be securely attached.

(f) ADJUSTMENTS.

1. ANTENNA CIRCUIT ALIGNMENT.—All receivers must be connected to the antenna.

a. Set the "CW-OFF-MCW" power switch on the control box for the first receiver to the "CW" position.

b. Set the "A TEL-B TEL" switch of the same receiver to the "A TEL" position.

c. Connect a head set into any "A TEL" jack or into a corresponding interphone jack box.

d. Set the "INCREASE OUTPUT" knob on the control box to its maximum position.

e. Tune the receiver to the highest frequency shown on the dial.

f. Use the "ALIGN INPUT" knob on the front of the receiver to align the antenna input circuit for maximum background noise.

g. Turn the "CW-OFF-MCW" switch for this receiver control box to the "OFF" position.

h. Repeat the above alignment procedure for the other receivers. Adjust only one receiver at a time to avoid misinterpretation of background noise.

2. DIAL ALIGNMENT.—Set each receiver control box dial to correspond with the dial of the receiver connected to it. The control box dial may be adjusted to the position of the receiver dial by first loosening the knurled screw in the center of the dial and then rotating the dial to the desired reading. The knurled screws must then be hand-tightened; do not use pliers for this operation.

(g) TEST AFTER INSTALLATION.—Test each receiver by listening to signals on "CW" at maximum gain while turning the entire band.

(h) RECEIVERS (BC-454-A, BC-453-A and BC-455-A).—The three receivers *(figure 490)* covering the ranges of 3.0 to 6.0 megacycles, 190 to 550 kilocycles, and 6.0 to 9.1 megacycles, respectively, are mounted in a rack, behind the pilot's seat just below the transmitters. The receivers are basically alike; each uses six metal 12-volt tubes, performing identical functions, and each may be operated in any of the three compartments of the rack although receiver BC-453-A should be installed in the center compartment of the rack to physically separate the other two receivers in order to reduce electrical interference between them. An antenna binding post is located on the upper left-hand corner of the front panel on each receiver. The tuning dial, which is controlled by a flexible shaft from the radio control box, is located in the center of the front panel on each receiver. This flexible shaft plugs into the front of the receiver to the right of the tuning dial. An input alignment control knob is located on the lower left-hand corner for the alignment of the antenna input. A tube set for each receiver consists of the following: 3 tubes VT-131, 1 tube VT-132, 1 tube VT-133, and 1 tube VT-134.

(i) DYNAMOTORS (DM-32-A).—A plug-in dynamotor *(figure 497)* which is held with snapslides, is mounted on the back of each receiver. Each dynamotor furnishes power for the receiver upon which it is mounted, and is controlled by the "CW-OFF-MCW" switch on the radio control box.

(j) RECEIVER RACK (FT-220-A).—The receiver rack *(figure 490)* fulfills three functions; it provides compartments into which the receivers are slid and locked in place; it provides an electrical junction box for essential interconnections; and it contains a receiver output-side-tone relay, an "A TEL-B TEL" toggle switch, a fuse, and three sets of "A TEL-B TEL" head set jacks.

Note

The "A TEL-B TEL" toggle switches in the center under the front of each receiver are covered by screw caps and are never operated when the receivers are remotely controlled.

(k) RADIO CONTROL BOX (BC-450-A).—The receivers are remotely operated by the pilot through the radio control box *(1, figure 488)* mounted to the left of the pilot's seat. The radio control box is built in three similar sections to control the three receivers. Each section contains an "A-B" switch, "CW-OFF-MCW" switch, volume control ("INCREASE OUTPUT"), tuning knob, receptacles for the electrical and remote cables, and two head set jacks ("A" and "B").

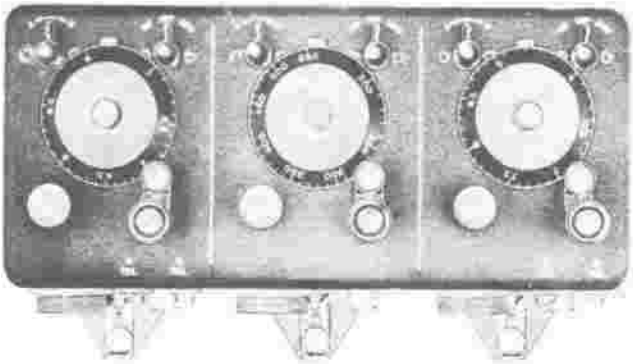


Figure 494—SCR-274-N Radio Receiver Remote Control Unit

Each section of the control box is used to tune and control one receiver independently of the others. The "A-B" switches are provided for switching between the two pairs of phone jacks mounted on the bottom of the box; however, these jacks are not used on this installation. The wiring is arranged so the switch in the "A" position connects the corresponding receiver to the interphone jack box selector switch "COMMAND" position, and the "B" position connects the corresponding receiver to the interphone jack box selector switch "LIAISON" position. Signals can be tuned in on two or three receivers simultaneously by using the "INCREASE OUTPUT" controls to adjust the volume or to fade the signal from one receiver to another. In each group of controls, the "CW-OFF-MCW" switch performs the functions of a battery power switch and a heterodyne oscillator switch (for the reception of "CW" signals) in the receiver which is controlled by that particular group.

(l) ANTENNA.

1. DESCRIPTION.—The antenna *(figure 501)* and relay unit *(figure 500)* which is used for the transmitter and which is described in paragraph 16. *b. (3) (k)* & *(l)*, this section, is also used for the receiver. It is automatically switched from the transmitter to the receiver when the microphone "press-to-talk" button is released.

2. REMOVAL.

a. Disconnect the aft end of the antenna from the horizontal stabilizer by removing the bolt holding the shock link to the stabilizer tip.

b. Disconnect the forward end of the antenna from the mast by removing the nut holding it to the lead-in.

(3) SCR-274-N RADIO TRANSMITTING EQUIPMENT.

(a) GENERAL.—The SCR-274-N RADIO transmitting equipment consists of three transmitters, a modulator, dynamotor, radio control box, antenna relay unit, antenna, and the necessary racks, mountings, and cords.

(b) REMOVAL AND DISASSEMBLY.—Carefully read WARNING, paragraph 16. *b.* (1), this section, before handling this equipment.

1. Disconnect the antenna from the "A" binding post.

2. Remove safety wires and unscrew knurled nuts in the rack in front of the transmitter far enough to unlock the transmitter from the rack.

3. Slide the transmitter from the rack (disconnecting it).

4. Disconnect the electrical cables from the front of the modulator unit.

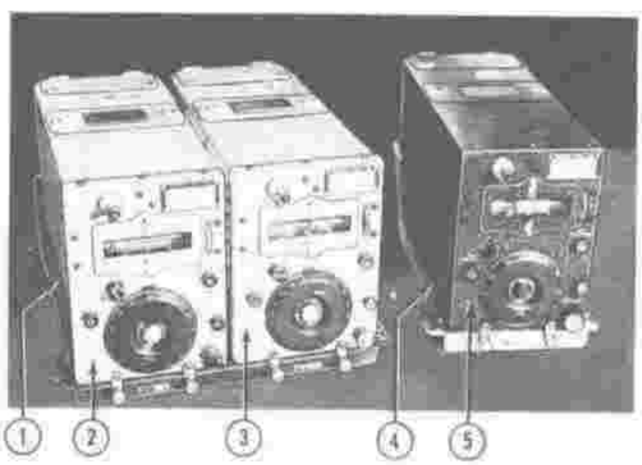
5. Release the snapslides and remove the modulator unit from the mount.

6. Release snapslides and lift dynamotor from modulator unit (disconnecting it).

7. Disconnect electrical plugs at the back of the transmitter rack.

8. Disconnect the ground wire connection at the "G" binding post.

9. Release the snapslides and lift rack from mounting.



1. Rack, FT-226-A
2. Transmitter, BC-457-A
3. Transmitter, BC-458-A
4. Rack, FT-234
5. Transmitter, BC-696-A

Figure 495 — SCR-274-N Radio Transmitter (Front View)

10. Disconnect the electrical cable from the bottom of the radio control box.

11. Release the snapslide at the bottom of the control box and lift box from mounting.

12. Disconnect the antenna leads and the electrical cable.

13. Release snapslide and remove unit from mount.

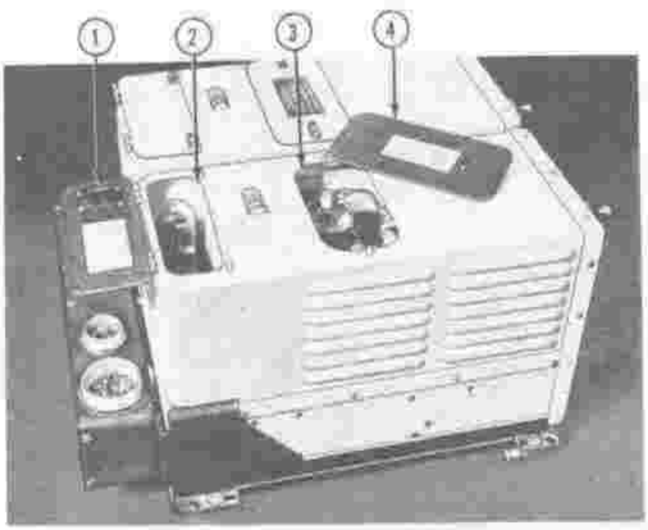
(c) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 16, *b*, (2) *(d)*, this section.

(d) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

(e) ADJUSTMENTS.

1. FREQUENCY CALIBRATION.—A plug-in crystal resonator is supplied in each transmitter for checking the frequency at one point of the dial. The frequencies of the crystals supplied with the different transmitters are as follows: 3.5 mc for the BC-696-A, 4.6 mc for the BC-457-A, and 6.2 mc for the BC-458-A. When a transmitter is operated at or near the frequency of the crystal in that transmitter, a dark three-cornered shadow appears in the round spot of green light on the screen of the tube VT-138. This shadow "opens" as the transmitting frequency passes through the frequency of the crystal; operation at exact resonance with the crystal frequency is indicated by a sharp maximum in the width of this shadow.

a. Open hinged cover at the top rear of the transmitter to such an angle that the reflection of the entire resonance indicator screen of tube VT-138 can be seen.



1. Hinge Cover with Metallic Mirror
2. Tube and Crystal Compartment
3. Tube Compartment
4. Cover

Figure 496 — SCR-274-N Radio Transmitter (Side View)

b. Tune the transmitter to the *lowest* frequency which will open the shadow on the resonance indicator. The indicated dial frequency should now correspond with that of the crystal (see above). If not, proceed as follows:

(1) Set the transmitter dial on the nominal frequency of the crystal.

(2) Insert a small metal screwdriver through the hole in the top of the transmitter which is covered with a metal slide and adjust the trimming control. A clockwise rotation of this trimming control lowers the transmitter frequency.

(3) Recheck the frequency correspondence to make certain that the crystal is resonating at its lowest frequency—that no "opening" of the resonance indicator is observed for any indicated frequency below that corresponding to the valve shown on the crystal holder. The calibration engraved on the frequency dial of the transmitter will then be correct at any point on the dial.

2. TUNING.—All receivers and transmitters should be connected to the antenna relay unit, and the antenna connected to it, before the transmitters are tuned up. Transmitters must be tuned up with the "TONE-CW-VOICE" switch on the radio control box in the "CW" position, and must not be readjusted in any way after switching to "TONE" or "VOICE."

a. Set the frequency control dial on the first transmitter to the desired transmitting frequency.

b. Set "ANT. COUPLING" knob on the transmitter to about "3" on its scale.

c. Set the radio control box "TONE-CW-VOICE" switch to "CW."

d. Set radio control box transmitter selector switch to transmitter being tuned ("1" for BC-457-A, "2" for BC-458-A, "3" for BC-696-A).

e. Make sure the microphone jack on the control box is turned in the maximum counterclockwise position and lock the built-in key by rotating it clockwise.

f. Set the "TRANS. POWER" switch "ON." This will start the transmitter dynamotor. Allow 15 seconds for the tubes to heat up.

g. Resonate the antenna circuit by adjusting the "ANT. INDUCTANCE" knob on the transmitter until the contact button behind the transparent window is in the extreme right-hand position (maximum antenna current).

h. Vary the "ANT. COUPLING" knob on the transmitter until maximum "CW" antenna current is indicated on the indicator of the antenna relay unit.

i. Readjust the "ANT. INDUCTANCE" knob on the transmitter for maximum antenna current (button behind window in extreme right-hand position).

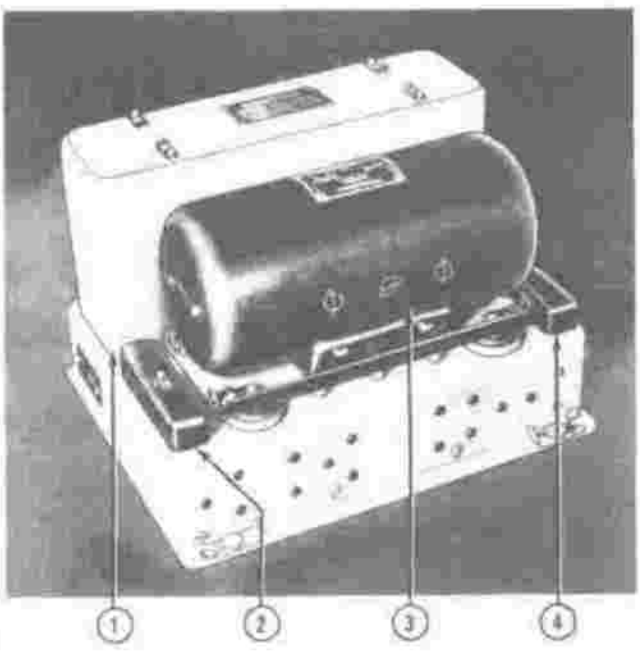
j. Tune up the other two transmitters in the same manner.

k. Lock the controls of each transmitter by rotating the "LOCK" knobs one-half turn clockwise to a stop. The engraving "LOCK" should then read right side up.

(f) TEST AFTER INSTALLATION.—Check the frequency calibration and tune up the transmitter for operation as described in paragraph *(e)*, ADJUSTMENTS, above.

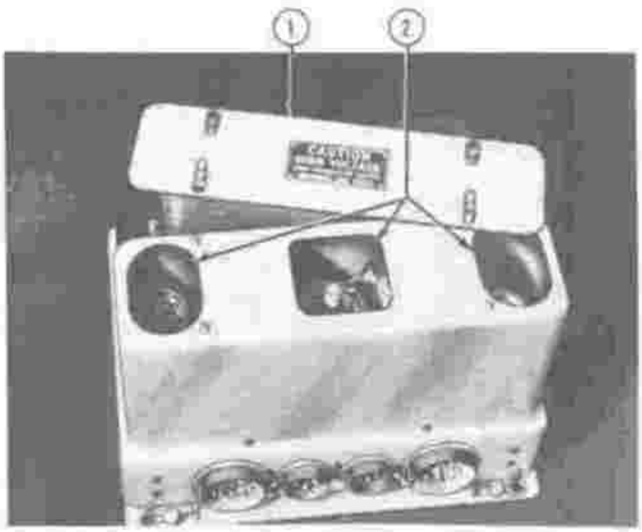
(g) TRANSMITTERS (BC-457-A, BC-458-A, BC-696-A). DESCRIPTION.—Two transmitter units *(figure 495)* with ranges of 4.0 to 5.3 megacycles and 5.3 to 7.0 megacycles respectively, are mounted on a rack on the left hand side of the fuselage behind the pilot's seat. One transmitter unit with a range of 3.0 to 4.0 megacycles is mounted on a rack directly below the other two transmitters. Each of these units contains a separate set of master-oscillator, R-F-power-amplifier, and resonance indicator tubes and associated circuits, but each unit depends for its high voltage d-c and its modulating voltages on a common modulator and dynamotor, and for its entire remote control on a common radio control box. On the front panel of each transmitter unit, just below the calibrated window, is located an "ANT. COUPLING" knob and lock which controls the amount of coupling of the antenna coupling coil. An "ANT. INDUCTANCE" knob and lock is located to the right of the calibrated window. This knob adjusts the inductance of the inductor in the antenna circuit and is the only antenna tuning control. An antenna binding post is located on the upper left-hand corner of each panel; the frequency control knob and lock is on the lower right-hand corner. On the side of the transmitting case are two snap caps, the small cap covering the hole to the shaft of the P.A. capacitor and the large cap covering the hole to the fine adjustment arm of the P.A. capacitor. A tube set for each transmitter consists of the following: 2 tubes VT-136, 1 tube VT-137, and 1 tube VT-138.

(h) MODULATOR (BC-456-A).—The modulator and dynamotor *(figure 497)* are mounted in one unit which is installed on the floor at the left-hand side of the fuselage, just aft of the pilot's seat. This unit as a whole contains a tone oscillator tube, a speech-amplifying and modulator tube, and a 150-volt voltage regulator tube.



1. Modulator Unit, BC-456-A
2. Fuse Cover
3. Dynamotor, DM-33-A
4. Fuse Cover

Figure 497 — SCR-274-N Radio Modulator and Dynamotor Unit (Front View)



1. Cover
2. Tube Compartment

Figure 498 — SCR-274-N Radio Modulator and Dynamotor Unit (Rear View)

(i) DYNAMOTOR (DM-33-A).—The dynamotor is held with snapslides on the modulator unit and generates the high voltage d-c for the transmitting equipment.

(j) TRANSMITTER RACKS (FT-226-A and FT-234).—Rack FT-226-A *(figure 495)*, used for transmitter BC-457-A and BC-458-A, contains two ground binding posts and circuits interconnecting the modulator unit with the transmitters and the antenna relay unit. Rack FT-234 is used for transmitter BC-696-A.

(k) RADIO CONTROL BOX (BC-451-A).—The radio control box *(figure 499)* for remote control of the transmitting equipment is mounted on the left-hand side of the pilot's compartment, adjacent to the receiver control box. This box contains a three-position switch ("TONE-CW-VOICE") which controls the circuits determining the type of emission, a four-position switch which controls the circuits determining the choice of transmitter, a microphone jack, an external key jack, a built-in key, a toggle switch in the line from the power, and one receptacle for connection to the modulator unit. The microphone jack is constructed in such a manner that the sleeve may be grounded to the box, or not, by turning the protruding knurled nut by hand as far as it will go, counterclockwise or clockwise, respectively.

Note

At the pilot's position in A-26B Airplanes the throat microphone is connected to the interphone via the throttle switch junction box instead of being plugged directly into "IC" jack of the control box, consequently the knurled nut is not used.

The throttle switch at the pilot's position or microphone switch at the other crew members positions may be used to key the transmitter on "TONE," "CW," or "VOICE." It is preferable to key the transmitter on "TONE" or "CW" using the built-in-key on the transmitter control box. If it is necessary to use cord CD-508, which contains switch SW-141-( ), plug cord CD-508 into "MIC" jack on transmitter control box. Turn knurled nut on sleeve of "MIC" jack to full counterclockwise position. Transmission on "VOICE" can now be effected by closing switch SW-141-( ) and "TONE" or "CW" transmission can be affected with the built-in-key. Although the "TRANSMITTER SELECTION" switch is a four-position switch designed to select one of four transmitters, only positions 1, 2, and 3 are used in this installation.

Note

Under a snap cap on the top of the control box next to the built-in-key is a two-position toggle switch which should always be in the "R-OUT" position.

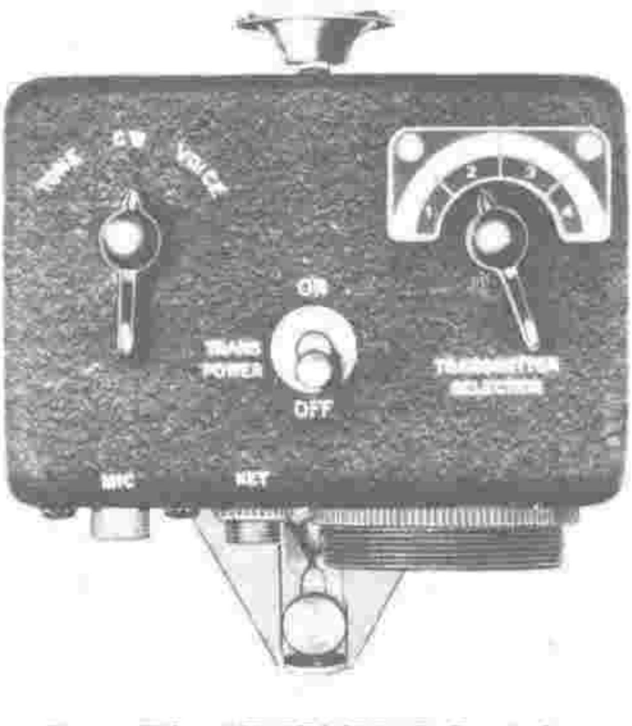


Figure 499 — SCR-274-N Radio Transmitter Remote Control Unit

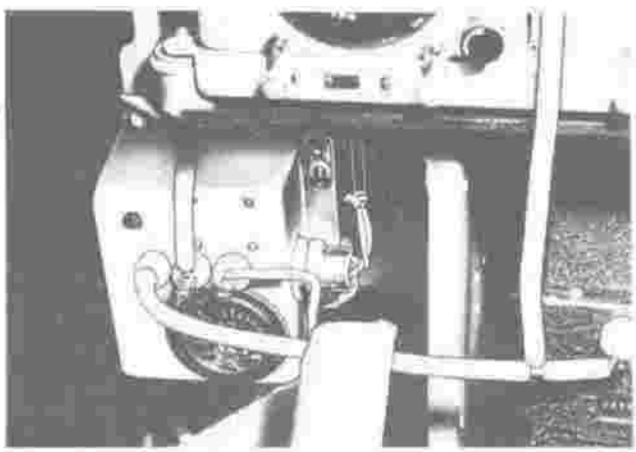


Figure 500 — Antenna Relay Unit

(l) ANTENNA RELAY UNIT (BC-442-A).—The antenna relay unit *(figure 500)* is attached to a bracket near the transmitter. This unit contains an antenna current indicator, a receptacle for the cable leading to the transmitter rack, and three binding posts which are for the transmitter, the receiver, and the antenna respectively.

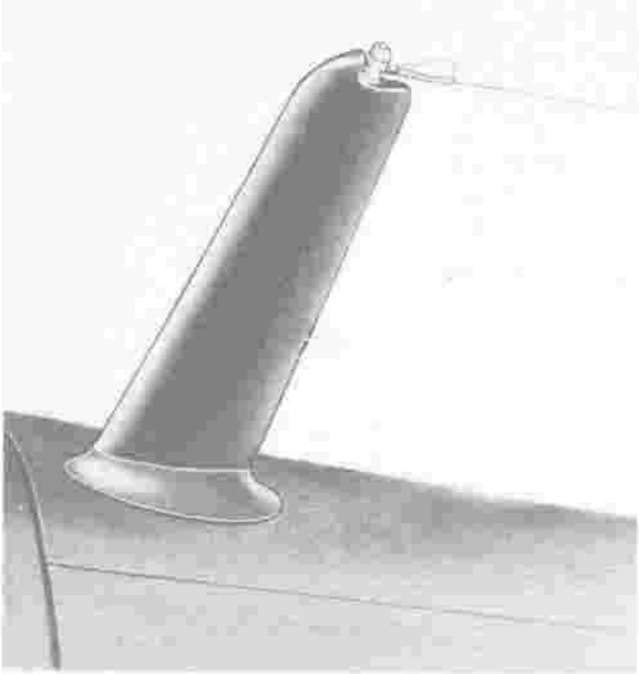


Figure 501 — Antenna Mast (SCR-247-N Radio)

(m) ANTENNA.—The antenna *(figure 501)*, which is used for both the transmitter and receiver, extends from a small mast mounted on the left-hand side of the fuselage aft of the pilot's enclosure, to the tip of the left-hand horizontal stabilizer. The antenna lead-in is fed through the mast to the antenna relay unit.

c. RADIO COMPASS EQUIPMENT.

(1) GENERAL.—The model MN-26Y radio compass equipment consists of a radio compass receiver, remote control unit, azimuth control, loop and sense antennas, left-right indicator, and interconnecting cables. The equipment comprises an aircraft navigational unit which provides: visual unidirectional left-right indications of the arrival of radio frequency energy with respect to the plane of the loop and simultaneous aural reception of radio frequency energy; aural reception using a non-directional antenna; aural reception using a loop antenna; and aural null directional indications of the arrival of radio frequency energy with respect to the plane of the loop for blind direction-finding.

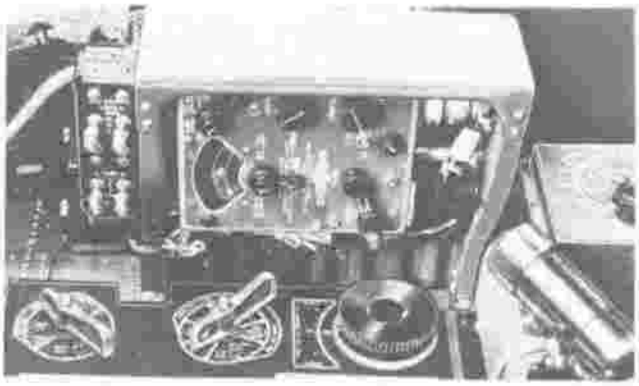


Figure 502 — Radio Compass Remote Control Installed

(2) REMOVAL.—See REMOVAL of the individual components below.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 16. *b.* (2) *(d)*, this section.

(4) ADJUSTMENTS AND TESTS.—It is very important that the proper adjustments and tests be made on the radio compass equipment before and after installation. Because of the complexity of these tests and the necessity for accurate adjustments for correct operation, it is important that trained personnel prepare the radio compass equipment for use under the guidance of the Signal Corps instruction book for this radio equipment.

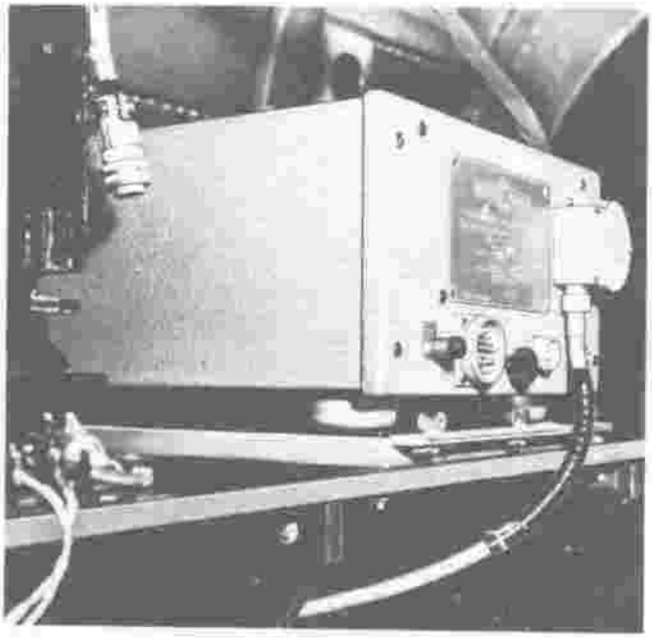


Figure 503 — Radio Compass Receiver

(5) RECEIVER.

(a) DESCRIPTION.—The Type MN-26Y radio compass receiver *(figure 503)* is installed on the right-hand side of the fuselage, aft of the gunner's compartment. The receiver is a remotely controlled, 12-tube superheterodyne with a frequency range covered by three bands calibrated as follows: Band I—150 to 325 KC, Band II—325 to 695 KC, Band III—3.4 MC to 7.0 MC. These bands are switched electrically by means

of a selector switch on the control unit and a motor within the receiver unit. The receiver unit contains the compass circuit elements, the superheterodyne receiver circuit elements, and a set of vacuum tubes consisting of one 6L7, two 6N7, one 6B8, two 2J5, five 6K7, and one 6F6.

(b) REMOVAL.

1. Disconnect the main electrical plug and the two antenna plugs.

2. Disconnect the flexible drive shaft.

3. Disconnect the ground connection.

4. Turn the "RELEASE" knob and pull the receiver out of the cover and mount.

(6) REMOTE CONTROL UNIT.

(a) DESCRIPTION.—The Type MN-28 Y Remote Control unit *(figure 504)* is mounted on the side of the step support on the pilot's control pedestal and contains all controls for operation of the radio compass unit. The control unit consists of the following: a tuning crank to operate the three dials calibrated from 150 to 325 KC, 325 to 695 KC, and 3.4 to 7.0 MC and selected by the band selector switch; a four position operation selector switch with the positions: "OFF," "COMP.," "REC. ANT.," and "REC. LOOP"; an "AUDIO" control knob to regulate the level of the audio signal in the headsets; a "COMPASS" control knob to regulate the sensitivity of the left-right indicator pointer; a "C.W. ON-OFF" switch; a "LIGHT" control to regulate the lamp illuminating the dial; and two headphone jacks. The positions of the operation selector switch have the following functions: "COMP." for compass operation, "REC. ANT." for a communication receiver function with the vertical sense antenna, and "REC. LOOP" for a communication receiver function with the directional loop antenna.

(b) REMOVAL.

1. Disconnect the flexible drive shaft.

2. Disconnect the electrical plug.

3. Remove the screws attaching the unit to the step support, and remove the unit.

(7) AZIMUTH CONTROL.

(a) DESCRIPTION.—The Type MN-52 ( ) Azimuth Control *(figure 505)* for control of the loop

Figure 504 — Radio Compass Remote Control

Figure 505 — Radio Compass Azimuth Control

antenna is mounted on the pilot's control column and consists of a dial, crank, lamp, and switch. The dial is calibrated to give direction readings to 2.5 degrees and is illuminated by a pilot lamp which is turned on or off by the "LIGHT" switch. The dial can be set by the crank at the bottom of the control face.

(b) REMOVAL.

1. Disconnect the tach-shaft.

2. Disconnect the electrical plug.

3. Remove the screws attaching the unit to the bracket and remove the unit.

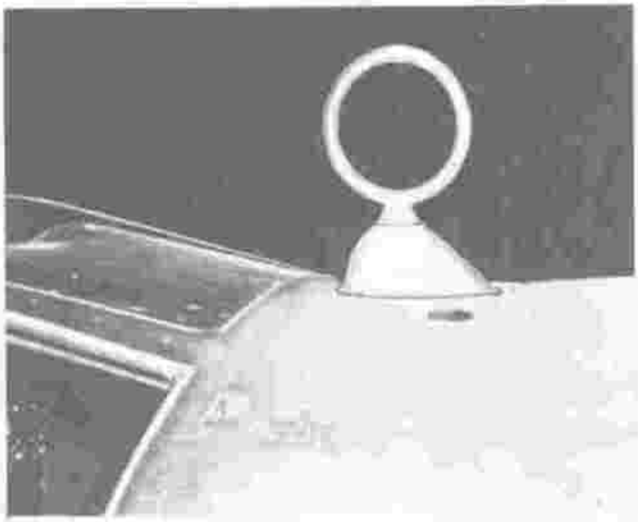


Figure 506 — Radio Compass Loop Antenna

(8) LOOP ANTENNA.

(a) DESCRIPTION.—The Type MN-20A Rotatable Loop Antenna *(figure 506)* is mounted on the fuselage top between the gunner's enclosure and the vertical stabilizer. The loop consists of a coil with center top enclosed in an electrostatic shield. At the top of the shield is a gap which is insulated and waterproofed. The loop is permanently fastened into the mounting base. All connections from the loop coil are made through slip rings to brushes which are connected to the loop transmission cable receptacle. Rotation of the loop is accomplished by means of the azimuth control, flexible tuning shaft, and fittings which drive the loop gears in the mounting base.

(b) REMOVAL.

1. Remove the screws attaching the loop unit to the fuselage.

2. Lift loop up and disconnect the electrical plug and tach-shaft.

3. Remove loop unit.

(9) SENSE ANTENNA.

(a) DESCRIPTION.—One non-directive sense antenna *(figure 507)* is strung from the tip of the vertical stabilizer to the fuselage skin above the radio compass receiver mounting. The antenna is wired from an insulator at the fuselage to the "ANTENNA" plug connection on the radio compass receiver. This sense antenna is used when the radio compass control switch is in the "REC. ANT." position for function of the equipment as a communication receiver (separate from the loop antenna).

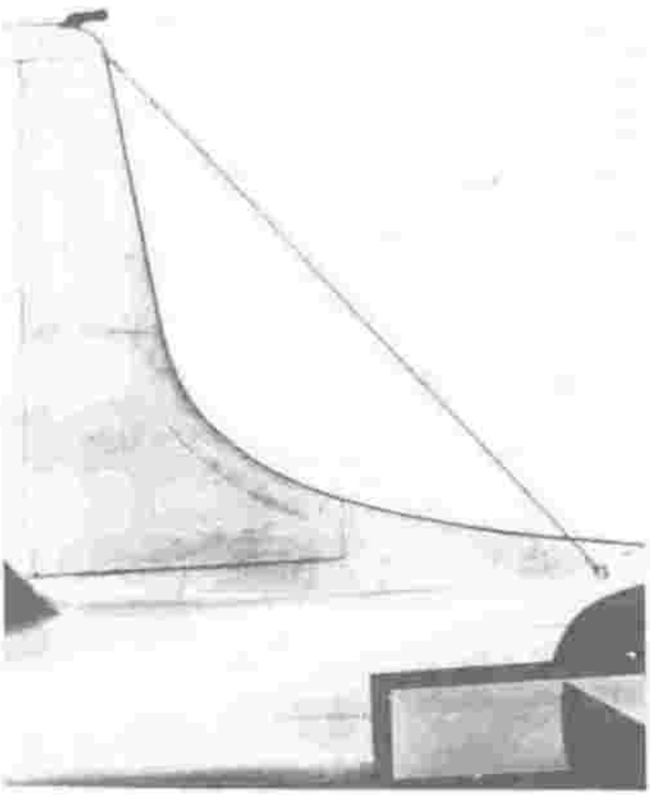


Figure 507 — Radio Compass Sense Antenna

(b) REMOVAL.

1. Disconnect the tension link from the vertical stabilizer tip.

2. Disconnect the other end of the antenna at the clip in the fuselage; disconnect the lead-in to the receiver.

(10) LEFT-RIGHT INDICATOR.

(a) DESCRIPTION.—The type IN-4A left-right indicator is mounted on the pilot's instrument panel *(3, figure 232)*. The indicator dial is marked with a small figure of an airplane to indicate on-course flight.

When the radio signal reaches the radio compas receiver, the circuit is so arranged that the pointer on the left-right indicator turns toward left or right according to the direction from which the signal was received.

(b) REMOVAL.—Detach electrical wiring and remove attaching screws.

d. RADIO SET SCR-595-A (OR SCR-695-A).

(1) GENERAL.—The Radio Set SCR-595-A (or SCR-695-A) consists of a receiver, control boxes, an emergency destructor circuit, and an antenna. Because of the complexity and confidential state of this radio set, it will be necessary to refer to the instruction and maintenance handbooks for the set. If the test procedure specified in the appropriate Handbook of Operating Instructions indicates that the radio set is operating improperly, and if installation has been checked and found to be satisfactory, the defective radio set should be sent to the nearest radio repair section or air depot and replaced by a properly operating set.

WARNING

Remember this radio set is equipped with a destructor. The destructor plug must be removed and stowed at all times except when the plane is about to take off or is engaged in actual flight operation. The plug must never be inserted in the destructor jack (in the receiver) until it has been determined that there is no voltage at the plug by connecting a test lamp or a buzzer across the plug terminals.

(2) RECEIVER.

(a) DESCRIPTION.—The Radio Receiver BC-966-A or {C-( )-46AAQ} is installed on a shock mounting on the right-hand side of the fuselage tail cone compartment. On the face of the receiver are the following receptacles: "ANT," for the antenna plug; "SUP.," for the suppressor cable (not used on this installation); the destructor unit receptacle for the plug from the detonator circuit; and two receptacles for the plugs from the power control box and selector control box.

(b) REMOVAL.

1. Remove the destructor plug from the receiver and hang on the plug holder mounted adjacent to the radio shelf.

2. Take out the destructor unit.

WARNING

This unit is explosive. Observe all service regulations for the handling and temporary storage of such material.

3. Disconnect all bonding jumpers and release the plug hold-down wire. Pull off all plugs.

4. Remove the tie wire from the two knurled clamping collars on the front edge of the receiver unit shock mounting and unscrew them for about half an inch until they can be disengaged from the hold-down lugs on the front of the receiver cabinet. The collars can then be allowed to drop downward out of the way.

5. Pull the receiver unit an inch or so toward the front edge of the shock mounting. This disengages the tapered hold-down plungers at the rear. Either draw the receiver forward or lift clear from the mounting.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—The radio set should be turned over to trained radio personnel for repair. Any radio equipment which is not functioning properly should be replaced, in the event that no trained personnel is available for maintenance repair. Replace a defective receiver as follows:

1. Place the receiver on the shock mounting and slide it toward the back until the two tapered hold-down plungers engage the holes in the angle members at the rear of the mounting.

2. Clamp the receiver unit by raising the two knurled clamping collars and screwing them over the front hold-down lugs on the receiver. Next, thread a piece of No. 16 A.W.G. steel tie-wire (0.051 inch, diameter) through one of the four holes in each clamping collar, draw it tight, and twist each end around the wire as though making a splice. Use a new wire, since a wire that has already been spliced several times is more likely to break during flight and allow vibration to loosen the clamping collars.

3. Restore destructor unit to its socket. Leave the destructor plug on its holder.

WARNING

This unit is explosive.

4. Put back all other plugs and connect all bonding jumpers.

(3) CONTROL BOX UNIT.

(a) DESCRIPTION.—The RC-255-A control box unit *(figure 508)* is located on the left-hand side of the gunner's compartment and consists of a BC-965-A selector control box and a BC-958-A power control box. The selector control box has a dial, a pointer, and receptacle for the plug from the receiver. The power control box has an "ON-OFF" switch, an "EMERGENCY" switch, a capped phone jack, and recep-

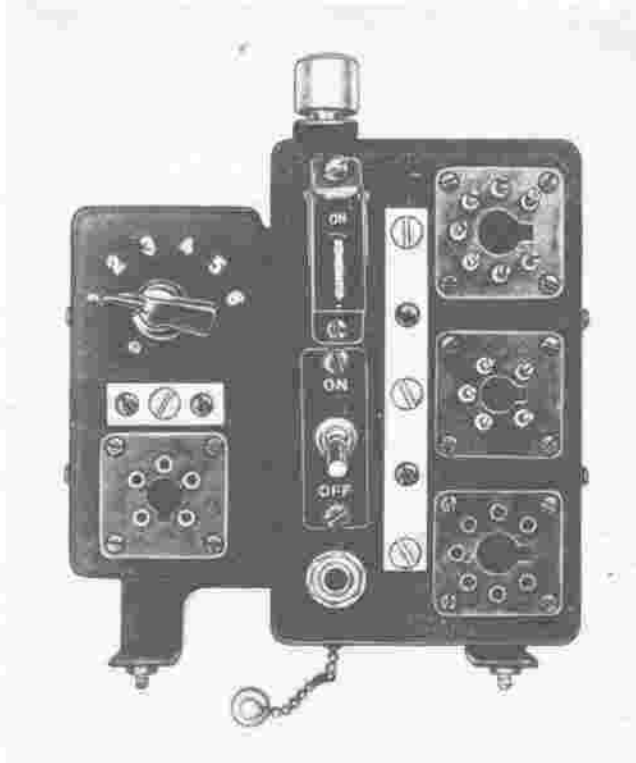


Figure 508 — SCR-595-A Radio Control Box Unit

tacles for the power plug from the battery, the plug from the pilot's switches, and the two plugs from the receiver. The power socket for the power plug is mounted forward of the power control box. There is also an "ON-OFF" switch and a guarded "EMERGENCY" switch in the pilot's compartment above the pilot seat.

Note

The SCR-695-A radio set is the same as the SCR-595-A set except that it contains an "ON-OFF" switch for the "G" band operating mechanism and a push-button switch for the "ON-OFF" control of the time control of the "G" band. Both switches are in the pilot's compartment.

(b) REMOVAL.—Power control box BC-958-A and selector control box BC-965-A are ordinarily handled as a single unit because both are screwed to the one mounting.

1. Disconnect all four cable bonding jumpers at the panels and pull out the plugs. Be sure that the battery cable assembly is disconnected first.

2. Loosen the knurled clamping nut by unscrewing it.

3. Pull control unit forward and lift out of mounting bracket. This combined pulling and lifting motion will disengage the two mounting lugs on the bottom of the securing plate from the slots in the mounting bracket.

4. Power control box BC-958-A can be taken off the securing plate by removing the three machine screws on the back. Selector control box BC-965-A can be taken off in a similar manner by removing the two screws.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replace a defective control box as follows:

1. Unscrew knurled clamping nut at the top of the mounting and insert two lugs at the bottom into the corresponding slots in the mounting bracket. Gently push the assembly back into the mounting bracket, guiding the screw carrying the clamping nut at the top into the slot.

2. Check to see that both bottom lugs engage the slots properly; if they do, tighten the knurled clamping nut.

3. Install the four plugs and reconnect all bonding jumpers. Put the battery cable assembly back last.

(4) DESTRUCTOR CIRCUIT.

(a) DESCRIPTION.—The destructor circuit consists of the following units. The destructor unit is located in the receiver and is connected to the destructor circuit by a plug. The BC-767 indicator box *(figure 509)* mounted aft of the receiver in the fuselage tail cone compartment consists of a red lamp and a green lamp. The BC-706-A or SA-3/A inertia switch box *(figure 511)* mounted in the fuselage tail cone compartment above the receiver consists of a pendulum-set impact switch. The BC-765 destructor switch box *(figure 510)* is mounted in the pilot's compartment above and behind the pilot's seat and consists of two push button switches.

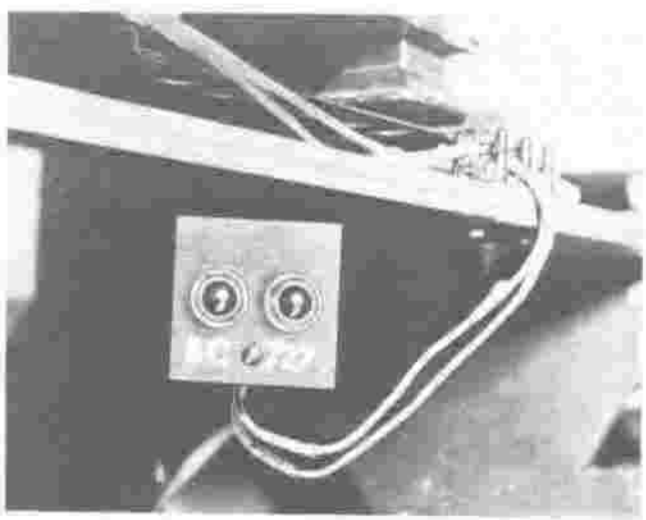


Figure 509 — Destructor Circuit Indicator Box

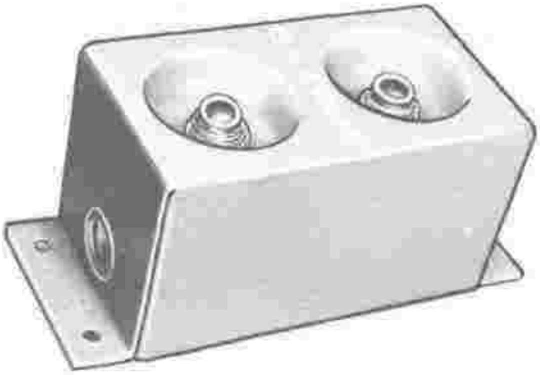


Figure 510 — Destructor Switch Box

(b) TEST AFTER INSTALLATION.

1. Check inertia switch box setting as follows:

WARNING

The plug must be disconnected from the destructor unit before testing the inertia switch.

Unscrew and remove the transparent cap. Displace the pendulum arm until a sharp snap indicates that the switch is tripped (all contacts closed). Reset the switch by inserting the blade of a screw driver in the slotted head screw on the right-hand side of the switch casing. Rotate the screw driver counterclockwise as far as it will go and then allow the screw driver to be rotated slowly by the spring in a clockwise position until it catches. The pendulum, which can be seen through the transparent cap, will then be approximately centered in the ring cast in the top of the cap. The switch box should be in a vertical position with the transparent cap uppermost. Replace the cap.

2. Test indicator box as follows: Since the indicator box is permanently connected in parallel with the destructor plug, the indicator lamps should light with the destructor plug removed from the destructor unit and the inertia switch box tripped. With the inertia switch box reset, simultaneously depress the two buttons marked "DANGER" on the pilot's destructor switch box. The lamps should light again. After testing, set the switches, including the inertia switch, for proper operating conditions, as indicated by absence of light from the indicator lamps. When the inertia switch has been finally set, rap the sides

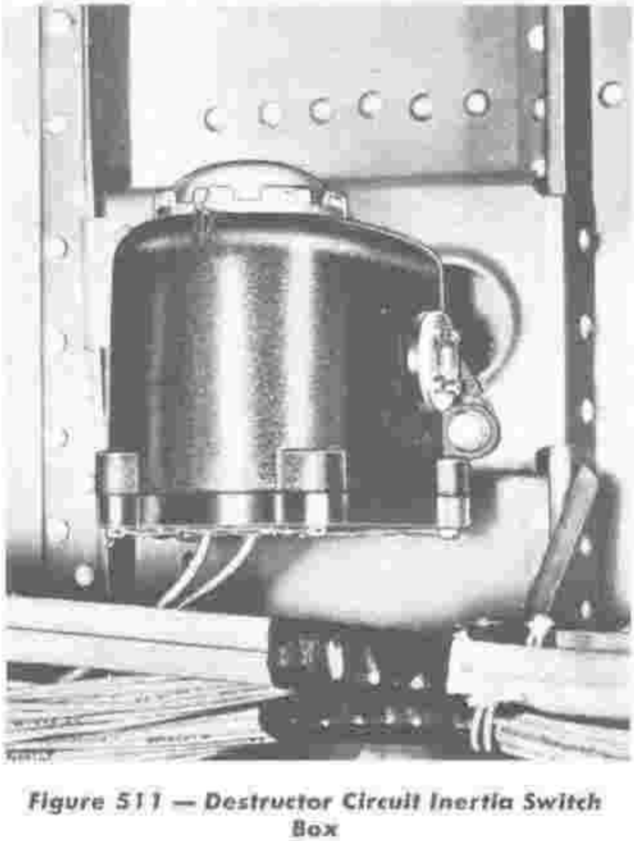


Figure 511 — Destructor Circuit Inertia Switch Box

Figure 512 — SCR-595-A Radio Antenna

lightly with the knuckles. If correctly set, the switch should not release. Before the destructor plug is inserted into the destructor unit, the indicator should show no voltage at the plug.

(5) ANTENNA.

(a) DECRIPTION.—Antenna wire is strung from the receiver through the fuselage to a vertical antenna mast which extends downward from below the tail cone horizontal stabilizer.

(b) TEST AFTER INSTALLATION.

1. Check for rigid attachment of antenna to fuselage and for possible damage from collision or other causes. Check for proper grounding of antenna bracket to fuselage through the bolts.

2. Look for weak spots or breaks in the rubber-like covering of the coaxial antenna transmission line.

e. INTERPHONE EQUIPMENT.

(1) GENERAL.—The interphone equipment consists of an interphone jack box, throat microphone and headset for each crew member, an interphone amplifier, a dynamotor, and a radio filter for the pilot's interphone. The interphone circuit is wired to power through a 10 ampere circuit breaker switch on the pilot's distribution panel. This equipment is used for communication between the crew members and for connection to the SCR-274-N Radio, the SCR-522 Radio and the Radio Compass radio set.

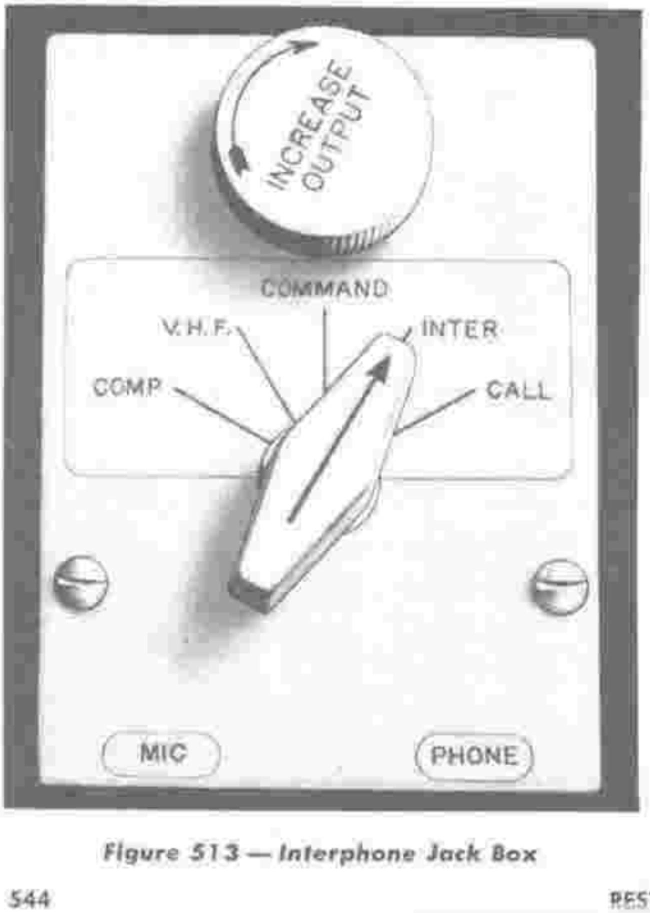


Figure 513 — Interphone Jack Box

(2) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 16. *b.*, this section.

(3) INTERPHONE JACK BOX.

(a) DESCRIPTION.—One interphone Jack Box BC-366 *(figure 513)* is installed for each crew member: one to the left of the pilot's seat, one on a bracket on the control pedestal to the right of the cannon-loader's seat, and one on the left-hand side of the forward bulkhead in the gunner's compartment. Each jack box has an "INCREASE OUTPUT" knob, a selector switch, and two jacks, one each for microphone and headset connections. The selector switch has the following positions for the following functions:

"COMP," supplies audio output of radio compass receiver.

"LIAISON," supplies audio output of command receivers of Radio Set SCR-274-N, and permits any crew member to modulate command transmitter where microphone "push-to-talk" switch is pressed. The "A-B" telephone switches of Radio Set SCR-274-N receiver control box must be in "B" position for reception on any of the three receivers. If Radio Set SCR-522-A is installed, transmission on reception is affected on "LIAISON" position and transmission or reception through Radio Set SCR-274-N can be affected only on "COMMAND" position.

"COMMAND," supplies the audio output of command receivers of Radio Set SCR-274-N and permits any crew member to modulate command transmitter when microphone push-to-talk switch is pressed. The "A-B" telephone switches of the receiver control box must be in "A" position for reception on any of the three receivers.

"INTER," permits communication with any crew member whose jack box selector switch is on "INTER." The "INCREASE OUTPUT" control is not effective.

"CALL," permits any crew member to call any other crew members regardless of the setting of their selector switches. The "INCREASE OUTPUT" control is not effective.

Note

Be sure the airplane electrical system is off.

(b) REMOVAL.

1. Remove the two screws which hold the cover to the body of the box.

2. Lift the cover straight out.

3. Disconnect the wires which are soldered to the plate inside the box. (The plate is roughly triangular shaped.)

4. Remove the three screws which fasten the plate to the bottom of the box and lift out the plate.

5. Lift out the micarta sheet which has been placed beneath the plate to expose the two screws at one end which secure the box in place.

6. Remove these two screws and the third screw at the opposite end of the box and lift the box from the airplane.

(4) INTERPHONE AMPLIFIER.

(a) DESCRIPTION.—One Interphone Amplifier BC-347-( ) *(3, figure 489)* is installed on the left-hand side of the fuselage behind the pilot's seat. The unit is a single stage push-pull audio amplifier utilizing one twin-triode type of vacuum tube VT-99 (commercial equivalent=6F8-G). All external wiring is connected to a jack terminal strip mounted in the bottom of the amplifier box. This plug-in chassis allows the amplifier assembly to be removed without disturbing any soldered connections. It is only necessary to remove the two screws which fasten the cover and lift straight up. The numbering of the terminals on the plug terminal strip corresponds to the numbering shown on the circuit label in the amplifier case.

(b) REMOVAL.

1. Remove the two screws which fasten the cover assembly to the box and pull the cover straight out.

2. Remove the soldered wires.

3. Remove the four screws in the bottom of the box which fasten it to the airplane.

4. Remove the box from the airplane.

(5) DYNAMOTOR.

(a) DESCRIPTION.—The type PE-86-( ) dynamotor *(4, figure 489)* for the interphone system is mounted on the left-hand side of the fuselage behind the pilot's seat, and is used to convert the airplane electrical system voltage to the higher d-c voltage required for the interphone system. The dynamotor is connected to the airplane power through a 10 ampere circuit breaker switch on the pilot's distribution panel and is ON when the airplane bus is energized by the generators, batteries, or external power source.

(b) REMOVAL.

1. Release the snapslides and lift the dynamotor from its mount.

Figure 514 — Interphone Dynamotor

2. Disconnect the electrical wires and remove dynamotor.

3. To remove the dynamotor box, extract the four screws in the bottom of the box which fasten it to the airplane.

(6) RADIO FILTER EQUIPMENT.

(a) DESCRIPTION.—The Type RC-198 filter equipment consists of a type FL-8 filter unit inside a switch box *(figure 515)* mounted to the left of the pilot's seat and controlled by a switch with the three positions: "RANGE," "VOICE," and "BOTH." "RANGE" reduces voice interference to range signals, "VOICE" reduces range interference to voice signals, and "BOTH" is the normal position of the switch

Figure 515 — Radio Filter Unit

until it is desired to separate voice and range signals during a period of simultaneous transmission of both types of signals. The filter equipment is not a part of the radio sets, but is merely introduced in series with the pilot's headset and can be used on any receiver which the pilot may select by his interphone jack box. Two jack plug sockets are located on the bottom of the switch box: the forward socket is for the headset plug; the aft socket is not used in this installation.

(*b*) REMOVAL.

1. Remove the two screws from the ears on both sides of the box.

2. One end of the box is a plate which is fastened at the corners by four screws. The wires are connected at this plate, and to separate them from the box, either disconnect the wires or detach the end plate from the box.

(7) THROAT MICROPHONES.—One Type T-30 microphone is provided for each crew member, and is used for voice modulation of the transmitters and interphone systems to which it is connected by inserting the microphone plug into the jack of the extension cord connected to the interphone jack box. Each microphone is controlled by a push-to-talk microphone switch for each crew member: the pilot switch is on the left-hand engine throttle, the cannon-loader's switch is to the right of his seat next to his interphone jack box, and the gunner's switch is on the left-hand sighting station grip.

(8) HEADSETS.—One Type HS-33 or HS-38 headset is provided for each crew member with extension cords to permit freedom of movement. Each cord is equipped with a jack, an adapter, and a plug. The headset extension cord is plugged into an adapter which, in turn, is connected to the radio filter.

f. RADIO SET SCR-515.—Provisions only are made for the alternate installation of the Radio Set SCR-515. The set incorporates the following units which may be located as follows: The Receiver-Transmitter BC-645-A and the Dynamotor-Coder PE-101-A can be mounted on the right-hand side of the fuselage aft section. The Radio Control Box BC-646-A can be mounted in the pilot's compartment to the left of the pilot's seat. The SW-181 switch can be installed below the control box.

g. RADIO SET SCR-522.

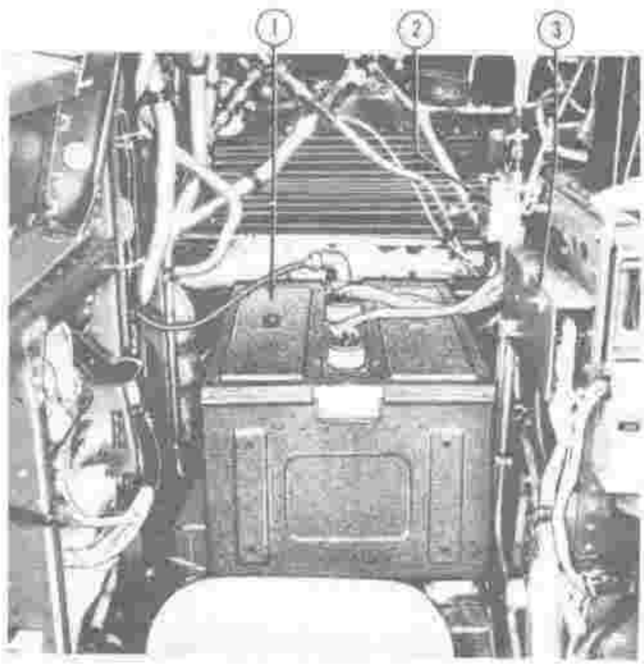
(1) GENERAL.—The SCR-522 radio is a two way, remotely controlled set consisting of a transmitter-receiver assembly, a dynamotor, a microphone adapter, a control box, and an antenna mast. This set may be operated on any one of four crystal-controlled channels lying within the frequency range of 100-156 mc. Power for the equipment is obtained by connections to the bus bar in the pilot's electrical distribution panel. This equipment is connected to the interphone circuit.

(2) REMOVAL.—All of the SCR-522 radio equipment is installed in the pilot's compartment. All of the equipment excepting the dynamotor is readily accessible for removal and maintenance. The dynamotor is located on the left side of the fuselage, to the left of the forward junction box. To gain access to the dynamotor it will be necessary to remove the ammunition cans from the nose, remove four pins from the hinged armor plate, and slide the armor plate toward the right side of the fuselage. When there are no guns or ammunition cans installed on the left side of the nose, the armor plate may be folded out of the way.

(3) MAINTENANCE REPAIR OR REPLACEMENT. — Field maintenance of the SCR-522 radio equipment is restricted to the replacement of vacuum tubes and indicator lamps. Work of a more serious nature should be done at repair depots by qualified personnel. Detailed instructions on the maintenance of the SCR-522 radio will be found in T.O. No. 08-10-105.

(4) SCR-522 TRANSMITTER-RECEIVER ASSEMBLY. *(See figure 516.)*

(*a*) GENERAL.—The transmitter-receiver assembly is installed in the pilot's compartment, aft of the



1. Transmitter and Receiver Unit
2. Microphone Adapter
3. Connector Panel

Figure 516 — SCR-522 Radio Transmitter Receiver

gun loader's seat. The assembly consists of a case containing a rack, a transmitter and a receiver. The transmitter and the receiver are simultaneously switched to any one of four available pre-set crystal-controlled channels whenever the appropriate channel-selector pushbutton (located on the control box) is pressed.

(b) TRANSMITTER (BC-625-A).—The transmitter employs a crystal-controlled oscillator circuit and operates in the frequency range 100-156 megacycles on any one of the four preset channels A, B, C and D. The top of the transmitter is equipped with four tuning controls, a receptacle for the d-c meter cord and a meter switch. The antenna-coupling control is located on the right side of the transmitter panel and the gain control is on the left. The crystal sockets are to the right of the meter switch and are identified by channel letters A, B, C and D. A tube set for the transmitter consists of the following: two tube VT-118, three tube VT-134, one tube VT-198 A, and two tube VT-199.

(c) RECEIVER (BC-624-A).—The receiver is a 10-tube superheterodyne set employing a heterodyne oscillator whose frequency is controlled by any one of four quartz-crystals. Any one of four crystal-controlled channel frequencies in the range of 100-156 mc may be selected at the remote control position. The audio amplifier portion of the receiver is used as an interphone communication and side-tone amplifier. All tuning controls are located on the receiver panel and are easily accessible.

(d) RACK (FT-244-A).—The rack for the SCR-522 radio is a shallow tray which contains inter-connecting wires for the receiver and transmitter, plug sockets for the attachment of cables, the antenna change-over relay, and the channel control motor. The rack also serves as a mounting base for the transmitter-receiver unit.

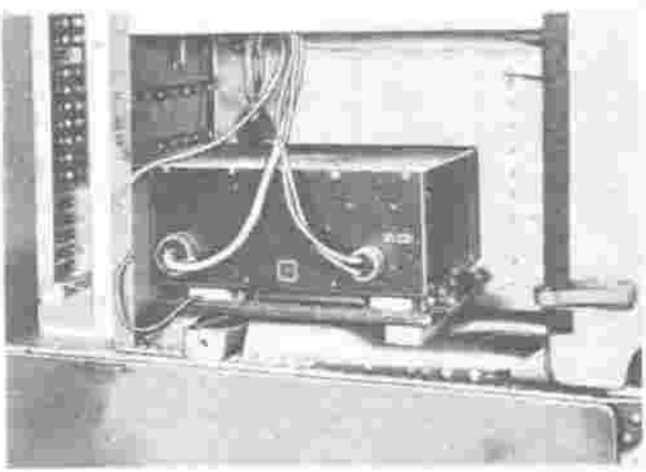


Figure 517 — SCR-522 Radio Dynamotor

(5) DYNAMOTOR (PE-94-C). *(See figure 517.)*—The SCR-522 radio dynamotor is installed on the left side of the fuselage, immediately aft of the nose section. The unit is the source of three regulated voltages required for the operation of the transmitter-receiver assembly: 300 v d. c. for the plates and screens of the vacuum tubes in the transmitter and receiver, 150 v d. c. for the grid bias in the transmitter, and 13 v d. c. for all tube heaters, control relays, the channel control motor, and indicator lamps.

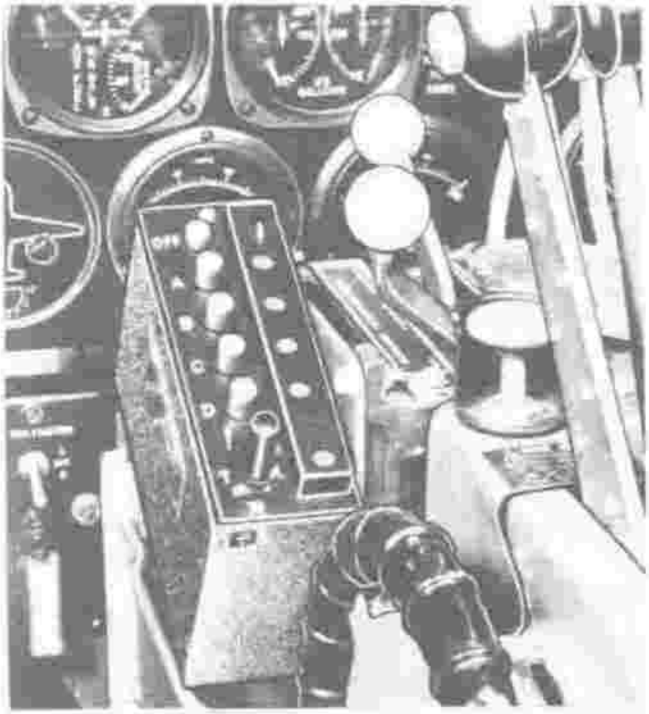
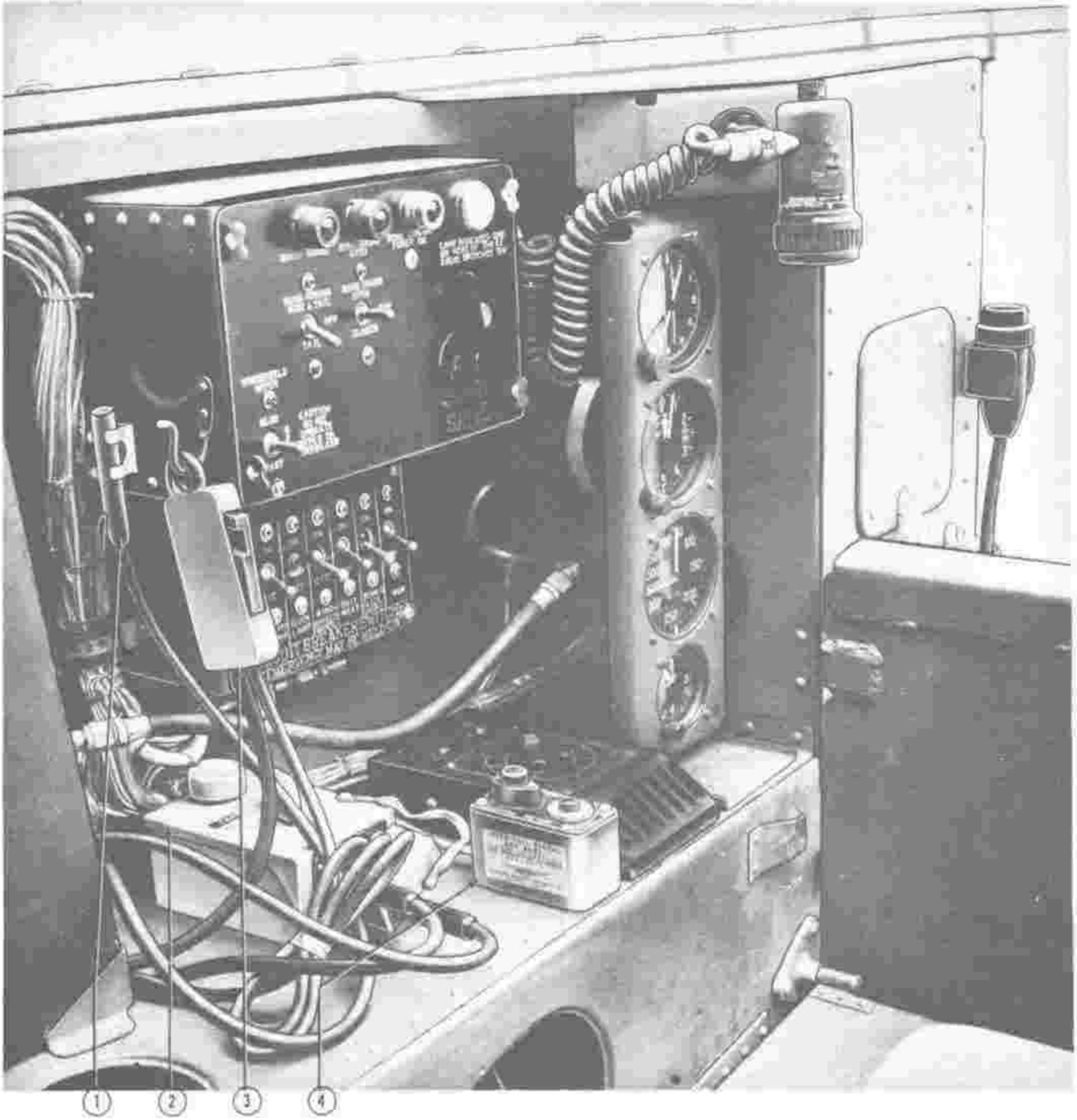


Figure 518 — SCR-522 Radio Control Box

(6) REMOTE CONTROL BOX (BC-602-A). *(See figure 518.)*—The SCR-522 radio remote control box provides complete control of communications functions. The box is mounted on the top of the control pedestal, just aft of the instrument panel, within easy reach of the pilot. Controls on the box consist of five red push buttons by which channels are selected and the power turned on or off; a T-R-REM switch, and a T-R-REM switch locking lever. When the T-R-REM switch is placed in the REM (remote) position, "press-to-talk" operation may be obtained by pressing the



1. Interphone Jack
2. Interphone Jack Box
3. Microphone Switch
4. Inter-Call Signal Box

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Figure 519 — Bombardier Nose Communications Equipment

pilot's microphone switch on the engine throttle. This action switches the equipment from receive to transmit. To maintain the T-R-REM switch in the remote position, it is necessary to raise the locking lever tab on the control box. When the tab is down it blocks the switch from the remote position and spring loads the switch lever, so that it stays in the "R" position unless held in the "T" position.

(7) MICROPHONE ADAPTER (M-299). *(See 2, figure 516.)*—The microphone adapter consists of an enclosed transformer which serves to adapt the interphone system to the ultra high frequency operation of the SCR-522 radio. The adapter is mounted on the control pedestal adjacent to the transmitter-receiver assembly.

(8) TERMINAL STRIP (2062648-10A). *(See 3, figure 516)*—The terminal strip is located on the control pedestal adjacent to the transmitter-receiver assembly. The strip links components of the transmitter-receiver assembly with the control box and the microphone adapter. The terminal strip also serves as a connector panel for the British A-1271 radio.

(9) ANTENNA (AN-104-A). *(See figure 520.)*—The antenna for the radio is strung from the transmitter-receiver assembly to the antenna mast mounted on the top of the fuselage above the pilot's compartment.

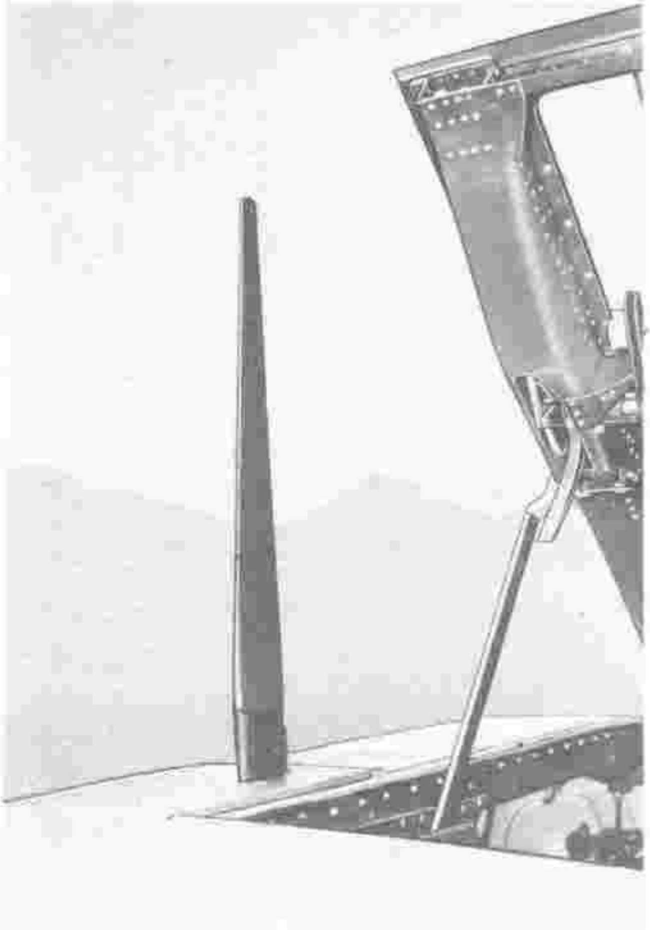


Figure 520 — SCR-522 Radio Antenna Mast

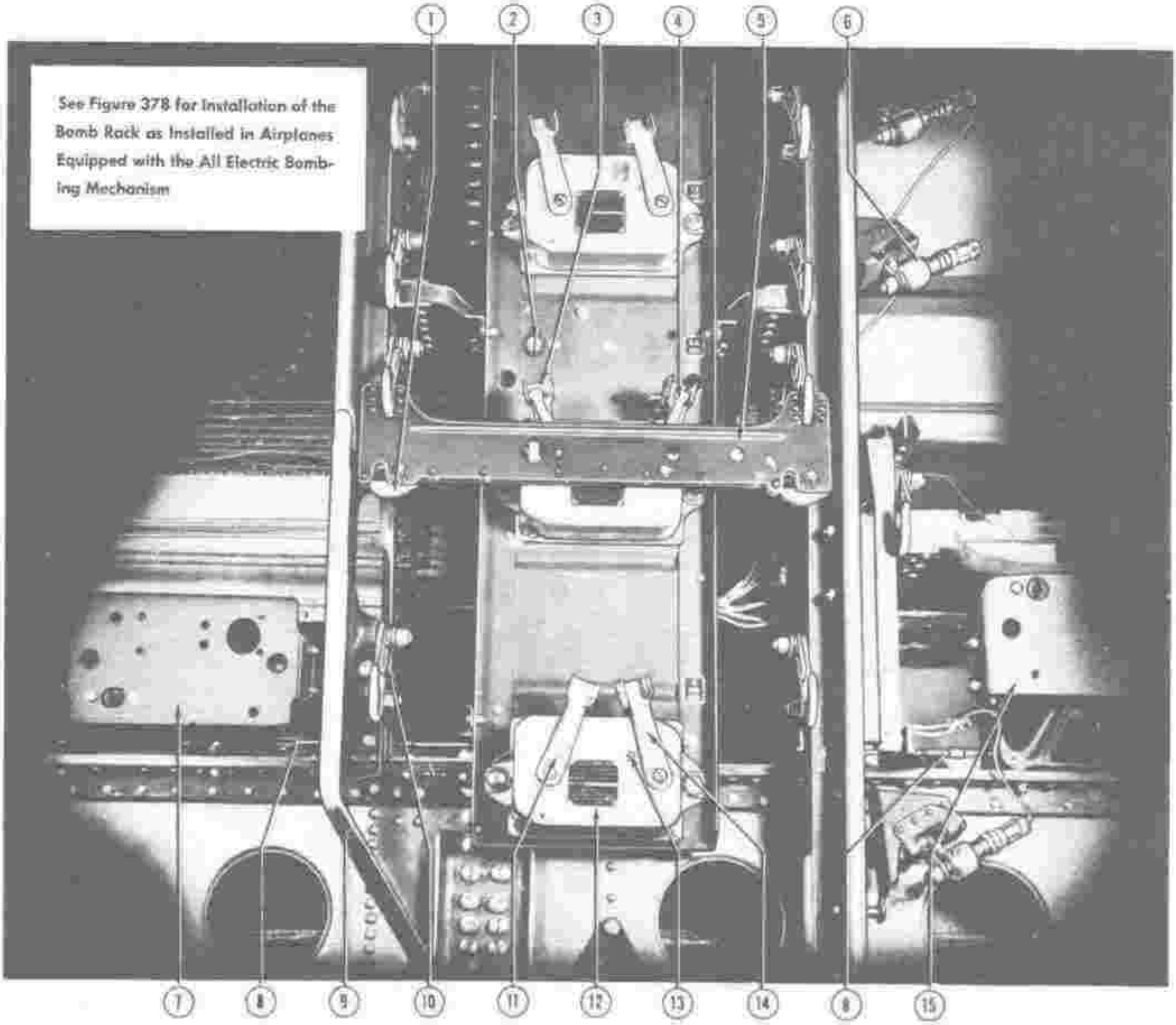
17. ARMAMENT

a. GENERAL.—Armament as interpreted in this handbook includes a treatment of the following subjects: bombing equipment, chemical tanks, torpedo carrying equipment, gunnery equipment and armor plate.

b. LOADING INSTRUCTIONS.—The loading of bombs, chemical tanks, torpedoes and ammunition is described in section V. A bomb-loading instruction diagram is installed on the left-hand side of the aft bomb bay.

c. BOMBING EQUIPMENT.

(1) GENERAL.—The A-26 series airplane may be equipped with either of two types bombing systems; one has electrical release mechanism and cable operated salvo release, the other is an all-electric bombing system. The all-electric system and the electrical release



1. Bomb Carrying Hooks
2. Salvo Coupling
3. Shackle Arming Lever
4. Shackle Release Lever
5. B-7 Bomb Shackle
6. Type A-2 Bomb Arming Control Unit
7. Torpedo Release Panel
8. Mechanical Bomb Salvo Release Cable
9. Removable Bomb Rail
10. Shackle Carrying Hooks
11. Type A-2 Release Unit Arming Lever
12. Type A-2 Bomb Release Unit
13. Release Unit Emergency Trip Screw
14. Release Unit Releasing Lever
15. Forward Bomb Panel

Figure 521 — Forward Fuselage Demolition Bomb Rack

1. Bomb Rack Control Torque Shaft Support
2. Bomb Rack Control Torque Shaft
3., 4., 33. Cable Assemblies
5. Cable Assembly
   (Figure 606, Items 57 Lower, 59 Upper)
6. Cable Assembly *(Figure 606, Items 28 & 29)*
7. Rear Bomb Rack Release Cam Bar Assembly (Typical for each rack)
8. Wing Bomb Rack Control Bracket — Sta. 66
9., 21., 29. Cable Assemblies
   (Figure 606, Items 59, 58, 9)
10. Wing Bomb Rack Control Bracket — Sta. 84
11. Pilot's Bomb Rack Control
12., 14. Cable Assemblies
   (Figure 606, Items 77 & 78 for both)
13. Pilot's Bomb Rack Pulley Bracket
15. Bracket Assembly
16. Tube Assembly
17. Bomb Rack Push-Pull Rod Assembly
18. Fuselage Bomb Rack Control Bracket — Sta. 103
19. Fuselage Bomb Rack Control Bracket — Sta. 127
20. Fuselage Bomb Rack Control Support — Sta. 143
22. Control Rod
23. Switch
24. Fuselage Aft Bomb Rack Control — Sta. 199
25. Wing Rack Bomb Control Bracket — Sta. 84
26. Wing Rack Bomb Control Brackets — Sta. 140
27. Wing Rack Bomb Control Brackets — Sta. 180
28. Bellcrank Bracket
30. Wing Outboard Bomb Rack Release Control Lever
31. Pulley Bomb Rack Installed
32. Wing Bomb Rack Installed
34. Wing Inboard Bomb Rack Release Control Lever

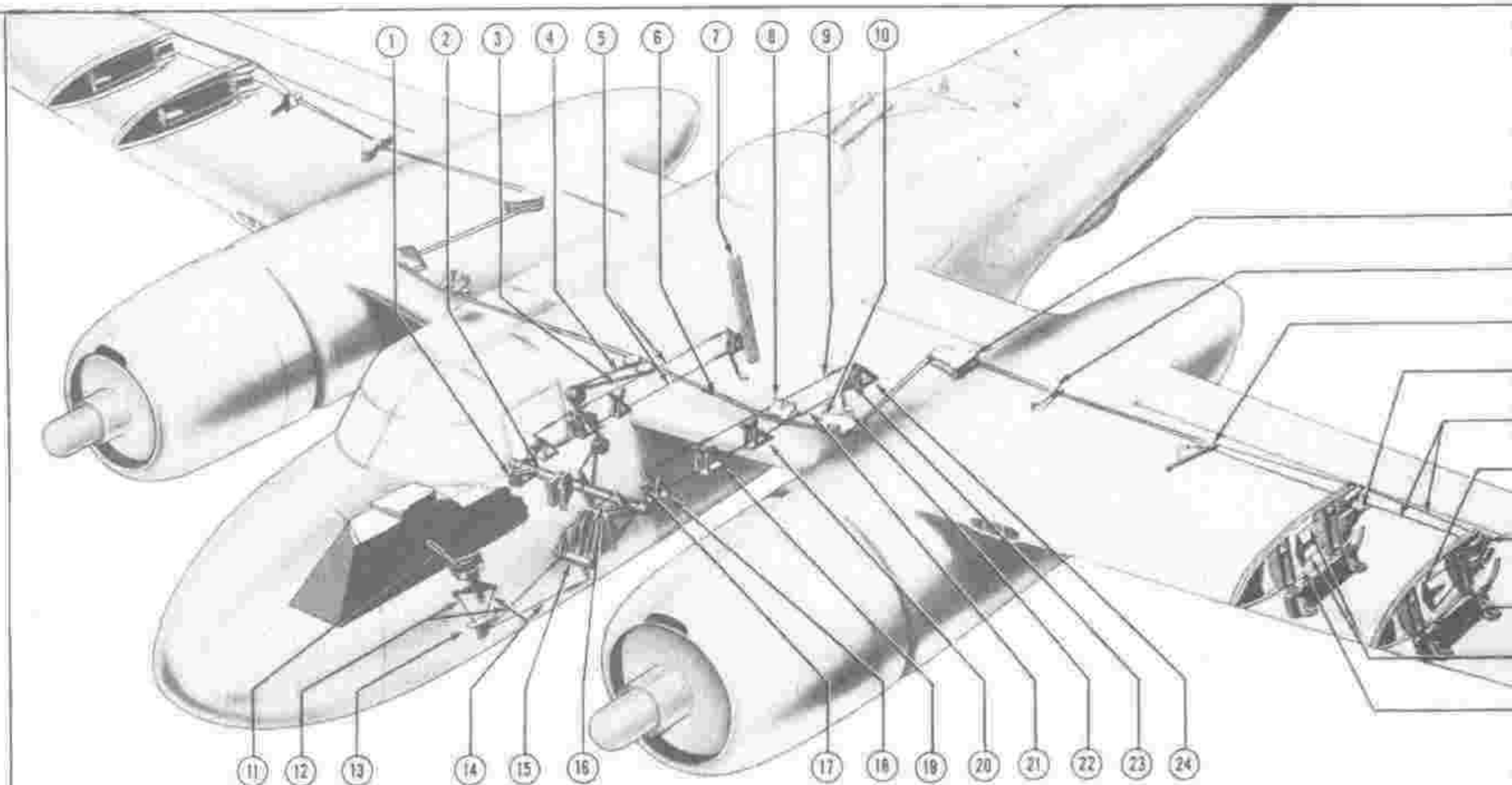


Figure 522 — Mechanical Bomb Release Controls

mechanism of the other system are covered in paragraph 15., ELECTRICAL, this section. Provisions are installed or provided for the carrying of bombs in the bomb bay and under the wings, outboard of the nacelles. The bomb load combinations may be determined by referring to the bomb loading chart in section V.

(2) FUSELAGE DEMOLITION BOMB RACKS. *(See figure 591.)*

(a) DESCRIPTION.—The forward bomb bay is equipped with right and left-side bomb release panels. *(See figure 521.)* Each panel has seven bomb stations, only five of which can be used at a time. A single station panel *(15, figure 251)* is furnished, further forward to accommodate 500 to 1000 pound bombs. The right and left aft bomb bay panels have five bombing stations, only three of which can be used at a time. Each station is marked for the size bomb to be carried. On some airplanes another single station panel is provided between the forward and aft bomb bay panels for the alternate installation of torpedoes. This panel is not installed on all airplanes, but is supplied in the torpedo kit. Type A-1 bomb arming controls are installed for each bomb to be carried to control the armed or safe condition of bombs to be released. Type A-4 bomb release mechanism is installed at each bombing station to be used. These units attach to the bomb panel by bolts and effect the electrical release of bombs. On some airplanes a Type A-2 release mechanism and provision for mechanical salvo is included. On these few airplanes a salvo cam bar is installed behind each bomb panel and connected by cables to the bomb control lever in the pilot's compartment. A salvo coupling on the release mechanism is turned by the cam bar

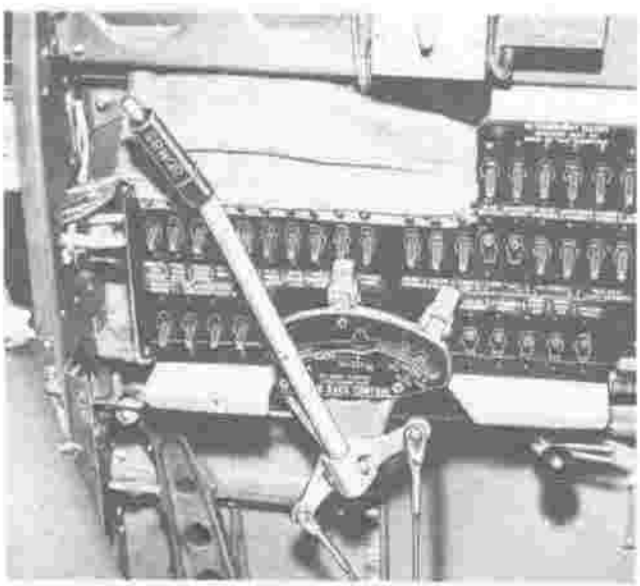


Figure 523—Bomb Control Lever (on airplanes equipped with mechanical release.)

and releases the bomb load in salvo. The panel moves up and down to move the salvo coupling on the A-2 release mechanism. The cams are spaced just far enough apart to drop the bombs progressively from bottom to top. This action is accomplished by moving the bomb control lever into the "SALVO" position.

(b) REMOVAL AND DISASSEMBLY.

1. Remove the Type A-4 bomb release unit as instructed in paragraph 15. *d.* (15) *(b)* *3.* c. *(4)* (b), and the Type A-2 as instructed in paragraph 15. *d.* (15) *(c)* 3. b., this section. Remove the bomb arming control as instructed in paragraph 15. *d.* (15) *(b)* *3.* e. *(2)* (b), this section.

2. Remove the bolts that hold the bomb rack panels to the fuselage structure of the bomb bay.

3. Remove the bolts which secure the removable bomb rails. *(See 9, figure 521.)*

4. Disconnect the electrical connections from the transfer switch box.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replace any parts that are cracked or seriously damaged.

(d) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL procedure.

(3) FUSELAGE FRAGMENTATION BOMB RACKS.

(a) DESCRIPTION.—Provisions are made to make possible the installation of 14 fragmentation bomb racks in the bomb bay. Support assemblies are hung across the bomb bay from bomb stations seven and eight in the forward bay, and five and six in the aft bay. Seven fragmentation racks are suspended from each support, each rack carrying eight fragmentation bombs. An alternate load of demolition bombs in one bay and fragmentation bombs in the other may be carried. The maximum load weight for fragmentation bombs is 2756 pounds, permitting 56 bombs to be carried in each bay. If the 75 mm cannon is installed, the three right hand racks in the forward bay must be omitted. In such case, the weight of the bomb load is 2172 pounds. Electrical operation of the fragmentation rack is accomplished through an A-4 bomb release unit mounted integrally at the rear of the rack. An impulse to this unit unlatches the door on the rear rack and releases the four bombs in the aft end of the rack. When the last bomb leaves the aft compartment, the forward rack door is tripped by linkage and the forward bombs are released. A skip switch is actuated when the last bomb drops which passes the impulse to the next rack in train. No provisions are made to release fragmentation bombs mechanically or in the SAFE condition.

(b) REMOVAL AND DISASSEMBLY. – Reverse the INSTALLATION procedure given below.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

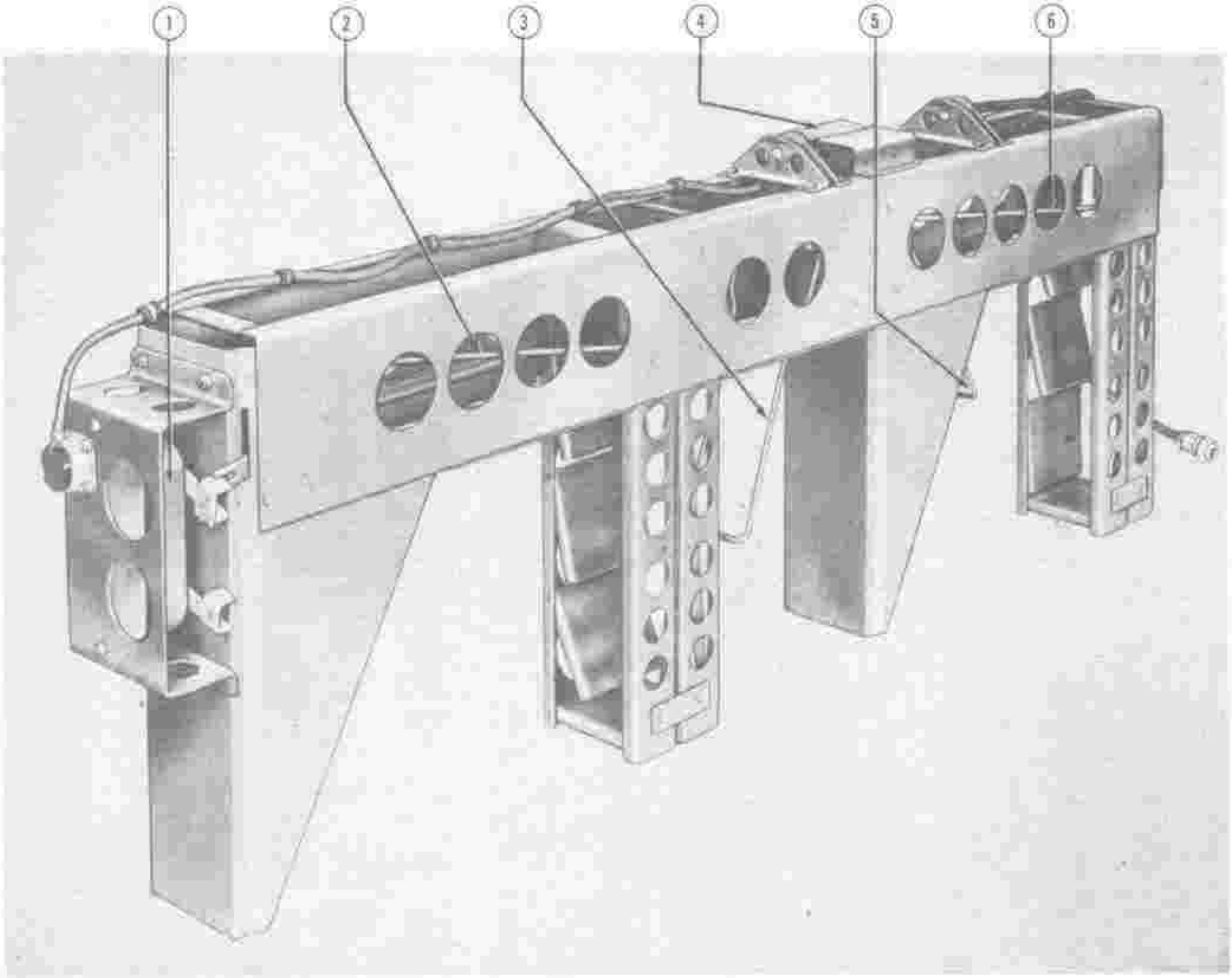
1. The fragmentation rack is designed to operate without lubrication of any kind and must be kept free of oil and dirt.

2. Repairs consist of replacement of parts when necessary, or such straightening, alignment, and adjustment of linkage as may be required. Whenever repairs are needed that are beyond the facilities of the service activities, the rack to be repaired will be appropriately marked and returned to the air depot.

(d) ASSEMBLY AND INSTALLATION. – Hang fragmentation rack support in bomb station hooks seven and eight (forward bay) or stations five and six in aft bay.

(4) WING BOMB RACKS. *(See figure 528.)*

(a) DESCRIPTION.—Four wing racks may be installed to carry bomb loads of one 100, 300, or 500 pound bomb each. The wing rack assembly incorporates the carrying shackles, the release mechanism, and the arming control as an integral unit. Each rack is secured to the wing by forward and aft hangers which bolt to the wing structure. Sway braces in the form of adjustable bolts are incorporated into the



1. Type A-4 Bomb Rack Release Unit
2. Rear Bomb Release Linkage
3. Forward Bomb Release Arm
4. Skip Switch
5. Skip Switch Arm
6. Forward Bomb Release Linkage

Figure 524 — Type R-1 Fragmentation Bomb Rack

lower part of the hangers. The rack provides for alternate installation of chemical tanks, paragraph 17. *d.* (3), this section, and wing machine guns, paragraph 17. *f.* (1) *(e)*, this section.

(b) REMOVAL AND DISASSEMBLY.

1. Disconnect the electrical plug *(1, figure 528)* at the aft end of the rack.

2. Disconnect the manual control lever by removing the bolt.

3. Remove the bolts which hold the rack in the wing rack hangers and remove the rack.

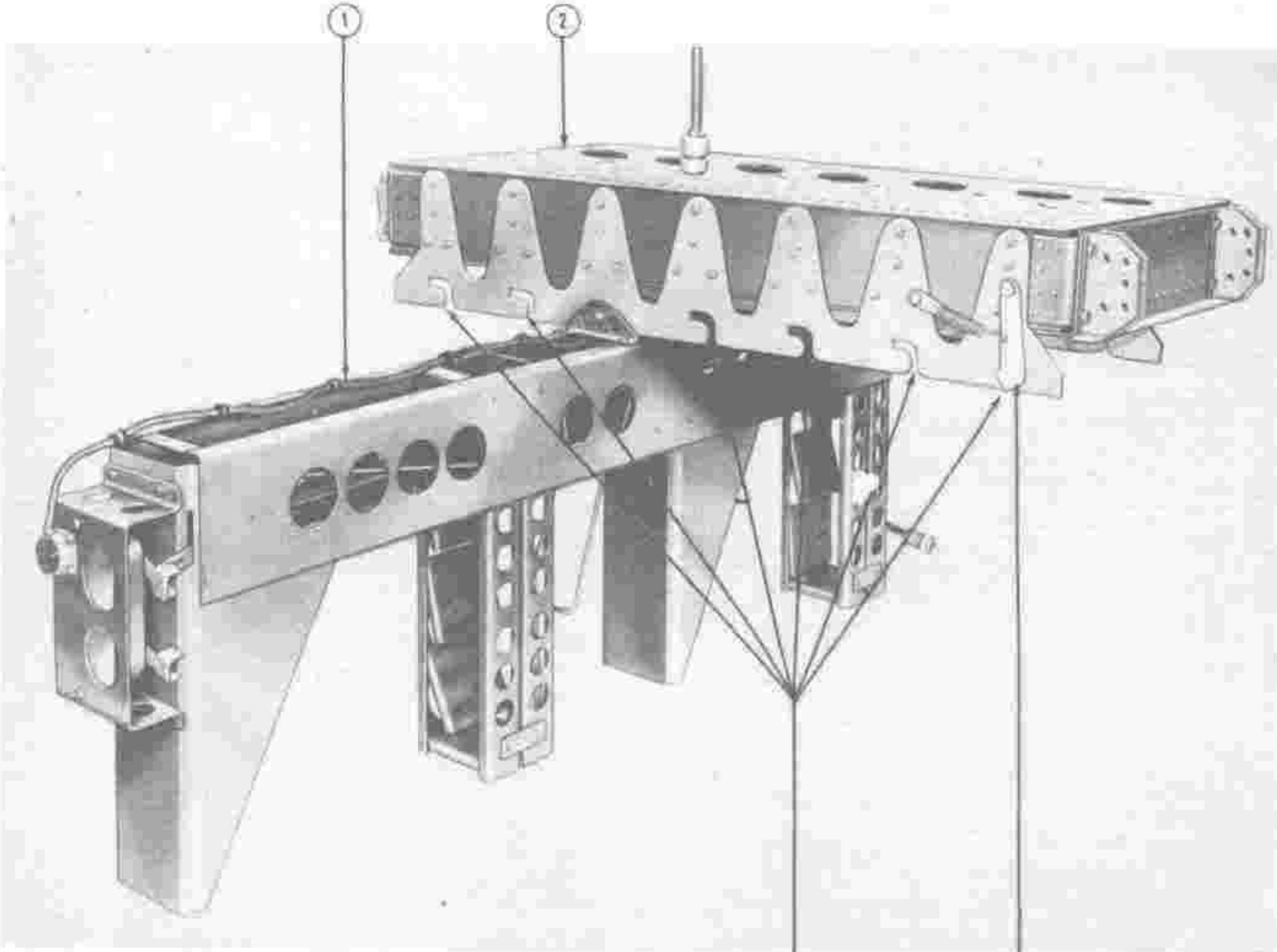
4. Unscrew the wing rack hangers from the wing structure.

(c) ASSEMBLY AND INSTALLATION. – When screwing the hangers into the wing structure be sure that they engage the backing plates on the inside of the wing skin. Screw the hanger into the structure as far as it will go. Then back it off as required to install the bomb rack.

(d) TEST AFTER INSTALLATION.

1. Check the arming spring. This spring should support a two pound weight but should not support a four pound weight suspended from the notch in the elevers.

2. Use round ring wire (.080 inch dia.) with an 11/16 inch inside diameter loop.



1. Type R-1 Fragmentation Bomb Rack
2. Adapter
3. Rack Mounting Slots
4. Locking Lever

Figure 525 — Fragmentation Bomb Rack Mounted on Adapter

(5) BOMB SHACKLE. *(See 5, figure 521.)*

(a) DESCRIPTION.—Type B-7 bomb shackles are used to carry 100-1100 pound bombs in the bomb bay. The shackles are latched to lugs on the bomb and then the shackle and bomb are hoisted to carrying hooks on the bomb rails. The B-7 units provide the linkage between the release unit and the bomb. The tail fusing loop is hooked into the arming slot in the shackle and is either armed or eleased SAFE by the action of the bomb release mechanism. The end of the shackle marked "FRONT" must be installed toward the nose of the bomb.

(b) REMOVAL AND DISASSEMBLY.

1. Press the spring loaded latch of each shackle carying hook *(10, figure 521)* on the bomb rack.

2. Lift the shackle off the hook.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replace worn or damaged bomb shackles.

Note

No lubrication is required on bomb shackles.

(6) BOMB BAY DOORS.—Bomb bay doors are opened and closed normally by the bomb doors switch on the electrical panel which operates a hydraulic bomb bay doors position selector valve on the control pedestal. In event of electrical failure the valve may be moved manually. On some airplanes the doors are operated normally by the bomb release lever at the left of the pilot. In emergency a selector valve on the pilot's control pedestal is turned to the

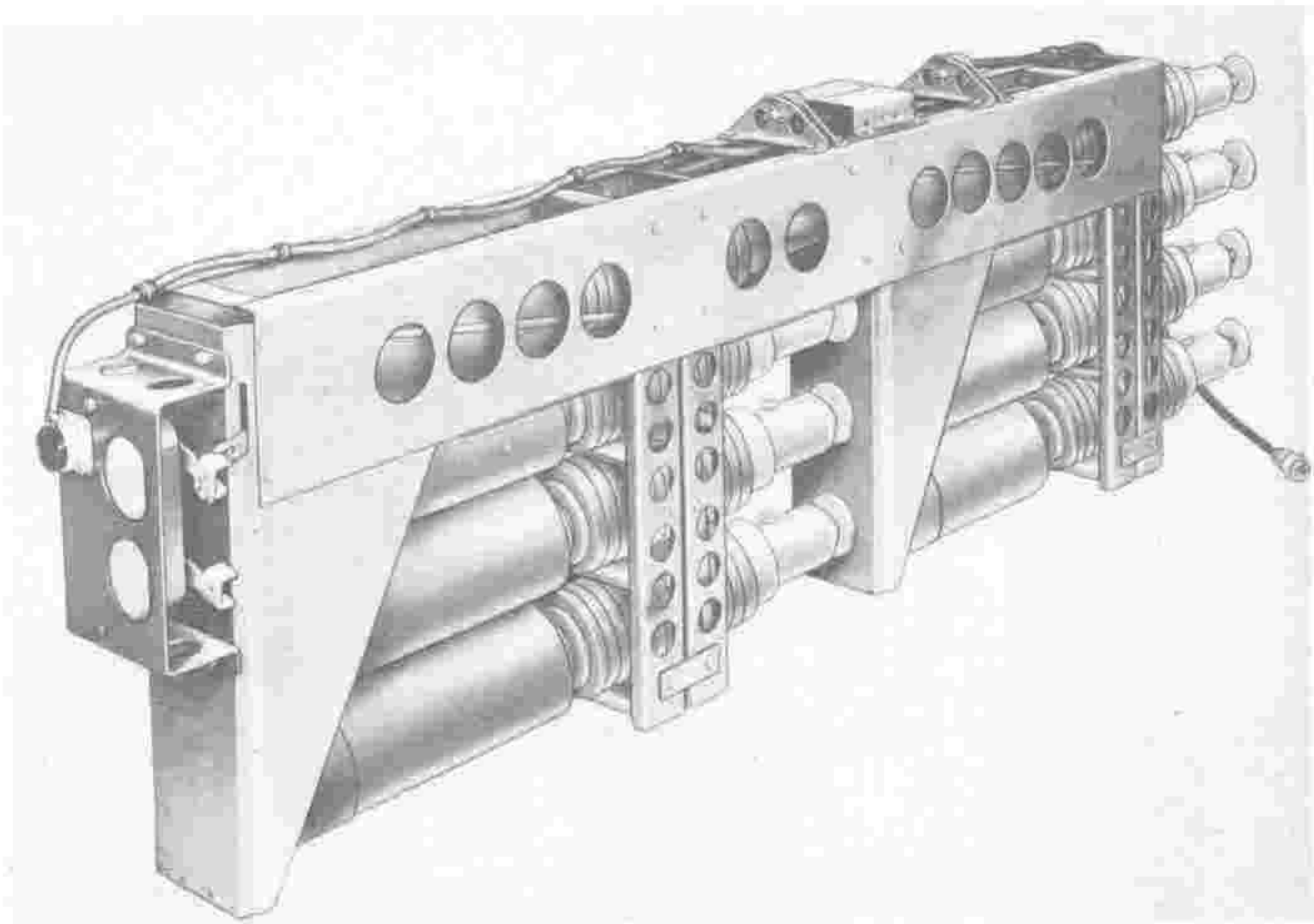
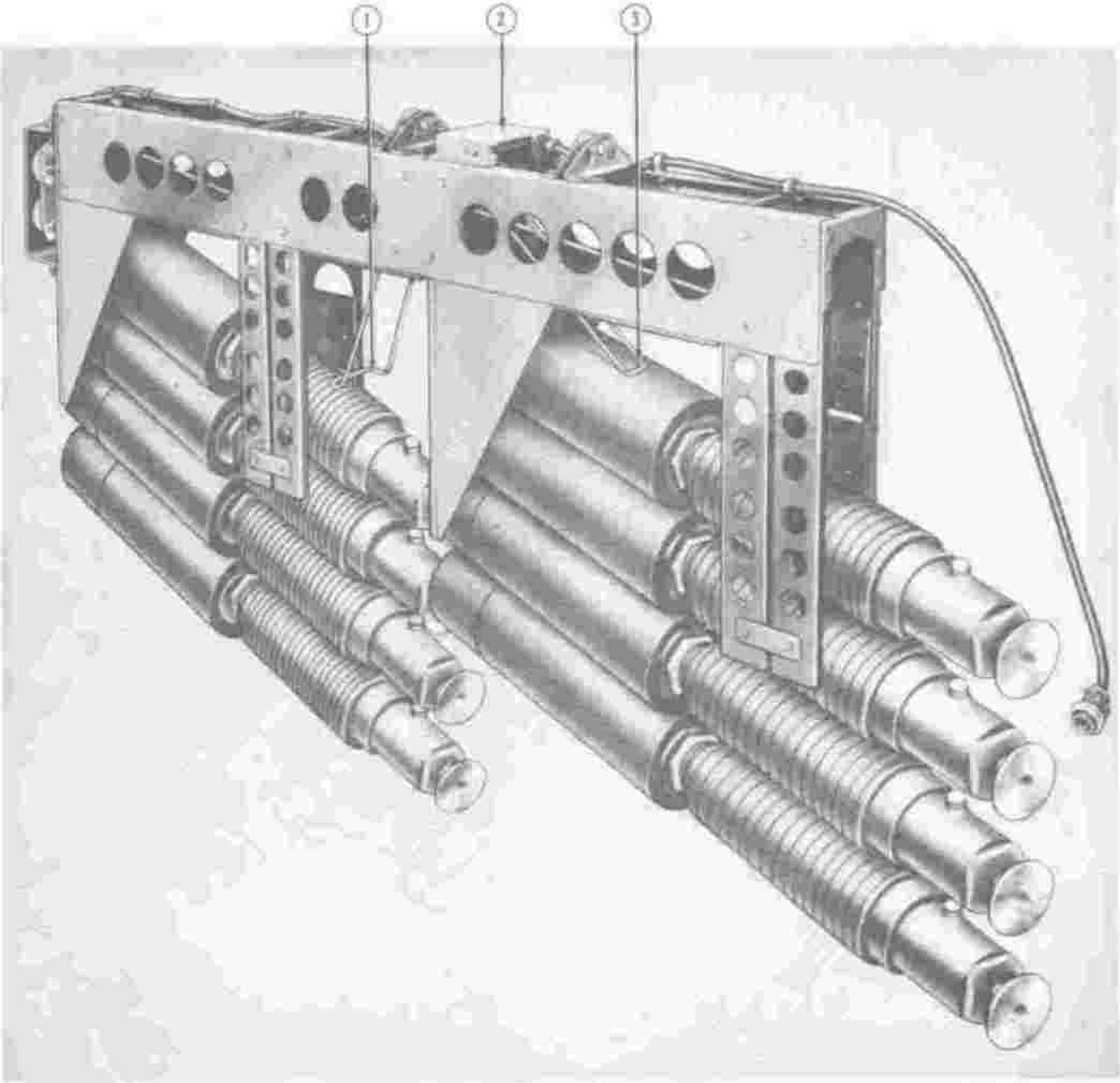


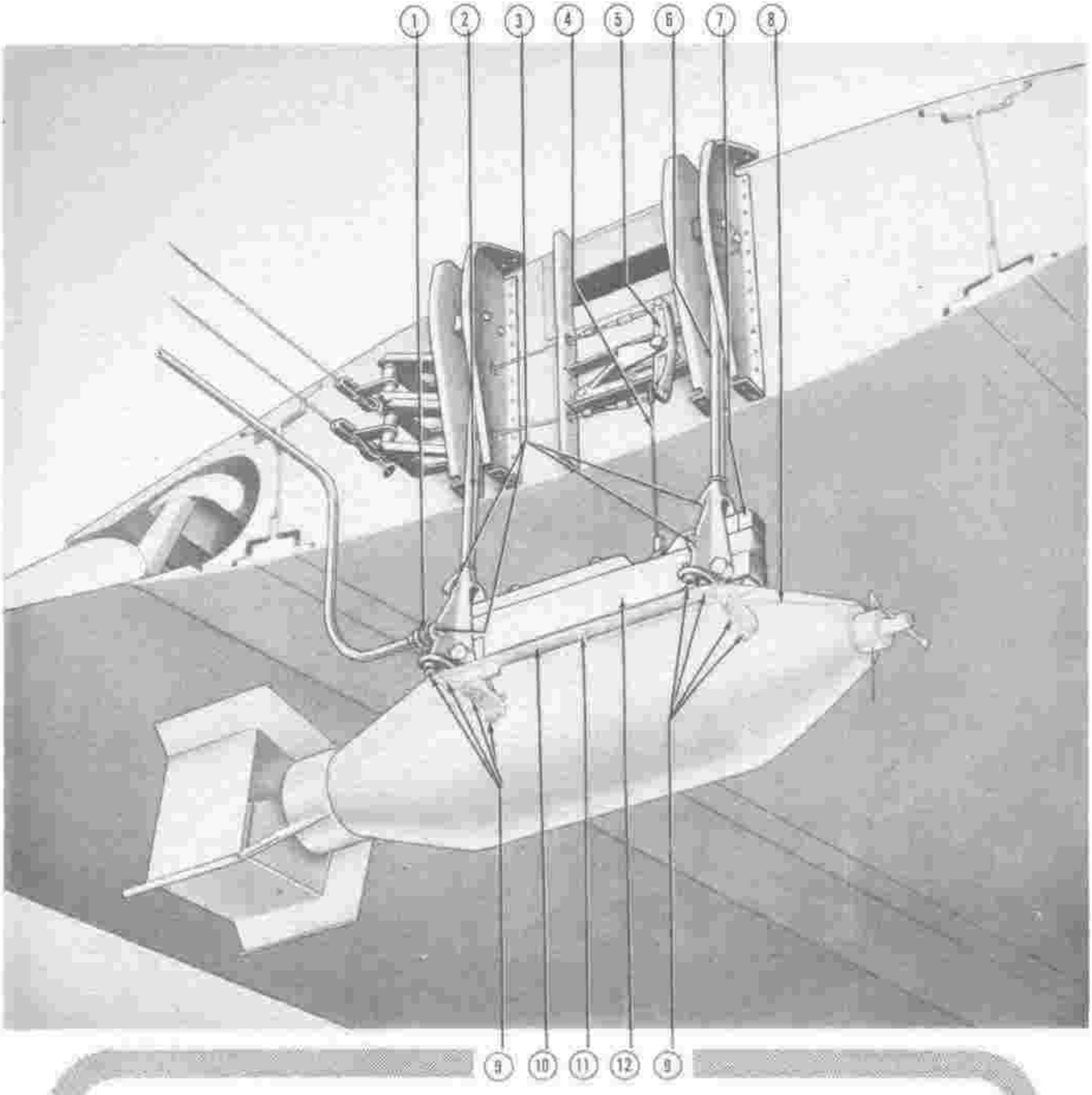
Figure 526—Fragmentation Bomb Rack—Fully Loaded

doors "OPEN" position. Electric syitches *(figure 380)* are located on both sides of the aft bomb bay to prevent release of bombs when the bomb bay doors are not completely opened. These switches are connected by linkage to the bomb bay doors. When the doors are closed the bomb release circuit is broken, when the doors are open the circuit is complete. Retractable bomb bay door spoilers are installed forward of the bomb bay. These are actuated hydraulically, in unison with the bomb bay doors. Two small cylinders supply pressure to the spoilers which open slightly before the bomb bay doors and close just after the doors. See paragraph 14. *d*., this section, for detailed information. Bomb bay door safety blocks are carried in the loose equipment roll in the left nacelle. These blocks are inserted in the door hinges to prevent the doors being closed if anyone is working in the bomb bay. Maintenance of the bomb bay doors is covered in paragraph 14., HYDRAULICS, this section.



1. Forward Bomb Release Arm
2. Skip Switch
3. Skip Switch Arm

Figure 527 — Fragmentation Bombs Falling from Rack



1. Electrical Connection
2. Wing Bomb Rack Aft Support
3. Bomb Hoist Attachment Points
4. Manual Release Cable (if installed)
5. Manual Release Lever (on airplanes equipped with mechanical bomb release)
6. Wing Bomb Rack Forward Support
7. Manual Charging Handle
8. Nose Arming Wire
9. Adjustable Bolts (sway braces)
10. Tail Arming Loop Retainer
11. Nose Arming Loop Retainer
12. Wing Bomb Rack

Figure 528 — Wing Bomb Rack Installed

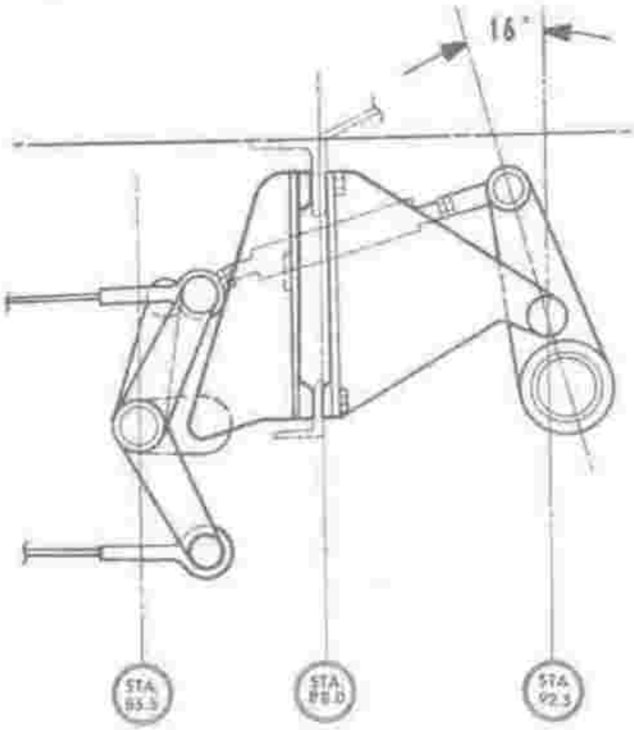


Figure 529—Bomb Torque Shaft Crank Adjustment

(7) RIGGING MECHANICAL BOMB CONTROL CABLES (IF INSTALLED).

(a) Place the bomb control lever in the "SEL" position.

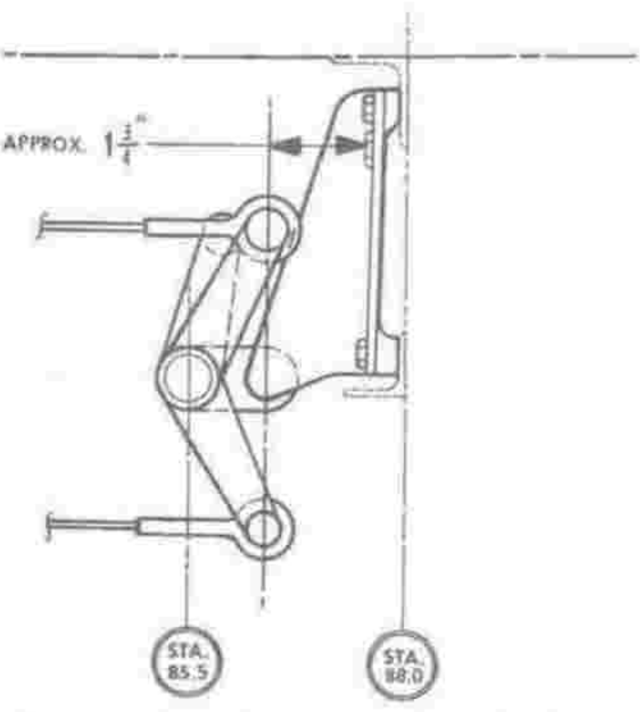


Figure 530—Bomb Release Cable Adjustment

(b) Starting at the aft bomb rack bracket, place the arm of each bracket in a vertical position.

(c) Adjust the link (on both sides of the bomb bay) between stations 92 and 103 so that the bellcrank station 103 is vertical.

(d) Adjust the link *(figure 529)* from station 85 to 92 to locate the torque shaft bellcrank 16 degrees forward from vertical.

(e) Adjust the cable turnbuckles between the bomb release handle and station 85 until the bellcrank at station 85 is vertical. *(See figure 530.)* The upper cable should be approximately $1\frac{3}{4}$ inches from the boss on the bellcrank support casting.

d. CHEMICAL TANKS. *(See figure 531.)*

(1) DESCRIPTION.—As an alternate load, four Type M-10 chemical tanks may be carried by the wing bomb racks. These units are discharged electrically by four switches located on the pilot's electrical panel, or the entire tank assembly may be released in the same manner as the wing bombs. Two switches are also installed to care for two chemical tanks to be carried in the bomb bay.

(2) REMOVAL.

(a) Remove the blasting wires from the blasting terminal posts on the wing rack. *(See 6, figure 531.)*

(b) Pull back on the spring loaded hooks which support the chemical tank from the bomb rack.

(3) INSTALLATION.—To hoist the chemical tanks follow instructions given in Section V.

e. TORPEDO CARRYING EQUIPMENT.

(1) DESCRIPTION.—Alternate equipment may be installed to permit the loading of two Mark 13, Model 1 or 2 torpedoes with Type II air stabilizers in the bomb bay. To accomplish this, the bomb rack panel and the removable portion of the rail of the front bomb bay must be removed. The following special equipment must then be added:

(a) Two torpedo support beams. *(4, figure 532.)*

(b) Torpedo stop bolt beam. *(8, figure 532.)*

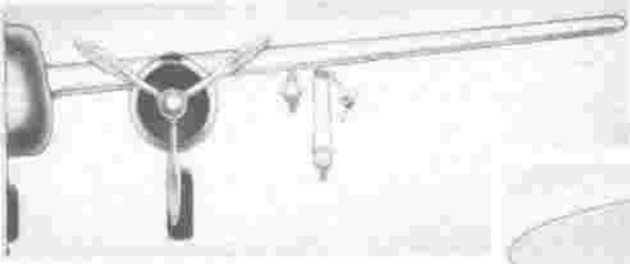
(c) Starting lanyard beam and controls. *(10, figure 532.)*

(d) Cable sling assemblies. *(3, figure 532.)*

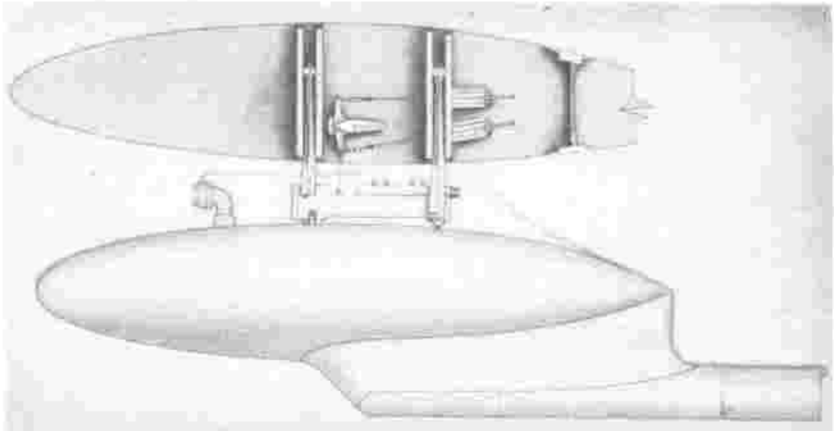
(e) Type D-6 shackles. *(7, figure 532.)*

(f) Retrieving cord assembly. *(15, figure 532.)*

Torpedoes are released electrically by means of the same push button release switch on the pilot's control wheel that is used to release bombs. Place the torpedo



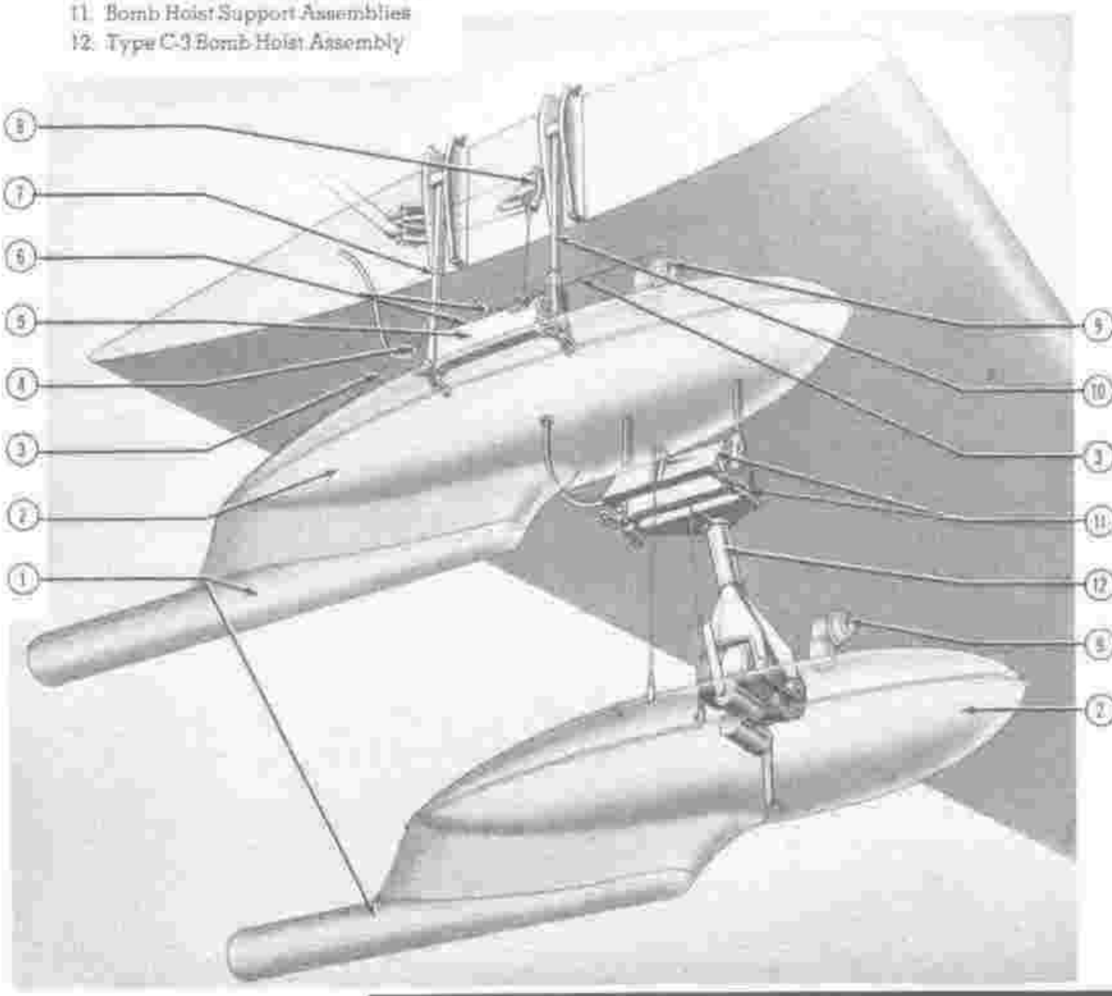
Hoisting Outboard Chemical Tank (Front View)



1. Discharge Pipe
2. Type M 10 Chemical Tank
3. Blasting Cap Wire
4. Electrical Connection
5. Wing Bomb Rack
6. Blasting Cap Terminals
7. Wing Bomb Rack Rear Support
8. Mechanical Release Assembly (on some airplanes)
9. Vent

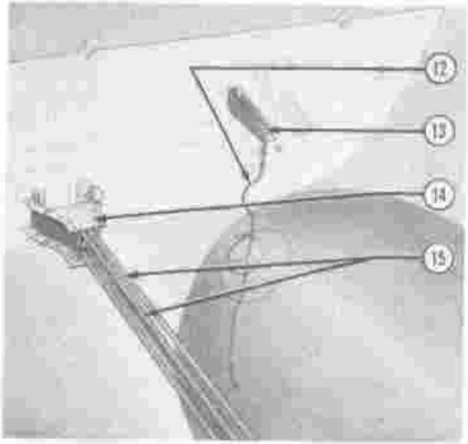
Chemical Tank Installed (Side View Shown Is Typical for Four Places)

10. Wing Bomb Rack Forward Support
11. Bomb Hoist Support Assemblies
12. Type C-3 Bomb Hoist Assembly



Hoisting Outboard Chemical Tank (View Looking Up and Outboard)

Figure 531 — Installation of Chemical Tanks on Wing Bomb Racks



Torpedo Installation Detail at Sta. 88

View Looking Forward and Outboard

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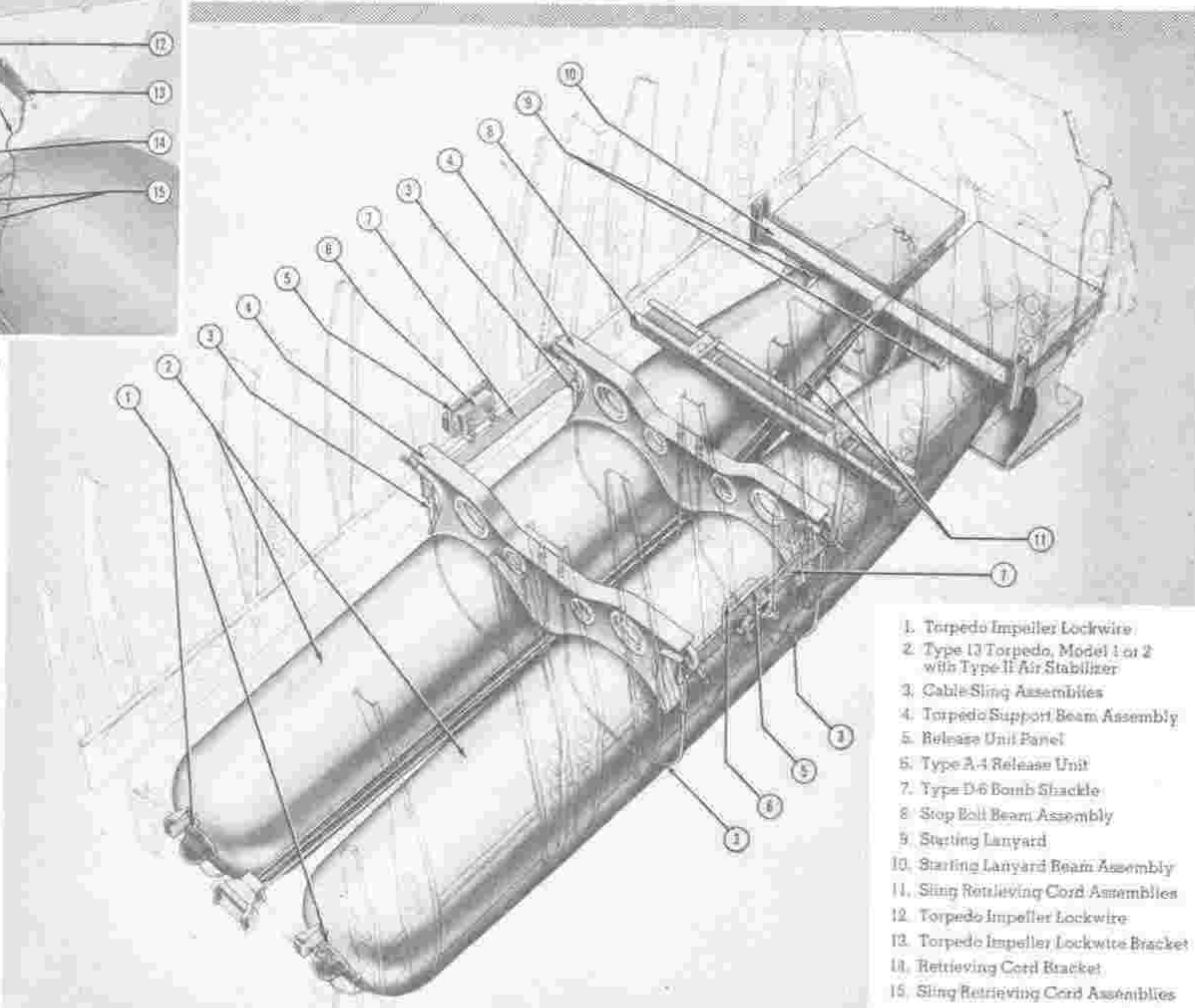


Torpedoes Installed

View Looking Inboard and Aft

1. Torpedo Impeller Lockwire
2. Type 13 Torpedo, Model 1 or 2 with Type II Air Stabilizer
3. Cable Sling Assemblies
4. Torpedo Support Beam Assembly
5. Release Unit Panel
6. Type A-4 Release Unit
7. Type D-6 Bomb Shackle
8. Stop Roll Beam Assembly
9. Starting Lanyard
10. Starting Lanyard Beam Assembly
11. Sling Retrieving Cord Assemblies
12. Torpedo Impeller Lockwire
13. Torpedo Impeller Lockwire Bracket
14. Retrieving Cord Bracket
15. Sling Retrieving Cord Assemblies

Figure 532 — Torpedo Installation

circuit switch in the "ON" position. On some airplanes torpedoes may be salvoed by placing the bomb control lever in the "SALVO" position. Bomb bay doors must be left open when torpedoes are carried, since the torpedo body extends below the fuselage contour.

(2) ASSEMBLY AND INSTALLATION.

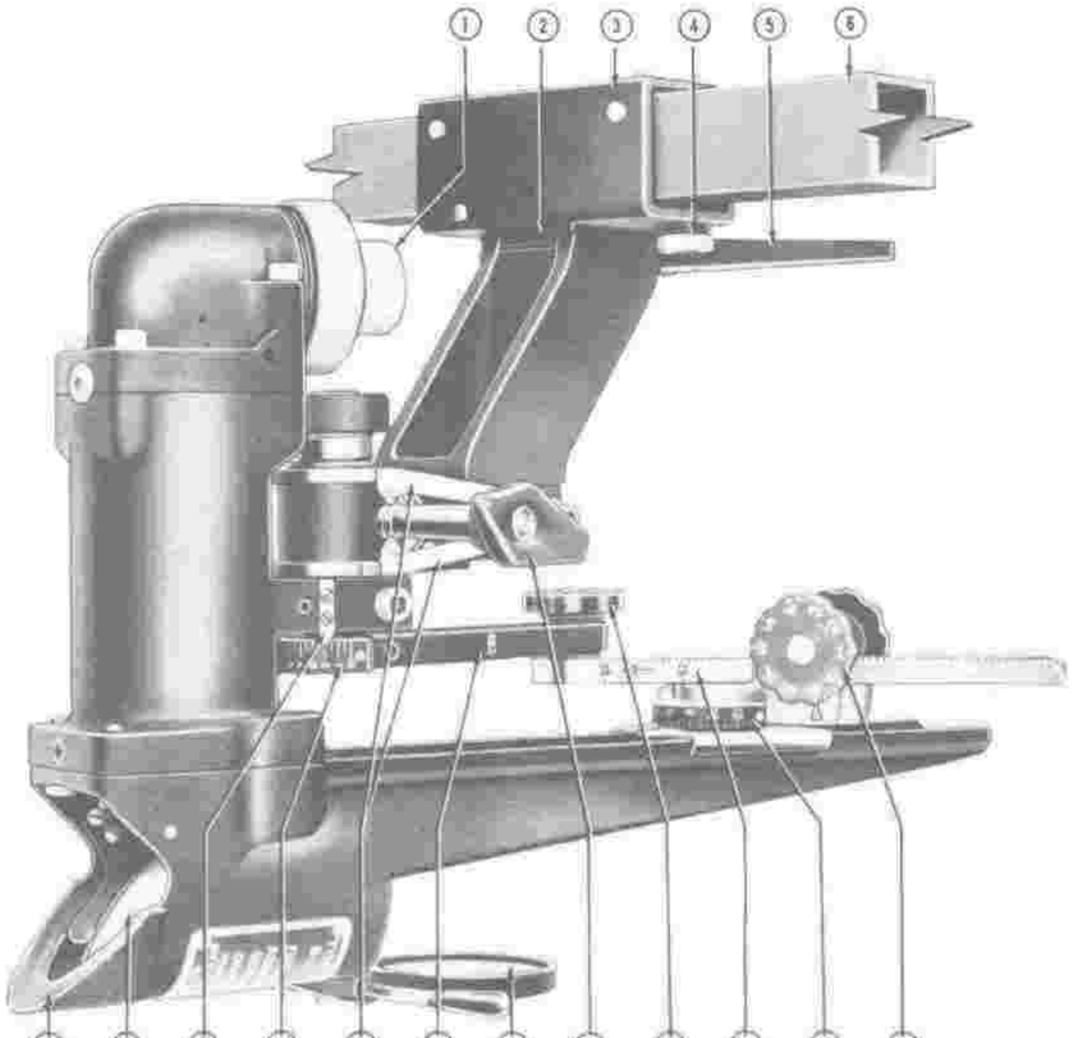
(a) Before installing torpedo carrying equipment, remove the following parts.

1. ON AIRPLANES EQUIPPED WITH A MECHANICAL SALVO CABLE CONTROL.

a. Removable bomb rail assembly, station 152 (5128326 & -1).

b. Aft demolition bomb rack panel assembly (5128450 & -1).

c. Forward demolition bomb rack panel assembly (5129955 & -1).



1. Electrical Connections
2. Mounting Bracket Support
3. Mounting Bracket
4. Rider Screws
5. Locking Handle
6. Overhead Bar Support
7. Rubber Bumper
8. Transparent Luminous Reticule
9. Right Hand Side Index Peg
10. Sighting Angle Protractor
11. Master Lock Assembly
12. Torpedo Arm
13. Polaroid Filter
14. Master Lock Knob
15. Mechanical Linkage Lock Knob
16. Target Arm
17. Interceptor Angle Protractor
18. Target Arm Adjustment Knob

Figure 533—Torpedo Director

2. ON AIRPLANES EQUIPPED WITH ALL-ELECTRIC BOMB RELEASE SYSTEMS.

a. Aft demolition bomb rack panel assembly (5204884 & -1).

b. Forward demolition bomb rack panel assembly (5204794 & -1).

(b) Bolt the two torpedo support beams *(4, figure 532)* to the sides of the bomb bay.

(c) Install the starting lanyard beam assembly *(9, figure 532)* to the sides of the bomb bay.

(d) Install the torpedo sling retrieving bracket *(14, figure 532)* and the torpedo impeller lockwire support bracket *(13, figure 532)*.

(e) Install the Type A-2 or Type A-4 bomb release mechanism *(6, figure 532)* to the torpedo rack panel. *(5, figure 532.)*

(3) TORPEDO DIRECTOR.

(a) DESCRIPTION.—A Type B-2 torpedo director *(figure 533)* is installed in the pilot's compartment when torpedoes are to be carried. The director is suspended from an overhead bar support directly forward of the pilot. The overhead support is attached to the left side of the pilot's compartment and on the right side to brackets in the center of the compartment. When not in use, the director is placed in the extreme left position but may be moved anywhere along the bar. Instructions for operation of this unit are found in the Pilot's Flight Operations Handbook, T.O. No. 01-40AJ-1.

The torpedo sight is mounted over the instrument panel directly aft of the windshield. The director will secure itself in any position, by pushing the lock handle *(5, figure 533)* forward.

(b) REMOVAL AND DISASSEMBLY.

1. Disconnect the electrical plug.

2. Remove the bolt and lift the torpedo director from the sliding bracket.

3. Keep the bolt with the director.

4. Remove the overhead support by taking out the attaching bolts.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. To replace the light bulb, remove the lamp assembly *(1, figure 533)* by unscrewing the collar. Remove the bulb and replace with a new Mazda No. 307, 21 c.p.

KEY TO FIGURE 534

1. Wing Gun Ammunition Boxes
2. Fire Control Panel
3. Gun Sight Rheostat
4. 75mm Cannon Shell Case Catcher
5. Upper Turret Ammunition Boxes
6. Upper Turret
7. Type M-2 Caliber .50 Turret Guns
8. Turret Control Box
9. Upper Periscope Head
10. Sighting Station
11. Lower Turret Ammunition Boxes
12. Lower Turret
13. Type M-2 Caliber .50 Turret Guns
14. Gunner's Seat
15. Turret Ammunition Box Hoisting Cable
16. Lower Periscope Head
17. Type M-2 Caliber .50 Wing Guns
18. Gun Charger Cable
19. Gun Charger Cable Handle
20. 75mm Shell Stowage Rack
21. Ring and Bead Sight
22. Cannon Firing Actuator Mechanism
23. Tell-Tale Indicator
24. T-13E1 75mm Cannon
25. Gun Sight Aiming Point Camera
26. Nose Gun Ammunition Box
27. Type M-2 Caliber .50 Nose Guns
28. Cannon Feed and Ejection Chute
29. Type N-9 Gun Sight
30. Gun Firing Triggers (Guns and Cannon)

2. The exposed glass surfaces of the transparent mirror *(8, figure 533)*, the lens, and the polaroid filter *(13, figure 533)*, may be cleaned with cotton or chamois and 14099 glass cleaner.

3. All linkage hinges can be adjusted to give the desired degree of friction. The track, rack, and hinges may be lubricated with a small amount of petrolatum if necessary. The friction of the bearing between the mount and the sight can be adjusted by tightening or loosening the nut of the adjusting bolt *(14, figure 533)*.

4. Should the interior glass surfaces fog after exposure to humid, then to cold air, leave the light on for a while. The fogging may temporarily increase, but then should promptly evaporate.

(d) INSTALLATION.

1. Assemble the torpedo director (with the sliding bracket attached) onto the support bar.

2. Press the handle *(5, figure 533)* toward the bracket and be sure that the cam controlled by this handle does not cock on the end of the support bar.

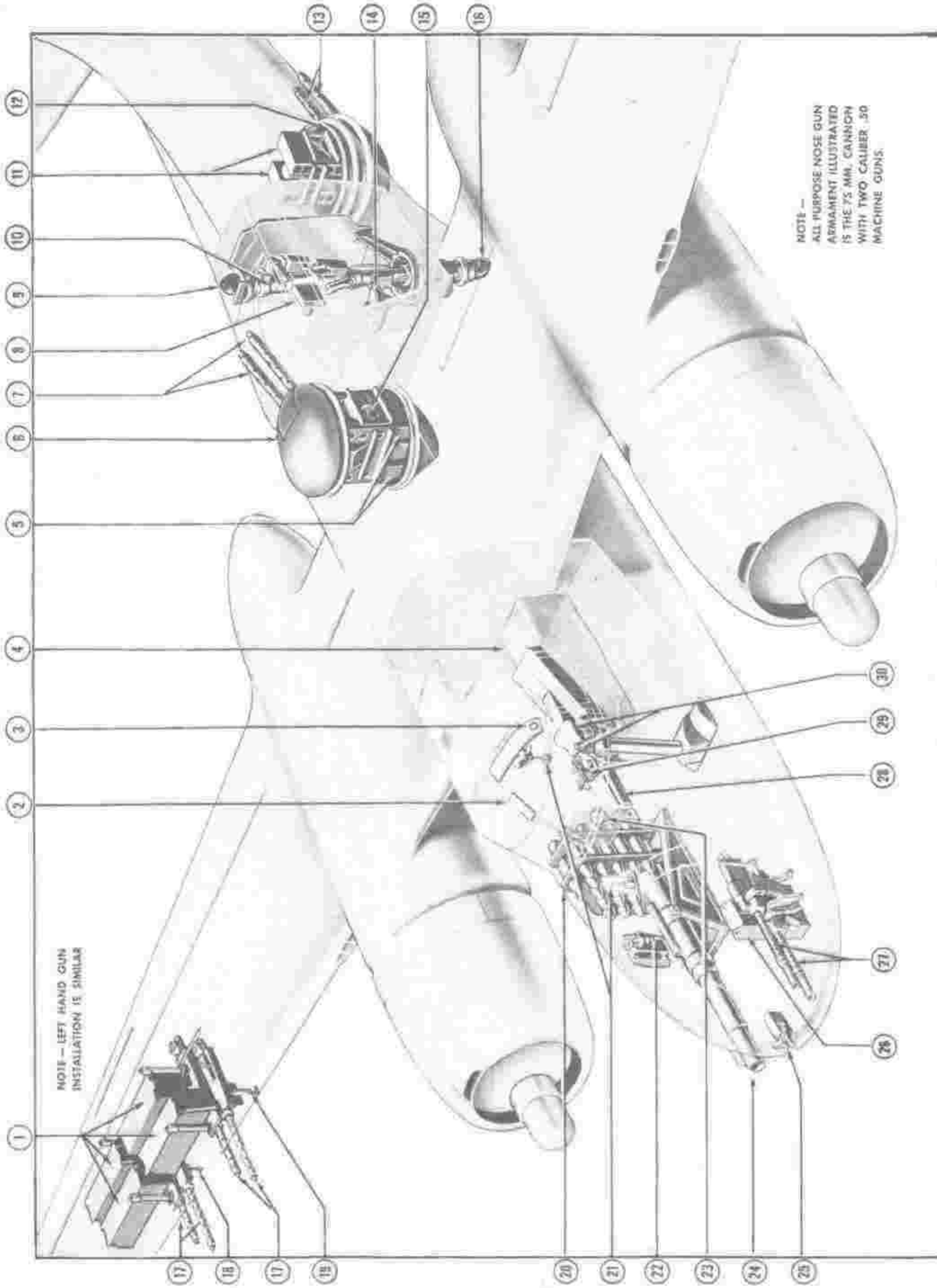
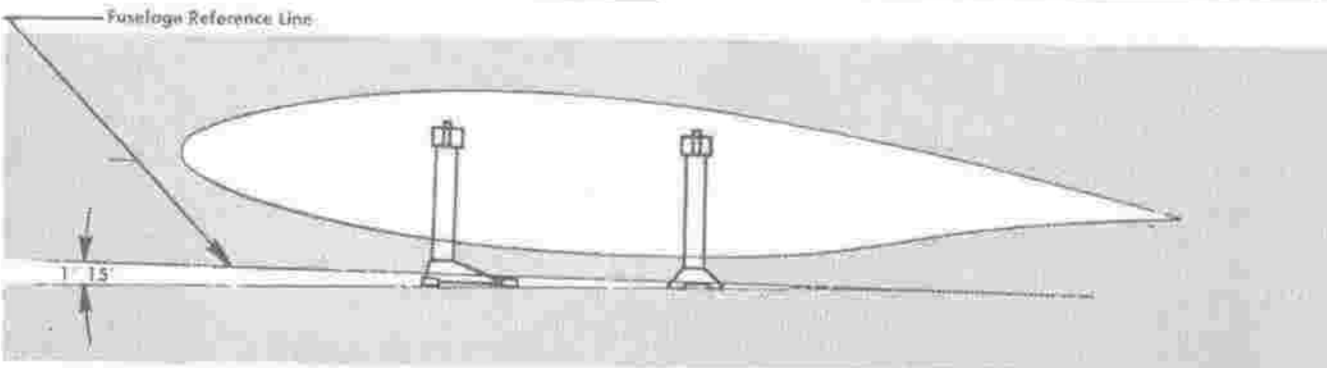


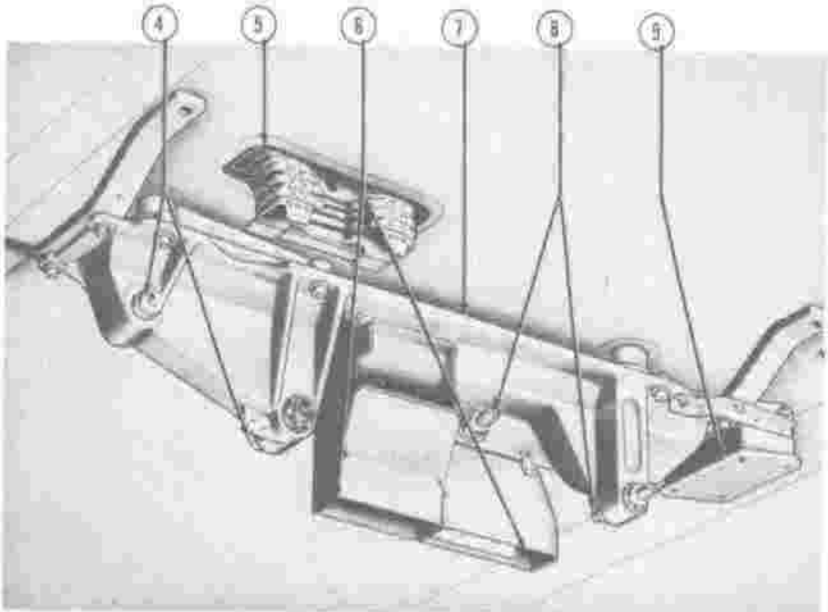
Figure 534 — Gunnery Equipment

1. Ammunition Chute Openings
2. Gun Mount Forward Hanger
3. Gun Mount Rear Hanger

Installation of Gun Mount Hangers in Wing



Gun Mount Hanger Adjustment

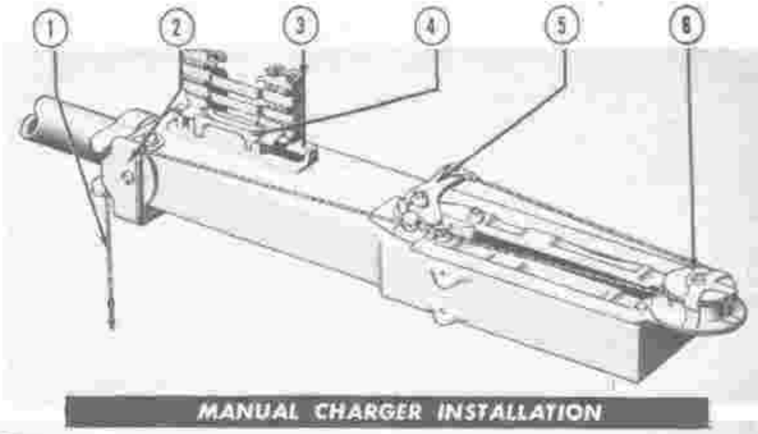


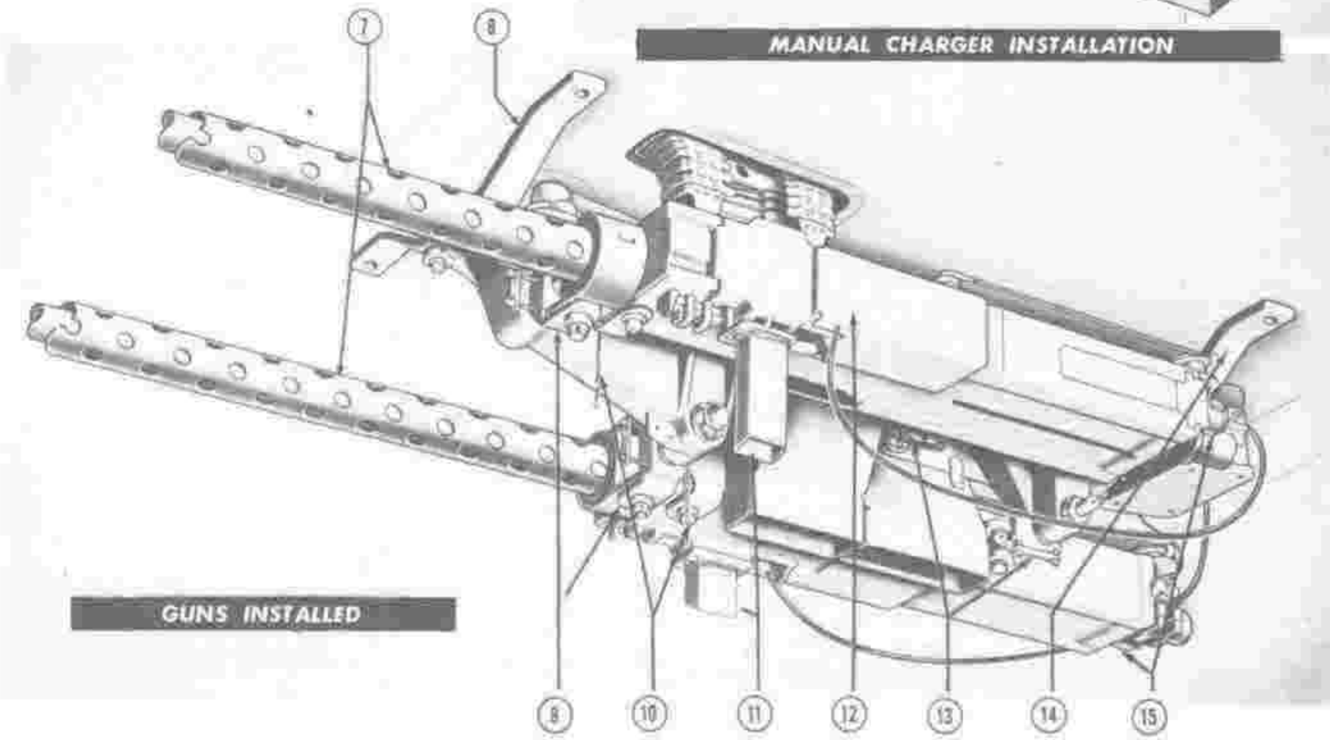
4. Forward Trunnion Posts
5. Ammunition Feed Chute
6. Shell Case Ejection Chutes
7. Gun Mount Casting
8. Rear Mounting Posts
9. Electric Junction Box

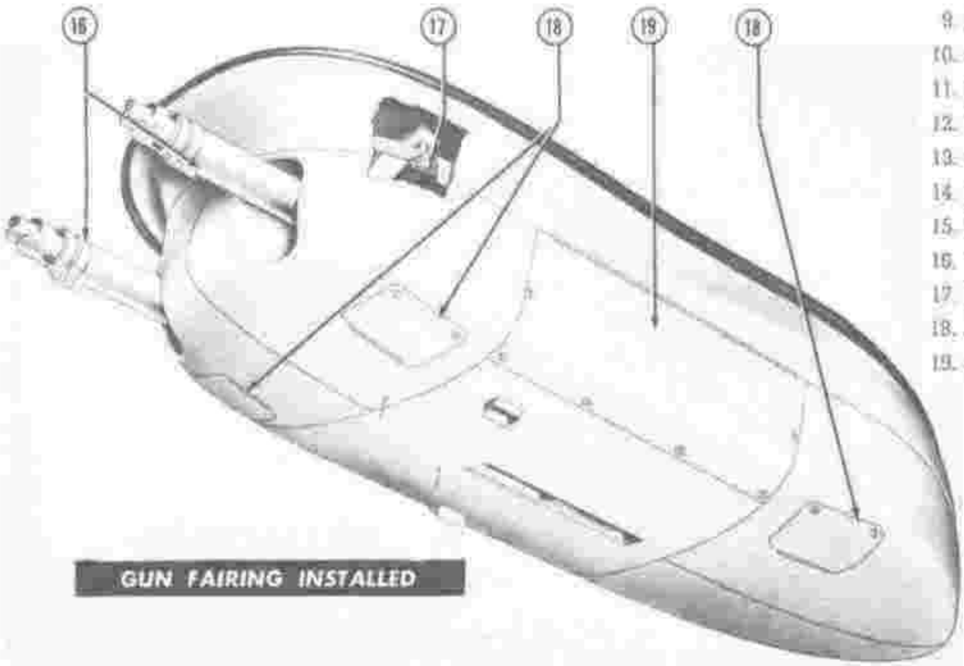
Gun Mount Installed

Figure 535 (Sheet 1 of 2) — Wing Gun Installations

1. Charging Cable
2. Pulley and Bracket
3. Ammunition Chute
4. L.H. Mount Type C-2
5. Charging Slide
6. Pulley and Bracket
7. Type M-2 Caliber .50 Machine Guns
8. Fairing Forward Mounting Channel







9. Forward Brackets
10. Charging Cables
11. Link Ejection Chute
12. Type J-1 Gun Heater
13. Rear Holders
14. Fairing Aft Mounting Channel
15. Type G-11 Firing Solenoids
16. Tubes
17. Fairing Attaching Bolt
18. Access Doors for Fairing Attach Bolts
19. Access Door

NOTE:
Outboard L.H. Gun Installation Shown Typical Four Places.

Figure 535 (Sheet 2 of 2)—Wing Gun Installation

3. If any of the rider screws *(4, figure 533)* fail to give clearance, loosen them until they do.

4. Mount this assembly in the airplane with the proper attaching bolts.

5. Connect the electrical plug into the socket provided *(1, figure 533).*

f. GUNNERY SYSTEM.

(1) WING GUN INSTALLATIONS.

(a) DESCRIPTION.—Provision is made for installation beneath the wings of eight forward firing machine guns. *(See figure 535.)* Two Type M-2 caliber .50 machine guns are attached to each of four mounts suspended from hangers which screw into the wings. Ammunition is fed to the guns through chutes which extend from ammunition boxes in the wings. Ejection troughs dump empty cases and links into the air stream. Each gun is charged on the ground by pulling a charging cable, *(1, figure 535, sheet 2 of 2.)* This cable connects by pulleys to the charging slide on the gun. Two charging cable handles are stowed in the left hand nacelle which are used to charge all eight guns. All wing guns are fired simultaneously by the pilot in the following manner:

1. Master guns safety and camera switch on fire control panel "GUNS AND CAMERA."

2. .50 CAL. wing guns switch on fire control panel "ON."

3. Depress gun firing trigger unde- left side of control wheel.

(b) AMMUNITION LOADING. — See section V.

(c) REMOVAL AND DISASSEMBLY.—Reverse the procedure outlined in INSTALLATION *(e)*, below.

(d) ADJUSTMENTS.

1. HORIZONTAL POSITIONING. — Horizontal positioning of the wing guns is controlled at the aft attaching point by moving the stop nuts on the mounting post assembly. *(8, figure 535, sheet 1 of 2.)*

2. VERTICAL POSITIONING.—Vertical adjustment of the wing guns is made by moving the threaded sleeve between the two ears at the aft attaching point. This adjustment moves the guns approximately 2½ degrees up or down. A set screw is provided to hold the proper adjustment. *(13, figure 535, sheet 2 of 2.)*

3. GUN FIRING SOLENOID.—Adjustment of gun head space and of the firing solenoid should be made in accordance with Technical Manual 9-1225.

4. BORESIGHTING.—See BORESIGHTING PROCEDURE FOR FIXED GUNS, paragraph 17. *f.* (7), this section.

(e) INSTALLATION.

1. Install front hanger by screwing into nut plate in the wing until it shoulders, then back off to align fore and aft parallel to center line of airplane *(2, figure 535, sheet 1 of 2).*

2. Install rear hanger by screwing into nut plate in the wing until it shoulders, then back off to align with front hanger *(3, figure 535, sheet 1 of 2).*

3. Check level of airplane fore and aft with a protractor level and take a reading in degrees.

4. Place a straight edge on bottom side of bosses from front hanger to rear hanger and check the angle with a protractor level. The angle of this plane should be one degree fifteen minutes plus or minus one half degree less than the angle reading obtained from procedure (c). Example: if level of airplane is three degrees nose up, the level of bottom bosses on the hangers must be one degree fifteen minutes less, or one degree forty-five minutes (plus or minus one half degree) reading on the protractor level. Adjust the rear hanger until the proper reading is obtained. *(See figure 535, sheet 1 of 2.)*

5. The following parts should be installed on the wing gun mount casting before mounting to the hangers:

a. Fairing forward support.

b. Fairing aft support.

c. Electric box.

d. Front case ejection chute.

e. Aft case ejection chute.

f. Front trunnion posts.

g. Rear mounting posts.

(See figure 535, sheet 1 of 2.)

6. Install wing gun mount casting at the six attach points on front and rear hangers.

7. The following parts should be installed on each Type M-2 caliber .50 basic machine gun before installing on the wing gun mount:

a. Gun charger assembly.

b. Gun charging slide group assembly.

c. Handle adapter (replacing wooden handle).

d. Type C-2 or C-3 feed chute adapter.

NOTE: C-2 installed on guns #2 and #4
C-3 installed on guns #1 and #3

e. Link chute (Proper link chute for each gun).

f. Type G-11 firing solenoid.

g. Type J-1 gun heater.

8. Install flexible chutes to ammunition boxes in the wing.

9. Install gun assembly to gun mount and connect feed chute to adapter.

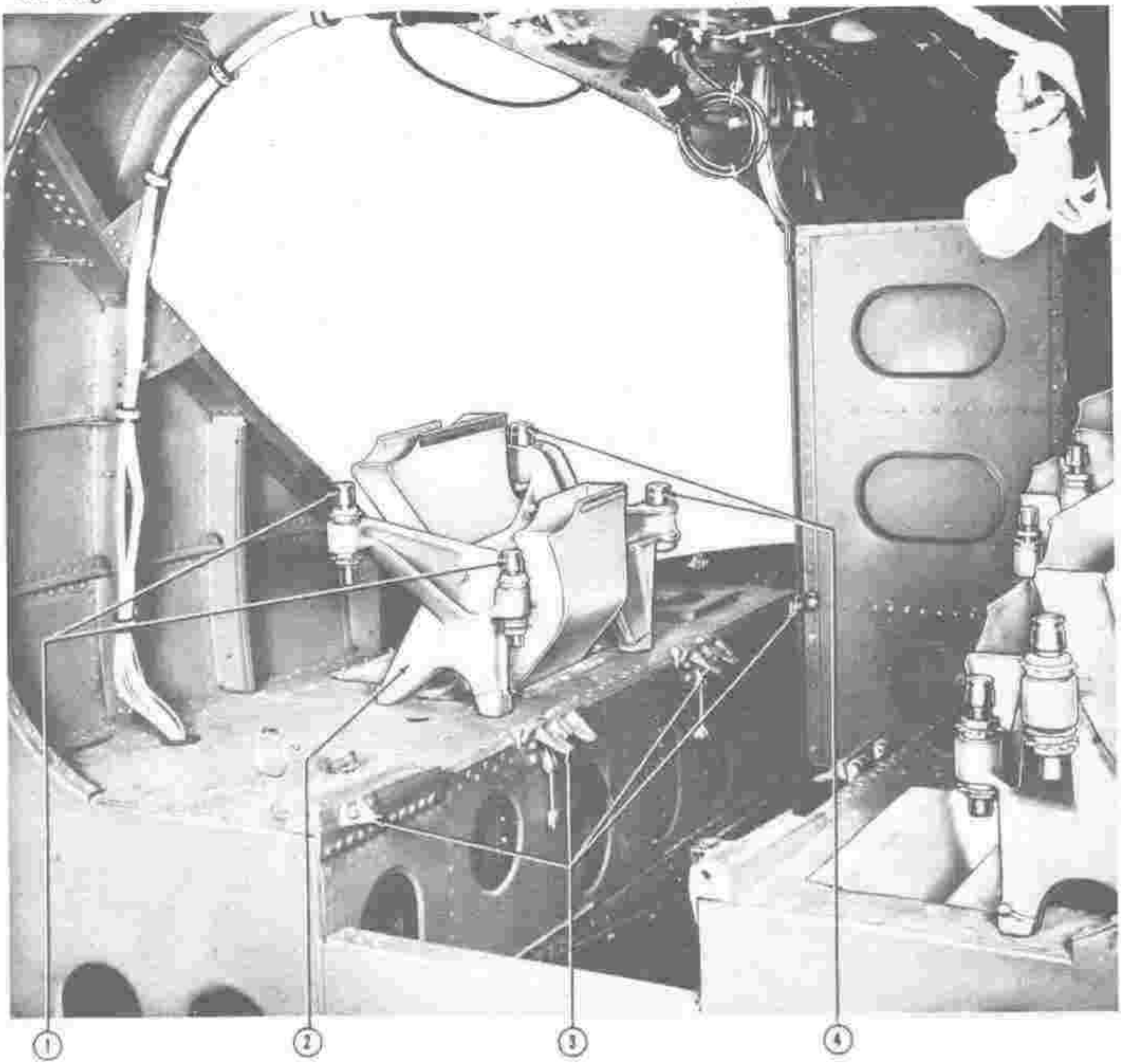
10. Connect firing solenoid wire to electric box. Connect main electric box wire to receptacle in the wing.

11. Connect gun heater wires to electric box receptacle.

12. Boresight guns per instructions outlined in BORESIGHTING PROCEDURE FOR FIXED GUNS, paragraph 17. *f.* (7), this section.

13. Install wing gun fairing on the four attach points on gun mount casting cross arms. *(17, figure 535, sheet 2 of 2.)*

14. Feed charging cables through holes provided in fairing.



1. Rear Trunnion Posts
2. L. H. Gun Mount and Chute Assembly
3. Ammunition Box Retainers
4. Forward Trunnion Posts

ALL-PURPOSE NOSE INSTALLATIONS
VIEW LOOKING FORWARD

Figure 536—L. H. Caliber .50 Gun Mount and Chutes Installed

15. Install blast tubes over gun barrels and secure lock in gun jacket slots.

16. Load ammunition boxes in the wings *(figure 595)* and feed ammunition to guns.

17. Charge guns, using charging handle stowed in left-hand nacelle.

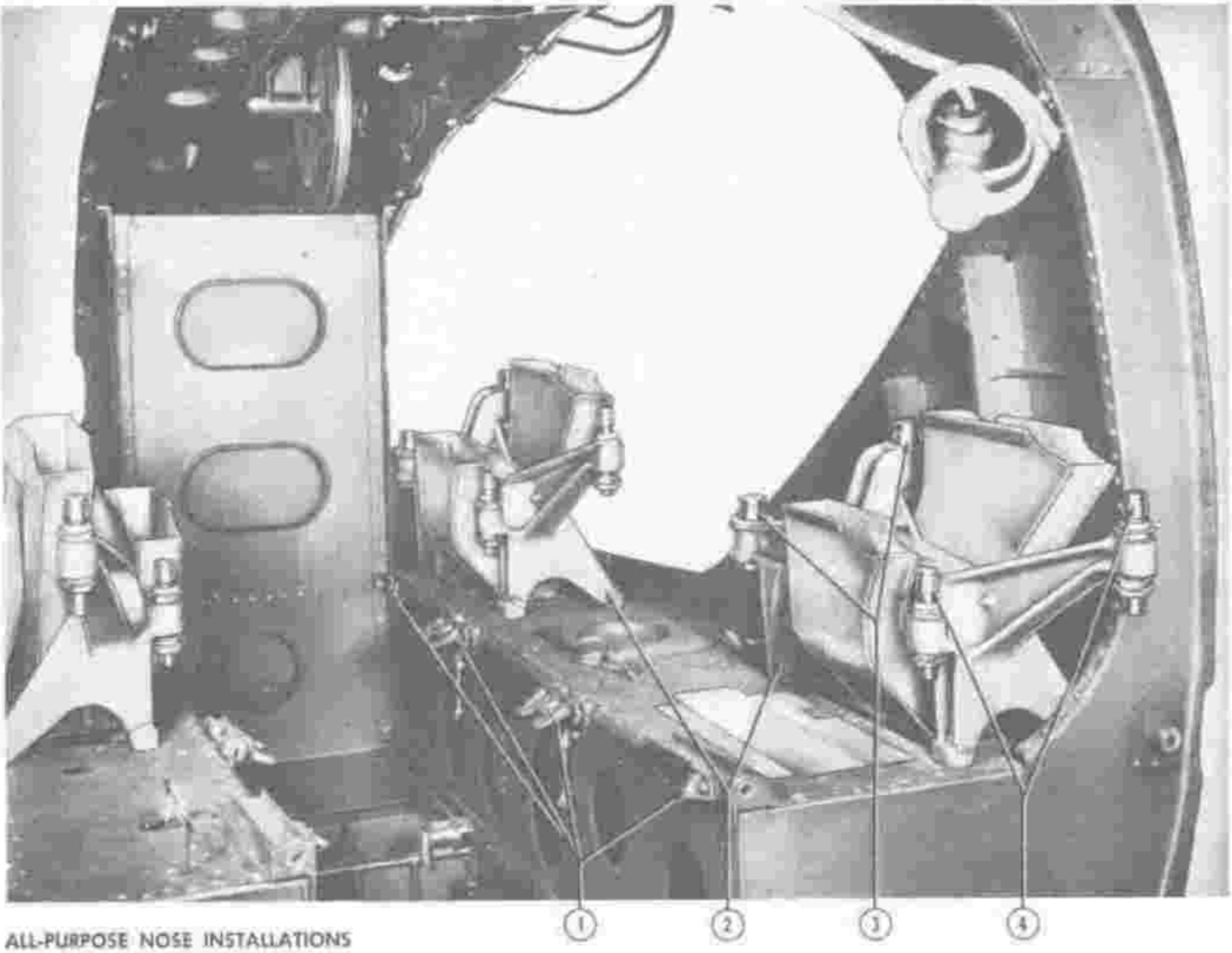
18. Fasten fairing doors securely.

(2) ALL-PURPOSE NOSE.

(a) GENERAL.–To provide for versatility of attack, an all-purpose gun nose has been installed on some airplanes. This nose provides for the quick interchangeability of three different calibers of fire-power to meet immediate combat needs. Five removable panels are provided to accommodate any of the six possible gun installations. Ammunition is carried in three boxes installed on a track between the left and right-hand guns. Boxes are hoisted into the nose by a type C-3 bomb hoist through the access door as shown in *figure* 597. All guns are charged manually on the ground and fired electrically by the pilot. Armor plate is used in the nose to protect guns and ammunition. The gun sight aiming point camera (paragraph 17. *f.* (5), this section), is installed in the nose to photograph in coordination with any of the nose guns.

(b) NOSE ASSEMBLY.

1. DESCRIPTION.–The all-purpose gun nose is secured by bolts to the forward end of the fuselage and the connection sealed on the outside with a



ALL-PURPOSE NOSE INSTALLATIONS
VIEW LOOKING FORWARD

1. Ammunition Box Retainers
2. R. H. Gun Mount and Chute Assemblies
3. Forward Trunnion Posts
4. Rear Trunnion Posts

Figure 537–R. H. Caliber .50 Gun Mounts and Chutes Installed

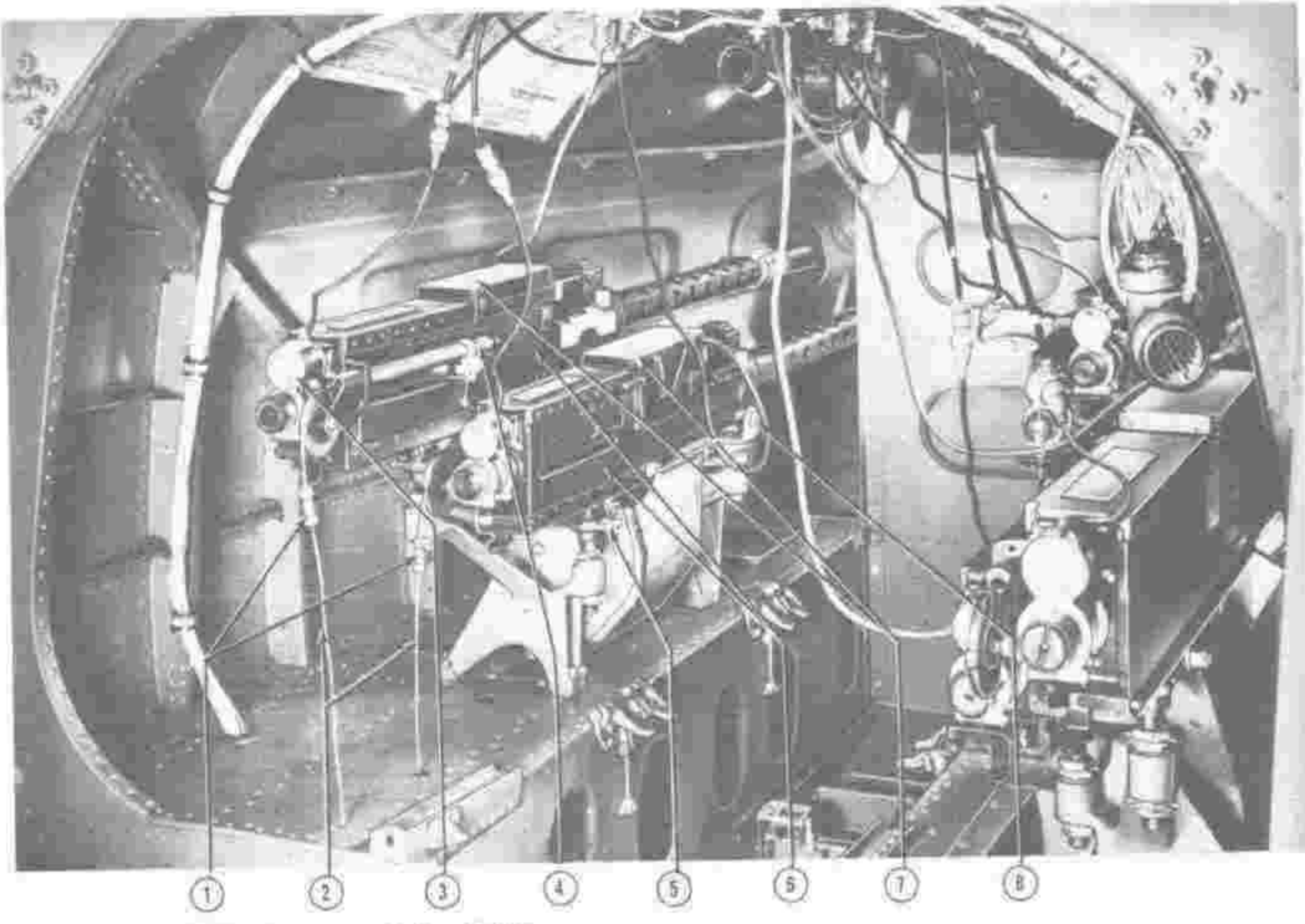
weatherproof liner. Left and right side upper access doors are secured with shakeproof fasteners and provide entrance for maintenance of guns and ammunition equipment. An access door is located on the under side of the nose through which ammunition boxes are lifted. Forward of this door is a smaller door, through which the hoist is attached for lifting the ammunition boxes. Access doors are also provided on either side for the charging cables. Three slots, two right side and one left side, are also included in the lower portion of the nose structure to permit discharge of empty shell cases in the air stream. Three left and two right side panels, which include gun ports, may be interchanged to accommodate whatever gun combinations are in use.

2. REMOVAL AND DISASSEMBLY.—See paragraph 4. *b.* (2) and (3), this section.

(c) GUN INSTALLATIONS.

1. DESCRIPTION.—The all-purpose gun nose is designed to accommodate any one of six possible armament installations. Any combination of three right side and two left side installations may be used. The six possible combinations are:

GUNS	SIDE OF NOSE
a. Two Type M-2 caliber .50 machine guns	L. H.
Four Type M-2 caliber .50 machine guns	R. H.
b. One Type M-9 37 mm cannon	L. H.
Four Type M-2 caliber .50 machine guns	R. H.
c. Two Type M-2 caliber .50 machine guns	L. H.



1. Tru-Loc "Quickies"
2. Charging Cables
3. Type G-11 Firing Solenoids
4. Gun Charger
5. Rear Holder
6. Type M-2 Caliber .50 Guns
7. Type J-1 Gun Heaters
8. Forward Bracket

ALL-PURPOSE NOSE INSTALLATIONS
VIEW LOOKING FORWARD

Figure 538—L. H. Caliber .50 Guns Installed

	One Type M-9 37 mm cannon	R. H.
d.	One Type M-9 37 mm cannon	L. H.
	One Type M-9 37 mm cannon	R. H.
e.	Two Type M-2 caliber .50 machine guns	L. H.
	One Type T-13E1 75 mm cannon	R. H.
f.	One Type M-9 37 mm cannon	L. H.
	One Type T-13E1 75 mm cannon	R. H.

Aluminum alloy mounts are used to install caliber .50 machine guns, each mount carrying two guns. Mounts for the 37 mm cannon and larger mount for the 75mm cannon are made of magnesium alloy.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL OF CALIBER .50 GUNS.

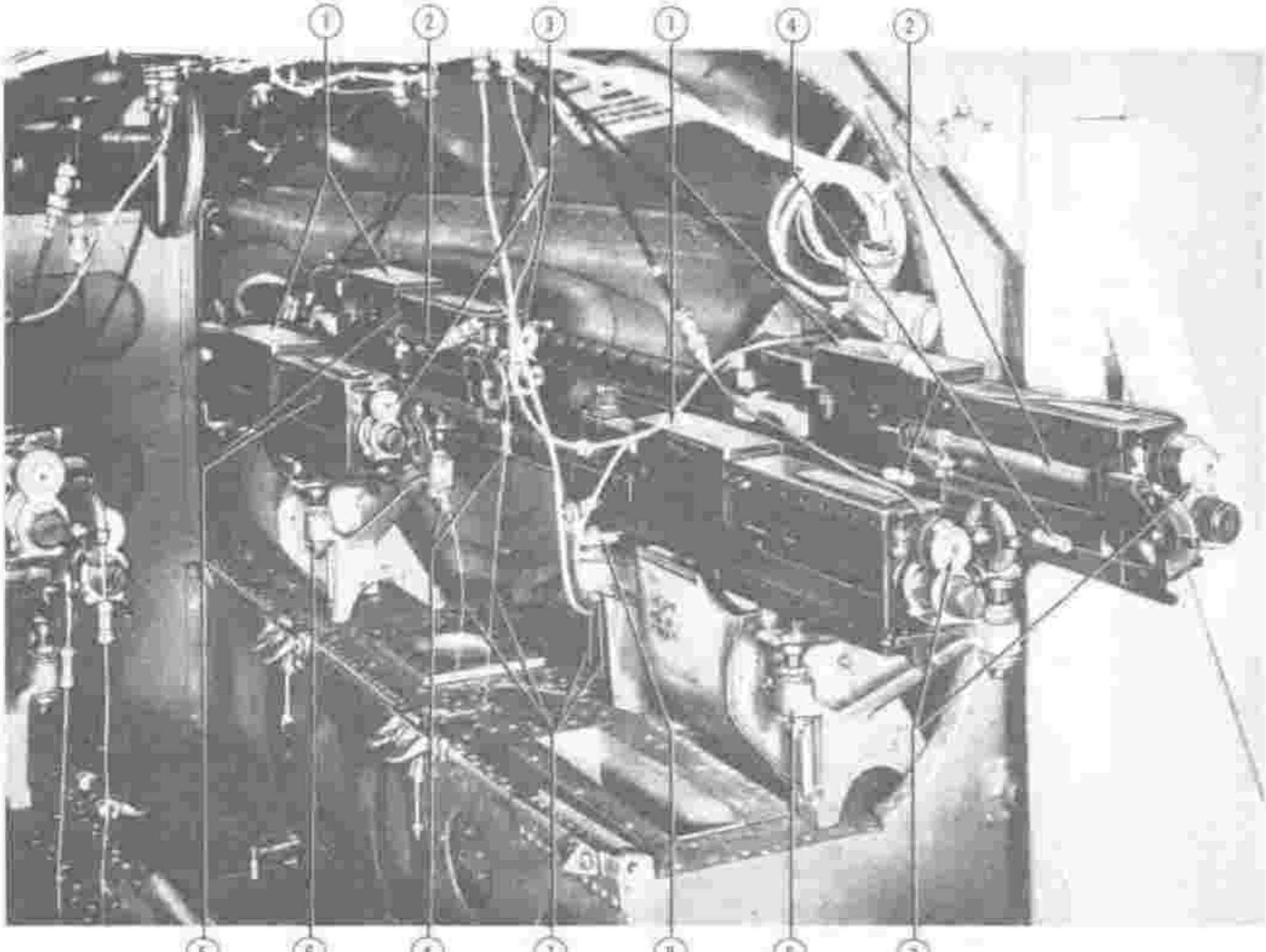
(1) Remove both upper access doors.

(2) Charge the guns and clear them to be sure that no ammunition is left in the gun.

(3) Loosen the clamps which secure the seal assembly to the blast tubes.

(4) Remove nose gun panels by unfastening the shakeproof cowl fasteners and lifting the panel from the nose.

(5) Remove the Morris heaters which are attached to the guns.



1. Type J-1 Gun Heaters
2. Gun Charger
3. Type G-11 Firing Solenoids
4. Tru-Loc "Quickies"
5. Type M-2 Caliber .50 Guns
6. Rear Holder
7. Charging Cables
8. Forward Bracket

ALL-PURPOSE NOSE INSTALLATIONS
VIEW LOOKING FORWARD

Figure 539—R. H. Caliber .50 Guns Installed

(6) Disconnect the charging cable at the Tru-loc "Quickie."

(7) If the caliber .50 guns are being replaced by 37 mm, pull the charger cable out through the access door on the lower portion of the nose.

(8) Disconnect the firing solenoid at the head of the gun.

(9) Unclip the ammunition feed and ejection chutes from the gun.

(10) Compress the spring loaded attach bolts which secure the gun to the mount and remove the gun.

(11) Remove the bolts which hold the mounts to the nose structure and lift the mounts out of the airplane.

b. REMOVAL OF 37 MM CANNON.

(1) Remove both upper access doors.

(2) Charge the guns and clear them to be sure that no ammunition is left in the gun.

(3) Remove left or right side gun panels by unfastening the shakeproof cowl fasteners and lifting the panel off.

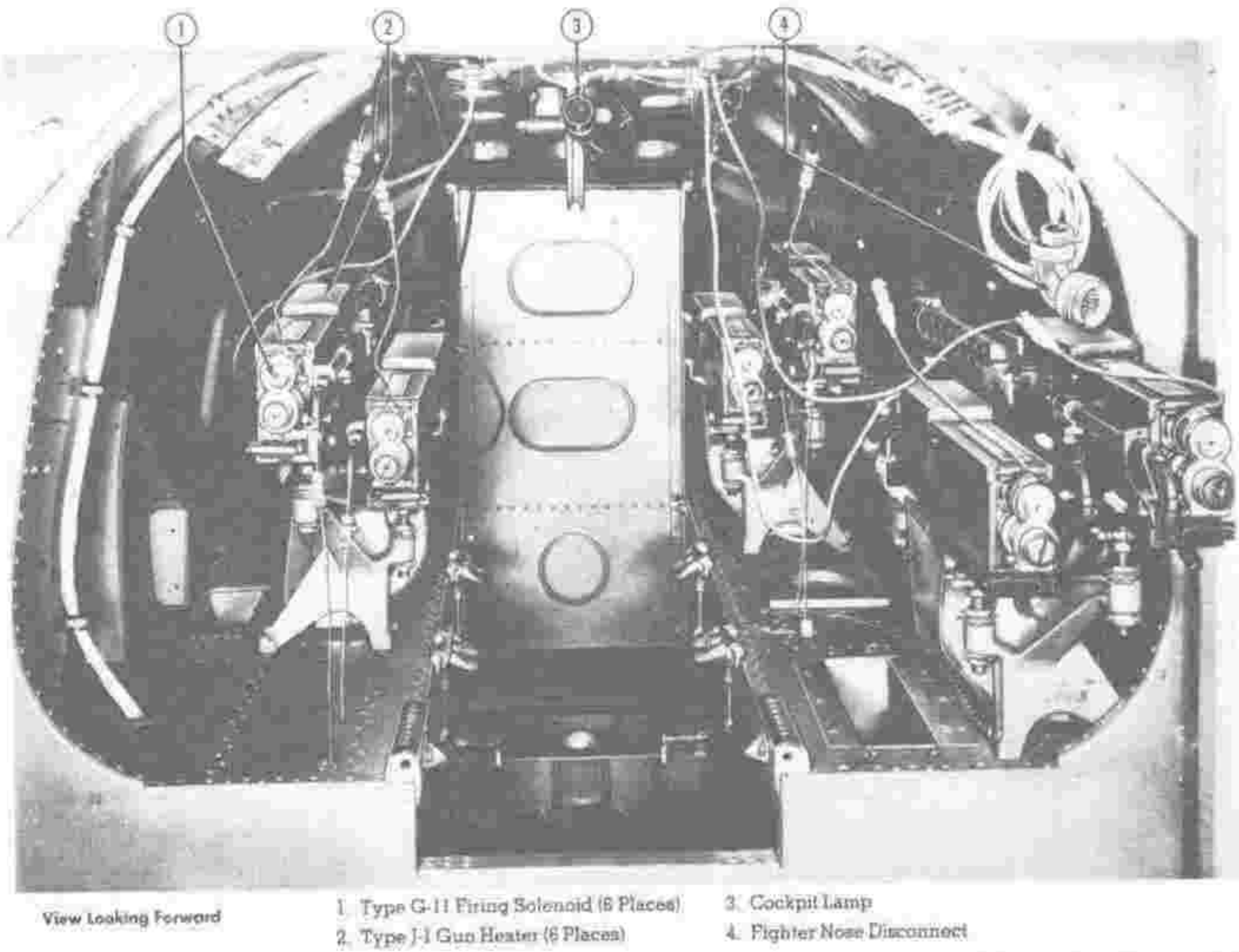
(4) Disconnect the electric plug from the cannon firing solenoid.

(5) Disconnect the charging cables at the Tru-lock "Quickies" provided.

(6) If another size gun is to be used, disconnect the cables from the charging lever and pull the cables out through the lower access door.

(7) Unclip the ammunition feed and ejection chutes from the gun.

(8) Remove the bolts which attach the adjusting link to the cannon aft of the mount.



View Looking Forward

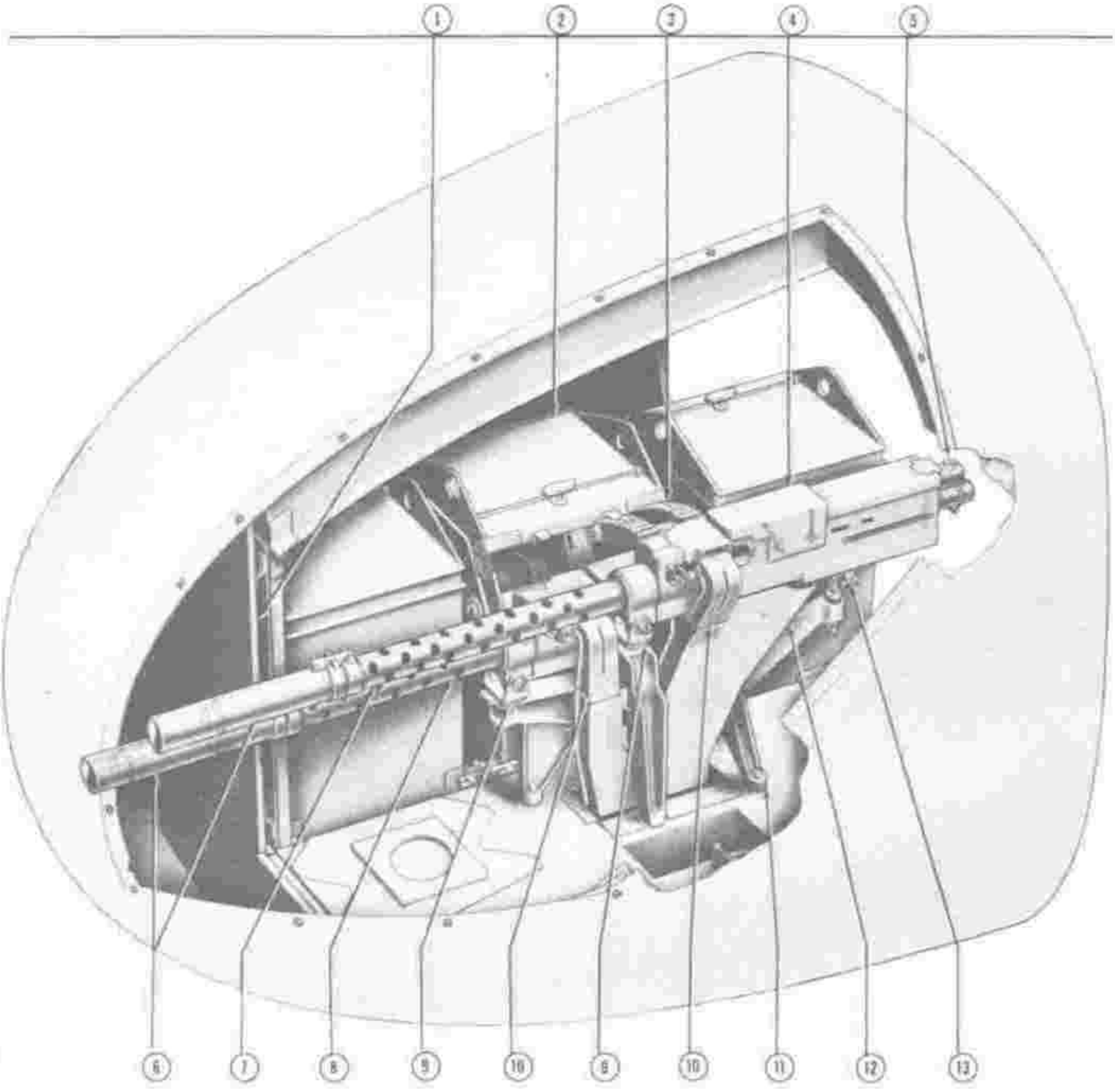
1. Type G-11 Firing Solenoid (6 Places)
2. Type J-1 Gun Heater (6 Places)
3. Cockpit Lamp
4. Fighter Nose Disconnect

Figure 540 — .50 Cal. Guns — All Purpose Nose

(9) With the cannon carefully supported, remove the bolts and lift the trunnion cap off the mount. Lift the cannon out of the airplane.

3. 75 MM CANNON.

a. DESCRIPTION.—Provision is made for the installation of one T-13E1 75 mm aircraft cannon *(figure 546)* in the right-hand side of the fuselage, with the tube projecting through a removable panel in the all-purpose nose. Twenty rounds of ammunition are carried in an ammunition rack *(1, figure 546)* installed over the cannon in the right-hand forward corner of

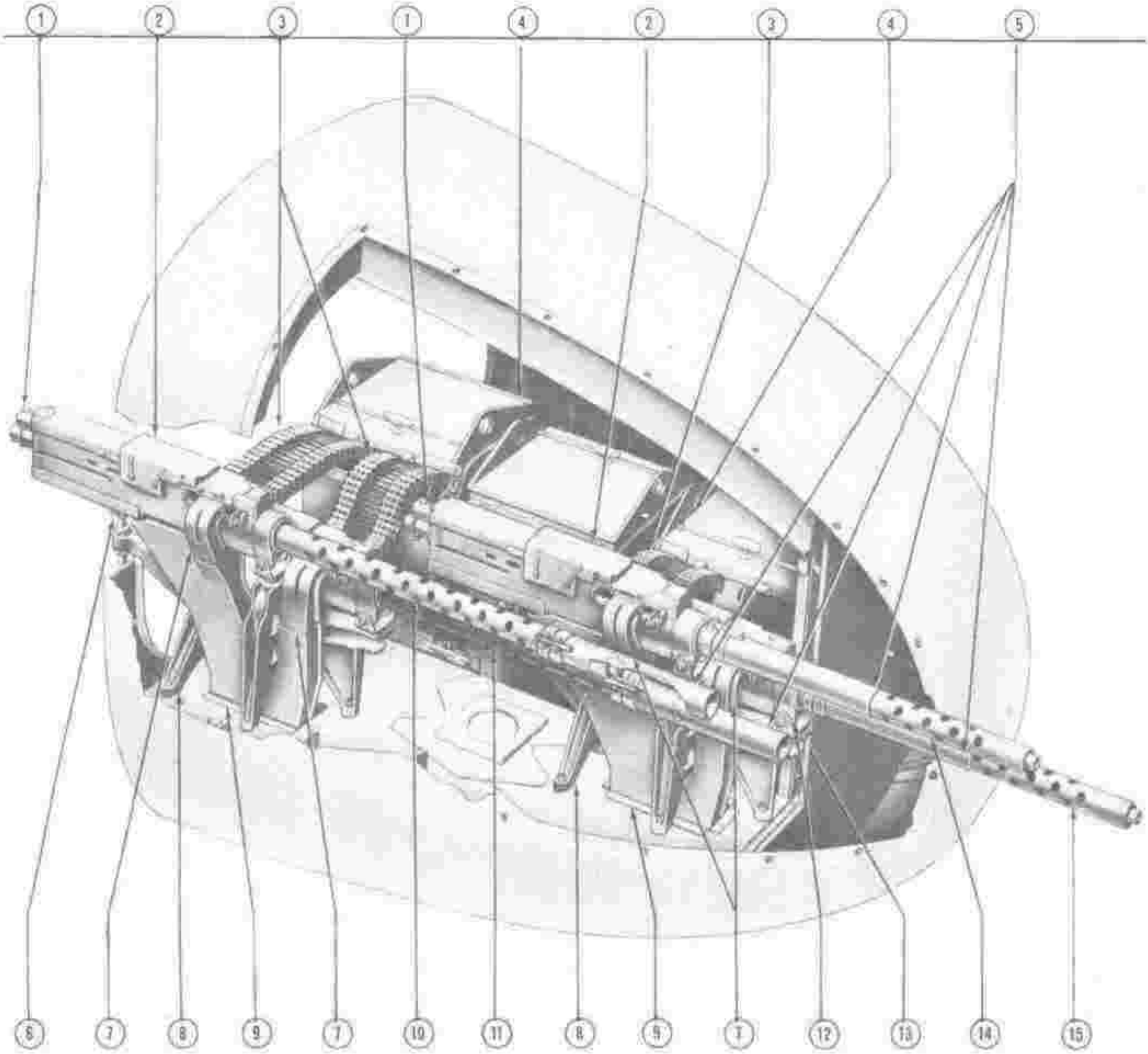


1. Armor Plate
2. Ammunition Box
3. Feed Chute
4. Type J-1 Gun Heater
5. Type G-11 Solenoid
6. Tube Assembly
7. #1 Gun (R.H. Feed)
8. #2 Gun (R.H. Feed)
9. Forward Bracket
10. Link Chute
11. Gun Mount
12. Shell Case and Link Ejection Chute
13. Bear Holder

Figure 541 — All-Purpose Nose — L.H. Caliber .50 Two Gun Installation

the pilot's compartment. Aft of the cannon in the pilot's compartment a seat *(3, figure 546)* is provided for the gun loader. The seat is mounted on an ejection chute *(2, figure 546)* through which ejected shell cases travel from the cannon into a canvas bag *(5, figure 546)* installed in the bomb bay. The cannon is loaded manually by the gun loader, and fired electrically by the pilot. The cannon firing actuator mechanism is installed on the right-hand side of the fuselage aft of station 0. A cable connects it to the breechblock of the gun. The following is a list of major cannon weights and dimensions:

Weight of Cannon..............757 pounds
Weight of Accessories...........139 pounds
Ammunition (20 Rounds)........400 pounds
Total Weight of Cannon
Installation ....1296 pounds



1. Type G-11 Solenoid
2. Type J-1 Gun Heater
3. Feed Chute
4. Ammunition Box
5. Tube Assembly
6. Rear Holder
7. Link Chute
8. Gun Mount
9. Shell Case and Link Ejection Chute
10. #6 Gun (L.H. Feed)
11. #5 Gun (L.H. Feed)
12. Forward Bracket
13. Armor Plate
14. #4 Gun (L.H. Feed)
15. #3 Gun (L.H. Feed)

Figure 542 — All-Purpose Nose — R.H. Caliber .50 Four Gun Installation

Normal Recoil	21 inches
Maximum Recoil	23 inches
Pistol Pull	19000 pounds per square inch
Drop of Breechblock	4.437 inches
Rotation of Handle	113 degrees
Length of Tube Forward of Mount	78.406 inches
Length of Tube Aft of Mount	42.1 inches
Total Length of Tube	116.375 inches
Overall Length of Cannon Installation	132.359 inches

b. REMOVAL AND DISASSEMBLY.—Reverse the INSTALLATION procedure outlined below.

c. CLEANING AND LUBRICATION.—In order to lengthen the accuracy life of the gun and to reduce the extent of copper fouling in the bore, it is essential that cleaning and lubricating instructions be followed. Ammunition should be cleaned before it is placed in the ammunition rack previous to firing. Whenever possible, the gunner should inspect the bore to see that it contains no foreign material such as particles of cartridge case wadding or unburned powder. The presence of any foreign material may cause damage to the tube. Lubrication charts *(figure 547)* are furnished for the T-13E1 Cannon and the M-4 Cannon. Use the chart applicable to the gun being worked on.

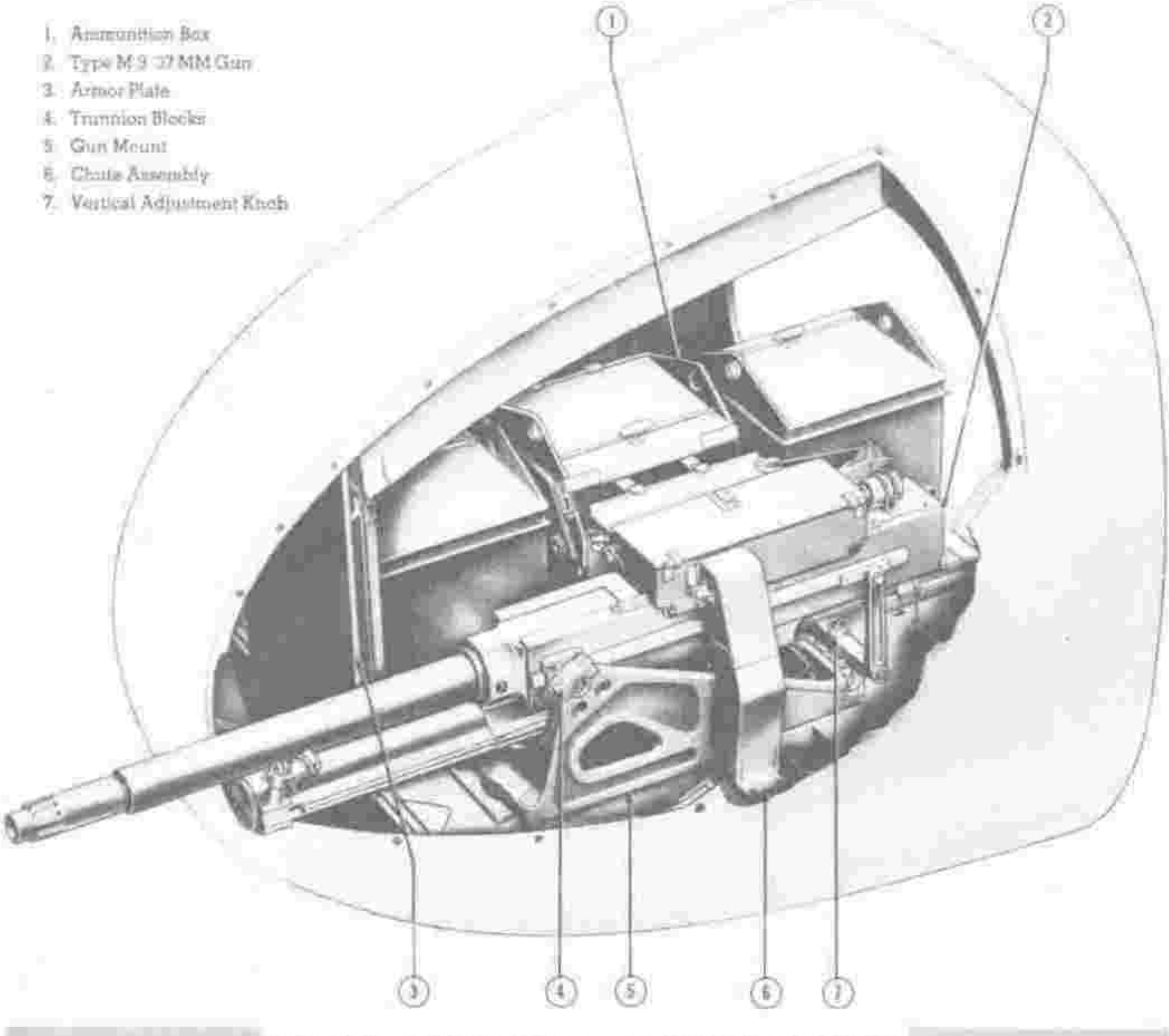


Figure 543 — All-Purpose Nose — L.H. 37 MM Gun Installation

(1) CLEANING INSTRUCTIONS.—All moving parts of the breech mechanism housed within the breech ring should be disassembled and cleaned thoroughly at regular intervals, or after firing, with dry-cleaning solvent. Wash the bore with a solution made by dissolving one-half pound of soda ash or one pound of sal soda in one gallon of water, using a sponge for swabbing purposes. Soap, castile and water may also be used. If neither soap nor soda ash is available, water should be used. After all powder fouling has been removed, swab the bore with clear water and dry with a piece of clean burlap or cleaning cloth. After cleaning, coat the bore and all operating parts with a thin protective coating *(figures 547)* considering the temperature, applying it with a slush brush. Under no circumstances should the gun be allowed to set without cleaning after it has been fired. For a complete list of cleaners and abrasives and information regarding their use see Technical Manual No. 9-850. The following materials are prescribed for general use:

(a) Burlap, jute, 8 ounce, is used over the bore sponge for cleaning the bore.

(b) Crocus cloth is used for removing rust or stain and for polishing parts of the breech mechanism and firing mechanism.

(c) Mixed cotton wiping cloth, sterilized (for machinery), is used instead of cotton waste for cleaning parts of the breech and firing mechanism. This material is preferable to cotton waste in all opera-

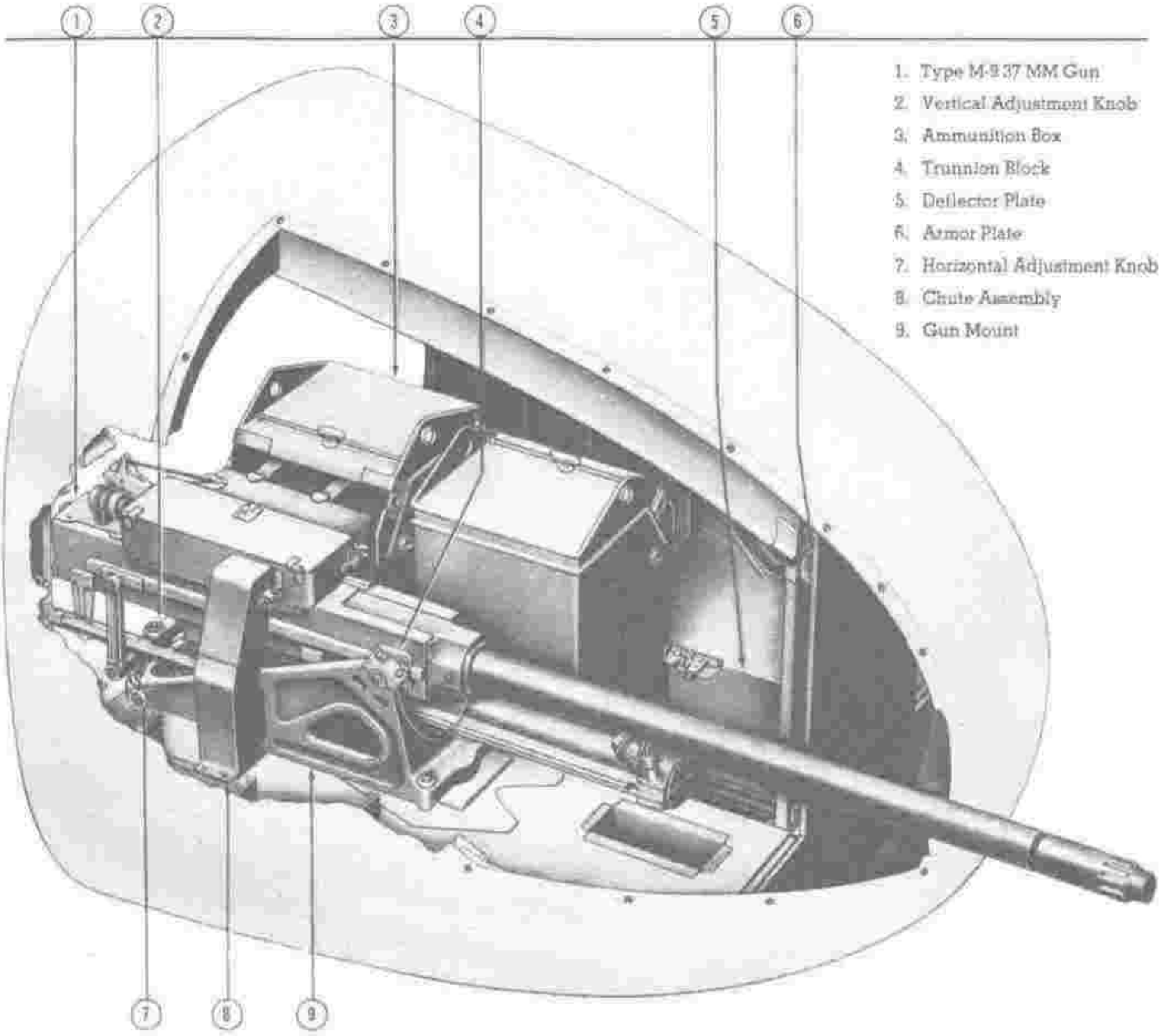
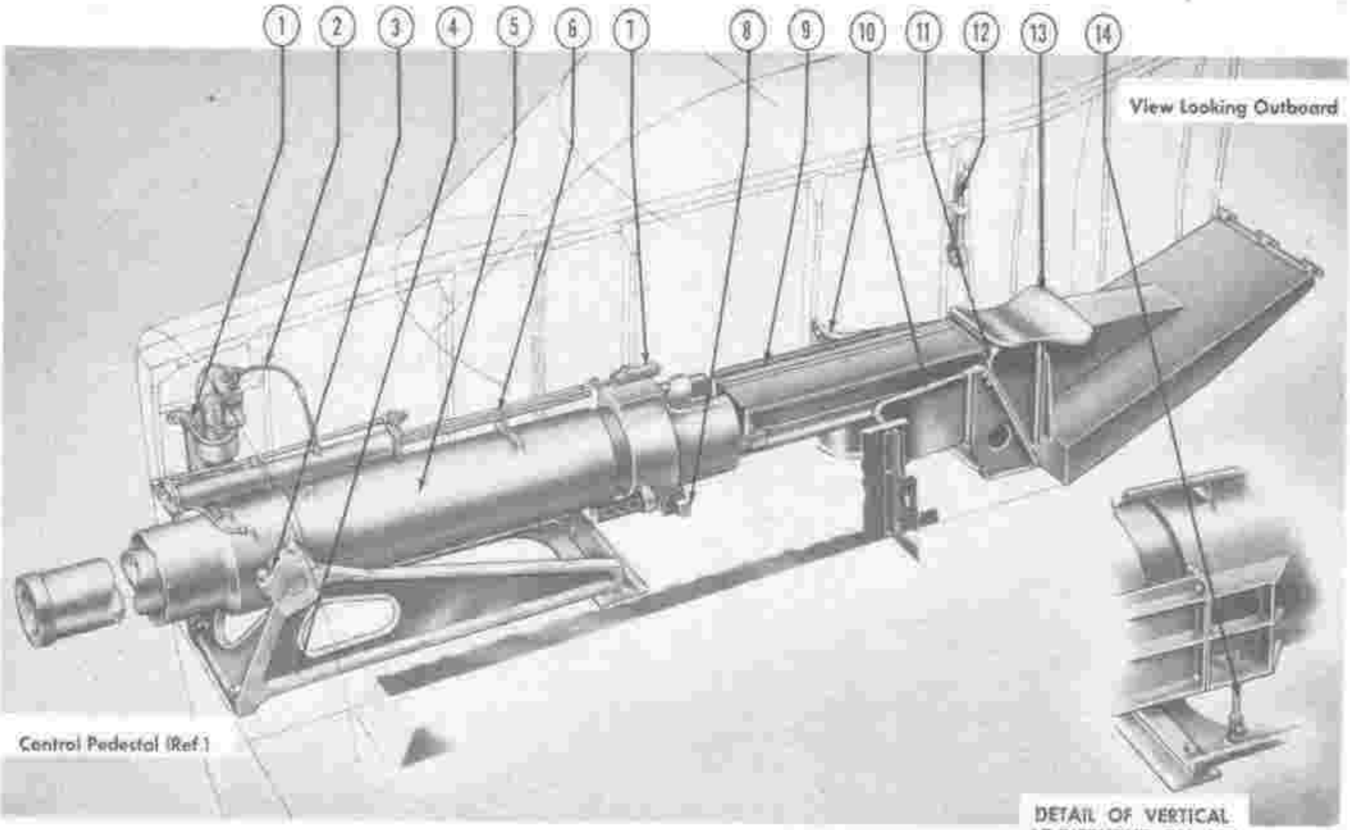
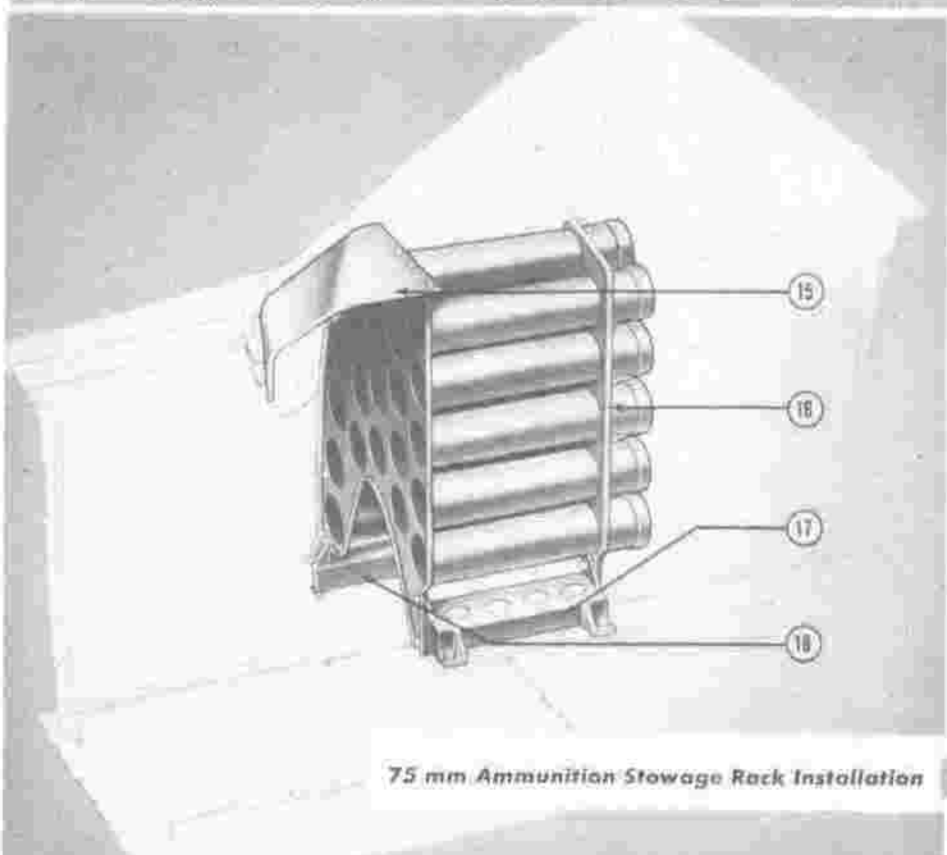


Figure 544 — All-Purpose Nose — R.H. 37 MM Gun Installation

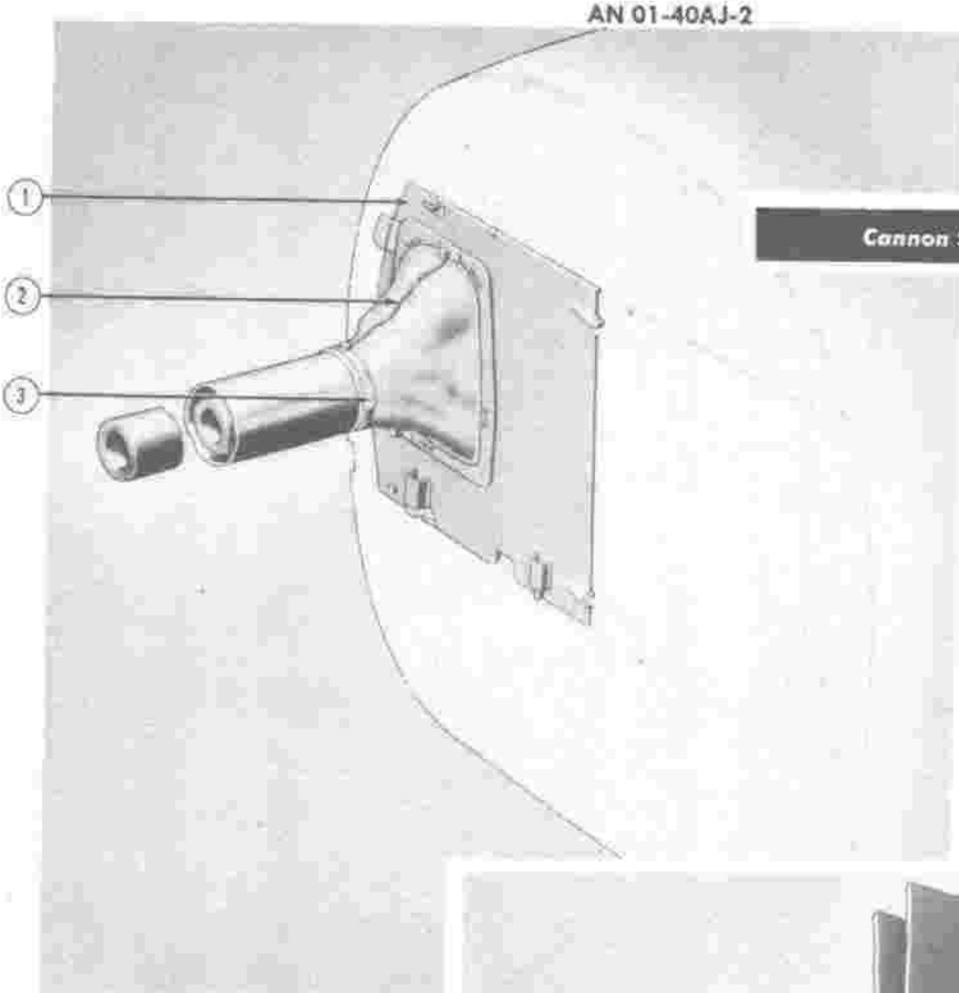




75 mm Ammunition Stowage Rack Installation

1. Firing Actuator Mechanism
2. Electrical Lead to Sta. 0 Junction Box
3. Trunnion Cap
4. Mount Assembly
5. Type T-13 75 mm Cannon
6. Firing Actuator Rod
7. Plunger
8. Breech Opening Lug
9. Feed and Ejection Chute Assembly
10. Leg Guard Assemblies
11. Chute Slider
12. Breech Lug Wrench
13. Cannon Loader's Seat
14. Vertical Adjusting Clevis
15. Ammunition Stowage Rack Armor Plate
16. Ammunition Stowage Rack
17. Ammunition Stowage Rack Inboard Support Casting
18. Ammunition Stowage Rack Outboard Bracket Assembly

Figure 545 (Sheet 1 of 2) — 75 mm Cannon Installation Details



Cannon Seal Installation at Sta. 0

View Looking Aft and Outboard

1. Armor Plate at Sta. 0
2. Cannon Seal Assembly
3. Clamp Assembly

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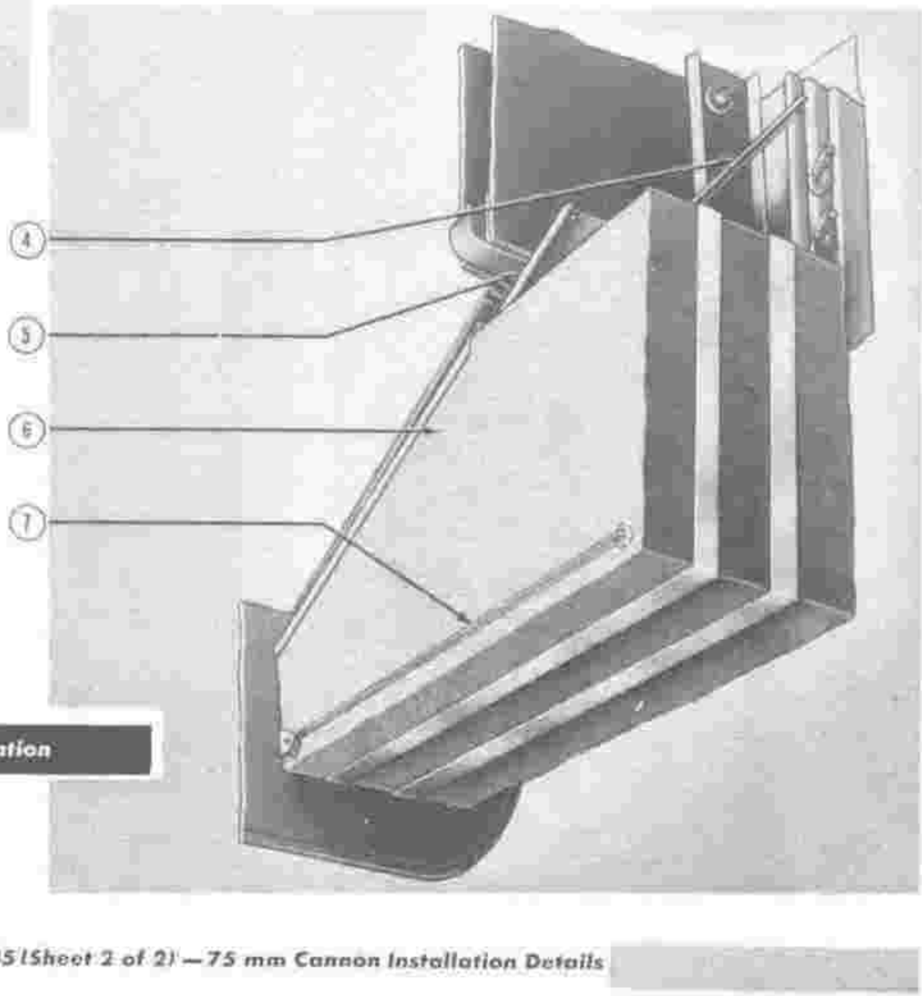

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4. Support
5. Bracket
6. Shell Case Catcher
7. Slide Fastener

View Looking Forward and Outboard from Bomb Bay

Shell Case Catcher Installation

Figure 545 (Sheet 2 of 2) — 75 mm Cannon Installation Details

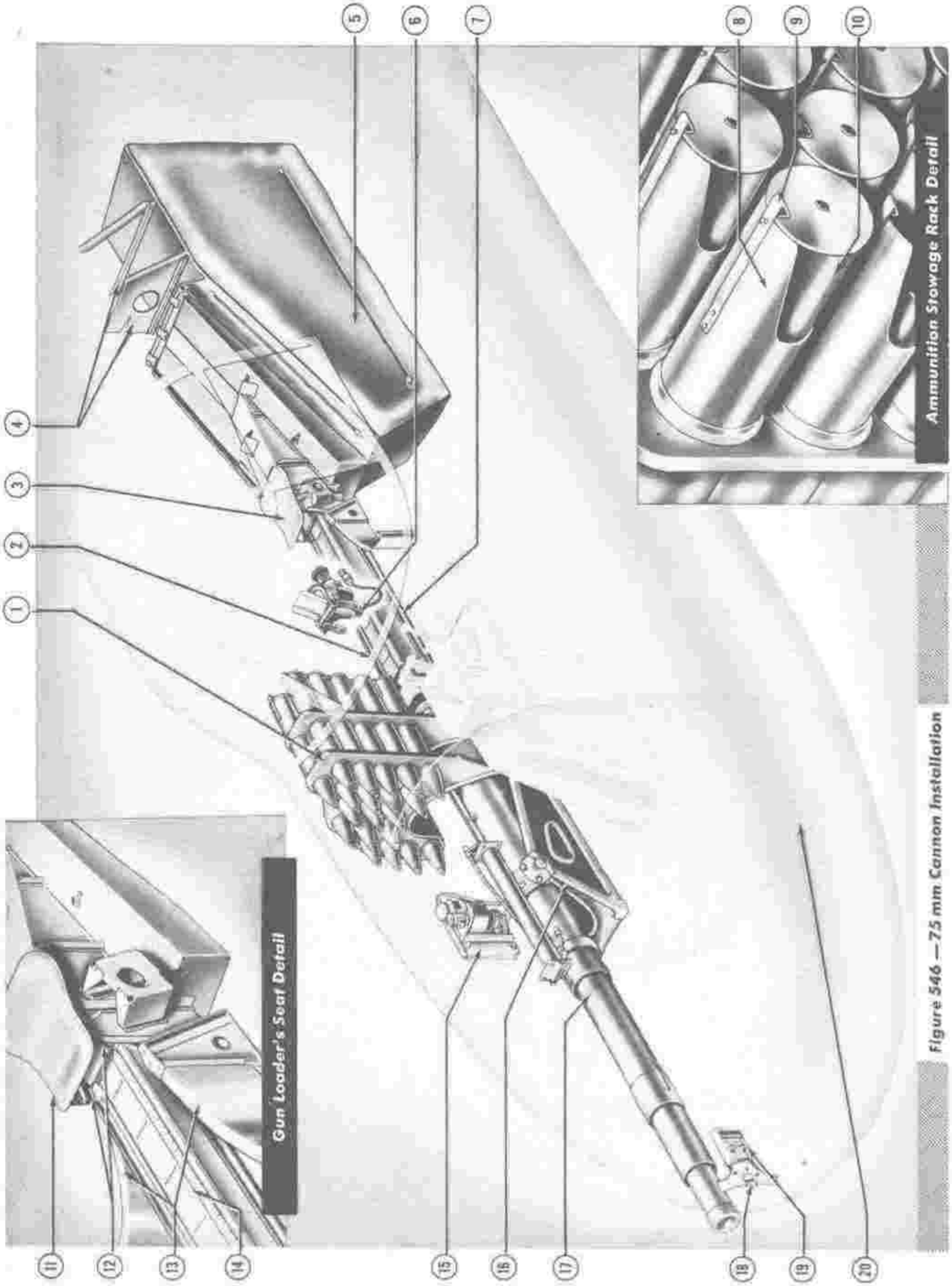


Figure 546 —75 mm Cannon Installation

KEY TO FIGURE 546

1. Ammunition Storage Rack
2. Feed and Ejection Rack
3. Gun Loader's Seat
4. Shell Case Catcher Supports
5. Shell Case Catcher
6. Type N-9 Gun Sight
7. Feed and Ejection Chute
8. Tube
9. Latch
10. 75 mm Shell
11. Gun Loader's Seat
12. Chute Sliders
13. Guards
14. Hinged Cover
15. Cannon Firing Actuator Mechanism
16. Cannon Mount
17. Type T-13E1 75 mm Cannon
18. Camera Window
19. Type N-4 G.S.A.P. Camera
20. Sta. O Armor Plate

tions where deposits of lint are apt to plug oil holes or create stoppages that would cause trouble.

(d) Castile soap is used in preparing a solution for sponging the bore of the cannon.

(e) Dry-cleaning solvent is used for cleaning all bright metal surfaces preparatory to the application of rust-preventive compound. It is used to remove grease and oil. Care is required in handling and storing dry-cleaning solvent because of the fire hazard. It should not be allowed to stand in open containers near a fire. Smoking is prohibited in the vicinity of, or while handling solvents.

(f) Sponge, (natural) is used with water and very mild cleaning solutions only (such as soap and water) for washing or rinsing.

(g) Cotton waste (two grades, colored and white), is used on the exterior of the equipment. White waste is used for cleaning all finished surfaces. Where clean rags are not available for use on the breech mechanism, white waste may be substituted.

(2) LUBRICATION INSTRUCTIONS. —Excessive wear can be prevented and the life of the gun increased to a marked degree by keeping the operating parts clean and properly lubricated. Apply sufficient lubrication, but avoid excessive and wasteful practices. Excessive lubrication permits dirt accumulations on the weapon, and through spreading or dripping, the excess lubrication may reach places not intended to be lubricated and malfunctions or deterioration may result. Particular attention should be given to the lubricating of sliding surfaces of the breech mechanism and other bearing surfaces that may not contain oil holes or lubrication fittings. Operate parts while lubricating them so as to distribute the lubricant over the bearing surfaces. Lubricate the gun as instructed by the lubrication chart *(figure 547)*. Use only those lubricants mentioned on the chart. Care must be taken when cleaning the parts to see that all foreign matter is thoroughly removed before parts are lubricated. For additional information on lubricants and the proper removal of rust or corrosion see Technical Manual No. 9-850.

(3) TREATMENT BEFORE STORING.

(a) As soon as practicable after firing, the bore of the tube and all moving parts of the breech ring, breechblock and percussion mechanism should be thoroughly cleaned and lubricated lightly at assembly. The operating parts should be coated with a thin film of oil *(figure 547)* applying it with a slush brush. If the gun is to be out of service temporarily, all parts should be protected with engine oil, S.A.E. 30. When the gun is to be placed in service again, the oil should be removed and the parts thoroughly lubricated with the proper lubricant in accordance with the lubrication chart. Whenever the gun is to be stored for a considerable time, the bore, breech mechanism, and finished, unpainted surfaces should be cleaned with dry-cleaning solvent and coated with medium rust-preventive compound.

Parts Lubricated	How Often	Method	Required Lubricants		
			Below 32° F	Above 32° F	Amount
BORE	DAILY	BRUSH	OIL, ENGINE S.A.E. NO. 10	OIL, ENGINE S.A.E. NO. 20	FILM
BREECH MECHANISM (SURFACES)	DAILY	BRUSH	OIL, ENGINE S.A.E. NO. 10	S.A.E. NO. 20	FILM
BREECH AND FIRING SHAFTS, PINS, PLUNGERS NOT ACCESSIBLE TO BRUSH	DAILY	HAND OILER	OIL, ENGINE S.A.E. NO. 10	OIL, ENGINE S.A.E. NO. 20	FILM
CLOSING SPRING	WEEKLY	HAND	GREASE	GREASE	
CHAIN			O.D. NO. 00	O.D. NO. 0	

NOTE — Clean and Lubricate Daily after Firing

Figure 547 75 MM Cannon Lubrication Chart

(b) Keep the breech closed and covered when not in use in order to prevent dust and grit from getting into the mechanism, causing wear and impeding smooth operation.

(c) Keep the breech mechanism clean and give the firing mechanism careful attention. Disassemble them frequently and wash the parts with dry-cleaning solvent. Wipe dry and coat with the prescribed lubricating oil. *(See figure 547.)*

(d) It is important that any scores or cuttings on the bearing surfaces of the breechblock, breech ring, or tube be reported to Ordnance specialists for correction.

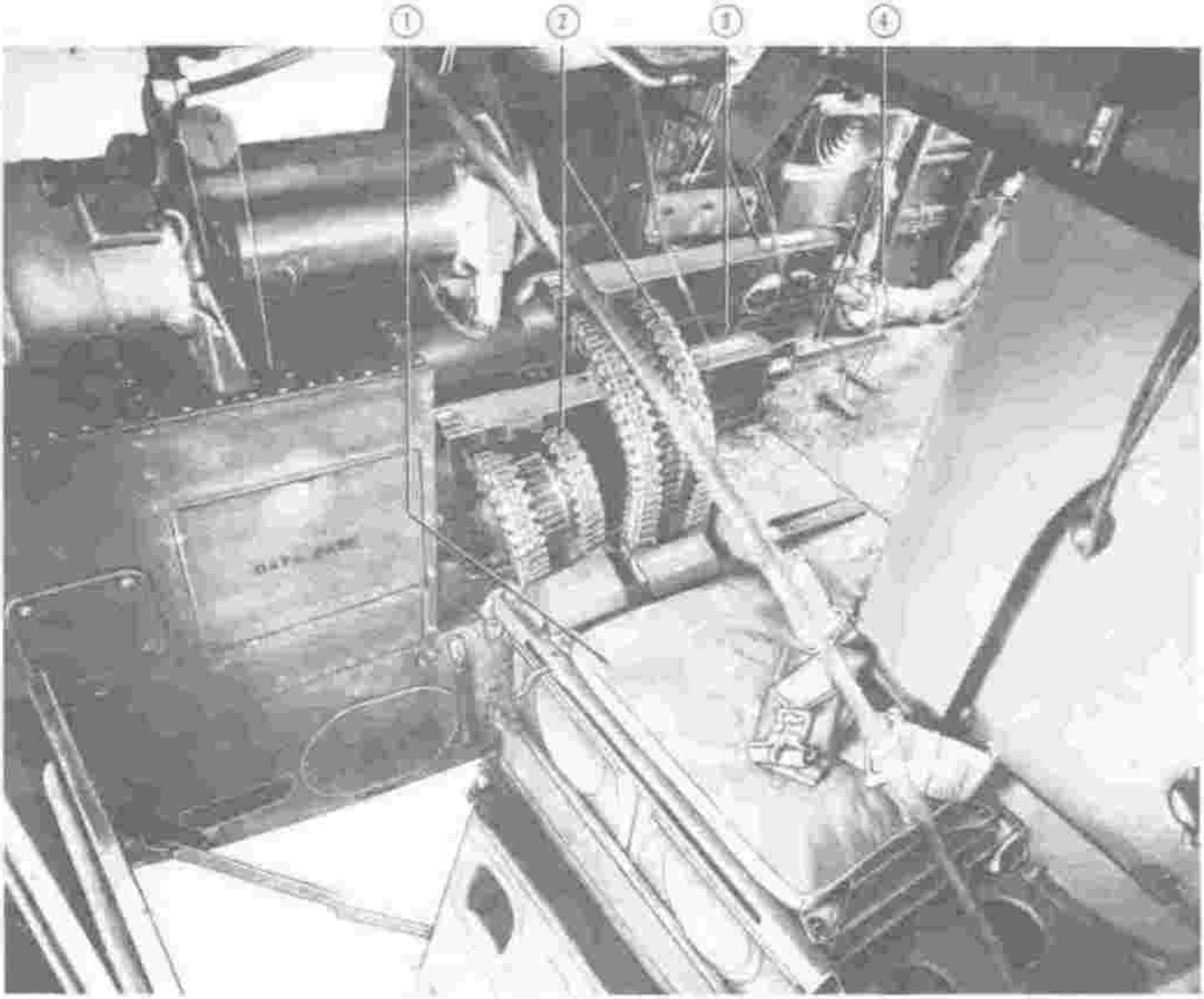
(e) If the breechblock does not operate smoothly, or if the mechanism requires a greater effort than usual, disassemble it and correct the cause of the binding.

(f) Never use a steel hammer directly on a part. Use a copper plate or drift, or a soft hammer in order to prevent deforming the part.

(g) The tube should NOT be removed from the breech ring except by Ordnance maintenance personnel, and then only when necessary for the replacement of these parts. When replacement is required, the disassembly and assembly operations should be performed with extreme care and with particular attention to position and alignment to avoid damage to the breech ring, tube, and support.

d. ASSEMBLY AND INSTALLATION.

(1) Install the four bolts which secure the cannon mount to the airplane.



1. Bombardier's Seat 2. Ammunition Chutes 3. Type M-2 Cal. .50 Guns 4. Charger Cables

Figure 548—Guns Installed in Bombardier Nose

(2) With the cannon attached to the handling fixture *(figure 19)* hoist it into position over the mount.

(3) Lower the cannon onto the mount trunnion and install the trunnion caps and bolts.

(4) Install the vertical positioning rod between the cannon breech and the cannon mount.

(5) Install the firing actuator mechanism to the bracket *(15, figure 546)* provided by using the four bolts.

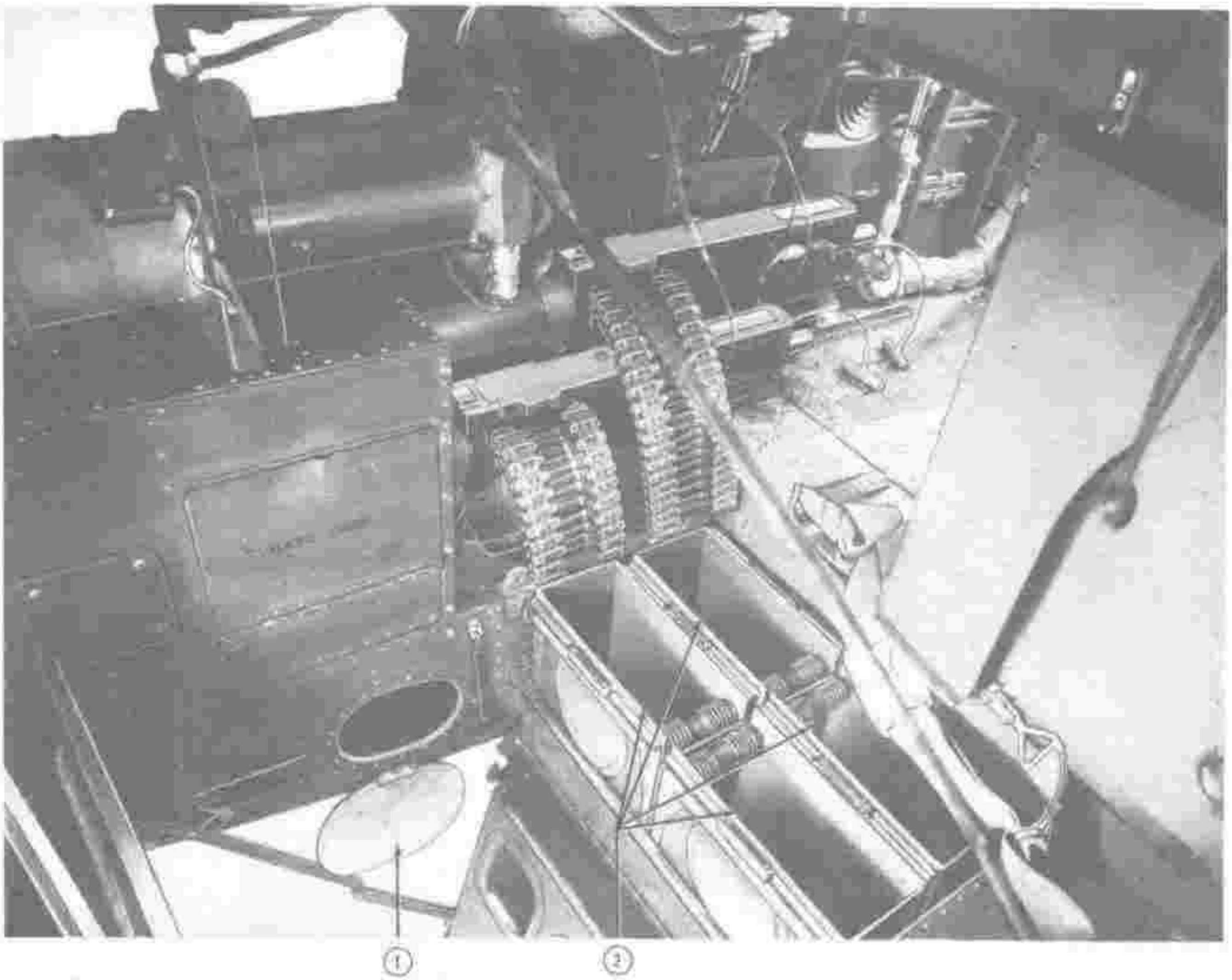
(6) Connect the cannon and the firing actuator mechanism with the cable provided.

e. ADJUSTMENTS.

(1) Vertical adjustment of the cannon is made by the vertical positioning rod installed between the cannon and the aft end of the cannon mount. Adjustment may be made between one degree, 25 minutes above horizontal and two degrees below horizontal.

(2) BORESIGHTING.—Refer to BORESIGHTING PROCEDURE FOR FIXED GUNS, paragraph 17. *f.* (7), this section.

f. OPERATION.—Firing of all guns mounted in this nose is electrically controlled from the pilot's compartment. Selector switches are located on the fire control panel *(figure 325)* for guns, gun sight aiming point camera, and gun heaters. Firing of the 37 mm or 75 mm cannon is accomplished by pressing the trigger underneath the right side of the pilot's control wheel, and of the caliber .50 machine guns by pressing the trigger on the left side of the control wheel. In order to fire the guns or cannon it is necessary to follow these steps:



1. Ammunition Case Access Door 2. Ammunition Boxes

Figure 549—Ammunition Boxes Installed in Bombardier Nose

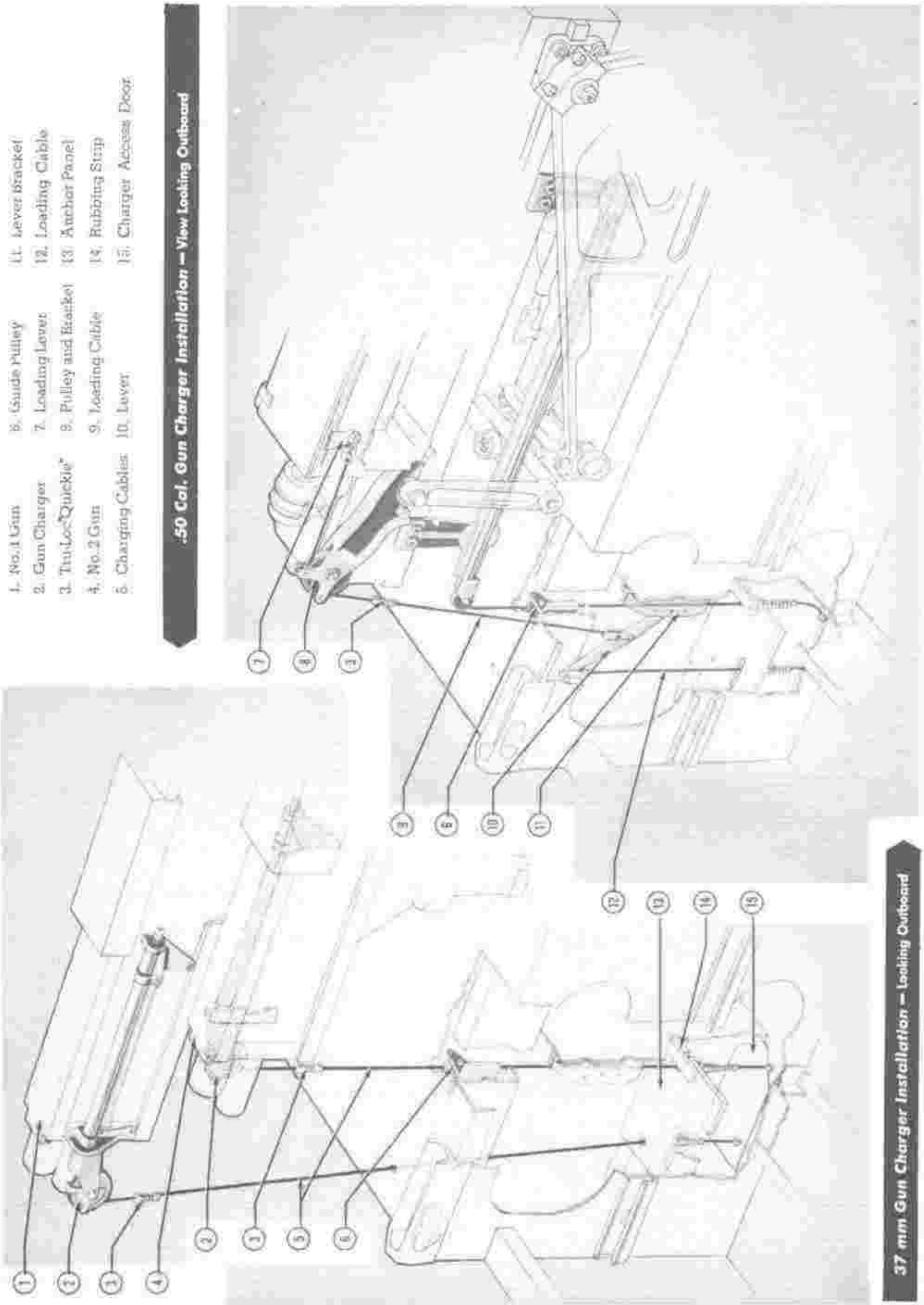
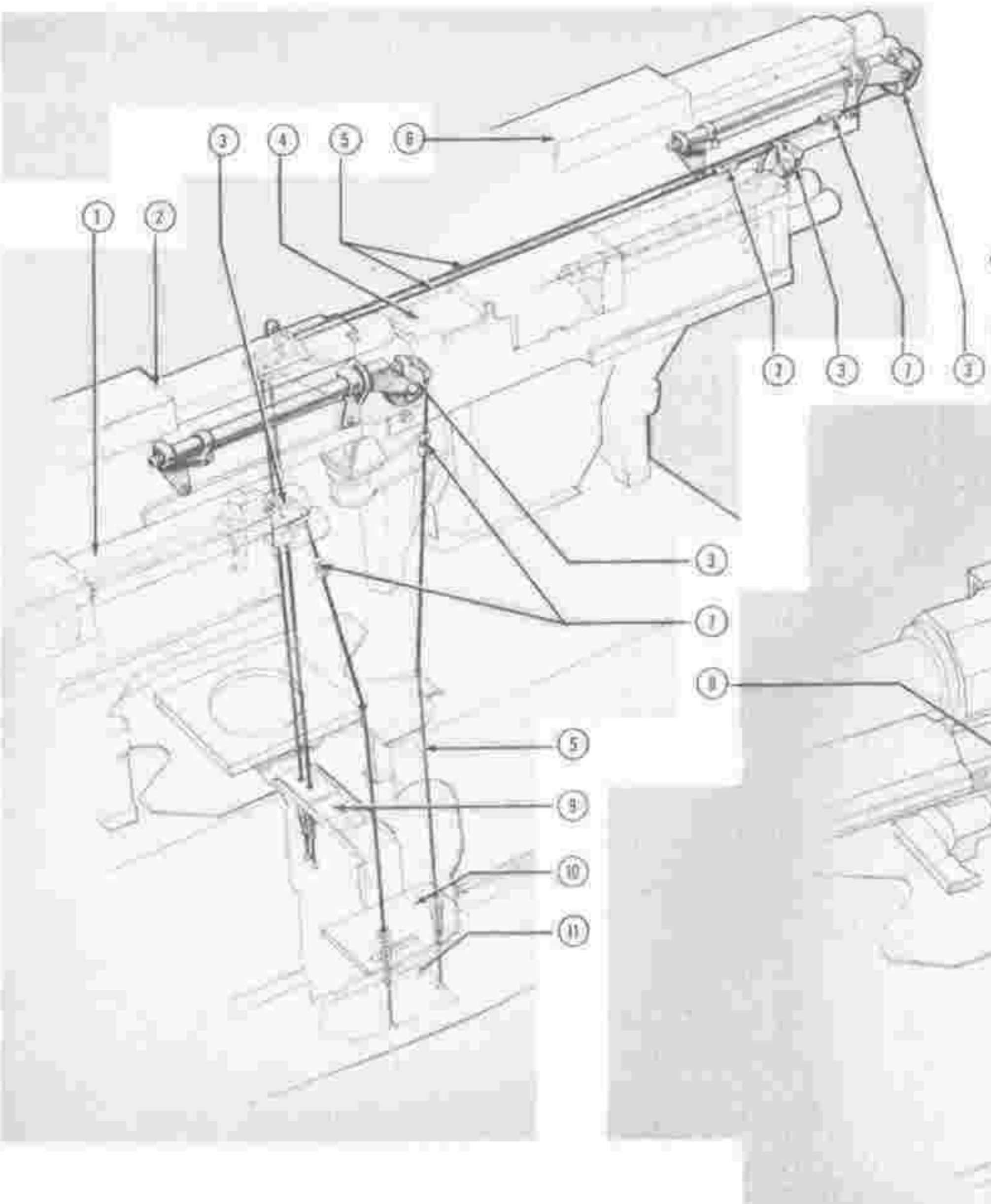
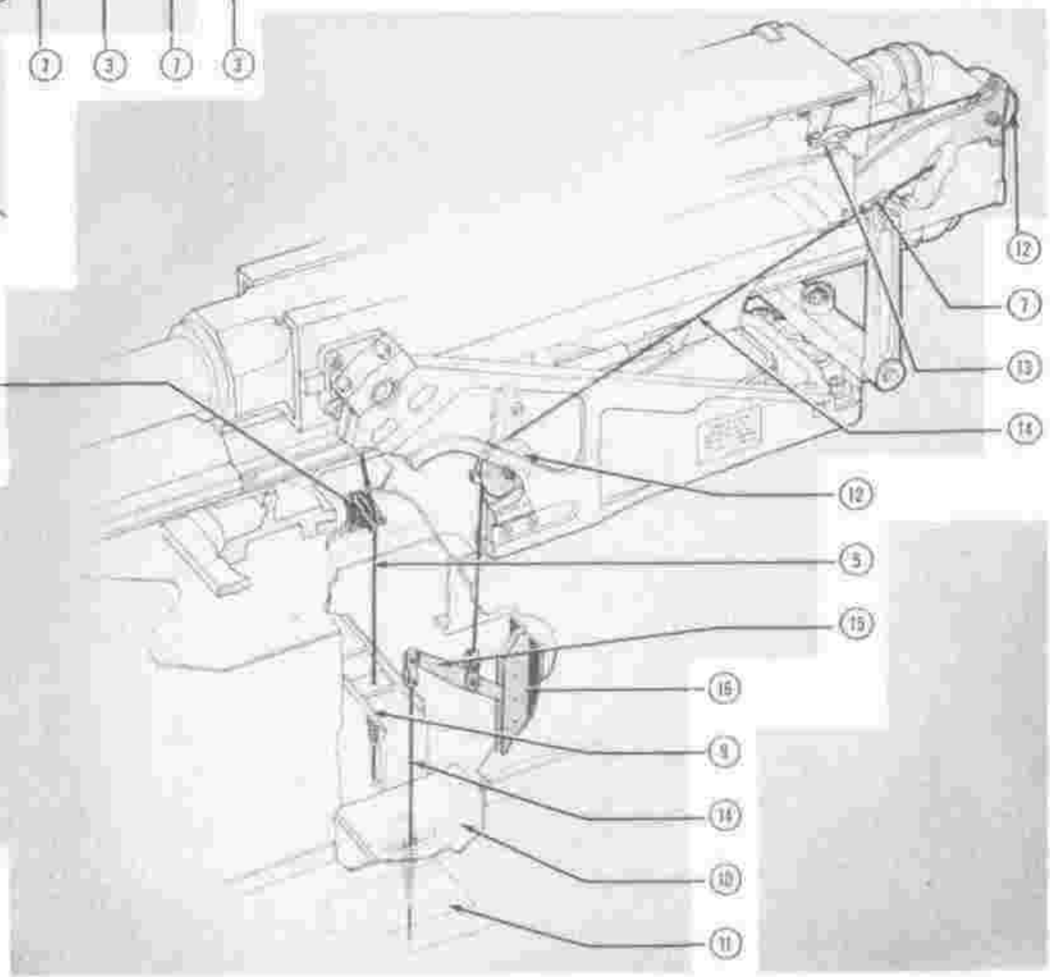


Figure 550 — L.H. Gun Charger Installations

1. No. 3 Gun
2. No. 4 Gun
3. Gun Charger
4. No. 5 Gun
5. Charging Cables
6. No. 6 Gun
7. Tru-Loc "Quickies"
8. Guide Pulley
9. Anchor Bracket
10. Anchor Panel
11. Charger Access Door
12. Bracket and Pulley
13. Loading Lever
14. Loading Cables
15. Lever
16. Lever Bracket



37 mm Gun Charger Installation — Looking Outboard



.50 Cal. Gun Charger Installation — View Looking Outboard

Figure 551 — R.H. Gun Charger Installations

a. TO FIRE CALIBER .50 NOSE GUNS.

(1) Master GUNS AND CAMERA safety switch on fire control panel *(figure 325)* in "GUNS & CAMERA" position.

(2) Caliber .50 NOSE GUN selector switch on fire control panel in "ON" position.

(3) PRESS trigger on left side of control wheel.

b. TO FIRE CANNON (37 mm or 75 mm).

(1) Master GUNS AND CAMERA safety switch on fire control panel in "GUNS AND CAMERA" position.

(2) 37 mm or 75 mm CANNON selector switch on fire control panel in "ON" position.

(3) Press trigger on right side of control wheel.

(3) BOMBARDIER NOSE GUNS.—In addition to bombing controls, the bombardier nose on the A-26C airplane is equipped with two Type M-2 caliber .50 fixed machine guns, mounted in the right side of the nose. These guns are electrically fired by the pilot. Ammunition is fed to the guns through flexible chutes from four ammunition boxes (two for each gun) located under the bombardier's seat. Each box has a capacity of 200 rounds. Ejected shell cases and links fall into the lower right hand section of the nose underneath the guns and are removed through an access door. Boresighting procedure for the bombardier nose guns will be furnished when available.

(4) GUN CHARGERS.—Caliber .50 and 37 mm guns are manually charged on the ground. Access doors are provided on both sides of the nose through which the cables may be reached. On 37 mm cannons one cable is provided which feeds the first shell into the chamber and a second cable which charges the gun. The 37 mm cannon on the right side of the nose has the shell feeder cable on the left side of the gun and the charger cable on the right side. The 37 mm cannon on the left side of the nose has both cables on the right side of the gun. The 75 mm cannon is loaded by hand in the pilot's compartment. See paragraph 17. *f.* (2) *(c)* 3., this section.

(5) G.S.A.P. CAMERA.

(a) GENERAL.—A bracket is provided in the foremost point of the nose *(figure 557)* for the mounting of a Type N-4 gun sight aiming point camera. A plexiglas window provides for the field of vision. The camera is electrically operated and controlled by the master guns safety and camera switch located on the fire control panel *(figure 325)*. Operation of the camera is synchronized to occur with firing of the nose and wing guns when the switch is in the "GUNS & CAM" position, or it may operate individually with the switch in the "CAM" position. An overrun control, mounted in the pilot's compartment, permits the camera to operate from 0 to 30 seconds after the guns cease to fire. For more information regarding the camera refer to paragraph 18, PHOTOGRAPHY, this section.

(b) REMOVAL.

1. Disconnect the electric conduit at the bottom of the camera case.

2. Remove the nuts from the four mounting studs, and pull camera from the mount.

(c) INSTALLATION.

1. Reverse procedure outlined in REMOVAL, above.

2. After installation it is necessary to boresight the camera to align with guns.

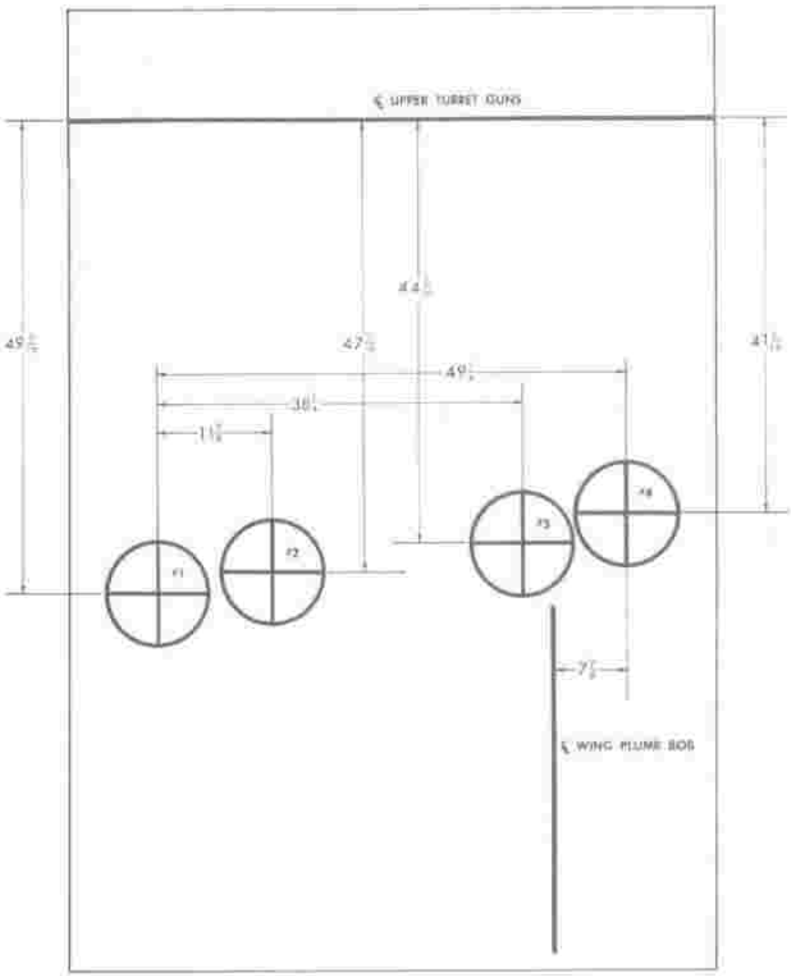
(6) TURRETS AND SIGHTING STATION.—All information relative to the turrets and sighting station has been incorporated in paragraph 15, ELECTRICAL, this section.

(7) BORESIGHTING PROCEDURE FOR FIXED GUNS.

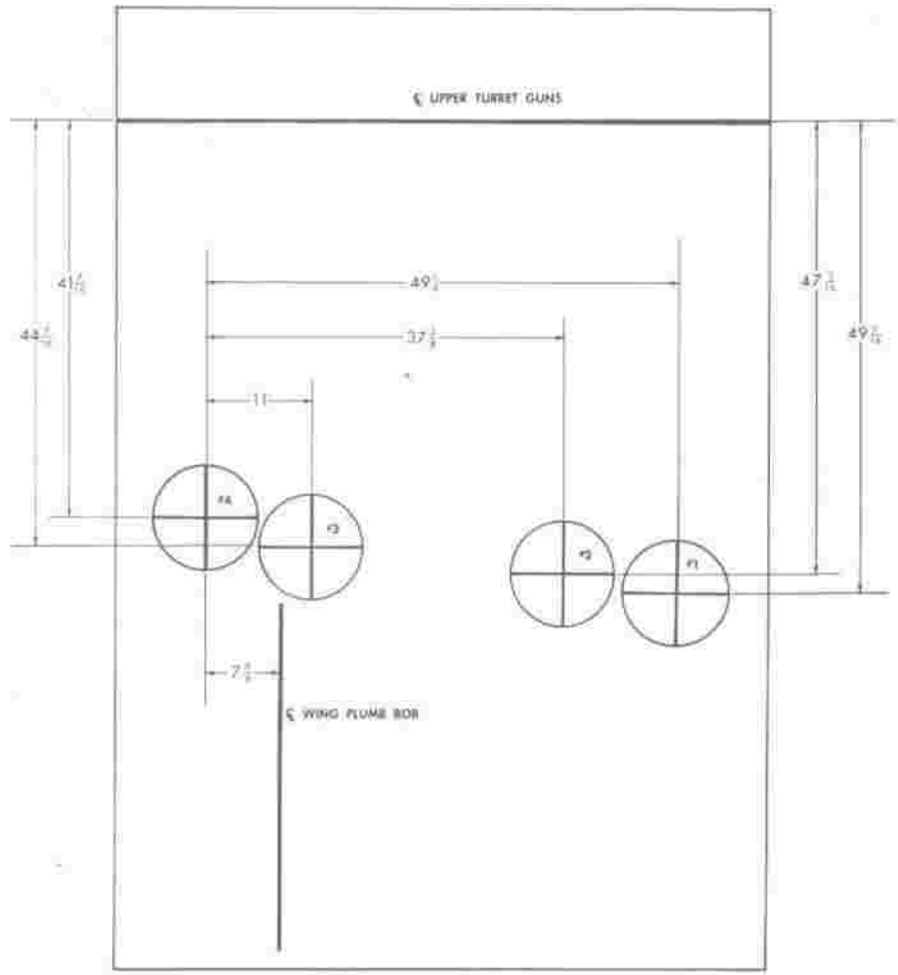
(a) GENERAL.—The instructions outlined below are intended for boresighting in the field where elaborate equipment such as wing jacks, tail jacks and target stands are not available. However, such equipment should be used when available. The correct alignment of the sight parallel to the flight line of the airplane is the most important factor to be considered in aerial gunnery with fixed guns. The next consideration is the alignment of the guns at the proper angle in relation to the line of sight.

Note

All boresighting targets furnished with the airplane *(figure 552)* are calculated on the basis of the attitude of the airplane flying at 250 m.p.h. indicated airspeed and loading gross weight of 31,000 lbs. which equals 1°-28' (26 mills) NOSE UP. The location of the sight line mark in relation to the upper turret reference line has been established on the target on the basis of 1°-28' NOSE UP.

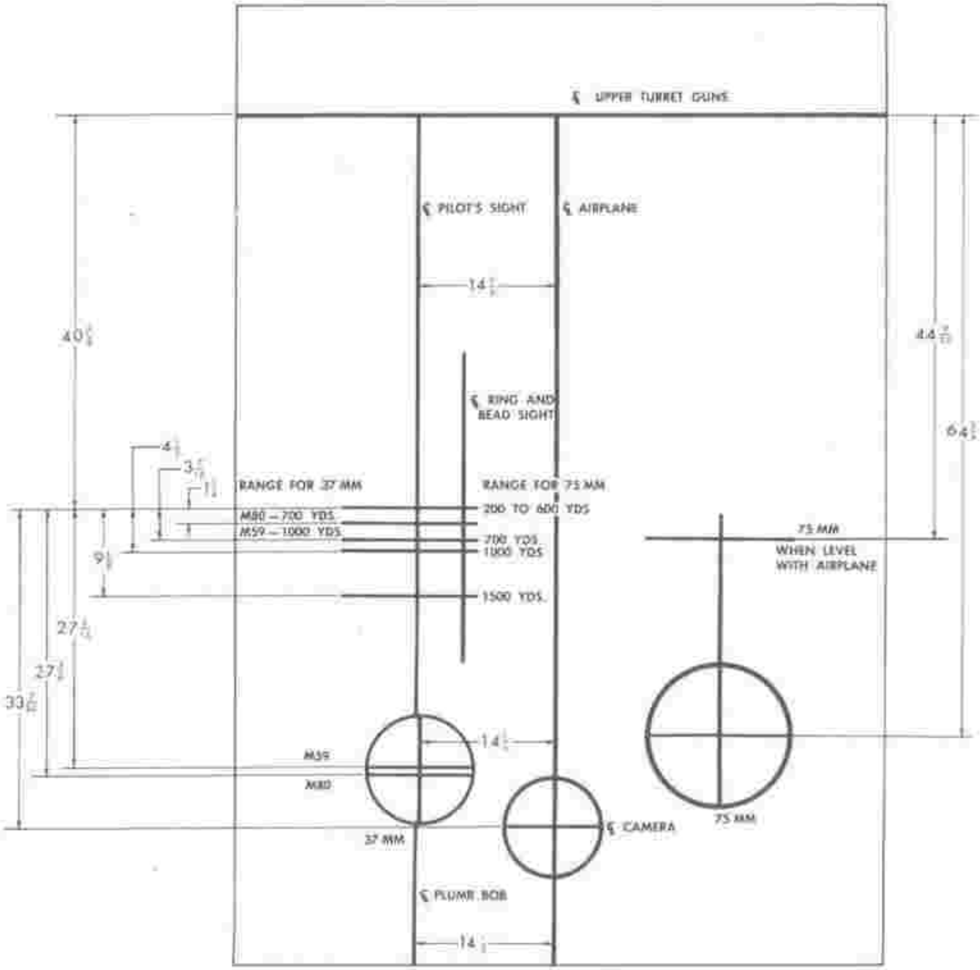


.50 CAL. WING GUNS—R. H.

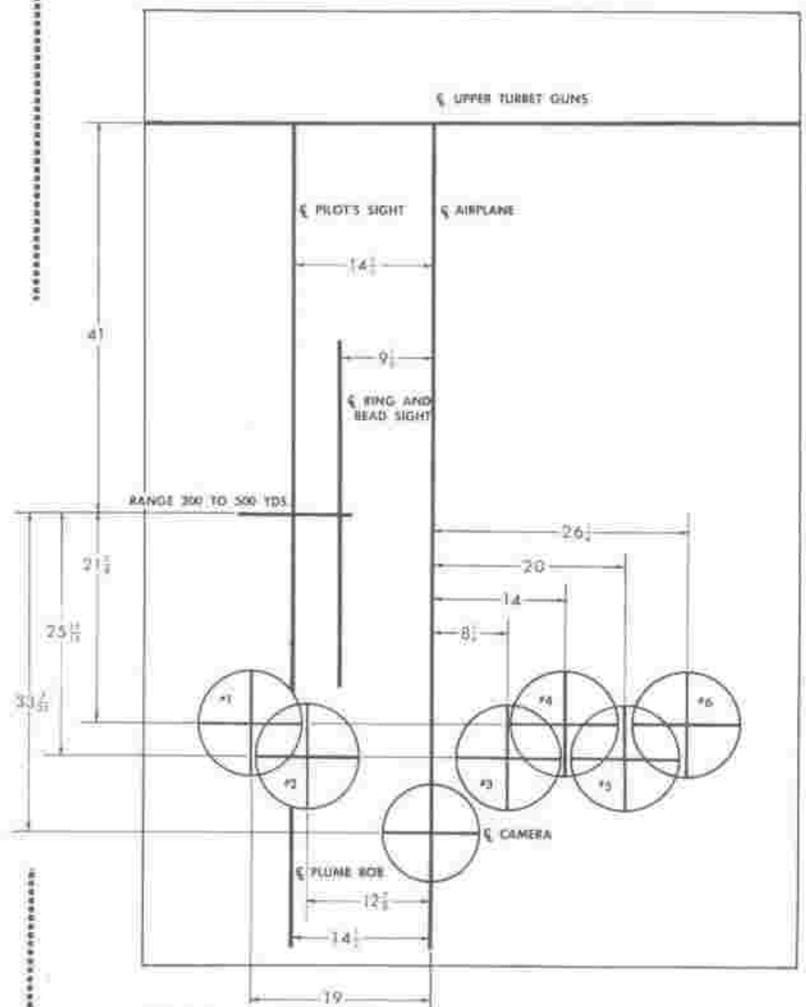


.50 CAL. WING GUNS—L. H.

Figure 552 (Sheet 1 of 4)—Bore Sighting Charts

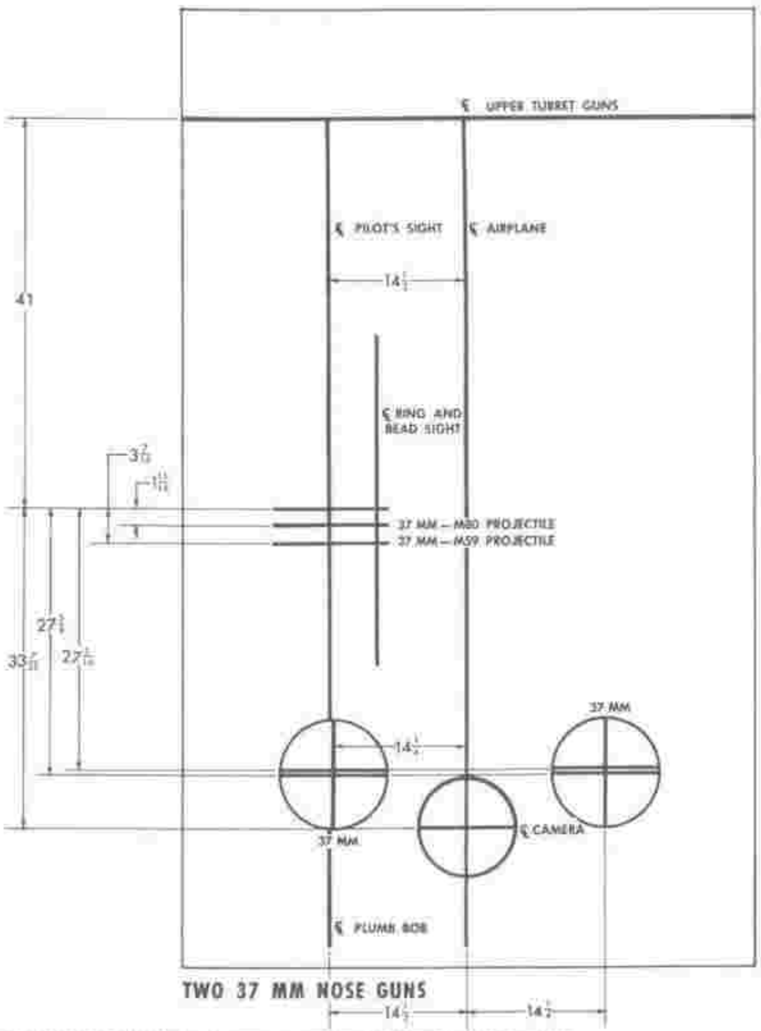


ONE 75 MM AND ONE 37 MM NOSE GUNS

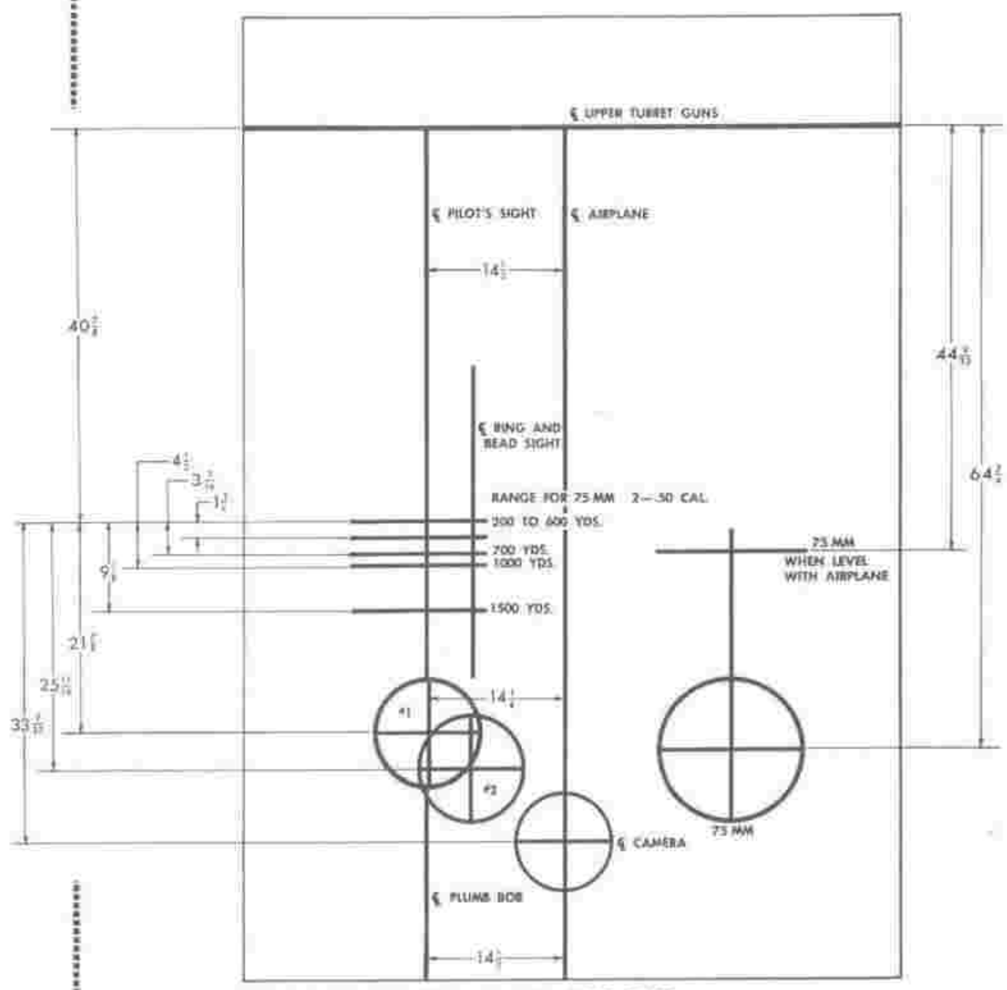


SIX .50 CAL. NOSE GUNS

Figure 552 (Sheet 2 of 4)—Bore Sighting Charts



TWO 37 MM NOSE GUNS



ONE 75 MM AND TWO .50 CAL. NOSE GUNS

Figure 552 (Sheet 3 of 4)—Bore Sighting Charts

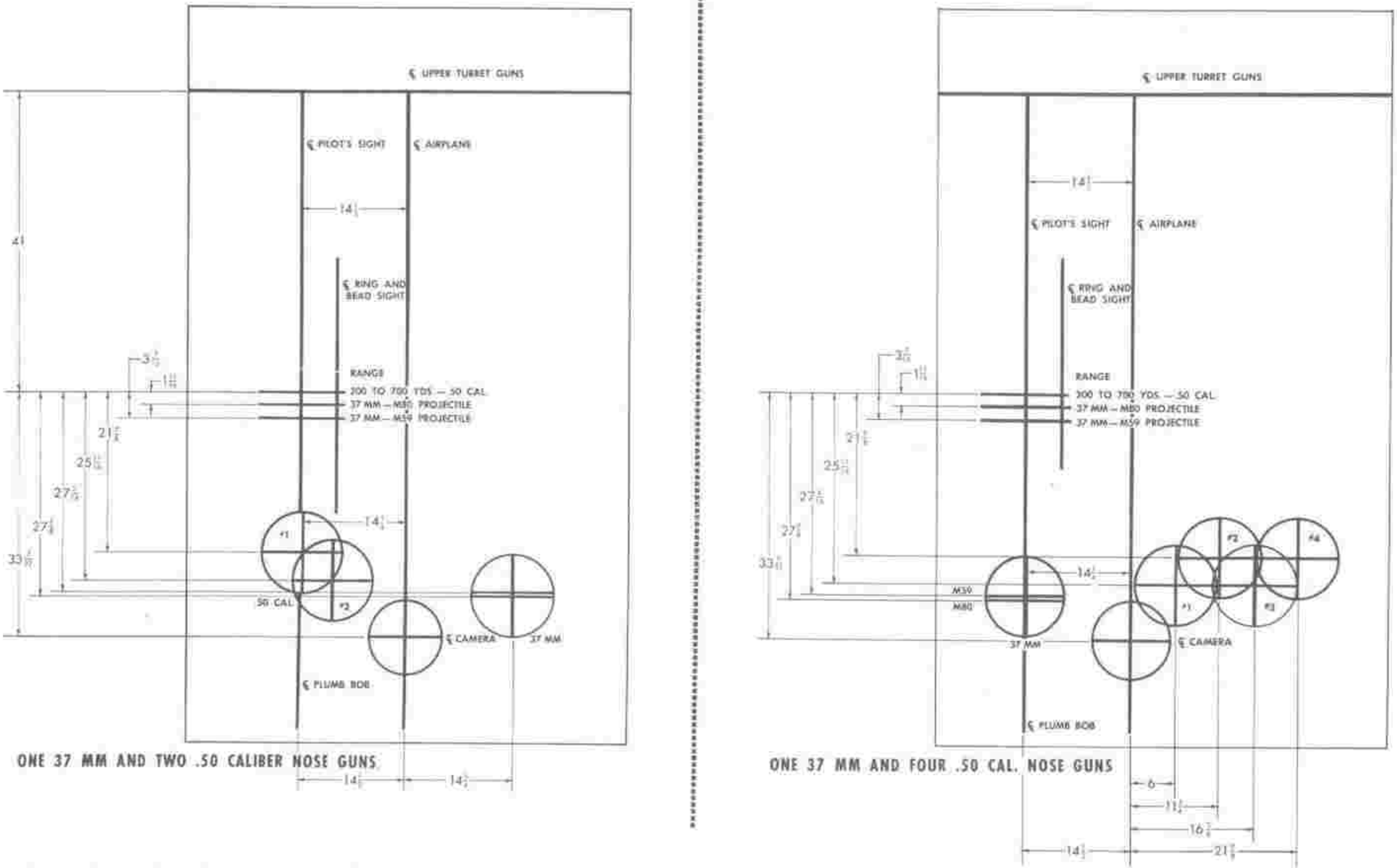


Figure 552 (Sheet 4 of 4)—Bore Sighting Charts

(*b*) BORESIGHTING PROCEDURE FOR NOSE GUNS.

1. Place the airplane in an approximately level position longitudinally, and level position laterally by the use of the fuselage leveling lugs inside the bomb bay.

2. Place the target corresponding to the nose gun configuration *(figure 552)* directly in front of the airplane 1000 inches from the center of the front trunnion bolt of the gun nearest the target.

3. To locate the target vertically in its true relation with the airplane, place the upper turret guns in the forward level firing position and lock. Place .50 cal. boresighting plug in forward end of R.H. turret gun barrel, and insert boresighting tool. Adjust target so that the upper turret horizontal reference line on target coincides with the intersection of the cross hairs in boresighting scope.

4. To locate the target laterally in its true relation with the airplane, drop two plumb bob lines; one from the nut plate located in the nose wheel well near station 40, and one from the nut plate underneath the fuselage near station 293. Drop each plumb bob in a small pan filled with oil. Sight along the two plumb bob lines and align target so that the vertical plumb bob reference line on target coincides with the lines hanging from fuselage.

5. Place boresighting tool in forward end of gun barrel and sight to corresponding mark on target. Adjust guns vertically and laterally so that intersection of cross hairs in boresighting scope coincides with the intersection of marks on target.

(*c*) ALIGNING GUN SIGHT.

1. Check bubble in the gun sight *(figure 554)* and level laterally with airplane. This is done by loosening the four attach bolts and shifting the sight until level. Tighten bolts and seal with wax.

2. Turn on the gun sight switch. The reflection of the circle and dot reticle will appear on the center of the reflector.

3. Sit in pilot's seat in a normal position. Turn adjusting knob on sight until the dot on the reflector coincides with the sight line mark on the target.

4. Set dial indicator to zero mark on sight and adjust stops to latching bar on sight. Adjust other stops to the remaining sight line marks.

5. Align ring and bead sight with the target by making necessary mechanical adjustments.

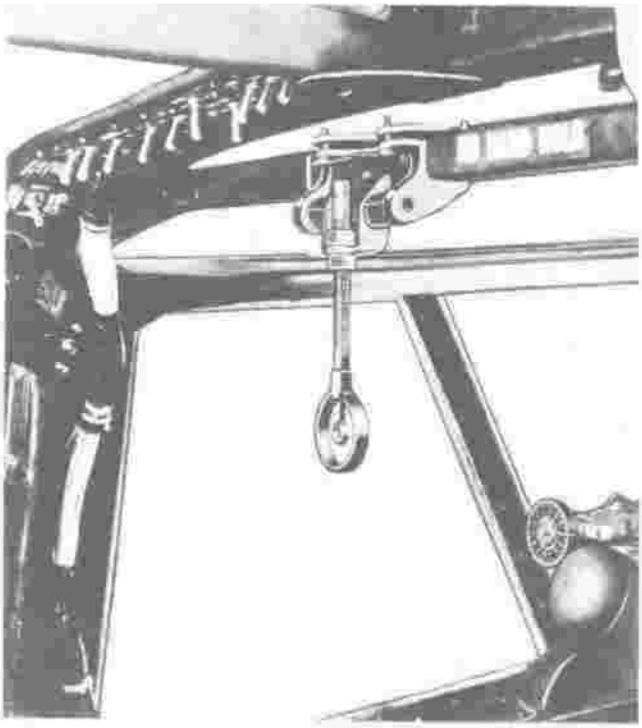


Figure 553—Ring and Bead Sight

(*d*) BORESIGHTING PROCEDURE FOR WING GUNS.

1. Place the airplane in an approximately level position longitudinally and level position laterally by the use of the fuselage leveling lugs inside the bomb bay.

2. Place the L.H. wing gun target *(figure 552, sheet 1 of 4)* in front of the airplane 1000 inches from the center of the front trunnion bolt of the L.H. wing guns nearest the target.

3. To locate the target vertically in its true relation with the airplane, place the upper turret gun in the forward level firing position, and latch in elevation. Place boresighting tool in forward end of R.H. turret gun barrel, and with the turret unlatched in azimuth, swing the turret guns to point to the target. Adjust the target so that the upper turret horizontal reference line on target coincides with the intersection of the cross hairs in boresighting scope.

4. To locate the target laterally in its true relation with the airplane, attach a plumb bob to each of the two nut plates, one forward and one aft, on the bottom of the wing between the inboard and outboard guns. Drop each plumb bob in a small pan filled with oil.

5. Sight along the two plumb bob lines and align target horizontally so that the vertical plumb bob reference line on target coincides with the lines hanging from wing.

6. Follow the same procedure to locate the R.H. wing gun target in relation with the R.H. wing guns.

7. Place boresighting tool in forward end of gun barrel and sight to corresponding mark on target. Adjust gun vertically and laterally so that intersection of cross hairs in boresighting scope coincides with the intersection of marks on target.

(8) TYPE N-9 GUN AND BOMB SIGHT.

(a) DESCRIPTION.—The Type N-9 gun and bomb sight and the Type A-3 gun and bomb sight head are an integral unit. It is mounted on the instrument panel glare shield directly in front of the pilot. *(See figure 554.)* It consists of a reflector, lens, reticle, and a mirror adjusted into the desired position by the head. In front of the sight and a part of the unit is a small lamp which must be lighted by electrical current for the use of the sight.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL OF SIGHT FROM AIRPLANE.

a. Disconnect the electrical plug behind the instrument panel.

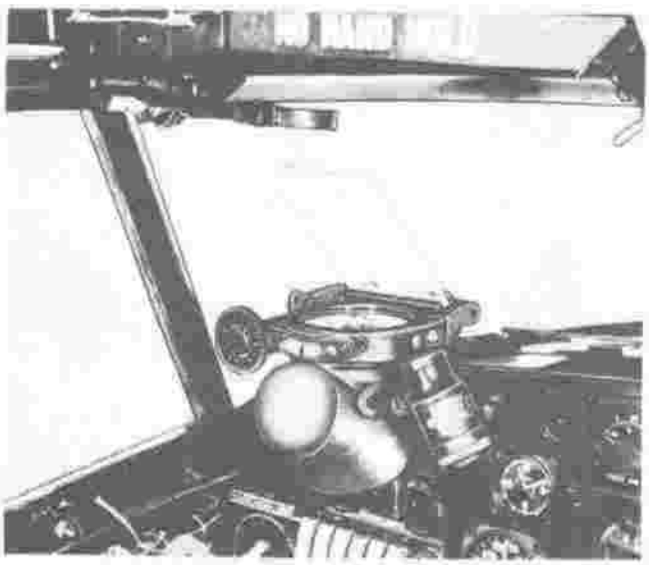


Figure 554—N-9 Gun Sight and Bomb Sight

b. Remove the four bolts attaching unit to instrument panel glare shield and remove the unit.

2. REMOVAL OF LAMP.

a. Press two buttons (one on either side of the lamp cover) to release cover and lamp.

b. Pull out cover and lamp assembly.

c. Unscrew bulb.

3. DISASSEMBLY.—Do not attempt to disassemble unit (exclusive of the lamp) except at a depot or optical shop.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Replace damaged or burned out lamp.

2. Replace entire unit if any other part is damaged, worn, or out of adjustment.

CAUTION

Do not try to adjust or repair any of the parts of the unit. This requires special tools and a technician.

(d) ADJUSTMENTS.—To align the sight with the target, see BORESIGHTING, paragraph 17. *f.* (7) *(c)*, this section.

g. ARMOR PLATE.—Two types of armor protection are provided on the A-26B airplane. Standard gage armor plate is installed as shown in *figure 555* for protection from direct machine gun fire. Three-eighths or five-sixteenths inch dural deflector plate is distributed over wide areas of fuselage, wing, and nacelle skin as shown in *figure 555* to give deflection protection from angular machine gun fire. The dural deflector plate is installed on the airplane by screws or rivets, while the armor plate is bolted or latched to structural parts. Different noses or gun installations require different armor plate installations. Whenever a 37 mm cannon is installed on either one or both sides of the nose, a deflector plate is installed on each side of the ammunition boxes *(5, figure 544)* for protection of the 37 mm shells. When a 75 mm cannon is installed, close-fitting armor plate panels *(figure 555)* are installed at station 0. The bombardier nose is provided with deflector plate as shown in *figure 555.*

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b. 75 mm CANNON TROUBLE SHOOTING LIST

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Fails to fire when firing plunger is operated and percussion on primer is obtained.	*a.* Defective primer.	*a.* After three percussions wait 5 minutes before opening breech, then insert another round of ammunition. If successive rounds fail to fire, the procedure 2 below will be followed.

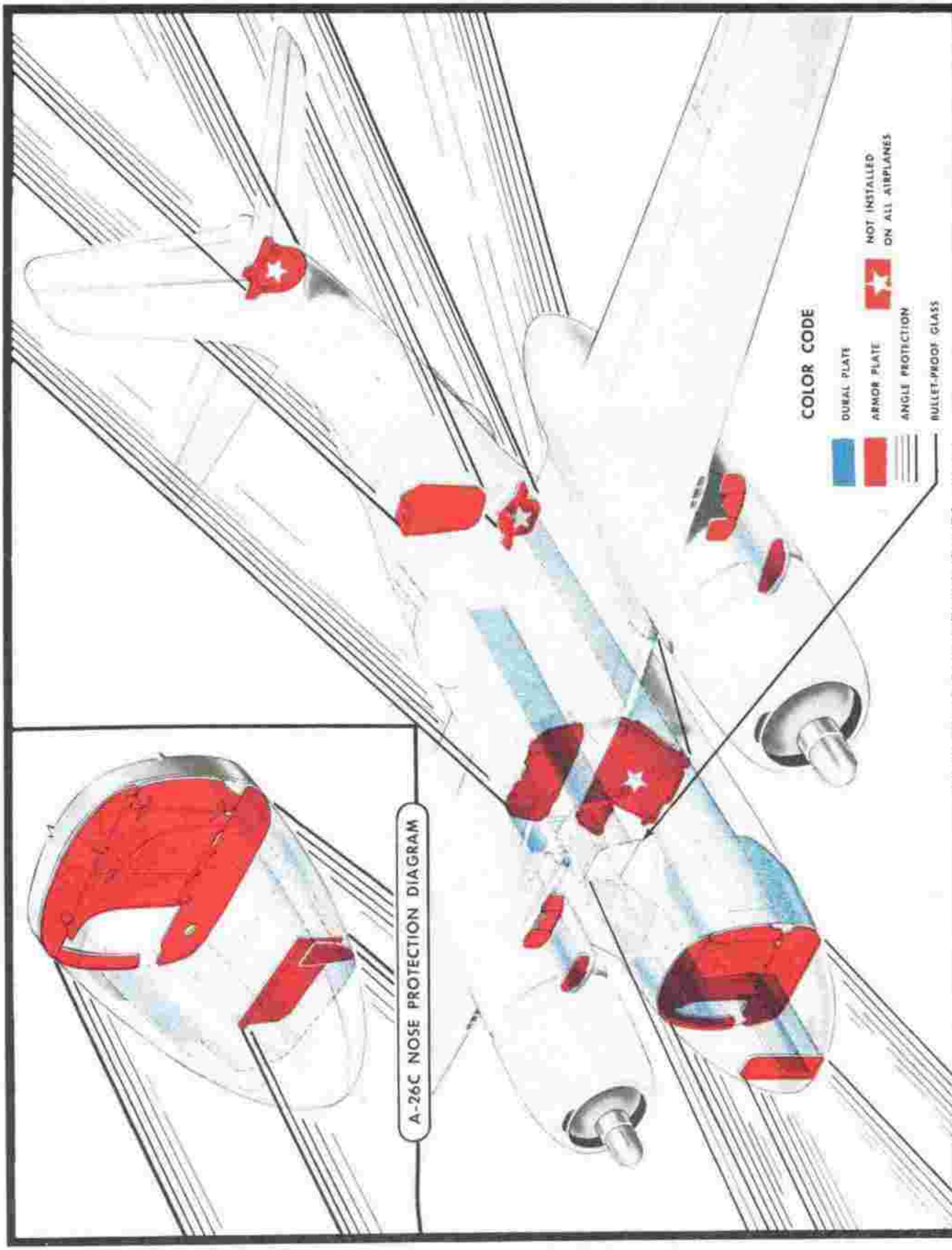


Figure 555—Armor Protection Diagram

2. Fails to fire until after several percussions on primer or fails to fire when percussion is obtained on successive rounds of ammunition.	*a.* Insufficient blow on primer; firing mechanism parts not working freely.	*a.* Remove firing spring retainer, firing spring, and firing pin guide assembly. Wash parts with dry-cleaning solvent. Check freedom of firing pin guide in bore of breechblock, and of firing spring stop in guide, disassembling firing pin and guide if necessary. Remove any burrs with oilstone or smooth file. Lubricate as specified. Replace broken or damaged parts.
	b. Insufficient blow on primer due to broken or weak firing spring.	*b.* Replace firing spring.
	c. Broken or deformed point on firing pin.	*c.* Replace firing pin.
3. Fails to fire; no percussion on primer.	*a.* Broken firing spring. Broken or deformed firing pin.	*a.* Disassemble and replace broken or deformed parts.
	b. Sear not retaining firing pin in cocked position.	*b.* Disassemble sear and sear spring, wash with dry-cleaning solvent and lubricate as specified *figure 547.* Check firing plunger for freedom of action. Replace broken or damaged parts.
	c. Broken or deformed cocking lever.	*c.* Replace the unserviceable part.
4. Failure to extract cartridge case.	*a.* Broken extractor.	*a.* Ram case out. Examine chamber for deformations or irregularities which might cause difficult extraction. Remove breechblock and replace broken extractor.
5. Breechblock fails to rise when extractors are forced forward.	*a.* Broken closing spring or broken chain.	*a.* Disassemble closing spring mechanism and replace broken part.
6. Breechblock fails to rise to fully closed position when extractors are forced forward.	*a.* Improper chambering of cartridge case.	*a.* Attempt to close the block. If block will not close manually drop the breechblock and insert another round. If the malfunction recurs proceed as in *b.*, *c.*, and *d.*, below.
	b. Lack of proper compression of closing spring.	*b.* Adjust tension by means of the closing spring piston rod nut.
	c. Lack of lubrication on breechblock bearing surfaces.	*c.* Clean and lubricate.
	d. Breechblock seized.	*d.* Report to Ordinance maintenance specialists.

18. PHOTOGRAPHIC EQUIPMENT

a. GENERAL.—Provision is made for the installation of photographic equipment intended to be operated for reconnaissance, in conjunction with firing the guns, and in conjunction with releasing the bombs. An N-4 gun sight aiming point camera is furnished with each turret and coordinates with the machine guns. A similar unit in the nose functions with the 75mm cannon, nose and the wing guns. A mount is installed in the fuselage, aft of the gunner's compartment, to accommodate a Type K-24 (British version; Type F-24) Orientation camera. This camera is electrically operated. On the American type, the motor is part of the camera housing; on the British type, the motor is mounted on the right-hand side of the camera. Current is transmitted to the motor through an intervalometer located in the pilot's compartment. Camera doors are povided in the gunner's compartment through which the hand-held camera may be operated.

b. G.S.A.P. CAMERAS (TURRET, WING, AND NOSE GUNS).

(1) DESCRIPTION.—The three N-4 cameras take motion pictures, using 16 mm film (Spec. No. 75-172) prethreaded into metal magazines.

Note

Some airplanes carry N-1 and N-6 cameras.

The camera (Spec. No. 75-251) operates each time the gun firing trigger is operated, serving to record hits on actual targets or to check smoothness in tracking targets during training operations. It is driven by a 24-volt constant speed electric motor mounted within the camera body.

(2) CAMERA BODY.—Besides the motor, the body contains the shutter and drive mechanism. A hand controlled dial allows pre-selection of any one of three operating speeds of 16, 32 or 64 frames per second. A hand controlled footage dial indicates the amount of film remaining unexposed. The body also contains the overrun indicator, a clutch to prevent damage in the event of a film jam, a motor cut-out to cut off power, a heater cut-out and heater resistors, and a socket for the connection of a lens filter heater.

(3) ACCESSORIES.—A carrying case is provided with compartments for spare lens, the aligning indicator, special tools, filter, spare magazine, and an instruction manual. A metal card holder is attached to each case for an identification card.

(4) LENS.—The camera is provided with a 35 mm, F/3.5 plain lens (Spec. No. 75-199) and a 90 degree erecting system lens. Each assembly incorporates a minus blue filter and diaphragm with stops at "Bright," "Hazy," and "Dull."

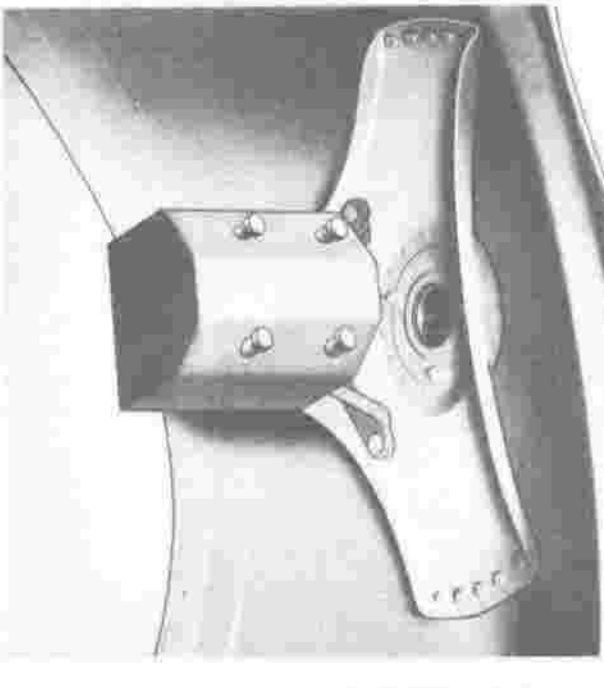


Figure 556—G.S.A.P Camera Installed (All Purpose Nose)

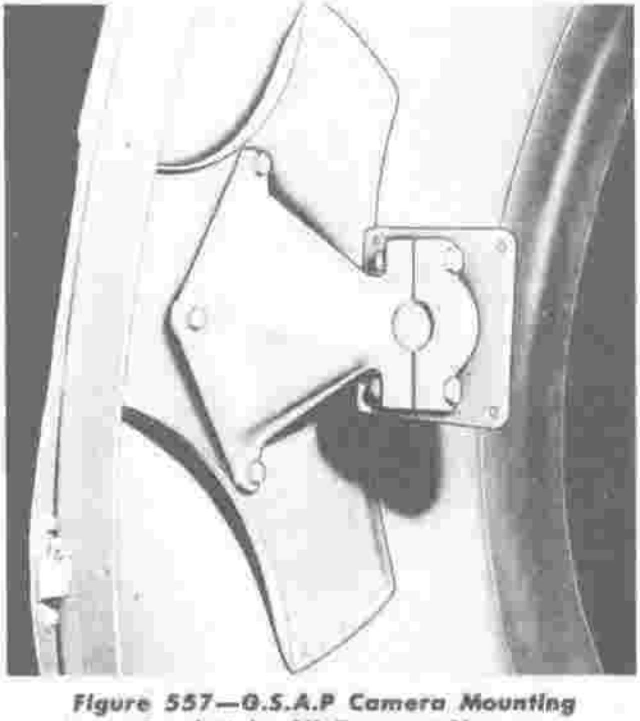


Figure 557—G.S.A.P Camera Mounting Bracket in All Purpose Nose

(5) OVERRUN CONTROL.—The time-control knob may be set to keep the camera running from zero to three seconds after firing has ceased. The over run control may be cut out by throwing the cut-out switch to "OFF." When the over run control is used, the film exposed during the overrun may be identified from that exposed during firing by the image of a retractile pointer which automatically moves into the aperture area from the upper left-hand corner when firing ceases and the overrun begins.

(6) ALIGNING INDICATOR.—Aligning the optical axis of the camera with that of the gun sight, the indicator fits into the camera magazine chamber in place of the magazine. It is a housing containing the reticle glass and optical system. The cross hairs on the reticle glass indicate the center of the film aperture. The eye piece and erector assembly fits into the housing and is of the rotating prismatic type.

(7) MAGAZINE.—The interchangeable A-6 film magazine will hold 50 ft. of 16 mm film.

(8) OPERATION.

(a) ATTACHING THE LENS.—Place lens on the No. 3 dowel studs and secure with the three stop nuts, using the lens nut wrench.

CAUTION

Do not force lens on camera body.

(b) LOADING THE CAMERA.

1. Open magazine access cover at end of camera by pressing the knobs forward toward the camera body, and pushing cover towards the mounting plate.

2. Move magazine latch out of the way.

3. Insert type A-6 film magazine into camera with aperture toward lens, and footage indicator on the magazine toward the mount side of the camera.

4. Move magazine latch over magazine end as far as it will go and close cover.

(c) CONNECTING THE CAMERA.—Insert line-cable plug into four-pin male receptacle. *Make certain that each numbered prong fits into the corresponding numbered hole of the socket.*

(d) SETTING SHUTTER SPEEDS.—Set exposure speed with shutter speed knob.

CAUTION

Never change shutter speeds when camera is running; always have index marks on shutter speed knob and top cover exactly aligned.

(e) SETTING FOOTAGE INDICATOR.—Push in and turn knob to the number of feet contained in the magazine, and it will then indicate the amount of film remaining at any time.

(f) LENS.—Adjust lens for both camera speed and light conditions.

1. Set the lens so that the shutter speed on the index ring corresponds to the index mark on the lens barrel.

2. Set diaphragm ring so index mark is set against proper stop as indicated on index ring.

CAUTION

The shutter speed knob and the index ring on lens must be set at the same shutter speeds.

(9) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.—For turret cameras refer to paragraph 15. *d.* (18) *(d)*, this section. For nose camera refer to paragraph 17. *f.* (5) *(b)*, this section.

(b) DISASSEMBLY.—The camera should be disassembled only by a camera technician. It should be disassembled every 3 months for check.

(10) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement of units rather than repair is advisable. Under no circumstances should the lens assemblies be disassembled. A slightly scratched mirror does not need replacement.

(a) CLEANING.—Refer to paragraph 18. *c.* (3) *(c)*, this section, for cleaning of lens. Clean mirrors with soap and water. Swab with cotton. Run hot water over mirror to remove soap and dry with an ear syringe. Keep outside of camera clean at all times.

(b) LUBRICATION.—Oil every 3 months with Houghton's triple "A" or equivalent.

CAUTION

Do not lubricate excessively and never oil the motor. Clean it with carbon tetrachloride.

(11) ASSEMBLY AND INSTALLATION.—Reverse REMOVAL AND DISASSEMBLY procedures.

e. ORIENTATION CAMERA.

(1) DESCRIPTION.—Either the American type K-24 or the British type F-24 Orientation camera may be installed in the mount provided in the aft fuselage section. An electric motor is located on the right-hand side of the camera (for British camera only), and a camera intervalometer is installed in the pilot's compartment adjacent to the radio equipment. A control

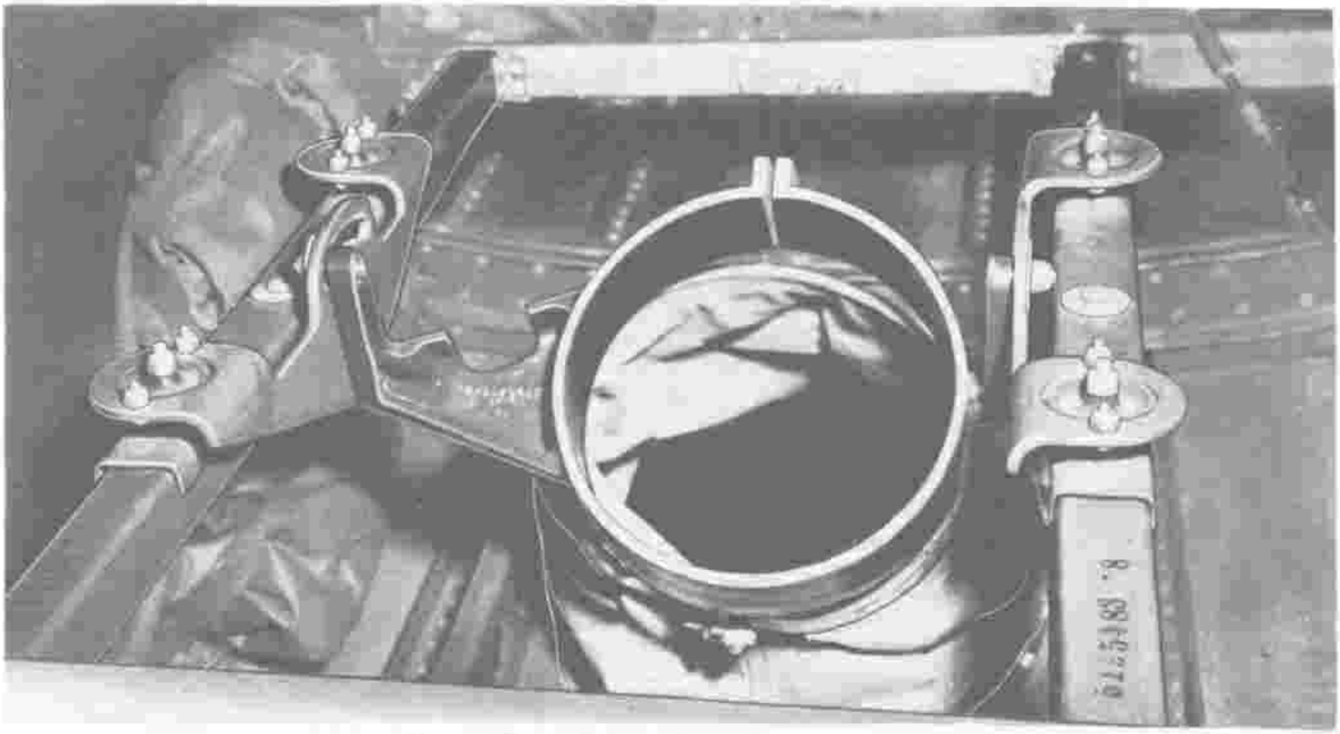


Figure 558—Orientations Camera Mount

switch *(figure 320)* is located on the pilot's electrical control panel which turns the Orientation camera circuit "ON" or "OFF." Exposures are made when the bomb release push button on the pilot's control wheel is pressed. The camera intervalometer may be adjusted to regulate the number of exposures to be made and the distance in feet between exposures, as determined by the ground speed of the airplane. As in the bombing interval control, the camera intervalometer may be set for single exposures or a sequence of exposures from one electrical impulse from the release button.

(2) REMOVAL.

(a) Loosen the tightening screw on the clamp which holds the boot to the camera.

(b) Remove the clamp and the boot.

(c) Disconnect the electrical plugs from the camera.

(d) Remove the camera from the camera mount by removing the attaching bolts.

(e) Remove the camera motor from the motor mount by lifting it off the slide support (British type F-24 only).

(f) Remove the intervalometer attaching bolts and remove the intervalometer.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Check the camera for security of mounting.

(b) Check the camera intervalometer and the camera motor for proper installation.

(c) Clean the camera lens as follows:

1. Carefully remove all dust from the lens surface with a soft camel's hair brush.

2. Moisten one corner of a small piece of lintless handkerchief linen with lens cleaning fluid. With a circular motion wipe the lens with the moist portion of the linen, working from the center to the edge of the glass.

3. Wipe the glass dry with an unmoistened portion of the linen.

4. Breathe lightly on the glass and wipe the surface with a special lens cleaning tissue. Polish briskly, using very light pressure.

(4) INSTALLATION.—Reverse the REMOVAL procedure.

d. GUNNER'S CAMERA EQUIPMENT.—Provisions are made in the gunner's compartment for operation of alternate camera equipment. This unit is hand held when being operated. A camera door is located on either side of the compartment, slightly above the compartment floor. In addition, the gunner can photograph through the bomb bay when the camera door in the aft right-hand bomb bay door is removed.

19. HEATING AND VENTILATING

a. GENERAL.—Two independent heating and ventilating systems are installed in the airplane. One system, controlled by the pilot, provides a regulated supply of warm or cold air to the forward section of the airplane. The other system, controlled by the gunner, provides a regulated supply of warm or cold air to the aft section.

The two systems function in the same manner and contain identical, or similar, component parts. Internal arrangement of ducts, lines, controls, and control linkages is, however, necessarily different.

Provision is made, in both systems, for the heating of cold air which enters from without the airplane. A complete description of the ducting heaters will be found in paragraph *b.* (1) *(b)*, below. Provision is also made, in both systems, for the reheating and recirculating of air within the fuselage. A complete description of the recirculating heaters will be found in paragraph *b.* (1) *(c)*, below.

The temperature level, of both systems, is maintained automatically (when the ducting heater within the applicable system is operative) by thermostatic controls.

Ventilation, as applied to either system, occurs only when the heaters, within that system, are inoperative and cold air is allowed to enter the air ducts.

b. HEATERS. *(See figures 559, 560.)*

(1) DESCRIPTION.

(a) GENERAL.—Two Stewart Warner heaters are installed in each of the 2 heating and ventilating systems. Both heaters, within a system, are identical, but are designated either as ducting or recirculating heaters according to the function which they perform. The function of a heater is determined by its position, and by its attachments. Both the ducting and the recirculating heaters operate in the following manner:

1. OPERATION.—A complete description of the heater controls and their function will be found in paragraph *b.*, below.

2. HEAT PRODUCTION.

a. A fuel-air mixture from the high pressure side of the applicable engine supercharger blower case enters the heater through the butterfly valve or throttle. Located in the line between the heater and the engine supercharger blower case is a solenoid shut-off valve which opens or closes to permit passage of fuel-air mixture. A complete description of the solenoid shut-off valve will be found in paragraph *e.*, below. *(See 8, figure 560.)*

b. After entering the heater, the fuel-air mixture flows through a flame arrestor *(13, figure 561)* which prevents flame in the combustion chamber from backing up into the fuel-air mixture inlet line.

c. The fuel-air mixture then flows through a burner tube, and comes in contact with the baffle cup. *(See 12, figure 561.)* This baffle distributes the fuel-air mixture throughout the combustion chamber, maintaining an evenly distributed combustion.

d. The fuel-air mixture is ignited by the igniter, *(10, figure 561)*, thus producting heat.

e. The burning fuel-air mixture comes in contact with a baffle in the heat exchanger, and is extinguished. The burned or exhaust gases are then conducted to the low pressure side of the applicable engine supercharger blower case.

f. Heat from the burned gases is conducted to the surface of the long copper fins *(8, figure 561)* that are attached to the outer case of the heat exchanger.

3. VARIATION OF HEAT OUTPUT.—The position of the butterfly valve or throttle (which controls the flow of fuel-air mixture) governs the heat output of a heater. The change in position for each butterfly valve is accomplished by means of a heater control linkage *(figures 567, 567, 569)* which is operated from the applicable (pilot's or gunner's) compartment.

4. PROTECTION FROM OPERATIONAL DAMAGE.

a. IGNITERS.

(1) The electric igniter *(10, figure 561)* has a resistance coil that heats when current from the electrical system of the airplane is flowing through its circuit. The circuit is broken, when, after ignition, the heater temperature rise actuates the thermostatic blade of the igniter switch. When the heater temperature cools sufficiently, the electric igniter again becomes active.

(2) A reigniter *(9, figure 561)* supplements the action of the igniter. It is made of inconel metal and becomes white hot. If, for any reason, the supply of fuel-air mixture should be momentarily interrupted (when the igniter has shut off) causing the heater to go out, the reigniter will remain sufficiently hot to reignite the fuel-air mixture if the flow is resumed within a fifteen second period. Therefore, with the fifteen second carry-over power of the reigniter, the heater will resume operation even though the heater has not cooled to the temperature where the igniter again becomes operative.

5. PREVENTION OF OVERHEATING IN THE HEATERS.—A duct overheat switch *(6, figure 561)* and a fin overheat switch *(15, figure 561)*, lo-

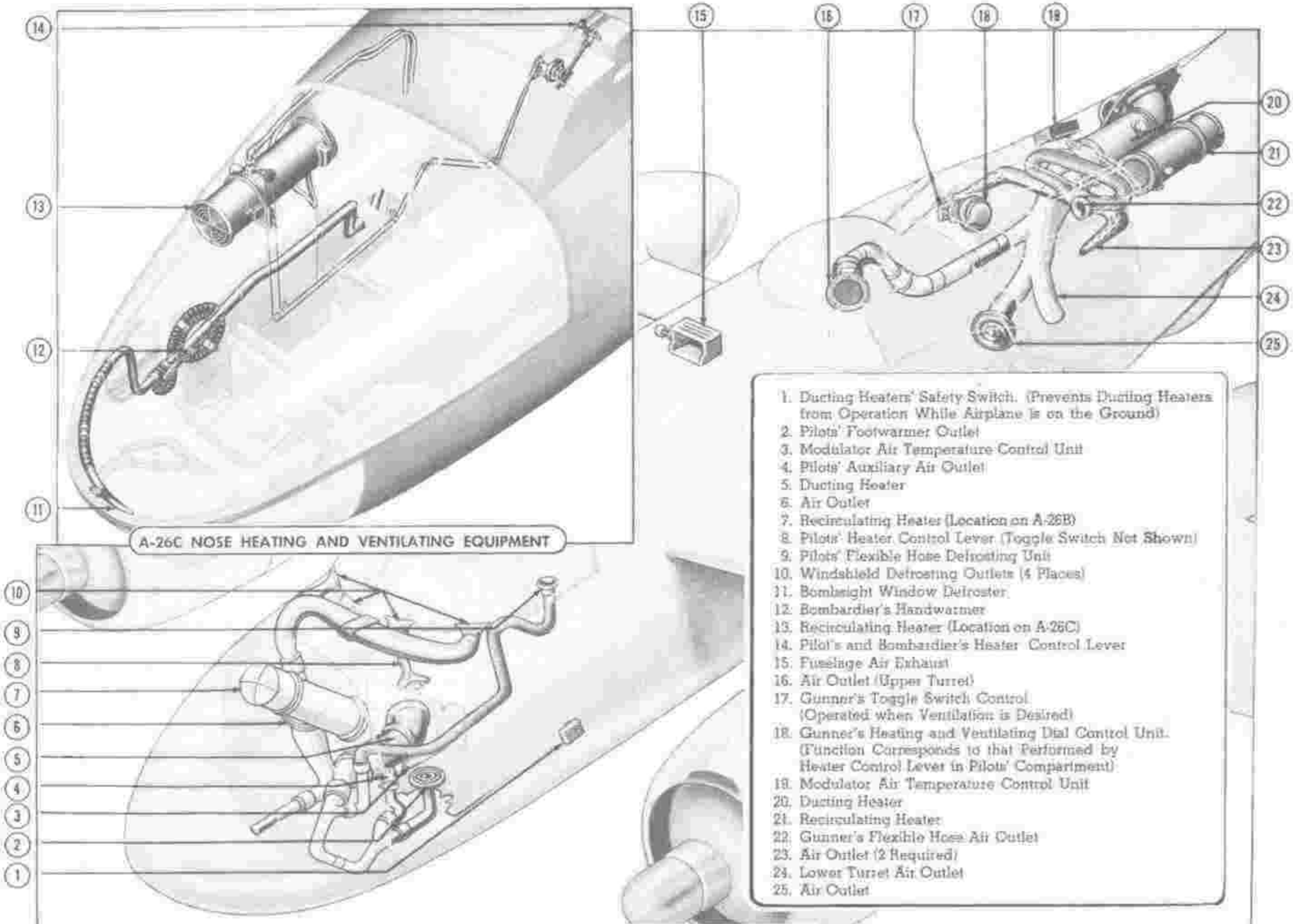


Figure 559—Heating and Ventilating Equipment

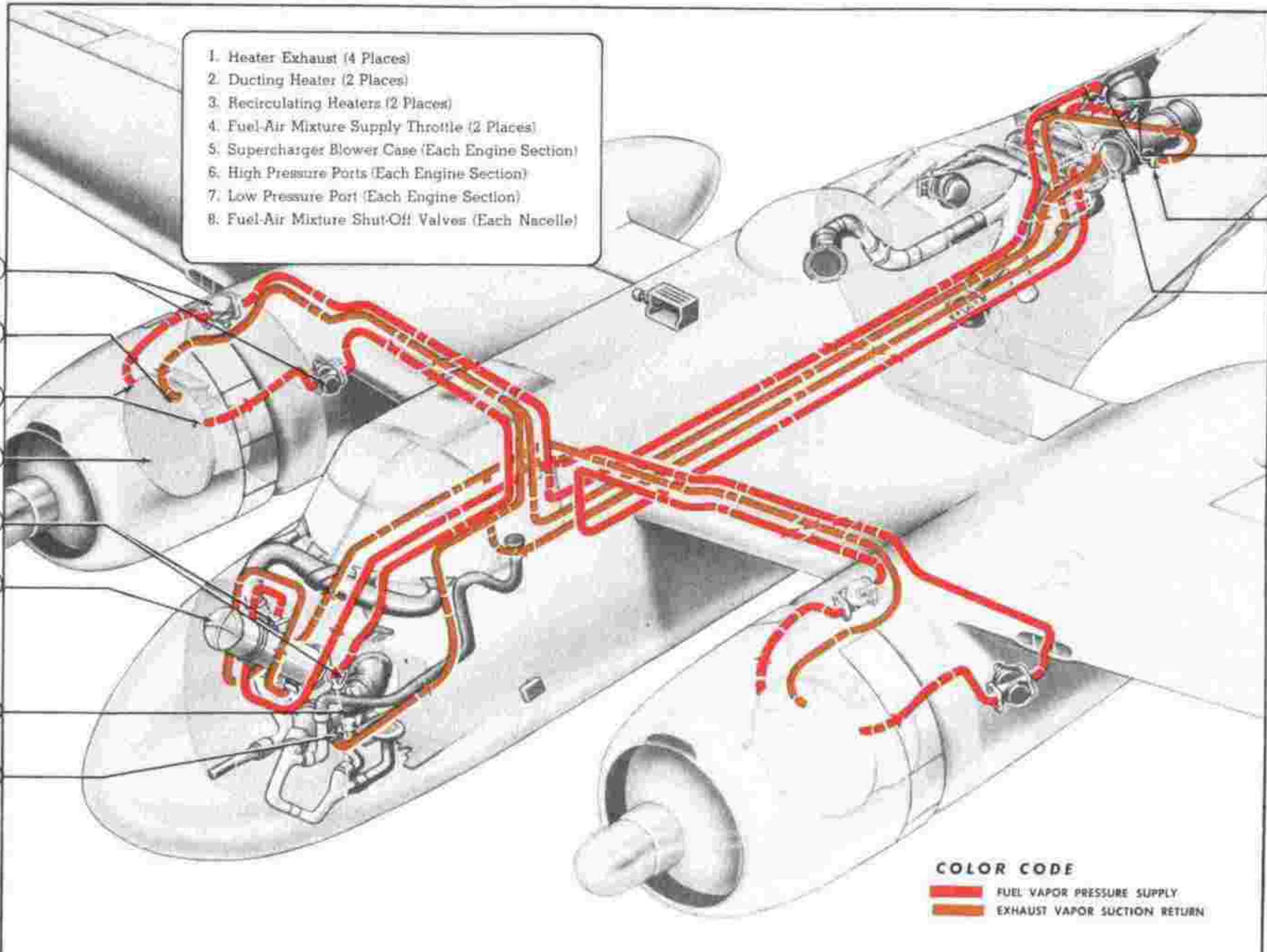
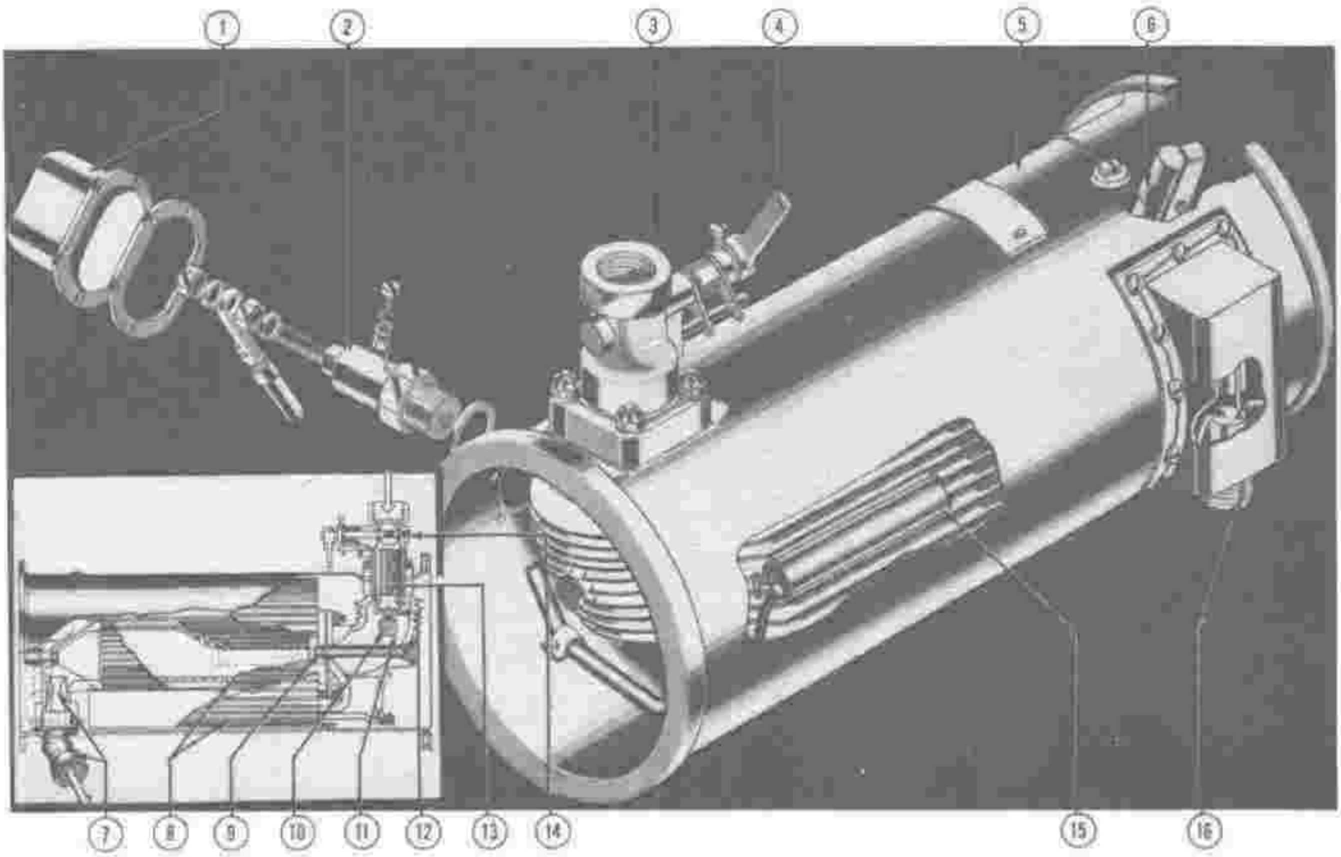


Figure 560 — Heating System Fuel Vapor Supply and Exhaust Return System

cated at points in the heater most apt to overheat, are connected to the fuel-air mixture solenoid shut-off valve. *(See 8, figure 560.)* A complete description of the fuel-air mixture solenoid shut-off valve will be found in paragraph e., this section. When overheating occurs, thermostatic action at the contact points of the switch affected, breaks the electrical circuit to the solenoid shut-off valve, thereby cutting off the flow of fuel-air mixture to the heater.

(d) DUCTING HEATERS. *(See figures 559, 560.)*—A ducting heater is installed in both the forward (pilot's) and the aft (gunner's) section of the heating and ventilating system. The forward ducting heater is located on the lower right hand side of the fuselage, slightly aft of the pilot's compartment. It is covered by two access doors, and is accessible from the outside. The aft ducting heater is located directly above the lower turret, on the right hand side of the fuselage. It is a-cessible from the gunner's compartment aft fuselage section opening. Each ducting heater is mounted between an air scoop and an air regulator valve. The air regulator valve is adjoined to an air duct. The heaters are known as ducting heaters because their function is to heat the cold air which enters through the air scoops. These heaters will operate only when the airplane is in flight because of the action of a safety switch *(1, figure 559)* which is operated by the nose wheel door. A complete description of the ducting heater safety switch is given in paragraph 15., this section. Each ducting heater will operate independently of the recirculating heater in the same heating and ventilating system while the airplane is in flight.

1. OPERATION.—All heaters (both ducting and recirculating) are set in operation in essentially



1. Igniter Cover
2. Igniter
3. Fuel-Mixture Inlet
4. Butterfly Valve (Throttle) Control Connection
5. Heater Case
6. Overheat Switch (Duct)
7. Restriction Fitting
8. Oven and Fins
9. Reigniter
10. Igniter
11. Combustion Chamber
12. Baffle Cup
13. Flame Arrestor
14. Throttle
15. Overheat Switch (Fin)
16. Connector Receptacle

Figure 561 — Heater (Cutaway)

the same way. A complete description of heater controls will be found in paragraph *b.*, below.

2. HEAT PRODUCTION OF DUCTING HEATERS.—All heaters (both ducting and recirculating) operate in the same way. A complete description of heater operation will be found in paragraph *b.* (1) *(a) 2.*, above.

Note

The fuel-air mixture for the ducting heaters is received from the high pressure side of the right-hand engine supercharger blower case and is exhausted, after combustion, to the low pressure side of the supercharger blower case.

3. VARIATION OF HEAT OUTPUT IN DUCTING HEATERS.—The heat output of all heaters (both ducting and recirculating) is varied in essentially the same way. Refer to paragraph *b.* (1) *(a) 3.*, above.

4. PROTECTION FROM OPERATIONAL DAMAGE.—All heaters (both ducting and recirculating) contain identical protective devices. Refer to paragraph *b.* (1) *(a) 4.*, above.

5. TRANSFER OF HEAT TO AIR.—The forward and the aft ducting heaters transfer heat to the air in essentially the same way. The heat-air transfer, for both ducting heaters, is made as follows:

a. Cold air enters through an external air scoop and is conducted to the heater, between the outer case *(5, figure 561)* and the fins *(8, figure 561)*.

b. The air picks up the heat from the fins and flows through the air regulator valve into the ducting system. A complete description of the air regulator valve is given in paragraph *c.*, below.

(c) RECIRCULATING HEATERS.—A recirculating heater is installed in both the forward (pilot's) and the aft (gunner's) section of the heating and ventilating system. The forward recirculating heater is located above and slightly forward of the right-hand side of the pilot's control pedestal. In the A-26C (bombardier version) the forward recirculating heater is installed in the nose to the right of the bombardier's seat. The aft recirculating heater is located above and slightly forward of the lower turret. It is accessible from the gunner's compartment aft fuselage section opening.

Each recirculating heater is equipped with a recirculating fan assembly *(figure 350)* and an outlet grill. Recirculating fan assemblies are mounted on the inlet ends of the recirculating heaters. The heaters are known as recirculating heaters because their function is to reheat, and diffuse, air already within the compartments.

Recirculating heaters will operate either on the ground or in the air provided that the left-hand engine is operative. When the airplane is in flight each recirculating heater operates in conjunction with its allied ducting heater or separately if the ducting heater fails.

Note

The ducting heater in each system is set in operation before the recirculating heater in the same system commences operation. Consequently, when the recirculating heater is in operation, the ducting heater (except in case of failure) also operates.

1. OPERATION.—All heaters (both recirculating and ducting) are set in operation in essentially the same way. A complete description of the heater controls will be found in paragraph *b.*, below.

2. HEAT PRODUCTION.—All heaters (both ducting and recirculating) operate in the same way. A complete description of heater operation will be found in paragraph 19. *b.* (1) *(a) 1.*, this section.

Note

The fuel-air mixture for the recirculating heaters is received from the high pressure side of the left-hand engine supercharger blower case and is exhausted, after combustion, to the low pressure side of the supercharger blower case.

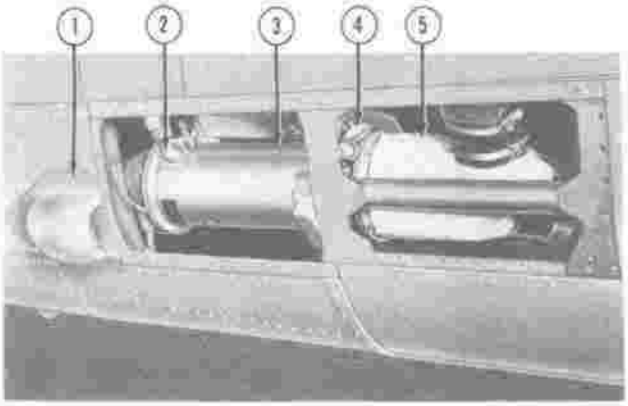
3. VARIATION OF HEAT PRODUCTION.—The heat output of all heaters (both recirculating and ducting) is varied in essentially the same way. Refer to paragraph 19. *b.* (1) *(a) 3.*, this section.

4. PROTECTION FROM OPERATIONAL DAMAGE.—All heaters (both recirculating and ducting) contain identical protective devices. Refer to paragraph 19. *b.* (1) *(a)* 4., this section.

5. TRANSFER OF HEAT TO AIR.—Each recirculating heater reheats, and diffuses, the air previously heated by the ducting heater within the same heating and ventilating system. The heat-air transfer, for each recirculating heater, is made as follows: The warm air is drawn in through the fan assembly, is further warmed by the heater, and then passes out through the outlet or diffuser grill.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.



1. Ram Air Intake Scoop
2. Fuel Air Mixture Inlet
3. Heater (Stewart-Warner 791-X)
4. Air Regulator Valve
5. Air Duct

Figure 562 — Forward Ducting Heater Installed (Access Doors Removed)

1. DUCTING HEATERS.

a. FORWARD DUCTING HEATER.

(1) Remove access doors covering heater.

(2) Disconnect intake and exhaust lines at heater fittings.

(3) Disconnect electrical connections from heater.

(4) Disconnect control linkage from throttle or butterfly valve arm.

(5) Remove bolts attaching heater to air intake scoop and air regulator valve. Lift out heater carefully so as to prevent marring of intake gasket.

b. AFT DUCTING HEATER.—The aft ducting heater is removed in a manner similar to the removal procedure for the forward ducting heater paragraph a., above, except that step *(1)* under a. is irrelevant.

2. RECIRCULATING HEATERS.

(See figures 563, 564.)

Note

Each recirculating heater and fan assembly is removed as a unit from the airplane. Two men should work together in order to prevent damage to the brackets and fittings. Removal is made as follows:

a. FORWARD RECIRCULATING HEATER. (A-26B)

(1) Disconnect intake and exhaust lines at heater fittings.

(2) Disconnect electrical plug from heater.

(3) Disconnect control linkage from the butterfly valve or throttle arm.

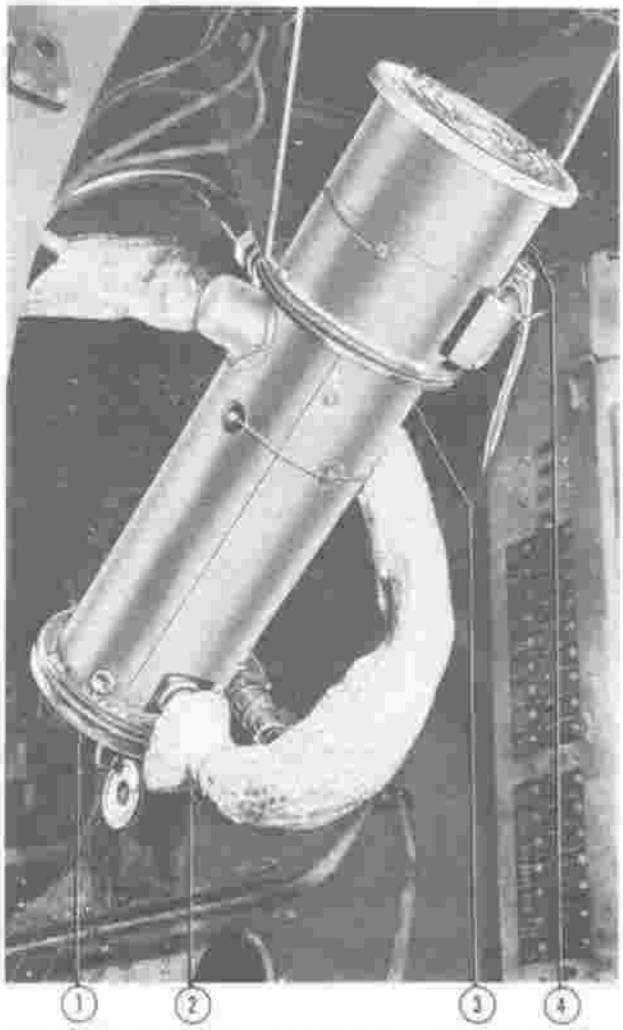
(4) Remove bolts attaching heater to bracket.

(5) Remove fan assembly and diffuser outlet grill from heater.

b. FORWARD RECIRCULATING HEATER. (A-26C)

(1) Disconnect fuel-air and exhaust lines at the fittings on the heater.

(2) Disconnect the electrical connections at the heater.



1. Grill (Air Outlet End)
2. Exhaust Vapor Line
3. Heater (Stewart-Warner 791-X)
4. Electric Motor and Fan Assembly

Figure 563 — Forward Heating and Ventilating System Recirculating Heater Installed

(3) Relieve the tension on the control cable by loosening the turnbuckle barrels, clip the lockwire at the pulley on the butterfly valve and free the cable from the pulley.

(4) Remove the attaching bolts and lift heater from the airplane.

c. AFT RECIRCULATING HEATER.—The aft recirculating heater is removed in a manner similar to the REMOVAL procedure for the forward recirculating heater, above.

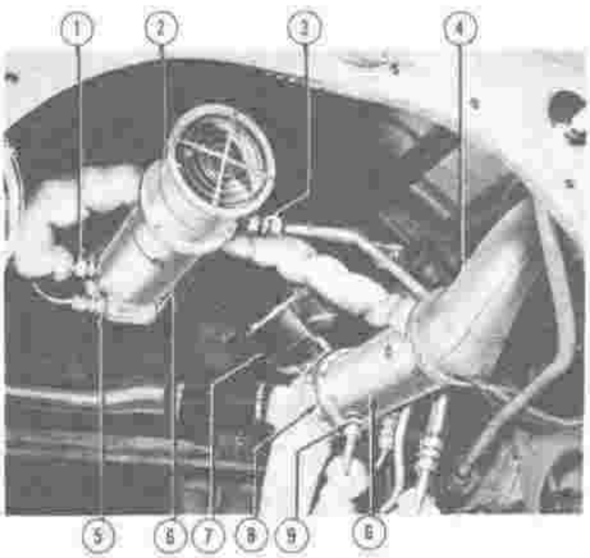
(b) DISASSEMBLY.—Except for the removal of electrical parts (igniter plug, thermo-snap switch, two overheat switches) all disassembly of heaters is to be done at a repair depot.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) MAINTENANCE REPAIR.—Except in an emergency, the heaters are to be repaired only at a repair depot. For emergency repairs refer to the following illustrations.

(b) REPLACEMENT.

1. Replace gasket on intake connection if gasket in use shows evidence of wear.



1. Fuel Air Mixture Exhaust Line
2. Electric Motor and Fan Assembly
3. Fuel Air Mixture Inlet
4. Duct (Attaches to Ram Air Intake Scoop)
5. Connector Receptacle
6. Heater (Stewart-Warner 791-X)
7. Modulator Temperature Control Unit
8. Air Regulator Valve
9. Exhaust Vapor Line

Figure 564—Aft Heaters Installed

2. Replace igniter plug, thermo-snap switch and two overheat switches if necessary. For a complete description of heater electrical parts replacement refer to paragraph 15., this section.

(4) ADJUSTMENTS.—The idle or closed position of the butterfly valve or throttle, is set by an adjustment set screw.

(5) TEST BEFORE INSTALLATION.

(a) TEST OF COMBUSTION CHAMBER.—Plug intake end of heater at butterfly valve or throttle *(3, figure 561)*. Direct 80 psi air pressure into exhaust end of heater. The allowable air pressure loss within a 10 minute period is 20 psi.

WARNING

A cracked combustion chamber is extremely dangerous because carbon-monoxide gas caused by the burning of the fuel-air mixture will be piped through the ducting system. Only a small amount of carbon-monoxide gas in the surrounding air (1 part in 800) is necessary to cause asphyxiation of an entire crew.

(b) TEST OF BUTTERFLY VALVE OR THROTTLE.—Test by hand to see that valve operates freely.

(c) TEST OF IGNITER.—A complete description of the igniter test will be found in paragraph 15., this section.

(d) TEST OF THERMO-SNAP SWITCH.—A complete description of the thermo-snap switch test will be found in paragraph 15., this section.

(6) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedures found in paragraph 19. *b.* (2), this section. Make certain that brackets and lines are in correct alignment. Attach heaters firmly in place.

(7) TEST AFTER INSTALLATION.

(a) DUCTING HEATERS.

1. GROUND TEST.—Refer to paragraph 19. *i.*, this section.

2. FLIGHT TEST.

a. FORWARD DUCTING HEATER.—The forward ducting heater is obscured from the view of the pilot and its operation cannot, therefore, be directly observed. An examination of the air duct terminations will, however, reveal whether or not the heater is working.

Move heater control slowly toward "MAXIMUM." Vary the speed and elevation of the airplane. If the heater continues to operate after several minutes of testing, it may be assumed that the heater is operating properly.

b. AFT DUCTING HEATER.—The gunner may obtain a direct view of the aft ducting heater by opening the gunner's compartment aft fuselage opening. A flashlight should be used in making the examination. If the heater is operating properly, the exhaust line should be hot. Make the test as directed in paragraph 19. *c.* (7) *(b)* *2.*, this section.

(b) RECIRCULATING HEATERS.

1. GROUND TEST.—Each recirculating heater may be tested while the airplane is on the ground, provided that the left-hand engine is running. Move applicable heater control as directed in paragraph *b.*, below.

CAUTION

Make certain that the recirculating fan assemblies are in operation. Otherwise the heaters will overheat.

2. FLIGHT TEST.—Make the test of the recirculating heaters in conjunction with the test of the ducting heaters. Refer to paragraph 19. *c.* (7) *(b)* *2.*, this section.

(8) EMERGENCY REPAIR. — Disassemble and clean as shown on the following illustrations:

c. AIR REGULATOR VALVES. *(See figures 562, 564.)*

(1) DESCRIPTION.

(a) GENERAL.—An air regulator valve controls the flow of air through each of the two ducting heaters.

(b) FUNCTION.—Each of the two air regulator valves functions by means of internal geared shutters (vanes) which open or close to allow varying amounts of warm or cold air into the attaching air duct.

(c) OPERATION OF SHUTTERS.

1. When the allied ducting heater is operative, each air regulator valve is controlled thermostatically by the modulator temperature control unit. A complete description of the modulator temperature control unit is given in *d.*, below.

2. Both the pilot, and the gunner, may control, from his respective compartment, the opening or closing of the applicable air regulator valve provided that the allied ducting heater is inoperative.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.—The air regulator valve, for each system, and the allied modulator temperature control unit are removed at the same time. For a complete description of the modulator temperature control unit removal refer to *d.*, below.

(b) DISASSEMBLY.

1. Remove bolts from projections at top and bottom of air regulator valve shell.

2. Remove nuts and washers from bolts holding gears in place.

3. Pull shell apart.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) MAINTENANCE REPAIR.—It is impractical to repair broken parts of air regulator valves.

(b) REPLACEMENT. — Replace air regulator valve parts if damaged or out of alignment. Be certain to note condition of bearings when mak. r check.

(4) ADJUSTMENTS. — Use alignment holes in making adjustments to check direction of gear travel. Blades open toward air flow.

(5) TEST BEFORE INSTALLATION.—Test air regulator valve shutters for ease of movement and correctness of position.

(6) ASSEMBLY AND INSTALLATION. — Reverse the REMOVAL AND DISASSEMBLY procedures.

(7) TEST AFTER INSTALLATION.

(a) GROUND TEST.—Refer to paragraph 19. *i.*, this section.

(b) FLIGHT TEST.

1. FORWARD AIR REGULATOR VALVE. —The forward air regulator valve is obscured from the view of the pilot and its action cannot, therefore, be directly observed. However, if the forward ducting heater warms the ducted air quickly and maintains a constant heat output (during test), it may be assumed that the air regulator valve is also operating efficiently. If the air regulator valve shutters fail to open (the normal position is closed), the overheat switches in the forward ducting heater will cause the heater to be shut off.

2. AFT AIR REGULATOR VALVE.—Note reaction of air regulator shutter gears at time test for aft ducting heater is being given. The air regulator valve shutter gears should fluctuate in accordance with the airspeed, elevation, outside temperature, and setting of the heater control. The gunner may obtain a view of the air regulator valve action through the gunner's compartment aft fuselage section opening. A flashlight should be used in making this inspection.

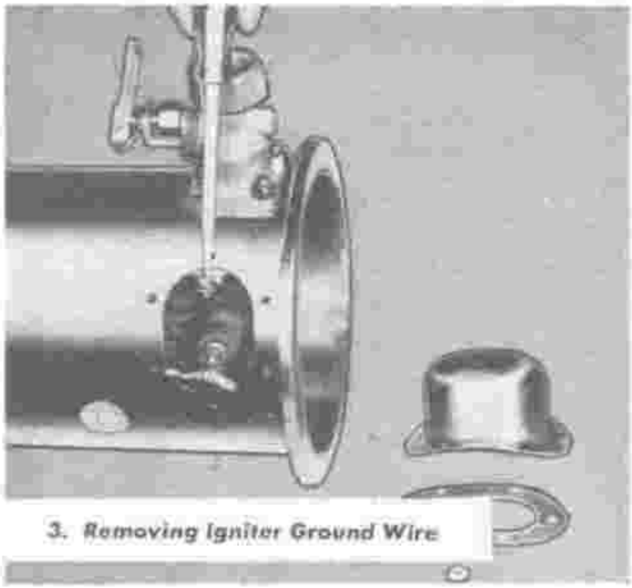
HOW TO REPLACE IGNITER

a. Remove igniter terminal lead.

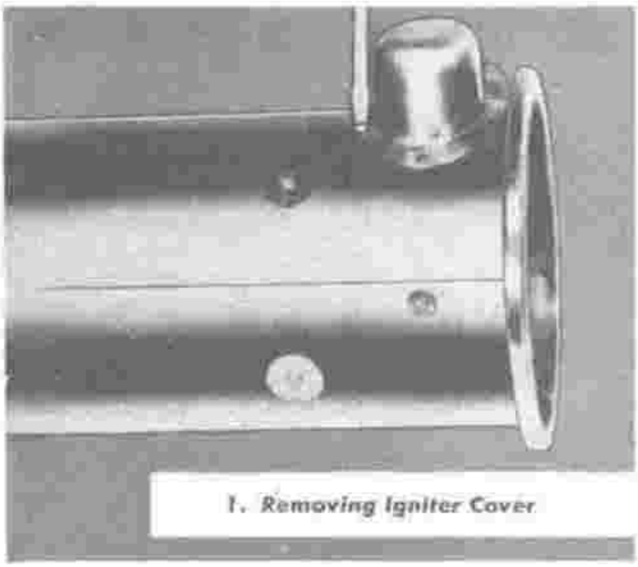
b. Remove igniter ground wire screw.

c. Remove igniter and gasket using a 15/16" socket wrench. Use care not to injure ground wire.

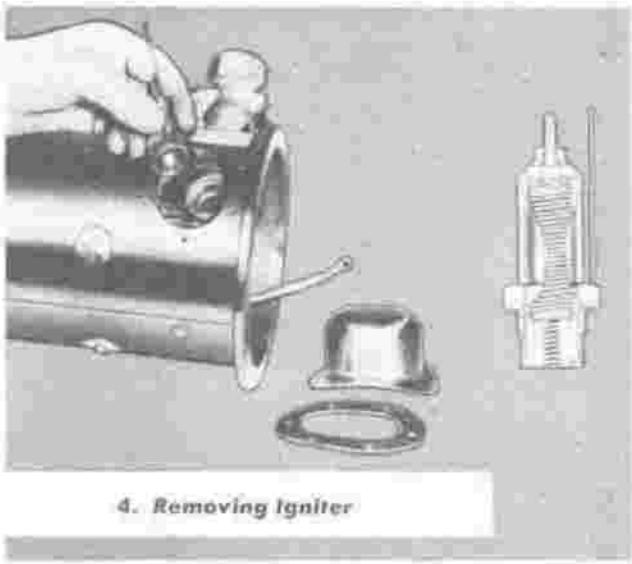
d. Remove igniter lead wire clip.



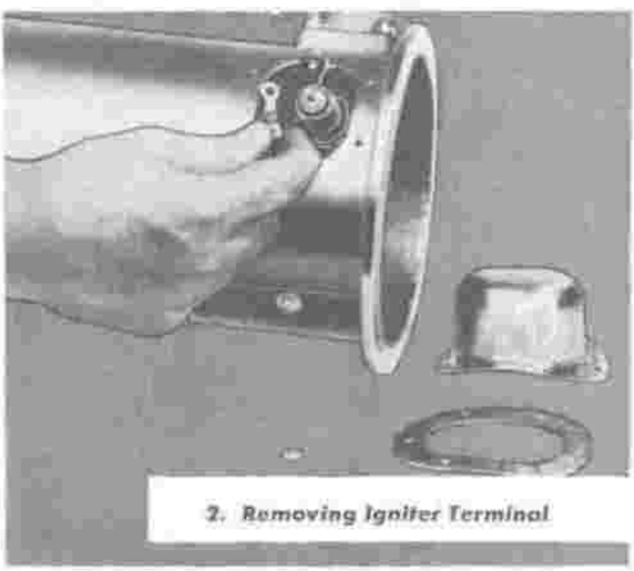
3. Removing Igniter Ground Wire



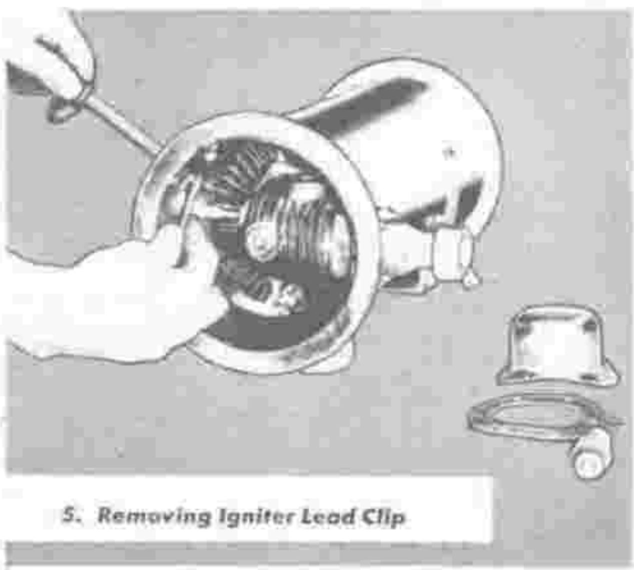
1. Removing Igniter Cover



4. Removing Igniter

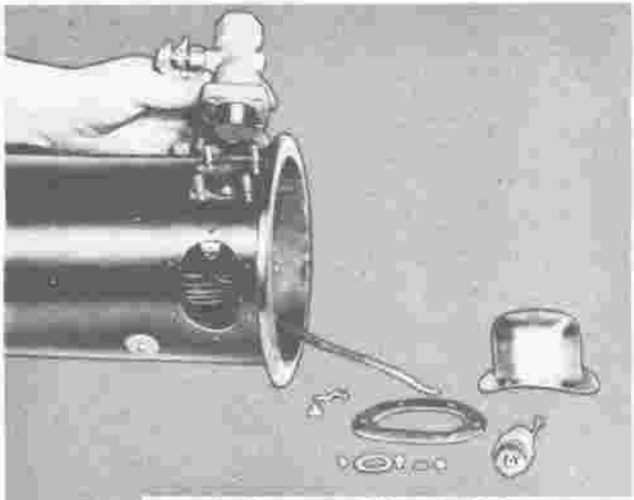


2. Removing Igniter Terminal



5. Removing Igniter Lead Clip

Figure 565 (Sheet 1 of 6)—Heater Assembly (Stewart-Warner)



1. Removing Throttle Valve and Flame Arrester

HOW TO REPLACE THROTTLE

a. Remove 4 nuts holding throttle valve in place.

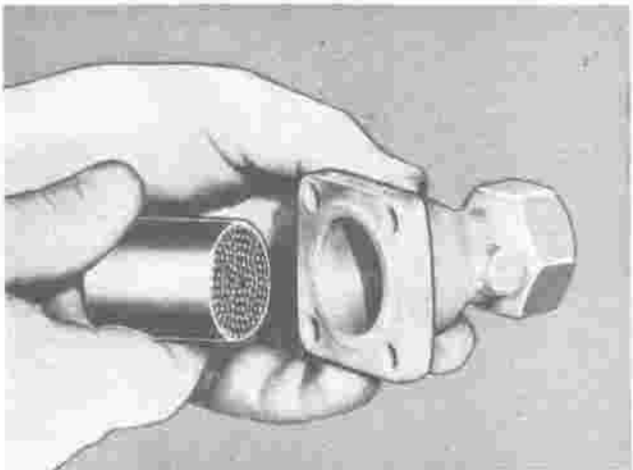
b. Remove throttle valve assembly.

c. Remove flame arrestor from throttle valve body.

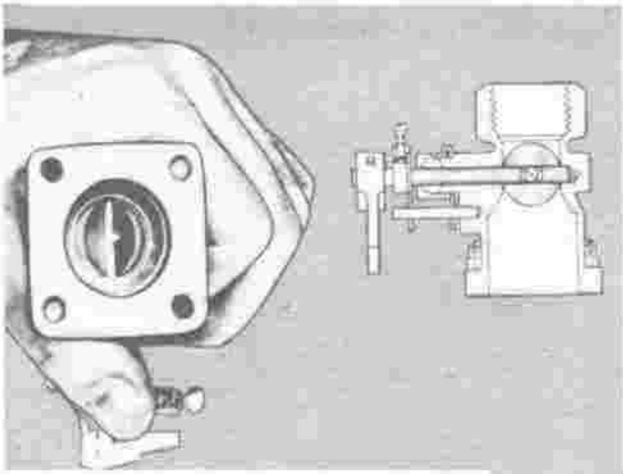
d. Examine flame arrestor. The tubes should be clean.

e. Check operation of throttle valve plate. This plate is set so that in the closed position there is still a 15% opening for the flow of fuel-air mixture. The valve setting is determind by a factory adjusted screw which is soldered in place.

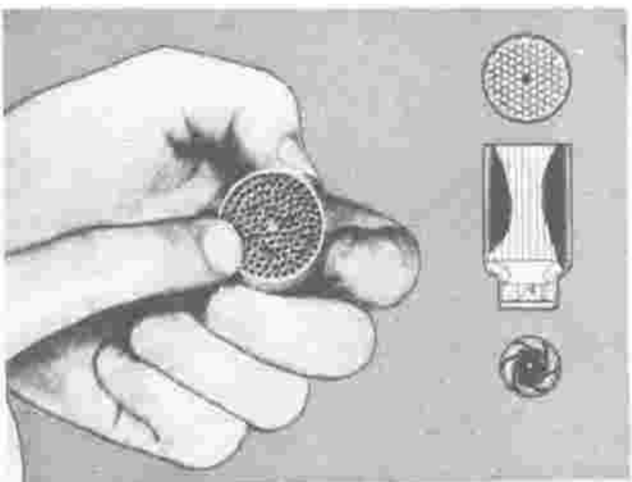
f. To continue disassembly of heater, remove 4 studs. These can be easily removed by tightening two nuts on the stud and applying the wrench on the bottom nut. The top nut acts as a lock nut and the stud can be removed.



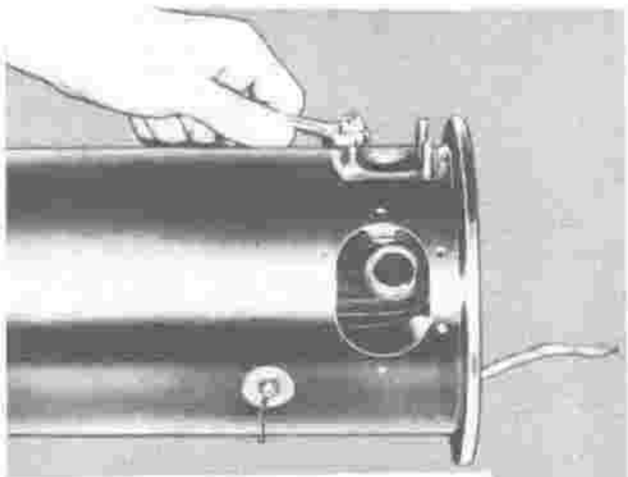
2. Removing Flame Arrester from Throttle Body



4. Check Butterfly Valve Plate



3. Examine Flame Arrester



5. Removing Studs at Combustion Chamber

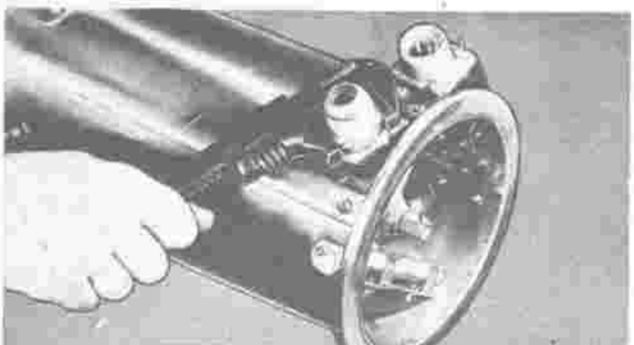
Figure 565 (Sheet 2 of 6)—Heater Assembly (Stewart-Warner)

HOW TO REPLACE EXHAUST RESTRICTION FITTING

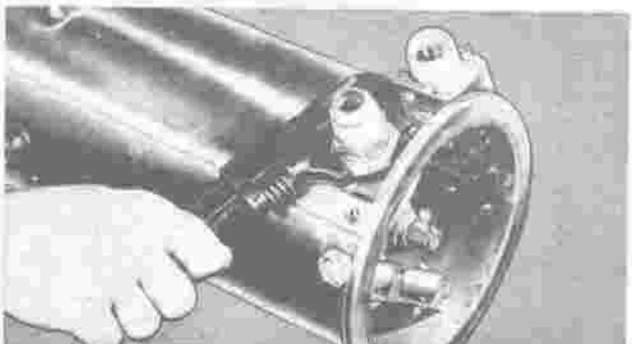
a. The exhaust restriction fitting can be easily removed for cleaning. It is held in place by a lock nut which must be removed first.

b. Unscrew exhaust restriction fitting.

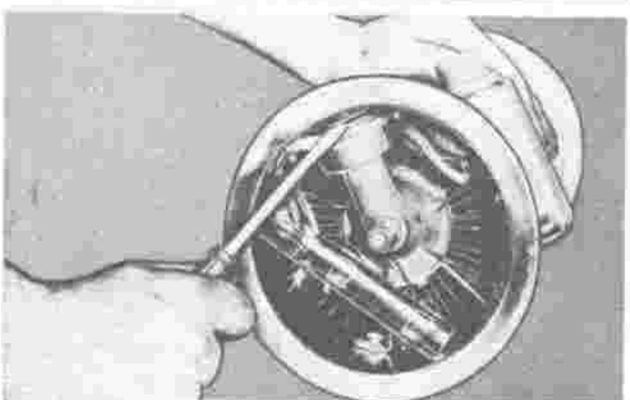
c. Remove exhaust gasket between case and exhaust elbow.



1. Loosen Exhaust Lock Fitting



2. Loosen Exhaust Lock Nut



3. Removing Exhaust Gasket

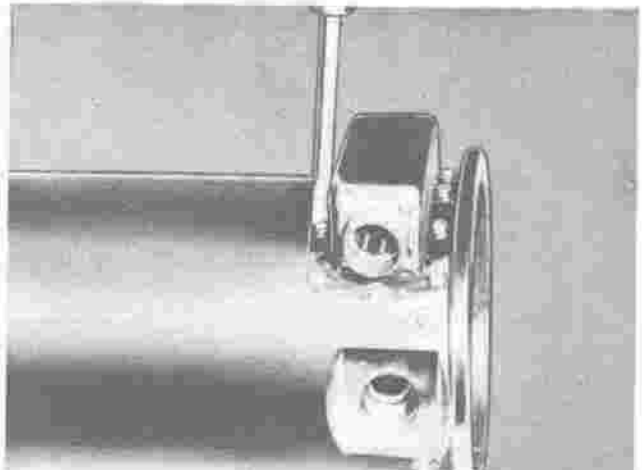
HOW TO SERVICE THERMO-SNAP SWITCH

a. Remove switch cover.

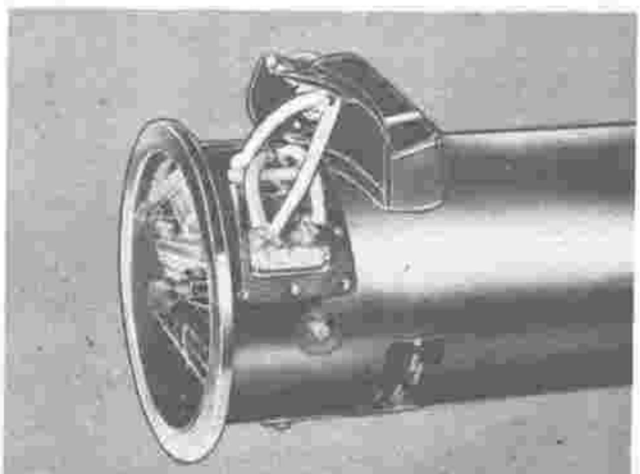
b. Unsolder switch wire at "A" prong of AN connector. It is not necessary to unsolder this wire for cleaning the switch points.

c. Unscrew wires at switch terminal and switch cover can be removed.

d. Remove thermo-snap switch and clean thoroughly.



1. Removing Thermo-snap Switch Cover



2. Switch Wires Exposed

Figure 565 (Sheet 3 of 6)—Heater Assembly (Stewart-Warner)

HOW TO SERVICE OVERHEAT SWITCHES

To service either of the Overheat Switches:

a. Remove clamp screws to loosen clamp.

b. Remove clamp so wires are loosened.

c. Remove clip holding overheat switch wiring.

d. Remove overheat switch leads from terminal.

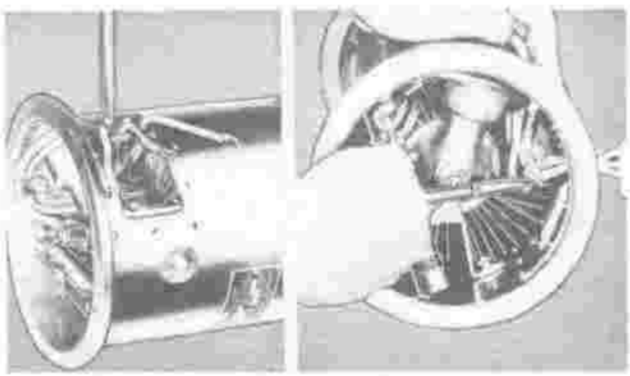
e. The duct overheat switch can now be removed. It should be pried out of holding clips.

f. Remove overheat switch shielding wire.

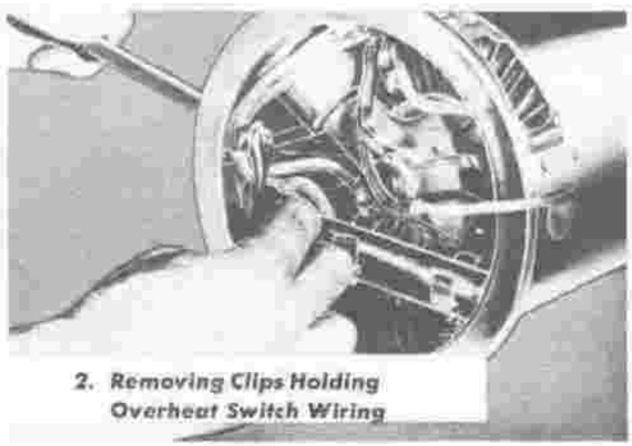
g. Remove igniter lead wire.

h. Remove fin overheat switch.

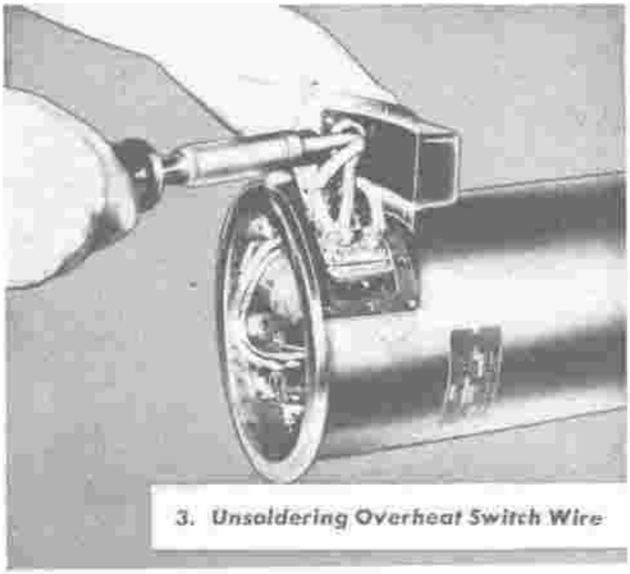
i. Pull out fin overheat switch lead wires.



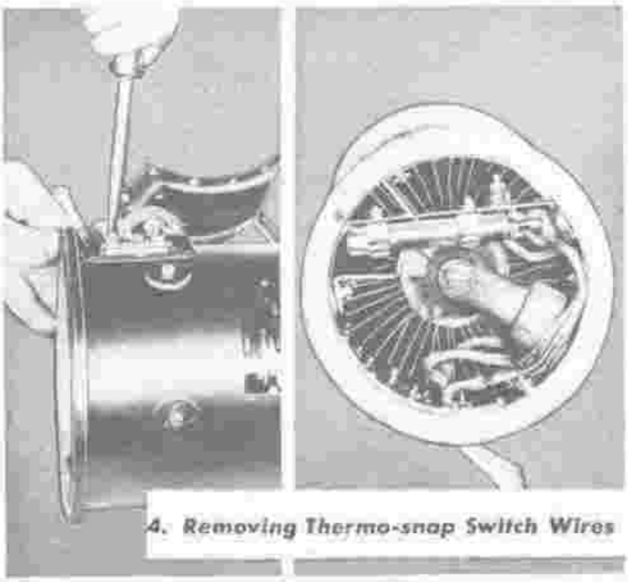
1. Removing Clamp Screws—Removing Clamp Plate



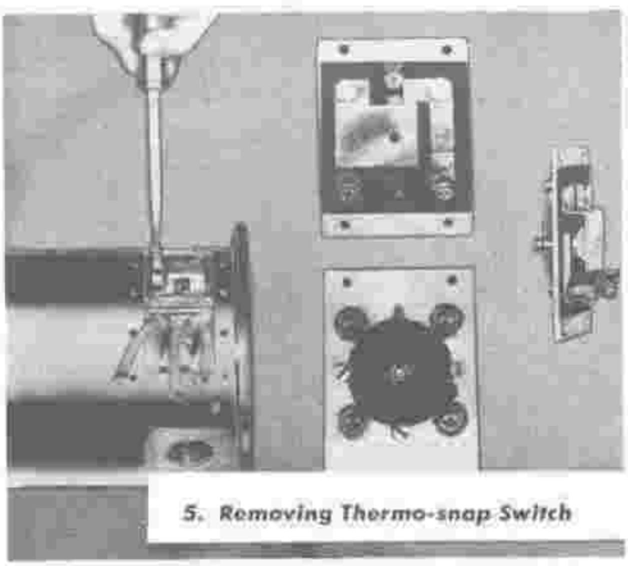
2. Removing Clips Holding Overheat Switch Wiring



3. Unsoldering Overheat Switch Wire

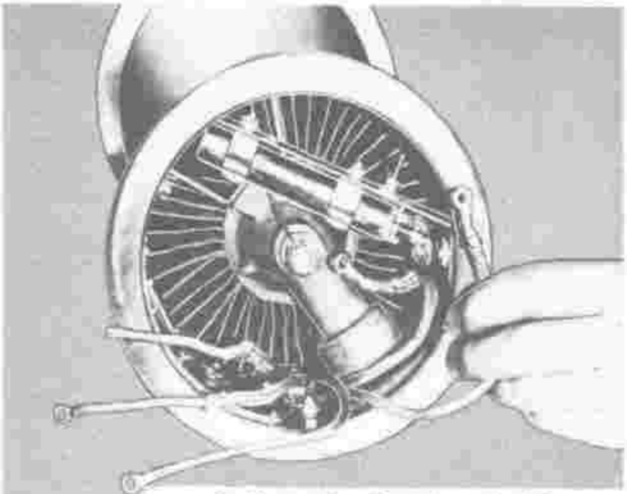


4. Removing Thermo-snap Switch Wires

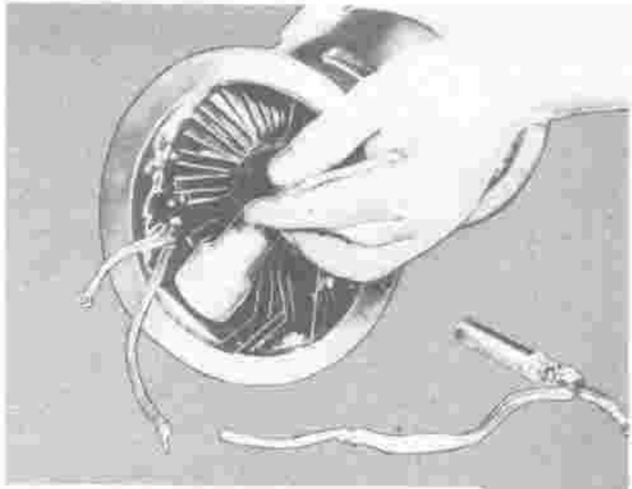


5. Removing Thermo-snap Switch

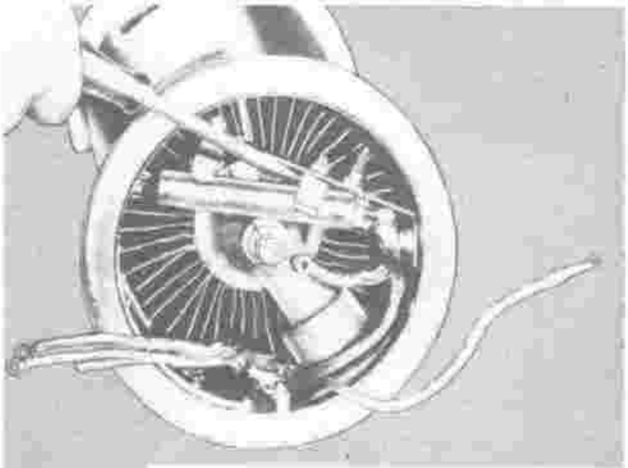
Figure 565 (Sheet 4 of 6)—Heater Assembly (Stewart-Warner)



3. Removing Overheat Switch Leads from Terminal

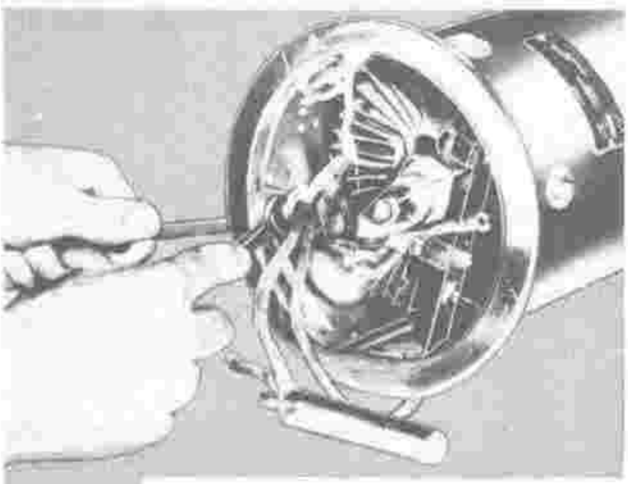


6. Removing Igniter Lead Wire

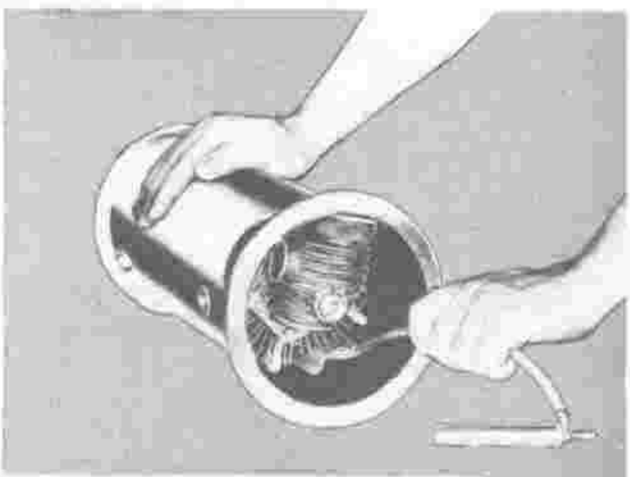


4. Removing Overheat Switch

7. Removing Fin Overheat Switch

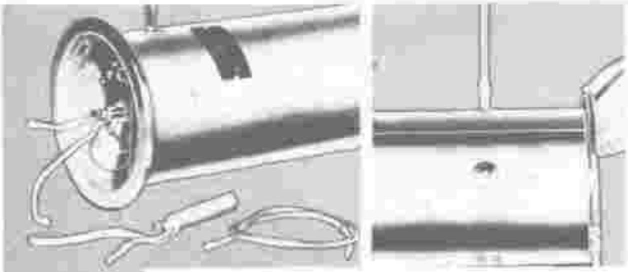


5. Removing Shielding Ground Lead

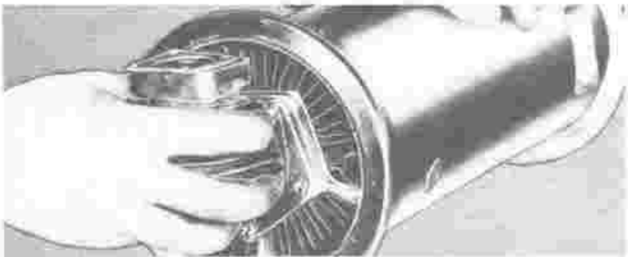


8. Removing Fin Overheat Switch Leads

Figure 565 (Sheet 5 of 6)—Heater Assembly (Stewart-Warner)

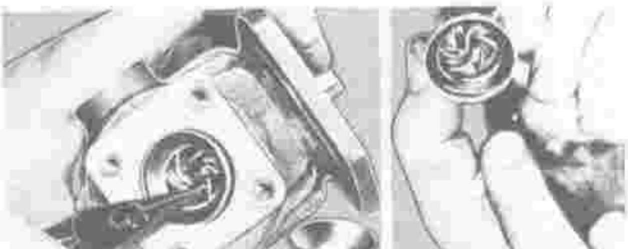


1. *Removing Support Screws*

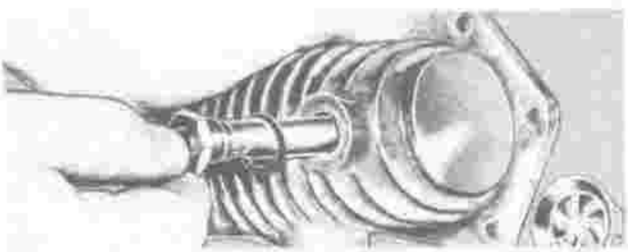


2. *Removing Heat Exchanger*

3. *Removing Combustion Chamber*



4. *Removing Baffle Cup*



5. *Removing Reigniter*

HOW TO SERVICE COMBUSTION CHAMBER

a. Remove case support screws.

b. Remove heat exchanger. The gasket between casting and case is also removed. The heat exchanger can be removed for cleaning without unsoldering or removing and electrical wiring.

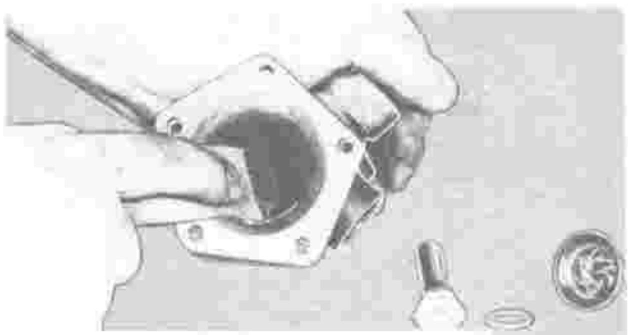
c. Remove combustion chamber.

d. Remove guide and baffle cup and clean.

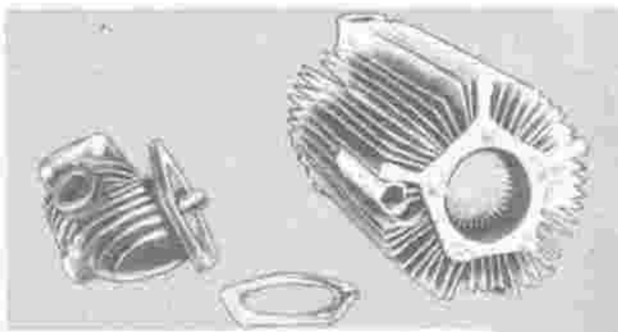
e. Remove reigniter.

The combustion chamber should be cleaned carefully to remove all lead deposits. If the small cover over the end of the igniter (inside the casing) is burned away the casting should be replaced.

g. Inspect the oven flues and if filled with lead, clean or replace the oven. A piece of welding rod or an electric drill may be used satisfactorily if the lead deposit is not too hard. Care must be taken not to injure the copper jacket surrounding the flues.



6. *Cleaning Combustion Chamber*



7. *Combustion Chamber Removed from Heat Exchanger*

Figure 565 (Sheet 6 of 6)—Heater Assembly (Stewart-Warner)

d. MODULATOR TEMPERATURE CONTROL UNIT. *(See figure 566.)*

(1) DESCRIPTION.—A modulator temperature control unit is installed in each of the two heating and ventilating systems within the airplane. One modulator is connected by a flexible shaft to the air regulator valve adjoining the forward ducting heater—the other is connected by a coupling to the air regulator valve adjoining the aft ducting heater. In each instance, the modulator temperature control unit thermostatically controls the action of the allied air regulator valve, provided that the ducting heater, within the same system, is operative. Each modulator temperature control unit operates as follows:

(a) A dial inside the modulator temperature control unit box is set, by hand, at the 200° point. For a complete description of the modulator temperature control adjustment, refer to paragraph 19. *d.* (4), this section.

(b) Fluid within the thermostat bulb (which fits between the air regulator valve shutters or vanes) contracts and expands in accordance with temperature changes brought about by varying air speeds, varying elevations, outside temperatures, and varying throttle settings of the ducting heater.

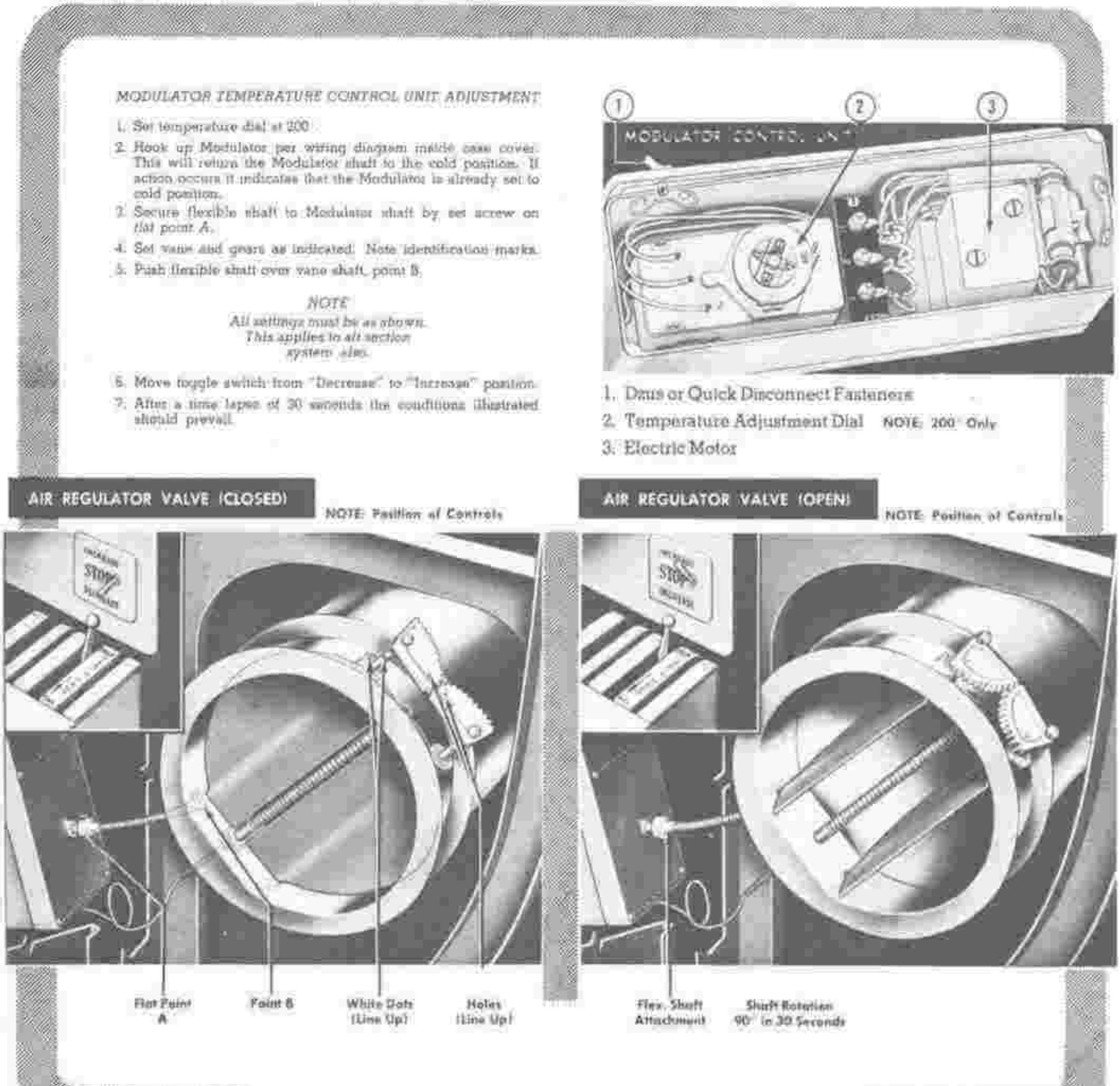


Figure 566 — Modulator Temperature Control Unit Adjustment

(c) If the temperature exceeds the dial setting, the expansion of the fluid within the thermostat bulb will cause a diaphragm in the modulator temperature control unit to make contact with a two-positional switch.

(d) The switch energizes the two-way reversible electric motor (encased in the modulator temperature control box) which, in turn, opens the air regulator valve shutters (vanes). A complete description of the two-way reversible electric motor will be found in paragraph 15., this section.

(e) If the temperature drops below the dial setting, the contraction of the fluid within the thermostat bulb will cause the diaphragm to make contact with the two-positional switch.

(f) The switch energizes the two-way reversible electric motor which, in turn, closes the air regulator valve shutters.

Note

The two-way reversible electric motor will operate independently of the thermostatic action of the modulator temperature control unit. For a complete description of the ventilation process refer to paragraph 19. *b.* (1) *(b)*, this section.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. Remove cover of modulator temperature control box and disconnect electrical wires at terminal block.

2. Loosen bolts holding air regulator valve in place.

3. Detach flexible shaft (or coupling) from modulator.

4. Loosen bolts attaching modulator temperature control unit to brackets.

5. Remove lockwire from thermostat gland nut.

6. Loosen gland nut.

7. Pull thermostat bulb from air regulator valve.

8. Lift out modulator temperature control unit and air regulator valve.

Note

Two men should work together in removing the modulator temperature control unit and the air regulator valve. Take care not to damage thermostat bulb.

(b) DISASSEMBLY.—The modulator temperature control unit should be disassembled at a repair depot.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) MAINTENANCE REPAIR.—Repair of the modulator temperature control unit is to be done at a repair depot.

(b) REPLACEMENT.—Replacement of internal parts of the modulator temperature control unit is to be done at a repair depot.

(4) ADJUSTMENT.

(a) Remove cover from modulator temperature control unit box. The cover is held in place by Dzus fasteners or quick disconnect fasteners.

(b) Adjust the selector indicator dial, by hand, at the 200° point.

CAUTION

Adjustment is to be made only when the airplane is on the ground.

(5) TEST BEFORE INSTALLATION.

(a) THERMOSTATIC CONTROL OF AIR REGULATOR VALVE ACTION.

1. Make certain that selector indicator dial is set at the 200° point. For a complete description of the adjustment procedure refer to paragraph 19. *d.* (4), this section.

2. Make necessary electrical connections to modulator temperature control unit. For a complete description of the modulator temperature control unit electrical connections, refer to paragraph 15., this section.

3. Collect 2 small vats of light oil.

4. Heat one vat of oil to a temperature of 38°C (100°F) and the other to a temperature of 93°C (200°F).

5. Immerse the thermostat bulb in one vat, and allow it to remain for several minutes. The shaft of the modulator two-way reversible electric motor should rotate approximately 90 degrees during this period.

6. After rotation has ceased, remove the thermostat from the first vat, and then immerse in the other vat. The two-way reversible electric motor shaft should rotate approximately 90 degrees in the reverse direction.

(b) OPERATION OF TWO-WAY REVERSIBLE ELECTRIC MOTOR.

Note

The two-way reversible motor acts in conjunction with the modulator thermostatic control, or independently when ventilation of the applicable system occurs.

1. If the modulator temperature control unit operates properly when the thermostatic action test is applied, it may be assumed that the two-way reversible electric motor is operative.

2. The two-way reversible electric motor should cause the air regulator valve shutters to open when the applicable ventilation controls are in position. Refer to *figure 566*.

(6) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedures.

(7) TEST AFTER INSTALLATION.

(a) TEST OF THERMOSTATIC FUNCTION.

1. GROUND TEST.—Refer to paragraph 19. *i.*, this section.

2. FLIGHT TEST.

a. TEST OF THE FORWARD UNIT.—The forward modulator temperature control unit is obscured from the view of the pilot and its action cannot, therefore, be directly observed. However, if the forward ducting heater maintains a constant heat output (during test) it may be assumed that the modulator is also operating efficiently.

b. TEST OF THE AFT UNIT.—The aft modulator temperature control unit is tested in conjunction with the test of the aft air regulator valve. If the air regulator valve operates properly, it may be assumed that the aft modulator temperature control unit is also operating properly.

(b) TEST OF OPERATION OF TWO-WAY REVERSIBLE ELECTRIC MOTOR.—Refer to paragraph 19. *d.* (5) *(b)*, this section.

e. FUEL-AIR MIXTURE SOLENOID SHUT-OFF VALVE. *(See 8, figure 560.)*—Each heater, within the airplane, is provided with a fuel-air mixture solenoid shut-off valve. The valves which serve the two ducting heaters are mounted approximately 11 inches aft of the firewall in the right-hand nacelle, one on either side. The valves which serve the two recirculating heaters are mounted approximately 11 inches aft of the firewall in the left-hand nacelle, one on either side. Each of the four valves is provided with an individual fuel-air mixture take-off fitting on the applicable engine supercharger blower case.

When a heater is inoperative, the applicable fuel-air mixture solenoid shut-off valve is closed. When a heater is in operation, the applicable solenoid valve is open, thus allowing passage of fuel-air mixture. If overheating occurs, overheat switches within the heater will cause the solenoid valve to shut off until proper operating temperature is regained.

Note

Further information pertaining to the fuel-air mixture solenoid shut-off valve will be found in paragraph 15., this section.

f. SCOOPS, DUCTS, HOSE, AND LINES. *(See figures 559, 560.)*

(1) DESCRIPTION.—An external air scoop is provided for each of the two ducting heaters. Each scoop is located on the right-hand side of the fuselage adjacent to the heater which it serves.

Air ducts conduct warm or cold air to outlet terminations within the system which they serve. In the forward system, air is conducted to the pilot's compartment, foot warmer, and the pilot's windshield. When the bombardier's nose is installed, a duct from the forward ducting heater supplies air to two ducts in the nose; the bombardier's window defroster duct, and the bombardier's hand warmer duct. In the aft section, air is conducted to the gunner's compartment, gunner's windows (by a fixed duct and a flexible hose), and the gun turrets. The ducts are made of weldable alloy and are joined together by synthetic rubber sleeves which are made firm by clamps.

At various places throughout the two heating and ventilating systems, neoprene hose is used to supplement the air ducts. Connection is made by clamps. Fuel lines consist of ¾" aluminum alloy tubing. The exhaust lines in the wing and across the fuselage are constructed of 1" corrosion resistant steel. The remaining exhaust lines are constructed of ¾" corrosion resistant steel tubing. Intake lines serving the ducting heaters connect to the high pressure side of the right-hand engine supercharger blower case. Exhaust lines serving the ducting heaters connect to the low pressure side of the right-hand engine supercharger blower case. Lines serving the recirculating heaters connect to the left-hand engine supercharger blower case in a similar manner.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. SCOOPS.—Scoops are not removed from the airplane.

2. DUCTS.

a. Loosen the clamps on the hose connectors that joint the sections together, and slide the clamps out of the way.

b. Remove the screws from the brackets which hold the ducts to the airplane structure; roll back the synthetic rubber sleeves, and then pull the sections apart.

3. HOSE.—Loosen clamps and remove.

4. LINES.—Unscrew fittings and remove.

(b) DISASSEMBLY.—Ducts, lines, and hose are disassembled when removed.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) SCOOPS.

1. MAINTENANCE REPAIR.—Rivet a thin strip of metal over small holes.

2. REPLACEMENT.—Replace badly damaged scoops.

(b) DUCTS.

1. MAINTENANCE REPAIR.

a. Weld or rivet a thin strip of metal over small holes.

b. Smooth out small dents or abrasions.

2. REPLACEMENT.—Replace badly damaged ducts.

(c) HOSE.

1. MAINTENANCE REPAIR.—It is generally impractical to repair hose. In an emergency, however, a faulty hose may be wrapped with tape.

2. REPLACEMENT.—Replace any hose which contains cracks, shows evidence of wear, or is perforated.

(d) LINES.—Replacement, rather than repair of lines is necessary. When replacing a line make certain that the new line is similar to the line which is removed—that it is of the correct material (exhaust lines are constructed of corrosion resistant steel; fuel-air mixture lines are constructed of aluminum alloy), has the correct diameter, and is properly attached to the adjoining lines. It is particularly important that any line attaching to a heater be made firm and leakproof in order to prevent possible fire, in case a quantity of fuel-air mixture is allowed to escape from the fuel-air mixture line; or, to prevent asphyxiation of the crew members, in case carbon monoxide gas is allowed to escape from the heater exhaust line. Make certain, also, that lines attaching to a heater are properly lagged with insulating blanket and that the blanket does not contain oil, dirt or other foreign material.

(4) ADJUSTMENTS.—No adjustments are necessary for the scoops, ducts, hose, or lines.

(5) TEST BEFORE INSTALLATION.—Scoops, ducts, hose, and lines are not tested before installation.

(6) ASSEMBLY AND INSTALLATION.—Assembly and installation for scoops, ducts, hose, and lines is the reverse of REMOVAL AND DISASSEMBLY procedure.

(7) TEST AFTER INSTALLATION.

(a) SCOOPS.—A test after installation is not required for the scoops.

(b) DUCTS.—A test after installation is not required for the ducts.

(c) HOSE.—A test after installation is not required for hose.

(d) LINES.

1. Fuel-air mixture lines.

a. Disconnect the fittings aft of the fuel-air mixture solenoid shut-off valves. Plug one end of the connecting lines.

b. Apply 80 psi air pressure to the open end of the lines. The allowable air leakage shall be 20 psi per line, in 10 minutes.

c. If air leakage is greater than is allowable, apply a soapy solution by means of a brush around all fittings and connections while the air pressure is applied. Replace any faulty line or fitting.

2. EXHAUST LINES.—Conduct a test similar to the one given the fuel-air mixture lines above; paragraph 19. *f.* (7) *(d)*, this section.

g. FUSELAGE AIR EXHAUST.—A fuselage air exhaust assembly is installed in the upper right-hand fuselage shoulder opposite the bomb by tank filler access door. The exhaust prevents excessive pressure from being built up within the fuselage, due to the air taken in by the ducting heaters. A water sump and an overboard drain is contained in the fuselage exhaust.

Note

No maintenance service is necessary for the fuselage air exhaust. Therefore, maintenance items relating to the fuselage air exhaust are not included.

h. CONTROLS AND OPERATIONS. *(See figures 567, 568, 569.)*

(1) DESCRIPTION.

(a) HEATING.—The ducting heater and the recirculating heater, for the forward (pilot's) heating

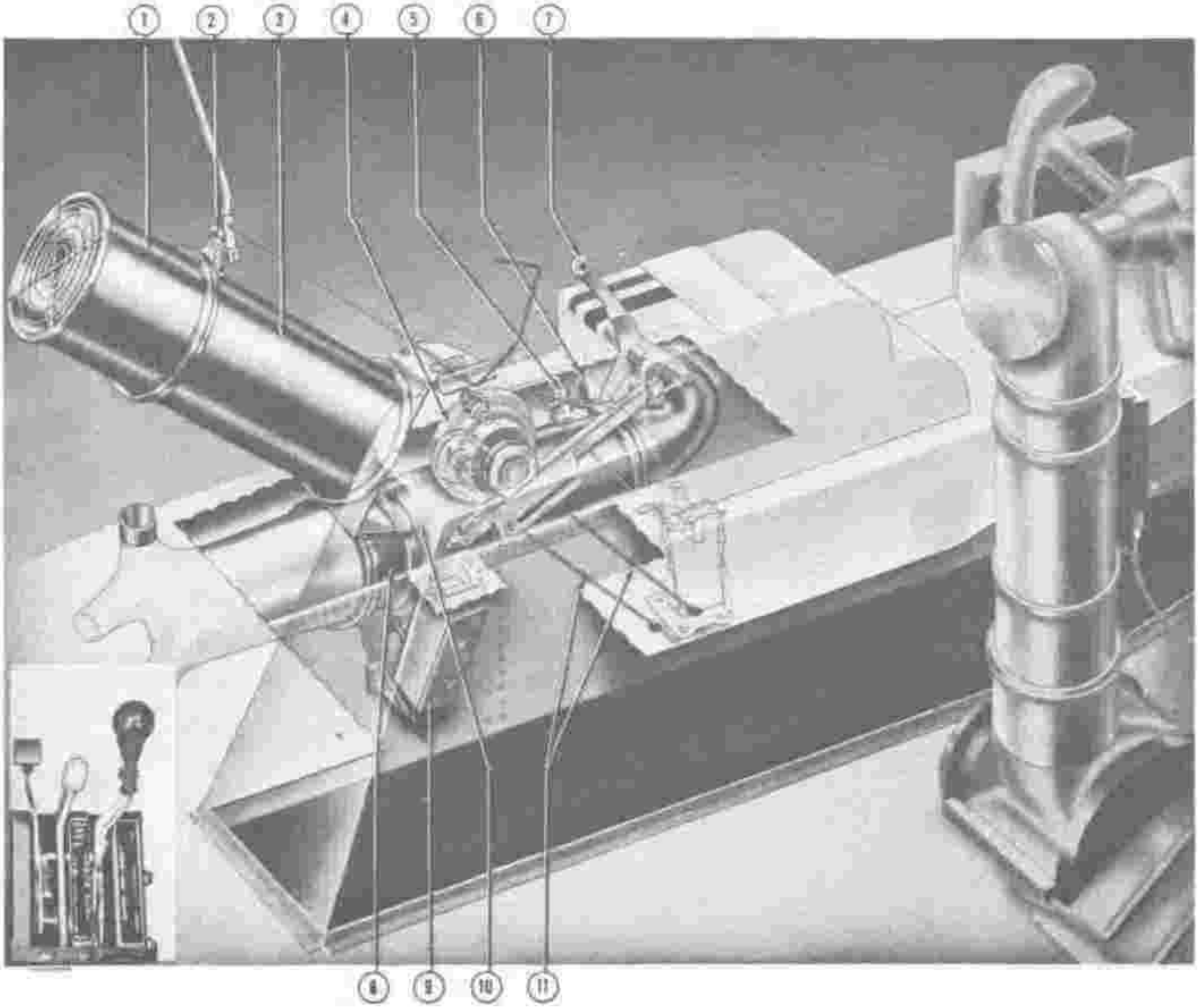
and ventilating system, are controlled by a heater control lever which is located on the upper right hand side of the pilot's control pedestal. The ducting heater and the recirculating heater, for the aft (gunner's) heating and ventilating system are controlled by a heater control dial which is located to the left of the gunner on the fuselage. The function and the essential operation of the two controls is identical. A description of the heater control (heater control lever, heater control dial) in relation to the applicable system (forward, aft) heaters follows:

1. OPERATION OF THE 2 FORWARD HEATERS.

a. FORWARD DUCTING HEATER.

(1) When the heater control lever is moved from the "OFF" position toward "MAX.," the ducting heater is set in operation. Three things happen simultaneously:

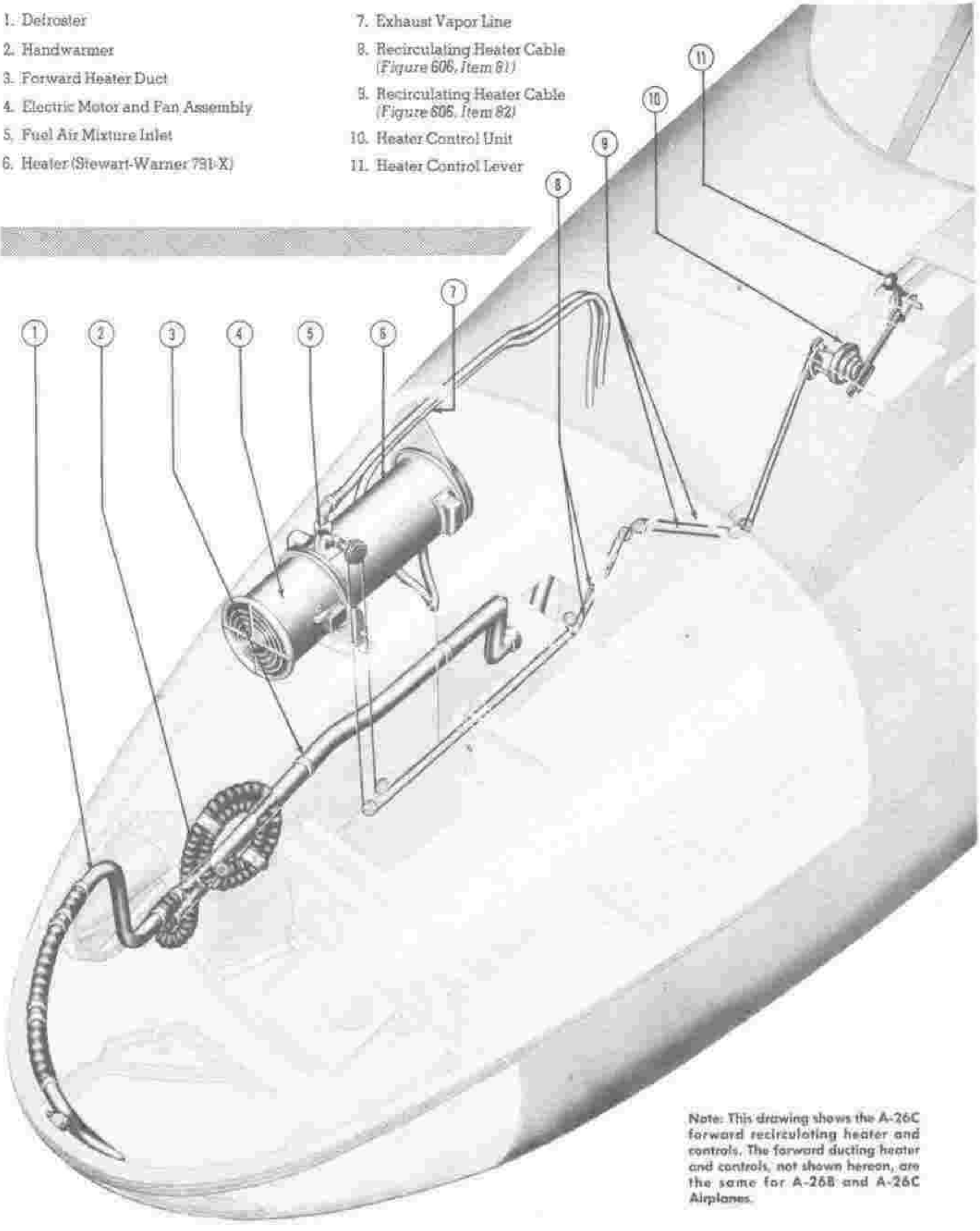
(2) The fuel-air mixture solenoid shut-off valve is opened, thus permitting fuel-air mixture to flow from the high pressure side of the right hand engine supercharger blower case to the heater butterfly valve or throttle.



1. Electric Motor and Fan Assembly
2. Fuel Air Mixture Inlet
3. Heater (Stewart-Warner 791-X)
4. Heater Control Unit
5. Fuel Air Mixture Inlet
6. Ram Air Intake Scoop
7. Heater Control Lever
8. Air Regulator Valve
9. Modulator Temperature Control Unit
10. Heater (Stewart-Warner 791-X)
11. Fuel Air Mixture Butterfly Valve Control Cable (Ducting) *(Fig. 606, Item 1)*

Figure 567 — Forward Heating and Ventilating System Controls

1. Defroster
2. Handwarmer
3. Forward Heater Duct
4. Electric Motor and Fan Assembly
5. Fuel Air Mixture Inlet
6. Heater (Stewart-Warner 791-X)
7. Exhaust Vapor Line
8. Recirculating Heater Cable *(Figure 606, Item 81)*
9. Recirculating Heater Cable *(Figure 606, Item 82)*
10. Heater Control Unit
11. Heater Control Lever



Note: This drawing shows the A-26C forward recirculating heater and controls. The forward ducting heater and controls, not shown hereon, are the same for A-26B and A-26C Airplanes.

Figure 568 — Forward Heating and Ventilating System Controls (A-26C)

(3) The butterfly valve or throttle is opened manually, thus permitting fuel-air mixture to enter the heater combustion chamber.

(4) The heater igniter is energized to the blowing stage, thus causing ignition of the fuel-air mixture.

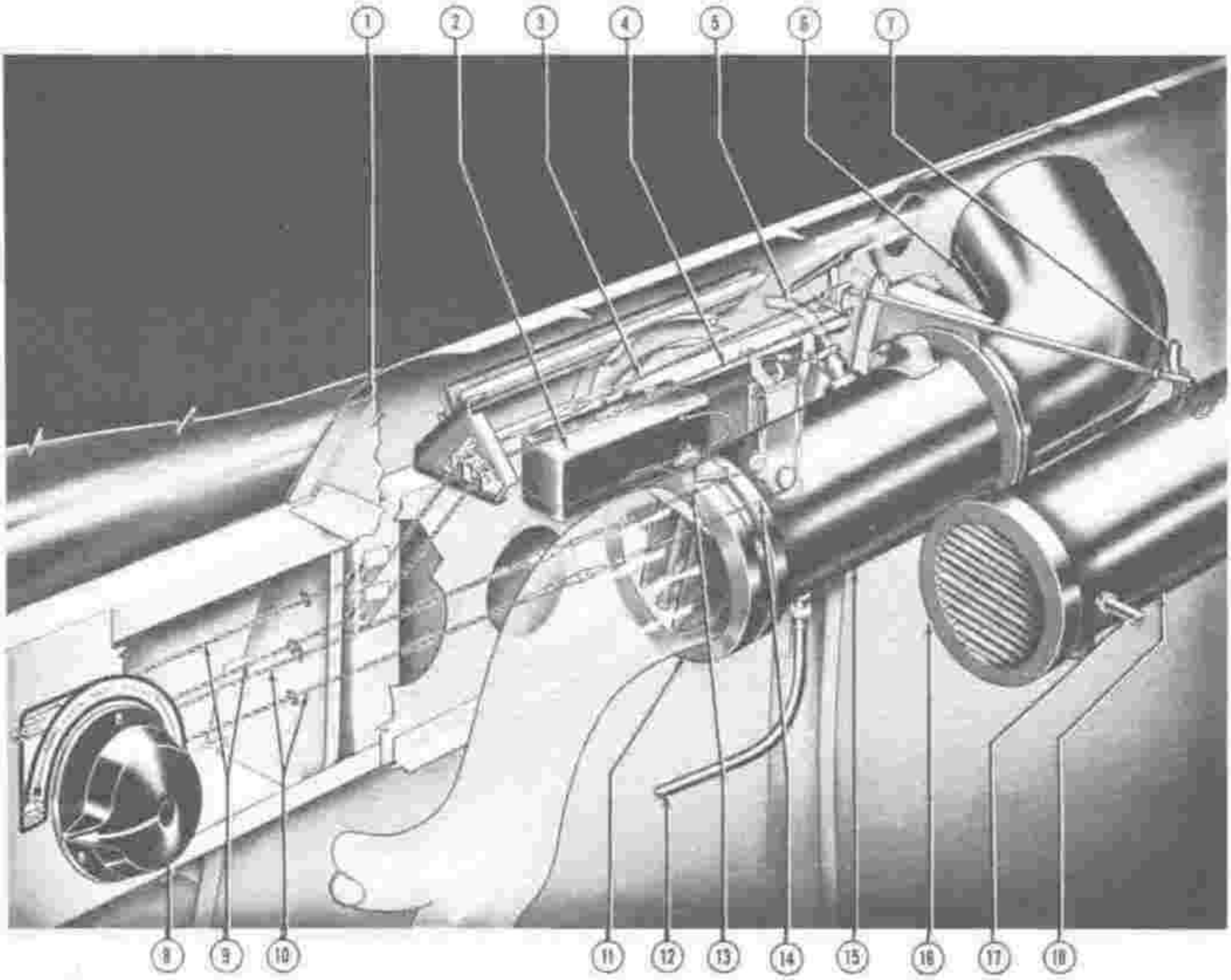
Note

Make certain that the Master Heater control switch is in the "ON" position.

b. OPERATION OF THE FORWARD RECIRCULATING HEATER.

(1) When the heater control lever is moved from approximately the half-way position toward "MAX.," the recirculating heater is set in operation. These 3 things happen simultaneously:

(2) The fuel-air mixture shut-off valve is opened, thus permitting fuel-air mixture to flow from



1. Aft Bulkhead Gunner's Compartment
2. Modulator Temperature Control Unit
3. (Decrease) Recirculating Heater Cable *(Figure 606, Item 4)*
4. (Increase) Recirculating Heater Cable *(Figure 606, Item 4)*
5. Fuel Air Mixture Inlet
6. Duct (Attaches to Ram Air Intake Scoop)
7. Fuel Air Mixture Intake
8. Heater Control Dial
9. Recirculating Heater Cable *(Figure 606, Item 79)*
10. Ducting Heater Cable *(Figure 606, Item 80)*
11. Air Regulator Valve
12. Exhaust Vapor Line
13. (Decrease) Ducting Heater Cable *(Figure 606, Item 2)*
14. (Increase) Ducting Heater Cable *(Figure 606, Item 3)*
15. Heater (Stewart-Warner 791-X)
16. Grill (Air Outlet End)
17. Exhaust Vapor Line
18. Heater (Stewart-Warner 791-X)

Figure 569 — Aft Heating and Ventilating System Controls

the high pressure side of the left-hand engine supercharger blower case to the heater butterfly valve or throttle.

(3) The butterfly valve or throttle is opened manually, thus permitting fuel-air mixture to enter the heater combustion chamber.

(4) The heater igniter is energized, thus causing the fuel-air mixture to ignite.

Note

The heater control position necessary to set the recirculating heater in operation is slightly past the position necessary to fully accelerate the heat output of the ducting heater. The ducting heater will operate independently of the recirculating heater, while the airplane is in flight. If the recirculating heater is put in operation, the ducting heater will also continue to operate. If, however, the airplane is on the ground, only the recirculating heater will operate.

2. OPERATION OF THE 2 AFT HEATERS.—The ducting and the recirculating heaters, for the aft (gunner's) heating and ventilating system, are set in operation in exactly the same way as the heaters in the forward system. Refer to paragraph *1.*, a., above. A heater control dial (instead of a heater control lever) operates the heaters in the aft system.

3. VARIATION OF HEAT OUTPUT OF THE 2 FORWARD HEATERS.

a. FORWARD DUCTING HEATER.—The maximum heat output of the ducting heater occurs when the heater control lever is in approximately the halfway position between "OFF" and "MAX." At this point the butterfly valve or throttle is completely open.

Note

The temperature within the air ducts is determined by the heat output of the ducting heater and the position of the air regulator valve shutters. The angle of the air regulator valve shutters is controlled thermostatically by the modulator temperature control unit. When the ducting heater lever is in the "OFF" position, the air regulator valve shutters are closed.

b. VARIATION OF HEAT OUTPUT OF THE FORWARD RECIRCULATING HEATER.—The maximum heat output of the recirculating heater occurs when the heater control is in the "MAX." position. At this point the butterfly valve is fully open.

4. VARIATION OF THE HEAT OUTPUT OF THE 2 AFT HEATERS.—The heat output of the forward and the aft heaters is varied in the same way that the heat output of the forward heaters is varied. A heater control dial (instead of a heater control lever) varies the heat output of the aft heaters.

5. CONNECTION OF THE HEATER CONTROL LEVER TO THE 2 HEATERS IN THE FORWARD HEATING AND VENTILATING SYSTEM.—The linkage between the heater control lever and the parts necessary to operate the forward ducting and recirculating heaters consist of a heater control unit, cable drum, rods, pulley and cables. The heater control unit contains a rotary switch and cam plate. As the heater control lever is moved, the heater control unit rotates, and, in succession, places the ducting and the recirculating heater in operation.

6. CONNECTION OF THE HEATER CONTROL DIAL TO THE 2 HEATERS IN THE AFT HEATING AND VENTILATING SYSTEM. *(See figure 569.)*—A linkage consisting of cables, pulleys, bellcranks and rods is connected from the heater control dial to the two aft heaters back of the dial, and performs the same function as the heater control unit in the forward system.

(b) VENTILATION.—Ventilation, as applied to either the forward (pilot's) or the aft (gunner's) heating and ventilating system, occurs only when the heaters, within that system, are inoperative and cold air is allowed to enter the air ducts through the applicable air regulator valve.

1. OPERATION OF VENTILATION WITHIN EACH HEATING AND VENTILATING SYSTEM.

a. Shift the heater control (heater control lever, heater control dial) from the "OFF" position to the "COLD AIR" position.

b. Shift the cold air two-way electric toggle switch *(figure 566)*, for the applicable heating and ventilating system, from the "STOP" position to the "INCREASE" position. The toggle switch, for both systems, is similar. In the forward (pilot's) heating and ventilating system the toggle switch is located adjacent to the heater control lever in the aft (gunner's) system the toggle switch is located adjacent to the heater control dial. When the 2 controls, within a system, are adjusted so as to allow ventilation the following action occurs:

(1) The two-way reversible electric motor, within the modulator temperature control box, is energized.

(2) The electric motor, in turn, opens the air regulator valve shutters, thus allowing cold air to enter the air ducts.

2. VARIATION OF VENTILATION WITHIN EACH OF THE HEATING AND VENTILATING SYSTEMS.

a. Approximately 30 seconds are required for air regulator valve shutters to fully open or close. Therefore, the pilot, or the gunner, may obtain a desired degree of ventilation by returning the toggle switch to the "STOP" position before the 30 second period has elapsed. The shutters will then remain partially open.

b. If the pilot, or the gunner, desires less ventilation, the applicable toggle switch may be shifted from the "STOP" position to the "DECREASE" position. The two-way reversible electric motor then reverses its action, and the air regulator valve shutters return to the closed position. At any time within 30 seconds the pilot, or the gunner, may stabilize the ventilation by placing the applicable two-way electric toggle switch in the "STOP" position.

Note

The two-way electric toggle switch must be in the "STOP" position before the heaters, within the same system, will operate.

(c) AIRPLANE HEATING AND VENTILATING MASTER SWITCH. *(See figures 319, 320.)*—A heating and ventilating master switch is located on the pilot's main electrical control panel. If a crash landing is anticipated, the pilot may instantly stop operation of all heaters within the airplane.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. FORWARD (PILOT'S) CONTROLS.

a. Remove nut or bolt which extends through heater control lever. Slide bolt only far enough to the left to lift heater control lever from place.

b. Remove nut attaching clevis bolt (which is attached to heater control lever) to heater control operating channel.

c. Disconnect the controls at the ducting heater butterfly valve or throttle.

d. Remove the butterfly valve or throttle control from the control unit.

e. Disconnect the wires from the terminals on the control unit.

f. Remove the control unit by removing bolts.

g. Remove the recirculating heater controls.

2. AFT (GUNNER'S) CONTROLS.

a. Disconnect rod assemblies (leading from heater control dial to the ducting heater and the recirculating heater) from butterfly valves or throttles.

b. Remove bellcranks from brackets.

c. Disconnect cables at barrels.

d. Remove stops attaching cables to pulley which are installed on the back of the heater control dial unit. Remove cables.

e. Remove the screws that hold the control unit to the side of the gunner's compartment.

f. Remove handle. Detach wires from terminals. Remove nut attaching control unit to handle assembly. Remove control unit assembly.

(b) DISASSEMBLY.

1. FORWARD (PILOT'S) CONTROLS.

a. DISASSEMBLY OF CONTROL UNIT.

(1) Remove nut at pulley and slide pulley from shaft.

(2) Remove horseshoe retaining clip.

(3) Remove plastic cover from back of control assembly.

(4) Lift out slotted wheel and shaft.

(5) Remove screw holding rotary switch unit.

(6) Remove rotary switch unit.

2. DISASSEMBLY OF AFT (GUNNER'S) CONTROLS.

(1) Remove horseshoe retaining clip.

(2) Remove plastic cover from back of control assembly.

(3) Lift out slotted wheel and shaft.

(4) Remove screws holding rotary switch unit.

(5) Remove rotary switch unit.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—All controls, and control linkages, for both the forward and the aft heating and ventilating systems are replaceable. Any part showing evidence of wear should be replaced. Note particularly the condition of cables, firmness of attaching bolts, and response of heater controls. If replacement of parts within the heater control unit is necessary, reassembly should follow the sequence shown in the pictures below. *(See figure 570.)*

(4) ADJUSTMENTS.—Lengthen or shorten the control linkage by turning the turnbuckle barrels as necessary to permit free and efficient operation of applicable heater. Readjust adjusting screw or rod ends adjacent to heaters if necessary. Make certain that the butterfly valve (throttle) completely opens and closes.

(5) TEST BEFORE INSTALLATION.—Controls and linkages are not tested before installation.

(6) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure above.

(7) TEST AFTER INSTALLATION.—The operation of the controls is tested in conjunction with the test after installation for the heaters. If the heaters operate properly it may be assumed that the controls are correctly installed. The heater control (heater control lever, heater control dial) for the applicable heating and ventilating system should move freely and without friction.

i. HEATING AND VENTILATING SYSTEM TEST.

(1) PRELIMINARY PROCEDURE.

(a) Obtain a blower capable of supplying at least 210 cubic feet of air per minute (standard air or atmosphere), per scoop, to furnish adequate ducting air.

(b) Attach flexible hose from blower to heater scoops. Make certain that all equipment is secured in such a manner that it cannot be blown off by the propeller blast.

(c) Start ground blower.

(d) Connect battery cart to airplane. If a battery cart is not available, turn airplane battery switches to the "ON" position.

(e) Turn master heater switch to the "ON" position.

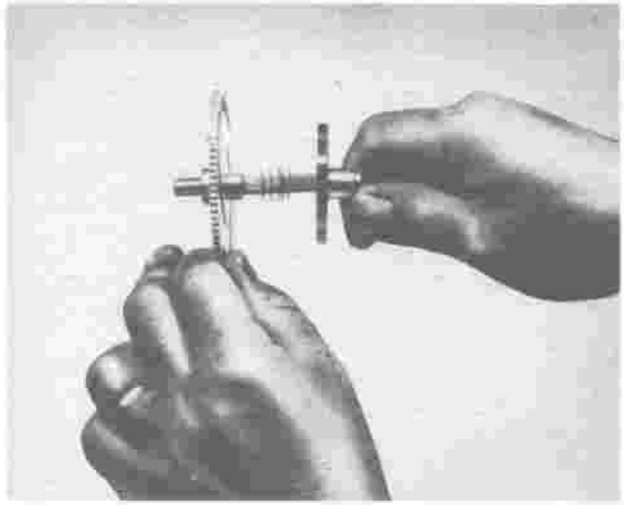
(2) VENTILATION (COLD AIR SUPPLY) CHECK. (FORWARD SYSTEM.)

(a) Place heater control lever in the "COLD AIR SET" position.

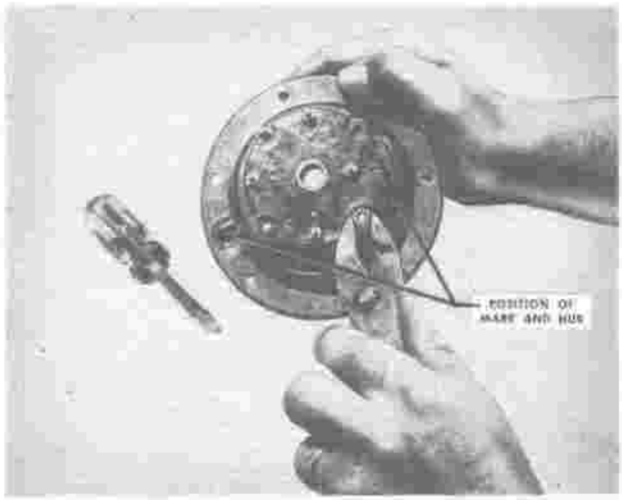
(b) Place the cold air two-way electric toggle switch in the "INCREASE" position.

1. Observe operation of the air regulator valve from the wheel well. The valve should move from closed to open position in approximately 30 seconds.

2. Check air flow by holding hand over windshield air outlets. The air volume should increase as the valve opens.



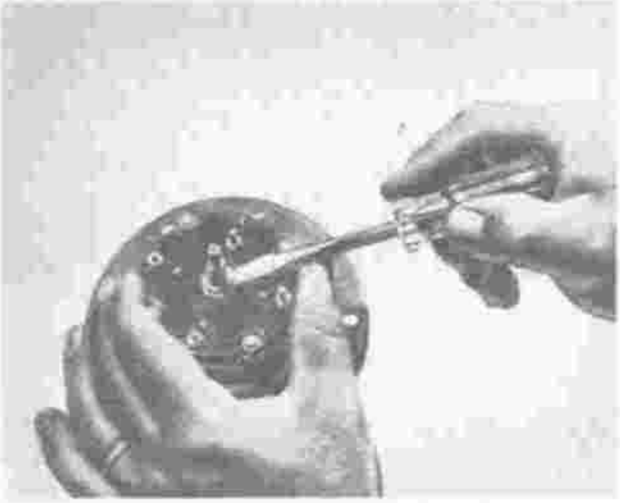
Assembly of Switch Cam and Main Cam



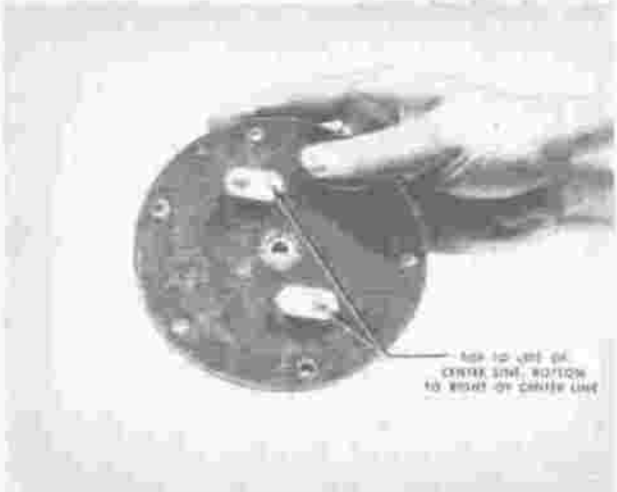
Attachment of Switch to Case

Installation of Cam in Body

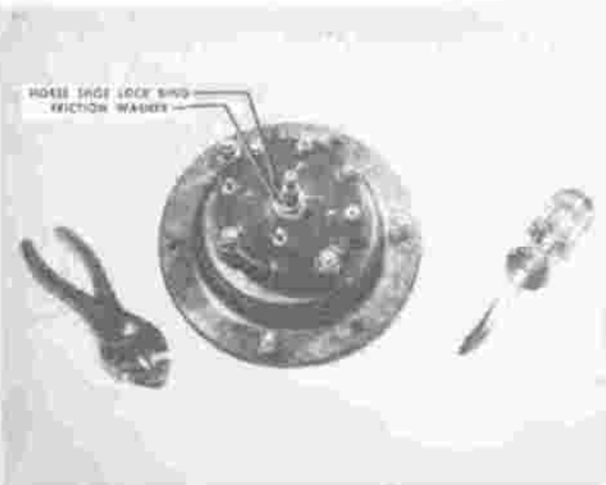
Figure 570 (Sheet 1 of 2) — Assembly Procedure of Heater Control Unit (Forward and Aft)



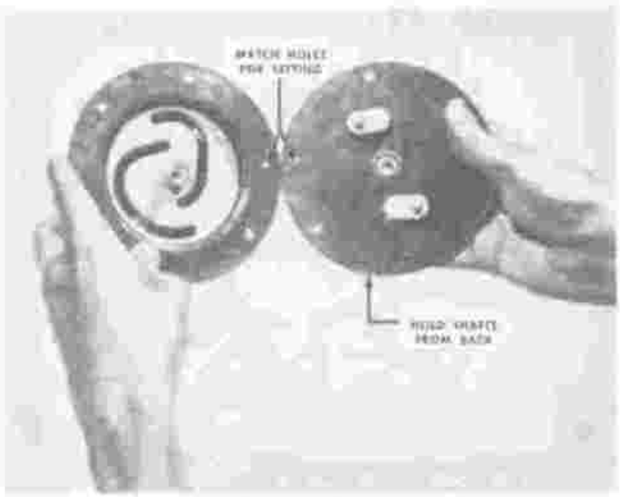
Attachment of Horse-Shoe Retaining Ring
to Retain Cams in Position



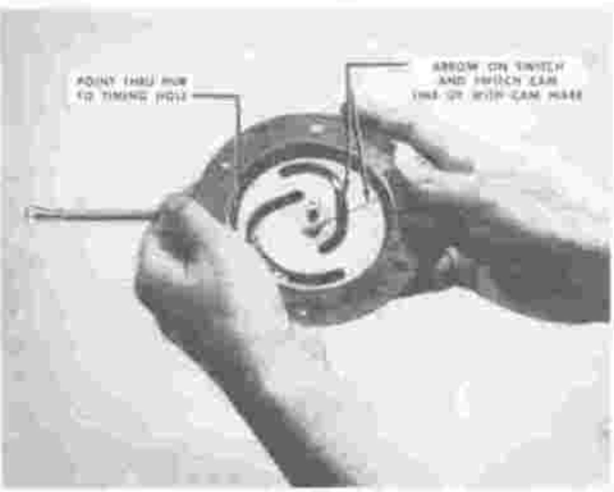
Adjustment of Cam Arms in Cover
before Assembly



Tools Needed for Assembly. Lock Ring and Cam
in Position with Switch



Line-up of Parts before Assembly



Checking of Cam Timing

Installing of Cam Clicker Pin

Figure 570 (Sheet 2 of 2) — Assembly Procedure of Heater Control Unit (Forward and Aft) *(c)* Place the cold air two-way electric toggle switch in the "DECREASE" position. In approximately 15 seconds move switch back to the "STOP" position. The air regulator valve should stop in a half closed position.

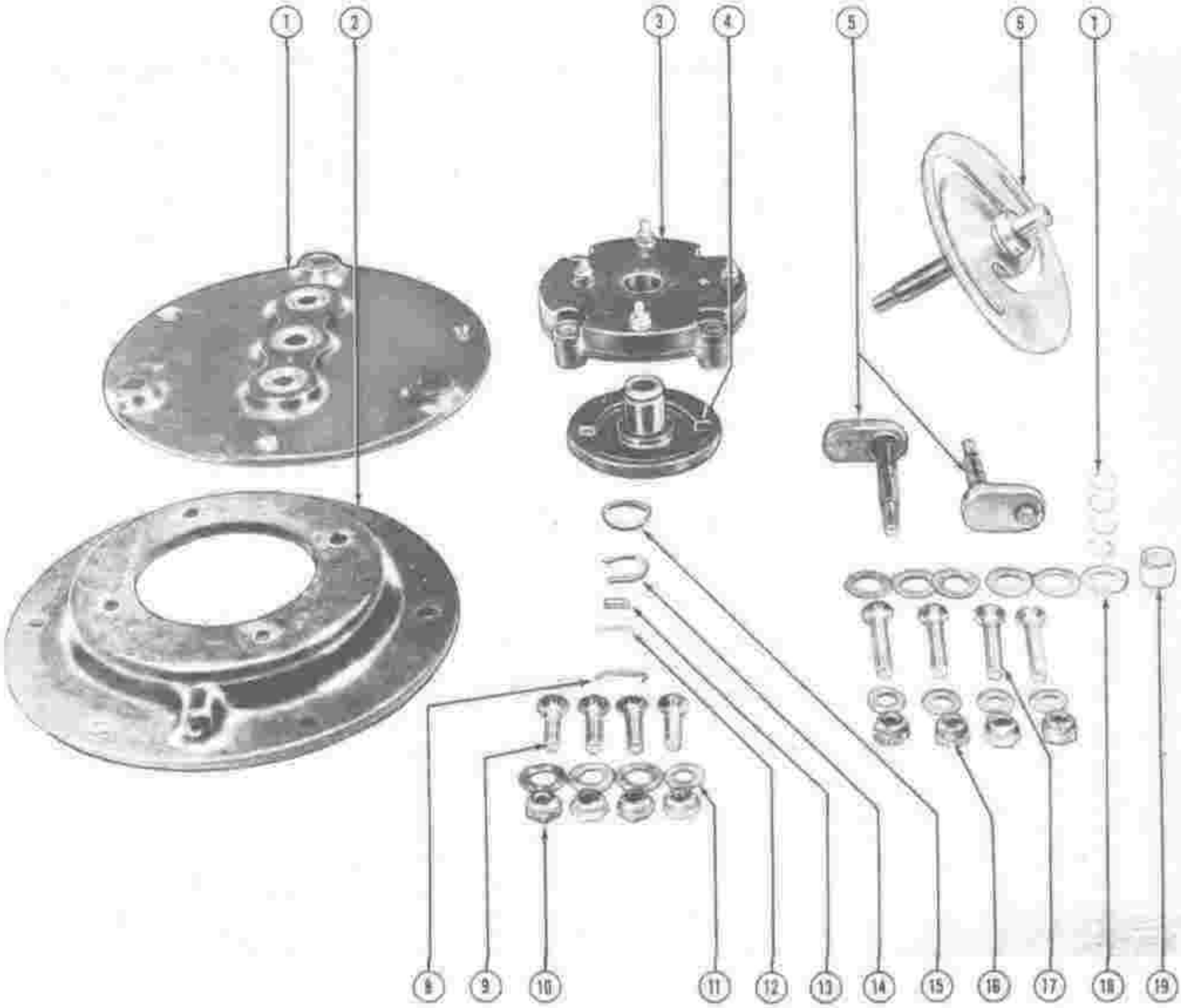
(d) Place the cold air two-way electric toggle switch in the "INCREASE" position. After 30 seconds move the heater control lever to the "ON" position. The air regulator valve should return to the closed position.

(e) Return heater control lever to the "OFF" position. Return cold air switch to the "STOP" position.

(3) HEATER (HOT AIR SUPPLY) CHECK. (FORWARD SYSTEM.)

(a) Clamp nose wheel door switch in closed position.

(b) Start both engines. If battery cart is not available, turn battery and generator switches to the "ON" position.



1. Cover Assembly
2. Case
3. Switch
4. Switch Component
5. Crank Assembly
6. Cam Assembly
7. Snap Ring
8. Wire
9. Screw
10. Nut
11. Washer
12. Spring
13. Pin
14. Horse Shoe Washer (Included in Switch)
15. Shim Washer (Included in Switch)
16. Nut
17. Screw
18. Washer (Use as Required to Control End Play)
19. Spacer

Figure 571 — Heater Control Unit

(c) Place heater control lever in "MAX" position. The heaters should start in from 2 to 4 minutes.

1. Check operation by holding hand over windshield air outlets and noting flow of warm air.

2. Check recirculating heater operation by holding hand along the right-hand side of the pedestal where a blast of warm air should be noticeable.

(d) While the heaters are in operation, open the nose wheel door heater shut-off switch. The ducting heater should shut off but the recirculating heater should continue to operate.

Note

The aft system is tested in essentially the same manner as the forward system. Identical, or similar, component parts are, however, located differently in relation to each other.

j. HEATING AND VENTILATING TROUBLE SHOOTING LIST

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. Heater inoperative.	*a.* Structural damage which presents operation	
	(1) Butterfly valve (throttle) will not operate.	(1) Clean valve or replace if necessary.
	(2) Fuel-air mixture solenoid shut-off valve will not operate.	(2) Check wiring.
	(3) Fuel-air mixture line (including exhaust) is obstructed or damaged.	(3) Replace. Clean with air pressure.
	(4) Controls (pilot's or gunner's) are faulty and fail to set heater in operation.	(4) Check electric wiring. Check linkage and replace if necessary. *See figures 355 and 356.)*
	b. Fuel-air mixture in heater is not ignited. (1) Heater ignition system is faulty.	(1) Check electrical wiring and igniter.
2. Air regulator valve will not operate or operates intermittently.	*a.* Structural damage which preents operation of the air regulator shutters.	*a.* Replace damaged parts.
	b. Modulator temperature control will not energize electric motor.	
	(1) Thermostat bulb leaks or is otherwise damaged.	(1) Replace modulator temperature control unit.
	(2) Two-way reversible electric motor is faulty.	(2) Replace modulator temperature control unit.
	(3) Electric connections are faulty.	(3) Correct wiring.
3. Heater does not produce sufficient heat.	*a.* Modulator temperature control unit dial setting is too low.	*a.* Change setting. Refer to *figure 354.*
	b. Modulator temperature control unit is faulty. (1) Igniter will not operate.	*b.* Replace. (1) Replace.
4. Heater overheats.	*a.* Overheat switches are faulty.	*a.* Replace.
	b. Air regulator valve (mounted on ducting heaters) is stuck.	*b.* Replace bushings, vanes or both.
	c. Modulator temperature control unit (which operates air regulator valve or ducting heater) is faulty.	*c.* Replace modulator.
	d. Fan in recirculating fan assembly (mounted on recirculating heater) is inoperative.	*d.* Check electric wiring. Replace electric motor if necessary.

20. ICE ELIMINATION

a. GENERAL.—Two separate systems are employed to accomplish ice elimination in the A-26B airplane. One system, designated as de-icing, operates by breaking a thin layer of ice immediately after it has formed. The other system, designated as anti-icing, operates by preventing the formation of ice, by means of a solvent or by heat. A windshield wiper is installed on the bomb sight window of the A-26C (bombardier version) nose.

b. DE-ICING SYSTEM. *(See figure 572.)*

(1) GENERAL.—The de-icing system consists of the de-icer shoes, which pulsate to cause the breakage of ice, and the component parts necessary for operation. The shoes are mounted on the leading edge of the wings and on the leading edges of the stabilizers. The de-icing system operates essentially as follows:

Air from the pressure side of each of the two engine-driven air (vacuum) pumps *(figure 237)* is discharged into an applicable oil separator *(11, figure 572.)*

Oil is removed from the air by the oil separators.

The cleansed air from each oil separator flows into an applicable safety valve *(11, figure 572)* which releases air, in excess of 9 psi, into the atmosphere.

The air from each safety valve then flows through an applicable check valve which is located in the "Y" of the four-way junction *(3, figure 572)*. The check valves act to control the flow of air in one direction.

The combined air flow from both air (vacuum) pumps is discharged into an air filter *(2, figure 572)* which removes the remaining oil from the air. A relief valve integral with the filter, acts to release excess air (over 8 psi pressure) into the exhaust overboard vent line. The air then flows into the de-icer distributor valve and is in turn directed into the tubes of the de-icer shoes in the proper sequence for inflation and deflation. *(See figure 575.)*

(2) SNAP ACTION DE-ICER DISTRIBUTOR VALVE.

(a) DESCRIPTION.—In the "OFF" position, air pressure from the pressure outlet of both air (vacuum) pumps flows through the distributor valve and out through the exhaust port *(10, figure 574)* into the air vent line which terminates on the left-hand side of the fuselage *(6, figure 572)*. In addition, air is sucked from the ports of the distributor valve not covered by the rotor (and consequently from the de-icer shoes) by one or the other of the air (vacuum) pumps. Refer to paragraph 20. *b.* (3), this section. This suction action assists in holding the shoes tight against the leading edge of the wing panels and the stabilizers, thus maintaining the proper airfoil. When the de-icing system is turned "ON," the distributor valve rotor remains in the same position for a period of 4⅛ seconds and then snaps to the next position. This snap action requires ⅞ of a second; 5 seconds, therefore, elapse during each position change of the rotor. The air pressure rotor chamber (which carries air to fill the de-icer shoes) precedes the chamber provided to conduct air pressure from the shoes. Rotation of the rotor is counterclockwise, viewed as shown in *figure 575*. Following the "OFF" position, the first stop of the rotor leaves the pressure chamber adjacent to a location with no port (position 2) and the next two stops are at plugged ports (position 3 and 4); therefore, no de-icing action takes place the first twenty seconds after the de-icer switch is energized. The fourth stop of the rotor (position 5) inflates the center tube of each wing de-icer shoe. The fifth stop of the rotor (position 6) deflates the center tube of each wing shoe and inflates the two outer tubes of each wing shoe. The exhausted air from the center tubes of the wing shoes goes out through the venturi port *(7, figure 574)* and overboard through the air vent line. This vent line is so installed through the side of the fuselage that the slipstream causes a venturi (suction) action which aids in the exhausting operation. The next snap position (position 7) allows the horizontal and vertical stabilizer de-icer shoes to inflate, and the outside tubes of the wing de-icer shoes to deflate through the venturi port. The rotor then snaps into a position (position 8) which allows the stabilizer shoe to deflate. No inflation action occurs as the pressure chamber of the rotor is at a location where there is no port. The next rotor stop is that known as the "OFF" position, i. e. that position (position 1) at which the rotor always stops when the electric switch is turned "OFF." Simultaneously with the rotation of the de-icer distributor valve rotor, suction action from one or the other of the air (vacuum) pumps assists in holding a tube tight against the surface of the wing or stabilizer until the tube is again in line with the rotor for inflation or deflation. This suction action continues both when the de-icing system is in operation and when it is in the "OFF" position.

The de-icer rotary air distributor valve consists of an electric motor, reduction housing and reduction gearing complete with Geneva mechanism, and distributor valve section complete with exhaust venturi.

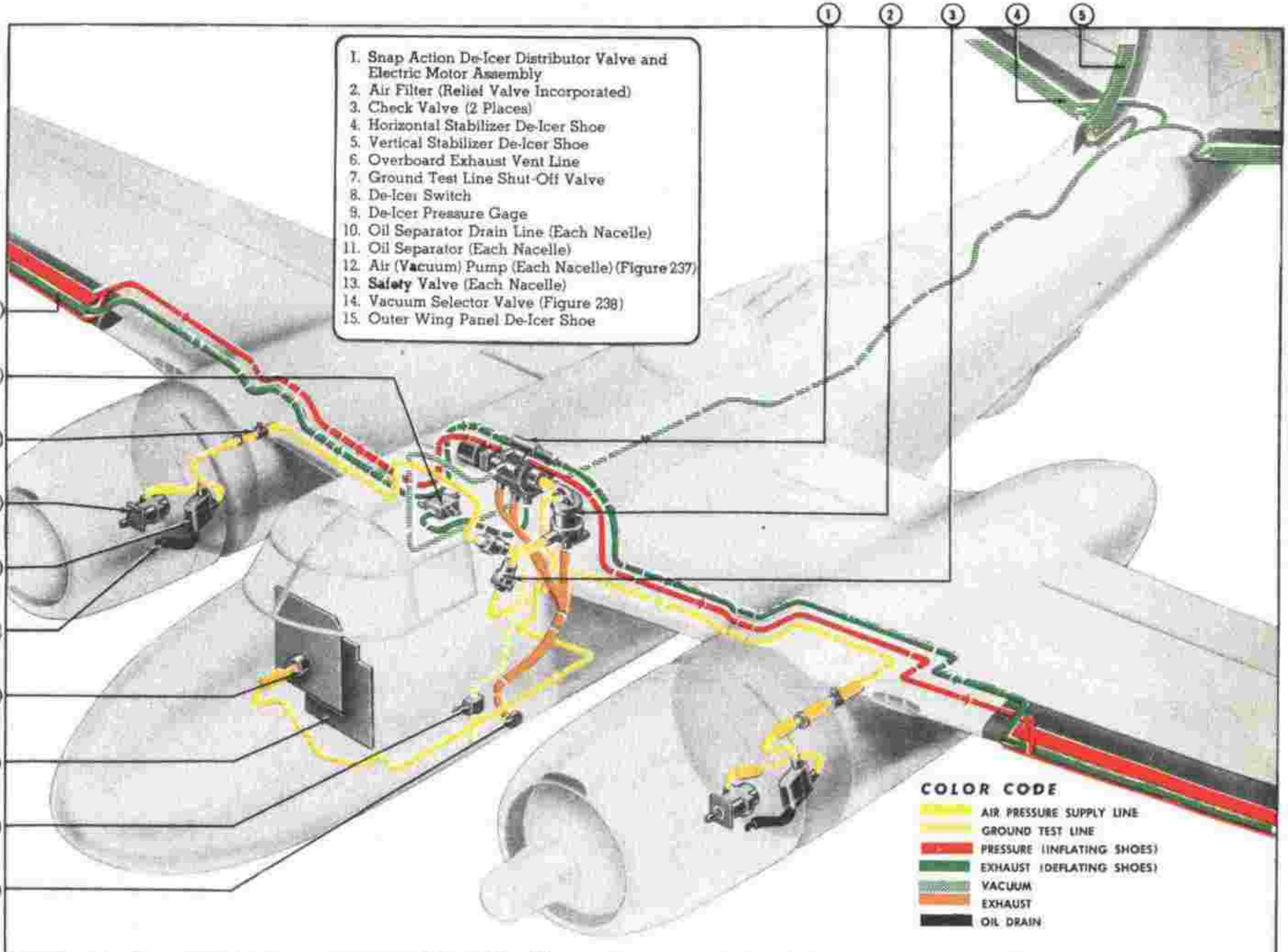


Figure 572— Wing and Empennage De-Icer System

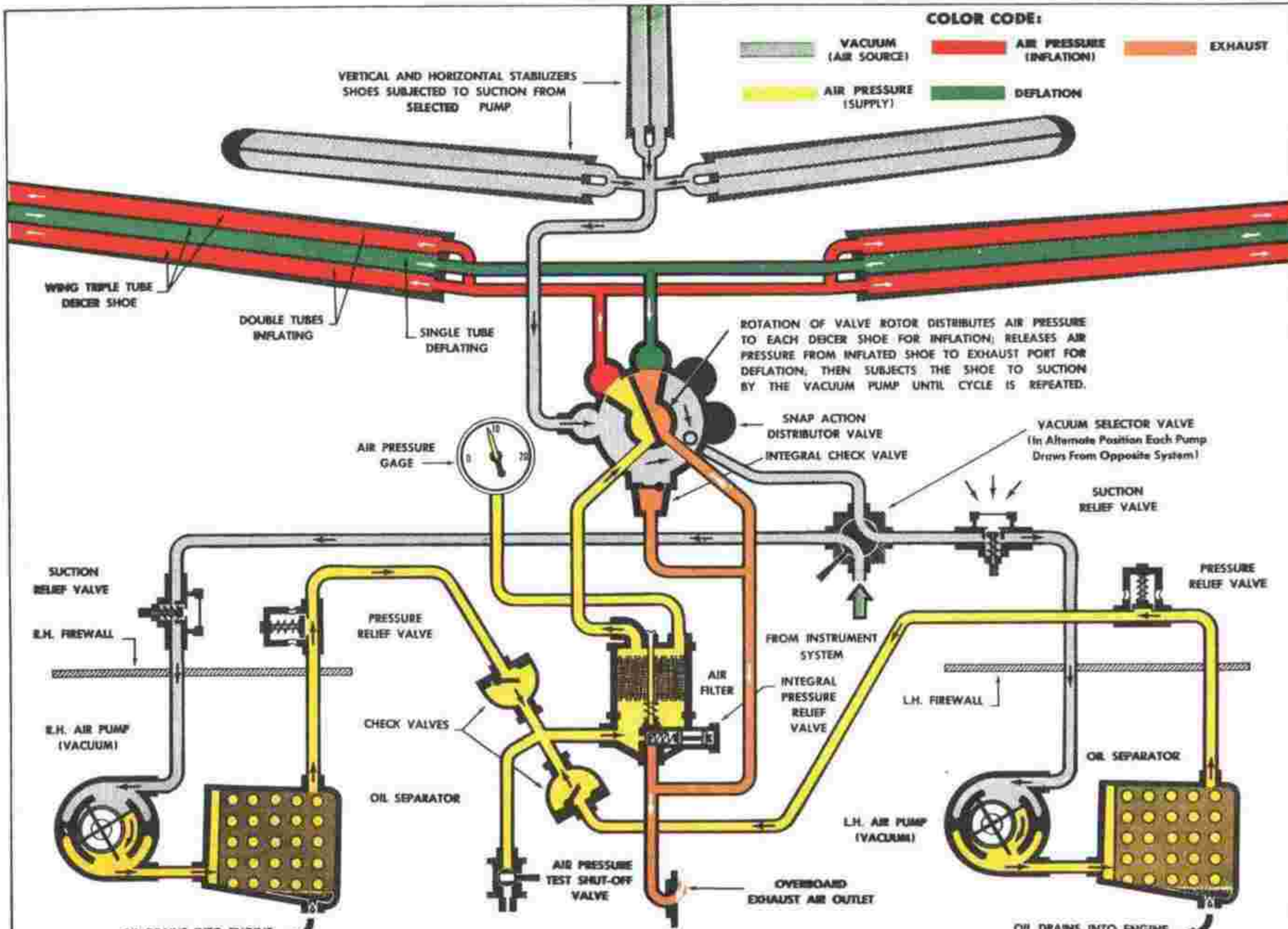
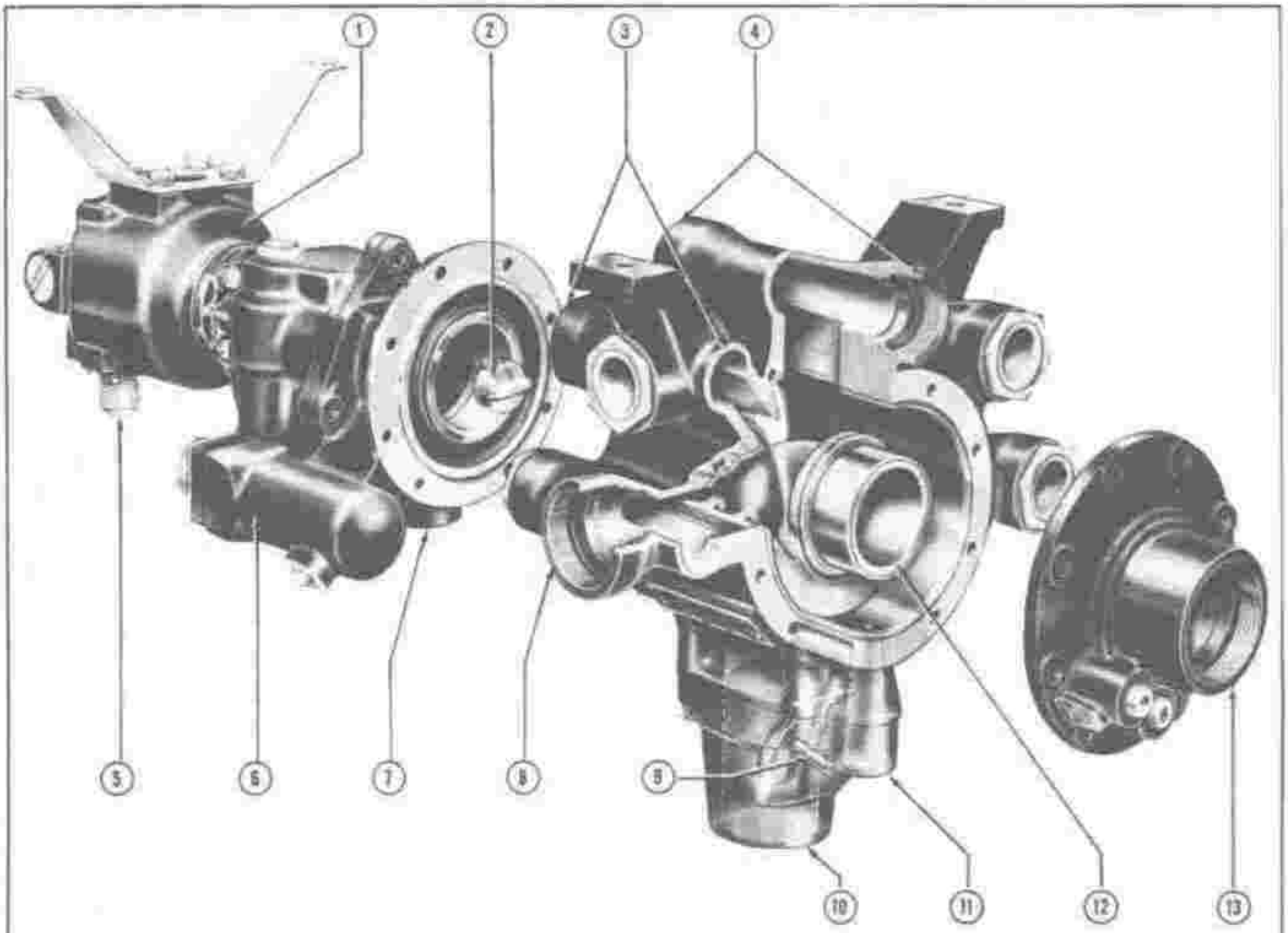


Figure 573—Surface Deicer System Air Flow Diagram

The reduction gearing consists of a double worm and worm wheel reduction with an effective ratio of 256 to 1. The primary (high speed) worm is mounted in a ball bearing at the motor end and on a plain bearing at the opposite end. The remainder of the bearings are plain bearings. The final shift of the worm reducer supports and drives the 8 to 1 Geneva stop mechanism which drives the de-icer distributor valve. The effective ratio of the double reduction and the Geneva mechanism is 2048 to 1.

The de-icer distributor valve section consists of a rotary valve, driven by the reduction gearings through an Oldham coupling, and supported at both ends on plain bearings. The Geneva mechanism provides for rapid shifting of the rotary valve in eight steps per revolution. The approximate cycle time is 40 seconds consisting of 4⅛ seconds at each position and ⅞ seconds required for each shifting operation.

The de-icer distributor valve rotor has eight operating positions as may be seen by referring to *figure 575*. Of these eight positions only one (position #1) is suitable for the overboard routing of air when the system is inoperative. The engine-driven air (vacuum) pumps are always supplying air under pressure to the de-icer system whenever the engines are running. It is important that the distributor valve rotor always stop at the #1 position when the system is shut off to allow the air under pressure to go overboard, thus preventing a continuous pressure in the de-icer system and eliminating the repeated opening and closing of the relief valve.



1. Electrical Motor
2. Drive
3. Port to Wing Double Tubes
4. Port to Wing Single Tubes
5. Electrical Connection
6. Micro Switch
7. Venturi Port (Overboard)
8. Empennage Shoes Port
9. Check Valve
10. Exhaust Port
11. Vacuum Port
12. Rotor
13. Air Pressure Port

Figure 574 — De-Icer Distributor Valve

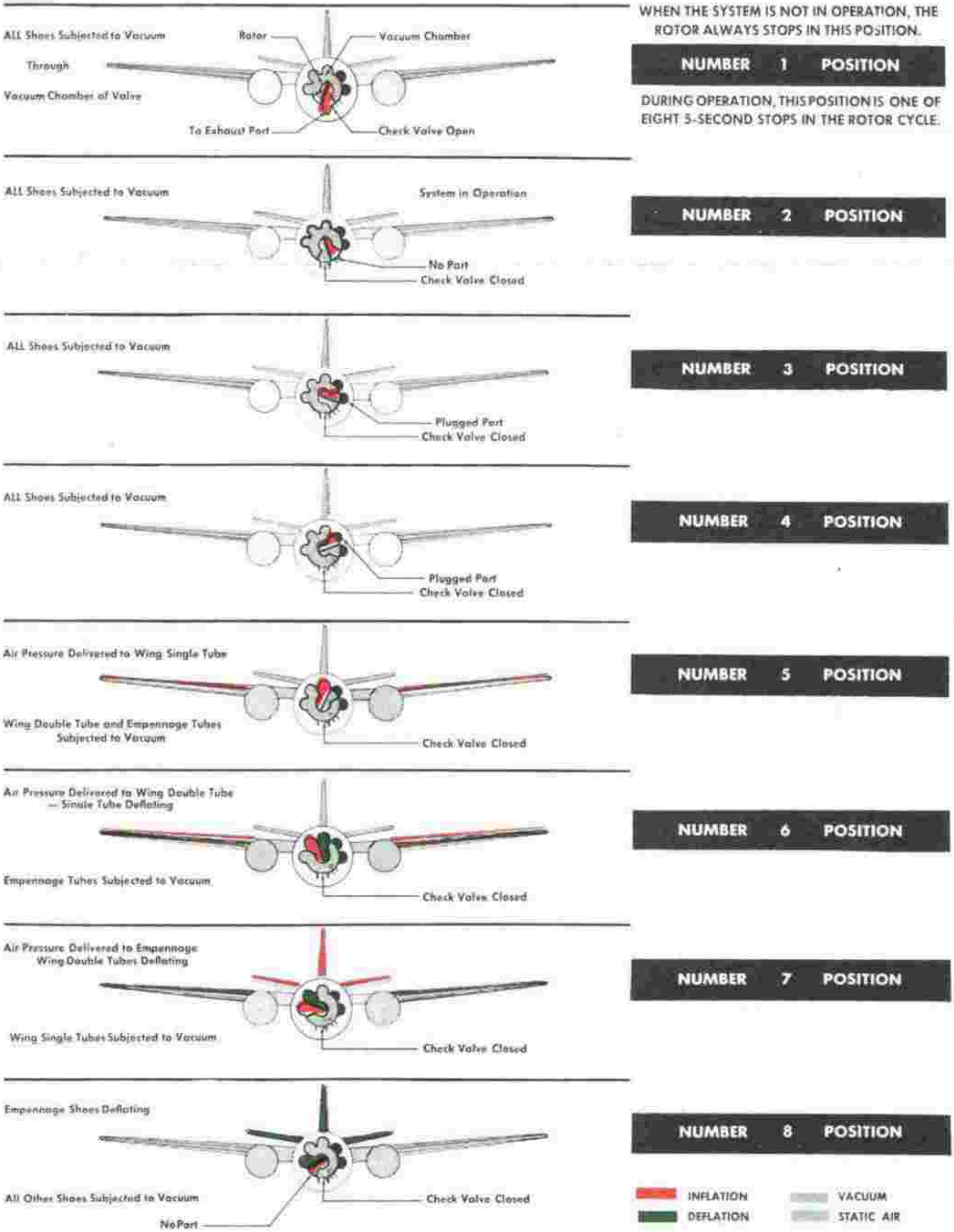


Figure 575 — De-Icer Distributor Valve Operation

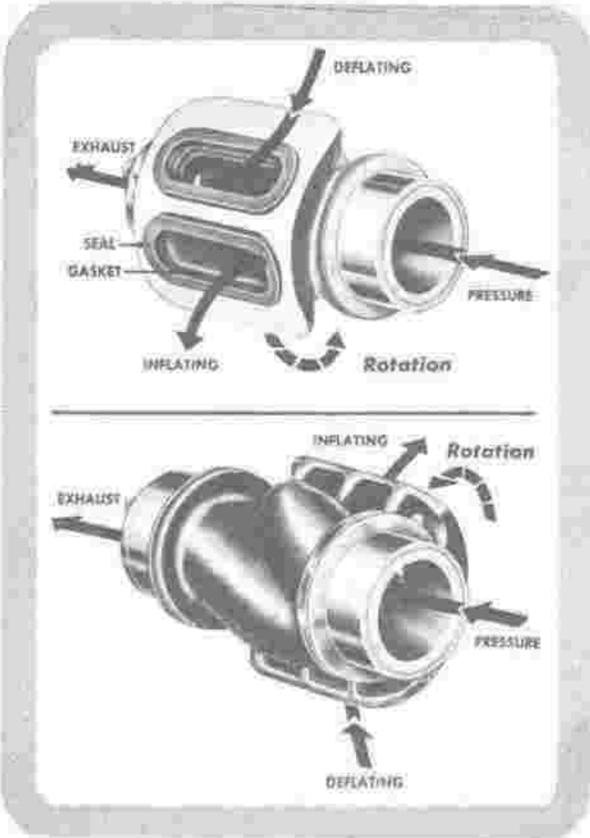


Figure 576 — De-Icer Distributor Valve Rotor

The electrical operation of the de-icer distributor valve is accomplished as follows: Two electrical circuits are connected to the valve motor; one of which is routed through the de-icer switch *(figure 320)* in the pilot's compartment, the other is routed through the micro switch *(6, figure 574)* installed upon the valve body. When the de-icer switch is turned to the "OFF" position, the one circuit is broken but unless the valve rotor is in position #1 the other circuit (through the micro switch) will supply electricity to the valve motor which continues to operate the rotor. When the rotor reaches position #1, the micro switch pin drops into a hole in the rotor, breaking the circuit within the switch.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Disconnect the electrical plugs from the distributor valve.

b. Disconnect and cap the lines leading into the valve.

c. Remove the bolts attaching the valve to the supports in the pilot's compartment. Remove the de-icer valve.

2. DISASSEMBLY.—Disassembly of the de-icer distributor valve is a repair depot function.

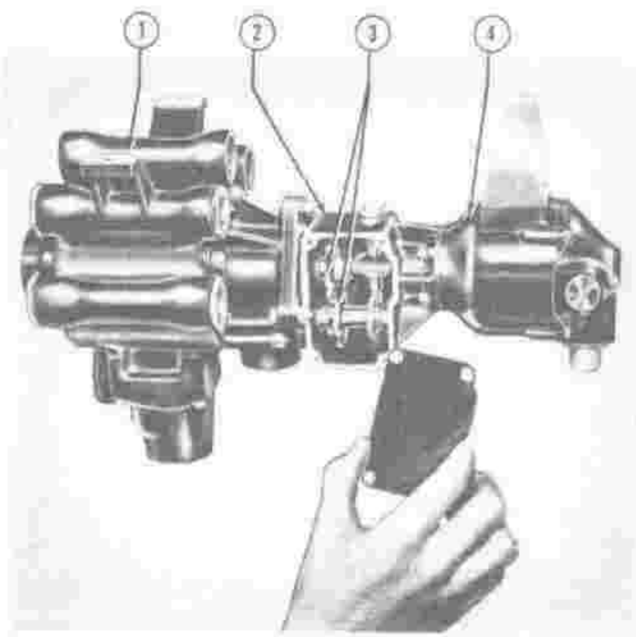
(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair of the de-icer distributor valve, will be necessary.

(d) ADJUSTMENTS.—The de-icer distributor valve does not require adjustment.

(e) TEST BEFORE INSTALLATION.—The de-icer distributor valve is tested at the factory. Hence, a test immediately prior to installation is unnecessary.

(f) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure *(b)*, above.

(g) TEST AFTER INSTALLATION.—The de-icer distributor valve is tested in conjunction with the test of the de-icer shoes. Refer to paragraph 20. *b.* (5) *(b)*, this section. If the de-icer shoes inflate and deflate in the correct order, it may be assumed that the distributor valve is also functioning correctly.



1. Valve Assembly
2. Gear Box Assembly
3. Geneva Mechanism
4. Motor

Figure 577 — De-Icer Distributor Valve (Snap Action Gear Mechanism Illustrated)

(3) AIR (VACUUM) PUMPS. *(See figure 237.)*—Two engine-driven air (vacuum) pumps, one on each engine section, are provided for the de-icing system. Each pump has a vacuum inlet and a pressure outlet. The vacuum inlet of one or the other of the two pumps sucks air from the distributor valve ports not covered by the rotor. At the same time, the vacuum inlet of the pump on the opposite engine section supplies suction for operating the gyro instruments.

By use of the selector valve, the function of the two pumps may be reversed. *(Refer to 14, figure 572.)* Discharged air from the pressure side of both pumps supplies the air under pressure for the operation of the inflation cycles of the de-icer system. Further information pertaining to air (vacuum) pumps will be found in paragraph 13. *d.* (10), this section.

(4) OIL SEPARATORS. *(See 11, figure 572.)*

(a) DESCRIPTION.—Two oil separators, one located in each engine section, are provided to remove the oil from the air which is used to inflate the de-icer shoes. The oil separator is necessary in this system because the air (vacuum) pump is lubricated by the engine oil system. The air has a tendency to carry this oil vapor which must not be permitted to enter the rubber de-icer shoes.

(b) OPERATION.

1. The discharge air of the air (vacuum) pump is directed into an oil separator.

2. Baffles within the separator collect the oil and discharge it into a screened drain which is connected to the engine crankcase.

3. The oil cleansed air is piped through a safety valve *(13, figure 572)* to an air filter *(2, figure 572)* located adjacent to the distributor valve.

(c) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Loosen the line clamps at the oil separator.

b. Disconnect and plug the line leading into the separator.

c. Remove the bolts which attach the separator bracket to its support. Remove the separator.

2. DISASSEMBLY.—Disassembly of the oil separator, other than the screened outlet, is neither advisable nor practical. Unscrew the nipple and lift out the gasket and strainer.

(d) MAINTENANCE REPAIR OR REPLACEMENT.

1. MAINTENANCE REPAIR.—It is impractical to repair oil separators.

2. REPLACEMENT.—Replace faulty oil separators.

(e) ADJUSTMENTS.—The oil separators require no adjustment.

(f) TEST BEFORE INSTALLATION.—The oil separators should be tested for leakage by plugging one port, applying approximately 20 pounds air pressure at the other port and submerging it in water to observe any leaks.

(g) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND ASSEMBLY procedure. Refer to *(c)*, above.

(h) TEST AFTER INSTALLATION. — Place the de-icing system in operation. Check to see whether or not any air leakage occurs around the screen outlet. Coat the fitting with a soapy solution. If air leakage is present, bubbles will indicate the source.

(5) WING DE-ICER SHOES.

(a) DESCRIPTION.—The wing de-icer shoes consist essentially of three longitudinal tubes which form an integral part of a rubber flap or strip. This strip is centered on the leading edge of the wing. When the de-icing system is set in operation, the tubes within the strip inflate and deflate in an order necessary to crack ice immediately after it is formed, and cause it to be carried away by the air stream.

(b) REMOVAL.

1. Remove all the screws, clamps, and fairings that secure the de-icer shoes.

2. Apply hi-test gas or benzol along and under the flap. After the cement softens, lift the flap.

3. As each fairing strip is removed, tag it for position so that when the strip is reinstalled, it can be put down in its proper place.

4. Disconnect the air supply hoses and remove the de-icer shoes.

5. Plug the ends of the air tubes to prevent the entrance of foreign particles.

(c) STORAGE.—It is important that a definite procedure be followed in storing shoes as sunlight and heat hasten deterioration.

1. Tag the air supply hoses and secure them inside the wing. Snap the summer caps in place.

2. Remove all oil, old rubber cement, and dirt from the shoes by washing them with a neutral soap and water solution. If the soap and water solution is ineffective, use hi-test gasoline or benzol. Use the latter solvents sparingly as they are harmful to the de-icer boots.

3. Lay out the de-icer shoes with the outer, or black side up. Tape the ends of the metal beads and metal air connections to prevent injury to the rubber.

4. Roll them in a coil, starting with a 4-inch to 6-inch diameter. Wing de-icer boots are rolled from the connection end—the vertical and horizontal stabilizer tip from the tip end.

5. Wrap the shoes in heavy paper, turning the edges in to keep out light. Be sure that the de-icer shoes are not wrinkled when stored. Store in a cool, dark, dry place.

(d) MAINTENANCE REPAIR OR REPLACEMENT.

1. MAINTENANCE REPAIR.

a. PUNCTURES.

(1) Clean surface in vicinity of damage with soap and water and wipe dry.

(2) Select correct size patch.

(3) Place proper size shield over hole so cut-out portion exposes area to be patched. Hold shield in place throughout the following operations:

(a) Rub with cloth soaked in benzol to soften and remove conductive surface.

(b) Roughen surface with wire buffer.

(c) Smooth out with emery buffer so surface has been removed approximately .003″.

(d) Clean with benzol and allow to dry.

(4) Apply one coat B. F. Goodrich No. 1 rubber cement and allow to dry.

(5) Remove fabric backing from patch and apply one coat B. F. Goodrich No. 1 cement to exposed surface.

(a) Keep tacky surface of patch clean after removing fabric and cementing.

(b) Allow to dry. Unlike glue, rubber cement must be thoroughly dry before patch is applied.

(6) Apply patch to de-icer shoe.

(a) Stick center or edge of patch in place and work remainder down. Do not trap air.

(b) Roll down with metal roller.

(c) If edges are not tight, recement and allow to dry; then roll down.

(7) Allow repair to set 10 or 15 minutes. Then, wipe patch and surrounding area lightly with benzol to remove all excess cement.

Note

Ordinarily the cold patch method, described above, should not be applied to cuts, holes, or cracks over ¾ inch in length. However, in case of an emergency, a puncture of considerably greater area may be repaired.

b. RESURFACING DE-ICER BOOTS.—The conductive outer surface of the de-icer shoes prevents static electrical discharges which would puncture the de-icer and interfere with radio reception. This surface can be restored, if it has been abraded, by spraying the installed de-icer shoes with Goodrich Conductive Cement. Proceed as follows:

(1) Scrub surface to be recoated with a clean soft cloth; wet with Butyl Acetate or Isopropyl Acetate. Scrub vigorously to remove all loose particles and smooth any wrinkles in the coating.

(2) Spray de-icer shoe with two light coats of conductive cement. Allow ample time to dry between coats.

(3) Avoid contact with surface until completely dry.

(4) The airplane should remain in a warm place as long as possible after application.

Note

Conductive cement will air cure at room temperature in approximately 24 hours. Consequently, it is desirable to reservice de-icer shoes before other servicing of the airplane.

2. REPLACEMENT.—Replace all de-icer shoes that are damaged beyond repair.

(e) ADJUSTMENTS.—The de-icer shoes do not require adjustments.

(f) TEST BEFORE INSTALLATION.—The de-icer shoes are not tested before installation.

(g) INSTALLATION.

1. Apply adhesive tape over all skin laps and rivet heads in the de-icer shoe area to prevent localized wear on the under surface of the rubber. Around salt water, use a coat of P-27 primer on the skin under the de-icer shoe.

2. Tape the under surfaces of the fairing strips flush with the trailing edge to prevent the strip marring the skin of the airplane.

3. Lay the proper fairing strip on the edge of the de-icer shoe.

4. Punch the holes (directly in line with the holes in the fairing strip) in the fabric-reinforced rubber so that the metal bead will bear against the screws when installed. Around the tip curve, the de-icer shoe should be punched only after the straight part has been located on the wing. Be careful not to damage the flap.

5. Slide the rubber back on the bead to curve the tip of the de-icer shoe to conform roughly to the wing-tip curve.

6. Rub talc on the back of the de-icer shoe.

7. Brush a mixture of talc and non-leaded gasoline on the leading edge to further lubricate the de-icer shoe.

8. Place pegs in the rivnut holes on the top of the wing. Hang the de-icer and fairing strips on these pegs. Be sure that the de-icer shoe is in the proper position at the air connections.

9. Attach the fairing strip and de-icer shoe with special attaching screws, removing the pegs as the screws are driven. Do not tighten the screws. Leave them loose.

10. Remove the summer caps. Pull out the air supply hoses and connect and safety them to the respective connections on the de-icer shoe; then adjust the connections properly in place inside the wing.

11. Starting near the connections, stretch the de-icer boot around the leading edge with a pair of de-icer pliers and peg it into place.

12. Then, install the fairing strip over the pegs according to initial layout.

13. Replace every other peg with a screw and tighten securely.

14. Replace the rest of the pegs with screws and be sure that they are all tight. Finally, tighten all screws along the top attachment.

15. Start operations on the wing tip curve. Hold the de-icer shoe up to the line of rivnuts. Then, mark the first few rivnut positions. Punch and peg the de-icer shoe.

16. Follow the same procedure on the bottom of the wing tip.

17. As the de-icer is pegged along the wing tip, be careful to fit the curve of the tip and to keep all puckers at right angles to the leading edge.

18. Place the curved fairing strip over the pegs. Then replace the pegs with screws. Tighten all screws progressively toward the tip.

(b) TEST AFTER INSTALLATION.

1. Attach an auxiliary air supply line to the two-way valve which is located on the right-hand side of the nose wheel well.

2. Make certain that the auxiliary air supply line will deliver a steady flow of air at between 8 and 10 psi.

3. Open the two-way valve.

4. Place the de-icer system control switch "ON."

5. Turn on the auxiliary air supply and observe the action of the shoes. Check pulsation cycle for correct operation.

Note

The air pressure gage on the instrument panel should be watched carefully during the test. If the air pressure exceeds 8½ pounds, turn "OFF" the de-icing system immediately and readjust relief valve to obtain a lower air pressure.

(6) EMPENNAGE DE-ICER SHOES.—A de-icer shoe, containing two tubes, is installed along each horizontal stabilizer and the vertical stabilizer. The shoes operate in the same manner as the wing de-icer shoes.

Note

Information pertaining to the maintenance of stabilizer de-icer shoes will be found in paragraph 20. *b.* (5) *(d)*, this section. All de-icer shoes are maintained in essentially the same way.

(7) DE-ICER AIR PRESSURE SAFETY VALVES. *(See 13, figure 572.)*

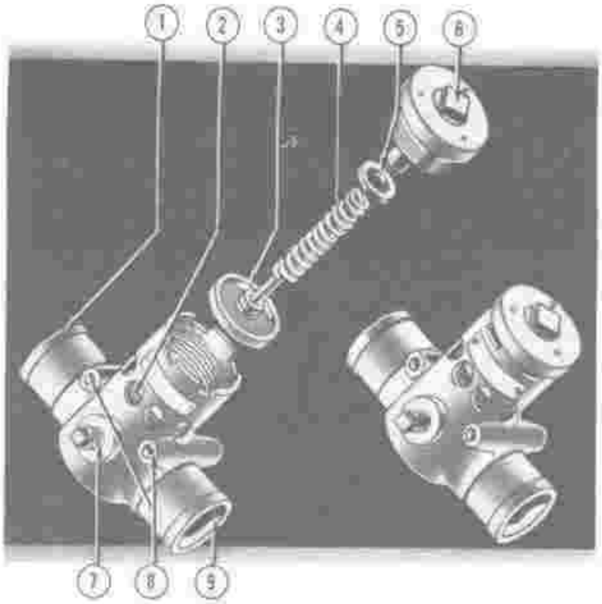
(a) DESCRIPTION.—Two safety valves, one adjacent to each air (vacuum) pump *(12, figure 572)* are provided for the de-icing system. Each valve is located aft of the applicable oil separator *(11, figure 572)* in a line which leads to the de-icer distributor valve. *(See 1, figure 572.)*

The valve is of the spring-loaded disc type. It is designed to act as an air pressure regulator and to relieve excessive pressure in the discharge line to prevent overloading of the pump.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Loosen the line clamp on each end of the safety valve.



1. Air Inlet
2. Air Outlet —Excess Pressure
3. Valve
4. Spring
5. Spacer
6. Guide, Screw and Washer
7. 1/8 inch p.t. Plug
8. Mounting Lugs
9. Air Outlet—To System

Figure 578 — De-Icing System Safety Valve

b. Disconnect and plug the two lines at the valve. Remove the safety valve.

2. DISASSEMBLY.—The safety valve may be completely disassembled by removing the valve guide.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. MAINTENANCE REPAIR.—Remove the valve guide and wash it in a suitable cleaning fluid. If the valve disc is worn, dress it carefully on a flat oilstone.

2. REPLACEMENT.—Test the spring tension by measuring the force required to compress it to 1⅛ inches long. The force must be at least 3.7 pounds. Replace if necessary.

(d) ADJUSTMENTS.—Adjustment of spring tension is made by means of subtracting or adding to the washers which are located under the spring guide. The valve is designed to open at 9 psi air pressure.

CAUTION

Do not adjust safety valve to open at a pressure of less than 9 psi. This valve is to operate in emergency only to prevent high pressures if the relief valve, which is set for 8½ psi, fails to open.

(e) TEST BEFORE INSTALLATION.—New safety valves are tested for operation at the factory. Consequently, a test immediately prior to installation of a new valve is unnecessary. A used valve must be tested to open at 9 psi air pressure before installation.

(f) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure, *(b)*, above.

(g) TEST AFTER INSTALLATION. — A specific test of the safety valves is not made after installation.

(8) DE-ICER AIR FILTER. *(See figure 579.)*

(a) DESCRIPTION.—An air filter, located adjacent to the de-icer distributor valve, removes the remaining oil from the air, after it has left the oil separator.

The filter consists of a centrifugal type oil separator with an integral air filter for removing residual oil vapor from the air. It incorporates an adjustable relief valve for regulating the maximum air pressure in the de-icing system to 8½ psi.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Disconnect and cap the lines leading into the air filter.

b. Remove the bolts which attach the filter to the pilot's compartment and remove the air filter.

2. DISASSEMBLY.

a. Remove the lockwire. Remove nut and washer holding filter cover in place.

b. Lift out cover and gasket. Lift out cylinder encasing the filter element.

c. Remove the lockwire. Remove the screw holding valve in place.

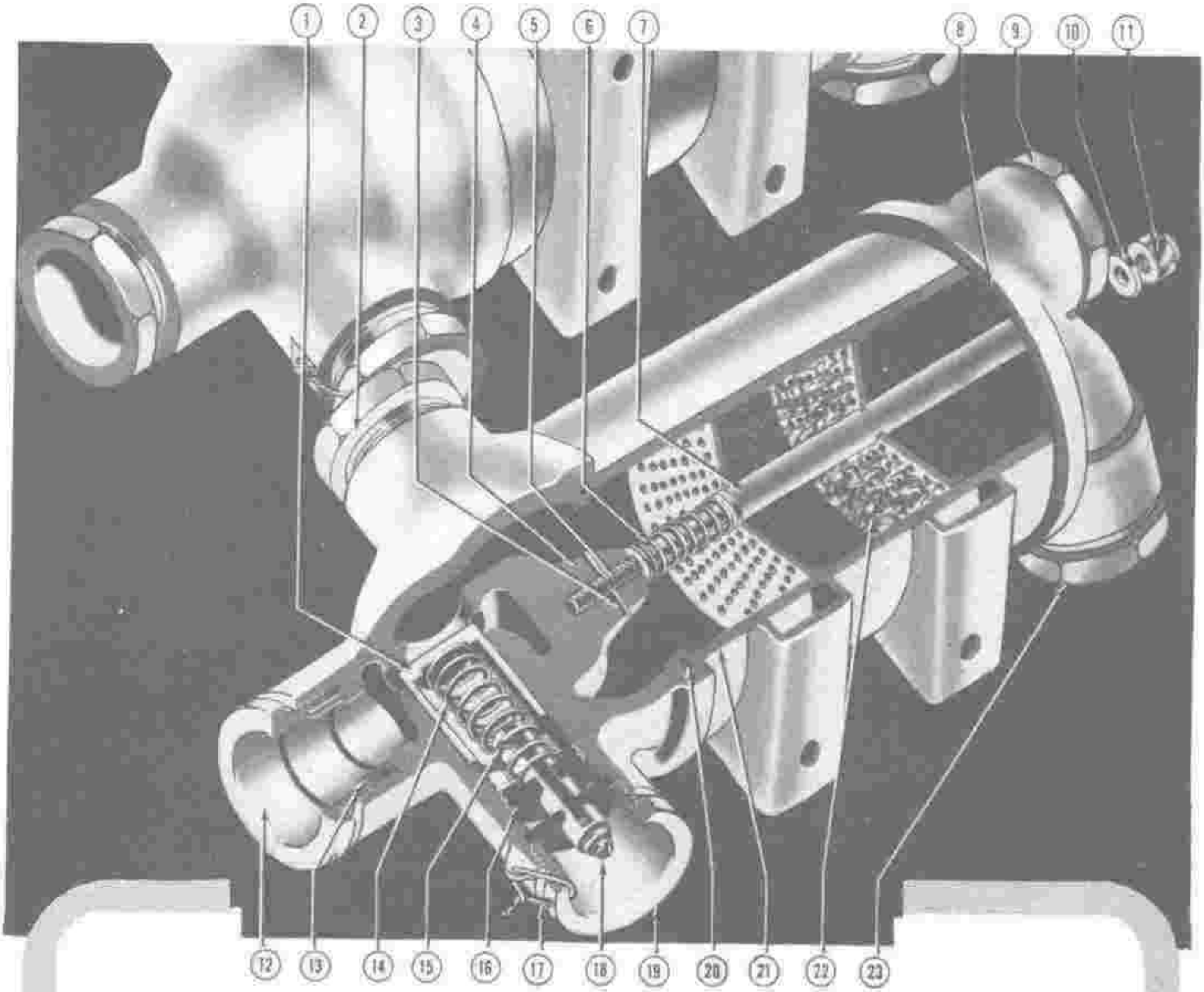
d. Remove the nut, spring, and valve.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, of damaged air filter parts will be necessary.

(d) ADJUSTMENTS.—Adjust the relief valve by loosening the lock nut, and by turning the adjusting screw clockwise to increase air pressure or counterclockwise to decrease air pressure. Eight and one-half psi is correct pressure.

(e) TEST BEFORE INSTALLATION.—The de-icer air filter is not tested immediately prior to installation.

(f) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedures, *(b)*, this section.



1. Air Pressure Relief Valve
2. Air Pressure Inlet
3. Dowel Pin
4. Housing Inlet
5. Stud
6. Spacer Spring
7. Tube Spacer
8. Cover
9. Plug
10. Washer
11. Stop Nut
12. Excess Air Pressure Outlet
13. Seal
14. Air Pressure Relief Valve Spring
15. Cotter Pin
16. Adjusting Screw
17. Lock Wire
18. Adjusting Shaft Assembly
19. Nut
20. Gasket
21. Tube Center
22. Oil Strainer
23. Air Pressure Outlet

Eclipse Type 659 Model 2

Figure 579 — De-Icing System Air Filter (Air Pressure Relief Valve Incorporated)

(9) TEST AFTER INSTALLATION.—Test the relief valve in the filter by performing the test described in paragraph 20. *b.* (5) *(b)*, this section.

(9) DE-ICER AIR PRESSURE CHECK VALVES.

(a) DESCRIPTION.—Two check valves are provided for the de-icing system. The valves a.e installed in the two lines which converge to form a "Y" (also four-way junction). These lines lead from each air pump and after converging, terminate at the air filter *(2, figure 572)*. The valves prevent back pressure in the lines. Each valve consists of a housing which contains a circular flap. Tension is provided by a spring in the hinge.

(b) REMOVAL AND ASSEMBLY.

1. REMOVAL.—Disconnect line on either side of check valve.

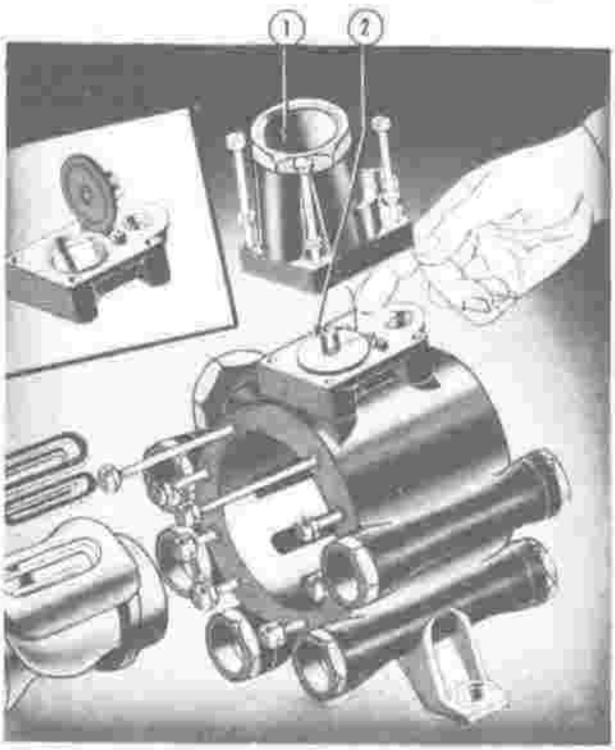
2. DISASSEMBLY.—Remove screws holding 2 parts of valve housing together. Remove hinge pin and lift out spring and circular flap.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. MAINTENANCE REPAIR.—Replacement, rather than repair, is necessary.

2. REPLACEMENT.

a. Replace circular flap and spring if worn or damaged.



1. Exhaust Port 2. Check Valve

Figure 580 — De-Icer Distributor Exhaust Check Valve

b. Replace entire valve if threads are scored.

(d) ADJUSTMENTS.—Check valves do not require adjustment.

(e) TEST BEFORE INSTALLATION.—Check valves do not require a test before installation.

(f) ASSEMBLY AND INSTALLATION. — Reverse the REMOVAL AND DISASSEMBLY procedure. Refer to *(b)*, above.

(g) TEST AFTER INSTALLATION.—Check valves do not require a test after installation.

(10) DE-ICER AIR PRESSURE GAGE. *(See 9, figure 572.)*

(a) DESCRIPTION.—The de-icer air pressure gage is of the direct indicating Bourdon type. It is located on the main electrical panel.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Remove mounting screws.

b. Disconnect union.

2. DISASSEMBLY.

a. Remove screws on back of gage.

b. Remove Bourdon tube.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, of the de-icer air pressure gage will be necessary.

(d) ADJUSTMENT.—The de-icer air pressure gage does not require adjustment.

(e) TEST BEFORE INSTALLATION.—Use a test stand to test operation of gage.

(f) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Refer to *(b)*, above.

(11) LINES.

(a) DESCRIPTION.—Lines included within the de-icing system are arranged as shown in *figure 572*. All lines are made of aluminum alloy.

(b) REMOVAL AND DISASSEMBLY.—Lines are removed in the ordinary manner. No special tools are required. Note description and removal of component parts described previously.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. MAINTENANCE REPAIR.—Small holes may be repaired by welding.

2. REPLACEMENT.—Replace badly damaged lines. Refer to section VIII.

(d) ADJUSTMENTS.—Lines do not require adjustments.

(e) TEST BEFORE INSTALLATION.—It is unnecessary to test lines before installation.

(f) ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure.

(12) DE-ICER CONTROL TOGGLE SWITCH. *(See figure 320.)*—A de-icer control toggle switch, located on the pilot's main electrical panel, is used to set the de-icing system in operation. This switch operates through the medium of the de-icer snap action air distributor valve and electric motor assembly.

c. ANTI-ICING EQUIPMENT.

(1) GENERAL.—The anti-icing system is differentiated into propeller anti-icing, sighting station periscope anti-icing, pitot tube anti-icing, and carburetor anti-icing. An electric windshield wiper is provided for the bomb sight window on the bombardier type nose. The propellers and the periscopes are anti-iced by means of AN F-13 Isopropyl alcohol; the pitot tube and the carburetor are anti-iced by heat.

(2) PROPELLER ANTI-ICING. *(See figure 582.)*

(a) GENERAL.—Propeller anti-icing is accomplished by means of an electrically driven anti-icing fluid pump, anti-icing fluid which is contained in a tank, necessary valves, lines, a filter, and a propeller slinger ring which distributes anti-icing fluid over the propeller blades.

(b) PROPELLER ANTI-ICER PUMP. *(See figure 581.)*

1. DESCRIPTION.—The propeller anti-icer pump has an explosion proof d-c driving motor and a ball bearing mounted armature designed to withstand all thrust loads. A worm gear is keyed to the end of the armature shaft and engages the worm wheel attached to the pump drive shaft. The worm and wheel has a gear reduction of 40:1. The pump drive shaft is connected to the pump drive gear through an Oldham type coupling. The drive gear, in turn, meshes with the floating pump gears in the pump section. The pump section consists of a port plate which contains one 1/8-inch NPT inlet port and one 1/8" NPT outlet port, a gem plate which is drilled out to accommodate two pump gears, and a back cover plate drilled through for the drive coupling. The assembly of the port plate, gear plate, gears, and cover plate is bolted together and assembled to the reduction housing. The inlet port has passages drilled to the suction side of each of the floating gears. The fluid is carried approximately 2/3 of a revolution of the pump gears to the outlet passage leading to the discharge port.

When the anti-icing system is set in operation, the pump delivers a metered supply of anti-icing fluid, from an anti-icing fluid tank *(figure 581)* to each of the propeller slinger rings *(1, figure 582)*. The pump is located in the aft end of the right-hand nacelle.

2. REMOVAL AND DISASSEMBLY.

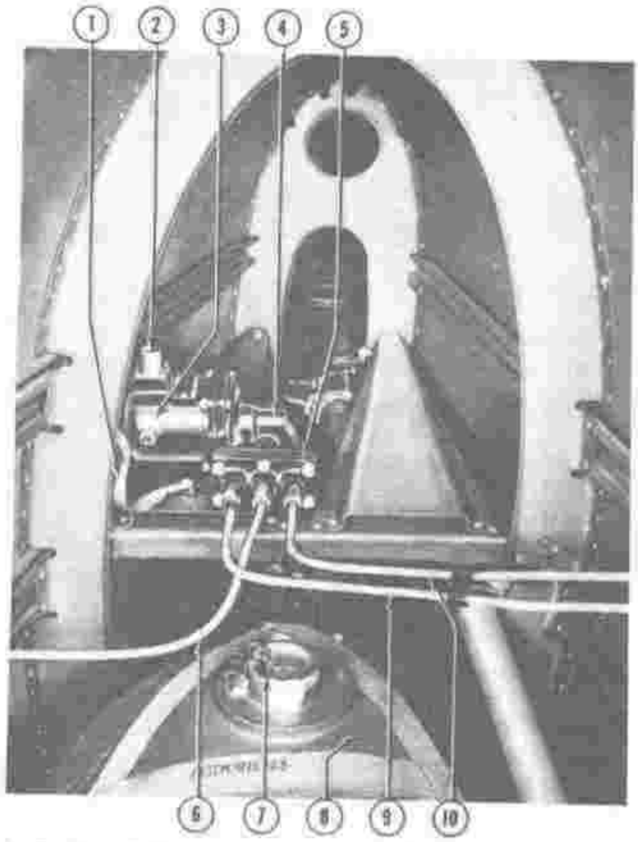
a. REMOVAL.

(1) Remove the fluid filter which is attached to the pump. Refer to paragraph 20. *c.* (2) *(c)*, this section.

(2) Disconnect and cap the lines leading into the pump.

(3) Disconnect the electrical plug at the bottom of the pump.

(4) Remove the screws holding pump to bulkhead. Remove pump.



1. Bonding Cable
2. Electrical Receptacle
3. Motor
4. Pump
5. Manifold Block
6. Supply Line from Tank
7. Filler Cap
8. Propeller Anti-Icer Fluid Tank (Cap. 6 U.S., 5 Imp. Gals.)
9. Feed Line to R.H. Propeller
10. Feed Line to L.H. Propeller

Figure 581 — Propeller Anti-Icing System Pump and Tank Installed

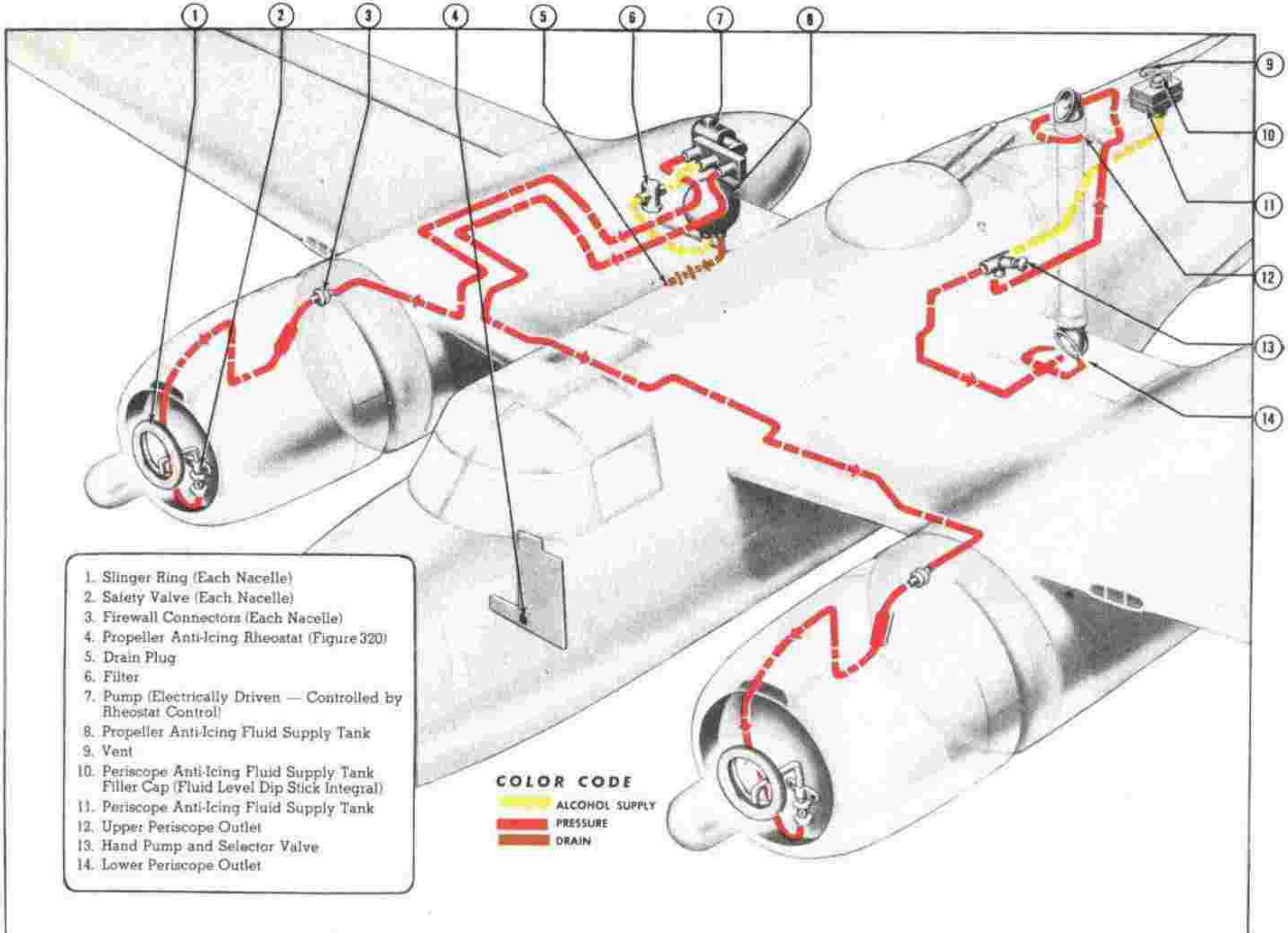


Figure 582– Propeller and Sighting Station Periscope Anti-Icing Systems

b. DISASSEMBLY.

(1) Separate pump from reduction gear housing by removing the connecting bolts located directly above and below the inlet port.

(2) Remove the bolts which fasten the pump assembly together and separate the cover plate gears, gear plate, back plate, and coupling. Handle these parts carefully in order to prevent possible damage to the gears. Although these parts are interchangeable, it is recommended that they be kept in sets in order to facilitate reassembly.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Propeller anti-icing fluid pumps should be replaced rather than repaired.

4. ADJUSTMENTS.—No adjustments are required for the propeller anti-icing pump.

5. TEST BEFORE INSTALLATION.—New anti-icer pumps are tested at the factory; hence, a test immediately prior to installation is unnecessary.

6. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Refer to *2.*, above.

7. TEST AFTER INSTALLATION.

a. Place the propeller anti-icing system in operation. Refer to PROPELLER ANTI-ICING FLUID CONTROLS, *(g)*, below.

b. Examine propeller slinger rings to see if anti-icer fluid is being emitted.

c. Vary the rpm of the pump and note increase and decrease of fluid output.

(c) PROPELLER ANTI-ICER FLUID FILTER.

1. DESCRIPTION.—The anti-icer fluid filter consists of a removable, disc type filter element assembled to a cap which is threaded into the filter housing. The housing contains two ⅛" NPT ports for attachment of the fluid lines. The purpose of the filter is to remove foreign material from the fluid before it enters the pump. The filter is located adjacent to the pump.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect and cap the lines leading into the filter.

(2) Plug the ports in the filter and remove it from the airplane.

b. DISASSEMBLY.—Remove disc type filter element from filter by unscrewing cap which is threaded into the filter housing.

3. MAINTENANCE REPAIR OR REPLACEMENT.—It is impractical to repair worn or damaged fluid filters. Replace the fluid element if any discs are cracked or bent.

4. ADJUSTMENTS.—No adjustment is required for the fluid filter.

5. TEST BEFORE INSTALLATION.—New fluid filters are tested at the factory; consequently, a test immediately prior to installation is unnecessary.

6. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Refer to *2.*, above.

7. TEST AFTER INSTALLATION.—With the system in operation, observe the fitting and filter for fluid leaks.

(d) SLINGER RINGS. *(See 1, figure 582.)*—The anti-icing fluid is distributed to the propeller blades by means of a slinger ring installed on each propeller hub. The slinger ring is a channel type collector ring with a delivery tube for each blade. Centrifugal force supplies the fluid from the slinger ring into the propeller boots, from which it is discharged onto the propeller blades.

Note

The slinger rings are subject to little wear and therefore do not require special maintenance service.

(e) ANTI-ICING FLUID TANK. *(See figure 581.)*

1. DESCRIPTION. — A spherical anti-icing fluid tank is located in the aft end of the right-hand nacelle. The tank holds 6 U.S. gallons, (5 Imp. gallons) of anti-icing fluid.

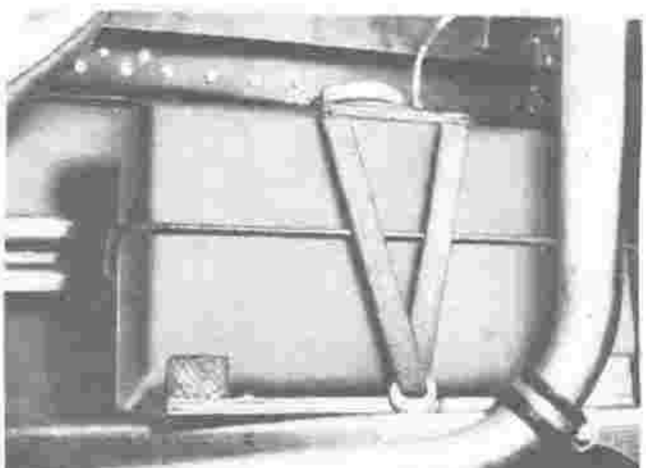


Figure 583—Periscope Anti-Icing Fluid Tank

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Remove clip and grommet on outlet end of drain line.

(2) Remove strap assembly.

(3) Remove drain lines by disconnecting connector, coupling, plug, and safety wire.

(4) Disconnect propeller anti-icing lines.

b. DISASSEMBLY.—Other than for the removal of the cap assembly and measuring rod, there is no disassembly of the anti-icing fluid tank.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MAINTENANCE REPAIR.—Repair any small holes by welding.

b. REPLACEMENT.—Replace any badly damaged tanks.

4. ADJUSTMENTS.—The anti-icing fluid tank does not require adjustment.

5. TEST BEFORE INSTALLATION.—The tank is air pressure tested by the factory. Therefore, a test immediately prior to installation is unnecessary. However, if a test stand is available, the tank may be tested for leakage by subjecting it to an air pressure of 5 psi. A soap solution applied to the surface of the tank will indicate, by bubbles, if leakage is present.

6. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Refer to *2.*, above.

7. TEST AFTER INSTALLATION.—After filling the tank for the first time after installation, check around the fittings for leaks.

(f) CHECK VALVES.

1. DESCRIPTION.—Two check valves, one for each propeller, are located adjacent to the applicable slinger ring. Each valve opens at 2-4 psi. pressure.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—Unscrew the fittings which hold check valve between slinger ring and propeller anti-icer fluid line. Remove the check valve.

b. DISASSEMBLY.—Unscrew the cap. Lift out spring and ball.

3. MAINTENANCE REPAIR OR REPLACEMENT.—It is advisable to replace the worn or damaged check valve assemblies or parts.

4. ADJUSTMENTS.—Check valve assemblies do not require adjustment.

5. TEST BEFORE INSTALLATION.—The check valve assemblies are set at the factory for an opening pressure of from 2-4 psi. If a test stand is available, the operation of each valve assembly may be determined.

6. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Refer to *2.*, above.

7. TEST AFTER INSTALLATION.—Check for fluid leaks around valve after installation.

(g) PROPELLER ANTI-ICING FLUID CONTROL. *(See figure 320.)*—The propeller anti-icing system is operated electrically by a rheostat control located on the bottom of the pilot's main electrical control panel. The rheostat control may be adjusted to allow varying amounts of anti-icing fluid to flow to the propeller slinger rings.

(h) PROPELLER ANTI-ICING FLUID LINES.

1. DESCRIPTION.—Lines included within the propeller anti-icing fluid system are arranged as shown in *figure 582.* All lines are made of aluminum alloy. Standard fittings are used throughout.

2. REMOVAL AND DISASSEMBLY.—The lines are removed in the ordinary manner. No special tools are required. Note description and removal of component parts described previously.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MAINTENANCE REPAIR.—Small holes may be repaired by welding.

b. REPLACEMENT.—Replace any badly damaged lines.

4. ADJUSTMENTS.—Lines do not require adjustments.

5. TEST BEFORE INSTALLATION.—It is unnecessary to test lines before installation.

6. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Refer to *2.*, above.

7. TEST AFTER INSTALLATION.—Set the propeller anti-icing system in operation. Check for free access of anti-icing fluid to slinger rings and for leakage of lines.

(3) SIGHTING STATION PERISCOPES ANTI-ICING *(See figure 582.)*

(a) GENERAL.—Periscope anti-icing is accomplished by means of a hand-operated pump, AN F-13 Isopropyl alcohol which is contained in a tank, and necessary supply lines.

(b) UPPER AND LOWER PERISCOPES.–Complete information about the periscopes will be found in paragraph 15. d. (16) (d), this section.

(c) ANTI-ICING FLUID PUMP. (See figure 584.)

1. DESCRIPTION.–A conventional two-engine fuel primer pump (with altered indicator plate) is used to supply anti-icing fluid to both the upper and the lower sighting station periscopes. A selector valve is integral with the pump. Either periscope may be supplied anti-icing fluid independently of the other, but both periscopes may not receive anti-icing fluid simultaneously. The pump is of the displacement plunger type. It is an entirely self contained unit and has no auxiliary valves or other parts. Distribution and shut-off are effected by the single pump handle.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.–Remove screws attaching pump to bracket and disconnect lines. Lift out pump.

b. DISASSEMBLY.–Complete disassembly of the pump is to be done only at a repair depot.

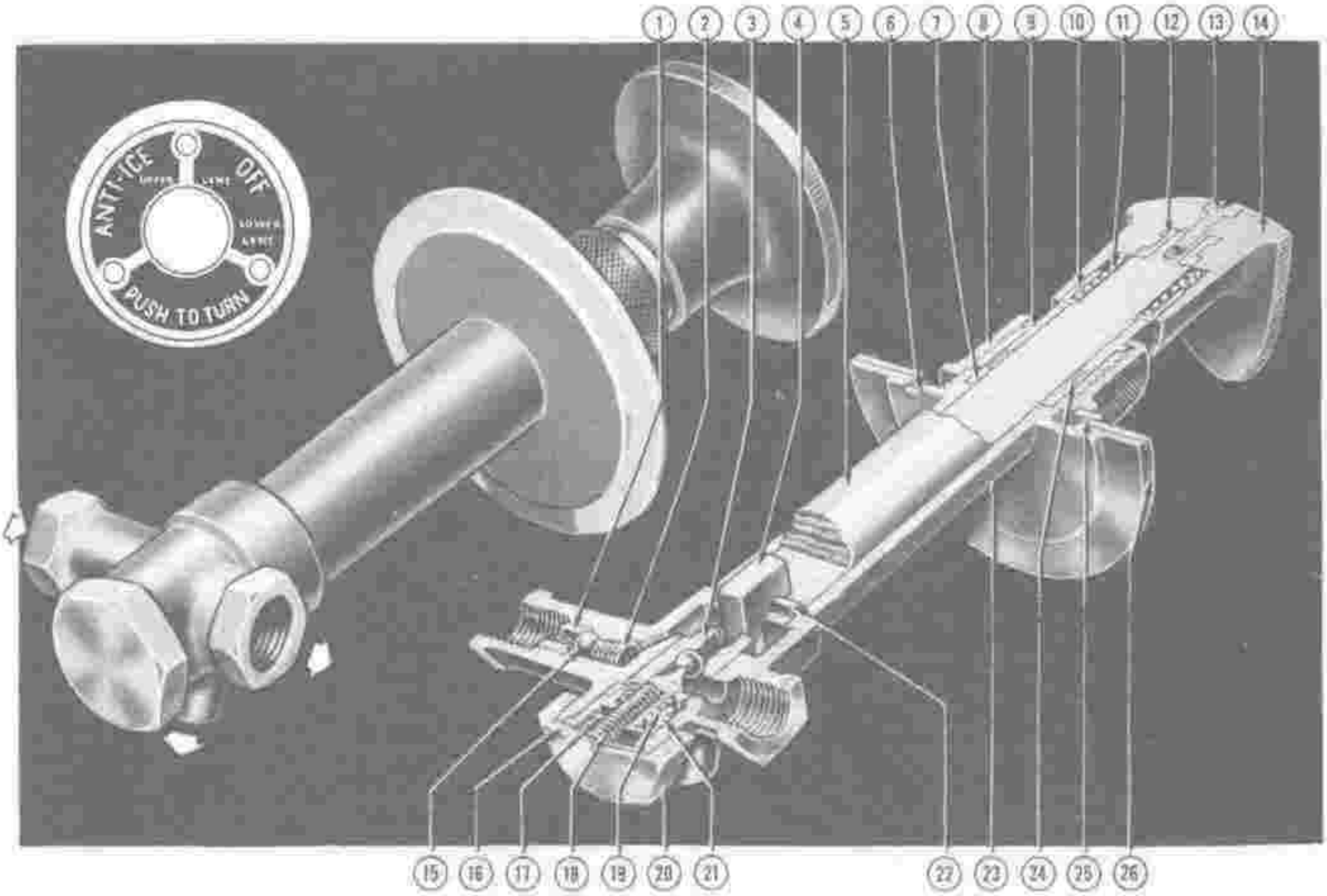
3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MAINTENANCE REPAIR.–Repack as follows:

(1) Turn the pump to either "UPPER LENS" or "LOWER LENS" position.

(2) Unscrew the packing cap.

(3) Pull the entire piston assembly out of its housing.



1. Inlet Check Insert
2. Inlet Check Spring
3. Plug
4. Piston Key
5. Piston
6. Rivets
7. Packing Washer
8. Packing Cap
9. Packing Follower
10. Handle Spring Follower
11. Handle Spring
12. Handle Bushing
13. Handle Screw
14. Handle
15. Inlet Check Ball
16. Diaphragm
17. Vacuum Check Piston
18. Vacuum Check Spring
19. Plug Spring
20. Vacuum Check Cap
21. Vacuum Check Insert
22. Pin
23. Body
24. Packing
25. Packing Cap Spring
26. Indicator Plate

Figure 584 — Periscope Anti-Icing System Hand Pump

(4) Remove handle screw, handle, handle spring, and handle spring follower.

(5) Remove the packing cap, packing follower, and packing off the piston barrel.

(6) Replace the old packing with the new, and reassemble the other parts in reverse order. Be certain that the correct packing is used.

Note

Do not grip plunger with vise or pliers.

b. REPLACEMENT.—Replace badly damaged pumps.

4. ADJUSTMENTS.—The primers do not require adjustment.

5. TEST BEFORE INSTALLATION.—New pumps are tested for proper operation at the factory. Consequently, a test immediately prior to installation is unnecessary.

6. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY, *2.*, above.

7. TEST AFTER INSTALLATION.—Operate pump. Check to see that first one and then the other periscope receives adequate anti-icing fluid. Note whether or not fluid leakage occurs around installations.

(d) PERISCOPE ANTI-ICING FLUID TANK. *(See figure 583.)*

1. DESCRIPTION.—A one U. S. .833 Imp.) gallon capacity anti-icing fluid tank (AN F-13 Isopropyl Alcohol) provided for periscope anti-icing, is installed on the left-hand side of the aft fuselage. The tank is made of weldable aluminum alloy and is provided with a vent line which leads to the fuselage. A measuring rod is attached to the cap.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect vent line at tank.

(2) Release strap assembly.

(3) Lift out tank.

b. DISASSEMBLY.—Except for the removal of the cap assembly, the tank is disassembled when removed.

Note

Further information pertaining to the periscope anti-icing fluid tank is identical with information pertaining to the propeller anti-icing fluid tank. Refer to paragraph 20. *c.* (2) *(e)*, this section.

(e) PERISCOPE ANTI-ICING FLUID LINES. *(See figure 582.)*—Essential information pertaining to all anti-icing lines (both for the periscope and for the propeller) is similar. Refer to paragraph 20. *c.* (2) *(b)*, this section. The following exception, however, in regard to periscope anti-icing fluid lines is made. The TEST AFTER INSTALLATION should encompass a check of the anti-icing fluid flow to both periscopes in accordance with the setting of the pump handle control. Refer to paragraph *(f) 2.*, below.

(f) PERISCOPE ANTI-ICING FLUID CONTROLS. *(See figure 584.)*—In order that either the upper or the lower periscope receive anti-icing fluid, the following procedure is necessary:

1. Turn the periscopes to the straight forward position.

2. Push in the pump handle and turn to the "UPPER LENS" or "LOWER LENS" position, as desired. A few operations of the pump are sufficient to supply anti-icing fluid to the desired sighting station periscope.

Note

Either periscope may receive anti-icing independently of the other, but both periscopes may not receive anti-icing fluid simultaneously.

(4) CARBURETOR ANTI-ICING.—A description of the carburetor air temperature control will be found in paragraph 15. *d.* (6), this section.

(5) PITOT TUBE ANTI-ICING.—A description of pitot tube anti-icing will be found in paragraph 15. *d.* (12) *(b)*, this section.

(6) BOMB SIGHT WINDOW ANTI-ICING. (A26C)

(a) WINDSHIELD WIPER ASSEMBLY.

1. DESCRIPTION.—Windshield wiping is accomplished by means of an electric motor, reduction gearing within a converter, necessary attachments, an actuating arms and blade assembly which oscillate to remove ice and water from the window. The windshield wiper installation consists of the following parts:

a. An electric motor.

b. A flexible drive shaft.

c. A converter.

d. A drive arm.

e. A blade and blade holder.

The entire system operates essentially as follows: The electric motor actuates the flexible drive shaft, which is attached to the converter. The converter transmits motion to the arm and blade assembly.

2. REMOVAL AND DISASSEMBLY.—Two mechanics should work together in removing the windshield wiper assembly. It must be remembered that the motor, flexible drive shaft, and drive units are mounted inside the bombardier's compartment; and that the drive arm, blade and blade holder, are installed on the outside of the airplane. Detach drive arm assembly, blade holder assembly and wiper blade as a unit from the shaft. Detach flexible drive assembly. Remove the converter. Detach the other end of the flexible drive assembly from electric motor. Remove electric motor.

3. MAINTENANCE REPAIR OR REPLACEMENT.—All windshield wiper assembly parts, other than the electric motor, should be replaced rather than repaired.

4. ADJUSTMENTS.—Obtain desired blade pressure (1½ to 2 pounds) by adjusting set screw on the drive arm.

5. TEST BEFORE INSTALLATION.—Windshield wiper assemblies are not tested immediately before installation.

6. ASSEMBLY AND INSTALLATION.—Reverse the REMOVAL AND DISASSEMBLY procedure. Refer to 2., above.

7. TEST AFTER INSTALLATION.—Place the windshield wiper in operation by means of the switch located on the pilot's main electrical control panel. Moisten the windshield with water before operation.

d. ICE ELIMINATION TROUBLE SHOOTING LIST.

TROUBLE	*PROBABLE CAUSE*	*REMEDY*
1. De-icing system will not operate.	*a.* Electrical wiring between de-icer switch and de-icer distributor valve motor is faulty.	*a.* Correct wiring.
	b. Lines are incorrectly attached.	*b.* Make correct attachment.
	c. Obstruction within a line or component part blocks flow of air.	*c.* Remove line, or component part, and clean.
	d. Electric motor brushes are worn.	*d.* Replace brushes.
2. De-icing system operates inefficiently.	*a.* Relief valve on filter is incorrectly adjusted.	*a.* Adjust as described in paragraph 20. *b.* (8) *(d)*, this section.
	b. Holes in de-icer shoes cause leakage of air.	*b.* Repair as described in paragraph 20. *b.* (5) *(d)*, this section.
	c. Safety valves are incorrectly adjusted.	*c.* Replace valve.
	d. Lines are incorrectly attached.	*d.* Make correct attachment.
	e. Filters or valves are partially obstructed.	*e.* Replacement, rather than repair or cleaning, is advisable.
	f. Air leakage occurs through holes in lines or at fittings.	*f.* Weld small holes in lines. Replace badly damaged lines. Replace fittings.
3. PROPELLER ANTI-ICING—Propeller slinger rings fail to receive anti-icing fluid.	*a.* Propeller pump electric motor fails to operate.	
	1. Electric wiring from pump to switch is faulty.	1. Correct wiring.
	2. Electric motor brushes are worn.	2. Replace brushes.
	3. Propeller pump may be faulty.	3. Replace pump. Install as directed in paragraph 20. *c.* (2) *(b)* 5. and 6., this section.
	b. Propeller anti-icing fluid tank is empty.	*b.* Fill tank.
	c. Propeller pump filter is clogged.	*c.* Replace filter.
	d. Lines are incorrectly attached.	*d.* Make correct attachment.
	e. Lines are obstructed.	*e.* Remove and force air through lines.
	f. Leakage occurs at fittings or through holes in lines.	*f.* Repair small holes in lines by welding Replace badly damaged lines. Replace fittings.
4. SIGHTING STATION PERISCOPE ANTI-ICING—Periscopes fail to receive anti-icing fluid.	*a.* Anti-icing fluid leaks through holes in lines or at fittings.	*a.* Repair small holes in lines by welding. Replace badly damaged lines. Replace fittings.
	b. Hand pump does not operate properly.	*b.* Replace or insert new packing as directed in paragraph 20. *c.* (2) *(b)* 3., this section.
	c. Periscopes are not in straight forward position.	*c.* Place in straight forward position.
	d. Lines are obstructed.	*d.* Remove line and blow clear by air pressure.
5. BOMB SIGHT WINDOW WIPER ANTI-ICING—Windshield wiper will not operate.	*a.* Electric wiring between switch and windshield wiper electric motor is faulty.	*a.* Correct electrical wiring.
	b. Electric motor brushes are worn.	*b.* Replace brushes.
	c. Mechanical linkage from motor to blade and blade holder is faulty.	*c.* Correct linkage between parts comprising windshield wiper and electric motor assembly.
6. Windshield wiper does not operate properly.	*a.* Blade pressure tension is incorrect.	*a.* Adjust to blade pressure of 1½ to 2 pounds pressure by adjusting the set screw on the drive arm.

21. FURNISHINGS AND MISCELLANEOUS EQUIPMENT

a. GENERAL.

Fuselage furnishings and miscellaneous equipment stowed or installed in the airplane are described in the following paragraphs. Location of the equipment is illustrated in *figure 585*.

b. LIFE RAFT.

(1) DESCRIPTION.—A five man pneumatic life raft, A-3 is installed on the forward bulkhead of the gunner's compartment. The raft is protected with a snap-on waterproof cover and is attached to the bulkhead by means of straps which can be freed automatically by pulling on the emergency release cord. The raft is accessible either from the inside or the outside of the airplane and can be inflated instantly with carbon-dioxide contained in a cylinder which is attached to the raft. The Type A-3 raft is constructed of rubberized fabric in the form of a boat-shaped inflatable tube.

Accessories provided with the raft, in addition to the carbon-dioxide cylinder and connecting valve, are as follows:

3 Seamarker dyes.
1 flashlight, floating type, and battery.
1 combination compass and match container.
1 shade and camouflage cloth.
1 sail and water catching cloth.
1 assembly emergency fishing kit.
9 units emergency subsistence rations, Type K. or 7 units of Life Raft Ration Type A.
1 Boy Scout type knife.
7 cans emergency drinking water.
1 police whistle.
1 first aid kit.
1 pyrotechnic pistol and 5 distress signals.
1 sea anchor.
3 oars.
1 hand pump, complete with hose.
1 pneumatic raft repair kit.
1 bailing bucket.
4 bullet hole repair plugs (wood).
1 central container assembly.
40 feet cotton cord, 75 lb. test.
1 signalling mirror.
1 set of religious pamphlets.
4 tubes of sunburn ointment.
4 water containers.
1 cellulose sponge.

To inflate the raft, remove it from the gunner's compartment, unfold at least one-half of its length, and allow the gas to enter by grasping the ball handle on the cylinder and jerking the valve release cord. Due to the low temperature of the gas the initial pressure in the raft may be low, but it will increase until atmospheric temperature is reached in five or ten minutes. The pneumatic seats are inflated with the hand pump, which also may be used for additional inflation of the raft if necessary.

To deflate the raft, unscrew the topping-off valve on each gas cell and also open the valves on the pneumatic seats. Exhaust all the gas with a deflation pump, powder the raft thoroughly with talc, and install a charged carbon-dioxide cylinder. Fold the raft so that the cylinder is near the outside and available for inspection, before returning the raft to its compartment.

(2) MAINTENANCE REPAIR OR REPLACEMENT.

(a) No repairs will be made to the rubberized fabric of the Type A-3 raft or the rubber bladder of the Type A-2 raft other than the patching of small holes. Such repairs will be made by cold-patching, using three coats of rubber cement. Large tears, rips, and severely chafed areas will be cause for condemnation of the raft. Normally, maintenance repairs and inspections requiring inflation tests will be performed by the station parachute repair personnel.

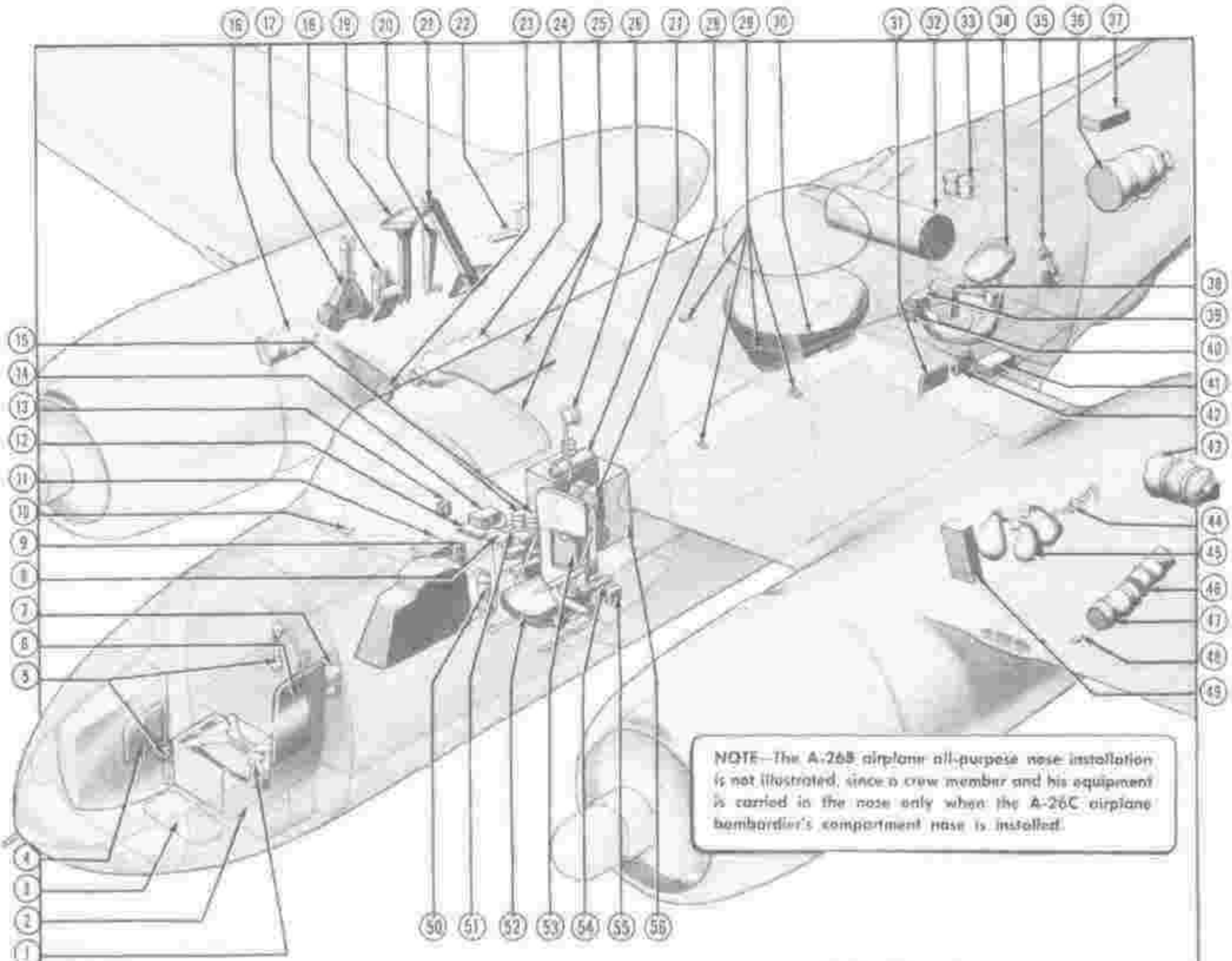
(b) Service activities shall not attempt to repair damage to the carbon-dioxide cylinder or remove the bushing and valve threaded directly into the cylinder body. Cylinder repairs other than painting shall be made at control depots which have been supplied with the necessary valving machines. Instructions for recharging carbon-dioxide cylinders will be found in T.O. No. 16-20-2.

c. PILOT'S SEAT.

The pilot's seat is installed on the left-hand side of the pilot's compartment. It is equipped with the Type B-11 safety belt, a safety belt shoulder strap, and a movable arm rest. The seat is adjustable both vertically and horizontally to accommodate pilots of varying stature. The vertical adjustment is made by operating a lever located on the lower right-hand side of the seat. The horizontal adjustment is made by operating a lever located in back of the right-hand arm of the seat.

d. GUN LOADER'S SEAT.

A fixed, saddle-type seat is provided for the gun loader on the right-hand side of the pilot's compartment. The seat is equipped with a Type B-11 safety belt.



1. Seat and Safety Belt (On Top of Ammunition Box)
2. Four Ammunition Boxes
3. Kneeling Pad
4. Data Case Holder
5. Entrance Assist Straps
6. Chart Board
7. Relief Container
8. Signal Container Assembly Type A-6
9. Load Adjuster
10. Clip Map Holder
11. Technical Orders
12. Gun Loader's Seat
13. Ash Trays
14. First Aid Kit
15. Disposable Relief Container
16. Bomb Hoist Bag Assembly Sling Stowage
17. Bomb Hoist Assembly
18. Wing Bomb Support Assembly
19. Bomb Hoist Beam Assembly
20. Bomb Hoist Handle Assemblies
21. Bomb Hoist Beam Assembly
22. Starter Hand Crank Assembly
23. Gear Box (Starting Crank)
24. Engine Tool Kit
25. Sun Curtain Assemblies
26. Hydraulic Reservoir Funnel
27. Type A-17 Fire Extinguisher
28. Pilot's Map Case and Glove Compartment
29. Bolts (Leveling Pins)
30. Bag, Ejected, Link and Case Catcher (Upper Turret)
31. Bomb Loading Diagrams
32. Life Raft
33. Disposable Crew Relief Containers
34. Gunner's Seat
35. Fireman's Small Hand Axe
36. Bomb Bay Vent Dust Excluder Assembly
37. Turret Spare Parts Kit (Type 2CSD1C1)
38. Gunner's Map Case and Glove Compartment
39. Bomb Rack Hook Assemblies
40. Bomb Hoist Pulley Bracket Assembly
41. Wing Rack Assemblies
42. Holder Bomb Loading Instruction Card
43. Engine Covers
44. Wing Gun Charging Handles
45. Outboard Wing Bomb Rack Support Assemblies (Forward and Aft)
46. Miscellaneous Handling Equipment Roll Assembly
47. Propeller Tool Kit
48. External Power Connection Adapter
49. Bomb Shackle Assemblies (Type B-7)
50. Type A-2 Fire Extinguisher
51. Pyrotechnic Pistol Type M-8
52. Pilot's Seat
53. Airplane Check List Holder
54. Airplane and Engine Data Name Plate
55. Ash Trays
56. Bag, Ejected, Link and Case Catcher (Cannon)

Figure 585 — Miscellaneous Equipment

e. GUNNER'S SEAT.

A spring-mounted, tractor-type seat for the gunner is installed as an integral part of the periscopic sighting station. The seat is designed to revolve with the sighting station, but if desired, it can be locked in either the forward or aft position by releasing a spring lock and pin assembly located at the base of the seat. Vertical adjustment of the seat is obtained while it is occupied by lifting up on a lever located on the under side of the seat. A Type B-11 safety belt is attached to the seat. A seat cushion is provided.

f. FIRE EXTINGUISHERS.

(1) DESCRIPTION. – Two hand-operated fire extinguishers are installed in the airplane. An extinguisher of the carbon-dioxide type *(27, figure 585)* is provided in the pilot's compartment. It is installed on the upper structure on the aft end of the control pedestal. A carbon-tetrachloride type extinguisher *(50, figure 585)*, intended primarily for ground use, is mounted on the aft bulkhead in the nose wheel well.

WARNING

When fighting a fire in a confined area with a carbon-tetrachloride extinguisher, work as far away as possible. Dangerous phosgene fumes are produced when the extinguisher fluid strikes fire.

(2) MAINTENANCE REPAIR OR REPLACEMENT.–Damaged or defective fire extinguishers must be replaced.

g. CREW RELIEF CONTAINERS. – Three leak-proof, disposable crew relief containers are installed in brackets in the pilot's compartment and two in the gunner's compartment.

h. PILOT'S MAP CASE AND GLOVE COMPARTMENT.–The pilot's map case and glove compartment is mounted on the radio support structure aft of the pilot's seat.

i. GUNNER'S MAP CASE AND GLOVE COMPARTMENT.–The gunner's map case and glove compartment is installed on the inboard side of the sighting station armor plate. (On the first five airplanes it is located on the left-hand side of the fuselage under the electrical circuit breaker box.)

j. CHECK LIST HOLDER.–An airplane check list holder is installed in the pilot's compartment to the right of the gun loader's seat.

k. CLIP MAP HOLDER.–A clip map holder is installed on the underside of the instrument panel shield in the pilot's compartment.

l. FIRST AID KIT.–An aeronautic first aid kit is installed on the back of the gun loader's seat in the pilot's compartment.

m. ASH TRAYS.–Two automobile-type ash trays are installed on the pilot's compartment structure, one to the left of the pilot and one to the right of the gun loader.

n. CURTAIN ASSEMBLIES. – Two overhead sun curtains are installed in the pilot's compartment, one above the pilot's seat and one above the gun loader's seat. When not in use the curtains are gathered and buttoned down into a compact assembly.

o. MISCELLANEOUS HANDLING EQUIPMENT ROLL.–The miscellaneous handling equipment roll is stowed on the outboard shelf in the left-hand nacelle. The roll contains four inboard wing jack pads, two fuselage jack pads, four bomb door operating mechanism stop bars, one nose gear ground safety block and pin, two main landing gear ground safety blocks and pins, two AN48-10 eye bolts and two AN315-8R nuts.

p. BOMB HOIST EQUIPMENT.–A bomb hoist is installed on the outboard shelf of the right hand nacelle. For operation see Section V.

q. STARTER HAND CRANK AND GEAR BOX.–A starter hand crank is installed on the aft, outboard side of the right-hand nacelle. A starter hand crank gear box is stowed on the forward inboard side of the right hand nacelle.

r. HYDRAULIC FLUID RESERVOIR FUNNEL.–A funnel used to fill the hydraulic fluid reservoir in the pilot's compartment is stowed on the aft side of the radio equipment shelf.

s. LOAD ADJUSTER AND CASE.–A load adjuster is provided in the pilot's compartment. It is a slide rule type instrument calibrated in accordance with the gross weight of this airplane. Rapid weight and balance calculations are made with this adjuster.

t. WING GUN CHARGING HANDLES.–Two wing gun charging handles are stowed in brackets on the forward, inboard side of the left-hand nacelle. The handles are used in charging the wing guns prior to take-off.

u. EMERGENCY FIRE AXE.–An emergency fire axe is mounted in brackets attached to the aft bulkhead of the gunner's compartment.

v. LEVELING PINS.–Four leveling pins are installed in the fuselage as an aid in the lateral and longitudinal leveling of the airplane on the ground.

Two longitudinal leveling pins are installed on the right-hand lower keel in the bomb bay. Two lateral leveling pins are installed on aft side of the cross tie plate in the bomb bay.

w. EXTERNAL POWER CONNECTION BRITISH ADAPTER.—This adapter is stowed in a canvas bag on the outboard side of the left-hand nacelle wheel well.

x. TURRET SPARE PARTS KIT.—Stowed in the extreme aft section of the fuselage is a kit containing dehydrating agents for the sighting stations.

y. LINK AND CASE EJECTED BAG.—Incorporated with the upper turret at the lower part of the turret mechanism in the bomb bay is a large canvas bag for catching and disposing of used shells. In the forward right-hand side of the bomb bay is a rectangular canvas bag for the catching of used cannon shell cases.

z. HOLDER, BOMB LOADING INSTRUCTION CARD.—On the aft lower left side of the bomb bay is a small plywood holder for cards containing instructions for loading bombs.

aa. BOMB LOADING DIAGRAMS.—On either side of the lower aft section of the bomb bay is a bomb loading diagram.

bb. SIGNAL CONTAINER ASSEMBLY.—To the right of the pilot's seat is a signal container.

cc. PYROTECHNIC PISTOL & HOLDER.—In front of the signal container are a pyrotechnic pistol and holder. See paragraph 22.

dd. NAME PLATES.—To the left of the pilot's seat are the airplane and engine data name plates and the military manufacturers' I. D. plate.

ee. WING BOMB RACK SUPPORT ASSEMBLY.—The outboard wing bomb rack support assembly is stowed in the left nacelle wheel well.

ff. PLACARDS.—Taped on the engine control pedestal near the fuel selector dial is a fuel tank selection fuel consumption limit warning placard. Taped to the control column is a 10 hour engine operating limitation placard.

gg. LOOSE ITEMS.—Loose items that are delivered with the airplane in boxes are as follows:

(1) *Box 1,* carried in the pilot's compartment, contains the following technical data: 1 book of Individual Wiring Circuits; 2 Radio Instruction Books; 1 Interphone Instruction Book; 1 Turret Operator Instruction Book; 1 Glide and Climb Clearance Chart; 1 Fuel System Diagram; 1 263B Form installed by AAF Inspection; and 1 each of the following Technical Orders: Erection & Maintenance Handbook; Pilot's Handbook; and Weight & Balance Data Handbook.

Note

These items will be distributed to the pilot's and gunner's data cases when unpacked.

(2) *Box 2* consists of the First Aid Kit and the Safety Belt Shoulder Strap Assembly. This box is carried in the pilot's compartment. The permanent stowage position of the Frst Aid Kit is behind the gunner's seat.

(3) *Box 3,* carried in the gunner's compartment, contains the following items:

Part Name	*Part No.*	*No. Req.*
Hook Assem., Bomb Rack	1126927	4
Hook Assem., Bomb Rack	1126927-1	4
Spring, Hook Latch, Bomb Rack	AF33A6186	4
Spring, Hook Latch, Bomb Rack	AF33A6186-1	4
Spacer Assem. Bomb Rack Hook	M28928	8
Bolt	AN6-13A	8
Washer	AN960-10L	16
Lockwire	AAF995-322	16
Support Assem., Type A-2	43B9887	4
Screw	AAF501-A10-8	8
Washer	AN960-10L	8
Lockwire	AAF995-322	4
Support Assem.	4155720	4
Bolt	AN6-12A	8
Latch	AF33A6182	4
Latch	AF33A6182-1	4
Bolt	AN3-10A	4
Screw	S-1087510-10-14	4
Nut	AAF365-1032	8
Washer	AN960-D10	8

(4) *Box 4,* carried in aft end of the fuselage contains the following:

Bomb Bay Vent Duct Dust Excluder	4143958	1
Exhaust Stack Dust Excluder	4203658	18
Carb. Air Intake Dust Excluder	5203612	2
Oil Cooler Air Intake Dust Excluder	5203536	2
Heat & Vent Air Scoop Dust Excldr.	4204878	2

(5) *Box 5,* carried in the rear gunner's compartment, contains the Bracket Assem. for the Bomb Hoist Pulley, Sta. 123—Part No. 5127967 and the Wing Bomb Hoist Inboard Attaching Support Assembly Part No. 5125683. These items are identified as item 38 on the drawing.

(6) *Box 6*, which is carried in the L. H. nacelle, contains the Propeller Tool Kit and the Armorer's Tool Roll (See drawing item #45). Number 5205026 Propeller Tool Kit contains the following items:

Part Name	*Part No.*	*No. Req.*
Wrench, Composite Combination	52829	1
Wrench, Retainer Nut	53004	1
Puller, Cam Slot Roller Shaft	52024	1
Handle, Dome	54101	1
Oil Seal, Barrel & Dome	52478	2
Oil Seal, Spider & Shaft	52965	2
Oil Seal, Dome Breather Tube	52645	2
Gasket, Valve Housing Copper	52664	2
Gasket, Valve Housing & Shaft Copper	53151	2
Roll, Armorer's Tool, .50 Cal.		

(7) *Box 7*, carried in the L. H. nacelle contains the Miscellaneous Handling Equipment Roll Assembly; see drawing item 44. Number 5153689 roll contains the following:

Part Name	*Part No.*	*No. Req.*
Wing Jack Pads	2126974	4
Bar Assem., Bomb Door Operating Mech. Stop	2150868	4
Fuselage Jack Pads	2126700	2
Eyebolt	AN48-10	2
Nut	AN315-8R	2
Main Landing Gear Ground Safety Pins Block Assem.	4151267	2

(8) *Box 8*, (see drawing item 16) carried in the forward part of the R. H. nacelle, contains the following:

Bomb Hoist Sling	(300 lbs.)
Bomb Hoist Sling	(500 lbs.)
Bomb Hoist Sling	(1000 lbs.)
Bomb Hoist Sling	(2000 lbs.)

(9) *Box 9*, Engine Tool Kit (Part No. PWA-1798) is carried on the inboard side of the R. H. nacelle.

Note

For contents of this kit, refer to Section III, paragraph 4. *b*. (3).

(10) *Box 10*, containing the four wing Rack Assemblies (Part No. 5194520), is stowed at the outboard aft end of the L. H. nacelle.

(11) *Box 11* (Part No. 33D5227 or 33D5226) contains the four Bomb Shackle Assemblies and is stowed in the L. H. nacelle on the inboard side of the wheel well (see drawing item #48).

hh. TARGETS.—Stowed on the gunner's seat on some airplanes are three oil cloth targets to be used for bore sighting.

ii. CLIP.—A clip for the pilot's pen flashlight is installed to the right of the gun loader's seat.

jj. BOMBARDIER NOSE EQUIPMENT.—Miscellaneous equipment in the bombardier's nose includes a seat kneeling cushion, assist straps, a small adjustable plywood table, a relief container, four ammunition boxes which form the seat, a data case, and a safety belt. The four ammunition boxes are covered by the seat cushion for the bombardier's seat.

22. PYROTECHNICS

a. GENERAL.—The airplane contains the following pyrotechnics provisions; a signal flare container, and a pistol holder. An outlet is located in the top of the fuselage aft of the pilot's seat for firing the pistol.

b. SIGNAL FLARE CONTAINER.

(1) A signal flare container is mounted on the control pedestal at a point inboard and aft of the pilot's seat. The container is constructed of canvas material and is attached to the control pedestal by two canvas straps. This container is a portable case carrying nine flares or signals. A combination of both flares and signals may be carried at one time. Separate pockets retain them in position preventing damage to the metal cases. They are easily inserted or removed through a slide fastener opening. The signals should be placed into the pockets with the firing caps down so the signal color markings may be readily distinguished. Flares should be placed with the firing caps at the top so they may be easily removed from the container.

Note

The gun should never be stowed until unloaded.

(2) REMOVAL.—To remove the signal flare container and the pyrotechnic pistol holder, release the snap fasteners.

(3) REPLACEMENT.

(a) The canvas straps should be replaced if they are damaged or worn.

(b) When a container has ripped seams or damaged material, it should be repaired or replaced, depending upon the extent of the damage and upon the facilities of the ground crew personnel.

c. PYROTECHNIC PISTOL HOLDER.

(1) DESCRIPTION.—The pyrotechnic pistol holder is attached to the flare container by snap fasteners which are attached to the canvas straps of the container.

(2) REMOVAL.—To detach the pistol holder from the container, release snap fastener.

(3) REPLACEMENT.

(a) Snap fasteners must be replaced when they are worn to the extent that they will not fasten securely.

(b) When a holder has ripped seams or torn material, it should be repaired or replaced, depending upon the extent of the damage and upon the facilities for making temporary repairs.

(4) ASSEMBLY AND INSTALLATION.—Insert pistol into position *(figure 586)*; turn until secured in lock.

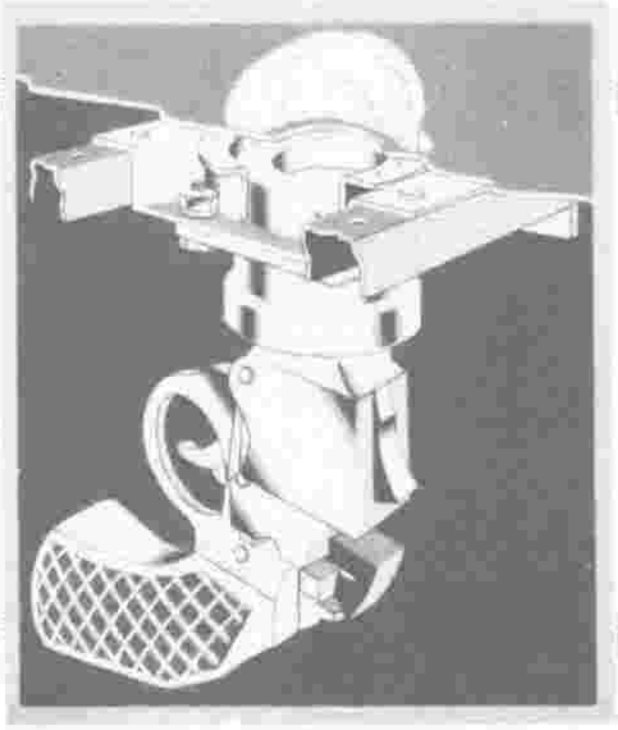
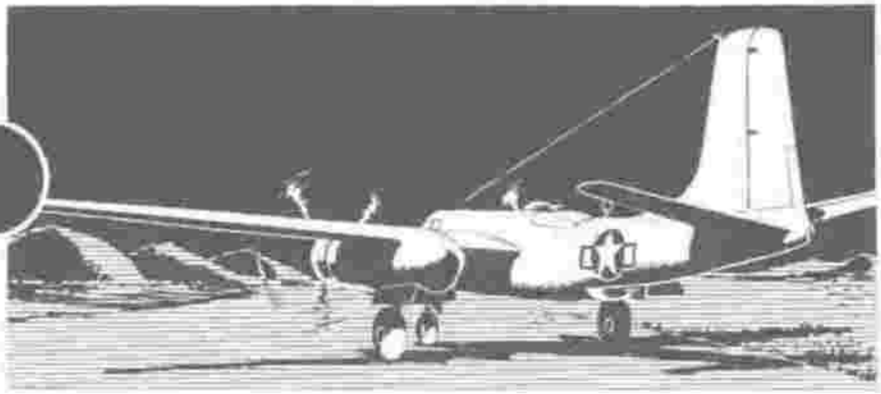


Figure 586—Pyrotechnic Gun in Firing Position

SECTION V



USEFUL OR MILITARY LOAD INSTALLATION

1. GENERAL.

With relation to the bomb loading chart *(figure 590)* and the location of the bomb rack *(figure 591)* in the bomb bay, this section includes the procedures for hoisting and loading bombs, ammunition boxes, torpedoes, and chemical tanks. It also contains a table of weights for various installations.

2. BOMB HOIST.

a. DESCRIPTION.—All bomb bay and wing bombs are lifted to position by Type C-3 drum and cable units. The hoist consists of two C-3 units held together with a retaining pin. Attachment points are provided at access doors in the right-hand bomb bay door *(figure 587)*, on the fuselage deck *(figure 588)*, and on the outboard side of each wing rack *(figure 589)*. All 100 pound bombs should be lifted manually to their stations. Slings are available for 300, 500, and 1000 pound bombs. The hoisting equipment *(figure 592)* is stowed in the outboard side of the right nacelle.

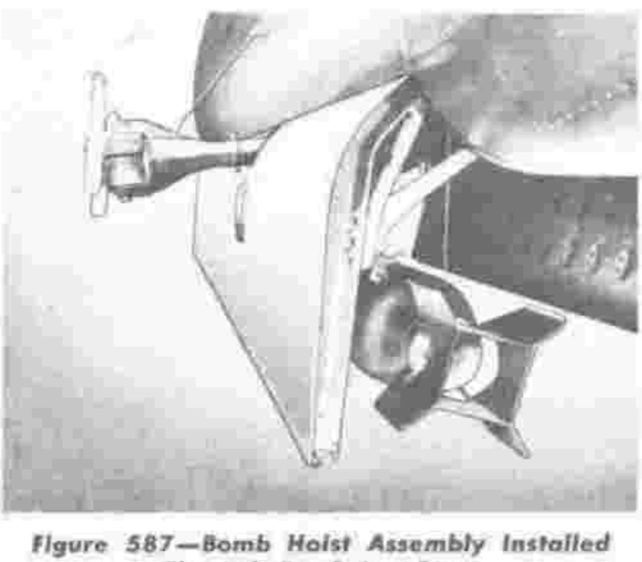


Figure 587—Bomb Hoist Assembly Installed Through Bomb Bay Door

b. MAINTENANCE REPAIR OR REPLACEMENT.

(1) Keep the bomb hoist slings free of mud, dirt, and water. Remove any mud or dirt as soon as practicable. Dry the sling slowly and do not expose to excessive heat. Always clean slings before storage.

(2) Repairs to fabric will be made only with proper equipment and by trained personnel. Always use at least as many stitches as were used originally. Replace 500 pound bomb slings torn 1/2" or more and 1000 pound bomb slings torn 1/4" or more.

(3) Straighten bent or dented sling yokes or replace if damaged beyond repair.

(4) Keep metal parts of hoist free from rust by using a light oil.

(5) Clean hoisting cables with kerosene.

(6) Be sure the worm drive on the hoist is properly greased. Pack with grease by removing end cap rather than by using lubrication hole.

(7) Check support attachments, idler pulleys, and mounts for indication of wear or failure.

(8) Keep the brake assembly free of grease.

(9) Remove burrs from the square ends on the drive shaft.

(10) Check pulleys for undue wear.

(11) Check bomb hoist bearings for wear.

(12) Inspect hoist cables for splice slippage.

CAUTION

Do not wind or unwind the hoist without a load on the cable. Failure to do so will cause the cable to snarl within the drum housing, causing the winch to bind, and possibly breaking the cable.

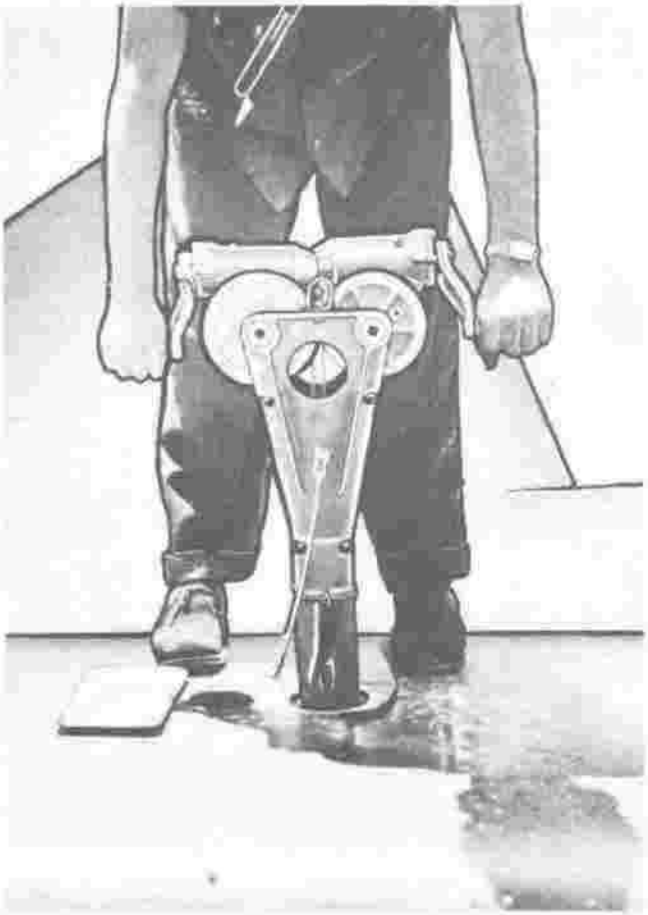


Figure 588—Bomb Hoist Assembly Installed on Fuselage Deck

3. LOADING PROCEDURE.

a. LOADING 100 POUND BOMBS INTO BOMB BAY.

(1) When loading 100 pound bombs on the right hand racks, keep the left bomb bay door closed. Lift the bombs into place, starting with the lowest station. Keep one foot on the closed door and the other on the bomb installed at the lowest station. Reverse this procedure for loading left hand racks.

(2) Use the following method for keeping only one bomb bay door closed:

(a) Open bomb bay doors.

(b) Install safety blocks in the sliding links of the actuating mechanism for one door.

(c) Place the bomb door selector switch (or the bombs control lever) in the doors "CLOSED" position.

(d) Install safety blocks in the sliding links of the closed door.

(e) Always install safety blocks on the under side of the sliding links.

b. HOISTING 300, 500, and 1000 POUND BOMBS ONTO BOMB BAY AFT RACKS.

(1) Set pilot's control lever (if installed) in "SELECTIVE" position.

WARNING

Be sure bomb bay door safety blocks are installed and all bombing system electrical switches are "OFF."

(2) Install the bomb hoist beam *(2, figure 593)* on bomb station hooks, numbers 9 and 10.

(3) Install bomb hoist socket *(lower 7, figure 593)* on left side of fuselage through left bomb bay door.

(4) Install bomb hoist assembly in socket *(upper 4, figure 593)*. Attach supporting cable to side of fuselage.

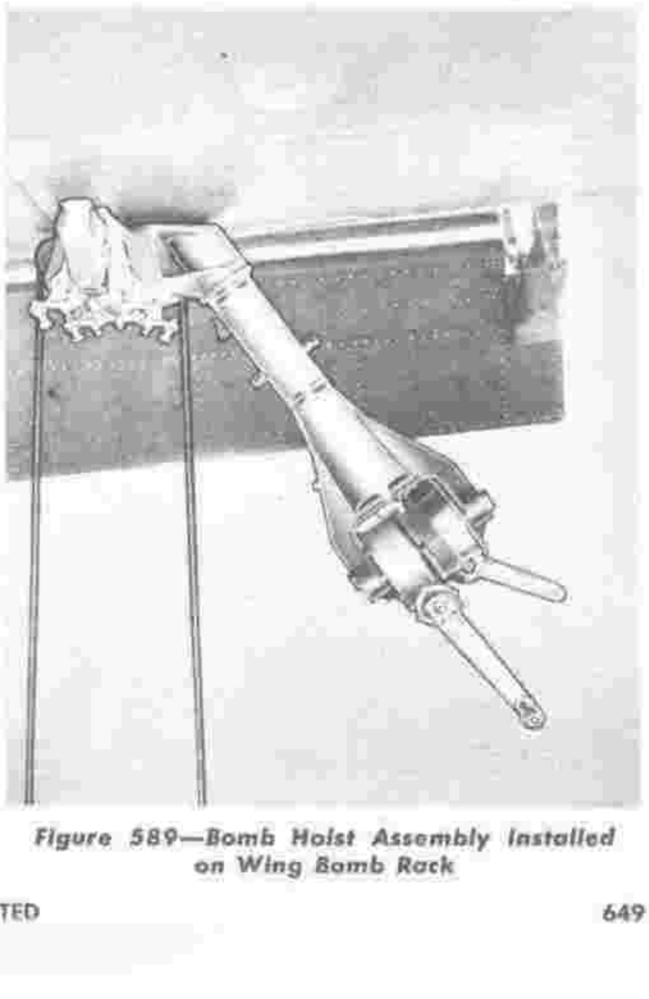


Figure 589—Bomb Hoist Assembly Installed on Wing Bomb Rack

DESCRIPTION OF BOMBS	FORWARD BOMB BAY														AFT BOMB BAY										TOTAL WEIGHT (BLUE)	TOTAL WEIGHT (BLUE & RED)
	L.H. BOMB RACK							R.H. BOMB RACK							L.H. BOMB RACK					R.H. BOMB RACK						
	4	4A	8	8A	12	14	16	3	3A	7	7A	11	13	15	2	2A	6	6A	10	1	1A	5	5A	9		
1000# AN-M65 GENERAL PURPOSE BOMBS		20° C&G							20° C&G							15°C 20°G					15°C 20°G				2991	3988
1000# AN-MK33 ARMOR PIERCING BOMBS		20° C&G							20° C&G							20°C 0°G					20°C 0°G				3024	4032
1000# AN-M59 SEMI-ARMOR PIERCING BOMBS		20° C&G							20° C&G							12°C 20°G					12°C 20°G				2970	3960
1000# AIRCRAFT MINE (A) AN-MK26 OR (B) AN-MK26 MOD. 1		20° C&G							20° C&G							12°C 20°G					12°C 20°G				*(A)2970 (B)3063	*(A)3960 (B)4084
500# AN-M64 GENERAL PURPOSE BOMBS		20° C&G							20° C&G						20° C&G			20° C&G		20° C&G			20° C&G		2610	3132
500# AN-M58A1 SEMI-ARMOR PIERCING BOMBS		20° C&G							20° C&G						20° C&G			20° C&G		20° C&G			20° C&G		2510	3012
500# INCENDIARY CLUSTER (A) AN-M7 OR AN-M9 OR (B) AN-M13		20° C&G							20° C&G						20° C&G			20° C&G		20° C&G			20° C&G		*(A)2700 (B)2085	*(A)3240 (B)2502
350# AIRCR'FT D'PTH BOMBS (A) AN-MK47 OR (B) AN-MK44		20° C&G							20° C&G						20° C&G			20° C&G		20° C&G			20° C&G		*(A)1773 (B)1750	*(A)2127 (B)2100
325# MK41 AIRCRAFT DEPTH BOMBS		20° C&G							20° C&G						20° C&G			20° C&G		20° C&G			20° C&G		1648	1977
250# AN-M57 GENERAL PURPOSE BOMBS	20° C&G			20° C&G				20° C&G			20° C&G				20° C&G			20° C&G		20° C&G			20° C&G		1512	2016
100# M38A2 PRACTICE BOMBS	20° C&G		20° C&G					20° C&G		20° C&G					20° C&G		20° C&G		0°C 0°G	20° C&G		20° C&G		0°C 0°G	800	1000
100# AN-M30 GENERAL PURPOSE BOMBS	20° C&G		20° C&G		0° C&G	0° C&G	0° C&G	20° C&G		20° C&G		0° C&G	0° C&G	0° C&G	20° C&G		20° C&G		0° C&G	20° C&G		20° C&G		0° C&G	1188	1728
100# CHEMICAL BOMBS (A) M47A2 (B) M70	20° C&G		20° C&G					20° C&G		20° C&G					20° C&G		20° C&G		0° C&G	20° C&G		20° C&G		0° C&G	*(A) 780 (B) 928	*(A) 975 (B)1160
100# M47-A1 CHEMICAL BOMBS	20° C&G		20° C&G					20° C&G		20° C&G					20° C&G		20° C&G		0° C&G			20° C&G		0° C&G	816	1020
100# M5 PRACTICE CLUSTER BOMBS	20° C&G		20° C&G					20° C&G		20° C&G					20° C&G		20° C&G		0° C&G	20° C&G		20° C&G		0° C&G	696	870
125# M1A1 & M2A1 FRAGMENTATION CLUSTER	20° C&G		20° C&G		0° C&G			20° C&G		20° C&G		0° C&G			20° C&G		20° C&G		0° C&G	20° C&G		20° C&G		0° C&G	1000	1250
100# INCENDIARY CLUSTER (A) AN-M6 OR AN-M8 (B) AN-M12	20° C&G		20° C&G					20° C&G		20° C&G					20° C&G		20° C&G		0° C&G	20° C&G		20° C&G		0° C&G	*(A)1160 (B) 785	*(A)1450 (B) 980
100# AN-M4 FRAGMENTATION CLUSTER	20° C&G		20° C&G		0° C&G			20° C&G		20° C&G		0° C&G			20° C&G		20° C&G		0° C&G	20° C&G		20° C&G		0° C&G	785	1046

COLOR CODE
- BLUE: Bomb Loading Arrangement with shell case container installed (Cannon may be used).
- BLUE AND RED: Bomb Loading Arrangement without shell case container installed (Cannon not to be used).

NOTE

The number of degrees indicate the maximum climb or glide angle at which each bomb can be released.

When carrying fragmentation bomb racks refer to section V, paragraph 3, 9 for description and operation.

*Refer to DESCRIPTION OF BOMBS column for the types of bombs for weights specified, i.e., (A) and (B).

Figure 890 — Bomb Bay Compartment Demolition Bomb Racks Loading Chart

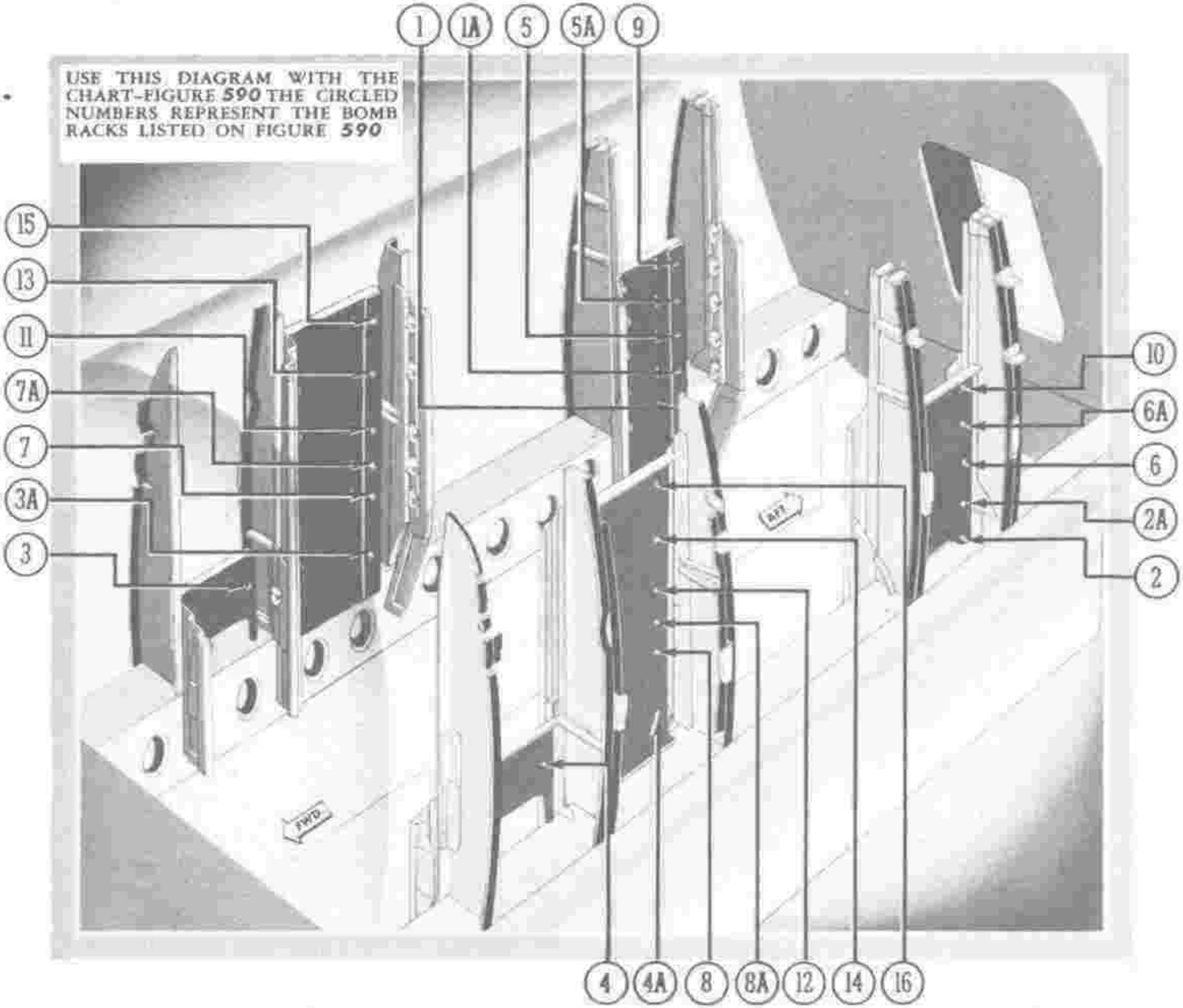


Figure 591—Bomb Racks

(5) Place pulleys in proper location for bomb in process of being loaded and route cables as shown in figures. Attach the bomb hoist sling to the ends of the cables.

c. HOISTING 300 POUND BOMBS ONTO BOMB BAY FORWARD RACKS.—Follow the procedure as outlined in the preceding paragraph except that the bomb hoist beam *(2, figure 593)* is to be installed on bomb station hooks, numbers 11 and 12.

d. HOISTING 500 & 1000 POUND BOMBS ONTO BOMB BAY FORWARD RACKS.

(1) Install bomb hoist pulley bracket assembly in holes provided at stations 120 and 138.

(2) Place bomb hoist assembly in socket provided on top of fuselage. *(See figure 588.)*

(3) Route cables through pulleys as shown in *figure 593.*

(4) Attach bomb sling to cable ends.

e. HOISTING WING BOMBS.—Follow instructions given in *b.* (3), this section.

f. HOISTING CHEMICAL TANKS ONTO WING RACKS.—The procedure is identical with hoisting wing bombs.

KEY TO FIGURE 593

1. Bomb Bay Forward Racks
2. Bomb Hoist Beam Assembly
3. Bomb Hoist Supporting Cable
4. Bomb Hoist Assembly
5. Type B-7 Bomb Shackle
6. 300 Pound Bomb
7. Bomb Hoist Socket
8. Bomb Bay Forward Racks
9. Bomb Bay Aft Racks
10. 300, 500, or 1000 Pound Bomb
11. Bomb Hoist Pulley Bracket
12. Bomb Hoist Sling Assembly
13. 500 or 1000 Pound Bomb

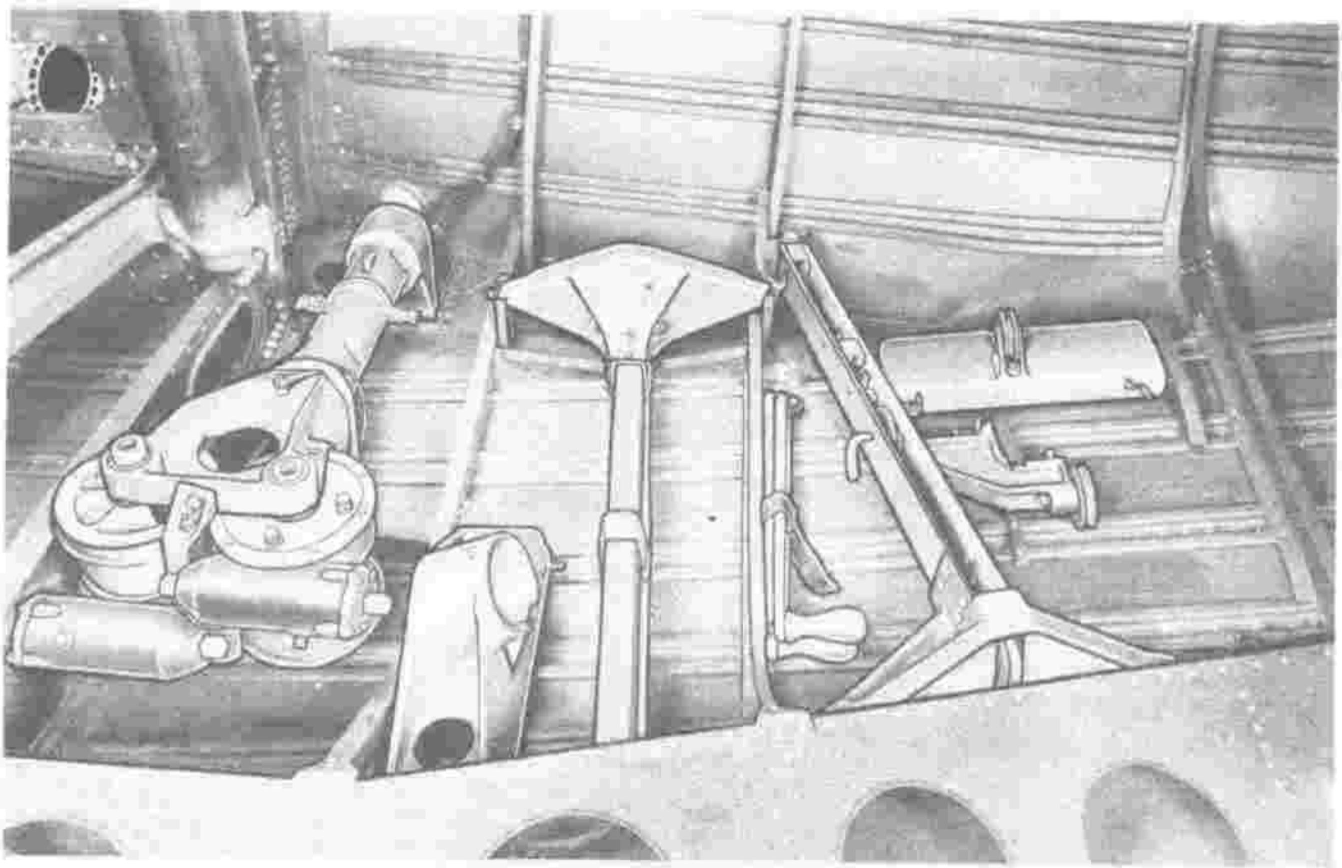


Figure 592—Bomb Hoist Stowage

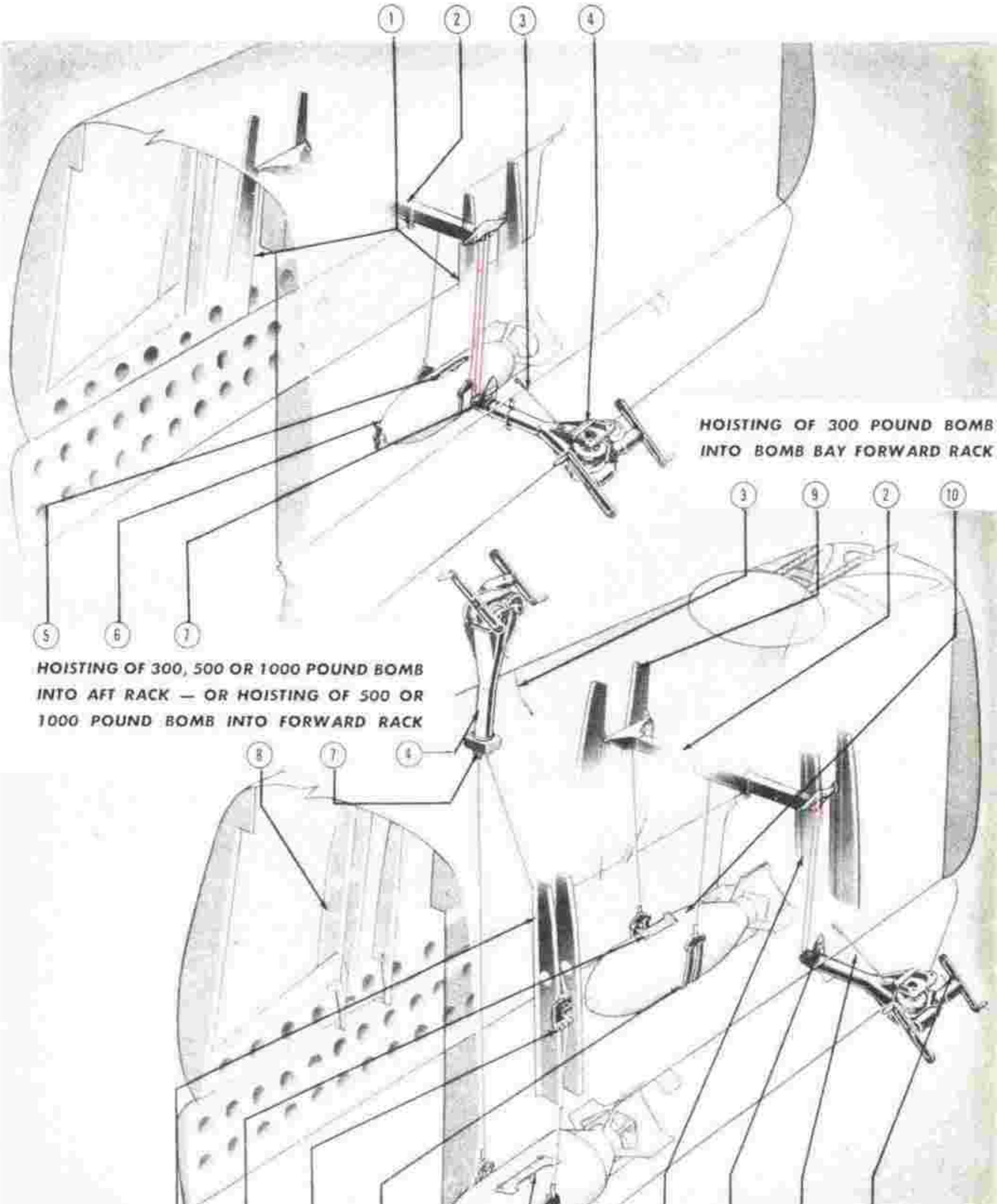
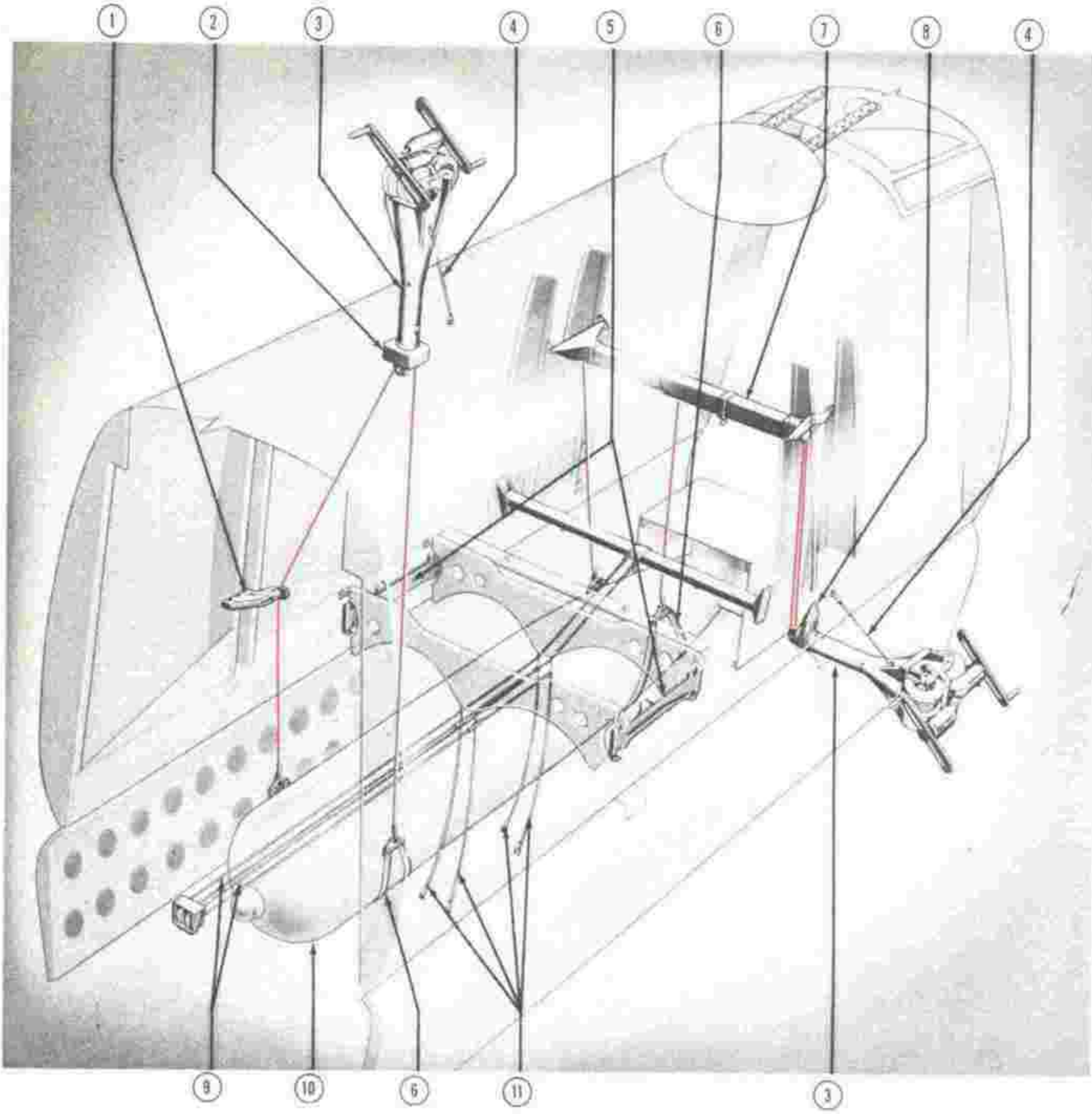


Figure 593 — Cable Routing for Bomb Hoisting Procedure



1. Bomb Hoist Pulley Bracket
2. Bomb Hoist Socket
3. Bomb Hoist Assembly
4. Bomb Hoist Supporting Cable
5. Type D-6 Bomb Shackle
6. Bomb Hoist Sling Assemblies
7. Bomb Hoist Beam Assembly
8. Bomb Hoist Socket
9. Sling Retrieving Cord Assemblies
10. Type -13 Torpedo Model -10R2
11. Cable Sling Assemblies

Figure 594—Cable Routing For Torpedo Hoisting Procedure

g. LOADING M-72 FRAGMENTATION BOMBS INTO THE RACKS.

(1) Grasp the cable soldered on the outside of the parachute container and tear off with a quick jerk.

(2) Remove the adhesive tape around the cover on the parachute container.

(a) Remove the cover.

(b) Slide the pull wire ring from under the sealing wire soldered to the inner cap and pull sharply, removing the cap.

(c) Hold the retaining disc within the container with the fingers to prevent the parachute from unfolding until the bomb is loaded into the racks.

(d) Lay the bomb rack on the left side.

(e) Make certain all retaining doors are lying flat and door holding bars are in their stowage slot.

(f) Slide first bomb into front compartment forcing skip switch arm against the top of the rack and the bomb lug into the locating slot provided.

(g) Close the retaining door against the bottom of the bomb and hold bar against the bottom of the door.

(h) Repeat procedure for next three bombs in the front group.

(i) Make certain the trip screw in the A-4 release is in the neutral position by turning it clockwise with a screw driver.

(j) Slide the fifth bomb into the rear compartment. Make certain as the bomb forces the forward bomb release arm against the top of the rack, the front bombs remain in position, and the front bottom door locks.

(k) Cock the A-4 release at the rear end of the rack after installing the last bomb and closing the rear bottom door.

(l) Make sure that both bottom doors are locked.

(m) Make certain that the arming wires are properly inserted in the fuses and remove the cotter pins from the fuse arming pins.

h. INSTALLING LOADED FRAGMENTATION RACKS INTO THE RACK SUPPORT.

(1) Lift the loaded bomb rack to its place in the adapter *(figure 525)*.

(2) Notice that the support is provided with a spring loaded lever which acts as a lock to the slot on one end of the rack. Loading of racks should start at the opposite end of the support. The last rack to be installed in the support should be locked in place.

(3) Make sure that the BOMB CIRCUIT MAIN POWER switch is "OFF."

(4) Insert the electrical connector in the rack support.

(5) Install the individual electrical connectors between the rack support and each fragmentation rack.

i. HOISTING TORPEDOES.

(1) Install bomb hoist beam assembly across bomb stations, numbers 9 and 10.

(2) Install bomb hoist pulley bracket assembly in holes provided at stations 120 and 138.

(3) Install bomb hoist in socket through aft opening in bomb bay door *(8, figure 594)*.

(4) Route cables as shown in *figure 594*.

(5) Attach cable end to torpedo sling.

(6) Install bomb hoist in socket on top of fuselage *(2, figure 594)*.

(7) Hook Type D-6 bomb shackle to torpedo and hoist into position.

Note

Install the retrieving cord assembly *(9, figure 594)* and, just before take-off, install the torpedo impeller lanyards *(1, figure 532)* and the starting lanyard *(9, figure 532)*.

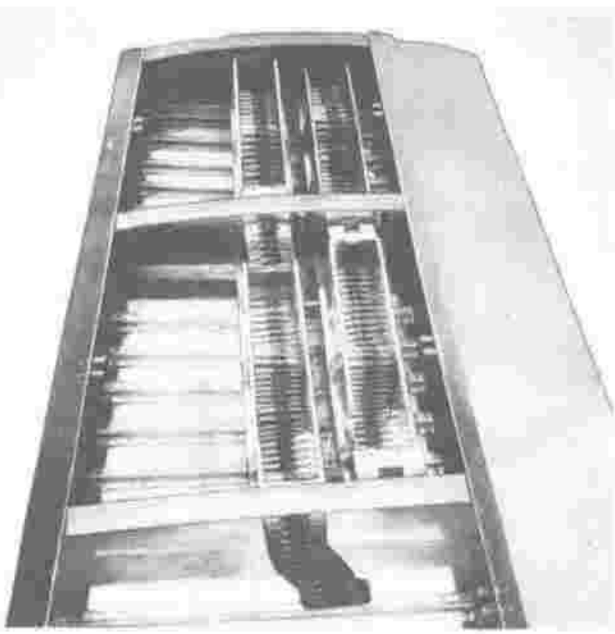


Figure 595—Wing Ammunition Boxes

j. LOADING GUN AMMUNITION BOXES.

(1) LOADING THE WING GUN AMMUNITION BOXES WITH FOUR GUNS INSTALLED (EACH WING).

(a) Load the inboard box through the inboard access hole.

(b) Place the single loop end of the link in the outboard corner of the box and lay the shells in layers.

(c) Always keep the link OVER the roller *(figure 595)* as it leaves the ammunition box.

(d) Load the outboard box in a similar manner through the outboard access hole.

(2) LOADING THE WING GUNS AMMUNITION BOXES WHEN USING ALTERNATE INSTALLATION (INBOARD GUNS ONLY INSTALLED).

(a) Load through the inboard access hole.

(b) Place the single loop end of the link in the outboard corner of the outboard box.

(c) Place the shells in layers as instructed in paragraph 3. *j.* (1) *(b)*, above, but continue the link over into the inboard box.

(3) HOISTING ALL-PURPOSE NOSE GUN AMMUNITION BOXES.

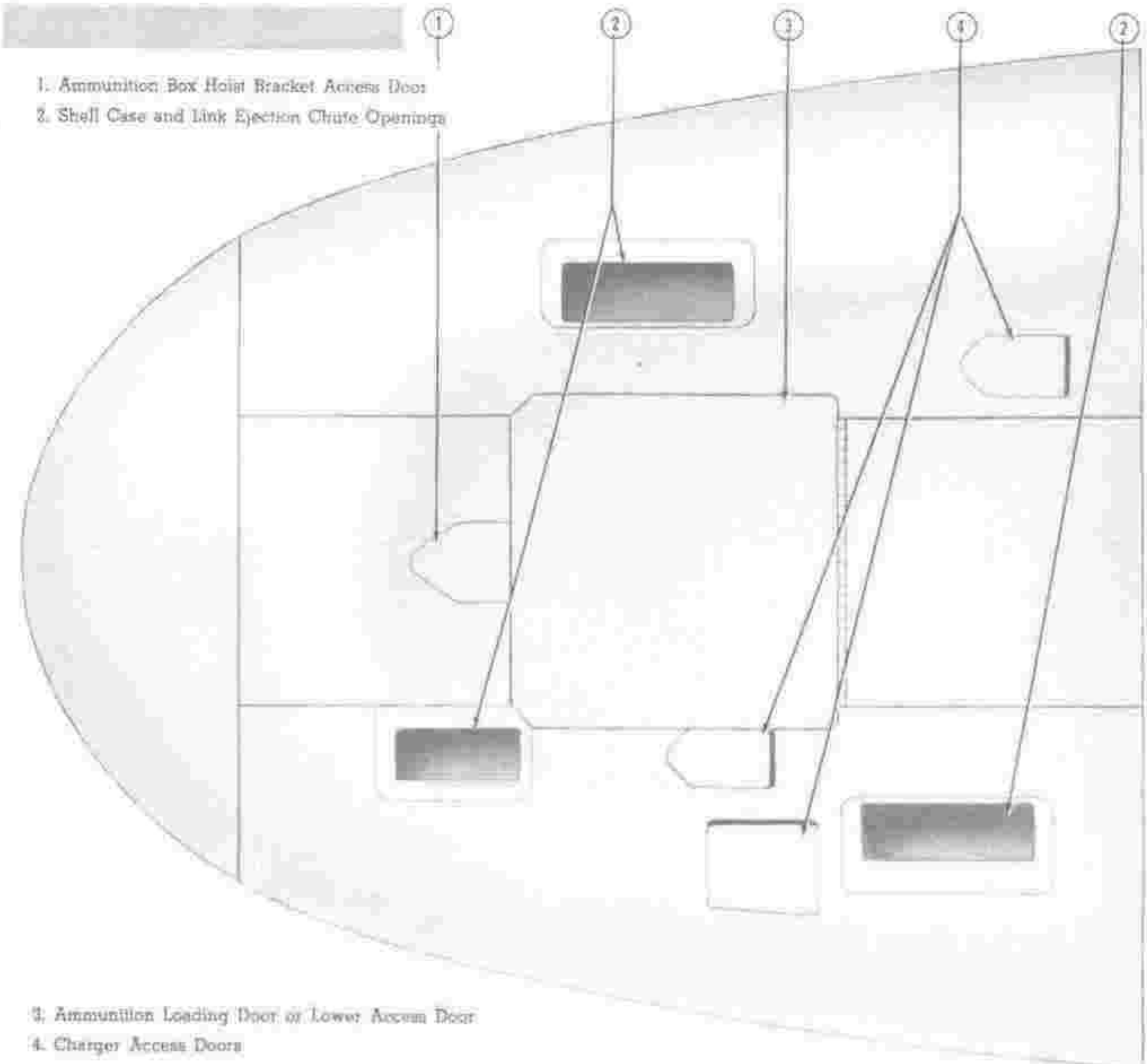
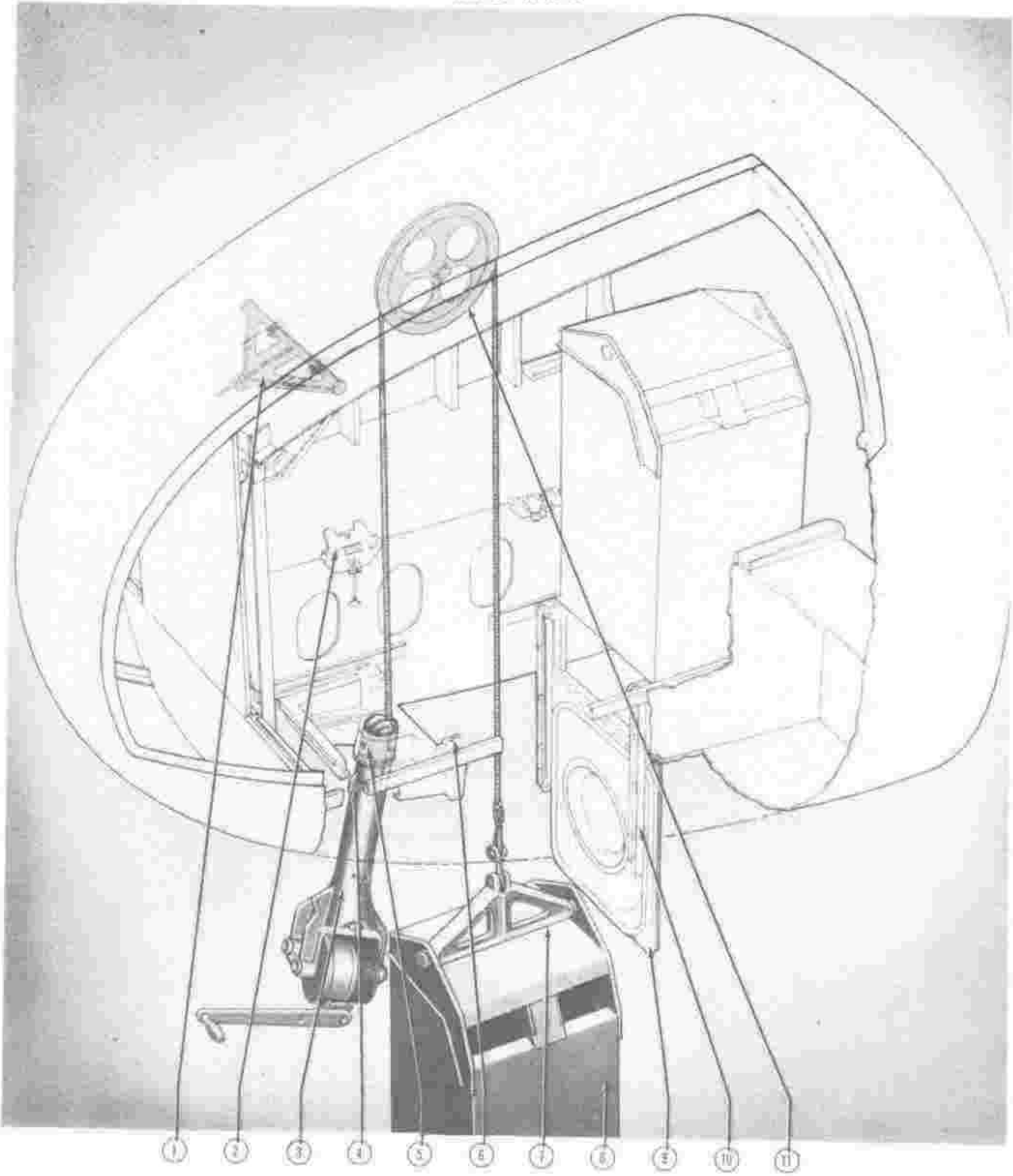


Figure 596—Bottom View of All-Purpose Nose—Access Doors and Chute Openings



1. Sling Stowage
2. Box Retainer
3. Type C-3 Bomb Hoist
4. Thumb Lever
5. Hoist Bracket
6. Lock Handles
7. Sling
8. Ammunition Box
9. Ammunition Loading Door
10. Center Section Track
11. Pulley

Figure 597 — Ammunition Box Ready for Hoisting (All Purpose Nose)

(a) Hoist three ammunition boxes, adaptable to either caliber .50 or 37 mm shells, into the nose through the lower access door with the Type C-3 bomb hoist.

(b) Attach the hoist in the attaching hole forward of the access door.

(c) Route the cable to a pulley at the top of the nose and then drop it down through the access door to the ground.

(d) Attach a sling to the ammunition which is being lifted.

(e) Hoist the boxes onto an ammunition box track installed on the floor of the nose and along which they can slide.

(f) Load the boxes as shown, being certain that 37 mm ammunition rollers are in the box if 37 mm shells are to be used.

Note

In loading 37 mm ammunition boxes, be sure large roller is forward, placing it under the nose of the shell.

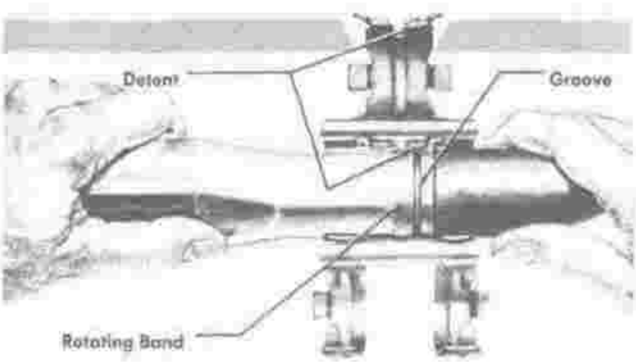
(g) Attach the bomb hoist to the bracket provided *(figure 597)*.

(h) Run the cable through the hoist attaching hole and over the pulley at the top of the nose.

(i) Attach the sling to the ammunition box and hook the hoist cable to the sling.

Note

When hoisting the boxes, be sure the forward and aft boxes feed to the right, and the center box to the left. This applies for any combination of guns.



WARNING: When Loading Belt—Locating Detent of Single Loop Must Fit Squarely in Groove on Rotating Band. Otherwise Gun Will Jam on Feeding

Figure 598 — 37 mm Belt Loading

(j) Hoist the forward and aft boxes into position first. When the center box has been hoisted into the nose, swing the track into place. Lower the box onto the track and remove hoisting equipment.

(4) LOADING BOMBARDIER NOSE GUN AMMUNITION BOXES.

(a) Load boxes either before or after hoisting.

(b) Hoist and place in position by hand.

(c) Follow procedure for all-purpose nose.

(5) LOADING 75 MM CANNON AMMUNITION RACK.—Load each shell by hand with the nose of the shell pointed forward.

(6) LOADING TURRET AMMUNITION BOXES.—Load each of the four ammunition boxes and hoist them into position with the hoist incorporated for each turret.

4. TABLE OF AMMUNITION WEIGHTS & CAPACITIES.

a. 6 GUN NOSE CONFIGURATION. (.50 Cal.)

Maximum number of rounds—2400 or 400 rounds for each gun.

Total weight of rounds—746 pounds.
3 ammunition boxes at 26 pounds each.
Total weight of boxes—78 pounds.
3 partitions at 4 pounds each.
Total weight of partitions—12 pounds.
Gross weight—836 pounds.

b. BOMBARDIER'S NOSE.

Maximum number of rounds 2—.50 Cal. gun installation—800 or 400 rounds for each gun.

Total weight of rounds—249 pounds.
4 ammunition boxes—17 pounds.
Gross weight—266 pounds.

c. WING GUNS.

(1) 8 GUN INSTALLATION (.50 Cal.).

Maximum number of rounds—2400.
Total weight of rounds—746 pounds.

Note

Wing gun racks are permanent installations and are not included as extra weight.
Gross weight—746 pounds.

(2) 4 GUN INSTALLATION (.50 Cal.).

Maximum number of rounds—1200.
Total weight of rounds—373 pounds.
Gross weight—373 pounds.

d. TURRET GUNS.

(1) UPPER (2–.50 Cal. guns).

Maximum number of rounds–1000 or 500 in each box.

Gross weight–311 pounds.

(2) LOWER–Same as upper turret.

e. 75 MM CANNON.

Maximum number of rounds (shells)–20.

Weight of rounds–200 pounds.

Weight of racks–39 pounds.

Gross weight–239 pounds.

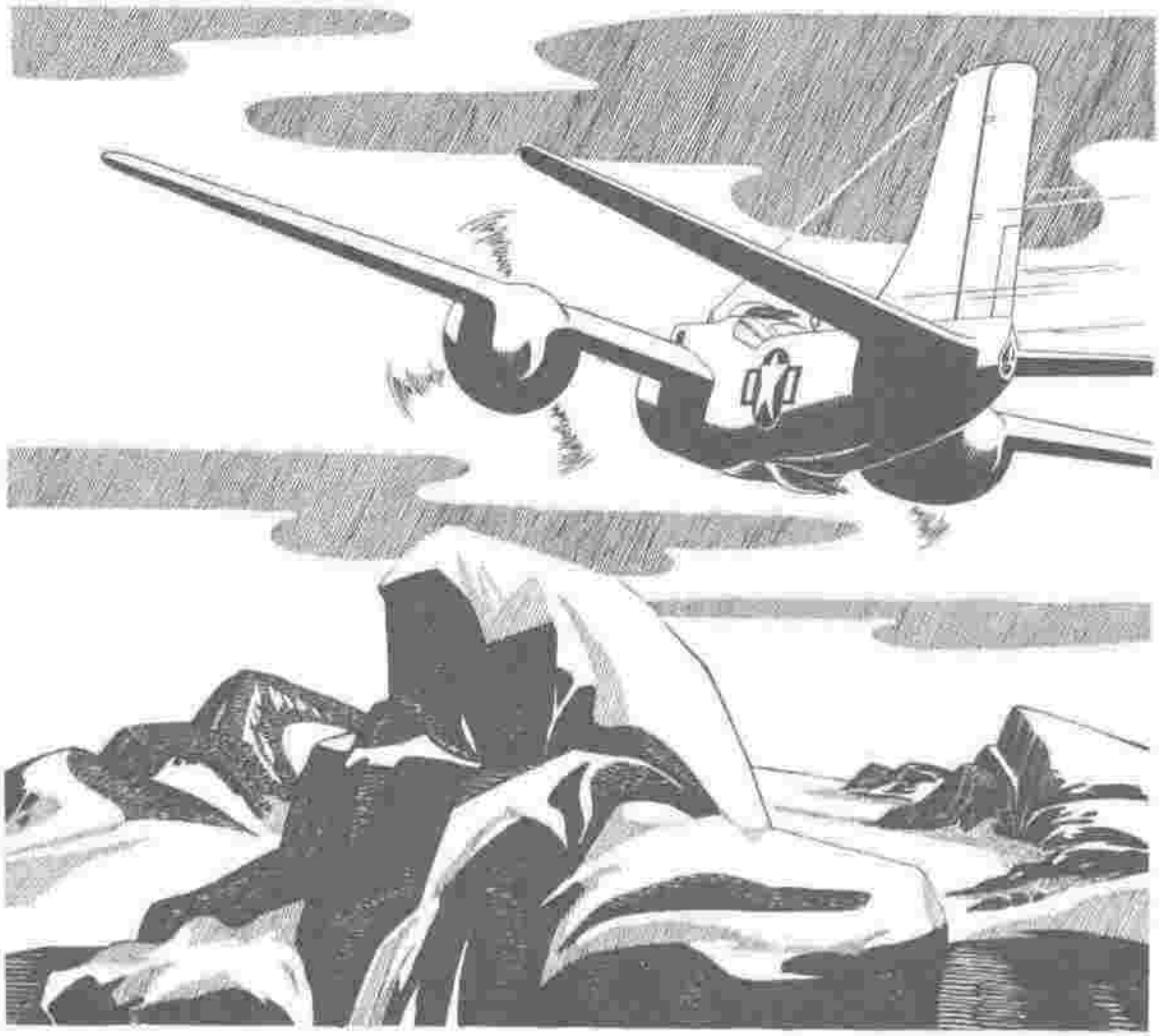
f. 37 MM CANNON.

Maximum number of rounds–75.

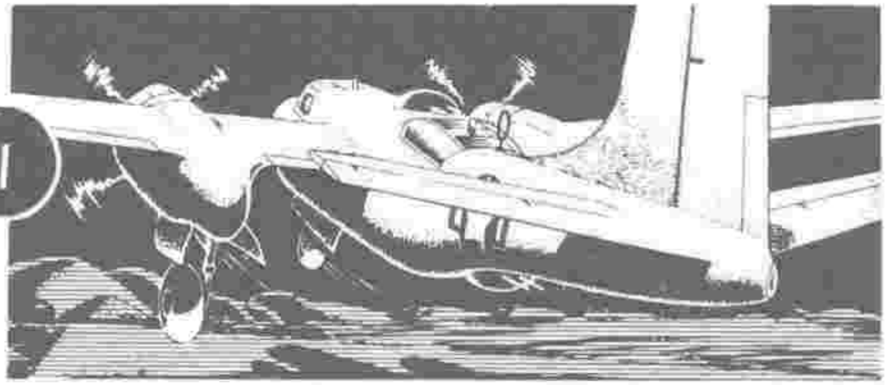
Total weight of rounds–254 pounds.

Weight of 2 ammunition boxes–52 pounds.

Gross weight–306 pounds.



SECTION VI



MATERIALS OF CONSTRUCTION

1. A table listing the titles, part numbers, items, materials, and the prescribed heat treatment for the metal from which the various assemblies are fabricated will be found on the following pages. This table will prove useful in the event replacement parts are to be made at repair stations.

2. Type A17ST rivets are not to be used as substitutes for Type D17ST or DD24ST rivets. A17ST rivets are used throughout the airplane except at points of stress where Type D17ST or DD24ST rivets are used.

3. The following table lists the Government specifications for the various materials which were used in the construction of this airplane.

MATERIALS OF CONSTRUCTION

PARTS	*SPECIFICATION*
ALUMINUM	
BAR AND/OR SHAPES	
2S) (Non-Structural) (SAE 25)	FED QQ-A-411 Cond. F, ½H, H
3S) (SAE 29)	FED QQ-A-356
53S)	FED QQ-A-331 Cond. A, W, T
24S (SAE 24)	FED QQ-A-331 Cond. A, W, T
14S	AN-A-8 Cond. T
CASTINGS	
Die	
13 (SAE 305)	AN-QQ-A-366 Comp. AL-13
Permanent Mold	
356-T6 (SAE 323)	FED QQ-A-596 Class 8 H.T. 1
B195-T6	AN-QQ-A-303 Class II
Pressure	
13X	AAF-11347 Comp. AL-13X
Sand	
356-T6 (SAE 323)	AN-QQ-A-394
195-T6 (SAE 38)	AN-QQ-A-390 Class II
220-T4 (SAE 324)	AN-QQ-A-392
FORGINGS	
A51S-T (Weldable) (SAE 280)	FED QQ-A-367 Class 3
14S-T	FED QQ-A-367 Class 5

PARTS	*SPECIFICATION*
SHEET & PLATE	
3S (SAE 29)	FED QQ-A-359 Type I Temp. A, ½H
61S	FED QQ-A-327 Cond. O,W,T
52S (SAE 201)	FED QQ-A-318 Temp A, ¼H, ½H
24S-AL (SAE 24)	AN-A-13 Cond. A,T,TR
24S (SAE 24)	AN-A-12 Cond. A,T,TR
XB75S-AL	AN-A-10 Cond. A,T
TUBE	
2S-½H (SAE 25)	FED WW-T-783 Temp. ½H
52S-O (SAE 201)	FED WW-T-787
61S	FED WW-T-789 Cond. O,W,T
24S-T (SAE 24)	FED WW-T-785 Cond. T

BRASS & BRONZE

BAR	
Comm'l. Brass (SAE 72)	FED QQ-B-611 Comp. B, Soft or Half-Hard
Naval Brass (Tobin Bronze) (SAE 73)	FED QQ-B-636 Hard for Rounds Half-Hard for Sq., Rect. and Hex.
Al. Bronze (SAE 701)	AN-B-16
CASTINGS	
Die	
Manganese Bronze	FED QQ-B-726 Class A
Sand	
Red Brass (SAE 40)	FED QQ-B-691 Type II Comp. 2
Gun Metal	FED QQ-B-691 Type II Comp. 5
Manganese Bronze	FED QQ-B-726 Class A
Aluminum Bronze	AN-QQ-B-672
SHEET	
Commercial Brass (SAE 72)	FED QQ-B-611 Comp. E
Spring Phosphor Bronze	FED QQ-B-746 Type V Gr. A

COPPER

BAR	FED QQ-C-501 Class A (Soft) Class B (Hard)
SHEET	FED QQ-C-501 Class A (Soft) Class B (Hard)
TUBE (Soft Annealed)	FED WW-T-799 Type N
WIRE (Soft)	FED QQ-W-341

COPPER, BERYLLIUM

BAR	AAF 11070 Type I Cond. AT (Hot Rolled and Heat Treated) Cond. HT (Cold Drawn and Heat Treated)
SHEET	AAF 11070 Type II Cond. A, ¼H, ½H, H

PARTS	SPECIFICATION

MAGNESIUM

BAR AND/OR SHAPES	
Dow M (AM3S) (SAE 51)	
(Lightly Stressed)	AAF 11336
CASTINGS	
Die	
Dow R (AM 263-C)	AN-M-16
Sand	
Dow H-HT (AM 264-T4) (SAE 50)	AN-QQ-M-56 Comp. A, Cond. H.T.
Permanent Mold	
Dow C (AM 260)	AAF 11349 Cond. H.T. Cond. H.T.A. (Heat Treated and Aged)
FORGINGS	
Press	
Dow O-1 Aged (AMC58S-Aged)	AAF 11321 Cond. B
SHEET	
Dow M (AM3S) (SAE 51)	AAF 11339 Cond. A or H
Dow FS-1 (AMC52S)	AAF 11340 Cond. A or H

STEEL

BAR	
Plain Carbon (SAE 1020, 1022, 1025)	AN-QQ-S-646
Free Machining (SAE 1113)	Commercial
Nickel Chrome Moly (NE 8620) (For Carburizing)	AN-S-13
Chrome-Moly (SAE 4130)	AN-QQ-S-684
Nickel Chrome Moly (NE8740)	AN-S-14
Chrome-Moly (SAE 4140)	AN-QQ-S-752
Moly (SAE 4340)	AN-QQ-S-756
SHEET	
Plain Carbon (SAE 1020 or 1025)	AN-S-11
Chrome-Moly (SAE 4130)	AN-QQ-S-685 Cond. N
TUBING	
Plain Carbon (SAE 1025)	AN-WW-T-846
Chrome-Moly (SAE 4130)	AN-WW-T-850 Cond. N
CABLE	
Flexible Preformed	AN-RR-C-43
WIRE	
Steel Wire (Zinc Coated)	AN-QQ-W-429
Music Wire	AN-QQ-W-441
Steel Wire (SAE 6150)	AN-QQ-S-687
FORGINGS	
Chrome-Moly (SAE 4130)	AN-QQ-S-684
Chrome-Moly (SAE 4140)	AN-QQ-S-752

PARTS	*SPECIFICATION*

CORROSION RESISTANT STEEL

BAR	
Free Machining–Unstabilized (AISI 303)	AN-QQ-S-771 Comp. F.M. Cond. A (Annealed) Cond. B (Cold Worked)
Stabilized (AISI 347)	FED-QQ-S-763 Class 8 Type A
SHEET	
Unstabilized (AISI 302)	AN-QQ-S-772 Class II Comp. G
Stabilized (AISI 347)	AN-QQ-S-757 Type 347
TUBING	
Unstabilized (AISI 302)	AN-WW-T-855 Cond. B ¼ Hard
Stabilized (AISI 347)	AN-WW-T-858 Annealed
WIRE (AISI 316)	AN-QQ-W-423 Cond. A (Annealed) Cond. B (Spring Temper)

HEAT TREATED PARTS

Title	*Part No.*	*Material*	*Heat Treatment*
Adapter–Manifold Press. Reg. Control Arm	2195055	C. M. Stl. (4130)	Normalize
Adapter–Mixt. Cont. Arm	2153852	C. M. Stl. (4130)	Normalize
Adapter–Throttle Control Arm	2153851	C. M. Stl. (4130)	Normalize
Angle–Power Plant Sec. Oil Sep.	5194611-2	C. M. Stl. (4130)	Normalize
Angle–Power Plant Sec. Oil Separator	5194611-4	C. M. Stl. (4130)	Normalize
Angle–P. P. Sec. Oil Sep. Support Assem.	5194611-6	C. M. Stl. (4130)	Normalize
Angle–P. P. Sec. Oil Sep. Support Assem.	5194611-8	C. M. Stl. (4130)	Normalize
Arm–Inbd. Flap Mech. Cover Hinge Assem.	2194672-4	C. M. Stl. (4130)	155,000-180,000
Arm–Landing Gear Pos. Transm. Actuating	2129316	C. M. Stl. (4130)	Normalize
Arm–Nose Wheel Down Latch Release	1151010-4	C. M. Stl. (4130)	Normalize
Arm–Main Ldg. Gear Latch Release	1127778	C. M. Stl. Forg. (4130)	Normalize
Arm Assem.–Nose Wheel R.H. Retracting	4151152	C. M. Stl. Forg. (4130)	150,000-180,000
Arm Assem.–Nose Wheel L.H. Retracting	4123617	C. M. Stl. Forg. (4130)	150,000-180,000
Arm–Nose Wheel Door L.H. Act.	4129536	C. M. Stl. Forg. (4130)	Normalize
Arm Assem.–Nose Wheel Door L.H. Actuating	4129510	C. M. Stl. Forg. (4130)	Normalize
Arm–Nose Wheel Down Latch Release	1151006	C. M. Stl. (4130)	125,000-145,000
Bar	2033901	C. M. Stl. (4130)	125,000-145,000
Barrel–Bomb Door Aft Act. Cylinder	4129497	C. M. Stl. (4130)	Normalize
Barrel–Bomb Door Forwd. Act. Cylinder	2129395	C. M. Stl. (4130)	Normalize
Barrel–Main Ldg. Gear Act. Cylinder	4127415	C. M. Stl. (4130)	Normalize
Barrel–Nose Wheel Door Act. Cylinder	2196532	C. M. Stl. (4130)	Normalize
Barrel–Nose Wheel Door Mech. Conn. Link	1154425	C. M. Stl. (4130)	125,000-145,000
Barrel Assem.–Main Ldg. Gr. Act. Cyl.	5128434-2	C. M. Stl. (4130)	Normalize
Base–Bomb Bay Fuel Tank Latch	4191510-4	C. M. Stl. (4130)	125,000-155,000
Base–Fixed Wing Gun Fwd. Att.	4202344-2	C. M. Stl. (4130)	Normalize
Base–Fixed Wing Gun Fwd. Att.	4202375-2	C. M. Stl. (4130)	Normalize
Bead Assem.–Eng. Fuel	2155164-6	C. M. Stl. (4130)	Normalize
Bead Elbow Assem.–Engine Oil	2123201-6	C. M. Stl. (4130)	Normalize
Bearing–Elevator Idler Link	1127600	C. M. Stl. (4130)	125,000-145,000
Bearing Assem.–Elev. Cont. Horn	2126661	C. M. Stl. (4130)	125,000-145,000
Bearing Assem.–Rud. Cont. Horn	2126660	C. M. Stl. (4130)	125,000-145,000

HEAT TREATED PARTS

Title	Part No.	Material	Heat Treatment
Bearing Assem.—Trim Tab Worm Gear Eccentric	1125844	C. M. Stl. (4130)	125,000-145,000
Bell Crank Assem. Arm—Throttle Control Operating Idler	4143192-4	C. M. Stl. (4130)	145,000-165,000
Blank—Ail. Cont. Tube End Forging	1060311	C. M. Stl. Forg. (4130)	Normalize
Blank—Anti-Drag Ring Fastener Operating Link Forging	1125956	C. M. Stl. Forg. (4130)	Normalize
Blank—Outbd. Wing Flap End Screw End Forging	1128719	C. M. Stl. Forg. (4130)	Normalize
Blank—Inbd. Wing Flap Gear Box Screw End Forging	1128721	C. M. Stl. Forg. (4130)	Normalize
Blank—Outbd. Wing Flap Center Screw End Forging	1128725	C. M. Stl. Forg. (4130)	Normalize
Blank—Wing Flap Torque Tube Forging	1143651	C. M. Stl. Forg. (4130)	Normalize
Blank—Wing Mooring Ring Forging	1127694	C. M. Stl. Forg. (4130)	Normalize
Blank—Wing Sta. 270½ Flap Door Push Rod Forging	1127740	C. M. Stl. Forg. (4130)	Normalize
Blank—Wing Flap Oper. Torque Tube Disconnect Forging	1193992	C. M. Stl. Forg. (4130)	Normalize
Blank—Anti-Drag Ring Fastener Lever Forging	2126815	C. M. Stl. Forg. (4130)	Normalize
Blank—Anti-Drag Ring Fastener Oper. Lever Forging	2153873	C. M. Stl. Forg. (4130)	Normalize
Blank—Bomb Door Act. Mech. Link Forging	4151127	C. M. Stl. Forg. (4140)	Normalize
Blank—Bomb Door Act. Mech. Ctr. Support Brkt. Forging	5150261	C. M. Stl. Forg. (4130)	Normalize
Blank—Bomb Door Act. Mech. End Bracket Forging	5150300	C. M. Stl. (4130)	Normalize
Blank—Bomb Door. Act. Mech. Link Forging	4151106	C. M. Stl. Forg. (4130)	Normalize
Blank—Bomb Door Act. Mech. Univ. Joint Link Forging	2150848	C. M. Stl. Forg. (4130)	Normalize
Blank—Bomb Door Aft. Act. Cyl. Head Forging	4129502	C. M. Stl. Forg. (4130)	Normalize
Blank—Bomb Door Forwd. Act. Cylinder Forging	2129397	C. M. Stl. Forg. (4130)	Normalize
Blank—Bomb Door Fwd. Act. Cyl. Head Forging	2150712	C. M. Stl. Forg. (4130)	Normalize
Blank—Cont. Horn Clevis	2190921	C. M. Stl. Forg. (4130)	Normalize
Blank—Fixed Wing Gun Aft. Attaching Supt.	4143449	C. M. Stl. Forg. (4130)	Normalize
Blank—Fixed Wing Gun Fwd. Support Attach.	5143399	C. M. Stl. Forg. (4130)	Normalize
Blank—Flap Rotating Rod Forg.	2126755	C. M. Stl. Forg. (4130)	Normalize
Blank—Forward Fus. Hoist Fitting	2195097	C. M. Stl. Forg. (4130)	Normalize
Blank—Fus. Bomb Bay Door End Hinge Segment Forging	4129435	C. M. Stl. Forg. (4130)	Normalize

HEAT TREATED PARTS

Title	*Part No.*	*Material*	*Heat Treatment*
Blank—Fus. Hoist	5157686	C. M. Stl. Forg. (4130)	Normalize
Blank—Fus. Tail Hold Down Ftg. Forging	2155221	C. M. Stl. Forg. (4130)	Normalize
Blank—Gunner's Seat Supt. Stop Forg.	2129238	C. M. Stl. Forg. (4130)	Normalize
Blank—Gunner's Seat Support Track Forging	4152632	C. M. Stl. Forg. (4130)	Normalize
Blank—Heater Control Crank	2193622	C. M. Stl. Forg. (4130)	Normalize
Blank—Nose Wheel Lower Retracting Link Forging	5127947	C. M. Stl. Forg. (4130)	Normalize
Blank—Main Ldg. Gr. Act. Cyl. Head Forging	4128186	C. M. Stl. Forg. (4130)	Normalize
Blank—Main Ldg. Gr. Ground Safety Block Forging	2120805	C. M. Stl. Forg. (4130)	Normalize
Blank—Main Ldg. Gr. Latch Release Arm Forging	1127779	C. M. Stl. Forg. (4130)	Normalize
Blank—Nose Wheel Door Act. Cyl. Head Forging	4129439	C. M. Stl. Forg. (4130)	Normalize
Blank—Nose Wheel Door L.H. Act. Arm Forging	4129509	C. M. Stl. Forg. (4130)	Normalize
Blank—Nose Wheel Door L.H. Act. Lever Forging	4129531	C. M. Stl. Forg. (4130)	Normalize
Blank—Nose Wheel Door R.H. Oper. Arm Supt. Forging	4129548	C. M. Stl. Forg. (4130)	Normalize
Blank—Nose Wheel Retracting Arm Forging	4123616	C. M. Stl. Forg. (4130)	Normalize
Blank—Outbd. Flap Support Forg.	5128013	C. M. Stl. Forg. (4130)	Normalize
Blank—Outbd. Wing Bomb Rack Supporting Forg.	5123499	C. M. Stl. Forg. (4140)	Normalize
Blank—Parking Brake Stop Plate Forging	2123273	C. M. Stl. Forg. (4130)	Normalize
Blank—Pilot Bomb Rack Cont. Handle Socket Forging	4193555	C. M. Stl. Forg. (4130)	Normalize
Blank—Rotating Mech. Swivel Forg.	2126891	C. M. Stl. Forg. (4130)	Normalize
Blank—Wing Drag. Ftg. Forging	5193064	C. M. Stl. Forg. (4130)	Normalize
Blank—Wing Flap Gr. Box Side Plate Forging	2126874	C. M. Stl. Forg. (4130)	Normalize
Blank—Wing Hoist Forging	4129575	C. M. Stl. Forg. (4130)	Normalize
Blank—Wing Hoist Link Universal	2143112	C. M. Stl. Forg. (4130)	Normalize
Block Assem.—Nac. Outbd. Door Act. Rod	1151341	C. M. Stl. (4130)	125,000-145,000
Bolt—3/4-16 Hollow Hex. Head	2076912	C. N. Moly (4340)	160,000-180,000
Bolt—1/4-28 Hollow Hex. Head	2076904	C. N. Moly (4340)	160,000-180,000
Bolt—160,000 Lb. Shear or Bearing	2035884	C. M. Stl. (4340)	160,000-180,000
Bolt—3/4-16 Crown Type Round Head	2126912	C. M. Stl. (4340)	160,000-180,000
Bolt—9/16-18 Crown Type Round Head	2126909	C. M. Stl. (4340)	160,000-180,000
Bolt—7/16-20 Crown Type Round Head	2126907	C. M. Stl. (4340)	160,000-180,000
Bolt—1/2-20 Crown Type Round Head	2126908	C. M. Stl. (4340)	160,000-180,000
Bolt—3/8-24 Crown Type Round Head	2126906	C. M. Stl. (4340)	160,000-180,000
Bolt—9/16-24 Crown Type Round Head	2126905	C. M. Stl. (4340)	160,000-180,000
Bolt—3/4x9/16 "U"	075849	C. M. Stl. (4130)	Normalize

HEAT TREATED PARTS

Title	Part No.	Material	Heat Treatment
Bolt–Center Tie	1125991	C. M. Stl. (4130)	125,000-145,000
Bolt–Shear or Bearing	111904	Ni. Stl. (2330)	125,000-145,000
Bolt–Special ¼x20 Thread	182718	Ni. Stl. (2330)	125,000-145,000
Bolt–¼-28 Crown Type Round Head	2126904	Ni. Stl. (4340)	160,000-180,000
Bolt–Armor Att.	1193932	C. M. Stl. (4130)	125,000-145,000
Bolt–Carb. Air Elbow Flex. Joint Clamp	2123285-2	C. M. Stl. (4130)	125,000-145,000
Bolt–Cont. Surface Locking	1125983	C. M. Stl. (4130)	125,000-145,000
Bolt–Engine Mount Attaching	1122834	C. M. Stl. (4130)	125,000-145,000
Bolt–Fixed Gun Sight Dust Cap Eye	1122876	C. M. Stl. (4130)	125,000-145,000
Bolt–Gun Camera Swivel Clamping	1151311	C. M. Stl. (4130)	125,000-145,000
Bolt–Hoist	1158415	C. M. Stl. (4130)	150,000-180,000
Bolt–Inbd. Flap Mech. Internal Wrenching	2153715	C. M. Stl. (4130)	160,000-180,000
Bolt–Lower Turret Aligning Ring	1195897	C. M. Stl. (4130)	150,000-180,000
Bolt–Main Ldg. Gr. Latch Cap	1150583	C. M. Stl. (4130)	125,000-145,000
Bolt–Nose Wheel Act. Cyl. Eye	1128865	C. M. Stl. (4130)	125,000-145,000
Bolt–Nose Wheel Retracting Links Stop	1151313	C. M. Stl. (4130)	125,000-145,000
Bolt–Nose Wheel Snubber Att.	1150910	C. M. Stl. (4130)	125,000-145,000
Bolt–Pedestal Pulley Special	1154397	C. M. Stl. (4130)	125,000-145,000
Bolt–Rudder Trim Tab Control	1151041	C. M. Stl. (4130)	125,000-145,000
Bolt–Torpedo Stop	2129399	C. M. Stl. (4130)	125,000-145,000
Bolt–Turret Elect. Equipment Mtg.	1128839	C. M. Stl. (4130)	125,000-145,000
Bolt Assem.–Nose Wheel Door Act. Cylinder Rod	1128949	C. M. Stl. (4130)	125,000-145,000
Boss–Oil Cooler Inbd. Hinge	1158464-4	C. M. Stl. (4130)	125,000-145,000
Boss–Link Assem. Fixed Gun Sight Projector Mech.	1122888-2	C. M. Stl. (4130)	Normalize
Boss–Fixed Wing Gun Fwd. Att.	4202344-10	C. M. Stl. (4130)	Normalize
Boss–Fixed Wing Gun Fwd. Att.	4202375-8	C. M. Stl. (4130)	Normalize
Bracket Assem.–Cowling Flap Oper. Mech. Inner Support	4123641-2	C. M. Stl. (4130)	Normalize
Bracket–Cowl Flap Oper. Unit Supt.	2126507	C. M. Stl. (4130)	155,000-180,000
Bracket–Oil Outlet Line Eng.	1127703	C. M. Stl. (4130)	Normalize
Bracket–Anti-Drag Ring Fwd. Ctr. Support	2191126	C. M. Stl. (4130)	100,000-120,000
Bracket–Anti-Drag Ring Fwd. Sup.	2191127	C. M. Stl. (4130)	100,000-120,000
Bracket–Anti-Drag Ring Rear Sup.	2191125	C. M. Stl. (4130)	100,000-120,000
Bracket–Cowl. Flap Oper. Mech. Control	1122886	C. M. Stl. (4130)	125,000-145,000
Bracket Assem.–Cowling Flap Oper. Mech. Inner Support	4123641-3	C. M. Stl. (4130)	Normalize
Bracket Assem.–Aft Bomb Bay Door Hinge	2190884-2	Sprg. Stl. (1095)	Spring Temper
Bracket Assem.–Bomb Bay Fuel Tank End Strap	5191860-8	C. M. Stl. (4130)	125,000-145,000
Bushing–	116500(C)	C. M. Stl. (4130)	125,000-145,000
Bushing–	131736(C)	C. M. Stl. (4130)	124,000-145,000
Bushing–	1059608	C. M. Stl. (4130)	125,000-145,000
Bushing–Ail. Cont. Lock Pin Driving	1151025	C. M. Stl. (4130)	125,000-145,000
Bushing Assem.–Ail. Torque Tube Aft Bearing Cont. Lock	1143173	C. M. Stl. (4130)	125,000-145,000

HEAT TREATED PARTS

Title	Part No.	Material	Heat Treatment
Bushing—Anti-Drag Ring Forward Bow Sup. Fitting	1125877	C. M. Stl. (4130)	125,000-145,000
Bushing—Anti-Drag Ring Front & Rear Bow Block	1125902	C. M. Stl. (4130)	125,000-145,000
Bushing—Anti-Drag Ring Rear Bow Attaching	1127641	C. M. Stl. (4130)	125,000-145,000
Bushing—Anti-Drag Ring Rear Bow Att. Fitting	1125874	C. M. Stl. (4130)	125,000-145,000
Bushing—Cont. Horn Hinge	1125988	C. M. Stl. (4130)	125,000-145,000
Bushing—Cowling Flap Hinge Bracket	1125967	C. M. Stl. (4130)	125,000-145,000
Bushing—Engine Mount Aligning	1122833	C. M. Stl. (4130)	125,000-145,000
Bushing—Fixed Cannon Mount	2192767	C. M. Stl. (4130)	Normalize
Bushing—Front Spar Lower Inbd. Fitting	1125823	C. M. Stl. (4130)	130,000-150,000
Bushing—Front Spar Upper Inbd. Fitting	1193214	C. M. Stl. (4130)	130,000-150,000
Bushing—Fus. Nose Ftg. Upper	1195882	C. M. Stl. (4130)	125,000-145,000
Bushing—Gunner's Seat	2126733	C. M. Stl. (4130)	Normalize
Bushing—Cowl Flap	4127549-4	C. M. Stl. (4130)	Normalize
Bushing—Horn Stop	1125993	Bushing (4130)	125,000-145,000
Bushing—Anti-Drag Ring Forward Bow Support Link Assem.	1125878-6	C. M. Stl. (4130)	Normalize
Bushing—Lower Front Fuselage Cross Tie	1125913	C. M. Stl. (4130)	125,000-145,000
Bushing—Mixture Cont. Lever Adjusting	1157840	C. M. Stl. (4140)	125,000-145,000
Bushing—Nose Gear Upper Retract.	1127767	C. M. Stl. (4130)	125,000-145,000
Bushing—Rear Fus. Cross Tie Lower	1125914	C. M. Stl. (4130)	125,000-145,000
Bushing—Rear Fus. Cross Tie Upper	1125911	C. M. Stl. (4130)	125,000-145,000
Bushing—Rear Spar Upper & Lower Inboard Fitting	1127755	C. M. Stl. (4130)	125,000-145,000
Bushing—Rudder Pedal Arm	1190669	C. M. Stl. (4130)	Normalize
Bushing—Rudder Surface Lock	1128701	C. M. Stl. (4130)	Normalize
Bushing—Surface Lock	1143076	C. M. Stl. (4130)	125,000-145,000
Bushing—Surface Lock	1125989	C. M. Stl. (4130)	125,000-145,000
Bushing—Torpedo Cross Beam Supt.	1190786	C. M. Stl. (4130)	125,000-145,000
Bushing—Upper Front Fus. Cross Tie	1125910	C. M. Stl. (4130)	125,000-145,000
Cam—Cabin Heat Control	4192935	C. M. Stl. (4130)	150,000-180,000
Cam—Nose Wheel Down Latch Release	1151011	C. M. Stl. (4130)	180,000-200,000
Cap—Pilot Retractable Ladder Lower	2195025-6	C. M. Stl. (4130)	Normalize
Catch—Retainer Pin	1193344	Sprg. Stl. Annealed	Spring Temper
Channel—Bomb Hoist Beam L.H.	5125783	C. M. Stl. (4130)	125,000-145,000
Channel—Oil Cooler Seal Cable	2126854	C. M. Stl. (4130)	90,000-125,000
Channel—Wing Front Spar Fwd. Ftg.	4191568	C. M. Stl. (4130)	180,000-200,000
Clamp—Battery Overflow Cont.	2155104	C. M. Stl. (4130)	Normalize
Clamp—Carb. Air Elbow Flex. Joint Forward Half	4123647	C. M. Stl. (4130)	Normalize
Clamp—Flap Emergency Crank	1191607-2	Sprg. Stl. (1095)	Spring Temper
Clamp—Flexible Defrost. Hose Support	1193387	Sprg. Stl. (1095)	Spring Temper
Clamp—Flex. Defrost. Hose Support	1121135	Sprg. Stl. (1095)	Spring Temper
Clamp—Joint Assem. Cold Air Scoop	4193466-2	Sprg. Stl. (1095)	Spring Temper

HEAT TREATED PARTS

Title	*Part No.*	*Material*	*Heat Treatment*
Clamp Assem.—Air Duct Coupling	1159934	Sprg. Stl. (1095)	Spring Temper
Clamp—Oil Cooler Seal	4127490-2	C. M. Stl. (4130)	Normalize to 90,000-125,000
Clevis—$\frac{5}{16}$ Special Thread	1127609	C. M. Stl. (4130)	125,000-145,000
Clevis—Nac. Door Rod Universal	1127765	C. M. Stl. (4130)	125,000-145,000
Clip—AFCE Directional Stab. Top Cover Retainer	1194832	Sprg. Stl. (1095)	Spring Temper
Clip—Armor Plate Attaching	1193848	C. M. Stl. (4130)	Normalize
Clip—Armor Plate Center	1193888	C. M. Stl. (4130)	Normalize
Clip—Armor Plate Lower Anchor	1193857	C. M. Stl. (4130)	150,000-180,000
Clip—Amor Plate Upper Anchor	1193856	C. M. Stl. (4130)	150,000-180,000
Clip—Engine Control Bell Crank	1125563	C. M. Stl. (4130)	Normalize
Clip—External Power Receptacle Box Cover	1151322	Sprg. Stl. Annealed	Spring Temper
Clip—Floor Attaching Dog	119310	C. M. Stl. (4130)	Normalize
Clip—Gunner Encl. Escape Door Hold Open Support	1193263	Sprg. Stl. (1095)	Spring Temper
Clip—Inbd. Flap Mech. Cover	2194672-2	C. M. Stl. (4130)	155,000-180,000
Clip—Hyd. Reservoir Funnel Stowage	1143118	Sprg. Stl. (1095)	Spring Temper
Clip—Ldg. Gr. Pos. Transm. Arm Attaching	1151086	C. M. Stl. (4130)	Normalize
Clip—Map Holder	1194961	Sprg. Stl. (1095)	Spring Temper
Clip—Outside Tunnel Door Att.	1193369	Sprg. Stl. (1095)	Spring Temper
Clip—Pilot Compt. Flex. Defrost Hose Sup.	1195995	Sprg. Stl. (1095)	Spring Temper
Clip—Pilot Instruction Placard	1194997	Sprg. Stl. (1095)	Spring Temper
Clip—Radio Headset Conn. Cord	1019534	Sprg. Stl. (1095)	Spring Temper
Clip—Radio Microphone	1017850	Sprg. Stl. (1095)	Spring Temper
Clip—Removable Bomb Rail Lower	1150923	C. M. Stl. (4130)	125,000-145,000
Collar Assem.—Oil Cooler Inbd. Hinge	1158464	C. M. Stl. (4130)	125,000-145,000
Collar—Main Ldg. Gr. Inbd. Shaft	1151350	C. M. Stl. (4130)	H.R. & Normalize
Collar—Wing Flap Gr. Box Screw Threaded	1191780	C. M. Stl. (4130)	125,000-145,000
Doubler—Bomb Hoist Beam Reinf.	2126668	C. M. Stl. (4130)	125,000-145,000
Elbow—Chem Tank Vent	2094984	Stl. Casting	125,000-145,000
End—Aileron Push Pull Tube	1159580	C. M. Stl. (4130)	125,000-145,000
End—Aileron Push Pull Tube	1122836	C. M. Stl. (4130)	125,000-145,000
End—Aileron Tab Rod Bearing	1122851	C. M. Stl. (4130)	125,000-145,000
End—Aileron Torque Tube	1150406	C. M. Stl. (4130)	H. R. & Normalize
End—Bomb Door Aft Act. Cyl. Rod.	1150412	C. M. Stl. (4130)	125,000-145,000
End—Bomb Door Fwd. Act. Cyl. Piston Adjust.	1150477	C. M. Stl. (4130)	125,000-145,000
End—Nose Wheel Side	4123687-4	C. M. Stl. (4130)	150,000-180,000
End—Brake Pedal Cont. Brg. Rod	1192288	C. M. Stl. (4130)	125,000-145,000
End—Clevis on Rod Assem.	278130	C. M. Stl. (4130)	Normalize
End—Control Rod	1085484	C. M. Stl. (4130)	125,000-145,000
End—Elev. Trim Tab Torque Tube	1127700	C. M. Stl. (4130)	125,000-145,000
End—Engine Control Rod	1074043	C. M. Stl. (4130)	125,000-145,000 & C. R.
End—Engine Control Rod	1080907	Ni. Stl. (2330)	125,000-145,000
End—Flap Rotating Rod Tube	1127650	C. M. Stl. (4130)	125,000-145,000

HEAT TREATED PARTS

Title	*Part No.*	*Material*	*Heat Treatment*
End—Flight Control Supt. Rod.	1156682	C. M. Stl. (4130)	125,000-145,000
End—L. H. Firewall Manifold Press. Reg. Tube	1194851	C. M. Stl. (4130)	125,000-145,000
End—Main Ldg. Gr. Act. Cyl. Piston Adjusting	2126828	C. M. Stl. (4130)	125,000-145,000
End—Mod. Control Flex. Shaft Serrated	1193944	C. M. Stl. (4130)	125,000-145,000
End—Nose Wheel Door Act. Cyl. Piston Adjusting	1128950	C. M. Stl. (4130)	125,000-145,000
End—Nose Wheel Door Mech. Connecting Link	1154426	C. M. Stl. (4130)	125,000-145,000
End—Nose Wheel Rotating Link	1128931	C. M. Stl. (4130)	125,000-145,000
End—Nose Wheel Side Brace	1125855	C. M. Stl. (4130)	125,000-145,000
End—Nose Wheel Snubber Piston Rod	1150918	C. M. Stl. (4130)	125,000-145,000
End Rod Assem.—Pilot's Inst. Panel R. H. Support	2126743-2	C. M. Stl. (4130)	125,000-145,000
End—Rudder Pedal Cont. Rod.	1122861	C. M. Stl. (4130)	125,000-145,000
End—Torpedo Release Sling	4191400	Corr. Res. Stl.	90,000-115,000
End—Torpedo Sling Fixed	4191402	Corr. Res. Stl.	90,000-115,000
End—Upper Support Rod	1127730	C. M. Stl. (4130)	125,000-145,000
End—Lower Support Rod	1127731	C. M. Stl. (4130)	125,000-145,000
End Assem.—Act. Cyl. Rod Main Ldg. Gr.	2126808	C. M. Stl. (4130)	125,000-145,000
End Assem.—Ail. Tab Rod. Adj. Bearing	1122850	C. M. Stl. (4130)	125,000-145,000
End Assem.—Nose Wheel Snubber Piston Rod	2150765	C. M. Stl. (4130)	125,000-145,000
End Fitting—Rod Assem. Pilot Inst. Panel L. H. Supt.	2195099-2	C. M. Stl. (4130)	125,000-145,000
Escutcheon Plate Door Assem.—Camera	5122151-12	C. M. Stl. (4130)	Normalize
Extension—Bomb Door Aft. Act. Cyl. Head	1150459	C. M. Stl. (4130)	125,000-145,000
Eye—Special 5/16 Female Thread	1127602	C. M. Stl. (4130)	125,000-145,000
Eye—Special 1/8 Cable Turnbuckle	1152933	C. M. Stl. (4130)	125,000-145,000
Eyebolt Assem.—Bomb Door Act. Mech. Link	2150812	C. M. Stl. (4130)	125,000-145,000
Fitting—	2129234	C. M. Stl. (4130)	125,000-145,000
Fitting—	4129413	C. M. Stl. (4130)	125,000-145,000
Fitting—Fuselage Wing Drag Stif.	4193421	C. M. Stl. (4140)	150,000-170,000
Fitting—Nacelle Door Rod	1127764	C. M. Stl. (4130)	125,000-145,000
Fitting—Nac. Outbd. Door Act. Rod End	1151340	C. M. Stl. (4130)	125,000-145,000
Fitting—Torpedo Sling L. H. Support	2159653	C. M. Stl. (4130)	125,000-145,000
Fitting—Torpedo Sling R. H. Support	2159654	C. M. Stl. (4130)	125,000-145,000
Fitting—Wing Front Spar Aft	5192406	C. M. Stl. (4130)	180,000-200,000
Fitting—Wing Front Spar Fwd.	5192407	C. M. Stl. (4130)	180,000-200,000
Fitting—Wing Hoist Link Univ.	2196533	C. M. Stl. Forg. (4130)	160,000-180,000
Fitting Assem.—Anti-Drag Ring Forward Bow Supt.	1125876	C. M. Stl. (4130)	125,000-145,000
Flange—Chem. Tank Vent	1126930	C. M. Stl. (4130)	Normalize
Flange Assem.—Eng. Fuel	2155164-2	C. M. Stl. (4130)	Normalize
Flange Elbow Assem.—Engine Oil	2123201-4	C. M. Stl. (4130)	Normalize
Fork—Fixed Cannon Convertible Adjusting	2195037	C. M. Stl. (4130)	125,000-145,000

HEAT TREATED PARTS

Title	*Part No.*	*Material*	*Heat Treatment*
Gear—Elev. Trim Tab Worm	2126535	C. M. Stl. (4130)	H.R. & Normalize
Gear—Flap Emergency Bevel	2190962	C. M. Stl. (4140)	85,000-125,000
Gear—Pilot Sliding Window Torque Tube	1192347	C. M. Stl. (4130)	Normalize
Guard—Nose Wheel Door Latch Pulley	1150442	C. M. Stl. (4130)	Normalize
Guide—Cont. Lock Lever Stop	1193220	C. M. Stl. (4130)	Normalize
Handle—Fwd. Gunner Access Door Latch	1190102-2	C. M. Stl. (4130)	Normalize
Handle—Wrench Assem.-Cont. Column Head Brg. Retaining Cap	2152718-4	C. M. Stl. (4130)	125,000-145,000
Handle Assem.—Aft Bomb Bay Access Door	2190885	C. M. Stl. (4130)	Normalize
Head—Main Ldg. Gr. Act. Cyl. Forg.	4128191	C. M. Stl. Forg. (4130)	Normalize
Head—Nose Wheel Act. Cyl.	4128218	C. M. Stl. (4130)	Normalize
Head—Tube Assem.-Oil Gage	3125455-2	C. M. Stl. (4130)	125,000-145,000
Hinge—	1084383	C. M. Stl. (4130)	Normalize
Hinge—Aft Bomb Bay Door Hinge	2190884-4	Sprg. Stl. (1095)	Spring Temper
Hinge—Cowl Flap	4127549-3	C. M. Stl. (4130)	Normalize
Hinge—Cowl Flap	4127549-2	C. M. Stl. (4130)	Normalize
Hinge—Inbd. Flap Mech. Cover	2194672-6	C. M. Stl. (4130)	155,000-180,000
Hinge Assem.—Inbd. Flap Mech. Cover	2194672-8	C. M. Stl. (4130)	155,000-180,000
Hook—Anti-Drag Ring Fastener	1125959	C. M. Stl. (4130)	180,000-200,000
Hook—Carb. Air Duct Latching	1195987	C. M. Stl. (4130)	125,000-145,000
Hook—Fwd. Gunner Access Door Latch	1193964	C. M. Stl. (4130)	125,000-145,000
Hook—Nose Wheel Up Latch	2129290	C. M. Stl. (4130)	150,000-180,000
Hook—Sleeve Assem. Air Duct to Elbow Flexible	5194627-16	C. M. Stl. (4130)	Normalize
Hook—Throat Micro. Sw. Supt.	1190750	Sprg. Stl. (1095)	Spring Temper
Hook Assem.—Nose Wheel Door Up	2150787	C. M. Stl. (4130)	180,000-200,000
Insert Assem.—Flap Oper. Torque Tube	1128814	C. M. Stl. (4130)	125,000-145,000
Key—Nose Wheel Down Latch Stop	1151369	C. M. Stl. (4130)	150,000-180,000
Knob Pad Assem.—Fus. Jack	2126700-4	C. M. Stl. (4130)	125,000-145,000
Latch—Nose Wheel Bungee	1193812	C. M. Stl. (4130)	150,000-180,000
Latch—Nose Wheel Down	1151009	C. M. Stl. (4130)	150,000-170,000
Latch—Upper Cowling Hold Down	1193975	C. M. Stl. (4130)	125,000-145,000
Leaf—No. 1 Nose Wheel Bungee Spring	1193808	C. M. Stl. (4130)	180,000-200,000
Leaf—No. 2 Nose Wheel Bungee Spring	1193810	C. M. Stl. (4130)	180,000-200,000
Leaf—No. 3 Nose Wheel Bungee Spring	1193809	C. M. Stl. (4130)	180,000-200,000
Leaf—No. 4 Nose Wheel Bungee Spring	1193947	C. M. Stl. (4130)	180,000-200,000
Lever—R. H. Blower Control	2159628	C. M. Stl. (4130)	Normalize
Lever—Buckle Assem.—Bomb Bay Fuel Tank Latch	4191510-2	C. M. Stl. (4130)	125,000-145,000
Lever—Ldg. Gear Control	4191523-2	C. M. Stl. (4130)	Normalize
Lever—Wing Flap Control	4151132-2	C. M. Stl. (4130)	Normalize
Lever Assem.—Nose Wheel Down Latch Release	1151010	C. M. Stl. (4130)	Normalize
Lever Assem.—Nose Wheel Position Indicator	1127713-4	C. M. Stl. (4130)	Normalize
Link—Anti-Drag Ring Forwd. Bow Support	1125878-2	C. M. Stl. (4130)	Normalize
Link—Bomb Door Act. Mech. Stop	2150824	C. M. Stl. (4130)	Normalize

HEAT TREATED PARTS

Title	Part No.	Material	Heat Treatment
Link—Bomb Bay Fuel Tank Latch	4191510-6	C. M. Stl. (4130)	125,000-145,000
Link—Ferry Tank Strap End	1193864	C. M. Stl. (4130)	Normalize
Link—Nose Wheel Pos. Transmitter	1127753	C. M. Stl. (4130)	Normalize
Link Assem.—Lower Nose Wheel Retracting	5127907	C. M. Stl. Forg. (4130)	150,000-170,000
Lock—Nose Wheel Ground Safety	4151268-6	C. M. Stl. (4130)	Normalize
Lock—Pin Assem.—Main Ldg. Gr. Ground Safety	2153888-6	C. M. Stl. (4130)	125,000-145,000
Lug—Fwd. Gunner Access Door Latch	1190125	C. M. Stl. (4130)	125,000-145,000
Lug—Pilot Sliding Window Stop	1194824	C. M. Stl. (4130)	125,000-145,000
Nut—5/16-24 Shoulder	1143193	C. M. Stl. (4130)	125,000-145,000
Nut—Crown Type Self Locking	2062624	Ni. Stl. (2330)	125,000-145,000
Nut—Bomb Door Act. Forwd. Cyl. External Packing	2150745	C. M. Stl. (4130)	125,000-145,000
Nut—Bomb Door Aft Act. Cyl. External Packing	2150731	C. M. Stl. (4135)	125,000-145,000
Nut—Bomb Door Fwd. Act. Cyl. Rod Packing	2150725	C. M. Stl. (4130)	125,000-145,000
Nut—Bomb Rack Support	1190609	C. M. Stl. (4130)	125,000-145,000
Nut—Chem. Tank Vent Seal Retain.	2126903	C. M. Stl. (4130)	Normalize
Nut—Cowl. Flap Operating Unit	1125814	C. M. Stl. (4130)	125,000-145,000
Nut—Cowling Flap Oper. Unit Flexible Shaft	1125818	C. M. Stl. (4130)	125,000-145,000 & C. R.
Nut—Engine Mount Attaching Trunnion	1122832	C. M. Stl. (4130)	125,000-145,000
Nut—Fixed Gun Sight Dust Camp Thumb	1122877	C. M. Stl. (4130)	125,000-145,000
Nut—Fixed Wing Gun Fwd. Hanger Support	1142944	C. M. Stl. (4130)	H. R. & Normalize
Nut—Internal Wrenching Elastic Stop	2032517	Ni. Stl. (2330)	125,000-145,000
Nut—Main Ldg. Gr. Act. Cyl. External Packing	2150742	C. M. Stl. (4130)	125,000-145,000
Nut—Main Ldg. Gr. Act. Cylinder Rod Stop Lock	1127790	C. M. Stl. (4130)	125,000-145,000
Nut—Nose Wheel Act. Cyl. External Packing	2150746	C. M. Stl. (4130)	125,000-145,000
Nut—Nose Wheel Act. Cyl. Piston Rod Packing	2129211	C. M. Stl. (4130)	125,000-145,000
Nut—Nose Wheel Door Act. Cyl. Piston Rod Packing	2129275	C. M. Stl. (4130)	125,000-145,000
Nut—Nose Wheel Snubber Piston Rod Packing	4129556	C. M. Stl. (4130)	125,000-145,000
Nut—Power Plant Sec. Cont. Locking	1156599	C. M. Stl. (4130)	125,000-145,000
Nut—Trim Tab Adjustable Coupling	1127701	C. M. Stl. (4130)	125,000-145,000
Nut—Trim Tab Coupling Lock	1127702	C. M. Stl. (4130)	125,000-145,000
Nut—Wing Flap Support Upper Att.	1127680	C. M. Stl. (4130)	125,000-145,000
Nut Assem.—Cowl Flap Oper. Unit	2126503	C. M. Stl. (4130)	Normalize
Pin—100 Degree Threaded 1/4x28 Drive	1048604	Ni. Stl. (2330)	125,000-145,000
Pin—100 Degree Threaded 5/16x24 Drive	1048605	Ni. Stl. (2330)	125,000-145,000
Pin—Threaded 5/16x24 Drive Fit	1048705	Ni. Stl. (2330)	125,000-145,000

HEAT TREATED PARTS

Title	*Part No.*	*Material*	*Heat Treatment*
Pin—Threaded 5/16x24 Drive Fit	1048706	Ni. Stl. (2330)	125,000-145,000
Pin—Aileron Control Lock	1151024	C. M. Stl. (4130)	125,000-145,000
Pin—Anti-Drag Ring Fastener Guide	1193253	C. M. Stl. (4130)	125,000-145,000
Pin—Anti-Drag Ring Fastener Locking	1193309	C. M. Stl. (4130)	150,000-180,000
Pin—Elev. Trim Tab Torque Tube	1125850	C. M. Stl. (4130)	150,000-180,000
Pin—Fus. Rear Wing Spar Attaching Lower	2126571	C. M. Stl. (4130)	180,000-200,000
Pin—Fus. Front Wing Spar Attaching Upper	2192706	C. M. Stl. (4130)	180,000-200,000
Pin—Fus. Nose Access Door Locking	1195828	C. M. Stl. (4130)	125,000-145,000
Pin—Fus. Rear Wing Spar Attaching	2126570	C. M. Stl. (4130)	180,000-200,000
Pin—Fwd. Gunner Access Door Latch	1190126	C. M. Stl. (4130)	125,000-145,000
Pin—Heater Control Crank	1193393	C. M. Stl. (4130)	150,000-180,000
Pin—Hoist Socket Plunger Act.	1150403	C. M. Stl. (4130)	125,000-145,000
Pin—Nose Wheel Ground Safety	4151268-2	C. M. Stl. (4130)	125,000-145,000
Pin Assem.—Inbd. Wing Jack	2126974-2	C. M. Stl. (4130)	125,000-145,000
Pin—Rod Assem. Nac. Outbd. Door Act.	2151647-4	C. M. Stl. (4130)	125,000-145,000
Pin—Rudder Pedal	1024896	Ni. Stl. (2330)	125,000-145,000
Pin—Rudder Pedal Lock	1024895	Ni. Stl. (2330)	125,000-145,000
Pin—Rudder Trim Tab Cont. Stop	1150901	C. M. Stl. (4130)	125,000-145,000
Pin—Throttler R.P.M. & Mix Cont. Lever Stop	1150994	C. M. Stl. (4130)	180,000-200,000
Pin—Torpedo Release Link	1150475	C. M. Stl. (4130)	125,000-145,000
Pin—Wing Drag	2192732	C. M. Stl. (4140)	180,000-200,000
Pin—Main Ldg. Gr. Ground Safety	2153888-2	C. M. Stl. (4130)	125,000-145,000
Piston—Bomb Door Aft Act. Cylinder	2129331	C. M. Stl. (4130)	H.R. & Normalize
Piston—Bomb Door Fwd. Act. Cylinder	2150700	C. M. Stl. (4130)	H.R. & Normalize
Piston—Main Ldg. Gr. Act. Cylinder	2126827	C. M. Stl. (4130)	H. R. & Normalize
Piston—Nose Wheel Act. Cylinder	2126872	C. M. Stl. (4130)	H. R. & Normalize
Piston—Nose Wheel Door Act. Cylinder	2129274	C. M. Stl. (4130)	Normalize
Piston—Nose Wheel Snubber	2150772	C. M. Stl. (4130)	H. R. & Normalize
Piston Assem.—Bomb Door Aft. Act. Cylinder	5150095-4	C. M. Stl. (4130)	125,000-155,000
Piston Assem.—Bomb Door Fwd.	4129519	C. M. Stl. (4130)	125,000-145,000
Piston Assem.—Main Ldg. Gr. Act. Cylinder	5128439-4	C. M. Stl. (4130)	Normalize
Plate—Anti-Drag Ring Fwd. Support	5123959-20	C. M. Stl. (4130)	Normalize
Plate—Bomb Bay Fwd. Access Door Striker	1154368	C. M. Stl. (4130)	Normalize
Plate—Camera Door Escutcheon	1151045	C. M. Stl. (4130)	100,000-125,000
Plate—Oil Cooler Inbd. Hinge	1158464-2	C. M. Stl. (4130)	125,000-145,000
Plate—Cowl. Flap Oper. Unit Tach Shaft	1122864		
Plate—Door Striker	1055213	C. M. Stl. (4130)	125,000-145,000
Plate—Elbow Assem.—Engine Oil	2123201-3	C. M. Stl. (4130)	Normalize
Plate—Elbow Assem.—Engine Oil	2123201-2	C. M. Stl. (4130)	Normalize
Plate Assem.—Hoist L.H.	5157687-2	C. M. Stl. (4130)	Normalize
Plate Assem.—R.H. Hoist	5193026-2	C. M. Stl. (4130)	Normalize
Plate—Fixed Cannon Amm. Stow. Aft	5194648	C. M. Stl. (4130)	180,000-200,000
Plate—Fixed Cannon Amm. Stowage Fwd.	5194649	C. M. Stl. (4130)	180,000-200,000

HEAT TREATED PARTS

Title	Part No.	Material	Heat Treatment
Plate–Fixed Spinner Attaching	2195142	C. M. Stl. (4130)	Normalize
Plate–Gunner Escape Door Striker	1192370	C. M. Stl. (4130)	Normalize
Plate on Skid Assem.–Tail	5157457-4	C. M. Stl. (4130)	Normalize
Plate–Bomb Bay Fuel Tank Support	4129452-2	C. M. Stl. (4130)	125,000-155,000
Plate–Wing Flap Cont. Lever Position	2159695	C. M. Stl. (4130)	Normalize
Plate–L. & R. Wing Generator Resistor Bottom	1150929	C. M. Stl. (4130)	Normalize
Plate–L. & R. Wing Generator Resistor Top	1150928	C. M. Stl. (4130)	Normalize
Plate–Wing Gun Sup. Shear	4143162	C. M. Stl. (4130)	125,000-145,000
Post–Gun Mount Trunnion	266809	Ni. Stl. (2330)	Carburize & Harden
Post–Lock. Assem.–Wing Bomb Rack Control Lever	1193807-2	C. M. Stl. (4130)	125,000-145,000
Post–Fixed Wing Gun Fwd. Att.	4202344-8	C. M. Stl. (4140)	Normalize
Release Assem.–Nose Wheel Up Latch Hook	2129289	C. M. Stl. (4130)	150,000-180,000
Retainer–Carb. Hot Air Door Bearing	1122866	C. M. Stl. (4130)	125,000-145,000
Ring–Control Lever Shaft Ret. Snap	1190037	Sprg. Stl. (1095)	Spring Temper
Ring–Case & Link Catcher Support	5150395-4	C. M. Stl. (4130)	Normalize
Ring–Shock Abs. Rotg. Arm Upper Wedge	2129342	C. M. Stl. (4130)	Normalize
Rod–Flap Door Push	1127676	C. M. Stl. (4130)	125,000-145,000
Rod Assem.–½ I.D. Steel Tube	2039637	C. M. Stl. (4130)	Normalize
Rod Assem.–Anti-Drag Ring Fastener Control	4152689	C. M. Stl. (4130)	Normalize
Rod Assem.–Elev. Interconnection	2126665	C. M. Stl. (4130)	125,000-145,000
Rod–Engine Control	146229	Ni. Stl. (2330)	125,000-145,000
Rod–Flash Weld Type Ball Bearing Engine Control	2085485	C. M. Stl. (4130)	Normalize
Rod–Nacelle Outboard Door Actuating	2151646	C. M. Stl. (4130)	125,000-145,000 & H. R.
Roller–Heater Cont. Camm	1193391	C. M. Stl. (4130)	150,000-180,000
Roller–Main Ldg. Gr. Latch Release	1150562	C. M. Stl. (4130)	180,000-200,000
Roller–Nose Wheel Bungee	1193813	C. M. Stl. (4130)	125,000-145,000
Screw–100 Degree Recessed Flat Head	1029421	C. M. Stl. (4130)	125,000-145,000
Screw–Chem. Tank Vent Detonator Retaining	1126917	C. M. Stl. (4130)	125,000-145,000
Screw–Cowl Flap Operating	2126506	C. M. Stl. (4130)	160,000-180,000
Screw–Inbd. Ring Flap Gear Box	2126846	C. M. Stl. (4130)	Normalize
Screw–Main Ldg. Gr. Ground Safety	1154362	C. M. Stl. (4130)	125,000-145,000
Screw–Nose Gear Retracting Link Adj.	1127756	C. M. Stl. (4130)	125,000-145,000
Screw–Outbd. Wing Flap Gr. Box	2126863	C. M. Stl. (4130)	125,000-145,000
Shackle–Fus. Hoist Cable	4195277	C. M. Stl. (4140)	180,000-200,000
Shaft–Aft Air Cont. Valve	1193304	Corr. Resis. Stl.	90,000-115,000
Shaft–Aileron Trim Tab Control	1150542	C. M. Stl. (4130)	125,000-145,000
Shaft–Air Cont. Drive	1192375	Corr. Resis. Stl.	90,000-115,000
Shaft–Air Cont. Gear Mount	1192376	Corr. Resis. Stl.	90,000-115,000
Shaft–Bomb Bay Fuel Selector Control	1150905	C. M. Stl. (4130)	125,000-145,000
Shaft–Cont. Pedestal Ctr. Lever	2157838	C. M. Stl. (4130)	125,000-145,000

HEAT TREATED PARTS

Title	Part No.	Material	Heat Treatment
Shaft—Disconnect Assem. Fus. Sec. Drive Shaft Welded	2195056-2	C. M. Stl. (4130)	125,000-145,000
Shaft—Elevator Idler Link	2129266	C. M. Stl. (4130)	125,000-145,000
Shaft Assem.—Bomb Bay Forwd. Access Door Latch	2155287	C. M. Stl. (4130)	Normalize
Shaft Assem.—Elev. Surface Lock	1127604	C. M. Stl. (4130)	125,000-145,000
Shaft—Emer. Hyd. Selector Control	1150525	C. M. Stl. (4130)	125,000-145,000
Shaft—Flap Actuator Main	2190958	C. M. Stl. (4130)	125,000-145,000
Shaft—Fwd. Gunner Access Door Latch	1190101	C. M. Stl. (4130)	Normalize
Shaft—Heater Control Main	1193325	C. M. Stl. (4140)	180,000-200,000
Shaft—Main Landing Gear Retracting Link	3126972	C. M. Stl. (4130)	180,000-200,000
Shaft—Nose Gear Upper Retracting	2126775	C. M. Stl. (4130)	150,000-170,000
Shaft—Nose Wheel Door L.H. Act. Arm	2150703	C. M. Stl. (4130)	125,000-145,000
Shaft—Rudder Trim Tab Cont. Drive	1150597	C. M. Stl. (4130)	125,000-145,000
Shaft—Rudder Trim Tab. Cont. Drum	1150594	C. M. Stl. (4130)	125,000-145,000
Shaft—Sliding Window Gear	1151047	C. M. Stl. (4130)	125,000-145,000
Shaft—Trim Tab Worm Gear	1125842	C. M. Stl. (4130)	125,000-145,000
Shaft Assem.—Rudder Surface Lock	1127608	C. M. Stl. (4130)	125,000-145,000
Sleeve—Arm Lock Lever Screw	1157835	C. M. Stl. (4130)	125,000-145,000
Sleeve—Cowl. Flap Drive Unit Tach. Shaft	1122899	C. M. Stl. (4130)	125,000-145,000
Sleeve—Elev. Trim Tab Torque Tube	1125851	C. M. Stl. (4130)	125,000-145,000
Sleeve—Flap Indicator	1150492	C. M. Stl. (4130)	125,000-145,000
Sleeve—Nose Wheel Down Latch Plunger	1151008	C. M. Stl. (4130)	125,000-145,000
Sleeve—Throttle Lock Lever Screw	1157841	C. M. Stl. (4130)	125,000-145,000
Sleeve—Wing Flap Torque Tube Bearing	1194839	C. M. Stl. (4130)	Normalize
Socket—Nose Wheel Rotat. Link	2129261	C. M. Stl. (4130)	125,000-145,000
Spacer—	117426	C. M. Stl. (4130)	H.R. & Normalize
Spacer—Anti-Drag Ring Fastening Lever	1128942	C. M. Stl. (4130)	Normalize
Spacer—Elevator Trim Tab Indicator	1150965	C. M. Stl. (4130)	125,000-145,000
Spacer—Cowl Flap	4127549-6	C. M. Stl. (4130)	Normalize
Spacer—Link Assem.—Anti-Drag Ring Forward Bow Support	1125878-4	C. M. Stl. (4130)	Normalize
Spacer—Nacelle Door Act. Bell Crank Arm	1154399	C. M. Stl. (4130)	Normalize
Spacer—Nose Wheel Down Latch Cam	1151312	C. M. Stl. (4130)	125,000-145,000
Spacer—Surface Lock Bearing	1127605	C. M. Stl. (4130)	125,000-145,000
Spring—Bomb Hoist Stowage Lock	2193737	C. M. Stl. (4130)	Spring Temper
Spring—Bomb Rack Control Lock Switch Actuating	1127726	Sprg. Stl. (1095)	Spring Temper
Spring—Bracket Assem. L. H. Bomb Hoist Beam Stowage	2192673-4	Sprg. Stl.	Spring Temper
Spring—Cont. Lock Lever	1193221	Oil Tempered Stl.	Spring Temper
Spring—Cover Assem.	1127660	Sprg. Stl. (1095)	Spring Temper
Spring—Cowling	1013321	Sprg. Stl. Annealed	Spring Temper
Spring—Crew Relief Container	1159970	Sprg. Stl. (1095)	Spring Temper
Spring—Crew Relief Container Bracket	1159969	Sprg. Stl. (1095)	Spring Temper
Spring—Flush Door Latch	1138114	Sprg. Stl. Annealed	Spring Temper
Spring—Fus. Nose Access Door Upper Link	1195814	Sprg. Stl. (1095)	Spring Temper

HEAT TREATED PARTS

Title	*Part No.*	*Material*	*Heat Treatment*
Spring–Ldg. Gear Lever	1191777	Sprg. Stl. (1095)	Spring Temper
Spring–Ldg. Gear Retracting Release Switch Actuating	1150440	Sprg. Stl. (1095)	H.T. & Sprg. Temp.
Spring–Main Ldg. Gr. Pos. Ind. Tran. Switch	1128911	Sprg. Stl. (1095)	Spring Temper
Spring–Main Ldg. Gr. Warning Switch	2196503	C. M. Stl. (4130)	150,000-180,000
Spring–Nacelle Engine Mount Bolt Access Door	1190063	Sprg. Stl. (1095)	Spring Temper
Spring–Upper Armor Latch	1193859	Sprg. Stl. (1095)	Spring Temper
Spring–Wing Gun. Ammun. Box Cover	1143369	Sprg. Stl. (1095)	Spring Temper
Stick–Anti-Icing Fluid Measuring	4195305	Sprg. Stl. (1095)	Spring Temper
Stick–Sighting Sta. Periscope Anti-Icing Fluid Measuring	4195314	Sprg. Stl. (1095)	Spring Temper
Stiffener-Bomb Hoist Beam	1150526	C. M. Stl. (4130)	125,000-145,000
Stiffener Assem.–Cowling Flap Oper. Mech. Inner Support	4123641-10	C. M. Stl. (4130)	Normalize
Stiffener–Bracket Assem.–Cowling Flap Oper. Mech. Inner Support	4123641-11	C. M. Stl. (4130)	Normalize
Stop–Main Ldg. Gr. Actuating Cyl. Rod	2126823	C. M. Stl. (4130)	125,000-145,000
Stop–Rudder Pedal	1125442	C. M. Stl. (4130)	125,000-145,000
Stop–Upper Cowling Hold Down Latch	2195031	C. M. Stl. (4130)	Normalize
Stop–Wing Flap Cont. Position	1151355	C. M. Stl. (4130)	Normalize
Stop Assem.–Nose Wheel Door Latch Lock Actuating	1128945	C. M. Stl. (4130)	125,000-145,000
Stud–Emer. Bomb Rel. Cable End	1127612	C. M. Stl. (4130)	125,000-145,000
Stud–Horizontal Stabilizer Att.	2157787	C. M. Stl. (4130)	160,000-180,000
Stud–Horizontal Stab. Shear Att.	2157788	C. M. Stl. (4130)	160,000-180,000
Stud–Outboard Att.	1125925	C. M. Stl. (4130)	125,000-145,000
Support–Battery Guide Tube	2126676	C. M. Stl. (4130)	Normalize
Support–Link Assem. Fixed Gun Sight Projector Mech.	1122888-4	C. M. Stl. (4130)	Normalize
Support–Nose Wheel Door Latch Up	2150764	C. M. Stl. (4130)	125,000-145,000
Support–Power Plant Sec. Oil Separator	5194611-10	C. M. Stl. (4130)	Normalize
Support–Power Plant Sec. Oil Separator	5194611-12	C. M. Stl. (4130)	Normalize
Support–Power Plant Sec. Oil Separator	5194611-14	C. M. Stl. (4130)	Normalize
Support–Prop. Governor Control Unit Upper	1154342	C. M. Stl. (4130)	Normalize
Support–Supercharger Cont. Unit	2153850	C. M. Stl. (4130)	160,000-180,000
Trunnion–Carb. Air Elbow Flex. Joint Clamp	1122881	C. M. Stl. (4130)	125,000-145,000
Trunnion–Nose Wheel Door Latch	1150443	C. M. Stl. (4130)	125,000-145,000
Trunnion–Oil Cooler Seal Clamp	1127655	C. M. Stl. (4130)	125,000-145,000
Tube–	2033900(S)	C. M. Stl. (4130)	Normalize
Tube–	4192802-2	C. M. Stl. (4130)	Normalize
Tube Assem.–Ail. Push Pull	2123224-2	C. M. Stl. (4130)	125,000-145,000
Tube–Aileron Torque	5128641-2	C. M. Stl. (4130)	Normalize
Tube Assem.–Bell Crank Act. Rod	2151650	C. M. Stl. (4130)	150,000-170,000
Tube–Bomb Bay Fuel Tank Support	4129452-4	C. M. Stl. (4130)	125,000-155,000

HEAT TREATED PARTS

Title	*Part No.*	*Material*	*Heat Treatment*
Tube–Bomb Door Act. Mech. Aft Support	2150899	C. M. Stl. (4130)	Normalize
Tube–Bomb Door Act. Mech. Forw. Support	2150898	C. M. Stl. (4130)	Normalize
Tube–Bomb Rack Cont. Torque	1128727	C. M. Stl. (4130)	Normalize
Tube–Nose Wheel Side	4123687-2	C. M. Stl. (4130)	150,000-180,000
Tube Assem.–Eng. Fuel	2155164-4	C. M. Stl. (4130)	Normalize
Tube–Equipment Shelf Door	3152264-2	C. M. Stl. (4130)	Normalize
Tube–Flap Rotating Rod	2126685-2	C. M. Stl. (4130)	150,000-170,000
Tube–Flap Rotating Rod	2126685-4	C. M. Stl. (4130)	150,000-170,000
Tube–Fwd. Gunner Access Door Latch	1190102-4	C. M. Stl. (4130)	Normalize
Tube–Fwd. Gunner Access Door Latch	1190154	C. M. Stl. (4130)	Normalize
Tube–Gunner's Seat Supt.	4127592	C. M. Stl. (4130)	125,000-145,000
Tube–Lever Assem. Rudder Pedal Adjustment	4123620-4	C. M. Stl. (4130)	Normalize
Tube–Nose Wheel Down Latch Release	1151010-2	C. M. Stl. (4130)	Normalize
Tube–Link Assem.–Nose Wheel Rotating Mech.	2129260-2	C. M. Stl. (4130)	Normalize
Tube–Oil Gage	3125455-4	C. M. Stl. (4130)	125,000-145,000
Tube–Pilot Retractable Ladder Upper	1194844	C. M. Stl. (4130)	Normalize
Tube–Piston Assem. Bomb Door Aft Act. Cyl.	5150095-2	C. M. Stl. (4130)	125,000-155,000
Tube–Piston Assem. Main Ldg. Gr. Act. Cyl.	5128439-4	C. M. Stl. (4130)	Normalize
Tube–Quadrant Retaining	1158672	C. M. Stl. (4130)	Normalize
Tube Assem.–Ail. Tab Control	2123243-2	C. M. Stl. (4130)	125,000-145,000
Tube–Rod Assem. Brake Pedal Control	2192192-2	C. M. Stl. (4130)	Normalize
Tube–Rod Assem. Flash Weld Quick Disconnect Control	2062641-2	C. M. Stl. (4130)	Normalize
Tube–Rod Assem.–Flight Control Support	2159581-2	C. M. Stl. (4130)	Normalize
Tube–Rod Assem.–Rudder Pedal Control	2123259-5	C. M. Stl. (4130)	Normalize
Tube–Rod Assem.–Rudder Pedal Control	2123259-2	C. M. Stl. (4130)	Normalize
Tube–Rudder Torque	3126961-2	C. M. Stl. (4130)	125,000-145,000
Tube–Shaft Assem.–Main Ldg. Gr. Latch Release	4128179-2	C. M. Stl. (4130)	Normalize
Tube–Fixed Wing Gun Fwd. Att.	4202375-4	C. M. Stl. (4140)	Normalize
Tube Assem.–Nac. Outbd. Door Act. Rod	2151649	C. M. Stl. (4130)	Normalize
Tube–Pilot Retractable Ladder Lower	2195025-2	C. M. Stl. (4130)	Normalize
Washer–Hollow Hex. Head	1075888	C. M. Stl. (4130)	Normalize
Washer–Bomb Hoist Beam	1150465	C. M. Stl. (4130)	125,000-145,000
Washer–Cowling Flap Oper. Unit "C"	1125816	C. M. Stl. (4130)	160,000-180,000
Washer–Pilot's Seat R.H. Fwd. Att.	1151055	C. M. Stl. (4130)	Normalize
Web–Fixed Wing Gun Fwd. Att.	4202344-4	C. M. Stl. (4130)	Normalize
Web–Fixed Wing Gun Fwd. Att.	4202344-6	C. M. Stl. (4130)	Normalize
Web–Fixed Wing Gun Fwd. Att.	4202375-6	C. M. Stl. (4130)	Normalize
Wedge–Door Lock Tube	1053754	C. M. Stl. (4130)	Normalize
Wing–Carb. Air Elbow Flex. Joint Clamp	2123285-4	C. M. Stl. (4130)	125,000-145,000
Worm–Elevator Trim Tab	2126536	C. M. Stl. (4130)	125,000-145,000
Worm–Rudder Trim Tab	2126528	C. M. Stl. (4130)	125,000-145,000

SECTION VII

FINISH SPECIFICATION

1. GENERAL.

a. The service life of any structure depends upon its protective coating and the care which it receives. Most of the alloys used in the construction of the Model A-26B Airplane are subject to corrosion in their unprotected state. Corrosion takes place quicker in damp coastal climates; therefore all scratches, abrasions, or marred finish surfaces must be cared for as soon as possible to avoid undue corrosion and extensive repairs. Prompt cleaning and application of a new protective coating to injured surfaces will prevent corrosion and insure proper care.

b. The methods and materials given in this section are those used in the manufacture of the airplane and conform to the Douglas Aircraft Company, Inc., Finish Specification F-76. These methods do not apply to Government furnished equipment which should be treated according to manufacturer-furnished instructions.

c. Whenever the peculiarity of a particular part or assembly prohibits the employment of the specified finish, the part or assembly should be given as high a degree of protection as is consistent with its proper functioning for its intended use.

d. Below is a table of the special products and materials called for in this section, together with the specifications covering them (when available) and the probable sources of supply. These special products are those used at the factory. It should be understood that any product, if similar or equivalent to those listed, can be used in the field.

Material	*Specification*	*Probable Source and Designation*
Primer (Darkened) Tint to	AN-TT-P-656 3-100 I	W. P. Fuller & Co. Arco Paint Co.
Enamel (Camouflage and Insignia)	A.F. 14109-A	*W. P. Fuller & Co. I. E. Dupont Sherwin-Williams
Enamel, Flat Black	AN-TT-L-51	*W. P. Fuller & Co. I. E. Dupont Sherwin-Williams
Dope, Clear Nitrate	AN-TT-D-514	I. E. Dupont
Dope, Yellow semi-pigmented Nitrate	AN-TT-D-556	I. E. Dupont
Dope, Camouflage	A.F. 14106-B	*I. E. Dupont
Lacquer, Black, Yellow (Propeller)	A.F. 14105-A	*W. P. Fuller & Co. Sherwin-Williams I. E. Dupont
Lacquer, Black Acid Resistant (Battery)	AC-3-16B	Sherwin-Williams, "LTB-447" W. P. Fuller & Co., Black A&A Lacquer TL 8198
Lacquer, Red (Emergency Units)	AN-TT-L-51	W. P. Fuller & Co.
Lacquer (Line Identification)	No Spec.	Sinclair Co., "Rogers Brushing Lacquer"
Enamel, Dull Bronze-Green	AN-TT-L-51	Wipe-On Corp., Los Angeles, "No. 55 Dull Dark Green Wood Enamel"

Wood Filler	AAF 14115	Wipe-On Corp., Los Angeles, "No. 74 Wood Filler"
Wood Primer Surfacer	No Spec.	Wipe-On Corp., Los Angeles, "No. P-40 Primer Surfacer"
Wood Sealer	AAF 14113	Wipe-On Corp., Los Angeles, "No. 74 Wood Sealer"
Thinner for P-40 Primer Surfacer	No Spec.	Wipe-On Corp., Los Angeles, "No. 173 Thinner"
Putty	No Spec.	Webb Products "Durite"
Permagum 55R Putty	No Spec.	Presstite Engineering Co.
Streamline Filler—Aircraft Glazing Cement 15% MD 75	No Spec.	Acme White Lead & Color Works, Los Angeles, Calif.
Tape, Cellulose (Line Identification)	No Spec.	Minnesota Mining & Mfg. Co., Los Angeles, Calif.
Tape, Transparent "Pliofilm" (Joint Seal)	No Spec.	Minnesota Mining & Mfg. Co., Los Angeles, Calif.
E C 70	No Spec.	Minnesota Mining & Mfg. Co., Los Angeles, Calif.
Fairprene No. 4	No Spec.	I. E. Dupont
Corrosion Preventive Compound (Dissimilar Metals)	AAF 3595	W. P. Fuller & Co., "T-3864 Slushing Compound"
"Turco Multiplex"	No Spec.	Turco Products Co.
"Stanavo Servo Liquid"	No Spec.	Standard Oil Co.
"No-Ox-Id"	A.C. 35688	Dearborn Chemical Co., "No-Ox-Id Grade A"
"Klenzine"	No. Spec.	Richfield Oil Co.
"Paralketone"	RM 61 B	Paraffine Co. Alex Corporation
Stoddards Solvent	No Spec.	Standard Oil Co. Shell Oil Co.
"Koroseal"	No Spec.	B. F. Goodrich Co.

*NOTE

Should be ordered per shade desired as shown in Army Air Force Bulletin 41.

2. GENERAL INSTRUCTIONS AND METHODS FOR THE PREPARATION AND CLEANSING OF SURFACES PRIOR TO FINISHING.

a. ALUMINUM AND ALUMINUM ALLOY SURFACES ANODIC TREATMENT.

(1) All alclad aluminum alloy sheet stock in the hard temper should receive a phosphoric acid wash (U. S. Army Specification 98-20007) prior to application of the shop coating. The phosphoric acid wash should not be applied to non-alclad aluminum alloys nor to spotwelded or other assemblies of aluminum alloys.

(2) All aluminum alloy parts, including spotwelded assemblies, except as noted in paragraph 2. *a.* (1), this section, should not receive the anodic treatment, but should receive a chromic acid dip (U. S. Army Specification 98-20007) prior to application of the shop coating.

(3) Aluminum or aluminum alloys should not be given the anodic treatment (AN-QQ-A-696) excepting the items specified in the following sub-paragraphs. These listed items should receive either the chromic or sulphuric (Alumilite #205) anodic treatment.

(a) Aluminum or aluminum alloy parts having male tapered threads.

(b) Aluminum alloy parts in hydraulic assemblies should be anodized only if so specified on the drawings.

(c) All rivets of heat treatable alloys such as 17S, A17S and 24S.

(d) Parker fittings.

(e) The engine mounting ring if fabrication includes a spinning operation.

(f) Aluminum alloy bolts, screws, nuts, nut plates, nut plate strips and spacers.

(g) Non-alclad sheets of the following alloys: 17S, 24S, 53S, and 61S.

(h) Small extrusions.

(i) Structural aluminum alloy tubing.

(j) Alcohol tanks. (Refer to paragraph 5. *b.* (1) *(b)* 2., this section.)

(4) All surfaces must be thoroughly cleaned and dried at the time any protective finish is applied. Once a surface has been cleaned, it must not be touched with greasy hands or objects. Surfaces shall be given the shop primer coating (zinc chromate) as soon as practicable after cleaning.

(5) Welded parts must be de-fluxed as soon as possible after welding.

b. CLEANING STEEL PARTS.

(1) Loose scale on unplated steel parts and tanks should be removed by wire brushing and then cleaned thoroughly with benzol, carbon tetrachloride or naphtha before the specified finish is applied.

(2) Corrosion-resistant steel parts can be cleaned by immersion in a solution of 20% nitric and 1% hydrofluoric acid and 79% water at 140° F., until scale and rust are removed. Then rinse in water and immerse in a 20% solution of nitric acid at 140° F. for 30 minutes.

(3) CLEANING TUBES.

(a) Aluminum tubes should be immersed in a 50-50 solution of Deetrex and Pearl Oil (kerosene), then rinsed completely with water and blown dry with air.

(b) Copper tubing should be cleaned by the following method:

1. Partially fill tank (to ¼ capacity) with tap water. Add slowly and cautiously, with constant stirring, 25 gallons of nitric acid, and 20 liquid ounces of hydrochloric acid for each one hundred gallons of final solution. Add in order given and make up to full tank level with tap water.

2. Dip parts in and out of solution until clean.

3. Wash thoroughly with tap water.

4. Rinse with hot water.

5. Dry (using compressed air if available).

(c) Steel tubes should be cleaned by the vapor degreaser method over boiling triclorethylene (boils at 188°F). When tubes are removed from degreaser, evaporation dries them.

(4) CLEANING BRASS, BRONZE AND COPPER.—Parts made of these metals should be cleaned by the method specified in paragraph 2. *b.* (3) *(b)*, this section.

(5) CLEANING MAGNESIUM.—Magnesium can be cleaned in an alkaline solution rinsed thoroughly with hot water and either blown or baked dry. Commercial compounds such as Douglas special cleaner made by the Kelite Company are also used.

(6) CLEANING WOOD.—Wood surfaces must be dry. If cleaning the surface by a sanding operation, any excess over 5% of the surface must not be removed. Dust can be brushed or blown off.

3. INITIAL ORGANIC PROTECTIVE COATINGS.

a. There are some parts of the airplane which must be free from paint. Therefore, paint should be omitted entirely from these following surfaces and parts: working surfaces, screw threads, oil holes, etc. Rubber and synthetic rubber surfaces should not be painted, greased or oiled. Fogging or overspraying of synthetic rubber surfaces is not a cause for rejection. Paint must not be applied to fittings in such a way as to cause the bearings to seize. No paint finish should be applied to parts in the Electrical system with the exception of the junction boxes attached to the firewall which should receive dissimilar metal protection. (See paragraph 5. *b.* (1), this section.)

b. The shop primer coating should be darkened with primer yellow zinc chromate (AN-TT-P-656) and with a specified amount of black enamel added—used on all parts needing a primer coating.

(1) Alclad aluminum alloy sheets in the hard temper should receive a shop primer coating on both surfaces as soon as the sheets are unpacked and cleaned. Alclad sheets in the soft temper should receive the shop coating on all surfaces after heat treatment and cleaning.

(2) Non-alclad aluminum alloy, such as castings, forgings and extrusions, should receive a shop primer coating immediately after cleaning or anodic treatment.

(3) Magnesium alloy parts should receive the Dow Chemical Treatment No. 7, after cleaning and prior to the shop coating, when close tolerances are involved. Otherwise, Dow Treatment No. 1 Chrome Pickling is used. Following the chemical treatment, magnesium alloy parts should receive two spray coats of the shop coating paint. Interior surfaces of magnesium alloy parts in the carburetor air induction system should receive no treatment other than the Dow Chemical Treatment.

(4) Steel parts not cadmium plated (with the exception of springs to be immersed in hydraulic oil) should be given two spray coats of the shop primer coating, provided however, that the coating does not interfere with the functional purpose of the part.

(5) All exposed wood on the interior or exterior of the airplane should be given one coat, either dip or spray, of W. P. Fuller RL-881, or Dupont RK-3037 sealer, immediately after cleaning and/or sanding. Wood assemblies or parts which are inaccessible to paint should receive two dip coats of wood primer sealer, W. P. Fuller RL-881, or Dupont RK-3037. No

attempt should be made to further finish these inaccessible surfaces. After all nail holes, seams, scratches, etc., have received a primer coating, exterior wood surfaces should be filled with a glazing compound, allowed to dry and sanded smooth. Touch-up is necessary if any primer is removed. Wood surfaces are not ready for final treatment.

(6) All metal surfaces should be insulated from doped fabrics with one coat of the shop primer coating.

(7) The interior surfaces of open aluminum and open steel structural tubular members should be given one shop primer coating.

(8) Cables should be treated as follows:

(a) Immerse cable in a mixture of four parts paralketone B, and one part Stoddard solvent for approximately 30 seconds, or until cable is saturated, at room temperature.

(b) Remove, and allow to drain and dry sufficiently for handling.

(c) Wrap in brown water-proof wrapping paper immediately after drying, and mark part number on each package for identification purposes.

(d) Do not remove excess compound from cable.

(e) Apply a heavy coat of paralketone B, full strength, to any part of the cable where the protective coating has been damaged or removed during handling or installation.

(9) Armor plate which has not been given the blackening treatment should receive two coats of the shop coating primer.

4. CADMIUM PLATING.

a. The external surfaces of all steel parts should be cadmium plated, except where blackening is applicable (see paragraph 4. *b.*, this section), with the following exceptions:

(1) Cables.

(2) Bearings.

(3) Parts in contact with hydraulic fluid.

(4) Special cases of close fitting bolts, etc., where cadmium plating would interfere.

(5) Armor Plate.

(6) Parts welded to unplated structure.

(7) Titeflex lines.

(8) Parts too large for the plating bath.

(9) Steel inserts such as bushings.

b. BLACKENING.—Where drawings call for non-glare finish on steel parts, the blackening treatment (U.S. Army Specification 57-0-21) should be used in lieu of cadmium plating.

c. EMBRITTLEMENT RELIEF.

(1) Cadmium plated springs should be baked for approximately 3 hours at 350°-400°F., to relieve acid brittleness. Apply this treatment immediately after cadmium plating.

(2) Do not flex springs before baking.

(3) Springs pickled but not cadmium plated should also be baked.

5. FINAL TREATMENT.

a. GENERAL.

(1) The final finish, although it supplies a further protective coat, is primarily one of camouflage, identification, and functional color.

(2) It is not necessary to touch up marred surfaces, rivet heads or points, with the exception of screw heads, etc., on the instrument panel and small brackets on the armor plate.

(3) Small extrusions such as bulb angles should be coated in random lengths. Large extrusions should be shop coated after all machining is complete. Small extrusions require no touch up of cut or scarfed ends.

(4) No paint, grease, or oil should be applied to rubber or synthetic rubber. However, rubber shock mounts should be coated with a material conforming to AAF Specification 26571. Fogging or overspraying on synthetic rubber is not cause for rejection.

(5) No coatings or treatments should be applied to phenolic type plastics such as bakelite, micarta, etc. However, such plastics that form an exterior surface of the airplane should be treated in accordance with paragraph 5. *b.* (1) *(b)*, this section.

b. EXTERIOR SURFACES.

(1) Exterior surfaces are defined as those easily visible directly from the exterior of the airplane, but not through transparent materials, when all doors, enclosures, and cowl flaps are in the closed positions, and all landing gear retracted.

(a) TOUCH-UP WITH PRIMER.

1. No touch-up of exterior surfaces should be given prior to the application of the camouflage paint. Bare spots that may result from cleaning prior to camouflaging need not be re-primed.

(b) CAMOUFLAGE.—Exterior metal surfaces of the airplane should be camouflaged according to AAF Specification 24114. The camouflage materials should be one coat of quick drying enamel in accordance with AAF Specification 14109.

(c) INSIGNIA AND MARKINGS. – Insignia and markings should be located as directed in AAF Specification 24114, except that any approved insignia and marking drawing which may supersede should prevail. The insignia and markings should be according to Douglas Drawing No. 5125001 and the latest change thereof.

(d) DOPING FABRIC COVERED SURFACES.

1. Fabric covered control surfaces should be doped as follows:

a. Cover with four hand brushed coats of clear nitrate dope.

b. Spray with two coats of thinned camouflaged nitrate dope.

c. Doped fabric surfaces should not be sanded.

(e) FIRE RETARDANT FINISH.—In addition to the shop coating, all surfaces in the fuel container compartments should receive a further single spray coat of the shop primer reduced with not more than one part thinner to one part package primer. The primer used for this purpose must have been approved by the Army Air Forces Materiel Division as a fire retardant finish when so applied.

(f) ALUMINUM ALLOY TUBES—OPEN AND CLOSED.

1. No finish should be applied to interior surfaces of non-structural open tubing such as conduits or lines.

2. No finish should be applied to the interior surfaces of closed aluminum or aluminum alloy tubing.

(g) INSIDE OF CLOSED STEEL TUBES.

1. After welding and brazing operations have been completed, the interior surfaces of closed steel tubular members should be given a hot linseed oil treatment under pressure, for 2 minutes, drained and wiped off externally with Klenzine and dried.

2. Steel tubing completely sealed by flash welding needs no internal treatment. Tubing which is to be heated should be drilled to make vent holes which release internal pressure during heat treatment.

(h) TANKS.

1. Metal fuel tanks if installed should be given a coat of Fuller's Slushing Compound No. T-3864 on the inside after anodization to within 4 inches of the main weld.

2. Alcohol tanks should be flushed with Dupont Methacrylate Varnish No. RC-901.

3. Flush oil tanks with S.A.E. No. 20 oil.

4. Pressure tanks cleaned as described in paragraph 2. *b.* (3) *(c)*, this section.

5. Finish all exterior surfaces of tanks to match adjacent areas.

(i) FINISH FOR ALCLAD ALUMINUM ALLOY.

1. Alclad aluminum alloy that requires heat treatment should receive a cold water quench in accordance with Army-Navy Spec. AN-QQ-H-186. As an alternate, alclad aluminum alloy parts that require heat treatment should receive a combination fog and air quench. The minimum air velocity past the parts should be 1500 linear feet per minute during the quenching period.

2. Discoloration resulting from heat treatment of alclad material should not be cause for rejection or rework unless the mechanical properties have been impaired.

3. Scratches of alclad aluminum alloy which do not extend through to the base metal should not be cause for rejection. No mechanical treatment such as a burnishing of scratches is necessary. Immediate treatment of any scratches or abrasions on the finished surface is recommended.

c. INTERIOR SURFACES AND EXCEPTIONS.

(1) Unless otherwise specified in the following paragraphs, no finish in addition to the shop coating should be applied to the interior aluminum and aluminum alloy parts and surfaces of the airplane.

(a) Small extrusions such as bulb angles should be shop coated in random lengths. No finish is required after cutting length. Large extrusions such as cap strips should be shop coated after all machining is complete.

(b) There should be no touch-up of scratches, rivet heads or points, except the screw heads on the instrument panel.

(c) A double spray coat of flat black lacquer which conforms to the requirements or Army-Navy Specification AN-TT-L-51 should be applied to exposed interior surfaces of the following:

1. INSTRUMENT PANEL.

2. PILOT'S COCKPIT COWL.

3. PILOT'S NOSE ENCLOSURE.

(d) Emergency units or areas thereof which require prominent markings should have a red background for the stenciling.

(e) No finish should be applied to interior stainless steel except where insulation of dissimilar metals is necessary.

(f) No finish should be applied to interior metal parts and surfaces in the engine section forward of the firewall—Exceptions are motor mounts, dissimilar metals and magnesium alloys which are finished as specified in paragraph 3. *b.* (3), this section.

(2) Propellers should receive one coat of black camouflage enamel. The tips should be coated with yellow camouflage enamel for a distance of four inches back from the tips. Touching-up propellers is not necessary.

d. LINES—FINISH AND IDENTIFICATION.

(1) No organic finish other than identification banding should be applied to lines.

(2) The identification of lines should be as follows:

(a) PROCEDURE.

1. All lines with the exception of titeflex lines should be identified by ½ inch wide color bands using colors as specified in the following color identifications list.

2. Color bands should be located near each joint or union. Only one banding is necessary when the line is of such length or shape that the banding is sufficiently close to the union to provide positive identification.

3. Titeflex lines used for aromatic fuel, etc., should be identified by one or more ⅛ inch wide longitudinal lines along its full length, using colors as specified in the following color identifications list.

(3) The following W. P. Fuller paints are used:

(a) Light Blue No. 7791

(b) Light Green No. 7795

(c) Dark Green No. 7793

(d) Orange No. 7797

(e) Brown No. L-8414

(f) Yellow No. TL-8415

(g) Red No. 7798

(h) Purple No. TL-8416

(i) White No. 7786

(j) Black No. 7787

(k) Clear Lacquer No. 5025

(l) International Orange No. 3127

(4) COLOR IDENTIFICATION:

Functional Use	*Identification Color*	*Applications*
Fuel	Red	1. All fuel carrying lines 2. Primer Lines 3. Fuel Pump Drain 4. Fuel Cross-Feed 5. Fuel Tank Vent 6. Fuel Tank Drain 7. Syphon Vent Lines 8. Induction System Drain 9. All Dilution Lines
Oil, Lubricating	Yellow	1. All lines carrying lubricating oil 2. Oil Drain Lines 3. Engine Oil Pressure Gauge Lines 4. Oil Drain Line from Oil Separator 5. Oil Breather Lines 6. Vacuum Pump Drain 7. Constant Speed Propeller Lines
Fire Extinguisher	Brown	1. All fire extinguishing lines
Oxygen, Dispensing	Light Green	1. All Lines carrying oxygen from oxygen bottles
Oxygen Filler	Light Green- Yellow- Light Green	1. All lines used to fill oxygen bottles

COLOR IDENTIFICATION: (Cont'd.)

Functional Use	*Identification Color*	*Applications*
Airspeed Pitot Tube	Black	
Static Pressure	Black-Light Green	1. All static tube lines for airspeed, altimeter, climb indicator, etc.
Manifold Pressure	White-Light Blue	1. All Manifold Pressure Lines 2. Supercharger Balance Line to Fuel Pressure Regulator valves and gauges
Vacuum	White-Light Green	1. All Vacuum Lines 2. Venturi and Carburetor Suction Lines for Instruments 3. Autopilot Vacuum Lines
Hydraulic Pressure Oil	Light Blue-Yellow-Light Blue	1. All Hydraulic Oil Lines 2. Hydraulic Brake Lines 3. Reservoir Tank Vent 4. Hydraulic Flap Actuating Lines 5. Hydraulic Door Actuating Lines 6. Hydraulic Landing Gear Actuating Lines 7. Hydraulic Pump Drain
Compressed Air Pressure		1. All compressed air lines 2. Wing and Empennage de-icer lines
Low Pressure Lines (20 p.s.i. Max.)	Light Blue-Light Green	3. De-icer air pressure gauge lines 4. Vacuum pump to oil separator line
High Pressure Lines	Yellow-Light	5. Emergency air brakes
(25 p.s.i. Min.)	Green	
Exhaust Analyzer	Light Blue-Brown	1. All Exhaust Analyzer lines
Ice Preventive Fluid	White-Red	1. All ice preventive fluid lines 2. Propeller anti-icer lines, etc.
Vent	Red-Black	1. Applies to vents on all closed compartments, such as battery, etc.

(a) Gas and oil drain cocks should be painted to match the identification lines to which they may be attached. Gas-Red, Oil-Yellow.

(b) All points or separation of tubes, controls, structures, etc., which are separated in dismantling Power Plant assemblies from the airplane, should be painted international orange, Fuller's No. 3127.

e. HANDLES AND KNOBS—FINISH AND IDENTIFICATION.

(1) The following charts specify the colors and where they are used on the control handles and knobs:

(a) COLOR CHART.

Color	*Catalin*	*W. P. Fuller L-12a. Lacquer Code No.*
Blue	1563	TL-237
Yellow	1533	TL-238
Green	1536	TL-239
Red	1501	TL-240
Black	560	TL-241
Orange	567	TL-242
Purple	575	TL-243
White	201	TL-244

(2) HANDLE OR KNOB LIST.

Color	*Handle or Knob*
Blue	Air controls (hot or cold) Vacuum instrument shut-off valve Vacuum instrument selector valve
Yellow	Automatic pilot controls Oil cooler
Red (Reserved for emergency handles and knobs)	Raw fuel controls Fire extinguisher release Fire extinguisher selector handle Landing gear Landing gear emergency release

	Flare release
	Hydraulic hand pump
	Propeller r.p.m. lock
	Throttle lock
	Nose wheel lock
	Gyro control (Emergency)
	Brake control (Emergency)
	Any other emergency controls
Green	Oxygen controls
	De-icer manual control
Black	Engine throttles
Color	*Handle or Knob*
Purple	Cowl flaps
White	Propeller r.p.m.
Optional	Electrical system main switches
(Black preferred)	Wing flap controls
	Fluid by-pass valves
	Fluid shut-off valves
	Hydraulic controls
	Hydraulic gage pump
	Parking brake
	Radio
	Tab controls

f. CABLES--COLOR IDENTIFICATION AND TREATMENT.

(1) The following engine control cable chart is reference for their identification.

(a) Apply identification bandings where they will not be hidden by bulkheads, brackets, etc.

(b) Bandings may be either cellulose tape or lacquer. The cellulose tape requires a protective coating of clear lacquer.

(c) ENGINE CONTROL CABLES – (Control Identification).

Control	*Color*	*Cable*	*Number Of Bands*
Throttle	Black	Open	2
		Close	1
Propeller R.P.M.	White	Increase	2
		Decrease	1
Mixture	Red	Rich	2
		Lean	1
Carburetor Air	Blue	Cold	2
		Hot	1
Oil Cooler Shutter	Yellow	Open	2
		Close	1
Cowl Flap	Purple	Open	2
		Close	1
De-icer	Green	Off	2

(2) Control cables should not be painted. Coiled cable should be immersed in a solution of 4 parts Paralketone "B" and one part Stoddard Solvent for 30 seconds. The cable, completely assembled, must be proof-loaded for 3 minutes at 60% of rated breaking load. Control cables are manufactured under Specification AN-RR-C-43. When any part of the protective coating has been removed through handling, a heavy coating of Paralketone "B" must be applied.

g. WOOD SURFACES—EXTERIOR, INTERIOR.

(1) Final finish on exterior wood surfaces should be according to A.A.F. Spec. 14109, or Dupont No. 71 line camouflage or equivalent. Only one coat need be applied.

(2) All interior wood surfaces should receive two final coats of bronze green lacquer, conforming to the requirements of Army-Navy Specification AN-TT-L-51.

(a) Following the wood primer sealer coating, writing surfaces such as chart boards should be given one coat of surfacer which conforms to the requirements of A.A.F. Specification 14115 (Fuller No. 2411) and two coats of the bronze green lacquer.

(b) Plywood with phenolic resin impregnated and compressed or densified faces requires no finish except to match a camouflage scheme.

h. MISCELLANEOUS TREATMENT.

(1) Additional protection (other than shop coatings, cadmium plating, etc.) must be applied to combinations of dissimilar metal assemblies. The additional coating may be given to either of the contacting surfaces. Forward of the firewall, the only protection necessary is between stainless steel and aluminum alloys. A coat of darkened primer, AN-TT-P-656, should be applied.

(2) Protective coatings in addition to shop coating.

Metal Combination	*Protective Coatings In Addition to Shop Coating*
ALUMINUM ALLOY	
VS Copper Alloys	*Primer
VS Corrosion Resist. Alloys	*Primer
VS Lead	*Aircraft Preservative Compound
VS Steel Bearings (Unplated)	Petrolatum
VS Steel, Unplated	Primer (Wet)
VS Steel, Cadmium Plated	*None
VS Magnesium	*None
MAGNESIUM ALLOY	
VS Bearings, Bushings, Inserts, Rivets	Primer (Wet)
VS Any other metal	Slushing Compound

(Where marked with * an extra primer coat is required if there is no shop coating on the aluminum alloy.)

(*a*) WOOD TO METAL CONTACTS.

1. FINISHED WOOD TO METAL CONTACTS.

a. In cases where finished wood surfaces contact metal surfaces, no additional protection should be applied to either the finished wood or metal surface.

2. BARE WOOD TO METAL CONTACTS.

a. In cases where metal bolts, screws, pins, or fittings pass through holes in wood, the holes should receive one coat of wood primer sealer at least 15 minutes prior to installation of metal bolts, etc. Metal surfaces of bolts, etc., in contact with the wood hole should have at least one coat of primer; all other cases of metal to bare wood no additional protection shall be applied.

(3) LUBRICATION OF THREADS.

(*a*) Thread lubricants are necessary to provide lubrication and to prevent seizing and galling of threaded parts during assembly, adjustment, and removal.

(*b*) All aluminum threaded parts should be anodized per AN Spec. AN-QQ-A-696.

(*c*) All brass or steel male pipe threads used in fluid line assemblies should be "tinned" lightly; i.e. given a solder bath (solder Specification 46S14A), using the correct flux.

(*d*) Apply a thin coat of thread lubricant to the male threads only, avoiding excessive use of the lubricant.

(*e*) It is important that the lead threads be covered and that no thread lubricant be used on female threads, fitting noses, or where it might enter the system.

(*f*) Bolts and machine screws require thread lubrication only where such parts are subject to adjustment or removal.

(*g*) Threads in elastic stop nuts are not to be treated.

(*h*) The Anodic treatment produces a film of aluminum oxide which relieves galling and seizure.

(*i*) The materials used as thread lubricants and the specifications thereof are listed as follows:

1. "DTL No. 1" which consists of:
Flake Graphite 2-4% Spec. 14G-5
Grease 24, 26% Spec. 14G-GR, 2 soft
Zinc Metal Powder Dust, Balance Spec. 5223E.

2. GPD 903B Socony Vacuum Oil Co. Spec. AN-C-53.

3. B. G. Mica Lubricant, A719 Spec. AN-VV-C-566.

4. Lubricating Oil S.A.E. 20.

5. "Glydag"—Acheson Colloids Corp.—Port Huron, Mich.

6. "Aquadag"—Acheson Colloids Corp.—Port Huron, Mich.

(*j*) Thread Lubricant is to conform to the following tables:

1. According to the kind of fluid:

Connections (threaded)	Magnesium Alloy	All Other Alloys
Air Pressure	SAE 20 Oil	DTL No. 1
Anti-icing Fluid	SAE 20 Oil	DTL No. 1
Fuel	SAE 20 Oil	DTL No. 1
Hydraulic Oil	SAE 20 Oil	DTL No. 1
Lubricating Oil	SAE 20 Oil	DTL No. 1
Oxygen	*Aquadag	*"Glydag"

2. According to the type of equipment:

Auto Pilot (Vacuum and Pressure)	SAE 20 Oil	DTL No. 1
Bolts	SAE 20 Oil	DTL No. 1
**Electrical	SAE 20 Oil	DTL No. 1
Fire Extinguisher	SAE 20 Oil	DTL No. 1
Instrument (Vacuum and Pressure)	SAE 20 Oil	DTL No. 1
Vent (Closed compartment)	SAE 20 Oil	DTL No. 1
Zerk Fittings	SAE 20 Oil	DTL No. 1
Studs	SAE 20 Oil	AN-C-53

Where one or both threads are magnesium, use the lubricant specified for magnesium.

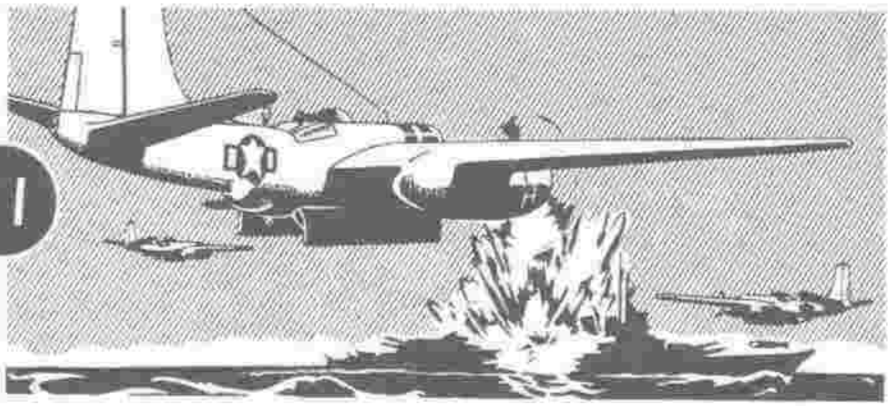
*Per AAF Spec. 40363-A.

**For threads subject to high temperature (thermocouples, spark plugs, etc.) use BG Mica A719.

i. ELECTRICAL BONDING.

(1) The airplane should be bonded electrically according to Douglas Drawing 2071382.

SECTION VIII



TUBING INFORMATION

1. GENERAL.

The proper assembly, installation and maintenance of lines are necessary for safe and effective operation of the airplane and its components. The following recommendations and suggestions are given to aid service personnel in accomplishing these operations.

2. TUBING IDENTIFICATION.

The tubing in this airplane is banded with colored tape. The colors used to designate the system tubing are in accordance with the following table.

TUBE COLOR BANDING TABLE

Type Tube	Color Banding
Air-Gasoline Mixture-Heater	Green & Red
Air-High Pressure (Emergency Air Brakes)	Green & Yellow
Air-Low Pressure (De-icer)	Blue & Green
Alcohol-Anti-icer	White & Yellow
Exhaust-Heater	Brown & Red
Gasoline	Red
Hydraulic Fluid	Blue, Yellow & Blue
Manifold Pressure	White & Blue
Oil-Engine	Yellow
Oxygen Supply	Green
Oxygen Filler	Green, Yellow & Green
Pitot Pressure	Black
Static Pressure	Black & Green
Vacuum	White & Green

The marking of tubes for future identification may be accomplished in the following manner:

a. APPLYING COLORED TAPE.

(1) Clean and dry surfaces.

(2) Apply tape around tube allowing at least ⅛" overlap.

(3) Apply one brush coat of lacquer Spec. AN-TT-L-51.

3. REPLACING TUBING (LINES).

Replace tubing, observing the following steps:

a. Determine the size and material of the tube to be replaced. Size includes outside diameter, wall thickness and length. The first two should be measured by the use of a caliper, the latter with a flexible rule. The length of the new tube should be cut 10% over the finished length of the old tube to allow for forming, cutting, flaring, etc. Most lines are 52SO aluminum alloy. Some are copper identified by the color of the material and others are stainless steel. Stainless steel lines are used in the heater exhaust system and are color banded brown and red.

b. Cutting the tubing should be done with a standard cutting tool, at right angles to the center line of the tube. *(See figure 600.)* Do not force tube out of round. A hack saw may be used if the cutting tool is not available. After cutting file the end square *(figure 600)* and remove the burrs from inside and outside the tube with a suitable burnishing tool.

c. To bend the new tube it will be necessary to follow a template (pattern). If the replaced tube is damaged to such an extent it can not be used for this purpose, make a template by bending a soft iron wire into the desired shape. Make the new tube as nearly like the replaced one as possible. Use a tube bending tool to insure against kinked or wrinkled bends. *(See figure 600.)* Do not attempt a bend of a lesser radius than those specified in the following chart.

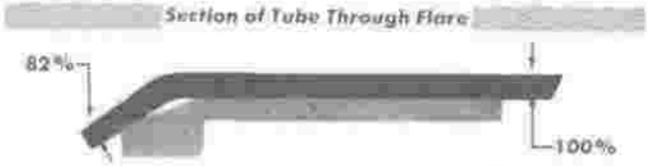


Figure 599—Section Through Tube Flare (Showing Sleeve)

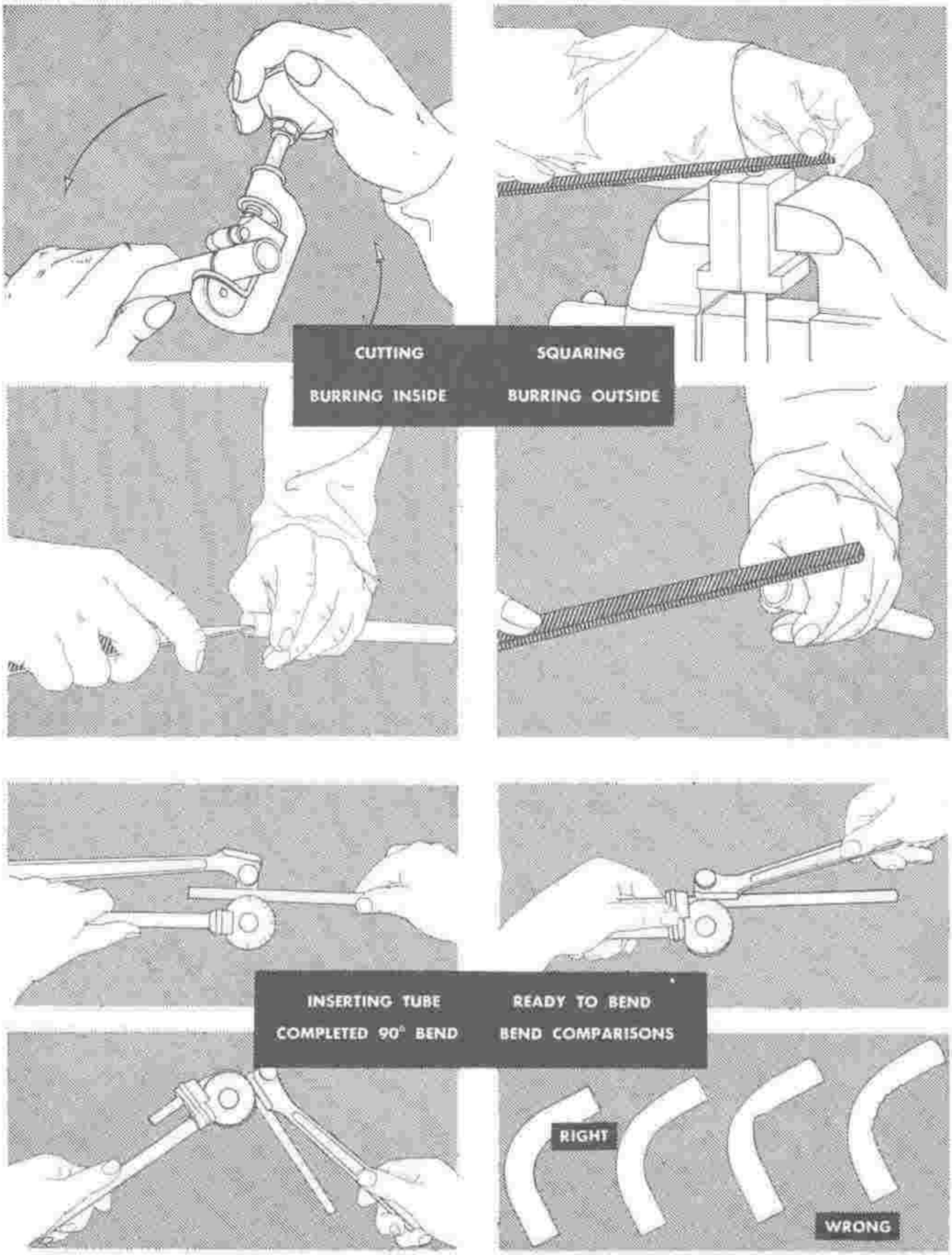


Figure 600 — Tube Cutting and Bending

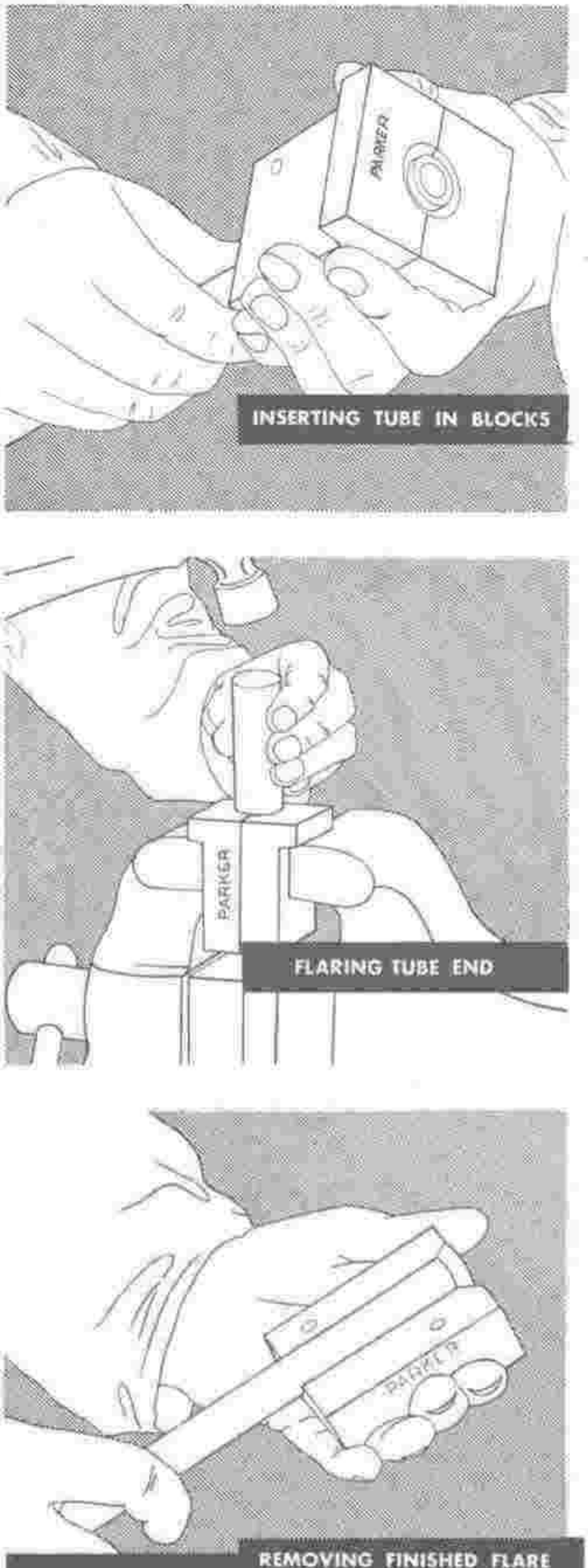


Figure 601 — Use of Block and Pin Type Flaring Tool

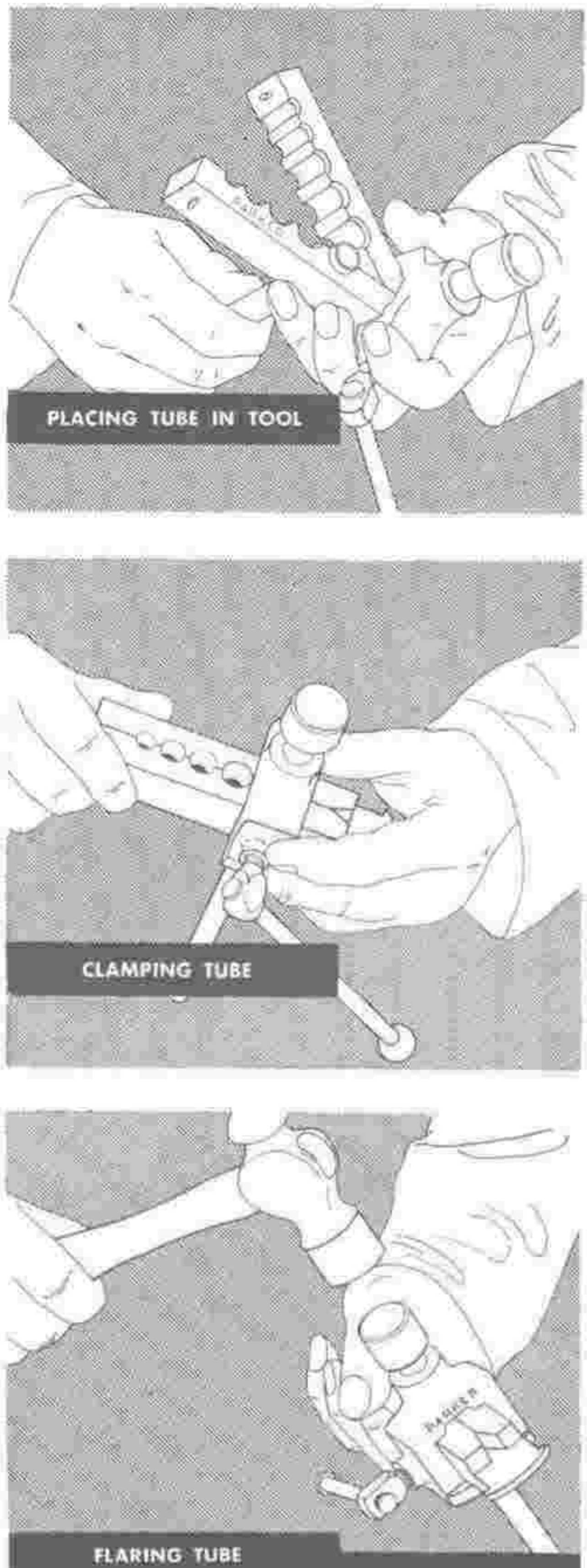


Figure 602 — Use of Combination Type Flaring Tool

TUBE O. D.	MINIMUM BEND RADII (measured to tube centerline)
1/8	3/8
3/16	7/16
1/4	9/16
5/16	11/16
3/8	15/16
1/2	1 1/4
5/8	1 1/2
3/4	1 3/4
1	3
1 1/4	3 3/4
1 1/2	5
1 3/4	7
2	8

d. Flare the tube end after the sleeve and nut have been slid on to the tube. Select the correct size flaring tool and vise block or combination flaring tool. *(See figures 601 & 602.)* Flare gradually and check the wall thickness at the flare maintaining at least 82% of the tubing wall thickness in the finished flare. *(See figure 599.)* The following illustrations show the correct and incorrect flare lengths in relation to the sleeve flange. *(See figure 604.)* The flange must extend at least 1/32"-1/16" beyond the sleeve and except the 1/8" tubing flange which should range from flush to 1/32" beyond the sleeve end.

e. Tubing over which hose type fittings is to be installed has a bead near the end which aids in holding the hose in place and in sealing the union. This bead is normally made with the use of a beading tool. *(See figure 605.)* If no beading tool is available a bead can be made on copper and steel tubing by soldering a piece of wire around the tube. *(See figure 605.)*

f. Install the tubing assembly into the airplane. Apply a sparing amount of an approved thread lube (see Section VII) on the fitting threads before installing the nuts. Over-tightening of line nuts is very often the cause for line failures. A condition such as shown in the following illustration may exist due to over-tightening of these nuts. *(See figure 603.)* To make certain that the nuts are correctly installed tighten to a torque value within the limits shown on the following chart.

BT-TYPE TUBING NUT TORQUE CHART
Recommended Maximum Torque Tabulated in Inch Pounds

Tubing O. D.	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1"
Copper Tubing	13	28	52	70	100	145	200	275	400	625
52 SO AL. Alloy Tubing	13	28	52	70	100	145	200	275	400	625
Steel Tubing		80	125	175	225		360	525	712	
Wrench Size	3/8"	7/16"	9/16"	5/8"	11/16"	3/4"	7/8"	1"	1-3/16"	1-1/2"

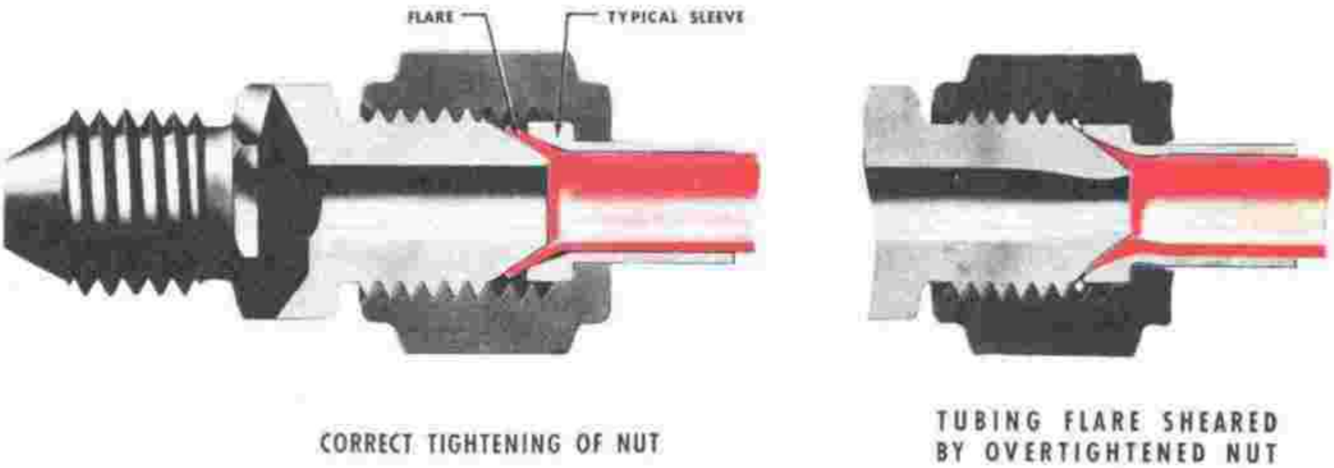


Figure 603—Tubing Nut and Sleeve Installed (Showing Correctly and Incorrectly Tightened Nut)

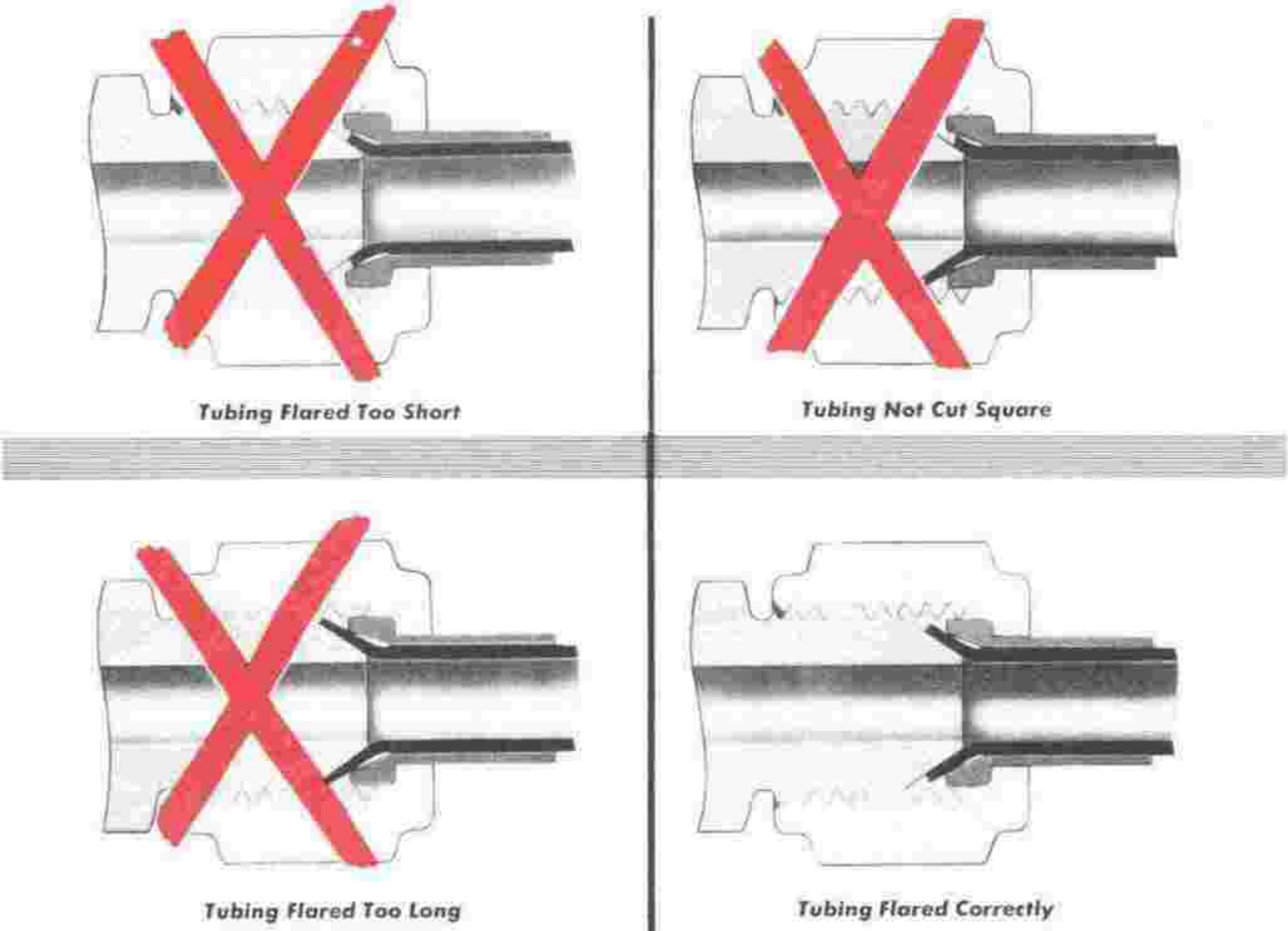
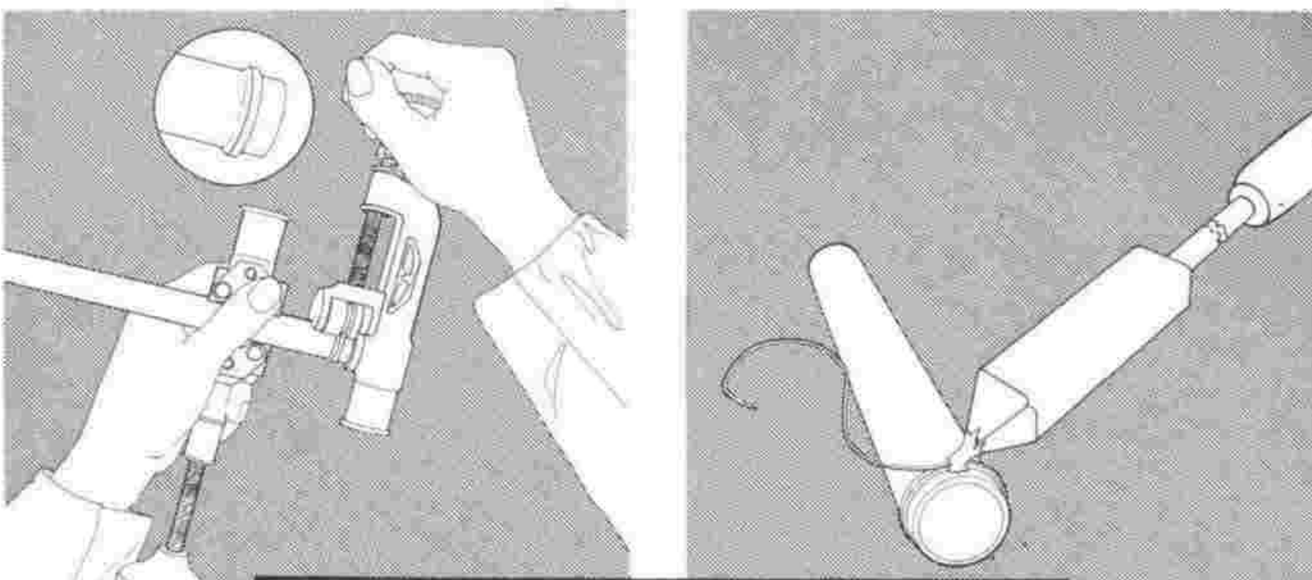


Figure 604—Tubing Flares (Correct and Incorrect)



BEADING TOOL **EMERGENCY WIRE BEADING**

Figure 605— Tube Beading

SECTION IX

CHARTS AND TABLES

1. GENERAL.

A cable manufacturing table which includes all information for replacing any cable assembly in the airplane, a table of engine torque recommendations, and a bolt torque chart which shows the location and wrench torque values of those bolts and/or nuts which require a specific torque, are a part of this section.

2. CABLE CHART.

The cable assembly lengths on the following chart are included under or as part of the cable assembly number in the left-hand column. In all cable assemblies that have a basic part number of 2074406, 2074407, 2074408, 2074409 or 2074410 the cable assembly length is included as part of the complete assembly number. This length coding is that portion of the part number following the last dash of the number, and indicates the cable assembly length in inches and 32nds of an inch. Example: If the cable assembly number is 2-74406-5-6-11028 the 11028 follows the last dash, and therefore indicates the cable length. The last two digits of this number always indicate 32nds of an inch and the remaining digits indicate inches, therefore 11028 indicates 110 inches and 28/32 inches or 110⅞ inches length. Of this complete assembly number 2074406-5-6-11028 the first number 2074406 is the drawing part number and the numbers after the first and second dashes indicate the type of end fittings. These numbers may be ignored, as the correct part numbers for the fittings may be found on the face of each small drawing in the right-hand column. Perspective drawings of each control system may be found in Section IV. The column in this chart headed Fig. No. Ref. is a cross reference to the figure number on which the cable assembly appears and to the key number of that specific cable assembly.

ITEM	PART NUMBER	DIA. AND MATERIAL	FIG. NO.	DETAIL OF CABLES
1	1193910 A Length 63 B Length 30	1/16 7 x 7 Flexible Steel	Figure 567 Item 11	
2	1203165-2 Length 8½	1/16 7 x 7 Flexible Steel	Figure 568 Item 13	
3	1203165-4 Length 11 9/16	1/16 7 x 7 Flexible Steel	Figure 568 Item 14	
4	1203165-6 Length 15 5/16	1/16 7 x 7 Flexible Steel	Figure 568 Items 3, 4	

Figure 606 (Sheet 1 of 12)—Cable Charts

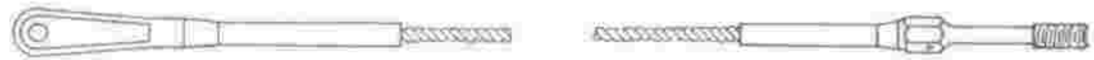
ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
5	2074406-5-6-11028	1/16 7 x 7 Flexible Steel	Figure 72 Item 7	 2049220-8DS-2R AN668-2
6	2074406-5-6-12200	1/16 7 x 7 Flexible Steel	Figure 72 Item 8	 2049220-8DS-2R AN668-2
7	2074406-6-4-27518	1/16 7 x 7 Flexible Steel	Figure 72 Item 6	 AN668-2 2049220-8DS-2L
8	2074406-6-4-28616	1/16 7 x 7 Flexible Steel	Figure 72 Item 5	 AN668-2 2049220-8DS-2L
9	2074407-2-12-5200	3/32 7 x 7 Flexible Steel	Figure 522 Item 29	 2049216-21A-3L 1159943 1152319-4
10	2074407-3-10-902	3/32 7 x 7 Flexible Steel	Figure 109 Item 10	 2049216-21A-3R 1112835
11	2074407-3-10-2028	3/32 7 x 7 Flexible Steel	Figure 109 Item 4	 2049216-21A-3R 1112835
12	2074407-4-4-10800	3/32 7 x 7 Flexible Steel	Figure 221 Item 2	 2049220-16DS-3L 2049220-16DS-3L

Figure 606 (Sheet 2 of 12)—Cable Charts

ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
13	2074407-4-4-16619	3/32 7 x 7 Flexible Steel	Figure 292 Item 3	 2049220-16DS-3L 2049220-16DS-3L
14	2074407-4-8-5216	3/32 7 x 7 Flexible Steel	Figure 286 Item 9	 2049220-16DS-3L AN668-3
15	2074407-5-5-4400	3/32 7 x 7 Flexible Steel	Figure 221 Item 4	 2049220-16DS-3R 2049220-16DS-3R
16	2074407-5-5-3700	3/32 7 x 7 Flexible Steel	Figure 292 Item 6	 2049220-16DS-3R 2049220-16DS-3R
17	2074407-6-6-24700	3/32 7 x 7 Flexible Steel	Figure 69 Item 3	 2049221-16DS-3R 2049221-16DS-3R
18	2074407-6-6-25516	3/32 7 x 7 Flexible Steel	Figure 220 Item 4	 2049219-16D-3L 2049219-16D-3L
19	2074407-6-6-26200	3/32 7 x 7 Flexible Steel	Figure 220 Item 3	 2049219-16D-3L 2049219-16D-3L
20	2074407-6-6-84714	3/32 7 x 7 Flexible Steel	Figure 70 Item 7	 2049219-16D-3L 2049219-16D-3L

Figure 606 (Sheet 3 of 12)—Cable Charts

ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
21	2074407-6-6-84900	3/32 7 x 7 Flexible Steel	Figure 71 Item 5	2049219-16D-3L / 2049219-16D-3L
22	2074407-7-7-29700	3/32 7 x 7 Flexible Steel	Figure 71 Item 8	2049219-16D-3R / 2049219-16D-3R
23	2074407-7-7-32010	3/32 7 x 7 Flexible Steel	Figure 220 Item 2	2049219-16D-3R / 2049219-16D-3R
24	2074407-7-7-32200	3/32 7 x 7 Flexible Steel	Figure 220 Item 7	2049219-16D-3R / 2049219-16D-3R
25	2074407-7-7-41716	3/32 7 x 7 Flexible Steel	Figure 70 Item 9	2049219-16D-3R / 2049219-16D-3R
26	2074407-7-8-24004	3/32 7 x 7 Flexible Steel	Figure 69 Item 16	2049219-16D-3R / AN668-3
27	2074407-7-8-27608	3/32 7 x 7 Flexible Steel	Figure 69 Item 15	2049219-16D-3R / AN668-3
28	2074407-7-11-18600	3/32 7 x 7 Flexible Steel	Figure 522 Item 6	2049219-16D-3R / 1159936 1152319-4

Figure 606 (Sheet 4 of 12)—Cable Charts

ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
29	2074407-7-11-20000	3/32 7 x 7 Flexible Steel	Figure 522 Item 6	 2049219-16D-3R; 1159936 1152319-4
30	2074407-8-4-3524	3/32 7 x 7 Flexible Steel	Figure 286 Item 9	 AN668-3; 2049220-16DS-3L
31	2074407-8-4-11123	3/32 7 x 7 Flexible Steel	Figure 259 Item 8	 AN668-3; 2049220-16DS-3L
32	2074407-9-9-13224	3/32 7 x 7 Flexible Steel	Figure 69 Item 14	 AN667-3; AN667-3
33	2074407-16-4-9824	3/32 7 x 7 Flexible Steel	Figure 72 Item 3	 1-160-ST3 1-162-SC3; 2049220-16DS-3L
34	2074407-16-4-10116	3/32 7 x 7 Flexible Steel	Figure 72 Item 2	 1-160-ST3 1-162-SC3; 2049220-16DS-3L
35	2074407-16-4-10608	3/32 7 x 7 Flexible Steel	Figure 297 Items 2 & 3	 1-160-ST3 1-162-SC3; 2049220-16DS-3L
36	2074407-16-4-11123	3/32 7 x 7 Flexible Steel	Figure 259 Item 7	 1-160-ST3 1-162-SC3; 2049220-16DS-3L

Figure 606 (Sheet 5 of 12)—Cable Charts

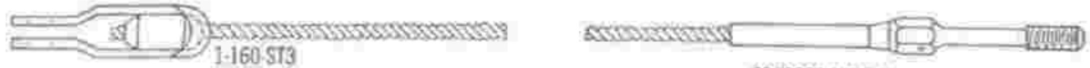
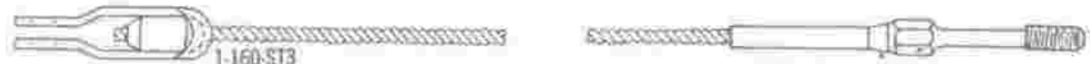
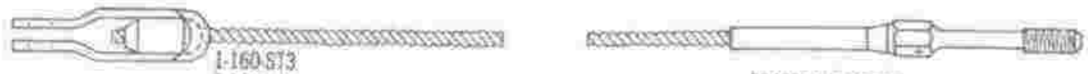
ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
37	2074407-16-4-14300	3/32 7 x 7 Flexible Steel	Figure 178 Item 7	 1-160-ST3 1-162-SC3 — 2049220-16DS-3L
38	2074407-16-4-15116	3/32 7 x 7 Flexible Steel	Figure 178 Items 10 & 9	 1-160-ST3 1-162-SC3 — 2049220-16DS-3L
39	2074407-16-4-16000	3/32 7 x 7 Flexible Steel	Figure 178 Item 8 Figure 177 Item 7	 1-160-ST3 1-162-SC3 — 2049220-16DS-3L
40	2074407-16-4-16624	3/32 7 x 7 Flexible Steel	Figure 199 Item 6	 1-160-ST3 1-162-SC3 — 2049220-16DS-3L
41	2074407-16-4-16824	3/32 7 x 7 Flexible Steel	Figure 199 Item 8 Figure 177 Items 8, 9, 10	 1-160-ST3 1-162-SC3 — 2049220-16DS-3L
42	2074407-16-4-17216	3/32 7 x 7 Flexible Steel	Figure 199 Items 5 & 7	 1-160-ST3 1-162-SC3 — 2049220-16DS-3R
43	2074407-16-5-2-22	3/32 7 x 7 Flexible Steel	Figure 199 Item 3	 1-160-ST3 1-162-SC3 — 2049220-16DS-3R
44	2074407-16-5-2718	3/32 7 x 7 Flexible Steel	Figure 199 Item 9	 1-160-ST3 1-162-SC3 — 2049220-16DS-3R

Figure 606 (Sheet 6 of 12)—Cable Charts

ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
45	2074407-16-5-2806	3/32 7 x 7 Flexible Steel	Figure 178 Item 11	
46	2074407-16-5-2828	3/32 7 x 7 Flexible Steel	Figure 178 Items 5 & 6	
47	2074407-16-5-2830	3/32 7 x 7 Flexible Steel	Figure 177 Item 5	
48	2074407-16-5-3008	3/32 7 x 7 Flexible Steel	Figure 199 Item 4	
49	2074407-16-5-3018	3/32 7 x 7 Flexible Steel	Figure 199 Item 10	
50	2074407-16-5-3030	3/32 7 x 7 Flexible Steel	Figure 177 Items 11 & 12	
50A	2074407-16-5-3724	3/32 7 x 7 Flexible Steel	Figure 177 Item 6	
51	2074407-16-5-4424	3/32 7 x 7 Flexible Steel	Figure 178 Item 12	
52	2074407-16-6-15100	3/32 7 x 7 Flexible Steel	Figure 176 Item 6 Figure 175 Items 5 & 8	

Figure 606 (Sheet 7 of 12)—Cable Charts

ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
53	2074407-16-6-16000	3/32 7 x 7 Flexible Steel	Figure 176 Item 7	
54	2074407-16-6-16700	3/32 7 x 7 Flexible Steel	Figure 176 Item 5 Figure 175 Items 6 & 7	
55	2074407-16-6-17416	3/32 7 x 7 Flexible Steel	Figure 176 Item 8	
56	2074407-8-4-4028	3/32 7 x 7 Flexible Steel	Figure 109 Item 14	
57	2074408-4-9-828	3/32 7 x 7 Flexible Steel	Figure 522 Item 5	
58	2074408-4-9-1920	3/32 7 x 7 Flexible Steel	Figure 522 Item 21	
59	2074408-4-9-4304	3/32 7 x 7 Flexible Steel	Figure 522 Items 5 & 9	
60	2074409-4-4-15708	3/32 7 x 7 Flexible Steel	Figure 69 Item 8	

Figure 606 (Sheet 8 of 12)—Cable Charts

ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
61	2074409-7-10-9800	5/32 7 x 19 Flexible Steel	Figure 71 Item 6	 2049219-32D-5R 2031138-4
62	2074409-7-10-11410	5/32 7 x 19 Flexible Steel	Figure 70 Item 12 L.H. Elev. Down	 2049219-32D-5R 2031138-4
63	2074409-7-10-11524	5/32 7 x 19 Flexible Steel	Figure 70 Item 12 R.H. Elev. Down	 2049219-32D-5R 2031138-4
64	2074409-7-10-12026	5/32 7 x 19 Flexible Steel	Figure 71 Item 7	 2049219-32D-5R 2031138-4
65	2074409-10-6-33300	5/32 7 x 19 Flexible Steel	Figure 70 Item 2	 2031138-4 2049219-32D-5L
66	2074409-10-6-36300	5/32 7 x 19 Flexible Steel	Figure 71 Item 4	 2031138-4 2049219-32D-5L
67	2074409-10-6-37709	5/32 7 x 19 Flexible Steel	Figure 71 Item 3	 2031138-4 2049219-32D-5L
68	2074410-7-10-32216	3/16 7 x 19 Flexible Steel	Figure 69 Item 17	 2049219-46D-6R 2031138-6

Figure 606 (Sheet 9 of 12) — Cable Charts

ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
69	2074410-7-10-33516	3/16 7 x 19 Flexible Steel	Figure 69 Item 18	2049219-46D-6R 2031138-6
70	2153779-2 LENGTH $36\frac{1}{2}$	5/32 7 x 19 Flexible Steel	Figure 69 Item 7	2129394-5 2049220-32DS-5R
71	2153779-4 Length 34	5/32 7 x 19 Flexible Steel	Figure 69 Items 7 & 9	2129394-5 2049220-32DS-5R
72	2153780-2 Length $41\frac{5}{16}$	3/16 7 x 19 Flexible Steel	Figure 69 Item 11	2129394-6 2049219-46D-6L
73	2153780-4 Length $55\frac{3}{4}$	3/16 7 x 19 Flexible Steel	Figure 69 Item 10	2129394-6 2049219-46D-6L
74	2153780-6 Length 64	3/16 7 x 19 Flexible Steel	Figure 69 Item 1	2129394-6 2049219-46D-6L
75	2153780-8 Length $76\frac{1}{4}$	3/16 7 x 19 Flexible Steel	Figure 69 Item 2	2129394-6 2049219-46D-6L
76	2153837-2 Length 85	5/32 7 x 19 Flexible Steel	Figure 70 Item 10	2049219-32D-5R 1154324

Figure 606 (Sheet 10 of 12)—Cable Charts

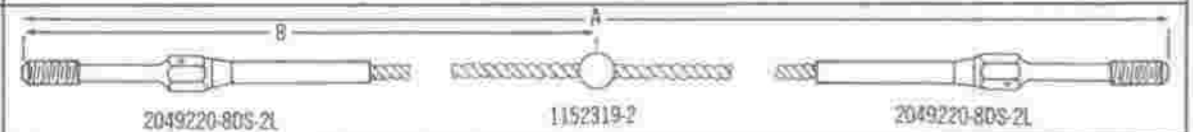
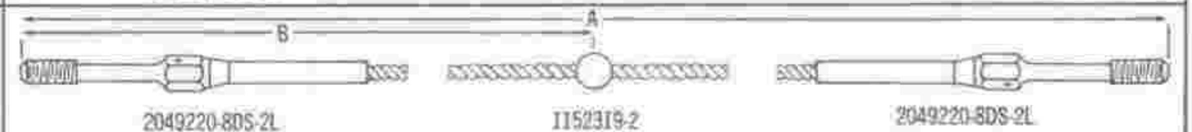
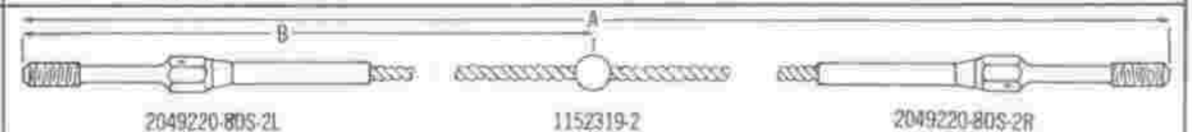
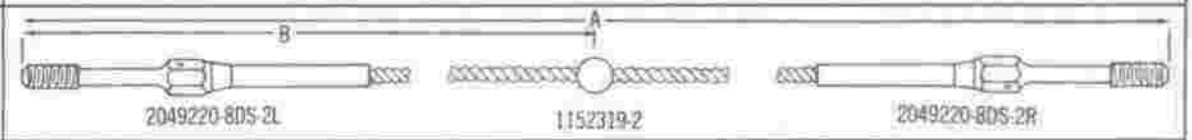
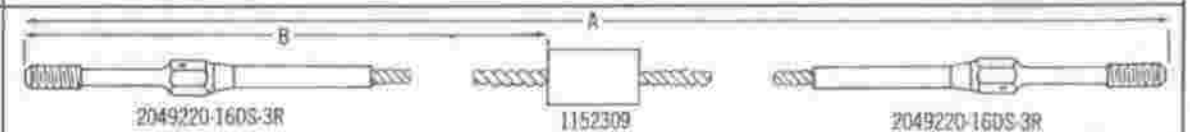
ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
77	2195064-8 Length $8\frac{3}{8}$	1/8 7 x 19 Flexible Steel	Figure 522 Items 12 & 14	
78	2195064-10 Length $53\frac{3}{8}$	1/8 7 x 19 Flexible Steel	Figure 522 Items 12 & 14	
79	2203085-2 A Length $63\frac{9}{16}$ B Length $30\frac{1}{2}$	1/16 7 x 7 Flexible Steel	Figure 569 Item 9	
80	2203085-4 A Length $72\frac{1}{2}$ B Length $43\frac{1}{2}$	1/16 7 x 7 Flexible Steel	Figure 569 Item 10	
81	2205066-2 A Length 125 B Length $62\frac{1}{2}$	1/16 7 x 7 Flexible Steel	Figure 568 Item 8	
82	2205066-4 A Length 89 B Length 30	1/16 7 x 7 Flexible Steel	Figure 568 Item 9	
82A	2205842 Length 363	5/32 7 x 19 Flexible Steel	Figure 70 Item 6	
83	4154040-16 A Length $18\frac{5}{8}$ B Length $9\frac{3}{8}$	3/32 7 x 7 Flexible Steel	Figure 259 Item 5	
84	4154040-18 A Length $18\frac{7}{8}$ B Length $9\frac{3}{4}$	3/32 7 x 7 Flexible Steel	Figure 297 Item 7	

Figure 606 (Sheet 11 of 12) — Cable Charts

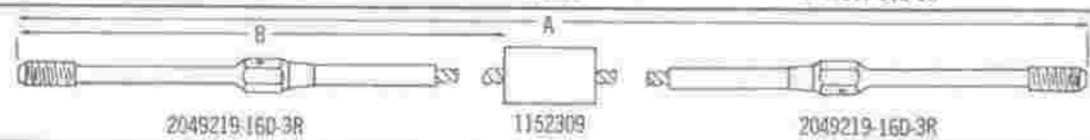
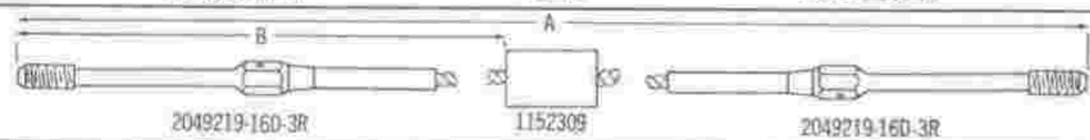
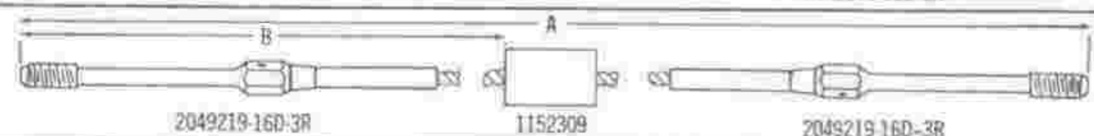
ITEM	PART NUMBER	DIA. STRANDS AND MATERIAL	FIG. NO. REF.	DETAIL OF CABLES
85	4154040-20 A Length 169 B Length 92 3/8	3/32 7 x 7 Flexible Steel	Figure 176 Items 3 & 4	
86	4154040-22 A Length 163 1/4 B Length 89 7/8	3/32 7 x 7 Flexible Steel	Figure 175 Items 3 & 4	
87	4154040-24 A Length 213 7/16 B Length 112 3/4	3/32 7 x 7 Flexible Steel	Figure 176 Items 9 & 10	
88	4154040-26 A Length 167 3/4 B Length 92 1/8	3/32 7 x 7 Flexible Steel	Figure 175 Items 9 & 10	

Figure 606 (Sheet 12 of 12) — Cable Charts

The following table contains the recommendations for the torque which should be applied in tightening the various bolts, nuts, and cap screws. Castellated nuts should not be loosened, after tightening to the recommended torque, in order to insert safety wire or cotter pins. In cases where misalignment occurs at the recommended torque, it is permissible to tighten the nuts to the next aligning position.

Torque indicating devices should be frequently checked and calibrated by means of weights and a measured lever arm, to insure that their accuracy is maintained. Checking one torque wrench against another is not sufficient. Some wrenches are quite sensitive as to the way they are supported during a tightening operation, and every effort should be made to adhere to the instructions furnished by the respective manufacturers.

There may be certain instances, other than those included under "SPECIFIC" recommendations, where it is obvious that the torque recommended for tightening a bolt, nut, or cap screw of a given size should not be used, due to the kind of material or the design of the engine part involved. Common sense and good judgment should, of course, be exercised in such cases.

GENERAL

	Recommended Torque
¼ in. Nuts and Cap Screws	75 in.-lbs.
$^5/_{16}$ in. Nuts and Cap Screws	100 in.-lbs.
⅜ in. Nuts and Cap Screws	300 in.-lbs.
$^7/_{16}$ in. Nuts and Cap Screws	485 in.-lbs.

SPECIFIC

Description	*Recommended Torque*
Center Main Crankcase Bolts	
⅜ in. Bolts	350 in.-lbs.
½ in. Bolts	750 in.-lbs.
⅝ in. Bolts	1000 in.-lbs.
Crankcase Through-Bolts	500 in.-lbs.
Crankshaft Bolts:	
"B" Type (Double Threaded Bolt)	Tighten until overall stretch of .010 to .012 in. is obtained.
Crankshaft Flyweights:	
Through Bolts	Tighten until overall stretch of .001 in. to .0015 in. is obtained.
Through-Bolt Expanders	250 in.-lbs.
Cylinder Hold-down Nuts	450 in.-lbs.
Flexible Engine Mount Assemblies:	
A. Flexible Mount Housing to Engine Mount Ring Attachment Stud Nuts	
Long Shank Type	1300 in.-lbs.
Short Shank Type	600 in.-lbs.
B. Flexible Housing Assembly Cap Screws	385 in.-lbs.
C. Engine Mount Bracket to Blower Case Attachment Stud Nuts	450 in.-lbs.
D. Flexible Mount to Engine Mount Bracket Attachment Stud Nuts	1000 in.-lbs.
Push Rod Cover Tube Gland Nuts	75 in.-lbs.
Rear Crankshaft Gear Screws	250 in.-lbs.
Rocker Box Cover Nuts	75 in.-lbs.
Rocker Shaft Nuts	Tighten snugly to approx. 35-in.-lbs. and turn to next cotter pin slot (135 in.-lbs. max.)
Spark Plugs	450 in.-lbs.
Valve Adjusting Screw Lock Nuts	275 in.-lbs.

Figure 607—Table of Engine Torque Recommendations

The accompanying chart gives the wrench torque requirements for all nuts and bolts that require an exact setting on the A-26 series airplane.

All other nuts and bolts on the A-26 series airplane are tightened by "feel." This sense of feel must be developed because, with average wrench leverages, the bolt body may be stretched, or the threads stripped, on bolts up to a diameter of ½ or ⅝ inch. Nuts or bolts must never be tightened by hammering on the wrench, and they must be installed free of grease or lubricant which would allow too great a torque load to be applied. It is also suggested that torque wrenches be calibrated at frequent intervals to insure correct values.

Item	Name	Ref. Dwg.	Bolt or Nut	Size (Inches)	Torque (Inch Lbs.)
1.	ENGINE TO ENGINE MOUNT	5122329	AN310	⅜	150*
			MR-36-6	½	500*
			MR-36-9	⅝	900*
2.	MAIN LANDING GEAR INSTALLATION	5122370	AN316	¾	1300 to 1500
3.	VERTICAL STABILIZER ATTACHMENT	5122110	NAS-152 or S-2076912	¾	2900 to 3200
4.	NACELLE TO WING ATTACHMENT—Forward Spar at Stations 84.86 and 140.86	5153006	NAS-147	7/16	570 to 640
			NAS-148	½	610 to 880
			NAS-149 or S-2126907 S-2126908 S-2126909	9/16	1000 to 1250
5.	NOSE GEAR INSTALLATION	5122380	AN316	¾	1300 to 1500
6.	NOSE SECTION TO FUSELAGE	5157240	NAS-147	7/16	570 to 640
7.	ENGINE MOUNT TO FIREWALL	5153327	1122834	½	480 to 690
8.	TAIL STUB ATTACHMENT	5153175	AN4	¼	50 to 70
9.	HORIZONTAL STABILIZER ATTACHMENT	5122110	12B-126	¾	2300 to 2500
10.	OUTBOARD WING FLAP—Center Hinge Lower Bolt	5153006	NAS-152	¾	2300 to 2500
11.	LANDING GEAR SUPPORT FITTING	5153030	NAS-145	5/16	130 to 180
			NAS-147	7/16	570 to 640
12.	NOSE WHEEL DOOR OPERATING MECHANISM	5122160	AN316	⅜	95 to 110

****Torque loads specified are the minimum allowable. If the cotter pin or safety wire cannot be inserted after these loads have been applied, the nut should be tightened until the next castellation aligns with the hole. The nut should NOT be backed off to attain alignment, as this practice may cause the torque value to fall below the minimum.***

Figure 608 (Sheet 1 of 3) Bolt Torque Charts

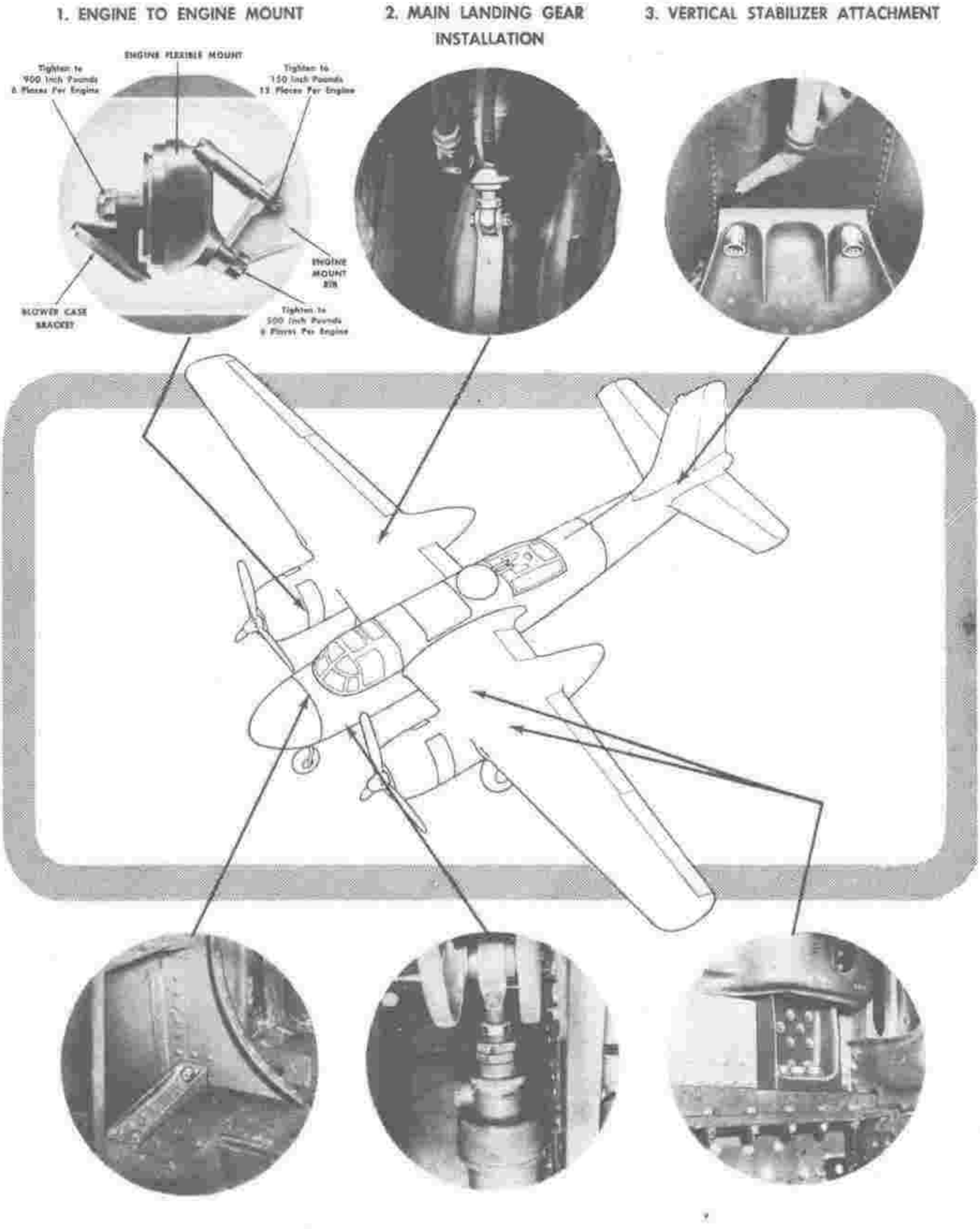
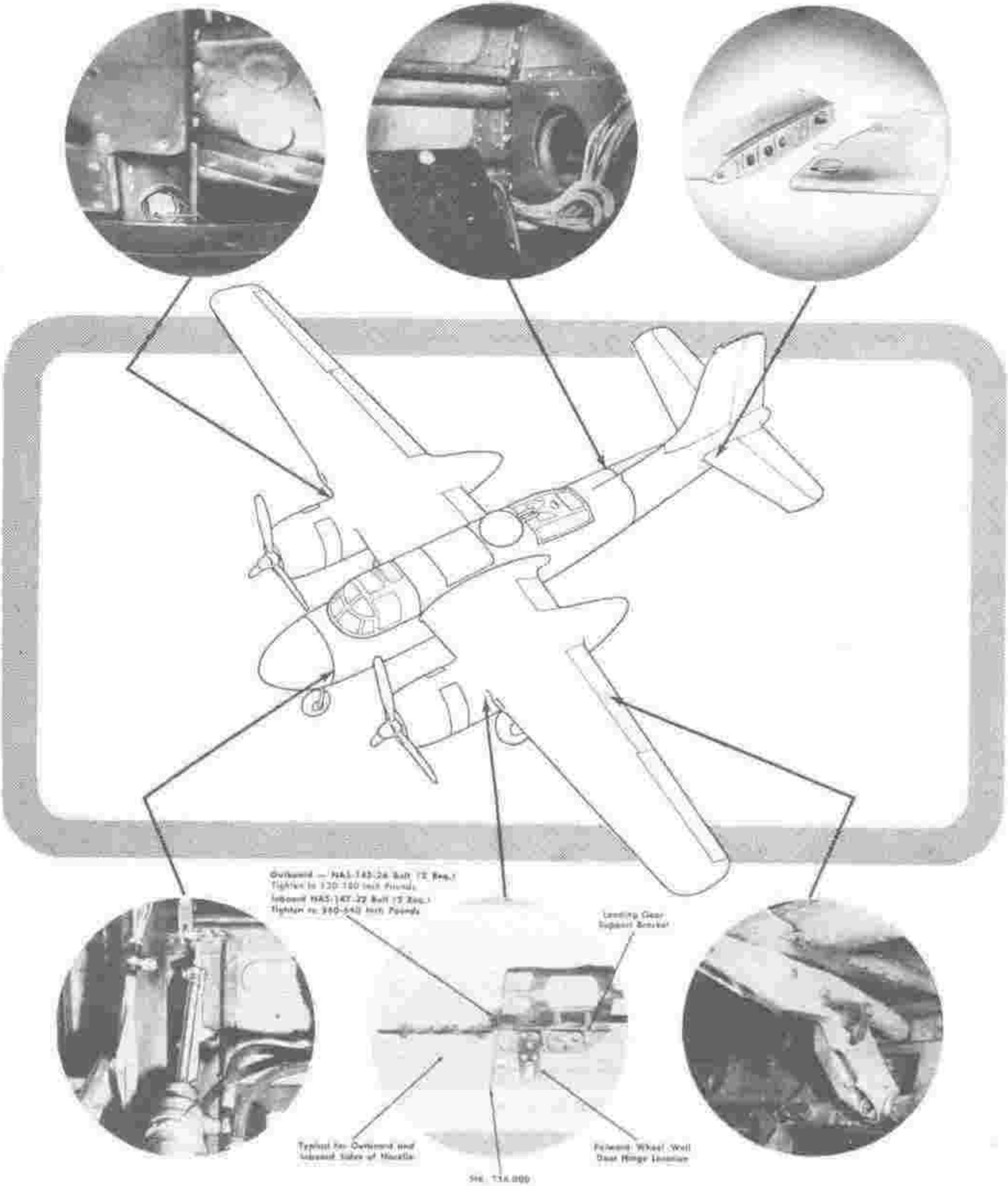


Figure 608 (Sheet 2 of 3) Bolt Torque Charts

7. ENGINE MOUNT TO FIREWALL

8. TAIL STUB ATTACHMENT

9. HORIZONTAL STABILIZER ATTACHMENT



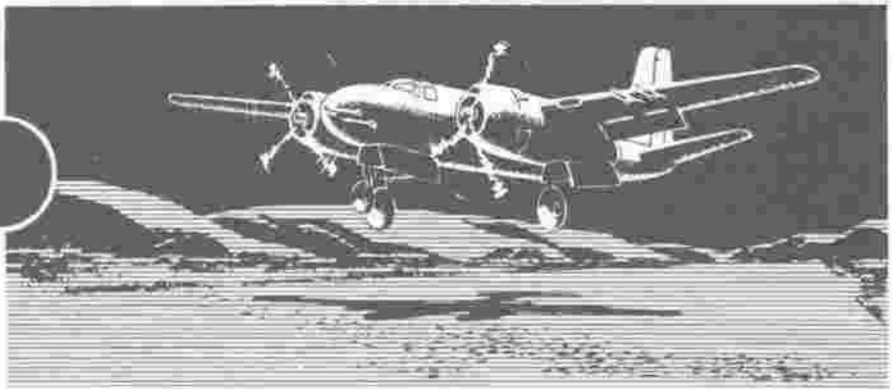
12. NOSE WHEEL DOOR OPERATING MECHANISM

11. LANDING GEAR SUPPORT FITTING

10. OUTBOARD WING FLAP Center Hinge Lower Bolt

Figure 608 (Sheet 3 of 3) Bolt Torque Charts

SECTION X



SERVICE INSPECTION

GENERAL

The inspection and maintenance requirements described are to be considered the minimum requirements. If, because of local conditions, peculiarities of equipment, or abnormal usage, the inspection procedures recommended are insufficient to obtain satisfactory maintenance, the scope and frequency of inspections should be increased. All aircraft require frequent adjustments and minor repairs. Inspection periods established for AAF and Navy service organizations are not identical. For that reason, inspection periods specified in this section in terms of hours consist of two figures, i.e. 25-30 hour inspection, the first figure of which indicates the AAF period, and the second figure of which indicates the comparable Navy period. Under each heading, however, the intervening time allowed for the completion of an inspection is identical. For example the 25-30 hour inspection indicates that the AAF 25 hour inspection may be accomplished at any time between the 20th and 30th hours, and that the Navy 30 hour inspection may be accomplished at any time between the 25th and 35th hours.

PREFLIGHT.—The preflight inspection is a check of the complete airplane prior to the first flight of the day to determine that the airplane controls, fuel system, engine instruments, etc., are functioning properly; that all cowling, fuel and oil container caps, etc., are in place and that the airplane is ready for flight.

DAILY.—The daily inspection determines the general condition of the airplane and is designed to detect aggravated conditions, improper adjustments, breaks, etc., but is not intended to be sufficiently thorough and searching as to detect slight wear and early stages of deterioration.

25-30 HOUR.—The 25-30 hour inspection should be accomplished between the 20th and 30th (25th and 35th Navy) flying hours after the completion of the last 50-60 hour inspection. It is not necessary that the 25-30 hour inspection be performed as one continuous operation with the airplane held "out of commission" from the time the inspection is started until the time the inspection is completed. The period of 10 flying hours allowed for the inspection makes it possible to spread the inspection over a period of several days. The 25-30 hour inspection includes the preflight and the daily inspections. It is designed to be thorough and searching. The parts inspected should be in a good condition and functioning properly. All routine maintenance operations should be accomplished.

The 50-60 HOUR.—The 50-60 hour inspection will be accomplished between the 40th and 60th flying hours (50th and 70th Navy) after the completion of the last 50-60 hour inspection. The 50-60 hour inspection may be spread over several days to avoid withdrawing the airplane from regular service. The 50-60 hour inspection includes preflight, daily, and 25-30 hour inspections and is designed to be a complete, thorough and searching examination of the entire airplane. The parts inspected should be in a good condition and functioning properly. All routine and maintenance work should be accomplished.

The 100-120 HOUR, 200-240 HOUR, 300 HOUR and subsequent inspections will be performed concurrently with the applicable 50-60 hour inspections due.

ENGINE CHANGE.—The engine change inspection will be accomplished each time an engine is changed, at which time all special instructions and maintenance work prescribed by technical instructions will be accomplished.

25-30 HOUR AFTER ENGINE CHANGE INSPECTION.—This inspection will be performed between the 20th and 30th flying hours (25th and 35th Navy) following an engine change. This is an engine "shakedown" inspection, at which time all special inspections incident to an engine change will be performed.

A.A.F. VISUAL INSPECTION SYSTEM.—For a complete description of "The Army Air Forces Visual Inspection System for Airplanes," refer to T.O. No. 00-20A.

BOMBING

TYPE C-3 BOMB HOIST.—Whenever the type C-3 bomb hoist assembly has been used, the following inspections will be made:

Inspect all parts for cleanliness, dryness, and proper lubrication.

Remove burrs if found on the squared ends of the drive shaft.

Inspect fabric slings for cleanliness, and dryness.

Inspect yokes of fabric slings for dents.

Check bomb hoist assembly for proper operation. If hoist shows any tendency to reverse under load, modify brake assembly.

Inspect support attachments, idler pulleys, and mounts for indication of wear or failure.

Check condition of cables with reference to attachment at drum and hooks, and any evidence of fraying or breaking of strands in cables.

TYPE A-2 BOMB ARMING CONTROL.

Preflight Inspections

Prior to each bombing mission test the ball catch of the A-2 arming control unit as instructed in Section IV., paragraph 17.

50-60 Hour Inspections

Repeat the preflight test at each 50 hour interval.

Inspect the control for mechanical looseness. All screws and nuts must be tight.

TYPE D-6 AND D-7 BOMB SHACKLES (T.O. NO. 11-5-10).

Preflight Inspections

Prior to each bombing mission the following inspection will be accomplished:

Check the shackle assembly for cleanliness. If an appreciable amount of foreign material is found, clean with kerosene but do not lubricate.

Check operation of moving parts for freedom from binding.

Manipulate shackle to determine condition and seating of springs.

Make a visual inspection of frame, carrying hooks, arming lever and releasing lever for any bending, warping or wearing of these parts.

With the shackle in the locked position, check for proper engagement of the releasing lever with the pawl, and of the pawl with the stop in the link assembly. Holes in the frame are provided for this check.

Shackles which are found to be faulty or which are in doubtful condition must be replaced.

50-60 Hour Inspections

Test arming hook spring with a standard arming wire. Hold the arming lever at "SAFE," find the force necessary to pull the wire from the retainer. The arming hook spring should resist a three pound pull. A four pound force should pull the wire from the arming wire seat. Springs failing to conform to these requirements must be replaced.

TYPE A-2 BOMB RELEASE MECHANISM.

Preflight Inspections

Check the releases for cleanliness and remove any dirt with a clean, dry cloth. Kerosene or any other cleaning fluids will not be used on the releases, for these solvents damage the solenoid.

Attach releases to all bomb positions on the racks that will be used, and see that the fasteners hold the release securely to the rack. Cock both arming and release levers on all releases to be used. Close firing switch and inspect each release to see that both levers have operated.

Install and test the release units as described in Section IV, paragraph 17.

Releases found to be faulty, or whose condition is questionable, will be replaced.

50-60 Hour Inspections

Before removing the release from the bomb rack, check the Simmonds fasteners and rings for excessive wear.

Test the lever tension of the arming and releasing levers as outlined in T.O. No. 11-5-28.

Check the trip screw bearing surface for wear by cocking the release, then tripping it with the trip screw while applying pressure to the axis of the screw. With a few pounds pressure on the screw, a worn bearing surface will permit the attached arming lever trip to assume a position directly over the indicator switch lever. Malfunction of this type is indicated by failure of the release to trip, since the bottom of the trip will jam against the arm of the indicator switch lever.

Check the maintenance procedure outlined in Section IV., paragraph 17.

GUNNERY

75 MM CANNON.–The following inspections of the 75 mm cannon should be made whenever the gun is cleaned and at least every five days whether the cannon has or has not been fired.

During all maintenance operations the gun should be disassembled and the parts thoroughly cleaned and inspected for wear, scoring, cracks, burrs, carbon, pitting, corrosion, and rust. Any burrs or rough edges should be removed by hand honing. Parts that are broken or worn, or that cannot be satisfactorily improved by hand honing should be replaced.

All springs should be inspected and those not within specifications should be replaced.

Check all threads for burrs or roughness.

Inspect the gun as a unit for:

General appearance and smoothness of operation of the breech mechanism.

Closing of spring mechanism.

Condition of bore for copper deposit on the lands and in the grooves and erosion at origin of rifling.

Bearing surface of exterior of tube for scoring or mutilation.

Inspect the breech ring. Remove the breechblock crank group and the breechblock assembly.

Check for scores or burrs on any of the bearing surfaces.

Breechblock Inspection

Check for proper operation of sear and cocking mechanism.

Make visual inspection of percussion mechanism.

Note whether there are scores or burrs on the breechblock and whether breechblock bushing screw is secure and flush with or below front face of breechblock.

TURRET SYSTEM.

Preflight and Daily Inspections

Check entire turret system for proper operation.

Check sighting station desiccator for pink desiccant.

Special 10 Hour Inspections

Inspect azimuth ring gear and elevation gear sector for dirty or dry gear surfaces.

Check optical surfaces to see if they are clean.

50-60 Hour Inspections

Check dynamotor brushes for wear.

Replace if worn to within ⅛ inch of the brush holder.

Check commutator and collector rings for dirt, looseness, or pitting.

Check amplidyne motor-generators for brush wear.

Check drive motor brushes. Replace brushes worn to within ⅛ inch of the brush holder. Inspect commutator for excessive dirt, pitting, or burning.

100-120 Hour Inspections

Inspect azimuth and elevation gear boxes for lack of lubrication. Lubricate with grease, Specification AN-G-3.

Check dynamotors, amplidynes, and drive motors for binding brushes, armature end play, or damaged insulation.

No oiling or greasing of the dynamotor, amplidynes, or drive motors is required. Bearings are provided sufficient grease to last for the life of bearing.

Check brushes in sighting station azimuth unit for proper seating. Brush tension should be between 6 and 8 ounces.

Clean and lubricate sighting station control gearing with grease, Specification AN-G-3.

500 Hour Inspections

Inspect control box for dirty contacts and loose connections.

Check servo-amplifier for dead tubes and loose connections, although the average life of the tubes in the servo-amplifier is 1000 hours.

Check fire interrupter system for proper operation.

Check lubrication of sighting station bearings. The initial lubrication should be satisfactory for the life of the instrument, providing it is not cleaned out during some maintenance operation. Relubricate with grease, Specification AN-G-3.

AMMUNITION BOOSTER.

Preflight and Daily Inspections

Check ammunition booster as follows:

Remove ammunition belts and any live rounds from the firing chamber.

Check that ammunition boosters are rigidly mounted to their supports.

Visually inspect booster units for damaged or loose parts and broken safety wire.

Inspect condition of rubber sprockets and drive pin through which the sprocket and shaft is driven by the main shaft. Check sprocket shafts for free rotation in such direction as to feed ammunition to the gun. The sprocket shafts cannot be turned in reverse direction.

Check bracket and guides for bent parts which would impair passage of ammunition through the booster.

Elevate guns to zenith position and pass ammunition belt through the booster. Check that ammunition belt passes through guides freely.

Operate the ammunition booster electrically by closing the firing switch. Check that booster motor drives both units.

CAUTION

Do not run the motor continuously since it will overheat.

GUN CHARGER.

Preflight and Daily Inspections

Check gun charger compressor as follows:
After the airplane's supply is turned on, check the operation of the compressor by pulling up on the "BLOW OFF" handle and releasing enough air to start the compressor. If the compressor fails to start, push hard on the turret circuit breaker on the turret switch box. If this doesn't remedy the trouble, replace the compressor. Check that the shut-off valve is fully open.

Note

Unless the valve is completely open or completely closed, the valve will leak air.

Special After Flight Inspection

Lubricate and clean the gun charger compressor as follows:

Release the air from the system, remove the anti-freeze plug in the top of the valve block assembly, and pour in 1 oz. of ethelyne glycol (Prestone) anti-freeze.

Drain the oil from the compressor and refill with approximately 2 ounces of Univis 48 oil (Standard Oil of New Jersey).

Clean the intake air filter with kerosene.

TYPE N-9 GUN SIGHT.

Preflight Inspections

Clean reflector glass.

Clean dust shield assembly over main lens.

Be sure that the reflector is held in its support. See that the gun sight body is held firmly in its mount.

Check electrical connections for proper contact and determine whether both filaments of the lamp will burn.

Determine whether the rheostat functions smoothly to control the intensity of light satisfactorily.

See that the reticule pattern is reflected properly by the sight reflectors.

Check the reflector for cracks or chips.

Check the alignment of the sight with the line of flight and harmonization of the guns with the sight line.

50-60 Hour Inspections

Check the general condition of the sight and reflector. Determine that all electrical parts are in working order.

Check the sight for condensation of moisture on its glass surfaces.

Clean the mirror in the lower part of the sight only if necessary.

CAUTION

The surface of the mirror is a thin coating of aluminum. Cleaning is to be done only with a cotton swab or lens cleaning tissue saturated with carbon tetrachloride. Excessive pressure may result in scratching the surface.

COMMUNICATIONS

COMMUNICATION EQUIPMENT.

Preflight Inspections

Make visual inspection of antennas. Check Form 1A for any remarks pertaining to communication equipment. Correct noted equipment defects which were not previously corrected and make appropriate entries of the corrective action taken.

Make simultaneous visual and operating inspection of equipment as follows:

Visual Inspection.—Check security of all communications equipment and component parts thereof.

Operating Inspection.—Test mechanical ease of operation and absence of excessive mechanical looseness of controls on all equipment. Listen for presence of undesired dynamotor overload, indicated by low rpm, when making the operational checks which follow.

RADIO SET SCR-274 N.

RECEIVERS.—Make an aural operating check, one receiver at a time (others turned "OFF"), as follows:

Place "A-B" switch on correct position "CW-OFF-MCW" switch on "CW," "INCREASE OUTPUT" control fully clockwise.

Tune receiver to midfrequency of the band. Adjust interphone jack box "INCREASE OUTPUT" to the point where noise background can be heard comfortably.

Tune from one end of the band to the other listening for the presence of undesired oscillations and of excessive noise. There should be no dropping out, sudden increase, or change of character (indicating unwanted oscillations) of the noise unless the receiver is tuned to a signal. Tune in a strong signal and check operation of receiver "INCREASE OUTPUT" control. (Excessive noise may be due to arcing of dynamotor brushes as a result of open armature winding. If noise is traced to this source exchange the dynamotor.)

Repeat preceding step with "CW-OFF-MCW" switch on "MCW."

Observe over-all sensitivity and accuracy of dial calibrations. Note mechanical ease of operation and absence of excessive looseness in all controls. Check operation of "INCREASE OUTPUT" control.

Tune in a weak signal and listen in the headset for presence of intermittent contacts while subjecting the control box, associated plugs and cordage to jarring. Repeat this check while subjecting receiver, antenna switching relay, and associated plugs and cordage to jarring.

Leave low frequency receiver "ON," "INCREASE OUTPUT" control fully clockwise for further tests of other equipment.

Check antenna circuit alignment as directed in Section IV., paragraph 15.

Note

The tests which follow should be made with regard to possible interference with radio communications in the vicinity.

TRANSMITTERS.—Turn "TRANSPOWER" switch "ON." Check the sidetone on each transmitter on "TONE," "CW" and "VOICE." Dynamotor should run continuously when emission switch is on "TONE" or "CW" but should run only when "press-to-talk" switch is closed if emission switch is on "VOICE." If necessary, set transmitters for frequencies anticipated in flight.

EACH TRANSMITTER.—With the emission switch on "VOICE," close the "press-to-talk" switch and observe the antenna current meter. Make a sustained "AH" sound in the throat microphone or whistle into the hand microphone when installed. Antenna current meter reading should increase momentarily about 10 to 15 per cent.

Switch to "TONE." Lock key down by turning it clockwise. Subject transmitter, control box, modulator unit, antenna switching relay and associated plugs and cordage to jarring, listening in headset and observing antenna current meter for evidence of loose elements or connections.

Check transmitter modulation (each transmitter) by contacting tower or another airplane.

100-120 Hour Inspections

RECEIVER, TRANSMITTERS AND MODULATOR UNIT.—Remove and take to a test bench. Remove all covers from chassis of each unit.

TUBES.—Check all tubes on a tube checker, tapping each tube while testing and watching for indication of loose or shorted elements. Reinstall good tubes in identical sockets from which they were removed. Replace any defective tubes. Make sure all tubes are firmly seated in their sockets and that grid clips are firmly attached. Should the master oscillator or a power amplifier tube be replaced, it will be necessary to retune the transmitter completely.

DYNAMOTORS.—Make following inspection of each receiver dynamotor and the transmitter dynamotor.

Remove the end bells.

Remove carbon dust and dirt.

Remove brushes from holders and examine for short, chipped, cracked or sticking condition. Brushes should be at least 3/8 inch long, and entire brush area should be in contact with commutator surface. Examine brushes to see that they have "worn-in" properly and are free from hard spots on the contact surfaces.

If commutator shows excessive wear or brushes have hard spots or show excess wear, exchange dynamotor. Rotate armature with finger observing freedom of rotation.

Inspect for evidence of excessive or lack of bearing lubricant. If improperly lubricated, exchange dynamotor.

Replace brushes, making sure that they are re-inserted in their respective holders with the polarity mark upward, that the pigtail connections inside the springs are secure, and that the brushes slide smoothly in their holders.

Replace and safety dynamotor end bells.

CHASSIS INSPECTION.—Inspect each chassis for broken or corroded joints, deterioration, and tightness of all electrical connections.

Inspect tube sockets and wire connections for corrosion. Clean out all dust and dirt. If tuning condensers need cleaning, use pipe cleaners dipped in carbon tetrachloride (U.S.A. Specification No. 4-503-110) or (P-S-661) solvent, working pipe cleaner between condenser plates.

FUSES.—Check all fuse clips and fuse end caps for corrosion and make sure fuse clips have proper tension to hold fuses firmly in place. See that all fuses are serviceable and of specified rating.

Reinstall dynamotor, receiver, and transmitter covers. Replace all screws and securely tighten them.

RACKS.—Check the condition of all wires or cords, plugs, antenna, and ground leads. Inspect plugs for corrosion or bent pins. Hand tighten all plugs.

REPLACEMENT OF UNITS.—Carefully slide the receivers and transmitters in their respective rack compartments. Reinstall the modulator unit. Hand tighten the knurled nuts which hold the locking lugs in place and fasten the modulator snapslides. Safety lock lugs and snapslides.

Check the correspondence of receiver dials with the reading of the dials on the receiver control box. Correct if necessary by varying the remote tuning dial until the readings coincide or as directed in Section IV., paragraph 15.

Replace the tuning shafts and tighten the plugs.

Replace plugs in modulator unit.

Connect the antenna leads to the receiver and transmitter binding posts.

INTERPHONE EQUIPMENT RC-36-( ).

INTERPHONE JACK BOXES BC-366.—Test all interphone jack boxes, observing:

Presence of voice on "INTER" and "CALL" positions.

Presence of compass receiver output on "COMP" position.

Presence of command receiver output on "COMMAND" position and operation of "INCREASE OUTPUT" control.

Note

The audio output of the receiver Radio Control Box BC-450-A can be heard on the "COMMAND" position of the interphone jack box when the "A-B" telephone switches are on "A." When the switches are in "B" position, command receiver audio output is channeled into the "LIAISON" position of the interphone jack box. The receiver audio output of Radio Set SCR-522-( ), when installed, can be heard on "LIAISON" position and audio output of command receivers of Radio Set SCR-274-N will then be heard only on "COMMAND" position.

Presence of command receiver output on "LIAISON" position.

Test headset and microphone cords for intermittent contact.

The characteristic signal produced by the test transmitter and radio set should be heard clearly. Care must be taken to insure that the test transmitter signal is being heard and not some unwanted oscillations from other sources.

Make an aural test of the operation of the "EMERGENCY" switch.

Make an aural test of the operation of the "695-G" band switches if installed.

Before inserting the detonator plug into the receiver, check for presence of unwanted voltage at the detonator plug terminals. Also subject the inertia switch to light jarring and check for proper centering of reset plunger. Warning lights should not light.

TURN OFF ALL EQUIPMENT.

Afterflight Inspection

Check Form 1A for entries pertaining to communications equipment.

Correct noted equipment defects and make appropriate entries of the corrective action taken.

Daily Inspection
Visual Inspection of Antennas

Check shock links and springs for tension and deterioration.

Check antenna wire for nicks and proper tension.

Replace any antenna found defective.

Check insulators for chipped, cracked, or dirty condition.

Check Form 1A for remarks pertaining to communications equipment.

Correct noted equipment defects which were not previously corrected and make appropriate entries of the corrective action taken.

INTERPHONE AMPLIFIER BC-347-( ) AND DYNAMOTOR UNIT PE-86-( ).—Test for presence of intermittent contacts when interphone amplifier, interphone dynamotor, and associated plugs and cordage are subjected to jarring.

Test amplifier tube and replace if defective. Check to insure that there is no interference between the cover assembly and the wiring.

Check for cleanliness and tightness of plug contacts and for broken or corroded connections.

CONTROL BOXES OF RADIO SET SCR-274-N, RADIO SET SCR-522-( ) WHEN INSTALLED, RADIO COMPASS MN-26Y, FILTER EQUIPMENT RC-198 AND INTERPHONE EQUIPMENT RS-36.

Check all control boxes of the above radio equipment for the following if applicable:

Proper action of all selector switches, knobs, and levers.

Proper tightness of control knobs, switches, jacks, and plug contacts.

Cleanliness of chassis and of contacts on all keys, switches, plugs, and jacks.

Broken or corroded connections and deterioration of any parts.

Proper action of lamp controls, operation of all dial lights and presence of spare lamps.

Make an operating test on all positions.

Make simultaneous visual and operating inspection as follows:

Visual Inspection

Check all equipment for proper security and condition of all cordage and plugs.

Check for correctness of applicable Radio Facility Charts.

Operating Inspection

Test mechanical ease of operation and absence of mechanical looseness of controls on all equipment checked during the operational checks which follow, as well as listen for presence of undesired dynamotor overload, indicated by low rpm.

RADIO SET SCR-595-A OR SCR-695-A.

WARNING

THE DETONATOR PLUG MUST BE DISCONNECTED FROM THE EQUIPMENT DURING ALL TESTS.

Turn set "ON" by using power switch on the control unit at the left-hand side of gunner's station or the power switch at the pilot's position on the main electrical control panel.

Plug a head set into the control unit and make an aural test of the equipment. No sound except possibly a series of clicks should be heard. If the set is found to be in self-oscillation, the receiver unit must be replaced.

Locate a properly adjusted test transmitter and test receiver near the antenna. The signal produced by the test equipment must be heard with the head set plugged into the Radio Set SCR-595-A control unit head set jack.

Plug a head set into the test receiver. The signal from Radio Set SCR-595-A must be heard without being blanketed by the signal transmitted directly to the test receiver by the test transmitter itself. The direct signal is too loud if the signal from Radio Set SCR-595-A has lost its own characteristic pitch, provided of course, that the equipment is operating properly. Arrange the test equipment with these considerations as a guide. With the test equipment operating, place the control unit selector switch on "1." Listen on the test receiver for the characteristic signal with the control unit selector switch on each of the six positions. Place the "EMERGENCY" switch on the control unit or at the pilot's position in the "ON" position. The characteristic signal should be heard in the phone of the test receiver.

Return this switch to its "OFF" position.

If a signal of sufficient strength is obtained in the preceding operations, the set is operating satisfactorily at one frequency.

If a weak signal is obtained, try shifting the position of the receiver by a foot or two to make sure that it is not located in a "dead" spot.

If installed, test operation of the "695-G" switches at pilot's position by throwing the toggle switch from "OFF" to "ON," and then momentarily depress the push-button type switch SW-180. The characteristic signal should be heard for 10 to 15 seconds in the phones at the test receiver. Return toggle switch to "OFF" position. While listening at the test receiver with the tone control set at its extreme clockwise position, slowly rotate the "B" band control on the test transmitter both above and below the original setting, meanwhile keeping the characteristic signal from the radio set tuned in on the test receiver by rotating its "B" band knob. Regular operation should be secured at all settings between the two extremes at which the characteristic signal disappears. This proves operation is possible over a normal frequency range.

TURN OFF ALL EQUIPMENT.

25-30 Hour Inspection

This inspection shall cover the items listed under the daily inspection and shall be conducted under the supervision of competent supervisory communications personnel designated by local authority. The objectives are to establish a uniform standard of inspection and maintenance as well as to provide a system that will be conducive to systematic training of operating maintenance personnel.

100-120 Hour Inspection

Visual inspection of antennas.—Check the shock links and springs for tension and deterioration.

Clean and check for nicks all exterior, fixed wire antennas.

If a reddish brown powder appears around the splices and ties, replace the antenna.

Clean insulators and inspect for cracks or chips.

Inspect loop mounting screws for tightness.

Check Form 1A for any entries pertaining to communications equipment. Correct noted equipment defects which were not previously corrected and make appropriate entries of the corrective action taken.

Check for correctness of applicable Radio Facility Charts.

Check security and condition of all equipment and component parts thereof while performing the inspections which follow.

TRANSMITTER ADJUSTMENT. — Loosen the "ANT COUPLING" and "ANT INDUCTANCE" locks on the No. 1 transmitter.

Turn the "TRANS POWER" switch "ON." See that the emission switch is on "CW" and the "TRANSMITTER SELECTOR" switch is on "1."

TRANSMITTER FREQUENCY.

CALIBRATION.—Make transmitter frequency calibration as directed in Section IV., paragraph 15.

TRANSMITTER TUNING. — Tune transmitter as directed in Section IV., paragraph 15.

EACH TRANSMITTER.—Switch to "TONE." Lock key down by turning it clockwise. Subject transmitter, modulator unit, control box, antenna switching relay, and associated plugs and cordage to jarring, listening in head set and observing antenna current meter for evidence of loose elements or connections.

Check transmitter modulation (each transmitter) by contacting tower or another airplane.

TURN OFF RADIO SET.

RADIO SET SCR-522-( ).—when installed.

Note

Adjustments of many of the various components are interdependent and extremely critical. These adjustments are made at the factory, prior to shipment, or at the various area Air Service Commands. Only adjustments specifically listed under inspection procedure are to be executed. Immediate corrections of the majority of failures encountered in the field can be accomplished by simple repair, but due to the complexity of some of these adjustments, only authorized personnel having proper facilities should attempt them. Procedure contained herein will be strictly adhered to in execution of inspections.

General Inspection

Check mountings of component parts for security.

Inspect ground straps for positive electrical connection. Hand tighten all plug locking and end rings. Inspect all cables for signs of chafing or wear due to vibration. Check for proper security and bonding to airplane. Inspect antenna mast for security of mounting, positive ground connection to skin of airplane, and for cracking at base. Remove covers of all junction and jack boxes. Inspect wiring connections to plug sockets. Check plug sockets for corrosion or loose pins.

RECEIVING AND TRANSMITTING COMPONENTS.—Test receiver output of each channel with interphone jack box "INCREASE OUTPUT" fully clockwise.

Listen for presence of extraneous receiver noises with engines running.

Check for proper modulation of transmitter section on any band. (Check with ground station or another airplane.)

Check for intermittent contacts, receiver operating, while subjecting major components and associated plugs and cordage to jarring.

Open transmitter cover and plug Test Set 1-139-A into transmitter meter socket.

Turn "METER SWITCH" to No. "3" position.

Push lowest frequency channel button and allow a 2-minute warm-up period.

Record meter reading in service log.

If latest current recorded differs by more than 10 milliamperes from previous recorded reading, retune transmitter in accordance with tuning instructions given under 100 Hour Inspection.

DYNAMOTOR.—Make inspection as follows:

Loosen plug locking ring on Plug PL-P172 or PL-Q-172 and Plug PL-P171 or PL-Q171 and remove dynamotor unit if necessary.

Remove dynamotor unit cover.

Remove brush or dust covers on dynamotor, if used.

If the dynamotor is to be removed for inspection, disconnect the connecting leads, and loosen the dynamotor retaining strap.

With dry compressed air, gently blow carbon and copper dust from all four commutators and from armature near commutators.

Inspect brush holder mounting slots for cracks or fractures.

Note

Brush holder is used on Dynamotors PE-94-A and PE-98-A. Inspect for restricted or sticking brushes, making certain that brush springs are in proper place and exerting proper pressure. If commutators or brushes show signs of excessive wear, exchange unit.

Replace dynamotor if removed.

Replace dynamotor unit cover making absolutely certain that cover is installed so ventilated portions of the ends of cover are adjacent to dynamotor proper and not adjacent to associated filter sections.

CAUTION

CORRECT INSTALLATION OF COVER WAS NOT DESIGNATED ON EARLY RUN DYNAMOTORS SO EXTREME CARE MUST BE TAKEN TO REINSTALL CORRECTLY. LATER RUNS HAVE RED ARROWS OR DOTS THAT MUST COINCIDE IF COVER IS PROPERLY INSTALLED.

Replace dynamotor unit if removed and replace plugs and tighten locking rings.

RACK, TRANSMITTER, AND RECEIVER. – Make inspection which follows:

Push button to "OFF" on Radio Control Box BC-602-A.

Open Dzus fasteners on receiver and transmitter covers so rack, receiver, and transmitter controls are in view.

Turn unit "ON" by pushing channel button.

With thumb or finger press armature of relay towards field coil until contacts close and ratchet or shifter motor runs continuously. Holding this relay closed, *count* the motor rpm as it shifts continuously from one channel to another.

Release armature. The number of motor rpm should be approximately as indicated below for various temperatures.

Temperatures		*Minimum Revolutions*
Fahrenheit	*Centrigrade*	*Per Minute*
140	60	22
104	40	24
68	20	24
32	0	22
– 4	—20	20
—40	—40	18

Press channel release button once and release. This releases all slides.

Push "OFF" button on control box.

Loosen plug locking rings and remove plugs from receptacles.

Remove Case CS-80-A from airplane.
Unfasten two large Dzus fasteners located on each side of Case CS-80-A.

By use of handles in each end of rack, lift rack, receiver and transmitter assembly out of case.

Making certain rack slides are disengaged, disassemble receiver and transmitter from rack by removing four red mounting screws in each unit.

RACK FT-244-A.—Make the following inspection of racks.

Remove six screws securing rack center cover and remove center cover.

Blow dust and dirt out with dry compressed air. Avoid subjecting delicate parts to direct blast.

Inspect mounting screws and electrical connections of antenna receptacle.

Inspect mounting screws and electrical connections on antenna relay.

Clean and burnish or polish relay contact points. DO NOT USE ANY KIND OF ABRASIVE FOR BURNISHING. If a burnishing tool is not available, clean contact points with a flat tooth pick dipped in carbon tetrachloride, working tooth pick between points.

Inspect condition of pins of receptacles.

Inspect relays by pressing armature lightly until it stops. Then check contact points of relay, verifying good condition.

If necessary, clean contact points as directed above.

Inspect cable wiring for wear where it goes through center channel of rack.

At same time inspect cable where it passes under receptacle and over shifter mechanism shield.

RACKSHIFTER MECHANISM AND RATCHET MOTOR.—Clean and lubricate each of the four channels of shifter mechanism and motor in the following manner:

Note

Stand rack on its end with motor down. The cross arms are more accessible for inspection from bottom or back of racks.

Using carbon tetrachloride or P-S-661 solvent, clean dirty grease from the following:

Receiver shifter actuating slides and their respective tracks and spacers.

Transmitter shifter actuating slides and their respective tracks, spacers and slide heads.

Motor arms.

Each pair of cross arms at each end and at pivoting point.

Ratchet wheels of motor.

Pawl and pawl stop of motor.

Hinge assembly on motor.

RECEIVER AND TRANSMITTER ACTUATING SLIDES.—Inspect the track in each actuating slide for undue wear or roughness and apply grease AN-G-3 to the following:

Heads of shifter actuating slides.

Teeth of ratchet wheel.

Pin and slot bearing surfaces at each end of cross arms.

Apply oil AN-O-4 to ratchet wheel shaft; cross arm pivot bearings, its slots and large bushings for both transmitter and receiver shifter actuating slides.

MOTOR INTERRUPTER CONTACTS.

Inspect motor for build-up on the tungsten contact.

Do not attempt to clean motor interrupter contacts unless the build-up of silver is excessive. A small deposit of silver on the tungsten is harmful only if relative lateral positioning of contacts is disturbed. The cleaning operation, when necessary, should be confined to removal of all silver which may be deposited on the tungsten. Do this by using an extremely thin, single faced contact file, or a magnet point file which has one side ground off, leaving thickness approximately .010 to .015 inch. After filing, clean tungsten contact by dressing with fine sandpaper.

CAUTION

DO NOT SAND SILVER CONTACT.

When filing and cleaning are completed, set interrupter adjusting screw so interrupter contacts open approximately .006 inch with armature in full energized position. Apply glyptol to threads of screw if adjusted.

RECEIVER.—Make inspection as follows:

Remove tubes, after marking in such a manner that each may be returned to its original socket, and test in a tube checker. Replace tubes in original sockets after testing and replacing defective tubes.

Make certain tube retaining clips on tubes VT-203 and VT-202 hold tubes firmly in their sockets.

Note

Vacuum tubes VT-202 and VT-203 will exhibit white oxides if there is an air leak due to a crack in tube base. Any of these tubes which show signs of oxidations should be replaced immediately. Vacuum Tubes VT-202, VT-203, and VT-118 are designed for VHF operation and consequently do not have molded bases. Pins are secured directly to glass envelope. This construction, though necessary, is mechanically weak. Extreme caution must be exercised in removing and installing these tubes. Remove tubes from sockets by pulling nearly straight up. Install tubes by pushing nearly straight down. A slight rocking motion may be used with extreme care. Inspect any sockets into which tubes fit unusually hard, as cracks may form later from prolonged strains on the pins.

Place receiver on bench with slides and tuning controls up, and rotate two tuning controls, making certain each turns easily and does not bind.

Note

As component parts of both receiver and transmitter are being inspected as specifically directed in this manual, a visual inspection may be made of electrical connections to those parts. Loose joints, frayed leads, broken strands of wire or nearly shorted connections are the chief source of trouble encountered.

Inspect security of four frequency shifter mounting screws.

Inspect mounting nuts on "AUDIO" control and "RELAY" control. If loose, these must be tightened and sealed with glyptol.

Using a small screw driver, turn shaft of both controls. There should be a definite drag as shaft is rotated.

Inspect mounting screws of all plugs or receptacles.

With finger, push each individual shifter slide in until it seats firmly.

Release quickly. Slide will return to released position. Tuning controls should rotate to their respective settings as each slide is depressed, unless a cam or positioning clip or clip spring is defective.

Inspect four cam assemblies on each tuning control for bent or worn parts.

Inspect four positioning clips and clip springs on each stack assembly.

Clean dirty bearing surfaces of shifter slides with carbon tetrachloride or P-S-661 solvent.

Apply grease AN-G-3 to any bearing surfaces cleaned. If cam or cam shaft assemblies are cleaned, it will be necessary to lubricate cams and spacer generously with oil AN-O-4.

Place receiver with shifter near top so that tuning controls face the operator and inspect security of mounting of R-F and oscillator assembly. Inspect mounting nuts on crystal board.

By grasping, inspect security of various parts mounted on chassis.

With receiver placed bottom up, exposing small tubes and under-chassis wiring, accomplish following inspection:

Check security of three mounting screws on end of chassis holding R-F on oscillator assembly.

Check security of mounting screws and nuts of each component part accessible from bottom of chassis.

Investigate any evidence of wearing of cables in chassis.

TRANSMITTER.—Make inspection as follows:

Place transmitter on bench with tuning controls up.

Remove power amplifier shield, located on end of chassis, by loosening four Dzus fasteners.

Remove tubes, after marking in such a manner as to insure each tube being returned to its original socket, and test in tube checker.

Note

If a tube checker is not available which accommodates vacuum Tube VT-118, check according to directions given later in this section.

Replace tubes in original sockets after testing and replacing all defective tubes.

Check security of parts and wiring in power amplifier section.

Replace power amplifier shield making certain the Mycalex strip rests securely between plate pins on vacuum Tube VT-118 and is exerting a downward pressure.

Inspect security of four frequency shifter mounting screws.

Rotate each of four tuning controls making certain that each turns easily.

Inspect mounting nut on "GAIN" control. If loose, tighten, and seal with glyptol.

Rotate knob of "METER SWITCH" from position "1" to "6" and check for normal rotation and locking.

With finger, push each individual shifter slide in until it seats firmly.

Release quickly. Slide will return to released position. Tuning controls should rotate to their respective settings as each slide is depressed, if not, a cam or positioning clip or clip spring is defective.

Inspect four cam assemblies on each tuning control for bent or worn parts.

Inspect four positioning clips and clip springs on each stack assembly.

Clean dirty bearing surface of shifter slides with carbon tetrachloride (U.S.A. Specification No. 4-503-110) or (P-S-661) solvent.

Apply grease AN-G-3 to bearing surfaces cleaned. If cam or cam shaft assemblies are cleaned it will be necessary to lubricate cams and spacers generously with oil AN-O-4.

Place transmitter on one side, then on other side and finally up on one end, and in each position inspect security of component parts accessible while in that position.

Reassemble receiver and transmitter with rack. Make certain before tightening mounting screws of receiver or transmitter that their respective actuating slides are approximaely 1/32 inch from slide assemblies when in released position. Reassemble in Case CS-80-A and connect plugs on rack. If vacuum Tubes VT-118 were not tested in tube checker, proceed as follows:

Plug Test Set I-139-A into meter socket and turn "METER SWITCH" knob to position No. "2."

Turn set "ON" by pushing channel "A" button and allow a 2-minute warm-up period.

Record reading of Test Set I-139-A.

Turn set "OFF" and remove from case.

Install a vacuum Tube VT-118, known to be in good condition, in the second harmonic amplifier socket. This is accessible from bottom of transmitter.

Replace in case, turn on "A" channel and after a 2-minute warm-up, record reading of Test Set I-139-A.

If current recorded with known good tube in socket exceeds appreciably the original current, replace old tube.

Note

Instances may be encountered where an old tube, or a new tube for that matter, reads 20 or more milliamperes above an average reading. If this is encountered, try several tubes. Occasionally a tube is gassy and this causes excessive plate current readings. Gassy tubes are never to be used.

Turn "METER SWITCH" knob to position No. "3" and record reading.

Turn set "OFF" and remove from case.

Install a vacuum Tube VT-118, known to be in good condition, in the power amplifier socket. To reach this tube it will be necessary to remove power amplifier shield on end of transmitter.

Replace tube shield and install in case.

Proceed as directed for checking Tube VT-118.

Reinstall Case CS-80-A in airplane.

TRANSMITTER AND RECEIVER TUNING.—Perform the following adjustments:

Plug transmitter crystal for frequency of channel to be tuned into crystal socket of Signal Generator I-130-A or I-96-A.

Plug Test Set I-139-A into signal generator meter socket and turn on the signal generator as follows:

Turn "MO CRYSTAL" to "CRYSTAL" position. Set "OUTPUT STEPS" control to position No. "2" and turn "OUTPUT CONTROL" to maximum.

Adjust "CRYSTAL TUNING CONTROL" to the dip or minimum reading on Test Set I-139-A (meter) nearest dial frequency of transmission.

Set "MEGACYCLES" control to approximately same setting as reading on "CRYSTAL CONTROL" dial. Tune large dial for minimum reading of meter. Connect signal generator "RF OUTPUT" socket and receiver antenna Socket SO-183 by means of Cable CD-477.

If no signal generator is available, a buzzer can be used and intensity regulated by moving it away from antenna. Type of signal source is not important since channels are crystal controlled and it is only necessary to tune for maximum output.

RECEIVER SECTION.

Install crystals corresponding to assigned frequencies in crystal sockets of receivers.

Turn set "ON" by pressing control box button for channel immediately preceding channel to be tuned, and allow receiver a 2-minute warm-up period.

Press channel release button.

Loosen lock nuts in controls so they exert a slight pressure on cams beneath.

Press control box button for channel to be tuned.

Loosen lock nuts completely.

Turn audio squelch "RELAY" and "AUDIO" gain controls to extreme clockwise position.

Connect output meter (0-30 volt scale) to jack box output terminals.

If an output meter is not available, use a head set to check for maximum output.

Turn oscillator plate coil tuning screws, for channel being tuned, counterclockwise until from three to five threads extend above sleeve.

Turn both tuning controls to approximately same setting as "CRYSTAL TUNING" dial on signal generator. Rock controls across this setting and locate on both a point of maximum meter reading or maximum head set output.

If no signal is found, turn oscillator plate coil tuning screw, corresponding to band being tuned, out one turn at a time and repeat rocking procedure until signal is located and point of maximum signal is found.

If meter reads off scale, or head set output is too strong, reduce signal generator output by turning "OUTPUT CONTROL" counterclockwise.

Turn plate coil tuning screw clockwise until output drops abruptly. One or more peaks may be passed through as screw is turned, but correct point will be identified by its very sharp cut-off.

Turn plate coil tuning screw counterclockwise until output is again evident on meter or phone, then one-half to three-quarter turns counterclockwise beyond this point to insure stable crystal operation.

Retune both controls for maximum output.

Hold tuning controls in exact position to which they were adjusted and tighten lock nuts to exert a slight pressure on cams.

Install transmitter crystal, for next channel to be adjusted, in signal generator and retune the same.

Press control box button for next channel to be tuned.

Loosen tuning control lock nuts completely.

Proceed with tuning of this channel as directed above.

Tune remaining channels in same manner. After completion of tuning of last channel, hold tuning controls in exact position to which they were adjusted and tighten lock nuts to exert a slight pressure on cams.

Press channel release button and tighten lock nuts as tightly as possible with fingers.

RELAY CONTROL ADJUSTMENT.

Adjust the relay control in the following manner:

Turn set "ON" and listen with headset plugged into jack box. Select a channel over which no signal is being received.

Turn "RELAY" control screw in a clockwise direction (if no background noise is heard) until a strong background noise level is obtained.

Turn "RELAY" control screw in a counterclockwise direction until noise drops abruptly, then a fraction of a turn beyond, in order to avoid relay flutter point. This relay is a squelch control and turns receiving section "OFF" when no signal is being received, and turns receiver "ON" when a signal is being received.

AUDIO CONTROL ADJUSTMENT.

Adjust the audio control in the following manner: If pilot's jack box, installed in plane, has no volume control, turn "AUDIO" control screw clockwise from full counterclockwise position until head set volume, as determined preferably by pilot while listening to a signal emission of another Radio Set SCR-522-( ), is normal. This setting is usually about one-third turn from full counterclockwise position. If pilot's jack box has a volume control, set "AUDIO" control screw at full clockwise position.

TRANSMITTER SECTION.

Install crystals corresponding to assigned channel frequencies in transmitter crystal socket.

Plug Test Set I-139-A into meter socket on transmitter.

Turn set "ON" by pressing control box button for channel immediately preceding lowest frequency channel to be tuned and allow a 2-minute warm-up period.

Press channel release button and slightly loosen the four tuning control lock nuts on transmitter tuning controls by turning counterclockwise.

Tighten lock nuts until they exert only a moderate pressure on cams beneath.

Press control box button for lowest frequency channel to be tuned.

Loosen tuning control lock nuts until tuning control knob pointers can be rotated.

Place Control Box "T-R-REM" selector switch in the "T" position.

Place transmitter "METER SWITCH" in position "1."

LOWEST FREQUENCY CHANNEL ADJUSTMENT.

Adjust oscillator plate tuning control for maximum meter reading.

Place transmitter "METER SWITCH" in position "2."

Adjust 1st harmonic amplifier plate tuning control for maximum meter reading.

Place transmitter "METER SWITCH" in position "3."

Adjust 2nd harmonic amplifier plate tuning control for maximum meter reading.

Adjust power amplifier plate tuning control with "METER SWITCH" still in position "3" for dip or minimum reading.

Note

This adjustment should immediately follow adjustment made on 2nd harmonic amplifier to prevent possible damage to power amplifier tube elements. Repeat adjustment of 2nd harmonic and power amplifier plate tuning controls several times in order to be certain of actual maximum and minimum readings respectively. Final reading should be approximately 63 MA. If not obtained, antenna coupling requires adjustment.

ANTENNA COUPLING ADJUSTMENT.—Make the adjustments which follow:

Note

Antenna coupling adjustment is to be made only with transmitter operating on lowest frequency channel. After completion of adjustment, extreme care is necessary when tightening antenna coupling lock screw as it must be tightened securely but not with excessive force, or damage to coil mounting parts will result. It will be found easier to make this adjustment with two screw drivers, one used as a "lever" between the adjacent edge of rack and lock screw and the other used to tighten the tension on lock screw while "lever" is holding it in place.

If final reading obtained above was *less* than 63 MA, turn "OFF" transmitter, slightly loosen antenna coupling control lock screw and move it toward tuning controls. (If *more* than 63 MA, move away from tuning controls.) Turn "ON" transmitter, retune power amplifier plate tuning control for minimum reading.

If 63 MA is not obtained, repeat operation.

Note

It is preferable to turn "OFF" transmitter when making this adjustment. If tuned with transmitter power "ON," care should be taken not to permit coupling coil to touch plate coil; otherwise, high voltage supply will be grounded through coupling coil.

Tighten antenna coupling lock screw.

After completely tuning this channel, record meter record meter readings for reference in subsequent operations with "METER SWITCH" on positions "1," "2," and "3." Hold tuning controls in exact position to which they were adjusted and tighten lock nuts to exert a moderate pressure on cams. Recheck meter reading. If different reading is attained from the recorded reading, the tuning controls were disturbed in tightening lock nuts, and channel must be completely retuned.

ADJUSTMENTS ON OTHER CHANNELS.–Make the adjustments on the transmitting channels other than the lowest frequency channel.

Press control box button for next channel.

Loosen lock nuts slightly.

Repeat tuning procedure given for lowest frequency channel.

Do not repeat antenna coupling adjustment.

After completion of antenna coupling adjustment, readings with switch in positions "1," "2," and "3." Repeat tuning operations for remaining channels.

Note

Meter readings for switch position No. "3" will probably be found progressively lower for successively higher frequency channels. Good results are obtained with a meter reading as low as 45 MA on highest frequency channel.

TRANSMITTER TUNING ADJUSTMENTS.– Check transmitter tuning adjustments as follows:

Hold tuning controls in exact position to which they were adjusted and tighten lock nuts until they exert a slight pressure on cams.

Press channel release button.

Tighten tuning control lock nuts as tight as possible with fingers. They must be securely tightened in order to retain correct adjustment. With "METER SWITCH" in position "3," check meter readings for all channels against recorded readings previously obtained in tuning operations.

METER READING ADJUSTMENT.–If meter reading for any channel has increased, perform the following:

Press control box button preceding the button for channel to be retuned.

Loosen lock nuts on power amplifier plate tuning control until it exerts only a slight pressure on cam.

Press button for channel to be retuned.

With "METER SWITCH" on position "3," adjust power amplifier plate tuning control for dip or minimum meter reading.

Press channel release button.

Tighten lock nut on power amplifier plate tuning control as tight as possible with fingers.

Press channel release button and check reading.

If decreased meter reading is found on position "1," retune oscillator plate tuning control (switch on position "1") as follows:

Loosen lock nut on tuning control until it exerts a slight pressure on cam.

Press control box button preceding the button for channel to be retuned.

Press button for channel to be retuned.

Adjust tuning control for a maximum reading.

Press channel release button.

Tighten lock nut on tuning control as tight as possible with fingers.

Press channel release button and check reading.

If decreased reading is found on position "2" or position "3," retune 1st or 2nd harmonic amplifier plate tuning control as directed under procedure above for retuning oscillator plate tuning control.

After all channels have been properly tuned, switch set 10 or 12 times through all channels, then check meter readings on switch position "3" for each channel. If any change is found, locate it and retune adjustment that has slipped, and tighten it securely.

When tune-up is completed, turn control shafts of "AUDIO" control and "RELAY" control completely counterclockwise.

With set turned "ON" and "T-R-REM" switch of control box in "R" position, listen to set determining if dynamotor noise is excessive. If in doubt, check dynamotor against one known to be quiet. When dynamotor test is completed, reset both "AUDIO" and "RELAY" controls as previously directed. Have airplane's engine or engines started, determining if excessive noise is being caused by any engine. Make several contacts with other airplanes or control towers on as many channels as possible.

Secure rack lids.

Much time can be saved and trouble averted by keeping a daily record of meter readings of Test Set I-139-A when plugged into transmitter meter socket with "METER SWITCH" on position "3." The daily record will be entered on a service log record sheet as directed by T.O. No. 08-10-105. Mistuned circuits, antennas or dynamotor defects, or failure of transmitter tubes or parts, are all reflected in this reading. Since all bands are detuned on any control on which the lock nut has loosened, a reading for lowest frequency channel will suffice. A clear picture of the operation of set will be presented by such readings when recorded in this manner. With switch on position "3," record daily meter readings for lowest frequency channel. Allow a 2-minute warm-up period. Compare daily readings to detect any change indicating present or impending operating defects.

TURN "OFF" RADIO SET.

RADIO COMPASS MN-26Y.

RECEIVER.—Make operating tests which follow, observing:

Note

Airplane should be located at least 200 feet from large electrically conductive objects or buildings. At "REC ANT" position — action of dial light and presence of spare lamp. Proper action of "AUDIO" control. Signal strength of a known station, interphone jack box "INCREASE OUTPUT" control fully clockwise, "CW" switch in both "ON" and "OFF" positions. Accuracy of frequency dial calibration. At "REC LOOP" position—presence of signal on each band. Proper action of azimuth control crank. Proper action of azimuth control light switch. At "COMP" position—signal strength and directional indication of the compass "LEFT-RIGHT" indicator pointer when a known station is tuned in on each band. Check "CW" switch operation both in "ON" and "OFF" positions. Return switch to "REC ANT" position, tune in signal, and leave "AUDIO" control fully clockwise for further tests of other equipment.

Test all tubes on tube checker. Replace tubes found defective and reinstall good tubes in identical sockets from which they were removed. Make certain they are firmly seated in their respective sockets and that all grid clips and cap shields are pushed down tightly and not shorting.

Check the mounting base screws and fasteners which hold the radio compass unit to the mounting. Be certain the ground strap is secured under the ground post.

Be sure that the antenna lead-in is secured.

Check tightness of plugs and ferrule couplings of plugs.

Using a head set, check loop antenna operation on all three bands, then check compass operation and "LEFT-RIGHT" indicator response. Jar the radio compass unit to check for possible sources of noise.

Switch the complete equipment "ON" and "OFF" to see whether or not the magnetic compass is affected.

Check for effects of other radio equipment in the airplane upon the communicational and navigational performance of the radio compass. Also determine the extent of interference, if any, produced by the radio compass in the other radio equipment.

Tune the radio compass to a transmitting station and operate on the "COMP," "REC ANT," and "REC LOOP" positions. Observe the compass indicator to be sure it is functioning properly, and check aural reception.

Check for freedom of rotation of azimuth control unit, indicator, and loop.

Switch to "COMP" position and tune in a station to the left of the airplane heading. Compass "LEFT-RIGHT" indicator needle should deflect to the left.

Tune in station to the right and needle should deflect to right.

With the "AUDIO" control fully clockwise, tune through each band with the engines stopped and note the noise level. Repeat the test with the engines running at various speeds. If any appreciable increase in noise is noted with the engines running at any speed, the aircraft shielding and bonding, or the battery circuit filtering must be improved.

Switch to "CW" and tune "CW" signals from several stations. Each station should give a strong 800-cycle audio signal when tuned in.

Tune the radio compass unit throughout its frequency range to ascertain that the sensitivity is satisfactory at all points, on all bands; it may be necessary to tolerate a somewhat higher noise level on the lower frequencies in order to obtain proper sensitivity of the higher frequencies. If the loop gain or threshold sensitivity need adjusting, take the receiver to a signal repair shop for adjustment. TURN "OFF" RADIO COMPASS.

COMPASS DYNAMOTOR.—Make inspection as directed under 100-Hour Inspection of Dynamotors for Radio Set SCR-274-N.

RADIO FILTER FL-8-A.—With proper receiver operating, test for rejection of radio range code signals on "VOICE" position, voice signals on "RANGE" position and for presence of both radio range code and voice signals on "BOTH" position. Test for presence of intermittent contacts when filter switch box and associated plugs and cordage are subjected to jarring.

HEAD SETS AND MICROPHONES.

Check head set and microphone cords for intermittent contacts and for corrosion and oxidation of plug contacts and condition of cord-holding clips.

Test operation of all "push-to-talk" buttons.

Check head set receivers, if weak, by suspending diaphragm on edge from pole piece of receiver for magnetic strength (good receivers will hold diaphragm). If weak, replace head set and have old one repaired at signal repair depot.

Replace headband if badly worn.

Check both receivers to see that they have the same output level.

Replace head set adapter (when installed) if plug and jack are badly worn. Replace plugs or jacks on head set and disconnector cords if the outer casing is badly worn or broken. Check linen cord and shellac.

Check rubber phone cushions to see that inner surface is not broken; if surface is broken, replace cushion as perspiration etc., will cause chafing.

ENGINE

Preflight and Daily Inspections

See that all cowling is properly fastened and that all inspection doors are secured.

Engine warm-up test periods should not exceed the limits specified in Section IV, paragraph 6. Do not run engines at high speeds with control surfaces locked. Refer to T.O. No. 01-1-29, "Ground Operation of Aircraft Engines."

Inspect for evidence of engines throwing oil.

Inspect for proper safetying of all drain plugs, covers, etc.

Inspect engine cowling for security of attachment.

If the locked indication marking is missing or indistinct, paint a 1/8" wide red line 2" long across the head of the anti-drag ring fastener operating bolts extending onto the skin on each side. Paint this line when the locking bolts are in the locked position.

Cowling must not be excessively tight when engine is cold.

Check engine mount for general condition and security of attachment.

Inspect security of mounting of carburetor air scoops.

Check exhaust stacks and clamps for excessive burning, general condition, and security of attachment.

Check intake pipes for security of attachment and leaking gaskets.

Inspect carburetor and fuel line connections for fuel leakage, paying particular attention to drain plugs, and passage plugs.

Inspect throttle and mixture controls for proper functioning, operating range, tightness, safetying and general condition.

Inspect carburetor air and engine blower controls for proper functioning, operating range, tightness and general condition of cables and Simmonds-Corsey push-pull units.

25-30 Hour Inspections

Inspect engine cowl flaps for operation, cracks or other damage, proper alignment, and security of mounting. Check individual cowl flap gear boxes and flexible shaft for wear. Check cylinders for damaged or broken fins.

Inspect entire engine control installation from levers in pilot's compartment through all rods and cables, linkage, support brackets and pulleys. Inspect for full and free movement, lost motion, bent rods, frayed cables, loose, broken, or misaligned pulleys. See that all levers are adjusted to prevent creeping.

Check spark plug elbow terminal and shielding nuts for security.

Check carburetor attachment bolts and air scoop nuts for tightness. Remove and clean fuel strainer. Fuel strainer can be removed without disconnecting fuel supply line.

On newly installed engines, perform 25-hour after engine change inspection, if due.

Check intake pipe packing nuts at the first 25-30 hour inspection period following engine overhaul and tighten if evidence of leakage is found.

Note

No further tightening to eliminate leakage will be accomplished at subsequent inspections. If leakage in the induction system is found at later inspections, the defective packing will be replaced with new packing.

Inspect all oil lines for leaks, particularly at connections; security of anchorage, wear, dents, or cracks. Oil screens will be removed and cleaned at each 25-hour inspection or more often if necessary. When oil screens are removed for cleaning, the inside of the sediment chamber also will be cleaned thoroughly.

50-60 Hour Inspections

IGNITION AND ELECTRICAL.—Check magneto for security of mounting. Check adjustment of each set of magneto contact points as outlined in Section IV, paragraph 15.

Press plunger type magneto cam oiler once at each 50-hour inspection. Never push in the plunger when the engine or magneto is being operated as too much oil will collect on the cam.

Inspect ignition shielding for proper anchorage and security of union nuts. This type of ignition shielding incorporates braided conduits covering the spark plug lead wires. These conduits are detachable and will be replaced if worn or broken.

Note

Whenever it is necessary to resolder any part of the ignition manifold assembly, use only solder, Specification 57-99-1 (lead and silver rod, 1/8 inch diameter). Apply solder with a properly heated soldering iron. Exercise extreme care to avoid burning ignition cable insulation. Whenever possible, the ignition cable will be withdrawn from the parts to be soldered.

Lubricate mixture control latch mechanism, using grease, Specification VV-G-681-medium. Lubricate throttle shaft bushings, using machine gun oil, Specification 2-27.

Since a hopper type oil tank is installed in the airplane, oil will be drained only at engine change, except when failure of an engine part makes it advisable to change oil before that time. Draining should be done while the oil is hot. Remove and clean all removable oil screens at oil change.

Inspect complete induction system for security of attachment, leaking gaskets, broken studs, and leaks in the pipes. Make sure that the carburetor air scoops are fastened securely. Be certain that the push rod tubes are tight and that packing nuts are properly safetied. The push rod cover packing nuts should be snug, but not excessively tight.

Inspect cylinders for general condition.

Check starter hand crank bracket and attachments for security.

Check Simmonds-Corsey push-pull controls for axial play in the linkage by disconnecting both sliding rods from their adjacent members. Next unscrew the sliding rod from the end of the control marked "F" (fixed) and pull on the adjustable end marked "A" (adjustable). Never attempt to withdraw a linkage by pulling on the fixed end as the inspection tubelet and locking barrel will become locked in one of the bends. Short linkages may be completely withdrawn at inspection, but when end play only is being checked long linkages need not be completely removed. The adjustment of the linkage is satisfactory if there is no end play between the olives and tubelets. When desirable, however, the cable may be inspected by removing the entire linkage from the casing tube and the locking barrel altogether from the terminal. The inspection tubelet may now be moved back over the terminal and each olive and tubelet in turn moved along the cable until it has been examined throughout its whole length.

Note

After the first 50-hour inspection, the Simmonds-Corsey controls must be checked semi-annually for freedom from axial play.

100-120 Hour Inspections

Replace all spark plugs with new or reconditioned plugs of approved type.

Remove top cover fastening nut and top cover of the induction vibrator. Inspect top cover gasket. If worn, or badly compressed, replace with new gasket and shellac gasket to the top cover.

Inspect "IGN.SW." outlet terminal assemblies for firm contacting against the terminal strips within the unit. If the contact is poor, trip the lock spring on the slotted outlet nut and tighten the slotted nut until a firm contact is made. The lock spring must be in position and secure after this operation.

Check tightness of terminal clip fastening screw on "+" cable attachment.

Inspect mounting bolts and nuts for tightness.

Check the cowling flap gear boxes for sufficient lubrication. Add approved low temperature grease as required.

SPECIAL.

The valve operating mechanism is lubricated automatically. The valve mechanism of these engines will be inspected and adjusted in accordance with the following instructions and periods:

Prior to Initial Operation.—Fill upper rocker boxes with engine oil of Grade 1120, Spec. AN-VV-O-446A.

Block Test.—A complete detailed inspection and adjustment of the valve mechansim will be made at repair depots after the engine has completed the block test run. No further inspection or adjustment of the valve mechanism is needed until the next overhaul period.

In making the inspections described above, the following additional instructions will be observed:

Check for broken springs.

Check condition of rocker box cover gaskets. Special care is necessary to avoid damaging the gaskets when replacing rocker box covers. Slightly damaged gaskets will cause leakage of oil. Permatex may be used to seal defective gaskets, if new gaskets are unavailable. Rocker arms should operate freely. Rockers will be removed and bearings inspected if any binding, restricted movement, or excessive side play is found.

INSTRUMENTS

Preflight and Daily

Before starting the engines, inspect all instruments for the following conditions:

Zero or correct position of pointers and cards.

Loose or broken cover glasses.

Cleanliness.

Security of mounting.

Security of line connections.

Security of electrical connections.

Chipped luminous markings.

Proper operation of fluorescent lamps.

After starting the engines, inspect the engine instruments for the following conditions:

Proper functioning.

Readings consistent with the stage of engine warm-up.

Excessive oscillation of pointers.

Make the following inspections of individual instruments and related equipment:

ALTIMETER.—Check the altimeter setting knob for free and easy turning and see that all pointers, reference markers, and the barometric scale move when the setting knob is turned.

AIRSPEED INDICATOR.—Inspect the pointer for excessive error at zero. Tap the instrument panel lightly and observe the effects of friction on the pointer movement.

RATE OF CLIMB INDICATOR.—Inspect the pointer for zero setting. Tap the panel to insure that the pointer is not affected by friction in the shaft.

PITOT-STATIC TUBE.—Inspect for proper operation of the pitot-static tube heater, after removing cover. Check openings for freedom from obstructions.

GYRO HORIZON (FLIGHT) INDICATOR.—Inspect the caging mechanism, controller, and shaft for freedom of operation. If necessary, lubricate the external part of the shaft with instrument oil.

DIRECTIONAL GYRO (TURN) INDICATOR.—Inspect the caging mechanism, controller, and shaft for freedom of operation. If necessary, lubricate the external part of the shaft with instrument oil.

MANIFOLD PRESSURE GAGE.—Check the functioning of the gage and, if practicable, compare the reading with that of a standard barometer. With engine operating at idling speed, drain moisture from the instrument line by turning on the valve control for a 30-second period. The control is located on the instrument panel just above the gage.

LANDING GEAR AND FLAP POSITION INDICATOR.—With the electrical power on, make certain that the pointers show the main and nose wheels to be in locked down position. Operate the flaps to ascertain that their movement is properly represented on the indicator. When the ignition is turned off, note that the indicator shows the "OFF" position.

FUEL LEVEL GAGES.—Inspect the gages for proper representation of the amount of fuel known to be in the tanks.

REMOTE MAGNETIC COMPASS INDICATOR.—With the electrical power on, turn the airplane through 360 degrees and note whether the indicator follows the transmitter on all headings.

CLOCK.—Wind the clock, check it for proper operation, and set it to the operations' office time.

50-60 Hour Inspections

INSTRUMENT PANEL.—Inspect the panel for cracks. Check the Lord vibration absorbers for cracks or wear.

PITOT-STATIC TUBE.—Inspect tube for proper alignment on the vertical stabilizer, freedom from obstructions, and proper operation of the heating unit. Clean pitot-static tube openings with soft copper wire.

PITOT-STATIC LINES.—Drain moisture from lines.

AIR FILTER.—Clean or replace the filter screens and elements.

BANK AND TURN INDICATOR.—Inspect the indicator for discolored liquid and free action of the ball.

MANIFOLD PRESSURE GAGE.—Check the gage reading with that of the station barometer or altimeter. Variation should not exceed 0.4 inches of mercury.

CYLINDER HEAD TEMPERATURE INDICATOR.—Inspect the indicator for accuracy of reading by opening the circuit, which will cause the instrument to indicate the temperature of the pilot's compartment only. Compare reading with another thermometer.

LANDING GEAR AND FLAP POSITION INDICATOR.—Check the transmitters for security of mechanical and electrical connections and proper contact tension.

TACHOMETER.—Inspect the generator for security of mounting and tightness of electrical and mechanical connections.

FUEL LEVEL GAGES.—Check the indications of the gages with the known content gasoline in the containers. Inspect the transmitters for proper and free operation of the floats.

REMOTE MAGNETIC COMPASS INDICATOR.—Inspect the indicator and the transmitter for security of mounting and check the transmitter for leakage of compass fluid. Disconnect the units and check the wiring for continuity with an ohmmeter.

100-120 Hour Inspection

VACUUM PUMP.—Inspect the vacuum pump for security of mounting on the engine.

SUCTION RELIEF VALVE.—Examine the valve screen and if it is dirty, remove the valve and loosen the screen assembly with a wrench. Clean the screen in clear gasoline and replace.

REMOTE MAGNETIC COMPASS INDICATOR AND TRANSMITTER.—Compensate the compass assembly and record the readings on AF Form No. 57 at the end of each 100 hours of flying time, at each change of engines, guns, armor plate or electrical equipment likely to affect the compass, or at least once during each three month period.

BANK AND TURN INDICATOR.—Remove the plug under the word "OIL" on the right side of the case and put approximately eight drops of gyro oil in the hole in the motor shaft. Oil should be put in slowly so that each drop is entirely absorbed by the wick before the next drop is applied. The gyro should not be running during the lubrication process.

500 Hour Inspection

REMOTE COMPASS INVERTER.—Remove the inverter from the airplane and make the following inspections and repairs:

Clean all wiring connections and repair any which are not in good condition.

Unscrew the brush caps and remove the brush assemblies. Mark the brushes so that they will be positioned properly and in their respective brush guide when reassembled. Check the brush spring tension. Replace the brushes with new ones if the spring tension is less than approximately two ounces when compressed to a length of 15/32 of an inch.

Clean the brushes with a gasoline dampened cloth. If the brushes are less than 5/32 of an inch in length, they shall be removed and replaced. To seat a new brush properly, insert a strip of No. 00 sandpaper, 3/8 of an inch wide, between the brush and the commutator with the sanded side toward the brush; then pull in the direction of the rotation of the commutator until the brush is fully seated. Then remove the sand and carbon particles with a jet of dry, clean air. Do not use emery cloth on either the brushes or the commutator since the emery dust will become embedded in the commutator and cause excessive sparking and wear.

1000 Hour Inspection

REMOTE COMPASS INVERTER.—After every 1000 flying hours, remove the inverter from the airplane for major overhaul and install a new inverter.

ELECTRICAL SYSTEM

Preflight and Daily Inspections

Check the generator for security of mounting.

With the generator switch "ON" and the engine running at cruising speed, note if the ammeter indicates a "charge."

Check operation of engines on each ignition switch with "L" and "R" positions. The loss in rpm when the engine is operating on one bank of spark plugs should not exceed 100 rpm.

Test ignition system as follows: With the engines not excessively hot and operating at approximately 1/3 open throttle, turn the ignition switches momentarily to the "OFF" position. If the engine does not stop firing entirely, stop the engine by turning off the fuel supply and check for defective "ground" connections.

WARNING

Do not touch the propeller until the engine has cooled and the defect located and corrected, as the engine may "kick over" and start.

Inspect the brushes of both generators after each flight, if one hour or more of the flight was at an altitude of 35,000 feet or higher. Replace brushes worn to prescribed limits.

Remove shield assembly and inspect voltage regulators for fine particles of dust and dirt. Be careful not to disturb contact fingers or adjustment of regulator.

Check specific gravity and electrolyte level of both batteries as described in Section IV, paragraph 15.

Inspect the starter for cracked housing and mounting flanges, security of mounting, tightness of housing bolts, and safety wiring of all connecting bolts. Replace the starter if crack appears in the housing or flanges.

Open the bomb bay doors and check bomb bay door safety switch for "ON" position; close bomb bay doors and check switch for "OFF" position. If a bomb bay door hydraulic selector valve latch solenoid and warning lamps are installed, check operation with bomb bay switches "ON" and "OFF."

Check operation of lamps. Replace defective bulbs.

Check operation of landing gear warning lamps by operating the test switch on the main electrical control panel.

Check operation of alarm bell by closing pilot's switch.

Check operation of suit heat rheostat with suit plugged in.

Check static wire for proper ground contact.

Inspect starters, switches, coils, solenoids, and magnetos for cracked housings or flanges, security of mounting, tightness of housing bolts, safetying, and obvious defects.

25-30 Hour Inspections

Make the following inspections on each generator, after covering the ventilating openings temporarily to prevent any bolts, nuts, or other foreign matter from entering the generator:

Make sure mounting bolts are tight and in place.

Make sure all external connections are secure and in good condition.

Remove dust, oil, or carbon dust from the exterior of the generator.

Loosen generator cover band and inspect inside of generator (especially commutator) for dust, oil, or other foreign matter. Oil on the commutator may cause excessive grooving of the commutator surface.

Inspect brushes for tight connections and wear. Replace brushes if their wearing length (distance from face of brush to shoulder on brush is less than 3/16 inch.

Inspect the commutator to see that it is smooth and that there is not an excess of carbon dust inside the generator. If the commutator is rough or glazed, it must be smoothed.

Check both batteries as follows:

Check specific gravity of all cells.

Check terminals. Remove corrosion by brushing with a stiff (not wire) brush. Then wash with sodium bicarbonate and water (1 lb. per gallon) to neutralize any elecrolyte remaining on metal surfaces. Rinse with water. After drying, apply thin coat of terminal grease or vaseline to metal terminals.

Check condition of battery mounting. Check mounting bolts for security. If evidence of leakage of acid due to broken case, defective sealing, or terminal leakage is found, the battery must be replaced.

Inspect condition of felt pads in vent jar. If dry, resaturate with concentrated solution of sodium bicarbonate and water. Use only enough solution to saturate the pads as the excess solution would flow into the vent lines.

Check vent and drain tubes for pockets and obstructions.

Inspect the fuel booster pumps for proper operation, leaks, security of mounting, fuel line, and electrical connections.

Inspect the brushes of the recirculating heater motor for wear or looseness. Replace brushes worn to approximately 1/16 inch from the brush holder.

50-60 Hour Inspections

Inspect the safetied generator cable connector nuts. If the tape has unraveled or become damaged, remove old tape and resafety the connector nuts as described in section IV, paragraph 15.

Check voltage regulator for security of mounting and condition of wiring. Check contact points for pitting and signs of excessive arcing. Check coils for signs of overheating. Turn generator switch off and examine armature for free and unrestricted movement.

Check the reverse current relay as follows:

Check for security of mounting and condition of wiring.

Check contact points for pitting and signs of excessive arcing.

Check resistor for signs of overheating.

Check starters as follows:

Remove the motor brush strap and check for worn or binding brushes and improper brush spring tension. Binding brushes and brush holders should be wiped clean with a gasoline-moistened cloth. Weak brush springs should be replaced. Brushes should be replaced if they are worn to within 3/32 inch from the brush holder.

Check the solenoid switch meshing device for security of mounting, cleanliness and tightness of leads and terminals. If operating troubles are experienced with this device, clean and tighten terminals and terminal leads; however, if the solenoid is found to be inoperative, it should be replaced.

Starters and starter motors are properly lubricated at the factory and repair depots. No lubrication is required by service personnel except that the hand crank extension support bearing should be oiled every 50 hours with engine oil, Specification AN-VV-O-446.

Check propeller feathering switch for improper contacting or binding of shaft.

Check all switches and rheostats for loose connections; replace faulty switches.

Check all relays for proper contacting; clean out contacts.

Check solenoid switches for security of mounting, and of all electrical connections.

Inspect the distributors for proper condition and functioning.

Inspect all electrical connections and leads for security of ground connections, anchorage of lines, tightness of connections, condition of insulation, safetying and security of Cannon type plugs.

Inspect the battery terminals, clean and coat with vaseline if necessary. Inspect the battery box for leaks and corrosion. Check drain for cleanliness, corrosion and security of attachment.

100-120 Hour Inspection

Check brushes of fuel booster pumps for excessive wear. Brushes tend to wear more rapidly at high altitudes, so it may be necessary to shorten the time between inspection periods on pumps installed in aircraft continually operating under this condition.

Disassemble the recirculating heater fuel shut-off valves and clean out any dirt and foreign matter.

200-240 Hour or 30-Day Inspections

Remove batteries for tests and charging, according to instructions outlined in section IV, paragraph 15.

250-Hour and Subsequent Inspections

This inspection involves overhaul procedure.

Replace the voltage regulator and completely overhaul at least every 1000 hours of operation.
Replace the reverse current relays and completely overhaul at least every 1000 hours of operation.

500 Hour Inspections

Inspect all electrical equipment and junction boxes to insure that connector panels, plugs, wiring, and other electrical items are securely anchored.

Remove battery disconnect relays and send to service depot for overhaul.

Remove the bearings of the recirculating heater motor. Clean and repack the bearing with AN-G-3 grease.

Remove the brushes of the cowl flap electrical drive motor and inspect for wear. Replace brushes if worn to within 1/16 inch of brush holder.

FUEL SYSTEM

Preflight and Daily Inspections

Check quantities of fuel in tanks and enter on Form No. 1A. This check and entry must be made prior to the first flight of the day.

Drain condensed moisture from fuel tank sumps. Be sure drain cocks are resafetied. Inspect entire fuel tank installation for evidence of leaks.

Turn fuel selector valves one complete revolution to determine that they turn freely. If binding exists, the control linkage will be checked for misalignment.

Be sure fuel container caps are secure.

Check engine primer solenoid valves for leaks when in the "OFF" position.

During engine warm-up, test functioning of engines on all fuel containers, obtaining a fuel pressure of 17 ± 1 psi. Observe changes in reading of the fuel level gages, check operation of the fuel booster pumps. Fuel tanks will be serviced to the normal supply after day's flying is completed and quantities entered on Form No. 1A.

Inspect fuel tanks for leaks. Drain fuel strainers and tank sumps.

25 Hour Inspections

Inspect the engine-driven fuel pump for security of mounting, leaks and proper operation.

Inspect the fuel selector valves for security of mounting, condition and security of control cables, and evidence of leakage around the fuel hose connections. If in turning the control handles in the pilot's compartment, the valve binds, investigate the manual controls as well as the valve.

With fuel "ON" and pressure built up, inspect the fuel lines and connections for leaks, cracks, security of anchorage, chafing, tightness and condition of hose connections and clamps. Inspect the overflow or drain lines for kinks, breaks, or stoppage.

Note

During inspection, the selector valve should be set in each selected container position and cross-feed valve "CROSS-FEED" position so that pressure will be in all lines.

Inspect the engine primer solenoid valves for security of mounting.

Inspect the fuel booster pump for security of anchorage and evidence of leakage at line connections.

Check the fuel container for evidence of leaks and drain any sediment from container.

Remove and clean fuel strainers, inspect for breaks and tears. Clean strainer bodies. Replace screens, plugs, and drain and resafety.

50 Hour Inspections

Check the engine primer solenoid valves for loose fuel or electrical connections.

Annual Inspections

Disassemble the engine primer solenoid valve and inspect it for corrosion of the insulating tube or plate.

Check the ball of the plunger assembly for wear and determine if the valve seat is loose or worn. Replace worn or defective parts.

At the end of each 12 months of service, inspect thoroughly the interior of all self-sealing fuel cells for any indication of improper installation, internal or external diffusion of gasoline, ruptured fittings, collapsing of cells or mechanical injury due to bullets or fragments. This will be accomplished through inspection openings, or if necessary, by actual removal of the cell from the airplane. If evidence of deterioration is found, each cell so affected will be repaired or replaced.

OIL SYSTEM

Preflight and Daily Inspections

Check the quantity of oil in the containers and enter on Form 1A. Oil should be indicated on the "N" (normal level) mark of the oil gage measuring stick.

Be certain oil pressure registers on the oil pressure gage after the engines are started.

Check the operation of the oil cooler doors. Place the control switch in the pilot's compartment in the "OPEN" position and then in the "CLOSE" position and note the travel of the oil cooler door. Make certain the door is not open more than 3/8 inch in the extreme closed position.

Inspect the oil containers for leaks, tightness of the filler cap and security of the drain cocks. Drain condensed moisture from the oil container sumps and the oil coolers. Check all oil system drain cocks for leaks.

Examine the stress panels beneath the oil coolers for evidence of oil leakage. Check the oil cooler air ducts forward and aft of the oil coolers for damage.

Make the following inspections of the oil temperature regulator installation:

Use a flashlight and examine the core in the oil cooler tubes for obstructions to the air flow and make certain that the face of the core does not indicate leakage of oil. Check for oil leakage where the core sections are soldered to the shell and to the baffles. Check for collapsed tubes in the core by looking through the core from the forward side of the cooler.

Check the oil coolers for security of mounting and for evidence of damage to the oil cooler external jackets.

Check the aft oil cooler ducts for oil splatter which would result from damaged tubes.

Start the engines and inspect all readily accessible oil lines for oil leaks, particularly at connections and sharp bends. Check for cracks, particularly at sharp bends, and for security of line anchorage. Check for wear by chafing or vibration, and investigate any cutting into the lines by clamps, screws, bolts, etc. Inspect the tank overflow lines for kinks, breaks, or stoppage.

Oil tanks will be serviced to the normal supply after day's flying is completed and quantities entered on Form 1A.

Special 5 Hour Inspection

At the end of the first five flying hours of a newly installed new or overhauled engine, the oil should be changed.

25-30 Hour Inspections

Inspect the oil lines for leaks, security attachment, dents, cracks, chafing, etc. Check hose connections and hose clamps for general condition and for proper location of clamps.

Inspect the oil coolers for security of mounting and general condition.

Inspect the oil tanks for dents and cracks for security of mounting. Make certain that all oil and vent line connections are secure.

50-60 Hour Inspections

Examine the oil tank sump body for cracks at flanges and line connections.

Check the oil cooler and core relief and surge protection valve assembly for oil leaks at the base of the valve assembly. Check tightness of attaching screws. Replace all leaking gaskets. Make certain that the large bolts that attach the air cooler to the support brackets are tight and that the cables that clamp the sealing strips forward and aft of the coolers are properly tensioned.

Inspect the oil cooler door electrical drive unit for damage and security of mounting. Check the security of electrical connections and inspect wiring for abrasions. Check for grease leakage around the gear box.

Inspect the oil dilution solenoid valve for security of mounting and the security of fuel or electrical connections. Be sure the valve is not cracked or damaged.

Inspect the oil lines directly forward of the oil cooler for leaks, cracks, or evidence of wear. Be sure that the hose connections at the core relief and surge protection valve are tight.

500 Hour Inspections

Replace the oil cooler valve assembly gaskets with new ones.

Replace the limit switches in the oil cooler door drive unit.

Remove and inspect the oil cooler door drive unit micarta follow-up cam, and replace it if it has been worn more than .015 inch.

To prevent contamination of the oil system with dirt, metal particles, and other foreign material, drain, and thoroughly flush and clean the oil lines and oil container as follows:

Disconnect the oil lines and remove the hose connections.

Inspect the lines for any trapped debris, and thoroughly flush and clean the system with kerosene.

WARNING

> When using kerosene, precautions against fire hazard must be observed at all times.

Make certain that all sludge and metal particles are removed from the bottom of the container by removing the oil container sump drain cock before pouring the kerosene into the container from the top.

Remove the oil cooler and clean it at each engine change or prior to making any solder repairs. Both the cooler and the core relief and surge protection valve should be cleaned IMMEDIATELY after removal from the airplane. Otherwise the oil sludge hardens and becomes more difficult to dissolve and remove. In the event of an engine change resulting from an internal engine failure that releases metal particles into the oil system, the cooler is dangerous to future engine operation, and should be removed, marked "Removed Because of Engine Failure," and forwarded to a major overhaul station for storage pending a repair investigation. If the cooler is ready for cleaning, and there is no cleaning machine available, the simplest method to use is as follows:

Remove the core relief and surge protection valve assembly from the cooler.

Fill the oil cooler three-quarters full of carbon tetrachloride, and close all of the openings.

Shake and rotate the cooler violently for four minutes, and then allow the cleaner to drain out.

Perform the preceding operation several times, using a fresh cleaning solution each time.

After cleaning the cooler thoroughly, drain it and blow compressed air through it for not less than 15 minutes to dry it for testing.

Test the cooler for leakage by submerging in water and applying an air pressure of 100 psi; watch for bubbles.

Remove the core relief and surge protection valve assembly from the cooler.

Wash the valve assembly thoroughly, inside and out, by submerging it in a solution of carbon tetrachloride. Rotate it in the solution until it is thoroughly cleaned.

Replace the vellumoid gaskets with new ones. The core relief and surge protection valve assembly should always be cleaned separately from the cooler. Extreme care should be taken to prevent dirt or grit entering the valve assembly after cleaning. Tape the opening until the assembly is reinstalled.

Inspection at Each Fourth Engine Change

Remove and clean the oil container with kerosene or steam (if available).

CAUTION

> When using kerosene in the cleaning operation, precautions against fire should be observed at all times. Also, if using steam, make certain that the steam is not too hot, and that it is not used continuously for too long a period of time. If care is not used, serious damage to self-sealing liner may result.

Disassemble the oil dilution solenoid valve and inspect for corrosion of the insulating tube or plate. Check the ball of the plunger assembly for wear, and determine whether or not the hardened valve seat is loose or worn. Replace such parts as necessary.

PROPELLER AND PROPELLER CONTROLS

Preflight and Daily Inspections

Check the operation of propeller and controls, taking care not to exceed the ground operating limits for the engine. Do not operate in the full decrease rpm position any longer than necessary to check operation.

With the propeller control set for 1400 rpm, and sufficient manifold pressure to just maintain this speed, depress the feathering switch and note that the engine speed drops. Pull out the switch to release before reaching 1200 rpm.

Check the governors for oil leaks around bases and heads. Check governor controls for lost motion.

Inspect the propeller for bent or damaged blades, nicks, cracks, oil leakage, or other defects.

If propeller vibration is noted or reported, check the blade angle setting. If necessary, check the track of each blade.

At the end of the day's flying, clean and inspect propellers. Coat propellers with clean engine oil.

50-60 Hour Inspections

Carefully examine the exterior of all parts of the propellers for cracks, bent blades, nicks and other damage. The entire leading edge, trailing edge, and tip of each propeller must be checked carefully for development of cracks. Use a magnifying glass and, when the condition of the blades warrants, perform local etching.

Check for deterioration of markings on the propeller blades and hubs.

Inspect the governors for oil leakage and for security of mounting. Check control system for security of attachment, freedom of movement, proper safetying of nuts, clevis pins, etc. Check for loose or worn bearings.

Check condition and operation of propeller controls in the pilot's compartment.

Check the hydraulic feathering pump and electric motor assembly for security of mounting nuts and tube connections. Examine for any indication of leakage around the pump ports. Check for leaks in lines. Inspect the vent plug in the adapter and be sure that it is clean and free from dirt.

Feather and unfeather the propellers with the engine stopped and engine sump drain plug removed.

100-120 Hour Inspections

Check the hydraulic feathering pump motor for condition of the brushes. If the brushes are worn excessively, new brushes will be installed. Clean and tighten all electrical connections.

Remove the dome assembly, and partially disassemble by removing the stops and the dome shell from the cam assembly. The piston and cams will not be disassembled. The piston, cams and inside of the dome will be washed in unleaded gasoline to remove carbon and sludge deposits. The dome assembly will then be reassembled and reinstalled on the propeller.

200-240 Hour Inspections

Check propeller retaining nut for tightness. Make each check with the proper wrench and see that each is tightened as required and properly safetied. If repeated tightening of propeller hub nuts is necessary to maintain the proper tightness, the propeller must be removed and the cause of the loosened nuts determined.

Engine Change Inspection

Check the propeller operating time since last overhaul. If the total time since the last overhaul, plus the maximum possible operating time for the replacement engine, totals over 1750 hours, the propeller will be overhauled.

If the propeller is removed for overhaul, remove, and forward the governor for overhaul.

Special

Examine the propeller carefully if struck by an object. Any propeller involved in an accident must be disassembled and the parts inspected carefully for damage and misalignment. If, for any reason, the propeller is removed from the shaft prior to the required overhaul inspection, the propeller hub cone seats, cones, and other attachment parts must be inspected for galling, wear, bottoming, proper fit, etc. All defects must be corrected before the propeller is reinstalled.

FUSELAGE

Preflight and Daily Inspections

Clean compartments (including windows). All articles that could foul or jam controls will be properly attached, stowed, or removed.

See that all inspection doors and covers are secure.

Check for dents, deep scratches, cracks, and bulges in the fuselage skin.

Inspect enclosures, doors, emergency exits for general condition, security and functioning.

If over-water flights are contemplated, see that the life raft is in place. Refer to T.O. No. 04-15-1 for complete information.

Check fire extinguishers for contents, security of mounting bracket, nozzle opening unobstructed, tag intact, security in bracket yet easily removable. Defective fire extinguishers should be replaced.

Check for presence of hand starter crank in the right nacelle.

25-30 Hour Inspections

Inspect the fuselage for general condition, corrosion, loose bolts or rivets, bent or cracked longerons and braces. Check security of inspection doors.

Check the windshield and sliding enclosures for condition of frame and security of attachment; breaks or cracks in glass or transparent sheets; condition and operation of mechanism on sliding and lifting enclosures.

Check condition and operation of releasing mechanism of all emergency exits.

Inspect fabric and leather parts of safety belts for cuts or fraying, latching devices for condition and operation; fittings and attaching parts for condition and security of fastening. Check for date of last weight test. The type B-11 safety belts are to be tested annually.

Inspect the seats for security of attachment (including supports and brackets); condition and functioning of adjusting mechanism; breaks or cracks in the seats which could foul parachute or clothing.

If seal has been broken, inspect the first-aid kit to determine items required for replacements. Required items will be obtained by requisition from the local medical department. Refer to T.O. 01-1-117.

MOVABLE SURFACES AND SURFACE CONTROLS

Preflight and Daily Inspections

Make certain that the control lock lever is in the "UNLOCKED" position.

Check all controls for full travel and free movement.

Check all controls, including the locking mechanism, for lost motion throughout the system. If necessary, adjust cable tension in accordance with the cable tension chart in Section IV, paragraph 3.

Check the alignment of all movable surfaces when the controls are in the neutral position.

Inspect for cleanliness of all working parts.

Inspect controls for interference with other assemblies or structure.

Check for binding or chattering in the gear boxes during operation of the flaps, and for excessive play in wing flap actuating screws.

Inspect all the movable surfaces for breaks, tears, distortion or other damage.

Inspect all cover plates for security of attachment.

Inspect all cables, rods, and attachment fittings for security and proper safetying.

25-30 Hour Inspections

Inspect all cables at the drum assemblies for security of attachment.

Inspect the rudder pedal mechanism for proper functioning and cleanliness.

Check the movable surfaces for strain at hinge points. This may be indicated by the misalignment, bending, or cracking of hinge assemblies, eye bolts, pulleys, bell cranks and push-pull rods.

Check the alclad sheeting on the vertical and horizontal stabilizers, elevators, wing flaps, and deflectors for cracks, dents, abrasions, and for sheared, loose or cracked rivets.

Inspect the aileron fabric for tears and loose fastenings.

Inspect the rubberized fabric gap seals for general condition and security of attachment.

50-60 Hour Inspections

Inspect the tab control mechanisms in the ailerons and elevators for looseness or wear in the drums and rod assemblies.

Inspect the control support assembly for security of attachment, cracks and breaks.

Inspect the pulleys for wear, especially around the flanges; replace the pulleys if they are worn appreciably.

Inspect the control locks mechanism for proper spring tension and general conditions.

Inspect the turnbuckles and guard pins for safety wiring.

Inspect fair leads for excessive wear and looseness.

Inspect supports and brackets for security of attachment.

Inspect the entire control system for frayed cables. Frayed 7 x 7 cables shall be considered serviceable unless there are more than two broken wires in any one-inch section.

Inspect the wing flap main gear box and motor for damaged areas, security of mounting, loose electrical connections, loose bolts and nuts, and grease leakage around gear box.

Check wing flap relay for proper contacting; clean out contacts.

500 Hour Inspections

Remove the wing flap main gear box motor brushes and check their condition.

WING

Preflight and Daily Inspections

Check all inspection doors to determine that they are secure.

Inspect the entire wing for holes, distortion, pulled rivets, or other damage.

25-30 Hour Inspection

Check the wing for following conditions:

Corrosion around the rib flanges, on the overlapping skin, and on the skin adjacent to the ribs of the trailing section.

Cracks, corrosion, and worn spots on the wing attaching fittings.

Breaks and "canning" in the wing skin near the ends of the main spars.

Cracks and breaks in the wing ribs adjacent to the longitudinal cutouts.

Cracks in the skin adjacent to the aileron hinge brackets. Dents, scratches, and holes in the wing panel and deflectors.

Corrosion of the skin beneath the corrosion-resistant steel sheets on the nacelle adjacent to the exhaust pipes.

50-60 Hour Inspections

Inspect the wing attaching fittings and pins for cracks, shearing, corrosion, security of attachment, and safetying of bolts and nuts.

Inspect the rubberized fabric aileron seal for general condition, security of attachment, and condition of the seal zipper.

EMPENNAGE

(HORIZONTAL AND VERTICAL STABILIZERS)

Preflight and Daily Inspections

Check the horizontal and vertical stabilizers for damage and obvious defects. Check the cover plates for security of attachment.

25-30 Hour Inspections

Inspect the horizontal and vertical stabilizers for cracks, dents, bulges, abrasions, and other damage. Examine for sheared, loose or cracked rivets.

Check for defective elastic stop nuts inside the horizontal and vertical stabilizers.

Inspect the ribs for security of attachment.

Inspect condition of gap seal.

ALIGHTING GEAR

Preflight and Daily Inspections

Visually inspect the shock struts for loss of air pressure as evidenced by abnormal deflation. If the red line on the strut piston tube is less than 1 7/8 inches from the end of the strut packing gland nut, inflate the strut as instructed in Section IV, paragraph 5. Examine the shock struts for evidence of hydraulic fluid leakage.

Check the tires for proper inflation. Tire pressures particularly should be checked frequently when the temperature ranges from normal to extremely hot.

Tire inflation must be sufficient to maintain the rolling radius of the tires. Overinflation will cause excessive stiffness and this condition will be increased when landing because of the reduced weight of the airplane at the end of the flight.

Check the main wheel tires for proper inflation by observing the continuous ring deflection markers molded on each sidewall of the tire. The deflection markers just touch the ground when the airplane is loaded for normal flight conditions.

Check the nose wheel tire for 38 psi (at normal gross weight) with an accurate tire pressure gage. Inflate in accordance with the deflection mark on the tire.

Inspect the complete landing gear for general condition of struts, braces, fittings, and cylinders. Check the shock struts for proper inflation and evidence of hydraulic fluid leakage; tighten the packing gland nut if leakage is discovered.

Check the wheels for distorted rim flanges and ribs, and for security of the retaining nut, bolts, and cotter pins.

Check the tire for wear, breaks, cuts, and bruises or any evidence of chafing with other parts.

Check operation of brakes and parking brake control. There must be sufficient slack in the parking brake control cables to allow full application of brakes without locking parking brake.

When the airplane is operated under slushy, muddy, sandy and dusty conditions, the exposed part of the piston tube of the landing gear shock struts and all hydraulic actuating cylinders will be wiped free of ice, mud, dust or sand by means of a cloth saturated with the same kind of hydraulic fluid used in the mechanism, Specification No. 3580 in the shock struts and AN-VV-O-366 in the hydraulic actuating cylinders. This work will be accomplished before each flight and after each landing to reduce excessive wear and possible failure of packing rings in the shock struts and actuating cylinders. When operating the aircraft during low temperatures, the piston tubes may be cleaned more easily if done after landing.

25-30 Hour Inspections

Inspect the entire landing gear assembly for cracks, bends, corrosion; security and condition of attaching fittings; loose, missing or unsafetied bolts, nuts and cotters, and elongated bolt holes.

Check the fluid level in the shock struts as follows:

Deflate the strut by slightly backing off the filler plug and allowing the air to escape slowly. This prevents the air valve core from being damaged by the sudden rush of air past the valve seat. Remove the filler plug and check the fluid level. It should be flush with the plug hole when the strut is fully compressed and the airplane is in normal taxiing position. If necessary, refill the strut.

CAUTION

Do not remove the filler plug until the strut has been entirely deflated.

Check the tires for wear, breaks, cuts and bruises or any evidence of chafing with other parts. If wear has exposed any part of the fabric carcass, the tire should be replaced.

Inspect the brakes for hydraulic fluid seepage. Do not remove the wheel unless leakage is evident. Inspect brakes for entrapped air (spongy feel to brake action). Bleed brakes if necessary.

50-60 Hour Inspections

Support the airplane on jacks, relieve pressure in the hydraulic system by applying toe pressure to and releasing the rudder-brake pedals until the hydraulic pressure gage indicates zero. Inspect the entire landing gear assembly for wear, cracks, security and condition of attaching fittings, elongated bolt holes, loose or missing bolts, nuts, and cotters. Check condition and functioning of nose wheel snubber.

Test the functioning of the retracting and extending mechanism, using the hydraulic hand pump to supply pressure. Inspect all moving parts for wear. Check the latches and latch rods for proper adjustment.

Test the nacelle doors for correct adjustment and freedom of movement.

Inspect the hydraulic operating mechanism for condition and functioning of selector valve and condition of hydraulic lines.

Inspect the wheel castings for cracks. Check the rims and flanges for corrosion or damage. Inspect paint on the wheels for chipping. Check bearing cups and felt grease retainers.

Remove the tires and examine for ruptures or breaks inside the carcass or along the beads. Check for breaks, cuts, blisters, loose cords, or other serious damage to either the inside or outside of the sidewalls. Check for cuts through the tread that expose the fabric carcass to moisture and dirt. If tire repair is not practicable, a new tire should be installed.

Remove the tire tubes and examine for faulty attachment of valves to tubes. Check valve stem washers for snug fit on tubes with metal valve stems. Inspect the tubes for wrinkles and creases, thin spots, cuts, and punctures. Inspect tubes for chafing on the tire bead or for breaks in the tire casing. If repair of the tubes is not practicable, new tubes should be installed.

Check and adjust clearances of the brake discs with three feeler gages. Adjust the brakes if necessary. Inspect the brake units for proper shape of discs, weak or broken piston return springs, damaged piston seal gaskets, anchor bracket keys for grooving or wear, insulating disc for oil saturation or distortion, and snug fit of disc retaining nut.

Inspect parking brake control cables, guides, and pulleys for general condition, security of attachments and proper safetying.

100-120 Hour Inspections

Inspect wheel bearings for adequate lubrication.

HYDRAULIC SYSTEM

Preflight and Daily Inspections

Rotate the handle at the top of the main system filter in the pilot's compartment four or five times in a clockwise direction to clean the filter element.

Check the emergency air brake pressure gage in the pilot's compartment. The gage should register at least 450 psi. If the gage shows a lower reading, the air bottle should be charged to 575 psi after investigating for leaks. Leaks must be repaired before flight.

Check for proper level of fluid in the hydraulic fluid reservoir. Fill if necessary.

With the emergency selector valve in the "SYSTEM" position, operate the hydraulic hand pump several times. The hydraulic pressure gage should indicate that the hand pump is building up pressure.

With the engines running at 800 to 1000 rpm, open and close the bomb bay doors to make certain that the engine-driven pumps and the system are operating properly.

After engine warm-up, check the hydraulic pressure gage; it should register 1000 ± 25 psi.

Check the cover glass of the hydraulic pressure gage for looseness and cracks. Check for excessive oscillaiton of the pointer. Check for reading consistent with the airplane requirements.

Inspect all hydraulic units for leakage.

25-30 Hour Inspections

Inspect all valves in the hydraulic system for evidence of external leakage, proper operation, condition, and security of mount and of operating lever.

Make a general surface inspection of all actuating cylinders for evidence of leakage at piston rod packing nut and cylinder head joints. All external parts, including attaching parts, should be inspected for general condition.

Check the air pressure in the pressure accumulator; the pressure should be between 600 and 750 psi.

Inspect the hydraulic lines as follows:

Shake the lines to determine possible loose anchorage.

Investigate any polished areas and worn spots to determine whether the lines have shifted or whether the lines have been fouled by moving parts of the airplane.

All lines that are dented, deformed, or kinked should be replaced with new lines.

Check the flexible hoses to determine if the hoses are held clear during the operation of the related mechanisms.

At places where damage is suspected, squeeze flexible hoses between the thumb and forefinger to detect soft spots and deterioration. Check for ballooning and cracking of flexible hoses.

Note the location and security of hose clamps. Keep hoses free from oil and grease.

Trace all leaks to their source. If a tube leaks, install a new tube. If a leak occurs at a connection, tighten the connection moderately. If tightening does not stop the leak, break the connection and inspect the tube flare for cracks, especially at the base of the flare.

Inspect all fittings for defects, and install new parts if necessary. Connections should be tightened snugly but not forced.

Check the hydraulic hand pump for condition and functioning. Possible external leakage should be investigated. Check the security of the pump mounting and the operating handle.

Check the fluid level in the main hydraulic reservoir. Add fluid if necessary, according to the instruction plate on the reservoir.

50-60 Hour Inspections

The engine-driven hydraulic pump installations should be thoroughly checked for security of mounting nuts and hose connections and for the evidence of leakage.

100-120 Hour Inspections

Operate all units in the hydraulic system, and time them according to the procedure outlined in section IV, paragraph 14.

Drain the main hydraulic system filter by removing the drain plug in the bottom of the filter case. Before draining the filter, rotate the cleaning handle four or five times in a clockwise direction.

Remove the emergency hydraulic system filter, located in the nose wheel well, from the airplane and clean it according to instructions in section IV, paragraph 14. This filter must be disassembled in order to be cleaned.

500 Hour Inspections

Check all relief valves in the hydraulic system for correct release pressure and adjust if necessary.

HEATING AND VENTILATING SYSTEM

Preflight and Daily Inspections

Check operation of the heating system.

Check the heaters for security of mounting. Inspect butterfly valve or throttles on the heaters.

Check the air regulator valves for security of mounting, proper alignment of shutters, and ease of operation. Make certain that a lockwire through gland nut holds thermostat bulb firmly. Inspect gland nut packing and condition of bushings.

Inspect the modulator temperature control units for correctness of wiring, mounting alignment, and condition of thermostat bulbs.

Examine the heating and ventilating system controls and linkages. Worn or damaged ports should be replaced.

Check the scoops, ducts, hose and lines for cracks and loose fittings around joints.

50-60 Hour Inspections

Remove the heater butterfly valves according to the procedure outlined in section IV, paragraph 19., and make the following inspections:

Check to see that the butterfly valve or throttle is not bent. Be sure butterfly valve is clean.

Check to see that the control arm is secured to the shaft. Inspect shaft for damage.

Remove the flame arrestors from the heaters as outlined in section IV, paragraph 19., and make the following inspections:

Check tubes and make certain they are clean. Soak tubes in gasoline if necessary to clean. The flame arrestors should be replaced if lead deposits cannot be removed easily.

100-120 Hour Inspections

Disassemble and clean the fuel shutoff valves of any foreign material.

200-240 Hour Inspections

Send the heaters to a repair depot for major overhaul.

DE-ICING SYSTEM

Preflight and Daily Inspections

Note

Place the de-icing system in operation when an inspection of the system is being made.

Check the system for proper inflation and deflation of the de-icer shoes on the wings and horizontal and vertical stabilizers.

Inspect the de-icer shoes for punctures, bruises, and loose patches.

Inspect lines and fittings for leakage of air.

Check distributor valve, air filter, oil separators, and safety valves for security of mounting.

25-30 Hour Inspections

Check tightness of screws that attach the de-icer shoes to the wings and horizontal and vertical stabilizers.

Check the condition and security of the de-icing system lines.

50-55 Hour Inspections

Check the electrical conductivity of the outer surface of the de-icer shoes as described in T.O. No. 03-35B-1.

ANTI-ICING SYSTEMS

Note

Place the anti-icing systems in operation when inspections are made of the system or anti-icing units.

Preflight and Daily Inspections

PROPELLER ANTI-ICING.—Check for free flow of anti-icing fluid to propeller slinger rings. Check fluid level in propeller anti-icing fluid tank. Inspect lines and fittings for fluid leaks.

SIGHTING STATION PERISCOPE ANTI-ICING.—Check for free flow of anti-icing fluid on the sighting station periscope if cold weather is anticipated. Check fluid contents of sighting station periscope anti-icing fluid tank. Inspect lines and fittings for fluid leaks.

50-60 Hour Inspections

Check security of the propeller anti-icing fluid pump attaching bolts. Inspect the pump motor brushes, armature, and all electrical fittings for condition and security. Check propeller slinger rings for security of attachment.

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