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AN 01-60F-2
A.P. 1691C, G

ERECTION AND MAINTENANCE INSTRUCTIONS

FOR

ARMY MODELS

AT-6, AT-6A, B, C and D

NAVY MODELS

SNJ-3, 4 and 5

BRITISH MODELS

HARVARD IIA and III

AIRPLANES

NOTE: This publication replaces T. O. No. 01-60FC-3, dated April 10, 1942

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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.

Page No.	*Latest Revised Date*
1	March 15, 1944
2	March 15, 1944
6	March 15, 1944
7	March 15, 1944
8	March 15, 1944
18A	March 15, 1944
18B	March 15, 1944
18C	March 15, 1944
18D	March 15, 1944
20	March 15, 1944
21	March 15, 1944
28	March 15, 1944
30	March 15, 1944
31	March 15, 1944
39	March 15, 1944
50	March 15, 1944
101	March 15, 1944
138	March 15, 1944
140	March 15, 1944
142	March 15, 1944
163	March 15, 1944
164	March 15, 1944
224	March 15, 1944
272	March 15, 1944
273	March 15, 1944
276	March 15, 1944
283	March 15, 1944
291	March 15, 1944
292	March 15, 1944
293	March 15, 1944
294	March 15, 1944
295	March 15, 1944
301	March 15, 1944
302	March 15, 1944
303	March 15, 1944
304	March 15, 1944
305	March 15, 1944
306	March 15, 1944
308	March 15, 1944
309	March 15, 1944
312	March 15, 1944
313	March 15, 1944
314	March 15, 1944

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TABLE OF CONTENTS

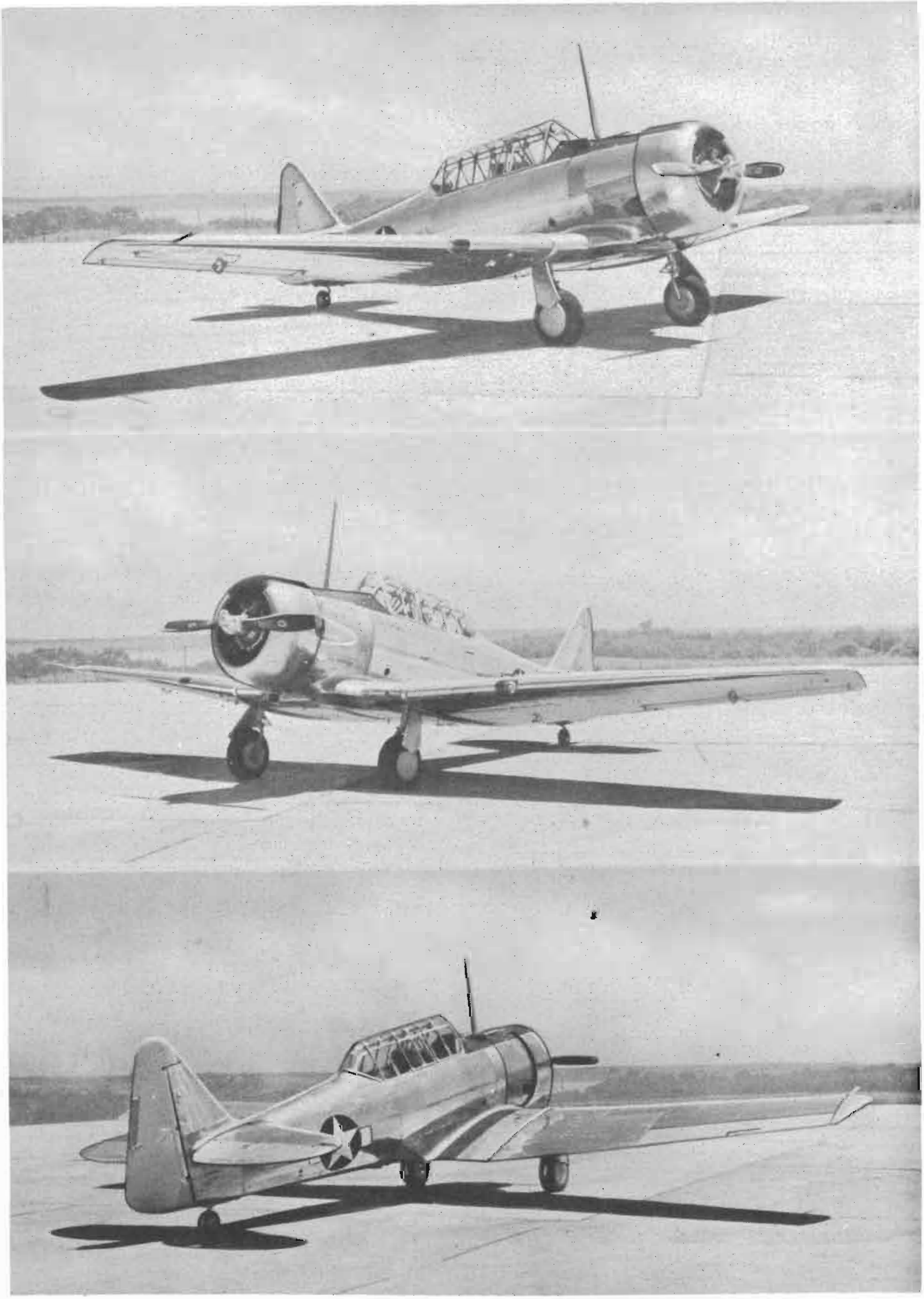


Figure 1 — Three Views of AT-6C

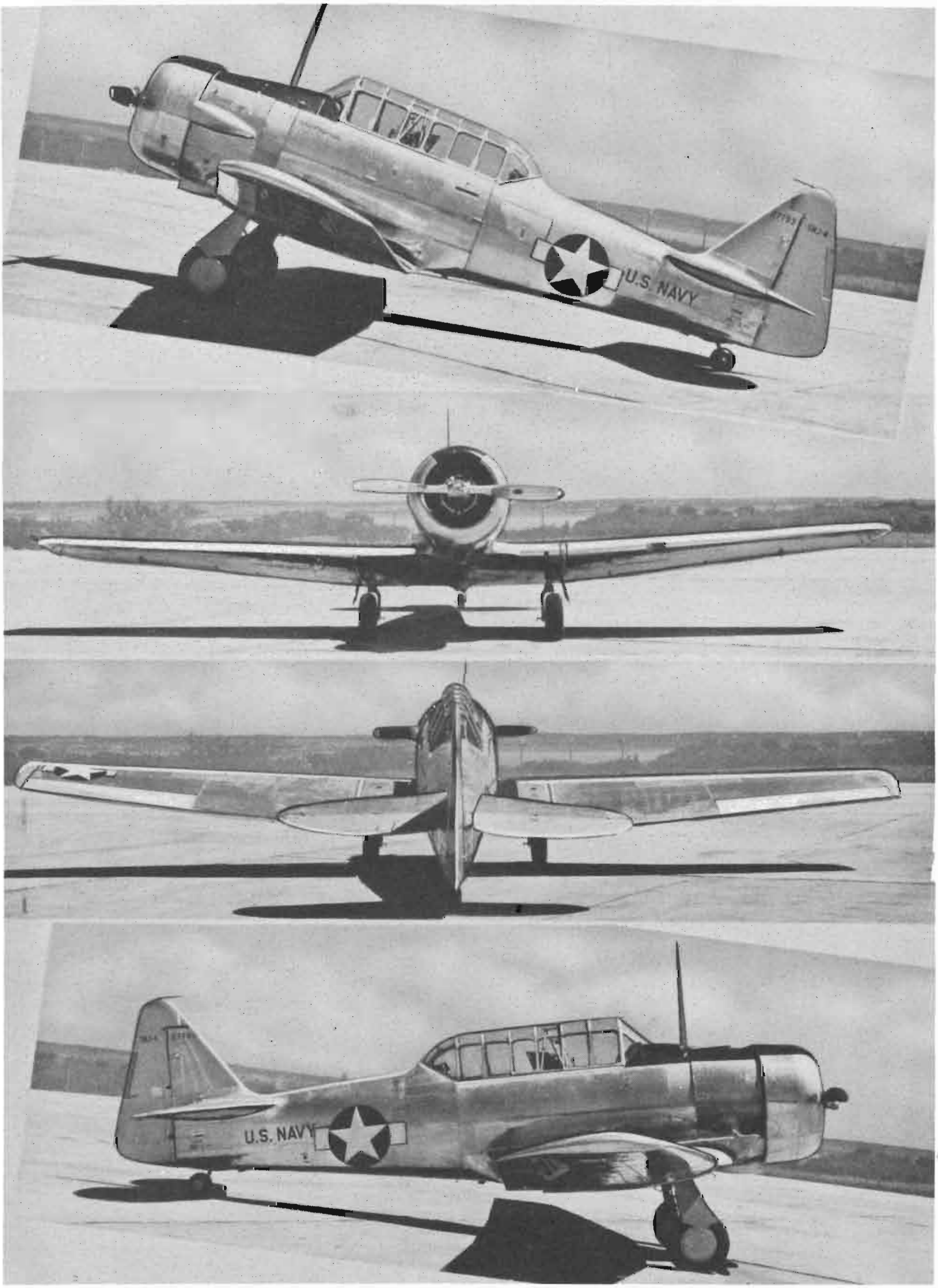


Figure 2 *Views of SNJ-4*

Figure 3 — Three-quarter Rear View of SNJ-4 (metal monocoque)

Figure 4 — Three-quarter Rear View of SNJ-4 (wooden monocoque)

SECTION I
DESCRIPTION, DIMENSIONS, AND LEADING PARTICULARS

1. DESCRIPTION.

a. GENERAL.—The AT-6 and SNJ series of airplanes are two-place, single-engine, low-wing monoplanes designed as advanced trainers with provision for the installation of bombs and gunnery equipment. The tactical mission of the airplane, therefore, is to provide a means for the advanced training of student pilots and their transition flying to combat-type airplanes. Each airplane is of all-metal construction except that in some later airplanes wood is employed in various parts of the structure. Airplanes delivered to the United Kingdom are identical with the standard AT-6C and SNJ-4 (Navy) airplanes except for the following items:

Yellow band, seven feet wide, painted on each wing.

Sutton harness installed in lieu of type B-11 safety belt.

Provisions for ballast weight in rear of fuselage.

Provisions for British radio and interphone equipment.

Cockpit covers provided.

Mixture control with standard British movement provided.

These items and other minor innovations are described in more detail in their proper places throughout this handbook. Later airplanes of the trainer series are designated as AT-6D and SNJ-5 (Navy) airplanes and may be distinguished from the previous models by the installation of a 24-volt electrical system in place of a 12-volt system.

b. WING.—The tapered wing is of all-metal stressed skin, full cantilever, low wing design, consisting of a detachable center section and two detachable outer wing panels with removable tips.

(1) AILERONS.—The cable-controlled, fabric-covered, metal frame ailerons are balanced statically and dynamically.

(2) WING FLAPS.—The split-type, all-metal wing flaps are normally operated by the engine-driven hydraulic pump.

c. EMPENNAGE.—The vertical and horizontal stabilizers are of metal construction, with the exception of wood-constructed horizontal stabilizers installed on some later airplanes. Rudder and elevators are of metal construction, fabric-covered, and are statically and dynamically balanced.

d. FUSELAGE.—The fuselage structure consists of two sections bolted together just aft of the rear cockpit. The engine mount is mounted on the front of the forward fuselage.

e. LANDING GEAR.—The landing-gear equipment consists of a main landing gear, hydraulically operated, and a steerable, nonretracting tail wheel.

f. HYDRAULIC SYSTEMS.—Two individual hydraulic systems are incorporated in the airplane; namely, the main system to operate the flaps and the landing gear, and the brake system.

g. POWER PLANT.

(1) ENGINE.—These airplanes are powered by a single Pratt and Whitney, model R-1340-49, or R-1340-AN-1, nine-cylinder, air-cooled, radial engine.

(2) PROPELLER.—The engine drives a two-blade, 9-foot-diameter, Hamilton Standard, constant-speed propeller.

(3) FUEL SYSTEM.—The fuel system consists essentially of two removable tanks housed within the center section structure, a type F-10 engine-driven fuel pump mounted on the engine accessory housing, a fuel unit on the forward side of the fire wall with a fuel cock at the bottom of the fuel unit, and a fuel selector valve. (AT-6 airplanes are equipped with integral fuel tanks.)

(4) OIL SYSTEM.—The oil system consists of an oil tank, an oil regulator, an engine-driven pump, an oil Y-drain valve, pressure and temperature indicators, and the necessary piping.

h. EQUIPMENT.

(1) FLIGHT CONTROLS.—Flight is controlled by a conventional stick in the cockpit, which operates the ailerons and elevators. Pedals for controlling the rudder and operating the wheel brakes are conventionally located.

(2) COMMUNICATIONS EQUIPMENT.—These airplanes are equipped for radio communications by voice and key on several frequencies.

(3) HEATING AND VENTILATING SYSTEM.—The airplanes are equipped with a cockpit heating and ventilating system and windshield defrosters.

(4) GUNNERY EQUIPMENT.—The gunnery equipment consists of three model M-2, 30-caliber Browning machine guns (two in AT-6 and AT-6A), and provisions for a gun camera.

(5) BOMBING EQUIPMENT.—Complete provisions have been incorporated in each airplane (not in AT-6 and AT-6A) for a flush-type bomb rack on the lower surface of each outer wing panel.

(6) OXYGEN EQUIPMENT.—Earlier airplanes are equipped with a high-pressure oxygen system. Later airplanes are equipped with a demand-type oxygen system.

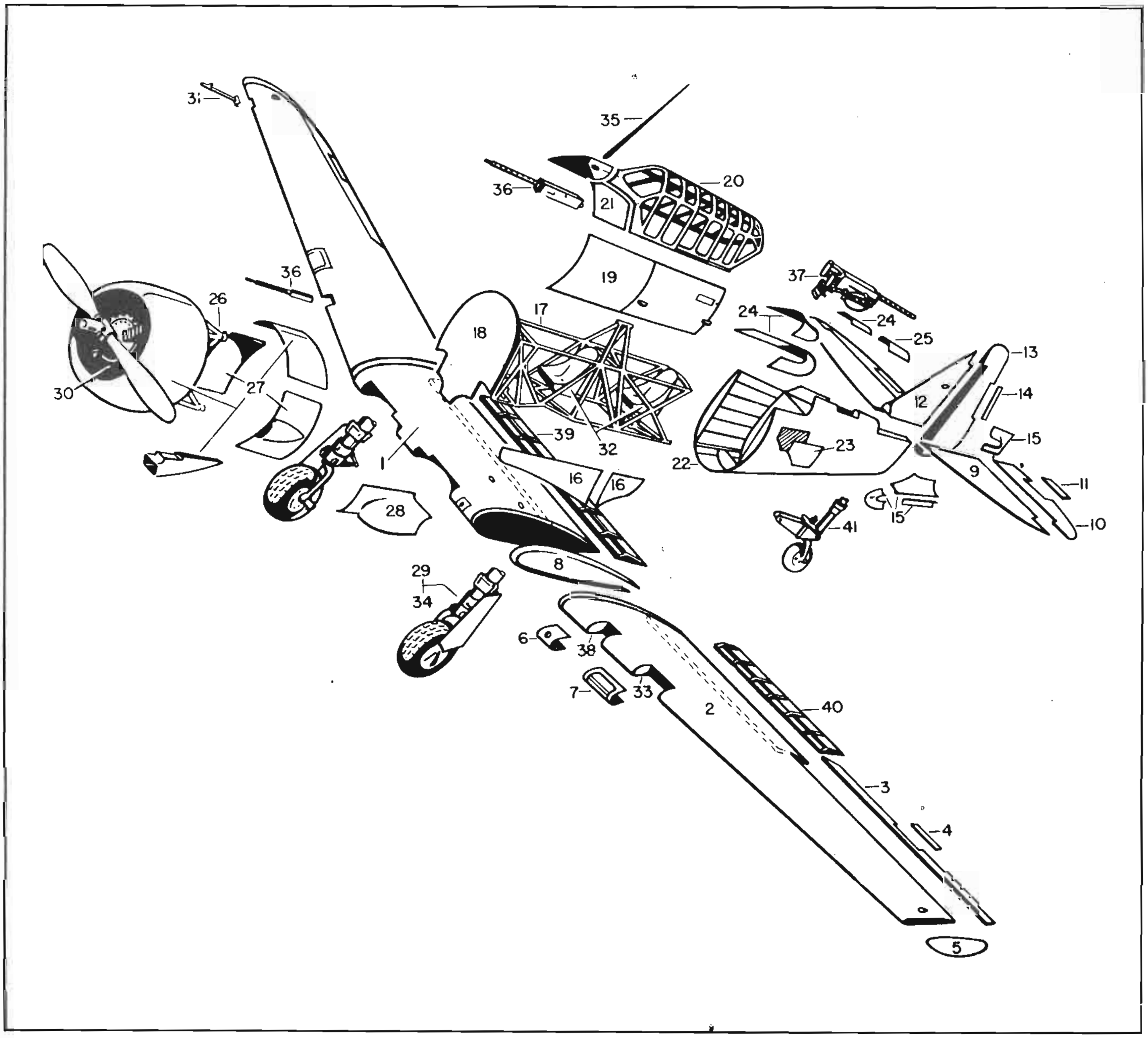


Figure 5 — Airplane Breakdown Diagram

1. Wing Center Section
2. Wing Outer Panel
3. Aileron
4. Aileron Booster Tab
5. Wing Tip
6. Gun Camera Bay Door
7. Outer Wing Landing Light Door
8. Outer Wing Bolting Angle
9. Horizontal Stabilizer
10. Elevator
11. Elevator Trim Tab
12. Vertical Stabilizer
13. Rudder
14. Rudder Trim Tab
15. Horizontal Stabilizer Fillet, Left Rear
16. Wing Fillets
17. Front Fuselage Frame Assembly
18. Fuselage Firewall
19. Panel, Fuselage Left Side
20. Cockpit Enclosure
21. Door, Fuselage Firewall to Windshield
22. Frame Assembly, Fuselage Rear Section
23. Baggage Compartment Door
24. Flexible Gun Cowling Assembly
25. Cover Assembly, Fuselage Rear Section Body Access
26. Engine Mount Assembly
27. Engine Ring Cowling
28. Engine Cowling, Removable Lower
29. Landing Gear Strut
30. Power Plant
31. Airspeed Tube
32. Pilot's Seat
33. Outer Wing Landing Light Bay
34. Landing Gear Fairing
35. Antenna Mast
36. Fixed Machine Gun
37. Flexible Machine Gun
38. Gun Camera Bay
39. Flap Assembly, Wing Center Section
40. Outer Wing Flap Assembly
41. Tail Wheel Assembly

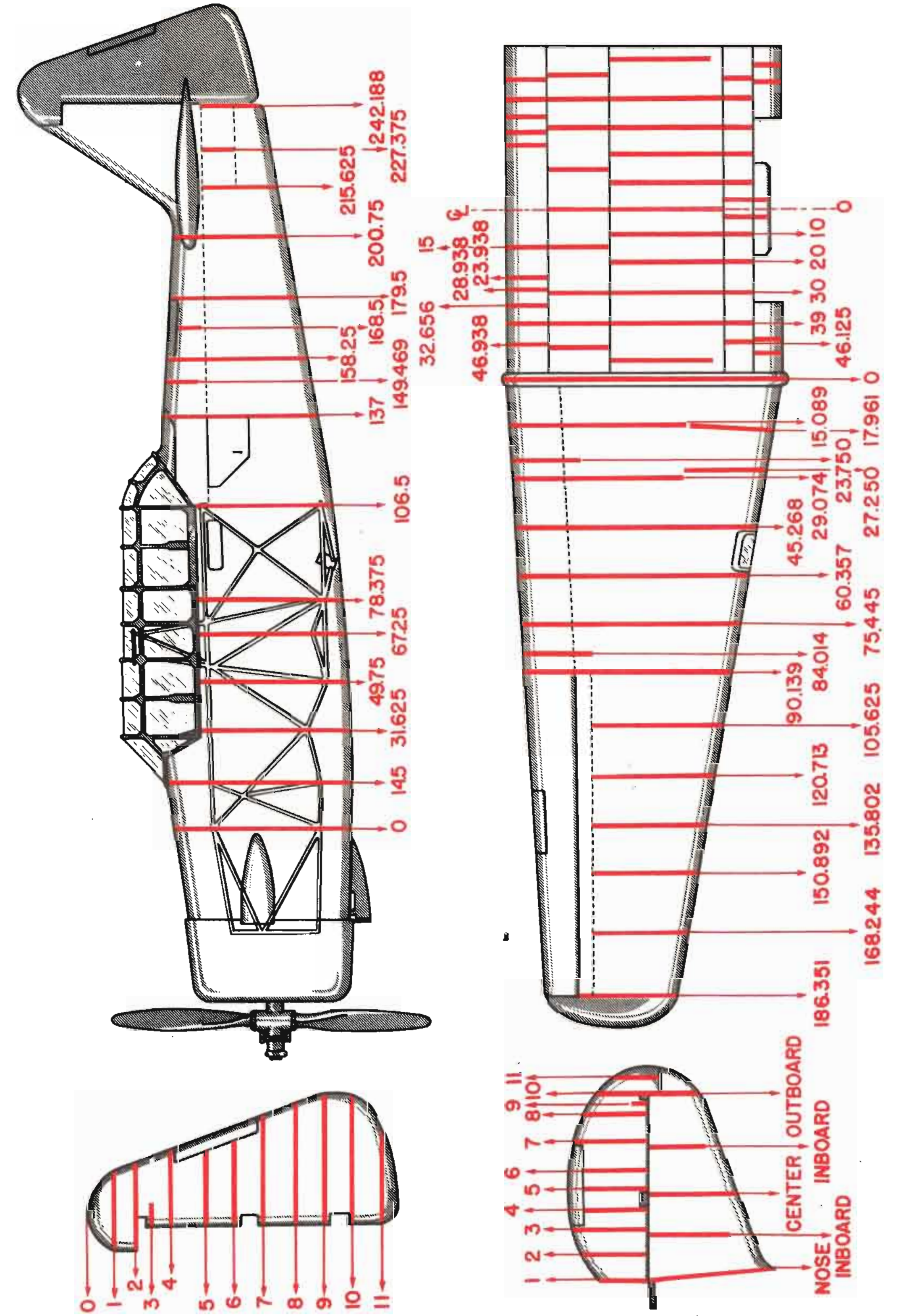


Figure 6 — Airplane Stations Diagram

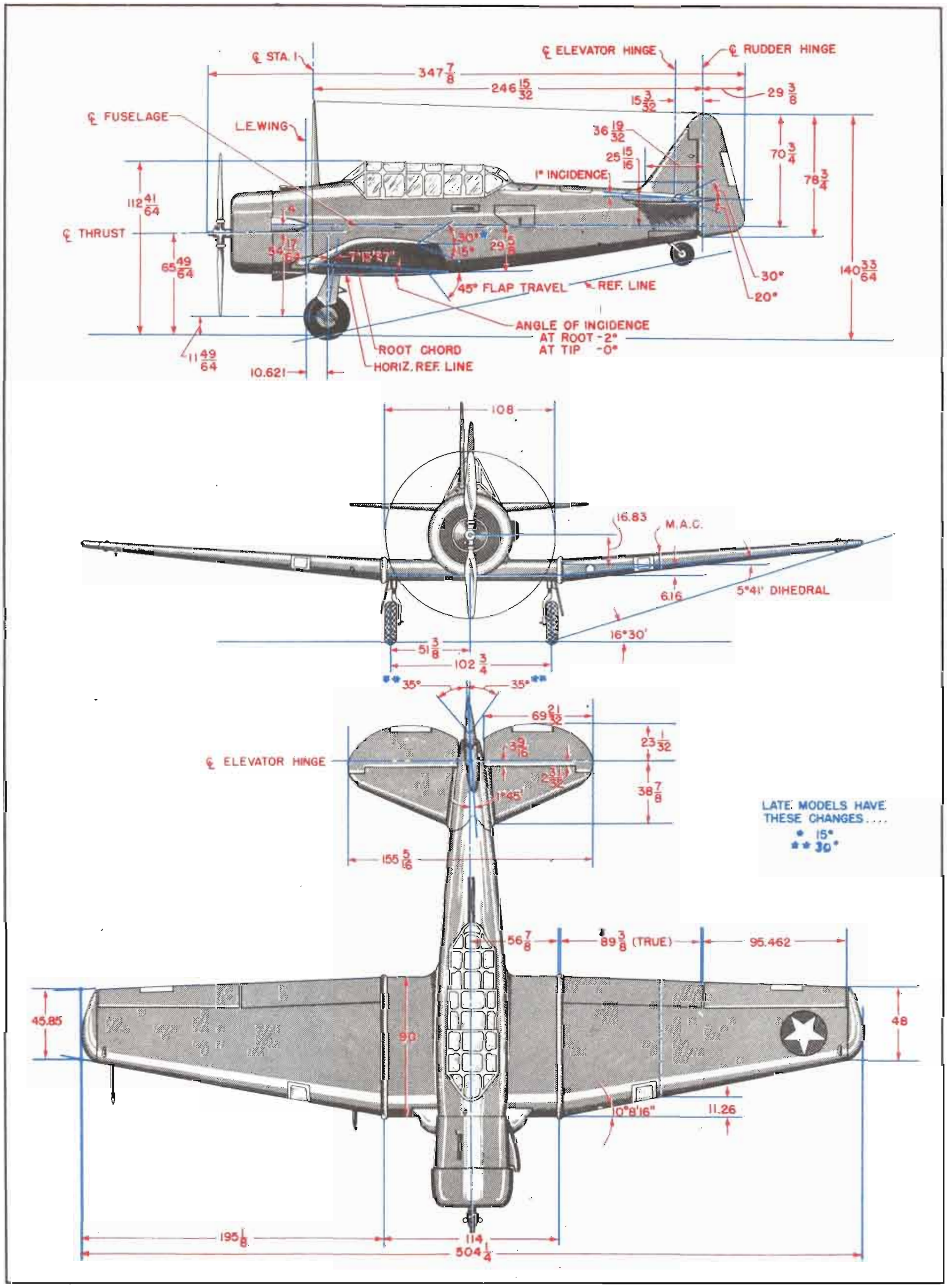


Figure 7 — Airplane Three-view Diagram

PRINCIPAL DIMENSIONS

GENERAL	*AT-6C, AT-6D, SNJ-4, SNJ-5, Airplanes*	*AT-6, AT-6A, AT-6B, SNJ-3, Airplanes*
Over-all wing span	42 ft, 1/4 in.	42 ft 7-1/4 in.
Over-all length	28 ft, 11-7/8 in.	28 ft 11-7/8 in.
Over-all height, antenna mast, thrust line level	12 ft, 9-1/4 in.	12 ft 9-1/4 in.
Over-all height, antenna mast three point position	12 ft, 6 in.	12 ft 6 in.
Height, propeller hub thrust line level	65-49/64 in.	68-11/16 in.
Clearance, propeller tips, thrust line level	11-49/64 in.	16-5/8 in.
Normal C.G. to wing leading edge-wheels down	30.54 in.	
Normal C.G. to wing leading edge-wheels up	30.27 in.	
C.G. limits to wing leading edge	29.60 to 33.75 in.	
Elevator hinge to wing leading edge	235-5/8 in.	
Minimum clearance of propeller and ring cowl	1 in.	
Angle of normal C.G. with wheel (side elevation)	18 deg, 11 min	
Angle of rearward C.G. with wheel (side elevation)	20 deg, 41 min	
Angle of wing tip and wheel bottom (front elevation)	16 deg, 30 min	
Angle of thrust line with ground (three-point position)	12 deg, 30 min	

WINGS

Airfoil section at root	NACA 2215	NACA 2215
Airfoil section at tip	NACA 4412	NACA 4412
Span	42 ft 1/4 in.	42 ft 7-1/4 in.
Mean aero. chord (Semi-wing)	75.96 in.	
Leading edge of M.A.C. (*)	11.26 in.	
Chord at root	90 in.	90 in.
Chord at tip	48 in.	48 in.
Dihedral-leading edge	5°, 41 min	5°, 41 min
Incidence at root	2°	2°
Incidence at tip	0°	0°
Washout at tip	2°	2°
Sweepback	10°, 18 min, 16 sec	10°, 18 min

FLAPS

Chord, each flap	14-11/32 in.	
Length of center section flap	113-3/4 in.	
Length of each outer wing flap	89-3/8 in.	

*Location behind leading edge center section

EMPENNAGE

Horizontal stabilizer		
Overall span	12 ft, 11-5/16 in.	12 ft 11-5/16 in.
Maximum chord (leading edge to hinge line)	38-7/8 in.	
Incidence (fixed setting)	1°	1°
Vertical stabilizer		
Maximum chord (leading edge to hinge line)	51-11/16 in.	
Setting, fixed	1° 45 min left	1° 45 min left
Elevators (each)		
Span	69-21/32 in.	

AREAS

	AT-6C, AT-6D, SNJ-4, SNJ-5 (Except as noted)	*AT-6, AT-6A, AT-6B, SNJ-3, Airplanes*
Wings (total area including ailerons)	253.73 sq ft	258.10 sq ft
Ailerons (each)		
Area aft of hinge line, including booster tab	8.98 sq ft	8.98 sq ft
Area of balance	2.42 sq ft	2.42 sq ft
Total area of each aileron	11.40 sq ft	11.40 sq ft
Area of booster tab	.38 sq ft	.38 sq ft
Flaps		
Area of center section flap	11.40 sq ft	11.06 sq ft
Area of each outer wing flap	8.73 sq ft	8.72 sq ft
Total area (3 flaps)	28.86 sq ft	28.52 sq ft
Empennage		
Total area horizontal tail surface, including 5.33 sq ft fuselage	50.11 sq ft	
Total area vertical surfaces	18.34 sq ft	
Horizontal stabilizer		
Total area, including 5.33 sq ft fuselage	28.34 sq ft	28.34 sq ft
Elevators (each)		
Area aft of hinge line, including tab	9.13 sq ft	9.13 sq ft
Area trim tab	.73 sq ft	.73 sq ft
Area of balance	1.74 sq ft	1.74 sq ft
Total area, including tab and balance	10.88 sq ft	10.88 sq ft
Vertical stabilizer	5.33 sq ft	5.33 sq ft
Rudder		
Area aft of hinge centerline	10.95 sq ft	10.95 sq ft
Area of balance	2.26 sq ft	2.26 sq ft
Area trim tab	.52 sq ft	.52 sq ft
AT-6D, SNJ-5*	.60 sq ft	
Total area including balance and tab	13.21 sq ft	13.21 sq ft

SETTINGS AND RANGES OF MOVEMENT OF CONTROL SURFACES

	AT-6C, AT-6D, SNJ-4, SNJ-5 (Except as noted)	*AT-6, AT-6A, AT-6B SNJ-3, Airplanes*
Ailerons		
Aileron travel	UP 30° DN 15°	UP 30° DN 15°
AT-6D, SNJ-5*	UP 15° DN 15°	
Booster tab travel	UP 15° DN 30°	UP 15° DN 30°
AT-6D, SNJ-5*	UP 15° DN 15°	
Flap movement	45°	45°
Elevators		
Elevator travel	UP 30° DN 20°	UP 30° DN 30°
Trim tab travel	UP 8° DN 16°	UP 8° DN 16°
Rudder		
Rudder travel	Right 35° Left 35°	Right 35° Left 35°
AT-6D, SNJ-5*	Right 30° Left 30°	
Trim tab travel	Right 4° Left 10°	Right 4° Left 10°

*Also AT-6C, AAF Ser. No. 42-49005 to 42-49069 incl. and 42-43847 to 42-44425 incl.,

ALIGHTING GEAR

WHEEL TYPE ALIGHTING GEAR

Type	Hydraulically retractable
Tread (width from center of tire to center of tire)	102-3/4 in.

MAIN SHOCK STRUTS

Type	Combination air and oil
Make (Bendix)	NAA 77-33102 AC Spec. 40228
Fluid required	Spec No 3580 (Red)
Approximate maximum air pressure	750 lb/sq in.

WHEELS (MAIN)

Type 11-drop center-27 in.	AC Spec No. 25258
Tire	27 in. 8 ply
Tire pressure	32 lb/sq in.

BRAKES

Type	Hayes-Hydraulic "Servo"
Fluid required	Spec No. 3586 (Blue)

TAIL WHEEL

Type	Steerable and non-retractable
Tire	12:5 in.
Tire pressure	38 lb/sq in.

TAIL SHOCK STRUT

Type	Combination air and oil
Make (Bendix or Gladden)	AC Spec No. 25272

ENGINE

Model	R-1340-AN-1, R-1340-49	Pratt & Whitney
Type		Radial, air-cooled
Number of cylinders		9
Blower ratio		10:1
Compression ratio		6.03:1
Rated power at sea level take-off		600 bhp/2250 rpm
Normal rating at 5000 ft		550 bhp/2200 rpm
Carburetor: Stromberg		NA-Y9E1
Fuel		91 octane

PROPELLER

Manufacturer	Hamilton Standard
Type	Two-blade, Constant speed
Hub	No. 12D40
Blade	No. 6101A-12
Diameter	9 ft
Control governor	No. 1M12-A

PROPELLER (Cont'd)

Pitch setting	
Low (Fine)	11°
High (Coarse)	27°

TANK CAPACITIES

Fuel tanks (2)	55.2 U.S. (46 Imperial) gal
Total fuel	110.4 U.S. (92 Imperial) gal

TANK CAPACITIES

Oil tank (1)	10.2 U.S. (8.5 Imperial) gal
Expansion space	2 U.S. (1.7 Imperial) gal

NOTE: All lumber construction on AT-6C crate is 2" x 4" yellow pine except 4" x 6" skids, 4" x 4" bracing, 2" x 12" end blocks and 1" x 12" flooring.

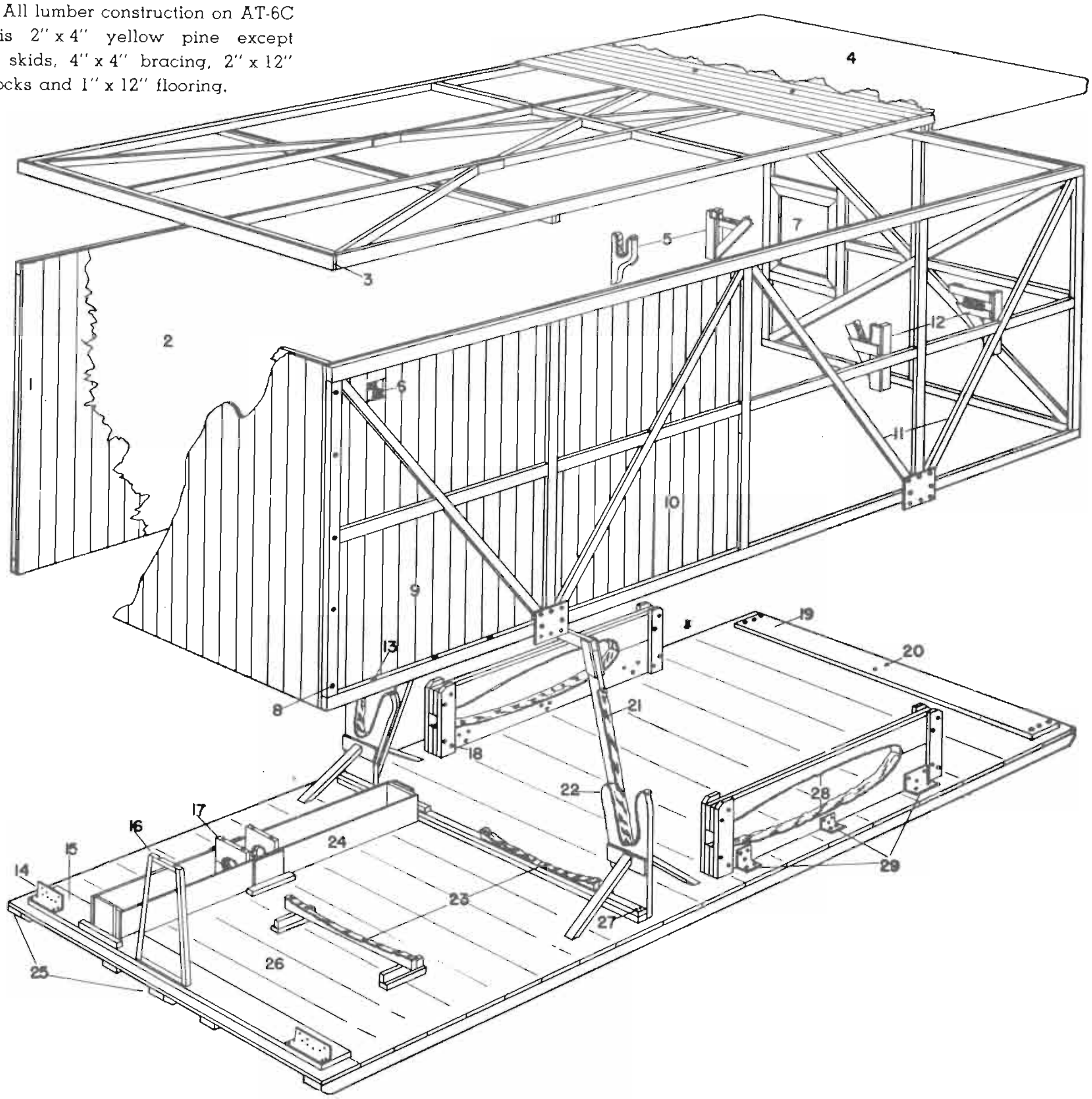


Figure 8 — Airplane Crate

SECTION II
SHIPMENT AND ERECTION PROCEDURE

1. SHIPMENT.

a. GENERAL.—*(See figures 8, 9, 10, 11.)*—After preparations for crating have been made, which include the draining of fuel, oil, and hydraulic systems (exclusive of the brake system), and the coating of exposed metal parts with a film of corrosion preventive, the airplane then is partially disassembled to facilitate shipment. The main section of the airplane, consisting of the entire fuselage, wing center section, and power plant, is hoisted into position on the platform section of a wooden crate. The crate consists of the platform and the ceiling and wall assemblies, which are hoisted into their proper positions and rigidly secured by bolts and screws. The wing outer panels, tail assemblies, propeller, and loose equipment are securely mounted by means of webbing to "cradles" in various positions in the crate. After the crating has been completed, the waterproofed roof inspected for possible cracks or tears, final inspection seals affixed, and hoisting notches cut to facilitate further handling, the airplane is ready for shipment. Location of cradles and containers within the crate are listed as follows:

Name	*Location*
Center section cradles	Front section on floors parallel next to side walls.
Wing cradles	On each side of platform just aft of center section cradles.
A-frame	Extends from wing cradles to and across ceiling.
Wing bolting angle Attachment plates	At both rear corners of platform.
Horizontal tail assembly crates	One on platform parallel and under A-frame: one in center of platform and between wing and wing cradle.

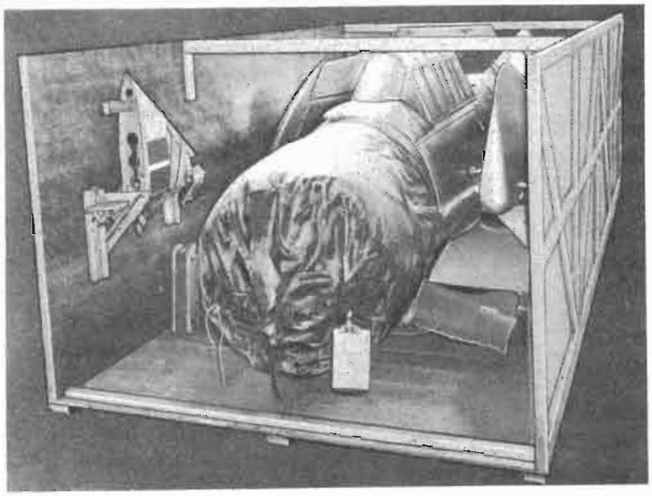


Figure 9 — Airplane in Crate — Front View

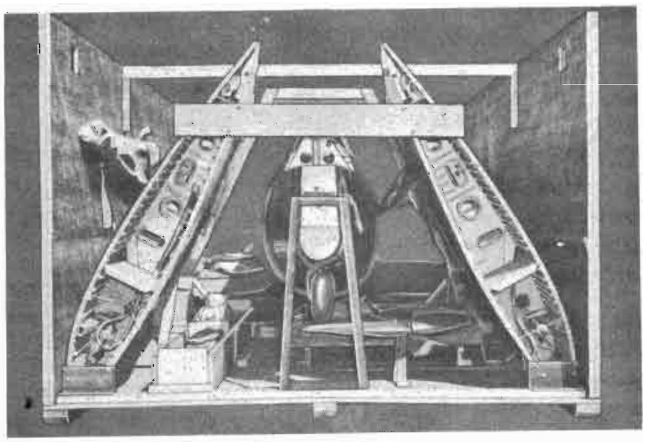


Figure 10 — Airplane in Crate — Rear View

Key to Figure 8

1. Inside View of Construction of Side Wall
2. 15-lb. Roofing Paper Used on Side Walls and Ends
3. Overlapping Joint at All Corners in Top Section
4. 15-lb. Roofing Paper Used on Roof
5. Vertical Stabilizer Cradles
6. Air Vent—1/4" Hardware Cloth and Screen Used
7. Door—2' x 3' (Swings Outward)
8. 3/8" x 6" Lag Bolts Used to Attach Sides to Ends
9. Outside View of Side Wall
10. Tongue and Groove Yellow Pine Used on Sheeting
11. Two 2" x 4" Used as Bracing on Sidewalls
12. Rudder Cradles
13. 7" x 3/8" Lag Bolts Used to Secure Top and Bottom to Sides and Ends
14. Wing Angle-Iron 3/8" x 5" Lag Screws—3/8" x 3 1/2" Machine Bolts
15. End Block
16. Tail Stand Frame—Support for Monocoque
17. Propeller Clamp
18. 1/2" x 7" Machine Bolts
19. End Block
20. 3/8" x 6" Lag Bolts Used on End Blocks
21. "A" Frame (Wooden)
22. Wing Cradle
23. Horizontal Tail Assembly Cradles
24. Propeller Box
25. 4" x 6" Skids
26. 1" x 12" Flooring
27. 3/8" x 7" Lag Screws
28. Center Section Cradle
29. Angle-Irons 1/2" x 4 1/2" Machine Bolts and 1/2" x 4" Lag Bolts

Name	*Location*
Propeller box	Extends from wing end on rear left platform to wing cradle.
Rudder cradle	On left side wall, forward.
Vertical stabilizer cradle	On right side wall, forward.
Loose equipment box	On platform inside door.
Fairings	Attached to left side wall, rearward.
Right wing gun	On top of right wing center section cradle, (others stationary).

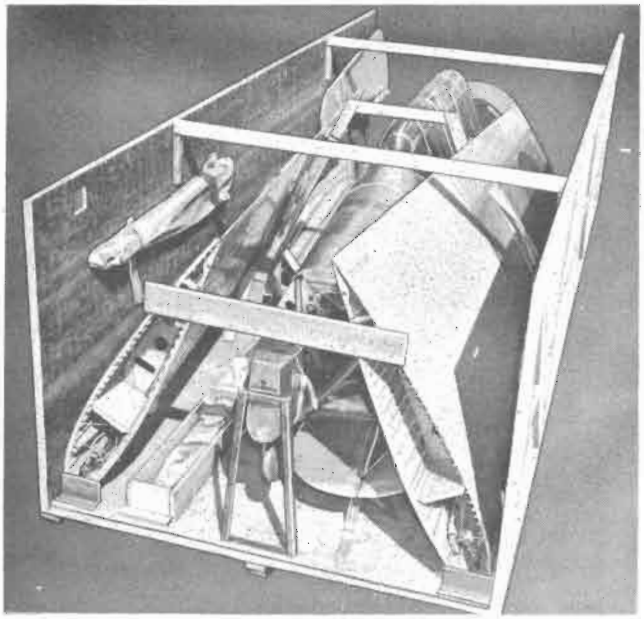


Figure 11 — Airplane in Crate — Three-quarter View

b. PREPARATION FOR CRATING.

(1) GENERAL.—In preparing the airplane for shipment, personnel should first take steps toward insuring a safe arrival of the airplane in the crate. The following detailed instructions are recommended for safe handling of the airplane.

(2) ENGINE.—Installed engines should be prepared for shipment by applying a coating of corrosion-preventive compound inside and out, as instructed in paragraph 3. When this procedure has been fully completed, cover engine and cowling with heavy wrapping paper and standard engine cover.

NOTE

Cylinder and crankcase dehydrator plugs should be inspected weekly at points of shipment and replaced when necessary.

(3) SURFACES AND LOOSE EQUIPMENT.—Instructions for preparation of surfaces and loose equipment for crating follow:

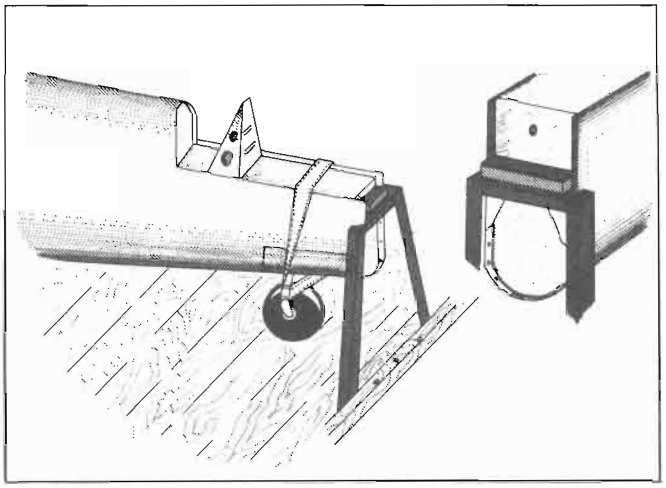


Figure 12 — Fuselage Rear End Attachment

(a) All exterior metal surfaces with the exception of painted surfaces, should be sprayed with corrosion-preventive compound.

(b) Remove from baggage compartment all loose equipment which may consist of the following:

Engine tool kit
Armorer's tool roll
Mooring kit
Miscellaneous loose equipment
Blind flying hood
Engine cover

List of parts contained in kits and miscellaneous loose equipment may be found in section III, paragraph 5. Place loose equipment in miscellaneous loose equipment box.

(c) Remove antenna mast and pitot tube. Wrap in heavy paper and attach to left wall by means of webbing.

(d) Detach outer panel, rudder, elevator, vertical and horizontal stabilizer assemblies, and wing gun (if carried). Attach machine gun windbreaker to leading edge of wing. Removal and disassembly instructions for fixed and movable surfaces are contained in section IV.

c. CRATING.

(1) GENERAL.—With all preparations having been completed for crating, a final visual inspection should be made to ascertain that no steps have been overlooked that might necessitate partial or complete uncrating procedure. A specially prepared check-off list contained at end of this section should be consulted. For handling procedure refer to section III. The sequence of operations for crating the airplane follows:

(a) Install hoist shackles and hoist the airplane clear of the floor.

(b) Place the landing gear in the retracted position and secure the landing gear control handle in the UP position to prevent an inadvertent release of the UP position latches.

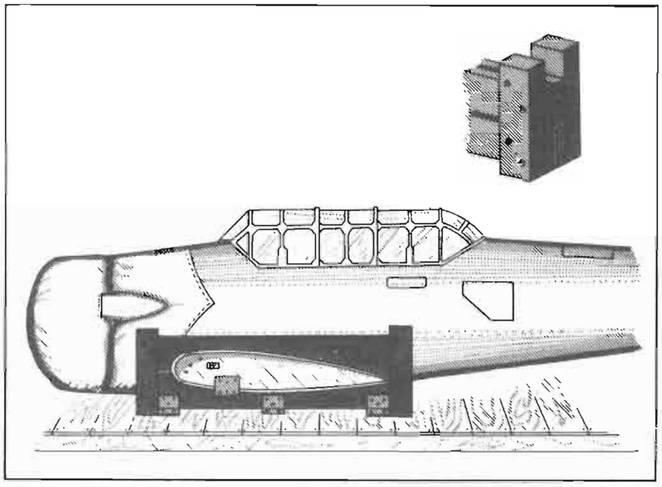


Figure 13 — Wing Center Section Cradles

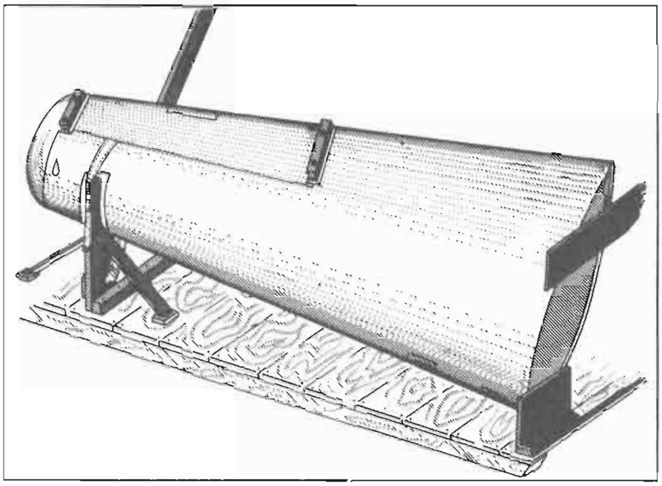


Figure 15 — Outer Wing Panel in Cradle

(c) Slide the floor of the crate under the airplane.

(d) Lower the airplane onto the floor of the crate, engaging the ends of the wing center section in the lower portion of the center section cradles. The upper and lower cradles should be properly padded to protect the surface of the wing.

(e) Bolt the rear end of the fuselage to the rubber mounting on top of the tail stand. (See figure 12.)

(f) Secure the wing center section in the lower cradles by means of the upper cradles, or "caps," and attaching bolts. (See figure 13.)

(g) Secure the horizontal tail assembly to the cradles under the fuselage by means of webbing straps. Nail ends of straps to platform using necessary wooden blocks. (See figure 14.)

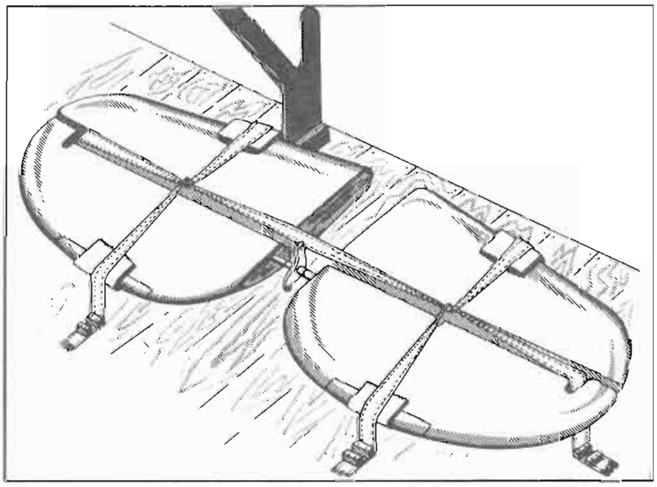


Figure 14 — Horizontal Tail Assembly Attached to Platform

(h) Place propeller in propeller box and secure by means of bolts at the propeller hub.

(i) Place the left wing outer panel in the wing cradle on the right side of the A-arm, bottom surface of the wing toward the fuselage, wing tip forward and leading edge down. (See figure 15.) Use same procedure for right wing.

(j) Swing the wing outer panel trailing edges inboard, and secure them at the bolting angles, with bolts, to a suitable cross brace.

(k) Secure the bolting angle at the leading edge to the floor of the crate, utilizing bolts and a heavy angle plate.

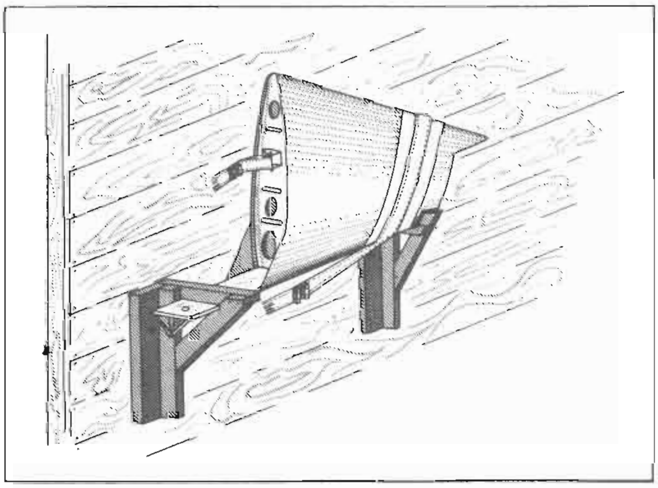


Figure 16 — Vertical Stabilizer Attached to Wall

(l) Assemble sides and support with cross braces, using dollies, hoists, or any other available equipment. Lag screws and bolts are used in assembling, as illustrated in figure 8.

(m) Attach vertical stabilizer to bracket on the front section of the right wall, using webbing for support. (See figure 16.)

(n) Attach rudder to bracket on the front section of the left wall, securing by means of webbing. (See figure 17.)

(o) Install all loose equipment, including loose

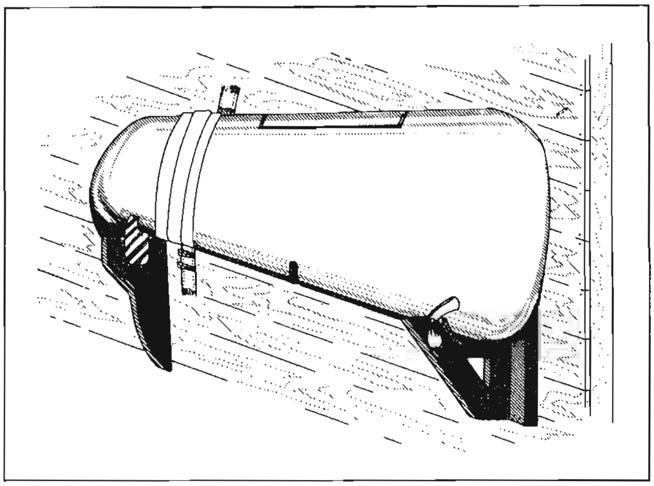


Figure 17 — Rudder Attached to Wall

equipment box which is to be located directly inside door at front left corner of platform.

(p) Install ends and top of crate.

(q) After assembly of the crate, tar paper or any other suitable roofing material is applied to the top.

d. UNCRATING.

(1) GENERAL.—For handling procedure, refer to section III. To remove the airplane from the shipping crate, the following procedure is recommended:

(a) Enter the crate through the door located at the forward end.

(b) Unscrew lag bolts around edge of top and four bolts located near center, and remove top of crate.

(c) Remove rudder, vertical stabilizer, and all loose parts from sides.

(d) Brace sides and remove the ends of the crate. Take care not to jar the sides, as component parts are attached thereto.

(e) Remove sides.

(f) In order to remove the outer wing panels, remove top cross braces and extract the bolts from the plates securing the roots of the panel to the floor of the crate. Detach the brace securing the panel roots together near their respective trailing edges. Lift the panels clear, using caution in handling.

(g) Remove the horizontal tail assembly and box of loose equipment from floor of crate.

(h) Remove propeller from box.

(i) Remove the upper portions of the center section cradles and three bolts fastening plate to bolt angle and bottom of the cradle.

(j) Remove hoisting rings from loose equipment box and attach to center section.

(k) Pass the cable or chain through the hoist rings extending upward from the top of the center section.

CAUTION

Be sure the load capacity of the cable or chain exceeds 3600 lb.

(l) Slip a tube or bar through the lift-tube aperture near the rear of the fuselage, and attach hoisting ropes or cable.

(m) Detach the rear of the fuselage from its support. Remove the bolts securing the support to the floor, and remove the support.

WARNING

Do not remove this support until the upper portions of the center section cradle have been removed and the tail of the airplane is supported by means of the lift-tube.

(n) Lift the airplane straight up out of the crate, exercising care in handling.

NOTE

Ascertain that everything has been removed from the crate before stowing for future use.

(o) Extend landing gear by placing selector handle in the "DOWN" position, releasing the latches holding the landing gear in the "UP" position.

CAUTION

Since there is no hydraulic fluid in the system, it is suggested that precaution be taken in extending the gear. When the gear has reached the "DOWN" position, a check should be made to determine whether or not the lockpins have securely locked the landing gear struts in the "DOWN" position. A spacer bar also should be placed between the landing gear struts as a safety device to prevent the gear from collapsing in the event the "DOWN" position latches should be fouled.

(p) Before attempting to assemble the airplane, it it suggested that the corrosion-preventive compound be completely removed from each component part, using naphtha, kerosene, gasoline, or any suitable solvent.

(q) Assembly and installation instructions are contained in section IV. Refer to section III for servicing instructions and paragraph 4, this section, for preparation of engine and accessories for flight.

e. CHECK-OFF LIST.

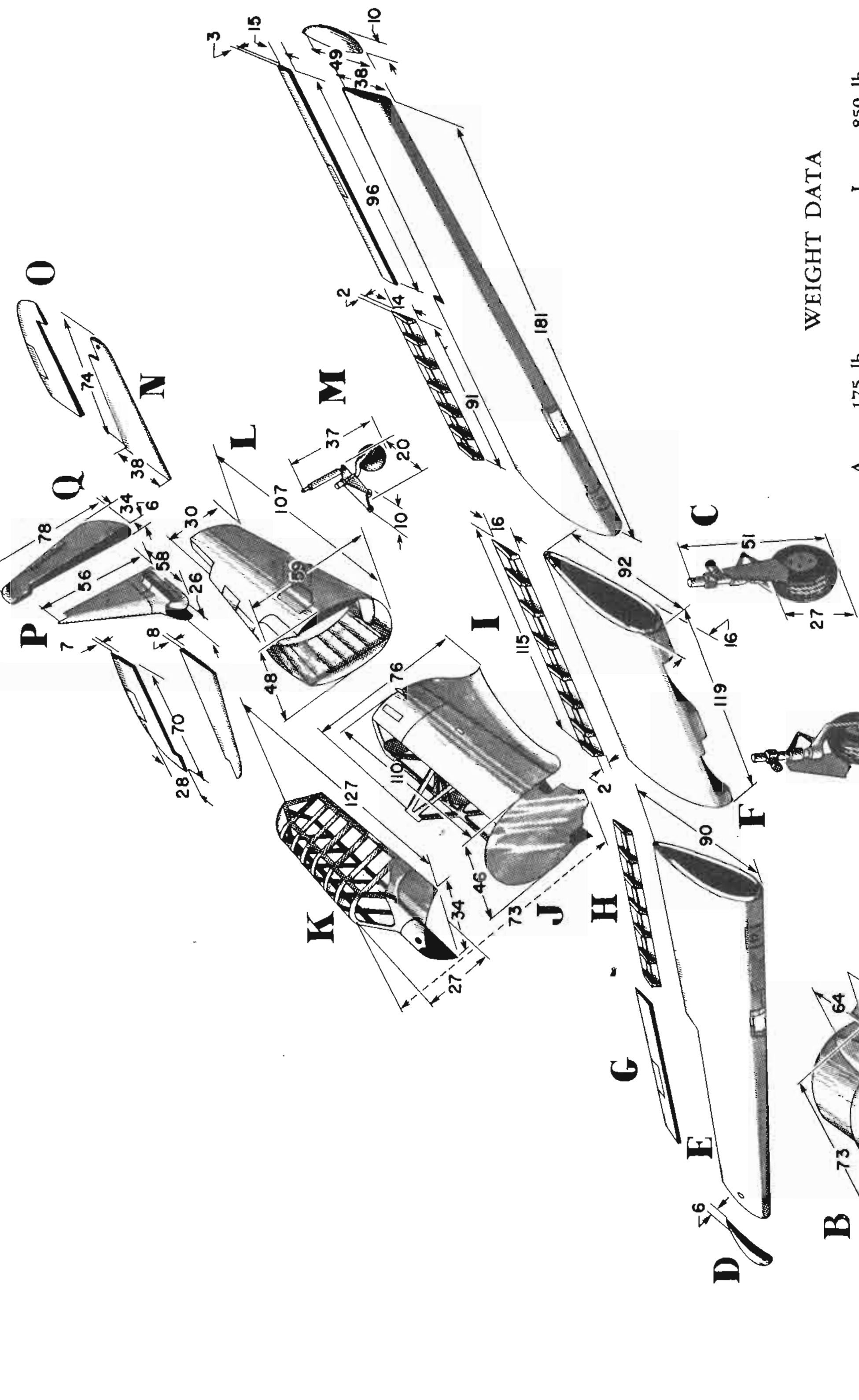
(1) GENERAL.—In order to ascertain that all steps for proper preparation of the airplane for shipping, and that all parts have been included in the crating, it is recommended that the following check-off list be consulted:

(2) PREPARATION FOR CRATING.

(a) Drain oil.

(b) Refill with corrosion-preventive mixture.

(c) Operate engine.



WEIGHT DATA

A	175 lb.	J	850 lb.
B	1225 lb.	K	105 lb.
C	145 lb. each	L	130 lb.
D	7 lb. each	M	40 lb.
E	210 lb. each	N	25 lb. each
F	500 lb.	O	19 lb. each
G	24 lb. each	P	15 lb.
H	8 lb. each	Q	18 lb.
I	11 lb.		

NOTE: All Weights listed are to the nearest pound. All dimensions shown are to the next integral inch.

Figure 18 — Exploded Shipping View

(*d*) Pump lubricating oil into fuel pump.

(*e*) Seal breather openings.

(*f*) Spray cylinders.

(*g*) Install dehydrator plugs.

(*h*) Empty carburetor; saftey plugs.

(*i*) Place bag of silica-gel in intake scoop and exhaust opening.

(*j*) Seal vent openings.

(*k*) Disconnect oil lines.

(*l*) Safety engine drain plug.

(*m*) Remove propeller; spray shaft.

(*n*) Remove thrust bearing plates and oil them.

(*o*) Spray engine externally.

(*p*) Cover engine.

(*q*) Spray metal surfaces.

(*r*) Remove loose equipment.

(*s*) Place loose equipment in box.

(*t*) Detach wing outer panels, tail assemblies, and right wing gun.

(3) CRATING.

(*a*) Install hoist shackles and hoist airplane.

(*b*) Retract landing gear.

(*c*) Lower fuselage on platform.

(*d*) Bolt rear end of fuselage to tail stand.

(*e*) Bolt caps to wing center section.

(*f*) Strap down horizontal tail assembly.

(*g*) Place propeller in box.

(*h*) Place and secure wings in cradles.

(*i*) Secure wings at bolting angles to platform.

(*j*) Assemble sides of crate.

(*k*) Attach vertical stabilizer and rudder.

(*l*) Install all loose equipment.

(*m*) Install ends and top of crate.

(*n*) Apply tar paper to roof.

(*o*) Attach inspection seals.

(*p*) Cut hoisting notches.

(4) UNCRATING.

(*a*) Enter crate through door.

(*b*) Remove top.

(*c*) Remove loose parts from sides.

(*d*) Remove ends of crate.

(*e*) Remove sides.

(*f*) Remove wing outer panels.

(*g*) Remove horizontal tail assembly and box of loose equipment.

(*h*) Remove propeller.

(*i*) Remove bolts securing center section.

(*j*) Attach hoisting rings.

(*k*) Detach fuselage tail stand support.

(*l*) Hoist airplane.

(*m*) Extend landing gear.

(*n*) Remove cosmolene or equivalent.

f. SHIPPING COMPONENT PARTS OF AIRPLANE.

(1) GENERAL.—For the shipment of component parts of the airplane separately, a diagram, figure 18, is provided to show a suggested break-down and the weights involved.

2. ERECTION.

Detailed instructions for assembly of the major component parts of the airplane will be found in section IV. Refer to paragraph 4 of this section for instructions for preparing engine for service.

3. PREPARATION OF ENGINE FOR STORAGE.

The following procedure will be completed as soon as possible after engine shutdown, but in every case the following procedure shall be completed within 12 hours. The corrosion-preventive mixture used in the engine consists of three parts grade 1120 engine oil and and one part corrosion-preventive compound, Specification No. AN-VV-C-576.

a. OIL DRAINAGE.—While the engine is still warm, the lubricating oil will be drained from the crankcase as instructed in section III paragraph 3. After the drain is completed, all drain plugs will be replaced and safetied.

b. ROCKER BOXES.—Rocker box covers will be removed and each rocker box cleaned and sprayed with a corrosion-preventive mixture thoroughly enough to coat the valve rocker arms, valve stems, springs push rods, and interior of boxes. Replace covers and gaskets, and screw down to an airtight seal.

c. EXHAUST PORTS AND MANIFOLDS.—Each exhaust port will be sprayed with a sufficient quantity of corrosion-preventive mixture to thoroughly coat the exhaust valve. A ½-pound bag containing silica-gel Specification No. AN-D-6, will be placed in the exhaust opening of the exhaust manifold, anchored in place and the opening sealed by covering with an oil and moisture-resistant diaphragm. The silica-gel bag will not be removed from its moistureproof container until immediately before being inserted in the opening.

d. THRUST BEARINGS.—Thoroughly coat thrust bearings with corrosion-preventive mixtures; install cover plate.

e. ACCESSORY DRIVES.—The cover plates will be removed, corrosion-preventive mixture applied, and the cover plates reinstalled.

f. CARBURETOR.—The carburetor will be emptied of all residual fuel and filled with oil conforming to grade No. 1065, Specification No. AN-VV-O-446, and all interior surfaces thoroughly slushed. Care should be exercised not to damage moving parts, such as floats and needle valve. Under no condition will the regular air chambers, air passages, or automatic control be slushed with oil; these units must be kept dry at all times. Drain the excess oil, replace the plugs, and lock the throttle in the open position. The carburetor will then be completely sealed in a moisture-resistant enclosure fabricated of a material conforming to Specification No. AN-O-P-406. A 1/2-pound bag of silica-gel will be placed within this enclosure and secured. Do not remove the silica-gel from its moistureproof container until just before applying to the carburetor.

g. CARBURETOR ADAPTER.—A 1/2-pound bag of silica-gel will be securely anchored in the throat of the carburetor adapter. Do not remove the silica-gel bag from the container until ready for use. Carburetor adapter will then be sealed with a gasket and an oil and moisture-resistant plate on the adapter, using carburetor attaching studs and nuts.

h. ACCESSORIES.—When fuel pumps are attached to the engine, oil conforming to Specification No. AN-VV-O-446, grade 1065 will be injected into the pump while the engine shaft is being rotated to insure a complete coverage of oil on the fuel pump parts.

i. OIL INTAKE AND OUTLET.—The oil intake and outlet will be sealed with oil and moisture-resistant covers of appropriate size.

j. BREATHERS.—All breather openings in the engine will be adequately sealed with oil and moisture-resistant covers or dehydrating plugs. Dehydrating plugs should be used if possible. The moisture seals of the dehydrating plugs must not be removed until immediately before screwing the plugs into their intended location.

k. CRANKCASE.—The oil sump plug will be removed and replaced with a crankcase dehydrator plug which will be screwed tight. The replaced sump plug should be retained with the engine for future use. The moisture seal on the plug should not be removed until immediately before screwing it into the sump.

l. CYLINDER BORES.—After checking valve clearances the interior of each cylinder will be sprayed through the spark plug holes with a corrosion-preventive compound while rotating the propeller shaft. This initial spraying will be done with the piston at bottom dead center in each case. Following this initial spraying, each cylinder will be resprayed through the spark plug holes without rotation of the crankshaft. Thereafter the propeller shaft will not be rotated. If by accident the shaft is rotated, the cylinders must be resprayed in accordance with the above procedure to insure adequate coverage of all surfaces. Engine cylinder dehydrator plugs will be installed in all spark plug openings and tightly sealed. The moisture seal will not be removed from the dehydrator plug until immediately before screwing them into the individual spark plug holes.

m. MAGNETOS.—The magnetos will need no preparation for storage since the cam, springs, and all other steel parts of the breaker mechanism are coated with oil. However, an inspection must be made to ascertain that the oil coating is sufficient. In the event that oil is to be applied, extreme care must be taken so that no oil reaches the breaker points, as the life of the breaker points will be materially shortened if exposed to oil or grease. Oil grade 1100A, Specification No. AN-VV-O-446, is suitable for coating magneto parts.

n. OTHER ENGINE OPENINGS.—All other openings in the engine will be closed with moistureproof seals to maintain the internal parts of the engine as airproof and moistureproof as possible.

4. PREPARATION FOR SERVICE AFTER STORAGE.

a. ENGINES.

(1) Engines installed in aircraft that have had the valves and valve mechanisms treated for temporary periods of idleness can be placed in service immediately, as the light coating of oil on the valves is soon burned away. Before starting the engine, inspect for the presence of oil that may have drained into the lower intake pipes under the blower section. Rotate the propeller slowly by hand at least four or five revolutions to make sure that the cylinders are free from any accumulation of water, oil, or fuel, and that the valves operate freely. If the valves stick, treat as noted in paragraph (2) *(d)* following, before operating the engine. If, after starting the engine, the spark plugs foul from excessive engine oil, remove them and wash with acetone.

(2) Engines which have been treated for extended storage will be prepared for service as follows:

(a) Remove all capping and plugs from tubes and other openings. Replace all disconnected fuel and oil lines, controls, etc.

(b) Wipe off all external steel parts with a rag. Wipe off the breaker mechanism of the magnetos thoroughly. No relubrication of magnetos is necessary.

(c) Remove the oil screens, thoroughly clean in gasoline, and reinstall.

(d) Remove the shipping plugs from the spark plug holes, and before installing the spark plugs, slowly rotate the crankshaft four or five revolutions to determine that the valve mechanism is operating properly, and that excessive corrosion-preventive is not present in the cylinders. Remove any excess compound with a hand pump or by draining. Lubricate the stems of any stuck valves with a mixture of gasoline and lubricating oil. Turn the engine over by hand until all valves are free. If the valves will not free, have them repaired. Do not put an engine with stuck valves into service.

(e) Remove the three lower intake pipes, and inspect for excess oil collection. If excess oil is found, also examine the intake pipes on each side of those removed. Continue this inspection toward the top cylinder until intake pipes are found free of excess oil. When removing intake pipes, loosen or remove the packing gland nut at the crankcase before loosening intake pipe at the cylinder. This precaution will prevent damage to packing, intake pipes, and attaching flanges.

(f) Reverse these operations to reinstall intake pipes.

(g) Put enough oil in the tanks for the ground test. After the engines have been ground-tested, drain the oil system and refill with new oil. Dispose of the drained oil. Being mixed with corrosion-preventive compound, it can not be reclaimed.

b. AIRPLANE.

(1) At the end of the storage period, clean and relubricate all bearings (except sealed bearings).

(2) Remove protective coatings from brake drums. The following mixture is suggested for removing primer coatings:

Benzol	3 parts
Acetone	1 part
Denatured Alcohol	1 part

Standard paint removers are not recommended for this purpose as they contain paraffin which will impair braking efficiency.

(3) Remove excess rust preventive from all parts of the airplane (except control cables).

Key to Figure 19

1. Oil Tank, Vacuum Pipe, Oil Separator and Oil Dilution Solenoid
2. Engine Accessory Compartment, Battery on Right Side
3. Oil Tank Filler Neck
4. Starter Brush-Lifting Lug
5. Front Cockpit Instruments
6. Handhold
7. Front Cockpit Instruments Plus Ignition Switch Box
8. Side Panels—Various Items
9. Hydraulic Fluid Reservoir
10. Hand Fire Extinguisher
11. Dynamotor, Control Cable Turnbuckles, Rudder and Tail Wheel Idler Arms and Tension Springs
12. Elevator Outer Hinge and Bonding Braid
13. Elevator Center Hinge, Trim Tab Operating Drum and Zerk
14. Elevator Trim Tab Operating Screw and Control Rod
15. Elevator Control Horns, Cables, and Torque Tube Attaching Bolts; Horizontal Stabilizer Spar and Fuselage Attaching Bolts and Fittings
16. Upper Rudder Hinge and Bonding Braid
17. Center Rudder Hinge
18. Rudder Trim Tab Screw and Control Rod
19. Elevator Trim Tab Operating Screw and Control Rod
20. Elevator Outer Hinge and Bonding Braid
21. Elevator Center Hinge, Trim Tab Operating Drum and Zerk
22. Rudder Stops and Lower Hinge
23. Tail Wheel Unit, Elevator Control Horn, and Rudder Light Junction Box
24. Wheel Bearing and Tire Valve Stem
25. Lower Tail Wheel Unit Including Control Cables, Horn, and Zerks
26. Control Cables and Pulleys
27. Baggage Compartment
28. Camera Door
29. Side Panel—Various Items
30. Camera Viewfinder Door
31. Fuel Tank Vent Line
32. Landing Gear Lock Fitting and Hoisting Provisions
33. Wheel Bearings
34. Side Panel—Various Items
35. Hydraulic Lines
36. Main Fuse Panel
37. Cowling Lock Fitting
38. Fuel Selector Valve Shaft
39. Flap Operating Cylinder Zerk
40. Navigation Light Outer Junction Box
41. Structural Inspection Provision
42. Structural Inspection Provision
43. Bomb Rack Installation Door
44. Bomb Rack Installation Door
45. Aileron Cable Turnbuckle and Disconnect Point
46. Fuel Tank Strap Turnbuckle
47. Aileron Cable Pulleys
48. Fuel Tank Sump, Drain Cock, Standpipes, and Strap Turnbuckles
49. Fuel Selector Valve, Cock, and Lines; Aileron Cable Pulleys
50. Fuel Tank Strap Turnbuckle
51. Aileron Cable Pulleys and Fuel Lines
52. Aileron Cable Pulleys and Fuel Lines
53. Fuel Tank Strap Turnbuckle
54. Fuel Tank Sump, Drain Cock, Standpipes, and Strap Turnbuckles
55. Aileron Cable Pulleys
56. Fuel Tank Strap Turnbuckle
57. Aileron Cable Turnbuckle and Disconnect Point
58. Gun Charging Cable Pulley
59. Bomb Rack Installation Door
60. Aileron Push-Pull Rod and Bellcrank
61. Structural Inspection Provision
62. Structural Inspection Provision
63. Navigation Light Outer Junction Box
64. Aileron Push-Pull Rod and Bellcrank
65. Landing Light Junction Box
66. Landing Light
67. Gun Camera Bay
68. Gun Camera Adjustment
69. Landing Gear Operating Cylinder, Wing Bolting Angle, and Electric and Hydraulic Lines
70. Landing Gear Lockpins and Linkage
71. Fuel Tank Door
72. Fuel Strainer
73. Fuel Tank Door
74. Landing Gear Lockpins and Linkage
75. Landing Gear Operating Cylinder, Wing Bolting Angle and Electric and Hydraulic Lines
76. Gun Shell Ejection Chute
77. Machine Gun Bay
78. Ammunition Bay
79. Landing Light
80. Landing Light Junction Box
81. Bomb Rack Installation Door

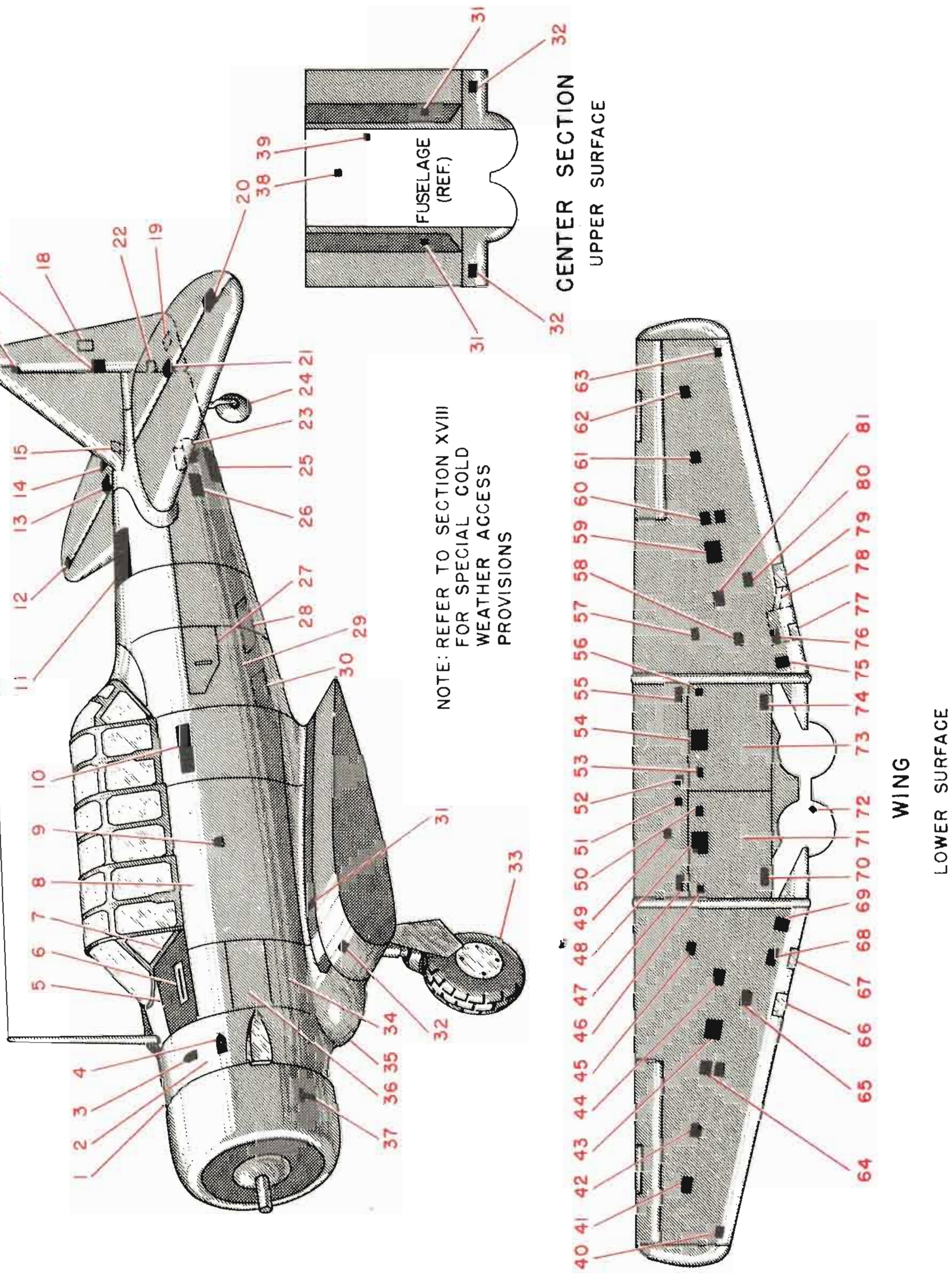


Figure 19 — Access Provisions Diagram

SECTION III

HANDLING AND GENERAL MAINTENANCE

1. ACCESS AND INSPECTION PROVISIONS.

The access provisions diagram, figure 19, includes a list of all access doors, covers, and parts accessible therein.

2. GROUND HANDLING.

a. GENERAL.—Do not push, pull, or lift the airplane by any means other than those prescribed and outlined in the following paragraphs. Provisions have been made for the proper execution of all necessary handling operations and if the following instructions are adhered to, damage to the airplane or its equipment will be prevented. The exercising of utmost care at all times in handling operations can not be too greatly stressed. Special tool part numbers noted in this section are for convenience in making use of equipment already on hand. Do not use these numbers in ordering parts.

b. STEPS, HANDHOLDS, AND WALKWAYS.—Two fixed steps are provided on the left side of the fuselage, one at each cockpit. A cut-out in each instrument panel shield is provided for a handhold to facilitate entrance and exit of the crew. A flush-type handhold located on the left side of the fuselage cowling just forward of the windshield, and a retractable step, extending through the engine compartment cowling just forward of the leading edge of the left wing, are provided to aid in starting the engine and servicing the oil tank and engine. Walkways of Tri-m-ite cloth applied with neoprene are provided on the wing center section on either side of the fuselage. The wings should not be walked on except where walkways are provided.

WARNING

Do not use windshield or antenna mast as handholds or the enclosure tracks and engine cowling supports as steps.

c. HOISTING PROVISIONS.

(1) HOISTING THE AIRPLANE.

(a) To hoist the complete airplane with the power plant installed, remove the access covers on the upper surface of the center section near the leading edge, and attach the hoist fittings 36-55009, provided with the airplane. Using the complete airplane sling, T.J. 3822 or equivalent, the type illustrated in the diagram, the lift tube bar, 88-05002, is inserted in the lift-mooring tube located in the aft section of the fuselage. The ends of the sling are then attached to the hoist fittings and the lift tube bar.

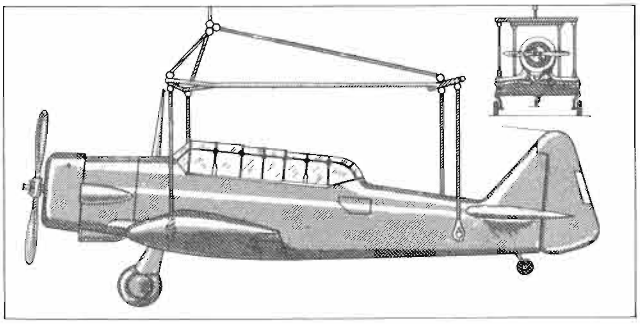
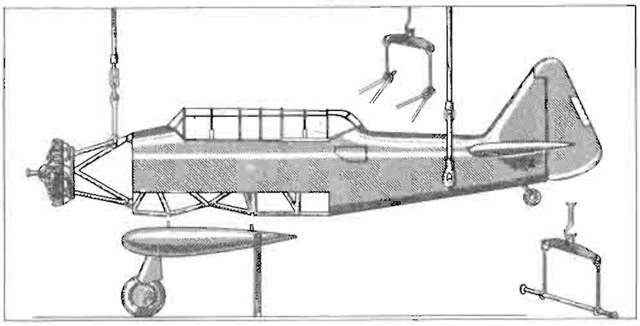


Figure 20 — Hoisting Airplane

(b) Hoisting of the fuselage from the center section may be done in the manner shown in figure 21.



Figŭre 21 — Hoisting Fuselage from Center Section

(c) In the event the power plant has been removed, the fuselage may be hoisted from the center section by employing the complete fuselage sling, T.J. 2400 or equivalent. The crossbar of the sling assembly is attached to the forward face of the fire wall by the upper engine mount bolts. The lift tube bar, 88-05002, is inserted in the lift-mooring tube in the aft section of the fuselage. Then, as illustrated in figure 22, the ends of the sling are securely fastened to each part.

WARNING

Never hoist the airplane by the two lugs located on the engine mount at the two upper points of attachment to the fuselage. These lugs are for hoisting the power plant only.

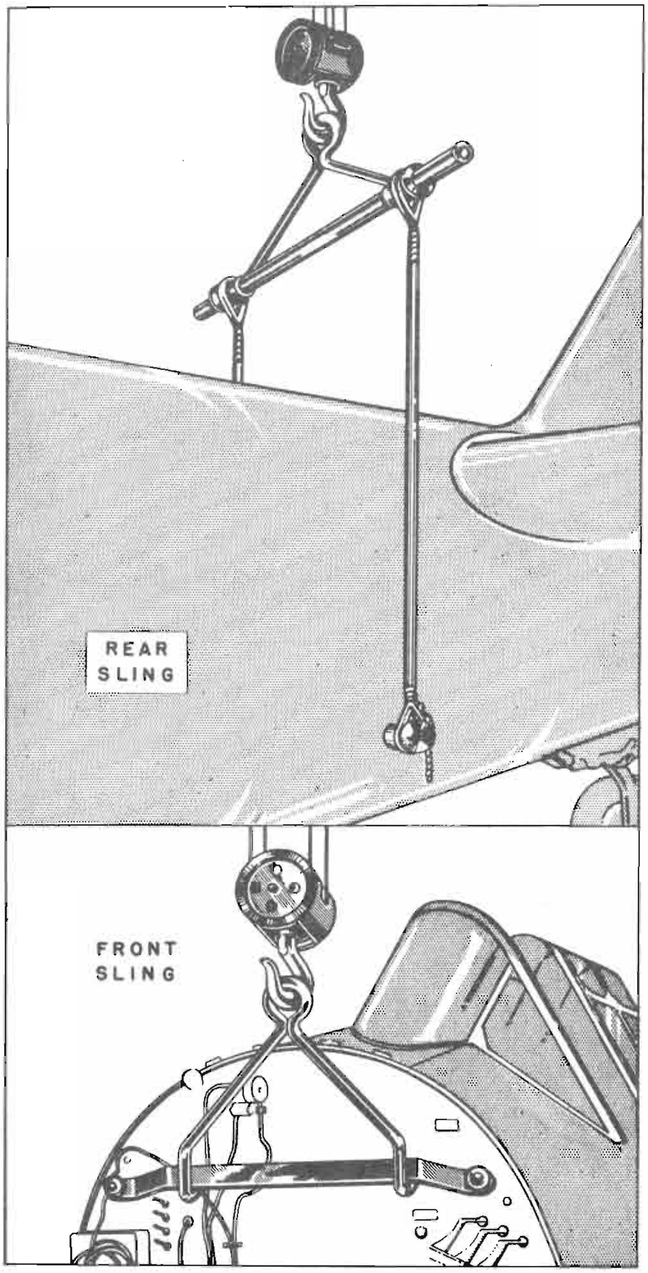


Figure 22 — Complete Fuselage Sling

(2) HOISTING THE POWER PLANT.

(*a*) Hoisting the complete power plant assembly by use of the hoisting eyes provided at the rear of No. 1 engine cylinder involves considerable work, because of the necessity of removing the cylinder pressure baffles in order to gain sufficient access to the eyes. However, the complete power plant may be safely hoisted when propeller is not installed, without using the engine hoisting eyes, by employing an engine and mount sling, R-5057, as shown in figure 23. Prior to the installation of this sling, the propeller shaft must be protected by lacing a suitable padded leather boot around it and installing a propeller shaft thread protector cap, 36544-40, furnished with the airplane. Assured of ample protection to the propeller shaft, the sling is made secure at that point, preferably with several loops around the shaft, and fastened to the mount.

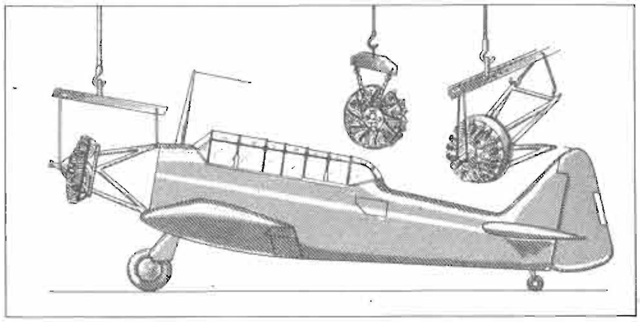


Figure 23 — Hoisting Power Plant

(*b*) When hoisting the engine separately, the lifting eyes provided on the engine should be used. Remove the cylinder pressure baffles and attach an engine sling, 49-55011 or equivalent.

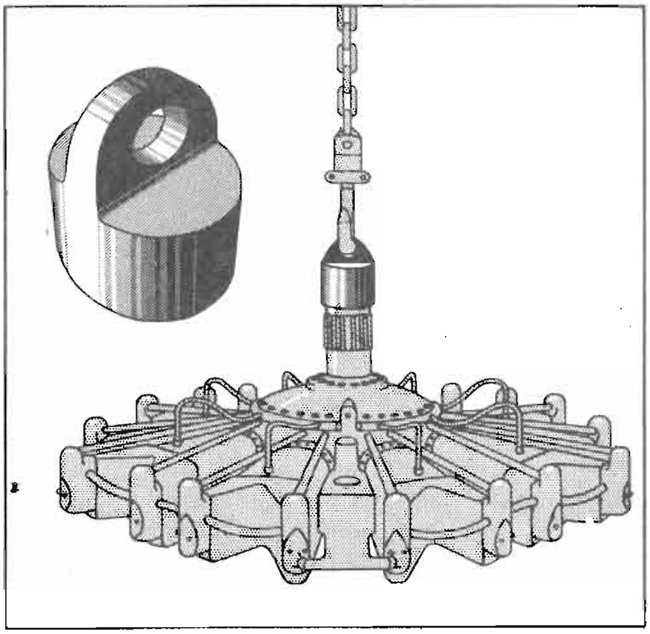


Figure 24 — Engine Lifting Eye

(*c*) If the power plant is in a horizontal position, it is advisable to hoist it by using the engine lifting eye, R-5059-2. The eye is firmly fitted to the engine crankshaft.

d. LIFTING.—A lift-mooring tube is provided in the aft section of the fuselage just forward of the tail surfaces as a means by which the airplane may be lifted or moored. A lift-tube bar, 88-05002, or similar bar up to 1-5/8 inches diameter, may be passed through this tube and the airplane lifted by support of personnel at each end or by means of a hoist. The lifting bar must be passed completely through the aperture to prevent damage to the tube. When lifting the tail of the airplane by this method with the power plant installed, the same precautions shall be taken as specified for jacking the tail of the airplane. Do not lift the tail of the airplane by means of the horizontal stabilizer.

e. JACKING ARRANGEMENTS.

(1) Jacking points are provided inboard of the landing gear struts.

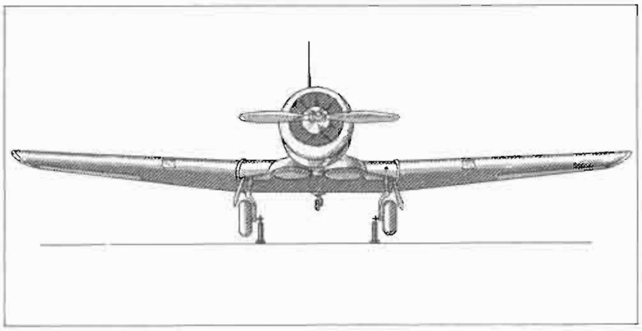


Figure 25 — Jacking at Landing Gear

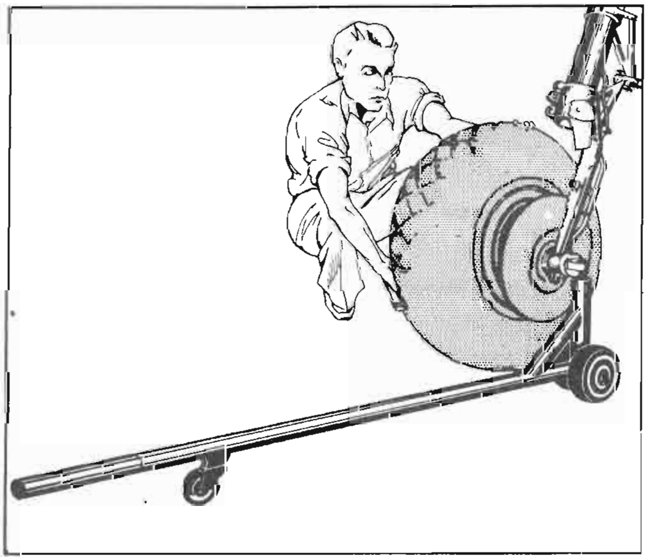


Figure 26 — Axle Hand Jack

(2) Blocks equipped with jacking points are installed at two well-marked locations on the front spar of the outer wing panels, approximately 30 inches outboard of the wing joint bolting angle.

WARNING

Do not jack the airplane at the wing jacking points when the fuel tank doors are removed from the center section.

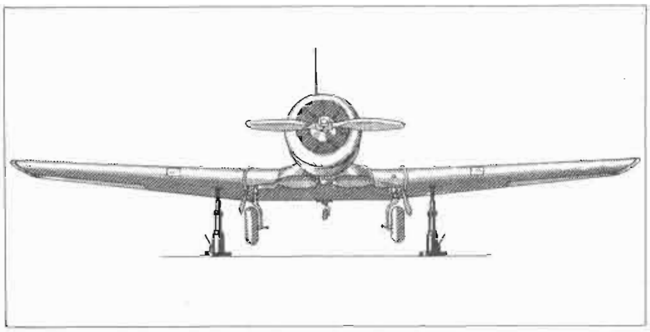


Figure 27 — Jacking at Outer Panels

(3) To jack the airplane when the outer wing panels are removed, the center section bolt angle pads, T.J. 2239-2, are suggested. These are attached to the center section bolt angle in the vicinity of the front spar to afford proper jacking points.

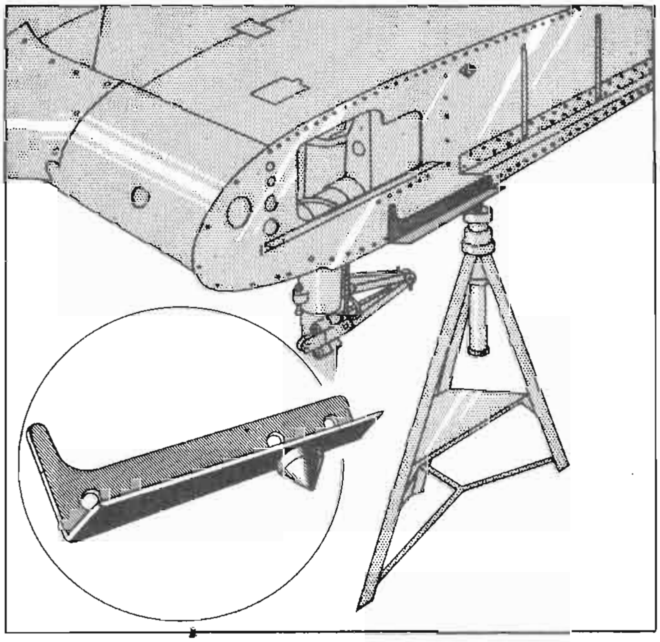


Figure 28 — Center Section Bolt Angle Pad

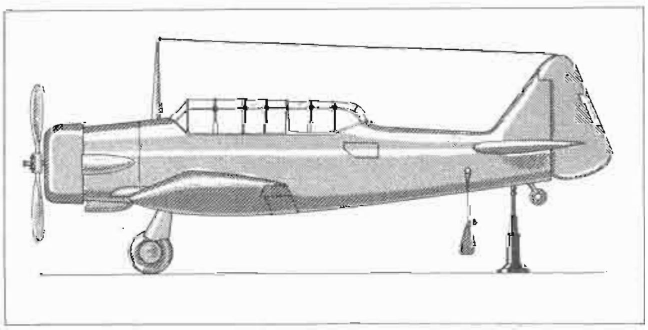


Figure 29 — Jacking at Tail

(4) The tail jacking point is located on the fuselage just forward of the tail wheel. Always make

certain that the head of the jack to be used is suitable for the type of jacking point provided.

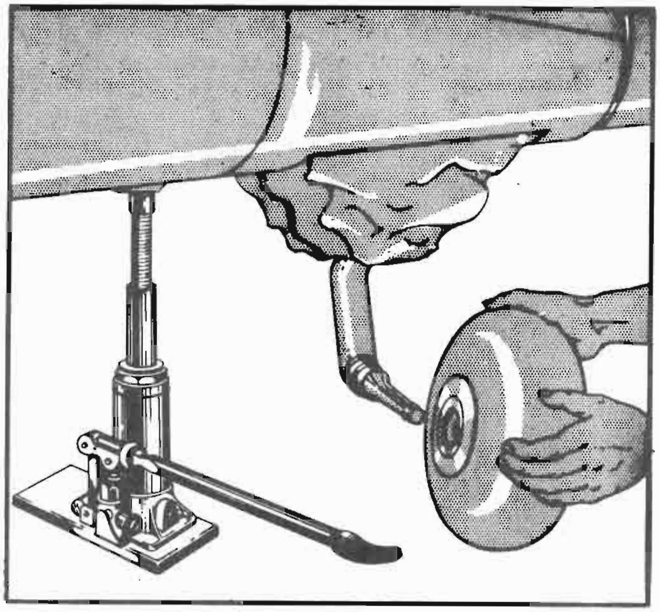


Figure 30 — Tail and Axle Hydraulic Jack

CAUTION

When jacking the tail of the airplane with the power plant installed, block the landing gear wheels, insert the bar, 88-05002, in the lift-mooring tube, and suspend sandbags or other like weights from the bar. This will prevent the airplane from accidentally nosing over.

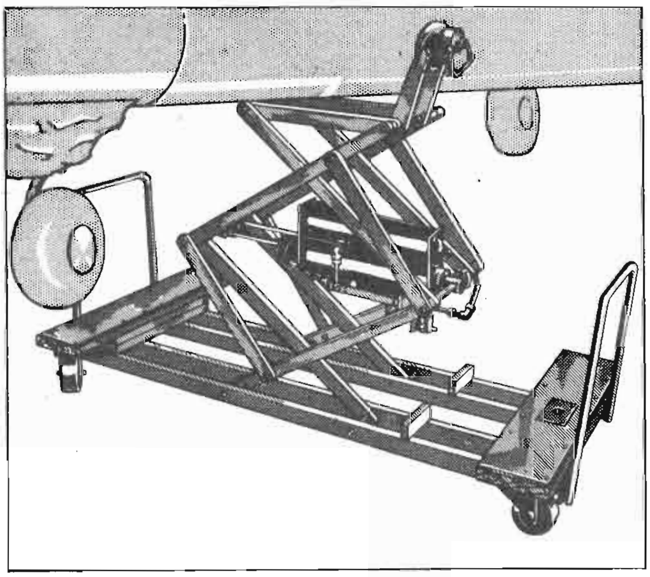
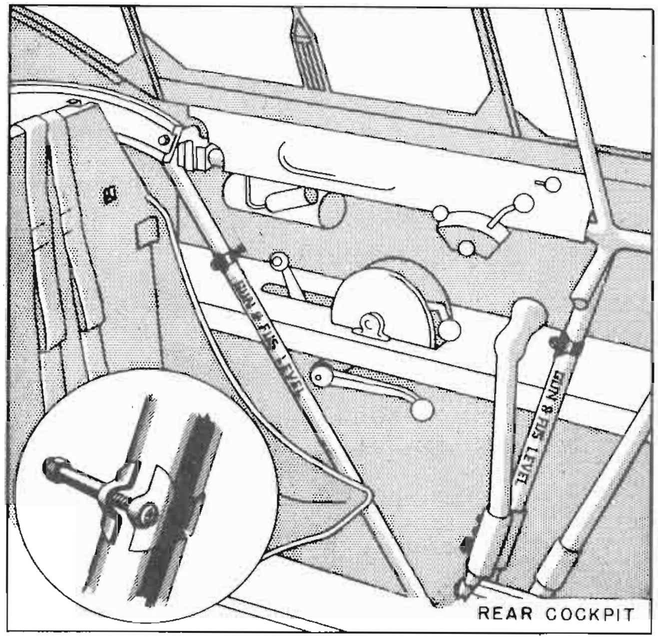


Figure 31 — Tail Jacking Conveyor

(5) A jacking conveyor, similar to that shown in figure 31, may be employed to jack and transport the airplane when "swinging" the compass. The conveyor is attached at the lift-mooring tube. Its use allows easier balance and mobility.

f. LEVELING.—The longitudinal leveling brackets are located on the fuselage diagonal tubes at the left side of the rear cockpit. The lateral leveling brackets are located on the upper fuselage cross tube immediately aft of the front cockpit seat. A level on these brackets will be parallel to the longitudinal and lateral reference datum lines of the airplane, respectively. (The longitudinal



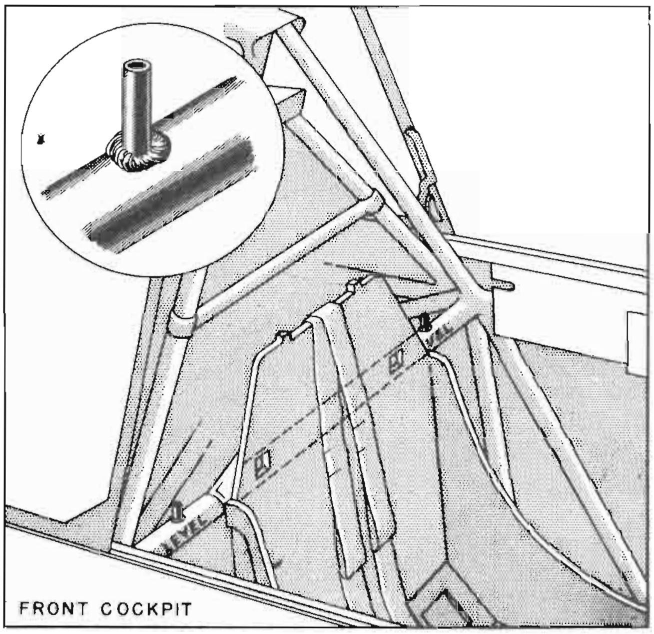


Figure 32 — Leveling Brackets Diagram

reference datum line is parallel with the thrust line.) When placing the airplane in the level flight position with the power plant installed, the same precautions shall be taken as specified for jacking the tail of the airplane.

g. DATUM POINT.—Two datum points for fuselage and gun alignment are provided on the center line of the airplane on the lower surface. One point is located on the wing center section directly aft of the fire wall, and the other is located on the fuselage rear section forward of the camera doors. The points are well marked with 1-1/2 inch diameter red circles and are provided with a nut plate for attaching plumb bobs.

h. MOORING.—Head the tail of the airplane into the wind, lock the surface controls, lock the brakes, and block the wheels. Insert the mooring rings, which are stowed in the baggage compartment, into the sockets provided on the lower surfaces of the outer wing panels near the tips, and attach the mooring ropes or lines thereto. Make the ends fast to ground mooring rings or weight with sandbags. The tail should be secured by passing mooring lines through the aperture of the lift-mooring tube or by lashing directly to the tail wheel fork.

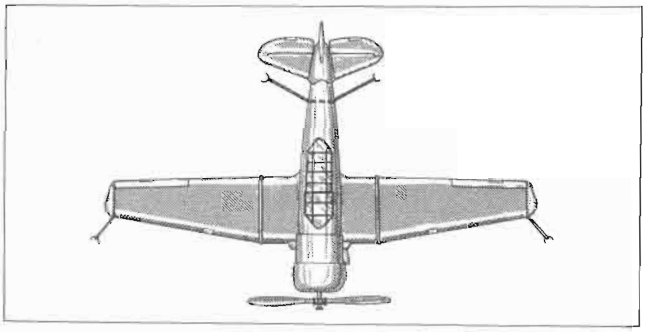


Figure 33 — Mooring

i. SURFACE CONTROL LOCK.—The surface control locking mechanism is located in the front cockpit to the left and forward of the control stick. To lock the entire surface control system, place the rudder pedals in neutral, push the control stick forward and center it laterally. Pull up and back on the lock handle assembly and engage the control stick in the lock recess; then engage the handle plunger in the locked position. To release, push forward on the control handle and then push the lock mechanism forward into the stowed position. The lock mechanism should be stowed in the locked-down position when not engaged with the control stick.

j. PARKING BRAKE CONTROLS.—A parking brake control knob is located on a sub-panel below the front instrument panel. To apply the parking brakes, pull out on the control knob and press both brake pedals to their full extent; release the brake pedals and then release the control knob. The parking brakes may be applied from the front cockpit only; however, they may be released from either cockpit by pressing on the pedals.

k. TOWING.

(1) Proper towing of the airplane is accomplished by use of a towing bar, such as T.J. 4113, attached to towing rings provided inboard of the landing gear strut.

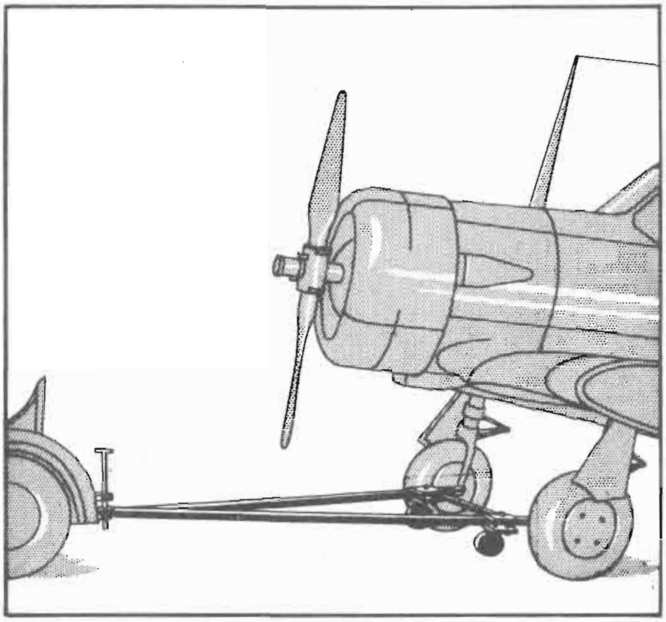


Figure 34 — Towing Bar

(2) Use of a tail steering bar, T.M. 2689, is suggested for moving the tail of the airplane.

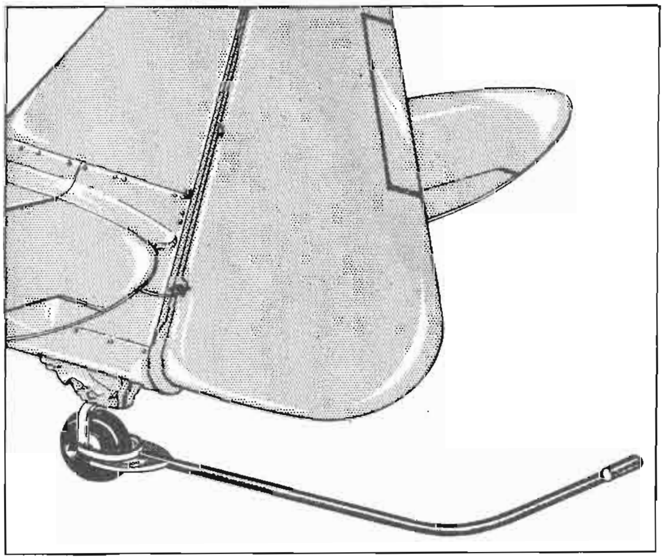


Figure 35 — Tail Steering Bar

WARNING

Do not tow the airplane with the controls locked.

l. AIRPLANE COVER.—An airplane engine cover is provided in the baggage compartment to protect the power plant installation. On British airplanes an enclosure cover is also provided.

m. LOCKING AIRPLANE.—The forward sliding section of the cockpit enclosure may be locked by inserting a padlock through the hole in the enclosure track at the left forward corner of the stationary section. The rear sliding section may be locked by inserting a padlock through the hasps provided at the rear of the gunner's hood. The baggage compartment may be locked by means of the lock in the door handle, the keys for which are stowed in the map and data case located at the right side of the front cockpit.

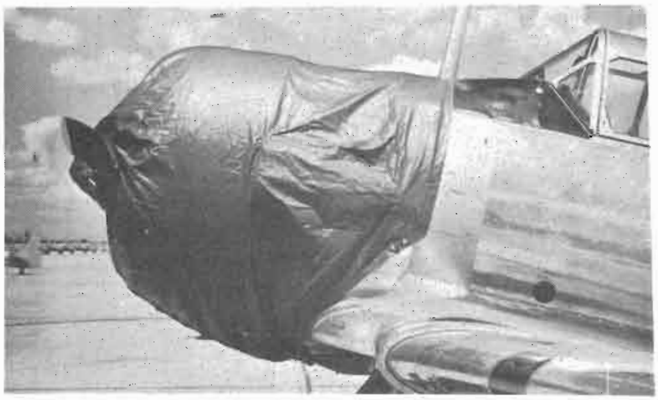


Figure 36 — Engine Cover

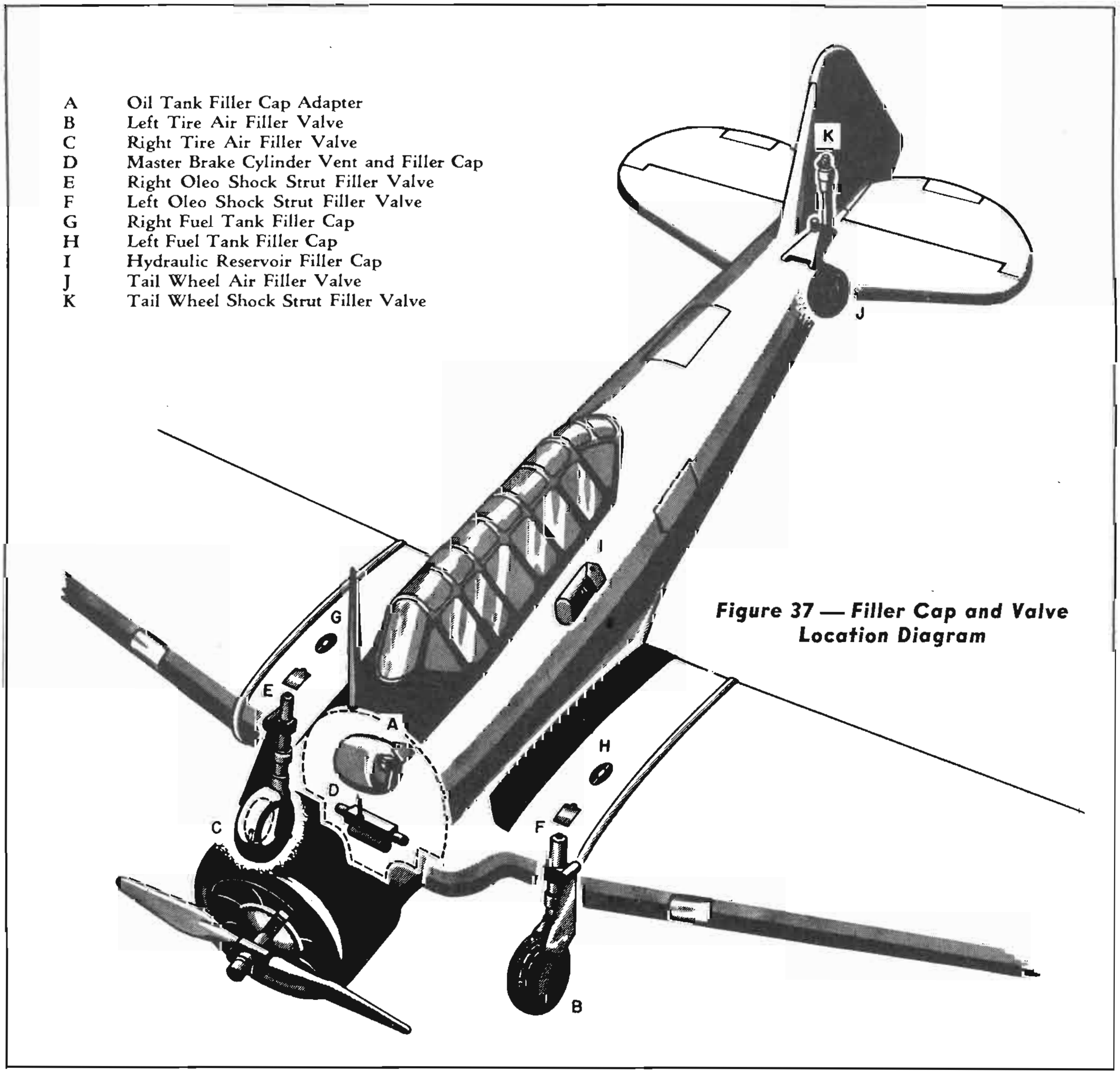


Figure 37 — Filler Cap and Valve Location Diagram

3. SERVICE INSTRUCTIONS.

a. FUEL SYSTEM.

(1) DRAINING THE FUEL SUMPS.—Drain the fuel sumps to remove any accumulation of water and foreign matter each time fuel is serviced to the tanks. Open the drain cocks at the bottom of sumps. Access to the drain cocks is by means of access holes in the lower surface of the center section. Also drain the strainer by means of a drain cock at the bottom of the fuel unit located at the lower forward side of the fire wall. An access cover is provided on the engine compartment cowling below the fuel unit. When the fuel tanks are filled, and it is desired to clean the fuel strainer located within the fuel unit, be sure to set the fuel selector valve in the "OFF" position.

(2) FILLING FUEL TANKS.—A fuel tank filler neck is located on the upper surface of the center section, just outboard of each walkway. Each of two tanks accommodates 55.2 U.S. gallons of fuel, making a total of 110.4 U.S. gallons. A fuel quantity gage of the built-in-float-type is attached directly to the upper surface of each tank and projects through the wing, at each side of the front cockpit. The gages are readily visible from both cockpits and are provided with lights which may be turned on from either cockpit. Fill the tanks to overflowing when the airplane is in a three-point position, as the gages are accurate only when the airplane is in a level flight position. A drain line, located inboard and aft of each filler cap on the lower surface of the wing center sections, is provided for the filler neck and is arranged to conduct overflowing fuel away from the airplane. When the airplane is in flight, the fuel gages indicate 5 gallons more than the actual contents when read from the rear cockpit. The tanks are to be serviced with 91 octane fuel.

NOTE

The fuel system is NOT suitable for aromatic fuels. If 91 octane fuel is not available, the next higher grade may be used in emergency.

(3) DRAINING FUEL SYSTEM.—To drain the complete fuel system, remove the stand pipes and corrosion-resistant capsules from the two sumps. Open the drain cock at the fuel unit and at the bottom of the fuel selector valve. The latter is the lowest point in the fuel system when the airplane is in a three-point position. Access to the drain cocks is provided by means of Dzus-fastened access covers. (See figure 19.) Drain the carburetor. Clean the strainers in the fuel unit and at the top of the carburetor and also the screen on the standpipes. Access to the drain cocks is provided by means of access holes in the lower surface of the center section. Drain the fuel unit strainers by means of a drain cock at the bottom of the fuel unit located at the lower forward side of the fire wall. An access cover is provided on the engine compartment cowling below the fuel unit. To remove possible accumulation of water and foreign matter from the system open the drain cocks daily, as instructed above.

b. OIL SYSTEM.

(1) FILLING OIL TANK.—The oil tank filler neck is reached through a Dzus-fastened access door in the upper left section of engine compartment cowling. An overflow collector ring forms part of the filler neck with the drain line terminating at the lower side of the engine compartment. The capacity of the oil tank is 10.2 U.S. gallons. Fill the tank to overflowing with engine oil, Specification No. AN-VV-O-446, grade 1120 (SAE 60). Reclaimed oil is suitable for engine run-up. Regular engine oil may be used for run-up only when reclaimed oil is not available. Reclaimed oil is always handled in *brown* drums with *yellow* bands around the middle. Drum heads must bear the following notation: "For use on engine ground run-up oil only: Do not use for fly-away oil."

(2) DRAINING OIL SYSTEM.—To drain the oil system, it is necessary to remove the lower right section of the removable engine compartment cowl assembly. Place a suitable receptacle under the oil drain line; open the Y-drain valve, located on the right side of the engine compartment. To drain engine, remove engine sump plugs and allow oil to drain. Replace plugs and safety.

c. MAIN HYDRAULIC SYSTEM.

(1) HANDLING HYDRAULIC FLUID.—Every precaution must be exercised while mixing and straining the hydraulic fluid to prevent its contamination. Dirt or other particles in the system, which may become lodged between the valves and seats and compensating ports in the various actuating cylinders, would prevent the systems from operating properly. Particles may also work under the seals on the master cylinder piston or under the brake piston seal and cause leaks, with subsequent brake failure.

(2) FILTERING.—Fluid that has been exposed to dust or otherwise contaminated should be filtered before using. Fluid that has been used should also be filtered before reuse. Filtering will remove the sludge from the used fluid, as well as all metal flakes and grit. The simplest equipment for filtering hydraulic fluid consists of a ribbed glass or metal funnel of approximately 1-gallon capacity, a sheet of standard commercial filter paper, and a container to support the funnel and hold the filtered oil. The filter paper is folded into a funnel shape and placed in the funnel. The oil will pass through the filter slowly and should be protected from dust particles in the air by a cloth dampened in hydraulic oil and placed around the funnel at the open end of the container. The filtered oil should be placed in clean containers, properly marked to identify the contents, and should be kept sealed until required for use.

(3) FILLING HYDRAULIC FLUID RESERVOIR.—Access to the hydraulic fluid reservoir is gained through a hinged, Dzus-fastened door located on the left side of the fuselage between the cockpits. An instruction plate

for filling reservoir is located on the inside of this door. With the ship in normal three-point position, fill the reservoir with mineral oil AAF Specification No. 3580, red color. Fill the reservoir to overflowing inasmuch as a visual inspection of the fluid contents through the filler opening is misleading. For satisfactory operations the reservoir must be full at all times. Total fluid capacity of the reservoir when airplane is in the three-point position is 0.77 U.S. gallons.

(4) DRAINING HYDRAULIC SYSTEM.—The drainage of the complete hydraulic system cannot be accomplished from any one point. However, to remove a considerable portion of the fluid, mainly that contained in the fluid reservoir, place ship in level flight position. Drainage may be accomplished at test pump connections at the left side of engine mount by removing plug from plug valves and turning handle to "TEST PUMP" position. Approximately 1/2 gallon of fluid will be obtained from this point. With landing gear control handle in "DOWN" position, further drainage may be accomplished by placing receptacle under drain T-fitting on landing gear hydraulic line, located in left landing gear retracting well, and removing plug. Using hand pump, remove balance of fluid. The total capacity of the hydraulic system is approximately 1-3/8 U.S. gallons.

d. BRAKE HYDRAULIC SYSTEM.—Refer to paragraphs *c.* (1) and (2) for handling of hydraulic fluid.

(1) FILLING MASTER BRAKE CYLINDER.—A combination vent and filler plug assembly for the master brake cylinder is located on the forward side of the fire wall. To refill cylinder, remove vent plug from fitting extending through fire wall and fill cylinder to overflowing. This should be accomplished with airplane in the three-point position and parking brakes released. The fluid used in the brake hydraulic system conforms to AAF Specification No. 3586, grade B, blue color which is a castor oil base hydraulic fluid.

(2) DRAINING BRAKE SYSTEM.—To drain the brake hydraulic system, disconnect brake line at fitting on each brake assembly, and place end of each line in a suitable receptacle. Then slowly pump brake pedals until fluid leaves the system. To clean the brake system, flush it with formula No. 1, denatured alcohol.

e. SHOCK ABSORBER STRUTS.

(1) FILLING MAIN LANDING GEAR SHOCK STRUTS.—If shock struts require refilling, the following servicing should be accomplished after rolling the airplane forward to a position on level ground, out of the wind and away from the slipstream of other airplane propellers. Adhere to the following procedure:

(a) To refill either shock strut, remove the access cover located on the upper surface of wing center section, directly above the strut.

(b) Remove hex cap in air valve at top of strut, slowly release all air from strut by backing off the filler plug not more than one turn until all the fizzing of air and fluid stops and the strut is fully compressed.

CAUTION

Do not attempt to remove filler plug until all fizzing ceases.

(c) Remove filler plug; check the fluid level. The level of the fluid should be flush with the filler plug hole when the strut is fully compressed. Fill as required with hydraulic fluid, Specification No. 3580-M. To clean cylinders, flush with kerosene or naptha.

(d) Replace filler plug loosely and cause the strut to extend and retract several times to eliminate air traps in the strut. Remove the plug and again check the fluid level. Repeat this procedure each time until proper fluid level is obtained. Then, seal plug tightly with a wrench.

NOTE

This filler plug is provided with an angular ring on the under side of the hex. A soft copper gasket is provided between this ring and the plug seat on strut. These seats must be free from dirt and marks, and the plug must be sealed snugly to prevent air leaks at this point. If necessary, a new gasket should be used each time the plug is replaced.

(2) INFLATING MAIN LANDING GEAR SHOCK STRUTS.—When inflating the shock strut as in the following procedure, the airplane should be rocked occasionally to overcome packing friction, thus preventing overinflation.

CAUTION

Do not overinflate, as hard taxying and bounce at contact will result. This is also important because of possible damage to the valve core as high pressure is released.

The actual air pressure required to inflate the strut depends upon the axial load on the strut because of the weight of the airplane and also the friction due to packing and any bending or torsional loads on the strut. Under normal loading conditions, approximately 200 pounds/square inch will be required. Because of the small quantity of air in the strut and the relative high pressure, it is inadvisable to attempt to measure the pressure with a gage. After the strut has been correctly adjusted, readjustment should not be made for minor changes; a variation of one-quarter inch is permissible. To inflate strut adhere to the following procedure:

(a) Attach high-pressure air hose to valve and inflate strut until it lifts the weight of the fully loaded airplane to a static position of 1-1/2 inches, the correct expansion under full load.

(b) Replace hex cap, which is a secondary seal, and screw down tightly, but not so tightly that the seat in the cap is forced inward, thereby depressing the valve core stem.

(c) Test valve core and seat around filler plug by putting a little soapy water around these joints to show the presence of air bubbles. Usually, leaks around other parts will be evidenced by seepage of fluid.

(3) FILLING TAIL WHEEL SHOCK STRUT.—Instructions for servicing shock strut are engraved on a metal plate attached to strut.

(a) Remove access cover at left side of airplane near the tail end of the fuselage.

(b) Remove hex cap on air valve at top aft end of strut piston. Slowly release all air from strut by backing off filler plug, which contains the air valve, one turn until all fizzing of air and fluid stops and strut is fully compressed.

CAUTION

Do not attempt to remove filler plug until all fizzing stops.

(c) Remove filler plug and check fluid level. The level of the fluid should be flush with the filler plug hole when strut is fully compressed. Fill, if necessary, with hydraulic fluid, Specification No. 3580-M. To clean cylinder, flush with kerosene or naptha.

(d) Make certain filler plug gasket is in good condition. Replace filler plug loosely; cause strut to extend and retract several times to eliminate air traps in the strut. When certain air traps have been removed and fluid level is correct, seal plug tightly with a wrench.

(4) INFLATING TAIL WHEEL SHOCK STRUT.—To inflate tail wheel shock strut, follow closely the procedure outlined below:

(a) Attach high-pressure air hose to air valve; inflate until the strut lifts the weight of the fully loaded airplane to a static position of 4-1/4 inches from its fully compressed position. Under normal conditions, this inflation is equivalent to approximately 160 pounds/square inch. In order readily to determine the correct strut inflation, a *red* line has been painted on the tail wheel knuckle housing fairing at the left side on the early models. This strut is extended a distance of 2 inches when the top of the line is flush with the lower edge of the fuselage lower rear cowl. Later airplanes have a *red* line painted on the upper end of the strut piston. The strut is properly inflated when a dimension of 1-7/8 inches exists between the lower edge of the red line and the top of the strut packing gland flange.

(b) Remove hex cap, which is a secondary seal, and screw down tightly, but not so tightly that the seat in the cap is forced inward, thereby depressing the valve core stem.

(c) With soapy water, test valve core and seat around filler plug for air leakage. Usually, leakage around gland nut will be evidenced by seepage of fluid. In the event of the latter, the strut must be completely deflated prior to tightening gland nut.

f. TIRES.

(1) INFLATING MAIN LANDING GEAR TIRES.—Access to valve is gained by removing Dzus-fastened outside wheel fairing. The landing gear tire pressure should be such that the deflection marks on the side of the tire just contact the ground line when the airplane is in the three-point position. Under normal loading conditions, this pressure will be apptoximately 30 pounds square inch. Tires should be checked and inflated with airplane on hard level ground.

(2) INFLATING TAIL WHEEL TIRE.—Access to valve is gained by removing screw-fastened right side wheel fairing. The tail wheel tire pressure should be such that the deflection marks on the side of the tire just contact the ground line when the airplane is in a three-point position on a flat hard surface. Under normal loading conditions, this inflation will be equivalent to approximately 30 pounds/square inch.

g. OXYGEN CYLINDERS.

(1) HIGH-PRESSURE SYSTEM.—The detachable high-pressure oxygen cylinders employed in earlier airplanes are interchangeable and must be removed for filling. Before removal of the cylinders for filling purposes, bleed the system by opening the regulators. Access to the cylinders is gained from the rear cockpit by removal of the yokes which secure them in their respective cradles. The high-pressure cylinders should be filled with oxygen at approximately 1800 pounds/square inch. Transferring the oxygen from supply cylinder to airplane cylinder is facilitated by means of a spring-loaded check valve in each cylinder. When connecting the oxygen cylinders to the line in the airplane, the check valve in the cylinders will release the pressure from the cylinder into the lines.

(2) DEMAND-TYPE SYSTEM.—It is not necessary to remove the low-pressure cylinders incorporated in the demand-type system of later airplanes for filling. Attach a hose from an oxygen supply cylinder to the filler valve, located on the left side of the rear fuselage and accessible from the outside. Turn the handle on the filler valve to secure the coupling. To facilitate the procedure, a pressure gage capable of registering up to 400 pounds/square inch should be attached to the oxygen supply hose; however, the oxygen regulator in the airplane will suffice if no gage is available. Open the supply cylinder valve and allow oxygen to flow into the cylinders until the pressure gage registers 370 pounds/square inch. As the oxygen regulator is the only means of determining the amount of oxygen that has entered the cylinders, it should be watched closely to prevent excess pressure. After ascertaining that a pressure of 370 pounds/square inch has been built up in the cylinders, allow oxygen to escape from the regulator until the pressure is reduced to 365 pounds square inch. This procedure will ascertain proper functioning of the system and at the same time bleed air from the oxygen. A specially dried type of breathing oxygen must be used and should be subjected to dampness tests, as well as tests for impurities. Damp oxygen will blister the user's face. Special care must be exercised in installation and maintenance of the entire system.

WARNING

Prior to filling, the cylinders must be thoroughly dry and under no circumstances is oil or hydraulic fluid to be permitted on or near the system. This necessary precaution is taken because of the highly explosive nature of the oxygen when in contact with oil or grease of any kind.

4. GROUND OPERATING INSTRUCTIONS.

a. STARTING THE ENGINE.

(1) Set parking brakes and block wheels.

(2) Unlock the flying controls; check their operation.

(3) Pull the propeller through several turns by hand if engine has been idle for more than 2 hours. Make certain that the ignition switch is "OFF."

(4) Place the carburetor air heat control at the position marked "HOT" (downward) so as to heat the carburetor air.

(5) Close the oil cooler shutters for cold weather starting.

(6) Set the propeller control at the "DECREASE RPM" (high pitch) position, if the control was inadvertently left otherwise when the engine was previously turned off.

(7) Set the mixture control at the full "RICH" position (forward).

(8) Set the throttle approximately ½ inch open (600 to 800 rpm).

(9) Turn the fuel selector valve to "RESERVE."

(10) With the hand fuel pump, slowly pump up fuel pressure to register 3 to 4 pounds when the hand pump is pushed slowly through a complete stroke.

(11) Prime the engine four to six full strokes with the priming pump when the engine is cold; two to four, when warm; and none, when hot. When priming is completed, lock the priming pump in the "CLOSED" position.

NOTE

In extremely cold weather, do not prime until the engine begins to crank; then, prime until complete firing is obtained.

(12) Switch on battery and generator main line switches.

(13) See that all personnel are clear of the propeller; then, turn the ignition switch to "BOTH ON."

(14) Press the rear of the starter pedal to energize the inertia starter; and when the flywheel has reached maximum speed, press the forward end of the pedal to engage the starter to the engine. On later airplanes equipped with a 24-volt electrical system, the starter is energized and the fly wheel is engaged to the engine by means of switches on the control panel in the front cockpit.

NOTE

If airplane is equipped with a 24-volt system and the starter switches do not normally respond, check circuit breaker, "Push to Reset" corresponding button to close starter circuit. The circuit breaker buttons are located on the left side, just forward of the hydraulic pressure gage in the front cockpit.

(15) In extremely cold weather, it is advisable to crank the starter by hand so as to be able to repeat the starting operation several times if necessary. When cranking by hand, all of the instructions above will apply except (14). Use the crank stowed in the baggage compartment. Before cranking, reach through the engine compartment cowling on the left side and raise the brush-lifting lug located on the rear of the electric starter to release the brushes from the commutator. After the engine has started, be sure to RETURN THE LUG TO ITS FORMER POSITION.

CAUTION

During the starting operation, do not pump the throttle when the engine is cold, as this may cause backfiring, with accompanying fire hazard.

b. ENGINE WARM-UP.

(1) After the engine has been started, idle the engine at 500 rpm or lower until oil pressure is established; continue at idling rpm for at least 30 seconds. If oil pressure does not show within this time, shut down the engine and investigate.

(2) When the oil pressure reaches 70 pounds, set the propeller control at the "INCREASE RPM" (low pitch) position and slowly advance the throttle to 1000 rpm for the engine warm-up.

(3) Adjust the carburetor air heat control as may be necessary. The fuel mixture thermometer should read from 2° to 5°C (35.6° to 41°F) at all times.

c. STOPPING THE ENGINE.

(1) Place the mixture control in the full "RICH" position.

(2) Open the throttle to about 1200 rpm and shift the propeller control to the "DECREASE RPM" (high pitch) position.

(3) After the blades have moved into high pitch as noted by the decrease in the engine rpm, allow the engine to run approximately 1 minute at the same speed in order that oil dumped into the engine from the propeller cylinder may be properly scavenged and returned to the oil tank.

NOTE

If a cold weather start is anticipated on the next engine run, dilute oil, as directed in paragraph *d.* following, before shutting down engine.

(4) Set the mixture control lever in the full "LEAN," (idle cut-off) position.

(5) After the engine has ceased firing, turn the ignition switch to "OFF."

(6) Turn the fuel selector valve to "OFF."

(7) Move the throttle to "CLOSED."

(8) Leave the mixture control lever at full "LEAN" as a precaution against accidental starting.

(9) Turn off the battery-disconnect and generator main-line switches.

d. OIL DILUTION PROCEDURE.

(1) Operate engine at 1000 to 1200 rpm.

(2) Maintain oil temperature below 50°C (122°F) and oil pressure above 15 pounds per square inch.

(3) Dilute engine oil as follows for ground temperatures shown:

4° to –12° C (40° to 10° F)	3 minutes
–12° to –29° C (10° to –20° F)	6 minutes
–29° to –46° C (–20° to –50° F)	9 minutes

Add 1 minute dilution for each additional 5°C (9°F) below –46°C (–50°F).

(4) For the last 2 minutes of the dilution, operate propeller pitch control to get change of 400 rpm. Repeat three times.

5. LUBRICATION REQUIREMENTS.

a. GENERAL.—See figure 38 for lubrication instructions including the period, location, and type of lubricant used. A zerk-type grease gun, located on the lower left engine mount tube and packed with low-temperature lubricating grease, provides means of lubrication at points equipped with zerk-type lubricator fittings. The lubricator fittings are painted *yellow* to insure ready identification. Ball bearings used in pulleys, bell cranks, hinge points, and rod ends are of the sealed type, packed with lubricant at assembly and require no further lubrication. Where light lubricating oil is specified but not available, clean engine oil will be found satisfactory. Where possible, assemblies requiring lubrication shall be lubricated at point of assembly. Excess application of lubricants is to be avoided. Do not apply oil or grease to cockpit enclosure tracks, as this will tend to attract dust and grit, causing difficulty in operation. Excess lubricant, exterior to the bearing surfaces, will attract dirt and grit and may cause malfunction of the mechanism.

b. APPLICATION OF GREASES.—Where a reservoir is not provided around the bearing, apply lubricant sparingly and wipe off excess.

(1) Seat adjustment tubes, etc., require only a thin film of grease. Do not lubricate lightly-loaded slides that work freely unless protection against corrosion is necessary.

(2) Most of the ball bearings used in the airplanes are of the sealed type and are prepacked with lubricant by the manufacturer. These bearings need no further attention. Unsealed ball bearings and needle bearings shall be packed with grease to approximately ⅔ capacity. When antifriction bearings are completely filled with lubricant, the following troubles are likely to occur:

(a) Lubricant will be expelled by the motion of the bearing.

(b) Lubricant will be expelled when the bearing becomes warm (thermal expansion).

(c) Resistance to motion at low temperatures will be excessive.

(3) In greasing the wheels, the roller assemblies shall be taken out of the hub, the grease completely removed from both assemblies, and the bearing cones cleaned with a suitable solvent. After the roller assemblies have dried completely, they shall be thoroughly daubed with grease, AAF Specification No. 3560 (Navy Specification M-372 for Model SNJ airplanes) care being exercised to see that lubricant enters the space between the rollers within the retainer ring.

Key to Figure 38

Lubrication Period	*No.*	*Part*	*Lubricant*
10-HOUR	1.	Lubricate Lockpin Sparingly	AN-O-6
	2.	Machine Guns	AXS-777
25-HOUR	3.	Rudder and Brake Pedals—Front and Rear Cockpits	AN-G-3
	4.	Hand Fuel Pump Bellcrank	AN-G-3
	5.	Landing Gear UP Position Latch	AN-G-3
	6.	Landing Gear Installation	AN-G-3
	7.	Trim Tab Actuating Screws	AN-G-3
	8.	Tail Wheel	3560 (Navy Spec. M-372)
	9.	Landing Gear and Flap Control Handle Front and Rear Cockpits	AN-G-3
	10.	Hydraulic Pressure Control Lever—Front and Rear Cockpits	AN-G-3
	11.	Flap Operating Cylinder	AN-G-3
	12.	Landing Gear and Flap Position Indicator Shafts—Front and Rear Cockpits	AN-G-3
	13.	Propeller Counter-weights	AN-G-4
50-HOUR	14.	Propeller Hub Spider	AN-G-4
	15.	Rudder Pedal Adjustment Slides—Front and Rear Cockpits	AN-G-3
	16.	Landing Gear Position Indicator Switch Actuating Rod and Guide	AN-G-3
	17.	Seat Adjustment Mechanism	AN-G-3
	18.	Baggage Compartment Door Lock Plunger and Mechanism	AN-O-6
	19.	Seat Support Tubes—Front and Rear Cockpits	AN-G-3
	20.	Flap Rod and Universal Joints	AN-O-6
	21.	Wheel Bearings	3560 (Navy Spec. M-372)
		NOTE: Rear Control Stick Lock Plunger, Throttle Shafts and Throttle Shaft Bearings, and Surface Control Lock Plunger	AN-G-3
		Clevis Bolts, Clevises, and other movable Linkage, if necessary	AN-O-6
100-HOUR	22.	Brake Linkage	AN-O-6
	23.	Wheel and Spindle Bearings	3560 (Navy Spec. M-372)
		NOTE: Magnetos	AN-VV-O-446, Grade 1120
400-HOUR		NOTE: Bank and Turn Instruments	AN-O-4

NOTE: All 25-hour period lubrication points except at landing gear torsion links and hand fuel pump bellcrank may be extended to 50 hours if operating conditions warrant. Refer to oil system filling instructions for specified engine lubrication.

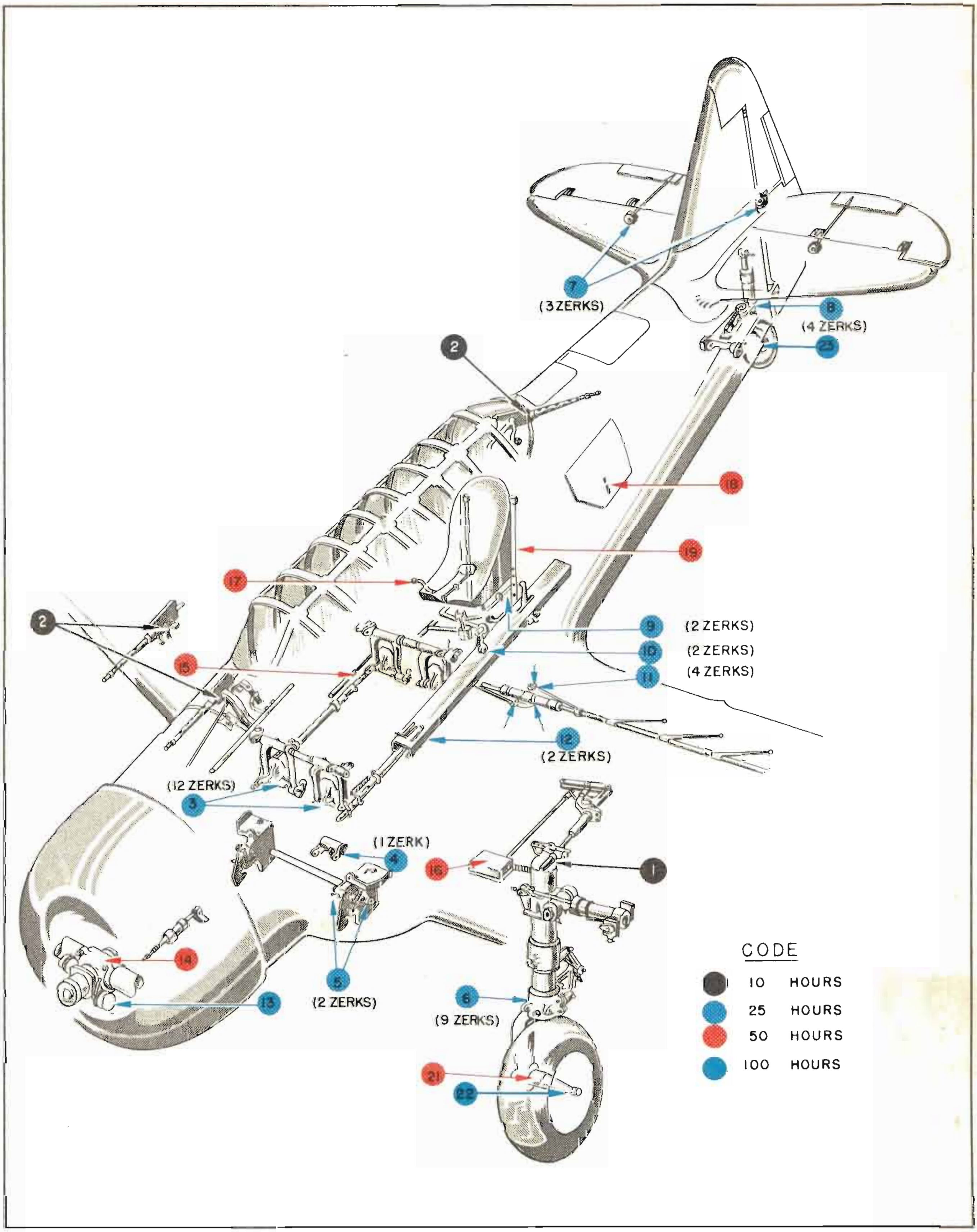


Figure 38 — Lubrication Diagram

NOTE

No grease shall be packed into the wheel hub. A little is permitted on the bearing race only. Prior to installation of the wheel, the axle shall be cleaned and the protective lacquer film removed with a suitable wash thinner.

(4) In filling the hub spider on the propeller, it is possible to force in an excessive amount of grease, which is discharged between the shim plate and through the barrel openings when the engine is running. Therefore, the practice of forcing grease into the hub spider until the grease appears around the shim plate is not recommended. To determine if a sufficient amount of grease has been forced into the hub spider, adjust the power-type zerk gun to cut out at a pressure of 2000 pounds. When using a hand-type zerk gun, a sudden increase in resistance to zerking will be noted. Any continuation of zerking beyond this point does no good and is undesirable.

c. APPLICATION OF OILS.

(1) Apply oil sparingly, never more than enough to coat the bearing surfaces.

(2) Since cables are sufficiently lubricated by the manufacturer, additional lubrication for the prevention of corrosion is not necessary, and is especially undesirable in dust-infested regions.

(3) Examine the magneto cam follower felt at the regular routine inspection periods to see that it is properly lubricated. If oil appears on its surface when the felt is squeezed with the fingers, do not add oil. However, if it is dry, moisten it with oil, grade 1120, Specification No. AN-VV-O-446. Do not apply too much oil as the excess will be thrown off during operation and will come between the contact points, thereby causing pitting and burning.

(4) Apply a thin film of oil, Specification No. AXS-777, to machine guns, contacting exterior and all accessible interior mechanisms. Use ram rod and suitable oil-saturated material for bores.

(5) The propeller counterweight shaft can be lubricated through the slot in the counterweight without removing the cap. If the counterweight cap is removed, care should be exercised to insure that the location of stop nuts on the adjusting screw is not disturbed, as any change in the stop nuts will affect the angle setting of the propeller blades.

(6) It is absolutely essential that the camera be properly lubricated. Therefore, the instructions given here should be followed to insure the best service. To oil and grease the camera thoroughly, the roll film magazine, the camera body, and the lens shutter should be gone over. The oiling and greasing should be done carefully to prevent it from spreading and perhaps getting on the film and the contact glass or dropping down on the lens. Because it is necessary to use an oil with an extremely light body which has a tendency to evaporate and dry up when the camera is not in use, frequent oiling is necessary. If the camera remains idle for several weeks between periods of use, it should be completely lubricated before going into the airplane.

WARNING

Oil or grease only where arrows indicate or direction stipulates. After oiling or greasing the various parts, go over the camera carefully to make sure no excess oil or grease is left. Use only the oil and grease specified for the camera, as it will not freeze at low temperature and slow the camera action. The oil to be used is oil, low-temperature lubricating, Specification No. AN-O-6. The grease to be used is, grease, lubricating, high melting point Specification No. 3560 Navy Specification M-372 for Model SNJ airplanes.

(a) CAMERA BODY.—Oil the mechanism in the camera body after every 1,000 exposures. If 75-foot lengths of film are used, the oiling will take place after every ninth roll of film. Oil should be put into the oil cup on the camera body and on the winding lever. A slight dab of grease should be put on all gears every 5,000 exposures. After oiling or greasing each part, carefully wipe off all excess with a dry lintless cloth. For type of oil and grease, see "WARNING" note above.

(b) DETACHABLE MOTOR.—The motor should be greased after every 5,000 exposures. It has been found that due to the conditions under which it is used this is necessary. Remove the cover from the gear; if the grease is hard and dried out, remove and replace with new grease. For type of grease, see "WARNING" above.

(c) ROLL FILM MAGAZINE.—The roll film magazine requires regular lubrication. It should be oiled once a month when in use or before using if it has not been used for a month or longer. Only a little oil should be used, and any excess should be carefully wiped off with a dry lintless cloth. For type of oil to be used, see "WARNING" note above.

(d) LENS SHUTTERS.—The oiling of the lens shutters should be done carefully and only where points of oil application are indicated for the lens shutters. Two points for oiling are located beneath the diaphragm sector, which must be removed to oil these two points. A drop of oil may be used at all places, but be sure that no excess oil remains. To oil the inside of the lens shutters, the shutter case cover must be removed. The lens shutter assembly should be oiled every 2 months regardless of how much the shutter is used. After the oiling operation is completed the entire shutter should be gone over to make sure that all surplus oil is removed. If this is not done, it is possible for it to find its way to the lens.

d. ANTI-SEIZE AND SEALING COMPOUNDS.

(1) Union type (straight thread) couplings, AAF Specification No. 2-118.

(2) Pipe thread couplings, Specification No. AN-C-53.

(3) All oxygen system fittings, Specification No. AN-C-86.

(4) Fuel and oil system fittings, Specification No. AN-G-14.

(5) Threaded rod adjustments, AAF Specification No. 2-118.

NOTE

Compounds shall be applied sparingly to the male portions of the fittings only. Excess compound must be avoided as plugging of lines, valves, and so forth, may result with consequent damage to the system. *Do not apply grease or oil to oxygen fittings.*

6. SPECIAL TOOLS AND EQUIPMENT.

Each airplane is supplied with certain special tools and equipment required for its proper maintenance and operation. These parts are stowed in the baggage compartment on the left side of the fuselage at the time of the airplane's delivery from the factory. Included are one Mooring Kit, one Pratt & Whitney Engine Tool Kit, one Armorer's Tool Roll, one Engine Cover, and miscellaneous loose equipment and special tools. See figures 39, 40, 41, 42 and 43.

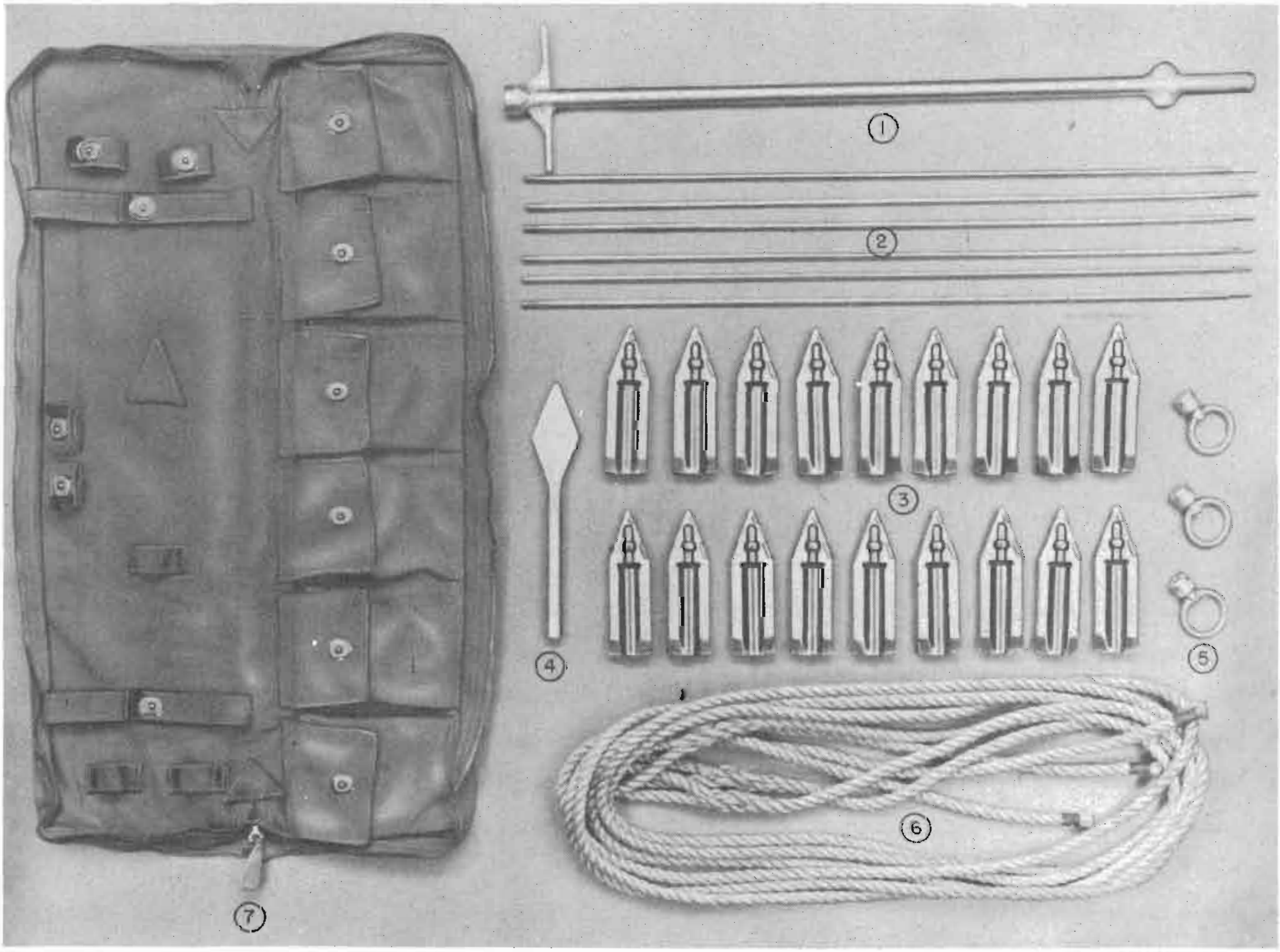


Figure 39 — Mooring Kit

1.	Anchor Driving Rod	36B4466
2.	Anchor Rods	36A4468
3.	Ground Breaking Arrows	36A4467
4.	Ground Breaking Pin	38B3323
5.	Anchor Rod Eye Assembly	36A4469
6.	Ropes (3)	33D2721

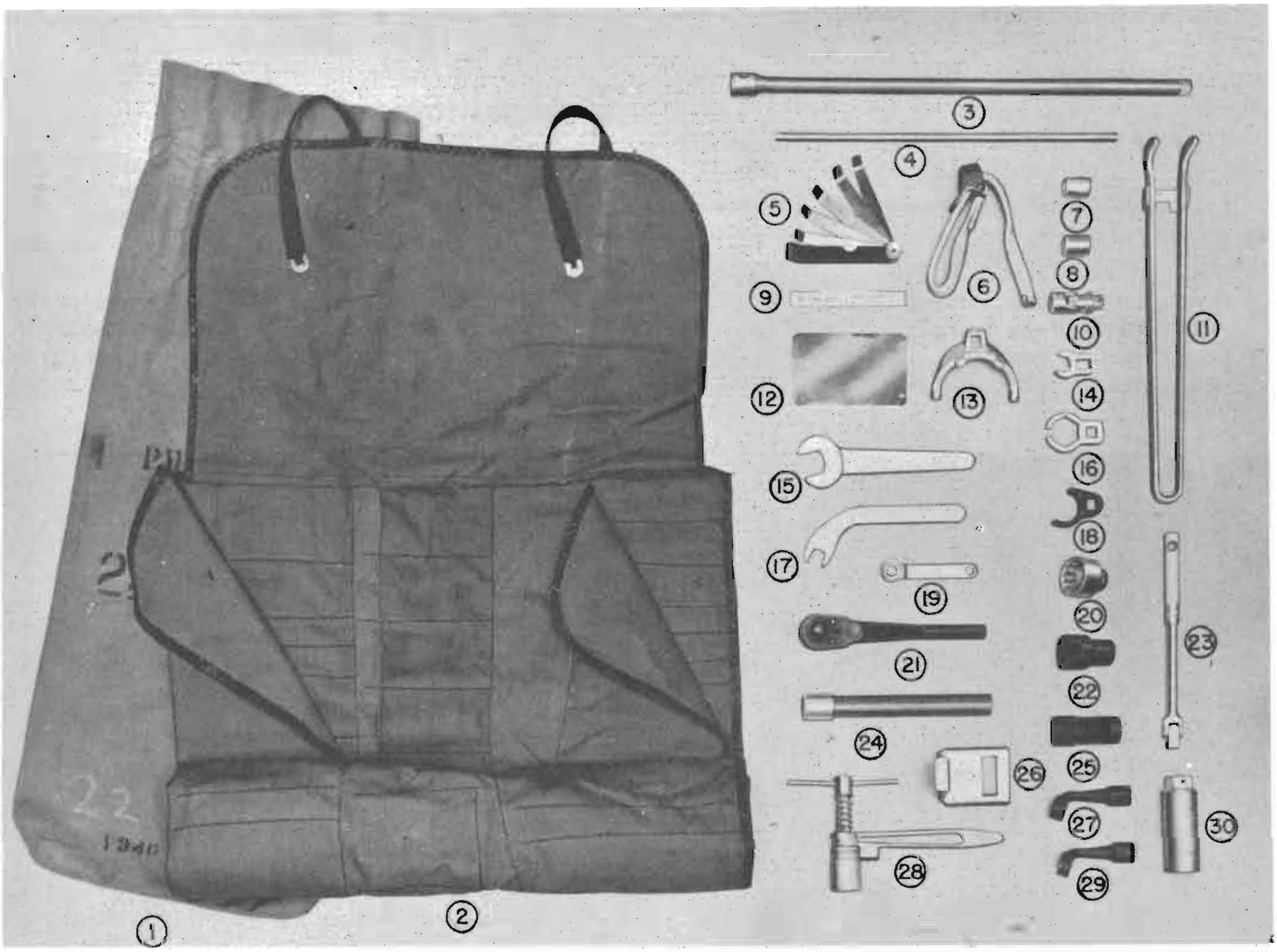


Figure 40 — Engine Tool Kit

1. Tool Kit Bag PWA211
2. Tool Container PWA36
3. 16-inch Extension, $\frac{3}{8}$-inch sq PWA1396
4. Bar-Wrench-Cross Handle PWA1400
5. Valve Clearance Gage PWA672
6. Adjustable Strap Wrench PWA1886
7. $\frac{7}{8}$-inch Socket Wrench PWA1404
8. $\frac{1}{4}$-inch Socket Wrench PWA1270
9. Mag Breaker Points Aligning Strip PWA996
10. $\frac{3}{8}$-inch Sq Universal Joint PWA1405
11. Depresser-Valve Spring PWA459-1
12. Mirror PWA1059
13. Intake Pipe Wrench PWA1399
14. Starter and Generator Wrench PWA1471
15. $\frac{13}{16}$-inch O.E. Relief Valve Wrench PWA956
16. Ratchet Shaft Nut Wrench PWA1502
17. Carb. Rear Center Nut Wrench PWA148
18. Push Rod Cover Wrench PWA1424
19. $\frac{3}{8}$-inch Palnut Wrench PWA1608
20. 1-inch Socket Wrench PWA1402
21. $\frac{3}{8}$-inch Ratchet Handle PWA1394
22. Rocket Arm Depresser PWA1392
23. Handle-hinge $\frac{3}{8}$-inch Sq PWA1397
24. Fibre-Drift PWA1395
25. Spark Plug Elbow Wrench PWA1683
26. Depresser-Valve Spring PWA459-2
27. Cylinder Nut Wrench PWA1393
28. Valve Adj. Screw and Locknut Wrench PWA1075
29. Gun Synchronizer Wrench PWA2379
30. Spark Plug Wrench PWA2254

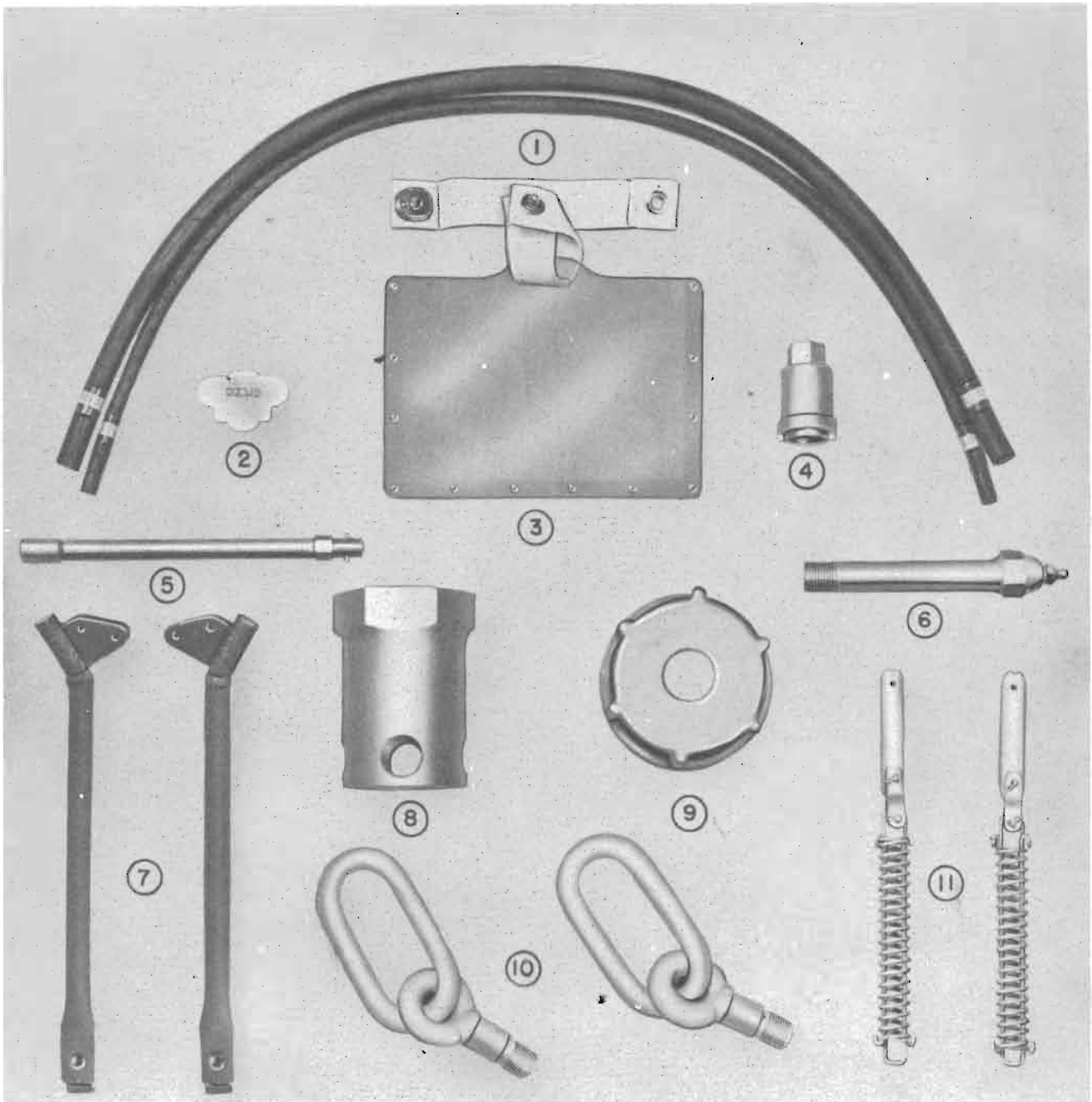


Figure 41 — Loose Equipment

1.	Wire Assembly	88-710-58
2.	Dzus Wrench	19-33447
3.	Check List Holder	39D3922
4.	Wrench	25-58178-2
5.	Grease Gun Extension	12D40T-1
6.	Lubricator	19A-53415
7.	Pivots, Right and Left Side	55-73013
8.	Propeller Wrench	S8499F
9.	Propeller Shaft Protector Cap	36554-40
10.	Hoist Fittings	36-55009
11.	Antenna Assembly	88-710-52
	Plate Assembly (not shown)	23-53096-18
	2 Sacks, Attaching Parts	

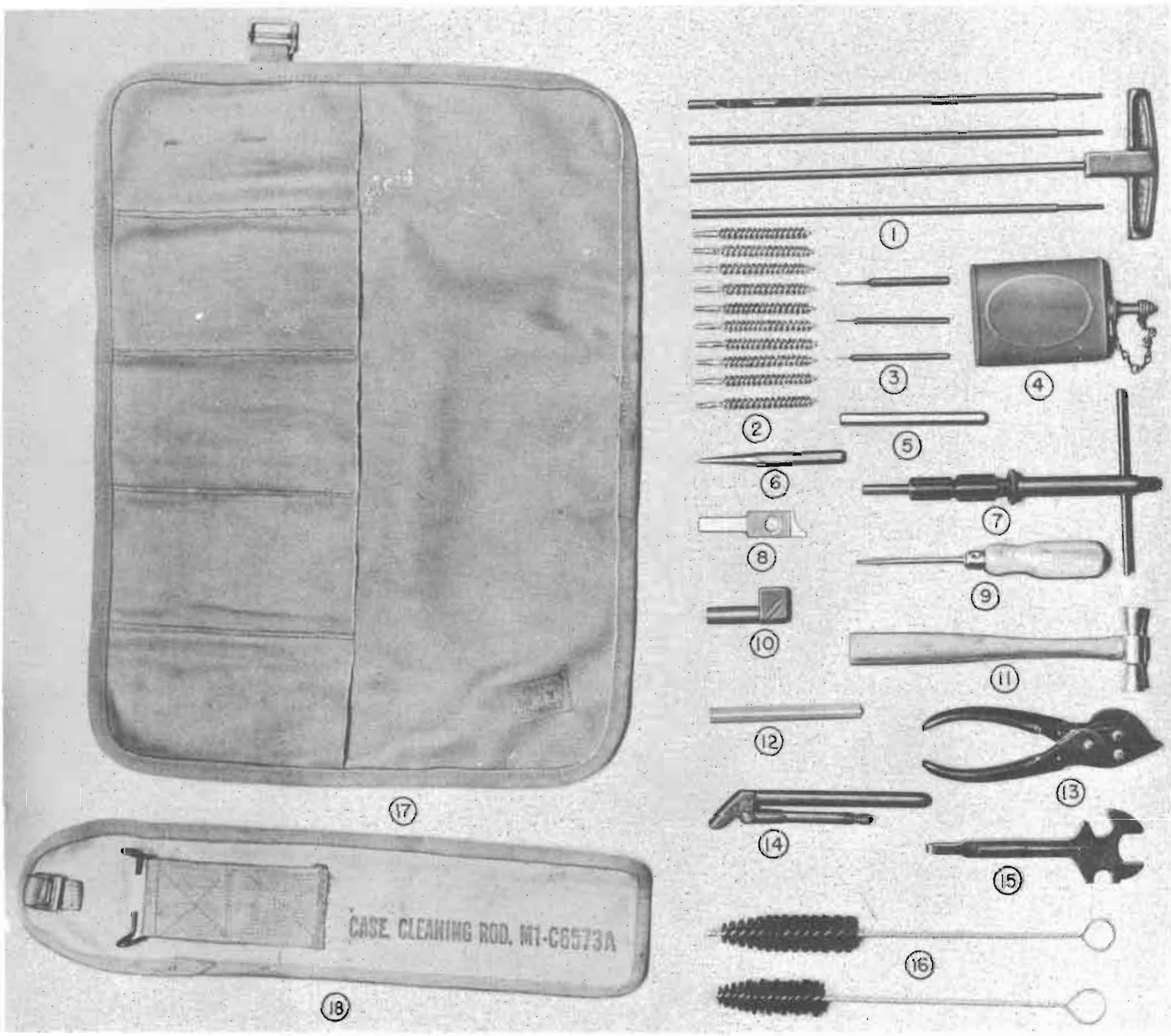


Figure 42 — Armorer's Tool Roll

1.	Jointed Cleaning Rod		D8237
2.	Cleaning Brushes, M-2		C4035
		.03-in.	TCFX2A
3.	Drive Pin Punches	.05-in.	TCFX2C
		.08-in. x ¾	TCFX2F
4.	3-oz Oval Oiler		C59737
5.	Brass Light Drift ⅜ Rd x 4		TCCX2D
6.	4-in. Center Punch		TCDX1A
7.	Carbon Removing Tool, M-4		C64302
8.	Headspace and Timing Gage		A196229
9.	3-in. Blade Screwdriver		TG-AX1A
10.	Barrel Reflector		B147001
11.	Brass Double-Bellface Hammer		TAFX2A
12.	Triangle Sharpening Stone		B147160
13.	6-in. Side Cutting Paral Jaw Pliers		THBX1A
14.	Ruptured Cartridge Extractor		C3854
15.	Combination Tool, M-2		B13134
16.	Chamber Cleaning Brushes, M-6		B108828
17.	Tool Case		
18.	Cleaning Rod Case, M-1		C6573

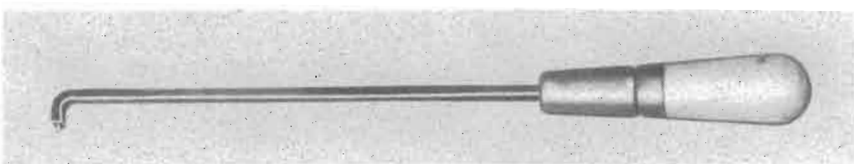


Figure 43 — Armorer's Tool Release

SECTION IV

MAJOR COMPONENT PARTS AND INSTALLATION

1. WING.

a. DESCRIPTION.—The tapered wing is of all-metal, stressed skin, full cantilever, low wing design, consisting of a detachable center section and two detachable outer wing panels with removable tips. The outer panels are joined to the center section by external bolting angles along the upper, lower, and leading edge skin surfaces. A plate at each joint distributes shear from each outer panel main spar to the two center section spars. The center section is of constant chord design and is set at positive 2-degree angle of incidence. Each outer panel is twisted 2 degrees forward at the tips, has a sweepback of 10 degrees, 18 minutes, 16 seconds at the leading edges and has, relative to the center section, a dihedral angle of 5 degrees, 41 minutes measured along the leading edges. Access doors are provided on the upper and lower surfaces of the wing to facilitate inspection, servicing, replacement, etc. The center section contains two fuel tanks, and mounting and housing for retractable landing gear.

NOTE

AT-6 airplanes have built-in fuel compartments; subsequent models of the AT-6 series have removable fuel tanks.

Navigation lights and landing and passing lights are installed in the outer panels along with provisions for the installation of a fixed machine gun, gun camera, and bomb racks.

(1) CENTER SECTION.—*(See figures 44 to 49.)*—The wing center section is attached to the fuselage by means of four bolts at two points of attachment to the front spar and four bolts at two points of attachment to the rear spar. It has an NACA 2215 airfoil section and is constructed of 24ST Alclad sheet, 24ST aluminum-alloy extrusions and sheet, and Alclad rolled sections, consisting of two spars, power-pressed ribs, and skin which is stiffened in a spanwise direction by stringers.

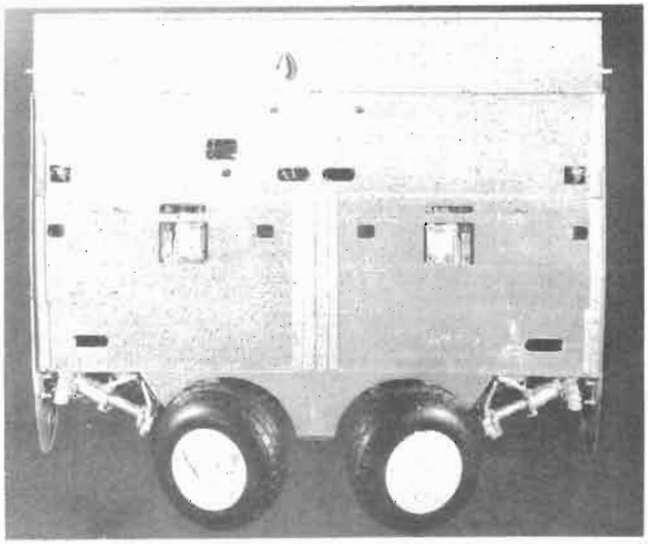


Figure 45 — Wing Center Section — Lower Surface

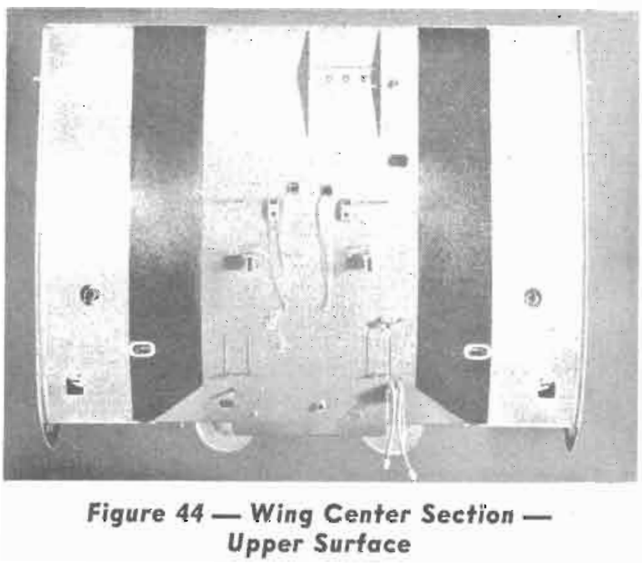


Figure 44 — Wing Center Section — Upper Surface

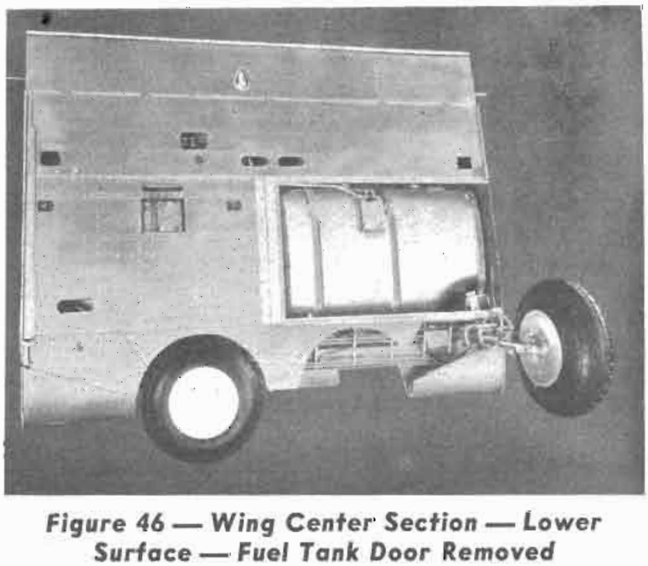


Figure 46 — Wing Center Section — Lower Surface — Fuel Tank Door Removed

The structure is of constant chord design and has an incidence of plus 2 degrees and no dihedral angle. The lap-jointed skin panels vary from .025 to .064 inch in thickness. Type AD rivets (A17S aluminum) are used for assembly, all skin riveting being flush to approximately 35 per cent chord on the top skin and to 10 per cent chord on the bottom skin. A trailing edge, split-type wing flap, and flap operating cylinder are installed in the aft portion of the center section. The landing-gear support castings and lockpin mechanism are installed near the outboard ends of the center section on the front spar. Wheel wells are provided in the leading edge of the structure to accommodate the landing gear wheels in the fully retracted position. Removable cantilever edges give easy accessibility to the landing-gear struts. Two fuel tanks, accessible through removable compartment doors, are also housed in the center section. Filler caps and fuel gages for the fuel tanks are located one on either side of the center section above each tank,

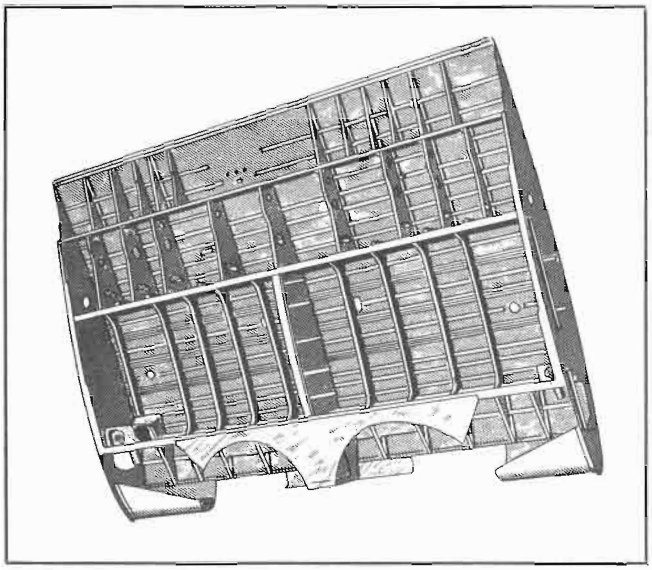


Figure 49 — Wing Center Section Structure

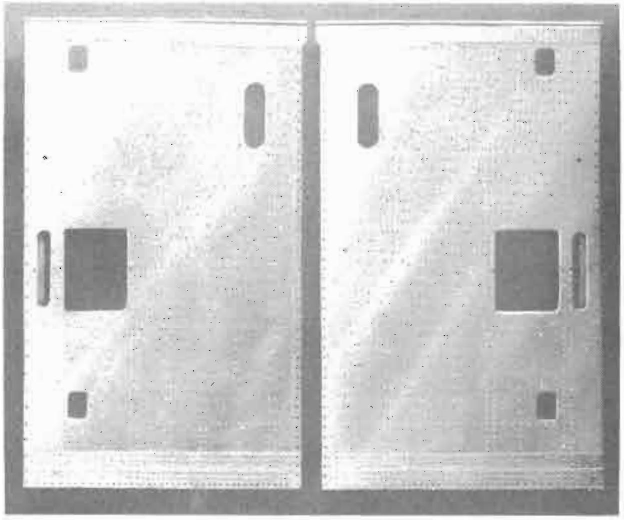


Figure 47 — Wing Center Section — Fuel Tank Doors

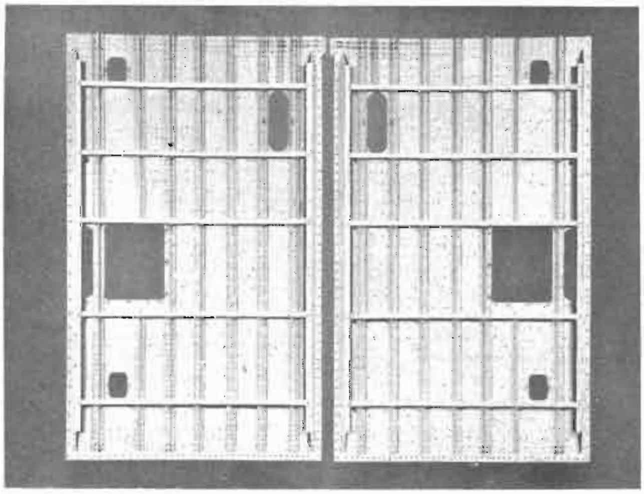


Figure 48 — Wing Center Section — Fuel Tank Door Structure

while the fuel selector valve rod and drain cock are installed on the left side of the center section. A fresh air intake port and tube are contained in the left leading edge of the structure. Various electrical wiring and hydraulic and instrument lines are routed through the center section to connect with their respective units. Walkways are provided on either side of the center section next to the fuselage, while hoisting shackles are installed near the bolting angle leading edge on the front spar.

(2) OUTER WING PANELS.—*(See figures 50 to 55.)*—The outer wing panels and the center section are joined by external bolting angles along the upper, lower, and leading edge skin surfaces. Each outer panel incorporates an angle of incidence of plus 2 degrees at the root which gradually changes to an angle of incidence of 0 degrees at the tip. Both panels are bolted to the center section at a dihedral angle of 5 degrees 41 minutes measured along the leading edge and have a NACA 2215 airfoil section at the root, tapering to a NACA 4412 airfoil section at the tip. They are constructed of 24ST Alclad sheet, 24ST aluminum-alloy extrusions and sheet, and Alclad rolled sections, consisting of one main spar, power-pressed ribs, and skin which is stiffened in a spanwise direction by stringers. The lap-jointed skin panels vary from .020 to .051 inch in thickness. Type AD rivets (A17S aluminum) are used for assembly, all skin riveting being flush to approximately 35 per cent chord on the top skin and to 10 per cent chord on the bottom skin. Each outer panel incorporates a trailing edge split-type wing flap and aileron which extends from the flap to the wing tip. Navigation lights are installed just inboard of each wing tip on both the upper and lower surfaces of the wing. Lights in the left wing are red; those in the right wing are green. A landing light is installed in the leading edge of each outer wing panel and a red passing light is installed in the left outer panel adjacent to the landing light in the same bay. Cover

glasses conform to the contour of the leading edge of the wing. Provisions for a fixed machine gun and gun camera are contained in the right and left outer panels respectively, while bomb rack provisions are installed on the lower surfaces of both outer panels. The pitot head assembly protrudes from the right outer panel leading edge and connects to lines extending into the fuselage. Sockets for the insertion of mooring rings are installed near the tip of each outer panel, and jacking points are contained on the front spar of both panels approximately 30 inches outboard of the bolting angle. Exception later airplanes, a free air thermometer is installed on the lower surface of the outer wing panel.

(3) WING FLAPS.—*(See figure 56.)*—Three split-type landing flap panels are incorporated in the lower surface of the wing trailing edge between the inboard ends of the ailerons.

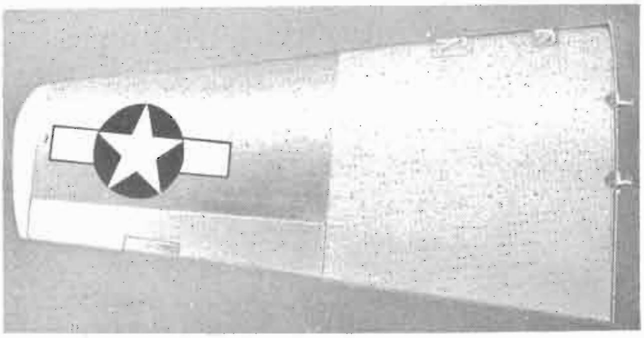


Figure 50 — Wing Outer Panel — Upper Surface (Left)

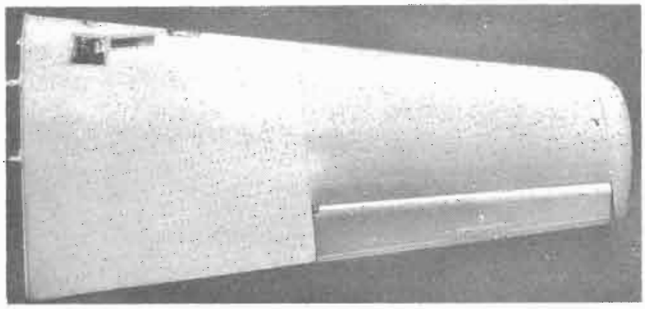


Figure 51 — Wing Outer Panel — Upper Surface (Right)

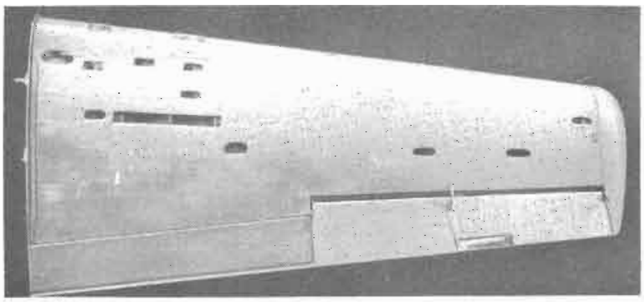


Figure 52 — Wing Outer Panel — Lower Surface (Left)

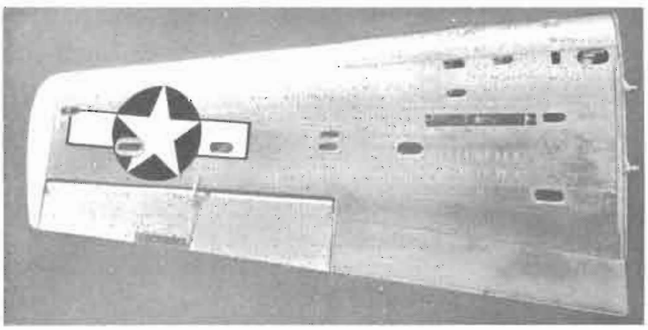


Figure 53 — Wing Outer Panel — Lower Surface (Right)

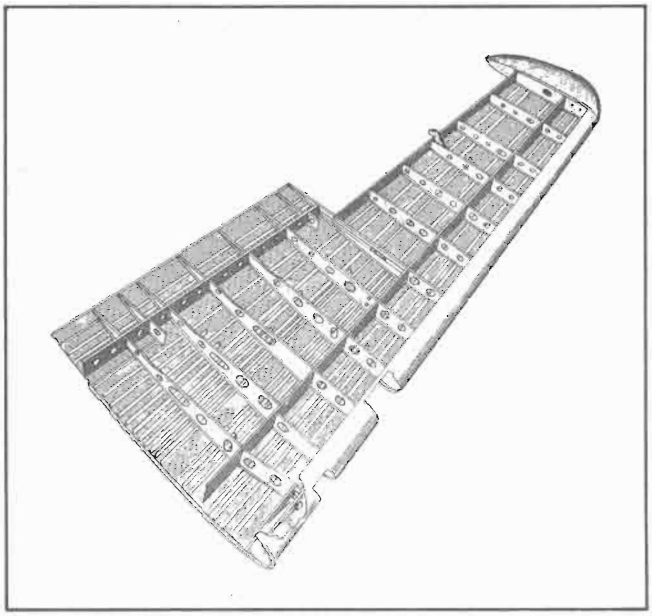


Figure 54 — Wing Outer Panel Structure

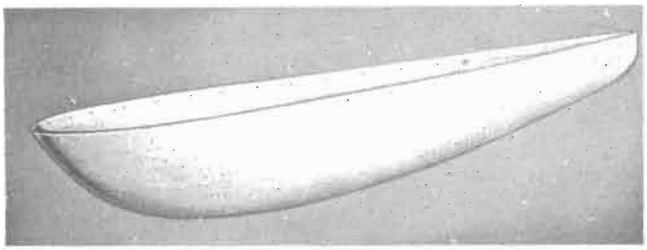


Figure 55 — Removable Wing Tip

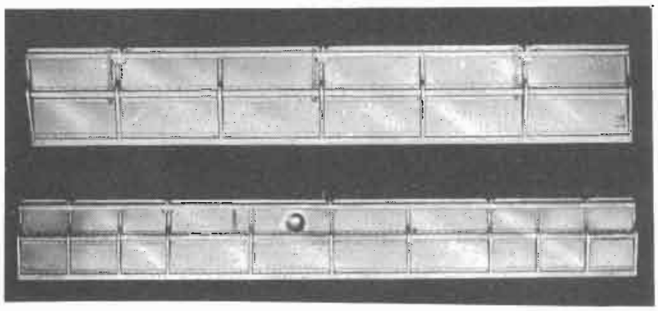


Figure 56 — Wing Flap Structure

NOTE

AT-6B and earlier models have four flap panels.

One flap section is on each outer panel, and one is on the center section. They are constructed of 24ST Alclad sheet with pressed-flanged ribs, a hat section spar located down the center, a channel section trailing edge and a channel section at the leading edge to which ball-bearing hinge brackets are attached. Where the hat section spar is riveted to the flap skin, a torsion box is formed which reacts the main bending loads. The maximum loads on the flaps occur when the flaps are in the fully extended position, which is 45 degrees down. Flap panels are attached to the wing by the ball-bearing hinge brackets on the flaps connecting with brackets on the wing. The panels are moved by actuating rods connected to the flap hat section and the flap push-pull rods. The push-pull rods are connected in turn to the flap operating cylinder and equalizer arms located beneath the trailing edge of the center section. The center section rods are connected at their outboard ends to the outer panel rods by universal joints. The operating cylinder actuates the rods which move all flaps in unison. Refer to section IV, paragraph 12 for further information concerning the operating cylinder. A flap position indicator cable leads from its bracket position on the center section flap panel up through the left outer panel into the fuselage where it connects to the control shelf flap position indicator at the left side of the front cockpit. All flap panels have a constant chord design.

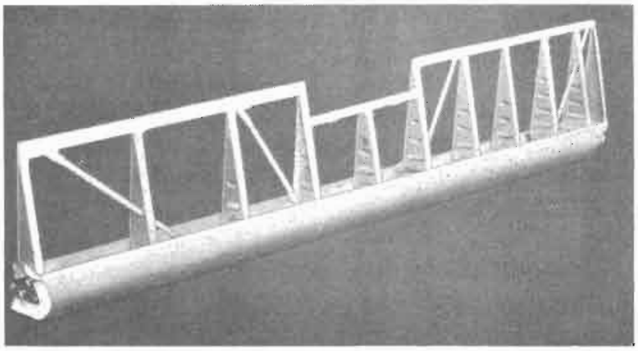


Figure 57 — Aileron Structure

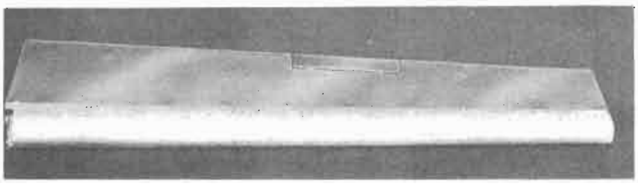


Figure 58 — Aileron

(4) AILERONS.—*(See figures 57, 58, 59.)*—Frise-type ailerons are installed in the trailing edge of each outer panel and are located outboard of the wing flaps from which they extend to the wing tips. The aileron frame structure is made principally of 24ST and

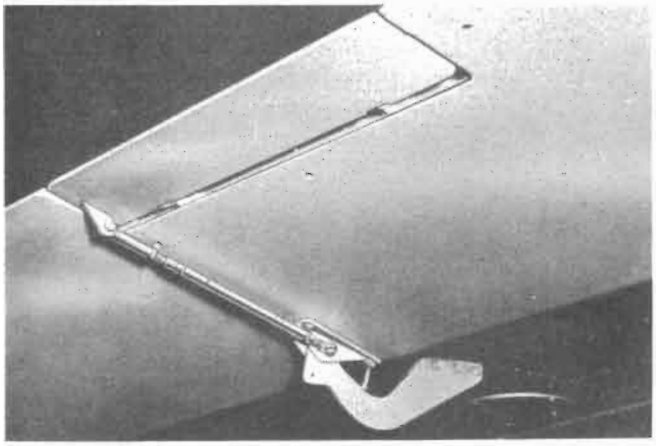


Figure 59 — Aileron Tab Connecting Rod

24SO Alclad and is covered with doped fabric. A 24ST Alclad spar, extending the full length of the aileron, and a 24ST Alclad leading edge skin, .025 inch in thickness, form a torsionally rigid box. Forward of the spar are flanged leading edge or nose ribs. Aft of the spar are trailing edge ribs. Both are made of 24SO Alclad and are .020 inch and .032 inch in thickness respectively. The nose ribs are riveted to the leading edge skin by means of the flanges and to the trailing edge ribs where the two meet at the spar. The latter ribs extend to the Alclad trailing edge strip to which the trailing edge ribs are riveted in turn. Further rigidity is given the structure by $\frac{1}{2}$ inch 24SO aluminum-alloy tube braces which, with ends flattened, are riveted to the trailing edge strip and to the spar. These braces are positioned diagonally. The trailing edge ribs are equipped with integral flanged capstrips in which dimpled holes are spaced to provide for the insertion of countersunk fabric attaching screws. Two balancing counterweights, lead permanent mold castings weighing 5.25 pounds and 6.25 pounds respectively are secured inside the outboard end leading edge skin and provide adequate static balance. Each aileron is shaped to conform with the 2-degree twist in the outer panels. Three hinges with sealed-type ball-bearings support and connect each aileron to the outer panel trailing edges. Drain holes are provided in the lower surface of each aileron. The ailerons have an angular movement of 15 degrees UP and 15 degrees DOWN. Aileron movement on earlier airplanes is 30 degrees UP and 15 degrees DOWN, utilizing a differential motion of 2 to 1. Angular movement is limited by a stop on the center hinge bracket. Additional stops are provided on the control stick torque tube assembly in the fuselage.

(5) AILERON TABS.—Either a booster or a trim tab is mounted on the trailing edge of each aileron. Booster tabs, installed on earlier airplanes, are adjustable from the ground only, and automatically operate upon movement of the ilerons. A push-pull rod extending from the tab is attached to a hinge bracket mounted on the wing. The attachment is such that the tab achieves its own automatic angular travel when the aileron changes position. Trim tabs are installed on later air-

planes and are adjustable from the ground only. A connecting rod extending from the tab is attached to a hinge fitting on the aileron. Unlike the booster tab, the trim tab has no angular travel of its own but remains in a fixed position in relation to the aileron when the latter changes position. AT-6C airplanes serial numbers 42-49005 to 42-49069 inclusive, and 42-43847 to 42-44425 inclusive, and all AT-6D airplanes. UP 15°, DOWN 15°. All other airplanes: UP 30°, DOWN 15°. (Refer to rigging and adjustment instructions in paragraph 11 for information concerning the proper adjustment of either type of aileron tab.) Neither of these tabs is adjustable from the cockpit nor are their mechanisms to be interchanged. Tabs on later airplanes are constructed of wood and phenolic fiber assembled with casein glue while those installed on earlier airplanes are of riveted Alclad construction. Wooden tabs consist of a leading edge spar and trailing edge strip joined together by ribs which fit into cut-outs in both members. The spar web is of 3-ply Douglas fir which is 3/16 inch in thickness. The spar cap forward of the web is made of pine; the spar cap aft of the web is made of spruce. Inboard and outboard ribs are both made of pine while the remaining three ribs of the tab are made of 3-ply Douglas fir which is 1/8 inch in thickness. The spruce trailing edge strip is 1/8 inch thick. Three-ply Douglas fir, 1/16 inch thick constitutes the skin covering. Drain holes are located in the lower surface of the skin. Two Ledaloyl bearing hinge assemblies installed in the tab leading edge provide a means of attachment to the aileron. A horn to which the connecting or push-pull rod fastens is installed on the lower surface of the tab near the inboard end. Metal tabs consist of a 24ST Alclad leading edge channel section, 24SO Alclad ribs and are covered by 24ST Alclad skin .016-inch thick. The flanged ribs are riveted to the channel section and the skin is riveted to the ribs. The skin, formed from one piece of material, is shaped around the tab structure. The trailing edge of the tab is thus formed by the bend in the skin. Drain holes are provided in the lower surface of the skin. Two ball-bearing hinge assemblies are riveted to the channel section and provide a means of attachment to the aileron. A connecting or push-pull rod horn is secured to the lower surface of the tab near the inboard end.

b. REMOVAL AND DISASSEMBLY.—The major sub-assemblies of the wing may be removed individually or, following instructions for removal of the center section from the fuselage, the complete wing may be removed as a unit. Make certain the parking brakes are disengaged before disconnecting the brake lines and that the wheels are blocked. Place a bar or rigid tubing with hooked ends between the towing lugs at the jacking point of each wheel to prevent possible collapse of the wheels during removal proceedings.

(1) WING TIP.—Remove the screws securing the wing tip to the outer panel and the bonding braid. Remove the assembly.

(2) OUTER WING PANELS.

(a) Remove all inspection and access door covers in the vicinity of the attachment angle. (See section III.)

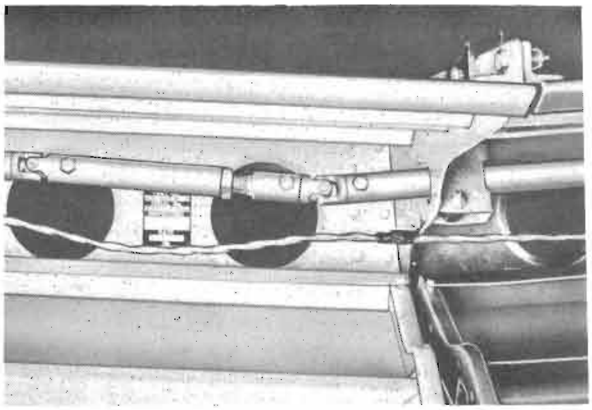


Figure 60 — Flap Push-Pull Rod Universal Joint

(b) Put the flap panels in the "DOWN" position and disconnect the flap push-pull rod at the universal joint located immediately outboard of the bolting angle by removing the bolt from the inboard end of the joint. (See figure 60.)

(c) Remove the free air thermometer from the lower surface of the left outer wing panel. Unthread the bulb through the grommet located in the lower surface of the wing and through the lightening hole located in the auxiliary spar. Unthread the bulb and tube through the grommet located in the center section trailing edge, and coil the tube in a large circle, taping it to the fuselage structure. This thermometer is not installed on later airplanes.

CAUTION

Do not bend, fold or pinch the capillary tube units and do not, under any circumstances, attempt to disassemble them or remove any portion of them.

(d) Disconnect the pitot lines in the leading edge of the right outer panel near the bolting angle. Access to connecting fittings is obtained through an inspection door on the underside of the right outer panel just outboard of the bolting angle.

(e) Remove the landing-gear hydraulic operating cylinder piston attaching bolt on the forward face of the landing-gear strut.

(f) Disconnect the landing-gear operating cylinder hydraulic lines at the wing joint plate.

(g) Disconnect the aileron cables at the turnbuckles, access to which is gained through an inspection door on the lower surface of the outer panel near the wing joint bolting angle.

(h) If the fixed wing machine gun is installed, disconnect the gun charging cable from the gun, which is located in the right outer panel. The access door for this purpose is located below the gun outboard of the wing joint bolting angle.

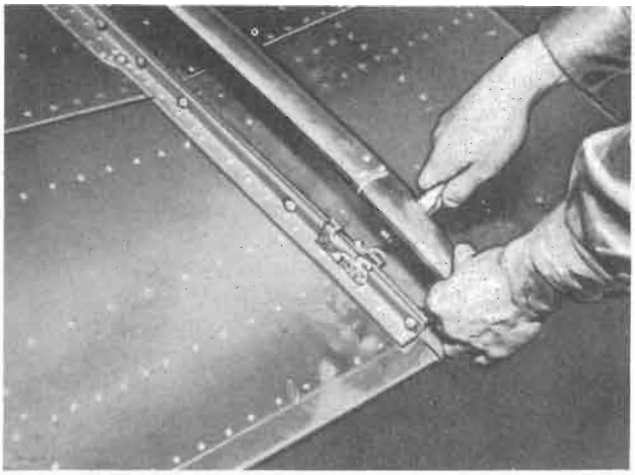
(i) If bomb racks are installed, disconnect the two bomb release cables at the bell crank in each outer panel, access to which may be obtained by means of

the access door directly inboard of the bomb rack in the lower surface of each outer panel.

(*j*) Disconnect the electrical wiring and its conduit at the junction box located in the leading edge of the center section just inboard of the wing joint bolting angle; thread the flexible conduit and wire through the grommet in the center section end plate, allowing the wire and conduit to remain with the outer panel.

WARNING

DO NOT disconnect the conduit at the access cover in the outer panel, as reassembly will be difficult.



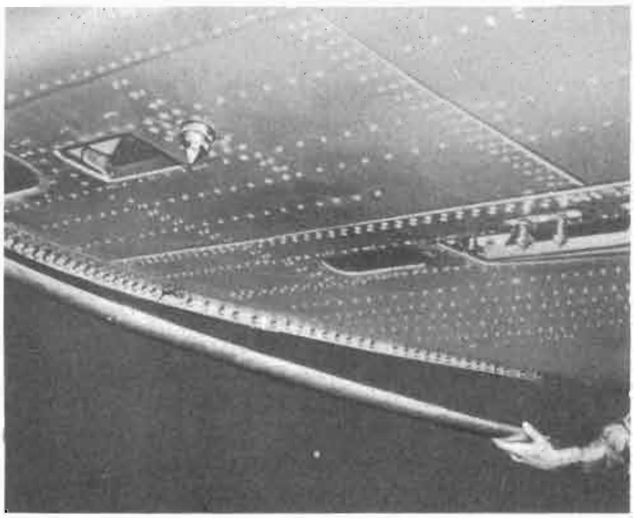


Figure 61 — Wing Joint Bolting Angle Cover Attachment

(*k*) Remove the wing joint bolting angle cover by removing the attaching screw located outboard on the bottom surface of the cover approximately midway between the trailing and leading edges of the wing, and by removing the safety wire and raising the latch on the upper surface trailing edge. This action will free the cover from the lower surface trailing edge fitting. (See figure 61.)

(*l*) Support the outer wing by means of padded cradles near the root and near the tip.

(*m*) Remove the five bolts attaching the angle on the main spar of the outer panel to the center section end plate. Access to the bolts is obtained through an inspection door on the underside of the wing just outboard of the wing joint bolting angle. (See figure 62.)

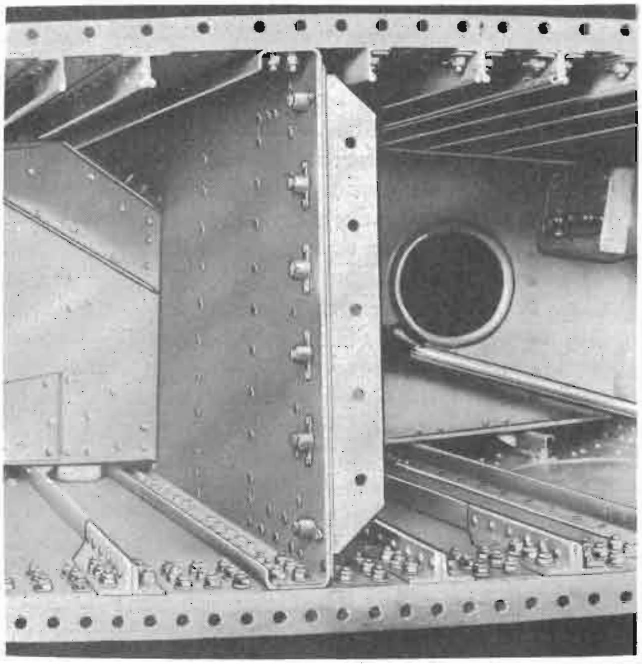


Figure 62 — Outer Panel — Spar Attachment

(*n*) Remove the bolts from the wing joint bolting angle starting at the trailing edge and working to the leading edge of the lower surface first and then the upper surface.

(*o*) When rolling the outer panel away from the center section, care should be exercised in guiding the landing-gear hydraulic operating cylinder piston rod through the end plate.

(3) CENTER SECTION. — Removal instructions for the wing center section constitute removal instructions for the entire wing as a unit.

(*a*) Remove the fuselage side panels and wing-to-fuselage fairing which are attached by screws.

(*b*) Disconnect the fuel line located at the center section front bulkhead.

(*c*) Disconnect the pitot pressure and static lines from the T-fittings located behind the right side of the fire wall above the center section, but allow the T-fittings to remain with the fuselage lines. (See figure 63.)

(*d*) Disconnect the cold air intake tube at the free sleeve fitting located between the center section elbow fittings and the cockpit ventilator control neck.

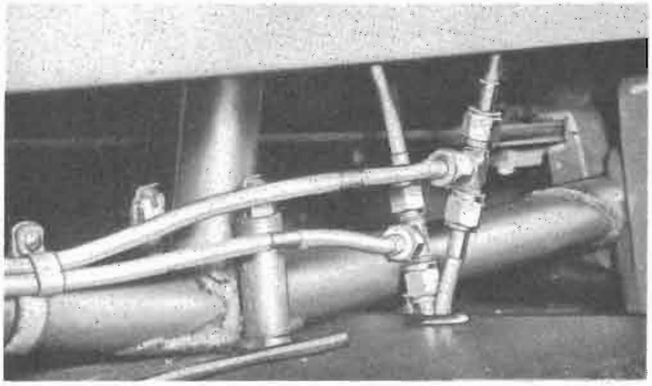


Figure 63 — Pitot Line Connection Aft of Fire Wall

(e) Disconnect the landing-gear position indicator cables from the indicator bell cranks, and coil and tape them to the center section.

(f) Remove the clamps and dust boot from the landing gear down-position lock control rod. Loosen the lock nut on the lower end of the control rod and disconnect the rod.

(g) Disconnect the flap position indicator cable from the angle on the center section flap panel; pull the cable through the fair-lead in the center section.

(h) Disconnect the fuel tank vent line at the fittings located on the upper surface of the center section at each side of the fuselage.

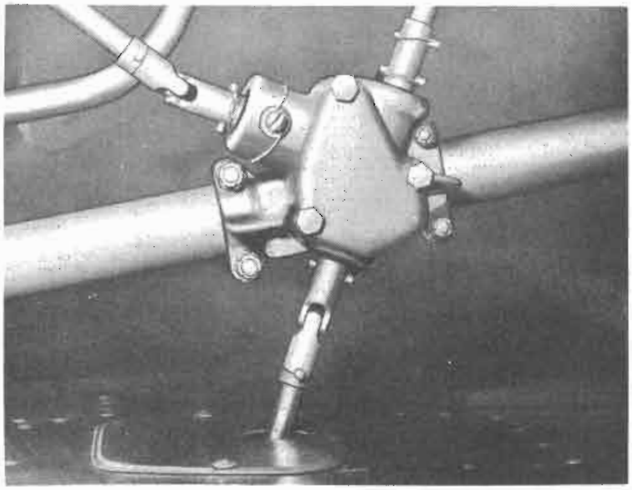


Figure 64 — Fuel Selector Control Rod Attachment

(i) Disconnect the fuel cock selector control rod by removing the two cotters from the yoke on the fuel cock. (See figure 64.)

(j) Remove the fuel gage light assemblies from the gages mounted on the center section, one on each side of the pilot's seat, by removing two screws from each, allowing the light assemblies to remain with the fuselage by taping them to the lower longeron tube.

(k) Disconnect the three flap hydraulic valve line fittings located at the rear of the center section below the fuselage.

(l) Disconnect the aileron control cables from the stick torque tube horn. Wire the ends together to prevent the cables from slipping into the center section. Identify them for convenience of reassembly.

(m) If the fixed wing machine gun which is located in the right outer panel is installed, disconnect the gun charging cable at the barrel fitting between the two pulleys at the right side of the fuselage.

(n) If bomb racks are installed, disconnect the right and left arming and release cables at the two connections between the pulleys at the left side of the fuselage.

(o) Remove the cover from the electrical junction box located on the left of the fuselage just aft of the fire wall, and disconnect the two flexible conduits at the junction box. Pull the wiring from the junction box; lower the conduits to the center section where they should be taped for convenience of reassembly.

(p) Disconnect the two landing-gear hydraulic lines at the fittings on the left upper surface of the center section just aft of the fire wall.

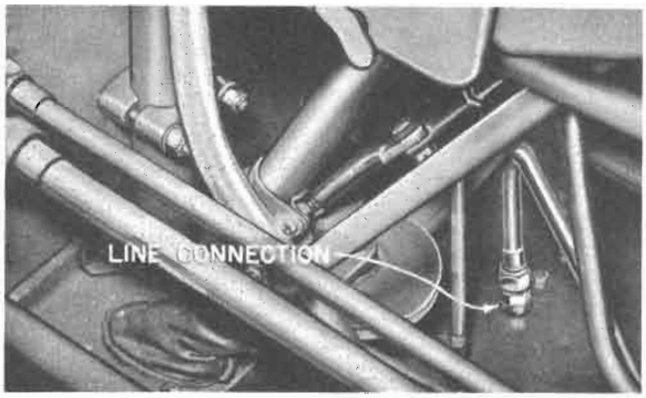


Figure 65 — Hydraulic Line Connection Aft of Fire Wall

(q) Disconnect the two brake hydraulic lines at the fittings located on each side of the center section upper surface just aft of the fire wall. (See figure 65.)

(r) Hoist the airplane into level flight position by passing a lifting bar through the lift tube at the rear of the fuselage and attaching hoist chains to it.

WARNING

If the airplane is to be hoisted to level flight position with the engine installed, attach weights to the lift tube at the rear of the fuselage to avoid the possibility of the airplane nosing over. Before hoisting the airplane make certain all lines, wires, cables, etc., are disconnected and that the ends of lines are plugged to prevent loss of fluid and foreign matter. Make certain the free air temperature indicator capillary tubing is disconnected and removed on airplanes having this installation. It must be coiled so as not to be in the way or damaged. Radii of all capillary bends should not be less than 6 inches.

NOTE

At least three men are required to hoist the fuselage from the center section, one to attend to each hoist chain and a third to see that an even list is maintained in sliding the fore-and-aft attachment fitting off the holes.

(s) Place suitable padded supports under the center section trailing edge and block the wheels. Be sure rigid bar or tubing with hooked ends is placed between towing lugs at the jacking point of each wheel.

(t) Remove the two nuts and washers at each of the four points of the fuselage-to-center-section attachment.

(u) To hoist the fuselage assembly from the center section it is necessary, if the power plant is installed, to arrange a hoisting sling around the upper engine mount members forward of the fuselage attachment fittings. Place a suitable bar through the lift tube in the rear portion of the fuselage and arrange hoisting slings around it. The fuselage assembly may then be hoisted, utilizing the two slings with a separate hoist for each sling, or a crane or hoist equipped with an equalizer or spreader bar. When hoisting the fuselage with the engine and engine mount removed, hooks must be added to the ends of the hoisting sling and the hooks inserted through the holes in the bottom of the upper engine mount terminals. (See section III.)

CAUTION

DO NOT use the engine mount lugs to hoist the airplane.

Hoist the fuselage clear of the center section at least 10 inches, exercising caution to see that proper hoisting chain clearances are observed to prevent damage to the fuselage assembly or installed equipment and that all disconnect control rods, lines, wires, and other installations are either supported or guided clear. Make sure that the lower section of the fuel cock control rod does not swing to the rear and engage the inner edge of the access hole.

(4) AILERON TABS.—Disconnect the aileron trim tab connecting rod from the bracket on the lower surface of the tab. This procedure also applies to the booster tab push-pull rod installed on earlier airplanes. Disconnect the tab at the two tab hinges; remove the tab.

(5) AILERONS.—Disconnect the adjustable end of the aileron control rod from the aileron control horn. (See figure 66.) Then disconnect the aileron from the outboard, inboard and center hinge fittings respectively; remove the aileron.

(6) WING FLAPS.—Each of the three landing flaps should be in the "DOWN" position prior to removal.

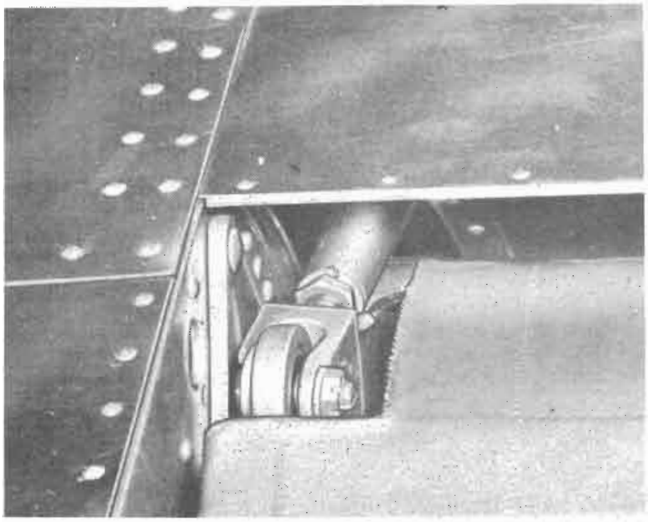


Figure 66 — Aileron Control Rod and Horn

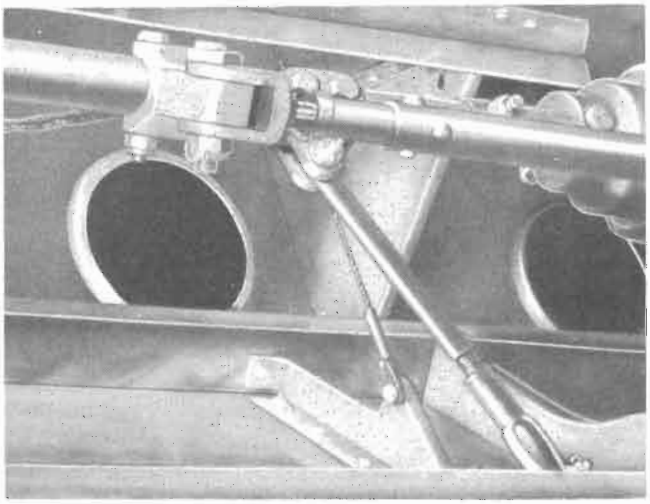


Figure 67 — Flap Position Indicator Cable

(a) Disconnect the flap position indicator cable from the angle plate riveted to the center section flap panel. (See figure 67.)

(b) Disconnect the upper fixed end of the small flap actuating rods from the attachment points on the push-pull rods.

(c) Disconnect the three flap panels from the outer panels and center section at their respective hinge points.

(d) Remove the flap panel.

c. ASSEMBLY AND INSTALLATION.—The major sub-assemblies of the complete wing assembly may be installed individually or the complete wing assembly may be installed beneath the fuselage in one unit as explained in following paragraphs. Do not remove the plugs from the ends of the pitot tube, fuel and hydraulic lines until ready to make line connections. These plugs are provided in order to prevent possible loss of fluid and entrance of foreign matter.

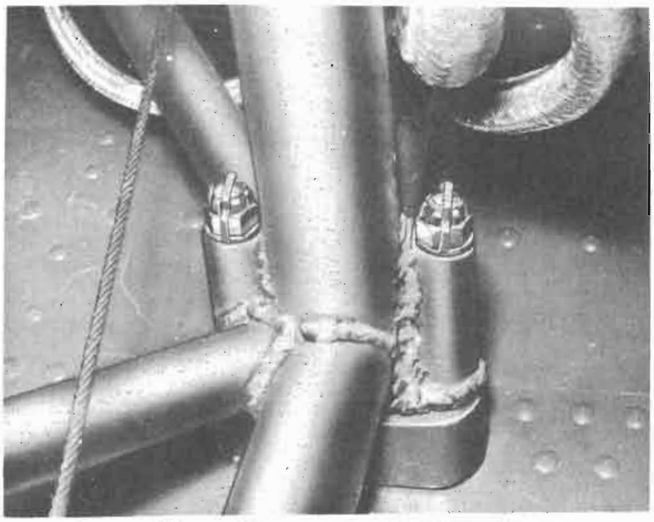


Figure 68 — Attachment of Wing Center Section to Fuselage

(1) CENTER SECTION. — *(See figure 68.)* — Prior to installation, the center section should be leveled and supported in position with the landing gear down. Place a bar or rigid tubing with hooked ends between the towing lugs at the jacking point of each wheel to prevent the wheels from retracting during the wing installation. The fuselage should be hoisted and then lowered to the center section and attaching points lined up. Care should be exercised when lowering the fuselage to see that all fittings, rods, wire, lines, fuel selector valve control shaft, etc., are either clear or guided into their proper position as required. Make sure that spacers are in position. Secure attachment bolts with nuts, cotters, and washers; adhere to the following procedure:

(a) Connect the electrical wiring at the left leading edge of the center section to respective terminals in the junction box just above this location. Attach the two conduits to the junction box; secure the conduits to the fuselage tube with clamps as required.

(b) Attach the fuel gage light assemblies with screws to the fuel gages mounted on the center section, one at each side of the pilot's seat.

(c) The aileron cables, extending through the fiber fair-leads to the upper surface of the center section, are identified to prevent them from slipping into the center section. Connect the cables to the aileron torque tube horn located between the two cockpits. Check to make sure the installation is correct.

(d) If the fixed wing machine gun which is located in the right outer panel is installed, connect the gun charging cable to the barrel fitting between the two pulleys at the right side of fuselage.

(e) If bomb racks are installed, connect the right and left bomb arming; release cables to the two connections between the pulleys at the left side of the fuselage.

(f) Connect the three flap hydraulic lines to the hydraulic cylinder fittings extending through the upper surface of the wing trailing edge at the left side of the fuselage.

(g) Safety the fuel selector valve drive shaft to the fuel cock unit with two cotters; make certain all taper pins are safetied.

(h) Lower the flaps, thread the end of the flap position indicator cable through the fair-lead at the left trailing edge of the center section, and attach the clevis end to the angle plate riveted to the center section flap panel. An adjustable clevis end is provided at the upper end of the cable, attaching to the indicator arm installed on the forward end of the control shelf in the front cockpit. Adjust the clevis end to obtain the correct position indication.

(i) Connect the two landing-gear position indicator cables to the indicator arms installed on the control shelf at the left side of the front cockpit, adjust the cable clevis ends to obtain the correct position indication.

(j) Connect the two landing gear hydraulic lines to the fittings on the center section leading edge at the left side of the fuselage.

(k) Connect the landing gear "DOWN" position lock mechanism by attaching the non-adjustable end of the actuating rod to the bell crank located in the side of the center section. Slide the dust boot on the rod, and attach the adjustable end to the corresponding bell crank forward of the control shelf. Attach the lower end of the dust boot to the flange on the mechanism support casting, and clamp the small upper end of the boot to the rod when the landing-gear control is set in the "UP" position.

CAUTION

Place a suitable spreader bar between the landing gear struts at the wheel jacking points before moving the landing gear controls to the "UP" position.

(l) Connect the fuel line leading from the fuel unit on the forward side of the fire wall to the fitting extending from the center section through the fire wall.

(m) Install hot and cold air ducts between the ventilation control valves and center section elbow fittings. Secure the ducts to the valves with bolts.

(n) Connect the hydraulic brake line at each side of the fuselage to the connector fittings provided on the upper surface of the center section leading edge.

(o) Install the fuselage side filler former at each side of the fuselage between the fire wall and center section.

(p) Connect the two pitot lines at the T-fittings located immediately above the leading edge of the center section at the right side of the fuselage.

(q) Check for proper adjustment and functioning of the control linkage, lock mechanisms, and indicator cables involved in this installation. Make certain the rubber grommets are installed where required.

(r) Install the wing-to-fuselage fillets and fuselage side panels. Install the front fillets first. Make certain the hydraulic fluid reservoir vent line is inserted through the hole in the fairing located aft of the center section under the fuselage and extending approximately 6 inches below the fairing.

(2) OUTER WING PANELS.—Each outer wing panel is twisted 2 degrees forward resulting in an angle of incidence of 0 degrees at the tip. Prior to installing an outer wing panel, clamp or tape the aileron in the "NEUTRAL" position and the flap panels in the "UP" position. Make certain all cables, tubes, lines, etc., are located or supported clear of the bolting angles and other parts of the wing structure. Each outer panel should then be supported near the tip and near the bolting angle by a suitable supporting cradle. With the foregoing accomplished, adhere to the following procedure:

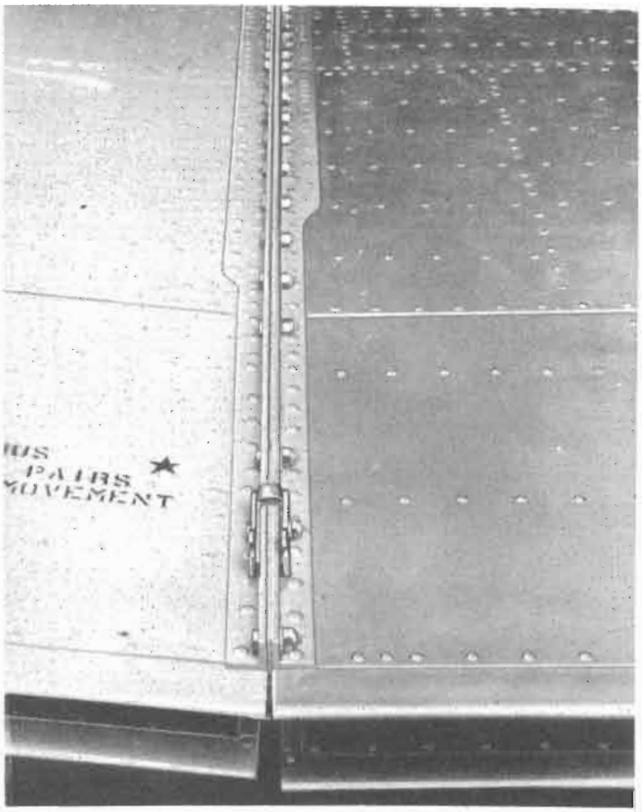


Figure 69 — Wing Bolting Angle Attachment

(a) Place the panel in position, align the bolt holes, and bolt the outer panel to the center section. Bolts of the upper surface should be inserted from the outboard side of the bolting angle; bolts at the lower surface, from the inboard side. (See figure 69.)

(b) Attach the front spar of the outer panel to the center section end plate by means of the outer panel spar bolting angle through which five bolts are inserted. These bolts should be started before installing those in the wing joint bolting angle and tightened after the latter are tightened.

(c) Connect the end of the landing gear operating cylinder piston rod to the attachment fitting on the front landing-gear strut assembly. (See figure 70.)

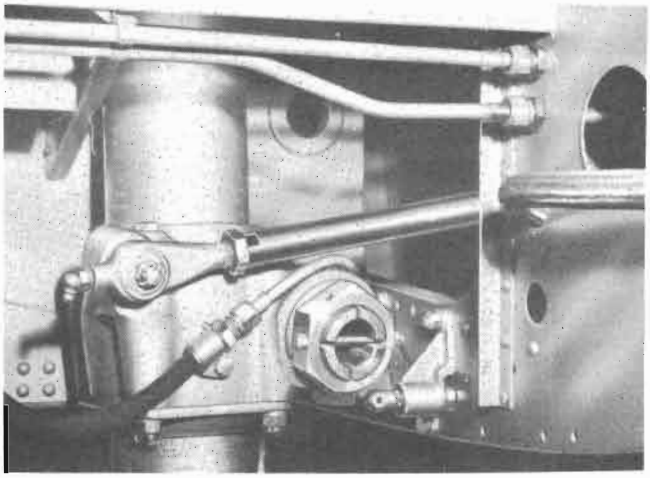


Figure 70 — Operating Cylinder Piston Rod Attachment

(d) Connect the electrical wiring and conduit at the junction box located in the leading edge of the center section.

(e) The aileron cables are identified for convenience of assembly, and the ends are attached to prevent them from slipping into the wing structure. Access to the aileron cables is made through Dzus-fastened inspection doors on the lower surface of the outer panel, approximately 2 feet outboard of the wing joint bolting angle. Connect the cable ends at the turnbuckles provided.

(f) If the fixed wing machine gun is to be installed, connect the gun charging cable to the gun which is located in the right outer panel. The access door for this purpose is located below the gun outboard of the wing joint angle.

(g) If bomb racks are to be installed, connect the two bomb release cables to the bell crank in each outer panel, access to which may be obtained by means of the access door directly inboard of the bomb rack in the lower surface of each outer panel.

(h) Connect the pitot lines in the leading edge of the right outer panel near the bolting angle.

(i) Connect the flap push-pull rod at the universal joint located immediately outboard of the bolting angle between the center section and the outer wing panel.

(j) Install the wing joint cover asemblies, incorporating extruded neoprene channels cemented to the edges of the covers with "caram" running board cement or equivalent. (See figure 61.)

(k) Check the installation and install all cover plates.

(l) Connect the two hydraulic lines from the retracting strut to the connector fittings on the center section end plate in the leading edge.

(3) WING TIPS.—Start two screws in the top and two in the bottom sides of the tip. Select locations approximately in the center.

(a) Align the trailing edge of the wing tip with the trailing edge of the aileron when the trailing edge of the aileron is in direct alignment with the trailing edge of the wing. Connect the bonding braid.

(b) Start all screws, reworking the nose of the wing tip if required to conform with the wing.

(c) Tighten all screws and recheck the alignment.

(4) AILERONS.—Place the aileron in position; secure it to the center, outboard and inboard hinge fittings respectively and then:

(a) Check the alignment of the hinge point centers in the event any of the hinge brackets have been replaced.

(b) Attach the adjustable end of the aileron control rod to the aileron control horn.

(5). AILERON TABS.—Place the trim tab in position; connect the two support tab hinges. Connect the aileron trim tab connecting rod on the lower surface of the tab to the aileron hinge bracket. The connecting point is on the axis of rotation of the aileron. This procedure also applies to the booster tab push-pull rod installed on earlier airplanes in which instance the rod is connected to a fixed part of the aileron hinge. Refer to DESCRIPTION, paragraph 1 *a.* (5) for additional information concerning the difference between the trim tab and booster tab.

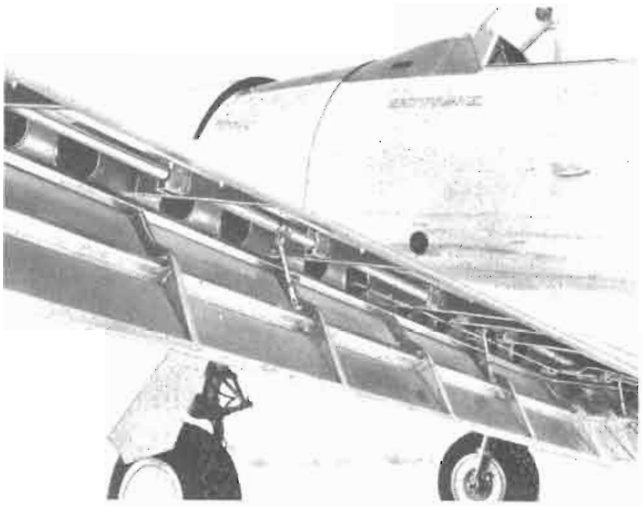


Figure 71 — Wing Flaps Installed

(6) WING FLAPS.—Prior to installing the flap panels, operate the flap controls to obtain the position of the actuating mechanism relative to the full "DOWN" position of the flaps.

(a) Attach the three flap panels to the lower surface of the center section and outer wing panels at their respective hinge points.

(b) Attach the upper fixed end of the small flap actuating rods to the points of attachment on the push-pull rod, the lower adjustable ends of the actuating rods being attached to the flap panel ribs.

(c) Attach the flap position indicator cable to the angle plate riveted to the center section flap panel.

Figure 72 — Empennage

2. EMPENNAGE.

a. GENERAL.—The tail assembly consists of a fin and stabilizer of metal construction (except for wood-constructed stabilizers installed on some later airplanes); a rudder of metal construction with fabric covering and provided with adjustable trim tab; and an elevator consisting of two sections of metal construction with fabric covering, each section having an adjustable trim tab. Navigation lights are installed on both sides of the fin. (Refer to section I for tail dimensions and Airplane Stations Diagram.)

b. STABILIZER.

(1) DESCRIPTION. — The stabilizer is a full cantilever, non-adjustable metal or wood structure consisting of right and left sections which are strictly interchangeable. In emergencies, both metal and wood sections can be installed on the same airplane although it is advisable to interchange units of the same construction whenever possible. The structure has a permanent setting of plus 1 degree relative to the longitudinal axis of the airplane. Metal units, formed from 24ST Alclad sheet with the exception of the aluminum-alloy tip assembly, consist essentially of two spars, regularly spaced ribs, and skin which is stiffened by spanwise stringers. The flush riveted leading edge and side skins are .040 and .032 inch in thickness, respectively, with

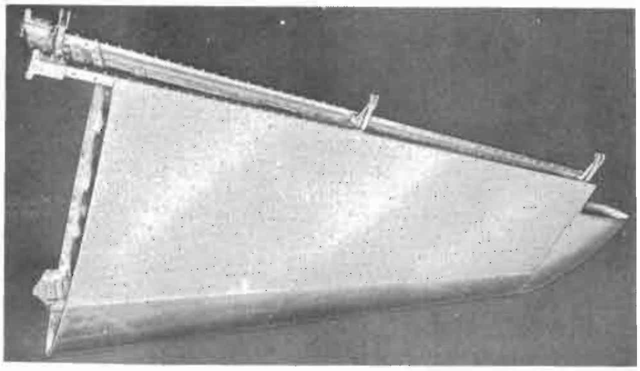


Figure 73 — Stabilizer

the stringers spot-welded to the side skins. The heavier metal provides extra protection for the leading edge. The tip assembly, secured by screws and readily removable, is a .032 inch in thickness. On wooden stabilizers the skin, as well as the spar and rib webs, are made from 3-ply mahogany, poplar core, plywood. The face grain of the skin describes a 45-degree angle to the main

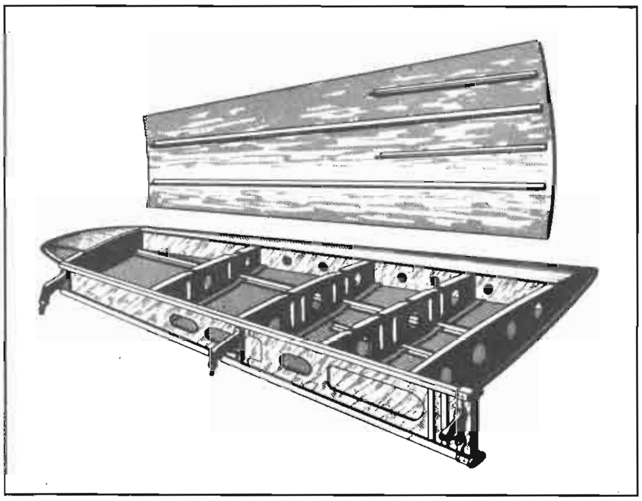


Figure 74 — Metal Stabilizer Structure

spar and is designed to give the structure greater strength. Internal units include spruce stiffeners with spruce tricleat caps, spruce spar caps, and elevator hinge supporting blocks of maple. Other structural blocks are of spruce. The skin is $\frac{1}{16}$ inch thick with the exception of the tips which are $\frac{3}{32}$ inch thick. The tips of the wooden stabilizer are not removable. The front spar base is made from birch veneer while the rear spar base is made from compregwood. The latter is an inpregnated and compressed maple laminated plywood. Laminated spruce provides strength for the leading edge. The stiffeners are held securely in position in the rib cut-outs by means of small wedges. Glue adheres one to the other and is used as a bonding agent. The skin is glued to the stiffeners, ribs, and spar caps. Either casein or resin glue is used in the assembly. A

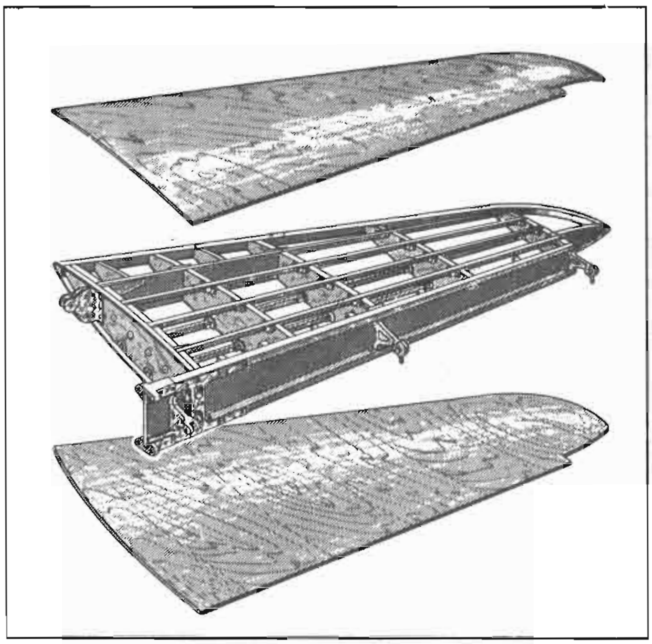


Figure 75 — Wooden Stabilizer Structure

smooth fabric covering doped in place completes the structure. The basic design of the metal and wood stabilizers is essentially the same. Both are provided with drain holes. Like the fin, the stabilizer is mounted simply. Four bolts, two on either side the rear spar joint, and two bolts, one on either side the front spar, secure the structure to the fuselage.

NOTE

Although the original requirements call for the various types of wood described above, certain substitute woods might be found in the various units of construction, as further requirements permit and as the manufacturers deem such substitutions necessary.

A second type of wood stabilizer, differing somewhat in construction from the one described above, is also used on some later airplanes. On this type the skin is made from 3-ply Douglas fir, poplar core, plywood, and is $\frac{3}{32}$ inch thick on all surfaces, including the tips. The skin grain is parallel to the rear spar. Also made from Douglas fir plywood are the front spar webs, front spar cap strip, ribs, and formers. Plain Douglas fir constitutes the rear spar webs and tricleats. Blocks are made from Douglas fir and maple. The rear spar cap strip, the bow of the leading edge and the front spar base are made from laminated Douglas fir. Fillers, flanges, pads, and the rear spar base are made from compregwood. Stiffeners are eliminated from this structure as are the nose ribs although one extra rib is added to the main body of the stabilizer. It is fabric-covered. Like the first wood stabilizer described, certain substitute woods may be used for units of construction.

(2) REMOVAL.—It is recommended that the two stabilizer sections be removed as a unit after removal of the fin. The elevator may be removed while connected

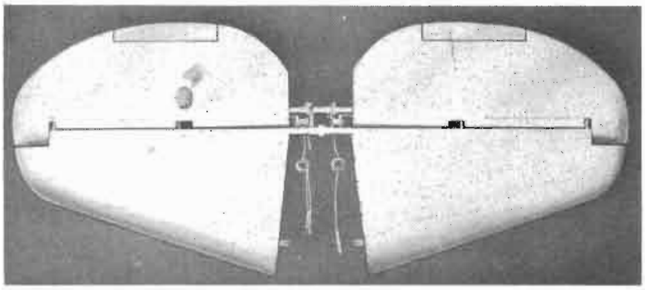


Figure 76 — Elevator Stabilizer Assembly

to the stabilizer. (Refer to paragraph *c.* (2) for information concerning the disconnecting of elevator cables, etc.)

(a) Remove the four bolts attaching the lower edge of the rear spar to the fuselage. Two bolts are on each side of the spar joint.

(b) Remove the two bolts attaching the front spars of the stabilizer sections to the fuselage.

(c) Lift the stabilizer assembly clear.

(d) Separate the two stabilizer sections by removing the four bolts holding the upper and lower edges of the rear spar together.

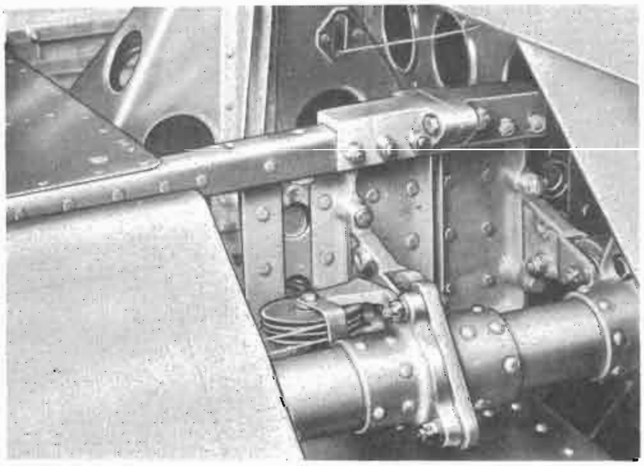


Figure 77 — Elevator-Stabilizer Installation

(3) INSTALLATION. — *(See figure 77.)* — The stabilizer assembly consists of two interchangeable sections which are bolted together through fittings provided on the upper and lower edges at the inboard ends of the rear spar. The stabilizer sections may be installed individually or prior to installing the vertical surfaces as a complete assembly. The elevator sections may or may not be attached to the stabilizer sections. Place the stabilizer in position on the fuselage tail, and secure it to the fuselage. The rear spar of each stabilizer section is held to the fuselage by two bolts; the front spar of each section is held to the fuselage by one bolt.

c. ELEVATOR.

(1) DESCRIPTION.—*(See figures 77 and 78.)*— The elevator assembly consists of two interchangeable

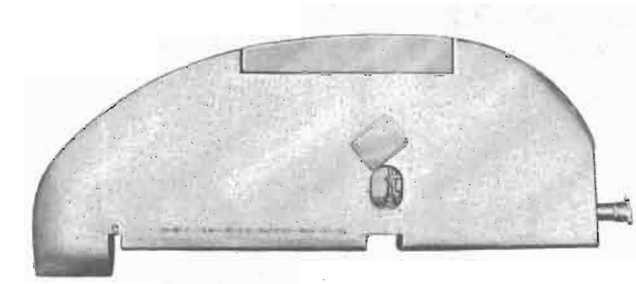


Figure 78 — Elevator

sections bolted to either end of a control horn torque tube to which are attached the center hinge points for the complete assembly. When the two sections are bolted together, the entire structure is supported by hinge brackets which are bolted to the rear spar of the stabilizer. The general construction of the elevator is substantially the same as that of the rudder. The 24ST Alclad aluminum frame for each elevator section is constructed around a $1\frac{3}{4}$-inch diameter 24ST aluminum-alloy torque tube which forms the primary load-bearing member of the structure. The ribs are formed from .020 inch thick 24SO Alclad sheet. In original rib forming, power-pressing was utilized to provide the integral cap strips, stiffening beads, and flanged cut-outs. The ribs extend from the leading edge to the trailing edge and are riveted to the torque tube by means of flanged collars. The leading edge forward of the torque tube is formed from several 24ST Alclad sheet sections which are .020 inch thick with the exception of the outboard nose skin which is .032 inch in thickness. The cast-lead counter weight at the outboard end of each section weighs 5.25 pounds. The elevator control horn, mounted upon the complete assembly, is forged from 14ST aluminum-alloy (aluminum-alloy permanent mold casting in later airplanes), while the metal cap assembly on the outboard end of each elevator section is formed from $52S\frac{1}{2}H$ aluminum-alloy sheet. A covering of doped fabric, provided with adequate drain holes, completes the structure. A controllable trim tab provided with drain holes, a trim tab operating mechanism, and cable are assembled on the frame. The entire elevator assembly has an angular movement of 30 degrees "UP" and 20 degrees "DOWN." Adjustable stops are located on the aileron torque tube in the fuselage.

(2) REMOVAL.—The two interchangeable elevator sections must be removed individually if the fin is installed, but may be removed together otherwise. Apply the following instructions, accordingly:

(a) Disconnect the cable ends from the tab control cables in the fuselage by removing the turnbuckles.

(b) Slip the trim tab drum cables out of the holes and fair-leads on the fuselage deck and the holes at the rear spar of the stabilizer. Unthread them from the pulleys.

(c) Disconnect the elevator control cable from the elevator control horn.

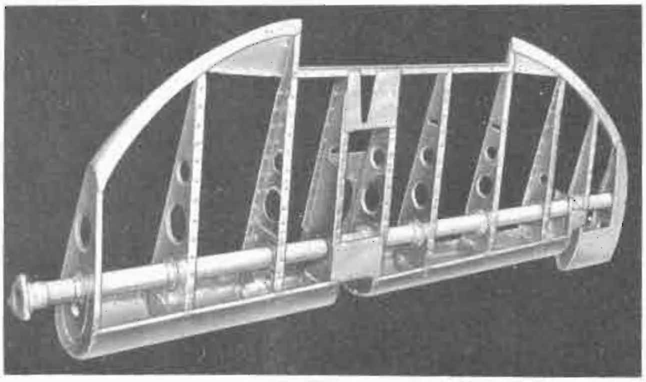


Figure 79 — Elevator Structure

(d) Disconnect the elevator assembly from the hinge brackets on the rear spar of the stabilizer. The assembly may now be removed if the fin is removed. If not, observe the next instruction.

(e) Disconnect the torque tube of the elevator section from the elevator horn torque tube and remove the elevator.

(3) INSTALLATION. — *(See figure 79.)* — The two interchangeable elevator sections must be installed individually if the fin is installed, but may be installed together otherwise. Apply the following instructions, accordingly. After interchanging the elevator sections or installing a spare section, make certain the drain holes on the upper surfaces are covered and that new drain holes are added to the lower surfaces.

(a) Attach each elevator section to the hinge brackets on the rear spar of the stabilizer at the two hinge points on the elevator control horn torque tube flanges after the elevator sections and torque tube have been bolted together. This applies if the fin is installed. If this is not the case, the elevator sections may be bolted to the control horn torque tube and the complete assembly lifted into position on the fuselage.

(b) Check for proper alignment of the hinge point centers in the event any of the hinge brackets have been replaced.

(c) Attach the elevator control cables to the elevator control horn.

(d) Thread the trim tab drum cables around the pulleys and through the holes at the rear spar of the stabilizer, through the holes and fair-leads on the fuselage deck.

(e) Connect the cable ends with turnbuckles to the tab control cable in the fuselage.

NOTE

Cable ends are color-coded to facilitate installation.

d. ELEVATOR TRIM TABS.

(1) DESCRIPTION.—A trim tab mounted on the trailing edge of each elevator section is adjustable by a control wheel on the left side of each cockpit. The tab is connected to a threaded actuating rod and drum cable assembly in its respective elevator section by a push-pull rod which extends from a horn on the tab to the clevis of the actuating rod. Trim cables lead from the drum assembly to the cockpit control wheels. (Refer to paragraph 77 for further information concerning trim tab controls, rigging and adjustment.) Tabs on later airplanes are constructed of wood and phenolic fiber assembled with casein glue, while those installed on earlier airplanes are of riveted Alclad construction. Wooden tabs consist of a leading edge spar and trailing edge strip joined together by ribs which fit into cut-outs in both members. The spar web is 3-ply Douglas fir which is 3/16 inch in thickness. The spar cap forward of the web is made of pine; the spar cap aft of the web is made of spruce. Inboard and outboard ribs are made of pine as is the No. 2 inboard rib. The middle rib and its neighboring outboard rib are constructed of 3-ply Douglas fir. There are five ribs in all. Three-ply Douglas fir, 1/16 inch thick, constitutes the skin covering. Drain holes are provided in the bottom skin of the tabs. Two Ledaloyl bearing hinge assemblies installed in each tab leading edge provide a means of attachment to the elevator sections. Metal tabs consist of a 24ST Alclad leading edge channel section and 24SO Alclad ribs. The complete structure is covered by 24ST Alclad skin which is 0.16 inch thick. Rivets hold the flanged ribs to the channel section while the skin is riveted to the ribs and to a 24ST Alclad trailing edge strip which lies between the two skin panels. Two ball-bearing hinge assemblies are secured to the channel section and provide a means of attachment to the elevator sections.

(2) REMOVAL.—Disconnect the trim tab push-pull rod from the bracket on the tab. Remove the attaching bolts from the brackets and remove the tab.

(3) INSTALLATION.—Place the trim tab in position, and secure it to the two brackets on the trailing edge of the elevator. Connect the trim tab push-pull rod to the bracket on the tab.

e. FIN.

(1) DESCRIPTION.—*(See figures 80 and 81.)*—The fin is a full cantilever non-adjustable structure formed from 24ST Alclad sheet and 24ST formed sections with a permanent setting of 1, 45, to the left of the longitudinal axis of the airplane. It consists of a front and rear spar, pressed-flanged ribs with stiffening intercostals, and a smooth metal covering. The rear spar is the main load-bearing member of the structure and has U-flanges formed along its length. The flush riveted leading edge and both spot-welded side skins are .040 and 0.25 inch thick, respectively. The heavier metal provides extra protection for the leading edge. The mounting of the structure is simple. Two bolts secure the rear spar to the fuselage bulkhead; two bolts and a fitting secure the front spar to the fuselage tripod assembly. Frosted white navigation lights are installed on both sides of the structure.

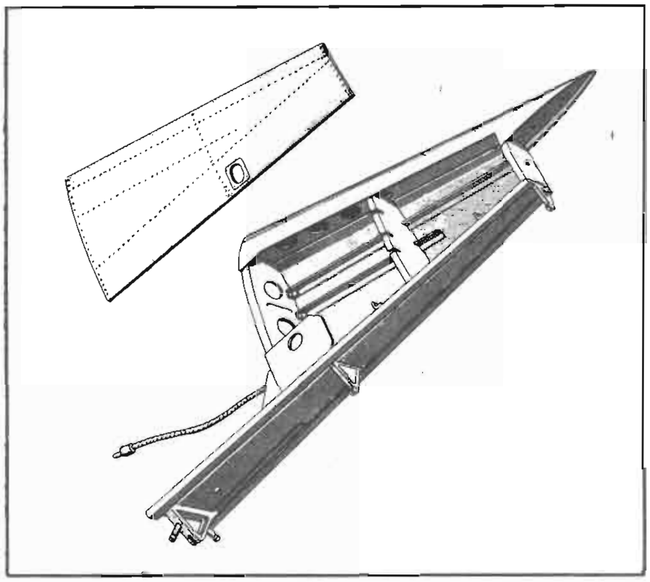


Figure 80 — Fin Structure

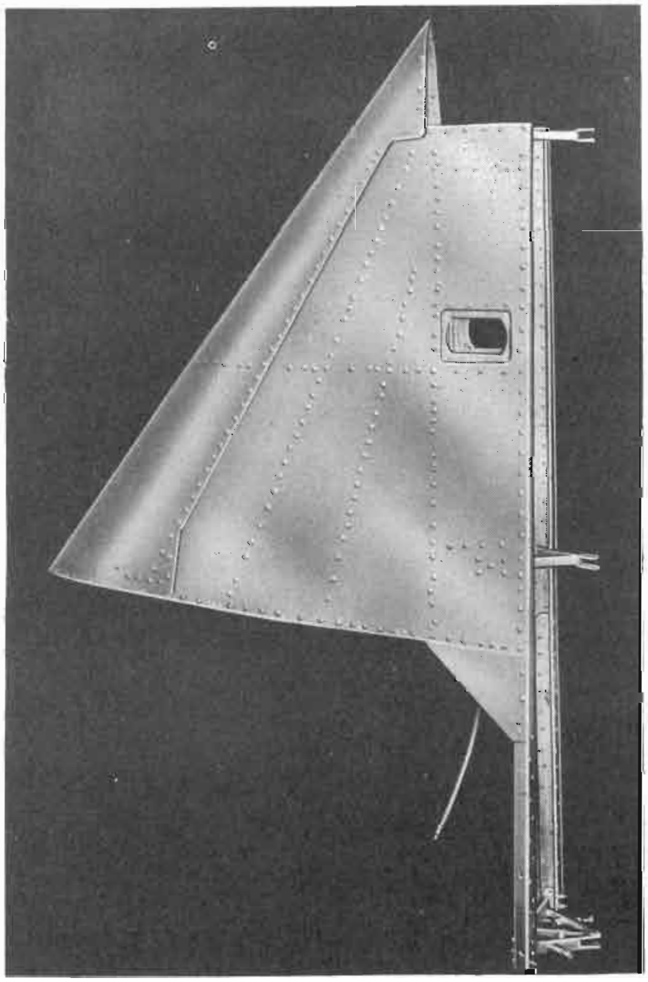


Figure 81 — Fin

(2) REMOVAL.—Before removing the fin, it is necessary to disconnect the navigation light wiring and conduit from the junction box on the forward side of the fuselage rear bulkhead. Access to the junction box is gained through the access hole on the sides of the fuselage under the stabilizer and elevator. The rudder must be removed first. (Refer to paragraph *f.* (2) for instructions in removing the rudder.)

(a) Remove the two bolts from each point of the rear spar-to-fuselage attachment and the lower bolt from the fitting at the point of the front spar-to-fuselage attachment.

(b) Lift the fin assembly clear.

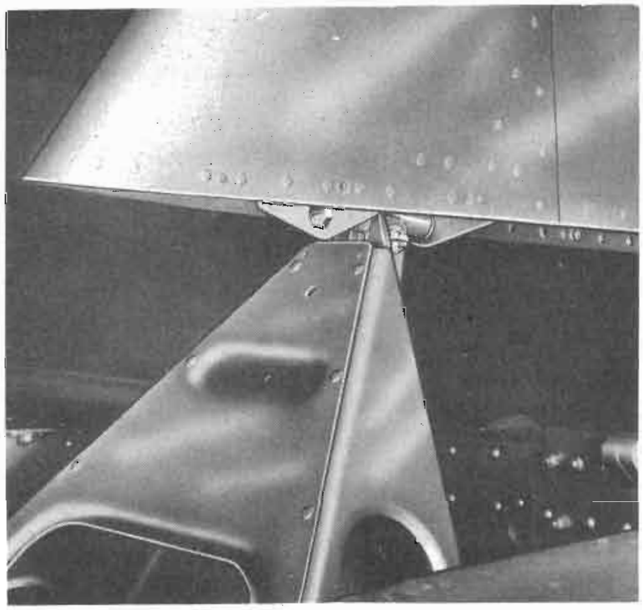


Figure 82 — Fin Installation

(3) INSTALLATION.—*(See figure 82.)*—Place the fin in position on the fuselage tail; bolt it to the two attachment points to the fuselage bulkhead and to the fuselage tripod assembly.

f. RUDDER.

(1) DESCRIPTION.—*(See figures 83 and 84.)*—The rudder is statically and dynamically balanced. The 24ST Alclad aluminum rudder frame is constructed around a 1-3/4 inch diameter 24ST aluminum-alloy torque tube which forms the primary load-bearing member of the structure. The trailing edge is excepted since it is formed from 24SO Alclad sheet .032-inch thick. The curved top of the rudder is formed from two shallow half sections of 52S1/2H aluminum-alloy sheet welded together about the common circumference and riveted to the uppermost rib of the structure. The ribs are formed from .020-inch thick 24SO Alclad sheet. In original rib forming, power-pressing was utilized to provide the integral capstrips, stiffening beads, and flanged cut-outs. The ribs extend from the leading edge to the trailing edge and are riveted to the torque tabs by means of flanged collars. The leading edge forward

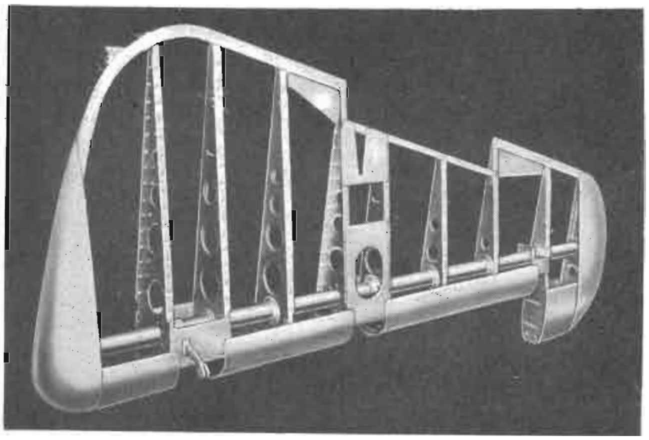


Figure 83 — Rudder Structure

of the torque tube is formed from several 24ST Alclad sheet sections which are .020-inch thick with the exception of the top leading edge skin which is .032 inch thick. A 3-pound cast-lead counterweight attached to the top of the rudder provides adequate static balance. A control horn, forged from 14ST aluminum-alloy (aluminum-alloy permanent mold casting in later airplanes), is attached to the torque tube at the lower hinge point. A controllable trim tab, a trim tab operating mechanism and cable, three sealed-type ball-bearing hinge fittings and the control horn are assembled on the frame. The rudder frame is covered with doped fabric. The rudder has an angular movement of 30 degrees to the left and 30 degrees to the right for AT-6C ariplanes bearing serial numbers 42-49005 to 42-49069 inclusive, and 42-43847 to 42-44425 inclusive, and for all AT-6D and SNJ-5 airplanes. For all other airplanes the rudder angular travel is 35 degrees to right and 35 degrees to left. The rudder assembly is attached to three hinge brackets on the rear spar of the vertical stabilizer. An adjustable stop is located on either side of the lower hinge bracket to limit rudder movement. Drain holes are provided at the bottom of the assembly.

(2) REMOVAL.—Disconnect the turnbuckles from the tab control cable in the fuselage by removing the turnbuckles; then proceed with the following instructions:

(a) Slip the trim tab drum cable away from the pulleys at the lower hinge bracket and out of the hole at the lower end of the fin rear spar.

(b) Disconnect the rudder control cable from the rudder horn.

(c) Disconnect the antenna from the top of the rudder at the hinge point centerline.

(d) Remove the bolts attaching the rudder to the lower, middle, and top fin spar hinge brackets, respectively.

(e) Remove the rudder.

(3) INSTALLATION.—Place the rudder in position, engaging the holes in the two upper torque tube fittings with the two upper fin spar hinge brackets, and proceed as follows:

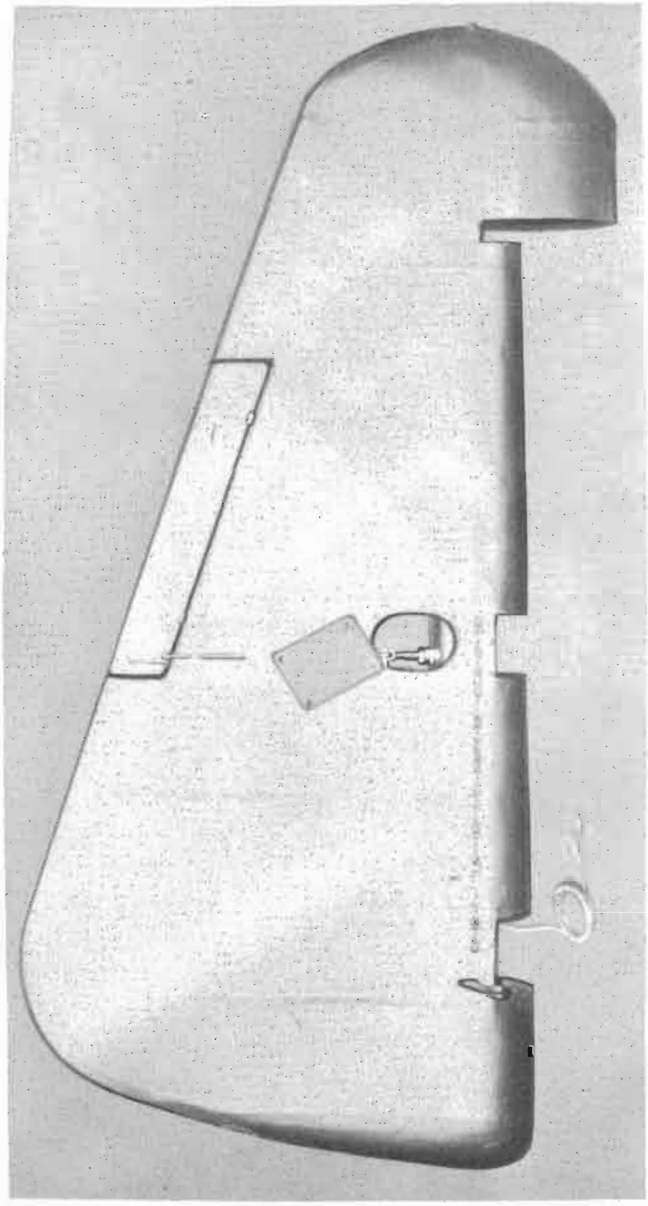


Figure 84 — Rudder

(a) Secure the lower fitting with the lower hinge bracket.

(b) Check for proper alignment of the hinge point centers in the event any of the hinge brackets have been replaced.

(c) Attach the antenna to the top of the rudder at the hinge point centerline.

(d) Attach the rudder control cable to the rudder horn.

(e) Thread the trim tab drum cable around the pulleys at the lower hinge bracket fin rear spar, attaching the cable with turnbuckles to the tab control cables in the fuselage.

g. RUDDER TRIM TAB.

(1) DESCRIPTION.—A trim tab mounted on the trailing edge of the rudder is adjustable by means of a control wheel on the left side of each cockpit. The tab is connected to a threaded actuating rod and drum cable assembly in the rudder by a push-pull rod, which extends from a horn on the tab to the clevis of the actuating rod. Trim cables lead from the drum assembly to the cockpit control wheels. (Refer to paragraph 11 for further information concerning trim tab controls, rigging and adjustment.) Tabs on later airplanes are constructed of wood and phenolic fiber assembled with casein glue, while those installed on earlier airplanes are riveted Alclad construction. Wooden tabs consist of a leading edge spar and trailing edge strip joined together by ribs which fit into cut-outs in both members. The spar web is of 3-ply Douglas fir which is 3/16 inch thick. The spar cap forward of the web is made of pine; the spar cap aft of the web is made of spruce. The end ribs are made of pine while the remaining three ribs are made of 3-ply Douglas fir. The spruce trailing edge is 5/16 inch thick. Three-ply Douglas fir, 1/16 inch thick, constitutes the skin covering. Drain holes are provided at the bottom of the tab. Two Ledaloyl bearing hinge assemblies installed in the tab's leading edge provide a means of attachment to the rudder. Metal tabs consist of a 24ST Alclad leading edge channel section and 24ST Alclad ribs with the exception of the lower rib of the structure which is formed of 24SO Alclad. The complete structure is covered by 24ST Alclad skin .020 inch thick. Rivets hold the flanged ribs to the channel section while the skin is riveted to the ribs. The skin is formed from one piece of material and is shaped around the structure of the tab. The trailing edge of the tab is thus formed by the bend in the skin. Two ball-bearing hinge assemblies are secured to the channel section and provide a means of attachment to the rudder.

(2) REMOVAL.—Disconnect the trim tab push-pull rod from the tab bracket; then disconnect the tab hinges and remove the tab.

(3) INSTALLATION.—Place the trim tab in position; secure it to the two brackets on the trailing edge and the rudder. Connect the trim tab push-pull rod to the tab bracket.

3. FUSELAGE.

a. GENERAL.—The fuselage structure consists of two sections, bolted together just aft of the rear cockpit. The engine mount, which is of welded chrome molybdenum steel tube construction, and the engine cowling are mounted on the front of the forward fuselage structure. Removable side panels and access doors are provided to permit necessary inspection and servicing. Space and installation provisions are made in the fuselage for radio and photographic equipment, armament and gunnery mountings and equipment, oxygen system, miscellaneous furnishings and facilities for operation of the airplane. A cockpit with tandem seats is enclosed by a full-vision enclosure and is provided with an instrument panel in both the front and rear cockpit. Quick detachable panels in the sliding sections of the front and rear cockpit enclosure provide means for emergency escape from the airplane. A cut-out handhold is provided in each instrument panel shield to facilitate ingress and egress of the crew. A baggage compartment is located in the rear section immediately aft of the rear cockpit. Provisions are made for carrying ballast weights in this compartment when the rear cockpit is unoccupied.

b. FRONT FUSELAGE SECTION.—The front fuselage section consists of welded chrome molybdenum steel tube and steel fitting structure and includes the fire wall, front and rear cockpit, cockpit enclosure, and all of the fittings, furnishings, equipment, and controls that are attached to and carried in this structure. Longitudinal leveling brackets are located on the fuselage diagonal braces at the left side of the rear cockpit, and

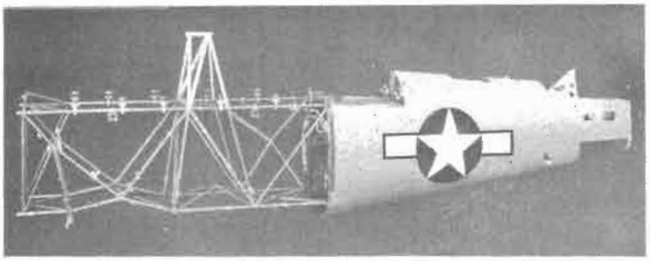
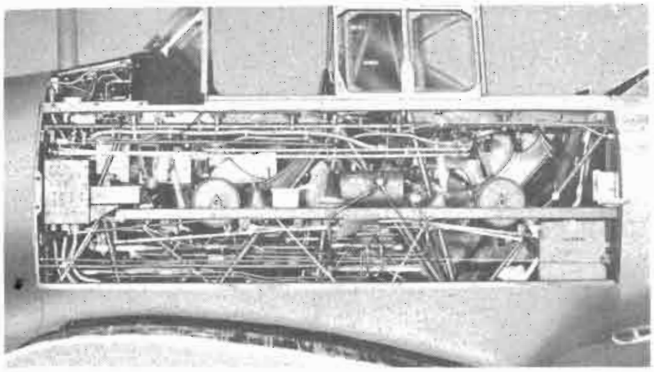


Figure 85 — Fuselage Structure



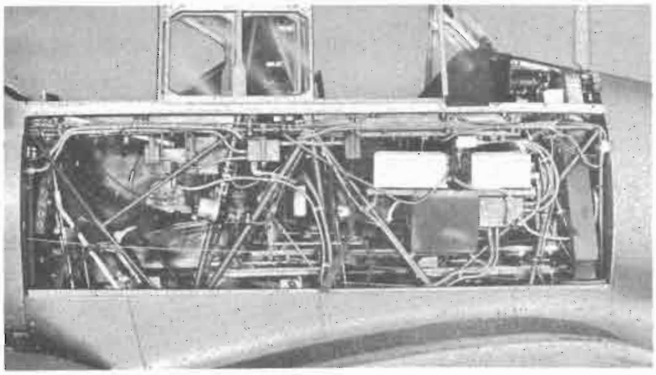


Figure 86 — Fuselage with Panels Removed (Left and Right Side) — Earlier Airplanes

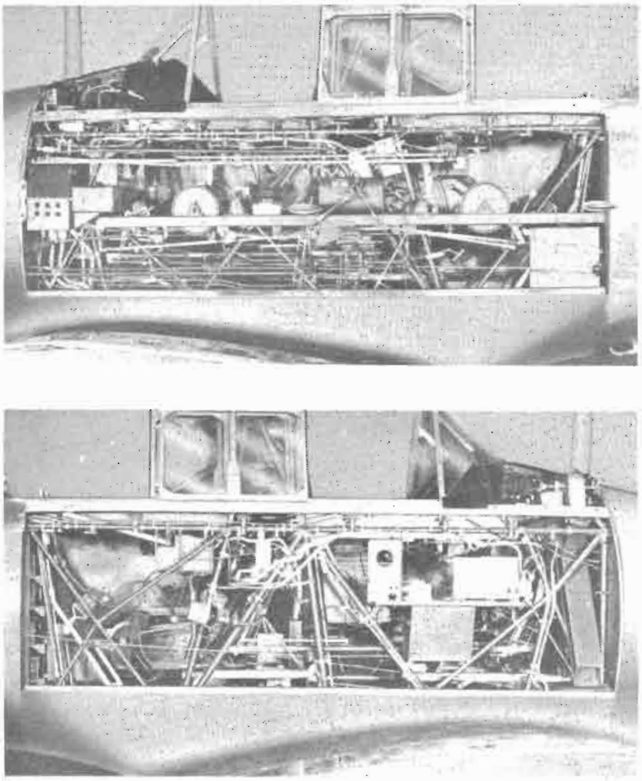


Figure 87 — Fuselage with Panels Removed (Left and Right Side) — Later Airplanes

lateral leveling brackets are located on the fuselage cross tube immediately aft of the front cockpit seat. Two fixed steps, which are attached securely to fittings on the fuselage structure, are provided on the left side of the fuselage, one for each cockpit. The side panel assemblies which cover the bay between the upper and lower longerons of the front tubular section of the fuselage, are secured to the fuselage former channels by screws and are readily detachable. The panels consist of vertical formers, made from 25ST Alclad sheet, longitudinal rolled-type 24ST stringers and .025- and .032-inch thick 24ST Alclad sheet covering. The assembly is spot-welded about the outside margins, and the remaining structure is assembled by rivets. Both the front and rear cockpits are provided with wooden floor assemblies which include floor troughs, supports, and brackets constructed of spruce and 3-ply birch-poplar plywood, attached to the lower fuselage structure by U-clamps and screws. On earlier airplanes, the foot troughs were constructed of riveted aluminum sheet. A fuel hose grounding jack is located near the lower margin of both the right and left panel directly below the rear attachment of the windshield. A door serving the hydraulic fluid tank is located slightly above the centerline of the left panel and below the front panel of the stationary section of the cockpit enclosure. A fire extinguisher is mounted on the inside surface of a door on the left of the rear cockpit. Two panel sections, the upper of which is fabric-base phenolic sheet, are located between the right side panel and the engine cowling. Three phenolic fabric-base panel sections are also located between the left-side panel and engine cowling. These, with the windshield cowling which is made from 24SO Alclad sheet, complete the covering of the front fuselage section. The lower front panel on the right side is of 24ST Alclad sheet construction and is equipped with a hinged Dzus-fastened 24ST Alclad door that serves the front machine gun ejection chute. The middle front panel on the left side is Dzus-fastened and affords access to the fuse box mounted aft of the fire wall on the left side of the front fuselage section. The nose-over structure, which is an integral part of the front fuselage frame structure, is located aft of the front cockpit within the fixed section of the cockpit enclosure, in a position which affords the greatest protection to the occupants of the front and rear seats. The front fuselage is securely attached to the wing center section at four points of attachment. The lower frame is drilled to take two bolts at each of the two attaching points on the wing center section front spar and rear spar.

(1) FIRE WALL.—*(See figure 88.)*—The fire wall consists of a single thickness of .019 corrosion-resistant steel sheet, and is provided with an angle about its circumference which is omitted at the lower portion. The fire wall is secured to the forward end of the fuselage frame assembly by means of engine mount attachment fittings and numerous brackets and clamps. Mounted on the forward face of the fire wall is the battery, main power panel box, throttle switch, mixture

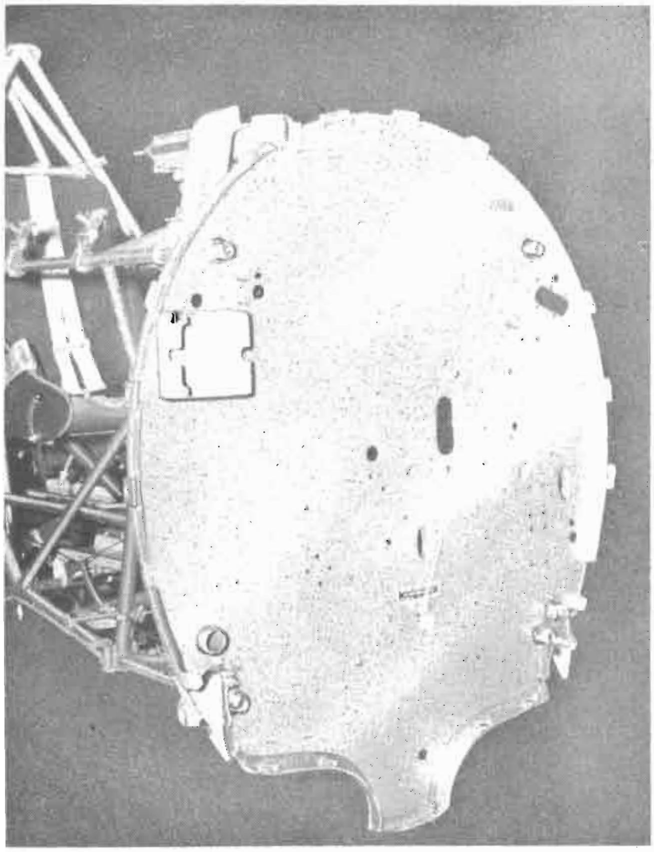


Figure 88 — Fire Wall

and propeller bell crank support bracket and numerous smaller units used in the operation and control of the airplane. An exhaust gas analyzer is mounted on the fire wall on some airplanes.

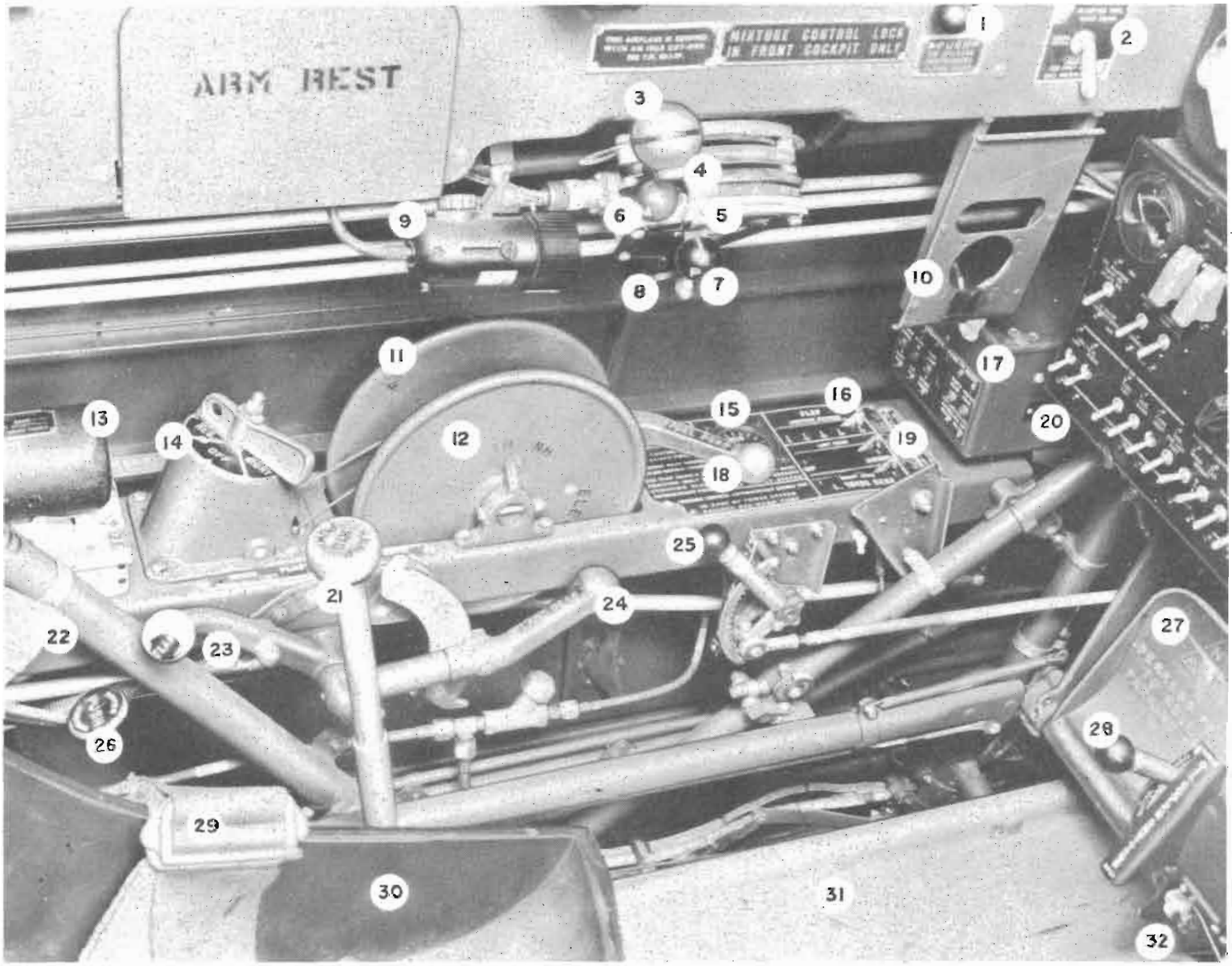


Figure 89 — Left Side of Front Cockpit — Later Airplanes

1. Blind Flying Hood Release
2. Manifold Pressure Gage Drain Valve
3. Throttle Control
4. Throat Microphone Switch
5. Mixture Control Lock Release
6. Mixture Control
7. Propeller Control
8. Engine Control Lock
9. Cockpit Light
10. Gun Camera Film Consumption Indicator Bracket
11. Rudder Trim Tab Control
12. Elevator Trim Tab Control
13. Marker Beacon Receiver Dynamotor
14. Fuel Selector Valve
15. Hydraulic Pressure Gage
16. Flap Position Indicator
17. Circuit Breaker
18. Hand Fuel Pump Handle
19. Landing Gear Position Indicator
20. Generator Circuit Breaker
21. Hydraulic Hand Pump
22. Flight Report Case
23. Flap Control
24. Landing Gear Control
25. Carburetor Air Temperature Control
26. Hydraulic Power Control
27. Left Rudder and Brake Pedal
28. Oil Cooler Shutter Control
29. Safety Belt
30. Cockpit Seat
31. Foot Trough
32. Cold Air Outlet

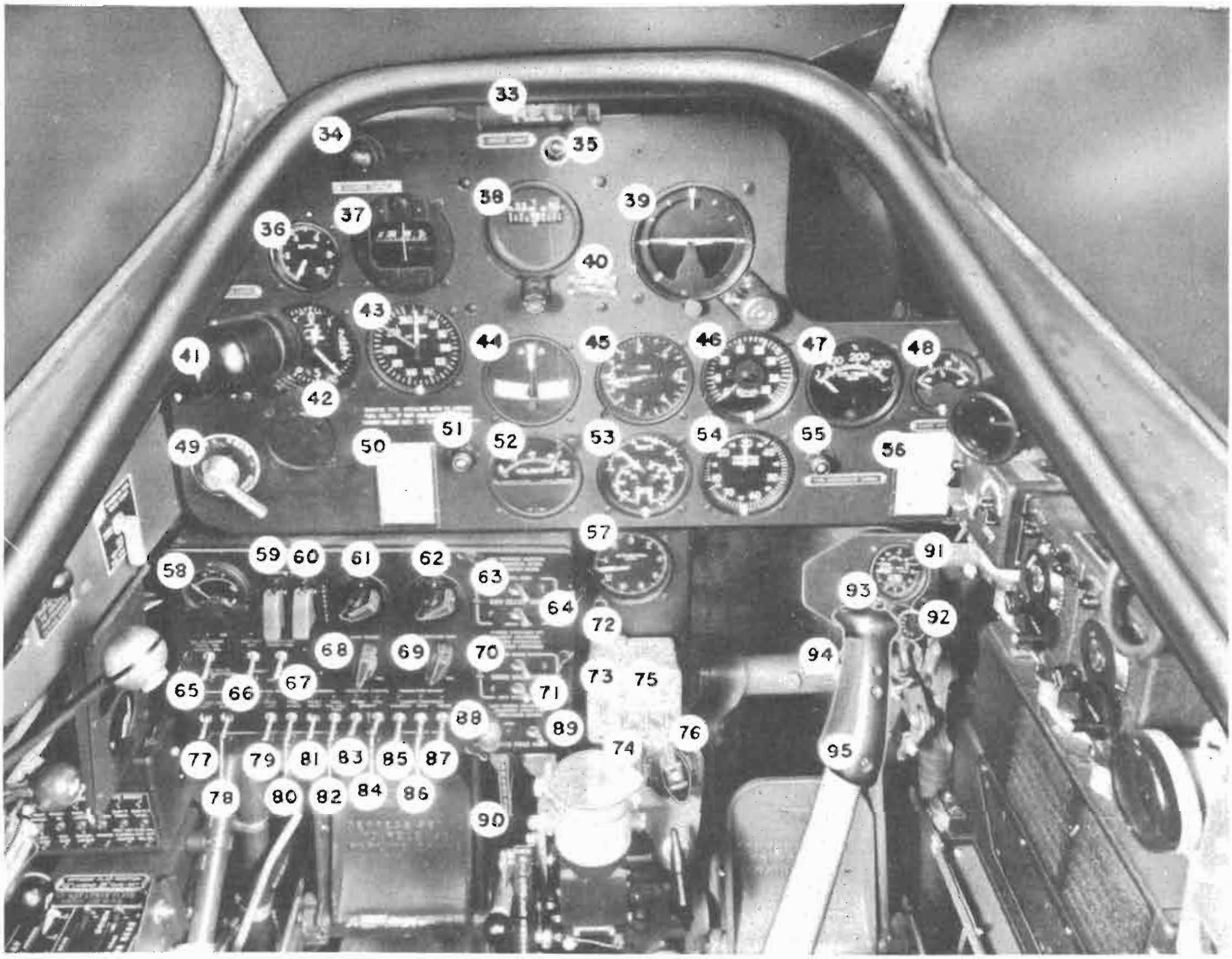


Figure 90 — Center of Front Cockpit — Later Airplanes

33. Blind Flying Hood Catch
34. Camera Signal Light
35. Spare Lamp
36. Suction Gage
37. Magnetic Compass
38. Directional Gyro
39. Flight Indicator
40. Radio Call Plate
41. Fluorescent Instrument Light
42. Altimeter
43. Air Speed Indicator
44. Bank and Turn Indicator
45. Rate of Climb Indicator
46. Tachometer
47. Cylinder Head Temperature Gage
48. Carburetor Mixture Temperature Gage
49. Ignition Switch
50. Altimeter Correction Chart
51. Marker Beacon Signal Light
52. Fuel-Air Ratio Gage
53. Oil Temperature-Fuel and Oil Pressure Gage
54. Manifold Pressure Gage
55. Fuel Switch-over Signal Light
56. Compass Correction Chart
57. Accelerometer
58. Generator Ammeter
59. Starter Energize Switch
60. Starter Energize Switch
61. Left Fluorescent Light Rheostat
62. Right Fluorescent Light Rheostat
63. Cowl Gun Selector Switch
64. Wing Gun Selector Switch
65. Oil Dilute Switch
66. Battery Disconnect Switch
67. Generator Main Line Switch
68. Gun Sight Rheostat
69. Compass Light Rheostat
70. Right Bomb Rack Selector Switch
71. Left Bomb Rack Selector Switch
72. Recognition Light Keying Switch
73. White Recognition Light Switch
74. Red Recognition Light Switch
75. Green Recognition Light Switch
76. Amber Recognition Light Switch
77. Left Landing Light Switch
78. Right Landing Light Switch
79. Passing Light Switch
80. Fuel Gage Light Switch
81. Pitot Heater Switch
82. Fuel Switch-over Signal Light Test Switch

83. Wing Position Light Switch
84. Tail Position Light Switch
85. Camera Safety Switch
86. Gun Safety Switch
87. Bomb Safety Switch
88. Bomb Arming Signal Light
89. Bomb Arming Safety Switch
90. Parking Brake Handle
91. Oxygen Pressure and Flow Gage
92. Oxygen Regulator
93. Bomb Release Switch
94. Gun Trigger Switch
95. Control Stick
96. Transmitter Signal Key

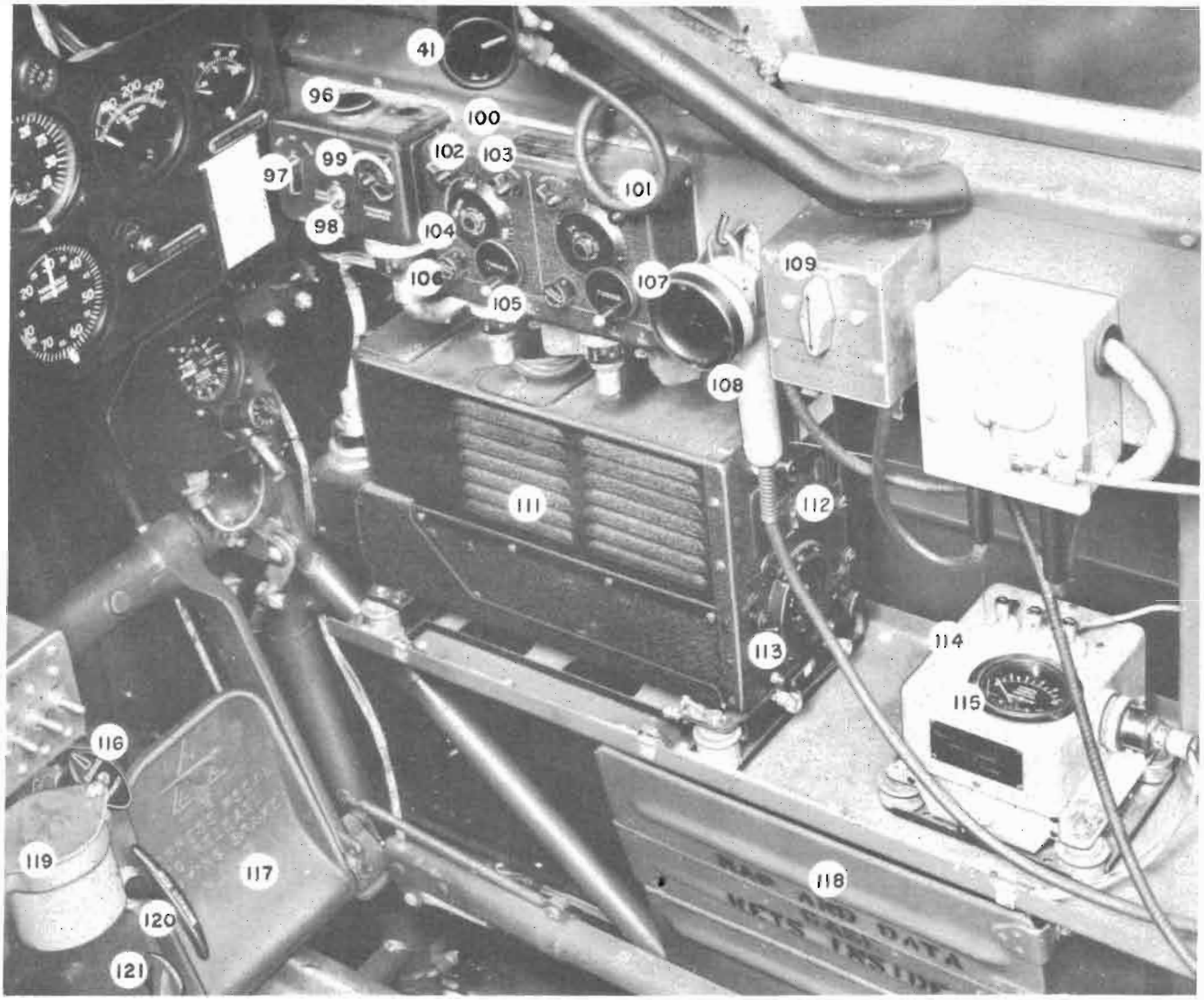


Figure 91 — Right Side of Front Cockpit — Later Airplanes

97. Transmitter Phone and CW Selector Switch
98. Transmitter Power Switch
99. Transmitter Frequency Selector Switch
100. 190-550 KC Receiver Control
101. 3-6 MC Receiver Control
102. Headphone Selector Switch
103. Power Switch
104. Tuning Dial
105. Tuning Crank
106. Volume Control
107. Microphone
108. Microphone Switch
109. Radio Filter Box
110. Radio-Interphone Selector Switch
111. Transmitter
112. Frequency Indicator
113. Tuning Dial
114. Antenna Relay
115. Antenna Current Indicator
116. Engine Primer
117. Right Brake and Rudder Pedal
118. Map and Data Case
119. Gun Sight
120. Gun Charger
121. Pedal Adjustment Latch

(2) FRONT COCKPIT.—The control shelf which is attached to two brackets on the outer left side of the front fuselage structure contains the following attachments:

Hydraulic pressure gage
Landing gear position indicator
Flap position indicator
Landing gear control
Flap control
Elevator trim tab control
Rudder trim tab control
Hand fuel pump handle
Fuel selector valve control
Carburetor air temperature control
Hydraulic power control

(3) REAR COCKPIT.—The control shelf which is attached to a flange bracket on the front bulkhead of the rear fuselage section contains the following controls and attachments:

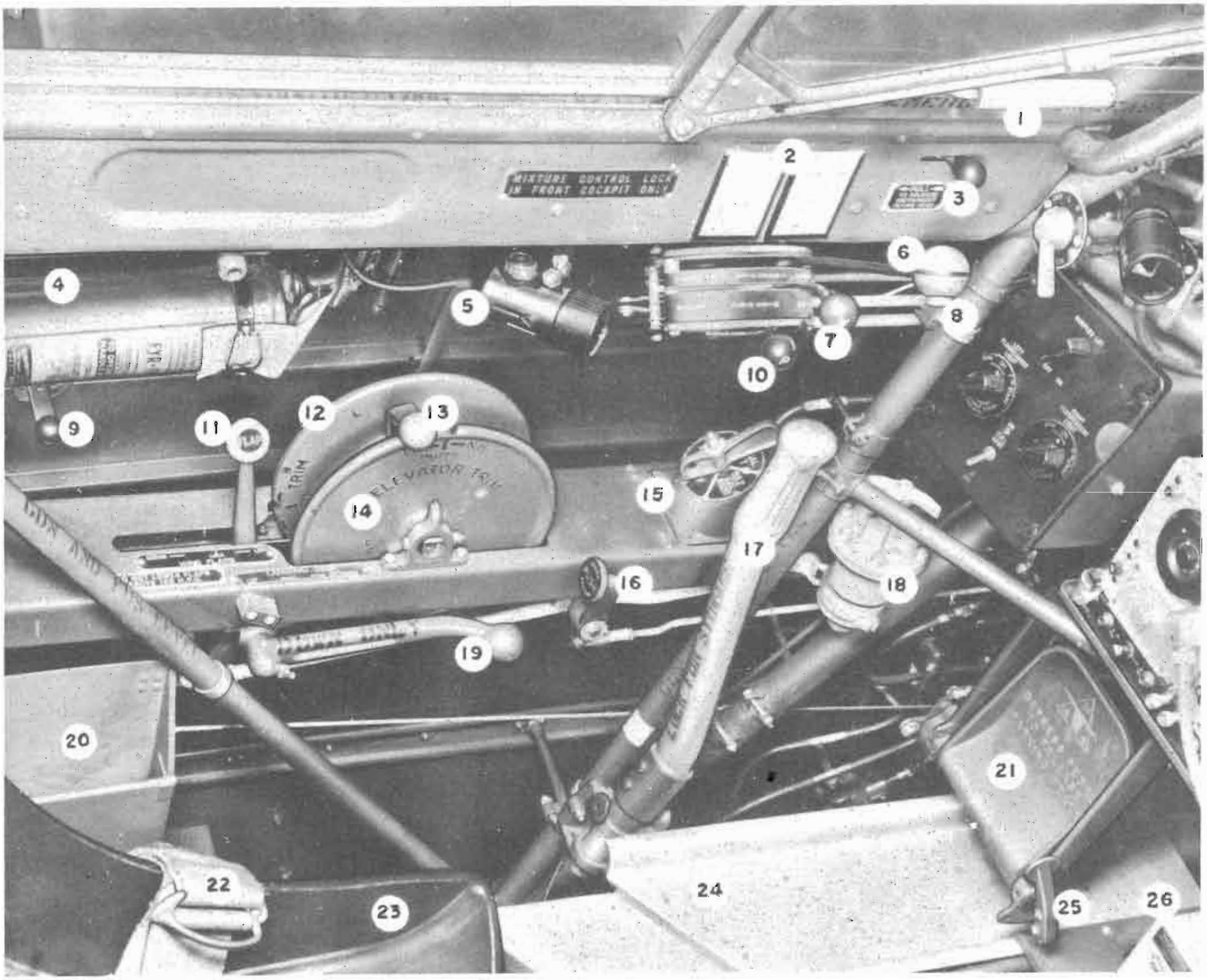


Figure 92 — Left Side of Rear Cockpit — Later Airplanes

1. Gunner's Hood Handle
2. Altimeter and Compass Correction Charts
3. Blind Flying Hood Release
4. Fire Extinguisher
5. Cockpit Light
6. Throttle Control
7. Mixture Control
8. Throat Microphone Switch
9. Ventilator Door Handle
10. Propeller Control
11. Flap Control
12. Rudder Trim Tab Control
13. Hand Fuel Pump Handle
14. Elevator Trim Tab Control
15. Fuel Selector Valve
16. Hydraulic Power Control
17. Control Stick (Stowed Position)
18. Hydraulic Filter

19. Landing Gear Control
20. Flight Report Case
21. Left Rudder and Brake Pedal
22. Safety Belt
23. Cockpit Seat
24. Foot Trough
25. Pedal Adjusting Latch
26. Marker Beacon Receiver

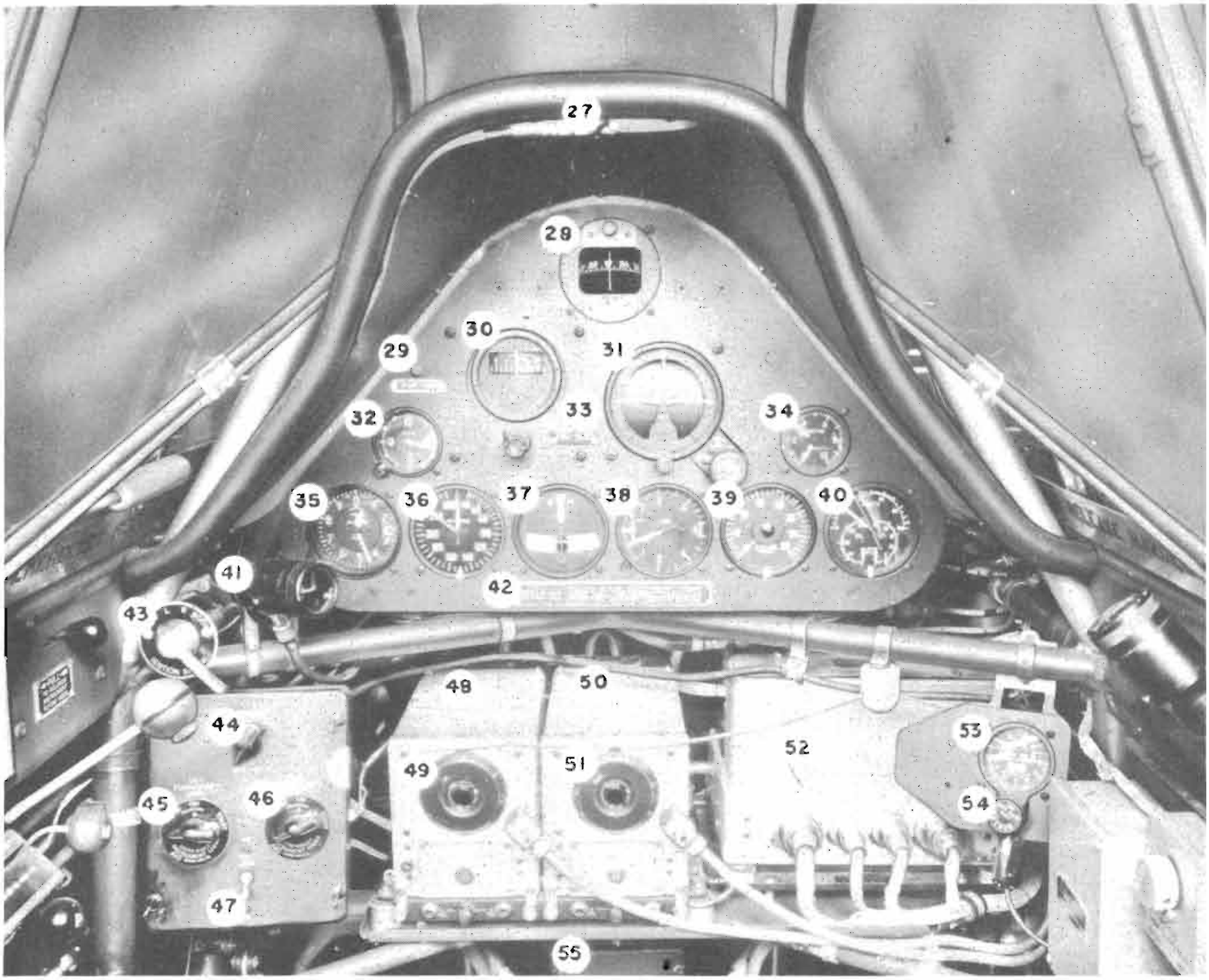


Figure 93 — Center of Rear Cockpit — Later Airplanes

27. Blind Flying Hood Catch
28. Magnetic Compass
29. Spare Lamp
30. Directional Gyro
31. Flight Indicator
32. Clock
33. Radio Call Plate
34. Suction Gage
35. Altimeter
36. Air Speed Indicator
37. Bank and Turn Indicator
38. Rate of Climb Indicator
39. Tachometer
40. Oil Temperature-Fuel and Oil Pressure Gage
41. Fluorescent Light
42. Warning Instruction Plate
43. Ignition Switch
44. Compass Light Rheostat
45. Left Fluorescent Light Rheostat
46. Right Fluorescent Light Rheostat
47. Fuel Gage Light Switch
48. 3-6 MC Receiver
49. Tuning Dial
50. 190-550 KC Receiver
51. Tuning Dial
52. Transmitter Modulator
53. Oxygen Pressure and Flow Gage
54. Oxygen Regulator
55. Radio Junction Box

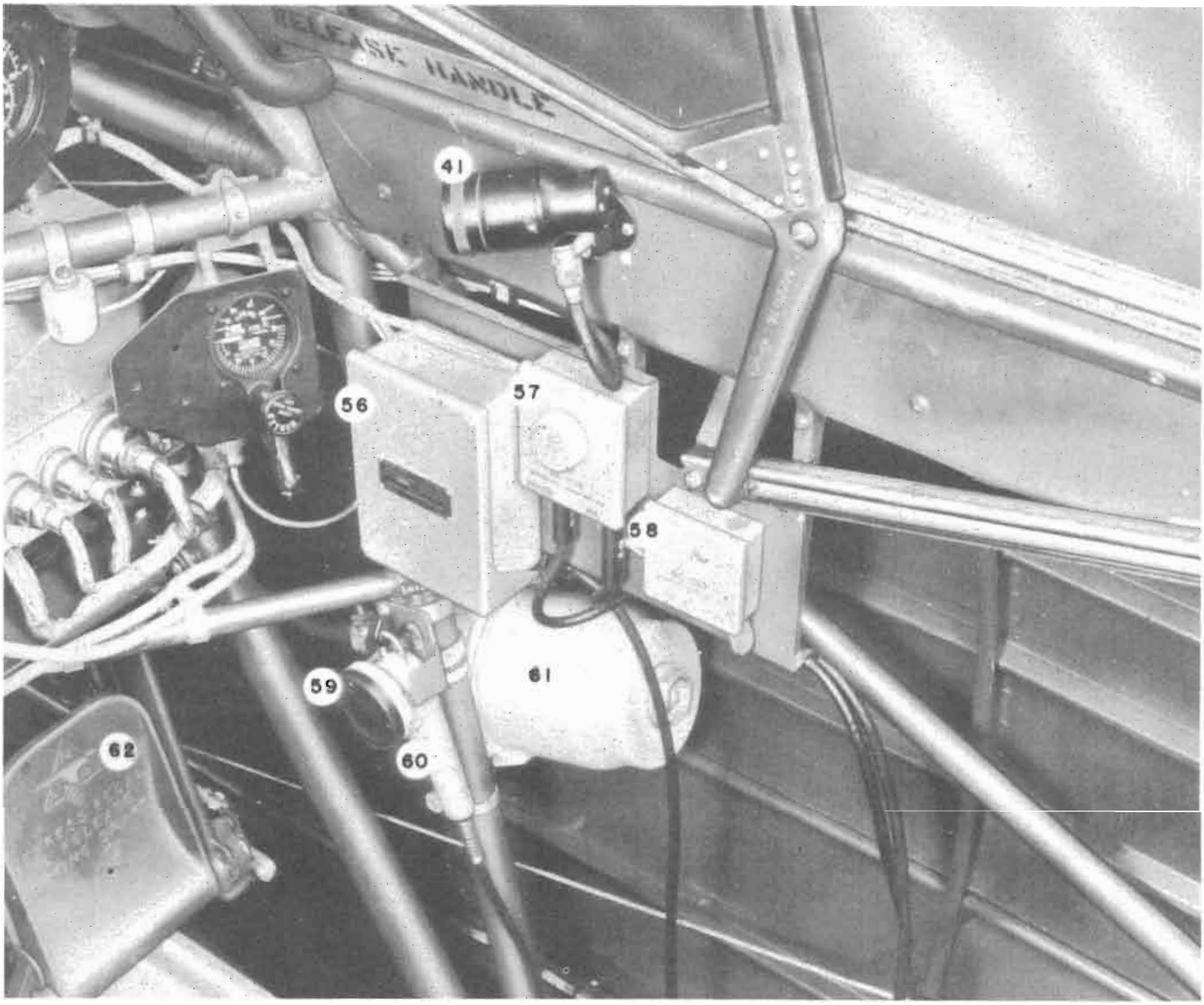


Figure 94 — Right Side of Rear Cockpit — Later Airplanes

56. Interphone Amplifier
57. Interphone Volume Control
58. Interphone-Radio Switch
59. Microphone
60. Microphone Switch
61. Vacuum Filter Unit
62. Right Rudder and Brake Pedal

Landing gear control
Flap control
Elevator trim tab control
Rudder trim tab control
Hand fuel pump handle
Fuel selector valve control
Hydraulic power control
Hydraulic fluid reservoir
Hydraulic fluid filter

(4) COCKPIT ENCLOSURE.—*(See figure 95.)*—The two tandem cockpits are under one enclosure, which consists of a windshield assembly, a sliding section over the front cockpit, a stationary center section between the cockpits, a sliding section over the rear cockpit, and a rear section gunner's hood at the rear of the enclosure assembly.

(a) WINDSHIELD ASSEMBLY.

1. DESCRIPTION.—The windshield is of 3-ply laminated glass. The central windshield panel is 1/4-inch thick glass and the smaller side panels are 3/16-inch thick glass.

2. REMOVAL AND DISASSEMBLY.—It is necessary to remove the windshield from the cowling before replacing a damaged glass panel. To do this, remove the bow and strips as one assembly by removing the

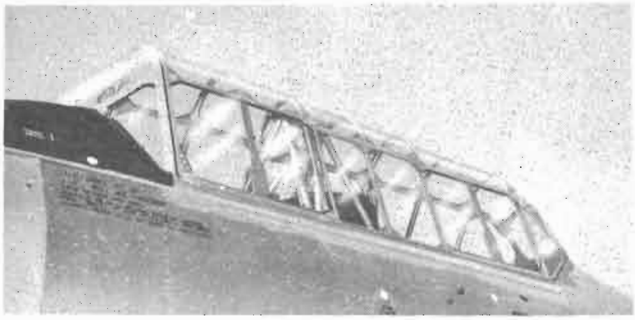


Figure 95 — Cockpit Enclosure

eight screws that secure the assembly to the cowling. A glass panel is then easily removed and replaced, without disassembly of the windshield frame. On earlier airplanes, drilling out rivets and partial disassembly of the frame are necessary.

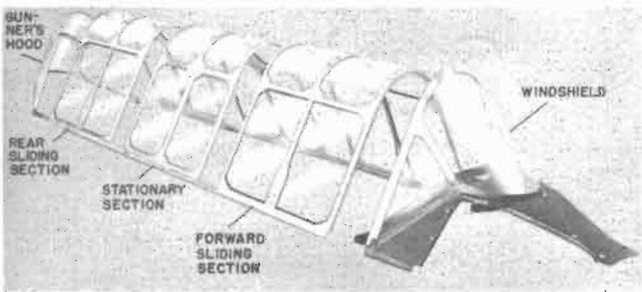


Figure 96 — Cockpit Enclosure Sections

3. ASSEMBLY AND INSTALLATION.—The windshield assembly includes three fuselage cowling panels, one extending forward from the lower edge of the center windshield panel, and the other two extending downward from the lower edges of the side panels. An instrument panel shield is also incorporated in the windshield assembly. Place the windshield in position on the fuselage; fasten the cowl panels and instrument panel shield to the fuselage formers. Prior to replacing a windshield panel in earlier airplanes, it may be necessary, depending upon the accessibility of the attaching rivets, to remove or partially remove the section assembly affected. This is not necessary in later airplanes, since no rivets are used in windshield installation. The same rubber channels may be utilized for replacement if they are in good condition. Apply a plastic caulking compound around the outside edges of the windshield, such as Hunt's mastic caulking compound or equivalent.

(b) SLIDING ENCLOSURE SECTIONS.

1. DESCRIPTION.—The side panels are 3-ply laminated glass. The top sections are provided with 1/8-inch thick non-inflammable transparent sheet. The sliding sections operate on channel tracks which are attached to the fixed enclosure section located between the cockpits. A handle and lever arrangement is located at the left side of each sliding section to provide a means of controlling the enclosure lock plungers from either inside or outside. The front and rear sliding sections can be locked at three and at one intermediate positions respectively, between the open and closed positions. Each sliding section is equipped with an emergency release latch assembly on both the right and left side. Each latch assembly consists of a corrosion-resistant steel, spot-welded frame in which is built a top panel release plunger, a bottom panel release plunger and a spring lever which operates both plungers simultaneously. The lever is safety-wired when the side panel structure of the sliding section is locked in place. Raising the lever disengages both plungers and releases the entire side panel from the cockpit enclosure, providing an emergency exit for the crew. The enclosure frame is constructed of 53S tempered aluminum-alloy riveted channel extrusions.

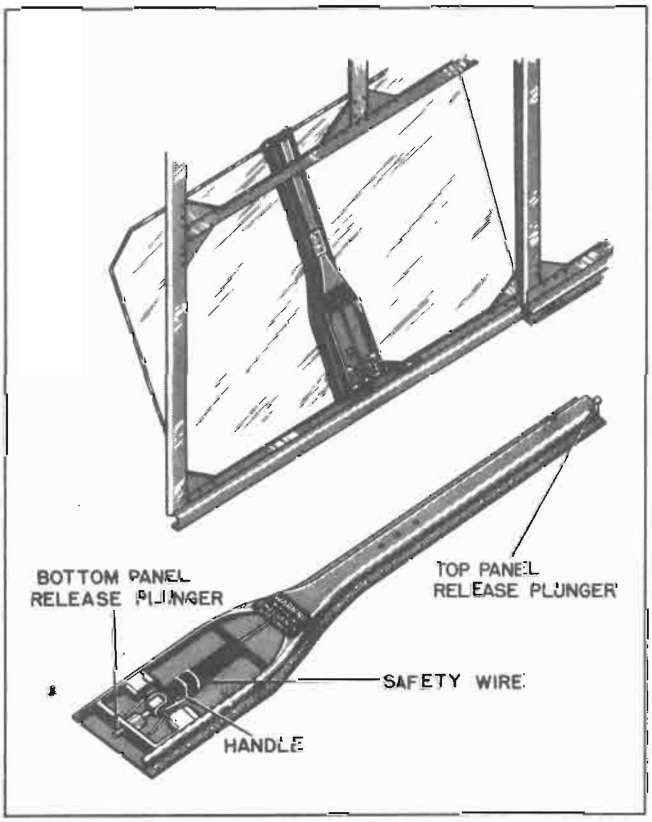


Figure 97 — Emergency Release Latch

2. REMOVAL.—To remove any of the side panels in either of the sliding sections pull the EMERGENCY RELEASE HANDLE which will release the panel section. To remove a defective panel, pull the rubber channel from the panel frame and remove the panel. To remove the forward or aft top panels of the front sliding section in earlier airplanes, it is necessary to remove the bow and corner blocks. To replace a forward top panel of the aft sliding section in the earlier airplanes, removal of the entire rear hood assembly is necessary; that is to permit the sliding

section to be moved aft. To remove the aft top panel of the section it is only necessary to remove the bow and corner blocks. In later airplanes all panels are removed and replaced without removal or disassembly of the sliding sections. The panels are encased in rubber channels which are fitted into the panel frames when panels are installed or replaced. To remove a panel, the rubber channel is pulled from the panel frame allowing free removal of the panel.

3. ASSEMBLY AND INSTALLATION.—Prior to installing the front or rear sliding sections, it is necessary to remove the windshield assembly or the gunner's hood respectively. In the latter case, it is necessary to remove the top fuselage cowl panels immediately aft of the enclosure assembly. In this case, the stationary sections may be removed by removing four screws and permit the front sliding section to be installed or removed without disturbing the windshield assembly. Care should be used in handling the enclosure sections before they are installed in order to prevent possible malfunctioning due to misalignment of the lower edges. Engaging the rollers of the sliding sections with the enclosure tracks, slide the sections into position over the front and rear cockpits. Install the roller stops at the attaching ends of the enclosure tracks in order to prevent overtravel of the sliding sections in the open position. If new panels replace damaged ones, the same rubber strips may be used if they are in good condition.

CAUTION

Ascertain that the EMERGENCY RELEASE HANDLE lockpins and safety wires are properly installed.

(c) STATIONARY ENCLOSURE SECTION.

1. DESCRIPTION.—The side panels are 3-ply laminated glass. The top sections are provided with 1/8-inch thick non-inflammable transparent sheet.

2. REMOVAL.—In earlier airplanes, remove the stationary section by removing the four block-shaped stops from the inside of both tracks. Lift the entire section clear. Remove the bow and corner blocks and remove the top or side panel as required. In later airplanes removal and disassembly is the same as described in paragraph *(b) 2.*

3. ASSEMBLY AND INSTALLATION.—The stationary section of the cockpit enclosure is installed between the tracks of the front and the rear sliding sections. The tracks may be installed with or without the stationary section attached. However, it is preferable to install the tracks and stationary section as a unit. Place the stationary enclosure section and tracks in position on the fuselage, and fasten the track sections to the upper fuselage side former channels.

(d) GUNNER'S HOOD.

1. DESCRIPTION.—The panels of the rear section gunner's hood are 1/8-inch thick non-inflammable transparent sheet.

2. REMOVAL.—To remove the gunner's hood, unbolt the corners of the hood from the lower rear corners of the movable rear section and disengage the roller at the lower end of the operating arm from the track.

3. INSTALLATION.—The gunner's hood is interconnected with the removable section in such a manner that when the section is opened the hood automatically slides and rotates in a forward and upward direction to the open position. To install the hood, engage the roller at the lower end of the operating arm with the track extending downward and forward at the right side of the rear cockpit. Bolt the corners of the hood to the lower rear corners of the movable section.

NOTE

When ordering a replacement part, be sure to give the correct number. Each panel has a separate part number and is called out on its respective assembly number. Refer to pertinent illustrated parts catalog.

(e) TRANSPARENT PLASTIC PANELS.—The following instructions concern transparent plastic panels of the cockpit enclosure. These repairs, for the most part, are for temporary service only and more permanent repairs to damaged units should be effected as soon as possible. It should be borne in mind that even a carefully patched plastic panel is not optically or structurally equal to a new section.

1. CLEANING.—In order to avoid scratching the panels, it is recommended that the panels be washed with a grit-free soft cloth, chamois or sponge. Never use a dry cloth. In addition to scratching the panels, wiping with a dry cloth also builds up an electric-static charge on the panels, which attracts dust particles. Washing with a damp chamois will remove this charge, and the dust will not scratch the surface. Soap and water or carbon tetrachloride may be used to remove grease and oil, but acetone, benzine and lacquer thinners will affect the surface. The application of a wax finish is recommended to protect the panels from undue scratching.

2. MINOR SCRATCHES.—Minor scratches may be removed by vigorously rubbing the affected area by hand, using a soft cloth moistened with a mixture of turpentine and chalk or automobile body cleaner. Rub the area both in the direction of the crack and at right angles to the crack, but do not rub too long in one place as the heat generated by friction may cause ridges.

3. DEEP SCRATCHES.—*(See figure 98.)*—If the scratches are too deep to be removed by the procedure outlined for minor scratches, it may be necessary to sand the area around the scratches. It is to be noted, however, that the panels should not be sanded unless absolutely necessary. Wrap a sheet of 320A fine

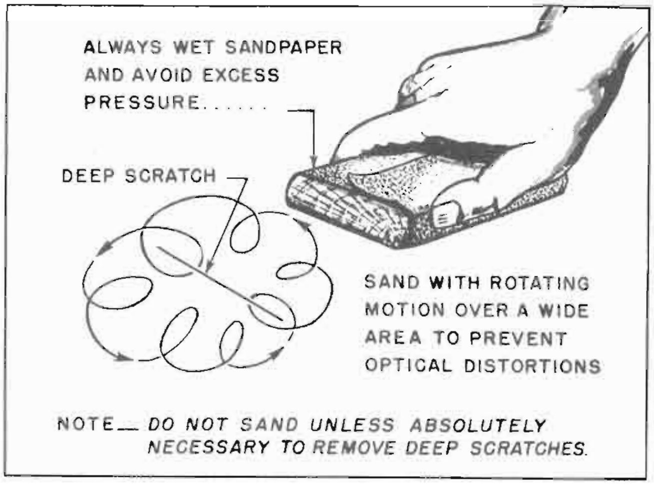


Figure 98 — Removing Deep Scratches from Plastic Panel

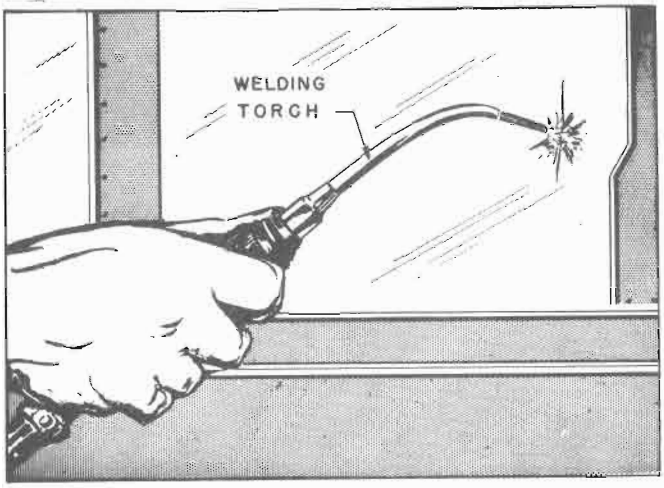


Figure 100 — Applying Torch Flame to Plastic Panel

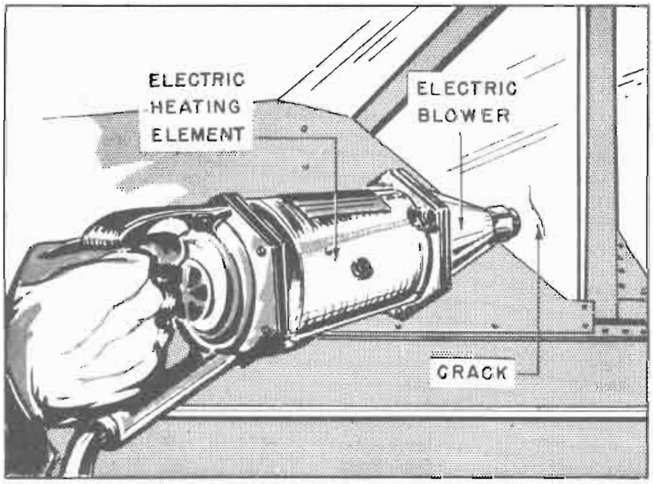


Figure 99 — Applying Hot Air Blast to Plastic Panel

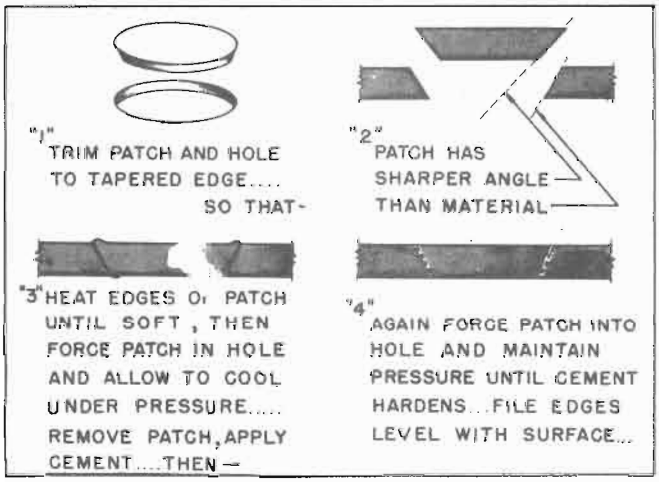


Figure 101 — Repairing Holes in Plastic Panels

sandpaper around a block, wet the sandpaper, and sand *lightly* over a wide area with a free circular motion. Do not confine the sanding to too small an area or objectionable distortions, or "bull's eyes," will result in the transparent plastic. Wash the surface, then sand lightly with a wet sheet of 400A or finer sandpaper. When the primary deep scratches are removed, remove the fine sandpaper scratches by the procedure outlined in the paragraph on Minor Scratches. If a buffing wheel is available, a more satisfactory method is to apply a preliminary polish to the deep scratches by means of a felt disc coated with a mixture of jeweler's rouge and water. Rotate the disc at approximately 250 rpm. Apply lightly and keep moist. After the depth of the scratches has been reduced, apply a final polish of turpentine and chalk with an 8- to 10-inch diameter silk buffing wheel rotated approximately 200 rpm. Clean the area and apply a wax coat.

4. ISOLATED CRACKS.—*(See figures 99 and 100.)*—At the first sign of cracking, a hole $1/8$- to $3/16$-inch in diameter should be drilled at the end of the crack. This simple operation helps to prevent further splitting by distributing the strain over a larger area. If the crack is small and repair facilities limited, stopping the crack with the drilled hole will usually suffice until a more permanent repair or a replacement can be made. However, if more permanent repair is to be effected, plug the hole as outlined in the following paragraph and apply Lucite Cement, H-65, (E. I. du Pont de Nemours & Co., Inc.) with a brush to both surfaces of the crack; then to the crack, apply a stream of intense hot air with a blower. Play the blower over the crack with a circular motion for approximately 5 minutes and let the material cool. If a hot-air blower is not available, a torch may be substituted. The torch should produce a soft bluish flame and should not be blowy. Hold the torch several inches from the panel. This type of repair may be regarded as permanent.

5. REPAIRING HOLES.—*(See figure 101.)*—The first step in repairing holes in transparent plastic panels is to trim the hole and surrounding cracks to a

circle as soon as possible. This will prevent the development of radial cracks and will confine the damage to a minimum area. Trim the edges of the hole to a 45-degree taper. Cut a transparent plastic patch of slightly thicker material than the section to be repaired, and trim its edges to a sharper angle than that of the hole. Heat the edges of the patch over a hot-air blower or an alcohol lamp until the edges are very soft and pliable. Force the patch into the hole and allow it to cool. Remove the patch and soak the edges of the patch in Lucite Cement, H-65,(E. I. du Pont de Nemours & Co., Inc.) for 2 or 3 minutes. Insert the patch into the hole again. Because the edges are tapered, pressure need to be applied on one surface only, and equal pressure will automatically be applied to all edges. Leave the patch under light pressure for upwards of 24 hours; and after the cement has hardened, sand or file the edges level with the adjacent surface. In patching a curved or a large section where it is not possible to heat the patch, it is possible to obtain a perfect fit by cutting the patch first and using it as a template. The area to be cut out of the damaged piece is indicated by scribe lines. The operator should saw within the scribe lines and sand or file the edges to a smooth 45-degree taper. With careful workmanship it will be possible to obtain a good fit. The patch should always be oval or round in shape, never square.

c. REAR FUSELAGE SECTION.—*(See figures 102 and 103.)*

(1) The rear section of the fuselage is of all-metal, semi-monocoque construction, consisting of 24ST Alclad longerons, 24SO Alclad bulkheads and 24ST aluminum-alloy stringers, covered with 24ST Alclad sheet. The rear section is provided with drainage facilities through drain holes in the bottom of each bulkhead. The four longerons extend the entire length of the rear fuselage structure, form the upper and lower points of attachment to the front fuselage section, and are designed to resist the main bending loads to which the airplane is subjected. Some of the later airplanes have been equipped with wooden rear fuselage assemblies which conform in general over-all dimensions, contours, and weight to those of all-metal construction. Three-ply mahogany plywood is used for the outside skin covering, bulkheads and shear webs. Solid spruce members serve as longerons, stringers, stiffeners, bulkhead flanges, and fillers. Maple compregwood is spliced to the spruce members at points where it is necessary to absorb excessive loads. In some locations 24ST aluminum-alloy is used to reinforce fittings. Bonding is used at all fittings. The skin panels are scarf-spliced and grain direction is laid at 45 degrees to vertical frames and bulkheads. To maintain the proper contour of the fuselage, there are eight frames spaced at approximately 21-inch intervals —some complete bulkheads, and others forming ring frames. Four longerons extend the entire length of the structure and provide the points of attachment to the front fuselage section. Substitutes may be used for the woods mentioned herewith in accordance with substitution specifications.

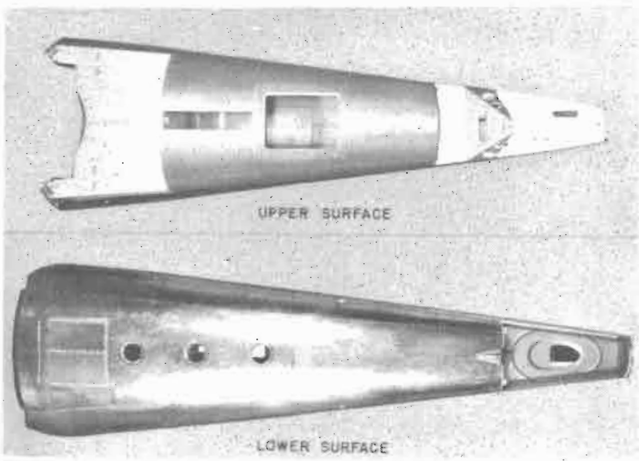


Figure 102 — Metal Monocoque

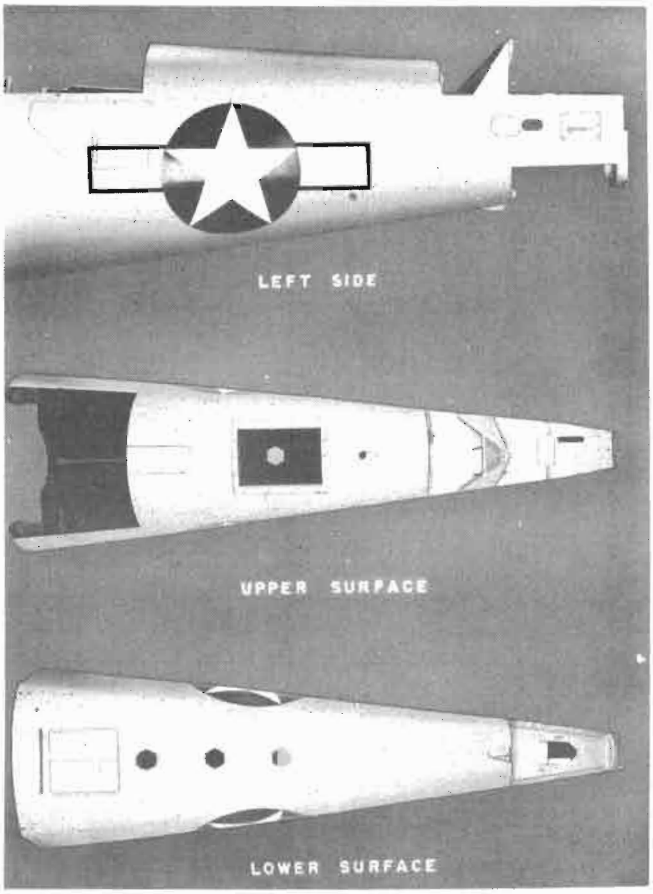


Figure 103 — Wooden Monocoque

(2) Space is provided in the fuselage rear section immediately aft of the rear cockpit for a baggage compartment. Space for photographic equipment is arranged for under the baggage compartment. Provision is made aft of the rear cockpit above the baggage compartment for mounting one model M-2, 30-caliber Browning flexible machine gun. A lift-mooring tube is provided in the fuselage just forward of the tail surfaces. A bar up to 1⅝-inch diameter may be passed through the

1. Operating Cylinder
2. Oleo Attaching Fitting
3. Pneudraulic Strut
4. Lock and Hoist Fitting
5. Warning Horn Switch Box
6. Fairing Door Actuating Rod
7. Strut Fairing
8. Torsion Link
9. Locking Mechanism Latch
10. Towing and Jacking Lug
11. Locking Mechanism Bellcrank
12. Position Indicators
13. Control Sector Assembly
14. Lock Torque Shaft

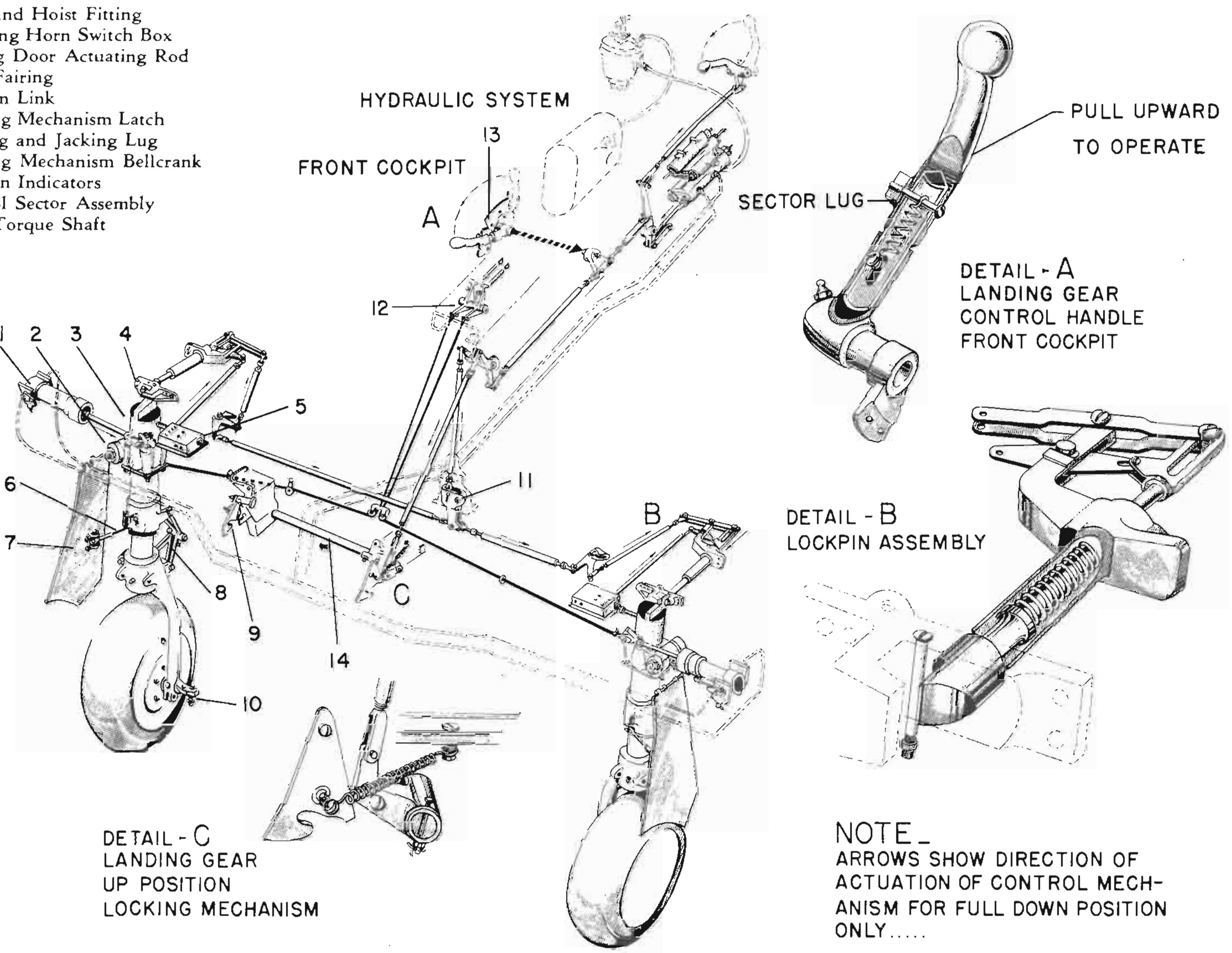


Figure 104 — Main Landing Gear Diagram

tube in order to lift the airplane by means of personnel at each end of the bar, or by hoist. Provisions are made for the installation of the tail assembly by means of a tripod assembly mounted to the top of the fuselage and the necessary means for holding the various attaching bolts. The tail wheel is attached to the fuselage aft section at three points. Reinforcement to the bottom of the fuselage immediately forward of the tail wheel provides attachment for the auxiliary tail skid and jack pad. Three signal lights are installed in the bottom of the rear fuselage section, to be flush with fuselage surface. Access doors on each side at the rear of the fuselage are provided to service the upper shock strut attachment. The baggage compartment door is located on the left side of the fuselage, and camera doors are installed in the bottom of the fuselage aft of the rear cockpit. Space is provided in the deck assembly in the rear fuselage, aft of the baggage compartment upper deck and the top fuselage structure, for oxygen cylinders.

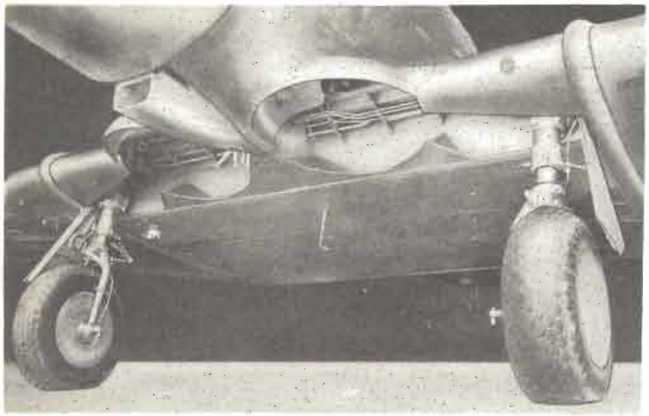


Figure 105 — Main Landing Gear Installed

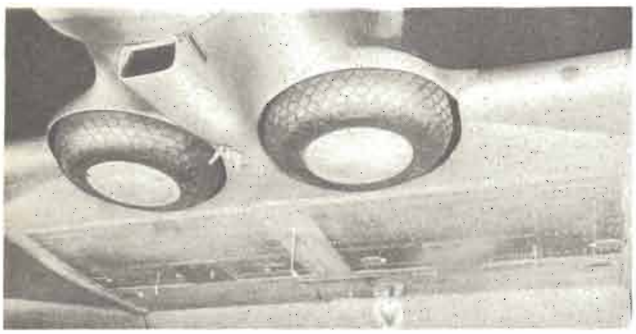


Figure 106 — Main Landing Gear Retracted

4. LANDING GEAR.

a. MAIN LANDING GEAR.

(1) GENERAL.—The main landing gear is of the single leg, half-fork type and is supported on the front spar of the wing-center section. It is retracted inboard into the center section directly forward of the front spar by means of the main hydraulic system. Positive mechanical up-lock latches and down-lock pins are provided. Both locking mechanisms are inter-connected with the landing gear control handle by means of lock control rod assemblies and bell cranks. Mechanical position indicators at the left side of the front cockpit on the control shelf show the approximate position of each strut at all times. These indicators should be used to determine that the landing gear is fully extended whenever it is necessary to push the lockpins into place manually. A warning horn sounds when the throttle is closed for landing if the landing gear is not locked in the down position. Provisions are made on the landing gear wheel forks for the installation of skis. Description and instructions for the landing gear hydraulic operating system will be found in paragraph 12 of this section. For adjustment of landing gear warning horn, refer to paragraph 13.

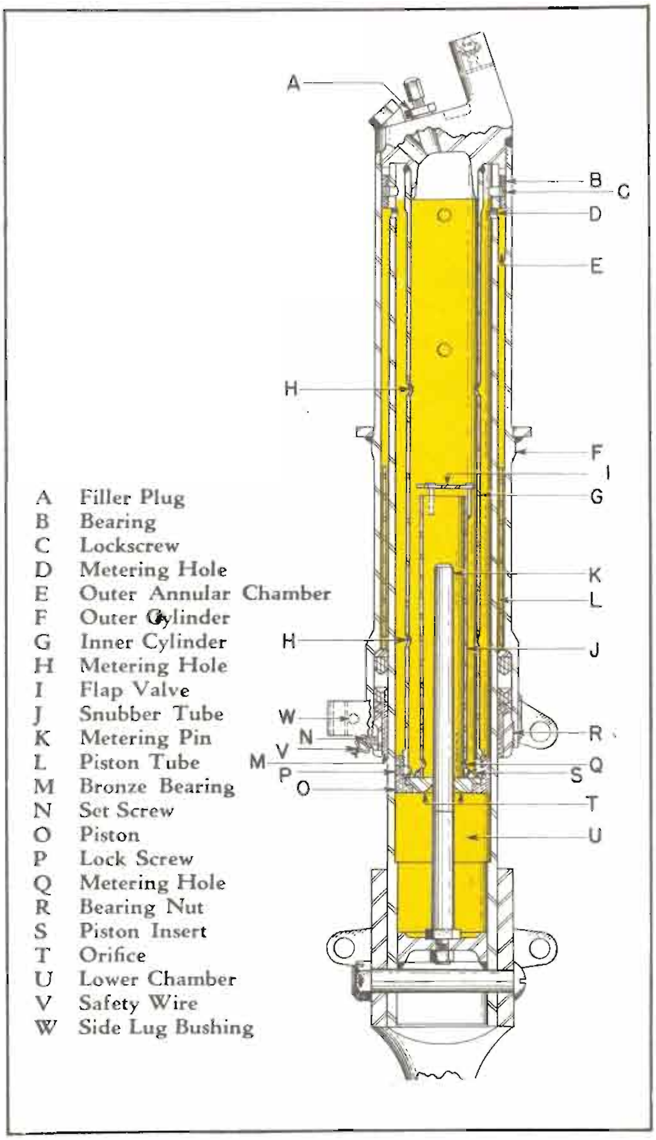


Figure 107 — Shock Strut Functional Diagram

NOTE

The landing gear of all AT-6 series airplanes is essentially similar. In the later models there is a shorter wing center section, which makes the landing gear tread of 102¾ inches, 7 inches shorter than earlier models. This difference does not affect the construction or maintenance of the landing gear units.

(2) SHOCK STRUTS.

(a) DESCRIPTION.—A shock strut of the combined hydraulic and pneumatic type and designed in accordance with AAF Specification No. 40228 constitutes the main unit of each main landing gear leg. Torsional resistance on the strut is afforded by a torque-arm scissors arrangement which interconnects the piston and cylinder of each unit. Each strut assembly is pivoted on a polished steel pin which is pressed into a support casting bolted to the wing center section front spar and end plate.

EXPLANATION OF MAIN LANDING GEAR SHOCK STRUT FUNCTION DIAGRAM

CONDITION I: COMPRESSION STROKE. — Compression stroke of the strut is the initial movement and occurs when the impact load of the landing airplane is applied to the landing gear.

The lower or inner cylinder G moves farther into outer cylinder F, thus reducing the volume of lower chamber U and forcing the strut fluid to leave the lower chamber U.

The fluid leaves the lower chamber by passing through orifice T and flows into the snubber tube J.

The flow of fluid through orifice T is automatically controlled at all points of strut compression and extension by the variable section of the metering pin K attached to lower cylinder G and projecting through orifice T.

The fluid, in overcoming the resistance to its flow through orifice T, absorbs the greater portion of the impact energy of the landing airplane. The energy so absorbed by the fluid is converted into heat and dissipated.

The fluid in rising causes flap valve I attached to the end of tube J to open, and the fluid passes to the upper chamber thereby compressing the air above it.

As the compression stroke continues, the oil level continues to rise and a portion of the fluid flows through holes H and into the outer annular chamber E through hole D.

Compression of the strut stops when the entire impact load of the landing airplane has been absorbed by the fluid and by the compression of the air in the upper chamber.

CONDITION II: EXPANSION STROKE.—Expansion of the strut takes place after a sufficient compression stroke has been made to absorb the energy of impact.

The air which has been compressed above the fluid level in the upper chamber expands, causing the strut to extend.

Flap valve I is closed instantly by the returning fluid.

The fluid must then pass through the small holes Q drilled in the lower end of tube J before it can enter the lower chamber.

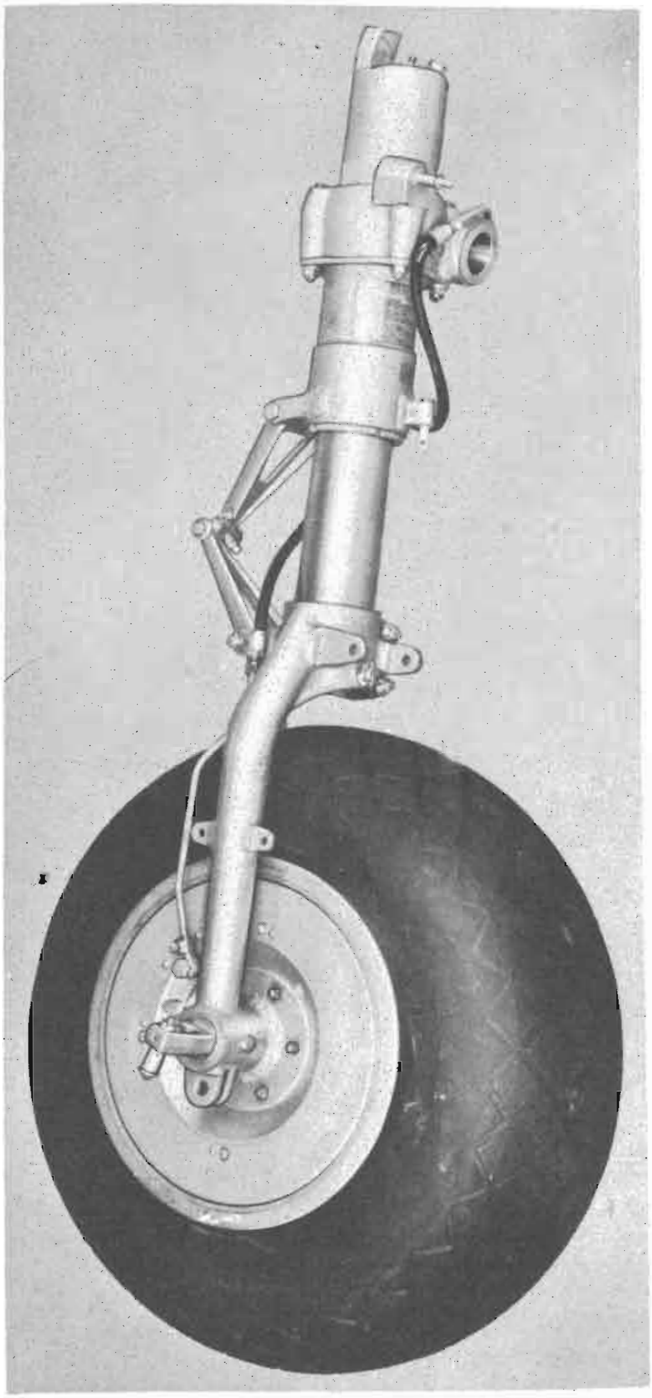


Figure 108 — Landing Gear Assembly

The extension of the strut reduces the volume of the outer annular chamber E, forcing fluid back through the small hole D, then through holes H, and finally into the lower chamber through the small holes Q.

By forcing the fluid to return through the small holes Q during the extension stroke, the expansion of the strut is slowed up because of resistance to flow created. This reduces rebound in two ways:

By actually absorbing energy.

By changing the natural period of oscillation in such a way that it damps out the tire oscillation. This is referred to as *snubbing effect.* The tail wheel shock strut operates on a similar principle.

(b) REMOVAL.—The left and right landing gear shock struts are interchangeable. The sequence necessary to remove a shock strut without removing the shock strut attachment fitting at the pivot pin is as follows:

1. Jack the airplane approximately 12 inches by means of the outer wing jacking points. (Refer to section III.)

2. Set the landing gear controls for the "UP" position of the landing gear to disengage the lockpins.

3. Completely deflate the strut by removing the hex cap on the air valve and backing the air valve filler plug not more than one turn to allow the air to escape slowly past the plug seat.

CAUTION

Do not depress air valve core to deflate strut. Do not attempt to remove filler plug past one turn until the strut is completely deflated and all hissing of air and fluid ceases.

4. Disconnect the brake line at the brake shoe operating cylinder, drain the brake system, and reconnect line.

5. Disconnect and remove the rigid brake line tubing, located between the two flexible hose sections on the strut, and plug the ends of the lines.

6. Disconnect the landing gear fairing rod from the strut.

7. Remove the four cotters and nuts from the bolts securing the strut to its attachment fitting on the strut pivot pin.

8. Lower the strut through its attachment fitting.

CAUTION

The shock strut should be well supported during removal since it is awkward to handle.

(c) DISASSEMBLY.—To disassemble the main landing gear strut, proceed as follows:

1. Ascertain that the strut is deflated and that all fluid has been drained from the strut.

2. Disconnect the upper scissor torsion arm link at the point of attachment on the strut cylinder after removing the cotter, nut, and bolt.

3. Remove the lock wire and unscrew the packing nut.

4. Pull out the piston tube assembly; if necessary, use a slight bumping action to loosen the packing rings.

5. A visual inspection will readily determine the procedure to follow in removing the rings.

(d) REPLACEMENT OF PACKING.

1. For replacements of packings and gaskets, refer to applicable illustrated parts catalog. New strut packing rings should be installed in the same manner as old ones. Use only the packing specified for the strut.

CAUTION

Should the lips of the packing rings become scored or nicked, replacements are necessary because tightening down the packing nut will not stop the leakage.

2. Coat the rings with the same hydraulic fluid used in the strut before installation. A thin piece of shim stock should be placed over the threads in the cylinder while installing the packing rings to prevent the rings from being cut or scored by the threads in the cylinder. After tightening the packing gland nut down firmly, safety the gland nut with safety wire. After filling the strut with fluid, Specification No. 3580M, at the filler port, the strut should be inflated with air at 60 pounds per square inch pressure and run in, provided a suitable machine is available.

(e) INSTALLATION.—To reinstall the strut, reverse the sequence of operations outlined above. Set landing-gear controls and connecting linkage for "DOWN" position. Bolt flange of shock strut to strut attachment fitting with two AN7-41 bolts and two AN7-50 bolts, securing with castle nuts and cotters. Bleed the brake system as instructed in section IV, paragraph 12, *c*, (4). Make certain the strut is fully extended before installing the brake line.

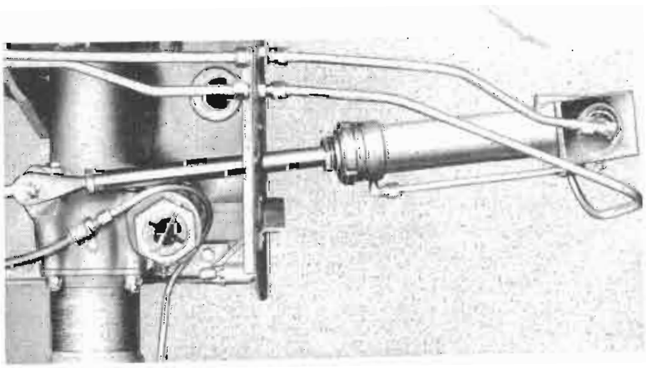


Figure 109 — Main Strut Operating Cylinder

(3) SHOCK STRUT ATTACHMENT FITTING.

(*a*) REMOVAL.

1. Remove the landing gear shock strut as outlined in paragraph (2) (*b*).

2. Disconnect the flexible electrical conduit from the inboard side of the center section end plate and from the center section leading edge.

3. Disconnect the cold air duct line from the wing leading edge section (left side only).

4. Remove the bolts, screws, and fairing as required, to remove the wing leading edge assembly from the center section.

5. Remove the shock strut fairing and its front hinge bolt from the wing attaching angle.

6. Disconnect the landing-gear position indicator cable from the lower rear side of the strut attaching fitting.

7. Loosen the lock nut on the operating cylinder piston rod, and rotate the piston rod until it becomes disengaged from the fitting which attaches the piston rod to the oleo attaching fitting. Care should be exercised to prevent damaging the polished surface of the piston rod.

8. Disconnect the flexible brake line from the support fitting by removing the attachment bolt.

9. Remove the pivot pin nut, locking bolt and slide the strut attachment fitting from the pivot pin.

(*b*) INSTALLATION.—To reinstall the shock strut attachment fitting, reverse the removal procedure. Make certain that the pivot pin is properly shimmed between the pivot pin support casting and the strut attachment fitting so that the boss at the top of the strut will freely contact the aft side of the lock fitting and have a clearance of .003-inch minimum to .015-inch maximum at the forward side. The maximum allowable tolerance between the landing-gear pivot pin and the strut attachment fitting is .0035 inch. Also, make certain that the retainer nut on the pivot pin is adjusted to prevent fore-and-aft travel of the strut on the pivot pin without binding. A clearance of .002-inch minimum to .020-inch maximum should be maintained between the shock strut boss and the "DOWN" position lockpin when the boss is contacting the inboard end of the lock pin fitting slot. Connect operating cylinder to gear and install brake lines as required. When installing the position indicator cables, ascertain that the clevis ends of the cables are properly adjusted so that the landing-gear indicator arm indicates the correct position of the landing-gear struts. The landing-gear strut should be a snug fit in the strut attachment fitting; no appreciable side play or shake should be present before the four nuts on the strut flange attaching studs are tightened.

(4) LOCKING MECHANISM.

(*a*) DESCRIPTION.

1. RETRACTED POSITION LATCHES.—(*See figure 111.*)—The landing gear is held in the "UP" or retracted position by means of triangular-shaped, spring-loaded latches located on the right and left side of the fuselage, immediately outboard of each lower engine mount fire wall attaching fitting. These latches are controlled by a linkage mechanism attached to the landing-gear control lever at the left side of each cockpit. The landing-gear jack pin, which is on the aft side of the landing-gear strut, is locked in position by the "UP" latch when the landing gear swings "UP" into its fully retracted position. The latch is so designed that when the strut jack pin comes in contact with a roller on the latch, the latch moves back allowing the jack pin to continue upward until it slips into the cam-shaped cut out in the latch. To release the latches, move the landing gear control handle to the "DOWN" position.

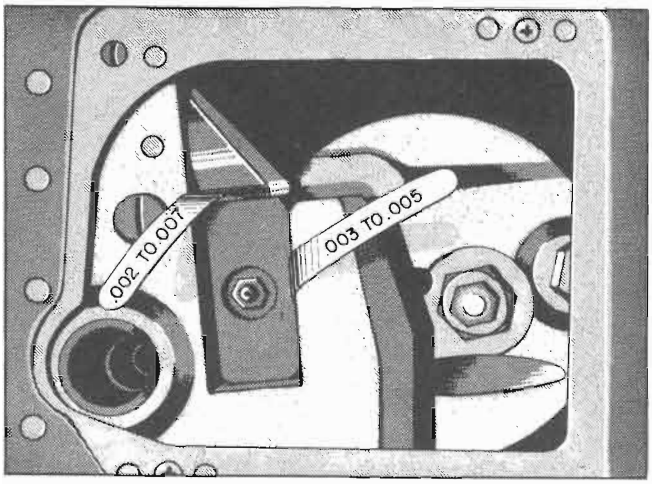


Figure 110 — Lock Fitting Clearance

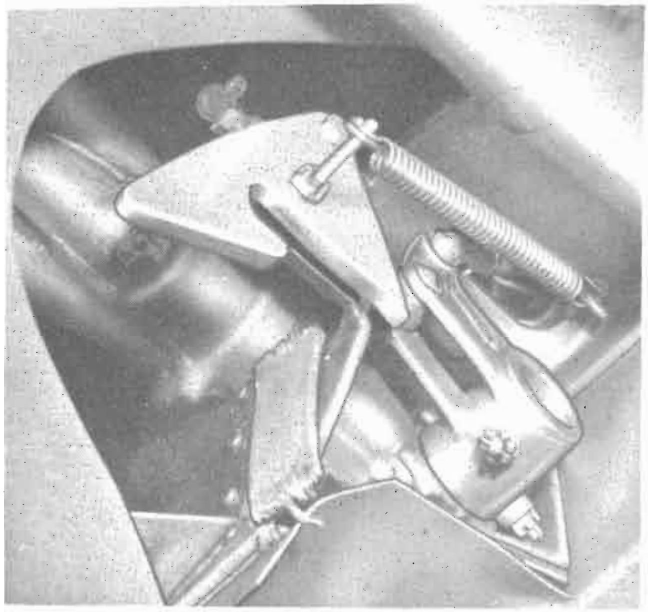


Figure 111 — Retracted Position Latch

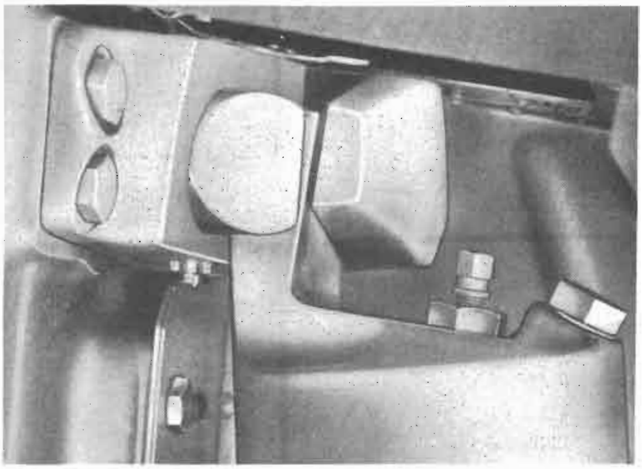


Figure 112 — Extended Position Latch

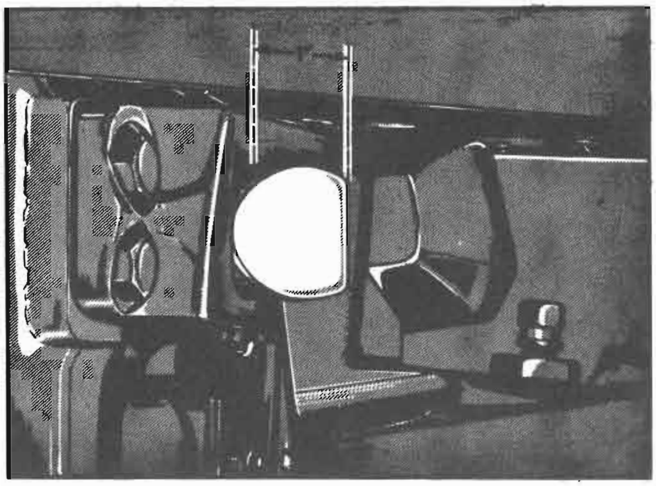


Figure 113 — Landing Gear Lockpin Adjustment

2. EXTENDED POSITION LOCK MECHANISM.—*(See figure 112.)*—As the landing gear reaches the "DOWN" position, a boss at the top of the shock strut slides into the slot of a steel lock fitting which is bolted to the landing-gear support casting. When the landing-gear strut has reached its fully extended position, the spring-loaded lockpin snaps into place behind the boss, thus securely locking the landing gear in the "DOWN" position. Should the springs behind the lockpins fail to move the pin forward to the locked position, the lockpins can be manually forced into place by moving the front cockpit landing-gear control handle down to the extreme end of the sector to the "EMERGENCY" position. The lockpins are released when the landing gear control handle is moved to the "UP" position.

(b) REMOVAL.—Disconnect landing-gear down position lock control rod and landing-gear position indicator actuating rod from lockpin actuating mechanism, located at rear of landing gear support casting. Remove the two bolts attaching mechanism support to landing-gear support casting, and remove assembly.

(c) INSTALLATION.—The surfaces of the lock fitting slots and lockpins should be lubricated with light oil before installation, and all grease fittings should be greased with high pressure grease after installation. All nuts should be safetied with cotters and lock wire as required. The lockpin linkage control rods should have sufficient clearance at all points to allow free movement of the rods and bell cranks.

(d) ADJUSTMENT.—The landing-gear down position lock mechanism should be adjusted to obtain a total movement of 1 inch (plus 1/8 inch minus 0 inch tolerance) of the lockpins. (See figure 113.) An access door to the lock mechanism is located on the lower surface of the center section immediately aft of each landing gear shock strut. Ascertain that the lock assemblies are properly installed and that the landing gear rod from the control shelf to the vertical bell crank in the center section is disconnected.

1. Adjust the push rod attached to the aft end of the lockpins to obtain at least 3/16 inch between the aft face of the push rod support fitting and the shoulder on the push rod. This should allow 1-inch movement of the lockpins.

2. Connect the aft arm of the lock mechanism to the slot in the lockpin push rod by means of an AN24-14 bolt, B1009-24-12 spacer, AN320-4 nut, a washer, and a cotter pin.

3. Obtain a distance of 10 7/8 inches between the attachment point centers of the left outboard control rod at the lockpin. (See figure 114.)

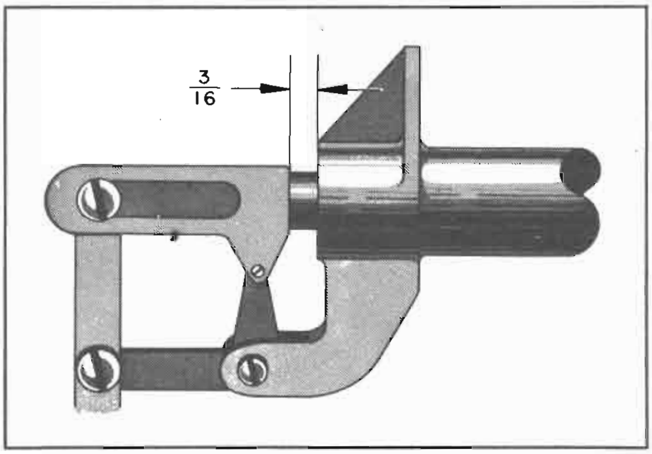


Figure 114 — Lockpin Push Rod Adjustment

4. With the lock mechanism in the extreme unlocked or "UP" position, ascertain that there is a clearance of approximately 1/8 inch between the left outboard control rod and the edge of the front hole in the center section spar.

5. Adjust the right outboard control rod (figure 114) at the lockpin to 11 1/8 inches, from the center rod at the end fitting hole to the center of the other rod-end fitting hole. Check for a measurement of approximately 3/8 inch between the center of the forward rod-end fitting hole of the right outboard control rod and the front face of the center section spar, with the lock mechanism in the extreme "EMERGENCY" position.

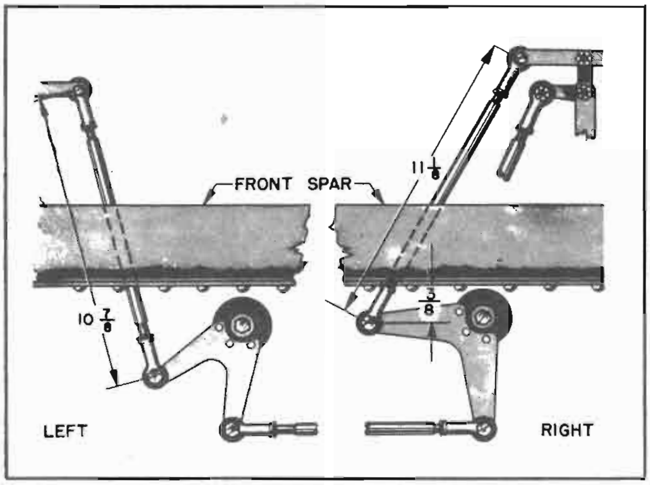


Figure 115 — Outboard Control Rod Adjustment

6. Obtain a length of 22 1/16 inches from the center of the outboard rod-end fitting hole and the inboard rod-end fitting hole. Connect it to the vertical bell crank in the left wheel well. Obtain approximately 61 9/16 inches from the center of the rod-end fitting hole to the center of the opposite rod-end hole on the right inboard control rod. (See figure 116.)

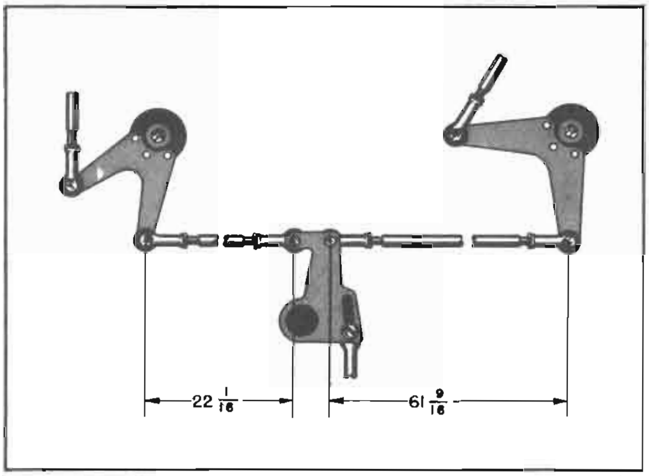


Figure 116 — Inboard Control Rod Adjustment

7. Before connecting the right inboard control rod to the vertical bell crank, move the control rods to the "EMERGENCY" position.

8. Make the necessary adjustment on the right inboard control rod to line up the rod-end fitting hole with the vertical bell crank.

9. Before installing the bell crank and control rod attaching bolt, move the control rods to the "DOWN" position, and ascertain that the right inboard control rod-end fitting hole still lines up with the hole in the vertical bell crank. If this is not the case it will be necessary to readjust the right outboard and inboard control rods as follows:

a. If the right inboard control rod is long, let out one turn on the right outboard rod and either one or two turns, as required, on the right inboard rod to line up the attachment holes.

b. If the right inboard control rod is short, take up one turn on the right outboard rod and either take up or let out one or two turns on the right inboard rod to line up the attachment holes.

c. Connect the right inboard control rod to the vertical bell crank.

d. Move the rods to the "UP" position. The lockpins must release the landing-gear struts simultaneously (1/16-inch lockpin movement). If this is not the case, proceed as follows:

(1) Disconnect the right inboard rod from the vertical bell crank.

(2) With the rods in the full "UP" position, adjust the right outboard and inboard rods to synchronize the lockpins. Line up the right inboard rod and vertical bell crank attachment holes, repeating foregoing procedures 7. through d.

NOTE

It may be necessary to make adjustments on the left inboard and outboard rods to obtain the proper adjustment; however, this should be avoided if possible.

10. With the front cockpit control handle positioned at the "EMERGENCY" position, adjust the control rods extending from the front cockpit control handle to the bell crank located at the forward end of the shelf and the control rod extending from the forward control shelf bell crank to the center section bell crank, as required. To position the control rods in the center section at the "EMERGENCY" position, move the control handle to the "UP" position, and ascertain that the lockpins are fully disengaged from the shock strut boss. If this is not the case, or if the control handle cannot be moved completely to the "UP" position, readjust the control shelf bell crank, as required to accomplish properly the "UP" and "EMERGENCY" positions. Then, check the "DOWN" position of the control handle to make sure that the lockpins completely engage the strut bosses.

11. Check the backlash in the landing gear control lever with the vertical bell crank control rod disconnected at the control shelf bell crank. If backlash is present when the control lever is placed in the "EMERGENCY" position, shorten the "UP" position lock latches rod. If play is present when the control lever is in the "UP" position, lengthen the lock latches rod. Adjust the "UP" position lock-latch rod so that the roller in the release arm just clears the lock-latch when the gear is in the "UP" position and the latch is completely engaged. Recheck the "EMERGENCY" position. There should be no backlash in either the "UP" or "EMERGENCY" position.

(5) WHEELS.

(a) DESCRIPTION.—The landing-gear wheel assembly (AAF No. 25258, 27-inch, type II) is of the one-piece cast aluminum-alloy drop-center type. The wheel is machined to permit installation of the steel brake drum liner, bearing cups, and tire. The wheel access fairing is of stamped aluminum-alloy, easily removed to inflate the tire and inspect the Timken roller bearings and internal bracing ribs of the wheel. The landing-gear wheels are provided with 27-inch tires (AAF No. 26545). Small raised inflation seams running around the outside circumference on each side of the casing are provided to aid in maintaining the proper inflation. Each tire has an inner tube (AAF No. 26546), which is equipped with a flexible rubber valve stem.

Figure 117 — Main Landing Gear Wheel and Tire

(b) REMOVAL.—To remove the main wheels, place an outer wing jacking stand under the outer wing jacking points and extend the jack until the wheel is free to rotate. (The tank doors must be installed before jacking the airplane at the outer wing jacking points.) An alternate method of jacking is accomplished by placing a small hydraulic jack in a main alighting gear wheel jack cradle and placing the center of the jack under each alighting gear strut at the jacking point provided. Extend the jack until the wheel is free to rotate. Remove the Dzus-fastened access fairing plate. Remove the hub nut cap retaining spring and the hub nut cap. Extract the cotter key and unscrew the large hex nut on the axle. Remove the bearing washer and the Timken bearing cone. Remove the wheel from the landing-gear strut axle.

(c) INSTALLATION.—When installing the wheels, ascertain that the bearing cups are pressed squarely into the wheel castings and that the wheel bearing cones are in good condition and properly lubricated. No grease should be packed in the wheel hub or in the cap, but all parts of the bearing cone and inboard and outboard axle bearing surface should be coated with a thin layer of grease.

(d) ADJUSTMENT.- -After replacing the main landing-gear wheel, check to see that there is no brake drag. To adjust the wheel bearing, turn the adjusting nut counterclockwise while revolving the wheel; then, with the wheel spinning, tighten the adjusting nut slowly until a bearing drag on the wheel is noticed. Back off the adjusting nut to the next castellation; safety with a cotter. Do not confuse *brake drag* with *bearing tightness* while rotating the wheel during bearing adjustment.

(6) BRAKES.

(a) DESCRIPTION.—The hydraulically operated brakes are of the reversible Hayes internal expanding "Servo" type, using a one-piece, Lynite brake band and moulded brake shoes. Due to the large braking surface used, the brakes require very little attention other than checking and adjusting the radial clearances between the brake shoes and the brake drum. A separate hydraulic system, consisting of a master brake cylinder installed on the lower fuselage cross tube or immediately aft of the fire wall, a small brake cylinder in each main landing gear wheel, and the necessary lines, is employed for operating the brakes of the airplane. Instructions on the hydraulic units of the brake system are given under "Hydraulic Systems," paragraph 12 of this section.

(b) REMOVAL.—To remove the brake assembly from the main landing gear shock strut for replacement or repairs, follow the instructions below:

1. Drain the brake line and brake shoe operating cylinder at the bleeder port of the brake shoe operating cylinder.

2. Remove the main landing gear wheel from the axle.

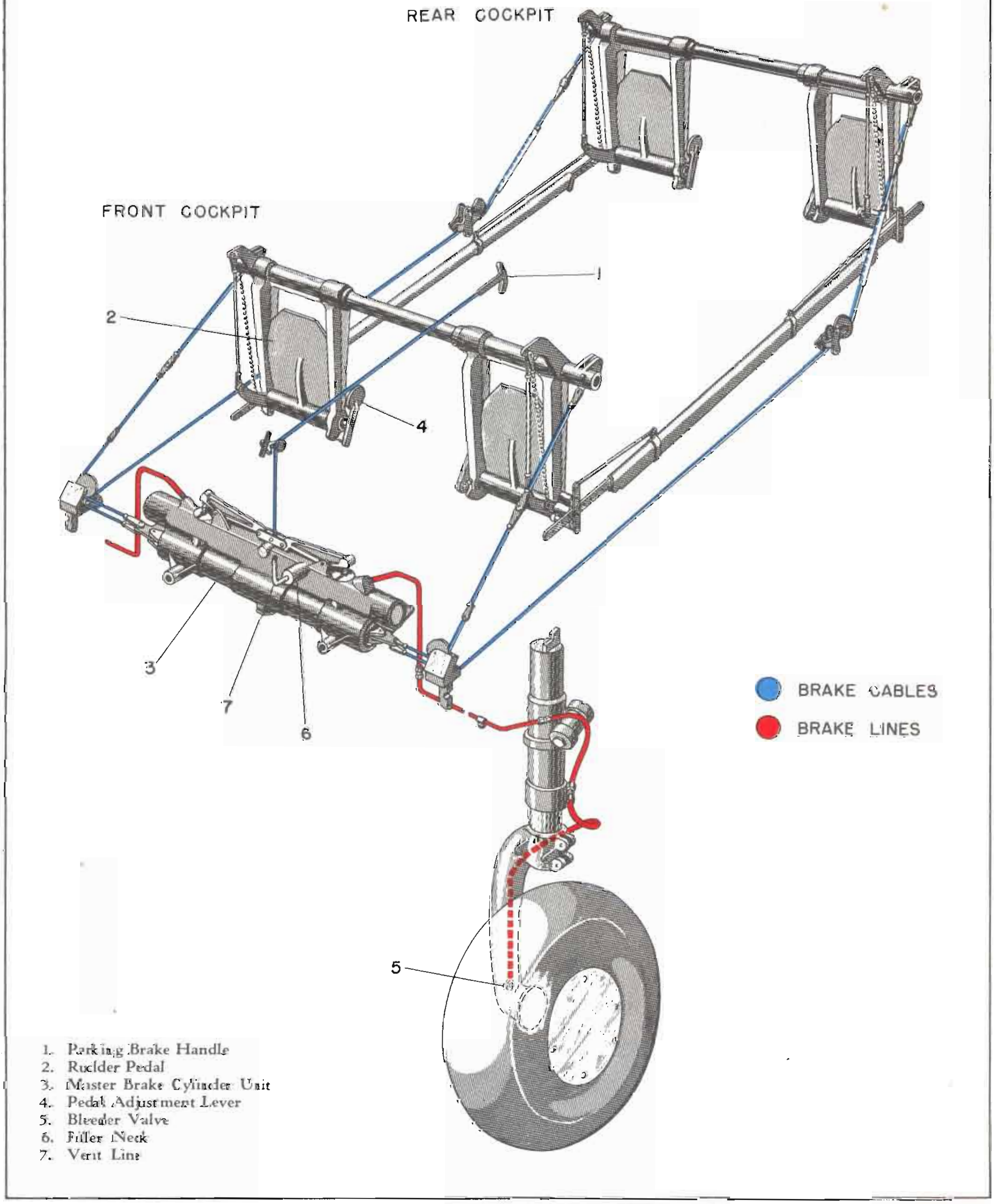
3. Disconnect the brake line at the brake shoe operating cylinder inlet fitting.

4. Plug the ends of the brake line and the brake shoe operating cylinder port.

5. Remove the six nuts, bolts, and washers which attach the brake assembly support plate to the landing gear strut flange; remove the brake shoe assembly from the strut.

CAUTION

Care should be exercised in the removal and installation of the brake shoes to see that they are not damaged or cracked by pulling the ends apart. When replacing the brake shoe return



1. Parking Brake Handle
2. Rudder Pedal
3. Master Brake Cylinder Unit
4. Pedal Adjustment Lever
5. Bleeder Valve
6. Filler Neck
7. Vent Line

Figure 118 — Brake Control System Diagram

springs, see that the hooks have not been straightened out to the point where they may work loose in service.

(c) DISASSEMBLY.—Disassembly of the brakes can readily be accomplished after first making a visual inspection and proceeding as follows:

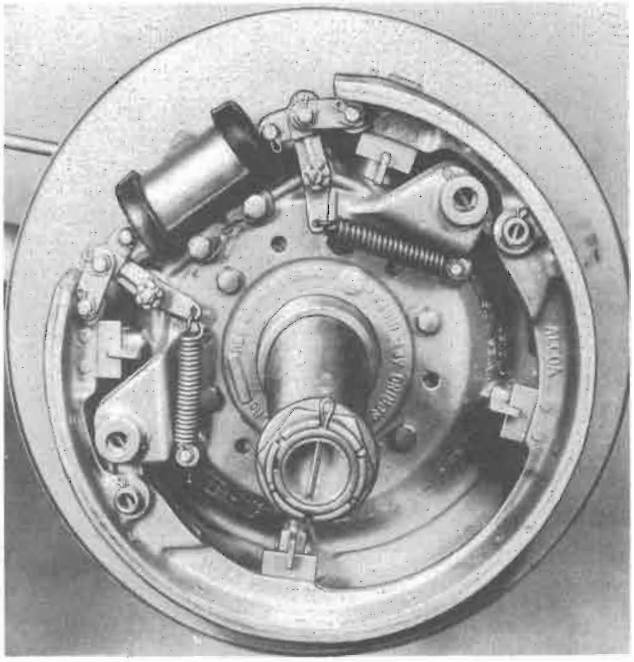


Figure 119 — Brake Shoe and Operating Cylinder

1. Remove the six screws which attach the brake shoe assembly backing plate to the brake assembly support plate.

2 Remove the cotters and washers which hold the brake shoe retracting springs in place; remove the spring from the assembly.

3. Remove the cotters from the tubular clevis pins which attach the brake shoes to the brake assembly support plate link bars.

4. Remove the cotters and clevis pins which attach the ends of the brake shoe to the operating cylinder rod linkage.

5. Rotate the brake shoe either clockwise or counterclockwise; detach it from the assembly.

NOTE

New brake lining must be ground after installation on the brake shoe to insure concentricity of the brake shoe, drum, and wheel. The wheel bearings should have no appreciable shake or side play.

(d) ASSEMBLY AND INSTALLATION.—Assembly and installation of the brakes is generally the reverse of the removal and disassembly procedure. After installation, bleed brake system as instructed in section IV, paragraph 12, *c*, (4). Ascertain that there is no interference between flexible brake line and torsion links.

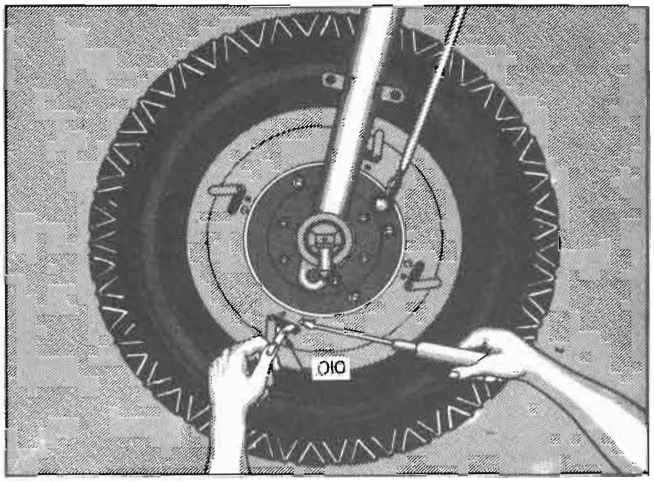


Figure 120 — Brake Shoe Clearance

(e) ADJUSTMENT.

1. BRAKE SHOES.—Bleeding the brake hydraulic system is not necessary before each brake adjustment unless there is an indication of air in the system. A spongy brake pedal usually indicates that there is air in the system. Jack the main landing gear wheels clear of the ground, utilizing the jacking point on the inboard side of each wheel axle. Before attempting to adjust the brakes, remove each wheel and inspect the brakes for damaged or worn parts. Examine the brake lining for grease; if the lining is greasy, it should be replaced with new lining. Ascertain that the brake shoe retracting springs have a good initial tension. If the initial tension is weak they should be replaced. After replacing the wheel and brake drum assembly, make sure that there is no brake drag. Do not confuse *brake drag* with *bearing tightness*. Adjust the wheel bearings as directed in paragraph (5), *(d)*. To adjust the brakes, proceed as follows:

a. Uncover the three inspection holes located on the inboard side of the wheel by rotating the covers aside.

b. With a screw driver, turn the adjusting screw, adjacent to the top forward inspection hole, clockwise until there is a radial clearance of approximately .010 inch between the outer surface of the brake lining and the brake drums. This clearance should be measured with a .010 inch feeler gage leaf, which is inserted through the inspection hole adjacent to the adjusting screw. (See figure 120.) If it is found that the clearance is greater than .010 inch after each adjusting screw has been screwed all the way, the brake shoes must be replaced. To do this, the wheels must be removed.

c. Follow the same procedure with the adjusting screw and inspection hole at the lower front portion of the wheel, and then at the lower rear portion of the wheel.

d. Rotate the wheel to see that the brake shoe does not drag on the brake drum.

e. Spin the wheels rapidly and apply the brakes. Both wheels should be stopped simultaneously. If the wheels are not stopped simultaneously, recheck the brake shoe radial clearance and ascertain that the brake operating cylinders and mechanical linkage are properly adjusted.

f. Release the brakes; revolve the wheels to see that they turn freely without drag. The foot pressure necessary to apply the brakes should be equal for each pedal; when the brakes are applied together, they should hold the airplane at full throttle.

2. BRAKE PEDALS.—The brake pedals should be adjusted with the master brake cylinder pistons fully retracted into the cylinders and the rudder pedal attachment bars adjusted to the center adjustment hole. Adjust the turnbuckle on each brake cable assembly so that the perpendicular distance between the center of the brake cable attachment bolt on the aft end of the front cockpit rudder pedal operating lever and the top of the forward end of the rudder pedal connecting bar is 10-1/8 inches. The perpendicular distance between the center of the brake cable attachment bolt in the rear cockpit rudder pedal lever and the top of the aft end of the rudder connecting bar should be 9-7/8 inches. After this adjustment has been made, adjust the brake operating link rod, which is attached to the operating lever and brake pedal, to position the forward face of the brake pedal approximately 1/2 inch beyond the forward face of the rudder pedal fork.

Figure 121 — Position Indicators

(7) POSITION INDICATOR.—When installing the landing-gear position indicator, connect the landing-gear position indicator cable to the strut attachment fitting; adjust the clevis end of the cable at indicator arms to obtain the correct indication.

(8) FAIRING INSTALLATION.—Attach the upper end of the landing gear fairing to the hinge brackets located on the wing center section, just forward of the front spar and inboard of the end plate, using two bolts. Interconnect fairing with landing gear by means of a rod assembly, and set for trial at approximately 6-3/4 inches, measured between pin centers. Adjust rod so that fairing contacts lower surface of center section snugly when gear is in the retracted position, and safety one end of rod only with wire.

(9) SKIS.—Provisions are made for the installation of X37G772, type H-1 skis, each one of which should be installed as follows:

(a) Remove fairing and attaching parts.

(b) Jack complete airplane according to instructions in section II, to a level flight position.

(c) Install axle extension 34A5 which should have a minimum length of 6-1/8 inches and outside

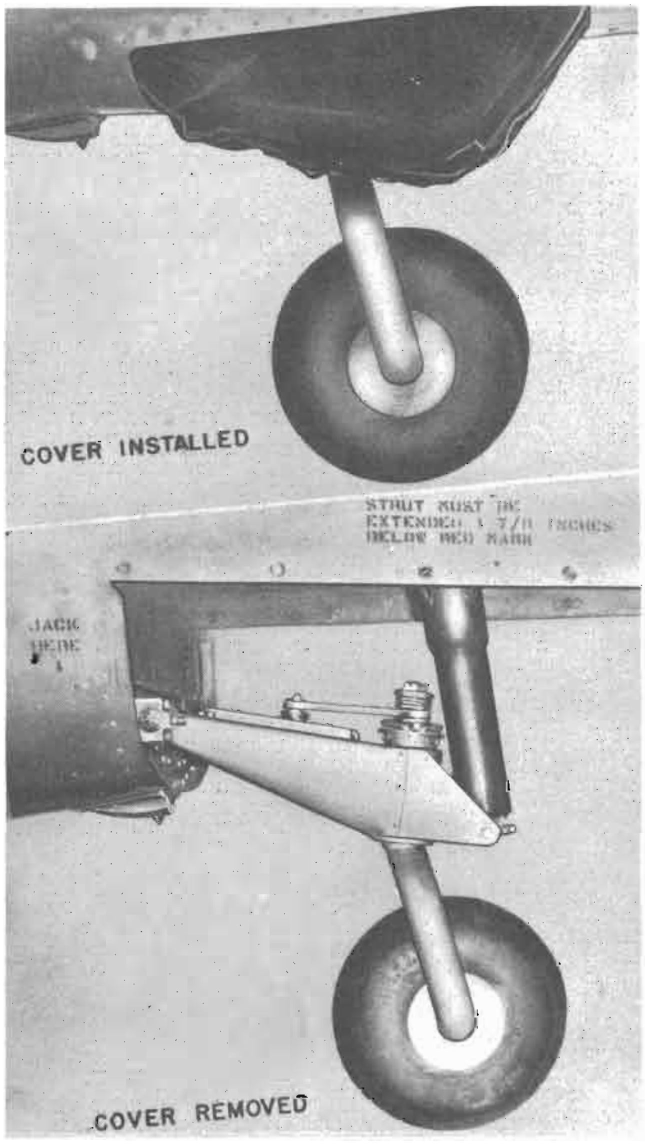


Figure 122 — Tail Wheel Landing Gear Installed

diameter of 1.0925 plus .000 minus .001 on the inboard end of the wheel axle.

(d) Attach aft fitting on ski to end of landing leg fork by means of an AN10-15 bolt, an AN310-10 nut, and an AN380-4-4 cotter pin. Attach aft fitting on ski to end of landing gear leg fork and extension by means of an AN10-14 bolt and the above nuts and cotters.

(e) Attach end of retainer 33B867 opposite piston rod end to forward fitting on ski with an AN6-12 bolt, AN310-6 nut, and AN380-3-3 cotter pin.

(f) Adjust length of retainer piston rod by means of clevis fork until an angle of 2 degrees is obtained between the forward lower side of the ski and the ground, with the airplane in the level flight position.

(g) Attach retainer piston rod end to fitting on landing leg fork by means of an AN6-11 bolt, an AN310-6 nut, and an AN380-3-3 cotter pin.

WARNING

Landing gear control handle in the front cockpit must be fastened with wire in the "EMERGENCY DOWN" position to prevent unintentional retraction of gear.

b. TAIL WHEEL ASSEMBLY.

(1) GENERAL.—The tail wheel assembly is a single-leg, half-fork full-cantilever structure, supported by an aluminum-alloy casting and a steel forging knuckle assembly mounted on roller bearings within the rear portion of the support. The tail wheel assembly is attached to the fuselage aft section at three points. Two of these points are the main trunnions at the forward end of the cast aluminum-alloy support, to which the fork and the steel ring mechanism is mounted. The third point of attachment is located at the top of the shock strut, the opposite end of the shock strut being attached to the aft end of the support casting. The axle and fork are of heat-treated alloy steel. The tail wheel assembly is not retractable, but the tail wheel knuckle shaft will revolve 360 degrees. The aluminum-alloy tail wheel housing fairing used on early airplanes is replaced by a dust-tight canvas shroud or cover on later airplanes.

(2) SHOCK STRUT.

(a) DESCRIPTION.—The tail wheel assembly is provided with a shock absorber strut of the pneudraulic-type, and it is designed to absorb shock transmitted to the tail landing gear assembly. Early airplanes are equipped with Bendix struts, and some later airplanes are equipped with Gladden struts. The shock strut is attached to the aft section of the fuselage and to the aft end of the aluminum-alloy casting support.

(b) REMOVAL.—To remove the tail wheel shock strut, follow the instructions below:

1. Jack up the airplane approximately 6 inches at the rear fuselage jacking point, and remove the tail wheel cowling and tail wheel housing fairing.

2. Check the parking brakes to ascertain that the brakes are applied.

3. Remove the bolt which attaches the knuckle support casting to the tail wheel shock strut.

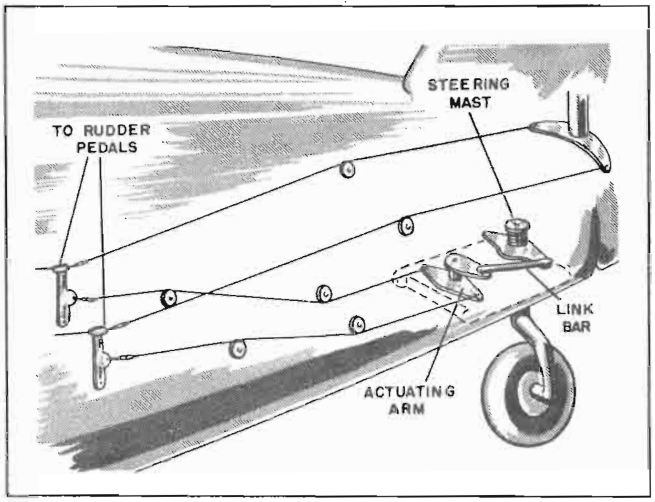


Figure 123 — Tail Wheel Steering Diagram

4. Remove the nut and washer from the bolt connecting the strut to the universal joint, and knock out the bolt, thus freeing the strut.

(c) DISASSEMBLY. — Completely deflate the strut, by removing hex cap and backing off filler plug one turn only. When fizzing stops, remove the filler plug; drain all fluid, and proceed as follows:

1. On the Gladden-type strut, remove the lock wire and four nuts on the studs which hold the packing gland flange in place. On the Bendix-type strut, remove the set screw lock wire and the packing nut set screw and unscrew the packing nut on the upper end.

2. Remove the piston from the tube assembly.

3. Visual inspection will readily determine the procedure to follow in removing the packing rings.

(d) REPLACEMENT OF PACKING.

1. To replace packing in the tail wheel shock strut, follow instructions given for main gear struts, paragraph 4, *a.* (2) *(d)*.

2. After new packing rings have been installed and the tail wheel strut reassembled, tighten the packing gland cap on the Bendix strut just tight enough to prevent leakage. The four nuts which hold the packing gland flange in place on the Gladden-type strut should be tightened down just enough to prevent leakage past the packing rings. Take care that the nuts on the studs are drawn down evenly to prevent uneven pressure on the packing rings and to prevent the packing gland from binding on the inside of the cylinder.

(e) TEST BEFORE INSTALLATION. — Test Bendix tail wheel strut, using procedure recommended

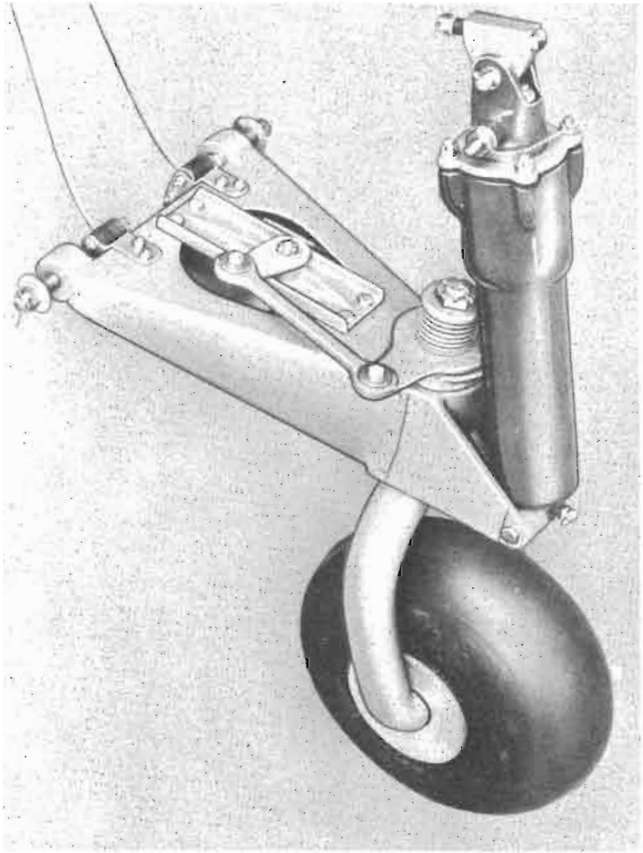


Figure 124 — Tail Wheel Assembly

for main landing gear struts. (Refer to paragraph 4. *a.* (2) *(e)*.) Test Gladden-type strut as follows:

1. Inflate the strut to 225 pounds per square inch air pressure and run in the strut, provided a suitable testing machine is available. If available, the strut should be run in after replacing the packing. This should be accomplished by a machine that will move the piston in and out through at least one-half its total stroke, a minimum of 750 cycles. There should be no appreciable loss of fluid or air.

NOTE

The strut should be serviced with oil and air before the running in is accomplished.

2. Inflate the strut to 225 pounds per square inch air pressure and leave it in a horizontal position for ½ hour. There should be no loss of air.

3. Inflate the strut to 225 pounds per square inch air pressure and leave it in a vertical position for ½ hour. There should be no loss of air.

4. Inflate the strut to 1688 pounds per square inch air pressure and leave for 15 minutes. There should be no loss of air.

(f) INSTALLATION.—With an AN6-17 bolt, secure the piston end of the shock strut to the lug provided directly between and below the horizontal stabilizer attaching lugs. The lower end of the shock strut is attached to the tail wheel housing at a point just aft of the tail wheel swivel fork, with an AN6-35 bolt and washers as required. For shock strut service instructions, refer to paragraph 3, section III.

(3) WHEEL.

(a) DESCRIPTION.—A 12½-inch diameter tail wheel is mounted on the axle at the lower end of the tail wheel fork. The cast aluminum-alloy wheel is fitted with Timken roller bearings and cups. A 12½-inch smooth contour static conducting tire (AAF Specification No. 26547) is mounted on the tail wheel. Small raised inflation seams located around the outside circumference on each side of the tire are provided to aid in maintaining proper inflation. The tire has an inner tube, AAF Specification No. 26550, equipped with a flexible valve stem.

NOTE

The earlier models have a 10-inch diameter wheel and use 10-inch tires.

(b) REMOVAL.—To remove the tail wheel, place a jack under the tail jacking point located at station 215-⅝; extend the jack until the wheel is free to rotate. Remove the three screws from the wheel fairing, if installed. Remove the cotter, nut, washer, and bearing cone. Remove the wheel from the knuckle axle.

CAUTION

Care should be exercised not to drop the tail wheel bearings.

(c) INSTALLATION.—To reassemble and install the tail wheel, reverse the procedure outlined under "Removal." See that the bearing cups and bearing cones are correctly installed and properly greased. See that the bearings are not too tight and that there is no appreciable end play. Refer to paragraph 4, *a.* (5) *(c)* for further instructions.

(4) TAIL WHEEL KNUCKLE.

(a) REMOVAL.—Remove the tail wheel assembly cowling, tail wheel housing fairing, if installed, and the damper spring cover. Proceed as follows:

1. Remove the cotter, nut, washer, spring, short steering mast, cotter, nut, cup, washer, bearing cone washer, and bearing cone, in that order.

2. Remove the knuckle from the housing.

(b) INSTALLATION.—When reinstalling the tail wheel knuckle shaft within the knuckle housing, care must be taken to see that the shaft bearing cone within the knuckle housing is not drawn up too tightly. The nut on the end of the tapered spindle shaft should be tightened just enough to eliminate any appreciable shake or end play.

(5) TAIL WHEEL KNUCKLE HOUSING.

(a) REMOVAL.—Remove the right and left cotters, hex nuts, washers, and bolts from the knuckle housing and fuselage attachment fittings. Remove the housing from the fuselage attachment fittings.

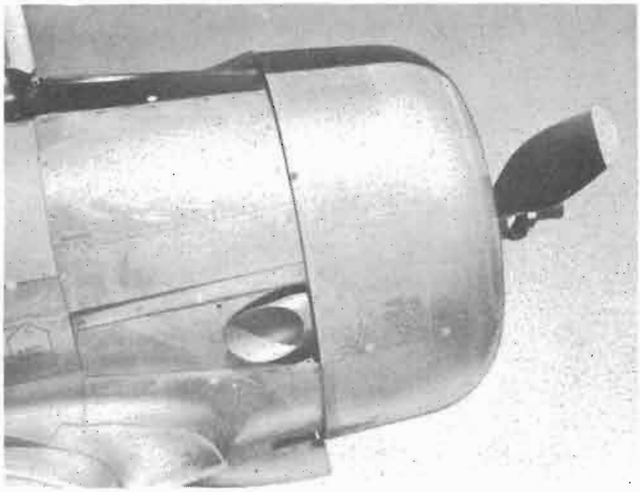


Figure 125 — Engine Cowling Installed — Part 1 of 2 parts

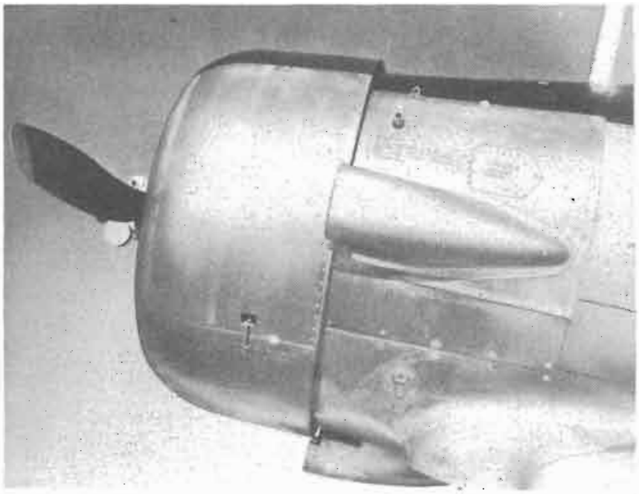


Figure 125 — Engine Cowling Installed — Part 2 of 2 parts

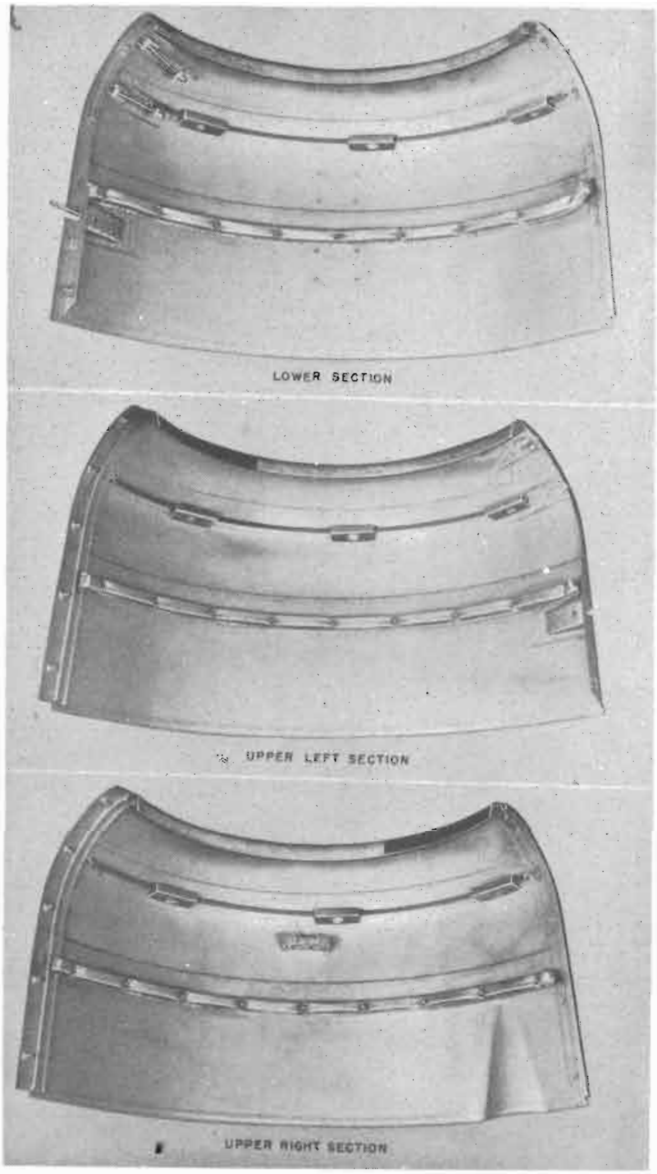


Figure 126 — Engine Ring Cowling

5. COWLING AND AIR INDUCTION SYSTEM.

a. COWLING.

(1) DESCRIPTION.

(a) ENGINE RING COWL.—The engine ring cowling consists of three easily detachable sections. The sections are joined together by means of hooks and Dzus-type fasteners. The three sections are pulled securely around the engine assembly by means of three bolts at the lower left cowling joint.

CAUTION

Do not tighten the bolts excessively; permit cowling to have just a snug fit to provide sufficient expansion and retraction.

Access to the two forward bolts, located inside the leading edge of the cowling, is gained through the front of the engine ring cowling. The rear bolt is readily accessible on the outside of the cowling.

(b) ENGINE COMPARTMENT COWLING. —The engine compartment cowling consists of a top and bottom section, and two right- and two left-side sections. These sections are attached together and to the fire wall and engine fixed ring cowl by means of Dzus-type fasteners.

b. AIR INDUCTION SYSTEM.

(1) DESCRIPTION.

(a) Cold air is introduced at the left side of the engine compartment cowling through a screened air scoop, which contains an easily removable carburetor

air intake filter. This filter prevents dirt, dust, and grit from entering the induction system. The filter is of the wire mesh "Air-Maze" type. A rubber-lined frame holds the filter secure in a diagonal position across the air intake duct. The cold air passes through a duct assembly to the carburetor air mixing chamber. This chamber is bolted to the lower inner portion of the engine fixed ring cowling and is interconnected with the cold air inlet duct and the carburetor by means of slip-type joint assemblies. In order to provide a chamber for preheating air before it enters the mixing chamber, the exhaust collector ring is jacketed with a Dzus-fastened shroud. The air as it circulates around the exhaust collector ring is heated and then conducted through the duct to the carburetor air mixing chamber.

(*b*) A control handle, mounted on the forward end of the control shelf at the left side of the front cockpit, is pulled back to admit hot air, and pushed forward to admit cold air to the carburetor mixing chamber. Intermediate positions of the control will position the valves to allow varying amounts of hot and cold air to enter the mixing chamber.

(*c*) A carburetor temperature indicator, actuated by a thermometer inserted in the duct assembly above the carburetor, is mounted on the main instrument panel of the front cockpit.

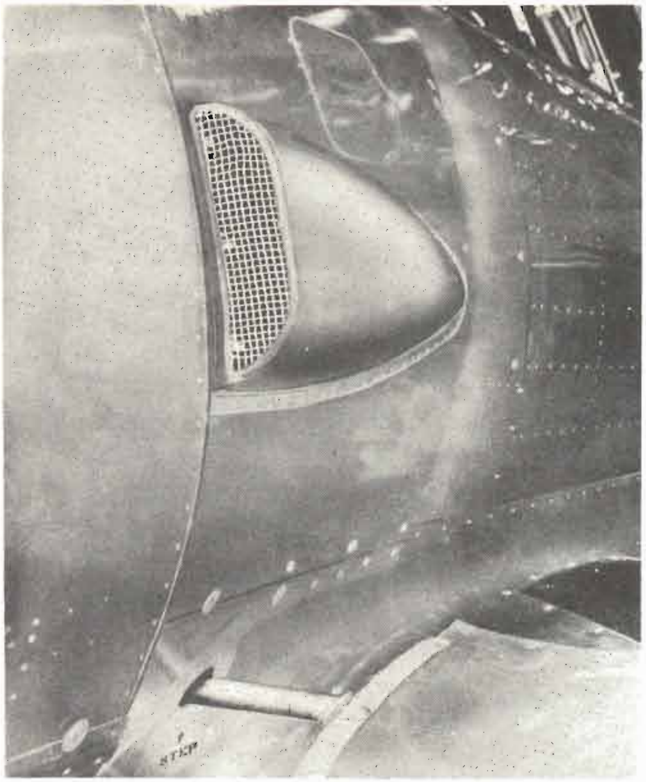


Figure 127—Carburetor Air Scoop Installed

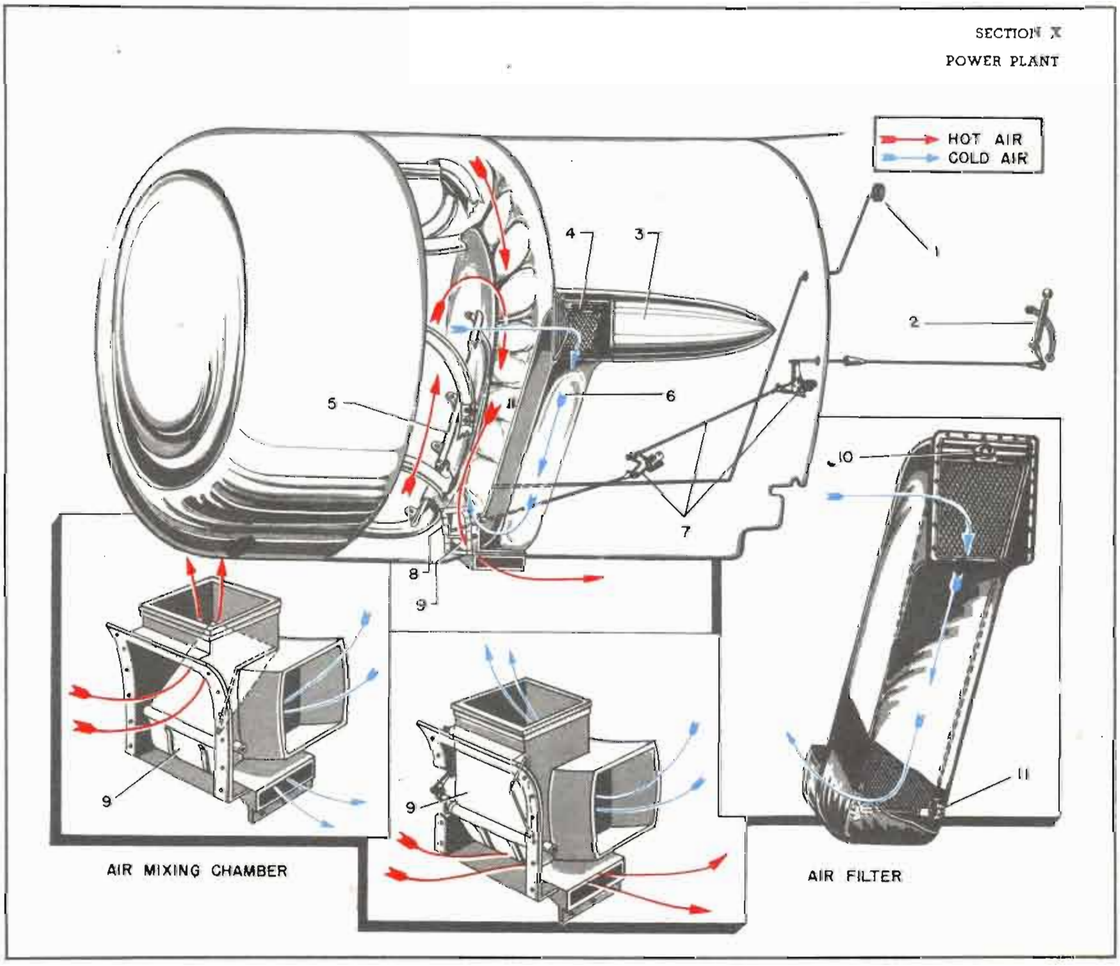


Figure 128—Carburetor Air Induction System

1. Air Temperature Gage
2. Air Control Quadrant
3. Cold Air Scoop
4. Air Scoop Filter Screen
5. Exhaust Manifold Shroud
6. Cold Air Duct
7. Control Linkage and Bellcranks
8. Air Mixing Chamber
9. Air Mixing Chamber Gate
10. Air Filter Fastener
11. Air Filter Bracket

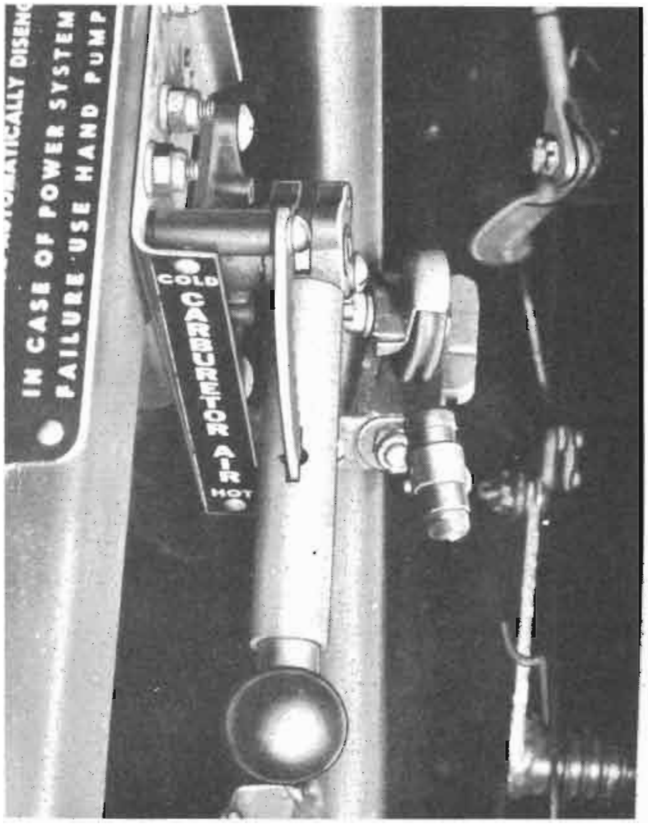


Figure 129 — Carburetor Air Control

(2) REMOVAL.

(a) CARBURETOR AIR SCOOP. — The carburetor air scoop may be removed by removing the two bolts at the forward points of attachment to the engine fixed cowl.

(b) CARBURETOR AIR FILTER.—To remove the carburetor air filter from the airplane, remove the left power plant compartment side panel over carburetor air duct, release Dzus fastener at top, and lift filter out of duct.

(3) INSTALLATION.—To install the carburetor air filter, ascertain that the mounting frame is clean, place filter in air duct, secure Dzus fastener at top, and reinstall the side panel over carburetor air duct. A spring-loaded cam arangement is incorporated in the mounting frame to automatically hold the lower end of the filter secure when it is pushed down into position.

6. POWER PLANT.

a. GENERAL.

(1) The airplane is powered with a single Pratt and Whitney, model R-1340-AN-1, nine-cylinder, air-cooled, radial engine. The blower ratio is 10:1; compression ratio is 6.03:1. For take-off at sea level, the engine rating is 600 brake horsepower at 2250 rpm, with 36 inches Hg manifold pressure for 5 minutes (maximum); normal rating at 5000 feet is 550 brake horsepower at 2200 rpm, with 32.5 inches Hg manifold pressure. The engine is to be serviced with 87 octane fuel.

NOTE

Model AT-6 airplanes were equipped with R-1340-49 engines. These engines are similar to the R-1340-AN-1 except for normal brake horsepower at sea level (2200 rpm) which, for the R-1340-49 is 501 brake horsepower, while for the R-1340-AN-1 it is 550 brake horsepower. For other engine characteristics, refer to section I.

(2) Engine equipment consists of two Scintilla model SB9RN magnetos (AT-6D and SNJ-5 airplanes) or two Scintilla model SB9R magnetos (earlier airplanes), a Stromberg model NA-Y9EI carburetor fitted with an idle cut-off device, an integral oil pump, and the following:

Fuel pump (Chandler-Evans or equivalent)	Type F-10
Hydraulic pump (Pesco)	263-E
Vacuum pump (Pesco)	Type B-12
Starter (Eclipse)	Type G-5 or H-5 (earlier airplanes)
Generator (Eclipse)	Type M-3 or E-5 (earlier airplanes)
Gun synchronizer (Pratt and Whitney)	Type E-4 or E-3 (earlier airplanes)
Tachometer generator (Weston)	Type E-12
Propeller governor (Hamilton Standard)	Model 1M12-A

NOTE

For complete instructions on operating the engine refer to Pilot's Flight Operating Instructions for the airplane.

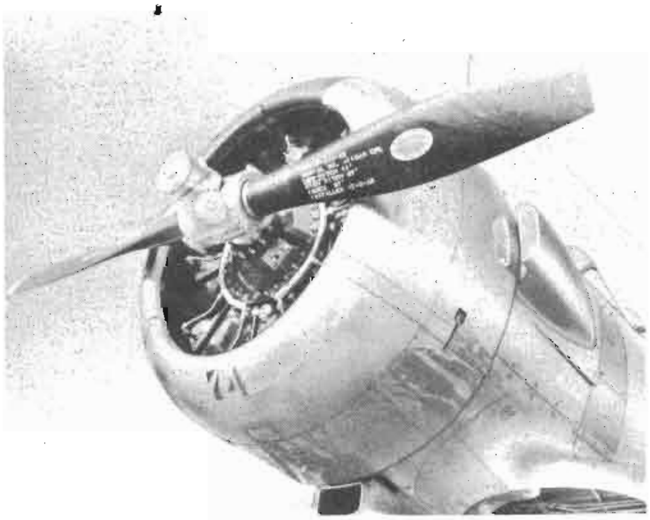
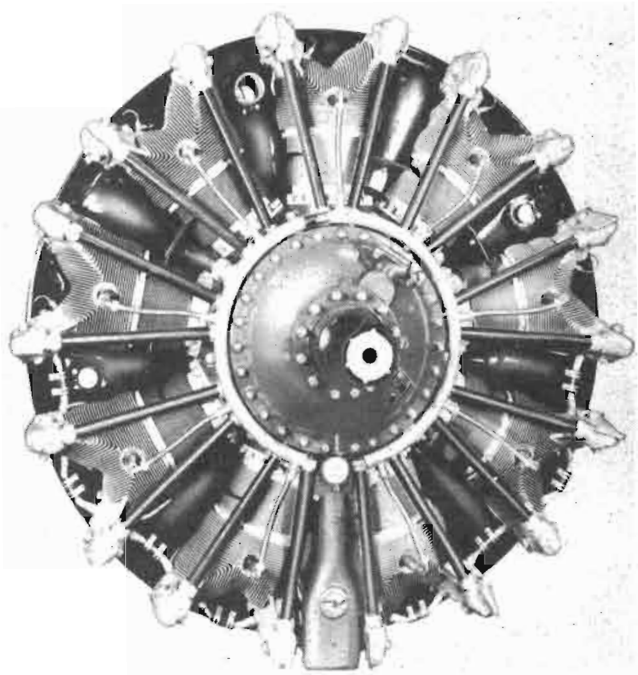


Figure 130 — Power Plant



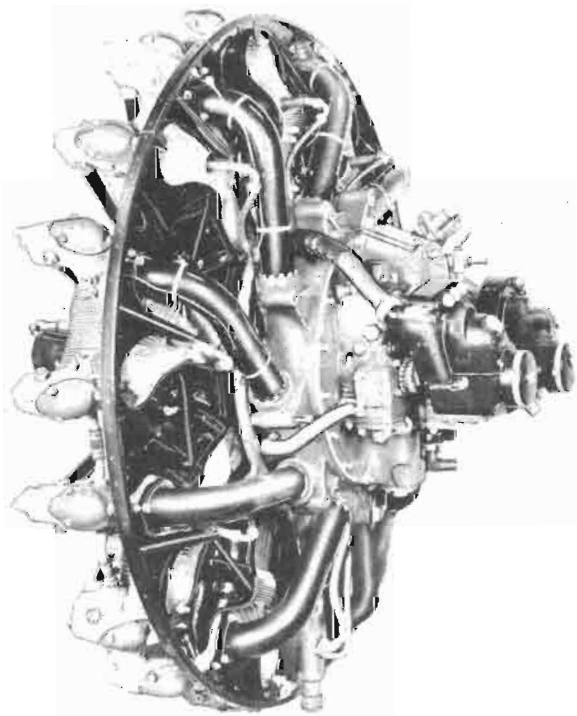


Figure 131 — Engine (Front and Side)

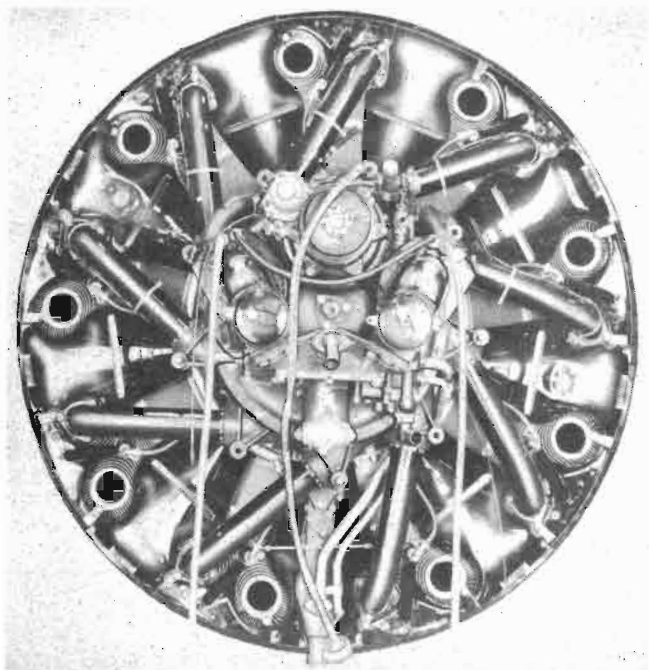


Figure 132 — Engine (Rear View)

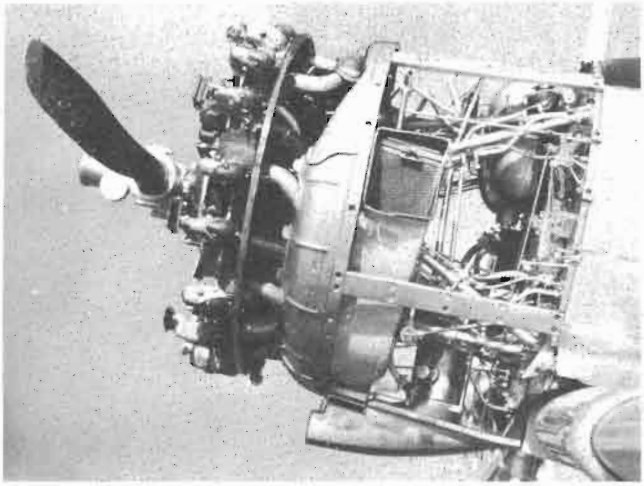
b. ENGINE.

(1) DESCRIPTION.—The engine is divided into five major groups: front section, main crankcase, cylinders, blower section, and rear section. The main crankcase, cylinders, and front section are usually referred to as the *power section,* while the blower and rear sections are called the *accessory section.* The engine may be split between the blower and the main crankcase to facilitate work on either or both halves of the engine.

(*a*) FRONT SECTION.—The front section of the crankcase is an aluminum forging and supports a deep groove ball bearing which transmits the thrust to the propeller from the crankshaft to the engine mounting via the crankcase. Studs are provided at the nose and where the front section joins the main crankcase for cowl mounting supports. Provision is made for a governor drive on the top of the front section.

(*b*) MAIN CRANKCASE. — The main crankcase is divided into two sections in the plane of the cylinders and united by nine through bolts between the cylinders, as well as by the cylinder flanges. With this type of construction the explosion forces are equally distributed between the two main bearings, one of which is carried in each section of the case. The two sections of the main crankcase are machined together. A rubber seal is used between each cylinder flange and the main crankcase. The front main crankcase carries the cam supported on a shelf forged integrally with the case forging. The tappets and tappet guides are also mounted in an integral shoulder.

(*c*) CYLINDERS.—The cylinders are of steel and aluminum construction. The cylinder barrels are machined from steel forgings and have integral cooling fins. The head is made from aluminum and has closely spaced cooling fins cast integrally. The cylinder has one inlet and one exhaust valve, the inlet seating on a bronze insert, and the exhaust seating on a steel insert, both of which are shrunk into the head casting. Fins are concentrated on the top and exhaust side of the hemispherical head and around the exhaust port where the greatest head dissipation is essential. Horizontal fins surround the lower portion with a heavy shrink band



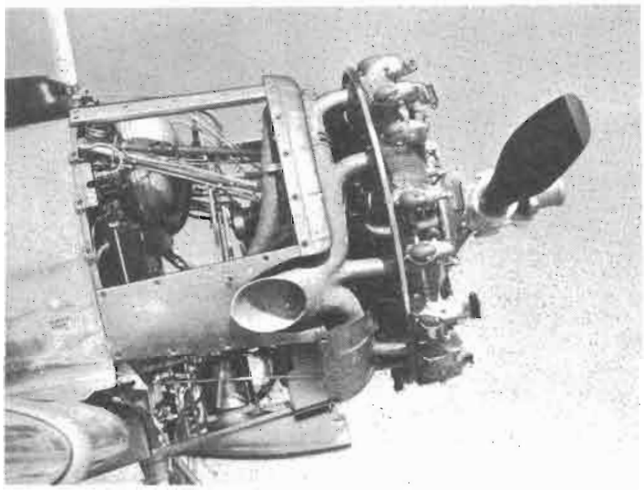


Figure 133 — Power Plant Installation

at the bottom. The cylinder pressure-type baffles force cooling air through and over the cylinder fins.

(*d*) VALVE MECHANISM.

1. All valves operating parts are enclosed. The rocker arms are supported by double row ball bearings in the rockers. Eighteen tappets located in the front main crankcase actuate the rocker arms through tubular push rods which have hardened steel ball ends. These rods are enclosed by removable oiltight cover tubes held in place by a nut and packing at the top and bottom. Rocker box covers are secured by studs and stop nuts. The valve clearance adjusting screw is in the end of the rocker arm over the valve. A half ball is used between the adjusting screw and valve stem to minimize friction at this point.

2. Two concentric valve springs are used and are secured to the valve stem by a split cone and washer. Inlet and exhaust valve springs are interchangeable and can be removed without taking out the rocker arms. To prevent possibility of valves being dropped into the cylinders while the split cones are being installed or removed, a safety ring is installed on each valve. The exhaust valves, made of a high-heat-resisting austenitic steel, are sodium-filled and stellite-faced on the seats.

3. The entire valve mechanism is pressure-lubricated; oil enters the tappets through the guides, then flows through the push rods and rockers. The rocker boxes are interconnected and drain into a separate compartment of the sump. An additional scavenge stage in the oil pump completes the circulating system. This full automatic lubrication makes possible greatly extended operating periods without any attention to the valve mechanism and practically eliminates all wear.

(*e*) TIMING GEAR.

1. By means of a train of spur gears and internal teeth in the cam ring forging, the cam is driven at $1/8$ crankshaft speed in the opposite direction to the crankshaft rotation.

2. The cam, which actuates all valves through two four-lobed tracks, rotates on a bronze bushing mounted on a shelf, forged integral with the front main crankcase. The cam reduction gear is mounted with a bearing on each side, one in the main case and the other in the nose section, assuring correct alignment.

(*f*) CRANKSHAFT.

1. The crankshaft is a single throw, two-piece split pin type supported on three bearings. There is a roller bearing on each side of the throw supported in the main crankcase, and a ball bearing in the front section which takes the propeller thrust as well as the radial load.

2. Two oil jets, one located in the front section rear plug and the other on the top of the rear cheek, furnish lubrication to the pistons, piston pins, and cylinders, in addition to the oil thrown off the master rod and knuckle pin bushings.

3. The weights of reciprocating and rotating parts connected to the crankshaft are counterbalanced by weights which are riveted to the cheeks of the crankshaft. The crankshaft is balanced statically and dynamically against a master balance weight. This insures a crankshaft that will operate without vibration at all speeds, and provides interchangeability of crankshaft between engines of a similar type.

(*g*) CONNECTING RODS.—The master connecting rod is solid and incorporates a shrunk-in steel backed lead-silver bearing. Eight "I" section link rods are attached to the master rod by means of knuckle pins fitted tightly in the master rod. Each link rod is bronze-bushed for the piston and knuckle pins. Oil, carried under pressure to the crankpin, lubricates the master rod bearings and also the knuckle pins through drilled passages. The piston pin bushings are lubricated by the oil thrown off by the master rod bearing, knuckle pin bushings, and oil jets.

(*h*) PISTONS.—Each piston, machined from an aluminum-alloy forging, has five ring grooves and is of the full-skirt type. The piston carries compression rings in the three top grooves, a dual oil ring in the fourth, and a scraper ring in the fifth, or bottom groove. The piston pin floats in the piston bosses as well as the connecting rod bushing.

(i) OIL SUMP.—The oil sump is located between cylinders No. 5 and No. 6. This sump is fastened at each end to the front and blower sections, which receive the drainage from the main crankcase. Oil is scavenged by the first stage of the oil pump. An oil pipe, supported in the upper part of the sump, carries oil under pressure from the rear to the front of the engine.

(j) BLOWER SECTION.

1. The blower section supports the engine in the airplane and is attached to the rear of the main case. The supercharger, together with its gearing, is carried in this section. An annulus in this section receives the mixture from the impeller through a diffuser chamber and delivers it to the cylinders through tangential intake pipes.

2. The supercharger is a high-speed centrifugal type having a 10:1 blower ratio. The supercharger is driven from the crankshaft by means of a spring coupling located inside the rear crankshaft gear and drives a floating gear in the blower section. By means of a pair of spur gears, the impeller is driven at a high rate of speed. The coupling relieves the blower gears of sudden strains of rapid acceleration and deceleration. Antifriction bearings are used throughout.

(k) REAR CRANKCASE.

1. The rear crankcase, attached to the blower section, is the accessory section. It carries all the auxiliaries: two Scintilla magnetos, a Stromberg carburetor, a hand-electric starter, a fuel pump, an oil pump, an oil strainer, tachometer drive, and two gun-synchronizer drives. Provision is made for mounting and driving a generator and two or three accessory pumps.

2. The rear section has blades in the elbow above the carburetor to direct the mixture evenly to the impeller, and vanes on the diffuser section which lead the mixture into the annulus in the blower section from which it is drawn through the intake pipes into the cylinders.

3. A check valve is provided in the oil pressure strainer to prevent seepage of oil from the tank into the engine when it is not in use.

(l) ACCESSORY DRIVES.—The accessories are grouped at the rear of the engine and are driven by three lay shafts which extend entirely through the blower and rear sections. Each shaft carries a spur gear at its forward end, which engages a gear attached to the rear of the crankshaft. The upper shaft provides a drive for the starter and generator. Each of the two lower shafts drives a magneto at its rear end by means of a readily adjustable flexible coupling. Besides this, four vertical drives are provided for a bevel gear on each shaft. The upper drives are for two gun synchronizers and two tachometers. The lower vertical shafts drive an oil pump on the right side and a fuel pump on the left.

(m) LUBRICATION.

1. Oil circulation is actuated by a three-section oil pump mounted on the right side of the rear section. The lower section supplies oil under pressure to the various moving parts of the engine. Oil is taken from the tank to the pump through the oil inlet connection. After passing through the pressure section, the oil flows from the outside to the inside of the pressure strainer located in the rear section just forward of the carburetor. From the inside of the pressure chamber, the oil flows forward through the blower section to the sump. A branch line feeds the accessory drive bushings in the rear section. An additional branch from the pressure chamber feeds the accessories on the right-hand side of the rear section through a series of drilled passages, and also leads directly to the main oil pressure relief valve located on the right-hand side of the rear section.

2. After the oil reaches the sump, it is passed through the top of the sump where it divides into two additional lines. One line directs oil to the top of the nose where it is available for use of the hydro-controllable propeller. The other line feeds directly to the front oil feed bracket and the oil is transferred to the cam drive gear sleeve by means of a bearing with oil seal rings and thence into the crankshaft. This pressure line also provides lubrication for the cam through a branch which leads to a groove around the shelf on which the cam is mounted.

3. Oil is fed to an annular groove machined around the front main crankcase and thence to the tappets through a series of drilled passages in the crankcase. This provides full pressure lubrication for the valve mechanism via the push rods.

4. Oil fed into the crankshaft lubricates the master rod bearing and knuckle pin bushings. Two No. 55 oil jets, one in the rear of the front section and the other on top of the rear cheek, furnish additional lubrication to the power section. The supercharger gearing and accessory shafts are lubricated by drilled passages from the oil strainer chamber and by an oil jet in the main oil feed line.

5. The surplus oil in the engine proper drains into the main sump. The surplus oil in the rocker boxes drains by gravity through the push rod cover tubes to the crankcase or through a system of intercylinder drain pipes to an additional compartment on the bottom of the sump, whence it is pumped to the engine oil outlet by the center stage of the oil pump.

6. Excess oil from the relief valve is routed to the inlet side of the pressure pump.

(2) ENGINE TROUBLE SHOOTING.

(a) FAILURE OF ENGINE TO START.

1. Lack of fuel at carburetor, or insufficient flow. Check carburetor strainer and airplane fuel strainer.

2. UNDERPRIMING OR OVERPRIMING.

a. Underpriming is sometimes caused by leaky primer line connections or primer pump packing. It is also well to check the fuel supply to the primer pump.

b. It is necessary to learn by trial the correct amount of priming necessary. Overpriming can be determined by wet spark plugs and gasoline being present at the exhaust stacks or in the collector ring, which is a dangerous fire hazard as well as a detriment to the oil film on the cylinder walls, causing scored pistons and cylinders.

3. INCORRECT THROTTLE OPENING.

a. The throttle should be set at one-tenth open until the engine starts to fire; then it should be opened slowly until the engine turns between 600-1000 RPM.

b. Check mixture control lever to insure its being in "FULL RICH" position.

4. DEFECTIVE IGNITION.

a. Examine ignition wiring for broken wires and burned or chafed insulation.

b. Check spark plugs for correct gap setting, fouled or leaded condition, and proper functioning.

c. Check magneto breaker points for opening, pitted condition, and cleanliness. (Over-oiled breakers can cause misfiring.)

d. Check starter or running magneto spark by disconnecting high tension lead and holding it from 1/4 inch to 3/8 inch from the engine. If these magnetos are functioning properly, a strong spark will jump this distance.

e. Check insulation on high tension wire, the ground connection, and the switch.

f. Check magneto timing.

5. FAULTY VALVE ACTION.

a. Check valves for freedom of action and broken valve springs.

b. Check for bent or worn push rods.

c. Check for correct valve adjustment clearance.

6. COLD OIL.

a. Turn propeller over by hand to insure engine being free.

b. During extremely cold weather, arrangements should be made to heat the oil before starting the engine.

7. AIR LEAKS.

a. Check intake pipes and carburetor gaskets for air leaks.

b. Check intake pipes for holes or cracks, particularly around the head end flange.

c. Check carburetor to see that it is tight.

d. Check tightness of plugs in cylinder primer connection holes (all cylinders).

e. Check intake packing nuts for tightness.

8. CARBURETOR FLOODING.

a. When using wobble pump, work slowly, never exceeding a pressure of 5 pounds.

b. The carburetor should be checked for leakage, externally and internally, by noting whether fuel comes out of the air intake. If there is a leakage, no attempt should be made to start the engine, because of the fire hazard involved. All external leaks should be corrected if possible; but in no case should the carburetor be dismantled to correct any internal leaks. The carburetor should be replaced instead.

(b) LOW OIL PRESSURE.

1. Determine quantity of oil in tank. Check oil pressure gage for correct recording.

2. Inspect all oil lines and connections from tank to inlet side of oil pump for tight connections, and determine if there are any air leaks. Check oil pressure connection to engine for correct location.

3. Check oil relief plunger for proper seating. Be sure there are no foreign particles on valve seat.

4. Check oil relief valve spring for length and pressure.

5. Check oil pump for excessive wear and proper functioning.

6. Remove oil pressure screen to see if it is partially clogged, or if the oil pressure screen plug has any metal particles present. If metal particles of appreciable size or quantity are found, the cause should be determined and the engine cleaned out before further operation.

7. The oil sump should be removed and inspected for metal particles. The oil pressure pipes in the sump should be checked for proper tightness.

8. After the above has been accomplished, if low oil pressure still persists, a cylinder should be removed, other than the master rod cylinder, and the master rod bearings checked for excessive wear or end clearance. This condition is almost always accompanied by the telltale of heavy deposits of metal particles in the oil pressure strainer cover. The same holds true if a bearing, bushing, or a cam bearing becomes scored or starts to "pick up."

9. Excessive clearance between the oil seal rings and ring carriers, or the cam and cam bearing liner, will also cause low oil pressure.

(c) LOW POWER.

1. Check valve mechanism for operation and timing.

2. Check magnetos for operation and timing.

3. Check spark plugs.

4. Check throttle throw to determine whether carburetor throttle valve is opening fully.

5. Check magnetos with switch to determine drop in rpm on each magneto individually. A drop of more than 100 rpm generally indicates faulty ignition, such as poor spark plugs, broken or damaged ignition wires, or malfunctioning of magnetos.

6. Check carburetor for proper setting and functioning.

7. Check fuel lines and strainers for restrictions to flow.

8. Check air intake system for restrictions or induction of exhaust gas.

9. Check preheater shut-off valve for hot-air leakage when in the cold-air position.

10. Check for air leaks in intake pipes, carburetor mounting flange, and carburetor body gasket.

11. Be sure the correct grade of fuel is being used. On engines of high power output, this is extremely important.

12. Check for ice formation in carburetor venturi.

13. Check propeller for correct design and setting.

(d) ROUGH RUNNING.

1. Check spark plugs and plug shields.

2. Check magneto timing and operation. Check ignition harness for broken wires, poor connections, and damaged insulation.

3. Check valve mechanism operation and timing.

4. Check propeller by installing a propeller from another engine which is known to run smoothly.

5. Check propeller hub nut, being sure it is tight.

6. Check propeller balance and track.

7. Check thrust nut to insure its tightness. Check propeller hub rear cone for galling.

8. Check engine mounting bolts for tightness.

9. Check engine mount for cracked or broken members.

10. Check running engine with hot air on to determine if poor distribution or ice formation in carburetor is causing roughness.

11. Check carburetor setting and operation to be sure it is functioning properly.

(e) HIGH OIL TEMPERATURES.

1. Check oil cooling system, particularly installations which have oil coolers with bypass valves.

2. Check valve timing and adjustment.

3. Check magneto timing.

4. Check compression for burned or scored pistons and weak piston rings.

5. Check oil strainer for metal particles, particularly master rod bearing and bushing metal.

6. Check carburetor for lean mixture.

7. Check cowling and intercylinder baffles when used, being sure that they are not interfering with correct air flow over engine.

8. Check to see that oil tank has sufficient air flow around it and that it has not been decreased by cowling alterations or changes.

(3) REPLACEMENT OF ENGINE PARTS.

(a) GENERAL.

1. This section will be limited to instructions for engine top overhaul. Discretion will be used in determining which parts should be removed, repaired, and replaced. If there are indications that internal engine parts have been damaged, the engine will be reported to the Area Air Service Command for disposition. Before complying with the following instructions, house the airplane indoors, if possible, to protect the engine from dust and moisture.

(b) REMOVAL OF PARTS.

1. PROPELLER.—For instructions on removing the propeller, refer to paragraph *4*.

2. COWLING. — All sections of cowling which would interfere with the necessary work on the engine will be removed.

3. SPARK PLUGS.—Refer to paragraph *d. (5)* for instructions on removing spark plugs.

4. EXHAUST PIPING.—Unscrew nuts which fasten exhaust stacks or exhaust manifold pipes to the cylinder heads, and remove the piping.

5. CYLINDER DEFLECTORS.—R-1340 series engines have been equipped with two different types of intercylinder deflectors. The names of these deflectors and the order in which they have been furnished are as follows: (1) "Bolted Type;" (2) "Latch Type." Both types of deflectors are attached to the cylinder barrels by means of a butterfly clamp and are also secured to adjacent cylinder head deflectors.

a. BOLTED TYPE.

(1) Remove all primer lines which fit through the rubber grommets in the deflectors and are connected to the cylinders.

(2) Remove bolts which attach intercylinder deflectors to the adjacent cylinder head deflectors.

(3) Unscrew wing nuts which fasten intercylinder deflectors to butterfly clamps; remove these parts.

(4) Remove nuts or screws which attach cylinder head deflectors to the top of the cylinders; lift off the deflectors.

b. LATCH TYPE.—Comply with the instructions outlined under "Bolted Type," with this exception: Detach the intercylinder deflectors from the cylinder head deflectors by compressing the latches which secure these parts together.

6. PUSH RODS AND COVERS.

a. The rocker box covers will be removed after the nuts which fasten them to the cylinder heads have been unscrewed.

b. Unscrew push rod cover packing nuts at top and bottom, using PWA-439 wrench.

c. Turn crankshaft until each valve, which is actuated by push rod to be removed, is fully closed.

d. Depress rocker arms with PWA-455 depressor; remove push rods and covers.

7. INTAKE PIPES.

a. Remove all primer lines, oil pipes, etc., which are fastened to the intake pipes.

b. Unscrew intake pipe gland nuts at blower section, using PWA-144 wrench.

c. Unscrew nuts and cap screws holding intake pipe flanges to the cylinders; remove pipes.

CAUTION

These pipes are made of thin gage aluminum and are easily damaged if dropped.

8. CYLINDERS AND PISTONS.

a. Remove spark plugs, exhaust piping, cylinder deflectors, push rods, push rod covers, and intake pipes, in accordance with the previous instructions.

b. Loosen clamps or wrap locks which fasten hose connections on intercylinder drain pipes. Slip the connections to one side so that the pipes between the cylinders are no longer connected.

c. Observe the following instructions before removing cylinders:

(1) The master rod cylinder (No. 5) will be the last removed, should its removal with one or more cylinders become necessary.

(2) Upon removal of the master rod cylinder, the rod will be centered rigidly in the crankcase opening by suitable blocking or wiring, and rotation of the crankshaft will be avoided. If these instructions are not complied with, the master rod may move sufficiently to permit the piston scraper rings to withdraw from the remaining cylinders, thereby causing damage to the pistons and cylinder skirts.

(3) After removal, the cylinders will be placed on wood or in some appropriate carrier to prevent mutilation at the bottom ends of the barrels. Also, the crankcase openings will be covered to prevent dust or grit from entering the crankcase.

(4) If difficulty is experienced in pushing out a piston pin, slightly heat the head of the piston and then lightly tap the pin using PWA-12 drift. When using the drift to drive out a piston pin, the connecting rod in which the pin is fitted will be supported to prevent it from striking the crankcase.

d. Turn crankshaft until piston within cylinder to be removed is at the top of the stroke.

e. Remove cylinder hold-down nuts, using PWA-186 wrench. Pull off each cylinder.

f. Push the piston pin out of each piston (after its respective cylinder has been pulled from the crankcase), and remove the latter.

9. VALVE SPRINGS AND ROCKER ARMS.

a. Remove rocker box covers, push rods, and push rod covers, as previously specified.

b. Observe the following instructions before removing the valve springs:

(1) If the cylinders have been removed before the valve springs are withdrawn, place a block (having the same contour as the inside of the head) against the dome of the combustion chamber to prevent the valve stems from descending in the guides when the springs are compressed for removal.

c. Compress each valve spring, using PWA-459 compressor. Remove the split lock, upper washer, valve springs, and lower washer.

d. Unscrew the castellated nuts from the ends of the rocker shafts.

e. Drive out the rocker arms shafts, using a suitable drift. Remove the rocker arm assemblies.

10. VALVES.

a. Remove cylinders, pistons, rocker arms, and valve springs, as previously specified.

b. Remove safety circlets on the valve stems. Withdraw the valves from the guides and through the cylinder barrels.

(c) REPLACEMENT OF PARTS.

1. PUSH ROD COVER PACKING GLANDS.

a. Remove the push rod and cover in accordance with previous instructions.

b. Replace the push rod cover gland with a .004-inch oversize gland.

c. Rotate crankshaft until tappet, which actuates push rod to be installed, has fully descended in its respective guide.

d. The number etched on the tappet end of each push rod should correspond with the number of the cylinder to which the rod is assembled. The rod will be fitted to the tappet and rocker arm for the exhaust or intake valve, depending on the designation (that is, "Ex." or "In.") etched on the tapet end of the rod.

e. Insert push rod in cover.

f. Depress rocker arm with PWA-455 depressor, and fit push rod and cover into proper position.

g. Tighten packing nuts on each end of the cover, using PWA-439 wrench. The packing nut at the tappet end of the cover will be tightened first.

CAUTION

Do not tighten these nuts excessively, as the cover may collapse.

2. INTAKE PIPE GASKET.

a. Loosen intake pipe gland nut at the blower section, using PWA-144 wrench.

b. Remove nuts and cap screw holding the intake pipe flange to the cylinder head.

c. Remove gasket, after the necessary clearance is obtained for its removal by a slight backward pull on the intake pipe.

d. Replace gasket. Fasten flanged end of pipe to cylinder head with nuts and cap screw.

CAUTION

Tighten screw and nuts evenly to prevent distortion and subsequent leakage.

e. Tighten gland nut of pipe at blower section, using PWA-237 wrench.

CAUTION

Do not tighten this nut excessively as, in doing so, the intake pipe may neck down.

3. INTAKE PIPE PACKING.

a. Remove intake pipe in accordance with previous instructions.

b. Fit the flange, gland nut, and rubber packing over the blower end of each intake pipe.

c. Place pipe in position, screw gland nut loosely into the blower.

d. Locate copper gasket in proper position; fasten flange on pipe to cylinder head with cap screw and nuts.

CAUTION

Tighten screw and nuts evenly to prevent distortion and subsequent leakage.

e. Tighten gland nut at blower end of pipe, using PWA-237 wrench.

CAUTION

Do not tighten this nut excessively, as the intake pipe may neck down.

4. EXHAUST MANIFOLD PIPE GASKET.

a. Remove nuts holding flange of exhaust manifold pipe to cylinder head.

b. Remove gasket, after the necessary clearance is obtained for its removal, by a slight backward pull on the exhaust manifold pipe.

c. Replace gasket. Fasten flanged end of pipe to cylinder head with the necessary nuts.

CAUTION

Tighten nuts evenly to prevent distortion and subsequent leakage.

NOTE

Replacement of gaskets and packing will be made when there is evidence of leakage at their respective locations, despite the fact that the nuts, screws, or gland nuts are snug.

5. ROCKER ARM BEARINGS.

a. Press bearing out of rocker arm with PWA-614 drift and base or its equivalent, using arbor press.

b. Observe the following instructions before installing new bearing in rocker arm: The two holes drilled through the outer race of the new bearing will be aligned as close as possible to the drilled passages in the rocker arm.

c. Press new bearing into rocker arm, using arbor press.

(4) ADJUSTMENT OF VALVE CLEARANCES.

(a) Whenever excessive valve clearances are found (.025 inch or more), remove the push rod cover tubes, flush these tubes, clean the push rods. Inspect for straightness, wear on ball ends, and security of ball ends on rods. Then grease the ball ends of the push rods, and inspect condition of cover tube gasket and packing (replace, if necessary). Reassemble, being sure that both ends of the cover tube fit properly in packing. Normally, push rods do not need to be removed between overhauls except when excessive valve clearances are found.

(b) When adjusting valves, make sure that the engine is thoroughly cool. In order to check valve clearance, first remove the valve rocker covers, being careful not to damage the gaskets. The front spark plugs should also be removed. Then, starting with No. 1 cylinder, turn the engine crankshaft counterclockwise until both valves are closed and the piston is at the exact top dead center of the compression stroke. When this has been accomplished, raise the rocker arm of the valve being checked as far as the clearance will permit, and insert the proper feeler (use PWA-35) between the valve tip and the valve clearance adjusting screw ball end. On the R-1340 engines, the proper valve clearance when cold is .010 inch for both inlet valves and exhaust valves. If adjustment is necessary, loosen the lock nut and back off or turn down the valve clearance adjusting screw. Difficulty in obtaining sufficient clearance may be due to "stretched" valves. When retightening the lock nut, be careful not to turn the adjusting screw. A box wrench, PWA-28, for loosening and tightening the adjusting screw lock nut and a tool for turning the adjusting screw are supplied in the engine service tool kit.

CAUTION

When adjusting screw lock nuts are tightened, an excessive pressure should not be exerted as such will preload the adjusting screw, and breakage will be likely in subsequent running. Tighten by hand, but do not strike wrench with any object.

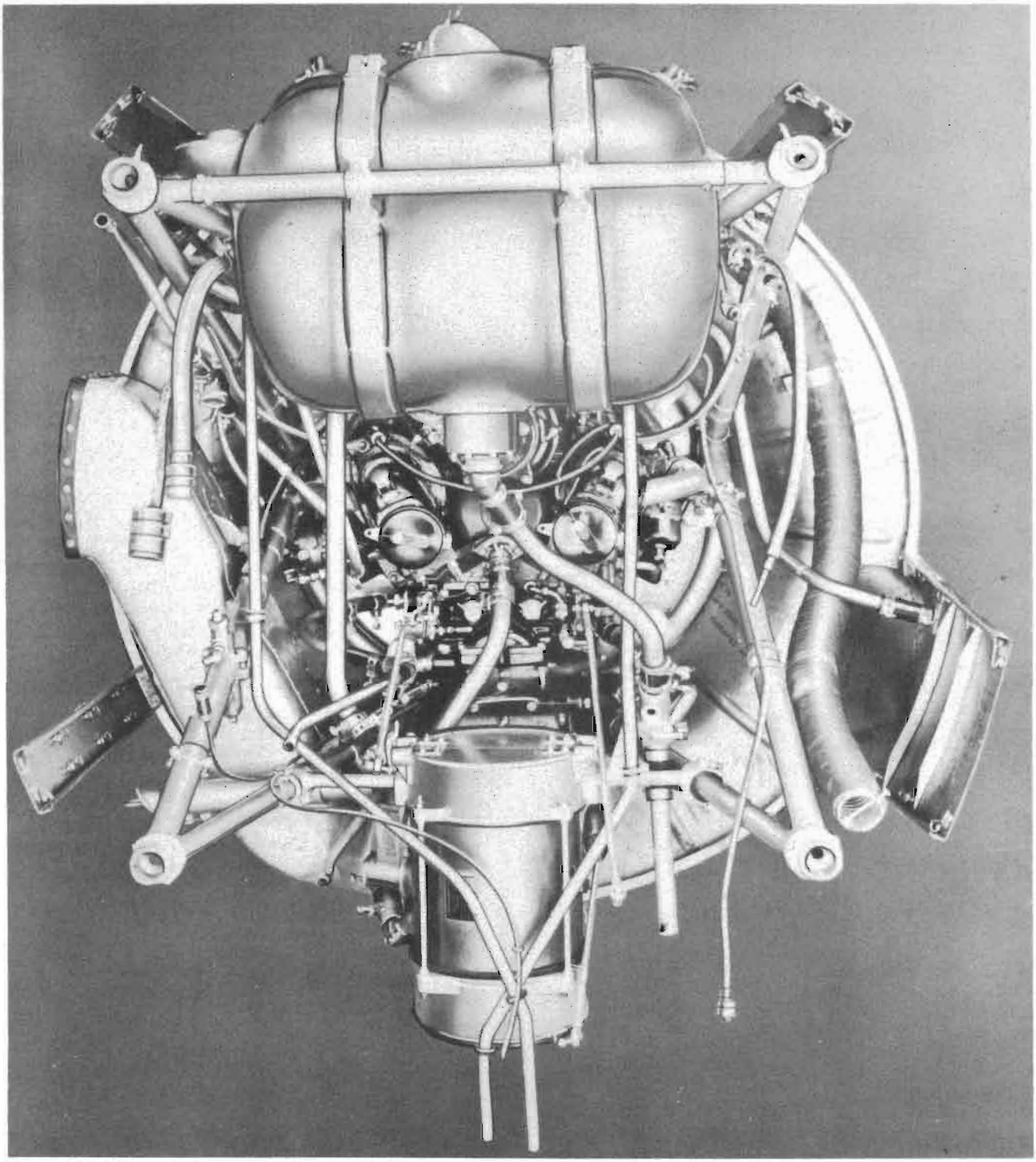


Figure 134 — Power Plant Assembly (Rear View)

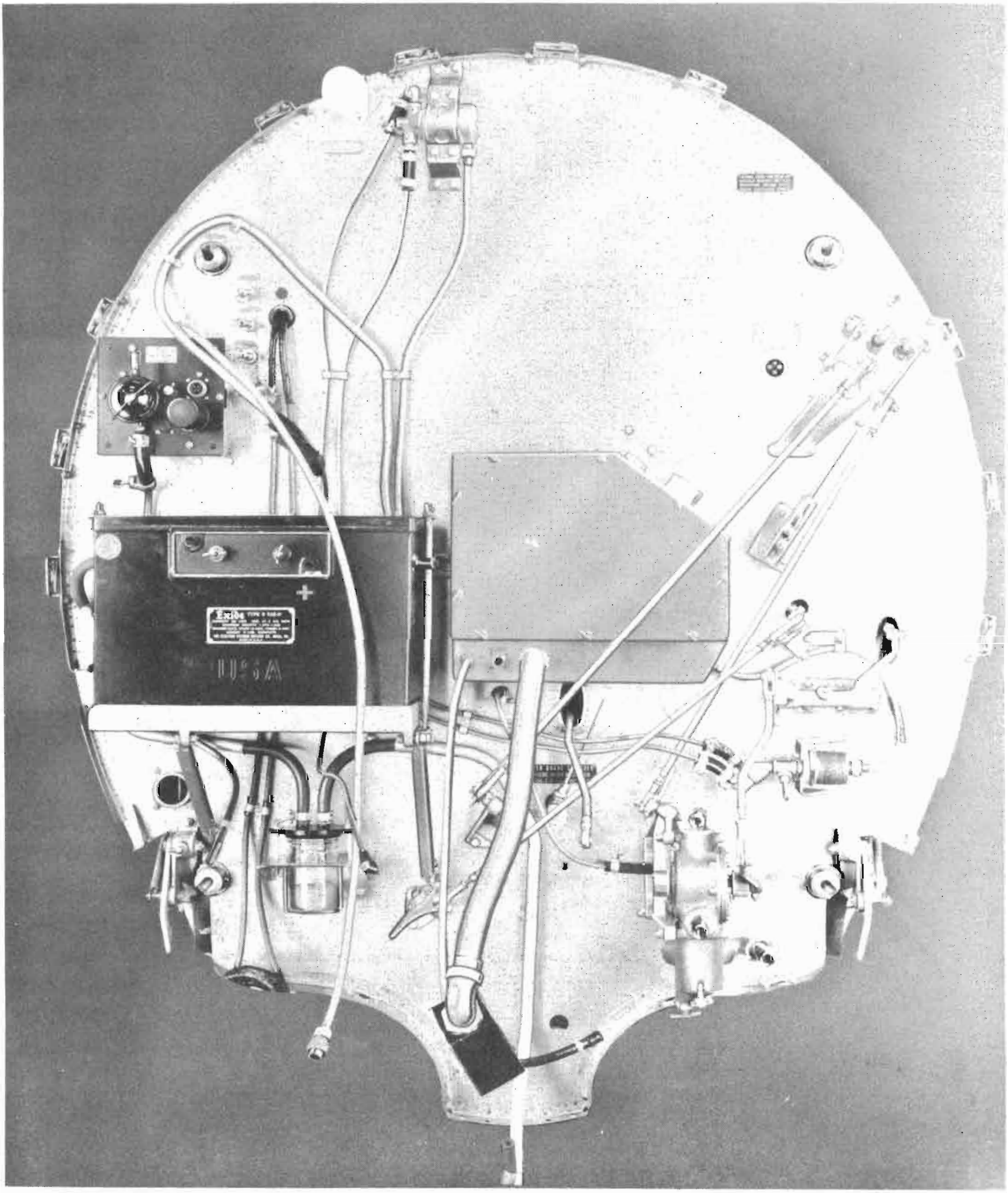


Figure 135 — Fire Wall Assembly

(c) Test tightness of valve clearance adjusting screw assemblies after the lock nuts have been tightened. An adjusting tool will be used on each valve clearance adjusting screw to make certain it will not move. In case any are found that can be moved, they will be replaced with screws selected to give the proper fit. The desired fit is one which will require moderate effort with an adjusting tool to move the screw before the lock nut is tightened.

(d) After tightening the lock nut, the clearance should again be checked. After completing the clearance check of the valve in No. 1 cylinder, check the other cylinders in their firing sequence in the same manner as described above. Upon completing the adjustment of the valves in all the cylinders, the crankshaft should be rotated eight complete revolutions and the clearances rechecked. This will insure all four lobes of the cam being properly timed. All clearances which are found to be below the minimum, (that is, .010 inch for the inlet and exhaust valves) ***should be reset to the minimum figure.*** Reset all inlet and exhaust valves if clearances exceed .025 inch.

(5) REMOVAL.

(a) GENERAL.—Before removing the engine or the complete power plant as a unit, drain the fuel and oil systems; remove the engine cowling and propeller. To disconnect the lines and engine mount at the fire wall, reverse the sequence of operations contained under installation of the power plant. Make certain that all lines, rods, wiring, etc., have been disconnected and are free from clamps and that nothing will interfere with the removal of the complete power plant or engine, as the case may be. When disconnecting lines, plug the ends to prevent the loss of fluid.

WARNING

When extracting the nine bolts securing the engine to the mounting ring, be sure to start with the bolts located at the bottom and work around both sides, so that the upper bolts will be removed last.

CAUTION

Two men are required to remove the engine: one to remove the bolts, and the other to operate the hoist. Carefully guide the engine through the mounting ring, taking care that the component parts of the engine are not damaged in passing through the mounting ring. Care should be exercised when removing the complete power plant from the fire wall, so that the rear of the mount does not drop down, as is the tendency, for this will result in damage to the oil tank and fixtures on the fire wall.

NOTE

When the ignition plug is disconnected, the engine ignition is on. Do not rotate the engine.

(b) ENGINE REMOVAL. — The following sequence of operations should be adhered to in removing the engine from the engine mount.

1. Remove the outer muff assemblies.

2. Remove starter crank extension and starter hand engaging ring and cable, located at the left side of the engine compartment.

3. Disconnect all electrical wiring and conduits at the respective engine units.

4. Disconnect the following lines from the engine and respective engine units, as noted:

a. Exhaust gas analyzer cell lines at right rear side of exhaust collector ring.

b. Oil pressure lines at pump.

c. Manifold pressure lines at top of engine.

d. Engine primer line at primer distribution unit.

e. Hydraulic pressure and return lines.

5. Disconnect the following control rods from their respective engine units:

Throttle	Carburetor air heat
Mixture	Propeller

6. Disconnect the cockpit heating and ventilating system hot air duct at the hot air muff, located at the upper right side of the exhaust collector ring.

7. Remove the magneto blast tubes.

8. Remove the generator.

9. Remove the vacuum pump and connecting vacuum lines.

10. Remove the hydraulic pump and connecting hydraulic lines.

11. Remove the gun synchronizer.

12. Remove the carburetor, carburetor mixing chamber, duct assembly, and connecting fuel lines.

13. Make certain all necessary rods, lines, wires, etc., are disconnected and are free from tie-down cords and clamps, and that they are supported clear, as required.

14. Attach the lifting sling, PWA-37, to the lifting eyes on the engine.

15. Maintain the proper hoisting chain clearances to avoid damage to the equipment.

16. Take up the slack in the chain fall or hoist.

17. Remove the nine bolts attaching the engine to the engine mount ring. Start with the bolts located at the bottom and work around both sides, so that the upper bolts are removed last.

CAUTION

Two men are required to remove the engine: one to remove the bolts, and the other to operate the hoist.

18. After the bolts are removed, carefully guide the engine through the engine mount ring. Take care that the magnetos, or any other part of the accessory section, are not damaged in passing through the ring.

(c) COMPLETE POWER PLANT REMOVAL.—The entire power plant from the fire wall forward may be removed from the airplane in one unit. Engine mount fittings and individual line disconnect blocks are conveniently located and easily disconnected. Lifting eyes are provided on the engine assembly, between cylinders No. 1 and No. 2, and cylinders No. 1 and No. 9. Power plant hoisting lugs are located on the engine mount at the two upper points of attachment to the fuselage.

NOTE

To remove the engine from the engine mount ring, refer to paragraph (b).

CAUTION

Do not use the power plant hoisting lugs on the engine mount to hoist the airplane.

1. Remove the propeller according to instructions in paragraph 7. *a.* (2), section IV.

2. Remove the engine ring cowl and the engine compartment cowling, which is secured by conventional Dzus type fasteners.

3. Remove the oil cooler air scoop and duct mounted below the engine compartment.

4. Disconnect the cowling formers at their point of attachment to the fire wall.

5. Disconnect the following control rods from their respective bell cranks at the fire wall:

Throttle
Mixture
Propeller pitch
Carburetor air heat

6. Disconnect all electrical wiring and conduits at the main power panel junction box on the fire wall.

7. Disconnect the cylinder head temperature thermocouple line running from engine cylinder No. 5 to the fire wall fitting just below the right upper engine mount attachment point at the fire wall.

8. Disconnect all magneto wiring and conduits at the connector fitting, located on the fire wall just below the upper left engine mount attachment point.

9. Disconnect the following lines as noted:

10. Oil temperature capillary line at thermometer well on oil tank to drain cock line located at right side of engine compartment, and remove attaching clamps.

11. Fuel pressure line from carburetor at fire wall disconnect block.

12. Vacuum line at fitting at upper left corner of fire wall.

13. Hydraulic pressure and suction lines from engine-driven hydraulic pump at connector fitting located at left side of fire wall.

14. Oil pressure line from oil pump at disconnect fitting on fire wall.

15. Manifold pressure line from top of engine to disconnect fitting on fire wall.

16. Engine primer line at lower right side of fire wall.

17. Fuel line from engine-driven fuel pump at "tee" fitting at bottom of hand fuel pump.

18. Fuel line from carburetor to relief valve at top of hand fuel pump.

19. Exhaust gas analyzer and oil dilution lines and tachometer shafts.

20. Disconnect the cabin ventilating system hot air duct at the lower right side of the fire wall.

21. Disconnect the machine gun impulse tube at the gun trigger motor, if a gun has been installed in the airplane.

(6) ASSEMBLY AND INSTALLATION.

(a) GENERAL.—The entire power plant, including all accessory units forward of the fire wall and with the cowl panels removed, may be installed on the airplane in one complete unit; or, the engine may be installed on the engine mount after the mount, oil tank, oil cooler, fixed engine ring cowling, and other power plant units are installed on the airplane. The sequency of operations required for both methods is outlined in following paragraphs. The engine mount attachment fittings, line-connecting blocks, control rods, etc., are conveniently located and easily connected. Lifting eyes are mounted between the top three cylinders. Hoisting lugs are located on the engine mount at the two upper points of attachment to the fuselage.

CAUTION

The engine mount lugs at the rear of the engine mount are for hoisting the power plant only. Do not use them to hoist the airplane.

ITEM NO.	PART NO. ENGINE SIDE	PART NO. FIREWALL SIDE	DESIGNATION	APPROPRIATE POSITION OF CONNECTION
1.	77-48812	Type D-3 fuel unit	Feed line from carburetor to relief valve on top of hand fuel pump.	Lower left side of firewall.
2.	77-48810	Type D-3 fuel unit	Fuel line from engine-driven fuel pump to bottom of hand fuel pump.	Lower left side of firewall.
3.	77-51825	Type C-3 Spec. 33215 fuel press. signal	Fuel pressure line from carburetor to firewall.	Lower left side of firewall.
4.	55-48827	55-48827	Engine primer line at firewall.	Upper right side of firewall.
5.	77-51821	77-51822	Manifold pressure line from top of engine to firewall.	Upper right side of firewall.
6.	77-51829	77-51830	Oil pressure line from oil pump to firewall.	Upper right side of firewall.
7.	55-58507 77-58507*	55-58508 77-58508*	Hydraulic pressure line from engine-driven hydraulic pump to connectors at left lower tube of engine mount.	Left lower side of firewall.
8.	55-58503 77-58503*	55-58505 77-58505*	Hydraulic return line from engine-driven hydraulic pump to connectors at left lower tube of engine mount.	Left lower side of firewall.
9.	77-51081 88-51081*	77-51081	Thermocouple line from cylinder No. 5 to connector on firewall.	Upper right side of firewall.
10.	77-51805 88-51805*	AC 882-10-10	Vacuum line to firewall	Upper left corner of firewall.
11.	U1050-B1	B-2 Spec. 27943	Front and rear oil temperature lines to capillary bulbs in "Y" valve.	Lower right side of engine.
12.	55-51845 88-51845	A-7 Spec. 27992	Outlet exhaust gas sampling line to exhaust gas analyzer unit.	Right side of firewall.
13.	77-51844 88-518-44*	A-7 Spec. 27992	Inlet exhaust gas sampling line to exhaust gas analyzer unit.	Right side of firewall.
14.	U1050-B1	77-47810	Oil dilution line to "Y" valve.	Lower right side of firewall.
15.	88-43802	28-43014	Throttle control rod to bellcrank at firewall.	Lower left side of firewall.
16.	55-43804	55-43012	Mixture control rod to bellcrank at firewall.	Lower center of firewall.
17.	88-43805	77-43030	Carburetor-air control rod to bellcrank at firewall.	Bottom side of firewall.
18.	88-44801	55-44011	Propeller control rod to bellcrank at firewall.	Upper left side of firewall.
19.	Type E-3 Tachometer Generator	25-54080-2AB-420	Tachometer conduit to tachometer generator.	Rear right side of motor.
20.	25-54080-2BB-500	88-54072	Gun solenoid and gun sights conduit to box assembly.	Center of firewall.
21.	NA-Y9E1 Carburetor	25-54080-2AB-214	Carburetor mixture temperature conduit to carburetor.	Rear center of motor.
22.	25-54080-8DG-330	88-54072	Starter conduit to box assembly.	Center of firewall.
23.	25-54080-6AB-394	88-54072	Generator conduit to box assembly.	Center of firewall.
24.	25-54080-3EG-290	55-54139	Ignition conduit to box assembly.	Upper left side of firewall.
25.	Type E-4 Gun Synchronizer	77-61004	Impulse tube unit, tube to synchronizer.	Rear center of engine.
26.	55-53308	55-53338	Ventilating system hot air duct to firewall.	Lower right side of firewall.
27.	77-31901	88-31104	Four engine mount nacelle attachment points.	Outside edge of firewall.

*Used on later airplanes.

a. The above disconnect points are marked by means of "International orange" lacquer.

b. Both units of separation are marked.

c. Markings consist of a daub of paint at least ¼" wide.

Figure 136 — Markings Chart: Engine Disconnect Points

(b) PREPARATION FOR COMPLETE POWER PLANT INSTALLATION.—After the following instructions have been complied with, proceed with the complete installation, as outlined in paragraph *(c)*. Disconnect (or attachment) points are marked as listed in figure No. 136.

1. Make certain that all lines, conduits, etc., are secured properly with suitable clips and clamps. Connect the heating system pipes.

2. Ascertain that all control rods are properly adjusted and safetied; that all line connections are sufficiently tightened; and that all lines, conduits, controls, etc., are bonded and protected against chafing.

3. Make certain complete exhaust-collector ring and muff assemblies are installed. Install engine compartment cowling formers and oil cooler air scoop, inserting the ends of the oil filler neck drain line, oil separator outlet line, battery vent line, and fuel pump flange drain line through the scoop.

4. Install the mechanical starter engaging cable assembly.

5. Install battery on shelf at the right side of the fire wall, and attach vent hose and conduit. Make certain that rubber padding is provided between battery base and the shelf.

6. Install engine ring cowling and engine compartment cowling.

7. Install propeller.

(c) COMPLETE POWER PLANT INSTALLATION.—The sequence of operations necessary to install the complete power plant, including all units forward of the fire wall is as follows:

1. Because of the snug fit, it is recommended that the four engine mount attachment fittings and attachment bolts, AN8-13, be cleaned and coated with graphite grease prior to installation.

2. When proper lifting sling arrangements and clearances have been obtained, take up slack in the chain hoist and raise the power plant into position, engaging the two upper points of attachment to the fuselage. Then, connect the two lower points of attachment.

3. Secure each engine mount attachment fitting to its respective fuselage attachment bolt with an AN960-816 washer, AN310-8 nut and AN380-3-3 cotter.

4. Lower the hoisting chains and disconnect the sling.

5. Connect and secure all lines and rods at their points of attachment as noted:

a. FUEL LINES.

(1) Connect fuel unit at fuel pump at forward end of fuel unit.

(2) Connect carburetor to fuel unit at top of fuel unit.

(3) Primer line to engine at upper right side of fire wall.

b. OIL LINES.—Connect oil dilution line at top of oil "Y" drain and dilution cock.

c. HYDRAULIC LINES.

(1) Connect pressure line to upper connector at lower left side of fire wall.

(2) Connect suction line to lower connector at lower left side of fire wall.

d. INSTRUMENT LINES.

(1) Connect fuel pressure line to fitting at signal switch of fire wall.

(2) Manifold pressure line to upper right side of fire wall.

(3) Oil pressure line to upper right side of fire wall.

(4) Vacuum line from check valve to upper left side of fire wall.

(5) Thermocouple to upper right side of fire wall.

(6) Connect oil temperature capillary. Insert bulbs in oil dilution and drain valve, short conduit in rear part.

(7) Secure long conduit to lower left engine mount tube.

(8) Exhaust gas analyzer inlet to fuel mixture cell on fire wall. Secure to fire wall.

e. ELECTRICAL CONDUITS.

(1) Connect the engine ignition to connector at upper left side of fire wall.

(2) Magneto boosters to right side of power control box.

(3) Engine starter to left side of power control box.

(4) Engine generator to left side of power control box.

(5) Tachometer generator to upper right side of fire wall (connect at tachometer junction box).

(6) Carburetor mixture temperature to lower right side of power control box.

(7) Gun synchronizing to lower right side of power control box.

(8) Secure conduit loop of exhaust gas analyzer to upper right engine mount tube.

f. CONTROL RODS.

(1) Adjust engine controls, as in paragraph 6., *e*.

(2) Connect throttle inboard of bell crank, at lower left side of fire wall.

(3) Mixture at upper side of bell crank, at lower center of fire wall.

(4) Carburetor air at upper side of bell crank, at lower left side of fire wall.

(d) INSTALLING ENGINE TO ENGINE-MOUNT RING.—The sequence of operations for installing the engine on the engine mount is as follows:

1. Prior to installation, in order to allow the engine accessory section to pass through the engine mounting ring, it is necessary to remove the carburetor, generator, vacuum pump, tachometer generator, and hydraulic pump from rear of the engine.

2. Install two B1144-2 rubber vibration absorber cushions in each of the nine engine mounting lugs, except in the rear side of the upper mounting lug between cylinders No. 1 and No. 2 which require one 36-31912 cushion.

3. Place an AN960-716 washer on each of the eight AN7-57 bolts and on the 49-42006 clevis bolt. Place a 55-31911 washer on the clevis bolt, and install through the rear side of the lug located between engine cylinders No. 1 and No. 2. Place washers, 55-31916 and 55-31919, on two of the AN7-57 bolts, and install these bolts in the lugs between engine cylinders No. 2 and No. 3, and No. 1 and No. 9, respectively. Place 2W3 washers on the remaining bolts; insert same in lugs; and place 2W3 washer over the end of all nine bolts.

4. Install the engine-fixed baffle assembly around the engine accessory section.

5. If oil tank and/or oil regulator are not installed on the engine mount assembly, install them before making any other installation.

6. Connect the two metal straps (65-42063) from the oil cooler to the rear connecting flange of the carburetor air-mixing chamber.

7. Attach lifting sling to engine lifting eyes.

NOTE

Provide ample chain clearances to avoid damage to equipment. See hoisting instructions.

8. Take up the slack in the chain hoist, raise the engine to the level of the mounting ring.

9. Carefully guide the engine through the mounting ring. Take care that the magnetos, engine ignition flexible conduit, and other attached accessories are not damaged when passing them through the mounting ring.

10. Install bonding braid (19-54079) on the mounting bolt at engine cylinders No. 2 and No. 7; fasten the engine to the mounting ring with AN960-716 washers, eight AN310-7 and one AN320-7 nuts. Safety with lock wire.

CAUTION

Tighten all bolts evenly to obtain maximum absorbing characteristics and to insure proper alignment of the engine with mounting ring. The proper tension of the engine mount bolts is between 300- and 500-inch pounds.

11. Lower the hoisting chain and remove the engine sling.

12. If the two halves of the engine fixed cowling ring have not been installed, they should be installed at this point. Attach the carburetor air-mixing chamber to the cowling ring, and install the assembly on the engine mounting ring. Install the carburetor cold-air intake duct at the left side of the power plant compartment with one attachment to the cowling ring; secure with three bolts and link.

13. Install carburetor and upper and lower duct assemblies between the carburetor and mixture chamber.

14. Install engine generator, hydraulic pump, vacuum pump, and tachometer generator.

15. Insert flexible end of each magneto blast tube assembly through the fiber fair-leads in engine-fixed baffle assembly, and secure the end of each assembly to its respective air scoop. Adjust the leather chafing collar so as to protect the tube at the fair-lead.

16. Check and secure the following lines and rods at the attachment points as noted:

a. FUEL LINES.

(1) Fuel line to carburetor at outboard side of pump to T-fitting at left rear corner of carburetor.

(2) Fuel pump drain line at rear of fuel pump flange.

(3) Primer line to fuel outlet distributor at top of engine.

(4) Hand pump to carburetor at the fitting on left rear corner of the carburetor.

(5) Hand pump to fuel pump on inboard side of fuel pump.

b. OIL LINES.

(1) Engine breather at top of engine crankcase.

(2) Oil inlet connects below oil pump.

(3) Oil outlet at center of engine case.

(4) Tank vents (2) to left and right sides of engine case.

(5) Ascertain that T-fitting is installed at end of right line for installation of vacuum line to oil separator.

c. HYDRAULIC LINES.

(1) Pressure line to inboard port of hydraulic pump.

(2) Suction line to outboard port of hydraulic pump.

d. INSTRUMENT LINES.

(1) Oil pressure to upper left side of engine case.

(2) Manifold pressure at elbow fitting above crankcase and aft of cylinder No. 1.

(3) Vacuum pump discharge to lower port on vacuum pump.

(4) Vacuum to upper port on vacuum pump.

(5) Connect oil separator vacuum to engine at T-fitting at the right oil tank vent line attachment to engine.

(6) Thermocouple to attachment fittings at rear of cylinder No. 5.

(7) Exhaust gas analyzer inlet to intake duct above carburetor.

e. ELECTRICAL CONDUIT.

(1) Engine ignition to left magneto.

(2) Magneto booster to right magneto, center plug.

(3) Engine starter to left side of power control box.

(4) Secure to upper left diagonal engine mount tube.

(5) Connect tachometer generator at generator on top of engine case.

(6) Carburetor mixture temperature at intake duct above carburetor rear side.

(7) Gun synchronizing to gun synchronizer at right side of engine case.

f. CONTROL RODS.

(1) Adjust the engine controls, as instructed in paragraph *e.* (2).

(2) Connect the throttle, mixture, propeller, and carburetor air control rods to their respective units.

c. CARBURETOR.—The Stromberg carburetor, type NA-Y9E1, is a double-barrel up-draft type. This type carburetor has a Y-type float mechanism, needle valve economizer, back suction-type mixture control, and an accelerating pump. The carburetor is also equipped with an idle cut-off device. The settings for cruising and full throttle have been determined by the manufacturer; therefore, no adjustment will be necessary. An idle adjustment is provided to take care of production variations. Two small levers at the rear of the throttle valve body may be moved to control the richness of the mixture at idling speeds. After the carburetor is properly installed and the idle adjustments are made, very little attention is required in service. A fuel strainer is located at the rear of the carburetor and may be removed by the removal of the large square head plug at the top of the main body. The strainer should be removed frequently to dispose of any dirt or water which may have accumulated in the strainer chamber.

WARNING

Because of the fire hazard involved, the engine must not be run if the carburetor leaks fuel excessively. In no case will the curburetor be disassembled to correct any leakage. Replace the carburetor instead.

CAUTION

When removing the carburetor, cover the engine intake passage with heavy cardboard or other material to prevent the entry of foreign matter.

(1) AUTOMATIC MIXTURE CONTROL ADJUSTMENT.—Since the automatic mixture control is set at the factory when new and at the depots during overhaul, where special equipment is used, no change will be made in the setting by operating personnel. If there is any malfunctioning or evidence that the adjustment has been changed, the complete automatic mixture control unit will be replaced. When replacing the automatic mixture control assembly, care will be taken to insure that the new assembly is the proper type and assembly number required for the particular carburetor.

d. IGNITION SYSTEM.

(1) GENERAL.—The ignition system consists of two magnetos, an ignition switch, a booster coil, 18 spark plugs, and the required wiring and radio-shielded ignition harness.

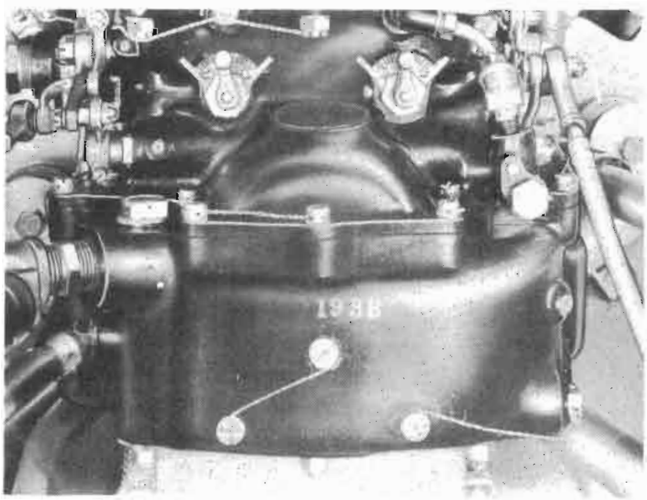


Figure 137 — Carburetor Installed

(2) TROUBLE SHOOTING.

Symptom	*Cause*	*Remedy*
ENGINE MISSES OR FAILS TO START	Excessive lubricant in magneto.	Clean magneto breaker assembly and adjust magneto.
	Open circuit or short in ignition circuit.	Repair or replace defective part.
	Defective spark* plugs.	Replace defective spark plugs.
	Fouled spark plugs.	Clean and adjust spark plugs.
	Defective booster coil.	Repair or replace booster coil.
	Defective ignition switch.	Repair or replace ignition switch.

*When a spark plug is removed from the engine, due to suspected trouble, the plug should be inspected thoroughly for indications of engine condition. These indications are as follows:

If the electrodes are clean, but the metal shows signs of over-heating (discoloration), the cylinder has been running too hot. This may indicate pre-ignition, detonation from poor fuel, operating at excessive manifold pressure, a loose core, or poor cooling.

If the electrodes are coated with a white powder after operating with leaded fuel, the plug may not have been firing, but still may have been subjected to excessive heat. Check ignition wires and spark plug terminals for failure. Check magneto breaker point functioning and spark plug gap.

Caked carbon means excessive consumption of oil or that the plug has not been firing due to magneto, terminal, or wire defects, or to failure of the plug to clean up after starting.

A thin layer of black soot on the nose of the insulator (otherwise free of deposits) may cause a shorted plug. This may be an indication of low plug operating temperatures and should be reported, as a change of plug type may be needed.

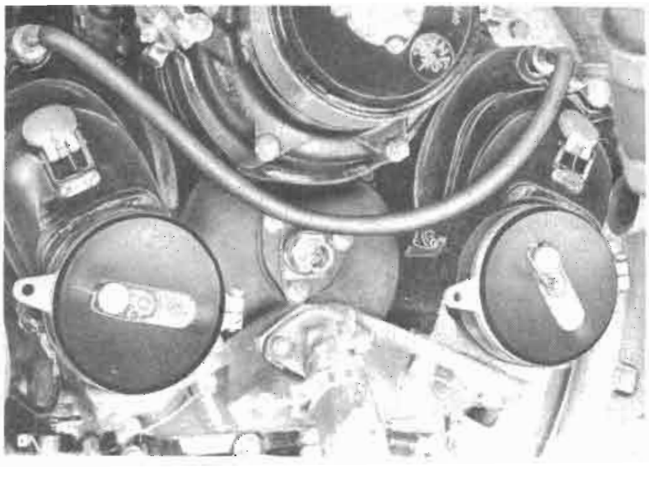


Figure 138 — Magnetos Installed

(3) MAGNETOS.

(a) DESCRIPTION.—Two Bendix-Scintilla SB-9RN (or SB-9R) magnetos are mounted on the rear of the engine, one at each side of the starter. Their function is to generate the current to furnish the spark to the spark plugs. A pivotless-type breaker is employed. Other features are a cobalt magnet, rubber encased coil, flat-type condenser mounted on top of the coil, and a distributor cylinder with replaceable segments. A magneto can be installed on either side of the engine by using the proper radio shields. A four pole magnet is used and the magneto is driven at 1-1/8 engine crankshaft speed.

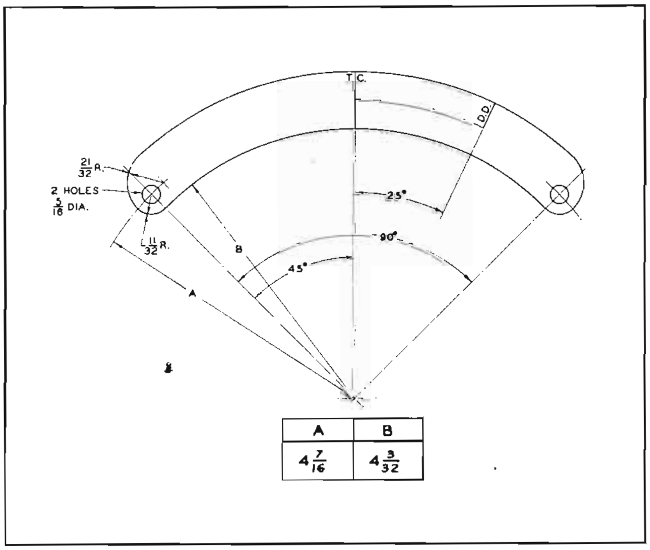


Figure 139 — Diagram for Timing and Synchronizing Magnetos

(b) TIMING MAGNETOS TO ENGINE.

1. Timing of the magnetos will be checked as follows:

a. Attach a template made up in accordance with figure 139 to the nose section of the engine at the two top holes which are provided for attaching cowling brackets.

b. Improvise a timing pointer by fastening a stiff piece of wire securely to the propeller hub, and line up its end with the top center mark on the template when No. 1 piston is at top center of its compression stroke.

c. Connect a timing light across the breakers, or insert a .0015-inch feeler gage between the breaker contacts of each magneto.

d. Turn the propeller shaft clockwise approximately 90 degrees, after which it should be returned gradually in a counterclockwise direction by jarring the propeller with the hand, until the points just start to open. Then note the position of the timing pointer (wire) with respect to the "specified advance" mark on the template, when each feeler gage can be removed from the breaker contacts with a slight pull, or when the timing lights indicate that the points are just opening.

(1) The contacts in both magnetos should break simultaneously when the timing pointer is aligned with the "specified advance" mark.

(2) If it is found that the timing of both magnetos is improperly synchronized or at an incorrect relation to the engine, each magneto will be properly timed as outlined below. No timing adjustment will be necessary on a magneto which is correctly timed with the engine.

2. Magnetos will be timed as follows:

a. Remove distributor blocks and breaker cover from the magneto.

b. Move spark advance lever (if used) to the full advance position.

c. Disengage magneto drive coupling and adjust relation of the magneto mechanism to the engine as follows:

(1) Remove cap screws which fasten magneto to engine rear section.

(2) Remove magneto from dowel pins in mounting pad.

(3) Turn magneto shaft until timing marks on the large distributor gear align with the timing marks on the inside of the front end plate. The running segment on the distributor rotor will now be in a position opposite the No. 1 distributor block electrode, and the breaker contacts should be just opening.

(4) Turn magneto shaft slightly until the breaker contacts begin to open and the feeler gage can be removed with a slight pull, or the timing light indicates that the points are just beginning to open.

(5) Place a steel scale on the step of the cam. Observe how close the straight edge of the scale is in relation to the timing marks on the rim of the breaker housing. If this distance is exceeded, adjust the breaker contact points as follows: (See figure 140.)

(a) Loosen the two screws (A).

(b) Adjust the contact points by means of the eccentric screw (B) so that the points just begin to open on the No. 1 lobe when the straight edge (E) coincides with the timing marks (C) and (D).

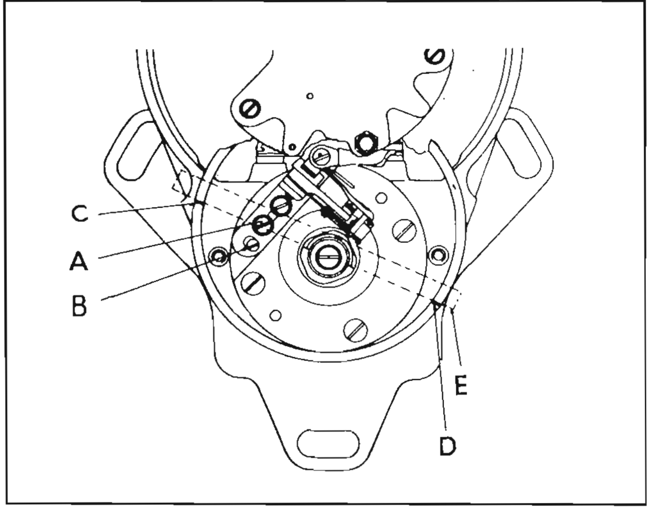


Figure 140 — Magneto Timing Diagram

(c) Tighten the screws (A) when the setting has been made, and recheck the adjustment.

(6) Use the No. 11-851 timing light or equivalent to determine the position where the contacts open. If the timing light is not available, the opening can be determined by placing a strip of .0015-inch shim stock between the points and pulling against it slightly. When the .0015-inch shim stock can be released with a slight pull as the crankshaft is turned slightly, the contact points are just beginning to open.

CAUTION

When inspecting the contact points for any reason, do not raise the breaker main spring beyond a point giving 1/16-inch clearance between the contact points. Any further tension on the main spring caused by raising it beyond this point will weaken and cause unsatisfactory magneto performance.

(7) Turn crankshaft counterclockwise until the piston in No. 1 cylinder is on the compression stroke (both valves closed) and the timing pointer aligns with the "specified advance" mark on the front section.

(8) Turn magneto drive coupling until it can be engaged in both coupling drive gears without causing the magneto shaft to turn.

(9) Engage coupling by fitting magneto over dowel pins in mounting pad; fasten magneto to engine rear section with the necessary cap screws.

(10) Turn crankshaft 90 degrees in a clockwise direction; then reverse rotation until the feeler gage can be removed from between the contact points with a slight pull. Note the position of the timing pointer with respect to the "specified advance" mark on the front section. (The contacts of both magnetos should break simultaneously when the aligning pointer aligns with the timing mark on the front section. If the

contacts do not break at this point, adjustment will be made in accordance with the instructions in the next paragraph.

(11) If the contacts break before the pointer aligns with the timing mark on the front section, remove magneto; turn coupling clockwise one or two notches; refasten magneto to engine rear section; recheck timing as previously outlined. If the contacts break after the pointer aligns with the timing mark on the front section, the above procedure will be followed except that the coupling will be turned counterclockwise one or two notches. Due to the fact that the coupling has 19 notches on one side and 20 notches on the other side, a rather fine adjustment can be made.

(12) After the magneto is properly timed, insure that cap screws which hold it in place are tight. Then secure screws with safety wire; fasten distributor blocks in position with spring clamps, and secure clamps with wire clips. Attach breaker cover to magneto with knurled screw, and secure screw with wire clip.

(13) Remove timing pointer from the propeller hub.

(4) BOOSTER COIL.—(See description in "Electrical System" paragraph 13.) The booster coil is mounted in a shielded case with flexible conduit shielding the leads to the magneto and is controlled by the engine's starter meshing switches. Its function is to aid in starting the engine by intensifying the spark.

(5) SPARK PLUGS.

(a) GENERAL.—The spark plugs recommended for the engine are listed below:

Description	*Mfr*	*Type*
Shielded short reach AN Spec. plug,	B. G. Corp.,	SS-454
Shielded short reach AN Spec. plug,	B. G. Corp.,	SS-485
Shielded short reach	B. G. Corp.,	SS-515
Shielded short reach	B. G. Corp.,	SS-453

(b) REMOVAL AND INSTALLATION.

1. Remove ignition cables, first loosening all elbow nuts with the proper wrench. Gently pull cable connectors straight out. Do not jerk them.

2. Apply a socket wrench to the spark plug shell hex only when removing or installing a plug.

CAUTION

Under no circumstances will chisels, punches, or oversize wrenches be used for this purpose. Do not apply too much pressure to the wrench when assembling or installing spark plugs, as the plug bodies may be stressed to a point that will result in distortion of the gasket seat between the core and the shell. When installing or removing spark plugs, be careful to prevent the wrench from tilting to one side or slipping and striking the head of the plug.

3. To install a plug, lubricate the threads with anti-seize compound and start the plug by hand. Make sure that it turns freely before using the wrench.

CAUTION

Use every precaution to avoid dropping a plug. If a plug is dropped, do not install it in an engine.

4. Tighten all spark plugs with the proper wrench and a handle not more than 10 inches long. Use not more than 480 pounds inch torque.

5. Replace ignition cables, inserting the cable connectors straight into the spark plug shields, not at an angle. When each connector is in place, start its elbow nut by hand, making sure that it turns freely before tightening.

6. Whenever checking the installation of shielded plugs, always check the terminals and elbows to see that they are securely tightened. Avoid excessive tightening of the elbows since this may cause rotation of the core with respect to the shell, thus closing the electrode gaps. Use elbow wrenches for tightening terminal elbows.

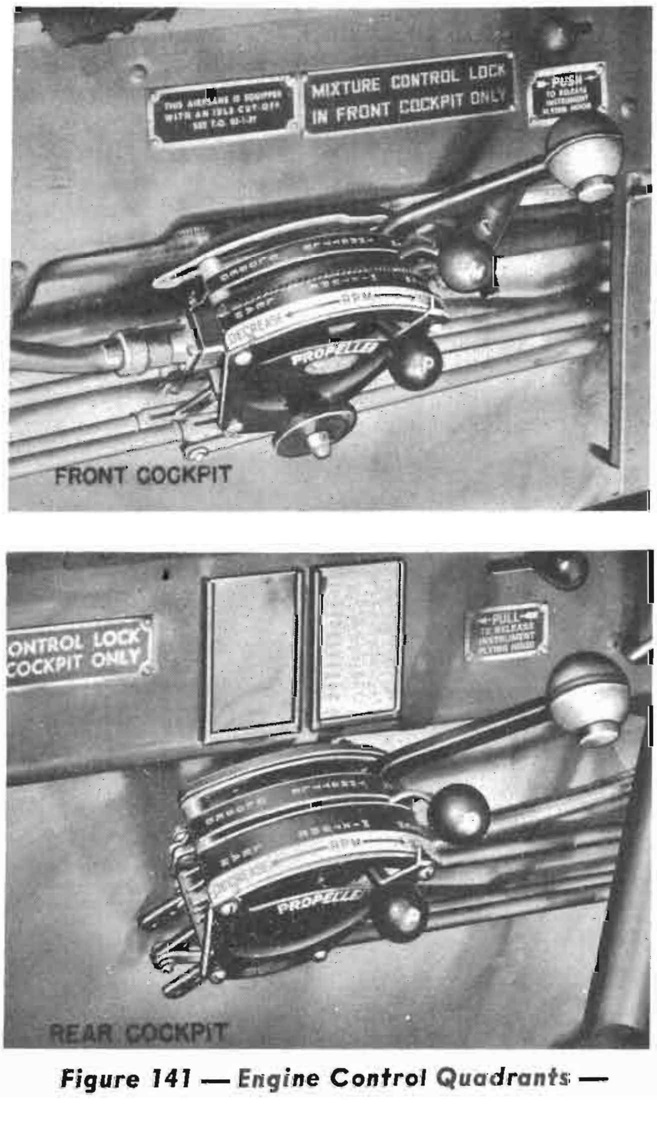


Figure 141 — Engine Control Quadrants —

e. ENGINE CONTROLS.

(1) GENERAL.—The engine controls are of the steel tube, push-pull type, with bell cranks and rod ends mounted on ball-bearings. The throttle, mixture, and propeller control levers are all assembled in a single quadrant located on the left side of each cockpit. Front and rear cockpit control levers are interconnected by means of rods. The engine controls are equipped with a friction lock to prevent the controls from creeping after setting. The lock is located in the front cockpit on the face of the quadrant and may be actuated at will by the pilot or occupant in the front cockpit. The controls may be set or tightened by screwing the small disc inward or loosened by screwing outward. The function and operation of the controls are as follows.

(a) THROTTLE CONTROL.—The forward position of the throttle control lever is "OPEN" and the rearward position "CLOSED," as indicated on the quadrant. The throttle in the front cockpit is provided with a joggle-type stop that should be adjusted to limit the travel of the control lever so that 36 inches Hg manifold pressure at 2250 rpm is not exceeded at sea level take-off. The throttle may be advanced beyond the stop for maximum power; however, this position is utilized only in case of an emergency and must not be used normally. The throttle lever is wired to two toggle switches in the wheel wells that operate the landing-gear warning horn. If the throttle is retarded within 7/16 inch of the "CLOSED" position, the warning horn will sound indicating that the landing gear is not down or locked in its extended position. Located in the knob-type handle on the throttle control lever is a radio button for British throat-type microphones, serving the same purpose as the switch on U.S. hand-type microphones.

(b) MIXTURE CONTROL.—The front cockpit mixture control lever is equipped with a spring-loaded lock and ratchet. When the controls are moved forward toward the "RICH" position, the lock is ineffective; however, in moving the control to the "LEAN" position, it is necessary to press forward on lock lever attached to the control handle. When this is done, the lock is disengaged from the ratchet and allows the control to be pulled back toward the "LEAN" position. This feature enables the occupant in the rear cockpit to enrich readily, but prevents him from leaning out the mixture. This is done because the engine instruments are in the front cockpit and cannot be checked visually from the rear cockpit. An idle cut-off device is provided and becomes effective when the mixture control handle is in the extreme rear or "LEAN" position.

(c) PROPELLER CONTROL.—The propeller control handle is mounted on the engine control quadrant. Control levers are interconnected by a rod and connected to the constant speed governor by means of push-pull rods and bell cranks. As indicated on the quadrant, the forward position of the propeller control lever results in "INCREASE RPM" and the rearward position results in "DECREASE RPM." Between these two positions is the "CONSTANT SPEED CONTROL RANGE" which permits the governor to automatically adjust the propeller pitch for the desired rpm. For take-off, climb, and landing, set the control for "INCREASE RPM." For cruising, high speed and prior to starting and stopping engine, set control for "DECREASE RPM."

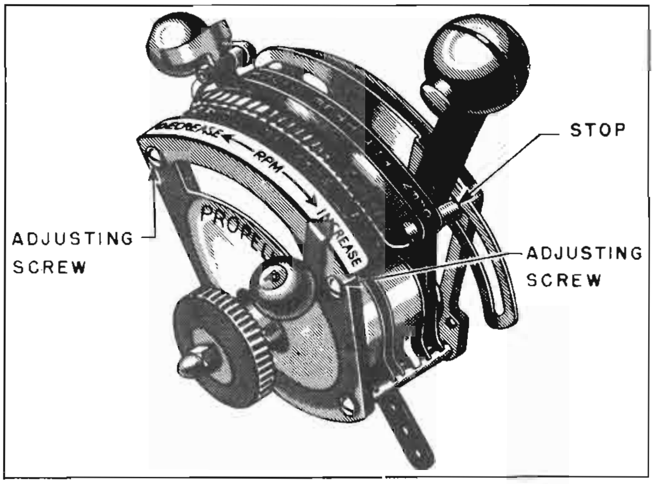


Figure 142 — Throttle Stop Adjustment

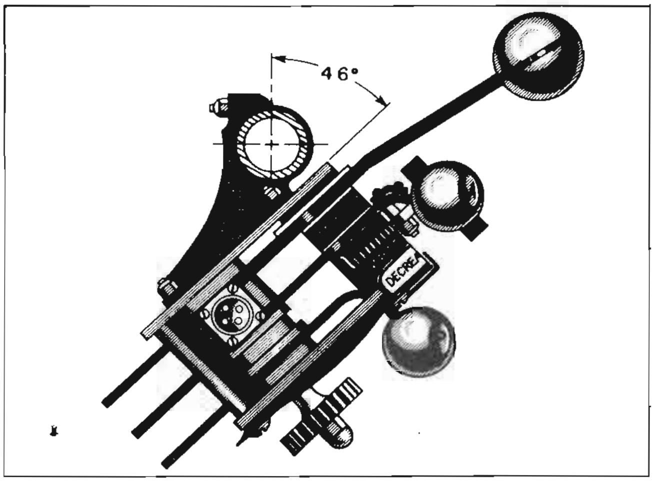


Figure 143 — Engine Control Quadrant Angle

(2) ADJUSTMENTS.

(a) THROTTLE STOP.—Loosen screws securing the throttle stop to the mounting in order that it can slide fore and aft. With the engine running, set the throttle for 36 inches Hg manifold pressure and 2250 rpm at sea level, and slide the stop against the throttle control for the proper setting. Then tighten the throttle stop mounting screws.

(b) ENGINE CONTROLS.—It is of extreme importance that the engine controls be properly adjusted to provide smooth and correct operation for the pilot. Each control quadrant should be at an angle of 46

degrees to the vertical axis. See paragraph 13. in this section for adjustment of the throttle switch actuating rod. With the propeller governor and the carburetor at proper settings, the length of the control rods from center to center should be as follows: Rods not listed will be lengthened or shortened as required for proper adjustment.

Name	*Number*	*Length*
Throttle	54-43053	32-9/16
	55-43802 (2 Req.)	23-7/8
	55-54177	8
Mixture	54-43053	32-9/16
	55-43806	27-11/16
	55-43804	21-15/16
Propeller	55-44802	32-5/8
	55-44801	23-7/16
	55-44803	27-1/2
Carburetor Air	84-43807	21-1/2
	55-43801	21-15/16
	65-43805	28-3/16

After the rod adjustment is made, check the controls at the quadrant for 1/8-inch spring back in the full forward and aft positions. Make any slight adjustment in the rods, if necessary, for proper spring back; then tighten the lock nuts and install cotter pins in the end bolts.

IMPORTANT

Bearing housing must be held in the correct position while tightening the lock nut to permit the rod end to be free at attachment to the bell crank or the operating arm. Distance from the lock nut to the shoulder of the rod should be approximately 5/16 inch at each end. At completion of an adjustment, operate the controls and check for play and binding. Play may be eliminated by making sure that all bolts, lock nuts, shaft bolts, and mounting bolts are tight. If ball bearing rod ends or bell crank bearings are causing play in the system, they should be replaced.

(c) PROPELLER GOVERNOR STOP.—The propeller governor stop is set at 40 degrees counterclockwise from top center for 2250 rpm. For instructions on adjustment of propeller governor control, see paragraph 7. *c.* (2).

f. EXHAUST SYSTEM.—The engine exhaust is collected by an exhaust collector ring and discharged at the right side of the engine cowling. The exhaust collector ring assembly, consisting of seven sections, is constructed of corrosion- and heat-resisting stainless steel. All sections are interconnected by clamp-type or slip-type joints that provide for expansion and contraction of the engine and manifold. This arrangement also

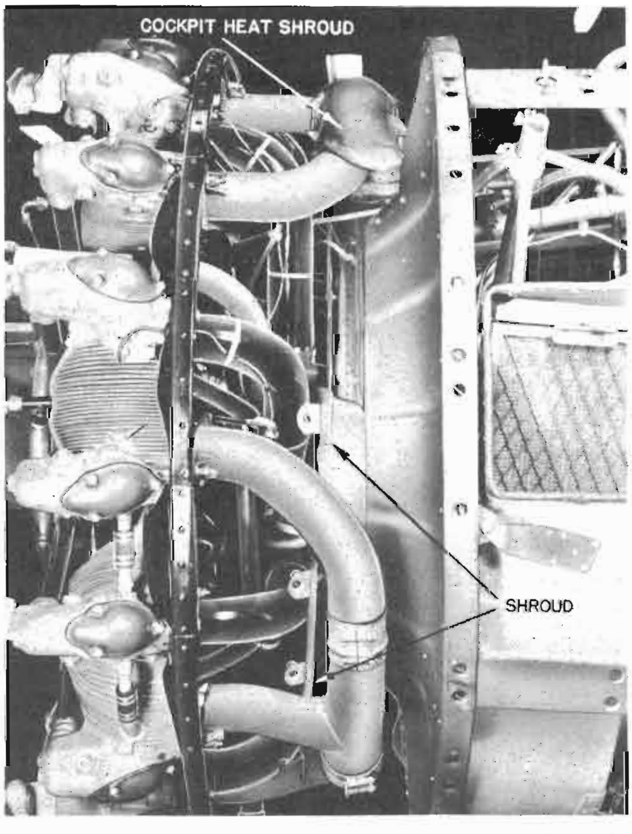


Figure 144 — Exhaust Manifold Installed (Left)

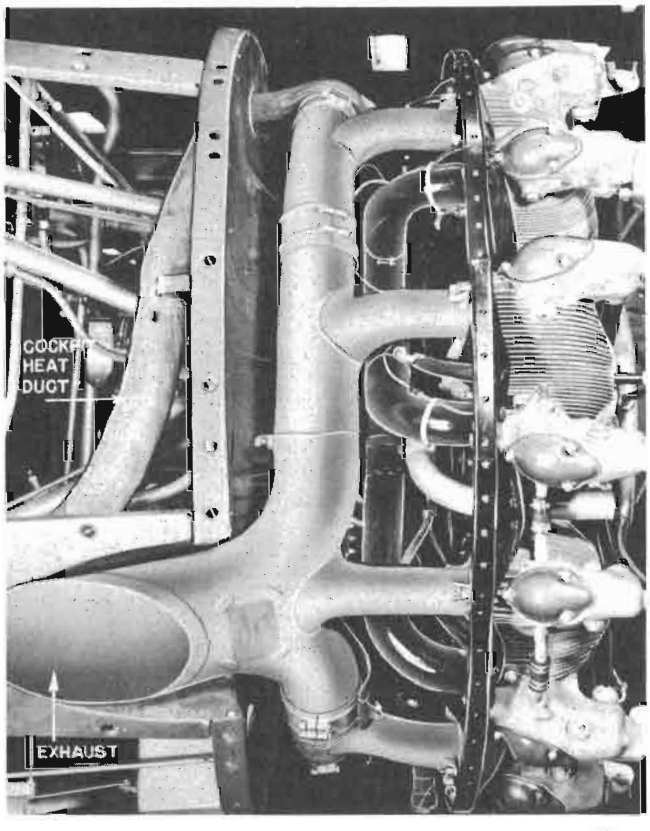


Figure 144 — Exhaust Manifold Installed (Right)

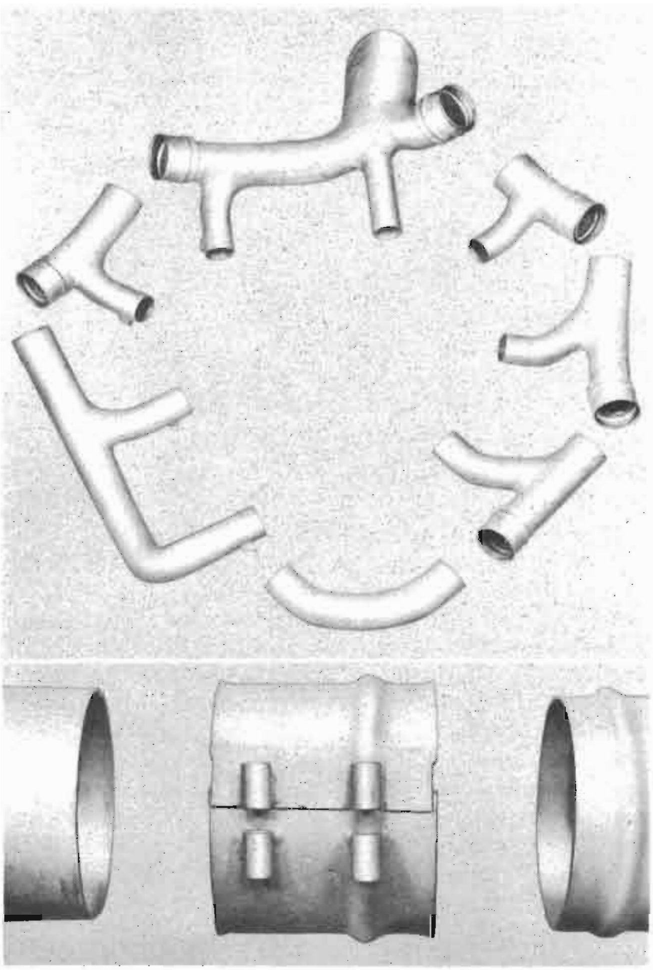


Figure 145 — Exhaust Manifold Sections and Slip Joint

makes it possible to remove any section of the exhaust collector ring without disturbing other sections of the assembly. The exhaust outlet joints are designed to prevent leakage of the exhaust gases and fouling of the airplane. The exhaust collector ring is jacketed with a Dzus-fastened shroud, which provides a chamber for preheating air before it enters the carburetor air mixing chamber. For details of exhaust heating system, refer to paragraph 14, section IV.

(1) EXHAUST GAS ANALYZER.—The exhaust gas analyzer indicates fuel-air ratio of the mixture entering the engine by electrically analyzing exhaust gases. The indicator normally responds in about 5 to 60 seconds after mixture change. Reading should not be taken until this time has elapsed. Correct fuel-air ratio indication does not lessen the importance of the cylinder head temperature indicator. Should detonation occur, the points of mixture indicator will move eratically, generally toward the "RICH" end of the scale. The mixture indicator cannot be relied upon when indicating less than .072. The exhaust gas analyzer consists primarily of an analysis cell located on the right side of the fire

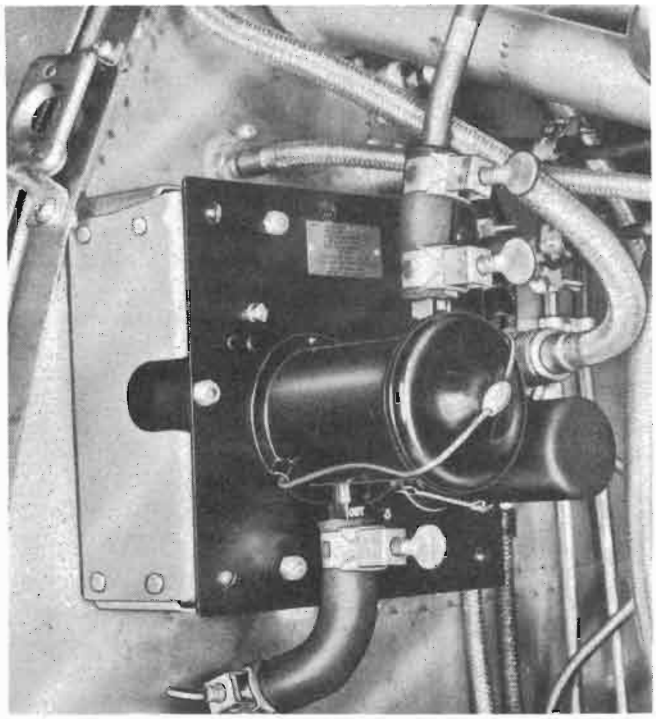


Figure 146 — Exhaust Gas Analyzer Installed

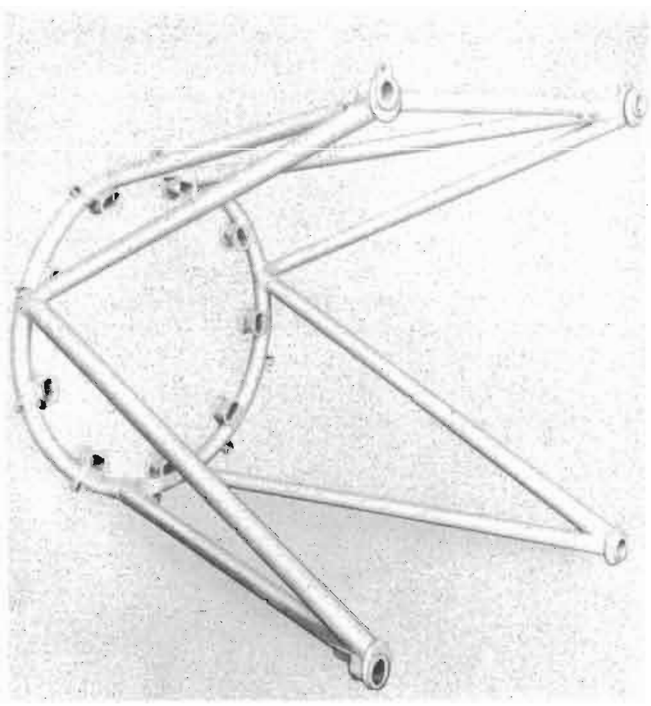


Figure 147 — Engine Mount

wall just above the battery and an indicator unit on the instrument panel. Lines from the manifold to the inlet and outlet sides of the analysis cell are copper. Airplanes of the SNJ-4 and SNJ-5 (Navy) models are not equipped with exhaust gas analyzers.

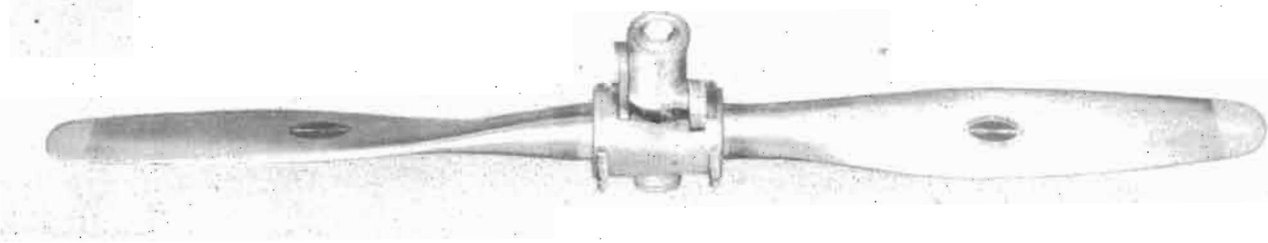


Figure 148 — Propeller

g. ENGINE MOUNT.—The engine mount is of welded chrome-molybdenum steel tubing construction, with the exception of the upper rear cross tube, which is of 24ST aluminum-alloy secured by four bolts to the welded structure. This tube supports the rear of the oil tank. Suitable mounting lugs and fittings are used for attachment of the engine to the mount and the mount to the fire wall. Two lugs at the upper fire wall attachment points provide for hoisting the power plant.

7. PROPELLER AND PROPELLER CONTROLS.

a. PROPELLER.

(1) DESCRIPTION.—The engine is equipped with a two-blade, nine-foot, one-inch nominal diameter, Hamilton Standard, constant-speed, counterweight-type propeller. The propeller hub assembly basic model number is 12D40; the propeller blade assembly model number is 6101A-12, and the constant speed propeller governor model number is 1M12-G. The blade angle settings, at the 42-inch station, are 11-1/2 degrees minimum, 27 degrees maximum, and 27 degrees index. Oil pressure is used to move the blades to the high rpm (low pitch) position. The blades are moved toward the low rpm (high pitch) position by centrifugal force acting on the counterweights attached to the blade brackets. The oil supply is obtained from the engine, and the flow of oil is controlled by a governor located on the top side of the engine nose casting, which automatically regulates the flow of oil to and from the cylinder of the propeller.

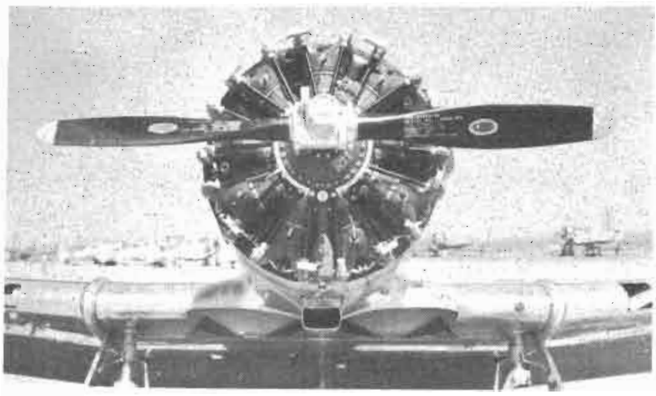


Figure 149 — Propeller Installed

(2) REMOVAL.

(a) Before removing the propeller from the engine shaft, place the blades in the low rpm (high pitch) position.

NOTE

At no time should a hammer or mallet be used on the blades, counterweight brackets, or cylinder to change the blade angle from low to high position. To change the position of the blade angles when the engine is not running, use a beam on each blade of the propeller assembly. Care should be exercised to insure that all blades are moved at the same time. Be sure to use thread protectors before removing blade.

(b) Disengage the cylinder head lock wire and remove the cylinder head. Have a pail handy to catch the oil from the cylinder.

(c) Disengage piston lock ring by removing cotter pins. It is a good practice to slide the lock ring up on the piston.

(d) Unscrew the piston. This will start the propeller off the engine shaft.

(e) Slide the propeller slowly forward on the engine shaft, and remove. Take care not to damage the engine shaft threads. Use thread protectors.

(3) MINOR REPAIR.

(a) GENERAL.—The types of damage described below can be repaired locally by any activity having the facilities and personnel familiar with the work.

1. NICKS AND DENTS.—Small nicks or dents in the leading edges, trailing edges, or tips will be removed by reworking the blade locally with a curved or "riffle" file. In urgent cases, this can be done while the propeller is on the airplane if the nicks are not too large; however, most desirable results are obtained if the propeller is rebalanced. When a nick is removed from a blade with the propeller on the airplane, balance can be attempted by weighing or calculating the weight of removed metal and installing weight to provide an equal moment on the same side of the hub, or removing weight to provide an equal moment on the opposite side of the hub. Care will be taken to remove the sharp base of the nicks, as these act as stress concentration points. The reworked surface will then be polished with a fine emery or crocus cloth. This rework is shown in figure 150.

2. CUTS AND SCRATCHES.—Longitudinal surface cuts or scratches which are located beyond the 50 percent radius may be reworked to form saucer-shaped depressions whose length, width, and depth do not exceed 1 inch, 3/8 inch, and 1/8 inch respectively. More than one of these defects is permitted provided they do not form a continuous line, or are not located nearer than 1 inch of one another in a transverse direction. Here again, in urgent cases, repair can be made while the propeller is on the airplane; however, an attempt should be made to secure balance by the method mentioned in *1.* (This reoperation is shown in figure 150.) Severe cuts or indentations which can be removed within the limitations of bullet damage can be treated the same as bullet damage.

3. BULLET HOLES.

a. In all cases where a bullet has entered a blade without going through the blade, but has resulted in damage beyond the limits of cuts or scratches given in paragraphs *1., 2.,* preceding, the blade will be drilled through and the damage treated as for a bullet hole.

b. No holes will be allowed outside 15 inches of the tip of the blade, and no holes are permitted inside the 21-1/2 inch station.

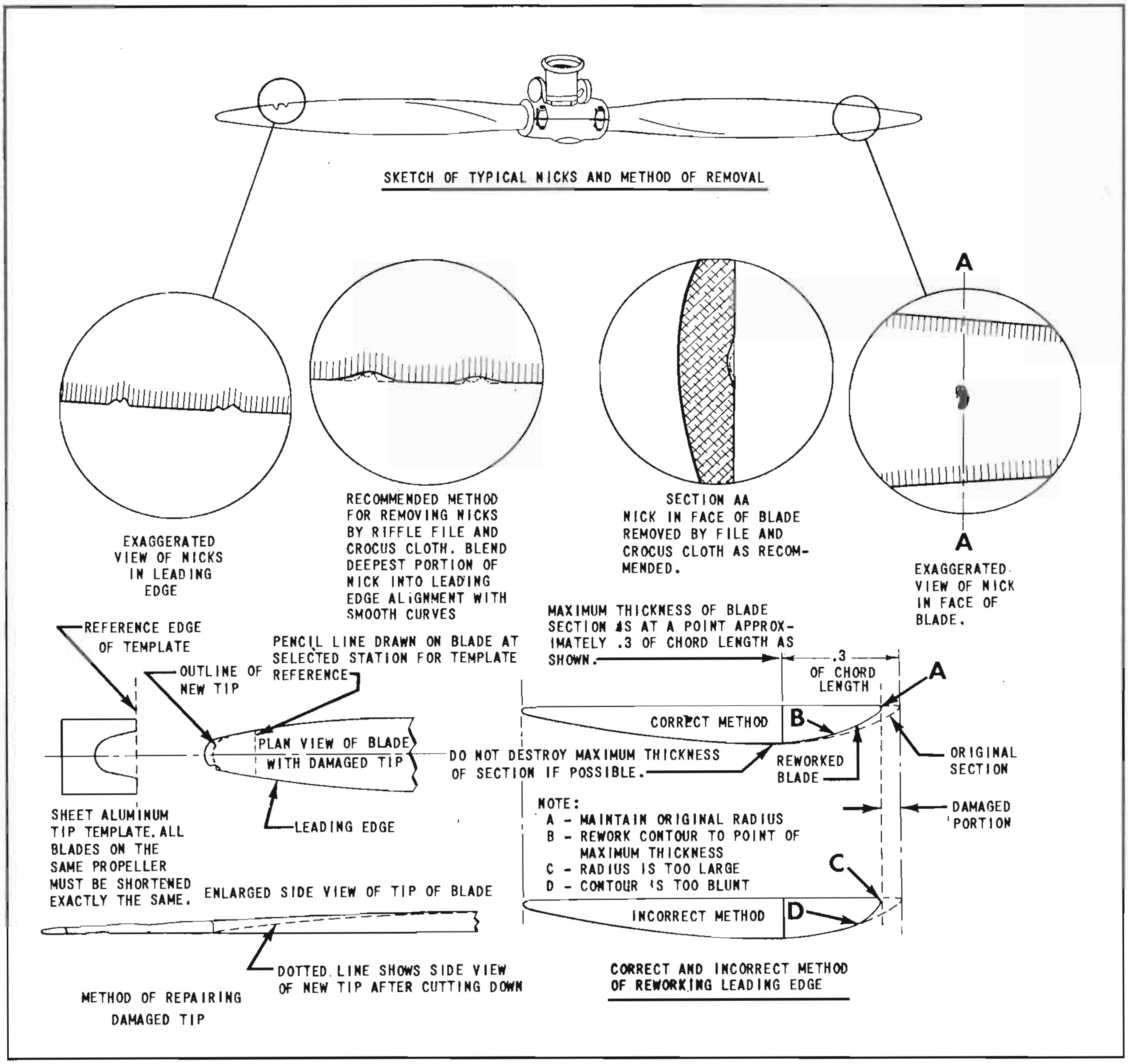
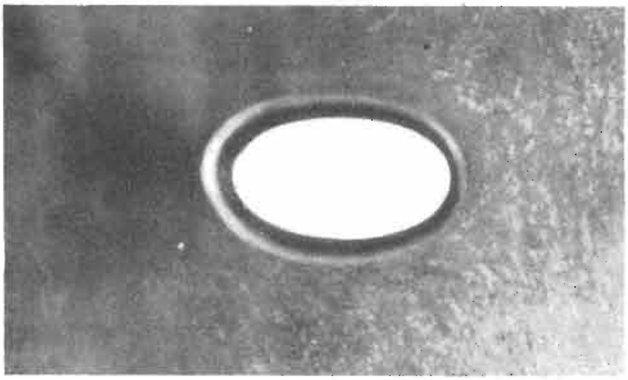


Figure 150 — Method of Repair



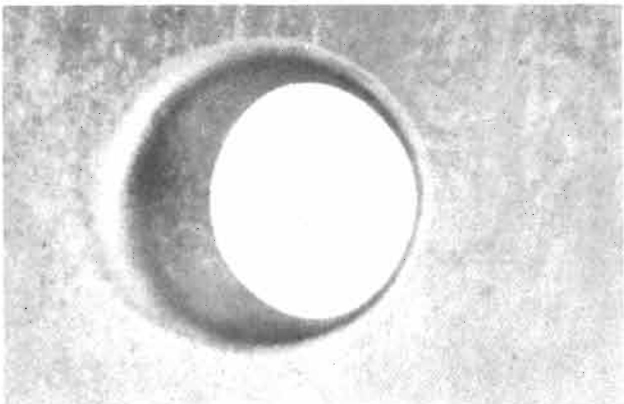


Figure 151 — Bullet Damage to Aluminum-alloy Blades

c. All holes must be cleaned out and blended into the blade surface with generous radii (at least 1/4 inches). (See figure 151.)

d. The nearest edge of a clean hole must be at least 3/4 inch from the leading or trailing edge of the blade.

e. The width of a cleaned hole (measured along the chord) must not be greater than 1/7 of the chord at that station.

f. The surface width of the blended hole (including radii) must not be greater than 2 inches, or 1/4 of the chord at that station, whichever is smaller.

g. There must not be more than one hole in any 6 inches length of the blade.

h. Bullet damage to the leading and trailing edges must be repaired in accordance with the present procedure for "nicks" and "cuts" as shown in figure 150.

i. Bullet damage to the tip portions will be treated the same as for cracks in the tips of the blades.

j. To insure that all cracks have been removed upon completion of repair of bullet holes, the vicinity of the repair will be etched and carefully examined. If cracks are found to persist, the blades will be condemned.

k. Blades damaged by bullet holes will be grouped and assembled in propellers in such a manner that the damage to each blade of the assembly is as nearly as possible identical.

(b) LOCAL ETCHING.

1. Caustic solutions for local etching will be prepared locally by adding to the required quantity of water as much commercial caustic soda as the water will dissolve at room temperature. The quantity of solution will depend on the amount of etching to be done. Glass or earthenware containers will be used for such solutions.

2. With No. 00 sandpaper, clean and smooth off the area being reworked. With a small swab or stick, apply to the area a small quantity of caustic solution heated to 160°-180° F.

3. After the area is well darkened, thoroughly wipe it off with a clean cloth dampened with clean water. Too much water may remove the solution from a defect and thereby spoil the etch.

4. If a crack or other defect extending into the metal exists, it will appear as a dark line or other mark; with the aid of a magnifying glass, small bubbles may be seen forming in the dark line or mark.

5. Several applications of the caustic solution may be necessary to determine when all the shallow cracks have been removed. Immediately on the completion of the final check, all traces of the caustic solution will be removed with nitric acid solution (20 percent by volume) which, in turn, will be thoroughly rinsed off with clean water. After completion of etching, the surface will be polished with fine emery or crocus cloth to remove all traces of the etch.

NOTE

The repair of damage other than that covered above requires special equipment. Damaged blades will be forwarded to the respective Area Air Service Command for repair or disposition.

(4) INSTALLATION.

(a) PRELIMINARY INSTRUCTIONS.—Before installing a propeller, all parts will be examined for defects and damage, and checked for proper fitting. All corrosion and all raised points of nicks, burrs, galls, scores, etc., on joining surfaces of the attaching parts, hubs, and crankshaft end will be carefully dressed off and the parts thoroughly cleaned before the propeller is installed on the shaft. In addition, the splines, front cones, front cone seats, etc., will be coated with clean engine oil to provide lubrication and prevent corrosion. Rear cones and rear cone seats will be installed dry. Cup grease or semifluid oils will not be used for this purpose. The threads in the propeller hub piston will be thoroughly coated with compound, thread, Specification No. AN-C-53.

(b) ATTACHING PARTS.—Special attaching parts will be furnished with each propeller and will be kept securely attached thereto. Standard attaching parts (nut, cones, snap ring, etc.) with each engine that are not required when a controllable propeller is installed will be returned to stock. When the propeller is removed, the special attaching parts will also be removed and kept with the propeller.

(c) INSTALLATION PROCEDURE.—The propeller is installed in the following steps, in order:

1. Thoroughly clean out the inside of the front portion of the crankshaft.

2. Remove the screw plug from inside the crankshaft.

3. Install bronze rear cone and rear cone spacer (if used) on engine shaft against the thrust nut.

4. Remove the propeller cylinder head lock wire; unscrew the cylinder head. Remove the lock ring from the hexagon portion of the piston.

5. Be sure that thread protectors are in place.

6. Place the propeller on the crankshaft. Make sure that the piston and crankshaft threads are in perfect alignment. In no case should force be used to tighten the piston if there is binding or indication that the threads are not properly started, otherwise serious damage may result.

7. When it is discovered that, due to handling or reassembling without proper adapters, the piston and shaft are not in alignment, the counterweights should be disassembled and the bearing shafts removed. This frees the cylinder and piston to permit easy starting of the threads and proper tightening of the propeller on the shaft. The counterweights may then be reassembled. Care should also be taken in tightening the piston to see that the front cone packing washer, when one is required, does not bind, but is pulled properly into place. As an aid in assembly, it is suggested that the piston be tightened a few turns and then the hub jarred slightly by hand. This will help prevent jamming the washer into the shaft threads.

8. Insert the proper wrench and tighten the piston, using a bar approximately 4 feet long. Apply a force at the end of the bar of approximately 175 pounds. One man of average weight (175 pounds) using a bar of this length can generally tighten the piston sufficiently without the need of additional leverage or the use of a hammer on the bar.

CAUTION

Do not, in any case, attempt to tighten the hub by hammering on the end of the bar.

9. Secure piston with lock ring. Cotter the lock ring, using $\frac{3}{32}$-inch steel cotter pins (2 or 3, as required). The heads of these cotters should be toward the crankshaft.

10. Check to see that the piston gasket nut is cottered.

11. Install cylinder head gasket on the cylinder head.

NOTE

In order to avoid the possibility of the gasket becoming damaged during assembly, care should be taken to insure that it is properly held in place on the pilot of the cylinder head.

12. Before installing the cylinder head, thoroughly coat the threads on the cylinder head and in the cylinder with lubricant, thread, Specification No. AN-C-53. Extreme care must be exercised in installing the cylinder head to insure that the threads are properly started. Tighten cylinder head sufficiently to prevent oil leaks, using the proper size wrench with a leverage of not more than 18 inches.

(d) ELIMINATING THE BOTTOMING OF FRONT CONES AGAINST SPLINES.—Due to manufacturing tolerance of crankshafts, propeller hubs, and attaching parts, it is possible that in some cases the front cone bottoms against the outer end of the splines and therefore cannot be tightened against the cone seat in the hub. Whenever this condition is found, a steel spacer approximately $\frac{1}{8}$ inch in thickness will be manufactured locally and installed between the thrust bearing retaining nut and the rear cone, or rear cone spacer when one is used. If the rear cone is found to bottom against the spline ends in the hub, either replace the cone with a new one, or rework the unsatisfactory cone by removing sufficient metal from the small end to eliminate bottoming.

b. PROPELLER CONTROLS.—The propeller control handles are mounted on the engine control quadrants in the front and rear cockpits. Control levers are interconnected by a rod and connected to the constant speed governor by means of push-pull rods and bell cranks. As indicated on the quadrant, the forward position of the propeller control lever results in "INCREASE RPM," and the rearward position results in "DECREASE RPM." Between these two positions is the constant speed control range which permits the governor to automatically adjust the propeller pitch for the desired rpm.

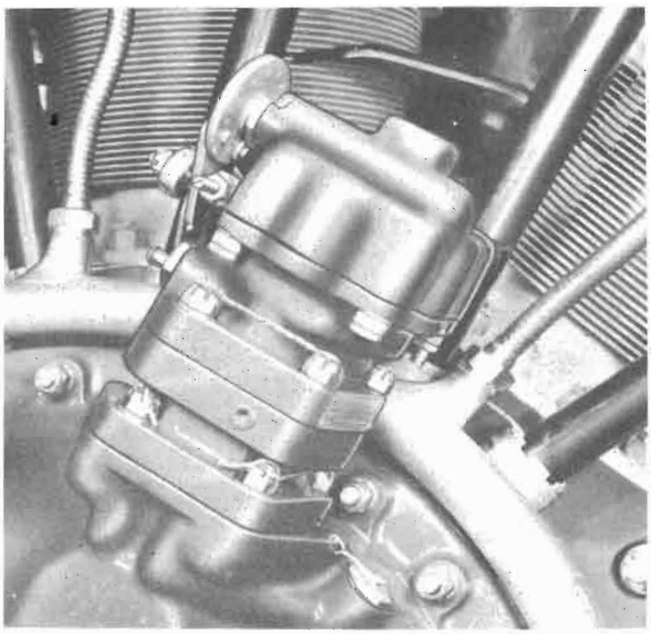


Figure 152 — Propeller Governor Installed

c. PROPELLER GOVERNOR.

(1) DESCRIPTION.—The propeller governor, model 1 M12-G, is mounted on the top of the engine nose casting. The governor is controlled by means of interconnected push-pull rods and bell cranks from the control quadrant in both front and rear cockpits. The purpose of the governor is to control the flow of oil to the propeller cylinder which will automatically adjust the propeller pitch for the desired rpm. Since it is the oil in the propeller cylinder that holds the blades at low pitch and prevents the pull of centrifugal force on the counterweights from rotating them to high pitch, it is apparent that they will move toward high pitch, low engine rpm, as soon as the oil is released. The hydraulic and centrifugal forces are such that when the revolutions are below normal, extra force is available for movement toward low pitch. When revolutions are above normal, extra force is available for movement toward high pitch.

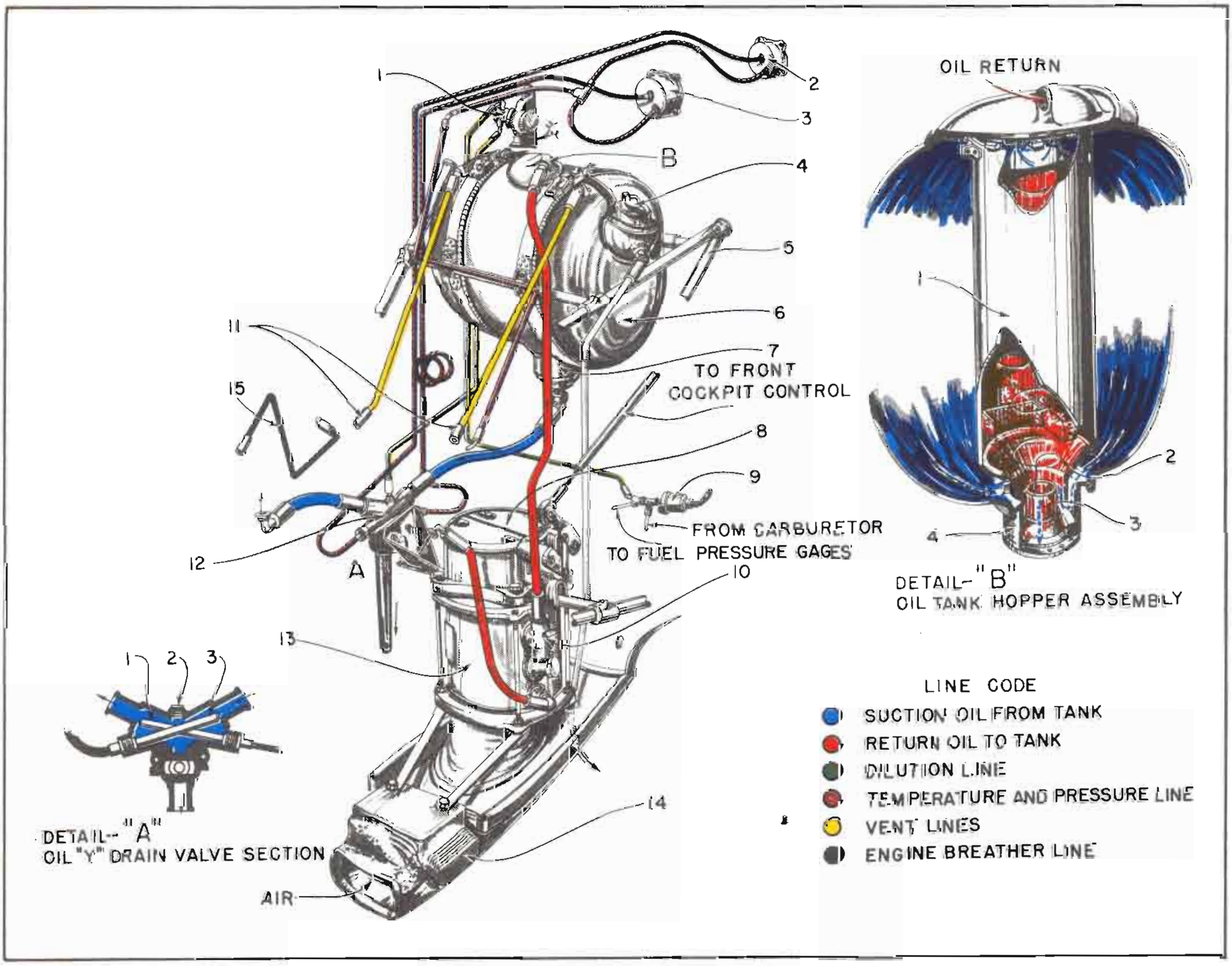


Figure 153 — Oil System Diagram

1. Oil Dilution Solenoid
2. Rear Engine Gage Unit
3. Front Engine Gage Unit
4. Tank Filler Cap and Adapter
5. Engine Mount Assembly
6. Oil Tank Assembly
7. Oil Tank Sump
8. Oil Cooler Shutter
9. Fuel Pressure Type Signal
10. Thermostat Relief Valve
11. Vent Line Attaching Elbow
12. Oil "Y" Drain Valve
13. Oil Cooler
14. Oil Cooler Duct
15. Engine Breather Line

DETAIL A—OIL "Y" DRAIN VALVE

1. Temperature Capillary Front
2. Fuel Line
3. Temperature Capillary Rear

DETAIL B—HOPPER ASSEMBLY

1. Tank Hopper Assembly
2. Support
3. Sump Standpipe
4. Sump

(2) ADJUSTMENTS.—It is important that the control system between the governor and the cockpit be adjusted to set the unit for rated rpm. In case governor adjustment has not been accomplished on a suitable test stand and it is necessary to adjust or readjust for take-off rpm, the following procedure will be adhered to: For trial setting, place the cockpit lever in the extreme rear position. Turn the pulley attached to the governor control shaft in a clockwise direction until the rack bottoms in the head. Connect control rod extending from the cockpit control lever to the pulley attached to the governor shaft. Start engine and operate on ground until desired take-off rpm is obtained, moving the governor lever in cockpit forward. If necessary, shift the position of the stop screw on the governor head to permit sufficient travel of the control. Stop engine, exercising care to insure that the setting of the governor lever in the cockpit is not disturbed. Adjust stop screw on governor head until it bottoms against pulley stop. Make flight test to insure that the governor is adjusted properly. If during flight the rated rpm cannot be obtained, or if excessive rpm is encountered, readjustment of the controls is necessary. Make a trial flight, adjusting cockpit control lever until rated rpm is obtained, marking the quadrant at this position. After landing and stopping the engine, adjust cockpit control lever to marking on the quadrant and reset governor stop. After the proper adjustment of the governor stop is obtained, rig the controls so that the cockpit lever is 1/8 inch from its extreme forward position when the governor is in the maximum rpm position.

CAUTION

If difficulty is experienced in obtaining take-off rpm with the airplane stationary on the ground, care must be taken not to adjust the governor when the cause of difficulty is lack of engine power, improper blade angle setting, etc. Adjustment of the governor under these conditions will not increase the rpm and may lead to overspeeding in flight. If take-off rpm is not obtained at take-off manifold pressure, check

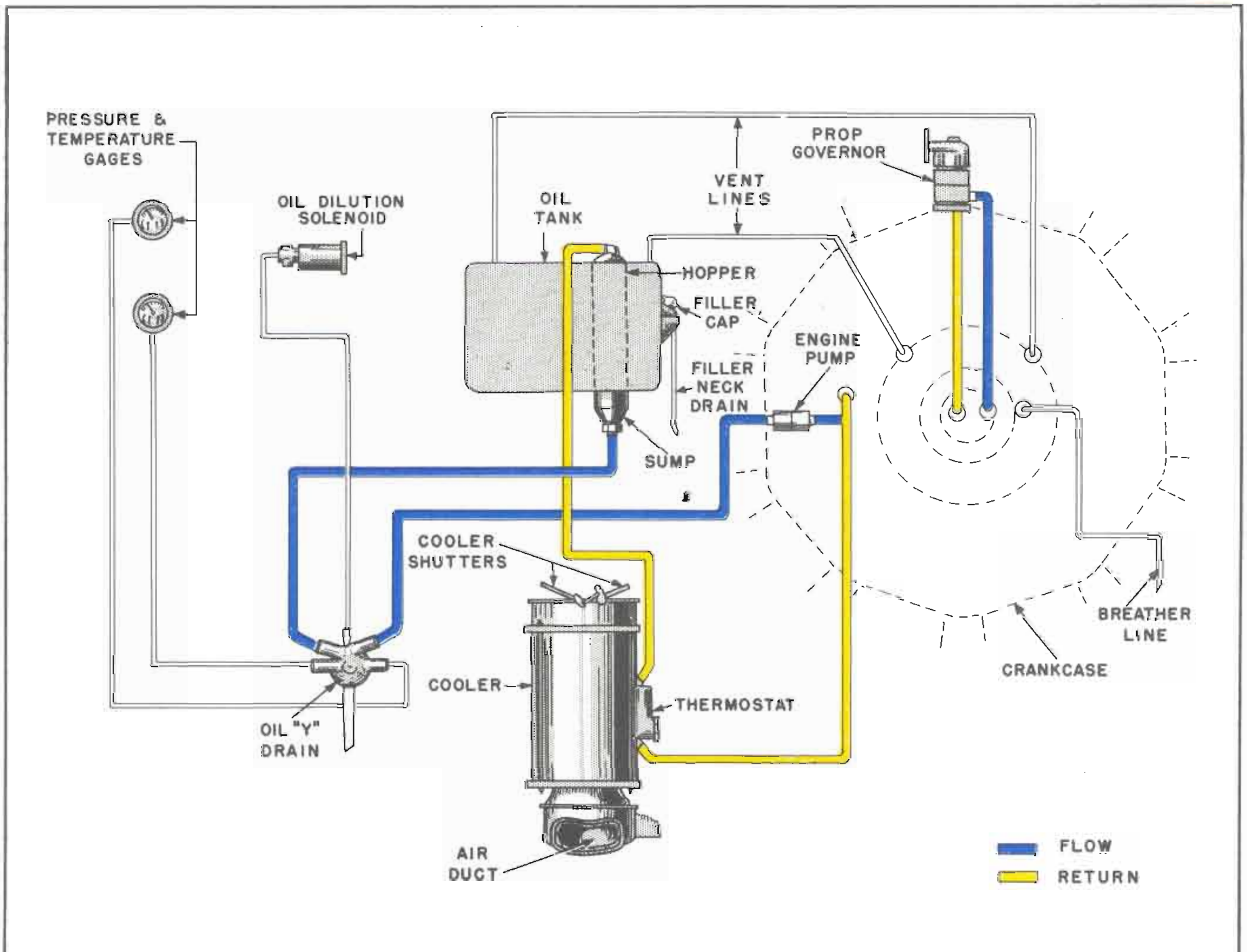


Figure 154 — Oil System Flow Diagram

by reducing manifold pressure slightly. If the rpm remains constant, the governor is controlling the propeller, but is set incorrectly. If, however, the rpm drops when the manifold pressure is reduced with the propeller blades in the extreme high rpm (low pitch) position, then the speed is not being controlled by the governor. Check the minimum blade angle, and check the engine for any defect causing loss of power.

8. OIL SYSTEM.

a. GENERAL.—*(See figures 153 and 154.)*—The oil system consists of an oil tank, and oil cooler, an engine-driven oil pump, an oil Y-drain valve, pressure and temperature indicators, and the necessary piping to carry the oil to and from the engine. The oil in the system flows from the bottom of the oil tank to the engine pressure pump. After circulating through the engine, the engine scavenger pump forces the oil back to the tank, either directly or through the oil temperature regulator, depending upon its temperature. The return flow of the oil to the tank is determined by a thermostatically controlled bypass valve at the oil temperature regulator. Oil system lines, including oil pressure lines, are identified with a *bright yellow band* about 3/4 inch wide. (Refer to section III, paragraph 3 for servicing instructions.)

b. OIL TANK.

(1) DESCRIPTION.—*(See figure 155.)*—The oil tank consists of front and rear halves of formed aluminum sheet welded together. A cylindrical hopper, providing accelerated warming of the oil, is installed in the tank and has a capacity of approximately 1.5 U.S. (1.2 Imperial) gallons. A sump and standpipe are located at the bottom of the hopper to which is attached the oil line going to the engine attachment. Access to the bottom of the hopper is gained by removing the oil line and eight nuts securing the standpipe to the sump. When reinstalling the standpipe, seal the gasket with sealing compound, AAF Specification No. 3597. The oil tank has a service capacity of 10.2 U.S. (8.5 Imperial) gallons, plus a foaming space of 2 U.S. (1.7 Imperial) gallons.

NOTE

AT-6 airplanes have a normal tank capacity of 10.8 U.S. (9 Imperial) gallons, with an overload total capacity of 15.5 U.S. (12.9 Imperial) gallons. A cock on the left side of the tank indicates the oil level of the normal capacity.

(2) REMOVAL.—Drain oil by opening the Y-drain valve on the lower right side of the engine compartment. Disconnect all bonding ribbons and the filler neck drain line. Disconnect the drain cock line at the bottom of the tank sump. Disconnect the oil return line and the oil tank vent line at the top of the oil tank. Remove the two tank bonding braids. Unhinge the upper

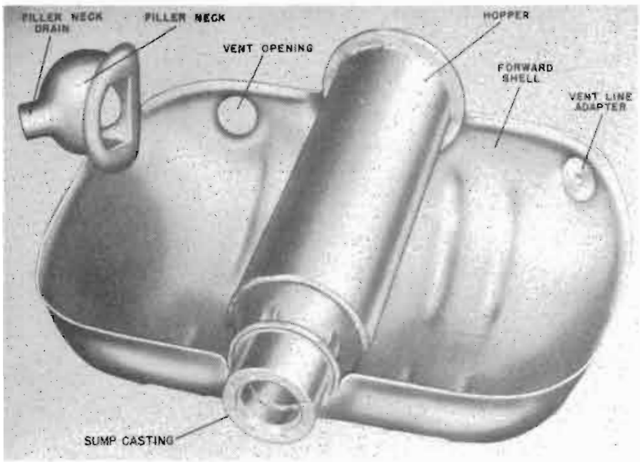
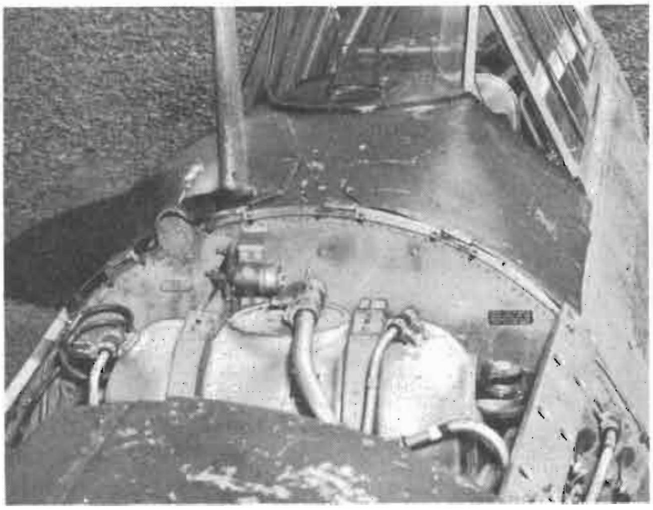


Figure 155 — Oil Tank



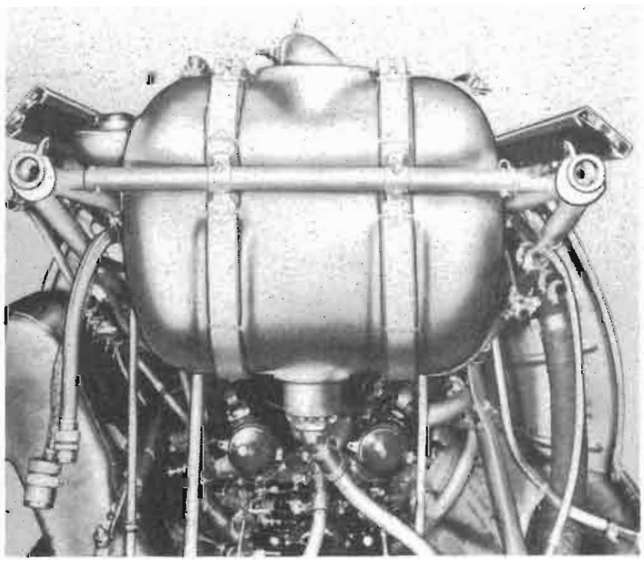


Figure 156 — Oil Tank Installation — Top and Bottom

straps over the top of the tank, and disconnect turnbuckles. Unfasten the ends of the upper and lower straps from fittings on the cross tubes, and lift out the tank.

(3) CLEANING.

CAUTION

Tanks removed from the airplane will be grounded at all times while work is progressing.

(a) Flush the tank with hot water, admitted at the bottom of the tank and allowed to overflow at the top, until all deposits of oil adhering to the inside surfaces are removed.

(b) Mount the tank so that an opening is available at the top and one at the bottom at the lowest point of the tank. Clean the tank with live steam. Feed the live steam in at the top opening; allow it to escape through the bottom opening. All other openings are to be closed. Pass the steam through the tank for at least 1 hour.

NOTE

When the exterior of the tank is to be cleaned with paint remover or other combustible solvents, do so before cleaning or steaming the interior.

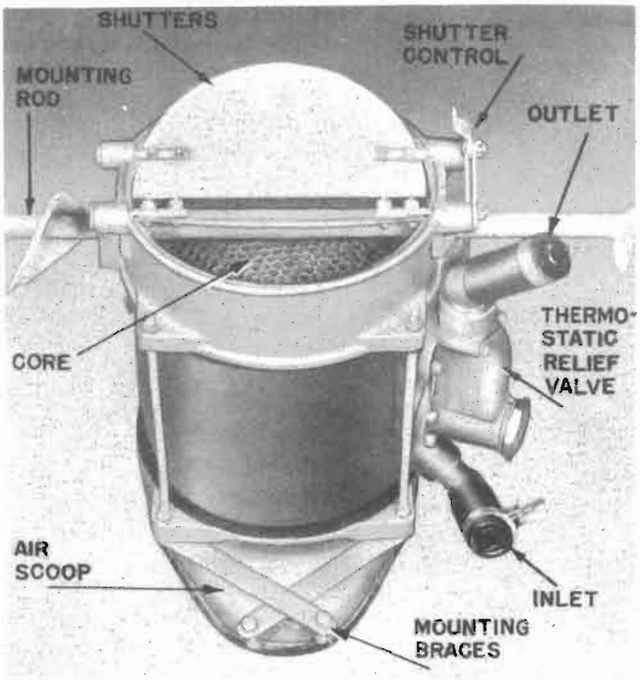
(4) REPAIR.

(a) No repairs requiring the application of heat will be accomplished on oil tanks while they are installed. Remove the tank and ground it.

(b) Clean the tank; repair as soon as possible after cleaning.

(c) Repairs consist of smoothing out small dents, sealing small cracks, welding split seams, and welding inserts into small holes or large cracks. All dented areas should be restored to the original contour of the tank shell. This may be accomplished by using a leather mallet and striking the dented area from the inside. Minor cracks may be repaired by sealing with a sealing compound, AAF Specification No. 3597. Press the mixture into the cracks with the fingers or thumb. Fillet out well to a feather edge; remove all excess cement. The tank may be used immediately after repair. (Refer to paragraph 9. *a.* (4) for further information.)

(5) INSTALLATION.—The oil tank is mounted by means of padded metal straps to the two upper cross tubes attached to the engine mount structure. The strap padding consists of soft felt, covered by mercerized cotton cloth dipped in varnish, with the excess removed. The padding may be cemented to the straps for easier handling at assembly and must be secured to the straps with waxed linen cord wrappings at intervals of approximately 6 inches. Secure the ends of the upper and lower straps to fittings on the cross tubes and position the oil tank on the lower straps with the filler cap on the left side. Hinge the upper straps over the top of the tank, and connect turnbuckles. When proper alignment of the straps is obtained, tighten the turnbuckles and safety with wire. Attach the two tank bonding braids. Connect the oil return and the oil tank vent line to the top of the oil tank. Connect tank to the



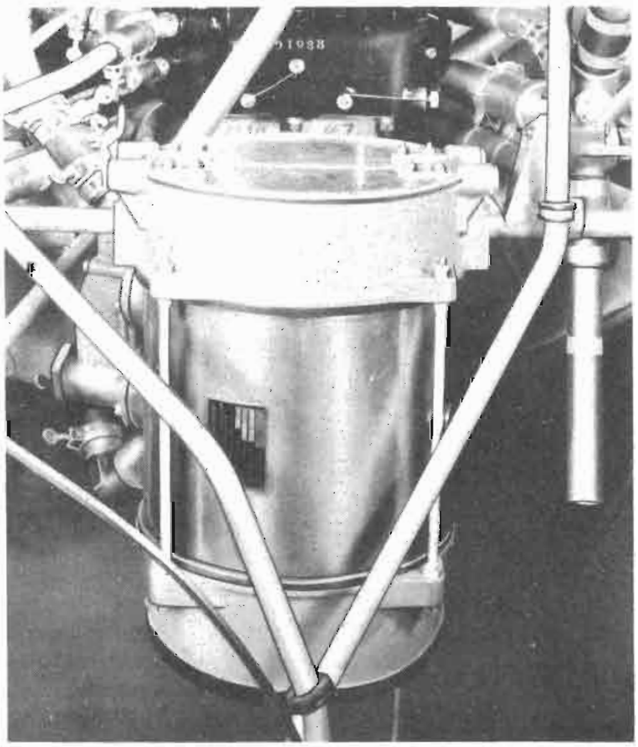


Figure 157 — Oil Temperature Regulator — Top and Bottom

drain cock line at the bottom of the tank sump. Install filler neck drain line. Use suitable rubber hose connections and clamps in making the above oil line connections. Make certain all bonding ribbons are wrapped around rubber between clamps, wherever bonding is required.

c. OIL TEMPERATURE REGULATOR.

(1) DESCRIPTION.—*(See figure 157.)*—An 8-inch diameter vertical temperature regulator, type C-5, is supported at the bottom of the engine mount structure. Cooling air is provided by means of a scoop forming the lower portion of the engine compartment cowling and fitted at the bottom of the regulator. Automatic temperature control depends on a thermostatic relief valve, type D-5, which allows the oil, when cold, to pass through the outside jacket, and, when hot, to flow through the radiator. A plug is provided for drainage when the unit is removed from the airplane. Shutters are provided on the top side of the oil temperature regulator with a ratchet-type control located in the front cockpit, below the switch panel, just forward of the control stick. The shutters may be opened, closed, or set in various intermediate positions to regulate the flow of air through the oil temperature regulator radiator.

(2) REMOVAL.—Detach all bonding ribbons and remove the engine-to-regulator and regulator-to-tank oil lines. Disconnect the two aluminum straps extending from the regulator to the carburetor mixing chamber, remove the two attaching bolts, and remove the regulator.

(3) CLEANING.

(a) Clean the oil temperature regulator at each normal engine change or before making any solder repairs.

NOTE

When the engine is changed due to an internal failure which releases metal particles into the oil system, *the oil temperature regulator must be rebuilt.* In such a case, remove the regulator, tag with AAF Form No. 50 marked "Metal-Rebuild," and forward it to the control depot.

(b) Prepare a cleaning solution from the following items:

Oleic acid, stock No. 8500-050000
7 parts by volume.
Triethanolamine, stock No. 8500-407600
3 parts by volume
Aromatic naphtha, stock No. 8500-617700
90 parts by volume

CAUTION

This fluid is highly inflammable.

(c) Fill the regulator three-quarters full of the cleaning solution and close all openings. Shake and rotate the regulator vigorously for 4 minutes and then drain. Perform this operation two additional times, using a fresh cleaning solution each time. Drain the regulator and apply a compressed air blast for at least 15 minutes to dry it out for testing. Test the regulator for leaks at 100 pounds pressure while submerged in warm water.

(4) REPAIR.

NOTE

Repair of oil temperature regulators is an operation requiring trained personnel, and permanent or major repairs will be made only by depots or depot groups. Exercise care to prevent mechanical damage to any equipment.

(a) Individual leaky tubes, up to 3 percent of the total number of tubes, may be repaired by plugging their ends with loosely packed copper wire and solder, Federal Specification No. QQ-S-571. Make sure soldering is thorough.

(b) If over 3 percent of the tubes are defective, the core should be replaced. If no core replacements are available, individual tubes may be replaced as follows.

1. Use two special soldering irons, AC Drawing 076707. Insert the tip of one heated iron in each end of the tube to be removed. (Corresponding tube ends can be identified by pushing a wire through the tube.) Push on the tube with one iron; and, while holding the other iron in place, apply a slight twisting motion to both irons. If the irons are hot enough, the tube will break loose and may be pulled out through the core with a pair of pliers. Be careful not to deform the ends of the adjacent tubes.

2. Flux each end of the replacement tube, and tin it with soft solder on the hexagon ends only.

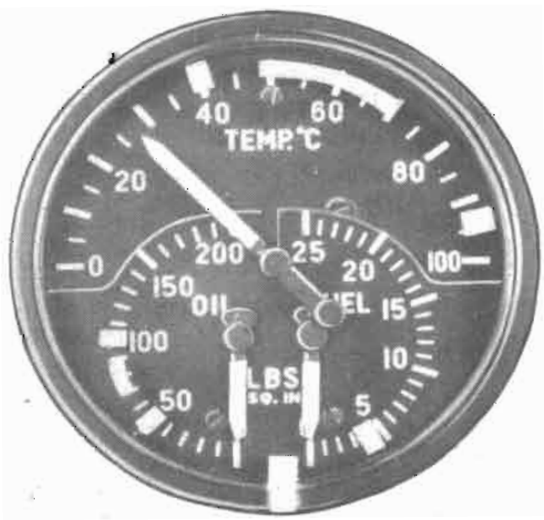


Figure 158 — Oil Pressure and Temperature Indicators

3. Install the replacement tube with a minimum of soft solder, Federal Specification No. QQ-S-571 and a standard type soldering iron. (A radiator torch may be used if extreme care is exercised not to anneal the tubes.)

4. After final testing, flush the oil temperature regulator inside and out with hot running water and then steam for ½ hour. Thoroughly dry the regulator by heating it in an oven for approximately 1 hour at 121-135°C (250-275°F) to evaporate all moisture. If

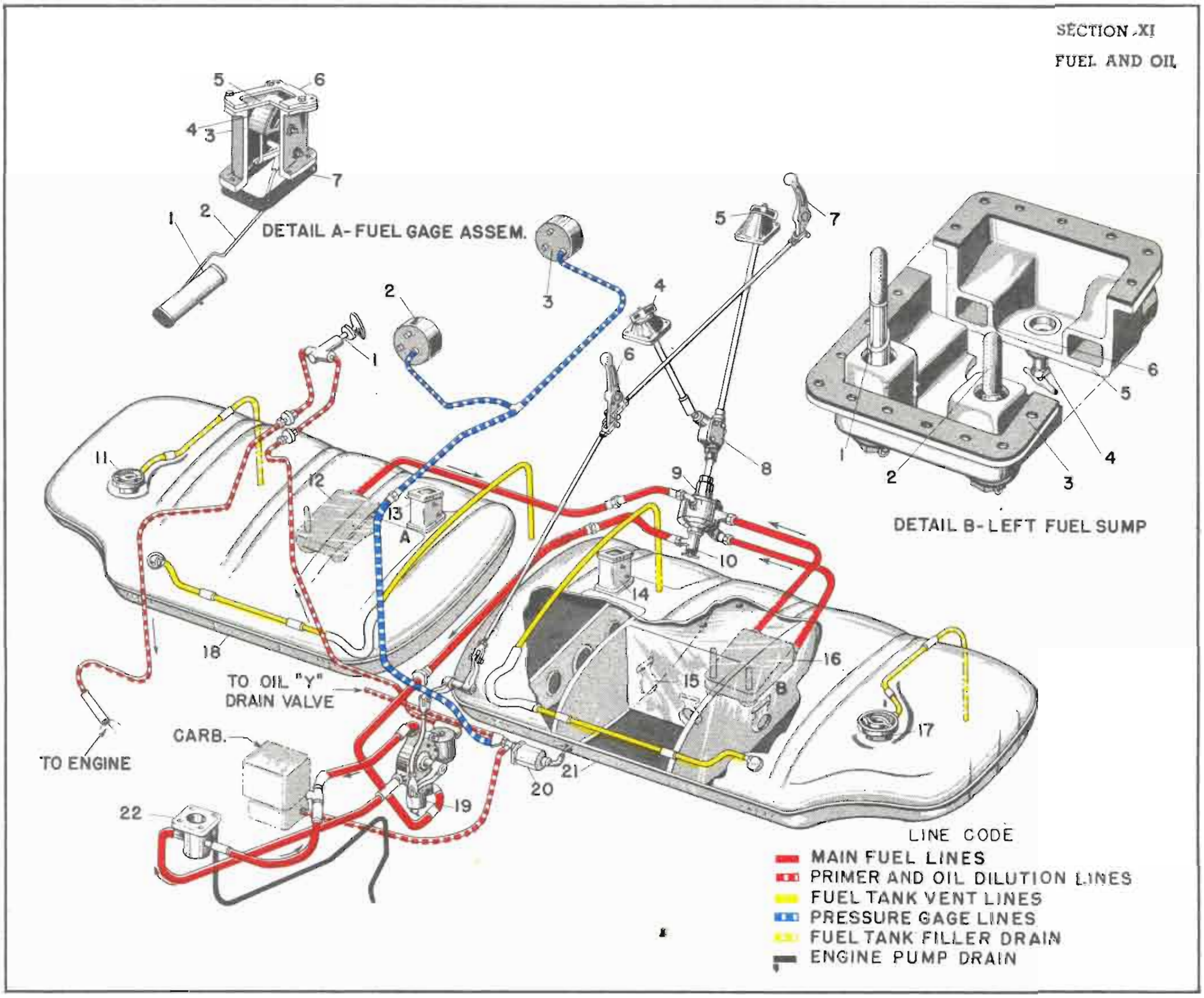


Figure 159 — Fuel System Diagram

1. Primer
2. Engine Front Gage
3. Engine Rear Gage
4. Front Fuel Selector Dial
5. Rear Fuel Selector Dial
6. Front Fuel Pump Handle
7. Rear Fuel Pump Handle
8. Selector Valve Gear
9. Fuel Selector Valve
10. Selector Valve Drain Cock
11. Right Tank Filler Cap
12. Right Fuel Tank Sump
13. Right Fuel Tank Gage Assembly
14. Left Fuel Tank Gage Assembly
15. Flapper Valve
16. Left Fuel Tank Sump
17. Left Tank Filler Cap
18. Right Fuel Tank
19. Fuel Unit
20. Fuel Pressure Signal
21. Left Fuel Tank
22. Engine-driven Pump

DETAIL A—FUEL GAGE ASSEMBLY

1. Float
2. Float Rod Assembly
3. Housing
4. Dial Assembly
5. Plexiglas
6. Retainer Plate
7. Gasket

DETAIL B—LEFT FUEL SUMP

1. Standpipe (Long)
2. Standpipe (Short-Reserve)
3. Gasket
4. Drain Cock
5. Reserve Outlet
6. Outlet

an oven is not available, immerse regulator in a tank of clean, light, neutral lubricating oil, SAE 20, Federal Specification No. VV-9-496, at approximately 121°C (250°F); shake the regulator until all bubbling ceases; drain the regulator; and reinstall it in the airplane.

(5) INSTALLATION.—The oil temperature regulator assembly is supported by means of a bracket extending from the top of the regulator, and is attached to the two lower engine mount tubes with rubber hose cushioning. Insulator AC-294-30 (N. A. standard part) is required at the attachments of the oil temperature regulator to the upper bracket and the lower duct. Fit the regulator over the air intake scoop, if installed, and attach the two aluminum-alloy straps extending from the regulator to the carburetor mixing chamber. Ascertain that the edge of the regulator lower duct, lined with C-297-32-0 (N. A. standard part) extruded neoprene, fits snugly around the opening in the air intake scoop. Connect the engine to the regulator, and the regulator to the tank oil lines. Use suitable rubber hose connections and clamps; attach bonding braid, as required.

d. OIL PRESSURE AND TEMPERATURE INDICATORS.—Oil pressure and temperature indicators are included in the engine gage unit mounted on the instrument panel of each cockpit. The oil temperature indicators are actuated by thermometers, which are inserted in wells located in the oil system drain cock assembly. (For further information refer to section IV, paragraph 10.)

9. FUEL SYSTEM.

a. GENERAL.—*(See figures 159 and 160.)*—The fuel system consists of two removable tanks,* housed within the center section structure, a type F-10 engine-driven fuel pump mounted on the engine accessory housing, a fuel unit (combination hand pump and strainer) on the forward side of the fire wall with a fuel cock at the bottom of the fuel unit, and a fuel selector valve. Two float-type fuel quantity gages, a fuel pressure signal, a carburetor mixture temperature indicator, engine priming and oil dilution systems, and the necessary piping, fittings, controls, etc., are provided. Fuel is inducted into the engine from either the left or right tank by means of the fuel tank selector valve, through the combination fuel unit to the engine-driven pump and into the carburetor. In the event that the engine-driven fuel pump fails, fuel is supplied to the carburetor by the fuel unit, with pressure being applied by the hand pump. Fuel system lines are identified by a *red* band.

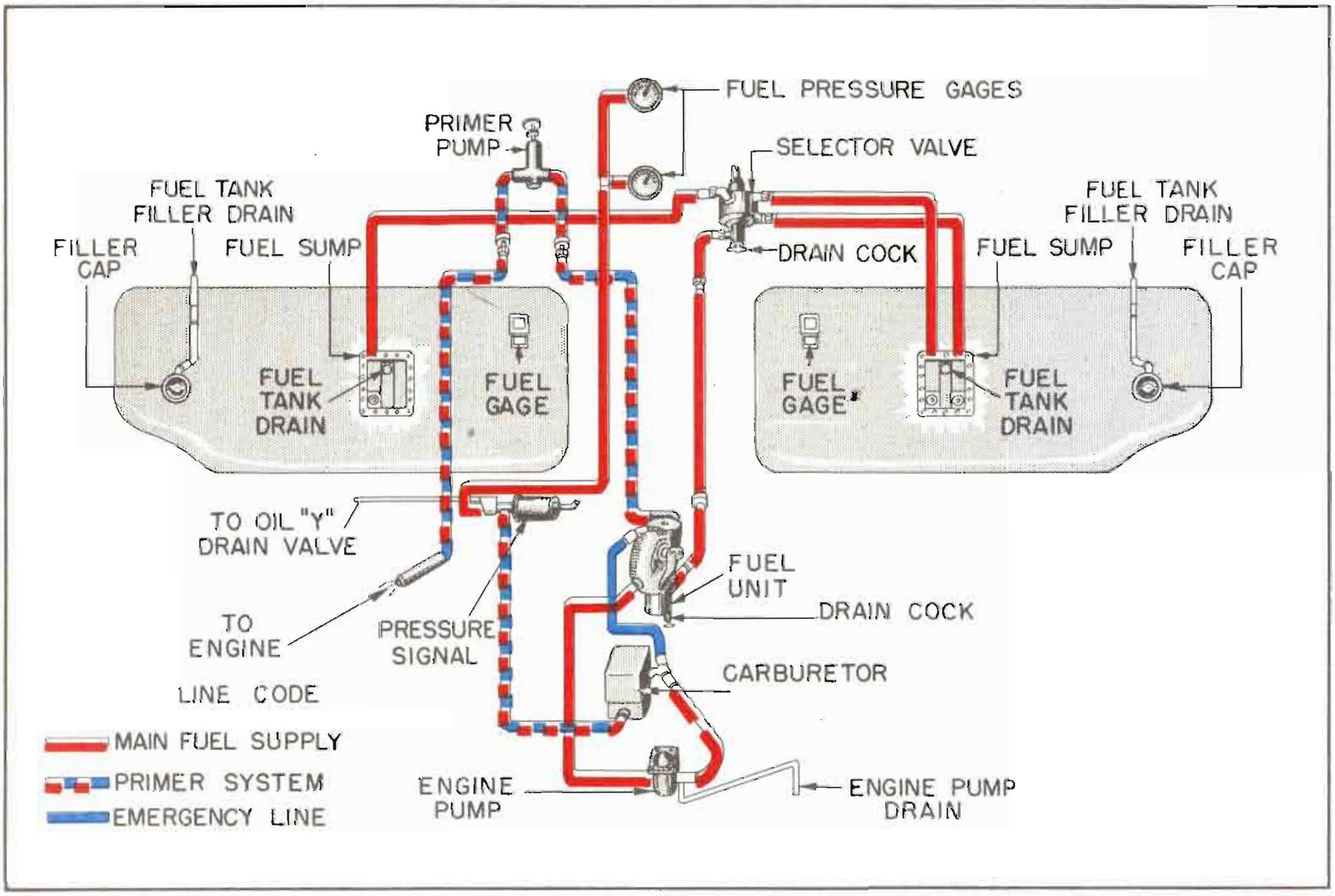


Figure 160 — Fuel System Flow Diagram

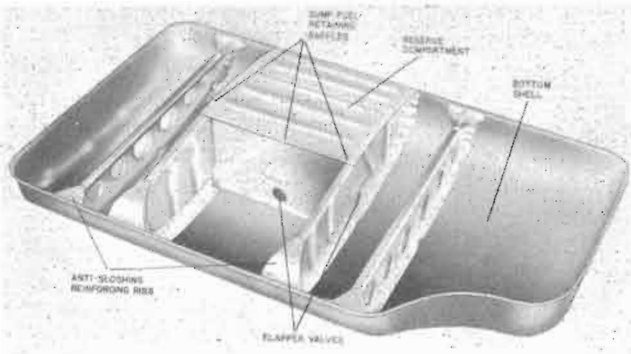


Figure 161 — Fuel Tank

***NOTE**

In the AT-6 only, there are two fixed fuel compartments as integral parts of the wing structure. Each compartment has a capacity of 89 U.S. (74 Imperial) gallons. A standpipe provides a reserve of 20 U.S. (16.7 Imperial) gallons of the total capacity.

b. REMOVABLE FUEL TANKS.

(1) DESCRIPTION. — The two pressed sheet aluminum fuel tanks, constructed of a top section and a bottom section which are welded together, are installed between the front and rear spars in the center section structure and are not interconnected. Each tank has a total capacity of 55.2 U.S. (46 Imperial) gallons. An extended standpipe has been provided in the left tank which prevents taking fuel from below the level of its top, thus creating a reserve supply. Access to the fuel tanks for draining and inspection purposes is gained through several access doors on the lower surface of the center section. The fuel tank sumps located on the bottom side of the tank have incorporated in them the main fuel outlets to the engine and the reserve supply outlet. The sumps are equipped with anti-corrosion capsules. The standpipes are covered with screens for the purpose of filtering the fuel as it is taken from the tank. A drain cock is located in the bottom of each sump for draining the fuel tanks. A chamber located around the tank sump is equipped with flapper valves which allow fuel to enter the sump compartment, but restrict it from leaving, thereby preventing exposure of the fuel outlets when the airplane is maneuvering.

(2) REMOVAL.—Drain the fuel system. (Refer to section III, paragraph 3.) Place padded supports under the outer wing panel tips prior to removing the fuel tank doors. These supports should remain under the tips until the fuel tank doors are reinstalled. *Do not* rock the airplane. Remove the fuel tank doors on the lower surface of the wing by first removing the bolts securing the door attaching angles to the outer wing panel attaching angles. Access to the bolts is provided by removing the bolting angle cover. Then remove the screws and bolts securing the doors to the center section spars and the bulkhead. Remove the cover plate from the upper surface of the center section above each tank to be removed, and disconnect the fuel tank vent lines. Remove the light assembly from the fuel gage and the cover plates located around the gage. Disconnect the fuel tank bonding braids. Remove the fuel lines at the sump. Unscrew the tank strap turnbuckles and remove the tanks, using one man to support the tank and another to guide the fuel gage through the upper surface of the center section. In preparation for storing the tanks, *do not* seal them as the air inside has a tendency to expand or contract under changing atmospheric conditions, resulting in possible warping of the tank. Vent the tanks for storage by plugging the holes for the vent lines with a soft wooden plug; drill a small hole through the plug. The fibers of the soft wood will prevent dirt from entering through the drilled hole.

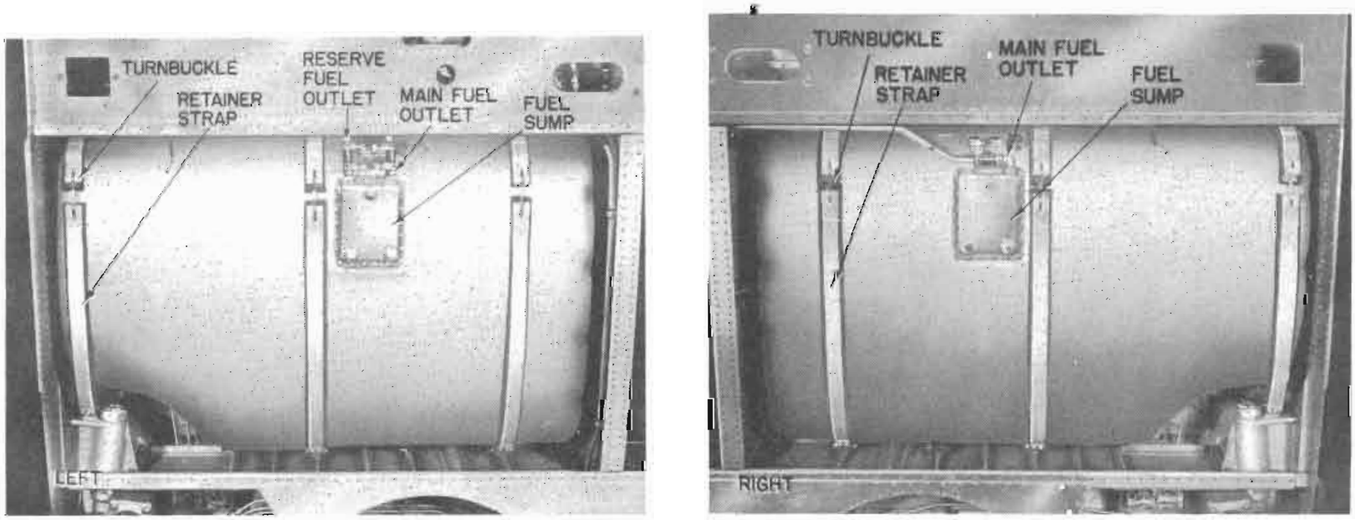


Figure 162 — Fuel Tanks Installed — Left and Right

WARNING

If the tank is to be pressure-tested in excess of 1 pound per square inch, it must be supported in a manner similar to the support provided in the airplane.

(3) CLEANING.

CAUTION

No work requiring the application of heat is permissible while tanks are installed. Tanks removed from the airplane will be carefully grounded and kept grounded until the work is completed.

(a) Flush the tank with hot water, admitted at the bottom and allowed to overflow from the top. Continue this flushing until there is no trace of fuel adhering to the inside surfaces of the tank.

(b) If live steam is available, force the steam through the tank for a minimum period of 3 hours. Mount the tank so that there is but one opening at the top and one at the bottom, at the lowest point of the tank. Seal all other openings.

(4) REPAIRS.

(a) (See figure 163.) Repairs of the fuel tanks will consist primarily of smoothing out small dents, sealing minute cracks, welding split seams, and welding inserts into small holes or large cracks. Prior to welding or applying an open flame of any kind, steam the inside of the tank thoroughly for at least three hours, or carefully flush with fire extinguisher fluid (carbon tetrachloride). Before welding the fuel tank areas located between the outermost baffles, remove the synthetic rubber flapper valves within the central chamber. These valves are subject to distortion when in the proximity of heat. Access to the valves may be gained by removing the fuel sump. Locating minor seepage or vapor leaks in the fuel and oil tanks may be ascertained by an air pressure test. The fuel and oil tanks may be tested for leaks as outlined in removal instructions. It is imperative that the tanks be supported

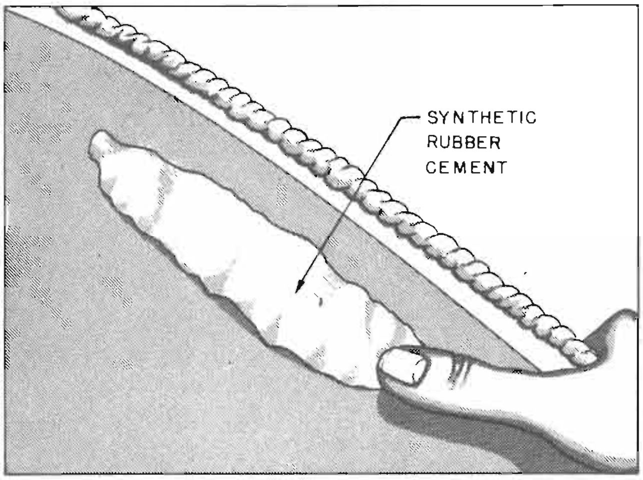


Figure 163 — a. Sealing Small Cracks

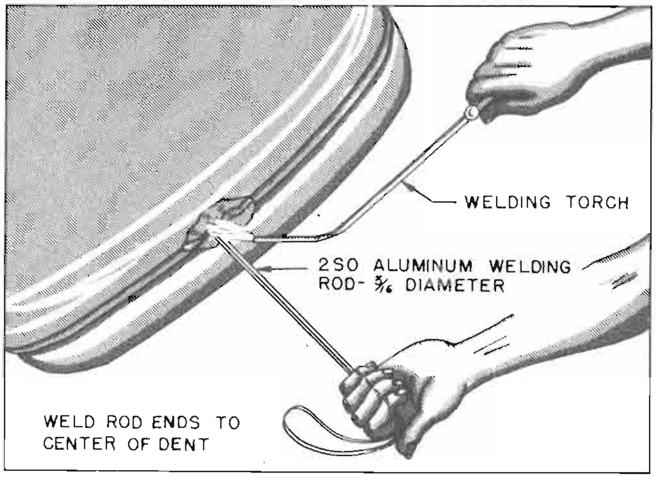


Figure 163 — c. Removing Dents

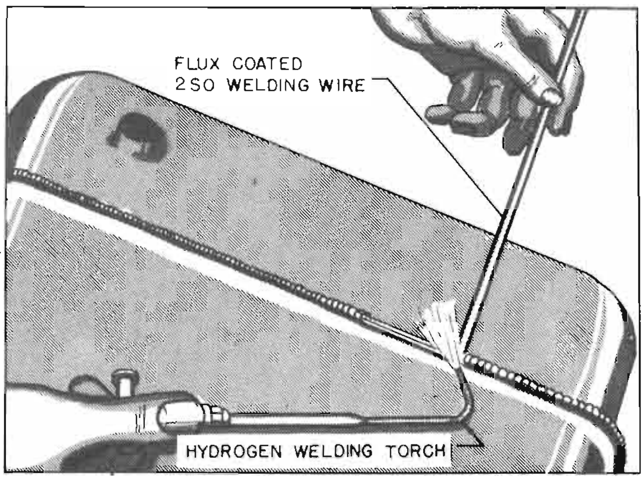


Figure 163 — b. Welding Split Seams

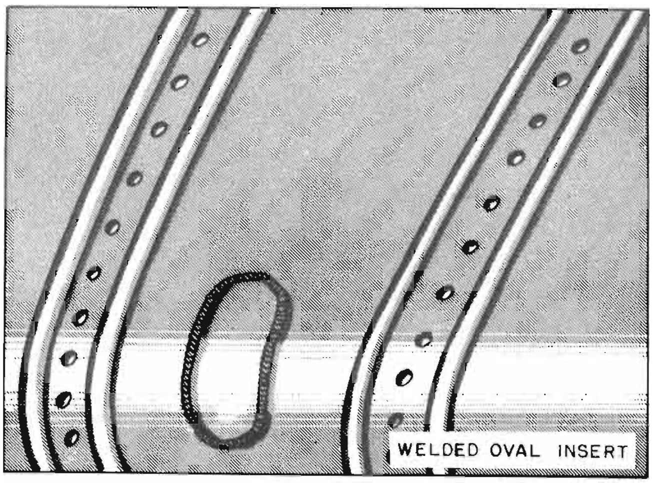


Figure 163 — d. Welding Inserts

in a manner similar to the installation of the airplane for pressure test.

(b) To seal small cracks, use a sealing compound AAF Specification No. 3596, or an equivalent water and gasoline resisting cement. It is supplied in paste form and can be easily applied by pressing it into the cracks with the fingers, and removing the excess from the surface. The tank may be used immediately after repair. This type of repair will last a considerable length of time; but if the crack has a tendency to enlarge, it is advisable to replace the synthetic compound by means of a welded insertion-type patch as soon as possible.

(c) Dented areas in a tank should be restored to the original contour of the tank shell. This may be accomplished by using a leather mallet and striking the dented area from the inside. This method may be used only when it is possible to gain access to the interior of the tank. Dents may sometimes be pulled back into shape by welding a 2SO welding wire to the lowest point of the dent and exerting a steady pull on the wire while applying a torch flame evenly over the dented area. Leaks at the seams may be remedied by fusing the cracks together with a welding torch and flux-coated welding wire. Holes and large cracks that can be rounded into holes may be repaired by welding a square, circular, or an overlaid insert into the flanged opening.

(d) PRESSURE-TEST THE TANKS.—Stop up the vent lines and filler necks with rubber expanding plugs and connect an air line, with a manometer or other sensitive pressure gage, to the fuel-tight tank at the sump. Interconnect the two tanks and raise to 3 pounds per square inch. If a drop on the manometer is as much as 3/32 inch (1/20 pounds per square inch) occurs over a period of 15 minutes, test the tanks separately to determine which tank is leaking. Apply liquid soap with glycerin added, along the seams and joints to aid in locating leaks. Remove the circular clip and retainer from the top of each corrosion-resistant cartridge drain plug at the sump, and refill with chemically pure potassium chromate crystals (No. 4 to 12 mesh size). The crystals should be free of all powder and should not pass through the holes in the cartridge. Care should be exercised in handling the plugs so as not to crack the crystals.

WARNING

Do not subject the tanks to air pressure unless supported in the airplane by a tank receiver and straps, or in a jig duplicating the same support.

(5) INSTALLATION.—To install a fuel tank, adhere to the following procedure:

(a) Ascertain that the fuel tank pads are properly cemented to the tank's former ribs and tank straps. Use du Pont "Cavalprene" cement or the equivalent for this purpose.

(b) Make certain that the sections of the fuel tank vent line are properly installed in the tank bay with the necessary rubber hose guards.

(c) See that the overflow line is connected to the tank filler neck flange and is spaced from the tank by means of two rubber hose guards. Position the "Noc-Out" clamps so that they will not chafe the tank or the wing structure. Tighten securely by hand only. Tubing, at each end of all rubber hose guards should be wrapped with friction tape and shellacked over tape. Also, wrap the line-to-neck attachment and shellac.

(d) See that bonding braids are properly bonded to the lugs on the tank and that the rubber ring is secured to the filler neck casting with cement.

(e) Check the fuel gage readings in level and inverted tank positions for empty and full positions. When properly installed, approximately 1/2-inch clearance will be present between the float rod and the tank baffle.

(f) Raise the tank into the bay, having a man positioned to guide the gage through the center section opening.

(g) Connect the tank straps, but do not tighten.

(h) Connect the tank vent line.

(i) Ascertain that tank filler neck is centrally located and that tank straps are positioned in the tank grooves.

(j) Tighten the tank straps by means of turnbuckles. It is exceedingly important that the straps be tightened the correct amount, as excess tightening may damage the tank and any looseness may cause the tank to shift. Straps are properly tightened when they can be moved with force into the tank groove.

(k) Safety the strap turnbuckles and connect the bonding braids.

(l) Clean the fuel lines and install as required, using Parker "Sealube" on the line connections.

(m) Test the tank for leaks, using 4 pounds per square inch air pressure connected to the tank sump drain cock.

(n) Install the tank doors.

(o) Install the tank gage covers, bonding, and lights.

c. FIXED TYPE TANKS (AT-6 ONLY)

(1) CLEANING.—Flush the tank with hot water, admitted at the bottom and allowed to overflow from the top. Continue this flushing until there is no trace of fuel adhering to the inside surfaces of the tank.

CAUTION

Precautions must be taken to protect the wing and accessories from the overflow.

(2) SEALING.

(a) In the repair and replacement of parts of the fuel compartments, all seams should be joined and seals should be covered with AAF 3596 sealing compound, and AAF 3595 slushing compound. AAF 3596 may be applied by hand and AAF 3595, by applicator (paint pressure pot type) or stiff brush. Apply com-

pound to interior of compartments only; faying surface coats *must* be uniform with no overlapping coats. In general, leaks occurring from crevices, gaps, slots, etc., can be stopped by use of AAF 3596 compound, and AAF 3595 compound shall be used only on faying surfaces; i.e., only when fittings or parts have been removed and require recoating prior to reassembling. AAF 3596 should be used on compartment interior to completely cover heads of all through bolts and nuts of elastic stop nut plates on seals; also plates, castings, and fuselage attaching bolts. Edges of compound must be spread out to give a "feather" edge all around; approximate thickness of compound applied should be 1/8 inch minimum to 1/2 inch. The compartment may then be filled with fuel immediately as no drying time is necessary.

(b) TW1063 wash thinner or equivalent should be used in cleaning seams, backing plates, and faying surfaces prior to applying zinc chromate compounds. Avoid excessive handling of parts after cleaning. Ethyl acetate may be used in removing excess zinc chromate compounds in areas ISOLATED from seams and retainers. Remove excess compound.

CAUTION

A natural solvent, ethyl acetate must not be allowed to stand in contact with zinc chromate. Massage hands after using cleaning solvents with Pro-Tek, (a protective cream manufactured by the DuPont Co., or equivalent).

(c) All components of the sealed structure must be fitted and drilled to size and then disassembled and cleaned of chips. The methods of repairing parts of fuel compartments are as follows:

1. Skin laps and angles, flanges to plate, skin or web and all fittings. Slight leaks can be repaired by wiping-in and leaving a small fillet of AAF 3596 compound, and excessively large leaks will require removal of angles, etc., and coating of seam components with AAF 3595 compound. Allow to dry at least 1 hour before reassembly. Cover plates and/or rivets and seam around through fittings with AAF 3596 compound.

NOTE

Do not apply compound to nuts and bolts in compartment interior at access doors, sump casting, or drain flange.

2. Backing plate seals. Permanently remove any metal retainers present at leak, and replace with backing plates where necessary. Before attaching backing plates, clean all members with TW1063 or equivalent wash thinner. Reassemble, using AAF 3595 compound on all faying surfaces, and then AAF 3596 where necessary.

3. Through-bolts. Remove bolts, thoroughly clean with ethyl acetate, apply AAF 3596 compound to countersunk recesses, and reassemble.

4. Gaskets. Coat both sides of all vellumoid gaskets with AAF 3595 compound and allow to dry 1 hour before reassembly. Dip bolts in AAF 3595 compound on assembly. Assemble fuselage attaching forgings and sump fairing attaching brackets, using AAF 3596 compound as gaskets.

(3) TESTING.—Stop off vent lines and filler necks with rubber expanding plugs, and connect manometer and air line through control valve to fuel-tight compartment. Interconnect the two compartments. Special access doors must be made for attaching test lines to compartments. Test compartments when interconnected; then test one separately at a minimum pressure of 3 pounds/square inch, all tests lasting for a duration of 15 minutes.

WARNING

Do not apply more than 3 pounds/square inch pressure.

If only single compartment test fails or when high "leg" of mercury in manometer drops more than 3/32-inch, remove access doors and reseal center bulkhead. If leakage occurs when compartments are interconnected, adjust air control valve to 2 pounds/square inch and check the following in the order given. Use liquid soap, with glycerin added, to detect leaks.

(a) Drain plugs
(b) Fuel lines
(c) Vent lines
(d) Filler neck cap
(e) Access doors
(f) Tube seals
(g) Corner and stringer seals
(h) Seams
(i) Rivets, bolts, screws

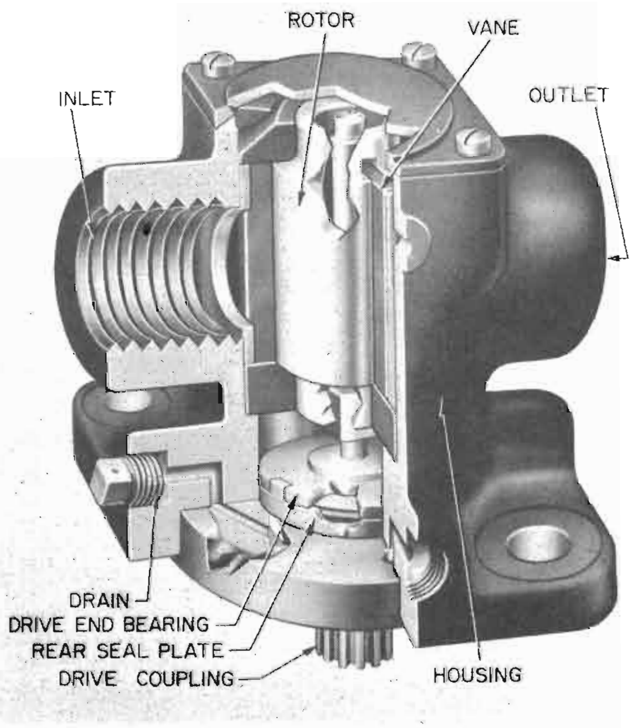


Figure 164 — Engine Fuel Pump

After leak has been repaired, apply test pressure of 3 pounds per square inch once more.

d. ENGINE-DRIVEN FUEL PUMP.

(1) DESCRIPTION.—*(See figure 164.)*—The engine-driven fuel pump, type F-10, is of the rotary positive displacement type. The pump consists of an aluminum housing in which a rotor with four vanes is driven by means of a drive shaft incorporating a spline gear mating with a gear on the accessory drive section of the engine housing. The fuel pump is located on the lower left side of the accessory section to the left of the carburetor. The pump incorporates a bypass relief valve that maintains a uniform discharge pressure during the varying pump speeds or when using a hand pump, by allowing the fuel to flow from the inlet to the outlet side of the fuel pump.

(2) MAINTENANCE.—In case of difficulty with the relief or bypass valve, remove the valve housing and inspect for foreign matter which may have lodged under the valve. Wash the housing carefully in a suitable cleaning fluid before replacing it. Also, check to see that there is no stoppage in the vent line.

(3) INSTALLATION. — Before mounting the pump on the engine, note carefully the direction of rotation of the drive gear. Place the gasket in position over the mounting studs, and mount the pump in position for the necessary connections. Take care to tighten the mounting nuts evenly; see that they are properly safetied. Connect intake and discharge lines to the proper pump ports. The discharge port for either direction of rotation is designated by arrows on the name plate fastened to the end of the body. Connections must be tightened carefully, and all tubing must be properly supported. Connect drain line to the drain hole provided in the pump body next to the mounting plate. This line is to carry away the slight amount of fuel that may work past the seal. See that the relief valve housing is mounted on the body with the intake side next to the pump intake port, as indicated on the instruction plate secured to the valve housing. If it is necessary to change the position of the valve housing, remove the four housing screws. When replacing these screws, tighten them evenly and carefully. See that they are properly safetied.

(4) LUBRICATION.—When the engine-driven fuel pump is first installed, the seal chamber of the pump should be half filled with grease, Specification No. VV-G-681, medium grade. Grease may be applied through zerk fitting in one of the 1/8-inch pipe tapped connections next to the mounting pad.

e. FUEL UNIT.—The type D-3 fuel unit is installed on the lower forward side of the fire wall. This unit

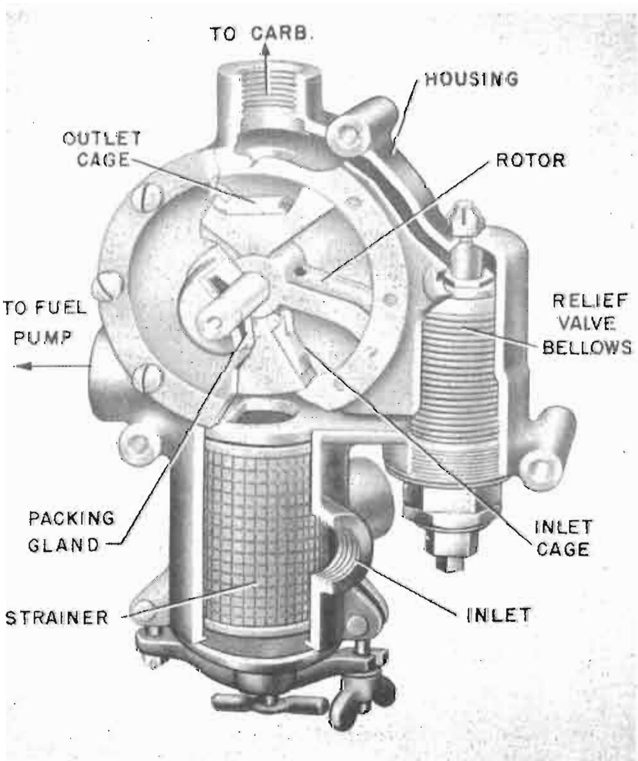


Figure 165 — Fuel Unit

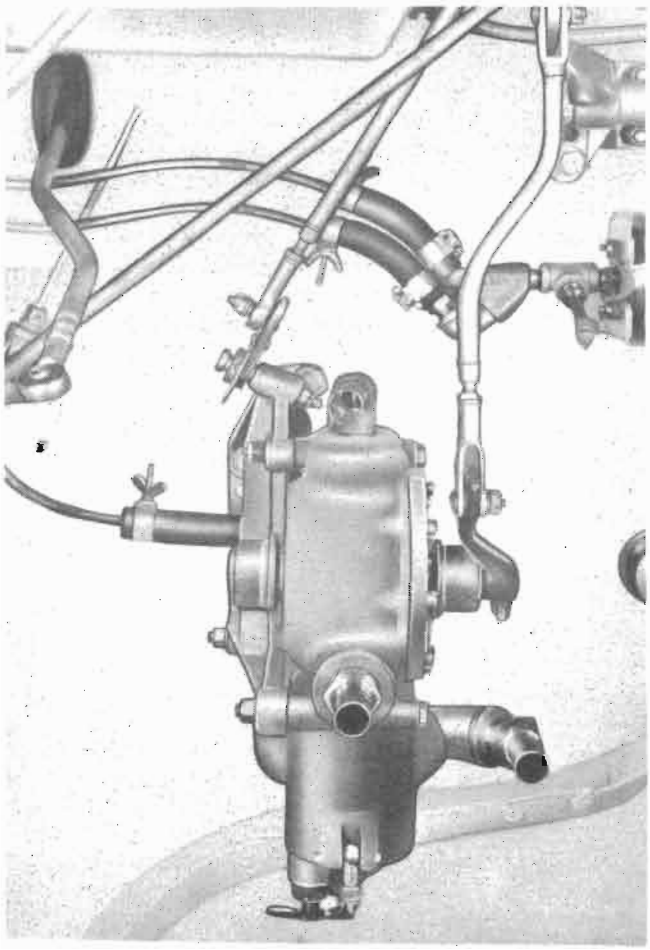


Figure 166 — Fuel Unit Installed

combines a hand fuel pump and fuel strainer with sump and drain cock, a fuel pressure relief valve, and a fuel check valve in one housing. The housing has three mounting posts, and pressure and primer connections are provided.

(1) RELIEF VALVE.

(a) DESCRIPTION.—The balanced pressure relief valve, of the bellows type, is provided with a dash pot to damp out flutter and high-frequency pulsations. Care should be taken to keep the vent hole free from obstructions.

(b) ADJUSTMENT.—The pressure relief valve on the fuel unit should be set for a discharge pressure of 4 pounds per square inch with a flow of 128 U. S. (106.6 Imperial) gallons per hour through the relief valve. If it is desired to remove the rotor from the unit, the rotor and valve cages should be removed simultaneously and reinstalled in the same manner by entering all three parts grouped together and pressing them into place by means of the cover plate, as otherwise the unit may be damaged by chafing.

(2) HAND PUMP.

(a) DESCRIPTION.—*(See figures 165 and 167.)* —The hand fuel pump being an integral part of the type D-3 fuel unit is installed on the lower forward side of the fire wall. The handle for operating the hand fuel pump is located on the control shelf at the left side of each cockpit, between the rudder and elevator trim tab control wheels. The control levers are interconnected by a rod and are connected to the hand pump arm by means of a push-pull rod and bell crank mounted on ball bearings. The function of the hand fuel pump is to obtain fuel pressure when the engine is not running, and it may be used in the event of failure of the engine-driven fuel pump. Insufficient operation of the hand pump will be indicated by the fuel pressure warning light.

(b) ADJUSTMENT.—Adjustment of the hand fuel pump fire wall bell crank should be such as to prevent the fuel pump from traveling the complete amount in either direction. To check for proper adjustment, place the cockpit control handles approximately 1/16 inch short of their full forward position. With the handles in this position, the fire wall bell crank adjustment bolt should be positioned against its stop. Remove the clevis bolt securing the control rod to the fuel pump handle, and check to make certain the pump handle is 1/8 inch into the control rod clevis. Move the cockpit handles to their full aft position, and check for the above distance between maximum pump handle travel and the control rod clevis. If the travel of the pump handle is not restricted as specified above, reposition it on its spline shaft and adjust the stops on the fire wall bell crank as required. It is desirable, if the linkage permits, to have the cockpit control handles fall 1/16 inch short of contact with their full forward stops when the fire wall bell crank stop is engaged. However, this is not considered an absolute necessity.

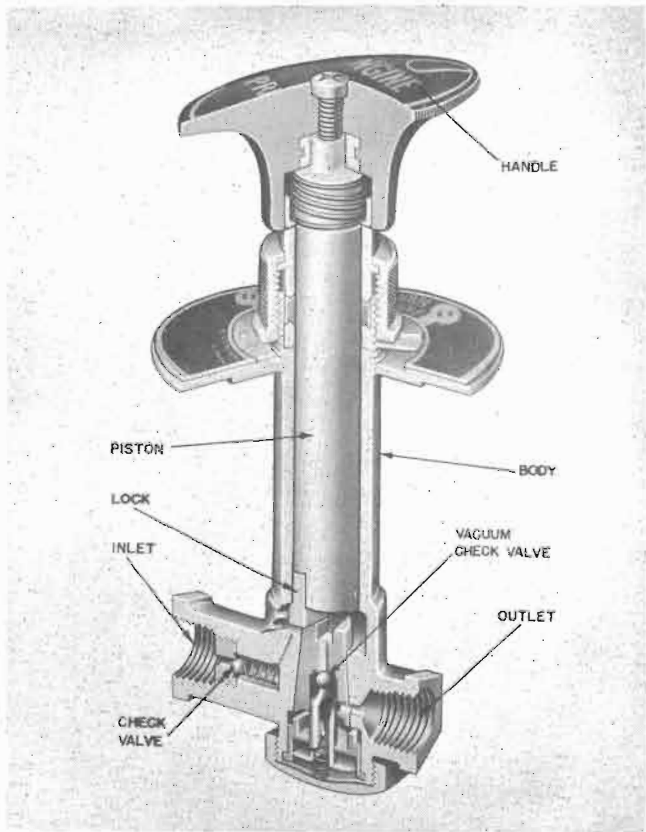


Figure 167 — Engine Primer

f. ENGINE PRIMER.—*(See figure 167.)*—The engine primer pump and the operating handle, Parker type 401, is installed on the sub-panel directly below the instrument panel in the front cockpit. The Parker primer is of the displacement plunger type. It is an entirely self-contained unit with no auxiliary valves or other parts. Distribution and shut-off are effected by the single pump handle. In the "OFF" position, the handle is positively locked against vibration. A special vacuum check valve prevents suction of fuel into the engine should the primer accidentally be left in the "ON" position. The fuel is pumped by means of the primer pump from the discharge side of the fuel unit to the engine fuel outlet distributor on cylinder No. 1 intake port. From the primer distributing inlet fuel diffuses through jets in the cylinder intake ports of cylinders 8, 9, 1, 2, and 3. To operate, push in on the handle and rotate counterclockwise. This unlocks the handle and allows the pump to be operated.

NOTE

Make certain the handle is pushed in and turned clockwise to the "OFF" position when the priming operations are completed.

g. FUEL SELECTOR VALVE.—*(See figure 169.)*— The fuel selector valve is a cork-seated cock-type G-2A

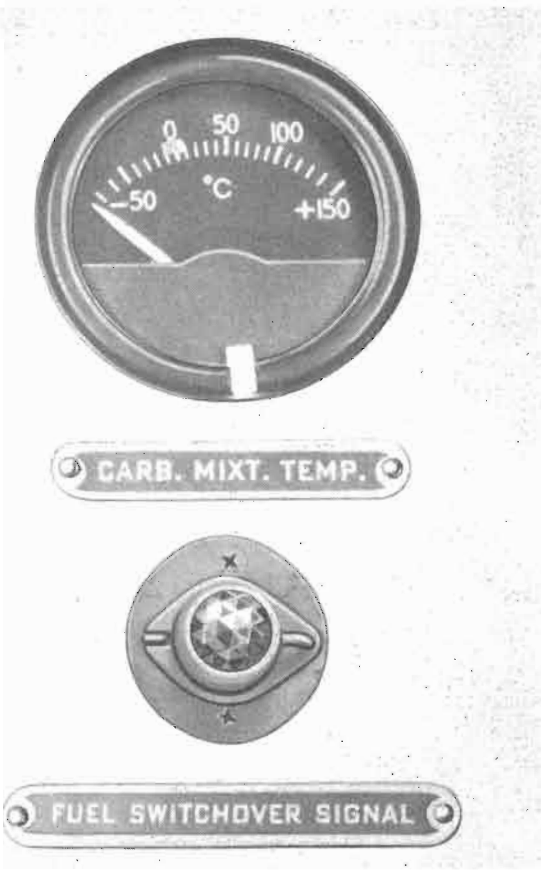


Figure 168 — Carburetor Mixture Temperature Gage and Fuel Signal

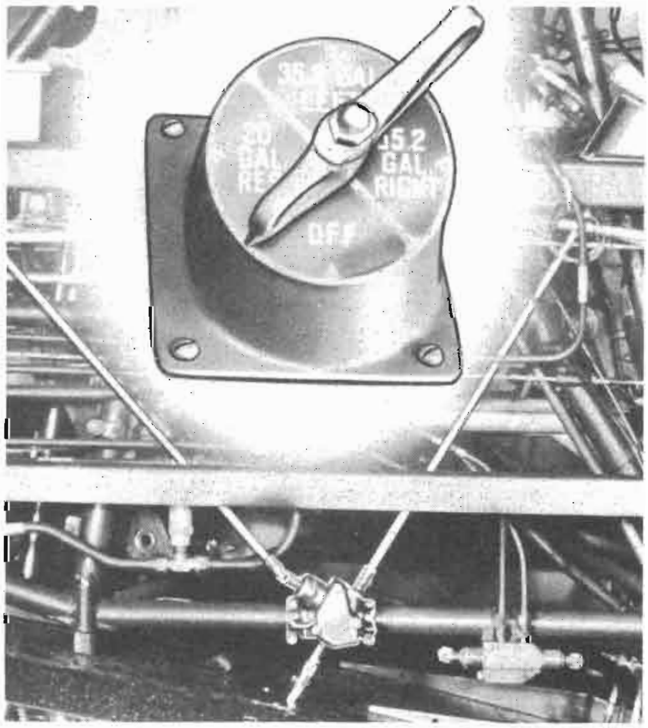


Figure 169 — Fuel Selector Valve

valve, with dial-type selectors. The fuel selector valve is located in the center section structure aft of the left fuel tank gage assembly and is connected by means of rod linkage to the dial selectors located on the control shelf. Fuel tank dial selectors are provided in both front and rear cockpits forward of the trim tab controls in the rear cockpit and aft of trim tab controls in front cockpit. Fuel may be taken from either the right tank, left tank, or the reserve supply by turning the dial selector to any one of these three positions, as indicated on the dial selector face plate. By turning the selector, the rod linkage revolves a cock-seated core in the selector valve, thus aligning on opening in the core with the passage connected to the fuel line from the selected fuel compartment. The fuel will then flow from the tank through the selector valve and on to the fuel unit. To shut-off the flow of fuel to the engine, turn the fuel selector to the "OFF" position.

h. FUEL SWITCH-OVER SIGNAL.—*(See figure 168.)*—A type C-2 fuel switch-over signal assembly is installed on the lower left forward side of the fire wall. This unit operates a fuel signal lamp assembly which is installed on the right side of the instrument panel in the front cockpit. When the carburetor fuel pressure is above 3 pounds per square inch (plus or minus 1/4 pound per square inch), enough pressure is exerted on the bellows and the spring within the signal assembly to maintain an open circuit. Upon reduction of the pressure, the bellows extend, allowing the electrical contacts which are located in a separate compartment to complete the circuit and operate the signal lamp. When the fuel supply in the compartment from which the engine is being operated is exhausted, the fuel pressure will drop and cause the signal lamp to operate for approximately 10 seconds before engine failure. Also, when hand fuel pump operation is insufficient to maintain the required fuel pressure, the signal will operate.

i. FUEL COMPARTMENT SUMP.—To remove fuel compartment sump, remove the fuel lines fore and aft of the sump. Remove the bolts attaching sump to wing center section, and remove.

10. INSTRUMENTS.

a. GENERAL.

(1) DESCRIPTION.—The instrument panels, installed in the conventional position in each cockpit, are mounted on rubber shock absorber mountings to prevent damage to the instruments, from engine vibration, hard landings, etc. Fluorescent lights are provided in each cockpit for lighting the instrument panels, and all instrument dials have fluorescent or fluorescent radioactive markings. The lights may be adjusted to give either ultra-violet and white light or ultra-violet. The compass on the instrument panel in each cockpit and the fuel gages are individually lighted. The fluorescent lights, compass lights, and fuel gage lights are controlled by switches on the control panel in each cockpit. In general, the same kind of instruments are mounted

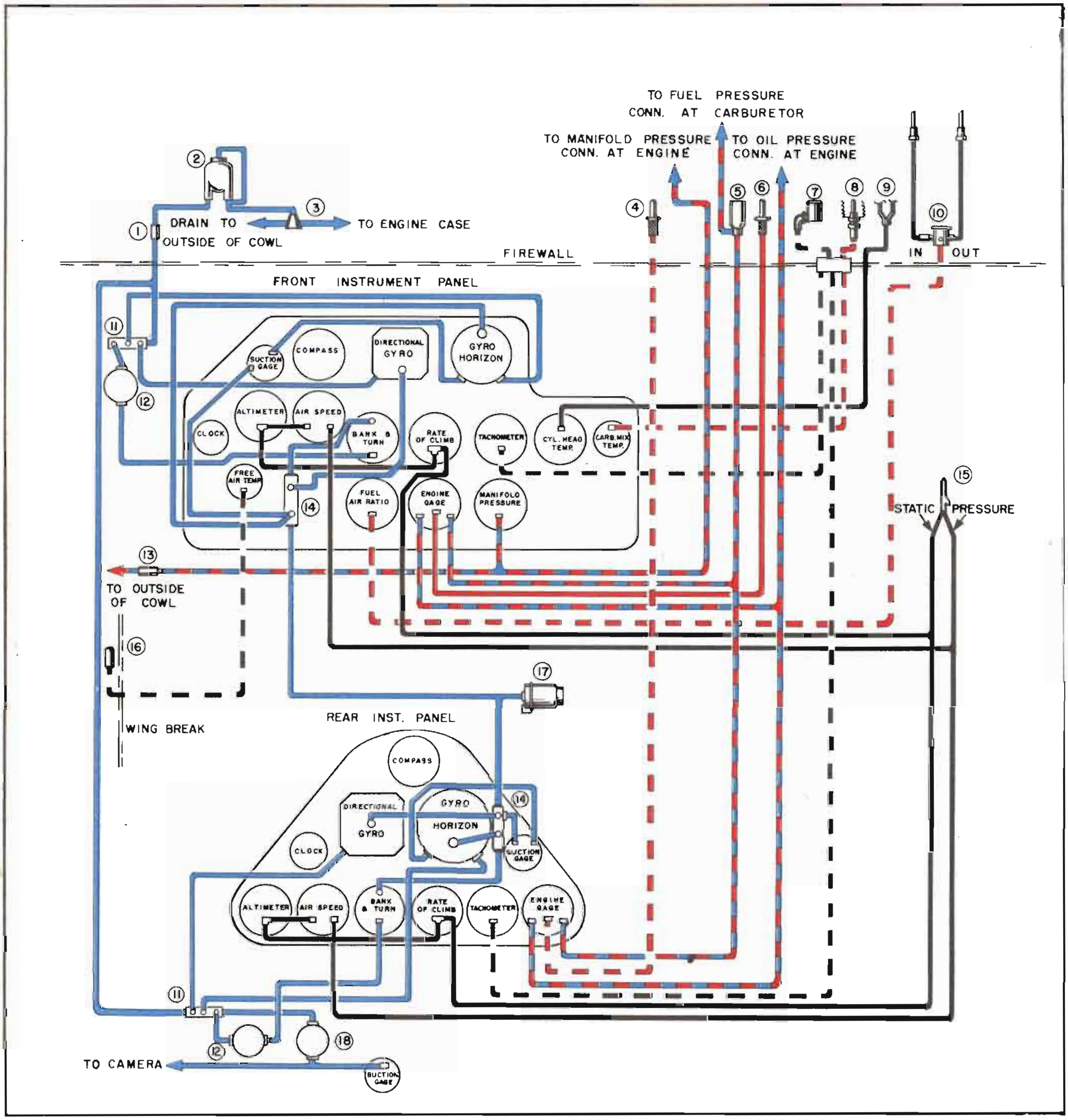


Figure 170 — Instrument Lines System Diagram

1. Vacuum Relief Valve
2. Vacuum Pump
3. Oil Separator
4. Oil Temp. Capillary Rear
5. Fuel Pressure Signal
6. Oil Temp. Capillary Front
7. Tachometer Generator
8. Carb. Mixture Temp. Bulb
9. Thermocouple
10. Exhaust Gas Analyzer
11. Vacuum Distribution Block
12. Vacuum Distribution Block
13. Manifold Pressure Gage Drain
14. Air Filter Distribution Block
15. Pitot Head
16. Free Air Thermometer Bulb
17. Air Filter
18. Camera Valve

on the instrument panels in both 12-volt and 24-volt airplanes. The instruments indicating manifold pressure, fuel air ratio, carburetor mixture temperature, and cylinder temperature (thermocouple) are on the front cockpit instrument panels only. The instruments mounted on the instrument panel in both cockpits are: a compass, an altimeter, an airspeed indicator, a suction gage, a clock, an engine gage, a rate of climb indicator, a tachometer, and three gyro-controlled instruments; bank-and-turn indicator, flight indicator (gyro horizon), and turn indicator (directional gyro). An accelerometer is mounted below the center of the instrument panel in the front cockpit, on 12-volt and some 24-volt airplanes. Fuel gages, a hydraulic pressure gage, a free air temperature indicator, and an ammeter are also mounted in the front cockpit. The instruments may be classified under four headings: vacuum operated instruments, pitot-static instruments, engine indicating instruments, and miscellaneous instruments.

(2) TROUBLE SHOOTING.—No attempt at disassembly and repair of the instruments themselves should be attempted except at properly equipped depots, with personnel trained for such work. Malfunctioning of the instruments is more often due to some external trouble, such as shorts, grounds, open circuits, or faulty electrical connections, leaking or clogged air lines, etc. Refer to the troubles, possible causes and remedies listed for individual instruments.

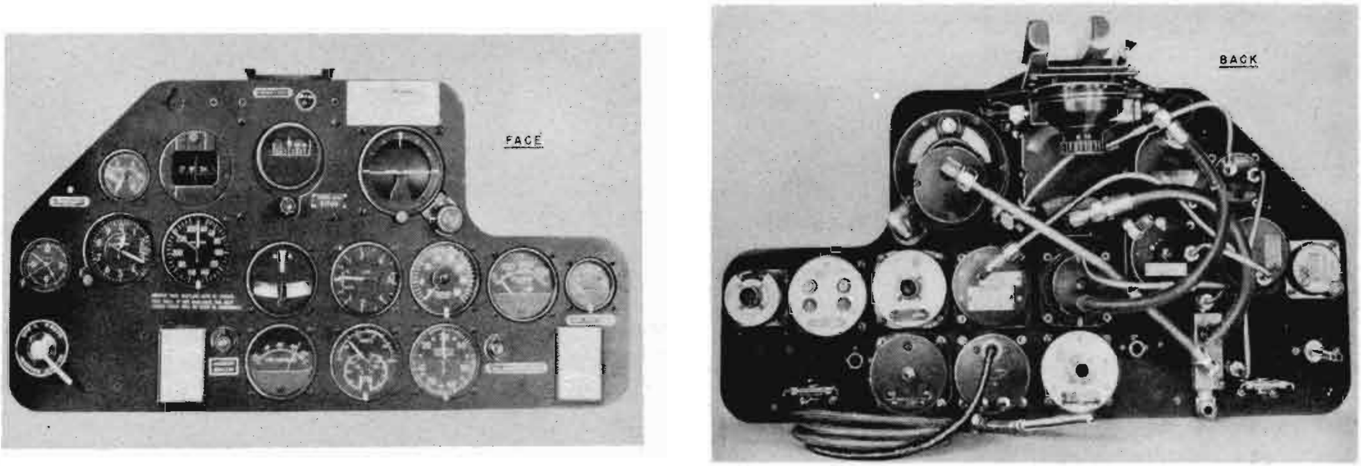


Figure 171 — Front Cockpit Instrument Panel (Top and Lower)

INSTRUMENT INSTALLATIONS	AT-6D & SNJ-5	AT-6C & SNJ-4	AT-6A, AT-6B, & SNJ-3	AT-6
Ammeter	F-10*	F-1*	F-1	F-1
Altimeter	C-13	C-13	C-13	C-11
Airspeed Indicator	C-14	C-14	C-14	C-7
Bank and Turn Indicator	A-11	A-8	A-8	A-5
Compass	B-16	B-16	B-16	B-16
Clock	A-11	A-11	A-11	A-9
Carburetor Mixture Temperature Indic.	AN5790-6*	F-9*	F-9*	F-2*
Engine Gage Unit	B-7	B-7	B-7	B-2
Fuel Level Gage	55-51010	36-51010*	36-51010	36-51010
Flight Indicator	AN5736	C-7	C-7	C-5*
Free Air Temperature Indic.	C-13A*	C-12*	C-12*	C-6*
Fuel Air Ratio Indicator	B-5*	A-7*	A-7*	A-2*
Hydraulic Pressure Gage	E-4*	E-4*	E-4	E-3
Manifold Pressure Gage	D-10*	D-9*	D-9*	D-2*
Radio Compass	———	———	———	165-B*
Rate of Climb Indicator	C-2	A-7	A-7	A-6
Suction Gage	F-4*	F-3	F-3	F-2*
Tachometer	E-12	E-12	C-9	C-7
Cylinder Temperature Indic.	B-9*	B-9*	B-9*	B-7*
Turn Indicator (Directional Gyro)	AN5735	A-5	A-5	B-3*
Voltmeter	B-1*	B-1*	B-1	B-1
Signal, Fuel Pressure	C-2*	C-2	C-2	C-2

* Front cockpit only.

pit instrument panels only. The instruments mounted on the instrument panel in both cockpits are: a compass, an altimeter, an airspeed indicator, a suction gage, a clock, an engine gage, a rate of climb indicator, a tachometer, and three gyro-controlled instruments; bank-and-turn indicator, flight indicator (gyro horizon), and turn indicator (directional gyro). An accelerometer is mounted below the center of the instrument panel in the front cockpit, on 12-volt and some 24-volt airplanes. Fuel gages, a hydraulic pressure gage, a free air temperature indicator, and an ammeter are also mounted in the front cockpit. The instruments may be classified under four headings: vacuum operated instruments, pitot-static instruments, engine indicating instruments, and miscellaneous instruments.

(2) TROUBLE SHOOTING.—No attempt at disassembly and repair of the instruments themselves should be attempted except at properly equipped depots, with personnel trained for such work. Malfunctioning of the instruments is more often due to some external trouble, such as shorts, grounds, open circuits, or faulty electrical connections, leaking or clogged air lines, etc. Refer to the troubles, possible causes and remedies listed for individual instruments.

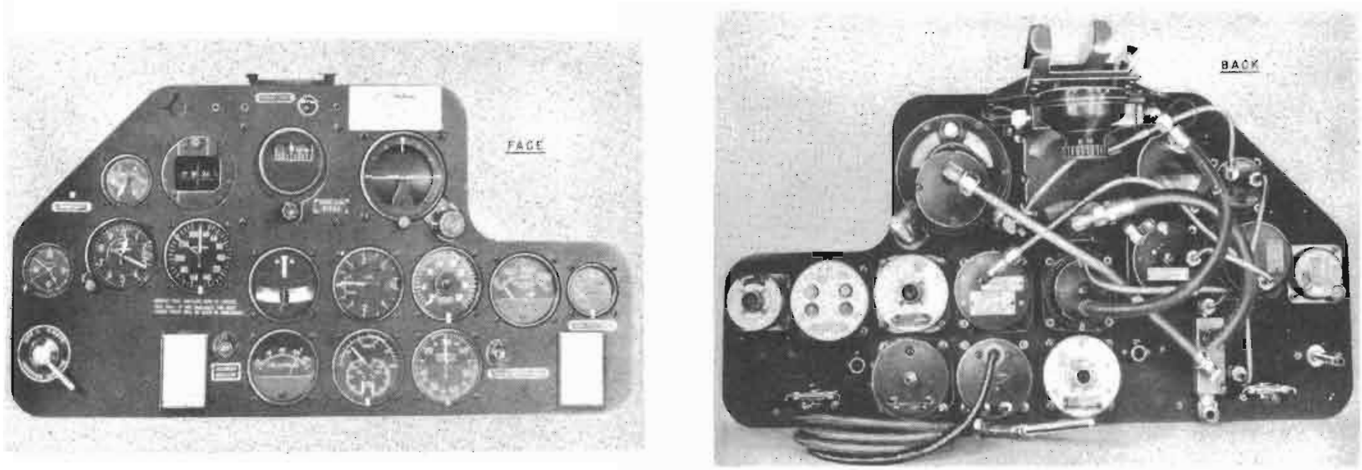
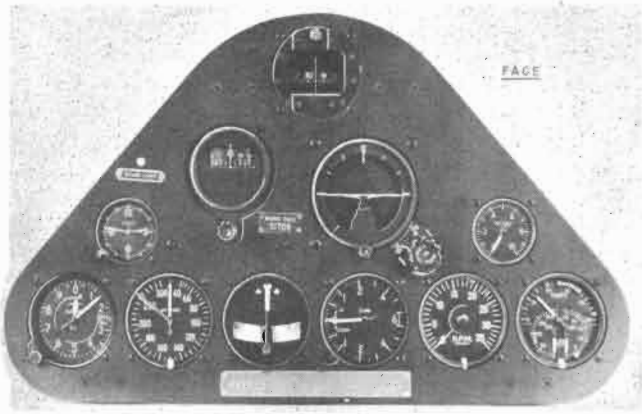


Figure 171 — Front Cockpit Instrument Panel (Top and Lower)

INSTRUMENT INSTALLATIONS	AT-6D & SNJ-5	AT-6C & SNJ-4	AT-6A, AT-6B, & SNJ-3	AT-6
Ammeter	F-10*	F-1*	F-1	F-1
Altimeter	C-13	C-13	C-13	C-11
Airspeed Indicator	C-14	C-14	C-14	C-7
Bank and Turn Indicator	A-11	A-8	A-8	A-5
Compass	B-16	B-16	B-16	B-16
Clock	A-11	A-11	A-11	A-9
Carburetor Mixture Temperature Indic.	AN5790-6*	F-9*	F-9*	F-2*
Engine Gage Unit	B-7	B-7	B-7	B-2
Fuel Level Gage	55-51010	36-51010*	36-51010	36-51010
Flight Indicator	AN5736	C-7	C-7	C-5*
Free Air Temperature Indic.	C-13A*	C-12*	C-12*	C-6*
Fuel Air Ratio Indicator	B-5*	A-7*	A-7*	A-2*
Hydraulic Pressure Gage	E-4*	E-4*	E-4	E-3
Manifold Pressure Gage	D-10*	D-9*	D-9*	D-2*
Radio Compass	———	———	———	165-B*
Rate of Climb Indicator	C-2	A-7	A-7	A-6
Suction Gage	F-4*	F-3	F-3	F-2*
Tachometer	E-12	E-12	C-9	C-7
Cylinder Temperature Indic.	B-9*	B-9*	B-9*	B-7*
Turn Indicator (Directional Gyro)	AN5735	A-5	A-5	B-3*
Voltmeter	B-1*	B-1*	B-1	B-1
Signal, Fuel Pressure	C-2*	C-2	C-2	C-2

* Front cockpit only.



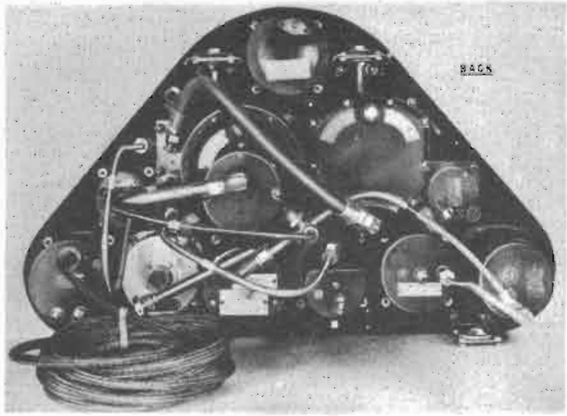


Figure 172 — Rear Cockpit Instrument Panel (Top and Lower)

(3) MAINTENANCE.

(a) Work on aircraft instruments which may be performed by the first echelon of maintenance (squadron, operating unit, etc.) will consist of routine inspections and checking of installed instruments, cleaning of glass covers, tightening of connections, checking installed instruments suspected of malfunctioning, the removal of instruments that require base or depot inspections and repairs, and the reinstallation of serviceable ones.

(b) Periodic inspection requiring the use of type C-1 portable testing equipment may be accomplished if the necessary facilities and trained personnel are available.

(c) An instrument reported as functioning improperly or otherwise suspected of being defective, will, whenever practicable, first be checked to determine whether or not the defect is in the instrument or the installation. If the instrument is found to be defective, it will be removed and replaced, the defective instrument being turned into stock in exchange for the serviceable one. However, if the defective instrument requires only minor repair operations to place it in serviceable condition, and these operations can be accomplished by the base instrument unit without undue delay, such repairs will be accomplished and the instrument reinstalled in the airplane from which removed.

(4) REMOVAL.—With few exceptions the instruments have obvious means of removal. Care should be taken, however, to see that upon removal of any instrument all connections are carefully marked. This is to prevent any damage to either the instrument or to the connecting system, and to insure correct operation of the reinstalled instrument. Instruments may be removed from the panel by removing the four screws attaching each instrument case to panel. All instruments except those which are connected to a capillary tube may be detached from their respective lines.

(5) INSTALLATION.—At installation of the shock-mounted panels, take care to adjust the supporting mounts so that panels, complete with instruments, controls, tubing, and wires, balance with the face of the panel vertical when the airplane is in the level flight position. Then adjust the steady mount connecting rods so that there is no load in the rods. Instruments may be installed on the panel by attaching instrument case to panel with screws. Lines are easily attached to their respective instruments by means of fittings provided.

(6) ROUTINE REPLACEMENTS.

(a) Gyro flight and turn indicators, automatic pilot gyro control units and altimeters will be removed from aircraft at the expiration of 1 year from date of installation, and replaced with serviceable instruments of like kind or authorized substitutes. Additional time, not to exceed 30 days, is authorized when the instruments function satisfactorily and local conditions warrant.

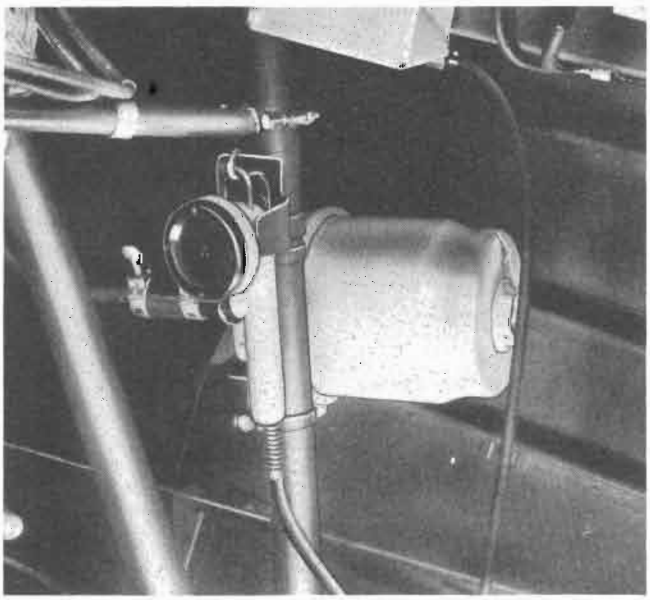


Figure 173 — Vacuum Air Filter

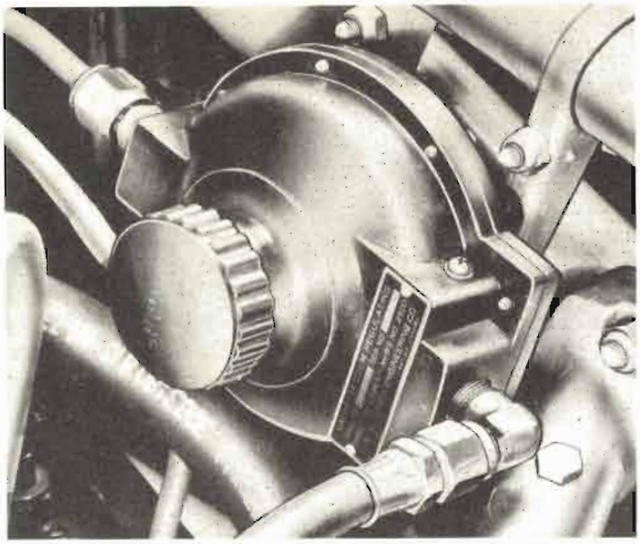


Figure 174 — Vacuum Regulator

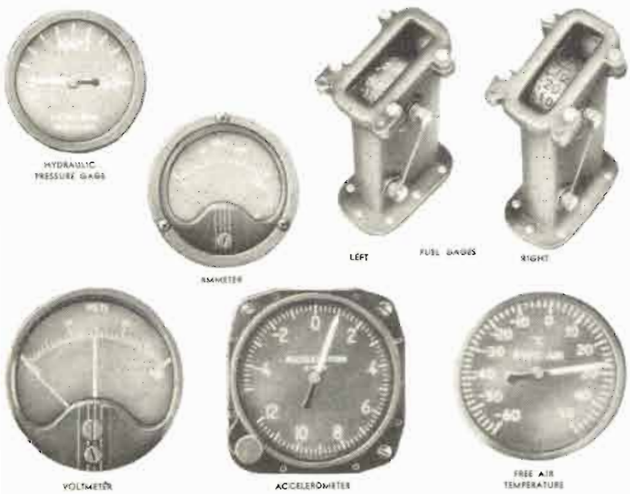


Figure 175 — Miscellaneous Instruments

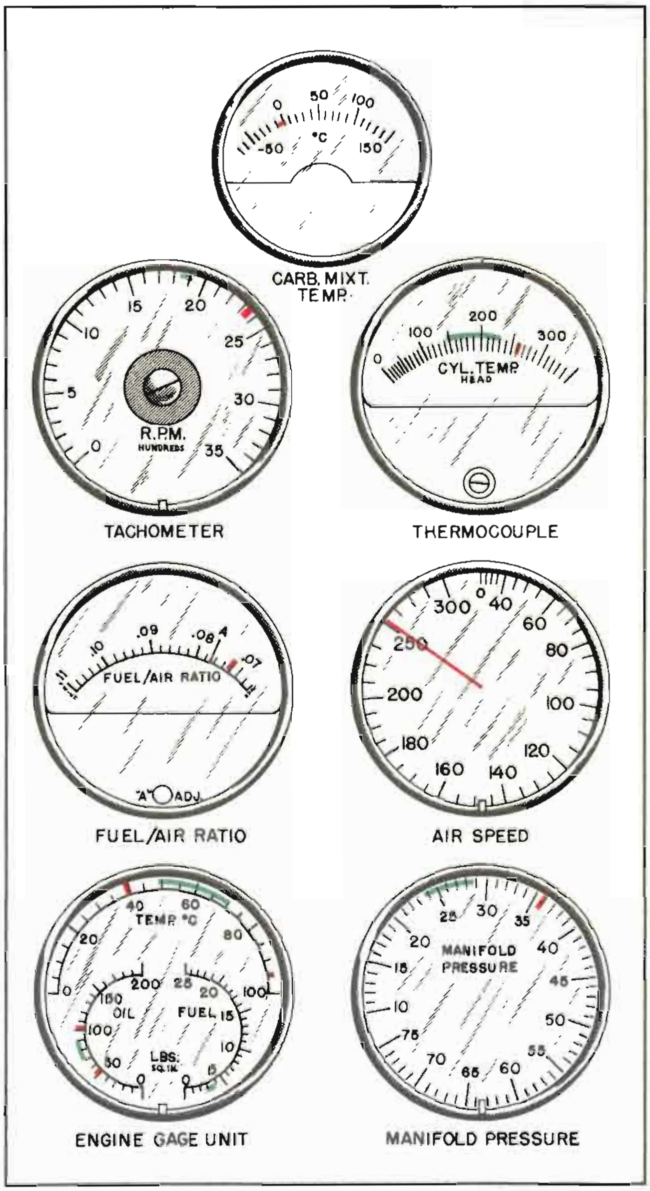


Figure 176 — Instrument Color Markings

(b) Instruments of other types will be removed when the general condition of the instrument indicates such action is warranted.

(7) INSTRUMENT MARKINGS.—*(See figure 176.)*—All engine indicating instruments have markings to show normal and unsafe operating conditions. The *green* sector indicates normal operating conditions, and the *red* marks indicate the approach to dangerous or unsafe operating conditions. A fixed pointer on the airspeed indicator is set at 251 mph, the maximum safe driving speed.

(8) FUSELAGE DEMAGNETIZATION. — Excessive compass deviation may be caused by magnetized metal parts of the airplane's structure or by current-carrying wires. The underlying cause may be determined by heading the airplane to magnetic north and east, with all electrical switches off. If the compass is approximately correct under these conditions, but deviation occurs when the switches are turned on, the trouble is obviously in the electrical wiring. If the deviation is approximately the same with the switches off, the trouble is caused by magnetized structure or other parts. If the trouble seems to be in the wiring, locate the offending circuit by turning on the switches one at a time, and relocate the wire to correct the trouble. If the deviation is caused by magnetized structure, demagnetization may be accomplished as follows:

(a) When starting the demagnetizing process, locate the magnetism by means of a pocket compass. In order of their greatest density, flux concentrations will be found in the "X" frames forward of either instrument panel, in the nose-over truss, and occasionally in the longerons. It has been found that only the

high fields near the compass need be demagnetized to obtain the desired results.

(b) Adjust the compass compensating screws to neutral.

(c) Place the airplane in a position so that the structure to be demagnetized will have its major axis perpendicular to the earth's magnetic field.

(d) To demagnetize members in which strong fields are found, it is necessary to use a choke coil similar to that shown in figure 177 in series with a variable resistance of 100 ohms. To construct such a coil, refer to paragraph (9).

(e) With the variable resistance set at zero, apply 110 volts ac to the coil. Bring the legs of the coil in contact with the part to be demagnetized and move the sliding contact of the resistor until the full amount of resistance is in the circuit. Disconnect the voltage supply. This should demagnetize that part of the structure between the legs of the coil.

(f) Set the resistance back to zero; repeat this procedure until all suspected parts have been demagnetized.

(g) Test the region again with a compass; go over with the demagnetizing coil, any parts that show appreciable magnetization.

NOTE

If it is necessary to use the demagnetizing coil in a region near instruments containing permanent magnets, the instruments should be removed first. If magnetic shields are to be demagnetized, they should first be removed from the instrument case.

(9) CHOKE COIL.—Use 67 laminations stamped in the shape of a square "C" having dimensions as given in specifications following. Clamp the laminations together and cut the feet of the "C" in a V-shape to a depth of 1 inch. After milling, completely cover each lamination with two coats of clear lacquer and allow them to dry 8 hours. Clamp laminations together and bind the arc with three layers of friction tape. Give each layer of tape a heavy coat of shellac, and allow it to dry thoroughly. Wrap empire cloth of .020-inch thickness over the tape; hold it in place by another layer of friction tape. Apply two coats of shellac to the arc; allow it to dry thoroughly. Use friction tape, applied lengthwise in strips around the core, to secure the magnet wire. Wind three layers of magnet wire 100 turns to each layer; secure the wire and tape in the usual manner. Give each layer of wire two coats of shellac and two layers of friction tape, wrapping the last layer of wire with friction tape while the shellac is *still wet*. Bake the assembly at 66°C (150°F) for 24 hours. Solder the cord, with the switch in series, to the coil leads; secure the cord by taping it to the laminations.

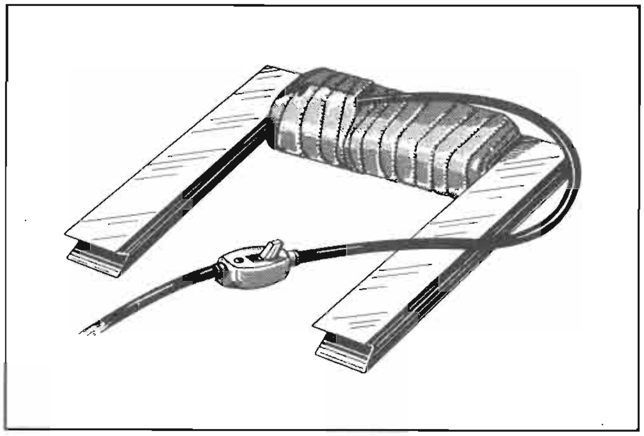


Figure 177 — Choke Coil

SPECIFICATIONS

Amperes	10
Cycles	60
Inductance, millihenries	39
Volts	110

LAMINATIONS

Type of material	Electric Core Steel
Thickness of material	0.015 inch
Total number of laminations	67
Number of turns	300
Wire number	12 (double cotton covered copper magnet wire)

DIMENSIONS EXCLUSIVE OF COIL

Length	12 inches
Legs (from back)	10 inches
Legs (width)	2 inches
Legs (thickness)	1 inch
Arc (to support coil)	2 inches

b. VACUUM OPERATED INSTRUMENTS.

(1) VACUUM SYSTEM.—The flight instruments, bank and turn indicator, flight indicator (gyro horizon), and turn indicator (directional gyro) are gyro-controlled and vacuum-operated. A suction gage is also incorporated in the vacuum system. An engine-driven vacuum pump supplies the suction for operating the air-driven gyroscopes in the gyro-controlled instruments. The gyros are driven by air striking on buckets incorporated in the gyroscope wheels. Air is taken into the vacuum system through a filter mounted on the right side of the rear cockpit. The filter is to prevent dirt or foreign matter from clogging the air lines or damaging the pendulus vanes or buckets on the gyroscope wheels. The engine-driven vacuum pump is lubricated with oil from the engine supply, and an oil-air separator is pro-

vided in the discharge line to return the oil to the engine crankcase. The air discharge line is vented out through the bottom of the engine compartment. A throttle valve is provided at the bank and turn indicator in both cockpits, as these instruments do not require as much suction as the other two gyro-controlled instruments. These throttle valves, installed in the lines just forward of the instrument panels, provide a means of regulating the suction on the bank and turn indicator only. These valves are adjusted to give a suction equal to 1.8 to 2.05 in. Hg at the instrument at engine speed of 1000 to 2250 rpm. A regulating valve on the main suction line near the vacuum pump provides a means of regulating the suction of the whole vacuum system and acts as a relief valve. This valve should be adjusted to indicate 3.75 to 4.25 in. Hg on suction gages at engine speeds of 1000 to maximum rpm attainable on the ground. A suction gage on the instrument panel in each cockpit indicates the suction in the directional gyro and the gyro horizon only. A vacuum line from the selector valve to the camera installed in the rear cockpit of 12-volt airplanes provides suction for holding the film flat against the frame.

(2) BANK AND TURN INDICATOR.

(a) DESCRIPTION.—The bank and turn indicator is used for indicating the flight of an airplane under conditions of poor visibility. This instrument enables the pilot to maintain a laterally level attitude while flying straight and to make a properly banked turn. There are actually two instruments combined in the one case. The turn indicator shows whether the airplane is flying straight, as when the pointer is centered, or when it is turning, and shows the direction of that turn, disregarding drift, bank, or pitch. It contains an air-driven gyroscope which precesses when its plane of spin is disturbed. The bank indicator, or inclinometer, is an encased ball which is affected by centrifugal force against the force of gravity, making the movements nil on a correctly banked turn. The turn indicator consists of a gyroscope, with the case acting as the outside gimbal ring, transmitting mechanism, a damping device, and an adjustable calibrated spring to restrain the precession. The stream of air is directed against the buckets of the rotor driving it at a speed of approximately 9000 rpm. The gyro rotates about the lateral axis in the frame and is not affected by rolling or pitching. Displacement is transmitted through the balance plate to the fork of the staff into pointer movement proportionate to the rate of turn of the airplane. The rotor is limited by stops of about 45 degrees each side of the vertical. A spring attached to the inner gimbal ring serves the double purpose of creating a force which balances the gyroscopic reaction during a turn and to centralize the assembly immediately after a turn.

(b) TROUBLE SHOOTING.

BANK AND TURN INDICATOR A-8 AND A-11

Trouble	*Possible Cause*	*Remedy*
POINTER FAILS TO RESPOND CORRECTLY.	No vacuum supplied to the instrument.	Check vacuum control valve for leaks and stoppage. Examine tubing for leaks and stoppage. Check vacuum at instrument and through the lines.
	Air inlet cap or screen clogged.	Remove cap or screen, clean and replace. Remove filter assembly and replace.
	Foreign matter in rotor bearings.	Remove instrument, forward to repair depot.
	Foreign matter in damping cylinder.	Remove instrument, forward to repair depot.
	Excessive clearance between rotor and rotor pivots.	Replace instrument.
INCORRECT SENSITIVITY.	Incorrect vacuum.	See remedies under "Pointer fails to respond." Adjust the adjustable restriction.
	Air inlet cap or screen clogged.	Remove cap or screen, clean and replace.
	Misadjustment of sensitivity spring.	Adjust by means of the sensitivity spring screw. If this pulls the pointer from zero, remove the instrument and forward to repair depot.
POINTER DOES NOT SET AT ZERO.	Gimbal and rotor assembly out of balance.	Remove instrument and forward to repair depot.

Trouble	Possible Cause	Remedy
POINTER DOES NOT SET AT ZERO. (Cont.)	Pointer incorrectly sets on its staff.	Remove instrument and forward to repair depot.
	Sensitivity adjustment pulls pointer off zero.	Remove instrument and forward to repair depot.
VIBRATING POINTER.	Excessive vibration.	If vibration is not apparent, forward instrument to repair depot, giving part number of the board and type of airplane, together with particulars of the instrument board mounting.
	Damping screw misadjustment.	Unscrew damping adjustment screw to the right until corrected.
	Lack of oil.	Lubricate.
	Gimbal and rotor assembly out of balance.	Remove instrument and forward to repair depot.
	Pitted or worn pivots or bearings.	Remove instrument and forward to repair depot.
IN LOW TEMPERATURE, POINTER FAILS TO RESPOND OR DOES SO SLUGGISHLY AND WITH AN INSUFFICIENT DEFLECTION.	Oil becomes too thick.	Remove instrument and forward to repair depot.
	Insufficient bearing clearance.	Remove instrument and forward to repair depot.
	Air inlet screen or cap clogged with ice crystals.	Clean the screen or cap with an absorbing pad.
POINTER SLUGGISH IN RETURNING TO ZERO AND DOES NOT SET ON ZERO WHEN STATIONARY.	Oil or dirt between damping pistons and cylinder.	Remove instrument and forward to repair depot.
	Excessive clearance between rotor and rotor pivots.	Remove intsrument and forward to repair depot.
BROKEN INCLINOMETER TUBE.	Excessive vibration, rough handling.	Replace instrument.
BALL IN INCLINOMETER DOES NOT CENTER.	Instrument out of alignment on panel.	Correct alignment.

(3) GYRO HORIZON INDICATOR.

(a) DESCRIPTION.—This instrument is used as a definite means of ascertaining the true attitude of the airplane relative to the earth. It is particularly valuable when the earth's horizon is not visible. The gyro is mounted in the flight indicator so that its plane of spin can assume any position in space. Obeying the gyroscopic principle of "rigidity" the gyro, when spinning, maintains its spinning axis upright, irrespective of the movements of the airplane, establishing a horizontal flight reference. Attitude positions are actuated through linkage by means of a pin protruding from the gyro housing through a slot in the outer gimbal ring. Diametrically balanced vanes are provided to exhaust the air and to maintain an upright position when the gyro attempts deviation. When the deviation occurs one vane opens its port while the diameterically opposite vane closes its port, causing a torque which precesses the gyro to its normal position. In view of the operating limits of 60-degree dives or climbs and 100-degree vertical banks, a caging knob is installed on the front of the instrument. This knob should always be in the off position when these limits are expected to be exceeded. This instrument should also be caged for all take-offs and landings. Another knob for adjustment of the miniature airplane indicator is also found on the front of the instrument.

(*b*) TROUBLE SHOOTING.

FLIGHT INDICATOR GYRO HORIZON TYPE AN5736

Trouble	*Possible Cause*	*Remedy*
BAR FAILS TO RESPOND.	Instrument caged. Air filter dirty. Insufficient vacuum. Suction regulator. Incorrect suction gage reading. Pump failure. Insufficient lubrication in pump. Vacuum line kinked, leaking. Defective mechanism.	Uncage. Clean or replace. Correct as follows: Adjust properly. Check calibration of gage. Repair and replace pump. Provide proper lubrication. Locate and repair—check flexible hose. Replace instrument.
BAR DOES NOT SETTLE.	Defective mechanism. Insufficient vacuum. Excessive vibration.	Replace instrument. Correct for insufficient vacuum. Test with vibrometer, examine shock mountings and connections.
BAR OSCILLATES.	Gyro not completely uncaged. Excessive vacuum. Dirty air filters. Suction regulator misadjusted. Incorrect suction gage reading. Defective mechanism. Excessive vibration.	Uncage. Correct. Examine and clean or replace. Adjust. Check calibration of gage. Replace instrument. Test with vibrometer, examine shock mountings and connections.
HORIZON BAR DOES NOT AGREE WITH FLIGHT ATTITUDE.	Instrument out of alignment on panel.	Correct alignment.
BAR AND BANKING INDICATOR NOT PERPENDICULAR TO EACH OTHER.	Mechanism out of alignment.	Replace instrument.
INSTRUMENT FAILS ON BENCH TEST.	Defective internal mechanism.	Replace instrument.

(4) DIRECTIONAL GYRO INDICATOR.

(*a*) DESCRIPTION.—This instrument is used to supplement the magnetic compass in maintaining a straight course. It also measures the degree of a turn made by the airplane. The rotor spins about the horizontal axis at approximately 10,000 rpm and is mounted in an inner and outer gimbal ring. The circular card which is attached to the outer ring is observed through an opening in the case. Due to the rigidity of the gyro, this card remains fixed in azimuth. The instrument is fitted with a caging knob used to set the gyro with the compass. The air jets which spin the rotor also serve to keep it upright. The air is divided into two parallel jets which strike the buckets at points equidistant from the center. If the rotor tilts, the air from the jets on one side strikes against the rim instead of the bucket, while the air from the other jet strikes against the sides of the buckets. Part of the force of the jets continues to spin the rotor, but part of the force acts to apply a torque on the outer ring, which precesses the rotor back to the orthogonal. The directional gyro is limited to 55 degree, climb, dive, or bank. If these limits are exceeded, the gyro can be caged and reset. The caging knob is located on the front of the instrument. Pulled out, the gyro is uncaged; pushed in completely, the gyro is caged. The knob is also used in IN position to set the gyro with the compass. This instrument should be caged for all take-offs and landings.

(*b*) TROUBLE SHOOTING.

DIRECTIONAL GYRO INDICATOR

Trouble	*Possible Cause*	*Remedy*
EXCESSIVE DRIFT.	Excessive vibration. Insufficient vacuum. Regulator misadjusted. Incorrect suction gage reading. Pump failure. Insufficient lubrication of vacuum pump. Vacuum line kinked. Defective mechanism.	Test with vibrometer. Correct as follows: Adjust suction regulator. Check calibration of gage. Repair and replace pump. Provide proper lubrication. Locate and remove for repair—check flexible hose. Remove and send for repair.

Trouble	Possible Cause	Remedy
DIAL SPINS CONTINUOUSLY IN ONE DIRECTION.	Defective mechanism.	Remove instrument. Inspect. If defective, send to repair depot.
CAGING MECHANISM WORKS HARD.	Lack of lubrication or corrosion.	Lubricate external part of shaft.
INSTRUMENT LACKS SENSITIVITY.	Insufficient speed for gyro rotor, dirty screws.	Clean screws and check suction.
LOOSE OR BROKEN COVER GLASS.	Excessive vibration.	Replace instrument.
INSTRUMENT FAILS ON BENCH TEST.	Defective internal mechanism.	Replace instrument.

(5) SUCTION GAGE.

(a) DESCRIPTION.—In the suction gage a diaphragm is mounted on a bracket which is screwed to the case. The movements of the diaphragm are transmitted to the pointer by means of a rocking shaft assembly sector, assembly, and pinion. The pointer staff is provided with a hairspring to eliminate backlash. A bimetallic lever compensates the instrument for changes in temperature.

(b) TROUBLE SHOOTING.

SUCTION GAGE

Trouble	Possible Cause	Remedy
EXCESSIVE ERROR AT ZERO.	Loose pointer. Seasoning of diaphragm.	Reset pointer. Replace instrument.
EXCESSIVE SCALE ERROR.	Improper calibration.	Adjust and calibrate.
EXCESSIVE POINTER OSCILLATION.	Rough relief valve seat.	Adjust or replace relief valve.

c. PITOT-STATIC INSTRUMENTS.

(1) DESCRIPTION.—The pitot-static system operates the airspeed indicator, the altimeter, and the rate of climb indicator. The impact pressure and static air conditions are derived from a pitot head mounted on the pitot mast extending forward of the leading edge of the right wing near the tip. An air line from the pitot head transmits the impact pressure, or pressure due to the forward speed of the airplane through the air, to the airspeed indicator only. The altimeter and rate of climb indicators are actuated by the atmospheric pressure at the level at which the airplane is flying. A static air line transmits this atmospheric pressure from the static head in the pitot tube to the indicating instruments. The static line is also connected to the airspeed indicator to relieve pressure that would be built up at this instrument. The pitot head contains integral heating elements to prevent ice from clogging the air-speed orifice and from forming in the static openings of the pitot head. The pitot heating elements are controlled from the front cockpit control panel. Removable moisture traps for the system lines are located just forward of the right wheel well and are accessible through a removable panel in the lower wing surface. A red marker on the glass of the airspeed indicator at 251 mph indicates maximum diving speed.

CAUTION

All activities are cautioned to properly maintain the entire air-speed tube installation. Particular care should be exercised in keeping the air-speed tube clean at all times. When airplanes are not flying, the air-speed tube will be protected from dust, dirt, oil, and other foreign particles by an appropriate cloth, canvas, or leather sack with a streamer to be fabricated locally. The sack should cover all openings in the tube.

(2) TROUBLE SHOOTING.

(a) AIRSPEED INDICATOR TYPE C-14.

CAUTION

In all trouble shooting it should be remembered that the air-speed indicator is connected through both the static and pressure lines to the pitot tube and that the altimeter and rate of climb indicators are connected through the same static line to the static outlets in the pitot-static tubes. Great care should be exercised not to damage any of these instruments when testing one of them.

Trouble	Possible Cause	Remedy
POINTER FAILS TO RESPOND.	Dynamic pressure connection (P) not connected properly to dynamic pressure line from pitot-static tube. Defective indicator mechanism.	Check tubing for correct connection. Replace with serviceable instrument.

Trouble	Possible Cause	Remedy
POINTER INDICATES INCORRECTLY.	Leak in tubing from pitot-static tube or in connection. Leak in indicator case. Defective indicator mechanism. Pitot-static head misaligned. Clogged static line.	Check lines to pitot-static tube for leaks. Replace with serviceable instrument. Replace with serviceable instrument. Align pitot-static head. Disconnect static line at instrument and blow through line to remove obstructions. Empty moisture trap.
POINTER DOES NOT SET ON ZERO WHEN AIRPLANE IS ON THE GROUND.	Defective indicator mechanism.	Replace with serviceable instrument.
POINTER VIBRATES.	Excessive vibration of instrument board.	Check instrument board and if excessive vibration is apparent, replace worn or deteriorated Lord mounting units.
POINTER OSCILLATES.	Leak in tubing from pitot-static tube or in connections. Leak in indicator case. Leak in rate of climb indicator or altimeter installations.	Disconnect lines from airspeed indicator. Check lines to pitot-static tube for leaks. Replace with serviceable instrument. Check lines for leaks. If an instrument is at fault replace with a serviceable instrument.
DEFECTIVE LIGHTING AND CASE LEAKS. TYPE C-7 INDICATORS WITH CASE NOT MARKED WITH A (P).	Due to shrinkage and distortion of Lucite light or window rings which soften at temperature of about 50° C (122° F). (P) means instrument has been equipped with Polystyrene light and window rings which will not soften until temperature of 85° C (125° F).	Replace with serviceable instrument.

(*b*) ALTIMETER TYPE C-13.

Trouble	Possible Cause	Remedy
EXCESSIVE SCALE ERROR.	Improper calibration adjustment.	Replace instrument.
EXCESSIVE POINTER OSCILLATION.	Defective mechanism. Excessive vibration.	Replace instrument. Eliminate vibration.
LOW READING.	Improper venting.	Eliminate leak in pressure line, and check alignment of airspeed tube.
SETTING KNOB TURNS EXCESSIVELY HARD.	Defective mechanism.	Replace instrument.
INNER REFERENCE MARKER FAILS TO MOVE WHEN SETTING KNOB IS ROTATED.	Out of engagement.	Replace instrument.
SETTING KNOB LOCK SCREW LOOSE OR MISSING.	Excessive vibration, careless maintenance.	Tighten screw, if loose. Replace instrument, if screw is missing.
CRACKED OR LOOSE COVER GLASS.	Excessive vibration.	Replace cover glass.
DULL OR DISCOLORED LUMINOUS MARKINGS.	Age.	Replace instrument.
BAROMETRIC SCALE AND REFERENCE MARKERS OUT OF SYNCHRONISM.	Slippage in mating parts.	Replace instrument.
BAROMETRIC SCALE AND REFERENCE MARKERS OUT OF SYNCHRONISM WITH POINTERS.	Drift in the mechanism or careless maintenance.	Replace instrument.

(*c*) RATE OF CLIMB INDICATOR TYPE C-2.

Trouble	Possible Cause	Remedy
POINTER OFF "ZERO."	Mechanism shift.	Return pointer to "ZERO" by means of knob. Tap panel next to instrument lightly while making adjustment.
POINTER OFF "ZERO" AND CANNOT BE BROUGHT BACK BY ZERO ADJUSTING KNOB.	Broken pivot.	Return to overhaul depot for overhaul.

Trouble	Possible Cause	Remedy
POINTER FAILS TO RESPOND.	Ob-truction in static line.	Disconnect all instruments which may be connected to the static line. Open drain plug and blow line clear.
	Defective mechanism.	Replace instrument.
INSTRUMENT INDICATES LESS THAN ACTUAL RATE OF CLIMB.	Case leak.	Return to overhaul depot for overhaul.
	Broken diffuser.	Return to overhaul depot for overhaul.
	Defective instrument.	Replace instrument.
FRICTION.	Dirty pivots and jewels.	Return to overhaul depot for overhaul.
	Broken jewels.	Return to overhaul depot for overhaul.
	Improper clearances.	Return to overhaul depot for overhaul.
POINTER OSCILLATES.	Defective instrument.	Replace instrument.

d. ENGINE INDICATING INSTRUMENTS.

(1) DESCRIPTION.—The engine instruments consist of a manifold pressure indicator, a tachometer, an engine gage unit, fuel air mixture indicator, cylinder temperature gage (thermocouple), and carburetor mixture temperature gage. A drain cock on the left side of the front cockpit marked "MANIFOLD PRESSURE GAGE DRAIN" should be opened for a short time when the engine is first started and running at idling speed to suck in the moisture that has accumulated in the manifold pressure line. The tachometer is of the electric-generator type. The assembly consists of an electric generator driven by the engine and connected to a voltmeter-type indicator that is responsive to the generator output voltage. The indicator is calibrated in engine revolutions per minute. The engine gage unit consists of three instruments in one, a distant reading indicating thermometer for oil temperature, and two gages for indicating oil pressure and fuel pressure. The thermocouple principle is used for indicating cylinder temperature. The thermocouple leads and thermocouples are made of constantan and iron so selected as to have a definite electromotive force per degree of heat.

NOTE

Theory of operation of the thermocouple: When two wires of dissimilar metal are joined together and the junction is heated, an electromotive force will appear at the opposite ends of the two wires. The magnitude of this E.M.F. will depend on the difference in temperature at the two ends of the wires and the composition of the metals used.

The induced E.M.F. is transmitted to the indicator having a sensitive D'Arsinal-type mechanism with a coil arranged to move in an annular air gap of a permanent magnet. The coil carries the pointer and the control is one bimetallic spring and two hair springs which also serve to conduct current into the coil. An adjusting screw on the face of the instrument provides a means of setting the pointer to indicate the temperature of the instrument. The instrument temperature may be determined by using a check thermometer.

NOTE

Before making pointer adjustment the thermocouple leads must be disconnected.

The carburetor air mixture temperature indicator is for indicating the temperature of the carburetor intake air. A resistance-type bulb screwed into the top of the carburetor is interconnected with the indicating instrument on the front cockpit instrument panel.

(2) TROUBLE SHOOTING.

(*a*) MANIFOLD PRESSURE INDICATOR TYPE D-9 AND D-10.

Trouble	Possible Cause	Remedy
EXCESSIVE ERROR AT EXISTING BAROMETRIC PRESSURE.	Pointer shifted.	Reset pointer to ZERO position (atmospheric pressure) when engine is not running.
EXCESSIVE ERROR WHEN ENGINE IS RUNNING.	Line leak.	Tighten line connections.
SLUGGISH OR JERKY POINTER MOVEMENT.	Improper damping adjustment.	Adjust damping screw.
BROKEN OR LOOSE COVER GLASS.	Vibration. Excessive pressure.	Replace glass and reseat case.
DULL OR DISCOLORED LUMINOUS MARKINGS.	Age.	Replace instrument.
INCORRECT READING.	Moisture in line.	Open manifold pressure drain for short period at idling speed.

(*b*) TACHOMETER TYPE E-12.

Trouble	*Possible Cause*	*Remedy*
POINTER WON'T ZERO.	Maladjustment of adjusting screw.	Make correction with adjusting screw.
EXCESSIVE SCALE ERROR.	Weak magnets in generator.	Replace generator.
NO READING ON INDICATOR EITHER PERMANENT OR INTERMITTENT.	Break or short circuits in leads. Poor connections at indicator or generator terminals. Break inside indicator or generator circuits.	Repair. Clean and tighten terminals. Replace indicator or generator.
LOW READING ON INDICATOR EITHER PERMANENT OR INTERMITTENT.	Poor connections at indicator or generator terminals. Zero corrector screw off adjustment on indicator. Defective indicator pivots.	Clean and tighten terminals. Disconnect lead and reset pointer to zero. Replace indicator.
HIGH READING ON INDICATOR EITHER PERMANENT OR INTERMITTENT.	Zero indicator screw off adjustment on indicator. Indicator resistance off adjustment.	Disconnect lead and reset pointer to zero. Replace indicator.

(*c*) ENGINE GAGE UNIT FUEL PRESSURE.

Trouble	*Possible Cause*	*Remedy*
EXCESSIVE ERROR AT ZERO.	Pointer loose on shaft. Excessive overpressure.	Reset pointer and calibrate. Reset pointer and calibrate.
EXCESSIVE SCALE ERROR.	Excessive pressure. Excessive vibration. Improper calibration adjustments.	Calibrate and adjust. Calibrate and adjust. Make proper adjustments.
EXCESSIVE POINTER OSCILLATION.	Improper damping.	Disconnect line and drain; reconnect making sure there are no leaks. If trouble persists, work on relief valve.

(*d*) ENGINE GAGE UNIT OIL PRESSURE.

Trouble	*Possible Cause*	*Remedy*
EXCESSIVE ERROR AT ZERO.	Pointer loose on shaft. Excessive overpressures. Seasoning of bourdon tube.	Reset pointer and calibrate gage. Reset pointer and calibrate gage. Reset pointer and calibrate gage.
EXCESSIVE SCALE ERROR.	Improper calibration adjustment.	Adjust and calibrate gage.
EXCESSIVE POINTER OSCILLATION.	Improper damping or rough relief valve.	Disconnect line and drain. Reconnect. Check for leaks. If trouble persists, clean and adjust relief valve.
SLUGGISH OPERATION OF POINTER OR PRESSURE FAILS TO BUILD UP.	Low temperature of fluid in line.	Drain line and refill.

(*e*) ENGINE GAGE UNIT OIL TEMPERATURE.

Trouble	*Possible Cause*	*Remedy*
INSTRUMENT FAILS TO SHOW ANY READING.	Broken or damaged capillary.	Replace instrument.
EXCESSIVE SCALE ERROR.	Improper calibration adjustment.	Calibrate instrument and make proper adjustments.
JERKY POINTER ACTION.	Progressive restrainer out of adjustment.	Calibrate instrument and make proper adjustments.
POINTER FAILS TO MOVE AS ENGINE IS WARMED UP.	Broken or damaged capillary.	Replace instrument.
SLUGGISH POINTER MOVEMENT.	Restricted capillary.	Replace instrument.
DULL OR DISCOLORED LUMINOUS MARKINGS.	Age.	Replace instrument.

(*f*) FUEL AIR MIXTURE INDICATOR TYPE A-7 AND B-5.

Trouble	*Possible Cause*	*Remedy*
EXCESSIVE ERROR AT MECHANICAL ZERO.	Pointer out of adjustment.	Make proper adjustment.
INCORRECT READING.	Unbalanced resistance in junction box. Unbalanced resistance in cell. Burnt out resistance in analysis cell.	Make proper circuit adjustment. Make adjustment of electrical zero. Replace instrument.
FAILURE OF POINTER TO MOVE.	Broken electrical circuit.	Check continuity of wiring.
REVERSED READINGS.	Fouled filter or corroded cell. Reversed electrical connections.	Clean filter and leave current on with engine inoperative for two hours. Check electrical connections.

(*g*) THERMOCOUPLE INDICATOR TYPE B-9.

Trouble	*Possible Cause*	*Remedy*
FAILURE TO INDICATE CORRECT ENGINE TEMPERATURE.	Break in lead. Break in thermocouple. Break in indicator.	Replace. Replace. Replace and return indicator to service station.
LOW READING, EITHER PERMANENT OR INTERMITTENT.	Poor connection at thermocouple connectors. Poor connection in the indicator. Short circuit in leads. Short circuit at thermocouple leads. Short circuit at indicator binding posts.	Clean and tighten. Replace and return indicator to depot. Repair. Repair. Repair.
INSTRUMENT RECEDING REVERSED.	Reverse leads at instrument.	Check connections.

(*h*) CARBURETOR MIXTURE TEMPERATURE INDICATOR TYPE B-9 AND AN5790-6.

Trouble	*Possible Cause*	*Remedy*
BROKEN OR LOOSE COVER GLASS.	Excessive vibration.	Replace glass.
DULL OR DISCOLORED LUMINOUS MARKINGS.	Age.	Replace instrument.

(3) MAINTENANCE.

(*a*) TACHOMETER SHAFT.—Nonmagnetic tachometer shafts, being constructed of nonferrous materials, must not be subjected to extreme loads due to improper lubrication or to faulty installation. Clean the shaft and the case thoroughly with solvent and compressed air, and lubricate LIGHTLY as directed in the Lubrication Chart, in section III of this Handbook. After lubrication, protect from dust and dirt until installed. Broken shafts are not reparable and must be replaced with new parts. Installation of shaft and casing is of primary importance in assuring satisfactory operation and should be accomplished as follows:

1. The assembled shaft and casing during handling must not be bent in a circle of less than *6 inches diameter at any time.*

2. When installing or handling, the shaft and casing should not be subjected to an end pull of *more than 15 pounds.*

3. The shaft should be installed so that all bends are in as large a radius as possible and in no case shall the bend be less than 12-inch diameter circle at any point. The amount of protrusion of the shaft from the casing will vary with the number of bends in one casing combination. As the number of bends is increased, the protrusion is increased.

4. When completely installed, the key end of the shaft should protrude beyond the face of the casing not less than 9/16 inch or more than 1¼ inches. If the protrusion is less than 9/16 inch, the casing has been subjected to excessive end pull. This condition can be corrected by loosening the casing from its points of attachment and recoiling it in approximately 16-inch diameter loops before reinstalling. If the protrusion is more than 1¼ inches, the casing may be lengthened by flexing and pulling along its lengths to eliminate small bends and kinks.

5. If the shaft assembly is removed from the casing for any reason, care must be taken when reassembling to keep the shaft and casing free of dirt. When assembling a shaft, the casing must be straightened so that the shaft and fitting may pass through freely.

6. After the shaft is in place and secured, and before connecting to the engine and tachometer, it should be tested for free rotation.

e. MISCELLANEOUS INSTRUMENTS.

(1) DESCRIPTION.—A Type B-16 internally lighted compass is mounted on the instrument panel in each cockpit. The compass lights are individually controlled from each cockpit. An 8-day clock is mounted on the instrument panel in each cockpit. An ammeter is mounted on the control panel in the front cockpit only. The 12-volt airplane also has a voltmeter mounted on this control panel. The hydraulic pressure gage is mounted on the hydraulic shelf at the left side of the front cockpit. On later airplanes a direct reading free air temperature indicator is installed on the left side of the front cockpit just forward of the fluorescent light holding bracket. Twelve-volt airplanes were equipped with a temperature bulb-type indicator installed on the front cockpit instrument panel. Individually lighted fuel gages are installed at each side of the front cockpit seat on the right and left fuel tanks. The fuel gage lights are controlled from either cockpit, and the gages are visible from either cockpit. A radio marker beacon indicating light is installed on the front cockpit instrument panel in the 24-volt airplane only. (The 12-volt airplane does not have marker beacon equipment.) Twelve-volt airplanes were equipped with a camera signal indicating light on the front cockpit instrument panel. A fuel switch-over signal indicating light is installed on the front cockpit instrument panel in both the 12- and 24-volt airplanes.

(2) TROUBLE SHOOTING.

(a) COMPASS TYPE B-16.

Trouble	*Possible Cause*	*Remedy*
EXCESSIVE CARD ERROR.	Compass not properly compensated. External magnetic interference.	Compensate instrument. Locate magnetic interference and eliminate if possible.
EXCESSIVE CARD OSCILLATION.	Insufficient liquid. Excessive vibration of instrument mounting panel.	Replace instrument. Remove excessive vibration of instrument mounting panel.
CARD ELEMENT NOT LEVEL.	Leaking float chamber. Card magnets detached from card.	Replace instrument. Replace instrument.
CARD SLUGGISH.	Weak card magnets. Excessive pivot friction or broken jewel. Instrument heavily compensated.	Replace instrument. Replace instrument. Remove excessive compensation.
LIQUID LEAKAGE.	Loose bezel screws. Broken cover glass or case. Defective sealing gaskets.	Replace instrument. Replace instrument. Replace instrument.
DISCOLORED LUMINOUS MARKINGS OR DAMPING LIQUID.	Age.	Replace instrument.
DEFECTIVE LIGHT.	Burnt out lamp or broken circuit.	Replace lamp. Check continuity of wiring.

(b) HYDRAULIC PRESSURE GAGE TYPE E-4.

Trouble	*Possible Cause*	*Remedy*
EXCESSIVE ERROR AT ZERO.	Pointer loose on shaft. Excessive overpressure. Seasoning bourdon tube.	Reset pointer and calibrate gage. Adjust and calibrate gage. Adjust and calibrate gage.
EXCESSIVE POINTER OSCILLATION.	Improper damping.	Disconnect line to instrument and drain. Reconnect line and make sure there are no leaks.
EXCESSIVE SCALE ERROR.	Improper calibration.	Adjust and calibrate gage.

(3) DRIFT METER INSTALLATION.—Before installing the drift meter in the airplane, remove the fuselage opening plug by pulling on the handle located on the face of the plug. Depress with fingers the tension spring in the end of each channel rail, and slide the meter onto the rails provided for it. The detent (guide pin) in the center of each rail will drop into an alignment hole when the meter is correctly positioned.

11. SURFACE CONTROLS.

a. DESCRIPTION.—A complete set of controls is installed in each cockpit for operating the ailerons, rudder, elevator assembly, and trim tabs.

(1) CONTROL STICKS.—The hickory control sticks (aluminum-alloy tube in earlier airplanes), located in the conventional position in each cockpit, are mounted on an aluminum-alloy torque tube horn

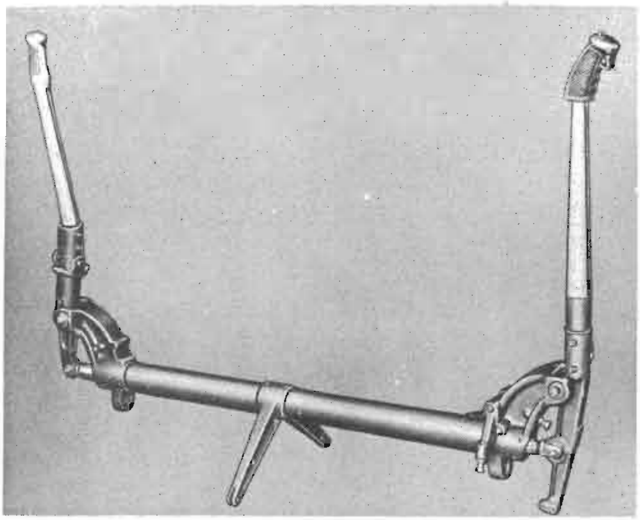


Figure 178 — Control Stick Torque Tube Assembly

assembly. Adjustable stops for the ailerons are provided on the torque tube horn assembly to limit the side movement of the sticks. Fore-and-aft movement of the control sticks, controlling the UP and DOWN movement of the elevator, is limited by an adjustable stop on either end of the aileron torque tube. (See figure 178.) Both sticks are connected by a push-pull rod passing through the aileron torque tube. A trigger-type electrical switch for firing machine guns is provided in the front of the handle on the front control stick while a push-type electrical button switch for releasing the bombs is centered in the top of this handle. The rear cockpit control stick may be removed by pulling aft on the lock plunger button at the base of the stick and may be locked in the stowage position at the left side of the cockpit by the same device. (See figure 179.)

CAUTION

Make certain the rear control stick is locked in the STOWED position when not in use.

(2) RUDDER PEDALS.—*(See figure 180.)*—Rudder control is obtained by rudder pedals located in the conventional position in each cockpit. They are connected with the rudder by cables. The steerable tail wheel cables are interconnected with the rudder cables by idler arms in the rear of the fuselage. The front and rear rudder pedal assemblies obtain a common balance through a rudder balance cable which, passing around two pulleys, connects both pedals of the rear

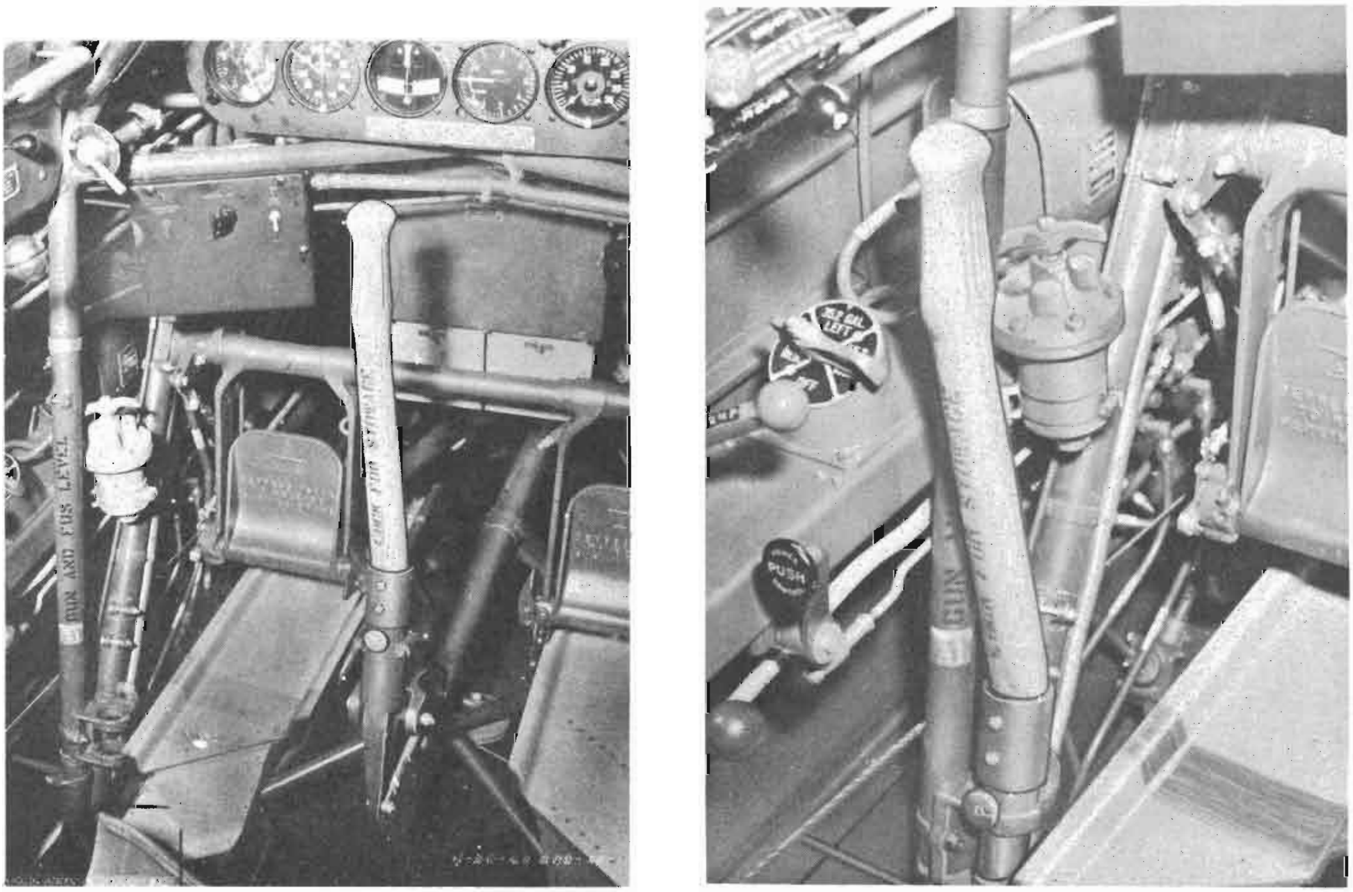


Figure 179 — Rear Cockpit Control Stick (Left and Right)

assembly. Balance of the rear pedals thus achieved is transmitted to the front pedals by connecting tubes. The tubes, attached to the outboard side of the pedals,

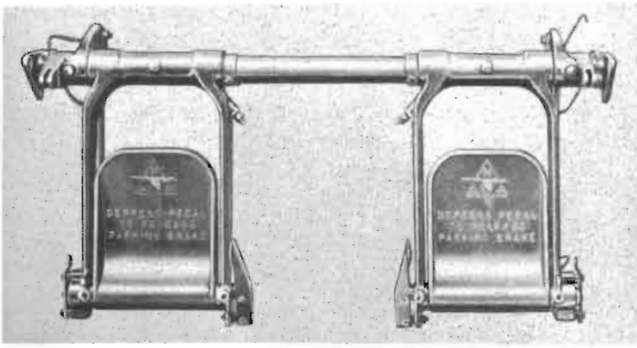


Figure 180 — Rudder Pedal Assembly

unite the respective right and left pedals of the front and rear pedal assemblies and provide an adjustment means to compensate for the pilot's leg length. This latter function is accomplished by a series of holes, the attachment points beginning at either end of the connecting tubes and extending a few inches along their length. By moving the point of attachment, the rudder pedals can be adjusted as desired. The pedals should be adjusted for proper leg length and the pedals checked to ascertain that they are adjusted so the pilot can easily maintain full rudder throw, especially when recovering from a spin. Adjustable stops are provided on either side of the lower rudder hinge support fitting on the vertical stabilizer rear spar to limit rudder movement. Brake control pedals are incorporated in the rudder pedal assemblies.

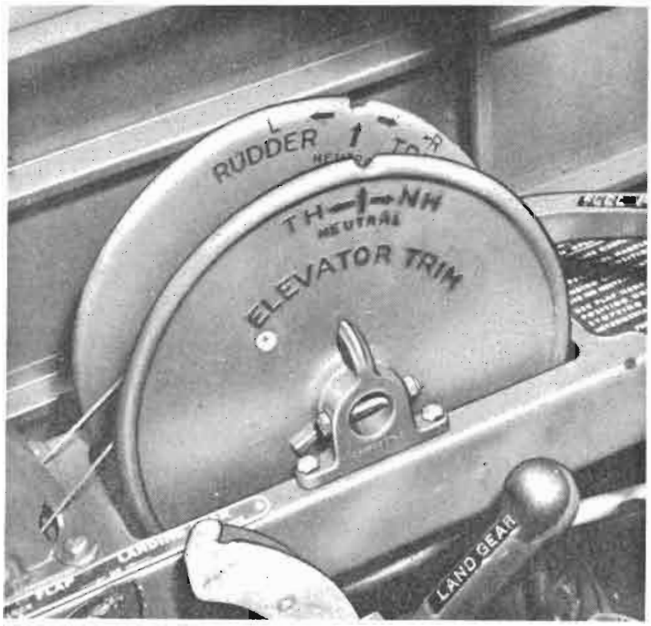


Figure 181 — Trim Tab Controls (Front Cockpit)

(3) TRIM TAB CONTROLS.—The aileron trim tabs, or the booster tabs installed on earlier airplanes, must be adjusted manually with the airplane on the ground. Elevator and rudder trim tabs are controlled by a system of cables and pulleys actuated by control wheels located at the left side of each cockpit. Trim tab control cables are connected with the trim tabs by means of a drum and tab operating mechanism located in the leading edge of each of the respective control surfaces. The

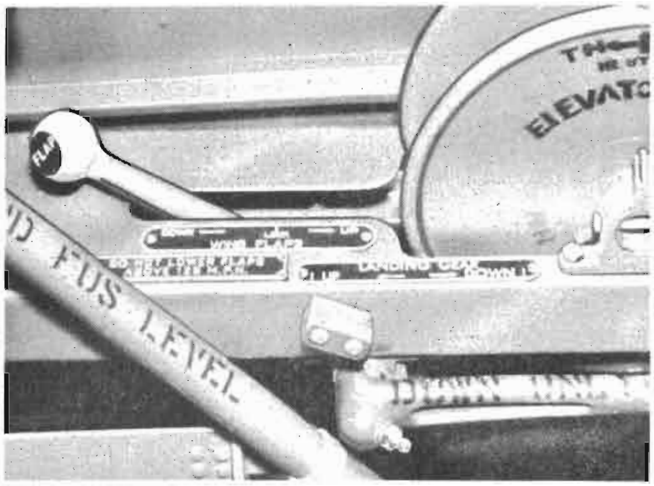


Figure 182 — Flap Control

tab mechanism is connected with the tab by a threaded push-pull rod assembly. Stops are provided on the control wheels in both cockpits. Neutral marks on control wheels when lined up vertically, locate the tabs. in a NEUTRAL position. The tabs should be adjusted as required to obtain directional and longitudinal trim of the airplane. Clockwise or counterclockwise rotation of the outboard wheel controlling the rudder tab compensates for directional instability to the left or right respectively. Clockwise or counterclockwise rotation of the inboard wheel which controls elevator tabs compensates for an existing tail-heavy or nose-heavy condition respectively.

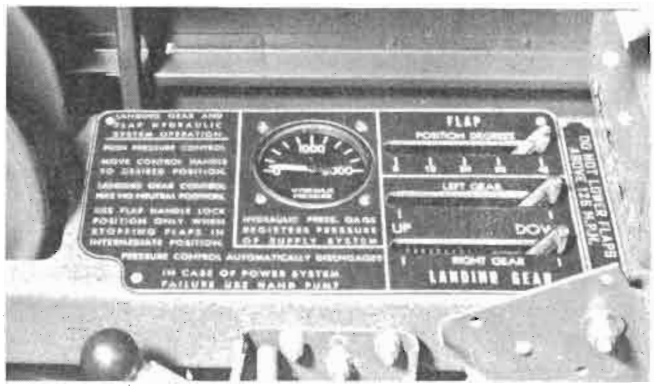


Figure 183 — Flap Position Indicator

(4) FLAP CONTROLS.—The split-type wing flaps are hydraulically operated. A flap control handle is mounted on the control shelf at the left side of each cockpit. The controls are interconnected with a hydraulic selector valve. The UP position of the flap control handle selects the UP position of the flaps and the DOWN position selects the DOWN position. The center LOCK position is used when it is desired to stop the flaps at any intermediate position between UP and DOWN. A flap position indicator is located at the left side of the front cockpit on the control shelf. In later airplanes, slight changes have been made in the rudder and aileron control systems to improve the spin characteristics of the airplane. Details of the wing flap hydraulic system are contained in section IV, paragraph 12.

(5) SURFACE CONTROL LOCK.—The surface control locking mechanism located left and forward of the control stick in the front cockpit locks the entire surface control system. To do this, place the rudder pedals in NEUTRAL, push the control stick forward, and center it laterally. Pull up and back on the lock handle assembly and engage the control stick in the lock recess; then engage the handle plunger in the locked position. To release, push forward on the control

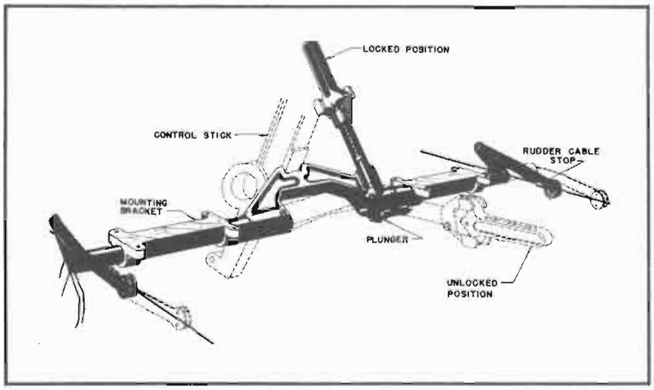


Figure 184 — Surface Control Lock Assembly

CABLE LOCATION	No. Reqd.	NAA Dwg. No.	Cable Dia.	Length in Inches	END FITTINGS	
Rudder Control Rear RH	1	88-52460-3	1/8	63-3/16	NAF310621-S21D-4LH	NAF310621-S21D-4LH
	1	*77-52460	1/8	63-5/32	NAF310621B-4	NAF310621-S21D-4LH
Rudder Control Rear LH	1	88-5240-2	1/8	63-11/16	AN668-4	NAF310621-S21D-4LH
	1	*66-52460	1/8	63-27/32	NAF310621-B-4	NAF310621-S21D-4LH
Rudder Control Intermediate RH	1	88-52479	1/8	56-11/16	NAF310621-B-4	NAF310621-S21D-4RH
Rudder Control Intermediate LH	1	88-52477	1/8	83-5/8	NAF310621-B-4	NAF310621-S21D-4RH
Rudder Control Front RH	1	38-52490	1/8	106-7/16	AN668-4	NAF310621-S21D-4LH
	1	*88-52478	1/8	107-7/16	NAF310621-B-4	NAF310621-S21D-4LH
Rudder Control Front LH	1	88-52491	1/8	79-17/32	AN668-4	NAF310621-S21D-4LH
	1	*88-52476	1/8	80-17/32	NAF310621-B-4	NAF310621-S21D-4LH
Rudder Balance	1	88-52461	3/32	112-7/16	AN668-3	AN669-53LH 23-52464 (Stop) 23-52453 (Stop)
	1	*66-52461	3/32	111-9/16	NAF310621-B-3	NAF310621-S16D-3LH 23-52464 (Stop) 23-52453 (Stop)
Rudder Trim Rear	1	66-52538	1/16	194-5/8	BI284-6	
Rudder Trim Intermediate Upper	1	88-52562	1/16	56-31/32	BI284-RH	NAF310621-8D-2RH
Rudder Trim Intermediate Lower	1	88-52563	1/16	66-15/16	BI284-RH	NAF310621-8D-2LH
Rudder Trim Front	1	88-52561	1/16	218-17/32	AN666-8D-2LH	AN666-8D-2RH
Elevator Control Rear	2	77-52219	1/8	45-19/32	NAF310621-B-4	NAF310621-S21D-4LH
Elevator Control Intermediate Upper	1	88-52229	1/8	93-13/32	NAF310621-S21D-4LH	NAF310621-S21D-4RH
Elevator Control Intermediate Lower	1	88-52226	1/8	102-7/16	NAF310621-S21D-4RH	NAF310621-S21D-4RH
Elevator Control Front Upper	1	88-52228	1/8	78-25/32	NAF310621-B-4	NAF310621-S21D-4RH
Elevator Control Front Lower	1	88-52227	1/8	111-1/2	NAF310621-B-4	NAF310621-S21D-4LH
Elevator Trim Rear	2	66-52527	1/16	231-1/8	BI284-L	AN111-3
Elevator Trim Intermediate Upper	1	88-52565	1/16	39-5/64	NAF310621-C-2	NAF310621-8D-2LH
Elevator Trim Intermediate Lower	1	88-52566	1/16	33-27/64	AN667-2	AN669-2
Elevator Trim Front	1	88-52564	1/16	231-1/2	AN666-8D-2LH	AN666-8D-2RH
Aileron Control Outer Wing Rear	2	88-52313	1/8	76-15/32	AN668-4	NAF310621-S21D-4LH
	2	*66-52313	1/8	69-15/32	AN668-4	NAF310621-S21D-4LH
Aileron Control Outer Wing Front	2	88-52312	1/8	74-23/32	AN668-4	NAF310621-S21D-4LH
	2	*66-52312	1/8	67-21/32	AN668-B-4	NAF310621-S21D-4LH
Aileron Control Wing Center Section Rear	2	66-52311	1/8	90-5/32	B1277-4	NAF310621-S21D-4RH
Aileron Control Wing Center Section Front	2	66-52310	1/8	92-13/32	B1277-4	NAF310621-S21D-4RH
Flap Position Indicator	1	55-52629	1/16	77-7/16	AC066135	25-33526
Tail Wheel Control	2	88-34012	5/32	33-5/32	NAF310621-B-5	NAF310621-S32D-5LH

*Used on Earlier Airplanes

Figure 185 — Chart of Control Cables

handle; then push the lock mechanism forward into the stowed position. The lock mechanism should be stowed in the lockdown position when not engaged with the control stick.

(6) BEARINGS.—Sealed-type ball bearings incorporated in all pulleys, bell cranks and control surface hinge points with the exception of wooden trim tabs which utilize Ledaloyl self-lubricating hinge bearings.

(7) CABLES.—All primary surface control cables are 1/8 inch diameter, with the exception of the rudder pedal equalizer cable which is 3/32 inch diameter. All trim tab control cables are 1/16 inch diameter.

b. MAINTENANCE REPAIRS.

(1) MINOR DAMAGE.—When broken wires are found in the cables of the trim tab control system or the main control system, where such breakages occur in that length of cable normally passing over a pulley or through a fairlead, they should be cut off short and served or soldered to the cable.

Figure 186 — Turnbuckle Safety Requirements

AILERONS
Cockpit—Left Horn on Torque Tube
Cockpit—Right Horn on Torque Tube
Wing—Forward Horn
Wing—Rear Horn

ELEVATORS
Control Stick Socket (Front)
Control Stick Socket (Rear)
Lower Horn (Nose Down)
Upper Horn (Nose Up)

ELEVATOR TRIM TABS
Forward Cable (Referred to Cockpit Drum)
Rear Cable (Referred to Cockpit Drum)

RUDDER
Left Horn (at Rudder)
Right Horn (at Rudder)

RUDDER TRIM TABS
Forward Cable (Referred to Cockpit Drum)
Rear Cable (Referred to Cockpit Drum)

TAIL WHEEL
Left Horn (at Cable)
Right Horn (at Cable)

*Applicable to earlier airplanes equipped with bellcranks, not later models having quadrants.

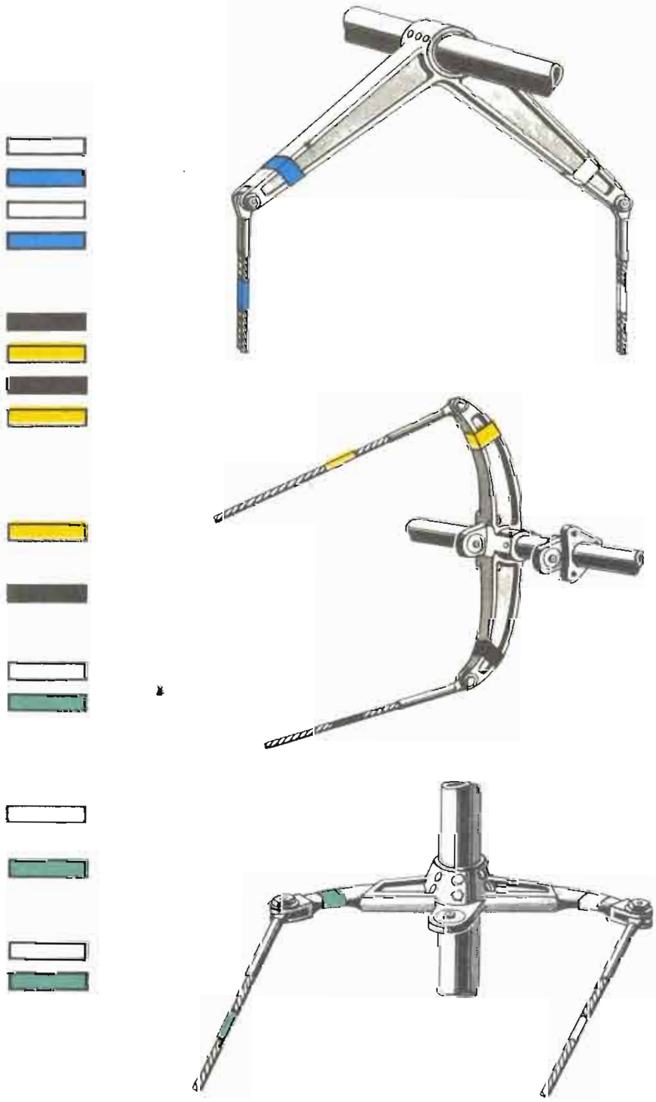


Figure 187 — Control Cable Color Band Chart

(2) CABLE REPLACEMENT.

(a) Cable replacement is necessary when broken strands exceed the maximum of seven broken wires along a straight uninterrupted length. Wherever possible, therefore, duplicate spare cables should be utilized for replacements. No difficulty should be experienced when installing control cables in the field. It is impractical to swage a replacement cable and for this reason they are manufactured with one end swaged while the other end is unfinished except for a drop of solder to keep the strands from fraying. When the cable is to be installed, the unfinished end is threaded through drum holes, pulleys, fair-leads, etc., as the case may be, while the swaged end is secured to its proper connection. The opposite end, before being connected, is fitted with the proper size bearing and the cable end secured around the latter by splicing and soldering. Wherever possible, use the bearing from the replaced cable to finish the raw end of the new one. Secure the bearing by splicing and soldering in the manner the bearing was secured to the old cable.

(b) The ends of rudder and elevator trim tab drum cables should be equidistant from their respective drums before either end is connected to fuselage cables. Drops of solder should be applied to the cables at the inside of the drum holes to keep them from slipping on the drums. Following this operation the trim tab cables are wrapped around the drums and passed into the fuselage for the proper connection.

(c) All cables and splices should be tested for proper strength prior to installation. They should be arranged to simulate installation, including pulleys where required and gradually tested by applying a load to one end of the cable for a period of 3 minutes. A suitable guard should be placed over the cable while it is being tested to prevent personal injury in the event of cable failure. The test load should be applied to cables as follows:

Cable Size	Load in Pounds
1/16	300
3/32	550
1/8	1150
5/32	1550

(3) COLOR MARKINGS.—To facilitate rigging and adjustment procedure, color markings for cables, cranks, and horns should be used to identify control cables and horns or arms to which they are attached. The width of each color in the marking band should be 1/2 inch. Cables may be banded with cellulose tape in appropriate colors and coated with clear lacquer approximately 1/2 inch behind each wrap. Horns and arms should be banded with lacquer in appropriate colors approximately 1/2 inch below the fork to which cables attach.

NOTE

Band at both sides of all turnbuckles.

(4) RUST PREVENTION.

(a) On airplanes operating from extremely dusty landing fields or through dusty (desert) areas, control cables will be thoroughly cleaned where they pass over pulleys, or through fair-leads, and at other points of contact throughout the airplane, and will not be coated with lubricant or rust preventive compound.

(b) In coastal or insular areas where conditions are conducive to corrosion, clean cables at points of contact and coat with rust-preventive compound, Specification No. AN-C-52.

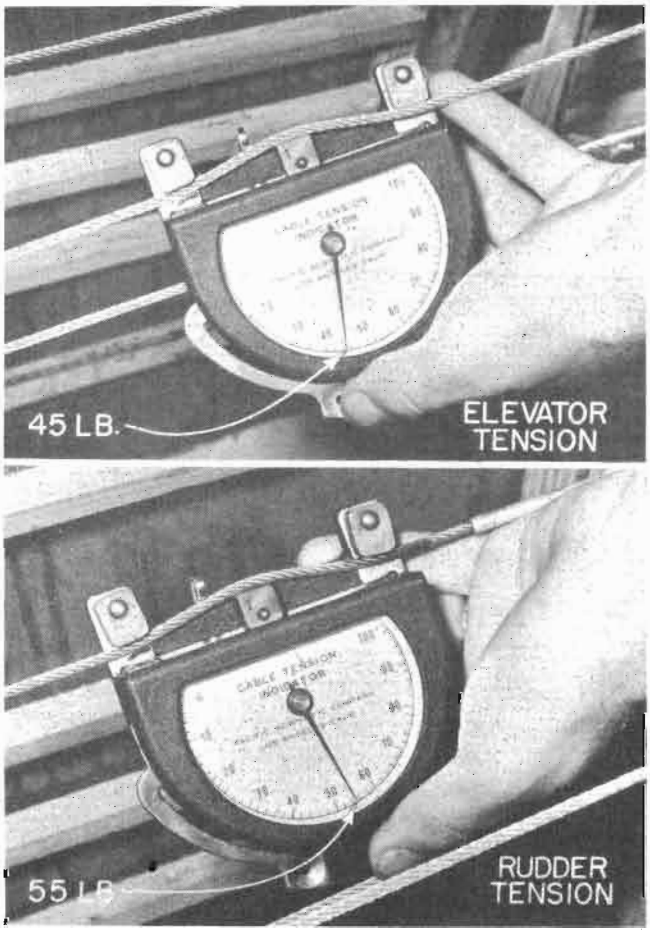


Figure 188 — Cable Tension Adjustment

c. RIGGING AND ADJUSTMENT.

NOTE

After performing any cable rigging operation, always ascertain that the cables are not crossed. Make a complete check for any other obstacle to proper cable operation.

(1) GENERAL.

(a) It is to be noted that control cable tensions will vary considerably with changes of air temperature. Cable tensions should be checked more frequently where these conditions are encountered and adjusted to com-

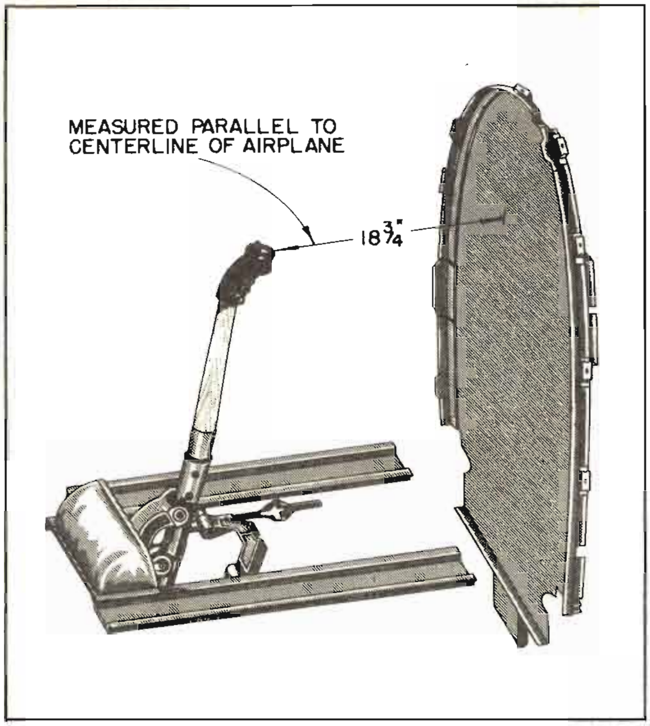


Figure 189 — Control Stick Forward Throw

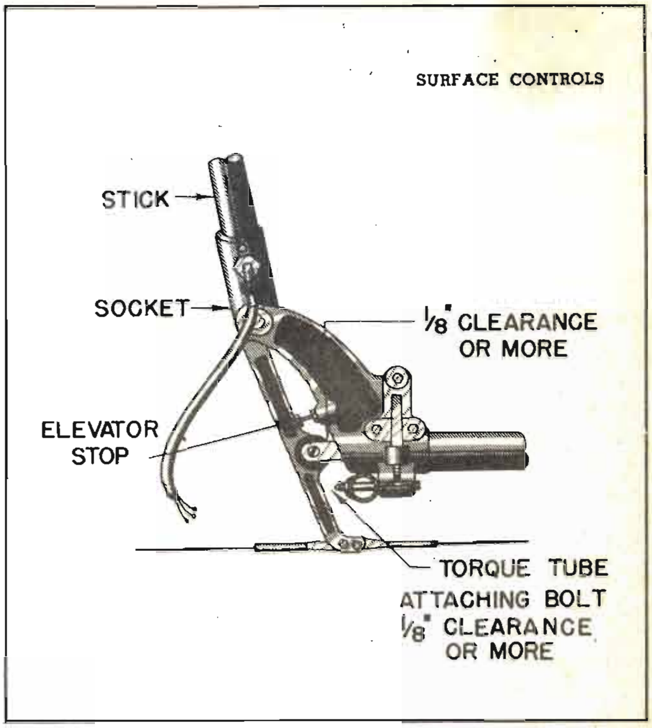


Figure 190 — Control Stick Clearance Check

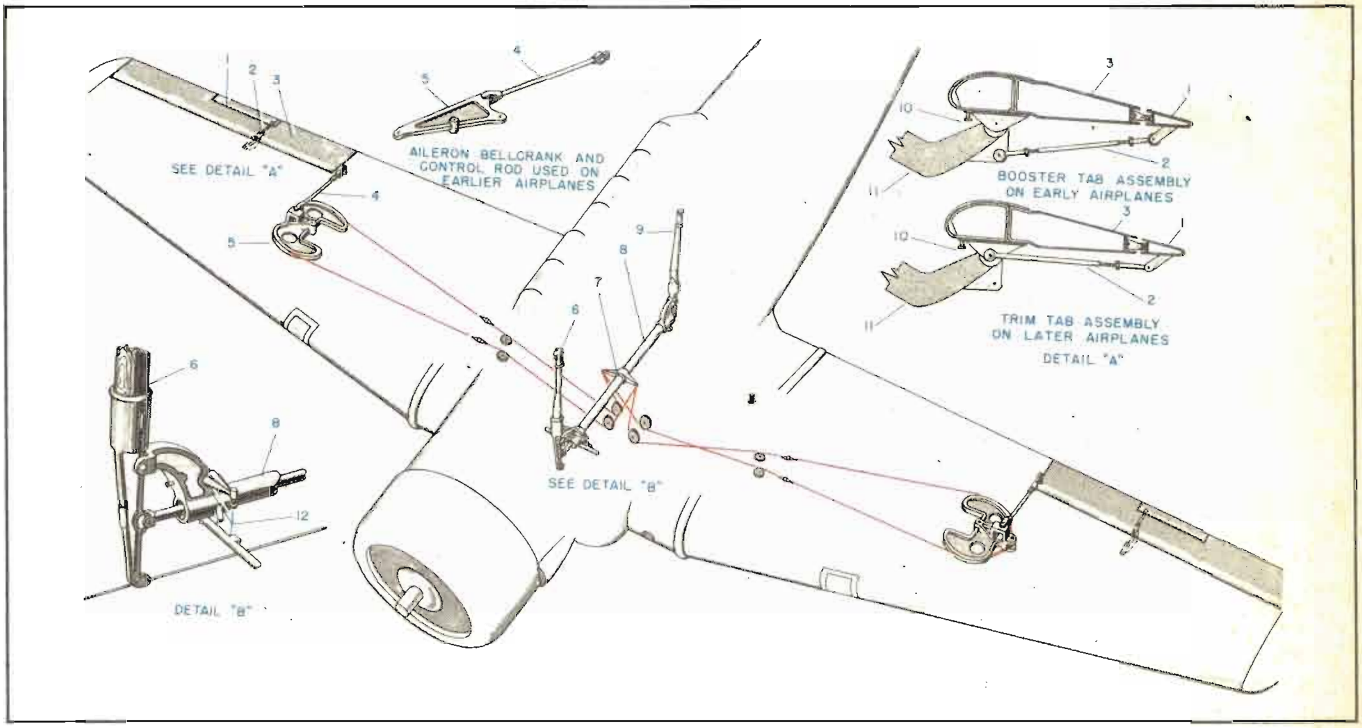


Figure 191 — Aileron Control System Diagram

1. Aileron Trim-Booster Tab
2. Trim-Booster Tab Connecting-Push-pull Rod
3. Aileron
4. Aileron Quadrant-Bellcrank Control Rod
5. Aileron Quadrant-Bellcrank
6. Front Control Stick
7. Aileron Torque Arm
8. Aileron Torque Tube
9. Rear Control Stick
10. Aileron Hinge Stop
11. Aileron Hinge Bracket
12. Aileron Torque Tube Stop Assembly and Stop Lug

pensate for the temperature changes. Cables should be rigged to the proper tension when the air temperature is as close as possible to the temperature at which the airplane is to be flown and is uniform for the whole airplane; that is, when one side of the airplane is not exposed to the hot sun. A tension tolerance of plus or minus 5 pounds is all that is permissible.

(b) Control cable turnbuckles are considered safe provided not more than four threads are exposed. All turnbuckles should be safetied with four to six turns of .040 inch brass wire. The adjustable rods and fittings are provided with safety holes. The threads of the adjustments must completely cover these holes in order to maintain the thread safety factor of the adjustment.

(c) Cable tensions are as follows:

Cable	Tension in Pounds
Elevator	45
Elevator trim tabs	20
Rudder	55
Tail wheel	20
Rudder trim tab	20
Aileron	45

(2) AILERON CONTROLS.—Prior to rigging the ailerons, the surface control lock must be adjusted to hold the control stick vertical in relation to the transverse leveling brackets of the airplane. Also ascertain that the aileron cables are properly attached to their respective bell cranks (quadrants in later airplanes) and are located over pulleys and through fair-leads as required.

(a) With the aileron cables disconnected at the wing joint bolting angles, adjust the aileron control rods to obtain an angular aileron setting of 16 degrees ($4\frac{1}{4}$ inches) below the trailing edge of the outer wing panels. Access to the adjustable end of the control rods is gained through access holes located on the lower surface of the outer panels directly forward of each aileron inboard hinge. When accomplishing this action, be sure the bell cranks or quadrants are parallel to the adjacent ribs representing the wing station lines, and see that the control racks are not fouled.

(b) Connect the aileron cables at the wing joint bolting angles by means of turnbuckles. Match the cables by matching corresponding identification colors. Access to the turnbuckles is gained through access holes located on the lower surface of the outer panels directly outboard of the bolting angles.

(c) By means of the turnbuckles, obtain a cable tension of 45 pounds; at the same time, locate the neutral static position of the ailerons which is one degree or $\frac{1}{4}$-inch below the trailing edge of the outer panels. (See figure 192.)

(d) Screw in the center hinge stop on each aileron sufficiently to prevent its interference with proper aileron movement. (See following NOTE.)

(e) Unlock the surface controls to obtain an angular aileron movement of 29 degrees ($8\frac{1}{2}$ inches)

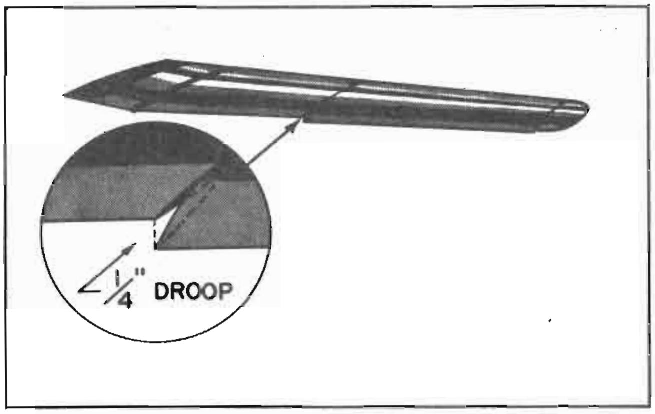


Figure 192 — Aileron Neutral Static Position

up from the trailing edge of the outer panels by means of the adjustable stops on the control stick torque tube. Access to the stops is gained in the front cockpit below the torque tube guard. Hold each aileron in the UP position by means of the control stick; adjust the aileron hinge stop to obtain a clearance of approximately $\frac{1}{32}$-inch between the stop and the aileron hinge bracket. (See figure 193.)

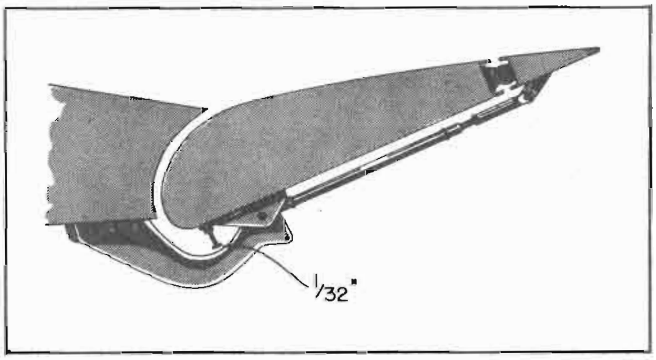


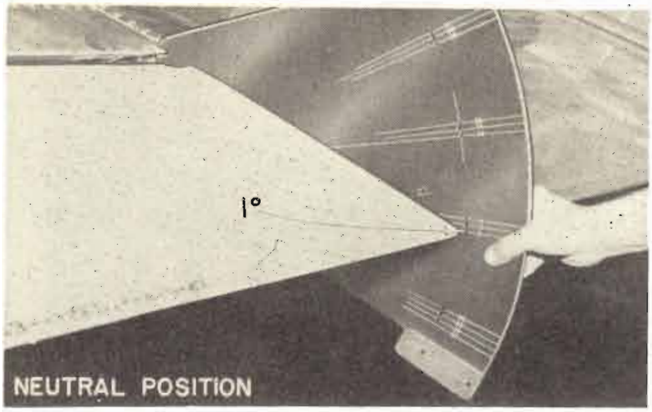
Figure 193 — Aileron Hinges Stop Clearance

(f) Securely tighten all lock nuts after the adjustments have been made.

(g) The ailerons should now have an angular movement of 15 degrees or $4\frac{1}{4}$ inches "DOWN" and 30 degrees or $8\frac{3}{8}$ inches UP from the "NEUTRAL" static position, (figure 194) for model AT-6A, AT-6B, AT-6C and SNJ-3 airplanes, (except airplanes designated in following NOTE)

NOTE

FOR MODEL AT-6C AIRPLANES BEARING SERIAL NUMBERS 42-49005 TO 42-49069 INCLUSIVE, AND 42-43847 TO 42-44425 INCLUSIVE, AND ALL AT-6D AND SNJ-5 AIRPLANES, THE SAME GENERAL DIRECTIONS APPLY. Following the instructions outlined in paragraphs (a), (b), (c) and (d), unlock the surface controls to obtain an angular aileron movement of 14 degrees (4 inches) up from the trailing edge of the outer panels, as



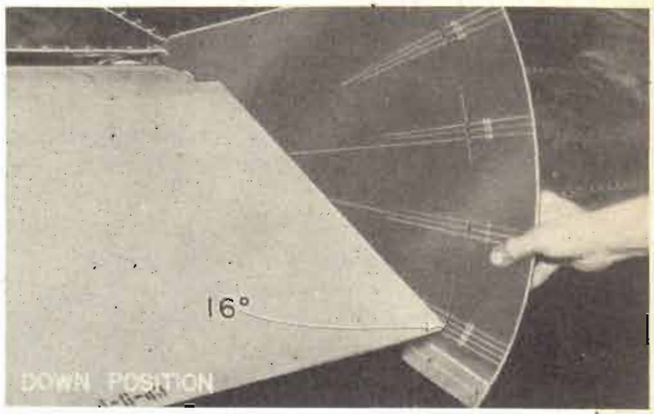


Figure 194 — Aileron Angular Travel

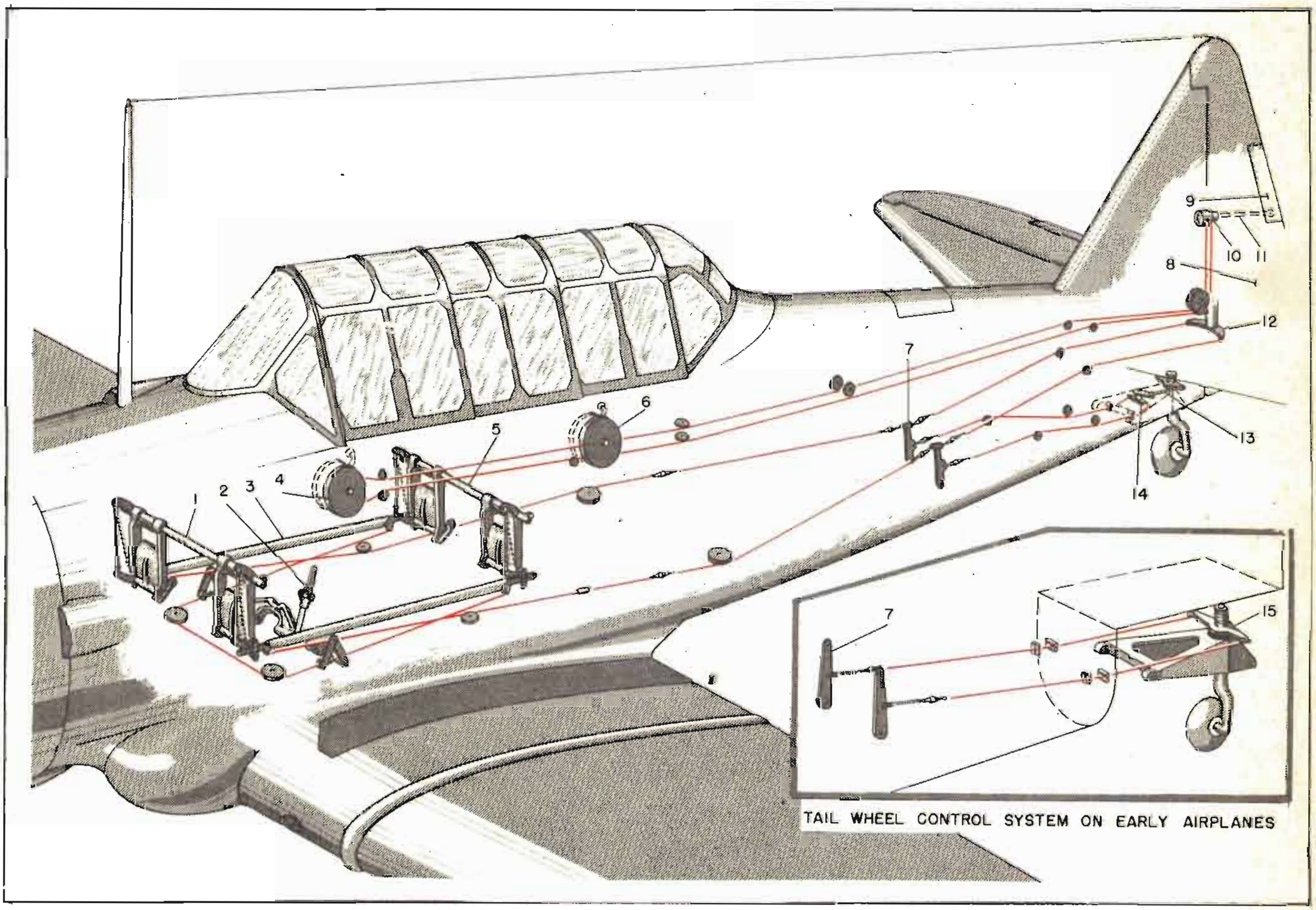


Figure 195 — Rudder Control System Diagram

1. Front rudder pedal assembly
2. Surface control lock
3. Rudder pedal connecting tube
4. Front trim tab control wheel
5. Rear rudder pedal assembly
6. Rear trim tab control wheel
7. Rudder cable idler arm
8. Rudder
9. Rudder trim tab
10. Trim tab drum
11. Trim tab push-pull rod
12. Rudder horn
13. Bellcrank linking rod
14. Bellcrank assembly
15. Post assembly

described in paragraph *(e)*. Observe directions in paragraph *(f)*. The ailerons should now have an angular movement of 15 degrees or $4\frac{1}{4}$ inches "UP" and "DOWN" from the neutral static position.

(3) RUDDER CONTROLS.—Prior to rigging the rudder, see that the elevators and surface control lock are properly adjusted.

(a) Ascertain that the rudder cable is properly attached to its fittings and the rudder control horn, and that the cable is properly positioned over the pulleys, guards, and through fair-leads as required.

(b) Support the tail section of the airplane by means of the jacking pad provided to hold the tail wheel strut at $3\frac{1}{4}$ inches from the top of the strut to the packing gland nut.

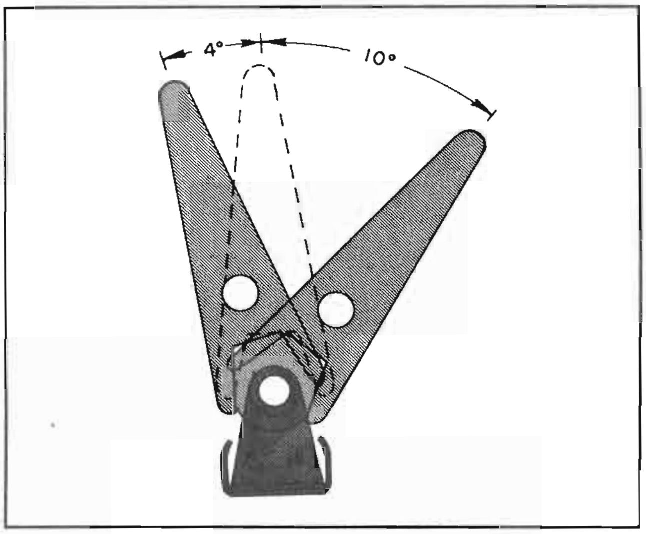


Figure 196 — Rudder Tab Angular Travel

(c) Engage the surface control lock so that the rudder pedals will be held in neutral to facilitate the adjustment of the rudder and tail wheel assemblies.

(d) Tighten the rudder and tail wheel cables simultaneously by means of the turnbuckles, to obtain a tension of 55 pounds on the rudder cables forward of the idler arms and of 20 pounds on the tail wheel cables.

(e) Let out and take up equal amounts on the left and right turnbuckles, respectively, in order to position the rudder in direct alignment with the vertical stabilizer and the tail wheel in direct alignment with the centerline of the fuselage.

(f) Place a protractor device on the rudder, unlock the surface controls and, by means of the stops located on the extrusions at the bottom of the vertical stabilizer rear spar, set the limit of rudder angular movement as follows:

For AT-6C airplanes, serial number 42-49005 to 42-49069 and 42-43847 to 42-44425, and for all AT-6D airplanes, the angle of rudder travel is 30° left and 30° right.

For all other airplanes of the AT-6 series the angle of rudder travel is 35° left and 35° right.

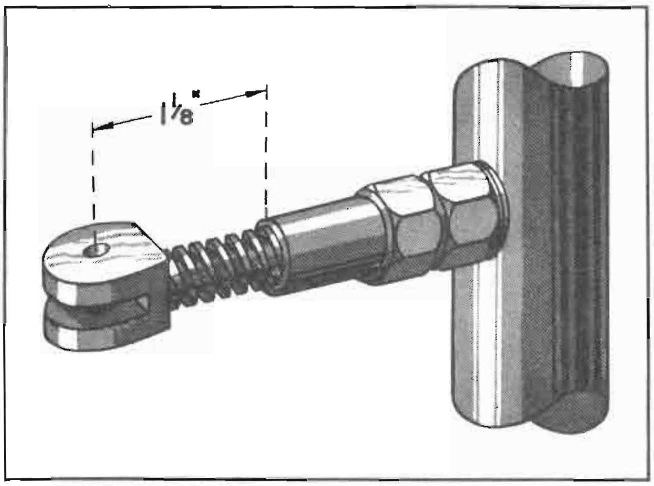


Figure 197 — Rudder Tab Drum Adjustment

(4) ELEVATOR CONTROLS. — Elevator stops for limiting the UP and DOWN movement of the elevator are located in the forward-and-aft cockpits respectively at the ends of the torque tube. The proper adjustment of the control stick interconnecting tube is $45\frac{3}{4}$ inches measured between the attachment point centers. It is to be noted, however, that neither the elevator stops nor the control stick interconnecting tube should be readjusted after replacement of the cable or elevator sections. Prior to rigging the elevator ascertain that the cable is properly connected to the forward cockpit control stick socket and the elevator control horn. Also, see that the cable is properly positioned over pulleys and through the fair-leads as required.

(a) Hold the elevator in alignment with the horizontal stabilizer; tighten the cable to 45 pounds cable tension by means of the turnbuckles located in the aft section of the fuselage.

(b) Release the elevator; adjust the forward elevator stop to obtain a distance of $18\frac{3}{4}$ inches measured between the extreme forward edge of the control stick grip and the aft side of the fire wall.

(c) After making this adjustment, ascertain that the forward control stick socket clears the torque tube and torque tube attachment bolt by at least $\frac{1}{8}$ inch.

(d) Place a protractor device on the elevator. Let out and take up the cable turnbuckles in equal amounts, as required to obtain a 20-degree DOWN movement of the elevator from the position in alignment with the horizontal stabilizer, and maintain the proper cable tension with the stick in the full forward position.

(e) Pull back on the control stick; adjust the elevator stop in the rear cockpit to obtain a 30-degree UP movement of the elevator.

(f) Securely lock the stop adjustment lock nuts; safety the turnbuckles.

(5) AILERON TAB CONTROLS.—Adjust the trim tab connecting rod at each aileron to align the tab

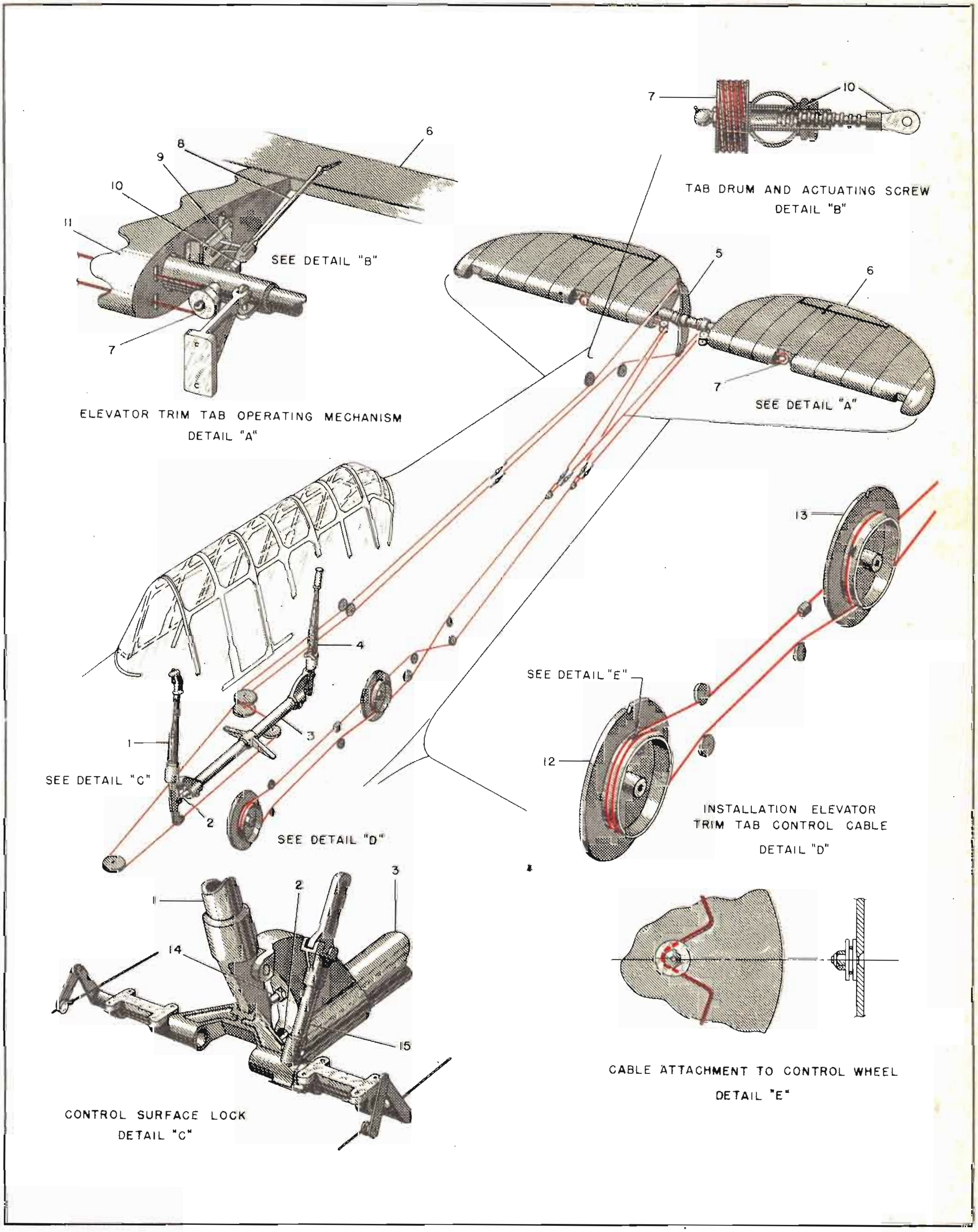


Figure 198 — Elevator Control System Diagram

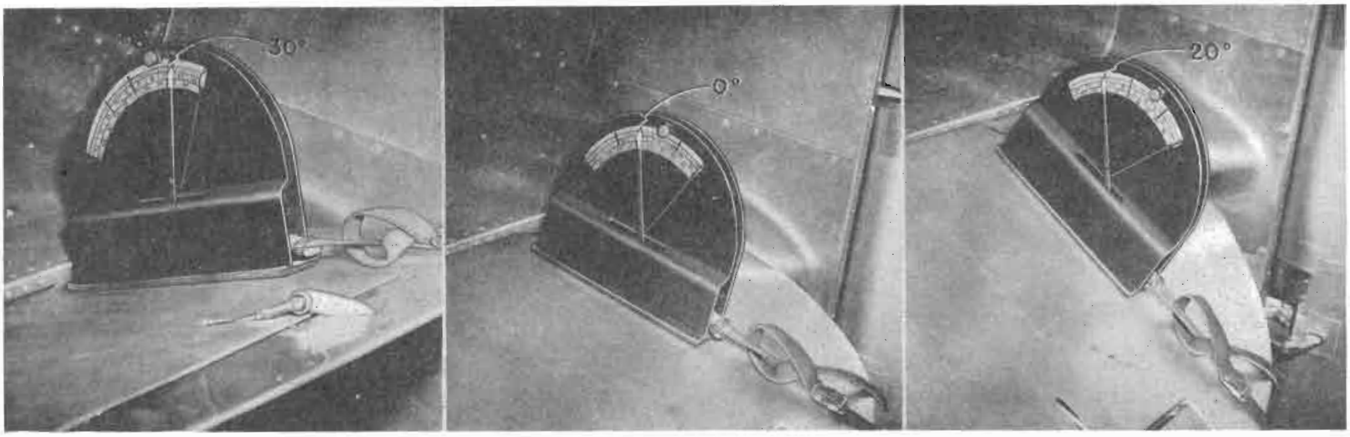


Figure 199 — Checking Elevator Angular Travel

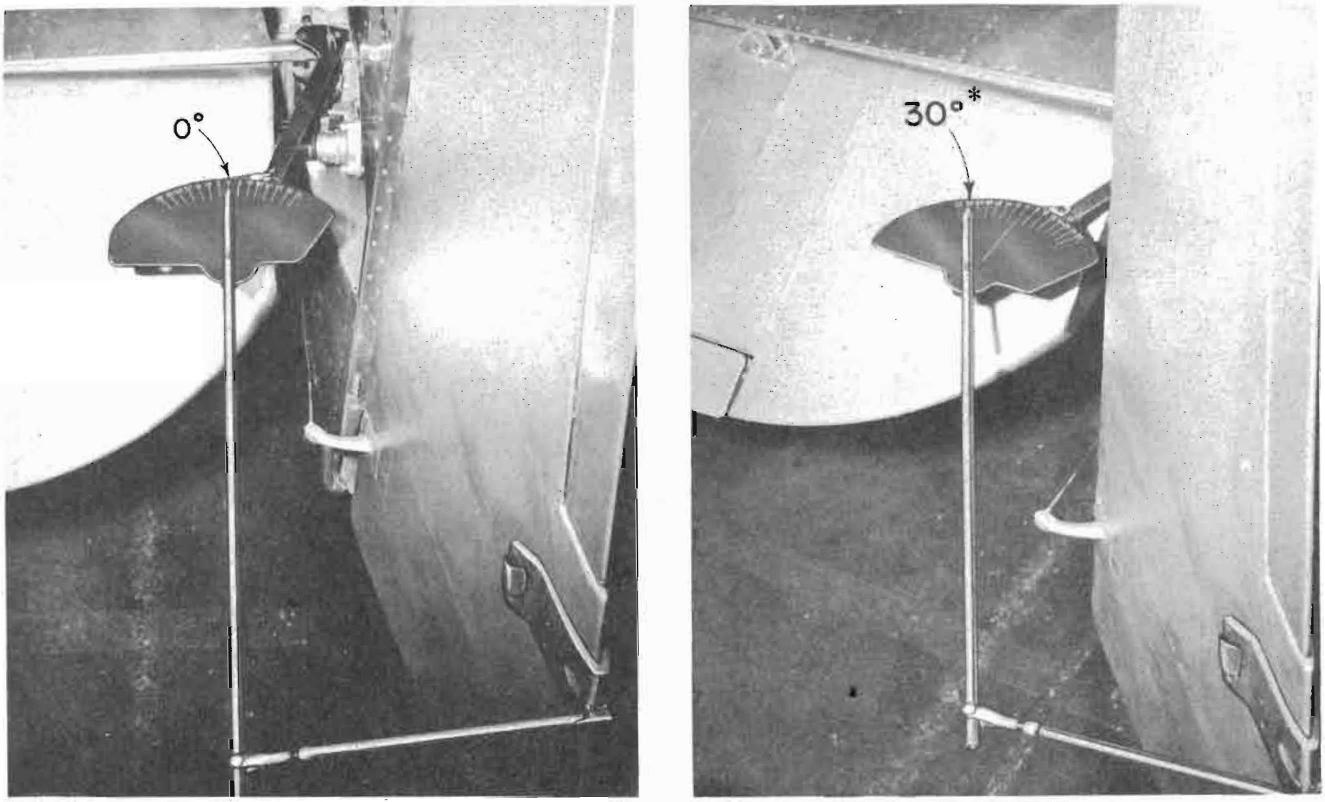


Figure 200 — Checking Rudder Angular Travel (Left and Right)

*Applicable to model AT-6C airplanes serial number 42-49005 to 429069 inclusive, and 42-43847 to 42-44425 inclusive, and to all model AT-6D airplanes. All other airplanes: 35°.

with the aileron. Final adjustment of the tab can be accomplished after flight-testing the airplane. On earlier airplanes having booster tabs, adjust the tab actuating rod at each aileron when the aileron is positioned in direct alignment with the trailing edge of the outer panel. It is important that the adjustment *not* be accomplished with the aileron in the NEUTRAL static position; that is, 1/4 inch below alignment with the outer panels. However, the booster tabs or trim tabs may be used to compensate for wing heaviness by lengthening or shortening the actuating rods. Final adjustment of this tab may also be made after flight-testing the airplane.

NOTE

To stay within the safety requirements when adjusting the aileron tab connecting rod, do not rotate it more than 3¾ turns either way from neutral; that is, when the tab, either trim or booster type, is in direct alignment with the aileron.

(6) RUDDER TRIM TAB CONTROLS.—Before proceeding with any adjustments, ascertain that the forward section of the trim tab control cable is properly positioned around the control wheels, wheel locks, and

pulleys and through fair-leads and lightening holes in the fuselage bulkheads.

(a) Extend the cable ends along the left side of the fuselage; hold or tie them so they will be even, taut, and in their approximate normal position.

(b) Skid the control wheels so as to place their respective notched neutral marks at the top vertical position; tighten the control cable locks by means of the screw, nut, and washers on the wheels.

(c) Hold the cable ends taut. Then permitting them to move, rotate the control wheels against the non-adjustable stops which limit the movement of the rudder trim tab to 4 degrees to the RIGHT and 10 degrees to the LEFT.

(d) Before making the necessary connections, be certain the rear section of the trim tab drum cable is properly secured by drops of solder at the drum holes to prevent it from slipping on the drum, that it is correctly wrapped around the drum grooves, and that the drum cover is installed to prevent the cable from unwinding.

(e) Connect the forward and rear sections of the drum cable by means of turnbuckles and by matching corresponding colors.

(f) Ascertain that the cable is properly positioned in the drum grooves by rotating the control wheels. If it is not, it may be positioned with a screw driver while the control wheels are slowly rotated.

(g) Adjust the turnbuckles simultaneously to obtain a cable tension of 20 pounds.

(h) Adjust the tab drum actuating screw to obtain approximately 1⅛ inches between the centerline of the hole in the clevis and the end of the drum sleeve. Adjust and tighten the two large nuts on the drum sleeve to allow the washer behind the nuts to turn without any lost fore-and-aft motion of the drum sleeve.

(i) Do not set the lock nuts too tightly, as binding in the tab actuating screw will result.

(j) Set the control wheels to NEUTRAL.

(k) Equally adjust both ends of the tab control rod to position the tab in alignment with the rudder when the rod is connected to the actuating screw and the tab.

(l) Connect the rod to the actuating screw.

(m) Connect the rod to the tab.

(7) ELEVATOR TRIM TAB CONTROLS.—Before proceeding with any adjustments, determine whether the forward trim tab control cable is in proper position around the control wheels, wheel locks, and pulleys, and through the fair-leads and lightening holes in the fuselage bulkheads.

(a) Extend the cable along the left side of the fuselage; hold or tie the ends so they will be even with each other, taut, and in their approximate normal positions.

(b) Skid the control wheels so as to place their respective notched neutral marks at the top vertical position. Tighten the control cable locks by means of the screws, nuts, and washers on the control wheels.

(c) Hold the cable ends taut, and permitting them to move, rotate the control wheels against the nonadjustable stops which are located on the forward wheel and which limit the movement of the elevator trim tab to 8 degrees UP and 16 degrees DOWN.

(d) Before making the necessary connections, see that the rear trim tab drum cables are properly secured by drops of solder at the drum holes to prevent them from slipping on the drums, that they are correctly wrapped around the drum grooves, and that the drum covers are installed to prevent the cables from unwinding.

(e) Making sure the drum cables are around their respective pulleys, connect them to the fuselage cables by means of links and turnbuckles. Connect the cables by matching corresponding colors. Ascertain that the cables are properly positioned in the drum grooves by rotating the control wheels. If they are not, they may be positioned in the grooves with a screw driver while the control wheels are slowly rotated.

(f) Adjust the turnbuckles simultaneously to obtain the cable tension of 20 pounds.

(g) Adjust the tab drum actuating screw to obtain approximately 1⅛ inches between the center line of the clevis hole and the end of the drum sleeve to allow the washer behind the nuts to turn without any fore-and-aft lost motion of the drum sleeve. Do not set the lock nuts too tightly, as binding in the tab actuating screw will result.

(h) With the tab control wheel set at NEUTRAL, adjust both ends of the tab control rod to position the tab in alignment with the elevator when the rod is connected to the actuating screw, clevis, and the tab.

(i) Connect the rod to the actuating screw.

(j) Connect the rod to the tab.

(8) FLAPS.—Adjust the flap panels to obtain an angular movement of 45 degrees from the UP position to the DOWN position. The flap panels must close securely and simultaneously without binding or warping. Prior to rigging the flap panels, the hydraulic system must be operable by means of the hand pump. The flap push-pull rods must be rigged in conjunction with the flap operating cylinder equalizer arm and rods.

(a) Determine an approximate basic setting of $\frac{9}{16}$ inch between the inboard end of the right push-pull center section rod and the lock nut when in its secured position by rotating the rod.

(b) Disconnect the left equalizer rod, ascertain that the center section flap panel is in its full DOWN position by operating the hand pump with the flap control handle in the DOWN position, and relocate the rod.

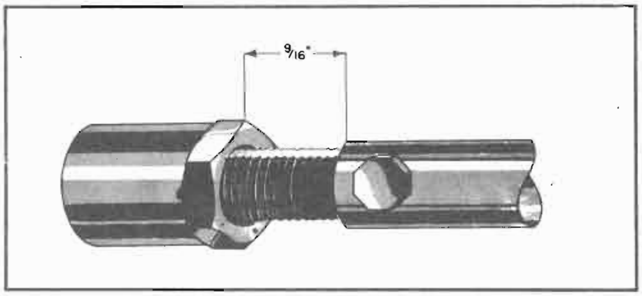


Figure 201 — Flap Push-Pull Rod Adjustment

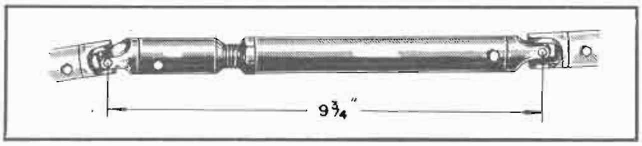


Figure 202 — Push-Pull Rod Universal Joint Adjustment

(c) Place a protractor device on the lower surface of the center section and the flap panel. Obtain the proper DOWN position by means of the turnbuckles connecting the flap to the push-pull rods.

(d) Check for a movement of 2⅜ inches of the push-pull rods by marking a line on the rods even with the surface of the center section end plates, moving the flap to the UP position and measuring the amount of rod movement. If the flap does not close evenly, take up and let out equal amounts on the adjustment of the right push-pull rod and left equalizer rod, respectively, or vice versa as required, to maintain the proper movement of the push-pull rods and to correct the error. Adjustment of the turnbuckles corrects any error of binding, warping, or insecure closing.

(e) Connect the outer panel push-pull rods to those of the center section by means of the universal joints and links. Obtain an initial setting of 9¾ inches between the universal joint attaching holes of the center section and outer panel push-pull rods.

(f) Connect the outer panel turnbuckles to the push-pull rods; make the necessary adjustments. If the flap panels do not close evenly, let out one turn on the push-pull rod adjustment and take up two turns on the turnbuckles, respectively, or vice versa as required, to correct the error.

(9) SURFACE CONTROL LOCK.—Before adjusting the surface control lock mechanism for the fore-and-aft position, adjust the turnbuckle on the rudder pedal balance cable to obtain the exact vertical position of the rudder pedal assemblies with the required tension on the rudder cables and with the rudder pedal adjustment plungers in the center adjustment holes.

(a) Loosen the lock contact stops on the rudder pedal balance cable to prevent interference during the stick-lock adjustment, which must be accomplished beforehand.

(b) Place the control stick in full forward position, centering it laterally.

(c) Engage the control lock in the locked position by lifting up on the handle and moving it back until the plunger is engaged.

(d) Move the control lock assembly forward or in the pilot's floor assembly as required.

(e) Tighten the screws holding the lock assembly to the floors when the desired engagement with the control stick is obtained.

(f) Check the control stick to ascertain that it is being held in the exact vertical position in relation to the airplane's transverse leveling brackets.

(g) If the stick is not vertical, loosen the clamps securing the aft end of the floor assemblies and move them to the side required.

(h) Retighten the clamps when the correct position of the stick is obtained and the control lock has no lost motion to either side and does not bind between the floor assemblies.

(i) Place a bar across the forward rudder pedals; secure them in neutral.

(j) With the control lock in its locked position, move the balance cable stops against the lock mechanism arms and tighten them slightly.

(k) Release the lock mechanism, move each cable stop forward 1/16 inch, and tighten them securely.

(l) Lock the surface controls; check for loose motion at the stops by moving the rudder pedals.

12. HYDRAULIC SYSTEMS.

NOTE

The hydraulic systems of all airplanes in the AT-6 series are essentially similar except for the selector valve unit and the wing flap auxiliary or ratchet valve. In AT-6 and AT-6A airplanes, the landing gear and the flap selector valve unit is N.A. Drawing No. 66-58011, while the selector valve in later models is N.A. Drawing No. 88-58011. AT-6 airplanes have wing flap auxiliary valve N.A. Drawing No. 55-58014. AT-6A and SNJ-3 have flap ratchet valve N.A. Drawing No. 66-58070. AT-6B, AT-6C, AT-6D, and Navy models SNJ-4 and SNJ-5 have flap ratchet valve N.A. Drawing No. 78-58070.

a. GENERAL.—Two individual hydraulic systems are incorporated in the airplane; namely, the main and the brake hydraulic systems. Each is treated separately in the text. However, the following general maintenance instructions are applicable to both systems.

(1) GENERAL MAINTENANCE DATA.—Access to all of the hydraulic units, with the exception of the engine-driven pump, landing gear and flap operating cylinder, and most brake system units, is gained by re-

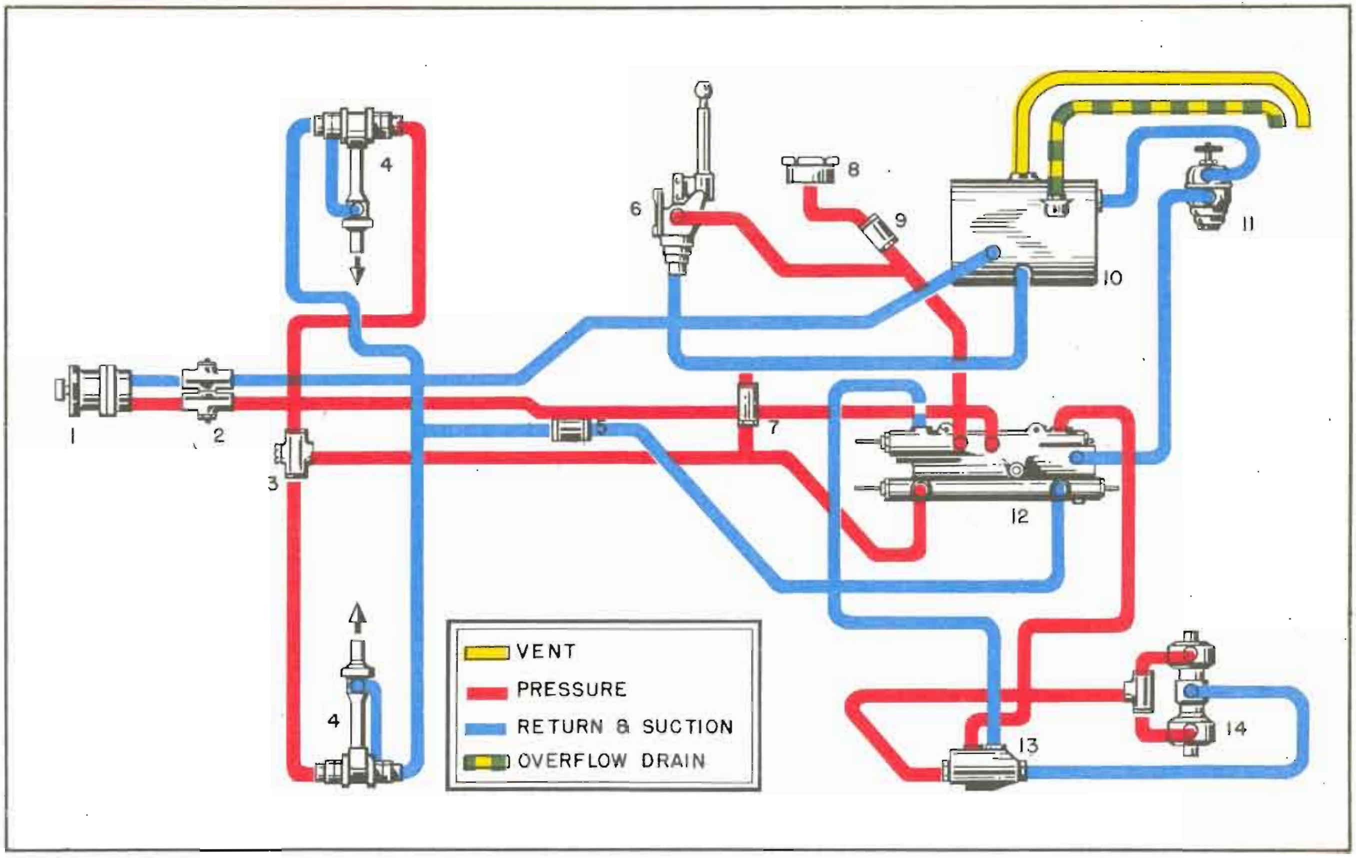


Figure 203 — Main Hydraulic System Flow Diagram

1. Engine-driven Pump (Page 150)
2. Test Connections
3. Drain Plug
4. Landing Gear Operating Cylinders (Page 158)
5. Restrictor Valve (Page 163)
6. Emergency Hand Pump (Page 160)
7. One-way Check Valve
8. Pressure Gage
9. Snubber Valve
10. Reservoir
11. Filter
12. Selector Valve (Page 153)
13. Ratchet Valve (Page 155)
14. Flap Operating Cylinder (Page 156)

moving the left-side panel from the forward section of the fuselage. Particular care should be exercised in seeing that the packing cups and rings are not damaged as they are withdrawn from the assembly. A visual inspection of some of the units in the hydraulic systems will readily determine the procedure to be followed in removal and disassembly; therefore, detailed instructions for the disassembly of these units are omitted. Reference to each exploded view of the assembly should clarify the disassembly and assembly procedure. After disconnecting hydraulic lines involved, plug the ends to prevent the entrance of foreign matter. As each of the hydraulic units is removed and disassembled, the component parts should be thoroughly cleaned. Bushings, springs, rubber washers, packing cups, rings, gaskets, etc., should be thoroughly inspected for deterioration, wear and damage. Replacement of parts is not necessary unless they are in poor condition. Prior to reassembly of a unit, thoroughly flush all lines. It is also important that the component parts of all hydraulic units be thoroughly cleaned and coated with hydraulic fluid prior to reassembly. All units in the hydraulic systems should be cleaned with kerosene or naphtha. For replacement of packings and gaskets, refer to the applicable Illustrated Parts Catalog. Most replacements will consist of gaskets and packings only. The majority of the units are replaced as an assembly should extensive damage and wear occur.

(2) REPLACEMENT OF SEALING MEDIUMS. —Replacement of parts or complete assemblies is necessary when adjustment will not correct leakage. Replacement of chevron rings and external seals of the landing gear operating strut piston rod, the wing flap piston rod, the hand-pump piston rod, and the selector valve plungers is not necessary unless the leak cannot be eliminated by adjustment of the respective packing nuts. Caution should be exercised, however, in tightening these nuts. They should be only slightly tighter than finger-tight. The seal of the pressure control plunger in the selector valve unit cannot be improved by tightening the nut. Leakage of internal parts is indicated by slow action of the operating units or complete malfunctioning. Parts to be replaced may be determined by the location of the leakage. A visual inspection of the location

where leakage is occurring and of attaching and surrounding parts will determine to what extent disassembly is necessary in order to accomplish replacement. If replacement is accomplished without removal of the unit, care should be taken to see that the mechanism is kept clean and free of foreign substances. Prior to installation, parts (except butadiene packing cups) should be thoroughly cleaned with kerosene or naphtha and coated with hydraulic oil as used in the hydraulic system. Replace gaskets that are in poor condition. During assembly, make certain that all sealing mediums, retainers, guides, pins, washers, etc., are properly installed and safetied as required. After the assembly of any unit, or part of a unit, it should be pressure-tested. Refer to the ensuing paragraphs for sealing medium requirements and pressure-testing.

(3) CLEANING.—Prior to reassembly of a unit, or installation of parts, thoroughly flush all lines and clean and coat the parts with hydraulic fluid. Clean hydraulic system with kerosene or naphtha only after all packing cups have been removed.

WARNING

Do not use kerosene, naphtha, or other cleaning solvents unless all packing cups have been removed, as these solvents may cause deterioration of the packing material. Packing cups may be cleaned with a clean lint-free cloth. During assembly make certain that all parts are correctly installed and locked as required. There must not be any leaks. All tube fittings for the hydraulic system are of the triple-compression type, which uses a sleeve under the tubing nut.

NOTE

When flaring new tubing, the proper flaring tool should be used and care exercised so that no burrs are left on the end of the tubing and that flared ends are not cracked. See section VIII for tube-bending data. Hydraulic lines are identified by a band of light blue on each side of a yellow band.

CAUTION

In all work involving the replacement of hydraulic tubing, use as few bends and restricting fittings as possible in order to minimize line pressure losses. Make the bend radius as large as possible. Check the installation carefully to see that all connections are tight and that all tubing is properly supported.

(4) TESTING.—For testing the hydraulic system, a suction line disconnect block and a pressure line disconnect block are incorporated in the suction and pressure lines of the hydraulic system, and are attached to the lower left tube of the engine structure. Remove the plugs from the disconnect blocks; connect the test equipment. Wherever a hydraulic unit is disassembled,

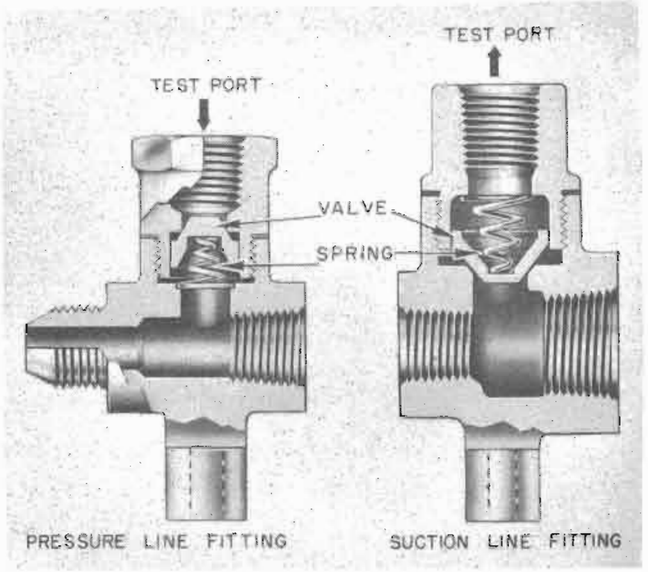


Figure 204 — Test Connections

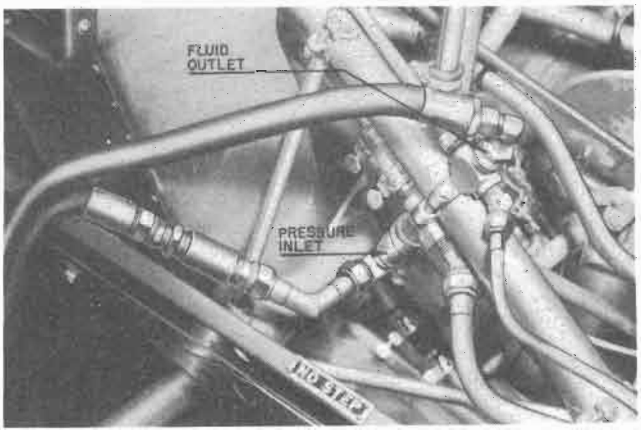


Figure 205 — Test Connections Installed

repaired, parts or cups replaced, or merely inspected, it should be pressure-tested after assembly. The tests require a high pressure hand pump, pressure gage (3000 pounds), fluid reservoir, and the necessary lines and fittings.

(5) HYDRAULIC FLUID.

NOTE

Refer to section III, paragraph 3, for instructions on servicing the main and brake hydraulic systems.

—Main Hydraulic System—Use only mineral base fluid AAF Specification No. 3580 (AN-VV-O-366) Red Color.

—Brake Hydraulic System—Use only vegetable base fluid AAF Specification No. 3586 Blue Color.

(a) HANDLING.—Every precaution must be observed in handling hydraulic fluid to prevent its contamination. The storage containers should be kept sealed. All handling equipment must be kept clean and should be used for handling hydraulic fluid only. Do not expose hydraulic fluid to the air longer than absolutely necessary. The fluid will absorb dust and grit from the air, and in certain localities this constitutes a serious menace.

(b) FILTERING.—Fluid that has been exposed to dust or other contamination should be filtered before using. Fluid that has been used should also be filtered before reuse. Filtering will remove the sludge from used fluid, as well as all metal flakes and grit. The simplest equipment for filtering hydraulic fluid consists of a ribbed glass or metal funnel of approximately 1-gallon capacity, a sheet of standard commercial filter paper, and a container to support the funnel and contain the filtered fluid. The filter paper is folded into a funnel shape and placed in the funnel. The oil passes through the filter slowly and should be protected from contamination by dust particles in the air. A cloth dampened in hydraulic fluid placed over the open end of the container will protect the filtered fluid during the operation. The filtered fluid should be placed in a clean container, properly marked to identify the contents, and kept sealed until required for use.

(6) FILLING MAIN HYDRAULIC SYSTEM WITH TEST STAND.—To fill the hydraulic system when ground test stand equipment is available, proceed as follows:

NOTE

It is not necessary to fill the hydraulic fluid reservoir before proceeding with the following instructions.

(a) Place the airplane on jacks and visually inspect all hydraulic pipe connections.

CAUTION

DO NOT use a wrench on any of the nuts unless they show leaks after the system has been filled with fluid.

(b) Remove the two plugs from the ground test connections on the lower left-hand engine mount tube. Connect the pressure line of the test equipment to the upper disconnect block and the suction line to the lower block.

(c) Place a clean container under the hydraulic fluid reservoir vent pipe located on the fuselage at the left wing trailing edge.

(d) Circulate fluid through the system until approximately one-half gallon has overflowed into the container.

(e) During the foregoing operation, operate the hydraulic hand pump to free this portion of the system from air.

NOTE

In case the hand pump does not take hold of fluid immediately, prime the pump by blowing air from a high-pressure air hose into the reservoir vent pipe, being particularly careful to hold the end of the hose at a distance of not less than 3 inches from the end of the vent tube, as excessive air pressure will damage the reservoir.

(f) With the ground test stand stopped, proceed to operate the landing gear and flaps several times by use of the hand pump to free these parts of the system from air locks. During these operations, pipes and equipment should be inspected for leaks and the proper fluid level maintained in the reservoir.

(g) Shut off test stand reservoir flow to the test pump so as to circulate only such fluid as is now in the system of the airplane. Start the test pump and operate the landing gear and flaps several times. During these operations, note the hydraulic gage pressure reading. This reading should be 1000 pounds per square inch after the landing gear or flap movement has been completed and before the pressure control starts to disengage. To correct variations of the above pressure, it will be necessary to adjust the system pressure relief valve.

(h) Stop the test pump, disconnect the ground test equipment, and replace and safety the plugs.

(i) Check the fluid level in the reservoir; replenish if necessary. Also, turn the strainer control handle at least one full turn before the airplane is placed in service.

(j) Ascertain that the landing gear control handle is placed in the "DOWN" position and that both landing gear legs are locked in the extended position. Take the airplane off the jacks and start the engine.

(k) Test the engine pump by operating the flaps only. In case no pressure is obtained from the engine pump with the engine running, loosen the pressure pipe at the pump to determine if the pump is operating. If the pump is not operating, remove and inspect for damage to the drive mechanism.

(7) FILLING MAIN HYDRAULIC SYSTEM WITH AIRPLANE HAND PUMP.—To fill the hydraulic system when there is no ground test pump equipment available, use the hand pump. Proceed as follows:

(a) Place the airplane on jacks and visually inspect all hydraulic pipe connections.

CAUTION

DO NOT use wrench on any of the nuts unless they show leaks after the system has been filled with fluid.

(b) Fill the fluid reservoir to overflowing.

(c) Operate the flaps and the landing gear separately several times by setting the control handles to either the "UP" or "DOWN" position and using the hand pump.

NOTE

If at the beginning of the above operation it is noticed that the hand pump does not take hold of fluid immediately, prime the pump by blowing air from a high-pressure air hose into the reservoir vent pipe, being particularly careful to hold the end of the hose at a distance of not less than 3 inches from the end of the vent tube, as excessive air pressure will damage the reservoir.

(d) Refill the fluid reservoir to overflowing.

(e) Ascertain that the landing gear control handle is placed in the "DOWN" position and that both landing gear legs are locked in the extended position. Take the airplane off the jacks and start the engine.

(f) Test the engine pump by operating the flaps only. In case no pressure is obtained from the engine pump with the engine running, loosen the pressure pipe at the pump to determine if the pump is operating. If the pump is not operating, remove and inspect for damage to the drive mechanism.

(g) As a final step, recheck the fluid reservoir; replenish, if necessary. Also turn the strainer control handle one full turn before the airplane is placed in service.

(8) DRAINING MAIN HYDRAULIC SYSTEM.—Complete drainage of the hydraulic system cannot be accomplished from any one point. However, to remove a considerable portion of the fluid (mainly that contained in the fluid reservoir), place the tail of the airplane slightly above the level flight position, and disconnect the aft line of the lower test pump connection block mounted on the left side of the engine mount. Approximately one-half gallon of fluid will be obtained from this point. With the landing gear control handle in the "DOWN" position, further drainage may be accomplished by placing a receptacle under the drain tee fitting on the landing gear hydraulic line, located in the left landing gear retracting well, and removing the cap. Using the hand pump, remove the balance of the fluid. The total capacity of the hydraulic system is approximately 11 pints, including the reservoir, lines, and the various units. The fluid that remains in the system may be drained from the various units as they are removed from the airplane.

WARNING

DO NOT operate the hand pump when any part of the hydraulic system is disconnected, except as noted above.

(9) ASSEMBLY OF HYDRAULIC UNITS.—Reference to the exploded view of the assembly will help to clarify the procedure and sequence to be followed in assembling the component parts. Exercise particular care to make certain that none of the synthetic rubber packing cups and rings are cut or damaged in any way when assembling the cups or rings themselves or an assembly on which they are attached. It is advisable to use shim stock to protect the rings from sharp corners when installing them in the assembly. All male fittings should be tinned before assembly. The application of white petroleum jelly (vaseline) is imperative before the tinned fittings are screwed into their female ports or "B" nuts. When flaring tubing, the proper flaring tool should be employed and care should be exercised to see that no burrs are left on the ends of the tubing. All parts of the assembly should be thoroughly cleaned with naphthalene or kerosene before assembly. Before assembling internal parts, coat them with hydraulic fluid to prevent scoring during assembly. Safety all drilled nuts and studs with lock wire; install the unit on the airplane using the anti-seize compound mentioned above on all male fittings. Excessive torque must not be applied to "B" nuts and fittings during assembly.

b. MAIN HYDRAULIC SYSTEM.—This hydraulic system is provided to operate the up and down movement of the wing flaps and landing gear.

(1) ENGINE-DRIVEN HYDRAULIC PUMP.

(a) DESCRIPTION.—A Pesco pump, model IP-263-E, is used in the system. This gear-type hydraulic pressure pump is mounted on the left side of the engine accessory case and is the normal source of energy for the hydraulic system. The pump is designed for one direction of rotation (clockwise) and is capable of operating under pressure of 500 to 1000 pounds per square inch for brief intervals. Hydraulic fluid is drawn from the reservoir into the engine-driven pump and is directed to the discharge port by means of a set of two closely meshed gears. The drive gear is coupled with the power take-off of the engine and furnishes energy to rotate the driven gear which is closely meshed in with the drive gear. Clearance between the two gears does not permit the fluid to flow directly between them, but diverts the flow around the gears in the direction in which they rotate. Thus the flow to the pressure line is actuated. The gear supporting bushings allow fluid to flow to either end of the gears and back into a section of the intake port channels in the bushings. Back pressure at the ends of the gears is also relieved through these channels. A ball-type check valve (spring loaded) encased in the drive gear keeps the pump primed with hydraulic fluid to prevent air from being drawn through when pump is first started. In the event the pressure check valve becomes inoperative, fluid would rush back into the pump causing possible damage to the mechanism; however, this possibility is eliminated by means of a shear coupling on the rotor assembly, which acts as a shear pin that renders the pump inoperative when excessive load is put on the pump.

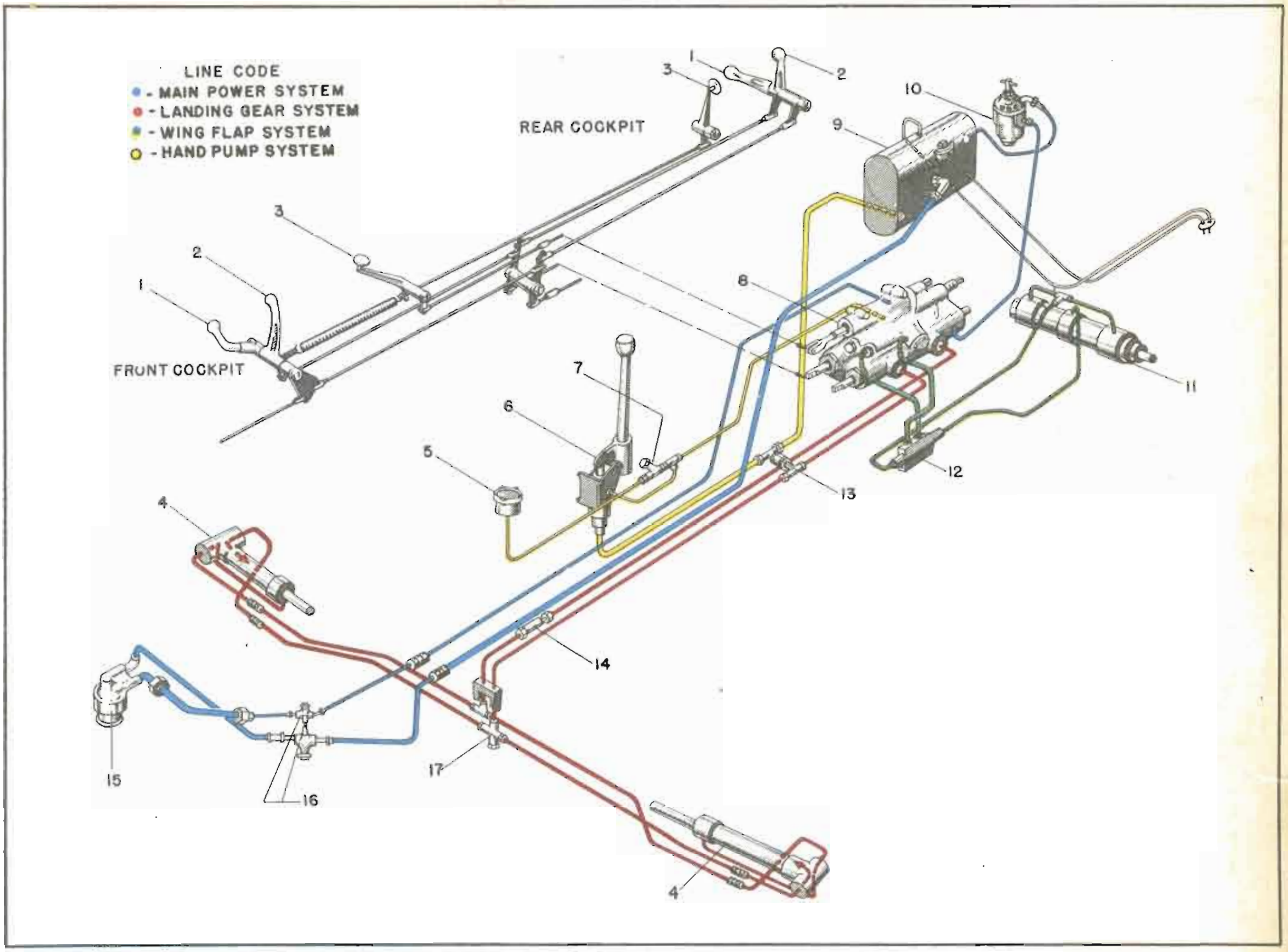


Figure 206 — Main Hydraulic System

1. Landing Gear Controls
2. Flap Controls
3. Power Controls
4. Landing Gear Operating Cylinders
5. Pressure Gage
6. Emergency Hand Pump
7. Snubber Valve
8. Selector Valve
9. Reservoir
10. Filter
11. Flap Operating Cylinder
12. Flap Ratchet Valve
13. One-way Check Valve
14. Restrictor Valve
15. Engine-driven Pump
16. Test Connections
17. Drain Plug

(b) REMOVAL.—The engine-driven hydraulic pump is mounted on the left side of the engine accessory section. To remove, first disconnect the two hydraulic lines attached to the inlet and outlet ports of the pump, then remove the four lockwired nuts which hold the pump body flange to the engine accessory section studs.

(c) TEST BEFORE INSTALLATION.—In the event that slow action in operating the hydraulic system cannot be traced to malfunction of other units of the system, the engine-driven pump is probably at fault, because of excessive wear. The pump should be removed and tested at 2200 rpm for an output of from ¾ to 1 gallon-per-minute and a pressure of 500 pounds per square inch.

(d) INSTALLATION.—Pumps in storage are filled with engine oil, so it is necessary to drain and flush with hydraulic fluid AAF Specification No. 3580 (AN-VV-O-366), before installing. Fill the pump about half full with the above fluid, and proceed as follows:

1. First remove the cover plate and gasket from the engine drive, and wipe the pad clean. Remove the shipping plugs from the pump ports; turn the shaft with the fingers to test for freedom of operation. Then, note carefully the direction of rotation of the engine drive, making sure it corresponds with the rotation as indicated by the markings on the pump. The markings are on the pump flange or pump body.

2. Before installing, coat drive splines with lubricant, AAF Specification No. 3590. Also, apply a thin coat of the same lubricant to the male pipe threads. Take care to see that the first (leading) thread gets no lubricant. Place the gasket over the mounting studs, and

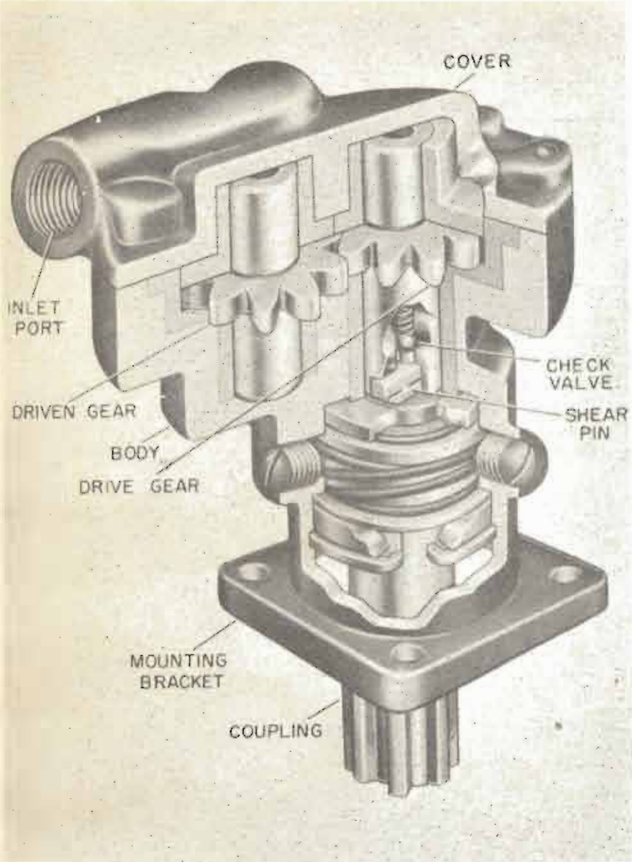


Figure 207 — Engine-driven Hydraulic Pump

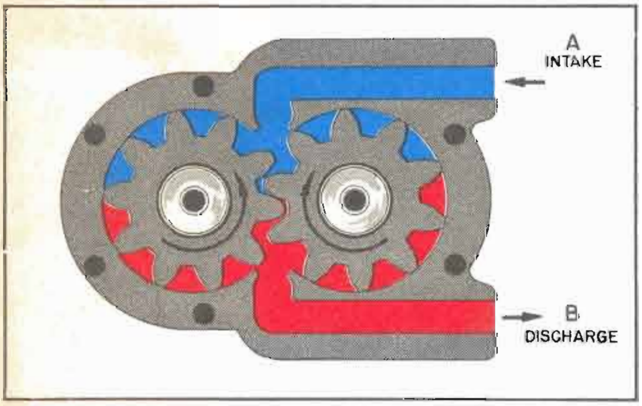


Figure 208 — Engine-driven Pump Function Diagram

mount the pump in the position most desirable for connecting the hydraulic lines. Pumps which have only one or two drain holes have removable adapters which may be located to provide a drain hole in the lowest position. The adapter can be relocated by removing the four adapter screws and replacing the adapter in the desired position. Tighten the adapter screws and secure with safety wire. Mount the pump on the engine; tighten the mounting nuts evenly and tightly, and safety.

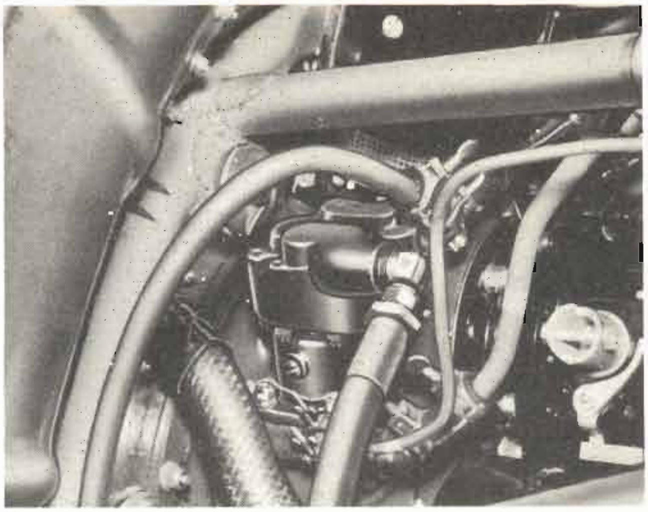


Figure 209 — Engine Pump Installed

(2) SELECTOR VALVE UNIT.—*(See figure 210.)*

(a) DESCRIPTION.—The selector valve unit is mounted by means of brackets below the control shelf at the forward left side of the rear cockpit. It is the main control unit of the hydraulic system which directs the flow of hydraulic fluid under pressure for operation of the landing gear and flaps and provides a relief valve for the power system. It is mounted by means of brackets below the control shelf at the forward left side of the rear cockpit. The selector valve unit incorporates the following valves: Power control valve, pressure relief valve, landing gear and flap selector valves, landing gear and flap one-way check valves, hand pump one-way check valve. The location and functions of these valves are contained in the paragraphs to follow.

1. POWER CONTROL VALVE.—This valve is incorporated in the upper part of the selector valve body and is connected to the power controls in the front and rear cockpits. When this valve is engaged, it directs the flow of fluid from its course through the selector valve to the reservoir and directs it to the landing gear and flap selector valves. It operates on the time-lag principle and automatically disengages after a set length of time, approximately twice the time necessary to operate the flaps and landing gear. After disengaging, the valve diverts the fluid back to the reservoir. When using the engine-driven hydraulic pump the power control valve must be engaged in order to operate the landing gear and flaps. The time-lag may be adjusted as described under paragraph *(d)*, ADJUSTMENTS.

2. PRESSURE RELIEF VALVE.—This valve is incorporated in the selector valve unit body below the power control valve and is set to relieve at approximately 1000 pounds per square inch, thus preventing excess pressure from building up and damaging the system. The relief valve is an easily adjustable, spring-loaded, piston-type valve which permits excess fluid to by-pass into the reservoir return port. The pressure relief valve will function only when the power control valve is engaged.

3. LANDING GEAR AND FLAP SELECTOR VALVES.—The lower portion of the selector valve unit body is composed of the landing gear and flap selector valves proper. They are of identical design. The outboard valve is the landing gear selector valve and the inboard valve is the flap selector valve. The two horizontal bores in the body of the unit are interconnected with drilled flow channels which permit the fluid to flow to and from the various component valves in the selector valve unit. Each of the above-mentioned horizontal bores contain a plunger with two large lap-fitted lobes designed to divert the pressure flow to the desired operating cylinder pressure line port.

4. LANDING GEAR AND FLAP ONE-WAY CHECK VALVES.—These two valves are of identical construction and function in identical manner. Each valve is simply a plunger with a conical-faced end which seats in the unit body and is held in place by a

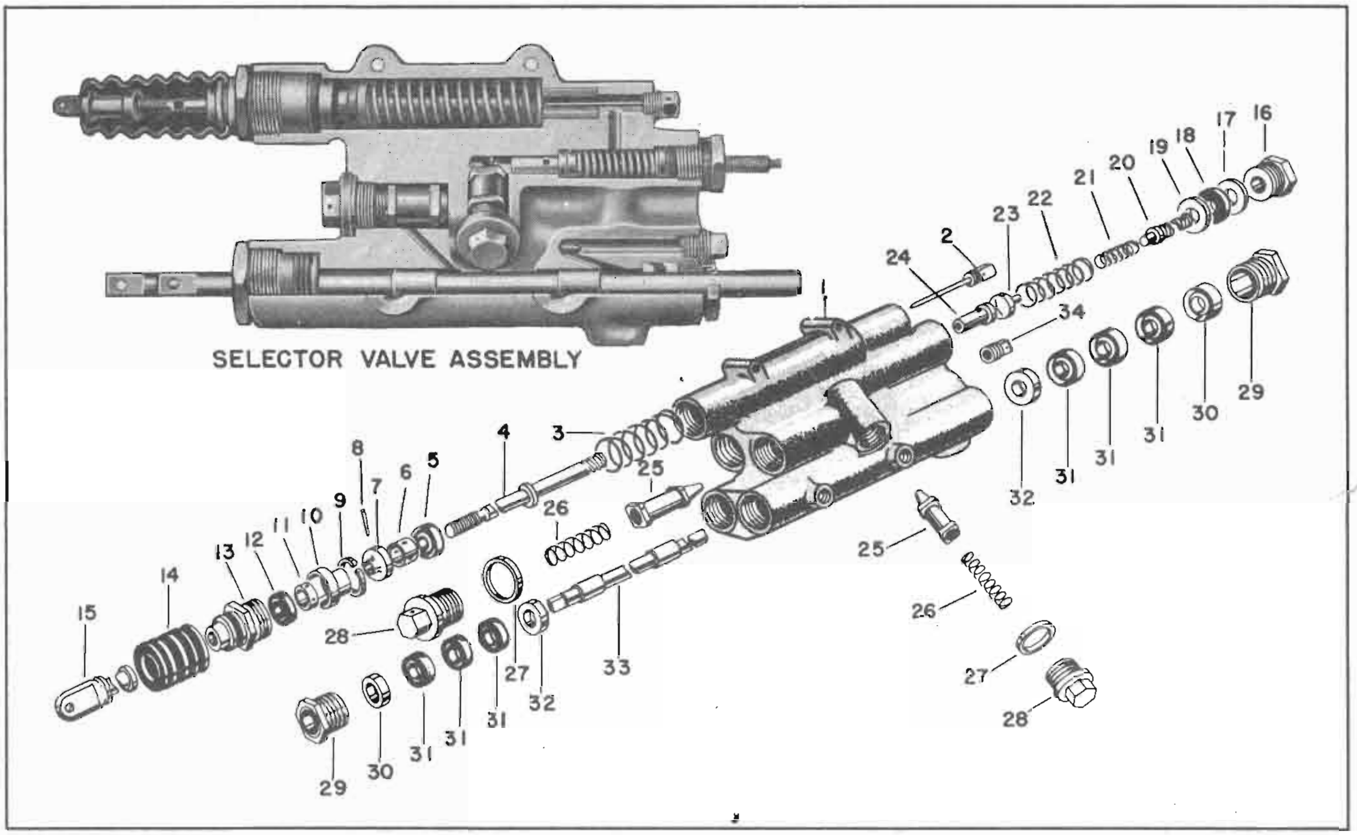


Figure 210 — Selector Unit

1. Control Unit body
2. Pressure control needle valve needle
3. Return spring
4. Pressure control needle valve
5. Cup
6. Center cup retainer
7. Valve stop
8. Pin
9. Seal gasket
10. End seal retainer
11. Relief valve cap small retainer
12. Cup
13. Control unit power control end
14. Dust boot
15. Rod clevis
16. Relief valve nut
17. Relief valve washer
18. Relief valve gasket
19. Relief valve seal base washer
20. Relief valve adjustment screw
21. Relief valve innerspring
22. Relief valve outer spring
23. Relief valve seat
24. Relief valve
25. One-way valve
26. One-way valve spring
27. One-way gasket
28. One-way valve chamber plug
29. End
30. Packing base ring
31. Packing ring
32. Packing base retainer
33. Control unit plunger
34. Plug

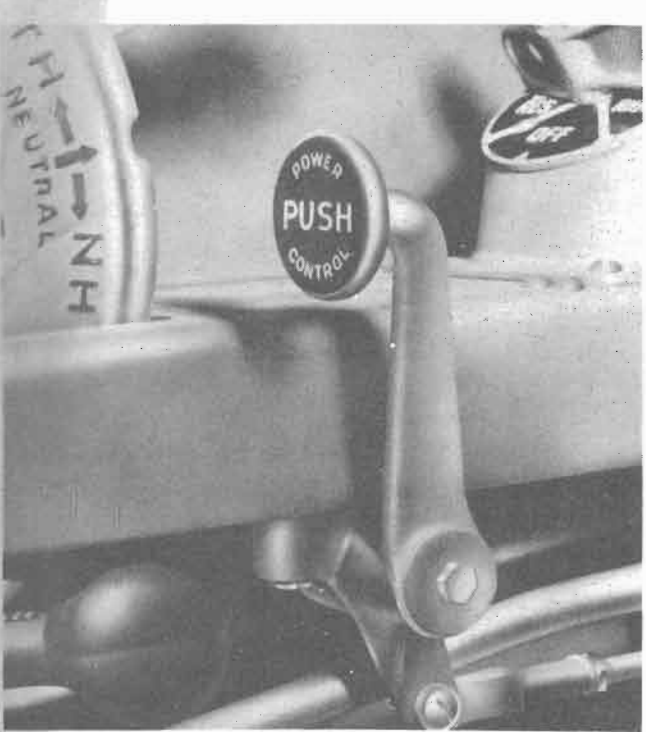


Figure 211 — Control Lever

spring. The landing gear one-way check valve is located directly above the landing gear selector valve and the flap one-way check valve is located directly above the flap selector valve. Each valve is placed between the power control valve pressure port and main center selector valve pressure port. The function of these two valves is to prevent pressure equalization in the event both the flap and landing gear selector valves are operated simultaneously. Fluid flowing from the power control valve pressure port unseats the valve and passes on to the selector valve main center pressure port. The instant the fluid ceases because of a sudden pressure drop, the pressure on the back side of the valve causes the valve to seat, thus preventing a return flow of fluid. Consequently, the initial pressure is confined in the corresponding selector valve and operating cylinder until the power control is again engaged, thus completing the operation.

5. HAND PUMP ONE-WAY CHECK VALVE.—The hand pump one-way check valve is located in the center of the outboard side of the selector valve unit body between the lower control valve pressure port and the landing gear one-way check valve. The hand pump pressure port has an inlet to the check valve chamber just behind the conical valve head. The hand pump one-way check valve prevents hand pump fluid pressure from by-passing through the power control pressure port and into the reservoir return line port. Thus pressure is confined to the landing gear and flap selector valves and operating cylinders as required. The hand pump check valve also prevents pressure generated by the hand pump from being dissipated through the system relief valve. No relief valve is necessary for hand-pump pressure output since the pump is designed to prevent generation of excessive pressure which would be detrimental to any part of the system.

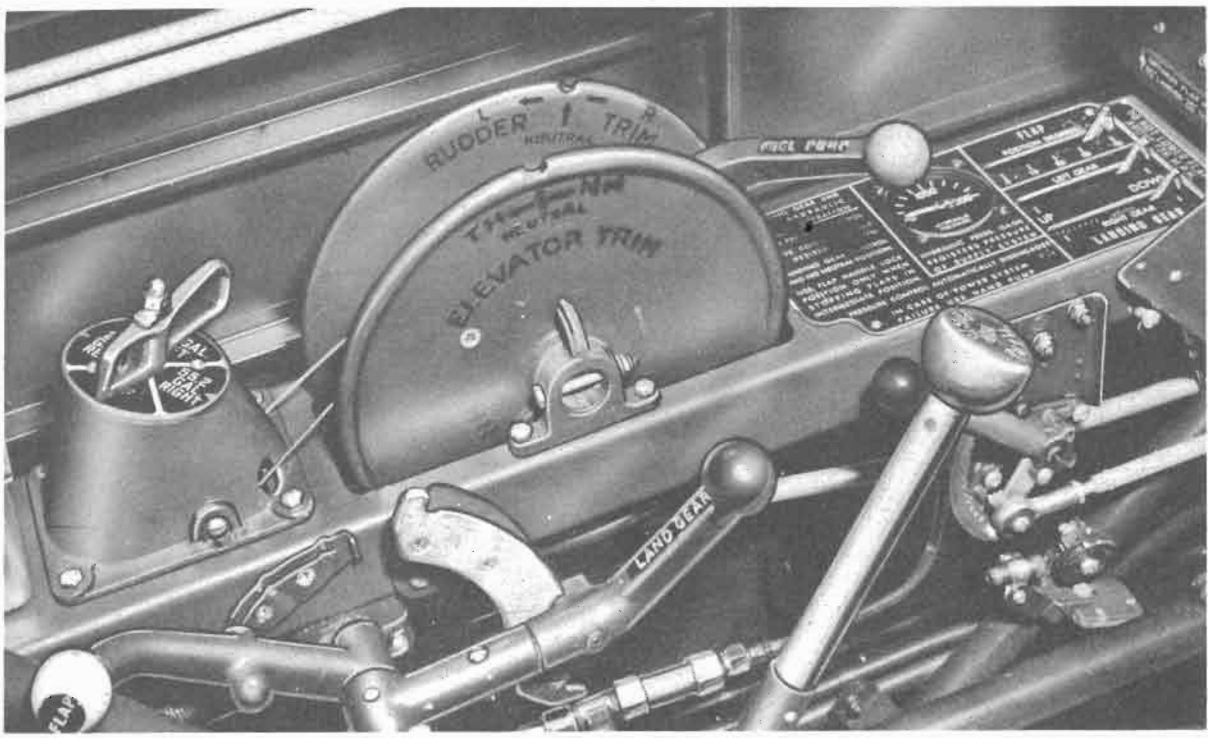


Figure 212 — Control Shelf

6. EXPLANATION OF SELECTOR VALVE FUNCTION DIAGRAM.

CONDITION I: AIRPLANE ON GROUND WITH ENGINE RUNNING—FLAPS AND LANDING GEAR INOPERATIVE.

Power Control—DISENGAGED
Flap Control—UP
Landing Gear Control—DOWN
Hand Pump—INOPERATIVE

Fluid under slight pressure from engine-driven pump flows unrestricted through the pressure control chamber "H," through channel "N" and out through return line channel "D." Fluid in other channels "O," "R," "P," "A," "V," "S," and "T" is static because the flap is in full "UP" position, the landing gear has already reached its full "DOWN" position and the piston seal cup and check valve in the hand pump prevents fluid from returning to reservoir; therefore, the fluid will take the path of least resistance through "H." The same applies if the landing gear selector valve "Y" is in the "UP" position and also if the flap selector valve "U" is in the "DOWN" or locked position. The check valves "K," "J," and "M" and the relief valve "L" are not used in this condition.

CONDITION II: AIRPLANE IN FLIGHT.

Landing Gear Control—DOWN
Flap Control—LOCKED
Power Control—ENGAGED
Hand Pump—INOPERATIVE

Power control valve stem "E" closes chamber "H," thus fluid under pressure from engine-driven pump flows through check valves "M" and "K" through line "R" to landing gear selector valve "Y" and out through port "B" to actuate the landing gear. Return fluid enters port "C," flows through channel "A" and returns to reservoir through line "D." A somewhat similar condition will exist when the landing gear or flap controls are moved for different selected positions. Check valves "K" and "J" will retain fluid under pressure in lines "R" and "P" if the original source of pressure is suddenly cut off. They will retain pressure for a certain length of time, such as to permit the power control to be pressed again immediately. During the time that the power control is engaged any pressure from port "F" in excess of 1000 pounds per square inch, which may result when landing gear has reached its full down position, will be relieved through relief valve "L." During the operation of the landing gear or flaps, the power control is gradually returning to the disengaged position by means of fluid slowly flowing through hole "A," displacing the fluid in chamber "D." When the power control valve is moved forward by the power control, fluid is forced past piston seal cup "B" into chamber "D." Packing cup "B" will not permit fluid to return. Therefore, pressure from spring "C" will force valve stem "E" to the left thus forcing fluid

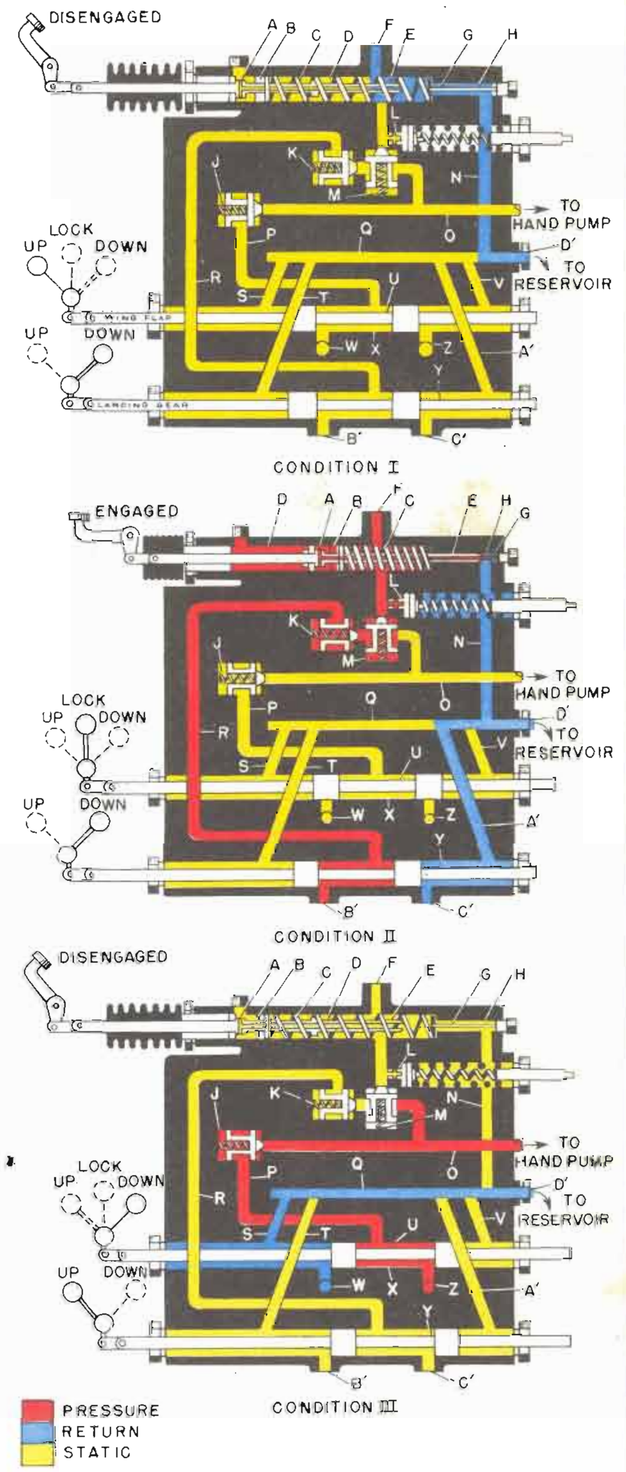


Figure 213 — Selector Valve Function Diagram

through hole "A" which will be metered out stem "E" by needle valve "G," permitting power control valve to slowly return to its disengaged position. When the power control valve has been disengaged, fluid from engine-driven pump will be diverted to reservoir. The flaps are maintained in a fixed intermediate position when the flap selector valve is in the LOCKED position, thus closing off both pressure-lines, selector valve ports "W" and "Z."

CONDITION III: HAND-PUMP OPERATION.

Power Control—DISENGAGED
Flap Control—DOWN
Landing Gear Control—UP
Hand Pump—IN OPERATION

The emergency hand pump is being operated to produce fluid pressure which flows through hand-pump pressure line "O" to hand-pump check valve "M." The hand-pump check valve prevents the fluid from flowing through the power control valve chamber and into the return line channel "N." Fluid under pressure flows past check valve "J" and into channel "P" and flap selector valve chamber "X." The fluid then flows out of the flap selector valve "DOWN" port "Z" to the flap operating cylinder to actuate the flaps. Fluid displaced by the flap operating cylinder piston returns through the flap "UP" lines, through port "W" and then to return channels "S" and "Q" and line "D." Since the landing gear remains unchanged in the retracted position, fluid pressure and flow is of no importance in the landing gear selector valve. A somewhat similar condition will exist when the flaps or landing gear controls are moved for different selected positions. When the engine-driven pump is in operation, the power control valve must be disengaged before the hand pump can be operated.

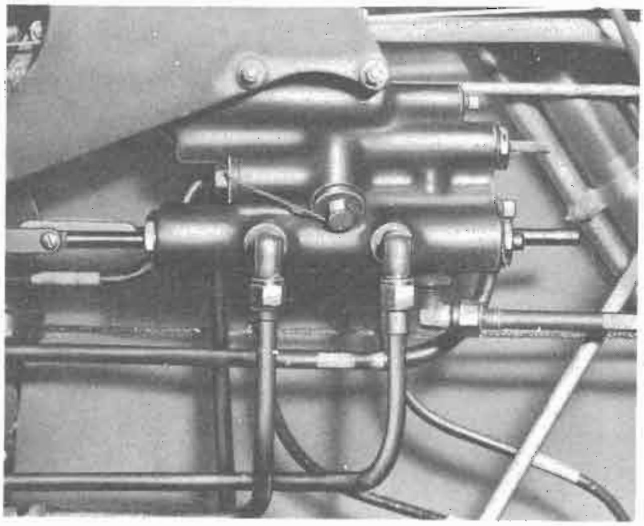


Figure 214 — Selector Valve Installed

(b) REMOVAL.—The landing gear and flap selector valve unit is mounted by means of brackets to the underside of the control shelf at the left forward side of the rear cockpit. Disconnect the seven hydraulic lines at outlets located on the valve body; also disconnect control rods attached to valve piston rods, remove the two bolts attaching the valve unit to the support bracket.

(c) TEST BEFORE INSTALLATION.—*(See figure 215.)*—To test the selector valve unit proceed as follows:

1. Apply 1000 pounds per square inch pressure at port "B" with ports "D," "E," "F" and "G" plugged. There should be no leakage at port "A" and a maximum leakage of 4 ounces per minute at port "C," with the selector valve rods in any of the three positions.

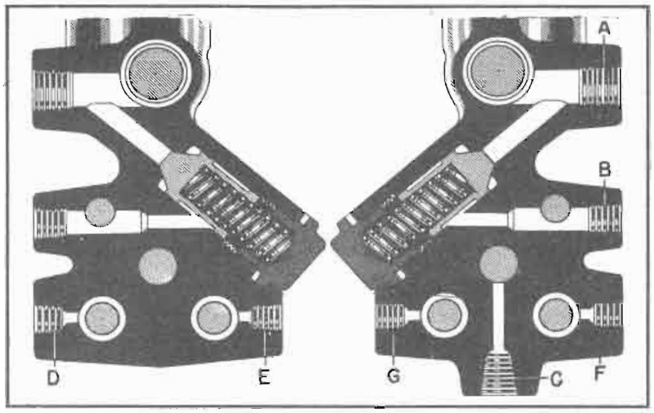


Figure 215 — Selector Valve Test Diagram

2. Apply 750 pounds per square inch pressure at ports "D" and "E," with the selector valve rods in the forward extended position and ports "F" and "G" plugged. There should be no leakage at port "B."

3. Apply 1000 pounds per square inch pressure at one gallon per minute at port "A;" fit the power control valve needle in the valve stem so that the needle in valve stem disengages in 120 seconds plus 30 minus 0.

4. Apply 1100 to 1200 pounds per square inch pressure at port "A;" adjust the relief valve to release at a pressure of 1000 pounds per square inch.

5. Apply 750 pounds per square inch pressure at port "A." Over-all leakage of the unit should not exceed 10 ounces per minute.

6. Apply 2000-2500 pounds per square inch pressure at port "A" with other ports plugged. Check for external leaks.

(d) ADJUSTMENTS.

1. SELECTOR VALVE UNIT PRESSURE CONTROL.—To check and adjust pressure control valve proceed as follows:

a. Although the time-lag of the power control valve may vary widely with extreme high or low temperatures, the select fit of the needle and valve should be such that the power control disengages at the end of 2 minutes plus 30 seconds minus 0 seconds.

The check for the time-lag should be made when the fluid in the system is warm but not hot, approximately 43°C (110°F).

b. It is to be noted here that when the system is cold, that is, when the engine is started after the airplane has not been flown for some time (especially in zero weather), the time-lag may be as much as 10 minutes. Therefore, time should not be checked until system is warm. When the system is very cold, engaging the power control several times will accelerate warming the fluid.

c. To check the time-lag, push firmly on power control lever with engine running, and record the time elapsed between the removal of the hand from lever until the pressure on the gage begins to drop. There will be no rapid complete drop of pressure, merely a reduction when the power control disengages. Make several tests; if the average is above or below the above limits, adjustments are necessary.

d. In all models beginning with AT-6b and SNJ-3, no means of external adjustment is provided for the power control time-lag on the selector valve unit itself, since the select fit of the power control valve needle and stem essentially control the time-lag interval. The stem and needle are a select fit on assembly, and the predetermined setting is such that the time-lag interval is of approximately 2 minutes duration when the fluid is warm. The fact that the time-lag interval is also affected by the distance the power control valve needle enters the valve stem provides a means for final adjustment of the power control time-lag. If the distance that the power control valve enters the valve stem is increased, the time-lag is increased. Decreasing the distance that the needle enters the stem decreases the time-lag. An adjustable setscrew, which is located on the front cockpit power control lever outboard shaft support, controls the movement of the power control lever, which in turn controls the inward movement of the power control valve stem. Turning the setscrew clockwise decreases the time-lag, while turning the setscrew counterclockwise increases the time-lag. (See figure 216.) If the average time-lag is longer than 2-1/2 minutes, turn the setscrew clockwise to decrease the time-lag and test. If after depressing the power control lever six or more times the average time-lag is less than 2 minutes, turn the setscrew counterclockwise to increase the time-lag. With the landing-gear cockpit control lever in the DOWN position, the landing gear selector valve plunger rod should be extended forward so that the DOWN port is open. It is imperative that a dimension of 2-7/16 inches exists between the center of the clevis bolt which attaches the selector valve plunger rod to the control rod and the lower forward face of the selector valve unit body.

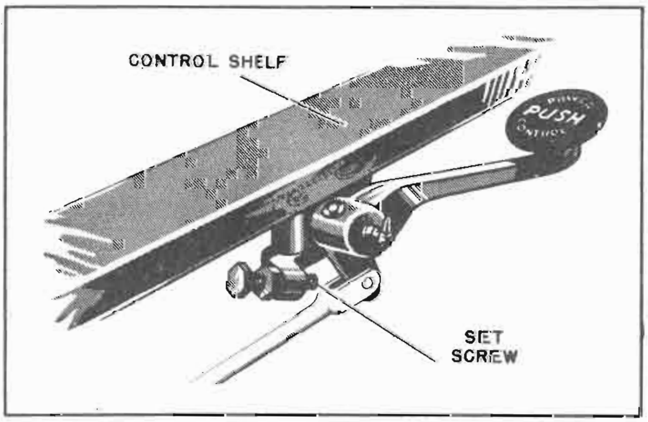


Figure 216 — Power Control Lever Adjustment Screw

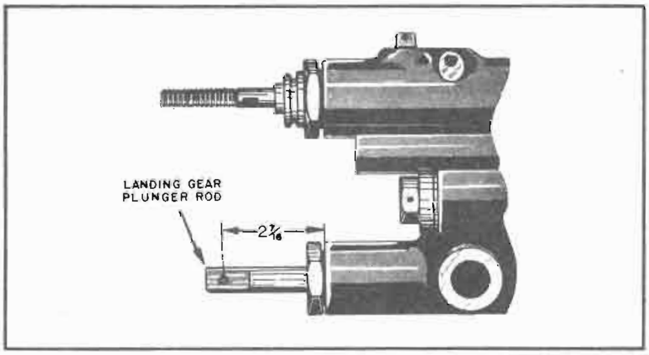


Figure 217 — Selector Valve Landing Gear Plunger Rod Position

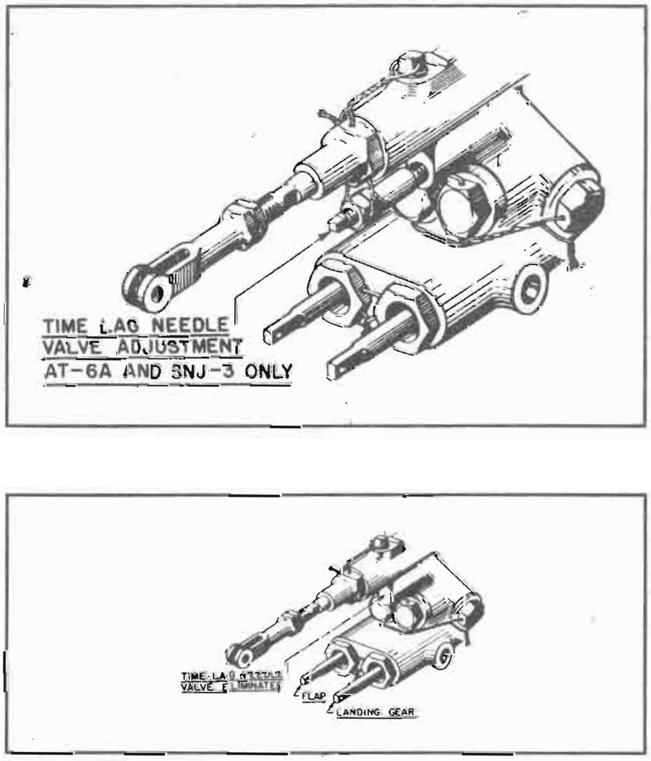


Figure 218 — Time Lag Adjustment (Earlier Models Only)

2. SELECTOR UNIT NEEDLE VALVE ADJUSTMENT (EARLY MODELS ONLY).

NOTE

AT-6, AT-6A, and SNJ-3 airplanes have time-lag needle valve adjustment.

Check time-lag as instructed in paragraph *1.* above. Readjust as follows, if necessary.

a. METERING PIN 50-58054.—Screw valve stem farther into the clevis for less time-lag, and farther out for more time-lag. This allows a total ½-inch adjustment. Adjustment should not be made in such a way that a wire can be passed through the inspection hole in the clevis, or in such a way that the stem screws into the clevis slot. After adjustment, recheck time-lag and readjust as indicated. If, after adjustment, the time-lag still exceeds 2 minutes, remove the pipe plug immediately under the pressure control valve stem, and remove the metering pin 50-58054. Metering pin 55-58202 is not interchangeable with pin 50-58054. For units employing pin 55-58202, see following additional pressure control adjustment instructions. After removing pin 50-58054, clean the chamber and lightly polish pin. Reassemble, recheck time, and readjust as required. If, after adjustment, the time lag is still less than 1 minute, the metering pin should be replaced. If new pins are not available, the diameter of the old pin may be built up slightly by tinning the pin. It must be hand-finished to suit; that is, it must be polished down until the proper time-lag is obtained, with the valve stem adjusted to a position intermediate between extremes. The power control will not engage unless the engine pump is running.

b. METERING PIN 55-58202.—Adjust the valve assembly with pin 55-58202 for the same time-lag as previously specified. Check to see that full stroke of 1¼ inches is obtained on movement of pressure control plunger; adjust if necessary. Back-off on hexagonal lock nut on time-lag adjusting valve located immediately below the pressure control plunger, and back-off on stud three to four turns. With engine pump or test pump running, operate pressure control six or more times. The control will disengage rapidly under these circumstances. After this has been done, adjust the time-lag valve stud in, until it is snugly tight; then back-off one-quarter turn. Check pressure control for time of engagement, and adjust valve stud *in* for more time-lag, or *out* for less.

3. RELIEF VALVE.—To adjust this valve, back off on the large hexagonal nut located on upper aft end of the valve approximately 1-½ turns. Then, with engine running at 1200 rpm, engage pressure control; adjust threaded stem until pressure of 1000 pounds per square inch is indicated on the pressure gage in the cockpit. Turn the stem clockwise to increase pressure, and counterclockwise to decrease it. When proper pressure is obtained, hold the stem to prevent it from turning, tighten the hexagon lock-nut, and safety with lock-wire.

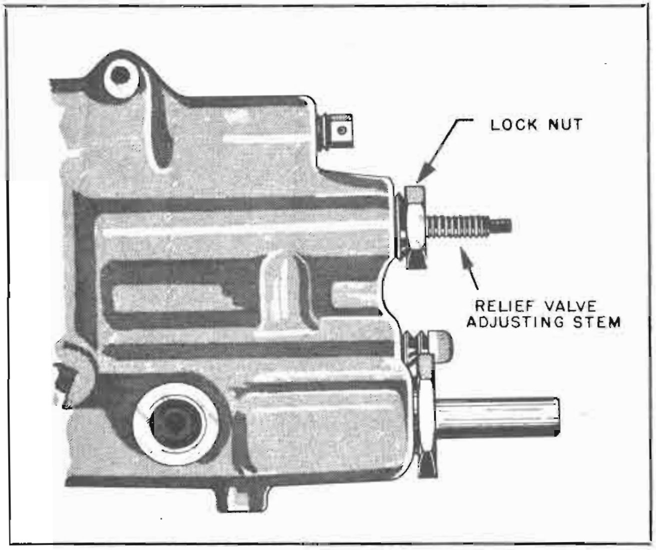


Figure 219 — Selector Valve Relief Valve Adjustment Stud

(e) INSTALLATION.—Attach inboard and outboard selector valve supports to flanges mounted on the control shelf forward of the rear cockpit, using two AN4-5A bolts at each flange. Insert bell crank shaft through the opening at the forward end of supports, at the same time installing bell cranks and washer on the shaft. Secure the shaft in place with an AN392-45 pin and cotter. Mount the selector valve unit between the supports and bolt in place with an AN3-44A bolt and an AN3-51A bolt. Connect bell cranks to actuating rods and selector valve plunger links.

(3) FLAP RATCHET VALVE.—AT-6B, C, and D, SNJ-4, and 5.

(a) DESCRIPTION.—The flap ratchet valve is located between the wing flap selector valve and the wing flap operating cylinder in the hydraulic system and is attached to the lower left fuselage longeron below the selector valve unit body. The valve consists of an aluminum-alloy body with a spring-centered plunger located between two spring-loaded, one-way check valves facing in opposite directions. The spring-centered plunger on earlier airplanes is made of steel, while some later airplanes have plungers made of phenolic fiber. The top front port provides an outlet to the flap selector valve "DOWN" port, while the top rear port provides an outlet to the flap selector valve "UP" port. The left end (or forward port) is the flap "DOWN" port to the flap operating cylinder, and the right end (or aft port) is the flap "UP" port to the flap operating cylinder. The function of the ratchet valve is to retain sufficient pressure in the flap operating cylinder to hold the flaps in the desired position since the selector valve is not designed to be leak-proof. A pressure of 700 pounds per

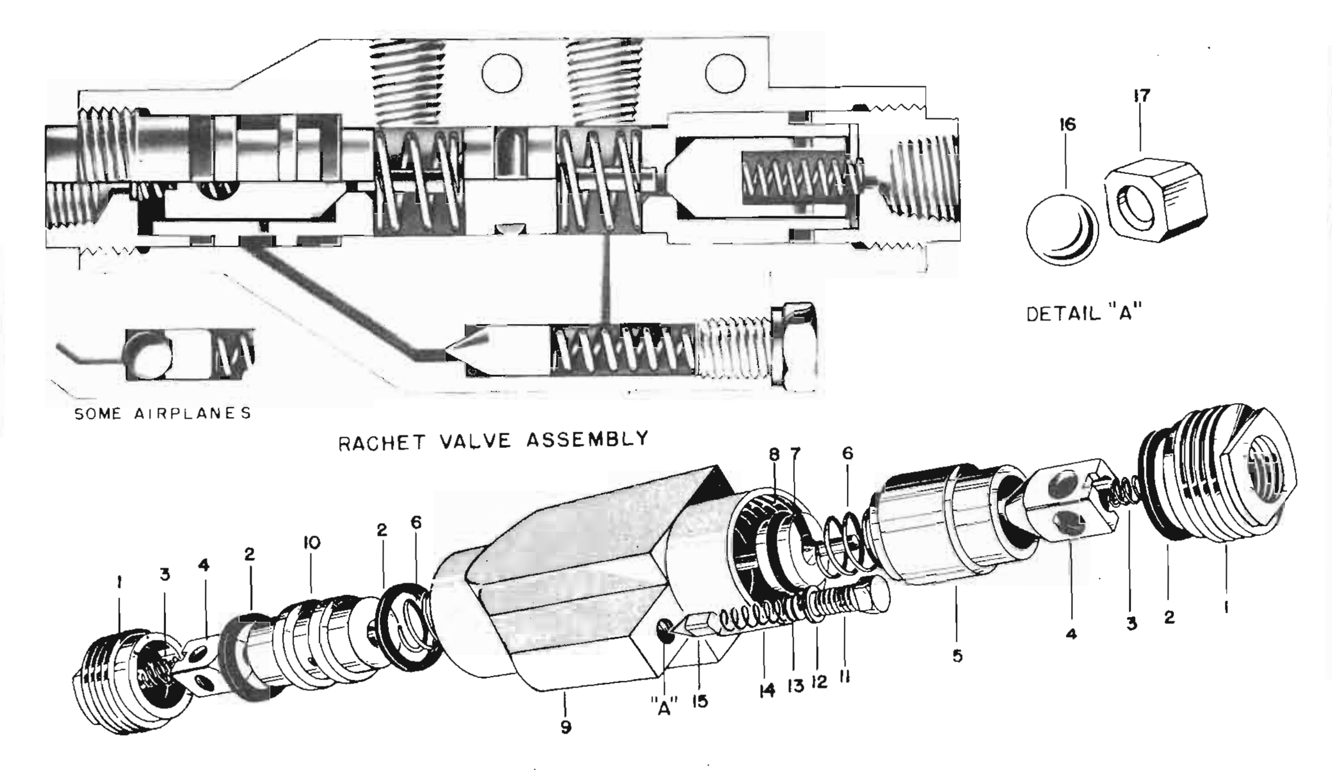
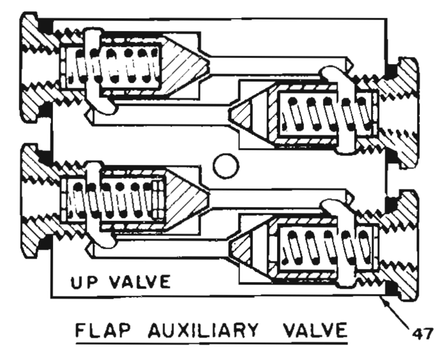


Figure 220 — Flap Ratchet Valve

1. End
2. Steel Gasket
3. Spring
4. Valve
5. Seat
6. Plunger
7. Plunger (Steel or Phenolic Fibre)
8. Molded Neoprene Ring
9. Valve Body
10. Seat
11. Bolt
12. Washer
13. Washer (for Adjustment)
14. Spring
15. Thermal Relief Valve
16. $\frac{7}{32}$ Diameter Steel Ball
17. Thermal Relief Valve Guide



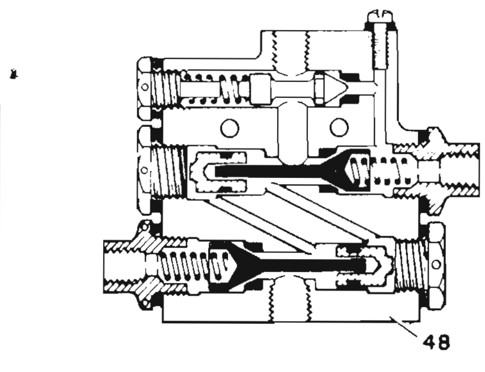


Figure 221 — Flap Ratchet Valve (Early Models)

square inch is usually retained in that portion of the system between the ratchet valve and the flap operating cylinder. The ratchet valve automatically locks the flaps in either the "UP," "DOWN," or "INTERMEDIATE" positions by means of the one-way check valve. An adjustable spring-loaded thermal relief valve located in the bottom of the ratchet valve body permits excess fluid to return to the selector valve unit via the flap "DOWN" pressure line should thermal expansion cause the fluid pressure to exceed 1400 pounds per square inch.

Early airplanes have a spring-loaded, conical-shaped valve and seat, while some airplanes have a guide and ball check valve.

NOTE

FLAP RATCHET VALVE—EARLY MODELS.

Earlier models of this series were equipped with units having the same function as the flap ratchet valve described above, but differing in details of construction. (See figure 221.)

AT-6 had a wing flap auxiliary valve (55-58014), while AT-6A, and the Navy model SNJ-3 were equipped with wing flap ratchet valves (66-58070). These valves do not include any neoprene or other parts subject to deterioration so do not require disassembly for replacements. The most likely cause of malfunctioning is foreign matter becoming lodged in the valve.

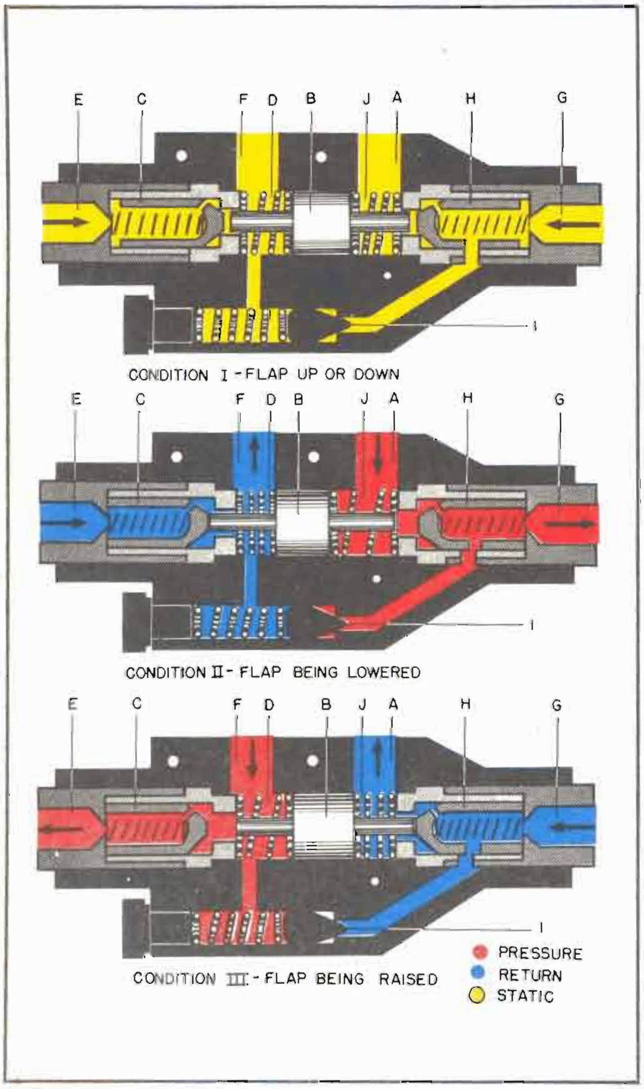


Figure 222 — Flap Ratchet Valve Function Diagram

EXPLANATION OF RATCHET VALVE FUNCTION DIAGRAM.—*(See figure 222.)*

CONDITION I: FLAPS UP OR DOWN—STATIC FLUID.—When the flap control cylinder has completed its operation of extending or retracting the flaps, the ratchet valve resumes this condition. With the flaps "DOWN," hydraulic fluid pressure from the operating cylinder entering port "G" forces valve "H" to its seated position. With the flaps UP hydraulic fluid pressure from the flap cylinder entering port "E" forces valve "C" to seat. Thus hydraulic pressure is locked in the flap operating cylinder. Should the pressure of the flap operating cylinder exceed 1400 pounds per square inch due to thermal expansion, the spring-loaded one-way relief valve "I" will move off its seat allowing excess fluid to drain into the main body of the valve and return to the selector valve through port "F."

CONDITION II: FLAPS BEING LOWERED.—Hydraulic fluid under pressure from the flap selector valve "UP" port enters port "A" and passes through check valve "H" and port "G" to the flap operating cylinder. The pressure necessary to move the operating cylinder piston builds up in chamber "J," thus moving plunger "B" which unseats check valve "C" allowing displaced fluid from the operating cylinder to enter port "E" and flow out port "F" to the selector valve return port. This condition, therefore, will permit the flap to actuate until necessary displacement has been completed and the pressure drops in the line entering port "A." When *pressure drops in port* "A," check valves "H" and "C" will seat, retaining fluid pressure in the operating cylinder, which in turn will hold the flaps in the desired position as illustrated in Condition I. A thermal expansion relief valve "I" is located in the bottom of the ratchet valve. This valve relieves pressure in the operating cylinder should it exceed 1400 pounds per square inch and allows the excess fluid to by-pass from chamber "J" through relief valve "I" into chamber "D."

CONDITION III: FLAPS BEING RAISED.—Hydraulic fluid under pressure from the flap selector valve "DOWN" port enters port "F" and passes through check valve "C" and port "E" to the flap operating cylinder. The pressure necessary to move the operating cylinder piston builds up in chamber "D," thus moving plunger "B" which unseats check valve "H" allowing displaced fluid from the operating cylinder to enter port "G" and flow out port "A" to the selector valve return port. This condition, therefore, will permit the flap operating cylinder to actuate until necessary displacement has been completed and the pressure drops in the line entering port "F." When pressure drops in port "F," check valves "C" and "H" will seat, retaining fluid in the operating cylinder, which in turn will hold the flaps in the desired position as illustrated in Condition I.

(b) REMOVAL.—The wing flap ratchet valve, located at the lower left forward corner of the rear cockpit, may be readily removed by disconnecting the four flap hydraulic lines and removing the two nuts and

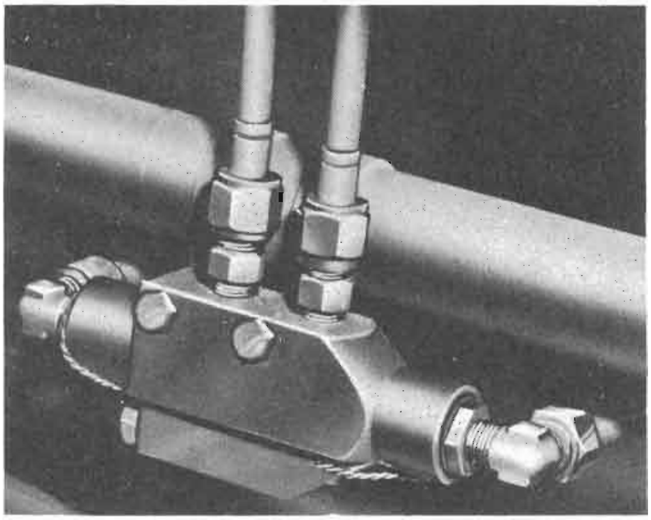


Figure 223 — Flap Ratchet Valve Installed

bolts attaching the valve body to its mounting clips on the lower left fuselage longeron.

(c) TEST BEFORE INSTALLATION.—Assemble test stand system, as shown in figure 224, and proceed as follows:

1. With ports "A," "B" and "D" plugged, apply 2500 pounds per square inch at port "C." Check for external leaks.

2. With valve "E" open, "F" closed, port "A" plugged and port "B" open, apply hand-pump pressure at port "C." Adjust thermal relief valve to release at 1500 plus or minus 100 pounds per square inch.

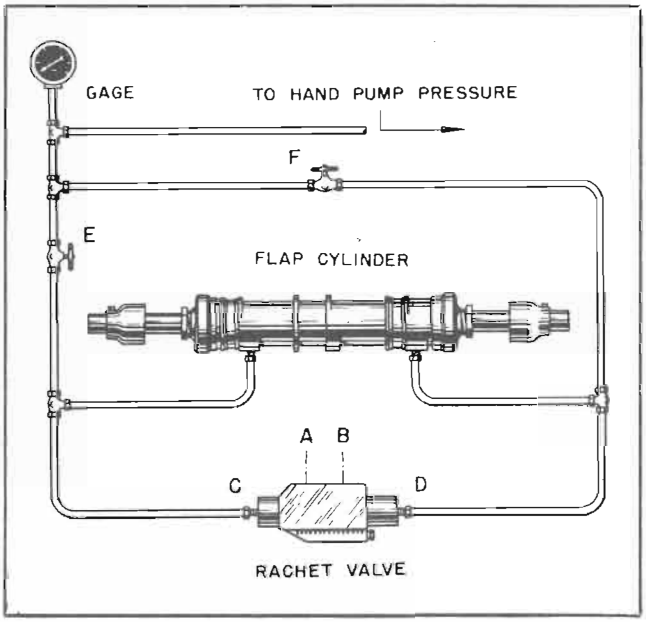


Figure 224 — Flap Ratchet Valve Test Diagram

3. Open valve "F," close valve "E," and with port "A" open, apply 1000 pounds per square inch pressure at port "B." The flap cylinder piston should travel its full stroke. Release the pressure at port "B," noting the drop in the pressure gage reading. The gage reading should not drop below 700 pounds per square inch and should remain at this pressure.

4. Open valve "E," close valve "F," and apply 1000 pounds per square inch pressure at port "A." The flap cylinder piston should travel through its full stroke in the opposite direction to the above-mentioned movement. Release the pressure at port "A," noting the drop in the pressure gage reading. The reading should not drop below 700 pounds per square inch and should remain at this pressure, denoting that the check valves are functioning properly.

(d) ADJUSTMENT.—After the ratchet valve is tested as outlined above, the ratchet valve should require no further adjustment. However, should leakage around either of the two check valves occur, lapping them in with fine emery paste should render them leak-proof. The thermal expansion relief valve should relieve at 1500 plus or minus 100 pounds per square inch. If the relief valve requires adjusting, remove the cap nut holding the compression spring-loaded plunger on the underside of the ratchet valve body, and insert or remove the small shims between the spring and the cap nut, thus increasing or decreasing the pressure relief setting. Assemble relief valve and test.

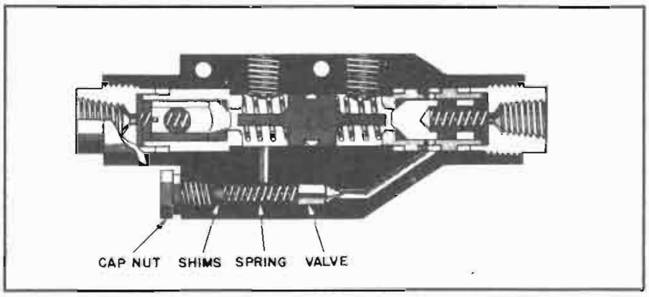


Figure 225 — Ratchet Valve Relief Valve Adjustment Spring Cap

(4) FLAP OPERATING CYLINDER.

(a) DESCRIPTION.—The flap operating cylinder is a single cylinder, dual piston, double acting hydraulic jack. The operating cylinder unit is attached to the bottom of the upper trailing edge of the wing center section, aft of the rear spar. A piston rod at each end of the cylinder is attached to the flap push-pull rod. A rotating sleeve bearing is located in the center and around the outside of the cylinder. A pivoted cross arm is attached to the rotating sleeve and to each end of the cross arm there is attached a connecting rod which in turn is attached to the flap push-pull rods beyond the ends of the piston rods. This rotating sleeve, cross arm and rod assembly functions as an equalizing mechanism which serves to equalize the

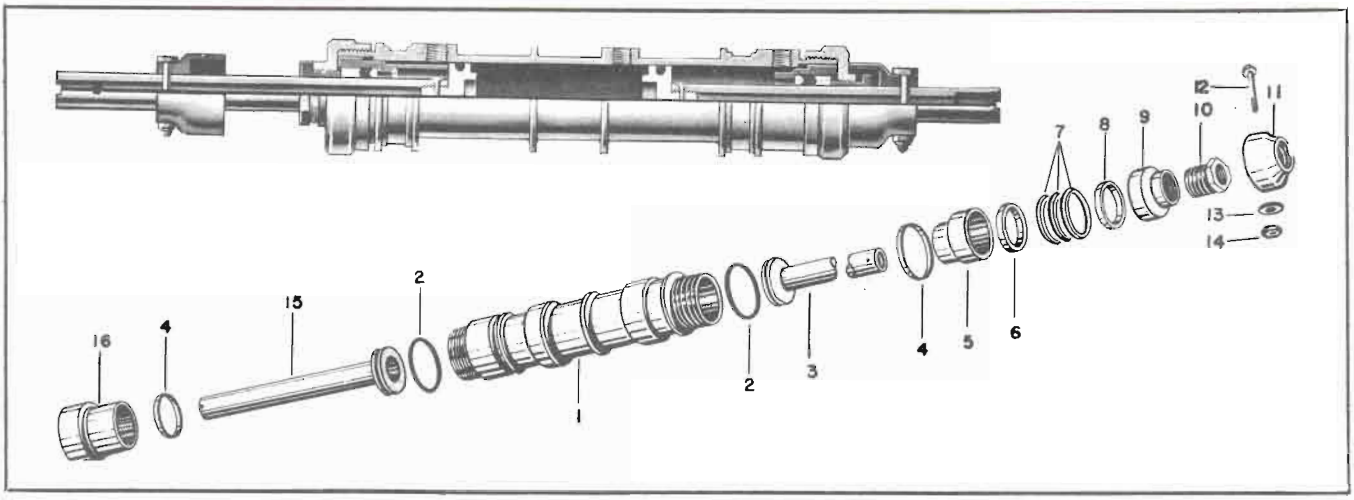


Figure 226 — Flap Operating Cylinder

1. Cylinder Body
2. Ring
3. Right Piston
4. Seal Gasket
5. Seal Retainer
6. Packing Base Ring
7. Garlock Chevron Packing
8. Packing Cap Ring
9. Piston Rod Outer Bearing
10. Packing Gland Nut
11. Piston Rod Stop
12. Bolt
13. Washer
14. Nut
15. Left Piston
16. Seal Retainer

Note: Items 7 through 15 contained in both ends of strut.

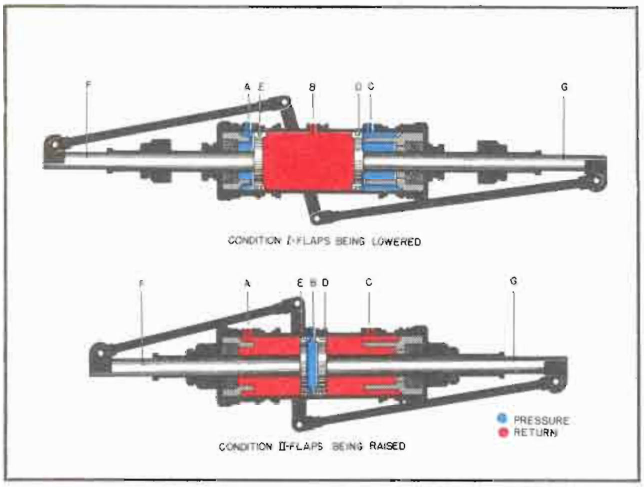


Figure 227 — Flap Operating Cylinder Function Diagram

movement and load on both the operating strut pistons and the push-pull rods. Since the mechanism equalizes the piston and flap push-pull rod movement, the movement of the flaps is synchronized. As fluid pressure is applied to the port at each end of the flap operating cylinder, the actuating pistons and flap rods are simultaneously moved toward the center of the operating cylinder, thus extending the flaps. The displaced fluid returns through the flap ratchet valve to the flap selector valve. As pressure is applied to the port in the center of the cylinder, the actuating pistons and flap push-pull rods are forced outward, thus retracting the flaps. The displaced fluid escapes through the ports in the ends of the cylinder and returns to the flap selector valve after passing through the flap ratchet valve. The time required to lower the flaps ranges from 5 to 15 seconds, while the time required to raise the flaps ranges from 5 to 10 seconds.

EXPLANATION OF FLAP OPERATING CYLINDER FUNCTION DIAGRAM.

CONDITION I: FLAPS BEING LOWERED. — Hydraulic fluid pressure is applied to both ports "A" and "C," simultaneously. The two pistons "E" and "D" retract causing flap push-pull rods "G" and "F" to move inward, thus lowering the flaps by means of short rods attached to the flaps proper. The rocker arm assembly, which pivots at a point of the flap cylinder, tends to guide and equalize the travel of the piston rods. The fluid displaced by the inward movement of the pistons escapes through port "B."

CONDITION II: FLAPS BEING RAISED. — Fluid pressure is applied at port "B," which forces pistons "E" and "D" outward causing flap push-pull rods "G" and "F" to extend outward, thus raising the flaps by means of short rods attached to the flaps proper. The fluid displaced by the pistons "E" and "D" escapes through ports "A" and "C" simultaneously.

(b) REMOVAL. — FLAP OPERATING CYLINDER.—This unit is supported by means of four bolts inserted through holes in upper surface of the center section trailing edge at the left side. To remove the operating cylinder, lower the flaps to the full "DOWN" position and disconnect the three hydraulic lines from the flap operating cylinder at the fittings extending through the upper surface of the wing center section. Disconnect the two flap equalizer control rods from the ends of the strut pistons. Remove the four bolts and fittings supporting the strut, and remove the assembly from the center section.

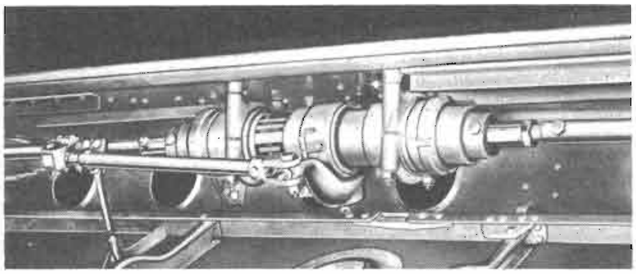


Figure 228 — Flap Operating Cylinder Installed

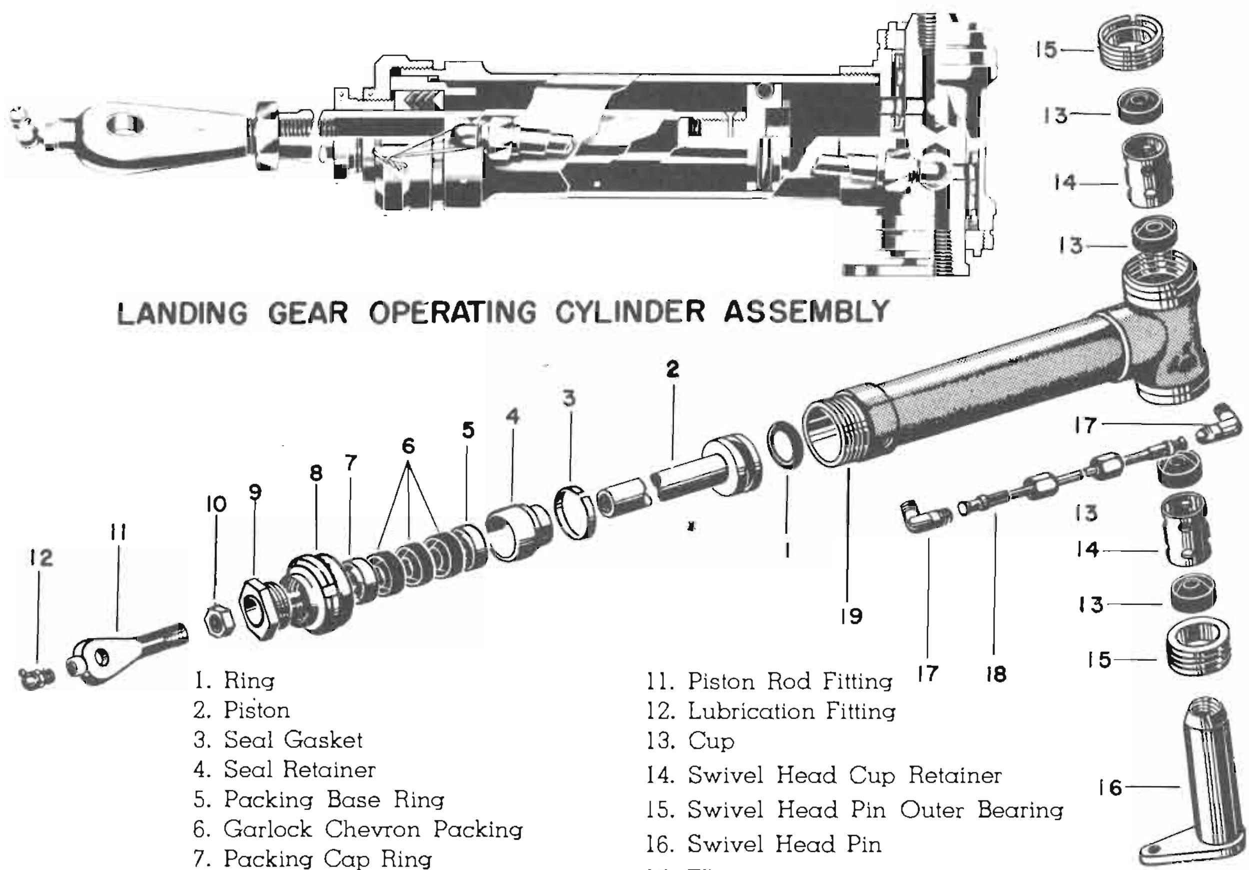
(c) TEST BEFORE INSTALLATION. — Pressure-test the flap operating cylinder by applying 2000 pounds per square inch alternately to each of the three ports, with the remaining ports open. Piston rod stop collars must be in place.

(d) ADJUSTMENT. — On reassembly of the flap operating cylinder, each piston should have a stroke of 2-3/8 inches.

(e) INSTALLATION.—Insert four AN4-35A bolts through holes in upper surface of center section at left side of trailing edge. Install upper half of cylinder supports over these bolts. With the threaded piston rod end facing toward the right, place flap cylinder in position with upper supports resting in grooves on the cylinder. Install lower half of cylinder supports over cylinder; secure with stop nuts. (See figure 228.)

(5) LANDING GEAR OPERATING CYLINDER.

(a) DESCRIPTION.—There are two hydraulic cylinders employed in the landing gear hydraulic system for the purpose of operating the "UP" and "DOWN" movement of the right and left landing



1. Ring
2. Piston
3. Seal Gasket
4. Seal Retainer
5. Packing Base Ring
6. Garlock Chevron Packing
7. Packing Cap Ring
8. Piston Rod Outer Bearing
9. Packing Gland Nut
10. Nut
11. Piston Rod Fitting
12. Lubrication Fitting
13. Cup
14. Swivel Head Cup Retainer
15. Swivel Head Pin Outer Bearing
16. Swivel Head Pin
17. Elbow
18. Retracting Line
19. Cylinder Body

Figure 229 — Landing Gear Operating Cylinder

gear. These cylinders are interchangeable from right to left. The cylinders are located inboard of the front of the right and left outer wing front spars in the wing nose-section. The head of the cylinder is securely mounted to a "hat-section" type support, which also includes a part of the castings and bearings that form the pivot point of the operating cylinder. Thus, the cylinder is free to follow the movements of the mechanism necessary in the operation of the "UP" and "DOWN" movement of the landing gear. These hydraulic cylinders are accessible after removing cover plates in the lower skin of the leading edge of the wings. These covers are located directly under each corresponding hydraulic cylinder. The forward end of the piston rod is coupled to the landing gear strut mechanism by means of a yoke fitting and a bearing. This attachment provides a linkage for transmitting force dispatched by the operating cylinder piston to actuate the "UP" and "DOWN" movement of the landing gear. The encased piston rods are extended and retracted in a horizontal direction by means of hydraulic fluid pressure transmitted to the head or base of the piston through inlet and displacement ports of the cylinder, which are connected to the main hydraulic system. With the landing gear in the "DOWN" position, the piston rod is extended, and in the "UP" position, the rod is retracted.

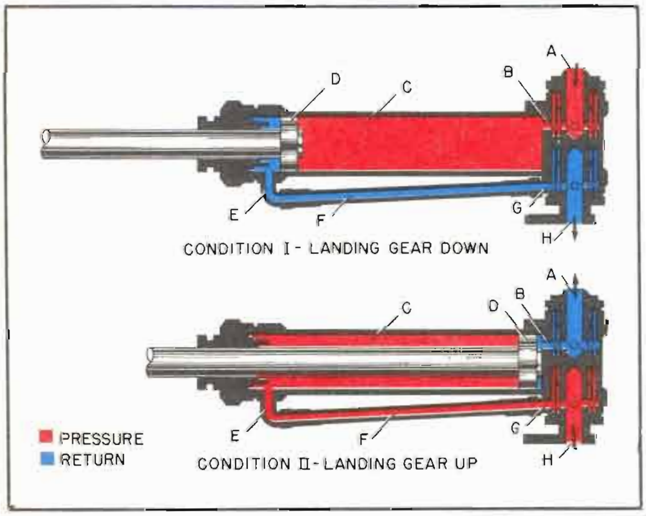


Figure 230 — Landing Gear Operating Cylinder Function Diagram

EXPLANATION OF LANDING GEAR OPERATING CYLINDER FUNCTION DIAGRAM.

CONDITION I: LANDING GEAR DOWN.—Fluid under pressure is applied at port "A." where it flows through swivel joint "B" into the actuating cylinder "C," forcing piston "D" to the left against the stop in the extreme left end of the cylinder as shown, thus moving the landing gear strut to the extended position. The displaced fluid is forced out port "E" to return line "F" and back through swivel joint "G" and finally out return port "H."

CONDITION II: LANDING GEAR UP.—Fluid under pressure enters port "H" and flows through swivel joint "G" and line "F" through port "E" into the cylinder chamber "C," forcing piston "D" to the right end of the cylinder, thus retracting the landing gear strut by means of the yoke attached to the end of the piston rod. Displaced fluid escapes from the cylinder through swivel joint "B" and finally flows out return port "A," as shown.

(b) REMOVAL.—A landing gear operating cylinder is located inboard on the front face of the front spar of both outer wing panels. The cylinder may be easily removed from the wing by first disconnecting the two hydraulic lines attached to the cylinder assembly, then removing the two bolts which attach the aft cylinder support bracket to the front spar, and then slipping the cylinder assembly back out of the front support bracket bearing. The aft bracket may then be removed from the cylinder assembly after removing the bolt attaching the cylinder pivot shaft flange to the support bracket. The aft hydraulic line elbow fitting may be removed before the bracket will slip free of the cylinder assembly.

(c) TEST BEFORE INSTALLATION.—Pressure is applied through the T-head and is alternated two or three times to clear the cylinder of air. Pressure is then

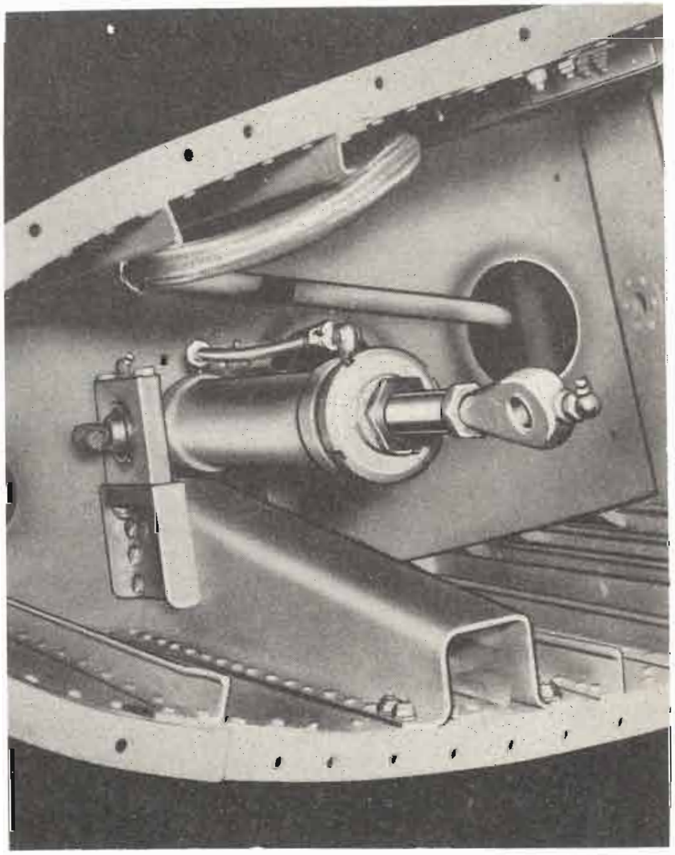


Figure 231 — Landing Gear Operating Cylinder Installed

applied at 2000 pounds per square inch and is held for 3 to 5 minutes. During this time check for leaks. If no sign of leaks occur, drop the pressure to 500 pounds per square inch and again hold for a period of 3 to 5 minutes and check for leaks.

(*d*) INSTALLATION.—(*See figure 231.*)

1. Ascertain that the operating cylinder bearing blocks are properly installed and that the operating cylinder moves freely between the bearing blocks.

2. Install the operating cylinder piston rod end fitting on the stud which is mounted on the landing gear shock strut fitting. Screw the piston rod onto the rod end fitting several turns. Since the outboard end of the operating cylinder is confined between the bearing blocks, it cannot move to either side along its swivel head pin to compensate for light, unavoidable misalignment in the landing gear strut and retracting mechanism due to manufacturing and assembly tolerances; consequently, the piston rod end fitting must be aligned so that it has sufficient free movement or side play along its attaching stud to permit free operation of the landing gear without causing misalignment of either end of the operating cylinder.

3. To align the piston rod end fitting, place the specified washers on either side of the rod end fitting as required so that a free movement or side play of approximately .050 inch between the washers and the fitting is obtained. The small outermost washer on the attaching stud should be held firmly against the shoulder on the stud by the castellated nut.

4. To check the stroke of the piston rod, unscrew the piston rod from the rod end fitting and pull the piston rod out of the cylinder so that a dimension of 10-38 inches exists between the inboard face of the operating cylinder piston rod bearing cap and the end of the piston rod. Then pull the piston rod out farther and

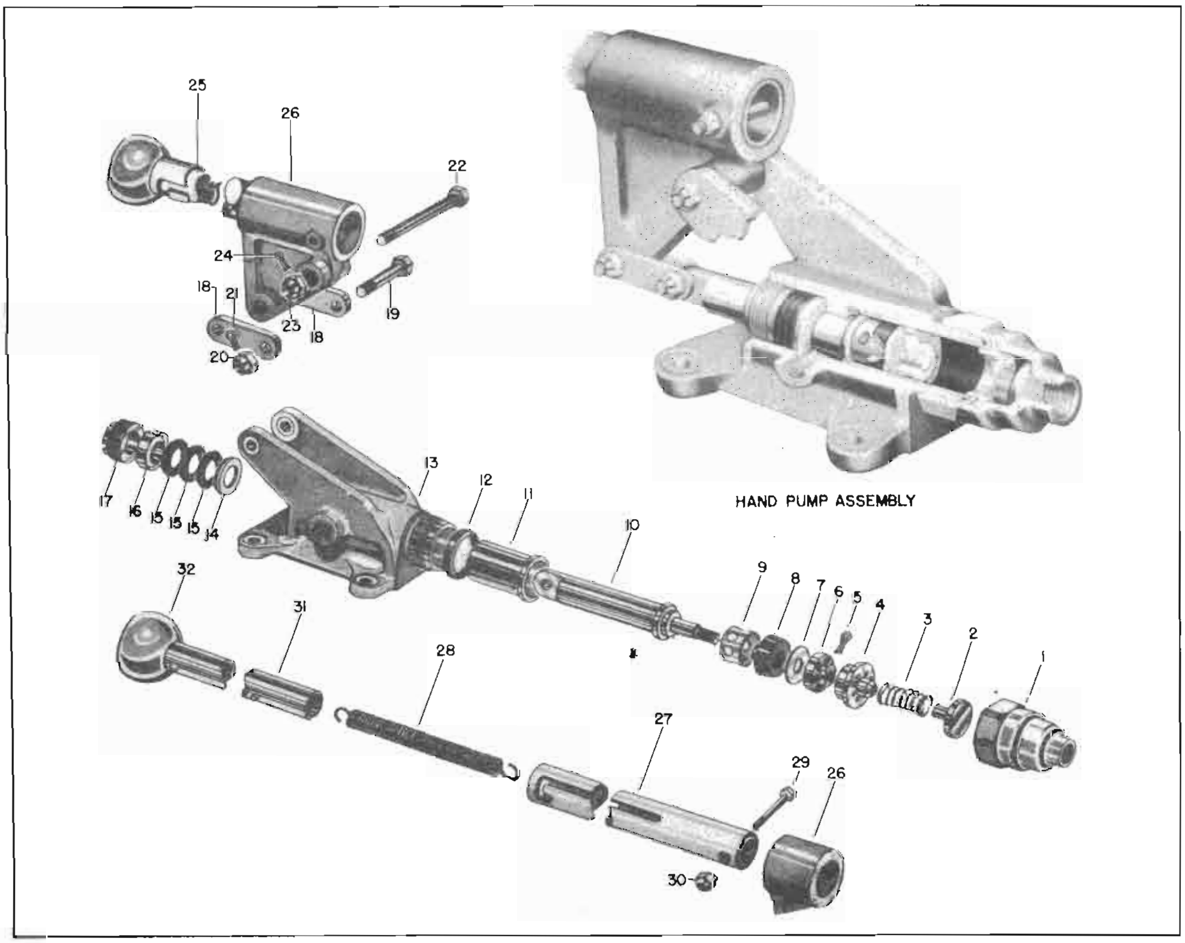


Figure 232 — Hand Pump

1. Head
2. One-way Valve
3. One-way Valve Spring
4. One-way Retainer
5. Pin
6. Piston Head
7. Washer
8. Cup
9. Head Cup Retainer
10. Piston
11. Cylinder Liner
12. Gasket
13. Body
14. Packing Base Ring
15. Packing
16. Packing Cap Ring
17. Piston Rod Bearing
18. Piston Link
19. Bolt
20. Nut
21. Pin
22. Bolt
23. Nut
24. Pin
25. Handle (Consists of 27 through 34)
26. Support Bracket
27. Support Tube
28. Retracting Spring
29. Bolt
30. Nut
31. Tube
32. Knob

check to see that it has an overstroke of $\frac{9}{32}$-inch plus or minus $\frac{1}{32}$ inch beyond the normal 10-$\frac{3}{8}$ inch stroke. This $\frac{9}{32}$ inch overstroke is necessary to prevent the piston from bottoming against the stop in the end of the operating cylinder.

5. To make a final adjustment of the piston rod stroke, place the landing gear strut in the DOWN, LOCKED position, pull the piston rod out of the cylinder and screw it onto the end of the piston rod end fitting until a dimension of 10-38 inches exists between the inboard face of the operating cylinder bearing cap and the end of the piston rod. Then while holding the piston rod to prevent it from turning, run the end fitting lock nut up against the end of the piston rod. Then while holding the piston rod to prevent it from turning, run the end fitting lock nut up against the end of the piston rod. Assuming that the operating cylinder has been properly assembled, the approximate $\frac{9}{32}$-inch overstroke should be obtained without further adjustment.

6. Recheck the free movement or side play of the end fitting on the attaching stud. Raise and lower the landing gear several times and check to see that the operating cylinder assembly does not bind at the bearing blocks or piston rod end fitting stud.

7. The two zerk fittings on the operating cylinder bearing blocks and the single fitting on the landing gear oleo pivot pin fitting and operating cylinder piston rod end fitting should be lubricated with low temperature lubricant, Specification AN-G-3. Although the boss on the top of the oleo shock strut is equipped with a zerk fitting, IT SHOULD NOT BE LUBRICATED. The surface of the strut boss and lock fitting together with the lock pin should be sparingly lubricated with low temperature lubricant, Specification AN-O-6.

(6) EMERGENCY HAND PUMP.—*(See figure 232.)*

(a) DESCRIPTION. — The emergency hand pump is located below the left front corner of the pilot's seat in the front cockpit. The pump is used in the event that the engine-driven pump becomes inoperative and for testing the hydraulic system when the airplane is at rest on the ground. The pump is a double-acting differential-type pump which produces pressure with each stroke of the piston. Fluid enters the pump cylinder through a bottom port and flows through a suction one-way check valve when the pump piston is moved upward. The volume of fluid which enters is equal to the area of the cylinder times the stroke. For a full stroke, this is about 1 cubic inch. When the piston is moved down the one-way suction check valve closes and prevents fluid from escaping through the suction line. Since the synthetic seal cup on the piston is designed to allow pressure to by-pass on the down stroke, the fluid flows past the seal cup on the piston and into the space above the piston. There is insufficient space for half the volume of fluid which flows into the upper area because the piston rod has a cross sectional area of about half that of the cylinder, consequently half of the fluid is forced out through the pressure port. When the piston is again moved upward, the piston seal cup expands, preventing the fluid remaining above the piston from by-passing, thus the fluid is compressed and forced out the pressure port. Simultaneously, the suction port check valve opens, allowing another charge of fluid to be drawn into the cylinder below the piston. A special type synthetic material seal cup with flexible lip is used, which seals sufficiently on the up stroke, but offers very little resistance to the fluid flowing by it on the down stroke. The pump rod is sealed with chevron-type packing. The pump handle is a spring-loaded telescoping type. The pump can be operated with the handle in the shortened position, but should be operated in the extended position in order to develop full efficiency.

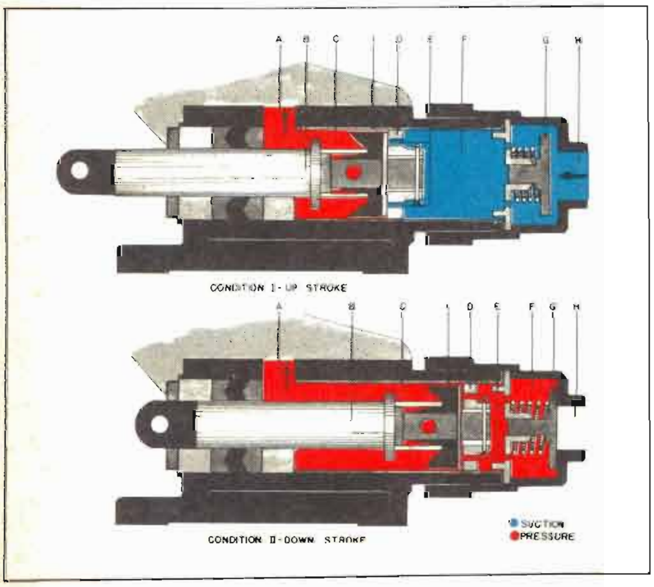


Figure 233 — Hand Pump Function Diagram

EXPLANATION OF HAND-PUMP FUNCTION DIAGRAM.

CONDITION I: INTAKE AND DISPLACEMENT OF FLUID UNDER PRESSURE ON UP STROKE OF PISTON.—As piston "D" is moved upward (to left on illustration), fluid is drawn in through port "H" as check valve "G" is moved off of its seat by the partial vacuum created in chamber "F." Fluid in chamber "C" is forced out port "A" to the selector valve unit since seal cup "I" prevents fluid from passing piston "D" and returning to chamber "F."

CONDITION II: DISPLACEMENT OF FLUID UNDER PRESSURE ON DOWNWARD STROKE OF PISTON.—As piston "D" is moved downward (to right on illustration), check valve "G" is forced against its seat preventing the escape of fluid through port "H." Fluid in chamber "F" passes through hole "E" in piston "D," between the seal cup and the cylinder wall and into chamber "C." A certain amount of fluid in chamber "E" passes by the piston head and seal cup into chamber "C." Simultaneously, fluid in chamber "C" is displaced by the large diameter piston rod "B" and forced out port "A" under pressure to the selector valve unit.

(b) REMOVAL.—The hydraulic hand pump assembly located at the forward left corner of the front cockpit seat may be readily removed by disconnecting the two lines at the fittings on the assembly and removing the five bolts securing the assembly to the support bracket and brace. Remove the head, valve, spring, and retainer from the lower end of the hand pump body assembly. The piston assembly may then be removed from the bottom of the body assembly and parts of the assembly replaced if necessary.

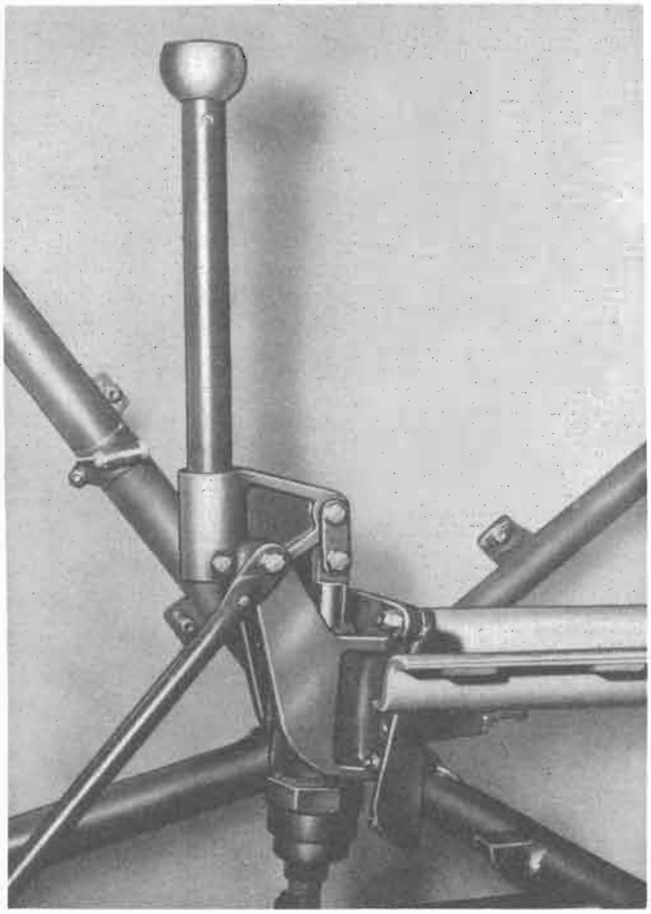


Figure 234 — Hand Pump Installed

(c) TEST BEFORE INSTALLATION.—Connect a ½-inch line from end port of pump to a reservoir containing hydraulic fluid approximately 2-½ feet below the pump. With side port open, operate pump handle. The maximum number of full strokes required for pump to prime itself is 150. Care should be taken to see that test lines and fittings are tight. When a full flow of fluid is obtained and lines are cleared of all air, check output of pump, which should be 100 cubic inches for 100 strokes (200 half-strokes) at the rate of approximately 100 per minute. The nonadjustable piston stroke is 1-⅛ inches. Test pump for leakage with ½-inch line still attached, lifting pump handle so that pump piston is extended and applying test pressure to side port. Test pressure is 2500 pounds per square inch.

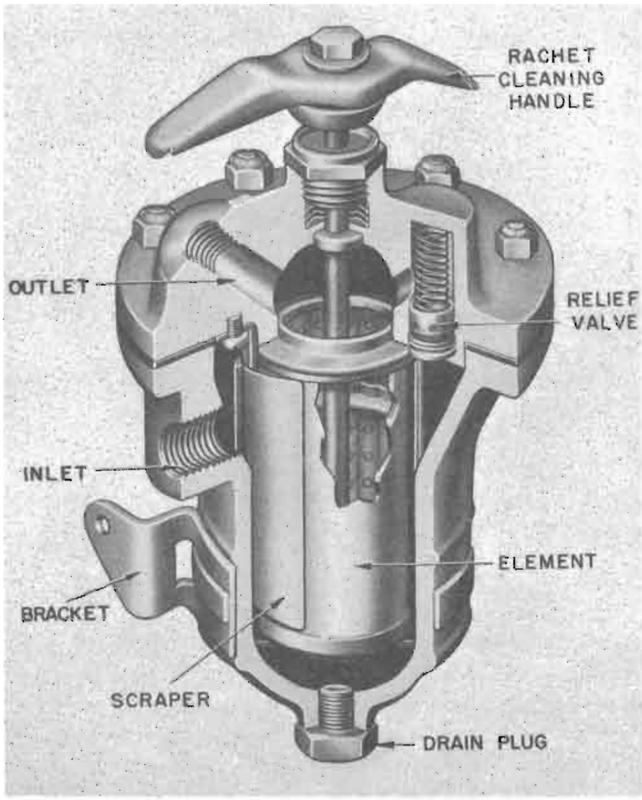


Figure 235 — Filter

(7) FILTER.

(a) DESCRIPTION. — The Purolator filter is located on the rear cockpit control shelf. The filter consists essentially of a container body and a cylindrical filter element which is simply a coil wound from deformed wire. Closely fitted to the outside of the element is a scraper blade which scrapes off foreign matter collected on the outside of the element cylinder and deposits it in the bottom of the filter body as the filter is revolved by means of the T-handle on the top of the unit. Fluid enters a port on the side of the filter body and passes through the small openings in the wound wire coil, depositing any foreign matter that might be present on the outside of the filter element. The filtered oil passes out of the filter element through a port in the top of the filter case. Two spring-loaded one-way ball-check valves are incorporated in the top of the unit which functions as relief valves in the event the filter element becomes stopped up with foreign material, thus preventing the return of fluid to the reservoir. The relief valves permit the fluid to by-pass without flowing through the filter element. The filter element T-handle should be turned one complete revolution after every 10 hours of operation. A drain plug in the bottom of the filter should be removed once every 50 hours to remove any sludge collected in the bottom of the filter.

(b) REMOVAL.—The fluid filter may be readily removed by disconnecting the two hydraulic lines

and removing the two bolts that secure it to the control shelf in the rear cockpit.

(c) TEST BEFORE INSTALLATION.—Apply a pressure of 250 pounds per square inch to the inlet port after plugging the outlet port. Check for leaks around gasket and packing.

(8) FLUID RESERVOIR.

(a) DESCRIPTION.—A fluid reservoir is provided in the hydraulic system to supply the main system and emergency hand-pump unit with fluid. It is located approximately half-way between the front and rear cockpits on the control shelf. The reservoir is made of aluminum-alloy sheet metal welded together. Outlets are provided for the main suction line, the hand-pump suction line, the return line, and the vent line. The hand-pump suction line draws fluid from an emergency supply made possible by tapping the fluid reservoir at a point below that of the main suction line. A filler neck with an overflow scupper and drain line provides a means of accurately filling the reservoir by overflowing when airplane is in the three-point position. Inside the filler neck is a screen which should not be removed when filling the reservoir since it serves to filter the fluid as it is poured into the reservoir. Since the reservoir is never completely full, an expansion area is provided in the upper part of the reservoir. Fluid entering the reservoir through the return port is deflected upward by a V-shaped baffle welded to the end plate of the reservoir, thus preventing foaming of the fluid. The total capacity of the reservoir is approxi-

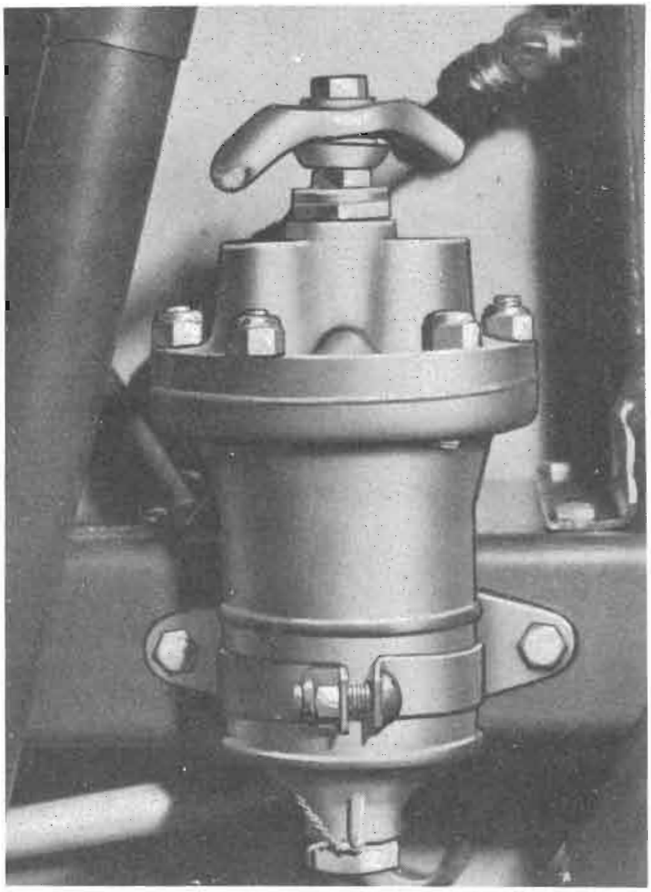


Figure 236 — Filter Installed

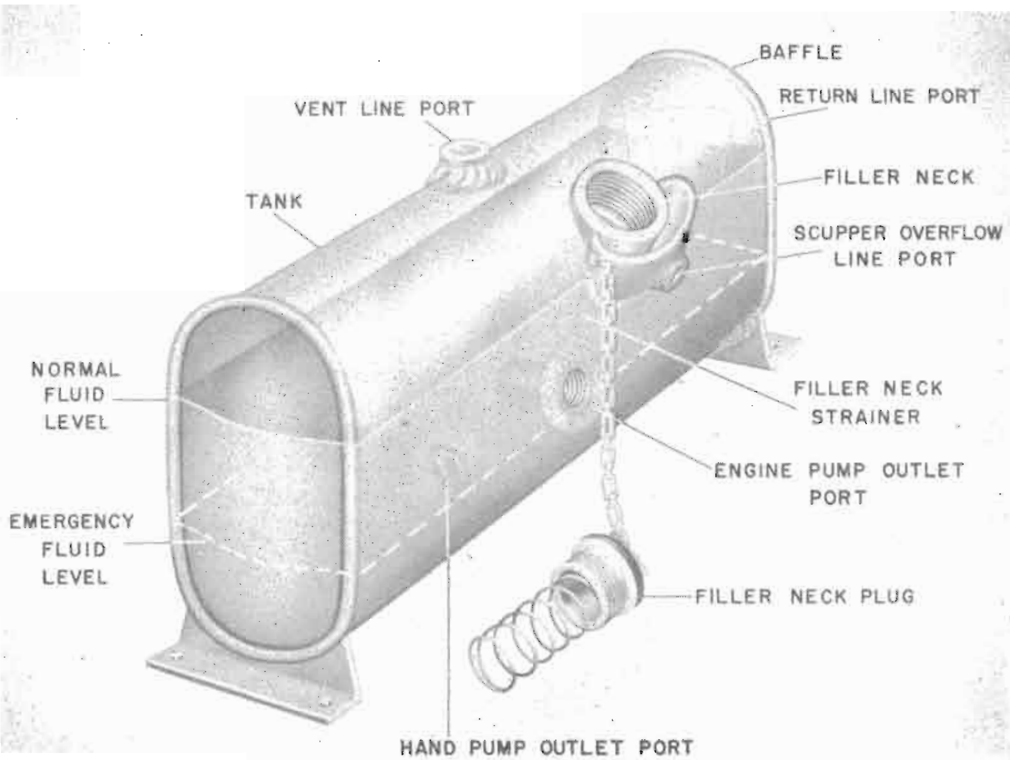


Figure 237 — Reservoir

mately 1 U. S. gallon. The fluid capacity is .77 U. S. gallons (.53 Imp. gallons) with the airplane in the three-point position. The hand pump reserve is .39 U. S. gallons (.27 Imp. gallons).

(b) REMOVAL.—The fluid reservoir is mounted on the control shelf at the left forward side of the rear cockpit. To remove tank, disconnect the five lines at the fittings on reservoir and remove the four bolts attaching the reservoir to the shelf. Remove the plug from the filler neck on the side of the tank; remove the strainer located within the filler neck.

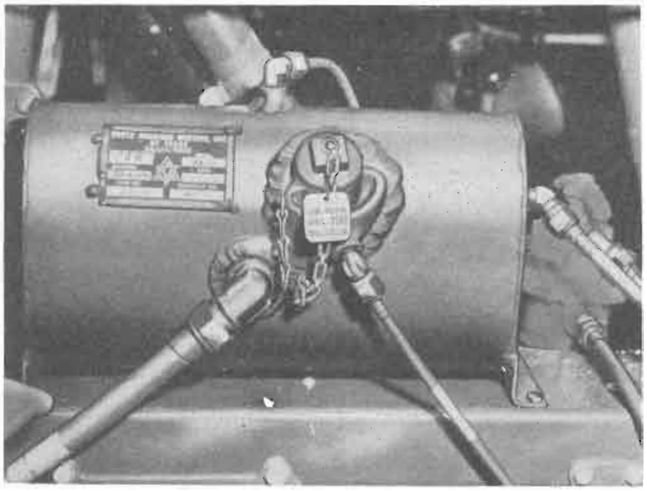


Figure 238 — Reservoir Installed

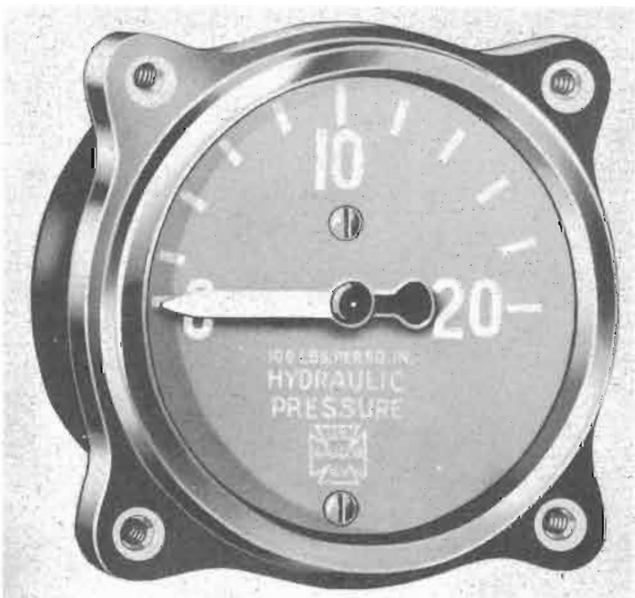


Figure 239 — Pressure Gage

(c) TEST BEFORE INSTALLATION.—Apply 5 to 7 pounds per square inch air pressure to any one of the four ports, with the remaining three ports plugged. Immerge in water; check to make sure no leaks appear.

(9) PRESSURE GAGE.—The pressure gage is located near the forward end of the pilot's control shelf and is visible from the front cockpit only. The gage is not repairable, except by the manufacturer.

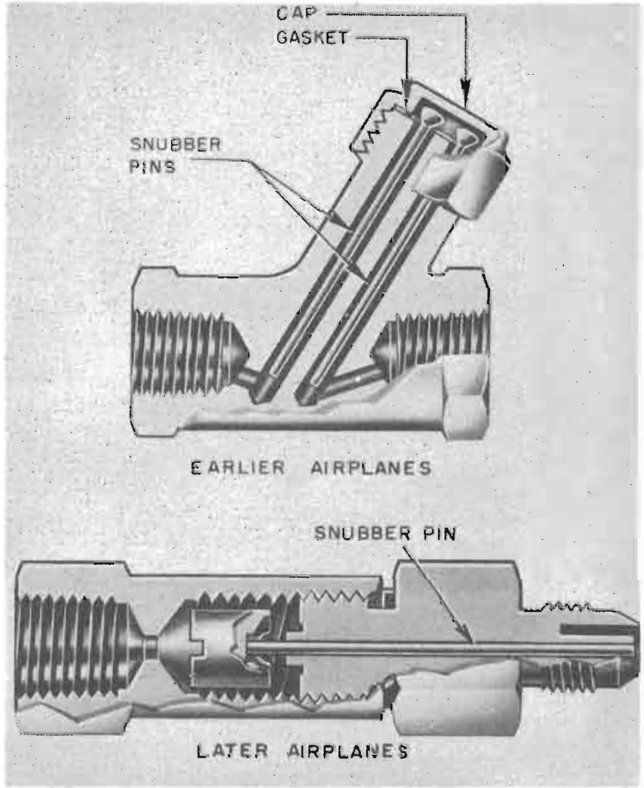


Figure 240 — Snubber Valves

*(10) SNUBBER VALVE.

(a) DESCRIPTION.—This valve is designed to protect the gage from sudden pressure surges and pulsations caused by sudden pressure fluctuations which would cause the gage needle to oscillate and otherwise impose undue strain on the gage mechanism. Early airplanes are equipped with a valve which has dual metering pins, while later airplanes have valves with a single metering pin. The early type valve is composed of a body and two metering pins which slide back and forth in two parallel drilled ports, with a common port at both ends. The fluid flow through the two drilled ports is metered by the pins, thus dampening surges and pulsations caused by sudden pressure changes. The new type valve operates on the same principle except that a single metering pin is employed.

(b) REMOVAL.—This valve is located between the hand-pump pressure line and the pressure gage line

at the left side of the front cockpit below the control shelf; it is held in place by two "B" nuts.

(c) TEST BEFORE INSTALLATION.—To test the snubber valve, attach pressure gage to OUT port and apply pressure. Pressure gage pointer should not oscillate.

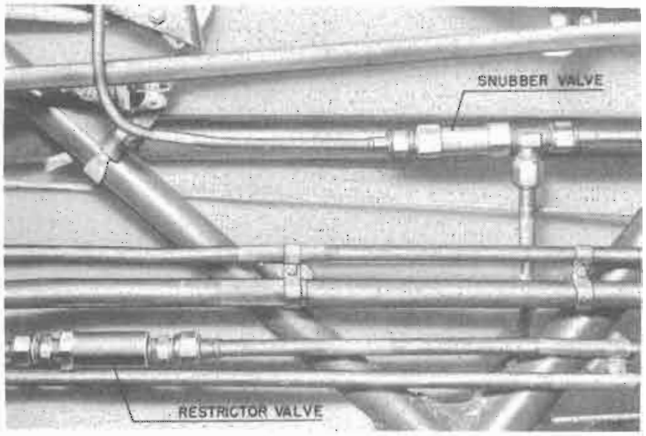


Figure 241 — Restrictor Valve and Snubber Valve Installed

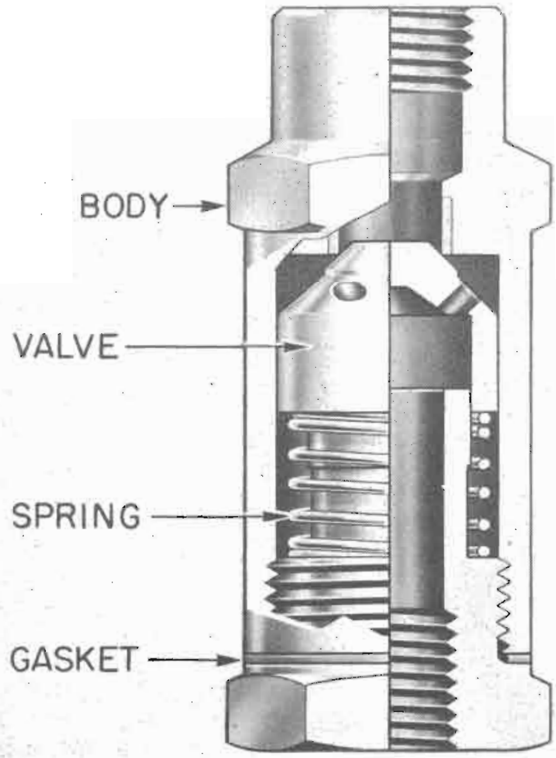


Figure 242 — One-way Check Valve

(11) ONE-WAY CHECK VALVE.

(a) DESCRIPTION.—This valve is located below and forward of the selector valve unit and between the landing gear DOWN pressure line and the hand-pump fluid supply line. The valve permits free fluid flow from the hand-pump supply line to the landing gear DOWN pressure line, but prevents fluid from flowing into the hand-pump supply line from the landing gear DOWN line. This valve is necessary to prevent a partial vacuum forming in the leading gear operating cylinder and landing gear DOWN pressure line when the landing gear is lowered without hydraulic pressure. The one-way check valve allows a sufficient amount of fluid to enter the landing gear DOWN line and operating cylinder to eliminate the partial vacuum formed.

(b) REMOVAL.—This valve connects the hand-pump suction line and the landing gear DOWN pressure line. It is attached to two T-fittings, which may be removed by backing off on the four B-nuts holding the assembly in the lines. The valve is located at the left side of the front cockpit below the control shelf.

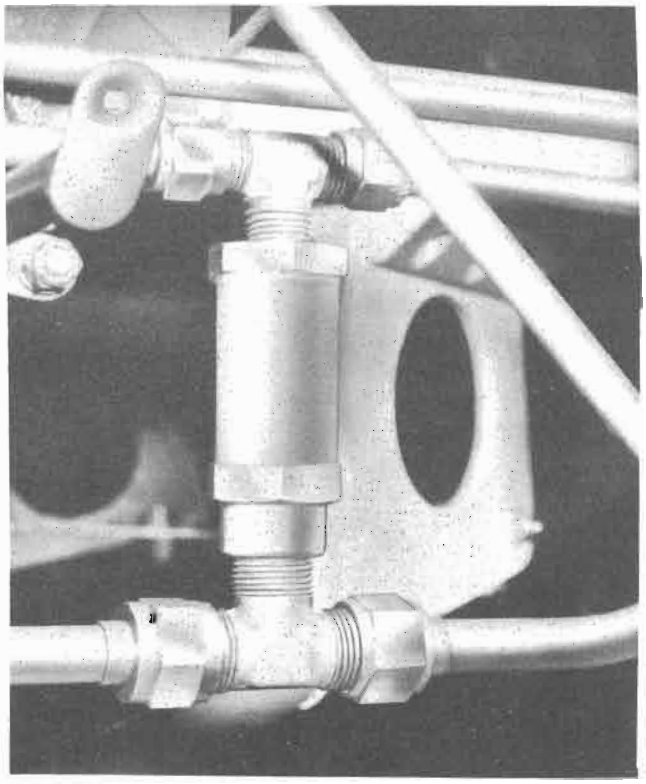


Figure 243 — One-way Check Valve Installed

(c) TEST BEFORE INSTALLATION.

ONE-WAY VALVE.—Denoting large end of one-way valve as port "A," and small end as port "B" and with direction of flow towards port "A," check free flow operation of valve applying pressure at port "B." Then with port "B" plugged, apply 2500 pounds per square inch pressure at port "A" to check for leakage at the gasket between the two sections of the valve body. With port "B" open, apply 1000 pounds per square inch pressure at port "A." Leakage from port "B" should not exceed 5 cubic inches per minute.

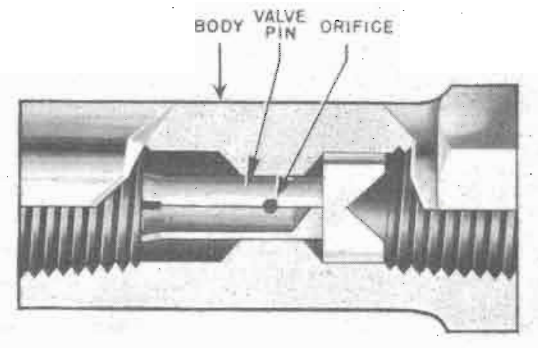


Figure 244 — Restrictor Valve

(12) RESTRICTOR VALVE.

(a) DESCRIPTION. — The landing gear restrictor valve is located in the landing gear UP line in the forward left corner of the front cockpit. The restrictor valve prevents the landing gear from being extended or retracted too rapidly. Fluid flow is more restricted when the landing gear is being extended than when it is being retracted. The valve restricts the return flow of displaced fluid through the landing gear UP line when pressure is being applied in the DOWN line, thus slowing down the movement of the landing gear operating cylinder piston. The flow is restricted as the fluid is permitted to pass through a small orifice in the head of the floating valve pin. The flow of fluid under pressure in the UP line to the operating cylinder is less restricted because the fluid is allowed to flow through the small orifice in the head of the valve pin, in addition to two other ports in the side of the valve pin. A certain amount of fluid is permitted to pass between the outer surface of the valve pin and the valve guide in either case.

EXPLANATION OF RESTRICTOR VALVE FUNCTION DIAGRAM.

CONDITION I: PRESSURE APPLIED TO LANDING GEAR DOWN LINE.—The flow of displaced fluid returning from the landing gear operating cylinder entering port "A" is restricted as valve "C" seats, permitting fluid to pass through the small hole "E" in the head of the valve pin and between the outer surface of the valve pin and the valve body guide, since the valve pin is a loose fit in the guide.

CONDITION II: PRESSURE APPLIED TO LANDING GEAR UP LINE.—Fluid under pressure flowing through the landing gear UP line enters port "B" forcing valve "C" to the left, as shown, thus allowing fluid to flow through valve pin "D" and out holes "E" and "F." Fluid also flows between the valve pin and the valve body guide.

(b) REMOVAL.—This unit is located in the landing gear DOWN line and may be removed by backing off on the two B-nuts holding it in the line which is below the control shelf at the lower side of the front cockpit.

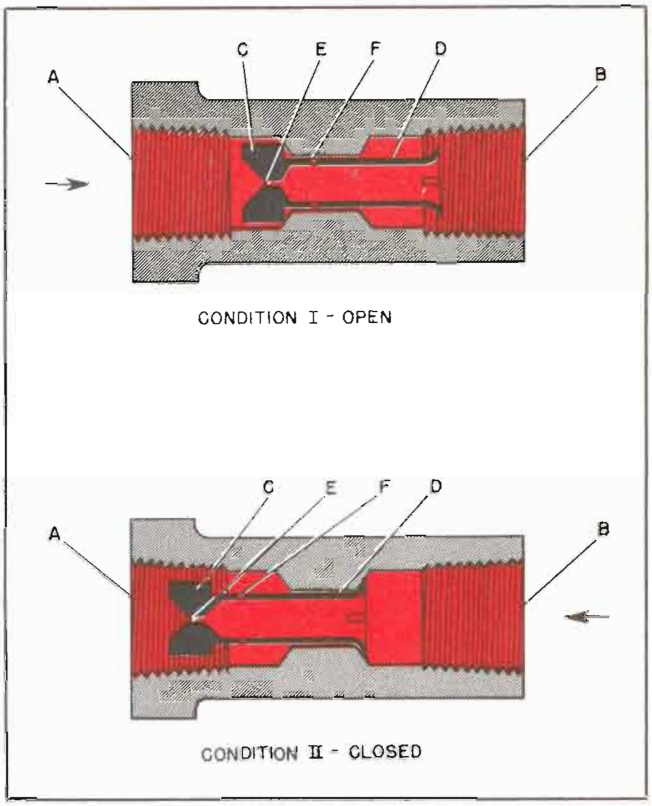


Figure 245 — Restrictor Valve Function Diagram

(c) TEST BEFORE INSTALLATION.—With 500 pounds per square inch pressure applied at port "A," the output should be from 2 to 2¼ gallons per minute at port "B." When 500 pounds per square inch pressure is applied at port "B," the output at port "A" should be from 7 to 8 gallons per minute.

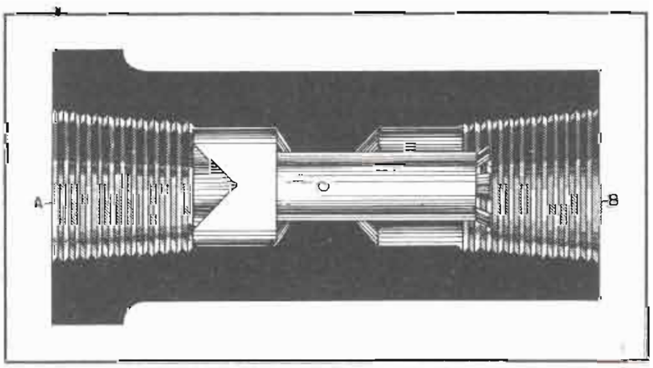


Figure 246 — Restrictor Valve Test Diagram

c. BRAKE HYDRAULIC SYSTEM.

(1) GENERAL.—The brake hydraulic system is separate from the main hydraulic system. The system consists essentially of a master brake cylinder unit which

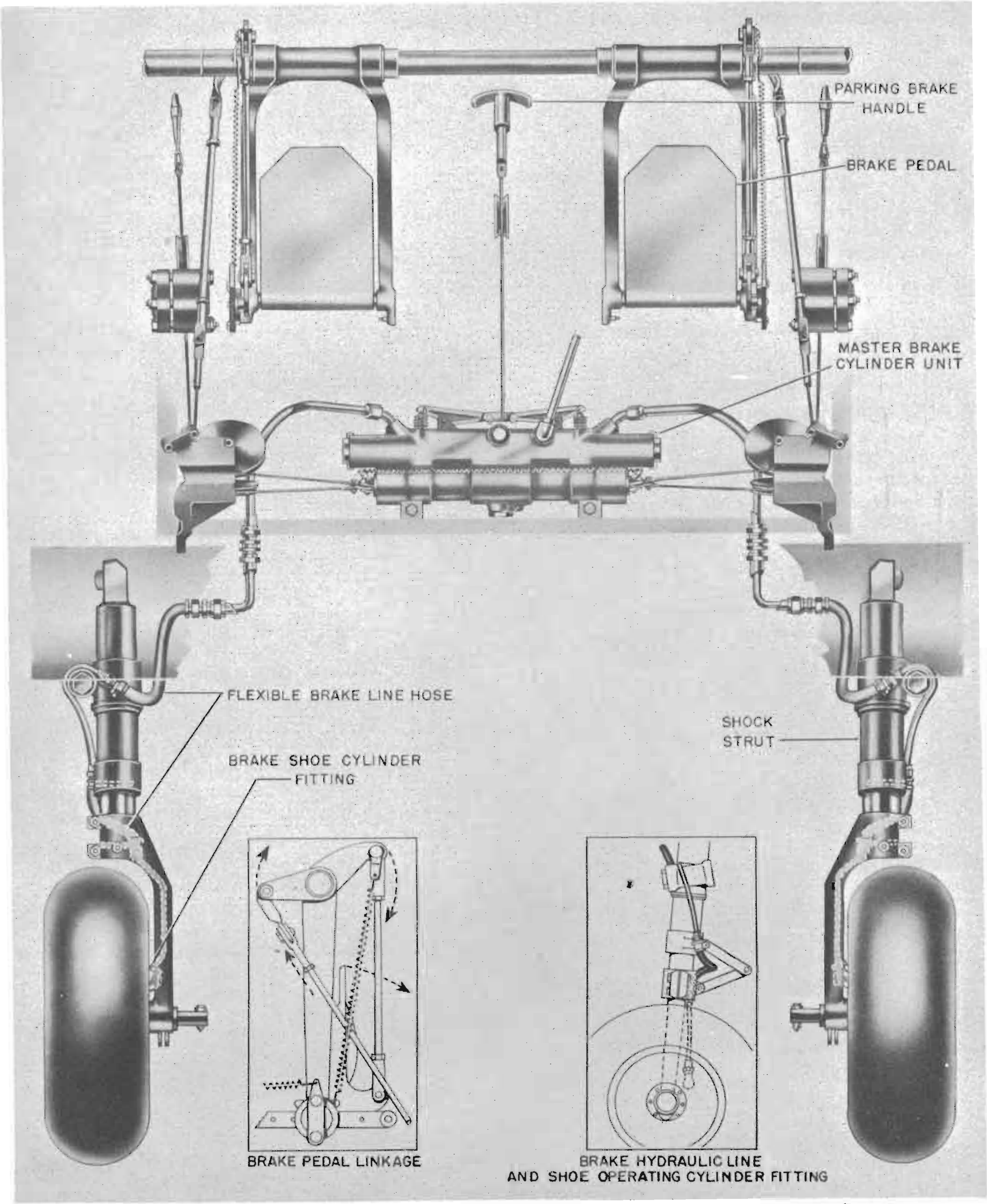


Figure 247 — **Brake Hydraulic System**

contains two independent master cylinders and a fluid reservoir common to both cylinders. A brake shoe operating cylinder is located on each landing gear wheel brake assembly support plate. Each master cylinder furnishes fluid pressure to its corresponding brake shoe operating cylinder when the tips of the rudder pedals are depressed. The pedals actuate the master brake cylinder by means of a cable, rod, and pulley linkage. Each brake operates independently of the other and either or both may be applied or released singly or together. A separate front cockpit parking brake control handle is interconnected with the master brake cylinder parking brake valve mechanism by means of a cable and pulley linkage. Fluid pressure produced in the master brake cylinder flows through the master brake cylinder ports and out through the connecting lines to the brake shoe operating cylinders where it is confined, thus actuating the individual brake shoe cylinder pistons. The direction of flow of the hydraulic fluid is back and forth from master brake cylinder to brake shoe cylinders. See paragraph 4. *a* (6) "LANDING GEAR BRAKES," in this section.

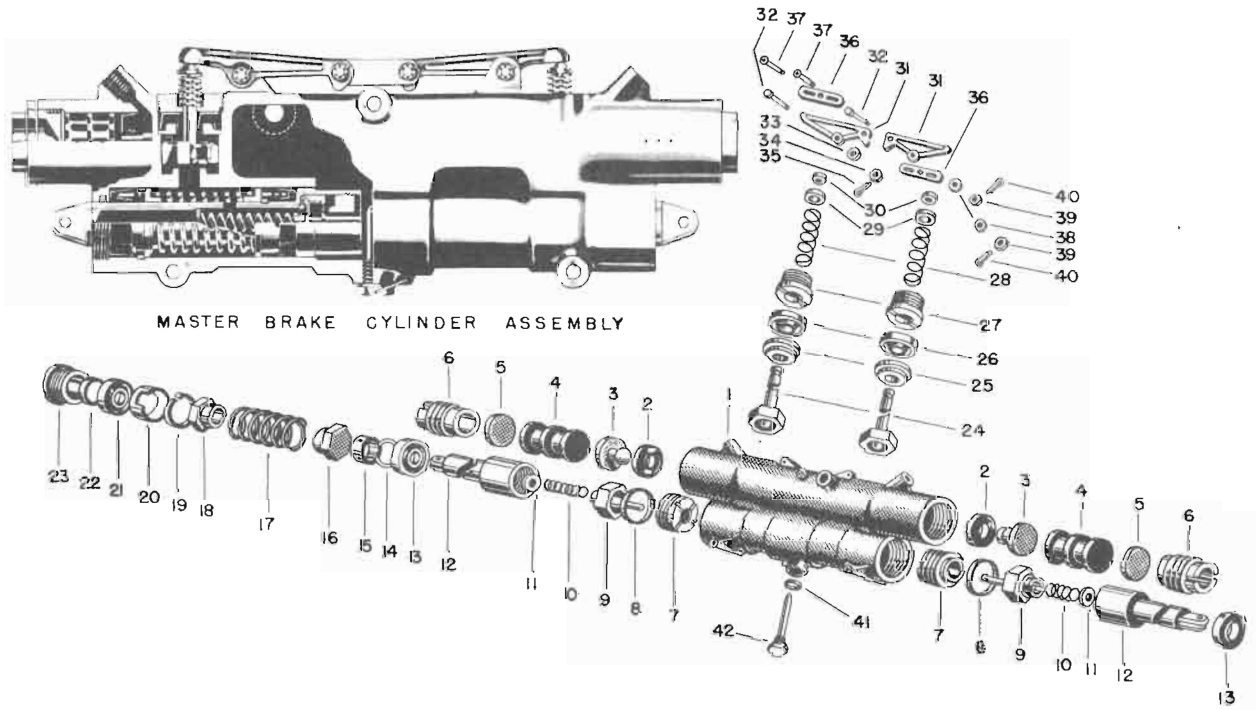


Figure 248 — Master Brake Cylinder

1. Body Cylinder	15. Piston Cup Seal Inner Retainer	29. Washer
2. Cup	16. Cup Retaining Washer	30. Spring Retainer Ring
3. Compensator Retainer	17. Spring	31. Parking Brake Control Arm
4. Compensator Spool	18. Cup Retaining Washer	32. Bolt
5. Retaining Washer	19. Snap Ring	33. Washer
6. Adjusting Screw	20. Piston Cup Seal Outer Retainer	34. Nut
7. Feed Valve Seat	21. Cup	35. Pin
8. Seal Gasket	22. Piston Wiper Washer	36. Parking Brake Control Plate
9. Feed Valve Stem	23. End	37. Bolt
10. Valve Spring	24. Brake Valve Stem	38. Washer
11. Washer	25. Valve Cup Retainer	39. Nut
12. Piston	26. Cup	40. Pin
13. Cup	27. End	41. Gasket
14. Piston Snap Ring	28. Spring	42. Piston Stop

NOTE: Items 14 through 23 are contained in both ends.

(2) MASTER BRAKE CYLINDER UNIT.—*(See figure 248.)*

(a) DESCRIPTION.—The brake system with the exception of the pressure lines and the brake shoe operating cylinders is wholly contained within one unit known as the master brake cylinder unit. Except for the brake system reservoir, which serves both sides, this unit is identical at both ends and each end constitutes an

individual master brake cylinder, one unit being connected to each of the two main landing gear brake operating cylinders, located outboard on the brake assembly support plates. The top center portion of the master brake cylinder unit is the reservoir which provides for the storage of fluid. This space is vented to the atmosphere by means of a breather tube mounted on the forward side of the unit. The filler port is located so that there will always be an air space at the top of the reservoir, and the breather tube extends a considerable distance above it. This air space is provided to accommodate fluid expansion and surges during operation, thus preventing excess fluid from overflowing. This unit, like the main system reservoir, should be filled when the airplane is in the three-point position. At the bottom of the unit are two piston assemblies. Pressure applied to the brake pedals pulls the piston assemblies outward forcing trapped fluid ahead of the piston heads and out through the brake line pressure ports to the brake shoe operating cylinders. When pressure is removed from the pedals, the pistons return to their original positions, thus releasing the pressure in the brake system. Pulling outward on the parking brake handle after the brake pedals have been depressed traps fluid under pressure in the upper chambers of the master brake cylinder by means of the parking brake valves, which are then held closed by pressure on top of the valves. To release the brakes, it is only necessary to depress the brake pedals sufficiently to cause the pressure on the underside of the brake valve to equal the pressure on top of the valve thus lifting the parking brake valves. Releasing the pressure on the rudder pedals then releases the pressure in the system. A fluid expansion chamber is provided in each upper end of the master brake cylinder unit. A synthetic spool which contains sufficient resilience to act as a cushion when a stem and cup are forced against it by the pressure in the chamber is located outboard of the stem and cup in the expansion chamber. When the brakes are applied, the spool is compressed, thus causing it to act as a cushion which resists the pressure built up in the system, and providing a reserve supply of pressure to keep the brakes locked in case a slight leak should occur in the system. The capacity of the spool to store reserve pressure, however, is so small that only the very slightest leakage can be compensated. This compensator unit also functions as a thermal expansion relief unit because after full brake pressure has been applied, there is still sufficient resilience in the synthetic spool to accommodate the increased volume due to thermal expansion.

EXPLANATION OF HYDRAULIC BRAKE MASTER CYLINDER FUNCTION DIAGRAM.

CONDITION I: FLUID STATIC.—The rudder pedal and parking brake control handle are in the released position and all valves are open, thus there is no pressure in the brake hydraulic system.

CONDITION II: BRAKES APPLIED.—As pressure is applied to the top of the rudder pedal, mechanical linkage attached to piston rod "A" causes piston "I" to be pulled outward against spring "H," allowing valve "D" to be moved inward against its seat by spring "E." Fluid is confined in chambers "O" and "P" and is prevented from returning to the reservoir "L." As the piston is moved outward, the fluid is compressed and forced upward through opening "J" into chamber "P," through opening "Q" and out brake-line port "B" to the corresponding brake shoe cylinder.

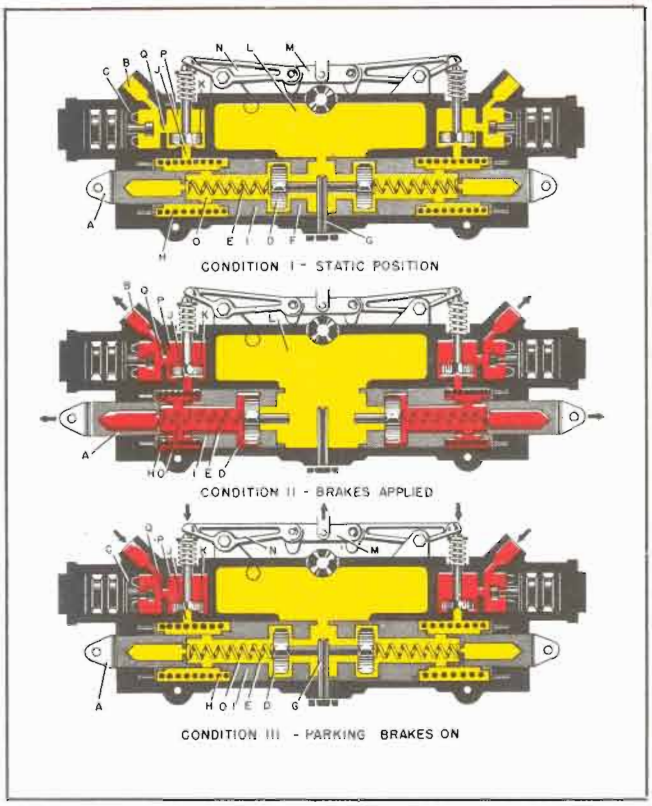


Figure 249 — Master Brake Cylinder Function Diagram

CONDITION III: PARKING BRAKES ON.—While pressure is being applied to the tips of the rudder pedals causing the condition outlined above to exist, the parking brake handle is pulled outward causing connecting bar "M" to move upward and rocker arm lever "N" to move downward, forcing valve "K" down over opening "J," thus confining the fluid under pressure in chamber "P" and in the brake line and brake shoe operating cylinder. Releasing the pressure on the pedal allows piston "I" to be moved inward against stop "G" by compression spring "H," thus forcing valve "D" off of its seat and releasing the fluid confined in chamber "O." Therefore, the higher pressure maintained in chamber "P" will hold valve "K" seated. A thermal expansion valve "C" is provided at the end of the brake cylinder, which expands to provide additional fluid area as the volume of the fluid increases, due to thermal expansion, thus preventing excessive pressure from building up in the system. The parking brake is released by depressing the tip of the rudder pedal, which has caused piston "I" to move outward, building up sufficient pressure to force valve "K" off its seat, thus releasing the pressure in chamber "P," and piston "I" moves inward against stop "G" after the release of the brake pedal. Thus all valves are open and the fluid is in a static condition as shown in condition I.

(b) REMOVAL.—The master brake cylinder unit is located just aft of the fire wall on the lower, front fuselage spar. It is attached to the spar by two bolts and nuts. To remove the master brake cylinder unit, remove the two bolts and nuts which attach the brake pedal cables to the piston rods, remove the nut and bolt attaching the master brake control cable to the actuating levers, and loosen the two B-nuts which connect the brake lines to the cylinder port elbow fittings.

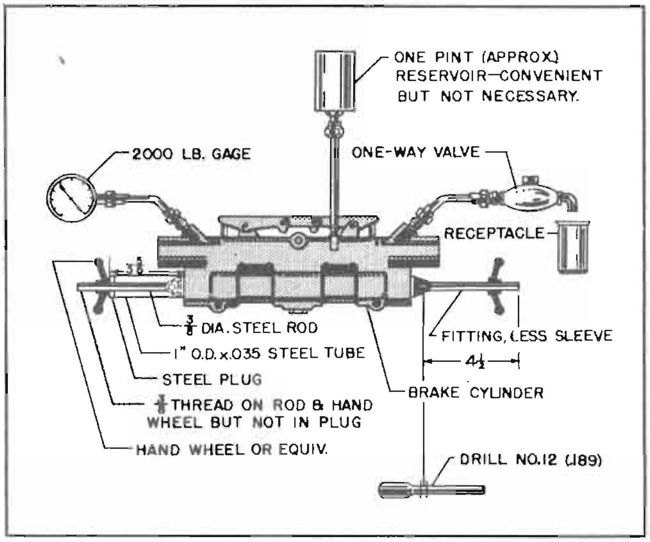


Figure 250 — Master Brake Cylinder Test Diagram

(c) TEST BEFORE INSTALLATION.—Testing the master brake cylinder unit requires special equipment listed below:

Special hand wheel fitting.
2000-pound per square inch hydraulic pressure gage.
Small ball-check one-way valve.
Auxiliary reservoir (desirable but not necessary).
Suitable receptacle.

1. Each side of the master brake cylinder unit should be tested separately as follows:

a. Attach a one-way check valve to the left outlet port to prevent air from getting in the unit, and install an auxiliary reservoir line at the filler plug port if possible. Fill the reservoir with fluid and move the piston in and out by hand to free the system of air and to see that the cylinder unit forces fluid through the one-way check valve when the piston is pulled outward. The piston displacement at 0 pounds per square inch pressure should be approximately 1.2 cubic inches. The effective displacement at 600-800 pounds per square inch should be approximately .974 cubic inch. Next remove

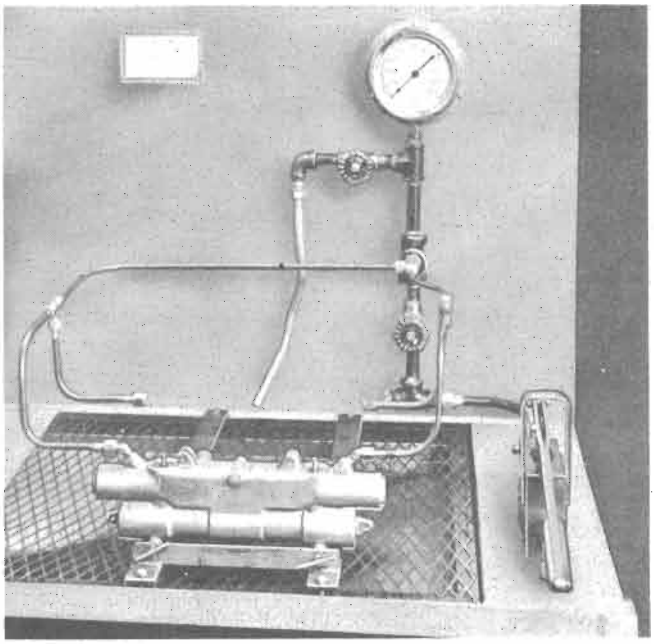


Figure 251 — Testing Master Brake Cylinder

the one-way check valve, and install a pressure gage in its place. Also, install a sleeve on the handwheel shaft as shown in figure 251. The B-nut at the gage should be left loose until the piston is pulled out at least once to permit any air in the unit to leak out around the loose fitting. Turn the handwheel counterclockwise to allow the piston to fully retract, then turn clockwise to move the piston outward until a pressure reading of 1200 pounds per square inch is noted on the pressure gage. Allow to stand 5 minutes; if any small loss of pressure is indicated, simply turn handwheel clockwise until 1200 pounds per square inch is again indicated and allow to stand for one-half hour. No loss of pressure should be evident at the end of this time. The possible slight loss of pressure after the first 5 minutes is normal, due to parts settling into place.

b. To check the proper release of the piston valve, turn the wheel counterclockwise to allow the piston to retract. The pressure should decrease as the wheel is backed off; when the piston nearly reaches its fully retracted position, the pressure should fall off rapidly and completely.

c. Repeat the foregoing test procedure on each side of the master brake cylinder unit.

2. The above check tests all valves and seats except the parking brake valve. Proceed as follows to check the parking brake valve:

a. Turn wheel counterclockwise to allow the piston to retract fully. Push down on the parking brake valve. Turn handwheel clockwise until 1200 pounds per square inch is indicated. Then still holding down parking brake valve, turn handwheel counterclockwise until it is free; remove the pressure on the parking brake valve. The gage should continue to read 1200 pounds per square inch. Allow to stand for one-half hour, at the end of which time no reduction of pressure should be evident.

b. Next, check for release of parking brake. With the parking brake valve closed and pressure applied as outlined in the preceding paragraph, turn handwheel clockwise. Two or three turns of the wheel after it begins to tighten should snap out the parking brake valve, and the pressure should drop as the wheel is turned counterclockwise.

c. Repeat procedure in preceding paragraphs, on opposite side of the master brake cylinder unit.

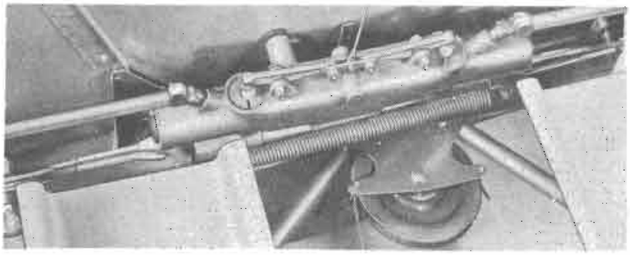


Figure 252 — Master Brake Cylinder Installed

(*d*) INSTALLATION.—Place master brake cylinder in position on aft side of fire wall at mounting brackets provided on lower fuselage cross tube. Front and rear brackets are provided on left side and a front bracket only on the right. Connect the two hydraulic fluid lines to fittings at cylinder ends and bulkhead fittings in top of wing center section. From forward side of fire wall, install elbow through hole in fire wall into brake cylinder. Assemble plug assembly in elbow. Attach brake cables to piston ends, utilizing two links. Assemble spring between extension arms on links at aft side of cylinder. Attach brake pull cables and parking brake cables.

(*e*) ADJUSTMENT.—The only adjustment on the master brake cylinder is on the thermal expansion plug or setscrew in the upper end of each cylinder. This plug should be screwed in so that the distance between the end of the plug and the end of the cylinder body is 3/16-inch, figure 253.

For adjustment of brake pedals, refer to section IV, paragraph 4, *a,* (6) *(d)*.

(3) BRAKE SHOE OPERATING CYLINDERS.

(*a*) DESCRIPTION.—The brake shoe operating cylinder is located between the ends of the brake shoe on the brake shoe support plate which is bolted to a flange attached to the inboard end of each landing gear strut wheel axle. Fluid under pressure flows from the master brake cylinder port, through the brake line, to the brake shoe operating cylinder where it forces two actuating pistons outward against the ends of the brake shoes, thus expanding the shoes against the brake drum. When the pressure is released, the spring-loaded ends of the brake shoe retract, forcing the pistons back into the cylinder. As the piston moves inward toward the center of the cylinder, fluid is displaced which returns through the port in the center of the cylinder to the master brake cylinder unit reservoir.

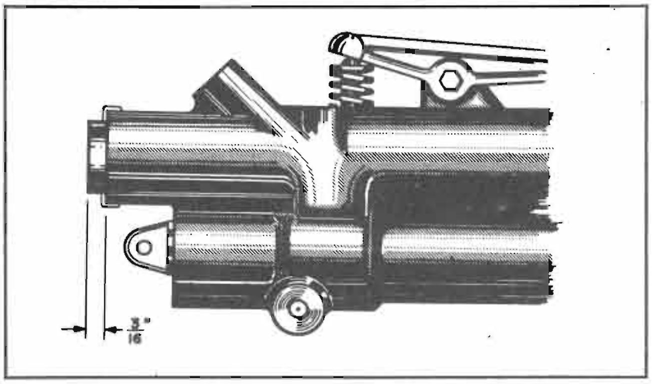


Figure 253 — Master Brake Cylinder Expansion Chamber Adjustment Plug

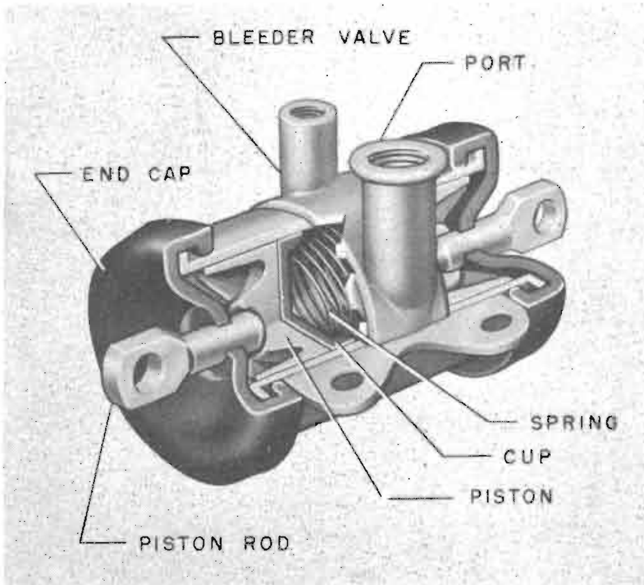


Figure 254 — Brake Shoe Operating Cylinder

EXPLANATION OF BRAKE SHOE CYLINDER FUNCTION DIAGRAM.

CONDITION I: BRAKES APPLIED.—Fluid under pressure has entered port "A" and cylinder "G" and has forced pistons "B" and "C" outward away from the center of the cylinder. Rods "H" and "I" have moved outward expanding the ends of the brake shoe. Spring "D" holds cups "E" and "F" against pistons "C" and "B."

CONDITION II: BRAKES RELEASED.—The pressure in the master brake cylinder unit has been released, allowing fluid to return through port "A." The brake shoe retracting springs have caused the brake shoe to retract, thus causing rods "H" and "I" and pistons "B" and "C" to move inward toward the center of the cylinder.

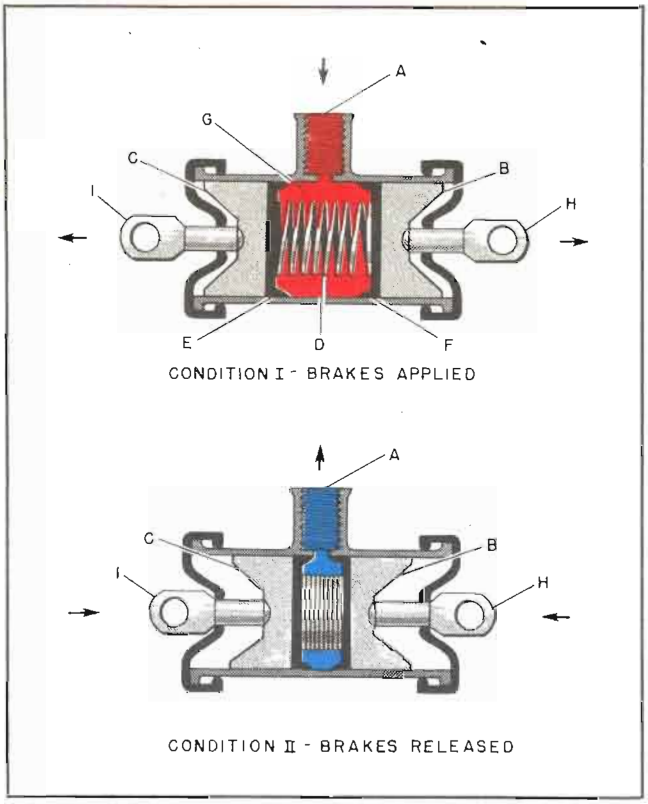


Figure 255 — Brake Shoe Operating Cylinder Function Diagram

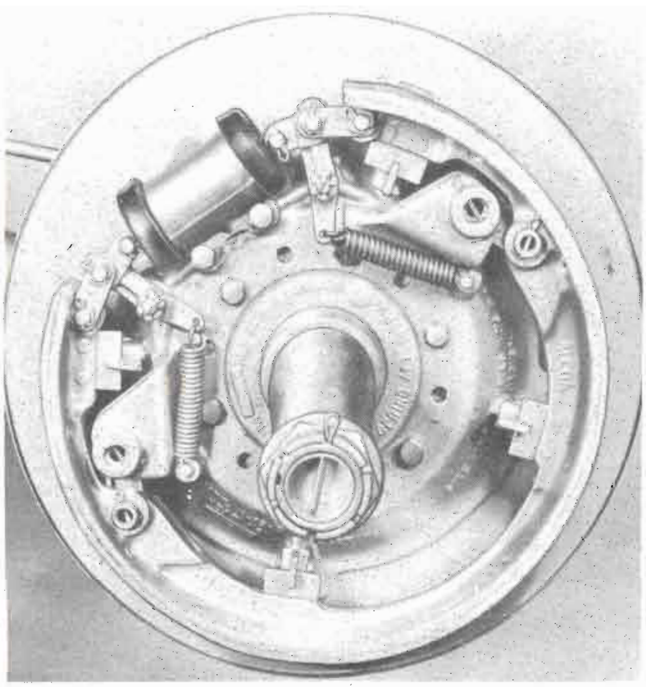


Figure 256 — Brake Shoe Operating Cylinder Installed

(b) REMOVAL.—Remove the two lock-wired bolts and the two screws attaching the cylinder body to the brake-shoe support flange. The two clevis pins attaching the piston rods to the brake shoe must be removed also.

(c) TEST BEFORE INSTALLATION. — The brake shoe operating cylinder should be tested by applying a pressure of 1200 pounds per square inch at port "A." Check for leaks around cylinder and packing cup while pressure is applied.

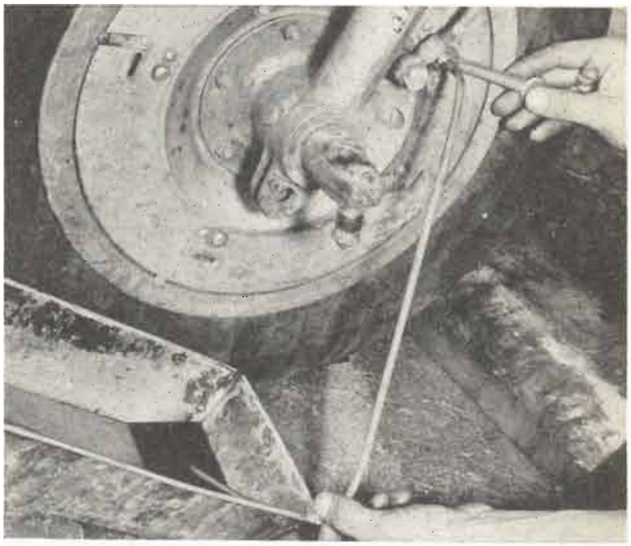


Figure 257 — Bleeding Brake System

(4) BLEEDING BRAKE SYSTEM. — Whenever the hydraulic line connecting the master cylinder to the brake cylinder is disconnected, air will be admitted to the system and the line must be bled to remove the air when line is reconnected. This same condition may develop if the master cylinder reservoir becomes empty. Air in the line may be determined by the action of the brake pedals. If a brake pedal has a spongy action when applying the brake, the cause may be due to air compressing in the system. It will be noted that there are two fittings on each brake actuating cylinder, the inlet fitting and the bleeder. To bleed the system, proceed as follows.

(a) Fill master cylinder reservoir with fluid. During the bleeding process, it will be necessary to check the fluid level in the reservoir several times; never allow it to become empty.

(b) Remove the cap from the bleeder fitting.

(c) Prepare a piece of rubber tube at least 12 inches long; slip one end of the tubing over the end of the bleeder fitting, allowing the free end of the tubing to hang below the level of a small amount of fluid in a container so that air bubbles will not enter system again.

(d) Operate the brake pedals back and forth slowly, to pump fluid out of the reservoir and through the system. Continue this operation until the fluid from the hose connection on the bleeder is free of air bubbles.

NOTE

Because of the frequent revisions made from time to time in the electrical system this electrical wiring diagram should be used ONLY as general reference with the occompanying text. For servicing and repairing of the electrical wiring system in the airplane refer to the latest revision of North American Dwg. No. 88-54002 which accompanies each airplane.

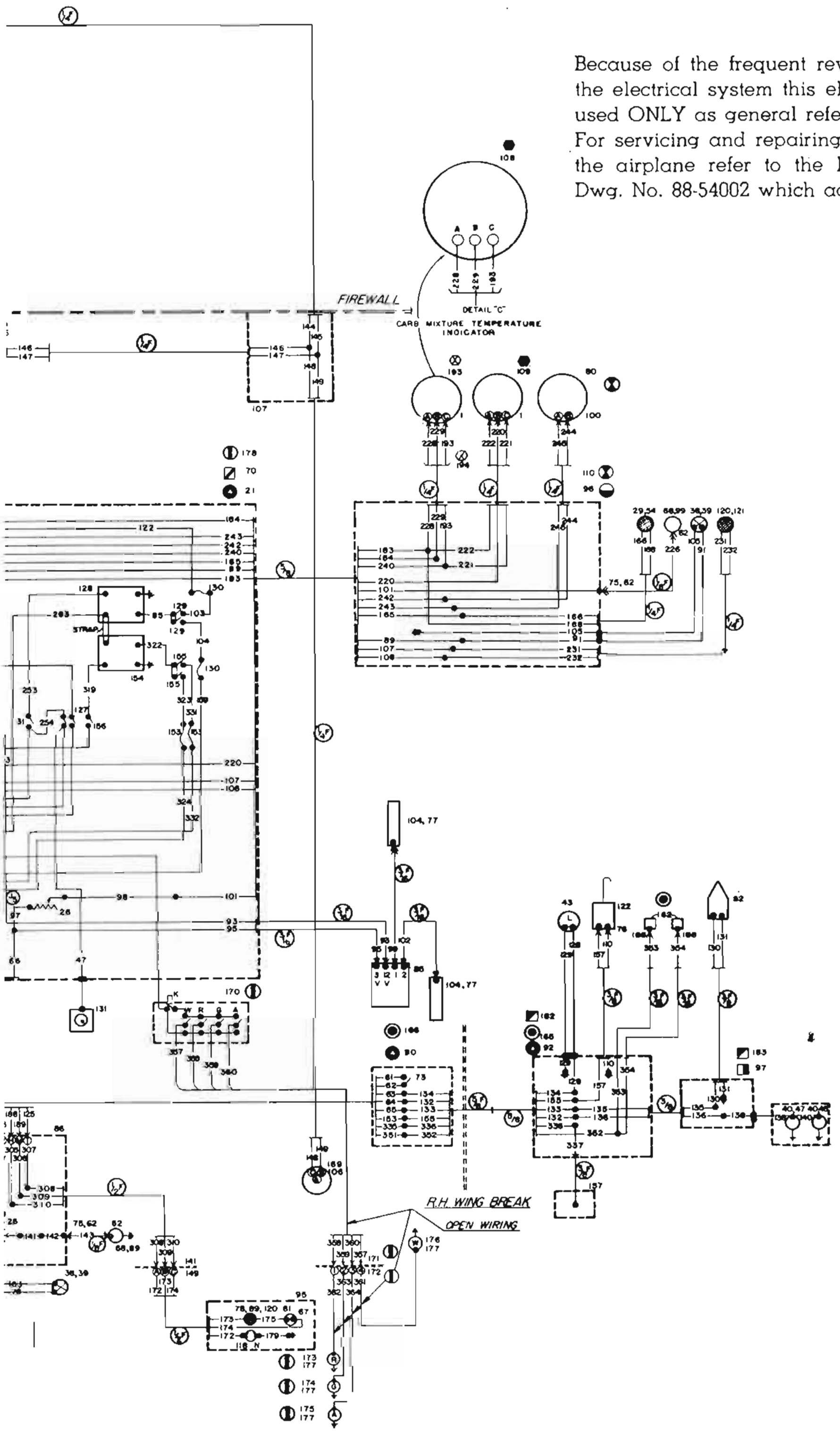
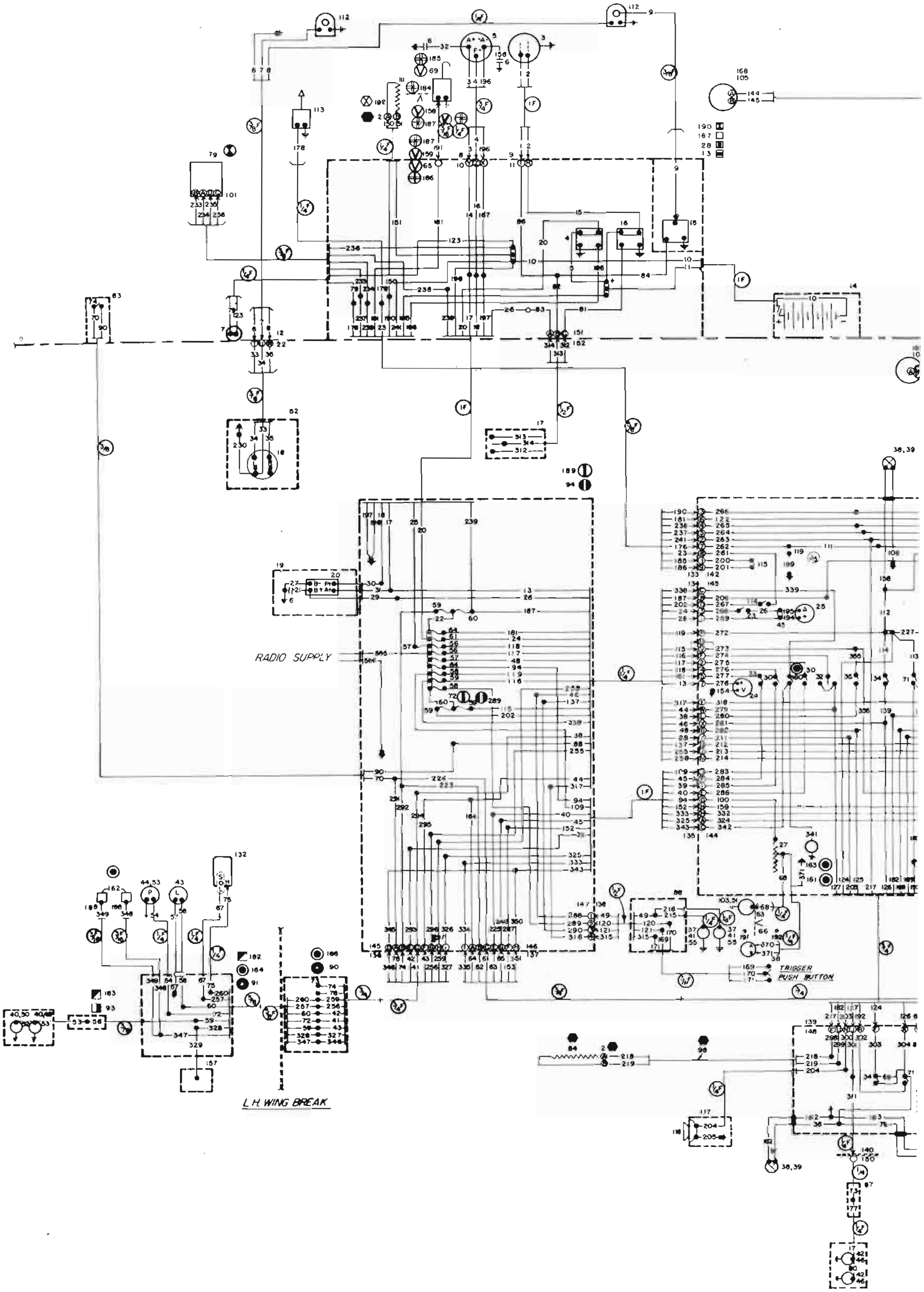


Figure 258 — Electrical System Wiring Diagram — 12-Volt System



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LEGEND — 12 VOLT WIRING DIAGRAM

CODING SYMBOLS

NO.	DESCRIPTION	TYPE	SPEC. OR PART NO.
1	Airplanes 1 to 332 and 1132 to 1330.		
2	Airplanes 333 to 520 inclusive.		
3	Airplanes 1 to 520 inclusive.		
4	Airplanes 1 to 332 inclusive.		
5	Airplanes 521 to 5370 inclusive.		
6	Airplanes 333 to 1131 and 1331 to 5370 inclusive.		
7	Airplanes 118 to 5370 inclusive.		
8	Airplanes 1 to 200 inclusive.		
9	Airplanes 1 to 117 inclusive.		
10	Airplanes 201 to 5370 inclusive.		
11	Airplanes 571 to 5370 inclusive.		
12	Airplanes 201 to 570 inclusive.		
13	Airplanes 201 to 970 inclusive.		
14	Airplanes 1 to 570 inclusive.		
15	Airplanes 971 to 5370 inclusive.		
16	Airplanes 1 to 970 inclusive.		
17	Airplanes 571 to 970 inclusive.		
18	Airplanes 521 to 1131 and 1331 to 5370 inclusive.		
19	Airplanes 1132 to 1330 inclusive.		
20	Airplanes 1 to 5370 inclusive.		
21	Airplanes 1 to 4328 inclusive, 4333 to 4382 inclusive and 4403 to 4570 inclusive.		
22	Airplanes 4329 to 4332 inclusive, 4383 to 4402 inclusive and 4571 to 5370 inclusive.		
23	Airplanes 1 to 4322 inclusive, 4333 to 4382 inclusive and 4403 to 4570 inclusive.		
24	Airplanes 4323 to 4332 inclusive, 4383 to 4402 inclusive and 4571 to 5370 inclusive.		

REFERENCE PARTS LIST

NO.	DESCRIPTION	TYPE	SPEC. OR PART NO.
1	Socket Assembly Carburetor Temperature Free Air	AN9534	AN3106-14s-1s
2	Socket Assembly Carburetor Temperature Free Air	AN9534	AN3106-12s-3s
3	*Starter—Electrical Inertia	H-5	32301
4	*Switch—Solenoid, Battery	B-1	32141-A
5	*Generator—15 volt, 50-amp.	E-5A	95-32018
6	Capacitor—0.5 MFD. 100 W.V.	......	50131
7	*Switch—Fuel Switch over Sig.	C-3	32215
8	Plug Assembly Generator	......	36A5956
9	Plug Assembly Starter	......	36A1874
10	Socket Assembly Generator	......	35B5168
11	Socket Assembly Starter	......	36A1881
12	Plug Assembly Ignition	......	35A2533
13	Box Assembly Main Power Pan.	NAA	88-54072-4
14	*Battery—12 volt, 68 A.H.	D-6	70-40
15	*Coil Assembly Booster	A-1	94-32083-4
16	*Switch—Solenoid, Starter	A-5A	94-32079
17	Switch—Foot Starter	B-11	AN3019
18	Switch—Ignition	A-7	32090
19	Shield—General Control Panel	NAA	55-54031
20	*Panel—Generator Control	A-1	32016
21	Box Assem.—Front Cockpit Switch	NAA	88-54003
22	Socket Assembly—Ignition	Breeze	E-1156-3-10
23	Switch—Generator Main Line	B-13	32103
24	*Voltmeter	B-1	32172
25	*Ammeter	F-1	94-032284
26	Rheostat—Compass Light	C-1 (25 ohm)	32009-C
27	Rheostat—Gun Sight	F-1 (8 ohm)	32032-C
28	Box Assem. Main Power Panel	NAA	88-54072
29	*Lamp 14 volt S.C. Clear Fuel Sig. 1 spare	T-3¼	
30	Switch—Landing Lights	B-5A	AN3015
31	Switch—Gun Safety	B-5A	AN3015
32	Switch—Running Lights	B-7A	AN3017
33	Switch—Pitot Heat	B-5A	AN3015
34	Switch—Fuel Gage Lights	B-5A	AN3015
35	Switch—Passing Light	B-5A	AN3015
36	*Switch—Gun Control Stick	B-4	39B1691
37	Socket—Lamp S.C. Fuel Ga. Lights	......	31A4527
38	Lamp—12-16-volt, 3 C.P. S.C., Cockpit	T-3¼	......
39	Lamp Assem. Cockpit—12 volt	C-4	94-32294
40	*Lamp—12-16-volt 6 C.P. S.C. Wing Tip	G-6	......
41	*Lamp—12-16-volt 2 C.P. S.C. Fuel Gage	F-4¼	......
42	*Lamp—18-24-volt 3 C.P. S.C. Tail Light	G-6	......
43	*Lamp—12-volt, 450 W. Sealed Beam	Landing Lamp	H41G9803
44	*Lamp—12-16-volt 50 C.P. S.C. Passing	RP-11	......
45	*Shunt—Ammeter	F-1	94-32284
46	*Lamp Assembly—Tail, Clear	A-8	37B4962-5
47	*Lamp Assembly Right Wing Upper (gr)	A-8	37B4962-2
48	*Lamp Assembly Right Wing Lower (gr)	A-8	37B4962-4
49	*Lamp Assem. Left Wing Upper (red)	B-8	37B4962-1
50	*Lamp Assem. Left Wing Lower (red)	A-8	37B4962-3
51	*Lamp 12-16-volt 21-21 C.P. Gun Sight	RP-11	......
52	Box Assembly—Ignition Switch	NAA	55-54054
53	*Lamp Assembly—Passing	B-3	37D4865
54	Lamp Assem.—Fuel Switch-over Sig.	Red	39A2822-2
55	Lamp Assem.—Fuel Level Gage	NAA	25-54052
56	Fuse Landing Lights (2 spare)	70-amp.	32084-C
57	Fuse—Camera and Start-switch (2 spare)	35-amp.	32084-C
58	Fuse—Cockpit Lights, Gun Sel. (3 spare)	20-amp.	32084-C
59	Fuse, Navigation Lights, Landing Gear (4 spare)	15-amp.	32084-C
60	Fuse—Fuel Signal Switch (1 spare)	1-amp.	32084-C
61	Fuse—Generator (1 spare)	100-amp.	32084-C
62	Plug—Inst. Lamp Connector	......	37A5157
63	Receptacle—Gun Sight	......	39A2390
64	Fuse—Pitot Heat, Gun Sight (2 spare)	30-amp.	32084-C
65	Socket—Gun Solenoid	......	AN3102-10s-2s
66	Retainer—Gun Sight	......	H39D2584
67	Sleeve—Lamp Socket	......	32A3376
68	*Lamp—3-volt Indiv. Inst. (2 spare)	......	36A3344
69	Solenoid—Cowl Gun	E-6	24743
70	Box Assem.—Front Cockpit Switch	NAA	88-54103
71	Switch—Fluorescent Lights	B-5A	AN3015
72	Fuse—Pitot Heat, Gun Sight (2 spare)	30-amp.	32084-C
73	Switch—Landing Gear Pos. Indic.	B-10	34A3846
74	Switch—Landing Gear, Warning Reset	B-12	34A6066
75	Socket—Inst. Lamp Conn.	......	38A1549
76	Plug Assem.—Wing Gun Sol.	......	37A2323
77	Cartridge—Fluorescent Lamp	......	H-35
78	Cap Assem.—Lamp Camera Sig.	Green	31-1455-2
79	*Cell—Fuel Mixt. Indicator	A-7	27992Engelhard
80	*Indicator—Fuel Mixture	A-7	27992Engelhard
81	Socket—Camera DC	......	32A1981
82	*Pitot Head—Elect. Heated	C-7	27884
83	Shield Assem. L. G. Throttle Switch	NAA	55-54139

ELECTRICAL

NO.	DESCRIPTION	TYPE	SPEC. OR PART NO.
84	*Bulb—Free Air Temperature	C-12	27990
85	*Inverter— 12 Volt	A-4	32280
86	Box Assem.—Rear Cockpit Switch	NAA	88-54004
87	Box Assem.—Tail Light Jct.	NAA	55-54019
88	Box Assem.—Stick Switch Jct.	NAA	88-54195-4
89	Socket—Camera Signal Light	P. R. Mallory Co., Inc.	49-54173
90	Box Assem.—Landing Gear Pos. Ind. Switch	NAA	84-54025-6 L.H. 84-5025-7 R.H.
91	Box Assem.—L.H. Landing Light Junction	NAA	88-54211
92	Box Assem.—R.H. Landing Light Junction	NAA	88-54212
93	Box Assem.—L.H. Wing Tip Light Junction	NAA	55-54209
94	Box Assem.—Main Fuse Panel	NAA	88-54068
95.	Box Assem.—Camera Power	NAA	55-54008
96	Box Assem.—Light Distr.	NAA	88-54077
97	Box Assem.—R.H. Wing Tip and Pitot Junction	NAA	55-54208
98	Wire Assembly—Free Air Therm.	NAA	77-54106
99	*Light Assembly—Compass	B-16	94-29807
100	Socket Assem.—Fuel—Air Indic.	AN9534	AN3106-12s-3s
101	Socket Assem.—Fuel Air Cell	AN9534	AN3106-14s-2s
102	Fuse—Nav. Lights, Landing Gear (3 spares)	15-amp.	32084-C
103	*Light Assem.—Fixed Gun Sight	N-3A	......
104	Lamp Assem.—Cockpit (Fluorescent)	......	X221
105	*Tachometer—Elect. Trans.	E-12	27311
106	*Tachometer—Elect. Indic.	F-12	27311
107	Box Assem.—Elect. Tachometer Junction.	NAA	78-54011
108	*Indic. Carb. Mixture Therm.	F-9	27991
109	*Indicator—Free Air Therm.	C-12	27990
110	Box Assem.—Light Distr.	NAA	88-54077-4
111	*Bulb—Carb. Mixture Therm.	F-9	27991
112	*Magneto—Furn. with Engine	Scint. SB9-R	13738
113	Solenoid—Oil Dilution	......	37D6210
114	Switch—Oil Dilution	B-6B	AN3016
115	Switch—Battery Main Line	B-5A	AN3015
116	Horn—Signal Assem. Landing Gear	B-3	32153
117	Box Assem.—Horn	NAA	55-54142
118	Receptacle—Camera Power	Harvey Hubble	7210
119	Switch—Fuel Signal Test	B-6B	AN3016
120	*Lamp— 6.3 volt, S.C. Clear, Camera Signals	T-3¼	......
121	Lamp Assem.—Camera Signal	Green	39A2822-3
122	*Solenoid—Wing Gun	C-4C	41B5099
123	*Indic. Fuel Mixture	A-7	27992 . Cambridge
124	*Cell—Fuel Mixture Indicator	A-7	27992 Cambridge
125	Socket Assem.—Fuel Mixt. Indic. (Cell)	AN9534	AN3106-18-4s
126	Socket Assem.—Fuel Mixt. Ind. (Indic.)	AN9534	AN3106-16s-1s
127	Switch—Camera Safety	Cutler Hammer	0701
128	Solenoid—Gun Control	Leach	5030
129	Switch—Gun Selector	B-5A	AN3015
130	Fuse—Cowl and Wing Gun (1 spare)	30-amp.	32084-C
131	*Indicator—Consumption (film)	......	W-7
132	*Cinegun Camera	......	W-7
133	Plug Assem.—Pilot's Switch Box	Breeze	36A4275
134	Plug Assem.—Pilot's Switch Box	Breeze	E1002-12-10
135	Plug Assem.—Pilot's Switch Box	Breeze	36A5955

NO.	DESCRIPTION	TYPE	SPEC. OR PART NO.
136	Plug Assem.—Right Wing	Breeze	36A5955
137	Plug Assem.—Left Wing	Breeze	36A5955
138	Plug Assem.—Stick Switch Jct.	Breeze	E1002-3-100
139	Plug Assem.—Rear Switch Box	Breeze	36A4276
140	Plug Assem.—Tail Light	Breeze	E1002-18-10
141	Plug Assem.—Camera Power	Breeze	E1002-4-120
142	Socket Assem.—Pilot's Switch Box	Breeze	35A5235
143	Socket Assem.—Pilot's Switch Box	Breeze	E1003-12-10
144	Socket Assem.—Pilot's Switch Box	Breeze	35B5160
145	Socket Assem.—Main Fuse Pan	Breeze	35B5160
146	Socket Assem.—Main Fuse Pan	Breeze	35B5160
147	Socket Assem.—Main Fuse Pan	Breeze	35A4269
148	Socket Assem.—Rear Switch Box	Breeze	36A3367
149	Socket Assem.—Camera Power	Breeze	E1156-4-30
150	Socket Assem.—Tail Light	Breeze	E1196-18-10
151	Socket Assem.—Starter Switch	Breeze	E1003-4-30
152	Plug Assem.—Starter Switch	Breeze	E1002-4-120
153	Fuse—Bomb Rack R.H. and L.H.	50-amp.	32084-C
154	Solenoid—Bomb Control	Leach	5030
155	Switch—Bomb Selector	B-5A	AN3015
156	Switch—Bomb Safety	B-5A	AN3015
157	Bomb Rack (See Note No. 17)	NAA	84-53005
158	Socket Assem.—Gun Sol Flex	AN9534	AN3106-10s-2s
159	Socket Assem.—Gun Sol Flex.	AN9534	AN3106-10s-2p
160	Switch—Arming Control	B-5A	AN3015
161	Lamp—Arm. Control Indic.	......	42B3593-2
162	*Control—Bomb Arming	B-1	24770
163	*Lamp—3 C.P. 33-amp. 13-volt S.C. Clear	T-3¼	......
164	Box Assem.—L.H. Landing Light Junction	NAA	88-54223
165	Box Assem.—R.H. Landing Light Junction	NAA	88-54224
166	Box Assem.—Landing Gear Pos. Ind. Switch	NAA	88-154025 L.H. 88-54025-1 R.H.
167	Box Assem.—Main Power Panel	NAA	88-54072-7
168	Plug Assem.—Tach. Transmitter	AN9534	AN3106-12s-3s
169	Plug Assem.—Tach Indicator	AN9534	AN3106-14s-1s
170	*Box Assem.—Recog. Light Cont'l	42D5051	88-54328
171	Plug Assem.—Recog. Light Disc.	Breeze	35A4273
172	Socket Assem.—Recog. Lights	Breeze	35A4269
173	*Lower Recog. Light (red)	E-2	32374
174	*Lower Recog. Light (green)	E-2	32374
175	*Lower Recog. Light (amber)	E-2	32374
176	*Upper Recog. Light (white)	E-1	32366
177	*Lamp— 13-volt, C and S. C. Bay 6.6-a. Clear	RP-11	Furn. with E-1 and E-2 Lights
178	Box Assem.—Front Cockpit Switch	NAA	88-54103-4
179	Switch—Resin Light	B-9A	AN-3018
180	Resistor—Ohmite (Acker)	25 ohm	25 watt
181	Resistor—Ohmite (Acker)	5 ohm	25 watt
182	Panel Assem.—Land Light Connector	NAA	88-54409
183	Panel Assem.—Wing Tip Conn.	NAA	88-54408
184	Retainer—Gun Solenoid Flex.	......	H39D2548
185	*Solenoid—Cowl Gun	E-4	24610B
186	Socket—Gun Solenoid	......	AC39A2388
187	Receptacle—Gun Solenoid	......	AC39A2390
188	*Plug Assem. Bomb Arming Cont.	AN9534	AN3106-10s-2s
189	Box Assem.—Main Fuse Panel	NAA	88-54068-4
190	Box Assem.—Main Power Panel	NAA	88-54072-9
191	Sight Assem.—Gun (Ref.)	N-3B	41G6436
192	Socket Assem.—Gun Sight	......	AN3106-12s-3s
193	*Ind. Carb. Mixture Therm.	AN5790-6	AN-GG-1-522a
194	Socket Assem.—Ind. Carb. Mix. Temp.	AN9534	AN3106-14s-2s
195	Socket Assem.—Bulb Carb. Mix. Temp.	AN9534	AN3106-12s-3s

*G.F.E. (Government Furnished Equipment)

At least 1 pint of fluid must be pumped through the system before all air is removed.

(e) Close bleeder fitting tightly; install the dust cover.

(f) Check the level of fluid in the master cylinder reservoir, adding fluid if necessary.

13. ELECTRICAL SYSTEM.

NOTE

AT-6C, SNJ-4, and earlier airplanes are equipped with a 12-volt electrical system. AT-6D and SNJ-5 airplanes have a 24-volt electrical system. This section is, therefore, divided into two parts: *a.* 12-Volt System and *b.* 24-Volt System.

a. 12-VOLT SYSTEM. (AT-6, 6A, B, C, SNJ-3, and 4.)

(1) GENERAL.

(a) DESCRIPTION. — *(See figures 258 and 259.)*—The electrical system of the airplane has two main sources of energy: a storage battery and an engine-driven generator, both connected to a common distribution system. The common system is energized by 12-volt direct current, but some equipment (fluorescent lights and compass lights) requiring alternating current are supplied by a dc to ac inverter. The distribution system is of the single hot-wire type with the metallic structure of the airplane serving as the return, except in some instances where it is necessary to use a two-wire circuit to prevent compass interference or to obtain a more efficient ground. The main power panel on the forward face of the fire wall contains the battery and starter solenoids, and the booster coil. The generator control panel at the forward left side of the front cockpit contains a voltage regulator and a relay cut-out. All circuits (except the bomb release and gun circuits) are fused in the main fuse box (figure 260) at the forward left side of the front cockpit. All electrical equipment is controlled from the control panel in the front cockpit. The bomb release and gun firing circuits are fused in the main control panel in the front cockpit and are controlled by switches on the face of this control panel.

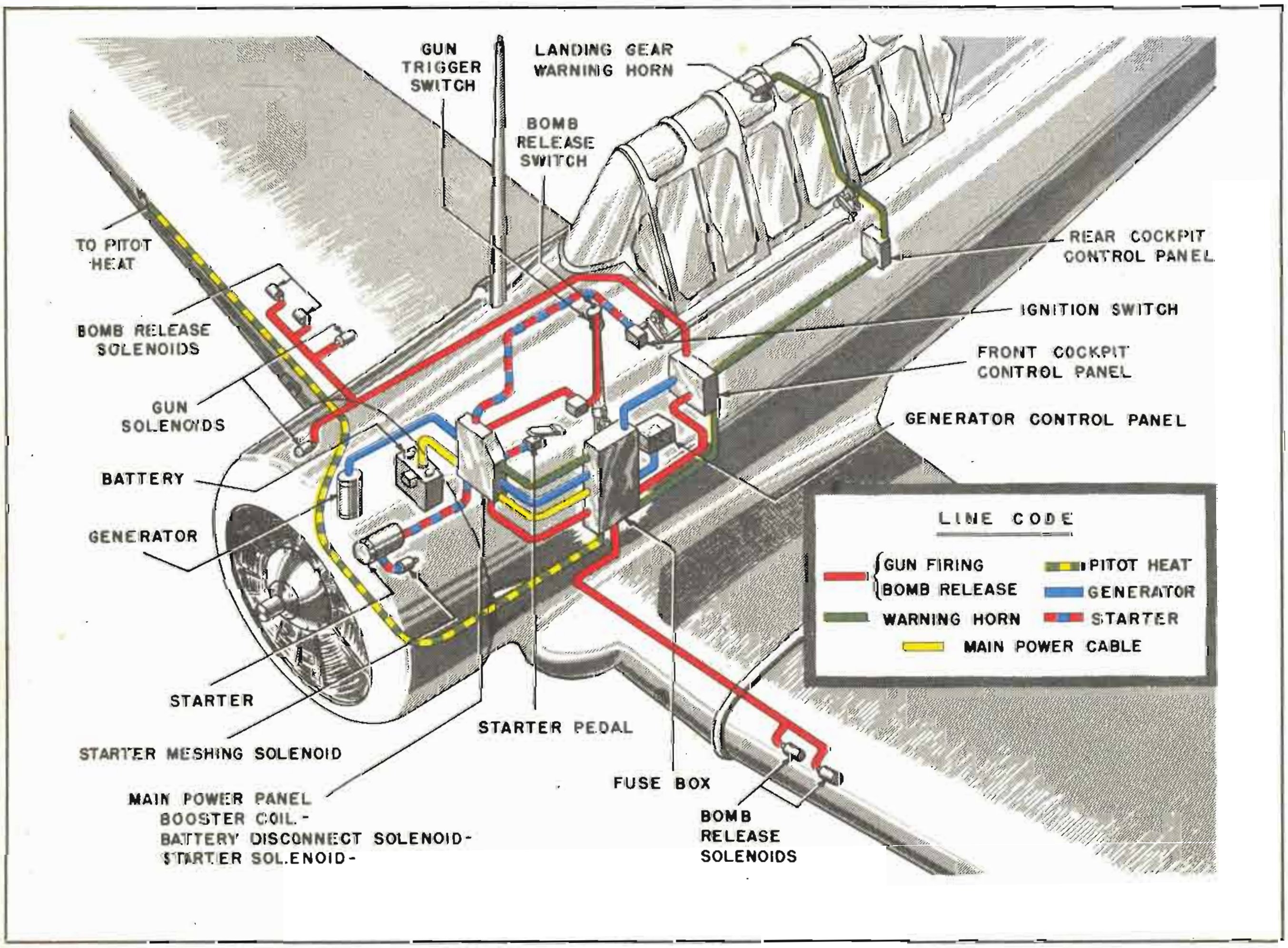

Figure 259 — Electrical Power System

(*b*) TROUBLE SHOOTING PROCEDURE.—In trouble shooting the airplane electrical system, the proper procedure is to check from the fuse box to the equipment involved. If after following this procedure the service man is convinced that the trouble exists inside the individual piece of equipment, it should be removed and an identical or interchangeable unit that has been tested for normal operation, installed in its place.

(*c*) MAINTENANCE REPAIRS. — Suitable shop and testing equipment should be available before attempting maintenance of any individual item of electrical equipment on the airplane. When it is necessary to test the various circuits and items of electrical equipment, the proper procedure is to first remove all electrical power from the equipment, make necessary circuit changes or meter connections, and then apply the power to the equipment involved.

(2) STORAGE BATTERY.—*(See figure 261.)*—A 12-volt, 68-ampere hour, type D-6 storage battery is installed in a covered metal case secured to a support on the right forward side of the fire wall. The battery is readily accessible for inspection and removal by removing the right engine cowling. The cover to the battery case is fitted with a rubber or neoprene gasket which forms a sealed air chamber inside the case to prevent the escape of corrosive gas. Provision is made to neutralize and vent these battery gases outside, as they would damage the metallic structure of the airplane. This is accomplished by a rubber or neoprene tube leading from an air intake in the bottom of the engine cowling to one side of the battery case, and a tube from the opposite side of the battery case leading to a glass jar containing a cellulose sponge disc 1 inch thick and saturated with a solution of tri-sodium phosphate (NA_3PO_4). (A solution of sodium bicarbonate [baking soda] may be substituted for this purpose and the sponge may be of felt.) This solution in the jar will neutralize any acid in the battery gases, and a tube from the top of the jar to a vent in the bottom of the cowling will carry the neutralized gas outside the airplane. The jar is accessible through an opening in the lower right side of the engine cowling.

(3) GENERATOR SYSTEM.—*(See figures 262 and 263.)*—A type E-5A engine-driven generator, mounted on the rear of the engine assembly, serves to keep the battery charged and to furnish power for operating the airplane's electrical equipment. A generator

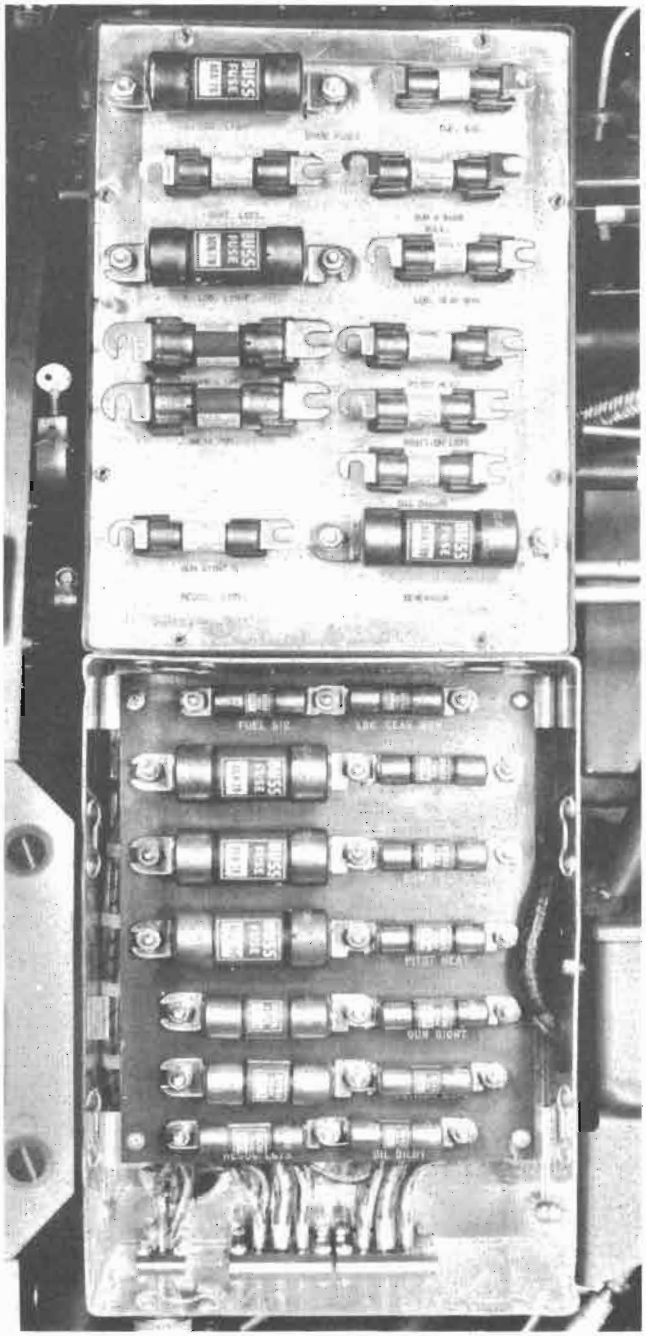

Figure 260 — Fuse Box Installed

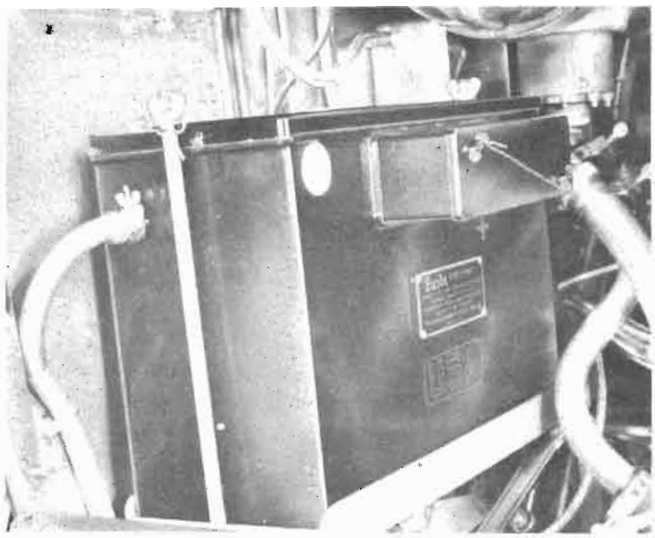

Figure 261 — Storage Battery Installed

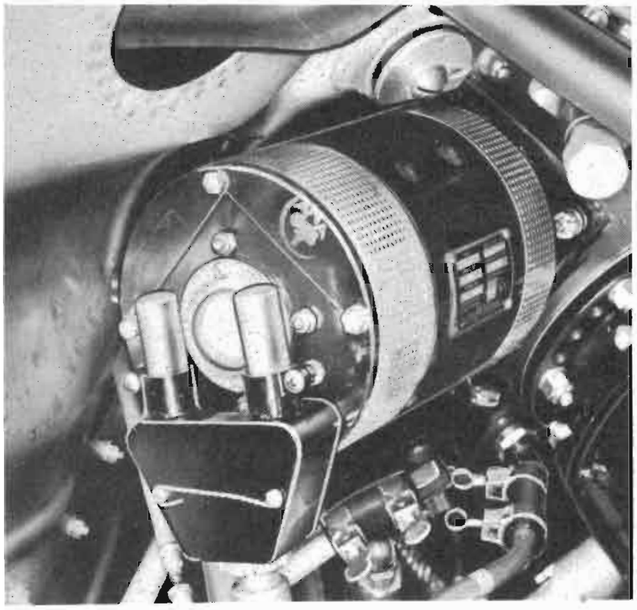

Figure 262 — Generator Installed

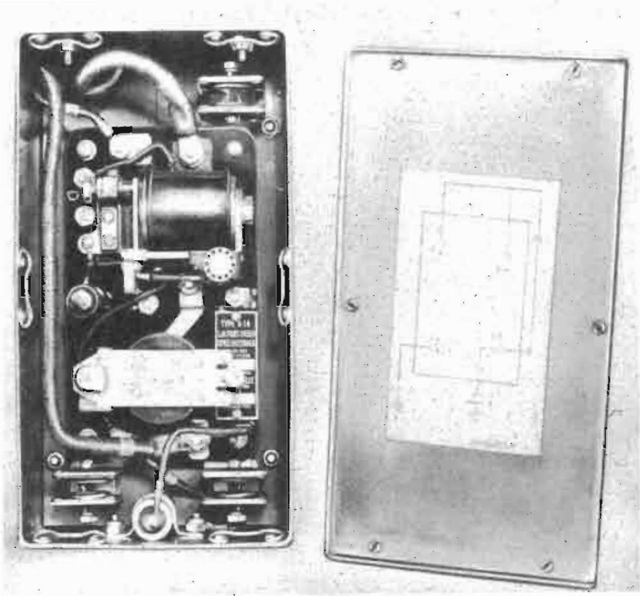

Figure 263 — Generator Control Panel

control panel mounted on the forward left side of the front cockpit serves to regulate the voltage output of the generator. The regulator, when properly adjusted, will hold the generator output for charging the battery to 14.25 volts when the battery voltage is 13.50 or less. An automatic relay cut out in the generator control panel serves to isolate the generator from the battery when the generator output drops below battery voltage. To suppress any interference in the communications circuit, two .5 mfd., 100-working-volt capacitors are connected in the

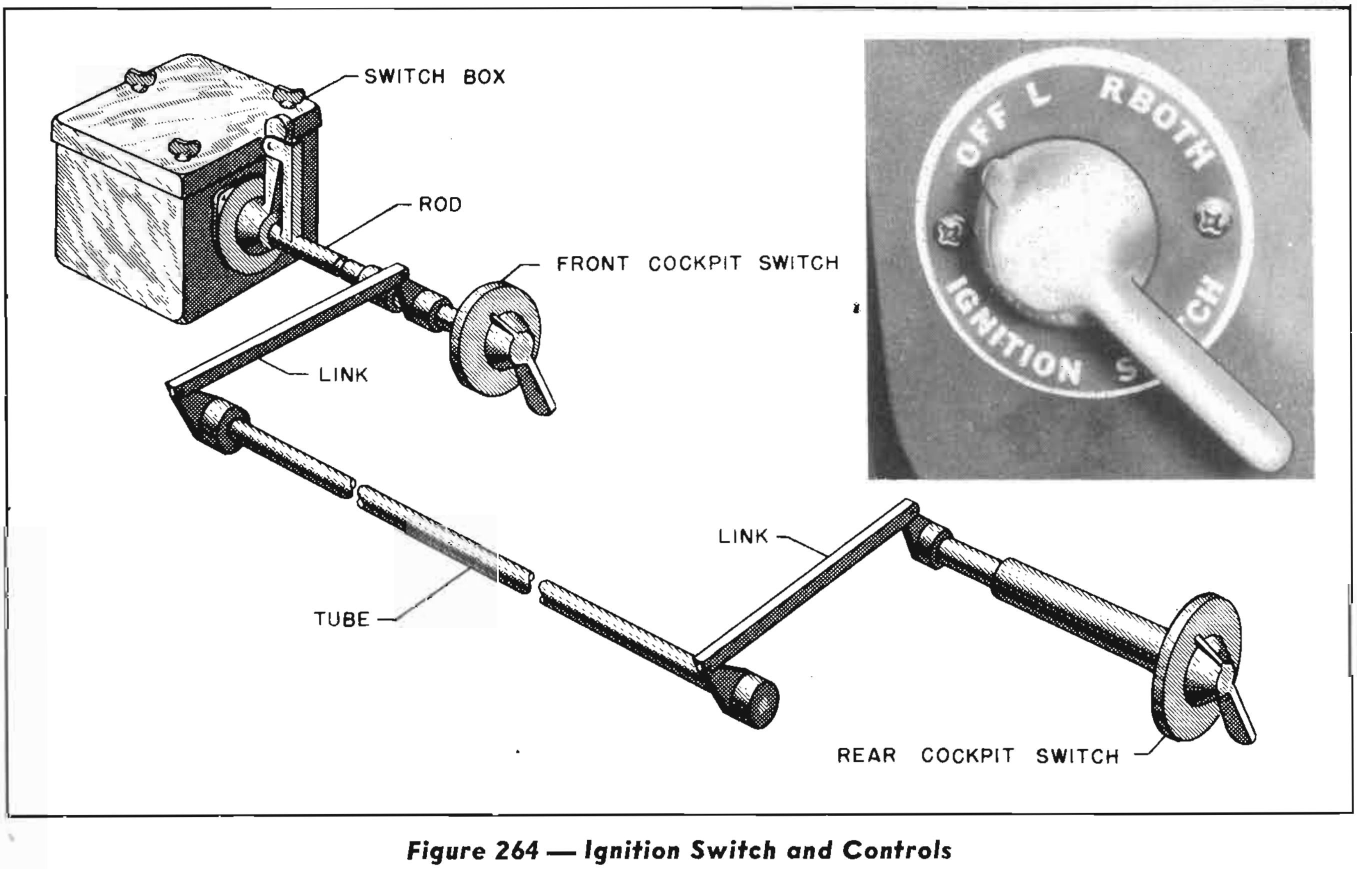

Figure 264 — Ignition Switch and Controls

generator circuit and one .5 mfd. 100-working-volt capacitor is connected in the generator control panel circuit. A type F-1 ammeter and a type B-1 voltmeter are installed on the front cockpit control panel. The stationary pointer of the voltmeter is set at 14.25 volts, which is the regulated voltage output of the generator. This gives a quick visual check for normal generator output.

(4) GENERATOR MAIN LINE SWITCH.—A generator main line switch on the front cockpit switch panel provides a means of opening the generator circuit in case the automatic relay cut out in the generator control panel fails to operate. The switch should be left in the "OFF" position when the engine is not running.

(5) IGNITION SWITCH.—*(See figure 264.)*—A master ignition switch box unit, wired directly to the rear of the magnetos, is located at the left side of the fuselage, forward of the front instrument panel. This master switch is operated from the left side of the instrument panel in both cockpits by a lever or pointer handle mechanically interconnected with the switch.

(6) ENGINE STARTING SYSTEM.

(a) A Type H-5 starter connected as an electric inertia starter or hand-cranking inertia starter is mounted on the rear of the engine assembly. The flywheel of this starting unit may be accelerated either electrically or by hand cranking. Prior to operating the unit as an electric inertia starter, clear the cylinders by turning the propeller through by hand. Before operating the starter make sure that the brush spring release is in the "ON" position. (When facing the starter, the brush spring release handle is moved clockwise to the "OFF" position and counterclockwise to the "ON" position.) Brush spring release handle can be reached through the small inspection door on the upper left side of engine compartment cowling. The starter is then operated by pressing foot pedal. (Foot pedal is mounted between the rudder pedals.) Pressing on the heel of the pedal energizes the starter, and pressing on the toe engages the starter. This foot pedal at one position operates a toggle switch which in turn operates the B-1 starter solenoid to energize the starting motor. At the other position, the switch will operate the meshing solenoid to engage the starter to the engine crank shaft and, at the same time, will energize the booster coil. Close the starter motor circuit by pressing the foot pedal to energize and holding it there for 10 or 12 seconds until the flywheel has attained its normal operating speed of 16000 rpm. With the flywheel turning at this speed, engage the starter jaw to engine by pressing foot pedal to engage position. When the engine starts, release the foot pedal. Due to the higher engine jaw speed, the jaws will disengage automatically. If the engine fails to start on the first trial, make certain the starter jaw is not engaged

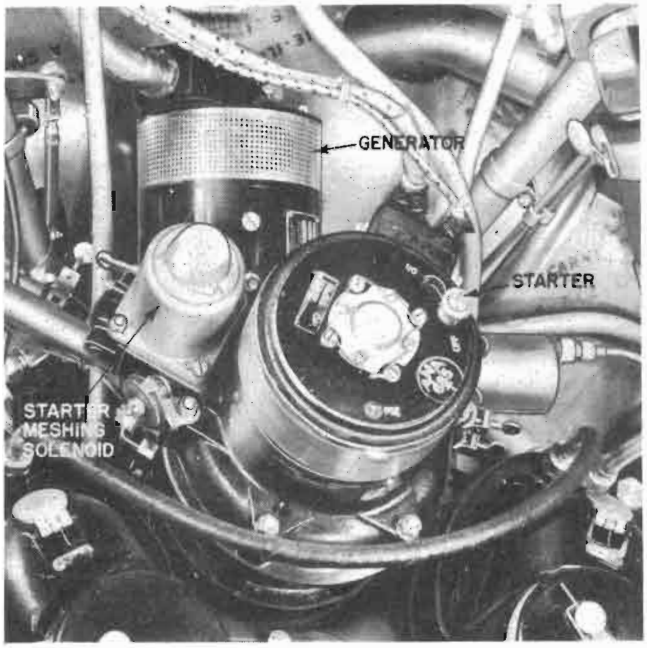

Figure 265 — Starter Installed

before operating the starter a second time. In case disengagement of the starter and engine jaws does not occur (due to engine compression), turn the propeller by hand (ignition off) about one-half turn in direction of engine rotation to release the starter jaw.

(b) For emergency operation when the source of electrical energy is not sufficient to provide proper electrical operation, the starter may be operated as a hand inertia starter. To operate the starter as such, move the brush spring release to the "OFF" position. (When facing the starter, the brush spring release handle is moved clockwise to the "OFF" position and

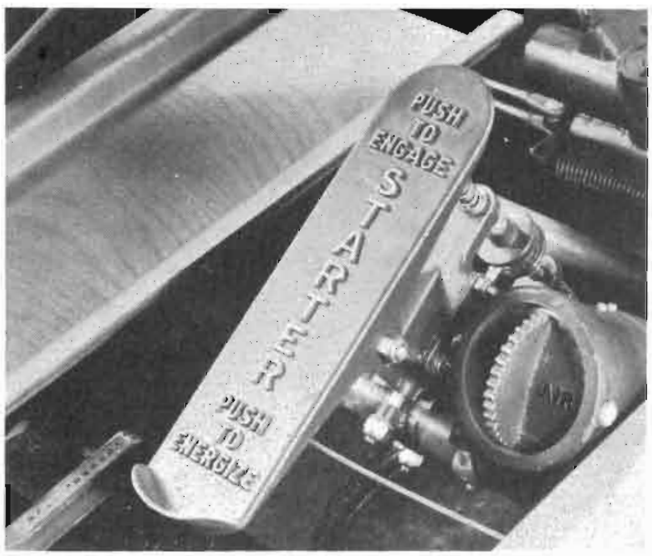

Figure 266 — Starter Foot Pedal Installed

counterclockwise to the "ON" position.) This is accomplished by reaching through a small inspection door on the upper left side of engine compartment cowling. Insert hand crank (hand crank is stowed in the baggage compartment) and turn the hand crank at approximately 80 rpm or until the flywheel has attained its normal operating speed. When this speed has been attained, remove the hand crank and pull the manual engaging control cable to engage the engine and starter jaws. When the engine starts, release the cable.

CAUTION

After engine is started, the brush spring release handle should always be returned to the "ON" position and safetied.

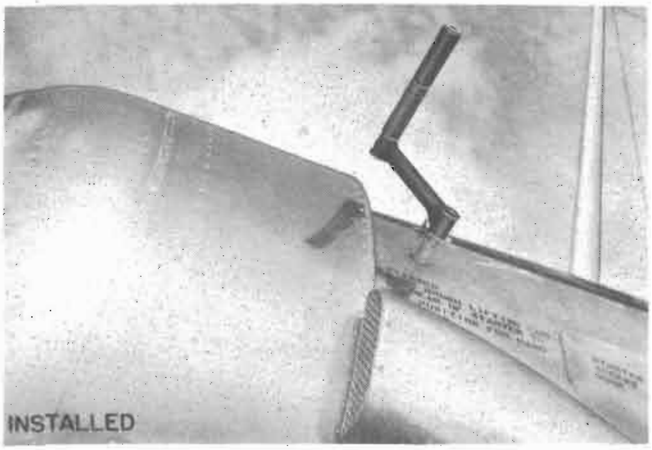

Figure 267 — Crank

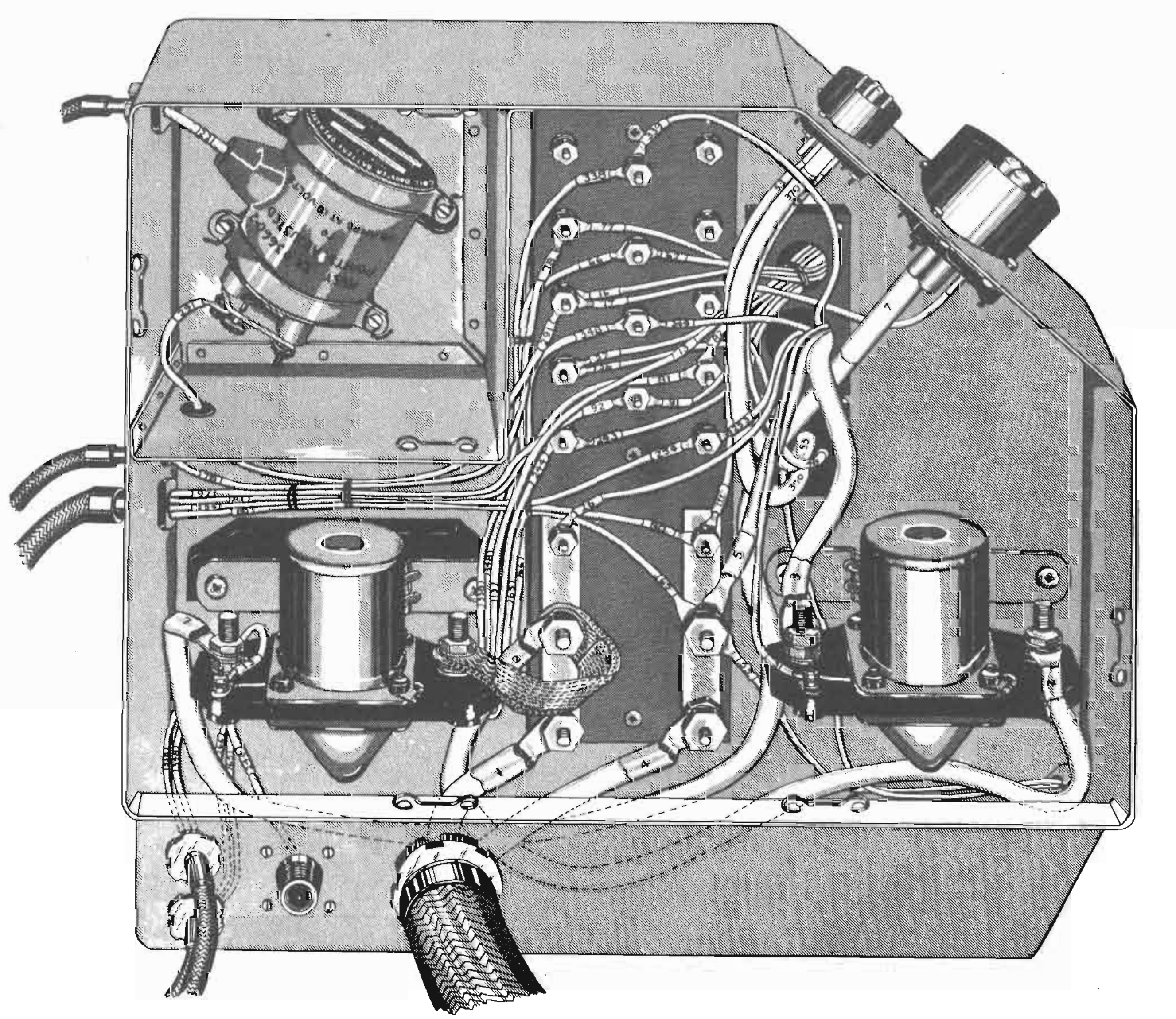

Figure 268 — Main Power Panel Wiring Diagram

When the starter flywheel has been accelerated to a speed of approximately 12,000 rpm, it will provide enough torque for engine starting. The starter is engaged by pulling outward on a ring on the left side of the cowling. This ring is on the end of a cable which operates a meshing solenoid on the starter. The starter is operated electrically by means of a foot pedal mounted between the rudder pedals. This foot pedal at one position operates a toggle switch, which in turn operates the type B-1 starter solenoid in the main power panel to energize the starting motor. At the other position, the switch will operate the meshing solenoid to engage the starter to the engine crankshaft and also energize the booster coil. Pressing on the heel of the pedal energizes, and pressing on the toe engages the starter.

(7) MAIN POWER PANEL.—The main power panel is mounted on the forward face of the fire wall. Circuits to all electrical equipment on the engine (except the ignition circuits) are routed through this panel. The battery solenoid, the starter solenoid, and the booster coil are mounted inside this panel.

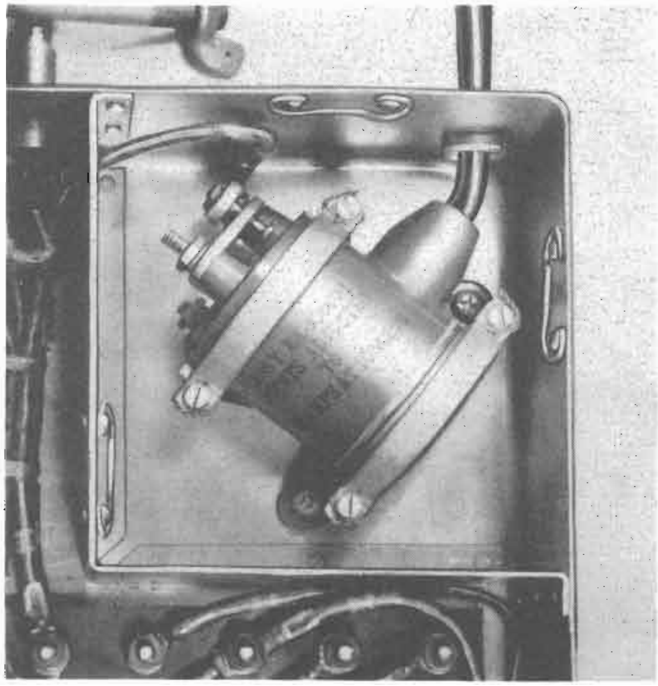

Figure 269 — Booster Coil Installed

(8) BOOSTER COIL.

(a) DESCRIPTION.—A type A-1 booster coil is mounted in shielded housing in the main power panel on the front of the fire wall. The booster coil is energized when the toe of the foot pedal is pressed to engage the starter. The booster coil acts as a high voltage step-up transformer for delivering a high-tension spark through the magnetos to the engine for starting only.

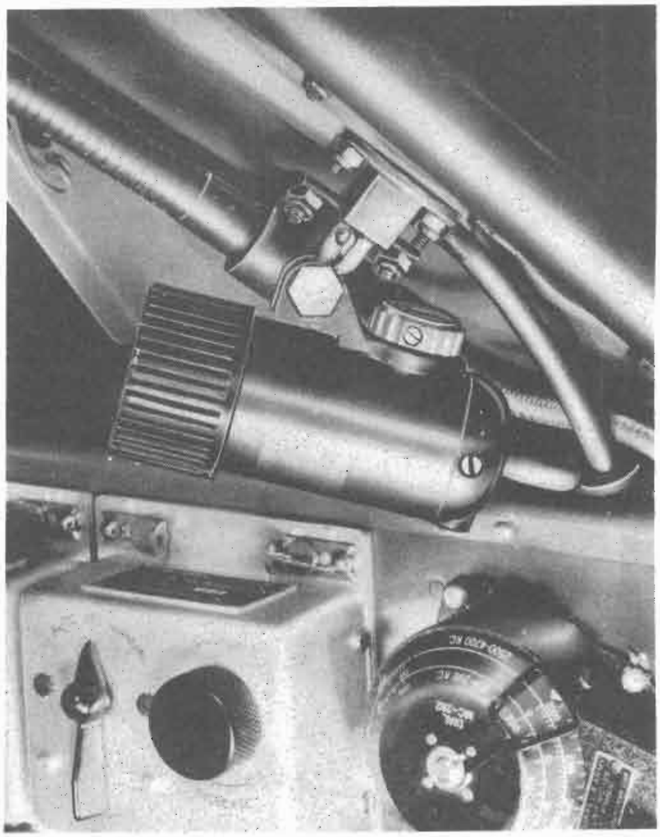

Figure 270 — Cockpit Light Installed

(b) ADJUSTMENT.—The following procedure is recommended for adjusting the booster coil for the proper gap setting.

1. Disconnect the booster coil. Connect the primary terminals of the coil in series with an ammeter

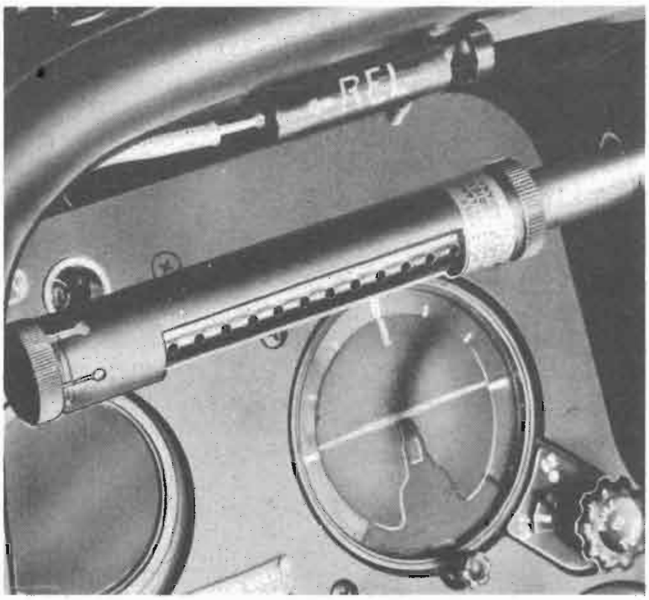

Figure 271 — Instrument Fluorescent Light

and control switch, and hook them to a 10- to 12-volt battery supply.

2. Connect the high-tension terminal of the coil to a spark plug having a .015-inch gap.

3. Install a return lead from the spark plug case to the booster coil housing.

4. With the adjusting screw in the extreme out position, gradually turn the screw in a clockwise direction until a good hot spark is obtained across the .015-inch gap in the spark plug. The current drain with the booster coil firing the .015-inch gap should be 2.0 to 2.5 amperes.

NOTE

If no ammeter is available, the approximate setting may be obtained by adjusting the screw contact on the coil until the spark will jump a 3/8-inch gap.

(9) BATTERY DISCONNECT SWITCH.—The battery disconnect switch on the control panel in the front cockpit is for operating a solenoid switch in the positive power lead of the battery circuit. The solenoid is mounted in the main power panel on the forward side of the fire wall. The switch is used to disconnect the battery from the electrical system to prevent overcharging.

WARNING

The battery disconnect switch must always be thrown to the "OFF" position before leaving the airplane.

(10) LIGHTING.

(a) DESCRIPTION.

1. COCKPIT LIGHTS.—Type C-4 cockpit lights are mounted on each side of both the front and rear cockpits. The lamp mounting has a swiveling

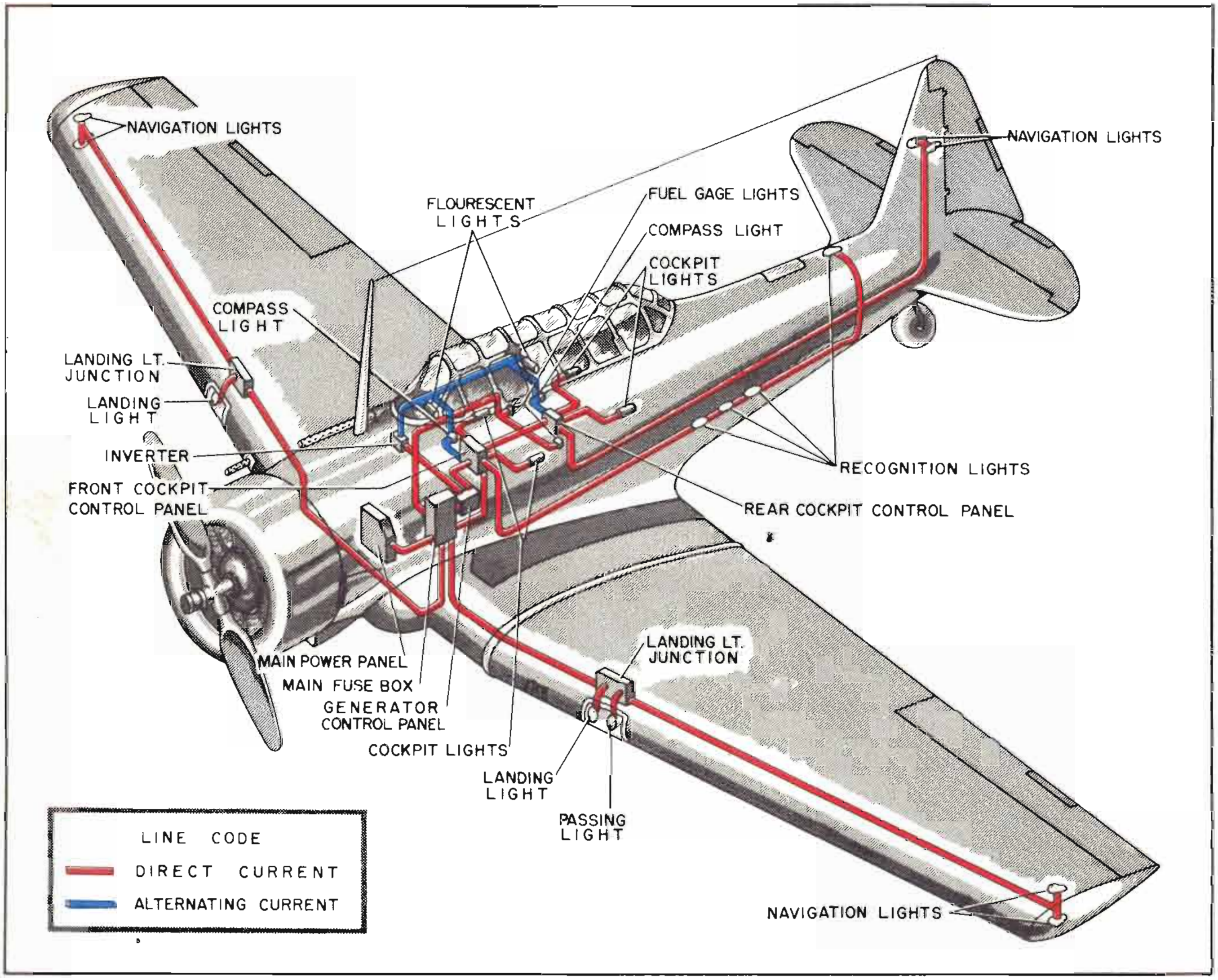

Figure 272 — Exterior and Interior Light System

range of 360 degrees. The lens housing of the lamp may be moved back or forward to give a beam adjustment from a concentrated spot to a floodlight. The cockpit lights are controlled with the red knob of a rheostat on the bottom of the lamp housings. The rheostats provide a means of varying the intensity of the lights. By lifting a lockspring the filter attachment may be removed to obtain a white light. The lamp assemblies are also equipped with a red push-button switch at the back, on top of the lamp housing, which provides a means of using the lights for signaling. The lamp may be removed from its holding bracket and held in any desired position.

2. INSTRUMENT LIGHTING.—Fluorescent lighting is provided for all instruments except the compasses. Both the fluorescent and compass lights operate on alternating current, which is supplied by a type A-4, DC to AC inverter mounted just below the front instrument panel. A fluorescent light is mounted on a flexible cable at the right side of each cockpit. On earlier airplanes, type X220 fluorescent lights were installed. The housings of this type light have an ultraviolet transmitting filter and a visible aperture. The outer housing of the type X220 lamp can be rotated to give visible or ultra-violet light, and a variable shutter may be moved to give full light, approximately two-thirds output or approximately one-third output for either ultra-violet or visible light. Later airplanes are equipped with type X221 fluorescent light assemblies, which will give only ultra-violet light. The movable shutter on this type light may be rotated to vary the amount of light output. The inverter which supplies alternating current for the fluorescent lights and the compass lights is controlled by the switch marked "FLUORESCENT LIGHTS" on the control panel in both front and rear cockpits. When either switch is thrown to the "ON" position, the fluorescent lights in both cockpits will come on. The 3-volt compass lights are integral with the compasses and are individually controlled by rheostat switches on the instrument panel in each cockpit. The compass lights, however, will not operate unless the fluorescent light switch is "ON." There is a light mounted on the fuel gage on each side of the front cockpit seat. The control panel in each cockpit has a switch for controlling these lights. Either switch will turn the lights on or off at any time. The fuel gages are visible from both cockpits.

3. NAVIGATION OR POSITION LIGHTS. —Type A-8 navigation lights are installed on both the upper and lower wing surfaces at each wing tip and on both sides of the vertical stabilizer. The lights on the left wing are *red,* on the right wing *green,* and on the vertical stabilizer they are *white.* The navigation lights are controlled by individual switches on the front cockpit control panel marked "WING" and "TAIL," with BRIGHT, DIM, and OFF positions.

4. RECOGNITION LIGHTS. — Later airplanes are equipped with four recognition lights installed on the surface of the fuselage aft of the rear

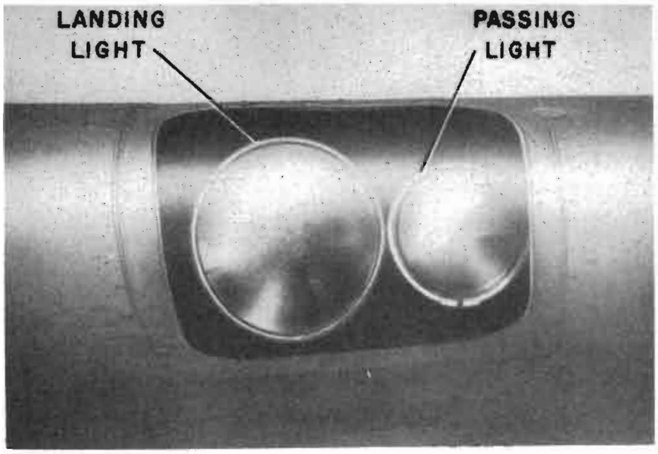

Figure 273 — Landing Light and Passing Light Installed

cockpit. Three type E-2 lights, *red, green,* and *amber* are located under the fuselage, and one type E-1 *white* light is on top of the fuselage. These lights are controlled by individual switches mounted in a switch box on the right side of the main control panel. The switches are wired in series with a push-button switch which acts as a telegraph key to provide a means of using lights for signaling. The individual switches must be thrown to the UP or KEY position for using the telegraph key. The down position is STEADY, and the center position is OFF. With proper switching these lights may be used for signaling in various combinations and sequences.

WARNING

Do not operate the recognition lights for more than ten seconds when the airplane is on the ground as there must be air circulation to dissipate the heat from the lights.

5. LANDING LIGHTS.—A landing light assembly is installed in the leading edge of each outer wing panel. The landing lights are of the fixed-focus type with the light beams parallel to the ground line when the airplane is in the three-point position. The lights are focused 10 degrees outboard from the centerline of the airplane and are controlled by individual switches from the front cockpit. The cover-glass of each lamp conforms to the contour of the leading edge of the wing.

WARNING

Do not operate the landing lights for more than 10 seconds when the airplane is on the ground and engine is not running.

(b) LAMP REPLACEMENT. — The following list will give information on lamps used on the 12-volt airplane:

Lamp Assem.	*Quan.*	*Type*	*Volts*	*Candle Power*	*Bulb Type*	*Spare Bulbs*
Landing Lights	2	A-8	14	240	A-19	—
Navigation Wing (2 *red,* 2 *green*)	4	A-8	12-16	6	G-6	—

Lamp Assem.	*Quan.*	*Type*	*Volts*	*Candle Power*	*Bulb Type*	*Spare Bulbs*
Navigation Tail (2 *white*)	2	A-8	12-16	3	G-6	—
Passing (*red*)	1	B-3	12-16	50	RP-11	—
Recognition (*red, green, amber*)	3	E-2	13	6.6A	RP-11	—
Recognition (*white*)	1	E-1	13	6.6A	RP-11	—
Cockpit	4	C-3	12-16	3	G-6	—
Compass	2	B-16	3	—	Spec. 36A3344-2	—
Fuel Gages	2	NAA	12-16	2	T-4-½	—
Fuel Switch-over Signal (*red*)	1	Spec. 39A2822-2	14	—	T-3-¼	1
Fixed Gun Sight	1	N-3A	12-16	21-21	RP-11	—
Camera Signal (*green*)	2	Spec. 39A2822-2		—	T-3¼	—
Fluorescent	2	C-1	—	4-W	T-6X5½	2
or	2	X221	—	4-W	—	—
Arm Control Ind.	1	Spec. 42B3593-2	13	.33A	T-3-¼	—

(11) FUSES.—*(See figure 260.)*

(a) Active fuses located in the main fuse box mounted on the left side just aft of the fire wall are plainly marked as to amperage and circuit. This box is accessible from the ground only, through a Dzus-fastened door in the removable side fairing. This box contains the following active fuses:

Quan.	*Capacity*	*Circuit*
1	1 amp	Fuel Signal Lights
2	70 amp	Landing Lights (right and left)
1	100 amp	Generator
1	35 amp	Starter Switch
1	35 amp	Camera Power
1	30 amp	Recognition Lights
1	15 amp	Landing Gear Warning Circuit
1	20 amp	Cockpit Lights
1	20 amp	Gun and Bomb Solenoids
1	30 amp	Pitot Heat
1	30 amp	Gun Sight
1	15 amp	Position Lights
1	15 amp	Oil Dilution

NOTE

A spare for each fuse in the main fuse panel is affixed to the inner side of the cover of this box, and is plainly marked as to the circuit for which it is intended.

(b) There are also four fuses in the main switch panel in the front cockpit. The two 50-ampere fuses in this panel are for the right and left bomb release circuits, and the two 30-ampere fuses are for the wing gun circuit and the cowl gun circuit. There is one spare 50-ampere fuse and one spare 30-ampere fuse affixed to the inside of the cover of this box.

Figure 274 — Front Cockpit Control Panel

(12) CONTROL PANELS.—Switches and rheostats for controlling electrical equipment of the airplane are located on the main control panel at the left side of the front cockpit. Some equipment may also be controlled from a switch panel at the left side of the rear cockpit. Each switch and rheostat is plainly marked to indicate its operation.

(a) FRONT COCKPIT.—The main controls for all electrical equipment are mounted on the control panel in the front cockpit. The control panel is forward of the pilot's left side. The controls for related equipment are grouped together as much as possible. The following switches are mounted on the control panel:

1. Battery Disconnect
2. Generator Main Line
3. Camera Safety
4. Compass Light (Rheostat)
5. Gun Sight (Rheostat)
6. Gun Safety
7. Gun Selectors (Cowl and Wing)
8. Bomb Safety
9. Bomb Selectors (Right and Left Bomb Rack)
10. Bomb Arming
11. Landing Lights (Left and Right)
12. Fluorescent Lights
13. Passing Lights
14. Fuel Gages
15. Pitot Heat
16. Fuel Switch-over Light Test
17. Running Lights (Wing and Tail)
18. Oil Dilution (Spring-loaded)

All switches on this control panel are equipped with luminous tips and markings. A voltmeter, and ammeter and a bombs-armed indicator light are also mounted on the control panel.

(b) REAR COCKPIT.—The control panel at the *left side* of the rear cockpit contains switches for the fluorescent lights, compass lights, and fuel gage lights. The switches on this control panel are also provided with luminous tips and markings.

(13) PITOT HEAT.—The pitot mast with its internal heading element is mounted on the leading edge of the right outer wing panel. This element is controlled by a switch on the front control panel and serves to prevent ice from clogging the airspeed orifice of the pitot mast.

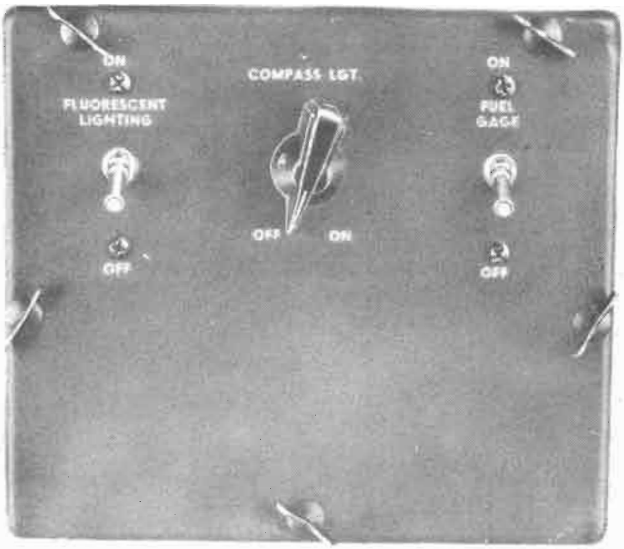

Figure 275 — Rear Cockpit Control Panel

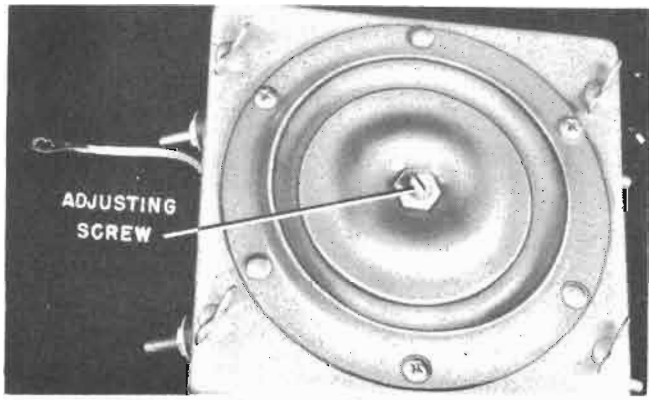

Figure 276 — Landing Gear Warning Horn

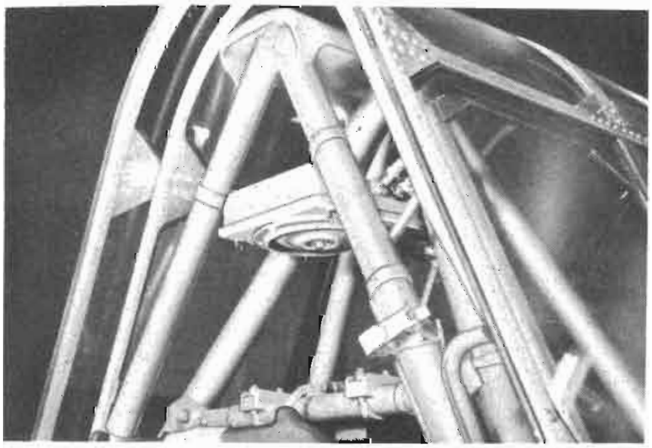

Figure 277 — Landing Gear Warning Horn Installed

WARNING

The pitot heat should never be turned on when the airplane is at rest on the ground except for momentary test, as without air circulation

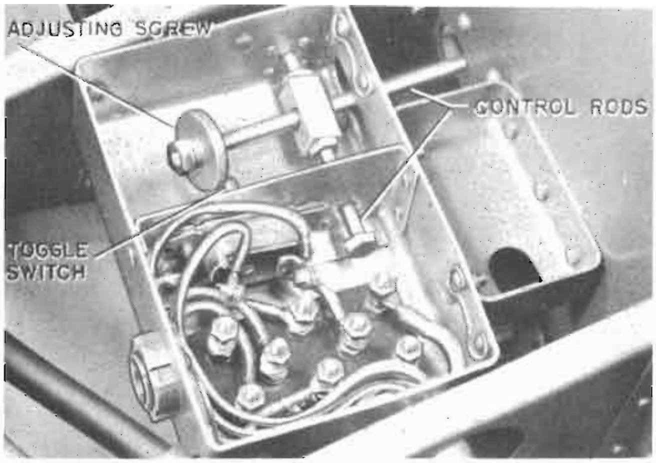

Figure 278 — Landing Gear Position Switch Adjustment

the heating element will be damaged from overheating.

(14) LANDING GEAR WARNING SYSTEM.

(a) DESCRIPTION.—The landing gear warning horn located on the nose-over structure between the front and rear cockpits is a warning device to indicate unsafe landing conditions. The horn is interconnected with the landing gear "DOWN" position lockpins and the throttle control so that the horn will sound when the throttle is retarded if the lockpins are not in place. A warning horn release is provided on earlier airplanes to stop the horn in case the throttle was retarded during flight maneuvers with the landing gear retracted. On later airplanes, however, this release was eliminated; in order to stop the horn from sounding, the throttle must be opened again or the landing gear must be put in the "DOWN" position with lockpins in place.

(b) ADJUSTMENTS.

1. LANDING GEAR POSITION INDICATOR SWITCH.—The landing gear position indicator switches, actuated by movement of the landing gear strut and lockpin mechanism, operate the horn. To coordinate the horn with the landing gear struts, a switch is provided on the center section at the inboard side of each landing gear strut. A rod and disc actuating each switch is interconnected with the "DOWN" position locking mechanism of each strut. Before adjusting the rod and disc, follow this procedure:

a. Jack the airplane so the landing gear can be operated.

NOTE

Make sure that each landing gear strut is in the full "DOWN" position and locked in place.

b. Remove switch box covers.

c. See that wiring in box is in orderly condition, and that screws holding switches and terminal ends are tight.

NOTE

Because of the frequent revisions made from time to time in the electrical system this electrical wiring diagram should be used ONLY as general reference with the accompanying text. For servicing and repairing of the electrical wiring system in the airplane refer to the latest revision of North American Dwg. No. 88-54002 which accompanies each airplane.

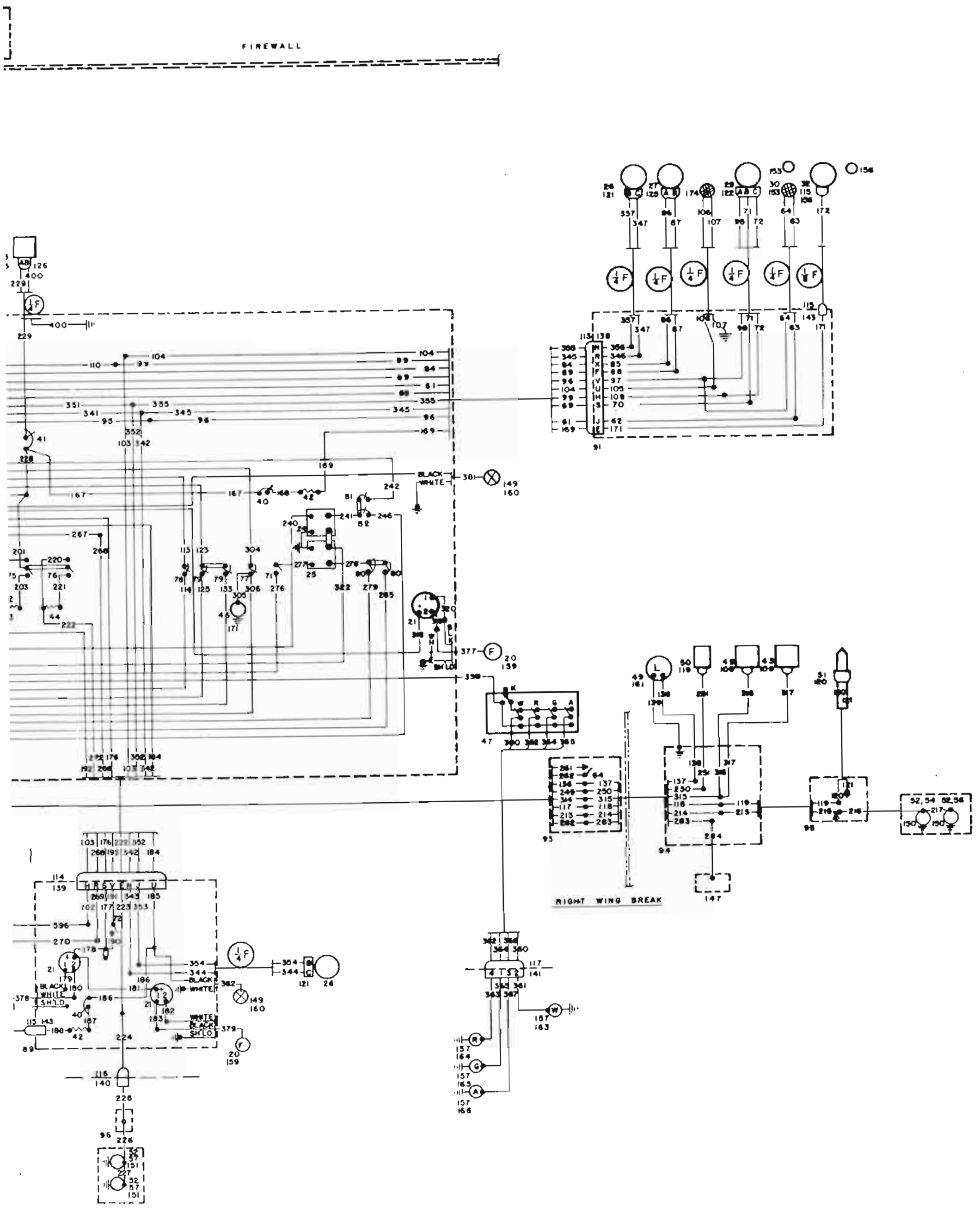

Figure 279 — Electrical System Wiring Diagram — 24-Volt System

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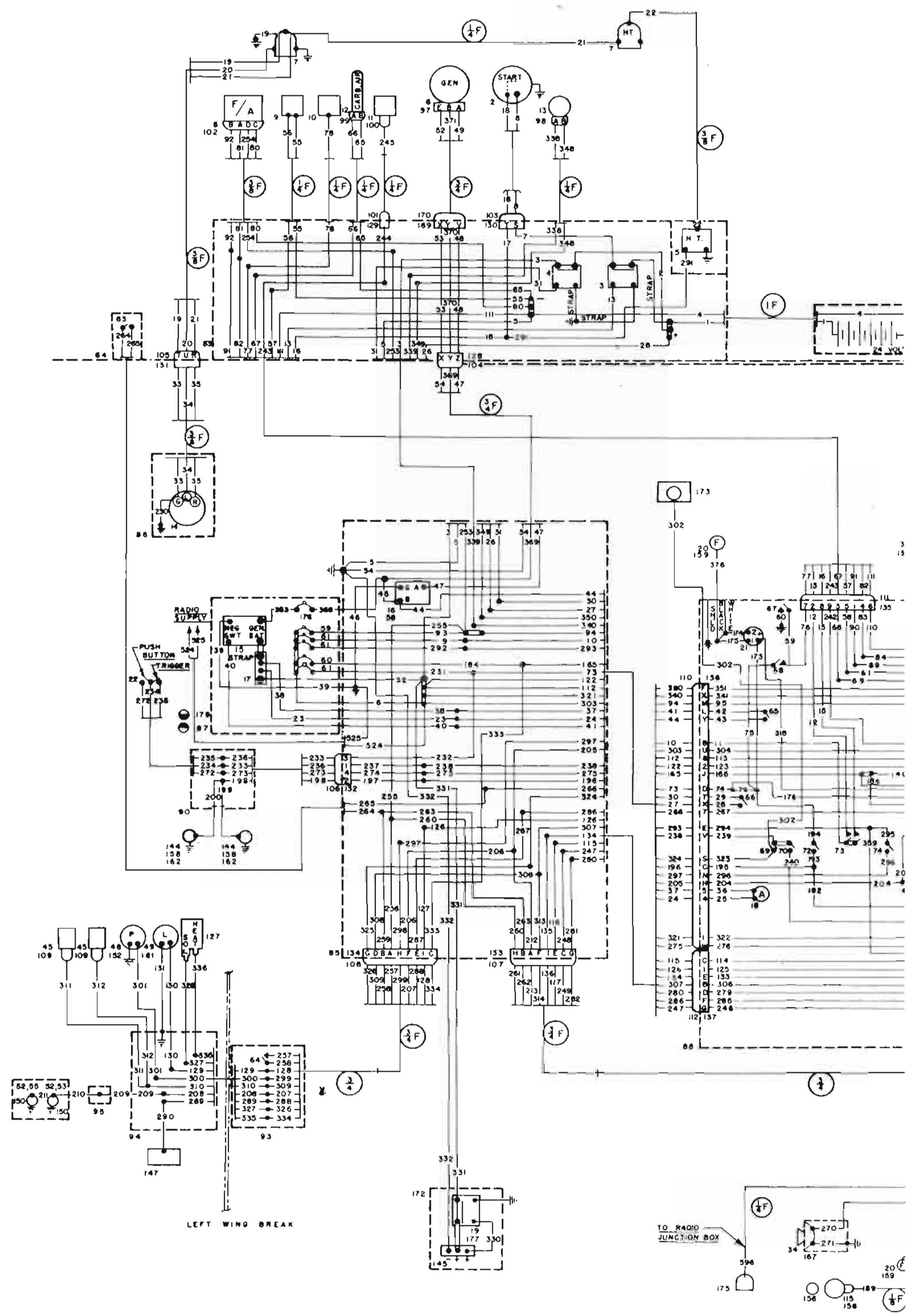

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LEGEND — 24 VOLT WIRING DIAGRAM

CODING SYMBOLS

Airplanes 5371 to 5970 Inclusive Only
Airplanes 5971 and Subsequent

REFERENCE PARTS LIST

NO.	DESCRIPTION	TYPE	SPEC OR PART NO.
1	*Battery—24 Volt 34 A.H.	G-1	32234
2	*Starter Electric, Inertia and Dir. Crank	G-5	95-32303
3	*Switch—Solenoid Starter	B-4	32324
4	*Switch-Solenoid Battery	B-4	32324
5	*Coil Assembly Booster	C-1	94-32182
6	*Generator—24 Volt, 24 Amp.	M-3	95-32361
7	*Magneto (Furn. with Engine)	Scint. SB9-R	13738
8	*Indicator Fuel Mixture—Cell	B-5	94-27932-A
9	*Signal Assembly Fuel Pressure	C-2	94-32175
10	Solenoid—Oil Dilution 24 Volt	......	37D5210
11	*Solenoid—Cowl Gun Sync.	G-18	24839
12	*Thermometer Carb. Mixture Bulb	AN 5525-1	AN-GG-B-796
13	*Tachometer—Electric Generator	E-12	27311
14	Switch—Ignition	A-7	32090
15	*Relay—Gen. Current Control	......	94-32278
16	*Regulator Voltage	......	94-32276
17	*Shunt—Ammeter	F-1	94-32284
18	*Ammeter	F-1	94-32284
19	*Switch—Solenoid Relay Cir. Control	B-4	94-32324-A
20	Lamp Assembly Fluorescent	C-5	94-32356
21	Control Unit Fluorescent—Light	C-5	94-32356
22	*Switch—Gun and Bomb Control	B-5	93-24708
24	Relay—Gun Control 24 Volt	B-5	94-32351
25	Relay—Bomb Control 24 Volt	B-5	94-32351
26	*Tachometer—Electric Indicator	E-12	27311
27	*Indicator Fuel Mixture Indicator	B-5	94-27932-A
29	*Thermometer Carb. Mixture	AN 5790-6	AN-GG-I-522a
30	Lamp Assembly—Fuel Pressure Indic.	Red	39A2822-2
32	*Light Assembly—Compass	B-16	94-29807
33	*Light Assem.—Fixed Gun Sight	N-3A	......
34	Signal—Landing Gear Warning	E-1	32184
40	Rheostat—Compass Light	C-1 (25 Ohm)	32[illegible]9-C
41	Rheostat—Gun Sight Light	C-1B (90 Ohm)	94-32229
42	Resistor—Compass Light	120 Ohm .5 W	37A5222-9
43	Resistor—Wing and Tip Pos. 10 Ohm, .25 Watt	Ohmite	Acker Type
44	Resistor—Tail Pos. 6[illegible] Ohm, .25 W.	Ohmite	Acker Type
45	*Arming Control—Bomb	A-2	43B9887
46	Lamp Assem.—Arm Control Indic.	......	43B3593-2
47	*Control Assem. Recog. Lights	42D5051	88 54386
48	*Lamp Assem.—Position (Passing)	B-3	37D4865
49	*Adapter-7" Sealed Beam Lamp	Adams & Westlake	CM-1356
50	*Solenoid—Gun Firing, Wing Gun	B-9	93-24706
51	*Pitot Head—Electric Heated	D-1	94-27876
52	*Lamp Assem.—Position (37B4982)	A-8	94-32116
53	*Lens—Position Lamp Upper L.H. Red	......	32B1984-1
54	*Lens—Position Lamp Upper R.H. Green	......	32B1984-2
55	*Lens—Position Lamp Lower L.H. Red	......	32B1984-3
56	*Lens—Position Lamp Lower R.H. Green	......	32B1984-4
57	*Lens-Pos. Lamp Tail Cl. & Opaque	......	32B1984-5
58	Base Assem.—Voltage Regulator	......	40D8445
59	Circuit Protector 5 Amp.	Klixon	PSM
60	Circuit Protector 10 Amp.	Klixon	PSM

NO.	DESCRIPTION
61	Circuit Protector 15 Amp.
63	Switch—Landing Gear Warning Throttle
64	Switch—Landing Gear Position Indicator
65	Switch—Generator Main Line
66	Switch—Battery Disconnect
67	Switch—Fuel Signal Light Test
68	Switch—Oil Dilution
69	Switch—Camera Safety
70	Switch—Gun Safety
71	Switch—Bomb Safety
72	Switch—Fuel Gage Lights
73	Switch—Starter
74	Switch—Passing Light
75	Switch—Position Lights (Wing)
76	Switch—Position Lights (Tail)
77	Circuit Breaker—Arm Control 5A
78	Circuit Breaker—Pitot Heat 10A
79	Circuit Breaker—Land. Lights 35
80	Circuit Breaker—Bomb Racks 15
81	Circuit Breaker—Cowl Gun 15A
82	Circuit Breaker—Wing Gun 10A
83	Box Assembly—Main Power Pan
84	Box Assembly Throttle Switch
85	Box Assem. Generator Control
86	Box Assem. Ignition Switch
87	Box Assem. Generator Relay
88	Box Assem. Front Pilot's Swt.
89	Box Assem. Rear Pilot's Swt.
90	Box Assem. Stick & Fuel Gage Jc
91	Box Assem. Instrument Distr.
93	Box Assem. Ldg. Gr. Pos. Ind. Sw
94	Connector Panel Assem. Landir Light
95	Connector Panel Assem. Wing T
96	Connector Panel Assembly Tail Lamp
97	Connector Assembly Generator
98	Connector Assembly Tach. Generator
99	Connector Assembly Carburetor Air Temperature Bulb
100	Connector Assem. Cowl Gun So
101	Connector Assem. Cowl Gun Dis
102	Connector Assem. Mixt. Indic. Ce
103	Connector Assem. Starter
104	Connector Assem. Gen. Control
105	Connector Assem. Ignition Disc.
106	Connector Assem. Stick Swt. Jct
107	Connector Assem. R. Wing Disc.
108	Connector Assem. L. Wing Disc
109	*Connector Assem.—Bomb Arr Cont.
110	Connector Assem.—Pilot's Swt. Box
111	Connector Assem.—Pilot's Swt. Box
112	Connector Assem. Pilot's Swt. Box
113	Connector Assem.—Inst. Dist. Bo
114	Connector Assem.—Rear Swt. Bc
115	Connector Assem.—Compass Lights
116	Connector Assem.—Tail Light
117	Connector Assem.—Recog. Ligh
119	Connector Assem. Wing Gun Sc
120	*Connector Assem.—Pilot Heate
121	Connector Assem.—Tach Indic.

. ELECTRICAL

	TYPE	SPEC. OR PART NO.
	Klixon	PSM
	B-12	34A6066
	B-10	34A3846
	B-5A	AN3015
	B-5A	AN3015
	B-6B	AN3016
	B-6B	AN3016
	B-5A	AN3015
	B-5A	AN3015
	B-5A	AN3015
	B-5A	AN3015
	B-6B	AN3016
	B-5A	AN3015
	B-9A	AN3018
	B-9A	AN3018
	Sq. D. Elec Co.	Class 9300-5B
	Sq. D. Elec Co.	Class 9300-10B
A	Sq. D. Elec Co.	Class 9300-35B
A	Sq. D. Elec Co.	Class 9300-15B
.	Sq. D. Elec Co.	Class 9300-15B
	Sq. D. Elec Co.	Class 9300-10B
el	NAA	88-54372
	NAA	55-54139-4
	NAA	88-54368
	NAA	55-54054
	NAA	88-54338
	NAA	88-54344
	NAA	88-54054
t.	NAA	88-54395
	NAA	88-54377
l.	NAA	88-54025-6 L.H. 88-54025-7 R.H.
g	NAA	88-54409
p	NAA	88-54408
	NAA	25-54054
	AN9534	AN3106-22-12s
	AN9534	AN3106-12s-3s
	AN9534	AN3106-12s-3s
l.	AN9534	AN3106-10s-2s
c.	AN9534	AN3106-10s-2p
ll	AN9534	AN3106-14s-2s
	......	36A1874
	......	E1002-3-30
	......	35A2533
.	......	E1002-3-160
	......	36A5955
.	......	36A5955
n.	AN9534	AN3106-10s-2s
	......	E1002-12-10
	......	36A4275
	......	36A5955
x	......	36A4276
ox	......	36A4276
	......	37A5157
	......	E1002-18-10
ts	......	E1002-3-160
l.	AN9534	AN3106-10s-2s
·	......	39A3637
	AN9534	AN3106-14s-1s

NO.	DESCRIPTION	TYPE	SPEC. OR PART NO.
122	Connector Assem.—Carb. Mixture	AN9534	AN3106-14s-2s
125	Connector Assem.—Mixture Indic.	AN9534	AN3106-12s-3s
126	Connector Assem.—Gunsight	......	AN3106-12s-3s
127	*Camera W-7 Fairchild		
128	Socket Assem.—Generator Control	......	E1002-3-30
129	Socket Assem.—Cowl Gun Sol. Disc.	AN9534	AN3102-10s-2s
130	Socket Assem.—Starter	......	36A1881
131	Socket Assem.—Ignition Disc.	......	E1156-3-10
132	Socket Assem.—Stick Swt. Jct.	......	E1003-3-70
133	Socket Assem.—Right Wing Disc.	......	35B5160
134	Socket Assem.—Left Wing Disc.	......	35B5160
135	Socket Assem.—Pilot's Swt. Box	......	35A5235
136	Socket Assem.—Pilot's Swt. Box	......	E1003-12-10
137	Socket Assem.—Pilot's Swt. Box	......	35B5160
138	Socket Assem.—Inst. Dist. Box	......	36A3367
139	Socket Assem.—Rear Swt. Box	......	36A3367
140	Socket Assem.—Tail Light	......	E1003-18-10
141	Socket Assem.—Recog. Light	......	E1003-3-70
143	Socket Assem.—Compass Light	......	38A1549
144	Socket Assem.—Fuel Gage Lamp Sc.	......	31A4527
145	Receptacle—External Pwr.	Thomas & Betts	42B3748
147	Bomb Rack (See Note No. 13)	......	......
149	Lamp Assem.—Cockpit	C-4	94-32294-A
150	*Lamp—6 CP., 28 V., S.C., B.B., Wing Position	G-6	......
151	*Lamp—3 CP., 28 V., S.C., B.B., Tail Position	T-4½	......
152	*Lamp—50 CP., 28 V., S.C., B.B., Passing Position	S-11	......
153	*Lamp—3 CP., 28 V., S.D., B.B., Fuel Signal (1 Spare)	T-3¼	......
155	*Lamp—21-21 C.P., 28 V., D.C., B.B., IF. Gunsight	RP-11	......
156	*Lamp—19 CP., 3 V. Inst. (2 Spare)	T-1¼	36A3344
157	*Lamp—27 Amp., 28 V., S.C.B.B. Recognition	RP-11	AN3120-2
158	*Lamp—3 CP., 28 V., S.C.B.B. Fuel Gage	T-4¼	......
159	Lamp—4 W., 28 V., D.C. Index. Fluorescent Lights	RP-12	......
160	Lamp—17 Amp., 24 V., Min. B.B. Cockpit Lights	T-3¼	......
161	*Lamp 450 W., 24 V., 7" Sealed Beam Ldg.	Par. 56	......
162	Lamp Assem.—Fuel Level Gage	NAA	25-54052
163	*Lamp Assem.—Recog. Upper, White	E-1	94-32366
164	*Lamp Assem.—Recog. Lower, Red	E-2	94-32374
165	*Lamp Assem.—Recog. Lower Green	E-2	94-32374
166	*Lamp Assem.—Recog. Lower, Amber	E-2	94-32374
167	Box Assem.—Landing Gear Warning Signal	NAA	55-54142
169	Socket Assem.—Gen. Disc.	......	35B5168
170	Connector Assem.—Gen. Disc.	......	E1002-3-30
171	*Lamp 17 Amp., 28 V., S.C.B.B. Arm Indic.	T-3¼	......
172	Box Assem.—Ext. Pwr. Recept.	NAA	88-54350
173	*Indicator-Consumption (Film)	......	W-7
174	Lamp Assem.—Marker Beacon	......	39B2822-4
175	Connector Assembly—Marker Beacon	......	37A5157
176	Circuit Breaker—50 Amp. (Klixon)	PLM	43A8305
177	Braid—(Jumper)—Ext. Power Box	......	88-54352
178	*Lamp—28 V., 17 Amp., S.C., Min. B.B. Marker Beacon	T-3¼	......
179	Box Assem.—Generator Relay	NAA	88-541001

*G.F.E. (Government Furnished Equipment)

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d. With struts partially retracted, make sure that the spring-loaded bolt at the outboard end of each switch box moves through its guides without binding. A distorted box will cause excessive binding of these bolts. Apply a small amount of graphite grease at the guide located within the box.

e. Place throttle switch in closed position. (It is located on the fire wall.)

f. Loosen lock nut at end of each switch, and back off the knurled actuating discs towards the ends of the rods.

NOTE

If it is desired to eliminate the noise of the horn while making adjustments, disconnect horn from wiring and connect a light in the circuit.

g. Place the battery disconnect switch in the ON position.

2. ACTUATING ROD AND DISC.—Until the following adjustment is made, the warning horn will continue to function:

a. Adjust the spring-loaded bolt, actuated by the hydraulic strut, so that the spring-back travel of the bolt is one-half inch from the fully extended position to the fully compressed position, actuated by the strut. The adjustment is made by loosening the lock nut on the bolt inside the switch box and rotating the bolt as desired.

b. Place the oleo strut in the LOCKED DOWN position.

c. Rotate the knurled disc on the switch actuating rod until the switch toggle has reached the maximum of its travel. Then back off the knurled disc enough to be able to insert a .030-inch feeler gage between the disc and the toggle.

NOTE

If the toggle switch cannot be BOTTOMED by means of the disc, lengthen the disc actuating rod accordingly.

d. Repeat step six. Make sure that the disc-locking nut is securely tightened after adjustment.

e. Raise and lower the landing gear several times to see that the actuating rod and disc are properly adjusted so as to cut out the warning horn when the landing gear is in the LOCKED DOWN position.

CAUTION

If the travel of the down position lockpins or the landing gear struts is changed, the warning horn adjustment must be changed accordingly.

3. LANDING GEAR THROTTLE SWITCH.—The throttle switch located on the forward left side of the fire wall must be adjusted after the landing gear warning horn switches have been correctly adjusted. Prior to the actual adjustment of the switch actuating rod, adhere to the following:

a. Jack up the airplane so that the landing gear struts may be operated.

b. Set the throttle control to the position used when coming in for a landing.

NOTE

This predetermined position is approximately 1000 rpm, or about 7/16 inch forward of the closed throttle position measured from the stop at the rear end of the throttle guide to the back of the throttle handle.

c. Pull the landing gear lockpins by means of the lever in the front cockpit. With the pins in the OUT position, the warning horn circuits are complete so that the throttle switch adjustment can be accomplished.

d. Disconnect the warning horn. Use a lamp if desirous of eliminating the horn noise while making adjustments.

4. WARNING HORN SWITCH.—After the above has been accomplished, follow this procedure but note that the operation of the switch actuating rod is such that when the throttle lever is pulled back to approximately 1000 rpm or less, a rod interconnected with the throttle lever moves DOWNWARD. At the lower end of the rod a small roller, traveling on a guide, makes contact with the lever of a momentary-type switch, thus making contact and/or closing the circuit of the warning horn.

a. With the throttle lever set at 7/16 inch forward of closed position, loosen lock nut at each end of rod. Then adjust the length of the rod so that the switch just makes contact. The horn will indicate this.

b. Work throttle back and forth to see that horn starts sounding at the proper point each time.

5. WARNING HORN.—Preparatory to adjustment of the horn, remove it from its mounting and disconnect the wiring. Connect horn to direct current and connect an ammeter in the circuit. Now, proceed to adjust the horn as follows:

a. Adjust the tone of the horn by varying the position of the adjusting screw at the back of the horn. The adjustment is very sensitive; so turn the screw a small amount at a time, and lock its position each time before sounding the horn. The horn should not pull more than 2 amperes when sounding. If the proper tone is not obtained with less than 2 amperes, it is necessary to adjust the air gap.

b. Follow this outline to adjust the air gap properly:

(1) Disconnect horn from circuits.

(2) Loosen lock nut on stud at front of the horn; turn the stud to the RIGHT until it just touches the core.

(3) Back the stud away from the core 1/4 turn to the LEFT, lock in position, and then connect

the horn to the current. If the tone is harsh and high pitched, turn the adjusting stud to the LEFT; if the pitch is too low, turn the stud to the RIGHT.

NOTE

When the adjustment is near the correct setting, turn the stud slightly and lock in position EACH TIME before trying the horn.

b. 24-VOLT SYSTEM.—(AT-6D)

(1) GENERAL.

(a) DESCRIPTION.—The electrical system of the airplane has two main sources of energy: a 24-volt storage battery and a 24-volt, 50-ampere engine-driven generator, both connected to a common distribution system. The distribution system is of the single hot-wire direct-current type with the metallic structure of the airplane serving as the return, except in some instances where it is necessary to use a two-wire circuit to prevent compass interference or to obtain a more efficient

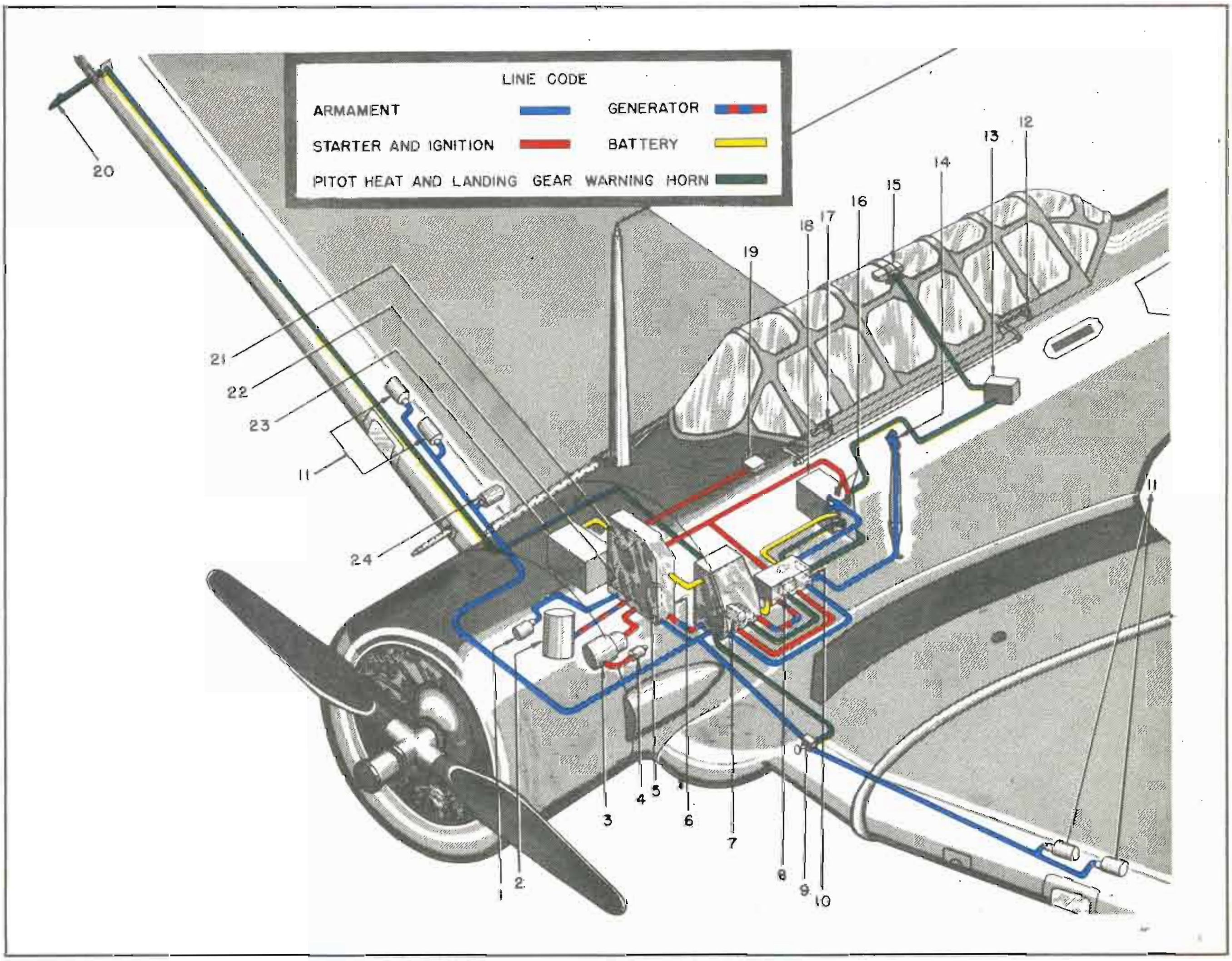


Figure 280 — Electrical Power System

1. Cowl Gun Solenoid
2. Generator
3. Starter
4. Starter Meshing Solenoid
5. Battery Disconnect Solenoid
6. Main Power Panel
7. Voltage Regulator
8. Reverse Current Relay
9. Landing Gear Warning Horn Switch Box
10. Circuit Release Solenoid
11. Bomb Release Solenoid
12. Ignition Switch Control, Rear Cockpit
13. Rear Cockpit Control Panel
14. Bomb Release and Gun Trigger Switches
15. Landing Gear Warning Horn
16. Starter Switches
17. Ignition Switch Control, Front Cockpit
18. Front Cockpit Control Panel
19. Ignition Switch
20. Pitot Head
21. Booster Coil
22. Starter Solenoid
23. Battery
24. Wing Gun Solenoid

ground. The main power panel on the forward face of the fire wall contains the booster coil and the starter and battery solenoids. The generator voltage regulator and reverse current relay are mounted in boxes on the left side of the front cockpit aft of the fire wall. Circuit breakers are employed for the protection of all circuits and are accessible for resetting from the front cockpit only. In place of the foot pedal starter, two toggle switches are installed on the front cockpit control panel. To prevent accidental operation, these switches are protected by a guard that must be raised against spring-action in order to operate the switch. One switch will energize and the other will engage the starter when held to the "ON" position. All electrical equipment is controlled from the main control panel in the front cockpit. Solenoid switches are incorporated in the bomb release and gun firing circuits. These solenoids are controlled by switches on the front cockpit switch panel only. Disconnect plugs are provided on the various power plant accessory connections to facilitate removal of the power plant from the airplane.

(b) MAINTENANCE REPAIRS.—The service man should not attempt either mechanical or electrical maintenance of any individual item of electrical equipment unless suitable shop and testing equipment are available, and authority to repair has been granted. When testing the complete electrical system for trouble, the proper procedure is to remove all power from the electrical equipment, make the necessary circuit changes or meter connections, and then apply the power to the equipment involved.

(2) STORAGE BATTERY.—A type G-1, 24-volt, 34-ampere hour storage battery of the integrally shielded (lead-acid) type, is located in a covered metal case on the lower right forward side of the fire wall. It is accessible by removing the cowling at the right side of the engine compartment. The function of the battery is to provide electric energy when the generator is inoperative or malfunctioning.

WARNING

The battery must be kept in a fully charged condition at all times. If the specific gravity reads 1.240 or less, the battery must be replaced with a battery that is known to be fully charged.

The cover to the battery case is fitted with a rubber or neoprene gasket which forms a sealed air chamber inside the case to prevent the escape of acid fumes from the battery. Provision is made to neutralize and vent these battery gases outside, as they would damage the metallic structure of the airplane. This is accomplished by passing outside air through the sealed air chamber at the top of the battery and, then through a glass jar containing a cellulose sponge disc 1 inch thick, saturated with a solution of tri-sodium phosphate (NA3PO4) to neutralize any acid in the battery gases. A felt pad saturated with a solution of bicarbonate of soda may also be used. Air is passed through the battery and neutralizing jar by means of rubber or neoprene tubing leading from an intake port in the bottom of the engine cowling to one side of the battery case and from the other side to the jar, and then to an exhaust tube in the bottom of the cowling. The neutralizing jar is accessible through an opening in the lower right rear side of the engine cowling.

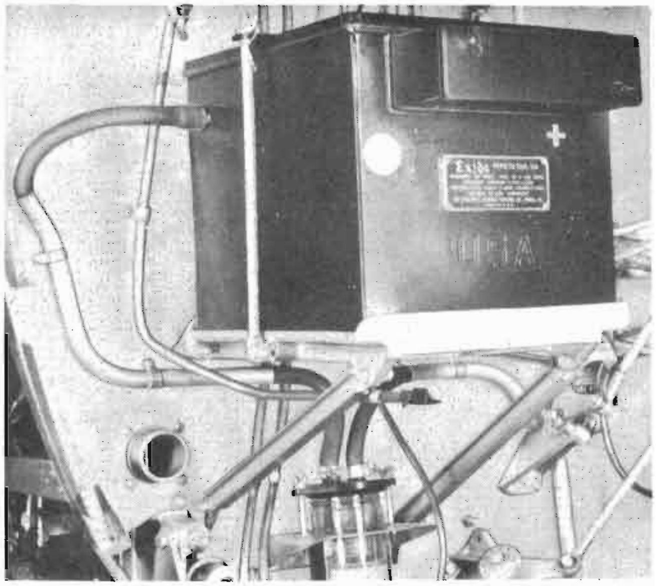


Figure 281 — Storage Battery Installed

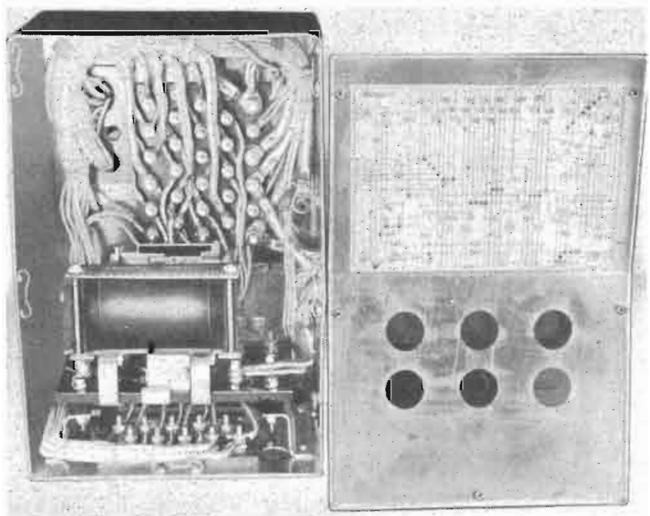


Figure 282 — Generator Voltage Regulator

(3) GENERATOR SYSTEM.

(a) DESCRIPTION.—The type M-3, 24-volt, 50-ampere generator, mounted on the rear of the engine assembly, serves to keep the battery charged and to furnish power for operating the airplane's electrical equipment. A generator voltage regulator is mounted in a box on the left side of the front cockpit just aft of the fire wall. The voltage regulator, when properly regulated, will hold the generator voltage out-

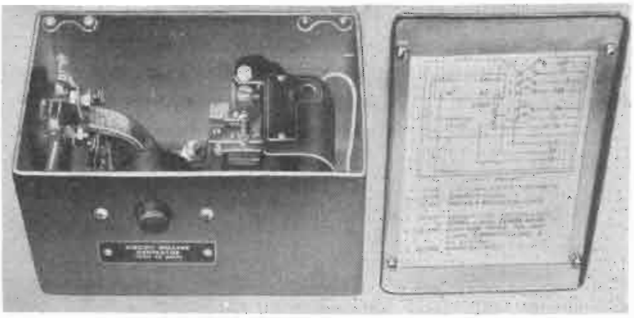


Figure 283 — Generator Reverse Current Relay

put to within plus or minus 2 percent of rated voltage (28.5 volts) at varying generator speeds. The voltage regulator is accessible only from the outside (when the airplane is on the ground). A reverse current relay, also connected in the generator circuit, is mounted in the box with the circuit breakers on the left side of the front cockpit just aft of the voltage regulator. The reverse current relay, when properly adjusted, will operate automatically to close the circuit and put the load on the generator when the generator voltage output reaches 26.5 volts plus or minus 0.5. When the generator voltage drops below that of the battery so that between 8 to 20 amperes would tend to flow in the reverse direction, the relay will open the circuit to isolate the generator from the system, thus preventing the flow of current from the battery to the generator. A 50-ampere circuit breaker is installed in the generator circuit as additional protection for the generator against extremely high reverse currents and generator overload. This circuit breaker is mounted in the circuit breaker box at the left side of the front cockpit and may be reset by a large push-button on the inboard side of the box. The type F-1 ammeter mounted on the control panel in the front cockpit will indicate the amount of current delivered by the generator.

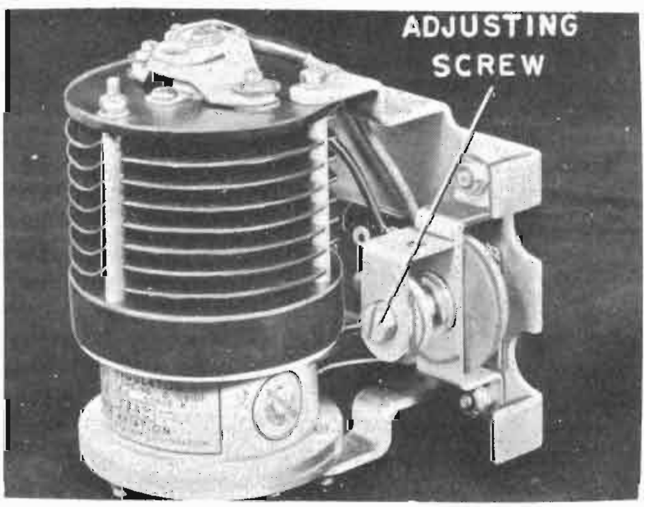


Figure 284 — Voltage Regulator Adjustment

(*b*) ADJUSTMENT.

1. VOLTAGE REGULATOR.—The voltage regulator in the generator circuit is properly adjusted and tested before being installed in the airplane, to maintain the system voltage at approximately 28 volts, independent of engine rpm or electrical load. At any indication of malfunctioning, the regulator should be removed for bench test and a regulator that has been properly tested, installed in its place.

2. REVERSE CURRENT RELAY.—The reverse current relay is adjusted and tested before installation in the airplane; and at any indication of malfunctioning, it should be removed and a unit that has been test-proven installed in its place. When properly adjusted, the reverse current relay will connect the generator to the electrical system at a point between 26- and 27- volt generator output and disconnect it if a reverse current of between 8 and 20 amperes tends to flow from the battery to the generator.

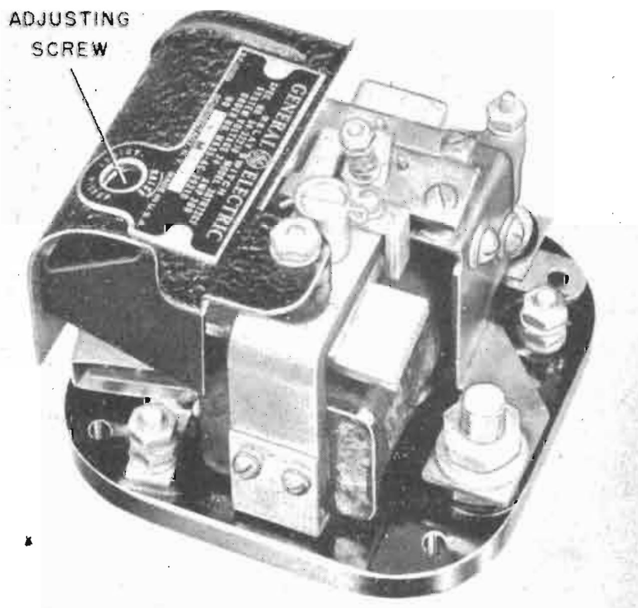


Figure 285 — Reverse Current Relay Adjustment

(4) GENERATOR MAIN LINE SWITCH.—The generator main line switch on the front cockpit switch panel provides a means of opening the generator circuit in case the automatic relay cut out, in the circuit breaker box at the left side of the front cockpit, fails to operate. The switch should be left in the "OFF" position when the engine is not running.

(5) IGNITION SWITCH.—A master ignition switch box unit, wired directly to the rear of the magnetos, is located at the left side of the fuselage forward of the front instrument panel. This master switch is operated from the left side of the instrument panel in

both cockpits by a lever or pointer handle mechanically interconnected with the switch.

(6) ENGINE STARTING SYSTEM.

(a) A type G-5 combination inertia, direct cranking electric and hand cranking inertia starting unit is mounted on the rear of the engine assembly. (But should be used for direct cranking only in an emergency and when engine is warm.) The flywheel of this starting unit may be accelerated either electrically or by hand cranking. Prior to operating the unit as an electric inertia starter, clear the cylinders by turning the propeller through by hand. Before energizing the starter, make sure that the brush spring release is in the "ON" position. (When facing the starter, the brush spring release handle is moved clockwise to the "OFF" position and counter-clockwise to the "ON" position. Brush spring release handle can be reached through the small inspection door on the upper left side of engine compartment cowling.) To accelerate the starter electrically, the switch (under the red guard on the control panel) in the front cockpit marked "ENERGIZE" must be held in the "ON" position for 10 or 12 seconds, until the flywheel has attained its normal operating speed of

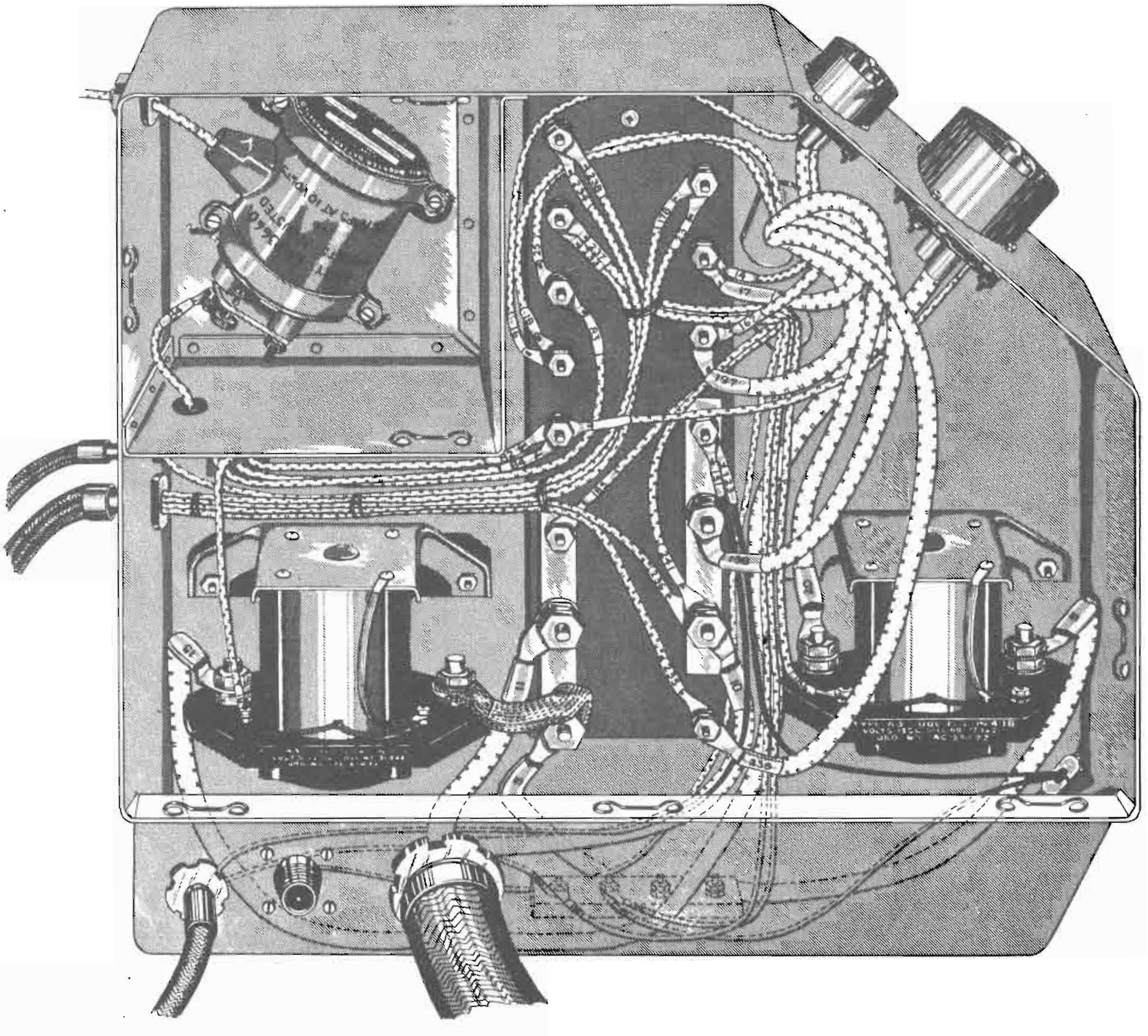


Figure 286 — Main Power Panel Wiring Diagram

16000 rpm. With the flywheel turning at this speed, return the control switch handle to the off position; at the same time, move the switch (under the red guard) marked "ENGAGE" to the "ON" position. When the engine starts, move the "ENGAGE" control switch to the off position again. To use starter as a direct cranking unit, energize the starter for 10 or 12 seconds; and after attaining the normal operating speed of 16000 rpm, move the "ENGAGE" switch to on, at the same time holding the "ENERGIZE" switch in the "ON" position. When the engine starts, move both switches back to the "OFF" position.

CAUTION

Direct cranking periods are limited to 60 seconds duration.

If the engine fails to start on the first trial, make certain the starter jaw is not engaged before operating the starter a second time. In case disengagement of the starter and engine jaws does not occur (due to engine compression), turn the propeller by hand (ignition off) about one-half turn in direction of engine rotation to release the starter jaw.

(b) For emergency operation when the source of electrical energy is not sufficient to provide proper electrical operation, the starter may be operated as a hand inertia starter. To operate the starter as such, move the brush spring release to the "OFF" position. (When facing the starter, the brush spring release handle is moved clockwise to the "OFF" position and counter-clockwise to the "ON" position.) This is accomplished by reaching through a small inspection door on the upper left side of engine compartment cowling. Insert hand crank (hand crank is stowed in the baggage compartment) and turn the hand crank at approximately 80 rpm or until the flywheel has attained its normal operating speed. When this speed has been attained, remove the hand crank and pull the manual engaging control cable to engage the engine and starter jaws. When the engine starts, release the cable. (This cable is accessible through the cowling at the hand crank position.)

CAUTION

After engine is started, the brush spring release handle should always be returned to the "ON" position and safetied.

WARNING

Use an outside battery or auxiliary power supply for all engine starting, and for all electrical and radio testing purposes. Never use the battery installed in the airplane for these purposes, as a low or partially discharged battery will cause malfunctioning of some of the electrical equipment, resulting in damage and interruption of the electrical power supply.

(7) MAIN POWER PANEL.—The main power panel is mounted on the forward face of the fire wall. Circuits to all electrical equipment on the engine (except the ignition circuits) are routed through this panel. The battery solenoid, the starter solenoid, and the booster coil are mounted inside this panel.

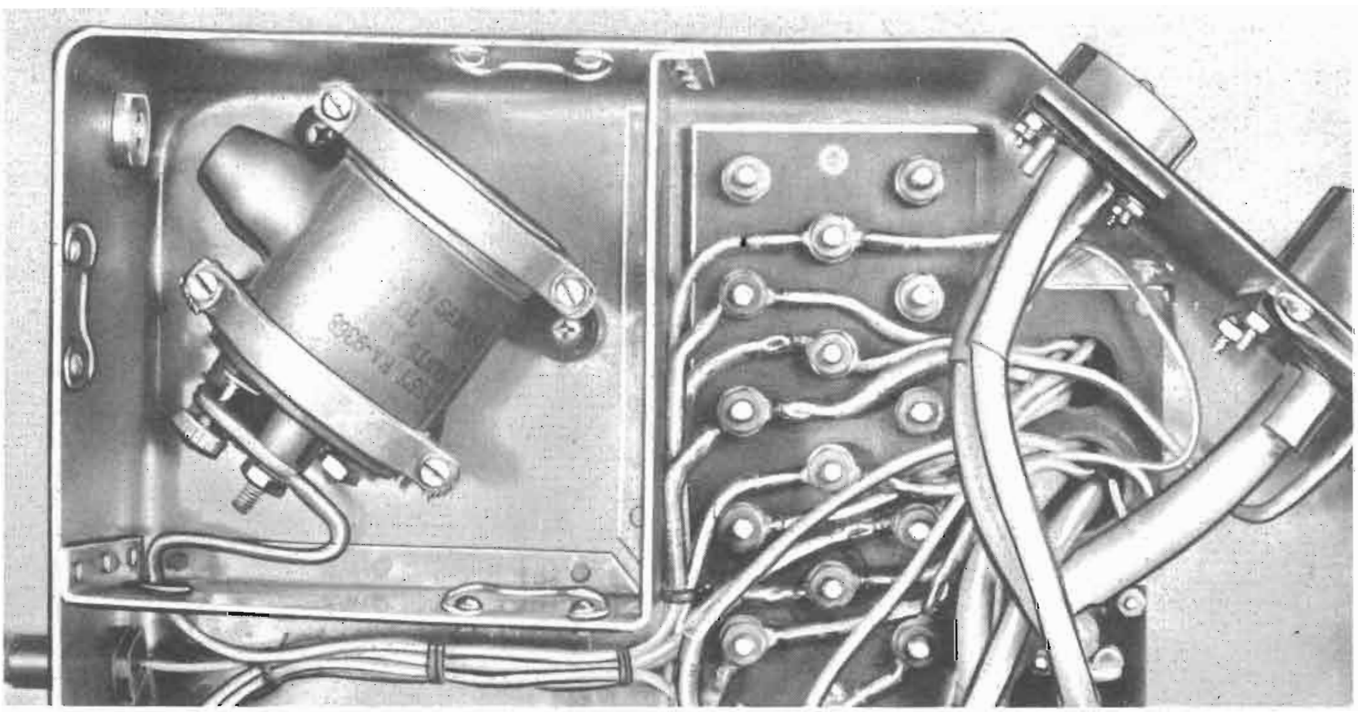


Figure 287 — Booster Coil Installed

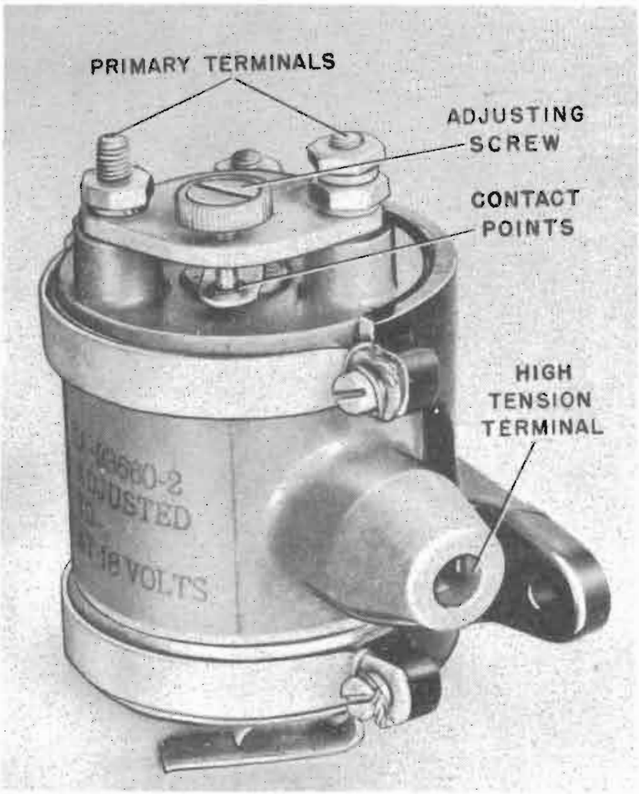


Figure 288 — Booster Coil Adjustment

(8) BOOSTER COIL.

(a) DESCRIPTION.—*(See figures 287 and 288.)*—A type C-1 booster coil mounted in a shielded housing in the main power panel on the front face of the fire wall is energized only when the starting switch is thrown to "ENGAGE." The booster coil acts as a high-voltage step-up transformer for delivering a retarded spark through the magnetos for starting only.

(b) ADJUSTMENTS. — The contact screw on the booster coil may be adjusted to obtain the correct gap setting as follows:

1. Check the contact points to see that they are clean and properly seating.

2. Connect the primary terminals of the coil in series with a 3-ampere fuse and 0.5-ampere ammeter and control switch; then connect them to an 18-volt battery supply.

NOTE

The battery voltage must be obtained by using the required number of cells and NOT by dropping the voltage through a series resistor.

3. Connect the high tension terminal to a spark plug having a 0.022-inch gap. Connect a return lead from the spark plug case to the booster coil housing.

4. With the adjusting screw in the extreme outward position, gradually turn screw clockwise until a good hot spark is obtained across the gap. With 18 volts applied, the current drain with the plug firing the 0.022-inch gap should be 1.80 amperes.

5. If no ammeter is available, the approximate setting may be obtained by turning the adjusting screw until the spark will jump a 3/8-inch gap at the plug.

(9) BATTERY DISCONNECT SWITCH.—*(See figure 292.)*—The type B-4 battery disconnect solenoid switch is mounted in the main power panel and is remotely controlled by a toggle switch on the switch panel in the front cockpit. This switch is used to disconnect the battery from the electrical system to prevent discharging when airplane is not in use.

WARNING

The battery disconnect switch must always be thrown to the "OFF" position before leaving the airplane.

(10) LIGHTING.

(a) DESCRIPTION.

1. COCKPIT LIGHTS.—*(See figure 269.)*—Both the front and rear cockpits are provided with a type C-4 cockpit light mounted at the left side of each cockpit. The lamp mounting has a swiveling range of 360 degrees. The lamp is provided with an adjustable beam which is controlled by moving the lens housing backward or forward. The beam is continuously adjustable from a concentrated spot to a floodlight beam. The intensity of the light is controlled with the *red* knob of a rheostat on the bottom of the lamp housing. The head of the lamp housing containing the red lens may be removed to obtain a white light. A push-button switch at the back end of the lamp housing provides a means of instantaneous control of the light so that it may be used for signaling. The lamp may be removed from its holding bracket and held in any desired position.

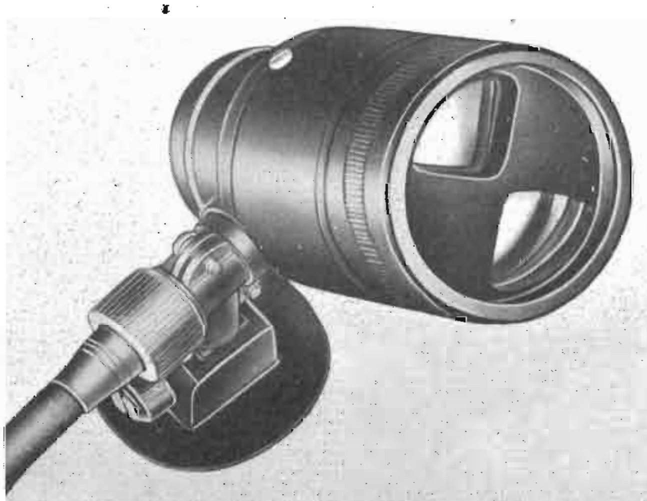


Figure 289 — Instrument Fluorescent Light

2. INSTRUMENT LIGHTING.—Fluorescent lighting is provided for the instruments in both cockpits. A type C-5 fluorescent light is mounted on both the right and left side of each cockpit. The lights have a swiveling range of 360 degrees and are adjustable to any desired angle. The head of the light housing may be rotated to give visible light or ultra-violet (invisible) light. The fluorescent lights are individually controlled by switches on the instrument panel in each cockpit. The switch must be turned to "START" and held until the fluorescent bulb lights, and then may be turned to "ON" for the full light or "DIM" for subdued light.

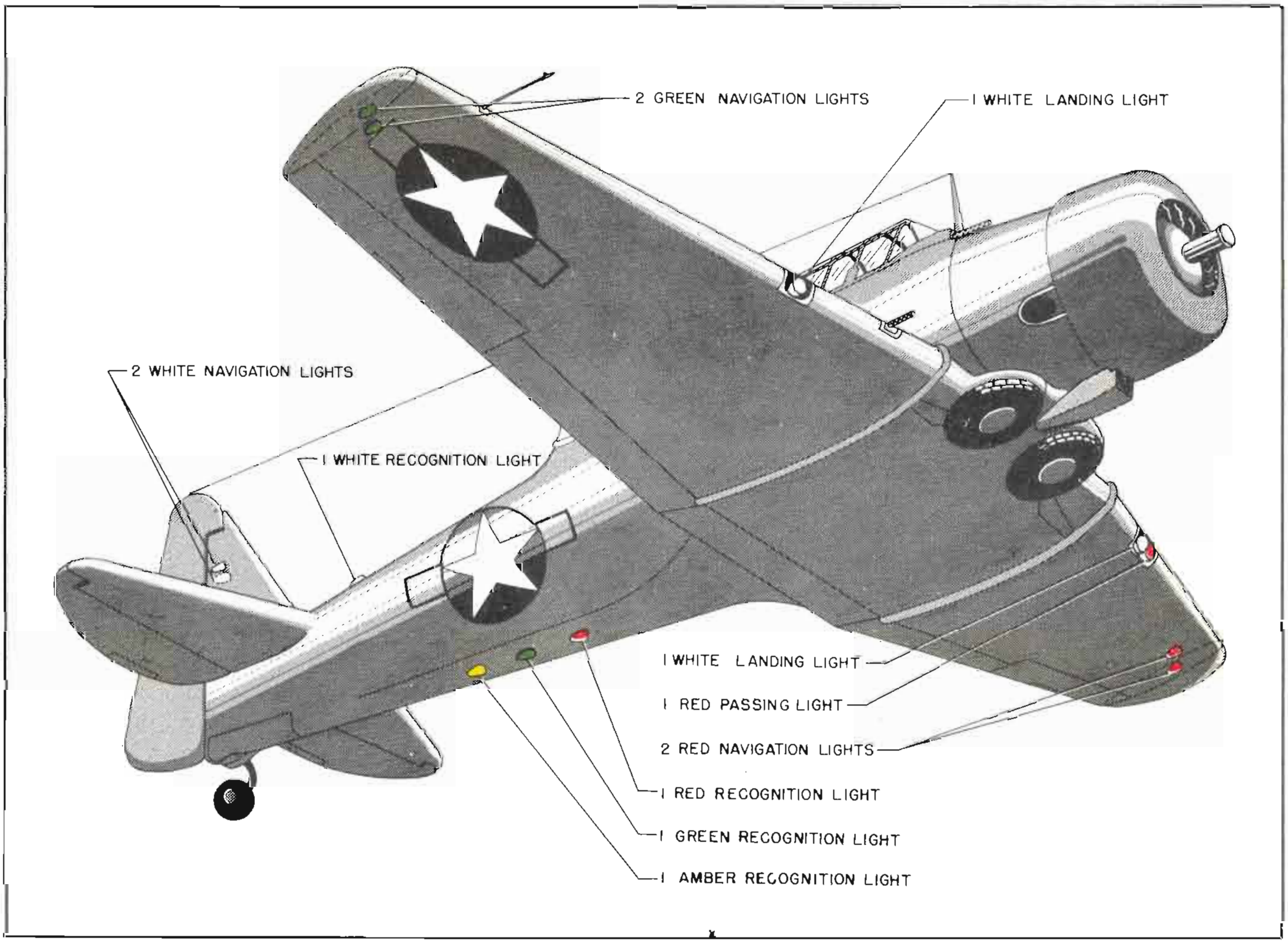


Figure 290 — Exterior Lights

3. NAVIGATION OR POSITION LIGHTS.—Type A-8 navigation lights are installed on both the upper and lower surface of each wing tip and on both sides of the vertical stabilizer. The lights on the left wing are *red,* on the right wing *green* and on the vertical stabilizer they are *white.* The navigation or position lights are controlled by individual switches on the front cockpit control panel marked "WING" and "TAIL," with "BRIGHT," "DIM" and "OFF" positions.

4. RECOGNITION LIGHTS.—The recognition lights are installed in the outer surface of the rear fuselage section just aft of the rear cockpit. Three type E-2 lights, *red, green* and *amber* are installed underneath, and one type E-1 *white* light is installed on top of the airplane. These lights are controlled by individual switches that are wired in series with a push-button switch that may be operated as a telegraph key to provide a means of using the lights for signaling in various combinations and sequences. The individual switches must be thrown to the *up* or *key* position for signaling with the push-button switch on top of the box. The *down* position of the switches is "STEADY" and the center position is "OFF." The recognition light switch box is mounted in the center of the front cockpit directly to the right of the control panel.

WARNING

Do not operate the recognition lights for more than 10 seconds when the airplane is on the ground, as there must be air circulation to dissipate the heat from the airplane.

5. LANDING LIGHTS.—Two, type PAR-56, landing lights are installed on the airplane, one in the leading edge of each outer wing panel. These lights are of the fixed-focus type with the light beams parallel to the ground line when the airplane is in the three-point position. The lights are focused 10 degrees outboard from the centerline of the airplane and are controlled by individual switches on the front cockpit switch panel. The cover glass of each light conforms to the contour of the leading edge of the wing.

WARNING

Do not operate the landing lights for more than 10 seconds when the airplane is on the ground and engine is not running.

6. PASSING LIGHT.—A type B-3 passing light is installed in the same bay with the landing light in the left outer wing panel. The cover glass of the passing light is *red*, and the light beam is parallel to the line of flight at operating speed. The light is controlled from the front cockpit only.

(b) LAMP REPLACEMENT.—The following list will give information on lamps used for lighting the 24-volt airplane.

	Qty.	*Type*	*Bulb*	*Volts*	*Candle Power*	*Contact*
Fluorescent	4	C-5	RP-12	28	4-W	DC
Cockpit	2	C-4	T-3¼	24	17A	—
Compass (2 spares)	2	B-16	T-1¾	3	19A	—
Fixed gun sight	1	N-3B	RP-11	28	21	DC*
Fuel signal (1 spare)	1	NAA	T-3¼	28	3	SC
Fuel gage	2	NAA	T-4½	28	3	SC
Bomb arm indicator	1	—	T-3¼	28	—	SC
Passing	1	B-3	S-11	28	50	SC
Position	6(4)	A-8	4-G-6	28	6	SC
	(2)		2-T-4½	28	3	SC
Recognition	1	E-1	RP-11	28	2.7A	SC
	3	E-2	RP-11	28	2.7A	SC
Landing, sealed beam	2	7" Dia.	Par-56	28	450W	—

DC—Double Contact
SC—Single Contact
* Mazda Type G-9 used on later airplanes.

(11) CIRCUIT BREAKERS.—All electrical circuits except the magneto ignition circuit are protected by circuit breakers instead of fuses. The only fuses on the airplane will be found in some of the radio equipment. The circuit breakers are of two types: the combination circuit breaker switch or toggle-type circuit breaker, and the conventional push-button reset type. The six push-button-reset circuit breakers are mounted at the left side of the front cockpit in the box containing the reverse current relay. The toggle-type circuit breakers on the switch panel in the front cockpit may be identified by the elongated slot in the face of the switch panel at the base of the toggle arm or lever. The following list will give information on circuit breakers used on the 24-volt airplane.

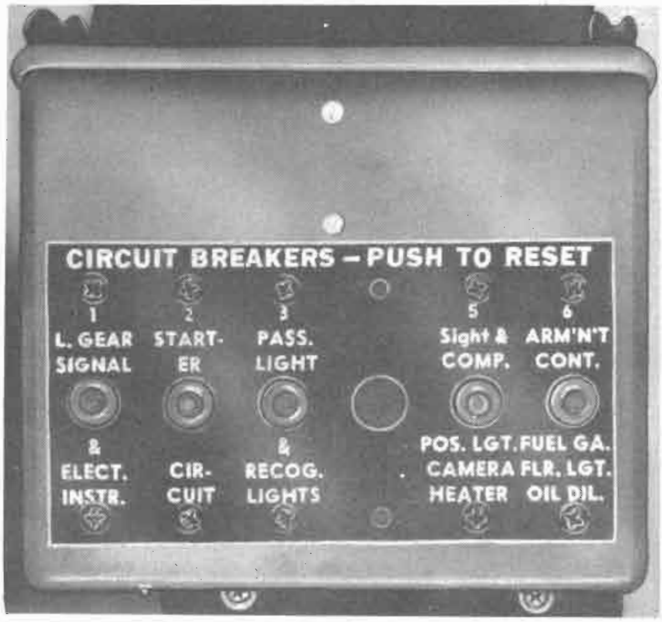


Figure 291 — Circuit Breaker Panel

(a) Toggle-type circuit breakers installed in front cockpit switch panel:

Bomb arm control	5 amp
Pitot heat	10 amp
Landing light (right)	35 amp
Landing light (left)	35 amp
Bomb selector (right wing)	15 amp
Bomb selector (left wing)	15 amp
Cowl gun	15 amp
Wing gun	10 amp

(b) Push-button-reset circuit protectors installed in box on left side front cockpit:

Landing gear signal and Electrical Inst.	15 amp
Starter circuit	15 amp
Passing lights and recognition lights	15 amp
Gun sight, compass, passing lights, and heater circuit	10 amp
Armt. control, fuel gage, fluorescent lights, and oil dilution	15 amp
Generator circuit	50 amp

(12) CONTROL PANELS.

(a) FRONT COCKPIT CONTROL PANEL.—The switches and controls for operating all electrical equipment in the airplane are on the control panel in the front cockpit. All switches are plainly marked to indicate their operation and the circuit they control. In addition to the ammeter, mounted in the upper left

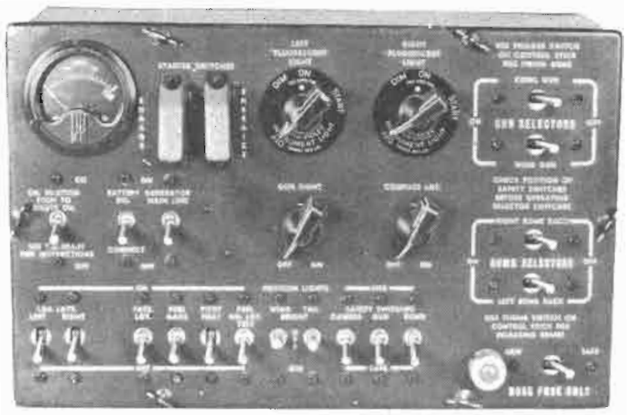


Figure 292 — Front Cockpit Control Panel

corner, the control panel contains the following switches:

1. Starter switches—"ENERGIZE" and "ENGAGE"

2. Fluorescent lights—left and right rheostat

3. Oil dilution—"PUSH TO DILUTE OIL"

4. Battery disconnect

5. Generator main line

6. Gun sight—Rheostat

7. Compass Light—Rheostat

8. Gun Selector (toggle circuit breakers)—Cowl and wing

9. Bomb selector (toggle circuit breakers)—right bomb rack and left bomb rack

10. Fire safety switches — camera, gun and bomb

11. Landing lights (toggle circuit breakers)—left and right

12. Passing light

13. Fuel gage

14. Pitot heat (toggle circuit breaker)

15. Fuel sight light test

16. Position lights—"WING" and "TAIL"

17. Nose Fuse only (toggle circuit breaker)

(b) REAR COCKPIT CONTROL PANEL.—The rear cockpit control panel contains the following switches: compass light, fluorescent lights (left and right), and fuel gage light. The fuel gages on each side of the front cockpit seat are visible from the rear cockpit, as well as the front cockpit.

(13) PITOT HEAT.—A pitot mast with internal heating element is located on the leading edge of the right wing tip. The heating element is controlled by a toggle switch on the control panel in the front cockpit only, and serves to prevent ice from clogging the airspeed orifice of the pitot mast.

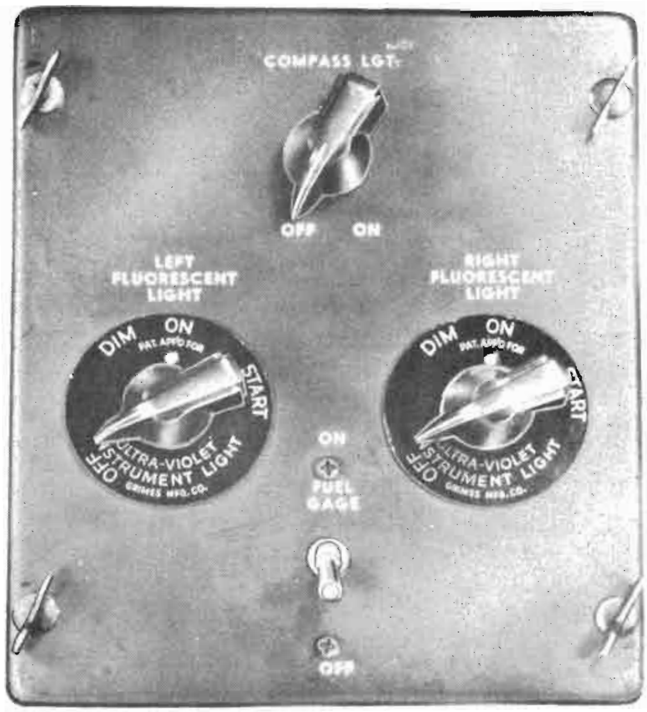


Figure 293 — Rear Cockpit Control Panel

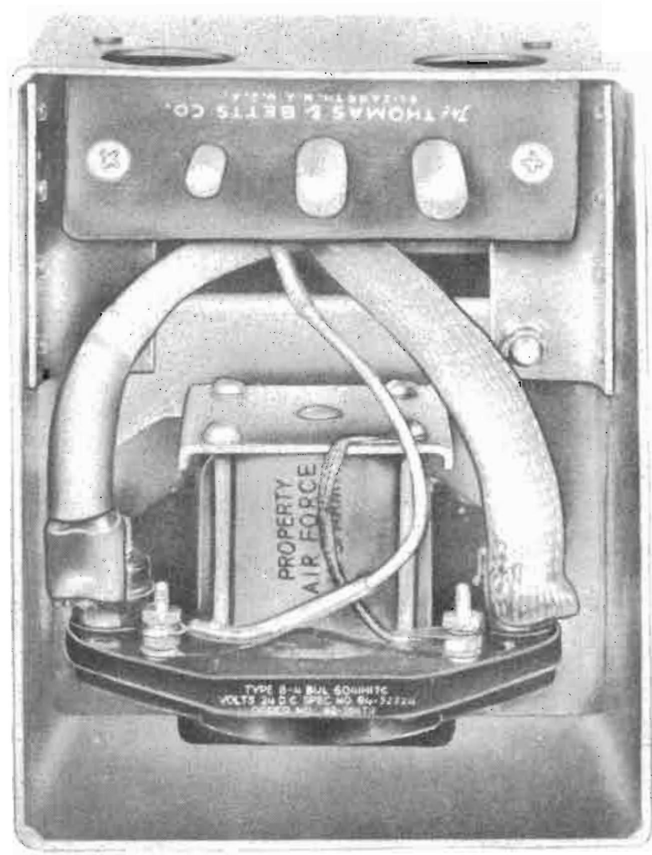


Figure 294 — Receptacle — Outside Power Supply

WARNING

The pitot heat should never be turned on when the airplane is at rest on the ground except for a momentary test, as without air circulation the heating element will be damaged from overheating.

(14) EXTERNAL POWER RECEPTACLE.—A receptacle for plugging in an outside power supply (for use when the airplane is on the ground) is located on the lower left side of the fuselage just aft of the wing trailing edge. A solenoid switch mounted in the box with the external power receptacle plug will close when the outside power supply is plugged in, thus connecting the outside power supply to the airplane's common electrical system. The receptacle is accessible through a Dzus-fastened door.

NOTE

All ground starting and testing should employ an external source of power in order to conserve the airplane's battery.

(15) LANDING GEAR WARNING SYSTEM.

(a) DESCRIPTION. — *(See figure 276.)* — The landing gear warning horn, located on the nose-over structure between the cockpits, serves as a warning device to indicate unsafe landing conditions. The horn is interconnected with the landing gear "DOWN" position lockpins and the throttle control, so that when the throttle is closed for landing, the horn will sound if the landing gear is not down and the "DOWN" position lockpins in place. If the throttle should be closed during flight maneuvers, the horn will continue to sound until the throttle is opened again or the landing gear is put in the "DOWN" and "LOCKED" position.

(b) ADJUSTMENT. — To adjust this equipment, follow the procedure given for the same equipment on the 12-volt airplane, paragraph *a.,* (14).

14. FUSELAGE EQUIPMENT.

a. COCKPIT SEATS.—The front and rear cockpits contain one seat each, arranged in tandem and mounted on chrome-plated chrome-molybdenum steel tubing. Each set is designed to accommodate a seat-type parachute, and is equipped with a seat cushion life preserver, relief tube and a type B-11 safety belt provided with quickly-detachable releases. A shoulder strap assembly is also provided, which is attached to a spring-loaded plunger at the back of each seat and passes over the shoulders of the occupant and fastens to the release on the safety belt. A spring release, which is controlled by a quadrant on the left side of each seat, is provided to permit the pilot and gunner more freedom of movement and yet be safety-strapped in. A Sutton safety harness is furnished on British airplanes in place of this shoulder strap assembly. The seats are of wood construction, consisting of spruce, 3-ply or 5-ply mahogany plywood with poplar filler, or birch plywood with poplar filler. The spruce base and plywood are assembled and formed under pressure after surfaces are faced with casein glue. In most cases the direction of grain in the plywood is 45 degrees from vertical. In earlier airplanes all-metal seats are used.

(1) FRONT COCKPIT SEAT.

(a) REMOVAL.

1. Raise the seat to its uppermost position.

2. Detach the shock cords from the metal hooks at the rear lower edges of the seat.

3. Remove the three attaching screws of the urinary horn bracket.

4. Remove the two bolts and nuts securing the seat support tubes to the fuselage cross members immediately behind the seat.

5. Lift the seat and support tubes as a unit out of the center section support fittings, taking care not to damage the installed cockpit equipment.

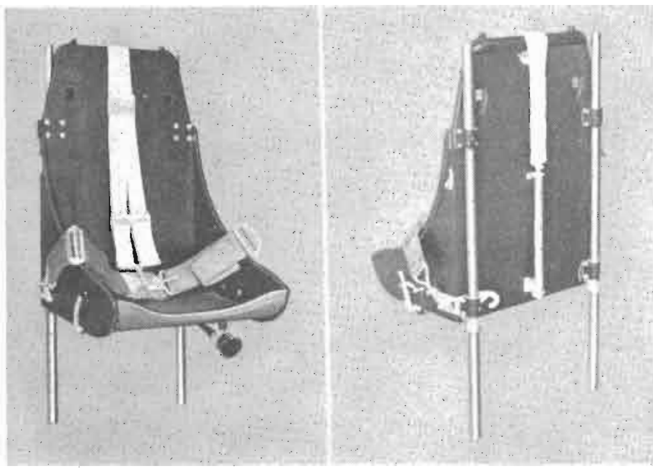


Figure 295 — Front Cockpit Seat

(b) INSTALLATION.

1. Pass the two seat support tubes through the two brackets on each side of the seat, and bolt the seat tube stops in place.

2. Set the lower ends of the seat support tubes in the two fittings provided on the wing center section.

3. Bolt the top ends of the seat support tubes to two brackets attached to the fuselage cross member immediately behind the seat.

4. Install the shock cord assembly. This is done by attaching the two top pulleys to the fuselage cross member back of the front seat, and one pulley to the fuselage diagonal brace back of the front seat.

5. Raise the seat to its uppermost position on the support tubes. Attach the ends of the shock cord to the two metal hooks at the rear lower corners of the seat.

6. Attach the urinary horn bracket.

(2) REAR COCKPIT SEAT.

(a) REMOVAL.—The rear seat may be removed by removing the large nut on the bottom of the seat support swivel housing and lifting the seat assembly clear after detaching the urinary horn bracket.

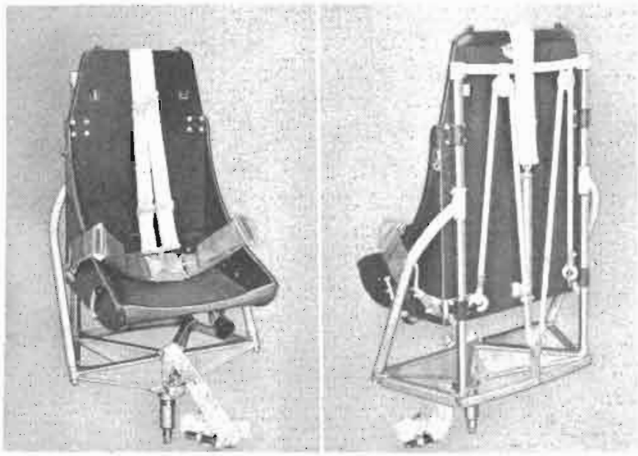


Figure 296 — Rear Cockpit Seat

(b) INSTALLATION.—The rear cockpit seat, with its supporting base, fittings, and controls, is assembled at the factory and is usually shipped and installed as a single unit. To install, raise seat assembly and lower swivel post through swivel housing. See that bearings on swivel post are greased and properly installed. Secure with large nut, washer, and cotter on bottom end of swivel post. Attach the urinary horn bracket.

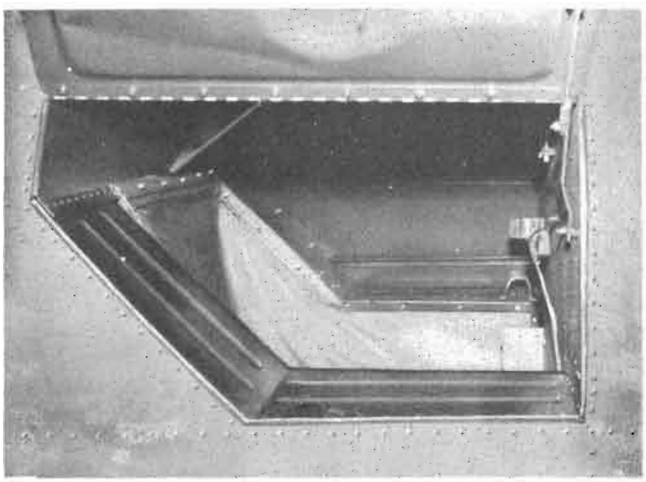


Figure 297 — Baggage Compartment

b. BAGGAGE COMPARTMENT.

(1) DESCRIPTION.—A collapsible baggage compartment with a volume of approximately 9 cubic feet of usable space is installed immediately aft of the rear cockpit. It consists of a wood floor, which is attached to the bulkhead by a full-length hinge, and a three-sided canvas compartment wall. In earlier airplanes, aluminum-alloy floors are used in the baggage compartment. The canvas compartment wall is attached to the compartment floor and to attachment plate fittings on each side of the fuselage and on the front bulkhead of the rear fuselage section. The bottom can be secured in a stowed UP position to provide space for installation of camera and radio equipment. The baggage compartment contains space for the stowage of personal baggage, engine tools, starter crank, mooring rings, and other equipment. When the rear cockpit is unoccupied, 100 pounds of ballast can be carried in the baggage compartment. On later airplanes, a data case is mounted on the aft partition of the baggage compartment slightly below the access door opening. Access to the compartment is made through a door located on the left side of the fuselage aft of the rear cockpit. The door is equipped with a built-in flush-type lock. The keys for the lock are stowed in the front cockpit map case.

(2) REMOVAL.—To remove the fabric part of the baggage compartment, remove screws attaching left edge of compartment to aprons. Remove the six metal clamps securing assembly to fuselage structure. Loosen wing nuts attaching the forward portion of the compartment floor to the camera mount. Fold the floor up and aft. Secure it to the back of the compartment with the straps provided. Remove the assembly through the door located on the right side of the fuselage.

(3) INSTALLATION.—To install the baggage compartment, fold the floor up and aft. Secure it to the back of the compartment with the strap provided. Insert the assembly through the side of the fuselage directly aft of the rear cockpit. Secure it to members of the fuselage structure, using six metal clamps. Fold baggage compartment floor down, insert attaching bolts into holes in camera mount, and secure with wing nuts. Attach left edge of compartment to aprons, using AC526 screws as required.

c. INSTRUMENT FLYING HOOD.

(1) DESCRIPTION.

(a) A quick detachable instrument flying hood for training in blind flying may be installed in either the front or rear cockpits. The hood structure consists of three tubular aluminum-alloy bows terminating at a hinge point on a pivot arm. The bows are covered with duck to form an enclosure for the cockpit in which the hood is installed. An opening at the back of the hood provides clearance for the gun mount when the hood is installed in the rear cockpit. This opening will also provide forward vision for the rear cockpit occupant when the hood is in the stowed position in the front cockpit. The hood is secured at the back by two pieces of elastic shock cord for attaching to hooks mounted on the fuselage cross tube in the front cockpit

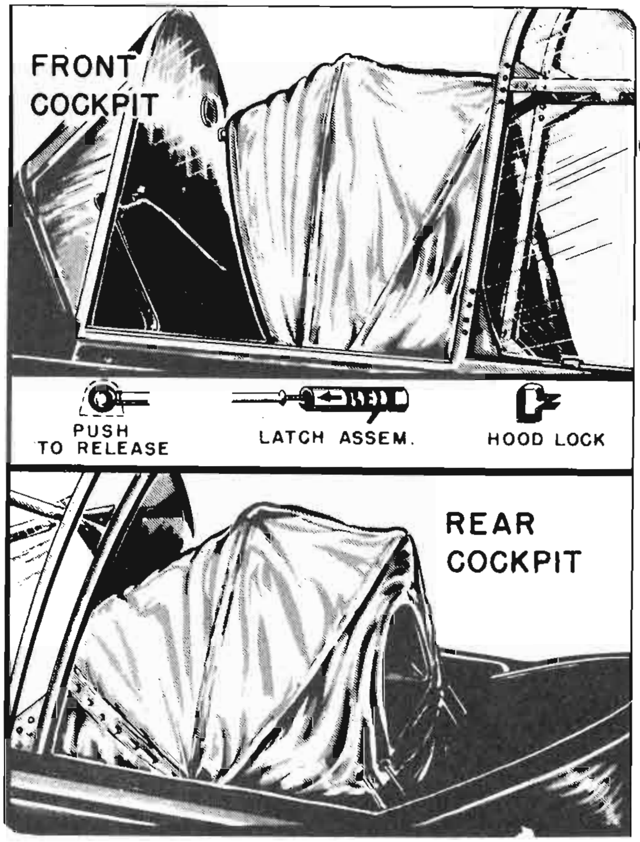


Figure 298 — Blind Flying Hood

and on the upper channel at the forward side of the baggage compartment in the rear cockpit. The hooks are located just aft of the seat in each cockpit. A spring-loaded latch assembly mounted on the instrument panel shield in each cockpit provides a means of attaching the forward bow of the hood to this shield. A strong elastic cord running from the top of the rear bow to the top of the forward bow will, when released, return the hood to its stowed position behind the seat. The hood is held in the stowed position in the front cockpit by a hold-back latch installed on the nose-over structure directly behind and above the pilot's seat.

(b) To place the hood in operating position, first make sure the seat is lowered for head clearance. Take hold of the front bow at the TOP and pull it FORWARD. When it is in the forward position, push the lock fitting on the forward hood bow into the opening at the spring-loaded latch below the edge of the instrument panel shield.

CAUTION

Make certain the latch plunger has snapped into place before releasing the hood.

(c) The hood may be released from EITHER cockpit and stowed, after first seeing that the seat is lowered for head clearance. The hood is released by pushing to the left, the lever extending from the latch assembly located below the top edge of the instrument panel shield. The hood may also be released from the adjoining cockpit by operating the control cable knob lever, located just below the trim strip at the front left side of the cockpit.

(2) INSTALLATION.

(a) FRONT COCKPIT INSTRUMENT FLYING HOOD.—To install the instrument flying hood in the front cockpit, first remove all sharp or jagged objects from the path of the hood.

1. Remove rear cockpit pivot arm assemblies if they are installed. Attach each pivot arm assembly to the hood with a grommet, screw, and a nut on the front bow, and three pins and three cotters on the center and rear bows.

NOTE

The nuts and cotters should be on the OUTBOARD side of the hood.

2. See that the rear hold-down hooks are properly installed, one at each side of the fuselage frame on the upper cross-tubes directly aft of the pilot's seat support tubes. Each hook is secured by a clamp, screw, and nut.

3. Ascertain that "hold-back" latch is properly installed on the left forward tube of the nose-over structure, approximately 14½ inches above the centerline of the fuselage frame upper longeron.

4. Be sure the release cable assemblies are properly installed.

5. See that the pivot arm attaching bracket is properly installed so that the pivot pin center is 8 inches *below* the centerline of the fuselage frame upper longeron.

6. Place the hood in position, press the lever at the bottom of the left and right pivot arms, and install the arms on pivot pins located on the fuselage diagonal tubes at the sides of the cockpit. Make sure the hood is securely engaged in place; release the lever.

7. Fasten the two elastic shock cords at the lower edge of the hood back to the hold-down hooks on the fuselage tube located directly aft of the seat.

8. Operate the hood as outlined above. Check for proper operation, and then engage the "hold-back" latch when the hood is stowed.

(b) REAR COCKPIT INSTRUMENT FLYING HOOD.—Place flexible gun in its stowed position before installing hood. To install the rear hood, proceed as follows:

1. Remove the front cockpit pivot arm assemblies if installed. Attach pivot arm assemblies to the hood with the same attaching parts used for attaching the front cockpit pivot arms to the hood.

2. Ascertain that the rear hood hold-down hooks are properly installed on the forward side of the baggage compartment, one at each end of the forward upper channel, by screws and nuts.

3. Make sure the release cable assemblies are properly installed.

4. See that the pivot arm support bracket is properly installed on the fuselage upper longeron.

5. Attach the curtain assemblies to the forward side of the hood.

6. Place the hood in position, pull out on the locking pins in the support brackets, install pivot pins in the support brackets, and engage the locking pins in pivot pins.

7. Fasten the two elastic shock cords at the lower edge of the hood, back to the hold-down hooks on the baggage compartment channel.

8. Operate the hood as outlined above; then place it in the stowed position.

NOTE

(AT-6 Airplanes.)—When blind flying hood is in use in rear cockpit and radio control of radio compass unit is required, radio compass control box H4043235 may be installed in rear cockpit by relocating compass control box and supports in rear cockpit and connecting control box to terminals provided on panel in marker beacon junction box, as per chart in junction box cover or radio wiring diagram 59-71002. The above installation will also require a change in length of tuning shaft, type MC-124, to connect control box to receiver, when compass control box is installed in rear cockpit.

d. HEATING AND VENTILATING SYSTEM.—Hot and cold air ventilating system controls are provided between the rudder pedals in the front cockpit. Hot or cold air is regulated into the cockpits as required by operating a notched control wheel fitted with a butterfly valve at the outlet of each system. Cold air is taken through a screened inlet located in the leading edge of the wing center section at the left of the fuselage and passes through flexible tubes and fittings that are attached to the inside structure of the wing center section, to the cold air butterfly valve in the front cockpit. The heating system consists of a two-section steel heater which completely envelopes the exhaust pipe of No. 1 and No. 9 cylinders, two insulated flexible tubes, a fitting which connects the tubes at the fire wall and the hot air butterfly valve. The air is heated by the exhaust

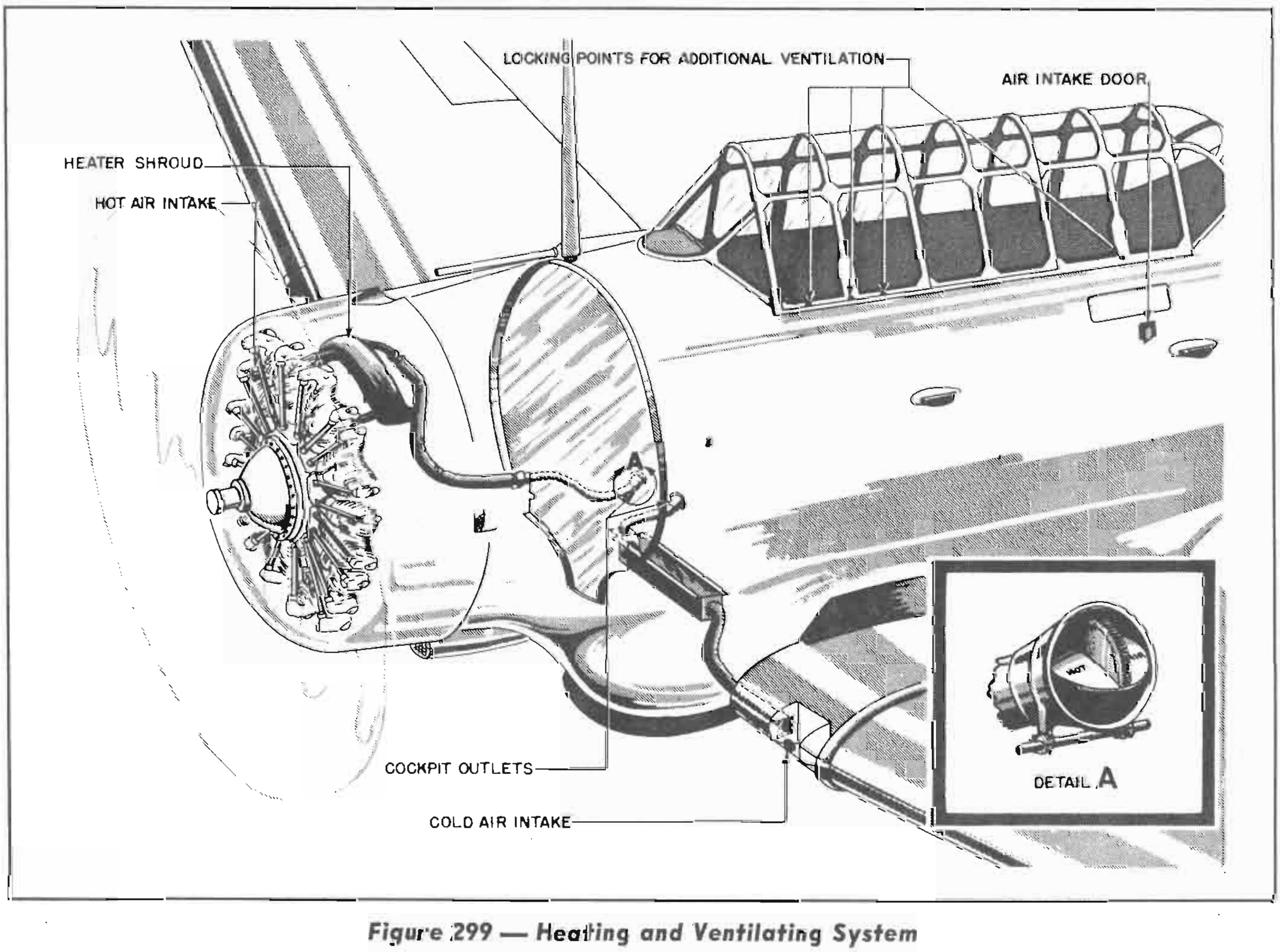


Figure 299 — Heating and Ventilating System

manifold. At the left end of the heater unit is a connection and an air passage vent between the top and bottom section of the heater unit. A pipe, with an opening between the No. 1 and No. 2 cylinders, admits air to the right end of the lower heater unit section. The air passes over baffles in the lower section, through the opening to the top section of the heater unit, then over baffles in the top section, through the flexible tube to the hot air butterfly valves located in the cockpit at the right of the cold air butterfly valve. A ventilator door is located at the left rear side of the rear cockpit, and the amount of air flow is governed by moving a control handle to the desired position between the full "OPEN" and "CLOSED" position. In addition to the ventilator controls, further ventilation may be obtained by opening the sliding sections of the cockpit enclosure to any one of the intermediate positions. Further heating facilities are described in appendix I.

e. COCKPIT COVER.—A cockpit cover designed to overspread the entire cockpit is provided for each British airplane. It is of 10-ounce waterproof army duck tapered to shape and provided with four tie-down cords on each side. It is stowed in the baggage compartment when not in use.

f. MIRROR.—An adjustable, rear-vision mirror is located at the right side of the windshield in the front cockpit.

g. ARMREST.—A pilot's armrest is provided on the left side of the front cockpit.

h. MAP AND DATA CASE.—A map and data case is installed at the right side of the front cockpit below the radio shelf and is fitted with a spring-loaded door to exclude dust. A small handle is attached to the aft end of the door to aid in gaining access to the inside of the case. The case will accommodate articles the maximum dimensions of which may be 10 x 11 inches and provides for the stowage of maps, the airplane electrical wiring diagram, technical information and instructions pertinent to the radio equipment. The case is constructed of aluminum-alloy or plastic wood. A plastic wood data case is also provided in the baggage compartment on later airplanes.

i. FLIGHT REPORT CASE.—A flight report case is installed at the left side of the pilot's seat in the front cockpit. It incorporates a sliding guard plate for securing stowed reports, the over-all dimensions of which may be 8 x 11 inches. It is of the same construction as the map and data case.

j. REAR COCKPIT MAP CASE. — A map case is located at the left side of the rear cockpit and is provided with a detachable strap for securing maps, charts or other material. It will accommodate articles the over-all dimensions of which may be 10 x 11 inches. Like the preceding cases, it is constructed of aluminum-alloy or plastic wood.

k. FIRE EXTINGUISHER.—*(See figure 300.)*—A hand-operated carbon tetrachloride fire extinguisher is

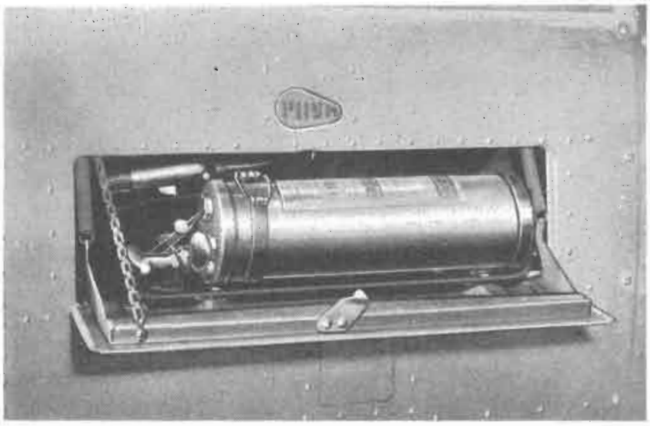


Figure 300 — Fire Extinguisher

mounted on the back of a door located on the left side of the rear cockpit. It is accessible from inside or outside the airplane.

l. URINARY EQUIPMENT. — Urinary equipment consisting of a horn, gum rubber tubing, and a stowage bracket, is provided under each seat. The rubber tubing leads from each horn to a T-fitting located below the rear seat at the bottom of the fuselage frame. From the fitting a tube terminates at a venturi mounted on the lower left side of the semi-monocoque section at the forward end.

m. PYROTECHNIC EQUIPMENT.—(AT-6 only).

(1) DESCRIPTION.—Two type A-4 flare racks are installed in the fuselage, just aft of the baggage compartment, to accommodate two type M-8 parachute flares. Two doors through which the flares are dropped are built into the bottom of the fuselage semi-monocoque rear section. These doors are individually controlled through a system of cables and pulleys by type A-3 release handles located on the right-hand side of the front cockpit near the pilot's seat. Dzus-fastened removable cowling is provided above the rack installation, so that the flares may be lowered by hand into rack chutes and hangwire swivel loops adjusted in the arming mechanism. A pyrotechnic pistol, type M-2, is stowed in a socket placed on the right-hand side of the fuselage semi-monocoque structure in the rear cockpit. Five type M-10 white star, five type M-11 red star pyrotechnic signals, and two type M-9 parachute flares are carried in racks located on the right side in the rear cockpit.

(2) INSTALLATION.

(a) TYPE A-4 FLARE RACK.—Insert racks through access door located above the fuselage semi-monocoque rear section. Attach flare racks to bottom of fuselage structure by means of AC525-10-12 screws. Attach cables to release levers on flare racks by means of AN393-11 pins and AN380-2-2 cotters. Attach upper support brace to fuselage bulkhead by means of AN520-10-6 screws, AN520-10-10 screws, and AC365-

1032 nuts. Join two halves of this brace by means of AN520-10-7 screws and AC365-1032 nuts.

(b) FLARE RELEASE MECHANISM.—Install the metal conduits, with the release cables inside, on the right side of the fuselage directly above the lower longeron, attaching with AC755 clips as required. Make very shallow bends in metal conduit, and only when necessary. Attach release cables to flare rack doors, and pass them around corresponding pulleys and brackets. Install the forward release pulley bracket assembly at the right side of the front cockpit seat. With two B1084-24 U-bolts, attach bracket to the vertical fuselage tube in a position that will permit the occupant of the seat to reach the release handles easily. Attach the release cables to the corresponding handles.

15. OXYGEN SYSTEM.

NOTE

Earlier airplanes of the series employ a high-pressure continuous-flow-type oxygen system. Later airplanes incorporate a demand-type oxygen system.

a. HIGH-PRESSURE TYPE SYSTEM.

(1) GENERAL.

(a) DESCRIPTION.—The high-pressure type oxygen system as installed on airplanes of the earlier series incorporates a regulator, pressure gage, and flow indicator in each cockpit. Oxygen is supplied by two high-pressure cylinders located just aft of the gunner's deck, through check valves and into lines extending along the right side of the fuselage to the regulator assemblies.

(b) REMOVAL.—Be sure to release all of the oxygen from the system before disassembling any part of the system. This may be accomplished by opening the regulators. Line fittings at the cylinders are sealed with a compound which forms a permanent seal. Care

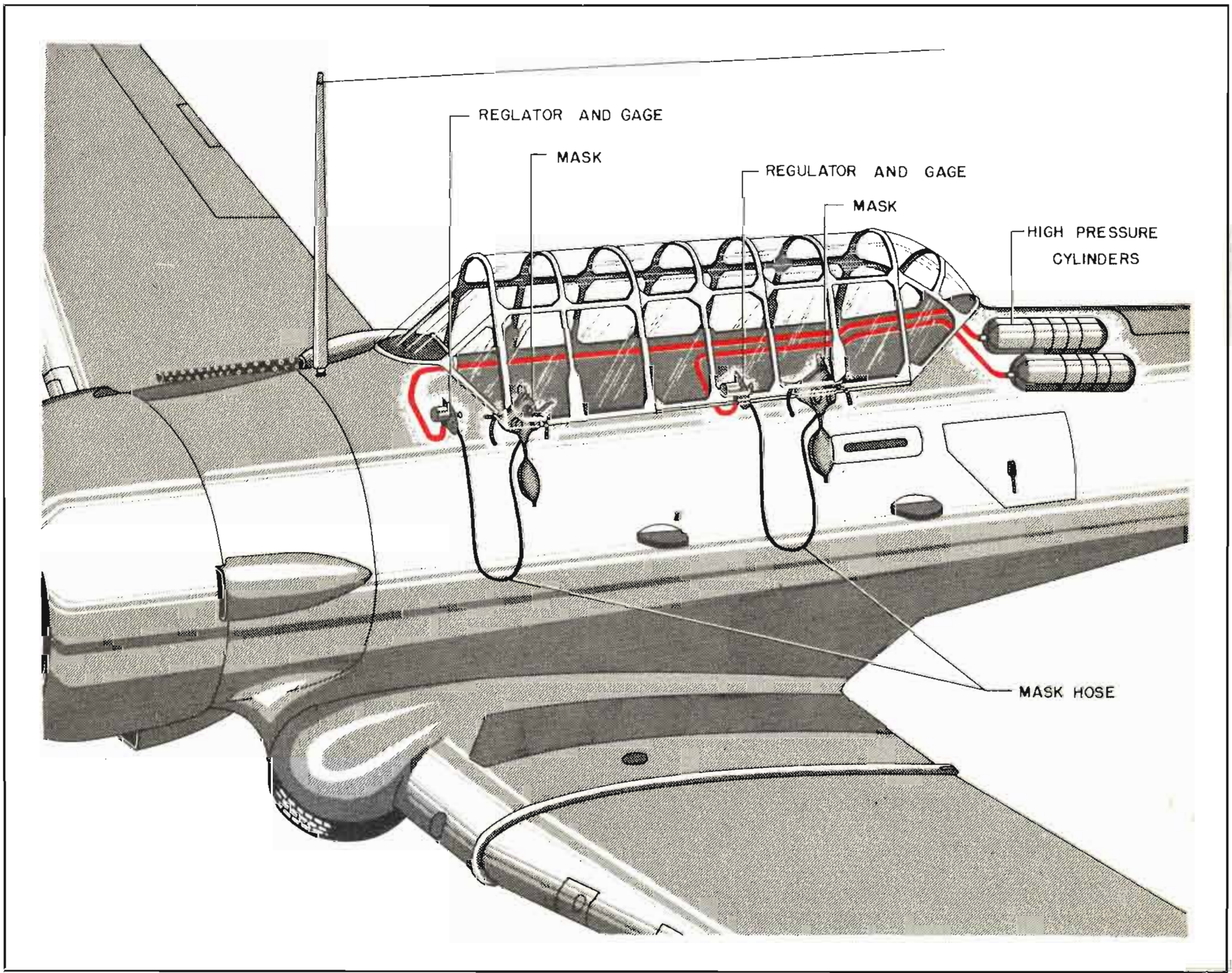


Figure 301 — Oxygen System

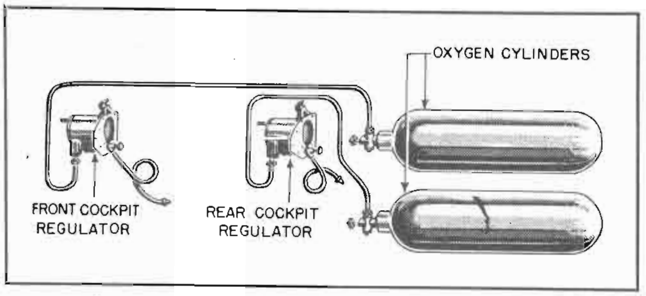


Figure 302 — Oxygen System Diagram

must be taken when disassembling the lines to prevent them from twisting and breaking. Be careful not to dent the oxygen cylinders, as damage of this nature weakens them structurally.

(c) TESTING.

1. CHECKING FOR LEAKS.—In checking the oxygen system for possible leaks, every precaution must be taken to prevent oil and any foreign matter from getting into the system, as oils and greases explode spontaneously in the presence of oxygen under pressure. The oxygen equipment should be tested for operational characteristics and leaks before installation. This test will expedite installation by eliminating leaks in connections that are inaccessible after installation. Soap solution is recommended in checking the system in accordance with the following procedure:

a. In testing for leaks with soap solution, use only castile soap. Wipe connections dry after testing. Some soaps contain ingredients that will explode in the presence of oxygen under pressure. Some of the soap may get into the system during replacement of fittings. The use of castile soap will remove this danger.

b. During the replacement of defective fittings, care must be taken to prevent moisture from entering any of the open lines. Moisture freezes at high altitudes, clogging valves and stopping the flow of oxygen.

c. The apparatus used to charge the system should incorporate a pressure regulator, a pressure relief valve, and an oxygen purifier.

d. The airplane should be moved out-of-doors and cleared of all personnel while the system is being charged.

e. After charging, the pressure gages should read within 25 pounds of the correct pressure.

f. No visible leaks should be present when the system is fully charged.

g. When the system is completely charged, leakage from the mask connection fitting should be less than necessary to burst a soap bubble in 10 seconds.

2. PRESSURE TEST.—Procedure for sustained pressure testing of the system is outlined below:

a. Charge the system to 1800 pounds per square inch, and relieve the pressure in the filler line to seat check valves.

b. Wait 1 hour for the oxygen to cool to air temperature.

NOTE

When cylinders are charged to maximum permissible capacity, they become warm. As the gas cools, the pressure will drop.

c. Measure the air temperature inside the airplane in the vicinity of the cylinders; read the pressure on all gages. Record this data together with the date and the time of day.

d. At the conclusion of the test, remeasure the temperature and pressure. Record as before.

NOTE

The sustained pressure test is only continued for 24 hours and when there is a perceptible pressure drop at the end of 6 hours, and when the rate of pressure loss indicates that not more than 15 pounds per square inch will be lost in 24 hours. Otherwise, the system is rechecked for leaks and the tests repeated.

(d) INSTALLATION.

1. GENERAL.—When installing the oxygen system care should be exercised in handling. Because of the highly explosive nature of pressurized oxygen when in contact with oil or grease of any kind, every precaution should be taken to avoid accidents. When installing oxygen lines, make sure that the lines are securely clamped to prevent chafing and vibration. At points where chafing is likely to occur, wrap the line three turns of friction tape and coat with clear shellac. To prevent thread seizure, use anti-seize compound, Specification No. AN-C-86.

2. LINES.—Before installing any of the oxygen system lines, ascertain that they are properly cleaned. Clean and install lines as outlined below:

a. Clean the lines in Bright Dip (Specification No. 98-20007, or approved equivalent).

b. Rinse in clean running water.

c. Dry with air pressure.

d. Apply lacquer.

e. Test the lines by forcing a dilute solution of sodium chromate through them. The sodium chromate acts as a flushing agent.

f. Dry the lines with air pressure. Be sure there is no oil in the air pressure system.

g. Cap the ends of the lines with scotch tape. Do not use friction tape.

h. Place the lines in the airplane, taking care not to bend them as this will cause difficulty in installing the lines in their proper location.

i. Connect lines and fittings to their respective cylinders and panel assemblies. Connect wiring.

(2) CYLINDERS.

(a) DESCRIPTION.—Two high-pressure type B-1 metal cylinders, each containing 4½-hours supply

of oxygen for an altitude of 30,000 feet, are located just aft of the gunner's deck. These cylinders are installed parallel with the centerline of the fuselage, the right cylinder furnishing oxygen for the front cockpit, and the other cylinder furnishing oxygen for the rear cockpit. Oxygen is released from the cylinders through check valves and into lines extending along the right side of the fuselage to the regulator assemblies.

(b) REMOVAL.—To remove the two high pressure cylinders, the following procedure is recommended:

1. Release oxygen from system.

2. Remove line fittings from the cylinders.

3. Remove yokes at forward ends of cylinders. Remove cylinders from cradles.

(c) INSTALLATION.—Since dents in cylinders tend to weaken them structurally, care must be exercised in handling the high-pressure type cylinders.

1. Place cylinders in cradles aft of the gunner's deck, with valve ends forward.

2. Place yokes at forward ends of cylinders. Secure.

(3) REGULATOR ASSEMBLIES.—(Type A-8)

(a) DESCRIPTION.—Regulators of the type A-8 series, are intended to be used with masks of the A-8 series only. The A-8 series regulators have been developed for use in high-altitude flying and deliver the proper mixture of air and oxygen to sustain life in the substratosphere. These regulators provide enough oxygen at 30,000 feet for people to rest or for those doing light work such as the pilot does. But the flow is insufficient for heavy work such as is required of a gunner engaged in swinging a gun in combat. The regulator contains two pointers which indicate over separate scales on the dial. The pressure condition in the supply cylinder is shown on the lower scale and the flow of metered oxygen on the upper scale. The flow scale is calibrated directly in altitude. That is to say, for a set indication the flow is automatically regulated to supply the required quantity of oxygen at that altitude. The instrument is divided into a back chamber and the front gage compartment. Oxygen enters the back chamber from the supply cylinder under the control of a regulating valve. This valve is operated by a spring-restrained diaphragm through a toggle link mechanism and automatically maintains a constant reduced pressure in this chamber throughout the wide operating pressure range of the supply cylinders. The valving action is extremely accurate. A small force on the diaphragm caused by a slight variation of pressure exerts, through the toggle links, a greater force on the valve seat, thereby insuring positive pressure control and definite shut-off of the supply for no flow conditions. From the back chamber, the oxygen flows through a needle valve, which is manually operated by a knob from the front of the instrument. From this point, a calibrated orifice meters the flow to the mask. The flow indicator, a

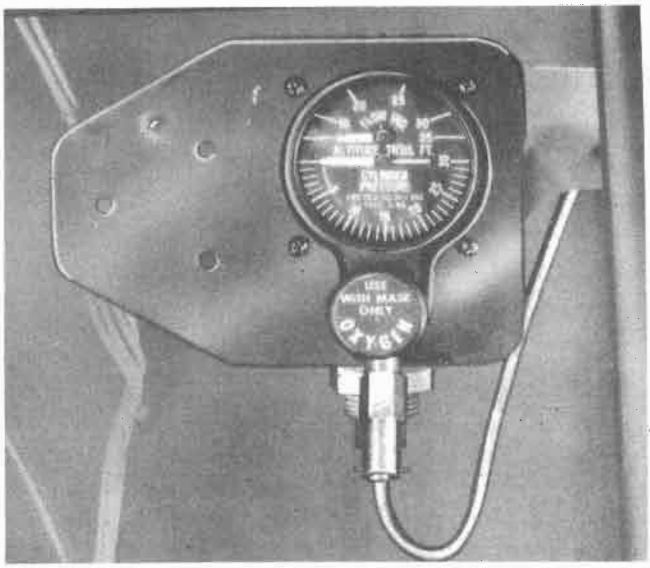


Figure 303 — Pressure Gage, Regulator, and Flow Indicator

Bourdon tube pressure gage, indicates directly the pressure differential across the calibrated orifice and is calibrated to indicate the flow corresponding to this pressure differential. The dial is marked directly in altitude for simplification, the proper oxygen flow for any altitude being obtained when the pointer is set at the corresponding graduation by opening or closing the needle valve. The cylinder pressure indicator, also a Bourdon tube type, is connected directly to the line from the oxygen cylinder. This unit shows the exact condition of the supply at a glance. A fine wire mesh filter is provided in the supply connection fitting to prevent dirt from entering the apparatus. Large tubes and orifices permit easy flow of oxygen, eliminating the possibility of plugging by foreign materials. A relief valve on the rear cover of the case is a safety feature that prevents over-pressure in the rear chamber and damage to the mechanism, should the regulating valve be temporarily held open for any reason. The pressure stage in the back chamber is automatically controlled and has complete temperature compensation. In the capillary tube to the gage units, the pressure is static as there is no flow. While the possibility is remote, should a leak in the gage occur, it would not be serious, as the small bore tubing would retard the flow through a leak and prevent building up of pressure in the vented gage compartment. The gages are removable as a combined unit. The cover which seals the back chamber is held in place by six screws.

(b) REMOVAL.—To remove the high pressure regulator assemblies, disconnect oxygen line from units; remove four mounting bolts on each panel.

(c) MAINTENANCE REPAIRS.—The following steps should be taken to clean and paint regulators.

1. Polish all brass fittings, adapter, and nipple on an electric buffer or with fine steel wool.

2. Clean the entire instrument with benzine.

3. With masking tape, mask off the name plate and number on the back plate. Mask off the knob, the nipple, and adapter.

4. Spray the entire instrument with dull air-drying black lacquer.

5. If any changes have been made in the insert and valve assembly, the case should be clearly marked with a red "V" (v). Red lacquer is suitable for this job. Make the "V" in an approximate half-inch square.

(d) INSTALLATION.—To install the high-pressure regulator assemblies, place each assembly in its respective panel and secure with four mounting bolts.

(4) PRESSURE GAGE.—*(See figure 303.)*—Each pressure gage is of the type A-8 series (Pioneer, or approved equivalent). It is an instrument that indicates the gage pressure of the oxygen in the supply cylinders, its purpose being to show the available oxygen pressure. The dial of the pressure gage is calibrated to show pounds-per-square-inch pressure. Satisfactory operation requires a pressure of from 500 pounds minimum to 3000 pounds maximum. The pressure gage consists of a metal case, enclosing a dial, frame, and mechanism assembly. The oxygen is admitted through a socket and into a Bourdon tube, which has only one end fastened to the sector and pointer by linkage; the Bourdon tube movement is transferred to an indication of pounds-per-square-inch pressure on the field.

(5) OXYGEN MASKS.—Provisions are made for the use of types A-8, A-8A, and A-8B oxygen masks, later airplanes using the later series masks. Detailed description of the three types of masks follows:

(a) TYPE A-8 MASK.—*(See figure 304.)*—The type A-8 mask is an oronasal-type (fits over both nose and mouth) which also permits rebreathing part of the oxygen expelled from the lungs and respiratory passages. It incorporates many improvements in design over the

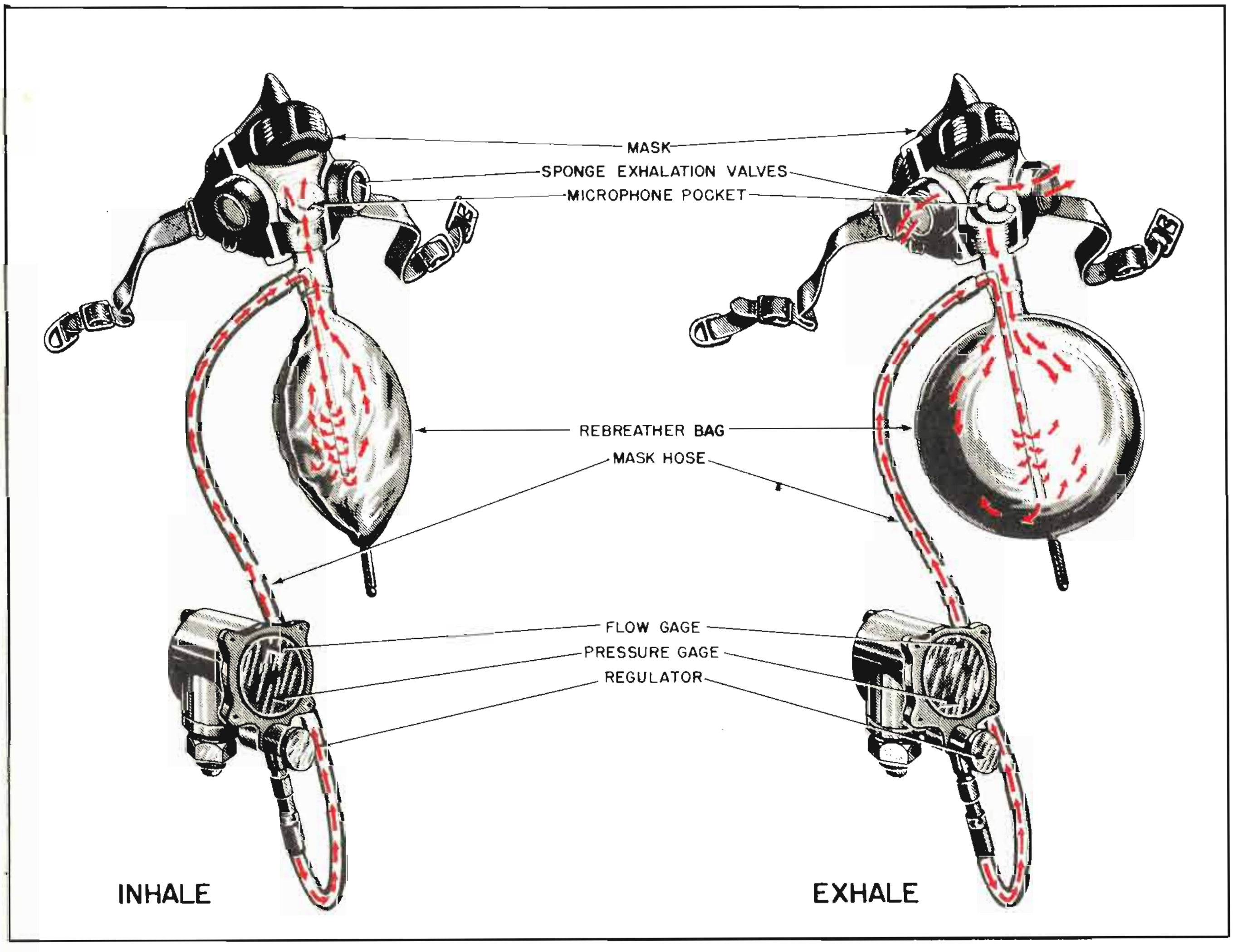


Figure 304 — High Pressure Mask Flow Diagram

type A-7 Mask, which was in use in the earlier oxygen systems and is now obsolete. This mask consists of a rubber-molded nasal cover with a rigid case of phenolic compound which supports the mask and a turret-like protrusion containing a sponge rubber disc in front of the mouth. Attached to the base of the mask is a connector sleeve of phenolic compound to which is attached a flexible rubber rebreather bag provided with an oxygen intake tube. The end of the intake tube is equipped with an oxygen mask coupling fitting, which permits the mask apparatus to be readily attached, bayonet fashion, to the oxygen outlet. The oronasal feature and the sponge rubber disc represent the principal improvements of this type of mask over the type A-7. The principle of the type A-8 mask is essentially the same as that of the type A-7, with the exception that there are no metal parts and the sponge rubber disc takes the place of the exhalation valve and the air-regulating mechanism. As in the type A-7 mask, a mixture of oxygen and previously exhaled gases is inhaled from the rubber reservoir bag. Upon exhalation, the first part of the expelled air passes into the bag; as soon as the bag becomes distended, the remaining gases pass out through the sponge rubber disc. Upon inhalation, first the gases are taken from the bag; when the bag is depleted, an additional amount of air is drawn in from the atmosphere through the sponge rubber disc. Increasing the flow of oxygen at higher altitudes permits the flyer to breathe a richer mixture of oxygen and lesser amounts of atmospheric air. In this mask there are no portholes to manipulate, and there is no danger of anoxia in the event the flyer breathes through his mouth. The valve, which is the sponge rubber disc, does not freeze up as rapidly as does the metal valve on the A-7 mask.

(b) TYPE A-8A MASK.—The type A-8A mask, for the most part, is identical with the type A-8 mask and contains just one change of importance. The inlet tube which formerly ran directly into the rubber bag and was suspended from the rubber bag is connected to the phenolic connector piece, thereby greatly relieving excessive wear and tear on the rubber bag.

NOTE

When one realizes the limitations of the type A-8 Mask and the continuous-flow system, and does what he can to surmount them, excellent results can be obtained with it. It has been used in flight to altitudes of 40,000 feet and in the test chamber to a simulated altitude of 43,000 feet.

(c) TYPE A-8B MASK.—*(See figure 305.)*— The type A-8B mask is the latest standard rebreather type of mask. The function and use of this mask are essentially the same as type A-8 and A-8A. The principal differences are in the means of suspension, the incorporation of a microphone pocket and two sponge rubber disc turrets. The A-8B mask is provided with

Figure 305 — High Pressure Mask

a helmet suspension. Buckle tabs to be used on the helmet are furnished. Leather and elastic strapping is used in the suspension in place of the rubber straps. The mask is buckled directly to the helmet. However, an adapter is available for use of the mask without the helmet. The microphone is installed in the central pocket, while the two turrets (one on either side of the pocket) contain the sponge rubber discs. Two discs reduce the breathing resistance and lessen the chance of freezing.

b. DEMAND-TYPE SYSTEM.

(1) The demand-type oxygen system consists of low-pressure shatter-proof oxygen cylinders, manifolded

together by means of check valves and distribution lines, and filled through a single filler valve. A type A-12 oxygen regulator, a pressure gage, a pressure signal lamp, and a flow indicator are installed in each cockpit. A demand-type mask, properly fitted to the face of the user, must be used with this system.

(2) The demand-type system provides the oxygen on demand, each time the user inhales. An automix valve is provided, which in the "ON" position automatically mixes the proper amount of air with the oxygen at all altitudes. When the automix valve is "OFF," the regulator delivers pure oxygen on demand. An emergency control can be turned on to supply a continuous flow of oxygen when this is necessary.

CAUTION

Extreme caution must be exercised in the use of oxygen equipment to insure that none of it becomes contaminated with oil or grease. Fire or explosion may result when slight traces of grease come in contact with oxygen under pressure. Be sure that all lines, fittings, instruments, ground equipment, and other oxygen items are free from oil grease and other foreign matter.

c. BAIL-OUT OXYGEN UNITS.—If an unusually high altitude flight is anticipated, bail-out units may be provided for crew members. This is a completely self-contained unit providing a supply of oxygen lasting from 4 to 8 minutes and consists of a high pressure cylinder, pressure gage, release valve, and "pipe-stem" mouthpiece. An auxiliary pocket is provided for securing the bail-out cylinder, which can be tied or sewed to the parachute harness, secured in a pocket of the clothing, or tied to the crew member's thigh. To use, the valve should be completely opened before leaving the airplane. The oxygen flow will be automatic.

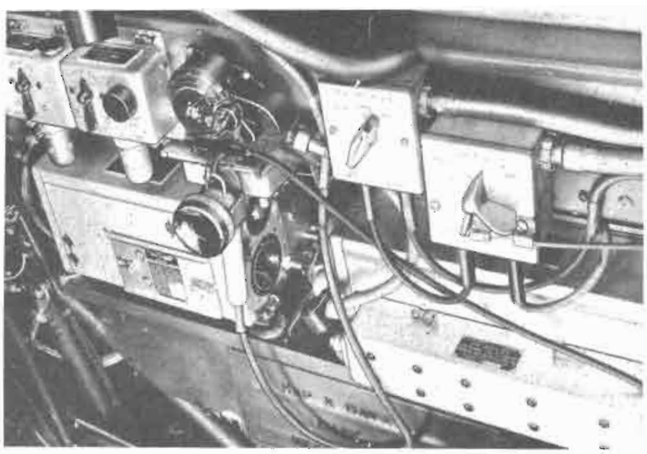


Figure 306 — Front Cockpit Radio Installation — 12-Volt System

16. COMMUNICATIONS EQUIPMENT.

NOTE

Radio command set SCR-AL-183 with RC-27 interphone equipment is installed on the 12-volt airplane. Command set SCR-274-N with RC-43B radio marker beacon equipment and RC-35 interphone equipment is installed on the 24-volt airplane. Both of these command sets are for short range communication between airplanes in flight or for contact between airplane and flying field. As these two radio sets are entirely different, they will be treated separately in this handbook.

a. 12-VOLT EQUIPMENT.

(1) DESCRIPTION.—The communications equipment installed on the 12-volt airplane consists of a radio command set, SCR-AL-183, necessary antenna equipment, two-place interphone equipment, RC-27, and miscellaneous equipment necessary for the operation of the communication system as a whole. The command set is directly controlled from the front cockpit and remotely controlled from the rear cockpit. All controls are installed on the right side of the cockpits, and provision is made for installing the receiver control box in either cockpit to provide receiver control from the cockpit in which the instrument flying hood is installed. A complete list of communications equipment installed in the 12-volt airplane follows.

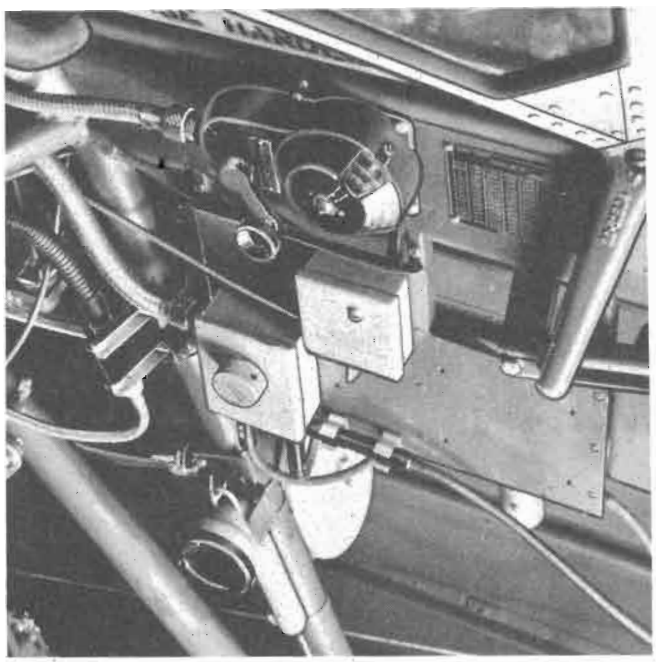


Figure 307 — Rear Cockpit Radio Installation

RADIO COMMAND SET SCR-AL-183

Transmitter Assembly

1 Transmitter, BC-AL-230
1 Mounting, FT-100
1 Coil Set, C-184
1 Coil Set, C-381
1 Coil Set, C-382
1 Coil Set, C-383
1 Coil Set, C-384
1 Coil Set, C-385
5 Cases, CS-47
1 Plug, PL-Q-64
1 Tube Set, Includes
  2 Tubes, VT-25
  2 Tubes, VT-52

Receiver Assembly

1 Receiver, BC-AL-229
1 Mounting, FT-99
1 Coil Set, C-377
1 Coil Set, C-379
1 Case, CS-44
1 Plug, PL-Q-61
1 Tube Set, includes
  1 Tube, VT-37
  1 Tube, VT-38
  4 Tubes, VT-49

Receiver Control Assembly

1 Control Box, BC-AL-231
1 Mounting, FT-118
2 Plugs, PL-Q-104

Transmitter Control Assembly

1 Control Box, BC-AL-232
1 Mounting, FT-118
1 Plug, PL-Q-63

Dynamotor Assembly

1 Dynamotor, BD-AL-83
  Less Mounting
1 Mounting, FT-141
1 Plug, PL-P-62

Antenna Assembly

1 Antenna Switching
  Relay BC-AL-198
1 Mounting, FT-118
1 Plug, PL-P-77

Antenna Equipment

40 ft Wire, W-106-A
3 Insulators, IN-88
1 Insulator, IN-79

Miscellaneous Items

1 Control Unit, MC-137
1 Coupling, MC-136
1 Tuning Shaft, MC-124
  10-1/2 in. long
1 Tuning Shaft, MC-124
  52 in. long
2 Tuning Units, MC-125-A
1 Chart, MC-261
1 Dial, MC-282
1 Dial, MC-322

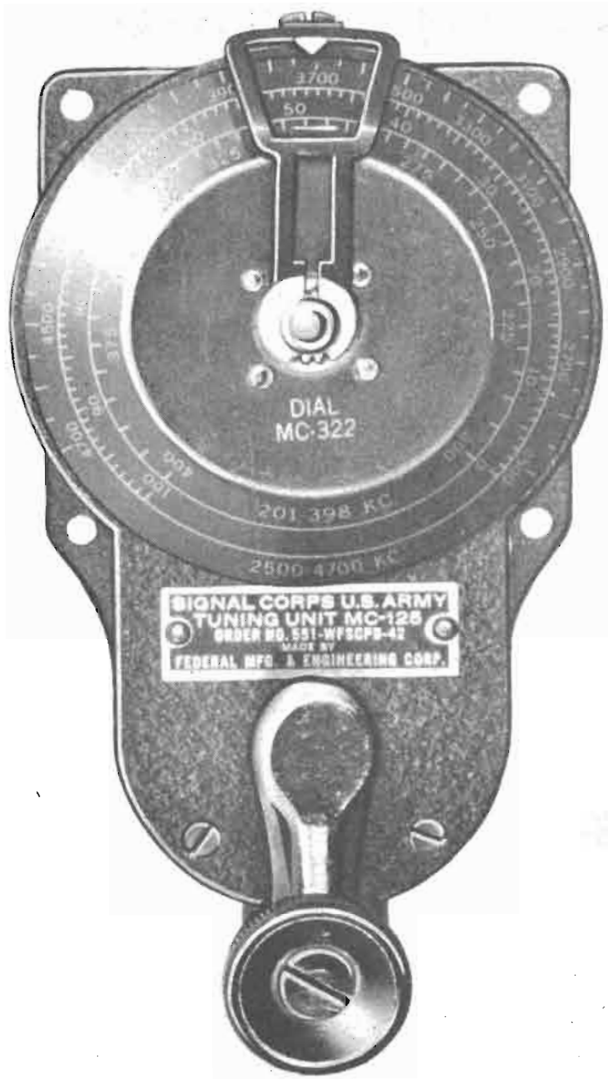


Figure 309 — Receiver Tuning Unit MC-125-A

Figure 308 — Receiver BC-AL-229

Figure 310 — Receiver Control Box BC-AL-231

INTERPHONE EQUIPMENT RC-27

2 Interphone Amplifiers, BC-212-C (one only installed on later airplanes) includes:	1 Control Shaft, MC-166
4 Tubes, VT-65	2 Plugs, PL-55
1 Control Box, BC-327	2 Jacks, JK-26
1 Control Box, BC-335	2 Microphones, T-17
1 Control Box, BC-334	2 Sockets, Type 99, (adapted to British use)
	12′ Cordage, CO-119-A

FILTER EQUIPMENT RC-32

1 Filter, FL-5-B	1 Switch Box, BC-345
2 Plugs, PL-55	

(*a*) RECEIVER EQUIPMENT.—*(See figures 308, 309, and 310.)*—Radio receiver BC-AL-229 consists of a set-box including the supply and coupling circuits, tube, sockets, power terminals, and plug-in coil terminals required for the reception of radio signals. The receiver comprises four stages of radio frequency amplification which amplify at the incoming frequency, a detector, and one stage of audio frequency amplification. The four radio frequency amplifier stages use tubes VT-49. The detector is a tube VT-37, and the audio amplifier stage uses one tube VT-38. Each of the coil sets includes the same essential parts of the radio frequency amplifier circuit. The receiver, BC-AL-229, is installed on shock absorber mounting, FT-99, attached to the radio shelf on the right side of the front cockpit. A receiver tuning unit, MC-125A, is mounted above and forward of the receiver in the front cockpit, and in the rear cockpit the MC-125A tuning unit is mounted above the radio remote control panel. The tuning unit with dial, MC-282, mounted in the front cockpit is connected to the receiver by tuning shaft, MC-124, 10-1/2 inches long. The tuning unit with dial, MC-322, mounted in the rear cockpit is also connected to the receiver by tuning shaft, MC-124, 52 inches long. A type BC-AL-231 receiver control box is installed on a type FT-118 mounting bracket directly above the transmitter on the right side of the front cockpit. An additional mounting bracket is installed on the radio remote control panel at the right side of the rear cockpit for alternate installation of the control box. A dummy receptacle is provided on each mounting bracket to stow the receiver control box plug where the box is not installed. Two coil sets are included in the receiver assembly; coil set, C-377, is mounted over the baggage compartment behind the seat in the rear cockpit, and coil set, C-379, is installed on the inboard side of the receiver unit. The coil sets are easily interchanged when radio reception is desired or a frequency band not applicable to the coil set installed in the receiver. Each coil set is applicable to two frequency bands, and a switch on the end of the unit provides for switching from one frequency band to the other.

(*b*) TRANSMITTER EQUIPMENT. — *(See figures 312, 313 and 314.)*—Radio transmitter, BC-AL-230, consists of a set box, including the circuits and tuning elements required for the generation, amplification, and modification of radio frequency circuits. The transmitter is mounted forward of the receiver on a shock absorber mounting, type FT-100, attached to the radio shelf. The transmitter comprises a radio frequency oscillator, a radio frequency amplifier, a coupling circuit for transferring radio frequency power from the

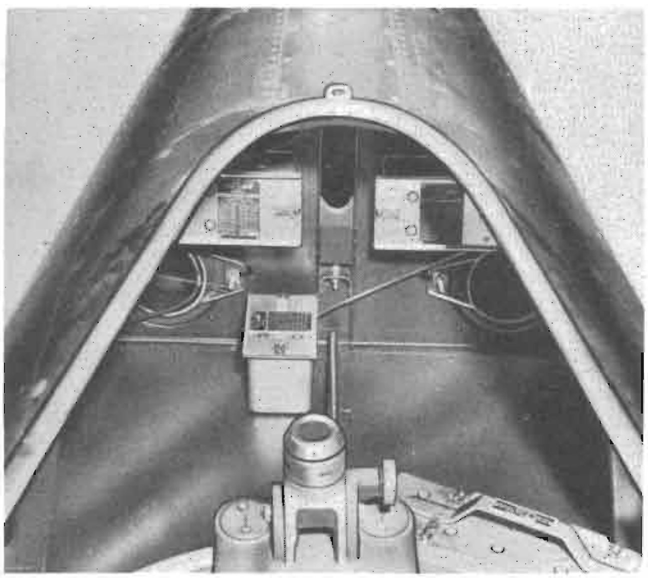


Figure 311 — Coil Sets Installed

Figure 312 — Transmitter BC-AL-230

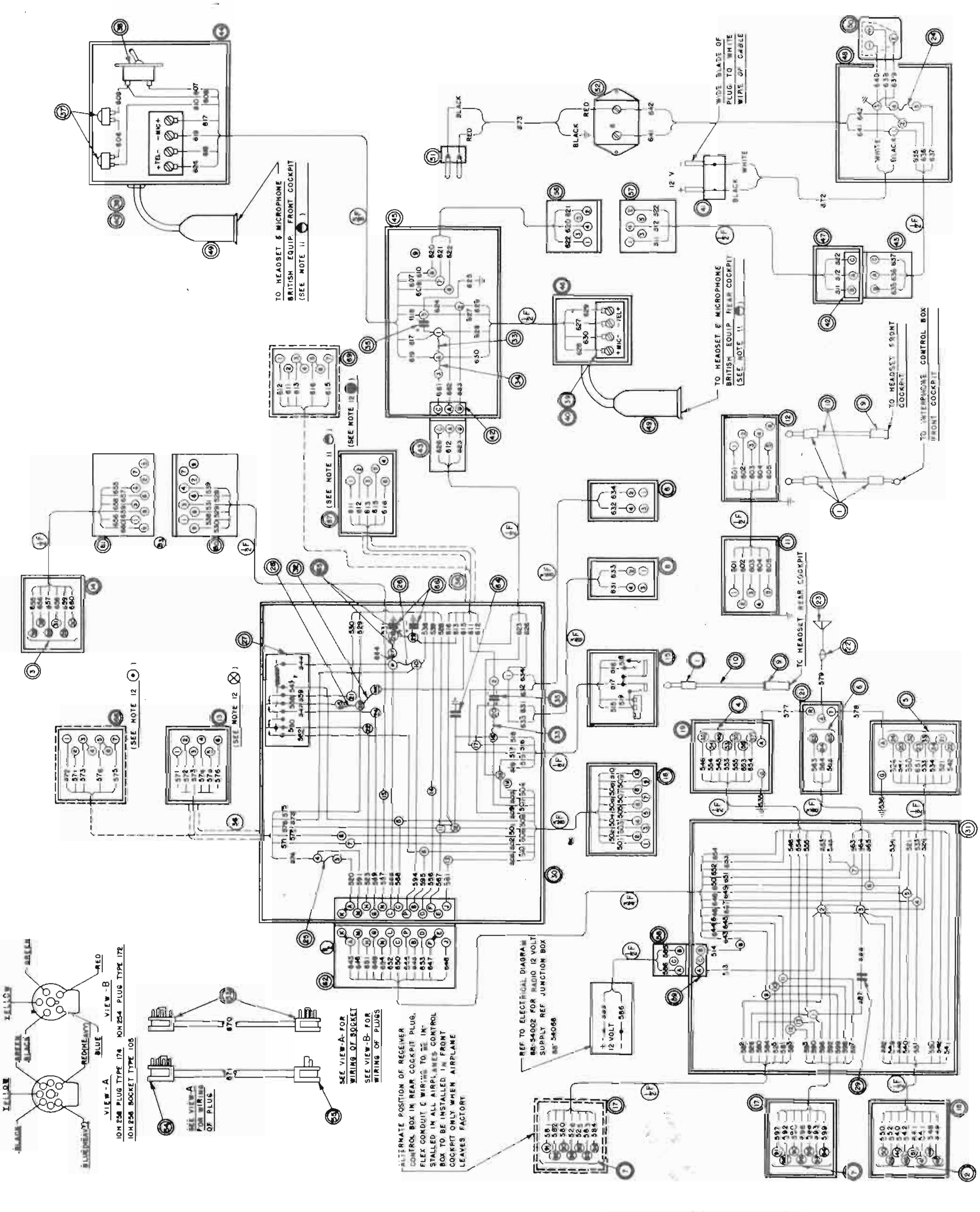


Figure 317 — Radio Wiring Diagram — 12-Volt System

structions. Persons not familiar with radio equipment should not attempt to operate it until they have made a thorough study of the applicable book of instructions.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous. Do not change tubes or make adjustments inside any unit of equipment with the dynamotor running.

(3) TROUBLE SHOOTING.—Many good radio sets have been ruined by internal alterations when the service failure was really due to some external cause. Probably the most common cause of poor radio reception in all airplane installations of high-sensitivity receivers is electrical noises of both local and atmospheric origin. Operators of the receiver should learn by experience to identify these noises in the telephone receivers, which indicate faults in the operation or installation. Such identification by ear will greatly facilitate correction of the fault.

(a) RECEIVER NOISE.—Atmospheric (static) and external man-made interference should be identified on the ground, with the engine not running. Static will be heard with some coil sets at all seasons of the year and at most times of the day. The general static level grows progressively lower with increasing frequency. The receiver cannot be adequately tested or inspected in ground locations where powerline interference, motor interference, etc., are excessive. Disconnecting the antenna at the receiver binding posts will generally give a satisfactory test; for if the noise encountered is static or powerline interference, it will greatly diminish or disappear when the antenna is disconnected. It is no uncommon occurrence for man-made interference to be received with destructive force when flying over certain areas, and to be of such a nature that it is easily confused with generator or dynamotor noise on the airplane itself. If machine noises are suddenly heard in flight, they may possibly be identified with a particular ground area. Also, it should be remembered that when flying through mist, rain, or snow, a noise is sometimes heard which sounds like a machine noise. It is produced by the impact of the charged particles on the receiving antenna and airplane, and is irremediable.

(b) DYNAMOTOR NOISE.—Noise caused by the dynamotor should be identified on the ground with the engine not running. This noise is usually related to the speed of the machine and can be identified by switching the power on and off at the BC-AL-231. The interruption of current in the commutators of the dynamotor machine sets up radio frequency oscillations in the connecting cords. These oscillations enter the receiver by way of the antenna and never through the conductors of the chords themselves. This fact may be verified by disconnecting the antenna at the receiver binding post. The transmission of dynamotor noise to the receiver is related to the condition of bonding of the cords, particularly at high frequencies. A dirty commutator will produce more noise than a clean one, but complete suppression can never be obtained if the shielded cords are not thoroughly bonded and grounded. When this noise occurs in an airplane installation, the bonding of all cords to the airplane should be checked for poor contacts. If the noise persists, the commutators of the machine may be cleaned with a clean dry cloth while it is turning over.

CAUTION

Never use emery on a commutator. A trace of oil or grease on a commutator may cause more trouble than any dirt deposit. The low voltage commutator is more likely to produce noise than the high voltage commutator. Under normal operating conditions the commutators of these enclosed machines should not require cleaning more often than about 300 hours.

(c) INTERMITTENT CONTACT. — Intermittent contact in phone, cord, plug, or contacts to telephone receivers should be identified on the ground with the engine not running. A loose bond or terminal plug should be identified with the engine not running.

(d) IGNITION NOISE.—Ignition noise should be identified on the ground by varying the engine speed and by switching from one magneto to the other.

(e) GENERATOR NOISE. — Generator noise may be identified on the ground, engine running, by advancing the throttle to the point where the generator cuts in. If it originates in the generator itself, it will be a characteristic machine noise. If it is in the voltage regulator, it will probably be intermittent and appear only above a certain critical engine speed (usually 800 to 1000 rpm). Noise originating in the generator and voltage regulator can be distinguished from ignition noise by the fact that generator and voltage regulator noise is usually suppressed by opening the airplane main line switch.

(f) VACUUM TUBE NOISE.—Tube noise may be identified on the ground with the engine running by a crackling or ringing sound. It will sometimes appear under sustained vibration and never be heard at all when the receiver box is jarred intermittently by hand. An intermittent contact inside a tube may be the first indication that its useful life is over. Noises originating inside the tubes are greatly accentuated by the presence of a strong incoming radio signal, particularly an unmodulated signal, and this may be used as a means of identifying such a noise. The faulty tube must be isolated by replacing the tubes one by one with new ones and observing when the disturbance vanishes.

(g) INTERNAL INTERMITTENT NOISE.—Intermittent contact in an internal circuit of the receiver may be identified with the engine running or by jarring the receiver by hand. Disconnecting the

antenna and vibrating the receiver is not necessarily a test because noises of this character may be increased to audibility by a strong incoming signal. Operating the receiver at excessively high voltage tends to make it noisy during op^ration and to increase the residual cause of noise.

NOTE

Never allow the radio set to be operated at a supply voltage greater than 15 volts. Operation at less than 12 volts will not damage the equipment, but the radio reception will be unsatisfactory.

(4) BILL OF MATERIAL—12 VOLT.

Item No.	*Description*	*Type No.*	*No. Req.*	*Part or Spec. No.*
1	*Plug—Head set connector cord	PL-55	4	
2	*Plug—Transmitter control box	PL-Q63	1	
3	*Plug—Dynamotor	PL-P62	1	
4	*Plug—Receiver	PL-Q61	1	
5	*Plug—Transmitter	PL-Q64	1	
6	*Plug—Antenna relay	PL-P77	1	
7	*Plug—Receiver control box	PL-Q104	2	
8	Plug—Throttle quadrants		2	35A4273
9	*Jack—Head set connector cord	JK-26	2	
10	*Cordage—Head set connector	CO-119	10 ft	
11	*Filter unit	FL-5B	1	H40D5671
12	*Box Assem.—Filter switch	BC-345	1	H39B2224
» 13	*Amplifier—Interphone	BC-212B	1	36B5857
14	*Dynamotor—Command set	BC ( ) 83	1	36D3530
15	*Box Assem.—Interphone remote	BC-335	1	H39B1571
16	*Box Assem.—Interphone master	BC-334	1	H39B1572
17	*Box Assem.—Receiver control	BC ( ) 231	1	36B3526
18	*Box Assem.—Transmitter control	BC ( ) 232	1	36B3529
19	*Receiver—Command set	BC ( ) 229	1	
20	*Transmitter—Command set	BC ( ) 230	1	36D3527
21	*Relay—Antenna switching	BC ( ) 98	1	36B3528
22	*Insulator—Antenna lead-in	IN-79	1	32A2329
23	*Wire—Radio antenna	W-106A	40 ft	
24	Fuse—10 amp (1 spare)		2	32084
25	Fuse—50 amp (1 spare)		2	32084
26	Fuse—15 amp (1 spare)		2	32084
27	Relay—Strowger	ZQA	1	SC-D-324
28	Resistor 30 OHMS ½ WATT (Allen Bradley)	E.B.	1	
29	Capacitor .004 mfd (Aerovox)	1461	1	
30	Box Assem.—Command set junct.	N.A.A.	1	88-71041
31	Box Assem.—Command set pull	N.A.A.	1	88-71033
32	Resistor 50,000 ohms, 2 watt (1R.C.)	BT-2	1	
33	Resistor 500 ohms, 1 watt (1R.C.)	BT-1	2	
34	Resistor 390 ohms, 1 watt (1R.C.)	BT-1	1	
35	Condenser 25 mfd, 25 volt (Cornell Dubilier)	BR-252A	2	
36	Spacer—Interphone amplifier	N.A.A.	1	77-71101
37	Switch—Push button		2	
38	Switch	B-5A	1	
39	Terminal—Strip (Bendix)	2727	2	
40	Insulator—Terminal strip (Bendix)	3218	2	
41	Cap—Metal-covered cord grip (Hubbel)	9102	1	
42	Socket—Box connector	AN3102-18-5P	2	
43	Plug—Connector straight	AN3106-18-5S	2	
44	Box Assem.—R3002 control	N.A.A.	1	88-71089
45	Box Assem.—Interphone junct.	N.A.A.	1	88-71087
46	Box Assem.—Interphone rear	N.A.A.	1	88-71091
47	Box Assem.—R3002 plug junct.	N.A.A.	1	88-71088
48	Box Assem.—R3002 junct.	N.A.A.	1	88-71049

Item No.	Description	Type No.	No. Req.	Part or Spec. No.
†‡ 49	⋆Socket	199	2	10H/625
50	⋆Socket	108	1	10H/261
51	⋆Socket	185	1	10H/460
52	⋆Switch—Fire extinguishing		1	21F/374
53	⋆Plug	172	2	10H/254
54	⋆Plug	174	1	10H/258
55	⋆Socket	105	1	10H/256
56	Plug (Breeze)	E1002-7-10	1	
57	Bulkhead Connector (Breeze)	E1156-7-10	1	
58	Plug (Breeze)	E1002-4-120	1	
59	Box Connector (Breeze)	E1003-4-30	1	
60	Plug (Breeze)	E1002-5-20	1	
61	Bulkhead Connector (Breeze)	E1156-5-20	1	
62	Plug	AN3106-28-2S	1	
63	Box—connector	AN3102-28-2P	1	
64	Condenser 1 mfd 600 volt (Cornell Dubilier)	DT-6P1	1	
65	Resistor 2 ohms, 1 watt (1R.C.)	BW-1	2	
66	Condenser 250 mfd, 25 V. (Cornell Dubilier)	BRH-2525	2	
‡ 67	⋆Amplifier—Interphone	BC-212-B	1	36B5857
§ 68	⋆Amplifier—Interphone	BC-347-C2	1	
† 69	⋆Amplifier—Interphone	BC-347-C2	1	

(5) CODING.

1. All wires marked thus "+" are to be individually shielded.
2. Parts marked thus "★" are Government Furnished Equipment.
3. Flexible conduit identified by single circles with letter "F." Item numbers appear in double circles.
4. All wire and cables to be identified by wire numbers as per drawing numbers to be taped to each end of wire with numbered cellulose tape.
5. This drawing effective only on AT-6C and SNJ-4 airplanes No. 1 to 5370 inclusive.
6. Parts coded thus are effective on the following airplanes only:
   No. 1 through No. 4639 inclusive.
   No. 4891 through No. 4910 inclusive.
7. Parts coded as follows effective on the following airplanes only:

§ {No. 4985 through No. 5070 inclusive.
No. 5143 through No. 5370 inclusive.

† {No. 5147 through No.5166 inclusive.
No. 5353 through No. 5370 inclusive.

» {No. 1 through No. 4984 inclusive.
No. 5071 through No.5142 inclusive.

(6) WIRE TABLE—12 VOLT.

Wire No.	Gage	Length in Inches	Terminals Sta-Kon	Req.
501	20	63	A-87G	1
502	20	43	A-87G	1
503	20	42	A-87G	1
504	20	41	A-87G	1
505	20	42	A-87G	1
506	20	42	A-87G	1
507	20	47	A-87G	1
508	20	42	A-87G	1
509	20	39	A-87G	1
510	20	49	A-87G	1
511	12	30	—	—
512	18	30	—	—
513	12	13	C-25	1
514	12	18	C-25	1
515	20	48	A-87G	1
516	20	38	A-87G	1
517	20	58	A-87G	1
518	20	46	A-87G	1
519	20	41	A-87G	1
520	12	10	C-25	1
521	20	27	A-87G	1
522	12	36	—	—
523	20	12	A-87G	1
524	16	25	B-87G	1
525	20	103	A-87G	1
526	20	98	A-87G	1
528	12	87	C-25	1
529	20	89	A-87G	1
530	20	86	A-87G	1
531	20	83	A-87G	1
533	20	26	A-87G	1
534	16	28	B-87G	1
535	16	6	B-87G	1
536	16	6	B-87G	1
538	12	100	C-25	1
539	20	88	A-87G	1
540	20	44	A-87G	1
541	20	48	—	—
542	20	48	—	—
543	20	9	A-87G	1
544	20	18	A-87G	1
545	16	36	B-87G	1
546	20	34	A-87G	1
547	20	20	A-87G	1
548	20	43	A-87G	1
549	20	41	A-87G	1
550	20	48	—	—
551	20	42	A-87G	1
552	20	41	A-87G	1
553	16	33	B-87G	1
554	20	32	A-87G	1
555	20	32	A-87G	1
556	20	20	A-87G	1
557	20	20	A-87G	1
558	20	10	A-87G	1
559	20	7	A-87G	1
560	20	20	A-87G	1

Wire No.	Gage	Length in Inches	Terminals Sta-Kon	Req.
561	20	17	A-87G	1
562	20	12	A-87G	1
563	20	42	A-87G	1
564	20	40	A-87G	1
565	20	41	A-87G	1
566	14	10	B-87G	1
567	12	14	C-25	1
568	20	26	A-87G	1
569	20	11	A-87G	1
571	20	21	A-87G	1
572	20	24	A-87G	1
573	12	14	C-25	1
††574	12	14	C-25	1
F 575	20	13½	A-87G	1
576	16	18	B-87G	1
*577	W106	12	—	—
*578	W106	12	—	—
*579	W106	12	—	—
580	20	100	A-87G	1
581	12	100	C-25	1
582	20	99	A-87G	1
583	20	101	A-87G	1
584	12	102	C-25	1
585	12	63	C-25	1
586	12	62	C-25	1
587	20	9	A-87G	1
588	20	9	A-87G	1
590	20	44	A-87G	1
591	12	11	C-25	1
592	20	42	A-87G	1
593	20	44	A-87G	1
594	12	10	C-25	1
595	20	25	A-87G	1
596	20	41	A-87G	1

Wire No.	Gage	Length in Inches	Terminals Sta-Kon	Req.
597	12	45	C-25	1
598	20	46	A-87G	1
599	12	47	C-25	1
601	20+	36	—	—
602	20+	33	—	—
603	20+	35	—	—
604	20+	34	—	—
605	20	35	—	—
606	18	8	A-87G	1 ea.
			A-85G	
607	12	28	C-25	2
608	12	27	C-25	2
			A-87G	
609	18	4	A-85G	1 ea.
610	18	24	A-87G	2
611	20	22	A-87G	1
612	20	33		
613	16	8	B-87G	1
615	20	27	A-87G	1
616	16	14	B-87G	1
617	20	22	A-87G	1
618	20	23	A-87G	1
619	20	20	A-87G	1
620	18	51	A-87G	1
621	12	53	C-25	1
622	12	51	C-25	1
623	20	48	A-87G	1
624	20	21	A-87G	1
625	20	9	A-87G	2
626	20	51	A-87G	1
627	20	26	A-87G	1
628	20	27	A-87G	1
629	20	28	A-87G	1
630	20	29	A-87G	1

Wire No.	Gage	Length in Inches	Terminals Sta-Kon	Req.
631	20	40	A-87G	1
632	20	44	A-87G	1
633	20	40	A-87G	1
634	20	44	A-87G	1
635	12	28	C-25	1
636	18	28	A-87G	1
637	12	28	C-25	1
638	12	6	C-25	1
639	12	6	C-25	1
640	12	6	C-25	1
641	18	24	A-87G	1
642	18	24	A-87G	1
643	12	89	C-25	1
644	12	87	C-25	1
645	20	86	A-87G	1
646	12	86	C-25	1
647	12	81	C-25	1
648	20	83	A-87G	1
649	20	84	A-87G	1
650	20	83	A-87G	1
651	20	83	—	—
652	14	86	B-87G	1
653	20	90	—	—
654	20	90	—	—
655	20	101	—	—
656	12	101	—	—
657	12	101	—	—
658	20	101	—	—
659	20	101	—	—
660	20	101	—	—
661	20	7	A-87G	1
662	20	10	A-87G	1
663	20	8	A-87G	1
664	16	6	B-87G	2

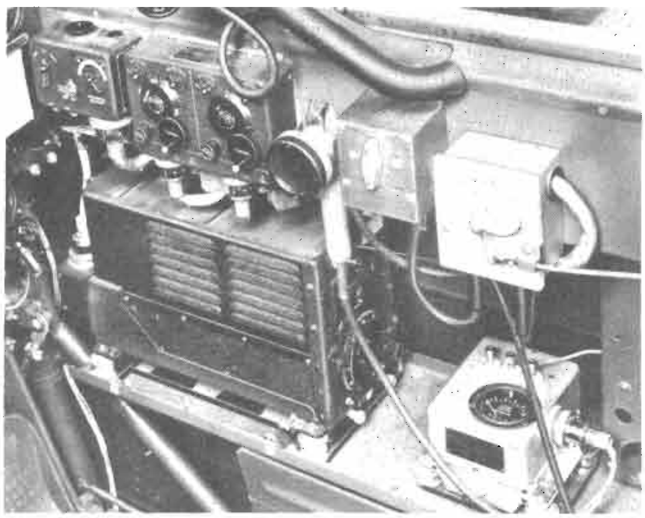


Figure 318 — Front Cockpit Radio Installation — 24-Volt System

b. 24-VOLT EQUIPMENT.

(1) DESCRIPTION.—*(See figures 318 and 319.)*

(a) DESCRIPTION. — The communication equipment on the 24-volt airplane consists of radio set, SCR-274-N, marker beacon equipment, RC-43-B, two-place interphone equipment, RC-35, and the necessary

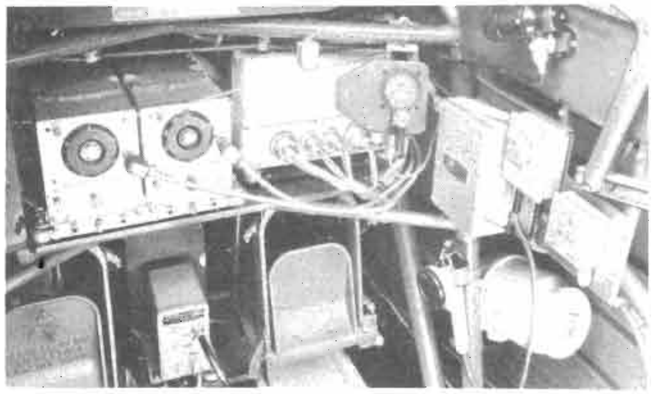


Figure 319 — Rear Cockpit Radio Installation

cordage, flexible shafts, jacks, plugs, and miscellaneous equipment necessary for the proper functioning of the communication system as a whole. A single antenna is used for both receiving and transmitting, and an antenna relay provides a means of switching the antenna between transmitter and receiver. The command set consists of one transmitter and two receivers with the controls for both transmitter and receivers located on the right side of the front cockpit only. The rear cockpit interphone, however, may be switched to radio by means of a control shaft from the rear cockpit to the interphone control box in the front cockpit. A telegraph key on top of the transmitter provides a means of transmitting keying signals. The command set is controlled by push-button controls (push-to-talk switches) on the throttle quadrant arm and on the hand-held microphone in each cockpit. The push buttons are connected to the command set so that when either button is pressed, the command set will change from receive to transmit. Command set SCR-274-N is a short range communication system used principally for ship to ship or ship to field contact. A receiver mounting shelf is installed aft of the rear cockpit, and a receiver control box support is installed on the right side of the front cockpit to provide for the installation of SCR-515 and SCR-535 radio equipment. A list of radio equipment installed on the 24-volt airplane follows.

COMMAND SET SCR-274-N

Transmitter Assembly

1 Transmitter, BC-696-A (3000 to 4000 KC)
1 Mounting, FT-232
1 Rack, FT-234
1 Plug, PL-154
1 Plug, PL-156
1 Tube Set consisting of:
  2 Tube, VT-136
  1 Tube, VT-137
  1 Tube, VT-138

Receiver Assembly

1 Receiver, BC-453-A (190 to 550 kc)
  Includes: 1 Adapter, FT-230-A
1 Receiver, BC-454-A (3.0 to 6.0 mc)
  Includes: 1 Adapter, FT-230-A
2 Dynamotor, DM-32-A
1 Mounting, FT-279-A
1 Rack, FT-277-A
1 Plug, PL-147
1 Plug, PL-151
2 Plug, PL-152
2 Tube Set each consisting of:
  3 Tube, VT-131
  1 Tube, VT-132
  1 Tube, VT-133
  1 Tube, VT-134

Transmitter Control Assembly

1 Control Box, BC-451-A
1 Mounting, FT-228-A
1 Plug, PL-153

Receiver Control Assembly

1 Control Box, BC-496-A
  Include: 1 Dial, MC-212 (190 to 550 kc)
  1 Dial, MC-213 (3.0 to 6.0 mc)
1 Mounting, FT-240-A
2 Plug, PL-152

Antenna Relay Unit Assembly

1 Antenna Relay Unit, BC-442-A
1 Mounting, FT-229-A
1 Plug, PL-156

Antenna Equipment

4 Insulator, IN-81
1 Insulator, IN-84
1 Insulator, IN-88
40′ Wire, W-106-A

Modulator Assembly

1 Modulator, BC-456-A
1 Dynamotor, DM-33-A
1 Mounting, FT-225-A
1 Plug, PL-148
1 Plug, PL-151
1 Plug, PL-153
1 Plug, PL-154
1 Tube Set consisting of:
  1 Tube, VT-135
  1 Tube, VT-136
  1 Tube, VT-139

Miscellaneous Items

4 Couplings, MC-211-A
1 Tuning Shaft, MC-215 (59 inches)
1 Tuning Shaft, MC-215 (61 inches)

MARKER BEACON RC-43-B

Receiver Assembly

1 Receiver, BC-357-B
1 Mounting, FT-161
1 Plug, PL-108
1 Tube Set consisting of:
  1 Tube, VT-104
  1 Tube, VT-153

Antenna Assembly

3′ Cable, WC-549
1 Coupling, MC-227
1 Terminal, TM-201
1 Nut, M-275
1 Plug, PL-219
12′ Wire, W-106-A
2 Insulator, IN-88

INTERPHONE RC-35

1 Interphone Amplifier, BC-347 Includes:
  1 Tube, VT-99
1 Dynamotor Unit, PE-86-A
1 Interphone Control Box, BC-334
1 Interphone Box, BC-335
1 Control Box, BC-327
1 Control Shaft, MC-166
2 Microphone, T-17
2 Headsets, HS-23
2 Plug, PL-55
2 Jack, JK-26
12′ Cordage, CO-119-A

FILTER EQUIPMENT RC-198

1 Filter, FL-8

(*b*) RECEIVER EQUIPMENT.

1. RECEIVERS.—The two receivers, BC-453-A and BC-454-A, attached to rack, FT-277-A, mounted on shock absorber mounting, FT-279-A, are located on a shelf just below the rear cockpit instrument panel. A dynamotor for supplying plate power for the command receivers is mounted on the rear of each receiver. A covered fuse box mounted on the rack behind the dynamotors contains active and spare fuses for the dynamotor circuits. Primary power for operating the dynamotors is obtained from the 24-28-volt supply of the airplane. The receivers are designed for satisfactory operation over a range of 22- to 30-volts input. The receivers are remotely controlled from receiver control box, BC-496-A, mounted in the front cockpit.

2. RECEIVER CONTROL BOX.—The receiver control box, BC-496-A, is mounted on the right side of the front cockpit directly above the transmitter on FT-240-A mounting bracket. This control box is divided into two sections: one section has dial, MC-212, for receiver, BC-453-A, (190 to 550 kc); and the other receiver has dial, MC-213, for receiver, BC-454-A, (3.0 to 6.0 mc). The receiver control box in the front cockpit is connected to the receivers in the rear cockpit by tuning shaft, MC-215 (59 inches), and tuning shaft, MC-215 (61 inches). These shafts are connected to the receiver at one end and to the control box at the other end by means of type MC-211-A couplings. The receiver must be equipped with a type FT-211-A adapter when so connected for remote control. The receiver control box contains the following controls for each receiver: a "CW-OFF-MCW" switch, a tuning knob, a gain-control marked increase output, and an "A-B" switch. Each receiver is independently controlled, and each control box contains two head set jacks marked "A-TEL." or "B-TEL." With the interphone installation, however, only the jacks in the interphone boxes are normally used, and the "A-B" switch is operative only at the "A" position.

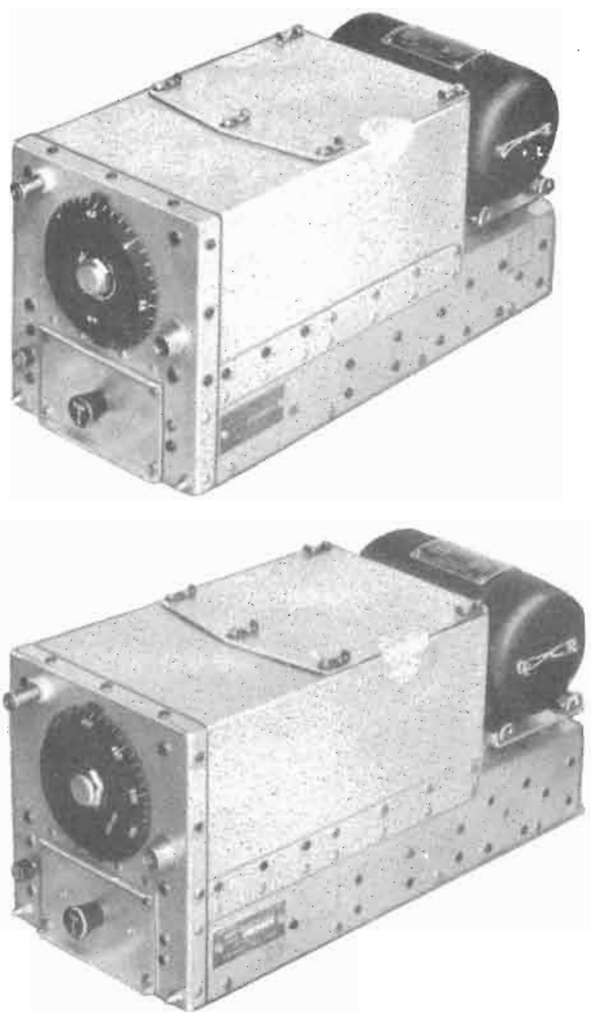


Figure 320 — Receiver Assembly BC-435-B and BC-454-B

(c) TRANSMITTER EQUIPMENT.—The transmitting equipment consists of radio transmitter, BC-696-A; dynamotor, DM-33-A, and modulator unit, BC-456-A, for supplying the high voltage dc and the modulating power for the transmitters; radio control box, BC-451-A, for control of the transmitters; and antenna relay unit, BC-442-A, for switching the common antenna between the receivers and transmitter. This equipment also includes the racks, mountings, cords, plugs, etc., necessary for the proper functioning of the receiving equipment as part of command set, SCR-274-N.

1. TRANSMITTER.—The BC-696-A transmitter covering a range of 3000 kc to 4000 kc is attached to rack, FT-234-A, mounted on shock absorber mounting, FT-232-A, on the radio shelf at the right side of the front cockpit. There are three controls on the front of the transmitter: the "FREQUENCY" control knob in the lower right corner; the "ANT INDUCTANCE" control in the upper right section; and the "ANT COUPLING" control in the middle left section. The transmitter is also supplied with a special frequency checking circuit which includes a plug-in crystal resonator. This crystal circuit is used for checking the frequency at one point on the dial and not for controlling the frequency.

2. CONTROL BOX.—The transmitter control box, BC-451-A, is mounted on the right side of

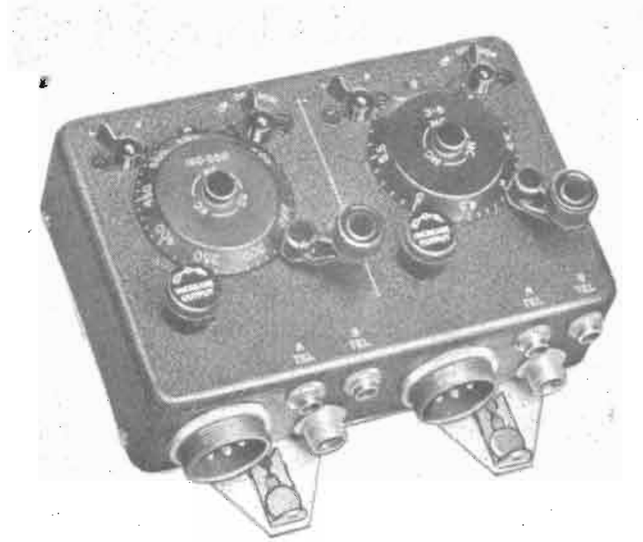


Figure 321 — Receiver Control Assembly BC-496-A

the front cockpit directly above the transmitter on mounting bracket, FT-228-A. This control box contains all the controls for operating the pretuned transmitter. The toggle switch marked "TRANS POWER" on the face of this box is for turning "ON" or "OFF" the primary power for the transmitting equipment. The three-position switch marked "TONE-CW-VOICE" controls the circuits which determine the type of emission from the transmitter. Only position No. 1 of the four-position transmitter selector switch is used as there is only one transmitter in the radio installation on this airplane. A data plate just above the switch is for marking the frequency to which the transmitter is tuned. A telegraph key on top of the box provides for transmitting keying signals when the three-way switch is in "TONE" or "CW" positions.

(d) INTERPHONE EQUIPMENT. — The RC-35 two-place interphone equipment consists of an amplifier, a filter, and a dynamotor, with interphone control boxes and microphones in both cockpits. The BC-347 amplifier is installed on the right side of the rear cockpit and the FL-8 filter unit is mounted on the right side of the front cockpit. The function of the interphone amplifier is to amplify the interphone messages so that they may be heard with ease; the function of the filter is to separate voice and range signals. The PE-86-A dynamotor is installed on the hydraulic shelf at the left side of the front cockpit. Interphone control box, BC-334, installed on the right side of the front cockpit, is connected by control shaft, MC-166, to control box, BC-327, in the rear cockpit. This provides a means of switching the rear cockpit interphone to radio by remote control. Interphone control box, BC-335, is installed on the right side of the rear cockpit to provide a means of radio volume control for the rear cockpit interphone. The T-17 microphones are held in a bracket attached to the right side of each cockpit. Push-to-talk buttons are installed on the handle to the microphones and also on the throttle quadrant arm in each cockpit. The push-to-talk buttons may be used as a key for transmitting code when the control box switch is turned to "CW" or "TONE" positions.

(e) ANTENNA SWITCHING RELAY.—The antenna switching relay unit, BC-442-A, is mounted on shock absorber mounting, FT-229-A, just aft of the transmitter, on the radio shelf at the right side of the front cockpit. This antenna relay unit provides a means

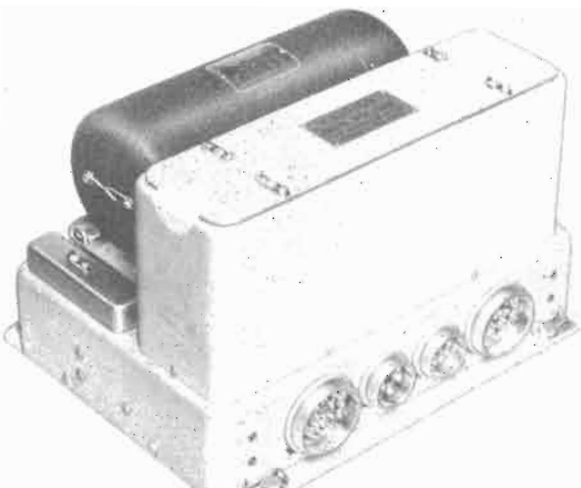


Figure 322 — Modulator Assembly BC-456-B

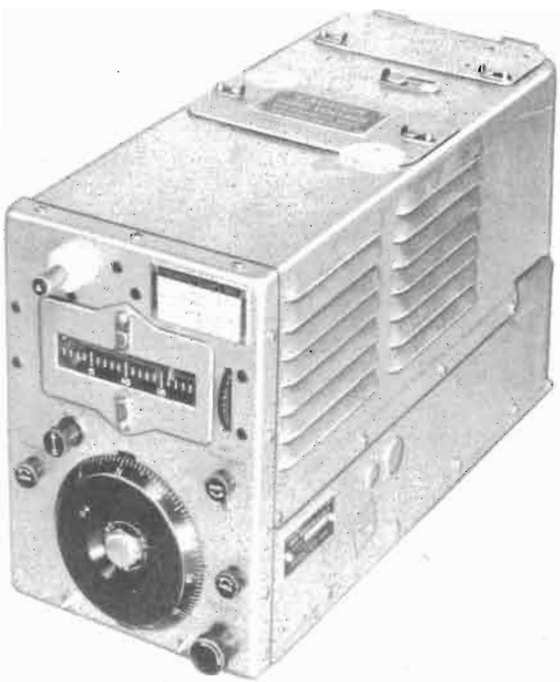


Figure 323 — Transmitter BC-696-A

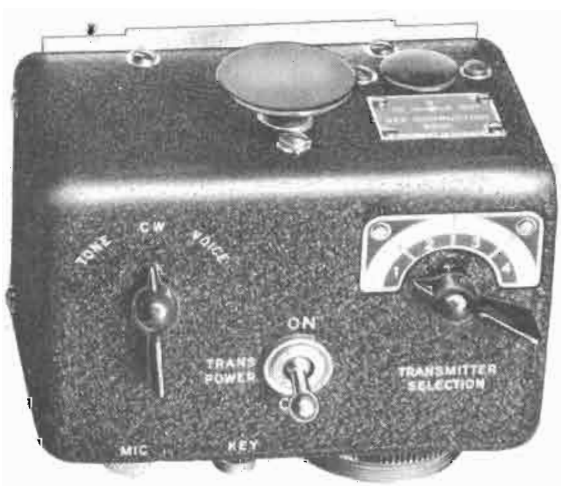


Figure 324 — Transmitter Control Assembly BC-451-A

of switching the common antenna between the receivers and the transmitter. This relay is operated simultaneously with the high-voltage keying relay in modulator unit, BC-456-A, and will ground the antenna lead to the receivers, during transmission.

(f) ANTENNA EQUIPMENT.—The W-106-A antenna wire for both the transmitter and the receivers extends from the top of the rudder to the antenna mast located forward and to the right of the windshield. The antenna wire is brought into the fuselage at the right side of the front cockpit. A spring-type shock connector and an insulator are installed between the antenna wire and the rudder attachment point to maintain an initial wire tension of 15 pounds (plus or minus ½ pound).

(g) MARKER BEACON EQUIPMENT.—The radio marker beacon equipment consists of a receiver and antenna equipment supplied by power from the same dynamotor supplying the interphone equipment. The BC-357-B receiver is mounted between the rudder pedals in the rear cockpit on mounting, FT-161, attached to the support between the floor boards. The antenna for the marker beacon equipment is mounted on short masts underneath the wing center section of the fuselage, extending fore-and-aft along the centerline of the airplane. (See figure 332.) A marker beacon signal light is installed on the instrument panel in the front cockpit only. The marker beacon receiving equipment will enable the pilot to determine when he is flying over a 75-megacycle marker transmitter. This transmitter may be of the Army instrument landing type or a cone of silence or fan marker found along commercial airways. The receiver will respond to any 75-megacycle signal,

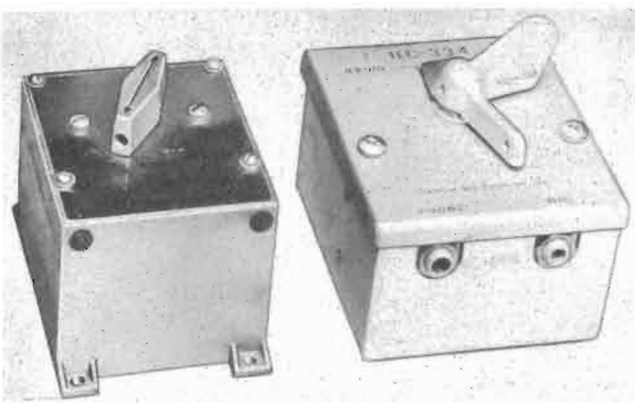


Figure 325 — Filter FL-8-A and Interphone Master Control Box BC-334

Figure 326 — Interphone Box BC-335 and BC-327

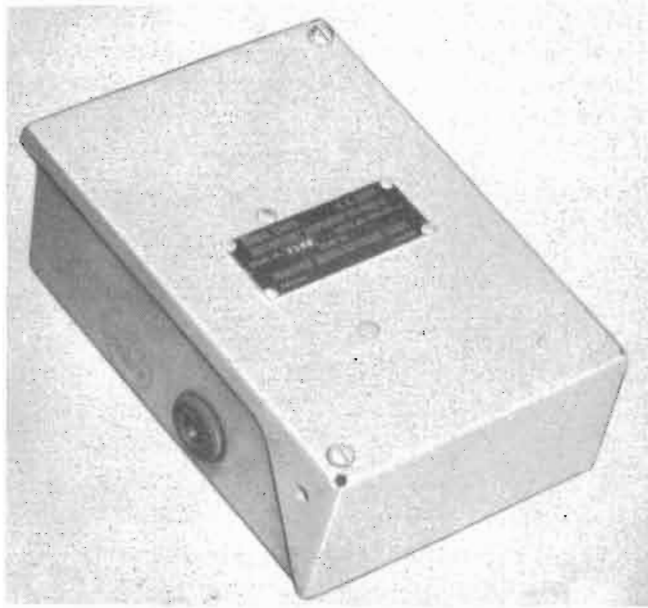


Figure 327 — Interphone Amplifier BC-347-C

Figure 328 — Antenna Relay Unit BC-442-A

which is horizontally polarized and modulated at an audio rate. The sensitivity of the receiver increases as the modulation rate increases, up to 3000 cycles. A signal many times greater is required at 60-cycle modulation than at 3000-cycle modulation to give normal output. This receiver was designed because the 60-cycle modulating transmitter used in some of the Army instrument landing systems is too powerful to use with the sensitive receiver required for cone of silence operation. The indicator lamp on the front instrument panel in the front cockpit will give the pilot a visual signal in accordance with the output of the receiver. When the receiver is over a keyed transmitter, such as a CAA marker or certain types of Army transmitters, the indicator lamp will identify the transmitter by flashing in definite sequence.

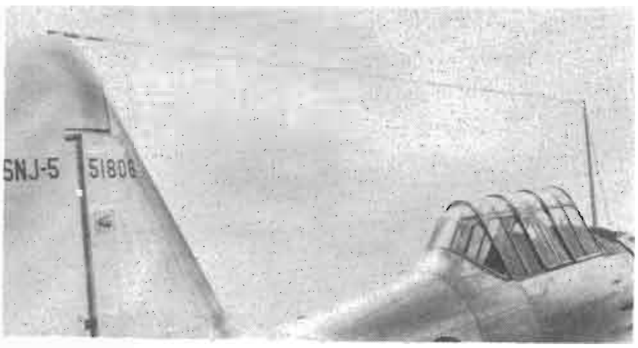


Figure 329 — Antenna Installed

Figure 330 — Marker Beacon Receiver BC-347-C

(2) MAINTENANCE.—The operation, maintenance, and repair of radio equipment is of a highly specialized nature. First and second echelons of communications maintenance personnel should not attempt any maintenance not recommended in this section or in the inspection section of this book except in emergency.

CAUTION

Dynamotor, DM-33-A, on the modulator unit of this radio set, generates 600 volts, dc. This is sufficient to cause severe shock or even death. Make absolutely certain that the dynamotor is not running before making any adjustment whatever, with the exception of 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 are 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.

Figure 331 — Dynamotor Unit PE-88-E

Do not depend alone upon hearing the dynamotor or upon observing the several switch positions to determine whether 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, as severe, irritating burns will result. Warn anyone who may be working near the antenna of your intention to turn on the power. Dynamotor, DM-32-A, on each of the receivers generates 250 volts dc. The danger of exposure to this voltage must not be ignored. Make certain that all control switches are OFF before performing any adjustment to the equipment other than antenna alignment.

(3) TROUBLE SHOOTING.—Refer to paragraph *a,* (3) for general instruction for localizing the causes of poor radio reception.

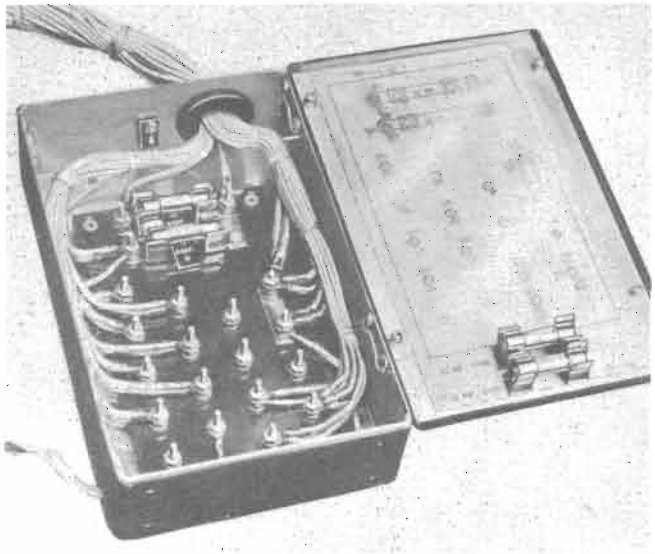


Figure 333 — Radio Junction Box

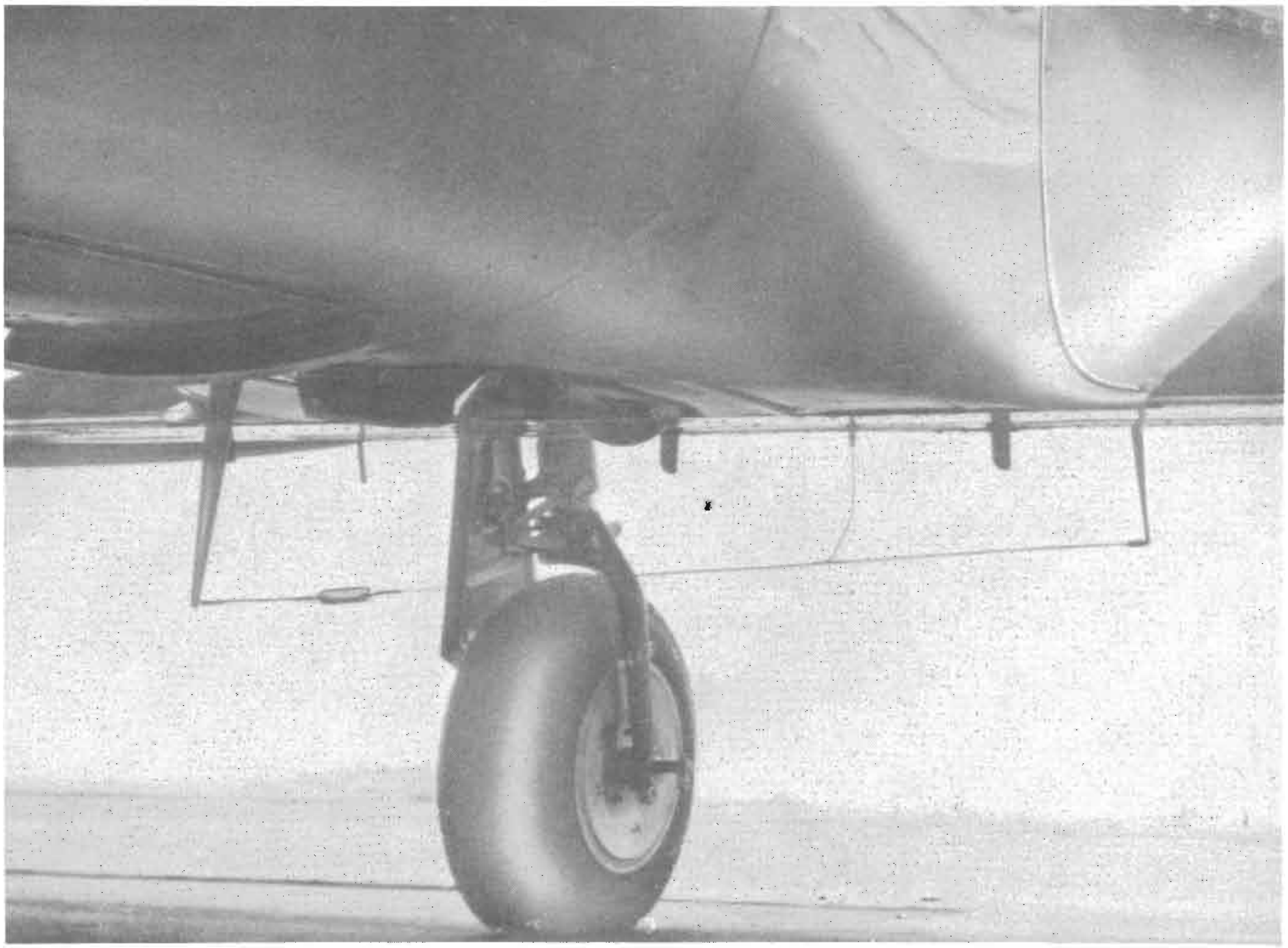


Figure 332 — Marker Beacon Antenna

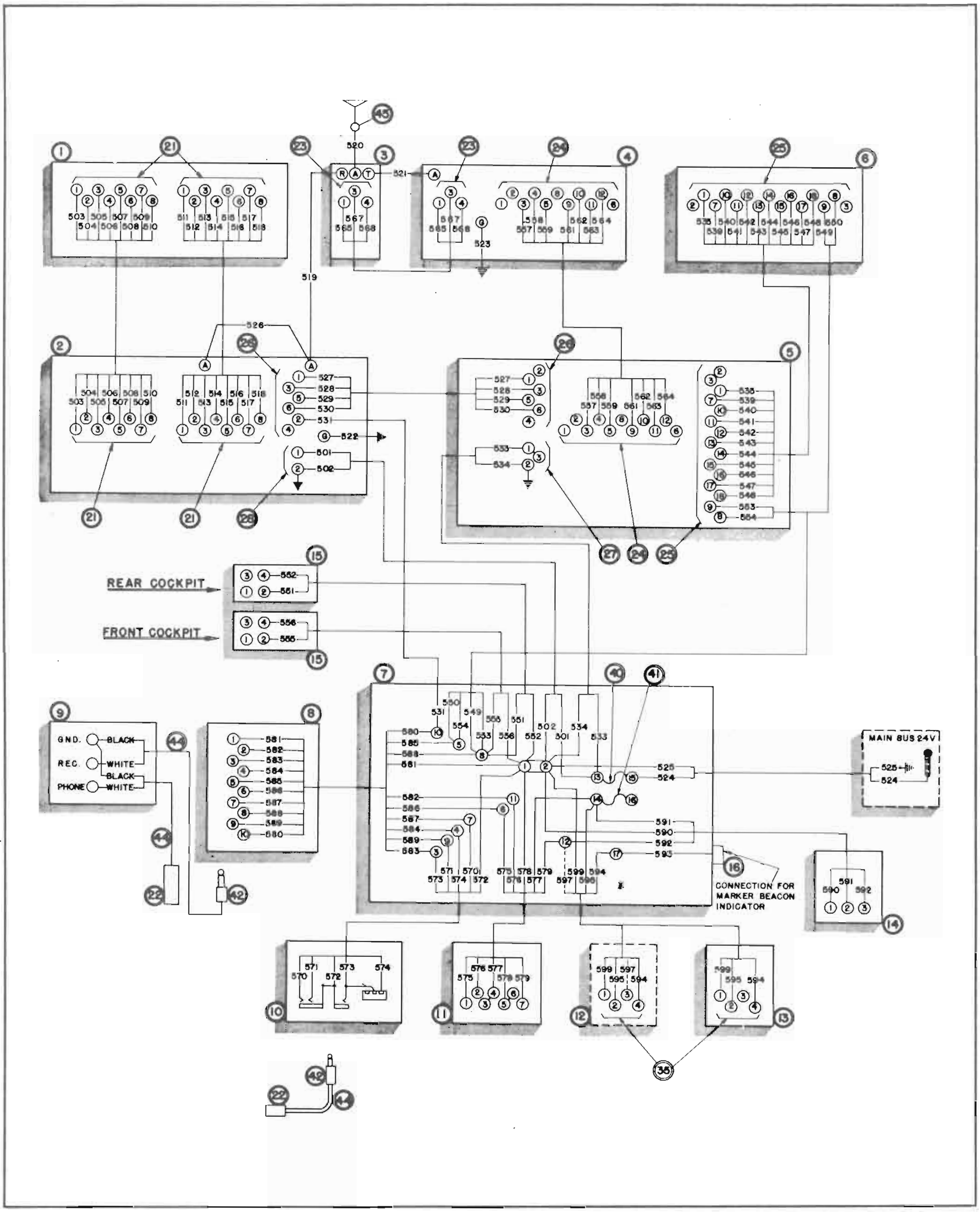


Figure 334 — Radio Wiring Diagram — 24 Volt

(4) BILL OF MATERIAL—24 VOLT.

Item No.	Description	Type No.	No. Req.	Part or Spec. No.
1	*Radio Control Box (Rec.)	BC-496-A	1	
2	*Receiver Rack	FT-220-A	1	
3	*Antenna Relay Unit	BC-442-A	1	
4	*Transmitter Rack	FT-234-A	1	
5	*Modulator Unit	BC-456-A	1	
6	*Radio Control Box (Trans.)	BC-451-A	1	
7	Radio Equip. Junction Box	N.A.A.	1	88-71241
8	*Interphone Control Box	BC-334	1	
9	*Filter Box	FL-8	1	
10	*Interphone Box (Remote)	BC-335	1	
11	*Interphone Amplifier	BC-347	1	
12	*Marker Beacon Receiver	BC-357-B	1	
14	*Dynamotor Unit	PE-86	1	
15	*Plug-Throttle Quadrants		2	35A4273
16	Socket		1	38A1549
21	*Plug	PL-152	4	
22	*Jack	JK-26	2	
23	*Plug	PL-156	2	
24	*Plug	PL-154	2	
25	Plug	PL-153	2	
26	*Plug	PL-151	2	
27	*Plug	PL-148	1	
28	*Plug	PL-147	1	
35	*Plug	PL-108	1	
40	Fuse 30 amp (1 spare)		2	94-40002-D
41	Fuse 10 amp (1 spare)		2	94-40002-D
42	*Plug	PL-55	2	
44	*Cordage	CO-119		
45	*Insulator-Antenna Lead-in	IN-84	1	

(5) WIRE TABLE—24 VOLT.

Wire No.	Ga.	Length in Inches	Terminals Sta-kon	Req.
501	18	28	A-85G	1
502	18	30	A-85G	2
503	18	59		
504	20	59		
505	20	59		
506	18	59		
507	20	59		
508	18	59		
509	20	59		
510	20	59		
511	18	62		
512	20	62		
513	20	62		
514	18	62		
515	20	62		
516	18	62		
517	20	62		
518	20	62		
519	16	51		
*520	W-106A	10		
*521	W-106A	10		
522	18	5	A-87G	1
523	18	5	A-87G	1
524	12	120	C-25	2
525	12	116	C-25	2
526	16	6	A-85G	1
527	20	37		
528	18	37		
529	18	37		
530	18	37		
531	20	25	A-85G	1
533	12	46	C-25	1
534	12	48	C-25	1
535	20	66		
539	18	66		
540	20	66		
541	20	66		
542	20	66		
543	20	66		
544	20	66		
545	18	66		
546	20	66	Sta-Kon	
547	20	66		
548	18	66		
549	18	69	A-85G	1
550	20	73	A-85G	1
551	20	65	A-85G	1
552	20	64	A-85G	1
553	18	54	A-85G	1
554	20	58	A-85G	1
555	20	54	A-85G	1
556	20	52	A-85G	1
557	20	68		
558	18	68		
559	18	68		
561	20	68		
562	20	68		
563	20	68		
564	20	68		
565	20	43		
567	20	43		
568	20	43		
570	20	55	A-85G	1

Wire No.	Ga.	Length in Inches	Terminals Sta-kon	Req.
571	20	54	A-85G	1
572	20	59	A-85G	1
573	20	51	A-85G	1
574	20	53	A-85G	1
575	20	56	A-85G	1
576	20	58	A-85G	1
577	18	54	A-85G	1
578	18	54	A-85G	1
579	20	58	A-85G	1
580	20	61	A-85G	1
581	20	57	A-85G	1
582	20	63	A-85G	1
583	20	59	A-85G	1
584	20	59	A-85G	1
585	20	63	A-85G	1
586	20	60	A-85G	1
587	20	60	A-85G	1
588	20	59	A-85G	1
589	20	60	A-85G	1
590	18	55	A-85G	1
591	18	54	Sta-Kon. Na-85G	1
592	20	55	A-85G	1
593	20	16	A-85G	1
594	20	18	A-85G	1
595	20	21	A-85G	1
597	20	22	A-85G	1
599	20	22	A-85G	1

17. PHOTOGRAPHIC EQUIPMENT.

a. GENERAL.—Provisions are made for the installation of a K-3B aerial camera, type A-8 camera mount, type A-2 viewfinder, type B-2 intervalometer, camera power junction box, camera vacuum valve, and a warning light.

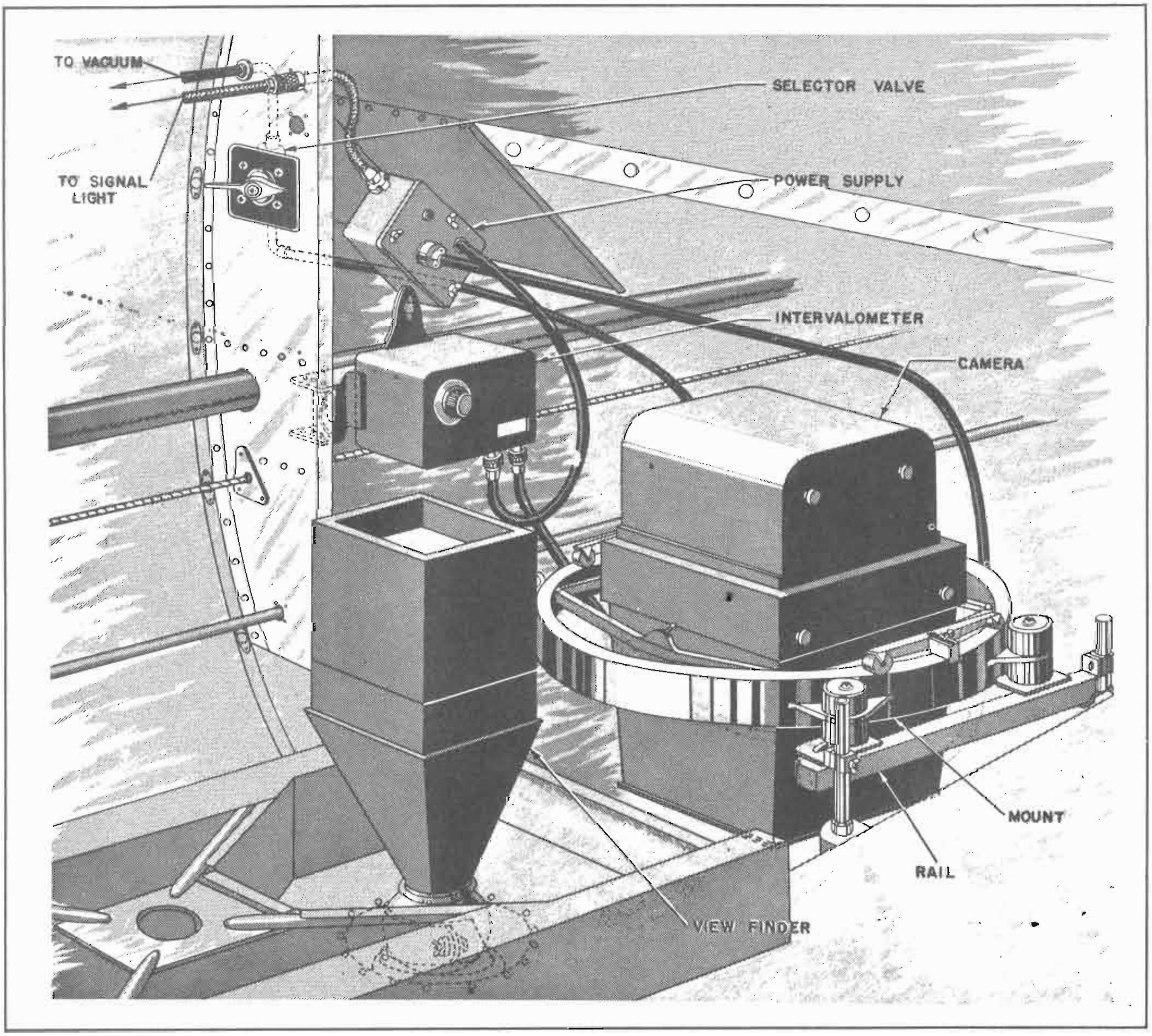


Figure 335 — Photographic Equipment Installation Diagram

CAUTION

Only photographic section personnel should remove or disassemble any of the items of actual photographic equipment, such as the viewfinder, cameras, camera lens cones, film magazines, etc.

b. CAMERA AND CAMERA MOUNT.

(1) DESCRIPTION.

(a) Support rails for the camera mount are located at the bottom of the fuselage, immediately aft of the rear cockpit.

(b) The K-3B Camera is designed for making both oblique and vertical photographs and produces a 7 x 9 negative. However, in earlier airplanes provisions are made only for vertical photography. The K-3B camera may be operated either manually or automatically by simply adding or removing certain camera accessories. When operated automatically, the camera is driven by a motor that derives its power from the storage battery. With the exception of the action of the vacuum system, it then becomes an entirely electrically operated photographic unit through the electric cable connection of the power supply box to the intervalometer and the camera, and the connection of the camera and intervalometer.

(c) A selector valve in the vacuum system regulates the vacuum action that holds the film to the focal plane contact glass. The intervalometer which governs the automatic operation of the camera provides for exposures from 6 to 75 seconds apart. Electric cables make the connections between the camera, intervalometer, signal lights, and the electric power. Two signal lights, one on the power junction box and one on the pilot's instrument panel, are connected to the intervalometer and warn the pilot and camera operator to level the airplane and the camera for the next exposure. The shutter-retard regulator located on the camera body may be adjusted for speeds of 1/30, 1/50, 1/100, and 1/150 of a second. When the camera is operated manually, the winding is done by using the manual wind; and the tripping, by using the trip lever located on the right side of the camera body. The interval of time between exposures may be timed by using the speed timer.

(d) The type A-1A roll film magazine is used with the K-3B aerial camera. It is detachable and light-tight when not attached to the camera. The number of photographs that can be made on a single flight is limited only by the number of fully loaded extra magazines carried. When necessary, the type A-1A roll film magazine may be replaced by the type B-1 cut-film magazine for use with 8 x 10 cut-film holders.

(e) The lens cone containing the lens and shutter is detachable and interchangeable with lens cones containing lens of other focal length. Provisions are made for the use of either a 12-inch cone or an 8¼-inch cone; no adjustment is necessary after attaching either lens cone, as it will be in focus as soon as it is in place. Only a few minutes are required to remove one lens cone and replace it with another. The lens and shutter assembly of each lens cone is a standard unit by itself and can be interchanged with other lens and shutter assemblies containing a lens of the same focal length. Trunnions are provided on each lens cone so that the camera can be suspended in a standard camera mount that is supplied for use when taking vertical aerial photographs.

(2) INSTALLATION.

(a) To install the camera, remove the rear control stick and instrument flying hood, if installed, and place the control stick in the stowed position. Rotate the seat to the aft position. Raise the baggage compartment bottom; secure it to the baggage compartment rear bulkhead by means of the strap provided. Position the camera support rails for the size lens cone to be used. The top position of the rails is used when operating the camera with a 12-inch cone; the bottom position is used when operating with an 8¼-inch cone.

(b) The type A-8 camera mount is installed on the camera support rails by positioning the mount so that the bolts beneath the corners of the mount will go into the keyhole slots provided for them at the top of the camera support rails. Push the mount forward to lock it in position. To remove the mount, depress the spring-loaded catch lock just aft of each of the two rear keyhole slots, slide the mount back, and lift it off the rails. The mount acts as a gimbal ring, leveling the camera during flight. The camera is orientated by means of a horizontal vernier scale on the mount.

(c) The following camera connections are applicable:

1. Connect the camera to the large outlet in the camera junction box by means of the camera power cable.

2. Connect the intervalometer to the camera by means of the camera-to-intervalometer cable; insert the bayonet plug of the intervalometer-to-warning light cable in the small socket in the camera power junction box.

3. Connect the camera to the vacuum connection tube by means of the camera vacuum hose.

4. See that all connections are securely made and that the cables are laid in such a manner that sufficient slack is allowed for free operation of the equipment.

5. When a cable is not connected, it should be coiled and secured so that it will not interfere with the operation of other equipment.

NOTE

When the vacuum connection is not used, the vacuum selector valve must be placed in the "OFF" position.

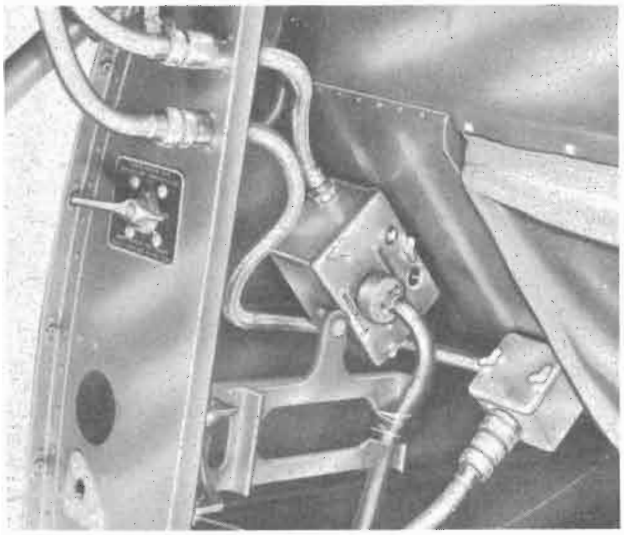


Figure 336 — Control Valve, Intervalometer, and Power Junction Box

(3) MAINTENANCE.

(a) GENERAL.—When the camera and its accessories are not being used, they should be kept in the carrying cases provided for them. In doing this, the life of the camera will be lengthened. It also keeps dust, grit, and other foreign objects from damaging the camera. The camera should be given a general inspection to make sure that everything is in its proper place and is operating properly before using. Care should also be used in the handling of the camera and the accessories, as they are precision instruments.

(b) CLEANING THE LENS.—For the best results, the lens must be clean at all times. Before each flight both surfaces should be wiped with a soft lintless cloth. Under no circumstances should water or liquid of any kind be used. If rubbing with a dry cloth is not sufficient, it may be necessary to moisten the surface of the lens by breathing on it.

(c) CLEANING THE MAGAZINE CONTACT GLASS.—The magazine contact glass must be kept clean, and all grit and dust must be kept from between the contact glass and the film. Before the magazine is attached each time, both sides of the glass should be thoroughly cleaned with a soft lintless cloth. The inside of the glass should be cleaned each time the magazine is loaded.

c. VIEWFINDER.

(1) DESCRIPTION.—The purpose of the type A-2 vertical viewfinder is to give a clear and distinct view of objects beneath the airplane and to provide accurate means for determining correct exposure intervals. It is installed in the floor of the front fuselage immediately aft of the rear cockpit seat over an opening provided for that purpose. The cover plate should be secured in place over this opening when the viewfinder is not installed.

(2) INSTALLATION. — To install, insert the three attaching lugs in the holes in the installation ring with locking knob forward. Rotate the entire assembly in a clockwise direction, and turn locking knob to secure viewfinder in place. Remove the cover plate from the fuselage bottom below the viewfinder.

d. INTERVALOMETER.—The type B-2 intervalometer is an instrument for automatically operating the camera at any predetermined interval and is electrically operated. It is installed by mounting on a bracket secured to the right side of the rear fuselage structure aft of the right forward bulkhead.

e. POWER JUNCTION BOX.

(1) DESCRIPTION.—The power junction box, which supplies the power connection for the camera,

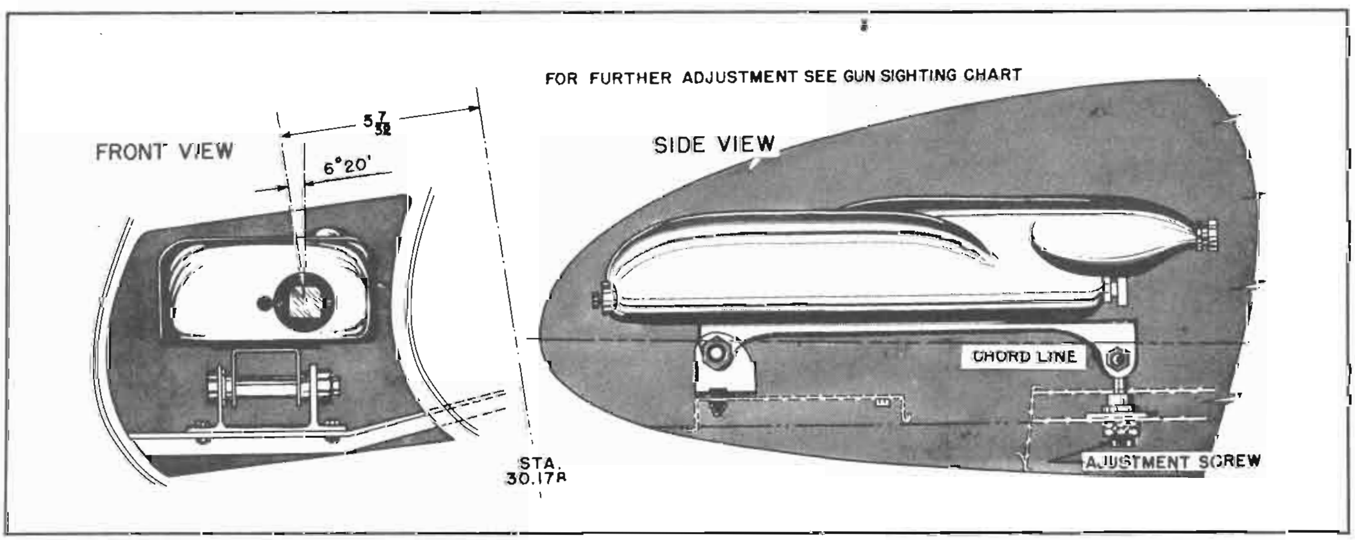


Figure 337 — Fixed Gun Camera Installation Dimensions

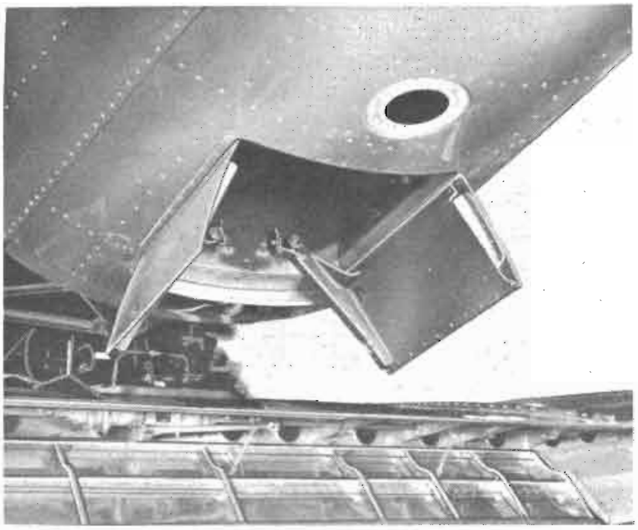


Figure 338 — Camera Door

the intervalometer connection, and camera signal lights, is attached by clamps to the fuselage immediately above the intervalometer.

(2) REMOVAL.—To disassemble and remove the camera power junction box, consult the electrical diagram in the map and data case.

f. WARNING LIGHT.—A warning light located on the camera junction box and on the front instrument panel flashes 3 seconds before each exposure, when using the intervalometer.

g. VACUUM VALVE.—The vacuum valve is installed on the right side of the fuselage aft of the rear cockpit.

h. GUN CAMERA.—An electrically operated Type W-7B gun camera which is suitable for fixed operation only may be installed in the inboard end of the outer wing leading edge. A gun camera safety switch is provided on the front cockpit control panel, and when it is in the "FIRE" position, the camera will automatically operate when either or both fixed guns are fired. A solenoid in the camera circuit is built into the rear of the gun camera itself. Provisions for installation include a bracket immediately aft of the camera opening in the leading edge for mounting the forward camera attachment, a rear connector assembly, and all the wiring and electrical fixtures and connections required for the operation of the camera. The rear connector assembly provides for both a horizontal and a vertical adjustment and is reached by removing an access plate in the bottom of the wing surface immediately below this assembly.

i. CAMERA DOORS.—Two camera doors are provided in the bottom of the rear fuselage below the baggage compartment to be used during camera operation. They are attached to longerons at each side of the door, opening by full length hinges. To open or close the camera doors, push down on the knob-type door handle; then push or pull the handle with a quick firm movement to engage the doors in an open or closed position, respectively.

NOTE

In the AT-6D and the SNJ-5 airplanes which do not have provisions for installing photographic equipment, these doors are sealed shut.

18. BOMBING EQUIPMENT.

a. GENERAL.—Complete provisions have been incorporated in the airplane for a flush-type bomb rack

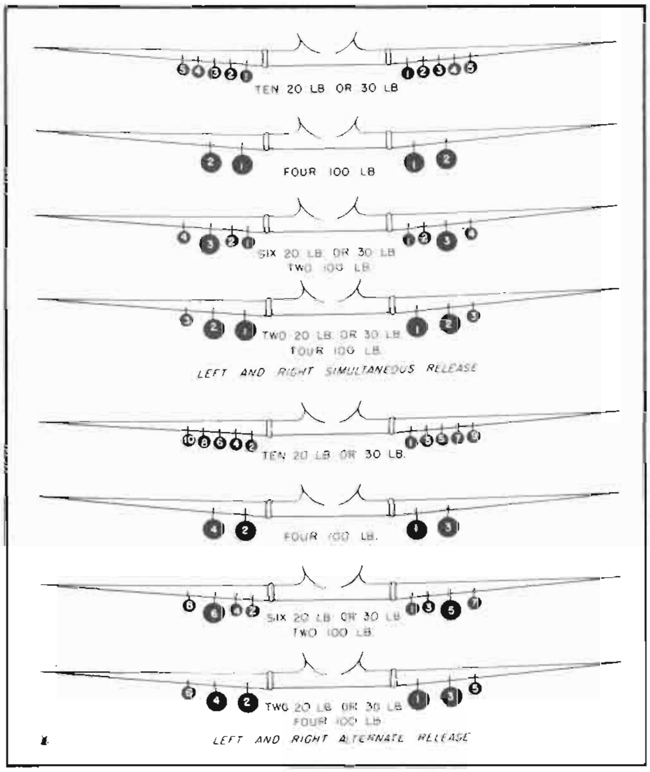


Figure 339 — Bomb Release Order Diagram

and other bombing equipment on the lower surface of each outer wing panel. Bomb equipment kits provide the necessary bomb racks, shackles, cables, and bombing control equipment. The bomb racks in each outer wing panel will carry five M-5, 30-pound fragmentation bombs, or five M-41, 20-pound fragmentation bombs, either U.S., or British. Two auxiliary bomb shackles may be added to each of these racks for carrying a total of four Mark 1, 100-pound bombs, either U.S. or British, in place of the smaller bombs. The smaller bombs are armed at the nose only, and the 100-pound bombs are armed at the tail by arming levers on the bomb rack. Four type B-1 bomb arming units are provided in the wing to nose-arm the 100-

pound bombs. Electrical control switches, which consist of one bomb safety switch, two bomb selector switches, and one nose fuse switch, are grouped on the pilot's electrical control panel in the front cockpit. The bomb safety switch, when "OFF," prevents accidental electrical release of the bombs. The switch must be "ON" before any electrical release can be accomplished. The bomb selector switches provide selection of the rack to be employed. "LEFT" or "RIGHT," or "LEFT" and "RIGHT" can be used as desired. The nose fuse switch operates the four type B-1 bomb arming units to nose-arm the 100-pound bombs. A signal lamp adjacent to this switch will glow when the 100-pound bombs are nose-armed. Release of the bombs, as selected, is accomplished by the push-button type thumb switch located on the control stick in the front cockpit. Bombs may be dropped selectively by pushing the control stick release button consecutively. The bombs are released in a definite order, from inboard to outboard and on alternate sides of the airplane when both racks are used together. The bomb selector circuits and the nose fuse circuits are protected from current overloads by integral toggle-type circuit breakers. The bomb safety switch circuits and the firing switch circuits on the control stick are protected from current overloads by the push-button type circuit protector ("ARMAMENT CONT.—PUSH-TO-RESET") located just above the pilot's control shelf and to the

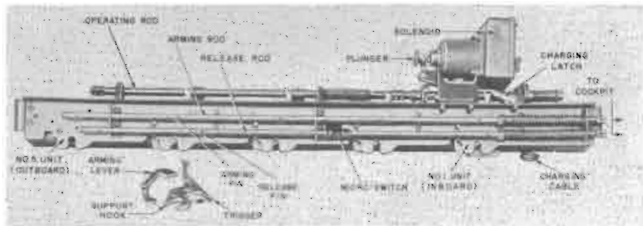


Figure 340 — Bomb Rack (Type NA 84-63005)

left of the electrical control panel. Provisions are made for a bomb control quadrant on the control shelf on the left side of the front cockpit. This quadrant provides an arming and release handle, stamped "A" and "R," respectively. The arming handle, by means of a cable to each of the wing bomb racks, will arm the

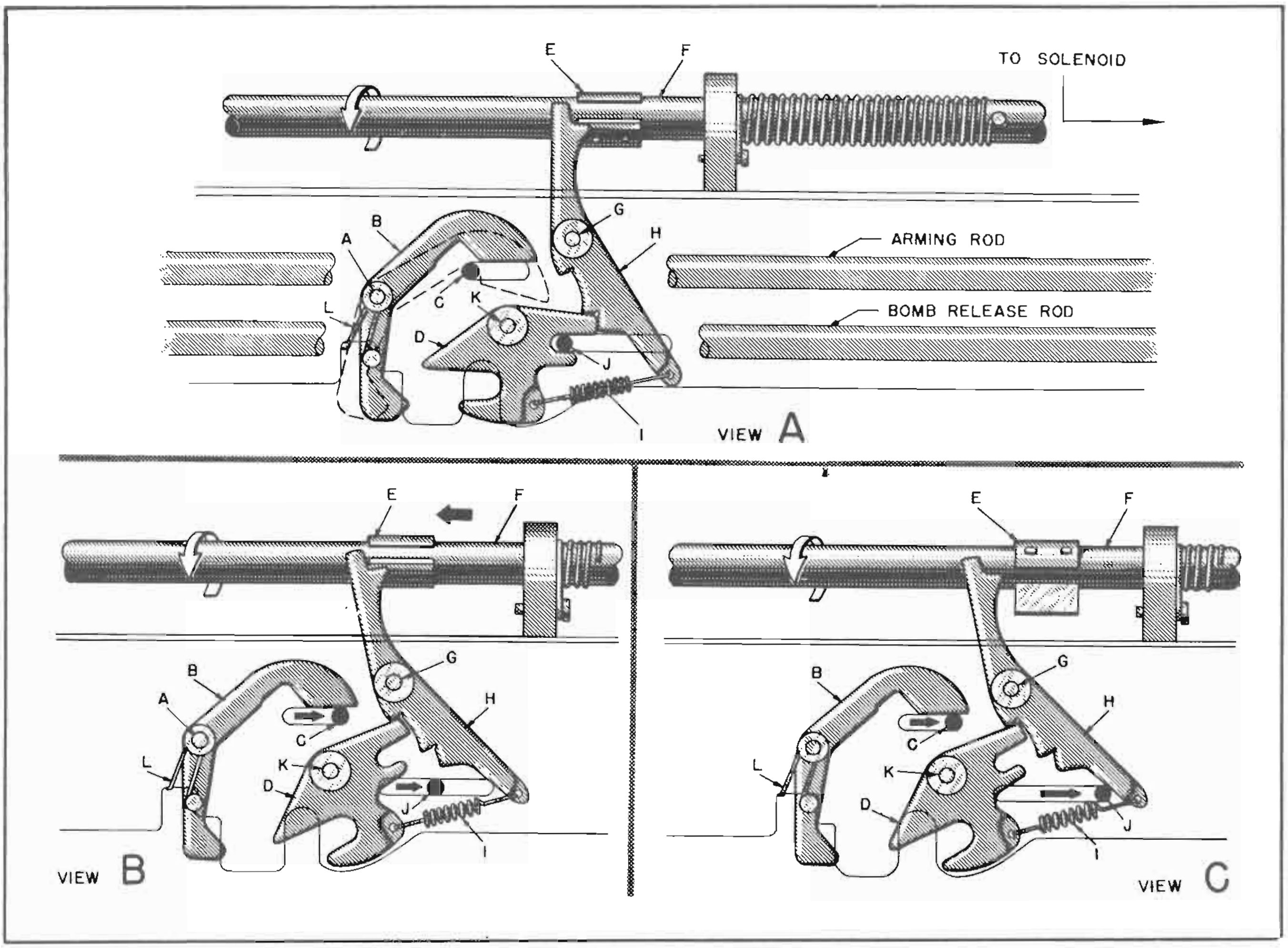


Figure 341 — Bomb Rack Operating Diagram (Type NA 84-63005)

20- and 30-pound bombs at the nose, and the 100-pound bombs at the tail. Except for nose-arming the 100-pound bombs, which is accomplished by the toggle switch on the electrical control panel, all arming must be done through this arming handle. The release handle, when at "LOCK" position, locks the entire system and will prevent release, either electrically or manually, of all bombs. The handle must be moved to "SELECTIVE" position before electrical release can be accomplished. In moving the release handle to "SALVO," all bombs are dropped simultaneously, either in the armed or safe condition according to the setting of the arming handle and the electrical toggle switches on the control panel. Provision is also made for a release handle in the rear cockpit (figure 345) beneath the control shelf on the left side, which will only SALVO all bombs. This is for use in an emergency and will release bombs either in the safe or armed condition, according to the position of the arming handle and the electrical toggle switches in the front cockpit.

b. BOMB RACKS.

(1) DESCRIPTION.—The bomb rack bays are located within the lower surface of each outer wing panel. The bays are sealed with an Alclad cover plate when the racks are not installed and protected by an Alclad cover plate with cut outs, allowing for the bomb support hooks and charging cable, when the racks are installed. The bomb rack can be operated selectively with the electrical bomb release switch on the pilot's control stick or in salvo with the manual bomb release handle in the front cockpit.

(a) TYPE NA 84-63005 BOMB RACKS.—On earlier models of this airplane, a 12-volt electrical system is employed. The bomb racks installed therein are designed for use only in a 12-volt electrical system. The bomb rack mechanism is illustrated in Fig. 341. There are five such units in each rack as shown in Fig. 342.

1. LOCK POSITION.—The bomb is carried by the bomb support hook "D," which is held in the closed, or cocked position, as illustrated in view "A," by the notch of the spring-loaded trigger "H." Movement of the release pin "J" is controlled by the bomb release rod, which, in turn, is connected by a cable to the release handle of the bomb control quadrant in the front cockpit. When the release handle is placed in "LOCK" position, the release pin "J" will engage the notch in the bomb support hook "D," thus preventing its rotation about pivot point "K." At the same time, the movement of the bomb release rod will depress a micro-switch, which will break all electrical connections to the rack. This will prevent release, either manually or electrically, of the bomb load.

2. SELECTIVE POSITION.—As the release handle is moved to the "SELECTIVE" position, the release pin "J" will move out of the notch in hook "D" (view "B"). An electrical impulse, started as the release switch on the pilot's control stick is depressed, will cause the solenoid to move the shaft "F" outboard, or to the left, as illustrated in view "B." Clip "E" will engage trigger "H" and move it about its pivot point "G." This movement will release the bomb support hook "D" and allow it to open. The bomb will drop free. Shaft "F" is spring-loaded to rotate as indicated. As the first bomb is dropped, the shaft will rotate bringing another clip into position to fire the second bomb and each of the remaining bombs consecutively, starting inboard and proceeding outboard. This provides selective firing, and one bomb will drop each time the bomb release switch on the pilot's control stick is depressed.

3. ARMING POSITION.—The arming lever "B" retains or releases the bomb arming cable when the arming handle, located on the bomb control quadrant in the front cockpit, is in the "ARMED" or "SAFE" position, respectively. The arming pin "C" is connected to the arming rod, which in turn is connected by a cable to the arming handle of the bomb control quadrant. When the arming handle is in the "SAFE" position, the arming lever "B" is free to move about its pivot point "A." In this condition, the weight of the bomb dropping free of the airplane is sufficient to pull the bomb arming cable free of the arming lever "B." Thus, the bomb drops unarmed or safe. As the arming handle moves to the "ARMED" position, pin "C" moves as illustrated in view "B," to a position which will prevent any rotation of the arming lever "B." In this condition, the bomb arming cable is held by the arming lever "B" as the bomb drops free. The bomb drops armed; at the nose in the case of the 20- or 30-pound fragmentary bombs, or at the tail in the case of the 100-pound bombs.

4. SALVO POSITION.—As the release handle on the bomb control quadrant is moved to the "SALVO" position, the release pin "J" will move as illustrated (view "C"), rotating trigger "H" and releasing the bomb support hook "D." By this operation, all bombs contained in the same rack are released simultaneously. They are released either in the armed or safe condition, depending upon the position of the arming handle on the bomb control quadrant and the toggle switches on the pilot's electrical control panel.

(b) TYPE R-1502 BOMB RACKS.—On later airplanes, with the 24-volt electrical system, a type R-1502 bomb rack is being used. This rack is of such design that it may be used on either 12- or 24-volt systems and is interchangeable with the NA 84-63005 rack. The rack mechanism is illustrated in figure 343.

1. LOCK POSITION.—The bomb is carried by the bomb support hook "C" which is held in the closed, or cocked position, as illustrated in view "A," by the trigger "D" through the link "B" and latch "E" assembly. As the hook "C" is rotated about its pivot point into the cocked positon, latch "E" is also rotated by the action of the connecting link "B" until it is held in the notch of the trigger "D." Pin "A" is controlled by the movement of the bomb release rod, which, in turn, is connected by a cable to the release handle of the bomb control quadrant in the front cockpit. As the release handle is moved to the "LOCK" position, the bomb release rod and pin "A" will move inboard or to the right, as illustrated, preventing trigger "D" from being tripped. This will prevent release either manually or electrically of the bomb load.

2. SELECTIVE POSITION.—As the release handle on the bomb control quadrant is moved to the "SELECTIVE" position, the pin "A" will move as illustrated in view "B," releasing the trigger "D" for movement. An electrical impulse, started as the release switch on the pilot's control stick is depressed, will cause the solenoid "G" to move the plunger "F" as indicated. Trigger "D" will rotate tripping the spring-loaded latch "E" and opening the bomb support hook "C" by the action of the connecting link "B." The bomb will drop free. With the release handle in "SELECTIVE" position, bombs will drop consecutively starting inboard and proceeding outboard. One bomb will drop each time the release button on the pilot's control stick is pressed. The electrical impulse for dropping the first, or inboard bomb, is transmitted through contacts "1" and "2" of the unit's switch block "H" to the solenoid "G." When the unit is in the cocked position (view "A"), contacts "1" and "2" are moved together by the pressure of the spring-loaded contact "2." As the unit is tripped (view "B"), contacts "1" and "2" are separated and contacts "2" and "3" are moved together by the pressure of spring "I" on spring "J." This action automatically transfers the electrical impulse to the "1" and "2" contacts on the second switch, which will fire the second bomb and each bomb thereafter in consecutive order as the release button is operated.

3. ARMING POSITION.—The spring-loaded arming pin "L" (view "C") retains or releases the bomb arming cable when the arming handle, located on the bomb control quadrant in the front cockpit, is in the "ARMED" or "SAFE" position, respectively. The spring-loaded plunger "K" when depressed (view "C") will lock the arming pin "L;" and as the bomb falls from the rack, the arming cable will be retained. Thus, the bomb will fall armed. When the plunger is not depressed (view "A"), the weight of the falling bomb will be sufficient to pull the cable free of the arming pin "L." The bomb will then fall safe, or unarmed. The plunger "K" is controlled by the rotation of the arming pawl "M," which, in turn, is controlled by the bomb arming rod. The bomb arming rod is connected by a cable to the arming lever on the bomb control quadrant in the front cockpit. When the arming handle is at "SAFE" position, the plunger "K" is not depressed (view "A"). As the handle is moved to the "ARMED" position, the bomb arming rod causes the arming pawl "M" to rotate. Thus, the plunger "K" is depressed (view "C"), the arming pin "L" is locked, and the unit is armed.

4. SALVO POSITION.—As the arming handle on the bomb control quadrant is moved to the "SALVO" position, the pin "A" will move as illustrated (view "C"), tripping the trigger "D" and opening the bomb support hook "C" through the action of link "B." This operation will release all bombs contained in the rack simultaneously. They will be released either in the armed or safe condition, depending upon the position of the arming handle on the bomb control quadrant, and the toggle switches on the pilot's electrical control panel.

(2) REMOVAL.—Removal from the airplane of either of the two types of bomb racks will be substantially the same, and any differences will be obvious upon inspection. The procedure is as follows:

(a) Remove the cover plate.

(b) Disconnect the lower cable at the turnbuckle.

(c) Disconnect the upper cable at the turnbuckle.

(d) Hold the rack in place; remove the nut at each end.

(e) Lower the rack; remove the flexible conduit and electrical wires at their connections on the rack.

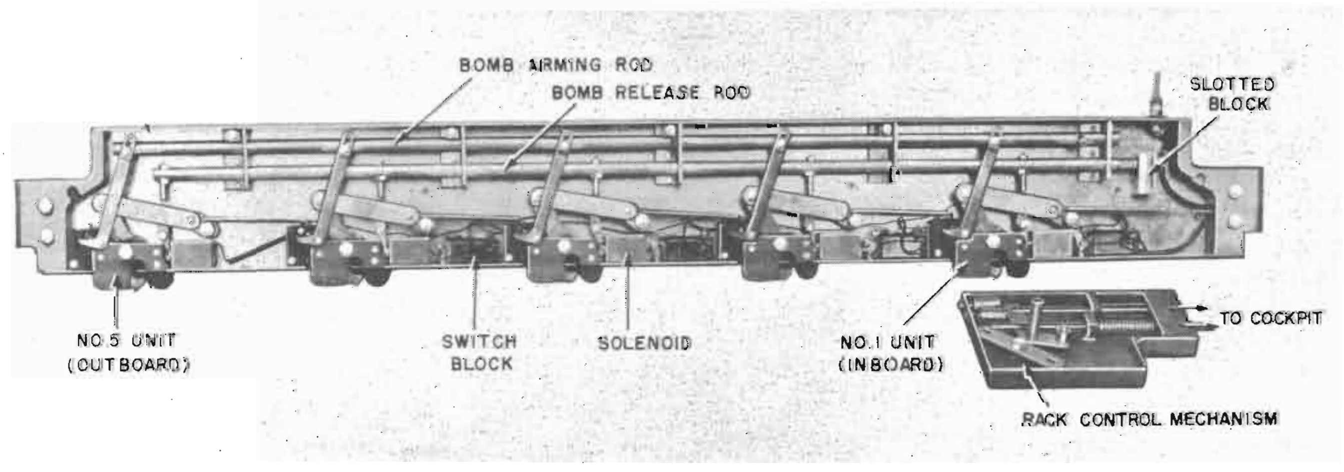
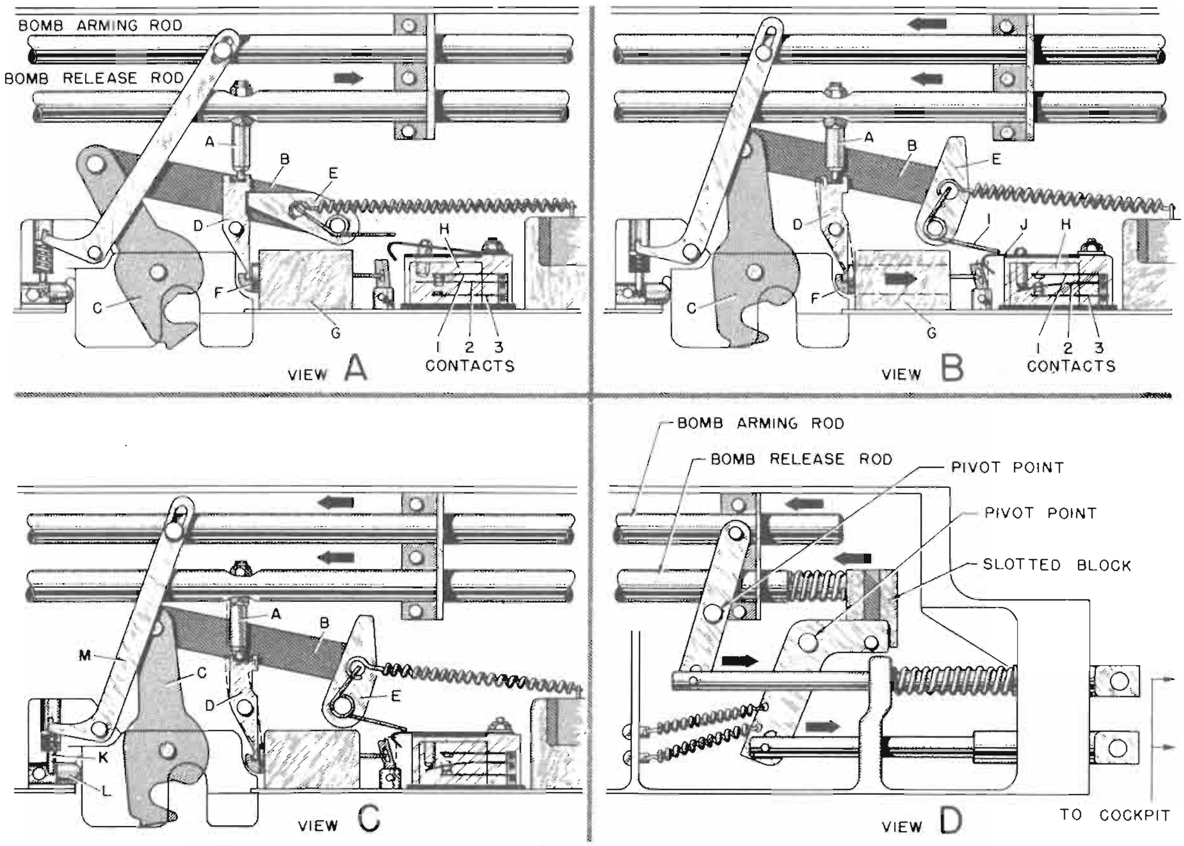


Figure 242 — Bomb Rack (Type R-1502)



A—Pin
B—Link
C—Bomb Support Hook
D—Trigger
E—Latch
F—Plunger
G—Solenoid
H—Switch Block
I—Spring
J—Spring
K—Plunger
L—Arming Pin
M—Arming Pawl

Figure 343 — Bomb Rack Operating Diagram (Type R-1502)

CAUTION

Great care should be exercised in the handling of bomb racks. If the rack is dropped or damaged in any way, a thorough check must be made to insure operational perfection.

(3) INSTALLATION.—Both types of bomb racks are installed, as instructed below:

(a) Raise the racks into place; secure them at each end. Add washers, as required, above the attachment fittings of the rack to position the lower surface of the rack frame with the lower surface of the outer panel.

(b) Connect the upper control cable to the clevis end of the upper rod on the rack by means of a turnbuckle.

(c) Connect the lower cable to the lower rod on the rack with a turnbuckle.

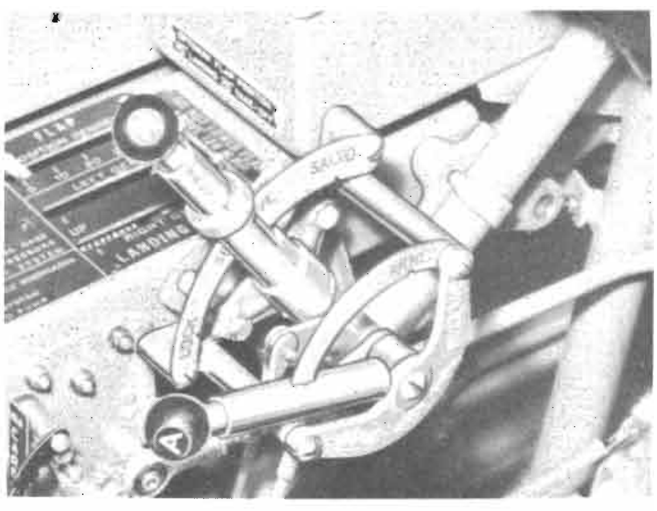


Figure 344 — Bomb Release Quadrant

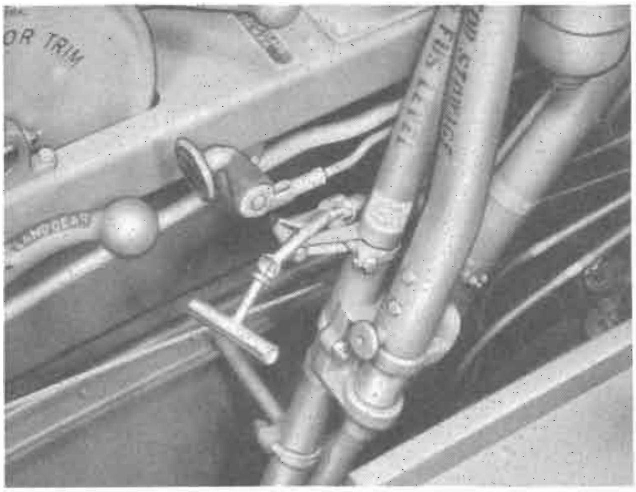


Figure 345 — Bomb Salvo Handle

(4) MAINTENANCE.

(a) The bomb racks are designed to operate without lubrication and must be kept free from oil and dirt. If an appreciable amount of dirt or oil is found on the mechanism, clean with kerosene and thoroughly dry with air pressure. The mechanism must be completely dry before being reinstalled or placed in storage.

(b) Repairs to this equipment will consist of the replacement of parts when necessary, or such straightening or alignment as may be required. Whenever repairs which are beyond the facilities of the service personnel are required, the repairable mechanism should be appropriately marked and returned to the control depot for repair.

(5) ADJUSTMENT.

NOTE

No adjustments are necessary, in service, on the type R-1502 bomb racks.

Before installation in the airplane, the type NA 84-63005 bomb racks should be adjusted as follows:

(a) Adjust the spring on the operating cam shaft so that it is wound up 1-$\frac{7}{8}$ turns when rack is in the "charged" position.

(b) Adjust bomb release trigger with .031 ($\frac{1}{32}$ plus $\frac{1}{64}$) clearance between the trigger and the release cam.

(c) Adjust solenoid plunger and bomb release solenoid trigger to .015 clearance before contact.

(6) TESTING.—Cock all bomb rack support hooks. With the release handle on the bomb control quadrant set at "SELECTIVE," press the firing switch on the control stick. Racks should operate as selected by the operator on the electrical control panel, and in the order indicated by figure 339.

(a) On the type R-1502 bomb racks, cock only the outboard support hooks, operate the racks electrically, and check operation of the skip-unit feature. The last support hook should operate without hesitation.

(b) Attach bomb shackles to the No. 2 and 4 bomb support hooks on each rack. Shackles should attach easily, and the bomb release lever on the shackle should engage the bomb support hook in the rack readily. Operate electrically to check function of the shackles.

(c) With all support hooks in both bomb racks cocked and the release handle on the bomb control quadrant at "LOCK," try electrical release. No bomb racks should operate.

(d) With all support hooks in both bomb racks cocked, move the release handle on the bomb control

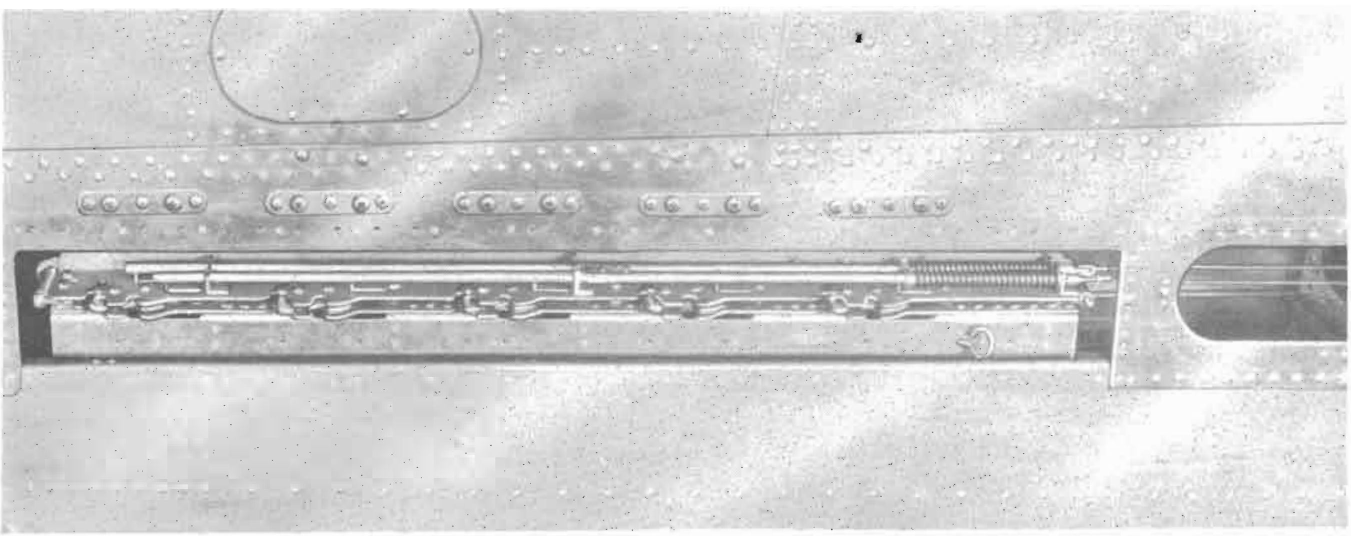


Figure 346 — Bomb Rack Installed

quadrant to "SALVO." All support hooks should release simultaneously.

(*e*) Check the release handle on the control quadrant to see that a satisfactory stop has been installed to prevent unintentional movement of the handle to "SALVO" position.

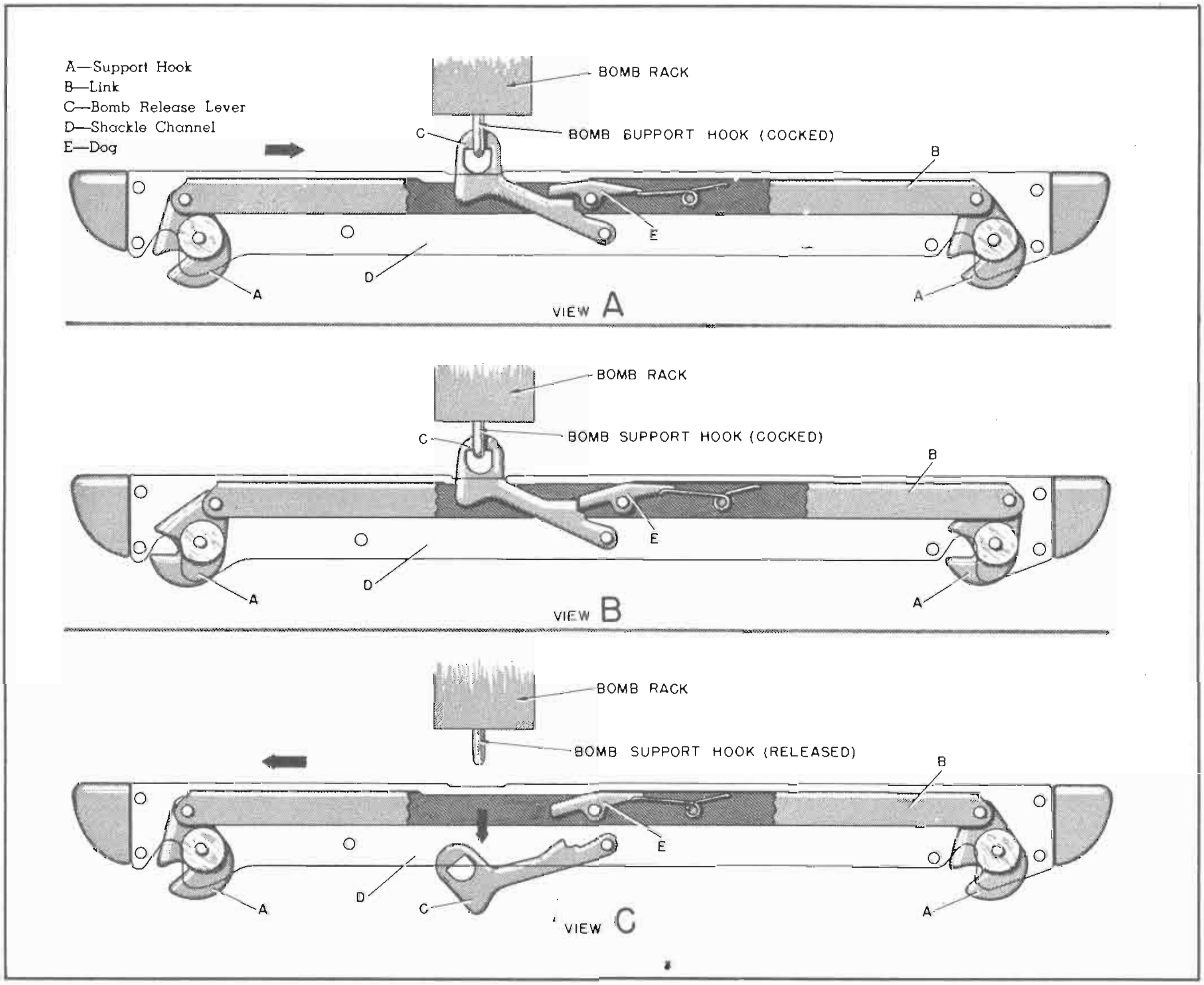


Figure 347 — Bomb Shackle Diagram

c. BOMB SHACKLES.

(1) DESCRIPTION.—When it is desired to carry the 100-pound bombs, two bomb shackles (type NA 84-63020), are attached to each bomb rack at the second and fourth bomb support hooks. Each shackle has two heavy brackets which are bolted to the lower surface of the wing just forward of the bomb rack. The bomb release lever "C" on the shackle should fall directly beneath the bomb support hook in the rack. Each shackle has two bomb support hooks, "A" connected by means of a link "B" in the shackle channel "D" and controlled by the bomb release lever "C" through the channel in the center of the shackle. The ring in the bomb release lever "C" is held up (view "A") by the bomb support hook in the bomb rack when the hook is in the closed, or cocked position. With the lever "C" in the up position and support hooks "A" opened, it will engage the spring-loaded dog "E" (view "A"). Then, as the bombs are loaded into position and the bomb support hooks "A" are closed manually, link "B" will move in the direction indicated, causing the dog "E" to lock against the release lever "C" (view "B"). This operation will prevent further movement of the link "B," and the hooks "A" will remain closed until lever "C" is released by the firing of the bomb rack and the subsequent opening of the bomb support hook in the bomb rack. As lever "C" is released, it will rotate downward (view "C"). The link "B" is again free to operate, and the weight of the bomb will pull the support hooks "A" open.

(2) INSTALLATION.—Prior to installing the bomb shackles, wind in the 20- and 30-pound bomb sway braces at the second and fourth stations as far as possible, and lock into place. Attach the shackles with screws.

(3) MAINTENANCE.—The bomb shackles are designed to operate without lubrication and must be kept free from oil and dirt. Clean the mechanism with kerosene when necessary and dry thoroughly with air pressure. Repairs will consist only of replacement of parts and such straightening or alignment as may be accomplished with the facilities available to the service personnel.

d. AUXILIARY ARMING UNITS (TYPE B-1).

(1) DESCRIPTION.—Two of these auxiliary arming units are provided for each bomb rack to nose-arm the 100-pound bombs, when installed. They are mounted within the wing on the wing lower surface forward of the bomb rack mechanism. This arming unit has a spring-actuated ball catch which retains the arming wire swivel loop. This ball catch may be locked in the "ARMED" position by energizing the integral solenoid. The solenoid is energized by the nose fuse toggle switch mounted on the electrical control panel in the front cockpit.

(2) REPAIR.—Minor repairs should be made by regular mechanics. In the case of major damage, such as a burned out solenoid or a broken part, complete replacement should be made.

(3) ADJUSTMENT.—The bomb arming control unit must be adjusted so that when it is not energized, it will support a 3-pound load without releasing the arming wire swivel loop, and will fail to support a 4-pound load. Also, adjust the unit so that when it is energized, it will support a 50-pound load.

e. CONTROL CABLES.

(1) REMOVAL.—In the event that any or all of the control cables must be removed for repair or replacement, the procedure is as follows:

(a) Disconnect the cables attached to the upper and lower bomb rack operating rods.

(b) Remove the clevis pin from the pulley bracket just inboard of the bomb rack.

(c) Disconnect the cables attached to the bell cranks just forward of the pulley bracket, and remove the outboard cables.

(d) Pull the cables into the cockpit.

(e) Disconnect the cables at the links just below the quadrant in the cockpit.

(f) Disconnect the two inboard cables at the bomb release operating quadrant.

(g) Disconnect the rear cockpit salvo release cable. (See figure 345.)

(2) INSTALLATION.

(a) Inspect cables for frayed splices, broken strands, and insecure attachment fittings before installation.

1. Attach the arming cable to the arming handle on the bomb control quadrant in the front cockpit, with a clevis pin.

2. Attach the release cable to the release handle with a clevis pin.

3. Attach a link to the free end of the arming cable and the release cable with clevis pins.

Figure 348 — Bombs Installed

4. String the cables over the pulleys at the bottom of the cockpit. Locate the cables from the arming control handle over the aft pulleys, and the cables from the release handle over the forward pulleys.

5. Run the arming cables through the aft tube on each side into the wing.

6. Run the release cables through the forward tube on each side into the wing.

7. Two bell cranks are installed inboard and forward of the bomb rack bay in each wing. Attach the release cables and arming cables to the forward and aft bell cranks, respectively, at the upper arm of each bell crank. Secure with clevis pins.

8. Attach the rack release rod, or cable, and the rack arming rod, or cable, to the forward end of the bell cranks, at the lower arm of each bell crank, respectively. Secure with clevis pins.

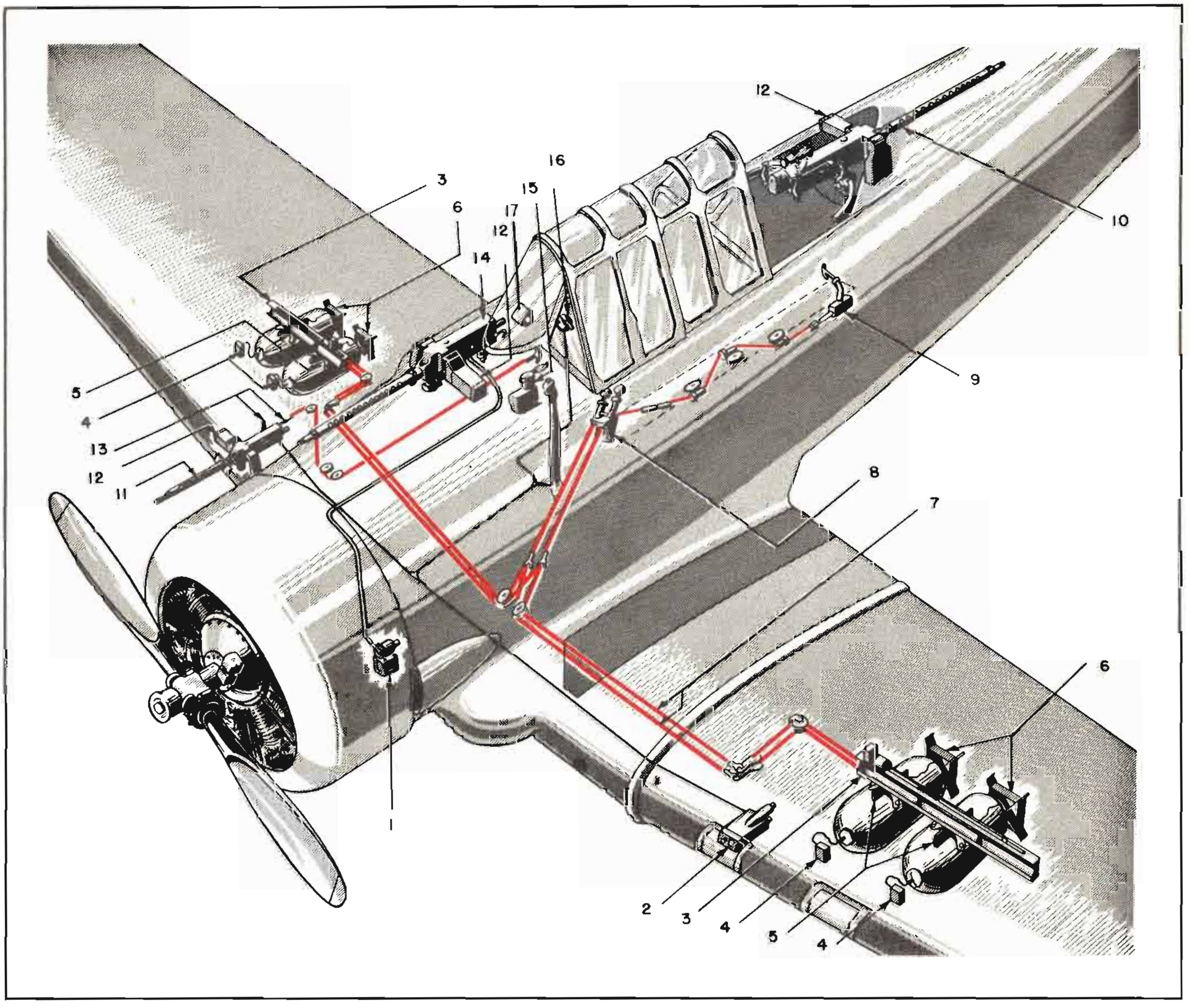


Figure 349 — Armament Installation Diagram

1. Gun Synchronizer and Impulse Unit
2. Gun Camera
3. Bomb Racks
4. Nose Fusing Solenoid
5. Bomb Shackles
6. Bombs
7. Control Cables
8. Front Cockpit Bomb Quadrant
9. Rear Cockpit Salvo Handle
10. Flexible Gun
11. Wing Gun
12. Ammunition Boxes
13. Gun Charger and Cable (Wing Gun)
14. Fuselage Gun
15. Gun Sight
16. Film Consumption Indicator
17. Gunsight Reflector Glass

9. String both cables over the pulleys just below and aft of the bell cranks in each wing; the arming cable over the upper pulleys, and the release cable over the lower pulleys. Insert clevis pins through the holes provided in the outboard corner of each bracket to act as pulley guards.

(b) Only the emergency salvo release cable extends to the rear cockpit. Rig as follows:

1. Attach the rear cockpit bomb salvo handle to the fuselage frame tube with a clamp and bolts. (See figure 345.)

2. String the cable over the bracket just above the connecting point; install the pulley guard and pulley.

3. Connect cable to the release cable in the front cockpit at the clip just above the link, with clevis pins.

19. GUNNERY EQUIPMENT.

a. GENERAL.—The gunnery equipment consists of three model M-2, Caliber .30 Browning Machine Guns. Two of the guns are fixed and one is flexible. The fixed guns are located, one on the right side of the fuselage forward of the front cockpit, and the other one in the right outer wing panel. (Model AT-6 and AT-6A airplanes were not provided with this outer wing gun.) The flexible gun is mounted on a track attached to the aft end of the rear cockpit. Provisions are made for manually charging the fixed guns from the cockpit. A type W-7B gun camera may be installed on the leading edge of the left wing and operated by the firing button on the control stick grip. A gun camera film consumption indicator may be installed on the bracket provided in the front cockpit. For further details on the gun camera, refer to paragraph 17, "Photographic." An optical gun sight, type N-3B, type N-2A, or N-3A on earlier airplanes, is installed. A gun synchronizing unit, type E-4, is installed to permit firing the fuselage gun through the propeller arc. (See figure 359.)

b. M-2 MACHINE GUNS.

(1) TROUBLE-SHOOTING. — During operation, an improper action of some part of the gun may result in a stoppage or accidental cessation of firing. Stoppages may be prevented by proper care of the gun and attention to preflight and after-flight inspection. (See "Inspection," section X.) However, stoppages may occur in spite of all that can be done to prevent them. Stoppages are classified according to the position in which the bolt is found when the gun stops firing.

(a) BOLT FORWARD.—When the bolt is all the way forward, malfunction can develop from the following causes:

1. Misfire due to defective primer.

2. Short or broken firing pin.

3. Weak or broken firing pin spring.

4. Faulty engagement of firing pin and sear notch.

5. Worn or bent cocking lever.

6. Belt improperly loaded (may cause a second position stoppage).

7. Short cartridge.

8. Bent or worn belt feed lever (may cause a second position stoppage).

9. Belt feed pawl spring weak or out.

10. Cover extractor spring weak or out.

11. Defective bolt switch (stud on end of belt feed lever jumps out of cam groove).

12. Damaged extractor (may cause a second position stoppage).

Figure 350 — Guns and Bombs Installed

13. Belt-holding pawl out or spring weak.

14. Belt-holding pawl fails to depress (may cause a third position stoppage).

15. Front end of trigger far bent downward.

16. Tip of trigger broken.

17. Early timing.

(b) BOLT HALFWAY BACK.—When the bolt is between all the way forward and halfway back, malfunction can develop from the following causes:

1. Separated case which stays in the chamber when bolt is pulled to rear.

2. Separated case which is partially removed from the chamber by the new round when bolt is pulled to the rear.

3. Separated case, due to too much head space (may cause either condition *1.* or *2.* preceding).

4. Head space adjustment too tight.

5. Broken or missing barrel-locking spring (may result in either condition *3.* or *4.* preceding).

6. Broken extractor.

7. Driving spring weak.

8. Barrel plunger spring wear.

9. Broken T-lug or bent barrel plunger stud on barrel extension.

10. Bullet loose in cartridge case.

11. Tight link in belt.

12. A bulged round.

(c) BOLT BACK.—When the bolt is between halfway forward and all the way back, malfunction can develop from the following causes:

1. Battered or thick rim of cartridge.

2. Broken cannelure.

3. Enlarged hole in recoil plate (set back primer).

4. Belt feed pawl arm bent or broken.

5. Top cam of extractor worn.

6. Cover extractor cam worn.

7. Broken or damaged T-cut in bolt.

8. Thin rim of cartridge permitting nose of bullet to drop below the chamber.

(2) DEGREASING.—If the gun has come from storage coated with rust-preventive compound or has been covered with the wrong type of grease, adhere to the following procedure to degrease the gun:

(a) Disassemble the gun completely and place all parts except the oil buffer assembly and back plate assembly in a vat of soda ash solution, (1/2 to 1 pound of soda ash to each gallon of water), or boiling soap and water (sufficient soap to make good suds), and allow them to remain in the solution approximately 30 minutes.

(b) After the parts have been thoroughly cleaned as above, they should be swirled in dry cleaning solvent to remove any traces of rust-preventive compound, thoroughly dried, and oiled.

(c) The oil buffer assembly and back plate assembly will be cleaned separately by hand with dry cleaning solvent to prevent damage to the oil buffer packing and back plate fiber discs.

(d) The surfaces must be thoroughly dried immediately after removal of the solvent. Since finger marks are ordinarily acid and induce corrosion, gloves should be worn by persons handling the parts after cleaning them.

NOTE

Dry-cleaning solvent will attack and discolor rubber.

(3) CLEANING.—To clean the gun after it has been fired, adhere to the following procedure:

(a) Place the gun barrel, muzzle down, in a vessel containing hot water. Add soap or sal soda solution to the water if either of them is available.

(b) Insert into the breech a cleaning rod with a flannel patch attached. Move the rod forward and back for about 1 minute to pump water in and out of the bore.

(c) While the bore is wet, run a brass or bronze brush through the barrel three or four times.

(d) Pump water through the bore again to clean it.

(e) Dry the cleaning rod and remove the barrel from the water. Using dry, clean flannel patches, thoroughly swab the bore until it is perfectly dry and clean. Dry and clean the chamber thoroughly, using a flannel patch on a stick if necessary.

(f) After cleaning, the guns will be oiled with oil, lubricating preservative, special, US Army Specification No. AXS-777, latest issue.

(g) Clean the gun not later than the evening of the day on which the gun is fired, preferably as soon as possible after cessation of firing.

(h) Inspect and clean the guns 3 days following cessation of firing.

(i) Wipe the receiver clean, carefully removing all dirt from the belt-holding pawl.

(j) Thoroughly clean the cover, bolt, barrel extension, oil buffer, and backplate, using a small stick covered with a flannel patch to remove dirt from all recesses, firing pin holes, etc.

(k) Wipe all of the parts with a clean oily rag.

c. WING GUN.

(1) DESCRIPTION.—Provisions are incorporated in the airplane for the installation and operation of a model M-2, 30-caliber Browning fixed machine gun in the right outer wing leading edge near the center section. Charging the wing gun is effected by a charging

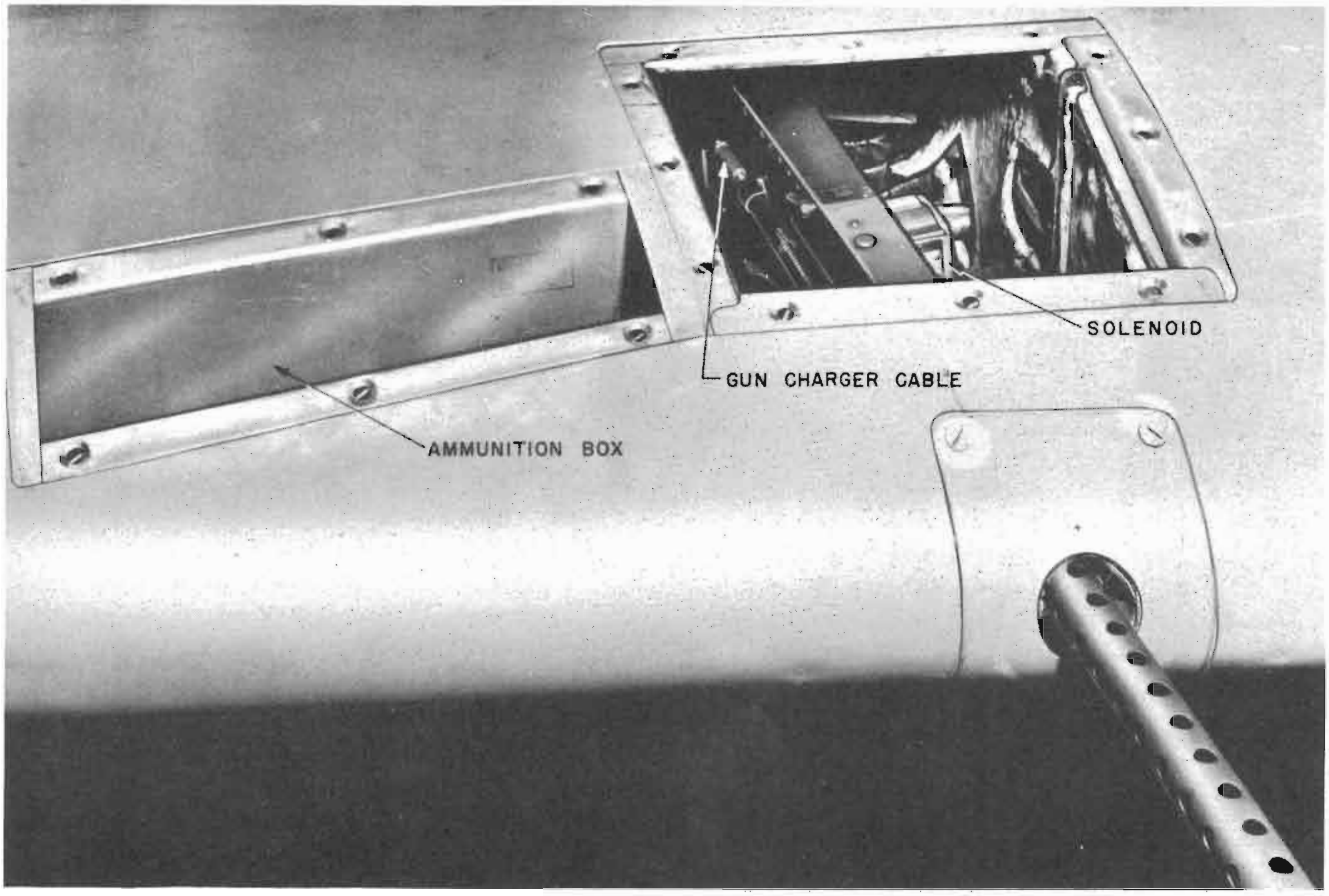


Figure 351 — Wing Gun Installed

cable assembly terminating in a charging control handle located in the pilot's cockpit to the right and below the pilot's electrical control panel. On some earlier airplanes preflight charging was provided and was accomplished by removing the gun bay cover plate and charging the gun directly with the charging handle. However, this feature has been changed to a remote charging system as used on later airplanes. A safety switch on the pilot's electrical control panel controls the electric current to both the wing gun and the fuselage gun. The gun is selectively controlled by means of a gun selector switch also located on the pilot's electrical control panel, and either gun may be selected or both guns may be fired at the same time. A gun firing trigger is provided on the forward side of the control stick grip, which also operates the gun camera when it is selected. A gun sighting chart for the wing gun is cemented to the back of the gun bay cover plate. A wing gun ammunition box accommodating 200 rounds of .30-caliber ammunition is located on the outboard side of the wing gun.

(2) REMOVAL.—To remove the wing gun, adhere to the following instructions:

(a) Remove the solenoid installed on the gun; revolve the solenoid one-half turn to remove.

(b) Remove the pilot's charging cable from the gun by unscrewing the turnbuckle.

(c) Take out the outboard attachment pin on the top of the gun through the inboard side of the feed chute. Detach the feed chute from the yoke.

(d) Remove the yoke at the outboard side of the gun bay. Detach the yoke from the bracket by removing the bolts.

(e) Take out the inboard attachment pin on the top of the gun.

(f) Detach the gun from the gun posts, pull the gun to the rear through the blast tube and remove the gun from the gun bay.

(g) Remove the post assemblies on the forward and aft gun supports.

(3) INSTALLATION.

NOTE

Extreme care must be exercised before and after installing the gun to prevent any foreign matter getting in or on the gun parts.

Install the wing gun as per the following procedure:

(a) Install the post assembly in the aft gun support.

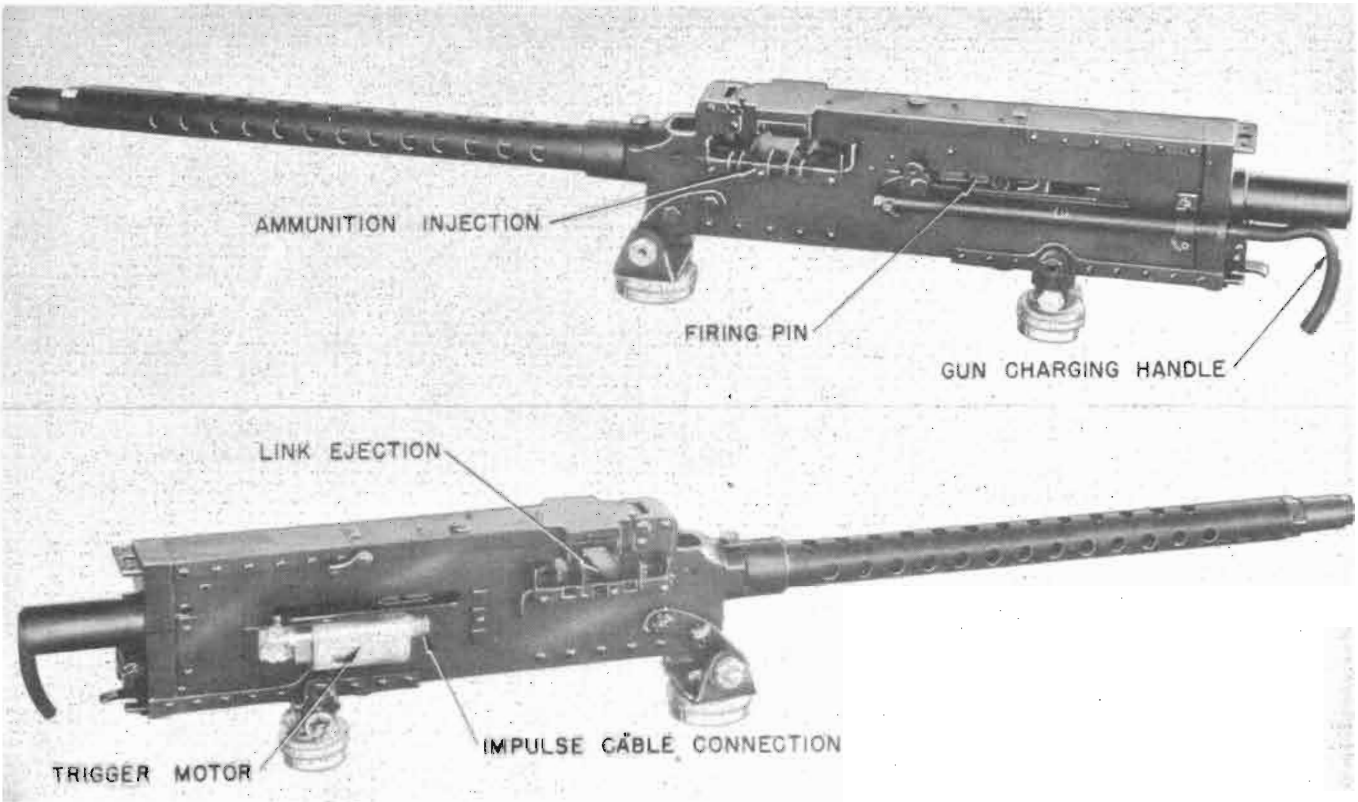


Figure 352 — Fixed Gun

(b) Install the post assembly in the forward gun support.

(c) Install the ejection chute at the outlet on the inboard side of the gun.

(d) Place the gun in the gun bay by inserting the barrel through the aft end of the blast tube; attach the gun to the gun posts.

(e) Insert the inboard attachment pin on top of the gun through the ejection chute clips.

(f) Install the yoke at the outboard side of the gun bay; attach the yoke to the bracket provided.

(g) Insert the outboard attachment pin on top of the gun through the inboard end of the feed chute; attach the feed chute to the yoke with the attachment pins.

(h) Attach the pilot's charging cable to the gun by means of the turnbuckle barrel attached to the cable.

(i) Remove the solenoid from the bracket on the inboard side of the gun bay, revolve the solenoid horizontally one-half turn, and install it on the gun with the same parts that held it on the bracket.

(4) ADJUSTMENTS.

(a) GUN MOUNTS.—After the installation of fixed guns is completed, minor adjustments may be made in order to accomplish accurate bore sighting.

1. Adjust gun on mounts so that distance from center line of gun to the center line of attachment on fuselage frame will be 9-5/16 inches for normal position.

2. By adjusting the adjustment stud on the mounting bracket, an elevation of 1 degree above or 2 degrees 15 minutes below center line may be acquired.

3. Azimuth adjustment of 1 degree to left or right of center line may be had by adjusting front gun post and bracket.

(b) GUN TIMING.—Check the timing of the gun by means of the headspace timing gage, ordnance part No. A-351217. Adjust the solenoid if necessary.

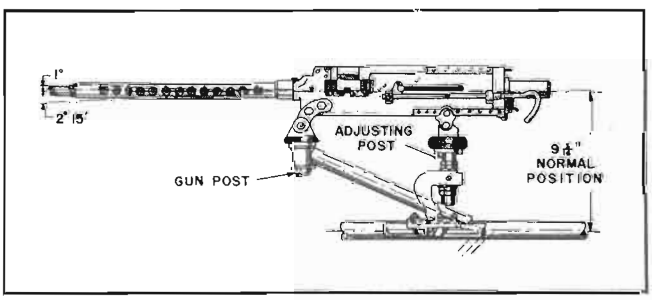


Figure 353 — Fixed Gun Adjustment

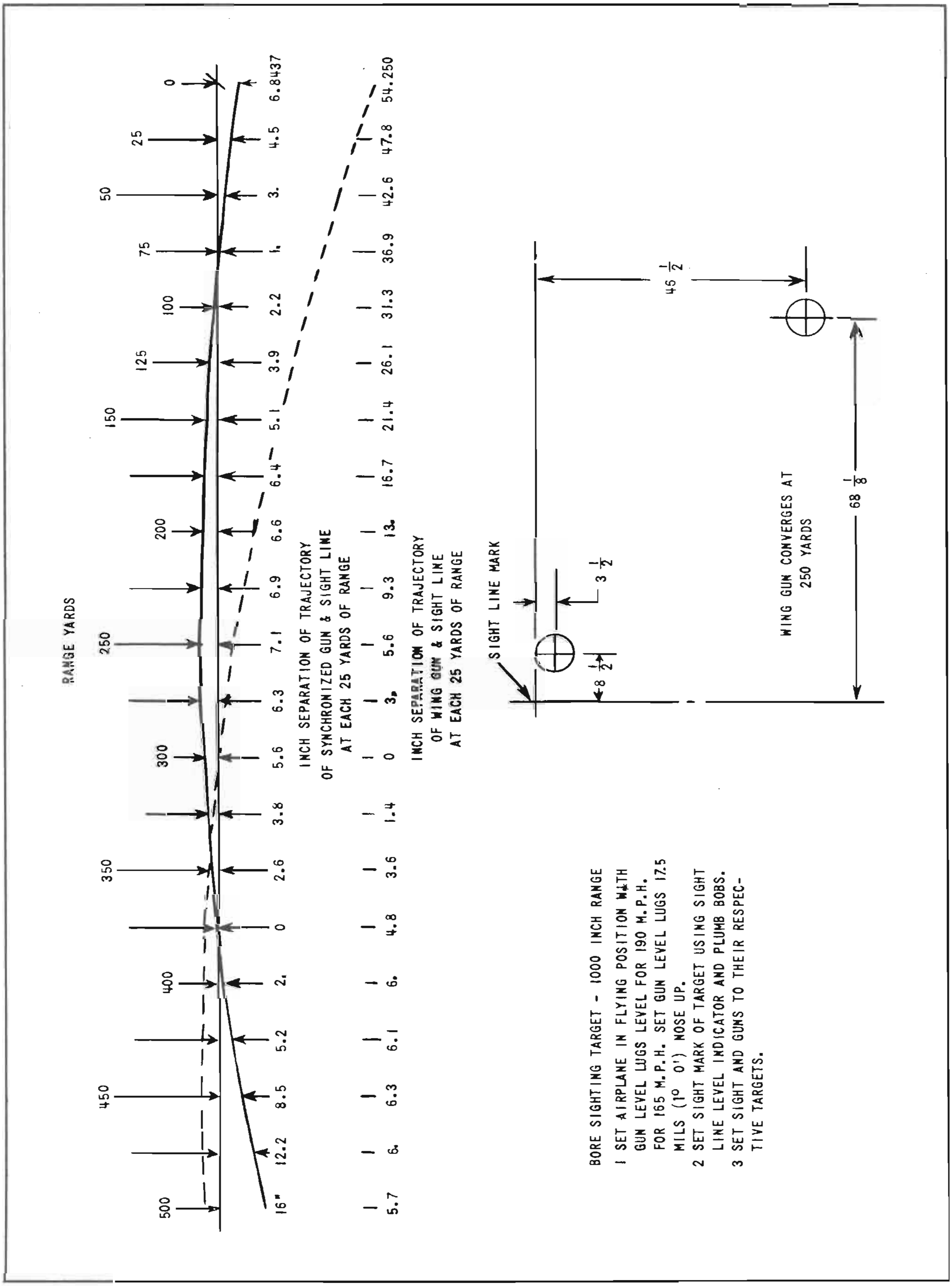


Figure 354 — Boresighting Target

(5) BORESIGHTING FIXED GUNS.—To boresight the fixed guns, proceed as follows:

(a) Jack up airplane, using wing jacks placed under the jack points of each panel and tail jacks stationed at either side of the airplane resting against a lift bar. Each end of the lift bar should be loaded with a 100-pound sandbag as an extra precaution. Screw type jacks shall be used whenever possible, as hydraulic jacks have a tendency to creep.

(b) Select desired target; set airplane at proper attitude indicated on the target. Use airplane level lugs unless otherwise specified on the target.

(c) Set up target 1000 inches from the approximate mean of the gun trunnion bolts.

(d) Attach plumb bobs to 10-32 screws. Insert screws into the two red-circled nut plates located on under surface of the nose and tail of the fuselage.

(e) Align target so that plumb bob strings line up with plub bob line on target.

(f) Attach an A-2 sight line level indicator, part No. 41D3689, to the gun sight reflector. Adjust indicator until bubble and reference line of indicator coincide. Raise target until sight line mark of target coincides with bubble and reference mark of indicator.

(g) Remove indicator and adjust gun sight to align with the sight line mark on target.

(h) Using the proper fixture from a boresighting kit, stock No. 5200-383515, boresight the guns and make adjustments so that they line up with the target.

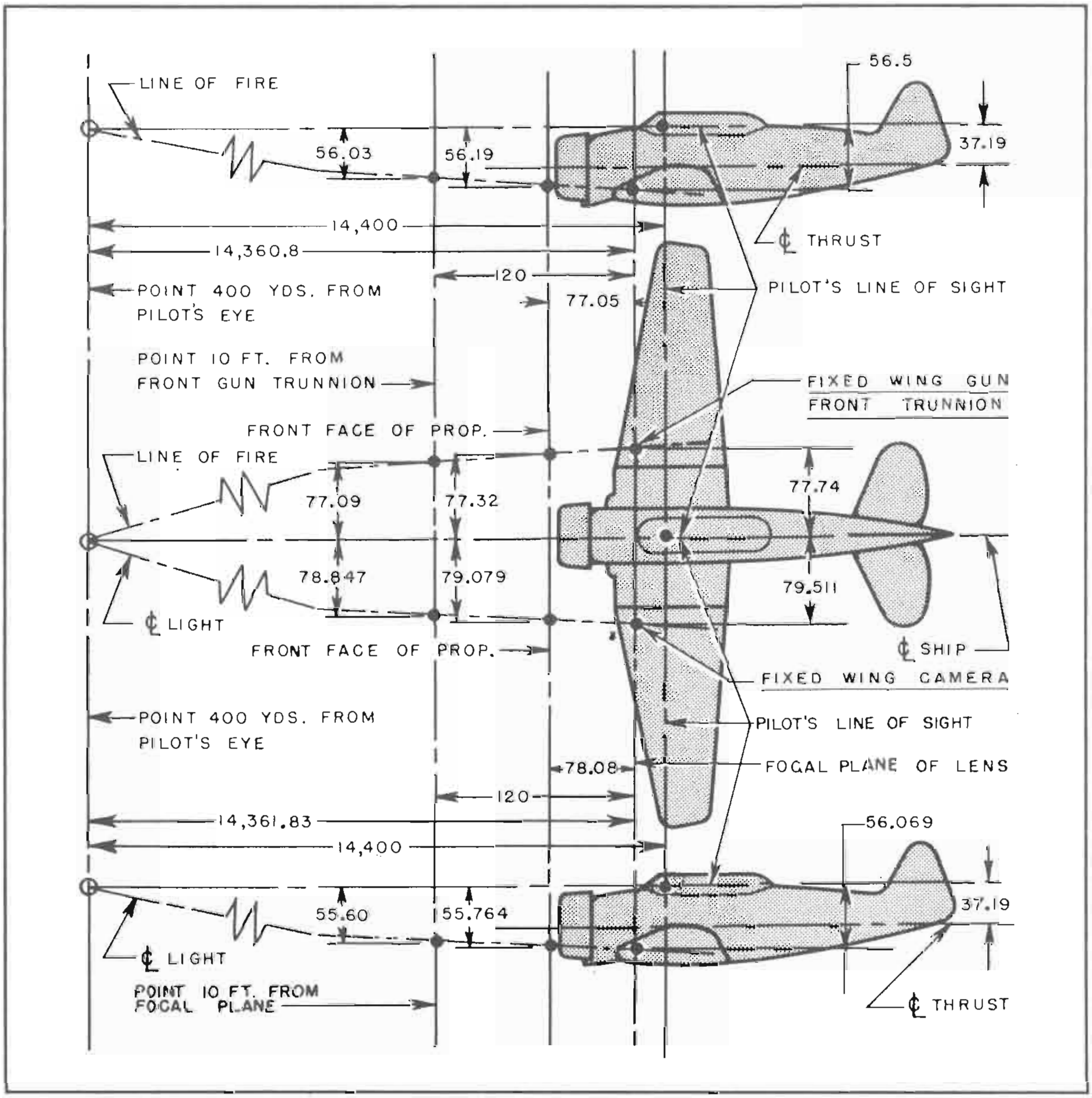


Figure 355 — Wing Gun and Gun Sighting Diagram

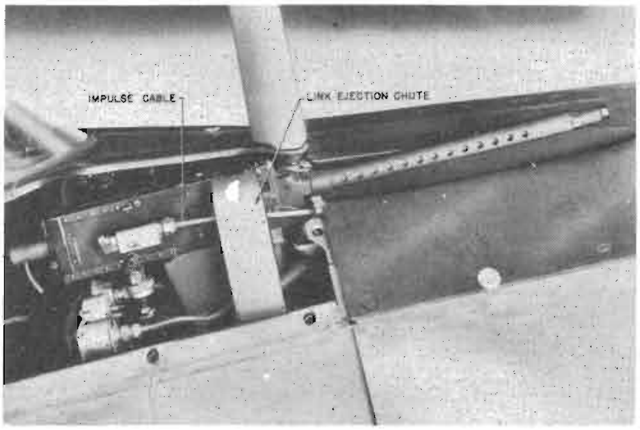


Figure 356 — Fuselage Gun Installed

c. FUSELAGE GUN.

(1) DESCRIPTION. — Provisions are incorporated in the airplane for the installation and operation of a model M-2, caliber .30 Browning fixed machine gun at the right upper side of the fuselage forward of the front cockpit, firing through the propeller arc. The fuselage gun is installed in a manner to provide direct charging with charging handle accessible from right side of front cockpit. A safety switch on the pilot's electrical control panel controls the electric current to the fuselage gun and the wing gun. Both wing and fuselage guns are controlled by means of gun selector switches also located on the pilot's electrical control panel. Either gun may be selected, or both may be fired at the same time by means of a gun firing trigger located on the forward side of the control stick grip. A gun sighting chart for the fuselage gun is cemented to the cowl at the upper left side of the fuselage just aft of the fire wall. The fuselage gun ammunition box, accommodating 200 rounds of caliber .30 ammunition is located on the inboard side of the gun. A gun synchronizing unit, type E-4, is installed to permit firing the fuselage gun through the propeller arc.

(2) REMOVAL.—Remove the fuselage gun according to the following instructions:

(a) Remove the solenoid electrical conduit from the solenoid socket.

(b) Remove the trigger motor from the outboard side of the gun; detach it from the impulse unit.

(c) Take out the gun attachment pin; slide out the feed chute.

(d) Loosen the knurled rings; remove the gun from the gun posts.

(e) Remove the ammunition box by taking out the screws and nuts at the bottom of each of the four corners.

(f) Detach the hinge at the outboard opening of the intermediate chute.

(g) Remove the case ejection chute by removing the nuts and screws between the gun posts.

(h) Remove the lower ejection chute.

(i) Remove the intermediate ejection chute below the gun.

(j) Remove the forward gun posts at the forward support.

(k) Remove the aft gun support and posts.

(3) INSTALLATION.—Install the fuselage gun according to the following procedure:

(a) Install the aft gun support.

(b) Install the aft gun post in the gun support with an adapter and a setscrew. When the gun is set properly, the top of the upper lock is even with the zero reading on the post. Tap the casting lightly to lock the setscrew.

(c) Install the forward gun post at the forward support.

(d) Install the intermediate ejection chute below the gun. Attach the chute to the fuselage frame tubing at the outboard side of the gun and at the gun support.

(e) Install the lower ejection chute.

(f) Install the case ejection chute between the gun posts.

(g) Attach the hinge at the outboard opening of the intermediate chute.

(h) Secure the ammunition box with two screws and nuts at the bottom in each of the four corners.

(i) Install the gun. Lock it in place on the gun posts by turning the knurled ring.

(j) Slide the feed chute on the outer edge of the ammunition box top, and insert the gun attachment pin through the chute attachment holes.

(k) Remove the lubricator fitting from the impulse unit, and attach it to the trigger motor on the outboard side of the gun.

(l) Take the solenoid electrical conduit from the dummy socket; insert it into the solenoid.

(4) ADJUSTMENTS.—For adjustments to the fixed fuselage gun, see "ADJUSTMENTS," paragraph *c.* (4), preceding.

(5) BORESIGHTING.—For boresighting procedure, see "BORESIGHTING FIXED GUNS," paragraph *c.* (5), preceding.

d. FLEXIBLE GUN.

(1) DESCRIPTION.—Provisions are made in the rear cockpit frame for the installation of a model M-2, caliber .30, Browning flexible machine gun. The gun is mounted on a gun mount that trains on a track attached to the aft end of the rear cockpit. A truck-locking handle is provided to secure the gun truck to the track. The locking handle must be raised before the gun truck can be moved along the track. The gun is equipped with a gun yoke locking device to secure it in the stowed position. To remove the gun from the stowed position, see operating instructions. Ammunition boxes located below

the gun, one on the right side and four on the left side of the fuselage, contain 500 rounds of caliber .30 ammunition. The gun is equipped with a type A-1 holder assembly and a type A-3 container assembly. Earlier airplanes use a type A-5 container. The mount and track will permit the gun to rotate approximately 160 degrees radius, facing aft of the airplane. The rear seat may be rotated 180 degrees so that it faces the gun. A foot-operated latch releases the seat from its fore-and-aft positions. A type A-3 gunner's belt with a quick release buckle is attached to the swivel point oı the cockpit seat. Releasing or removing the belt can be effected by pulling up on the handle provided on the buckle, thus allowing the shoulder straps and belt to fall free. The gun may be stowed in a special compartment or trough aft of the rear cockpit by centering

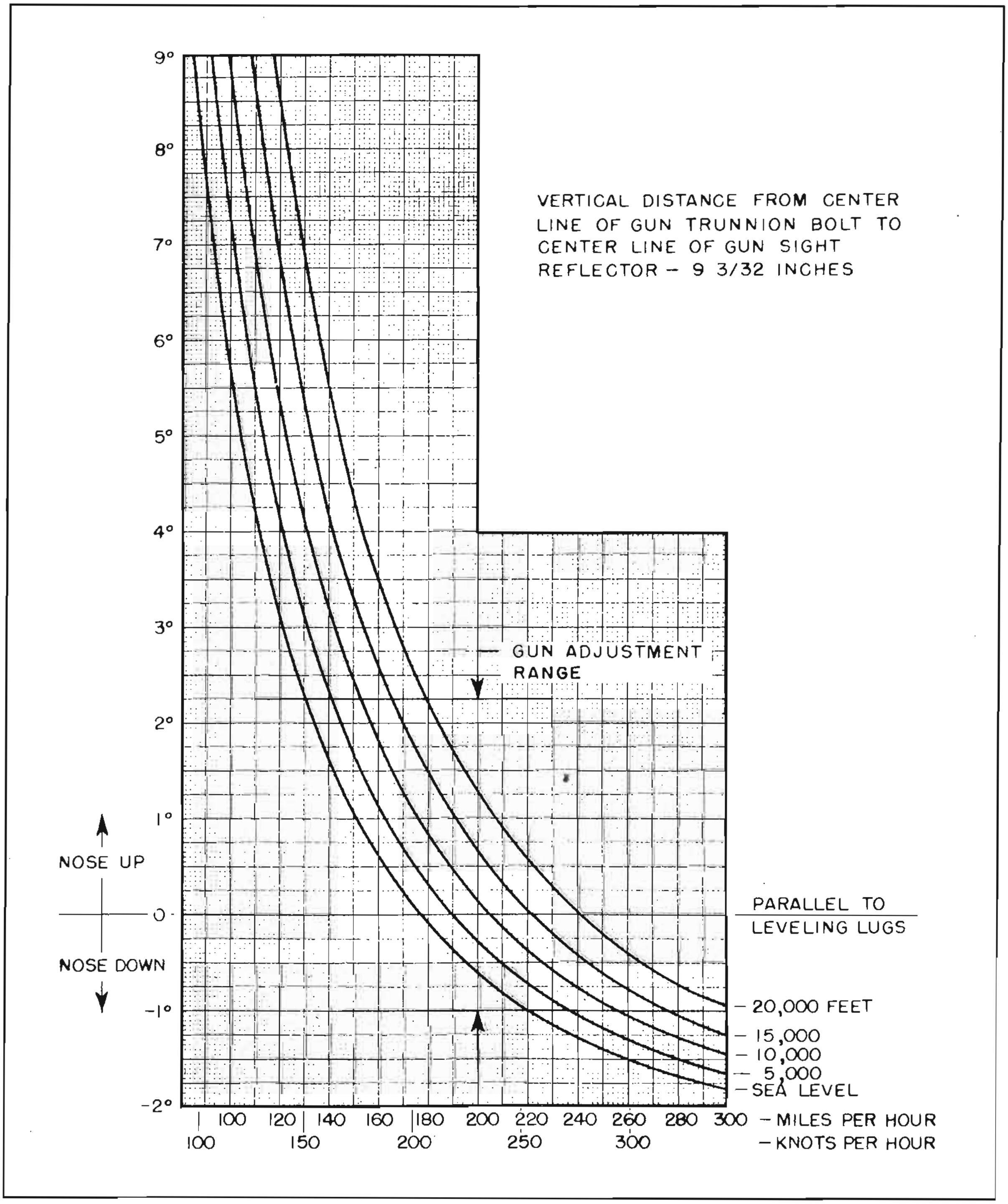


Figure 357 — Fuselage Gun Sighting Chart

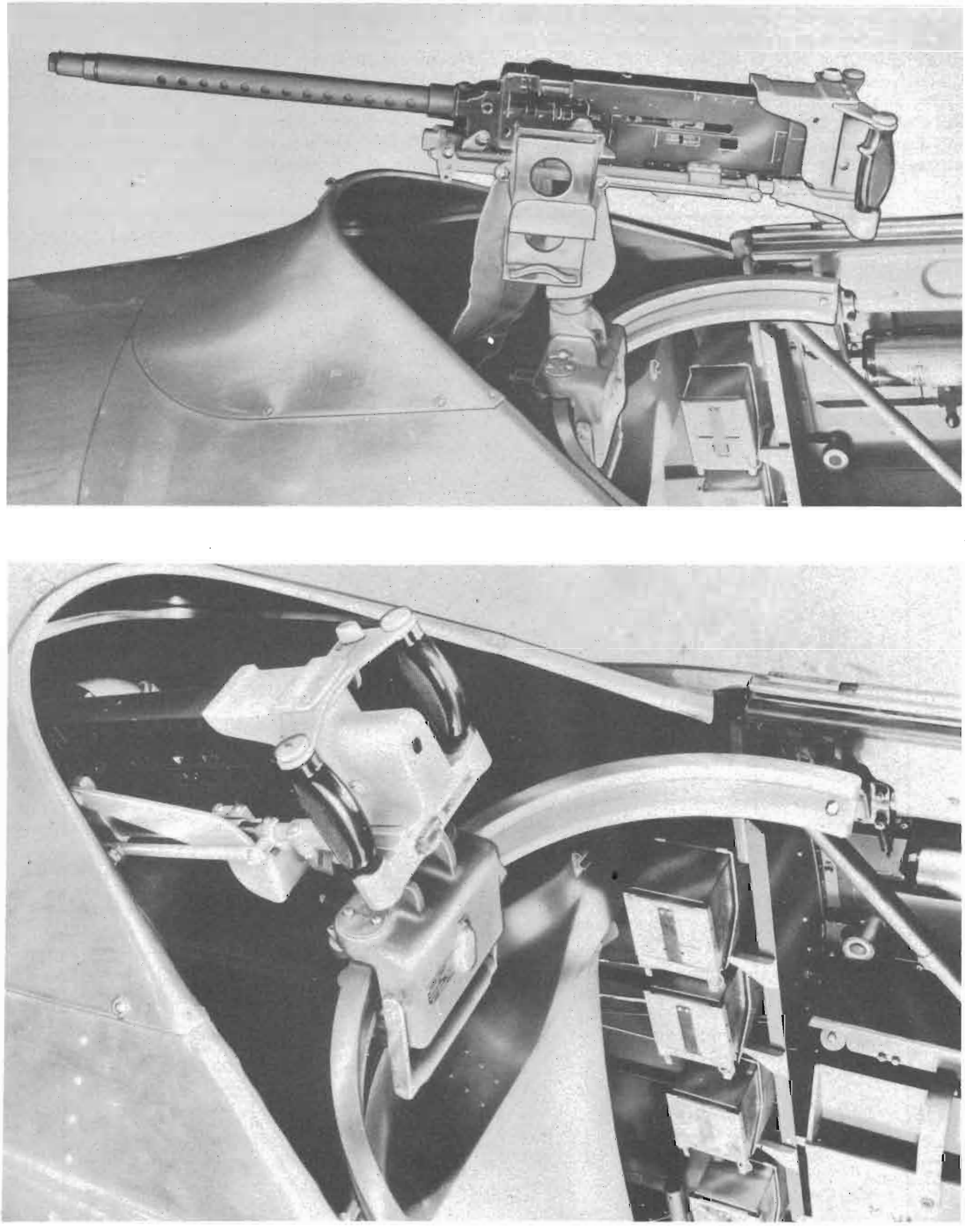


Figure 358 — Flexible Gun Installed (Upper and Lower)

the gun truck on the track, releasing the yoke and pushing the gun into the trough.

(2) REMOVAL.—To remove the flexible gun from the rear cockpit, proceed as follows:

(a) Remove the gun truck by removing the bolts from the aft bracket and side supports.

(b) Remove the gun truck from the gun track.

(c) Remove the gun track support on each side of the cockpit.

(d) Remove the gun track attaching brackets from the aft edge of the rear cockpit.

Figure 359 — Gun Synchronizer and Solenoid (Upper and Lower)

(3) INSTALLATION.—Install the flexible gun as per the following procedure:

(a) Install the gun track attaching bracket on the aft edge of the rear cockpit.

(b) Install a gun track support on each side of the cockpit with U-bolts and nuts. Do not tighten the nuts until the track is installed and the proper position of each support is located by the bolt holes in the track.

(c) Install the gun track with an AN5-33A bolt through the aft bracket and one AN5-32A bolt through each side support. Use AN365-524 nuts on all of the attaching bolts.

(d) Install the gun truck on the track.

(e) Install gun on track.

e. GUN SYNCHRONIZER.

(1) DESCRIPTION.—A type E-4 gun synchronizer is interconnected with a type E-3A trigger motor by means of a 55-61004 impulse unit on AT-6 airplanes, and a 77-61004 impulse unit on subsequent models of the AT-6 series. A 19A-53415 special lubricator fitting (figure 382) is furnished, attached to the end of the impulse unit that connects to the trigger motor.

NOTE

When trigger motor is not installed, the lubricator fitting should be installed on the impulse tube. Also, when impulse generator is not installed, the electrical conduit to the solenoid should be stowed in the dummy socket provided on the nearby engine mount tube.

(2) REMOVAL.—Disconnect the trigger motor impulse tube from the impulse generator located on the right engine vertical drive pad. Remove the impulse generator, with the aid of special wrench, 36-61039, and the electrical control unit solenoid. Immediately after removing these units, install the cover plates specified for this particular engine.

CAUTION

Do not rotate or move the crankshaft during this operation.

(3) INSTALLATION. — To engage mounting flange of synchronizer with studs on engine mounting base, it is necessary to tip the top of synchronizer to the right. Due to synchronizer casting design, it is necessary to lower base of synchronizer as nuts are drawn up. A special wrench, 36-61039, is required for the forward inboard attachment bolt. Secure nuts with lock wire. A lock washer may be utilized to secure the right forward nut in lieu of a lock wire. Connect gun impulse tube and solenoid cable to synchronizer.

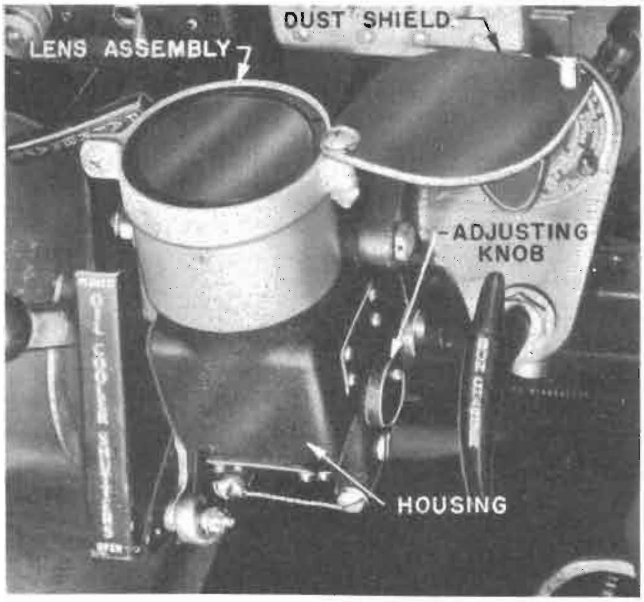


Figure 360 — Gun Sight and Charger Handle

f. GUNSIGHT.

(1) DESCRIPTION.—A bracket, an adjustment stud, and a shield are provided directly below the front cockpit instrument panel for installation of a type N-3B, N-3A or N-2A optical gun sight. The gun sight, consisting essentially of a main housing which contains the lamp and lamp socket, the reticle, mirror assembly and lens assembly, is installed in a manner so that the reflected image shall be free of movement. A reflector glass is mounted on a bracket below the windshield on the fuselage, level with the pilot's line of sight; a reticle pattern is projected on the reflector from the lens assembly, with the light intensity regulated by a rheostat located on the electrical control panel. Normally the N-3B, N-3A or N-2A gun sight is properly adjusted by the manufacturer, and it should not be necessary to readjust either the reticle or main lens throughout the life of the sight. If the reticle image is not projected on the vertical center line with the reflector, an adjusting knob located on the right side of the sight housing is provided to focus the reticle in the center of the reflector glass.

(2) ADJUSTMENTS.—Unless the pattern of the reticle as reflected upon the reflector glass is out of focus, it should not be necessary during the life of the sight to adjust the main lens assembly. If adjustment is necessary, the following procedure must be followed:

(a) Unscrew the dust shield assembly, which is provided to keep dust and other particles from the main lens assembly.

(b) Back out locking screw which holds lens cell from turning.

(c) Turn lens assembly until reticle image is viewed as reflected through the reflector glass and superimposed upon a target approximately 500 yards distant, and until it does not change in relation to the target as the head is moved over the field of vision of the sight.

(d) Turn lens cell until nearest notch lines up with hole for locking screw. Lock screw tightly being careful that the end of the screw engages one of the four notches provided in the lens cell. Assemble dust shield assembly.

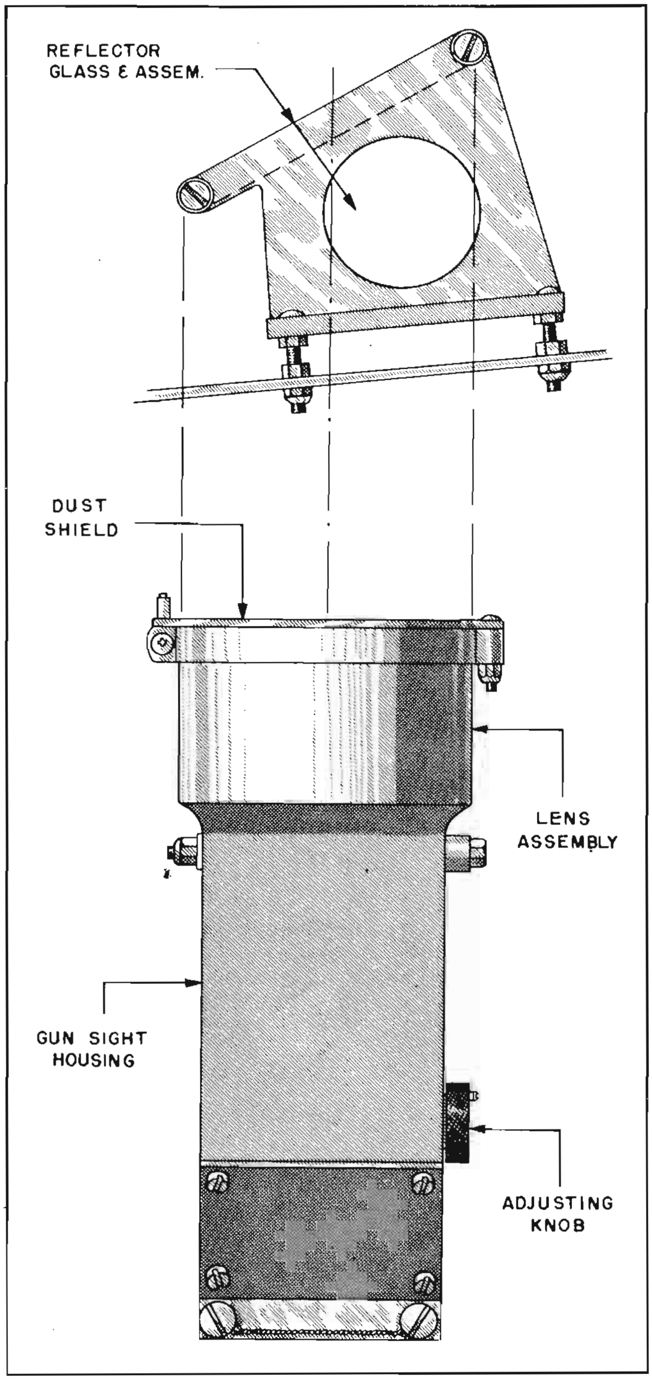


Figure 361 — Gun Sight Adjustment

SECTION V

USEFUL OR MILITARY LOAD

1. BOMB LOADING.

(See figure 339.)

a. 20- AND 30-POUND BOMBS.—The sequence of operations necessary for loading 20- or 30-pound bombs is as follows:

(1) Move the release handle, located on the bomb control quadrant in the front cockpit, to the "SALVO" position and then to the "SELECTIVE" position. Move the arming handle, also in the bomb control quadrant, to the "SAFE" position.

CAUTION

Do not move the release handle to "SALVO" if any bombs are installed. If it is desired to remove any support hooks, it should be accomplished by moving the handle to the "SELECTIVE" position and manually tripping the release triggers at the rack.

(2) Screw the 20- and 30-pound bomb sway braces far enough into the lower surface of the wing panels to facilitate loading.

(3) (Type NA 84-63005 rack only.) Pull and hold down charging cable ring, and install bomb No. 1 at the inboard end of the rack.

NOTE

The inboard bomb must be loaded first and the fins rotated to 45 degrees from the perpendicular center line of the bomb.

(4) Push the bomb support hook closed until it snaps into place. *Do not* engage any support hooks that are not used, since bombs will not release consecutively, under these conditions, as the firing switch is operated.

(5) (Type NA 84-63005 rack only.) Pull and hold charging cable. The rack operating shaft should remain in the charged position. If this is not the case, release the bomb by pushing inboard on the lower end of the trigger until the support becomes disengaged. Repeat the above operation; and if the charging cable will not stay in the right position, check the rack thoroughly for accumulation of foreign matter or visible defects. Replace the rack if necessary.

(6) Engage the fin braces with the fins of the bombs; screw the sway braces out until they press evenly and firmly against the sides of the bomb.

(7) Install the arming wire loop in the arming lever.

(8) Pass the arming wire between the bomb and the sway brace; connect it to the bomb as required.

NOTE

When the arming wire is attached, fold excess wire and tape to the surface of the bomb. Use thin paper tape wrapped around the bomb once only.

(9) Install the remaining bombs in the same manner. Loading order, after the inboard bomb has been installed, is optional.

b. 100-POUND BOMBS.—The sequence of operations necessary for loading 100-pound bombs is as follows:

(1) Move the release handle on the bomb control quadrant in the front cockpit to "SALVO" position and then to the "SELECTIVE" position. Move the arming handle to the "SAFE" position.

CAUTION

Do not move the release handle to "SALVO" if any bombs are installed. If it is desired to release any support hooks under these conditions, it should be accomplished by moving the bomb controls to the "SELECTIVE" position and manually tripping the release triggers at the bomb rack.

(2) Bolt the two 100-pound bomb shackles on the lower surface of each outer wing panel directly under the second and fourth bomb support hooks on the bomb rack.

(3) Unscrew the two special adjustment bolts, one at each outer point of the sway brace, to facilitate loading.

(4) Push up the inboard bomb shackle lever by means of a screw driver inserted through the bottom of the shackle so that the lever will engage the support hook of the bomb rack when the hook is pushed closed. (Refer to figure 347.) Make sure that the bomb support hooks on the shackle are held open.

NOTE

The inboard bomb shackle must be charged first.

(5) Pull out and hold the bomb rack charging cable (type NA 84-63005), and push the bomb rack support hook closed until it snaps into engagement with the shackle lever.

(6) Release the charging cable (type NA 84-63005). The rack operating shaft should remain in the charged position. If this is not the case, release the support hook by pushing inboard on the lower end of the trigger until the support hook becomes disengaged. Repeat operations (4) through (6) above.

(7) Charge the outboard bomb shackle in the same manner as described in paragraphs (4) through (6) above. It is not necessary to pull down on the charging

cable after the first support hook is properly engaged.

(8) Install the inboard bomb first, engaging the carrying lugs of the bombs with the support hooks of the bomb shackle.

(9) Push the support hooks closed until they snap into place.

(10) Engage the tail arming wire with the arming lever located adjacent to the support hook in the bomb rack.

(11) Pass the arming wire between the bomb and the bomb shackle, and connect it to the tail of the bomb as required.

(12) Engage the nose-arming wire with the auxiliary arming control unit located within the wing, forward of the bomb rack.

(13) On a U.S.-type bomb, pass the arming wire back through the forward lug on the bomb, and connect it to the nose of the bomb as required. On a British-type bomb, the arming wire will reach only from the nose direct to the arming control unit.

NOTE

When the arming wire is attached, fold excess wire and tape to the surface of the bomb. Use thin paper tape wrapped around the bomb once only.

(14) Adjust the special sway brace bolts evenly to hold the bomb firmly. Do not tighten bolts excessively.

(15) Safety the adjusting bolts to the sway braces, using .040-inch brass wire.

(16) Move the release handle on the bomb control quadrant in the front cockpit to the "LOCK" position.

2. GUN LOADING.

a. FUSELAGE GUN.—Check to see that the cowl gun selector switch, located on the switch panel to the left and below the instrument panel, is in the "OFF" position. Load the ammunition for the fuselage gun according to the following instructions:

(1) Remove the gun and ammunition bay access plate from the cowl just forward of the cockpit.

(2) Check the ammunition belt to ascertain that the cartridges are properly arranged in the links.

(3) Lift the ammunition box cover.

(4) Starting with the single loop end of the belt, load the belt in the smooth layers in the ammunition box.

(5) Lift the feed chute; cover and thread the double loop end of the belt through the feed chute and to the feedway of the gun.

(6) Push the double loop end of belt and the first cartridge into the feedway until it is held by the belt-holding pawl.

(7) Charge the gun by pulling the upper gun charger handle, on the right side of the front cockpit, to the full rear position and then release it. Repeat this operation and the gun is loaded.

b. WING GUN.—Check to see that the wing gun selector switch, located on the switch panel to the left and below the instrument panel, is in the "OFF" position, then load the gun in the following manner:

(1) Remove the ammunition bay and gun bay access doors from the upper surface of the right wing.

(2) Check to ascertain that the cartridges are properly arranged in the links.

(3) Start with the single loop end, and lay the ammunition belt into the ammunition compartment in smooth layers. Load the compartment up to the feed chute opening.

(4) Thread the belt through the feed chute to the gun feedway.

(5) Push the double loop end of belt and first cartridge into the feedway as far as possible so the cartridge is held by the belt-holding pawl. This prevents the belt from slipping back out of the gun.

(6) Charge the gun by pulling the lower gun charger handle on the right side of the cockpit to the full rear position and release. Repeat this operation and the gun is ready to fire.

c. FLEXIBLE GUN. — There are five ammunition container storage boxes installed aft of the rear cockpit seat: four on the gunner's right and one on his left when in combat position (facing aft). To load the ammunition, proceed as follows:

(1) Load each of the five type L-4 ammunition boxes with a 100-cartridge ammunition belt, being careful to keep the cartridges and links uniform, and the belt in a smooth layer. Load the belt into the box with the single loop end of the belt first.

(2) Stow four of the loaded ammunition boxes in the four storage boxes located on the left side. Place the other one in the ammunition box holder, attached to the right side. The cartridges must be pointing in the same direction the gun is pointing.

(3) Push the double loop end of the belt and first cartridge into the feedway of the gun until the first cartridge is held by the belt-holding pawl.

(4) Charge the gun by pulling back the bolt handle all the way and releasing it; repeat this operation and the gun is ready to fire. If the gun is not to be fired immediately, the trigger safety should be set, thereby locking the trigger.

SECTION VI

MATERIALS OF CONSTRUCTION

1. GENERAL.

The following list of heat-treated parts includes only heat-treated castings, forgings, and steel members used in the construction of the airplane. Generally, the repair of these parts is not recommended, and any extent of damage necessitates complete replacement of the damaged member. However, it is to be noted that in the event of an improvised replacement, the heat treatment of the fabricated member must produce the tensil strength given on the subsequent pages in the "HEAT TREAT" column.

2. MATERIAL CODE.

The following code used in the heat-treated parts list simplifies the identification of materials and their physical properties.

AA-E—Aluminum-Alloy Extrusion	24S	Federal Specification No. QQ-A-354
AA-F—Aluminum-Alloy Forging	14S	Federal Specification No. QQ-A-367A GR. 5
AA-F—Aluminum-Alloy Forging	17S	Federal Specification No. QQ-A-367A GR. 1
AA-F—Aluminum-Alloy Forging	A51S	Federal Specification No. QQ-A-367A GR. 3
AA-T—Aluminum-Alloy Tube	24S	AC Specification No. 10235A
CM-B—Chrome-Molybdenum Steel Bar	4140	AN-QQ-S-752
CM-F—Chrome-Molybdenum Steel Forging		AC Specification No. 57-105B
CM-R—Chrome-Molybdenum Steel Bar	X4130	AN-QQ-S-684
CM-S—Chrome-Molybdenum Steel Sheet	X4130	AN-QQ-S-685
CM-T—Chrome-Molybdenum Steel Tube	X4130	AN-WW-T-850a
MA-C—Magnesium-Alloy Casting		AN-QQ-M-56 COND. H. T.
MC-F—Mild Carbon Steel Forging		AC Specification No. 57-105B
MW—Music Wire		AN-QQ-W-441
NS-R—Nickel Steel Rod	2330	AN-QQ-S-689

3. HEAT-TREATED PARTS LIST.

Part No.	*Title*	*Material Code*	*Heat Treat to Tensile Strength in lb/sq in. or as Noted*
B1226	Eye-bolt—Ball bearing	CM-F	125-145,000
B1190	Ring—Airplane mooring	CM-F	125-140,000
66-13013	Angle—Wing center section upper bolting	AA-E	58,000
66-13104	Angle—Wing center section front bolting	AA-E	58,000
77-13303	Angle—Wing center section fuel tank cover bolting	AA-E	58,000
55-14027	Angle—Outer wing upper bolting	AA-E	58,000
54-14028	Angle—Outer wing nose bolting	AA-E	58,000
88-14029	Angle—Outer wing lower front bolting	AA-E	58,000
54-14030	Angle—Outer wing lower rear bolting	AA-E	58,000
55-14065	Bracket—Aileron outboard hinge	AA-F (17ST)	55,000
55-14066	Bracket—Aileron inboard hinge	AA-F (14ST)	65,000
55-14069	Bracket—Aileron center hinge	AA-F (14ST)	65,000
55-14244	Support—Aileron bell crank bearing	AA-F (17ST)	55,000
55-16080	Bracket—Aileron inboard hinge	AA-F (14ST)	65,000
55-16081	Fitting—Aileron center hinge	AA-F (17ST)	55,000
55-18022	Hinge Fitting—Flap	AA-F (A51ST)	43,000
55-18024	Eye-bolt—Wing flap	CM-B	125,000
52-21018	Fitting—Elevator center hinge support	AA-F	65,000
52-21019	Fitting—Elevator center hinge support	AA-F	65,000
55-21020	Fitting—Stabilizer attaching	AA-F (A51ST)	43,000

HEAT-TREATED PARTS LISTS (Continued)

Part No.	*Title*	*Material Code*	*Heat Treat to Tensile Strength in lb/sq in. or as Noted*
52-21026	Bracket—Elevator inboard hinge support	AA-F	65,000
55-22037	Hinge Fitting—Trim tab	AA-F (17ST)	55,000
52-23012	Fitting—Rudder upper hinge support	AA-F	65,000
52-23013	Fitting—Rudder center hinge support	AA-F	65,000
52-23014	Fitting—Rudder lower hinge support	AA-F	65,000
28-31053	Fastener—Engine ring cowling rear	AA-S	62,000
66-31058-2	Catch—Fire extinguisher door release	AM-S	125,000
66-31010-2	Hook—Engine ring cowling	AA-E	62,000
57-31103-2	Tube—Fuselage station No. 1 lower cross	CM-T	Normalize
19-31105	Fitting—Fuselage connection	CM-F	Normalize
55-31174	Fitting—Fuselage connection	CM-B	125-140,000
55-31220	Step—Cockpit	MA-C	32,000
19-31231	Bracket—Fuselage pilot's seat support	CM-F	Normalize
55-31383	Guide—Fuselage front step tube	CM-B	125,000
55-31385	Spring—Fuselage front step tube keeper	MW	*(10 Minutes)
49-31894	Finger—Enclosure release handle	CM-S	160-180,000
25-31902	Fitting—Engine mount attaching	CM-F	Normalize
66-33109	Pin—Landing gear retract arm attaching	CM-B	145-160,000
36-33112	Pin—Landing gear pivot	CM-T	160-180,000
36-33117	Bushing—Landing gear support	CM-B	160-180,000
36-33119	Bushing—Landing gear attaching fitting	CM-B	125-140,000
36-33120	Nut—Landing gear pivot pin	CM-B	125,000
19-33447	Wrench—Special	CM-S	180-200,000
55-33467	Spring—Brake cylinder ext.	MW	*(20 Minutes)
36-33515	Latch—Landing gear lock cam	CM-S	125,000
55-33525	Pin—Landing gear lock	CM-B	160-180,000
44-33534-2	Fitting—Landing gear lock and hoist	CM-F	160-180,000
44-33534-3	Fitting—Landing gear lock and hoist	CM-F	160-180,000
66-33536	Bolt—Landing gear lock and hoist fitting attaching	NS-R	160-180,000
36-33541	Rod—Landing gear lockpin push	CM-F	Normalize
36-33542	Bolt—Landing gear mechanism	CM-B	125,000
55-33544	Bell Crank Assembly—Landing gear locking mechanism	CM-F	125,000
66-42012	Shaft—Carburetor mixing chamber	CM-T	125,000
51-47032	Stud—Oil tank sump	NS-R	125,000
49-51047	Support—Oil separator outer	AA-S	62,000
55-52119	Spring—Surface lock	MW	*(20 Minutes)
55-52302	Bell Crank—Aileron	AA-F (17ST)	55,000
55-52316	Clevis—Aileron control rod	CM-F	125,000
55-52428-2	Rod—Rudder brake pedal	CM-R	125,000
19-52440	Spring—Tension coil	MW	*(20 Minutes)
49-52441	Spring—Rear cockpit rudder pedal adjusting	MW	*(20 Minutes)
55-52610	Arm—Flap indicator	MA-C	32,000
55-52649-2	Rod—Flap connecting	CM-B	125,000
55-52653	Plunger—Flap control handle lock spring	NS-R	Carburize 1/32-inch
58-53004-3	Tube—Pilot's cockpit seat support	CM-T	160-180,000
49-53060	Clamp—Alemite grease gun	SS-S	Spring Temper
55-53061	Pin—Observer's seat latch	CM-B	160-180,000
49-53073	Plunger—Seat adjusting	CM-R	125-140,000
55-53075	Tube—Observer's seat adjusting	CM-T	160-180,000
55-53076	Brace Assembly—Observer's seat	CM-T	150-170,000
55-53096	Spring—Observer's seat latch	MW	*(10 Minutes)

*—Heat treated spring at 260°-288°C (500°-550°F) for period noted.

HEAT-TREATED PARTS LISTS (Continued)

Part No.	Title	Material Code	Heat Treat to Tensile Strength in lb/sq in. or as Noted
55-53104	Axle—Observer's seat	CM-B	160,000
36-54029	Bearing—Landing gear position indicator switch box	CM-B	125,000
36-54033	Guide—Landing gear position indicator switch box	CM-B	125,000
55-54083	Bracket—Ignition switch hand support	MA-C	32,000
55-54125	Spring—Landing gear position indicator switch	MW	*(10 Minutes)
36-55009	Fitting Assembly—Wing center section hoist	CM-F	125-140,000
36-58008-2	Fitting—Landing gear hydraulic strut	CM-B	125,000
88-58101	Body—Hydraulic landing gear and flap control unit	AA-F (17ST)	55,000
55-58137	Spring—Hydraulic one-way valve	MW	*(5 Minutes)
55-58143	Spring—Hydraulic landing gear and flap relief outer	MW	*(20 Minutes)
55-58144	Spring—Hydraulic landing gear and flap relief inner	MW	*(10 Minutes)
55-58152	Spring—Control unit one-way valve	MW	*(20 Minutes)
55-58196	Spring—Pressure control return	MW	*(20 Minutes)
55-61040	Screw—Ammunition box and ejection chute adjusting	NS-R	125,000
59-73006	Bow—Instrument flying hood	AA-T	62,000
59-73007	Bow—Instrument flying hood	AA-T	62,000

*—Heat treated spring at 260°-288°C (500°-550°F) for period noted.

SECTION VII
FINISH SPECIFICATIONS

1. GENERAL REQUIREMENTS.

The requirements stated herein are a minimum. In the finishing of areas where color only is specified, the number of coats shall be such as to give complete hiding, except where the number of coats is noted in detail below. The finish for exterior (exposed) surfaces or parts of this airplane shall be as follows:

Ailerons, exterior	Aluminum
Ailerons, interior and interior parts	No finish*
Anti-glare	Flat bronze-green No. 9
Castings, forgings	To match
Cockpit, front	Yellow-green
Cockpit, rear	Yellow-green
Compartment, landing light	Flat black
Compartment, baggage	Yellow-green
Cowling, exterior	Aluminum
Cowling, interior	No finish*
Elevators, exterior	Aluminum
Elevators, interior and interior parts	No finish*
Fairing, fin to fuselage	Aluminum
Fairing, landing gear	Aluminum
Fairing, stabilizer to fuselage	Aluminum
Fairing, tail wheel	Aluminum
Fairing, wing to fuselage	Aluminum
Fin, exterior	Aluminum
Fin, interior and interior parts	No finish*
Flaps, exterior	Aluminum
Flaps, interior and interior parts	No finish*
Fuselage, exterior	Aluminum
Fuselage, frame	Yellow-green
Fuselage, interior parts, cockpits	Yellow-green
Nose-over structure	Aluminum
Fuselage, interior parts, aft of baggage compartment	No finish*
Horns, control	To match
Instrument panels	Flat black
Landing gear	Aluminum
Propeller, rear face	Flat black
Rudder, balance portion	Aluminum
Rudder, interior and interior parts	No finish*
Rudder, rear of hinge	Aluminum
Seats, wood	Flat bronze-green No. 9
Seats, metal	Aluminum
Stabilizer, exterior	Aluminum
Stabilizer, interior and interior parts	No finish*
Steps, plates	Aluminum

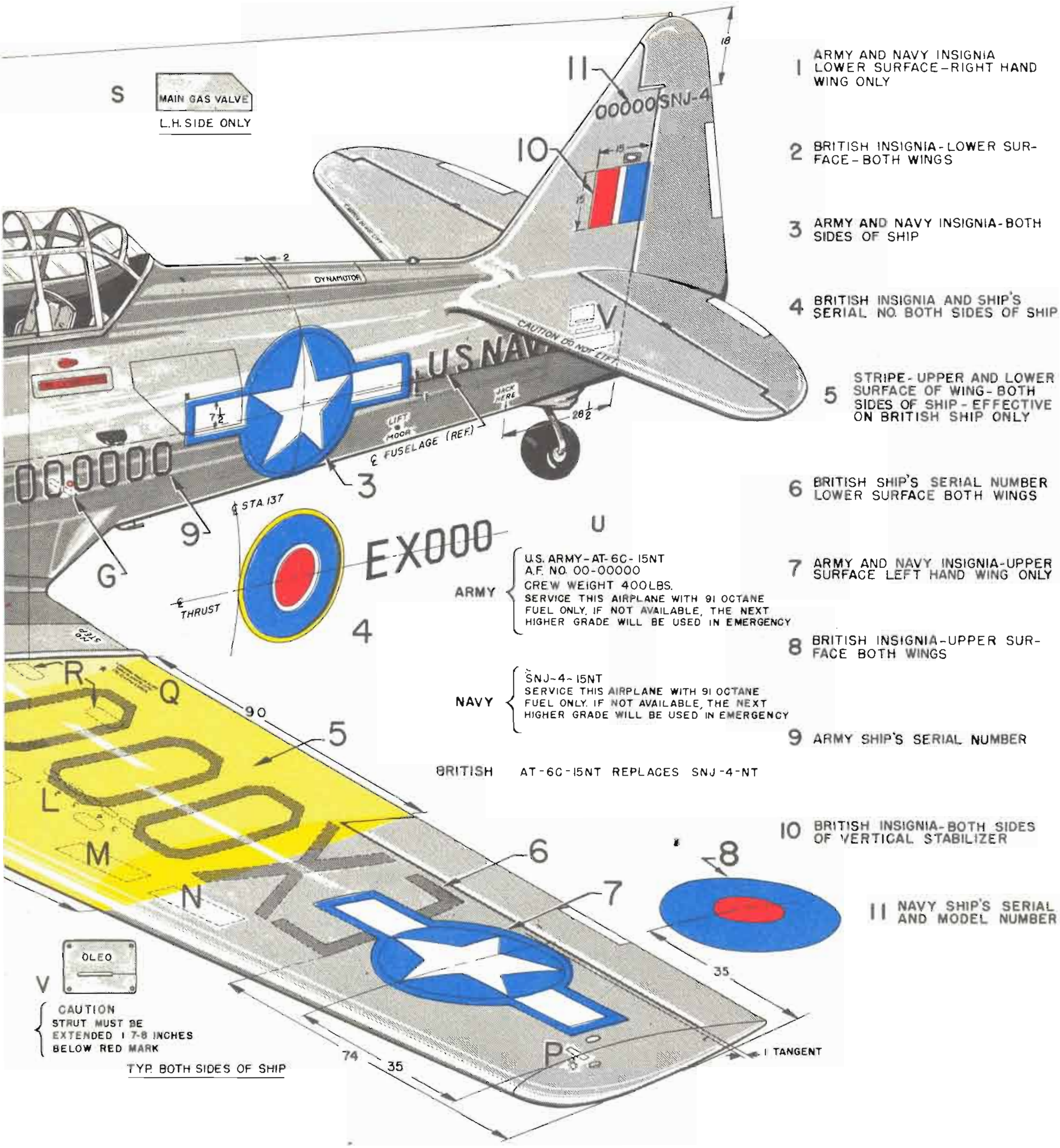


Figure 362 — Exterior Airplane Markings

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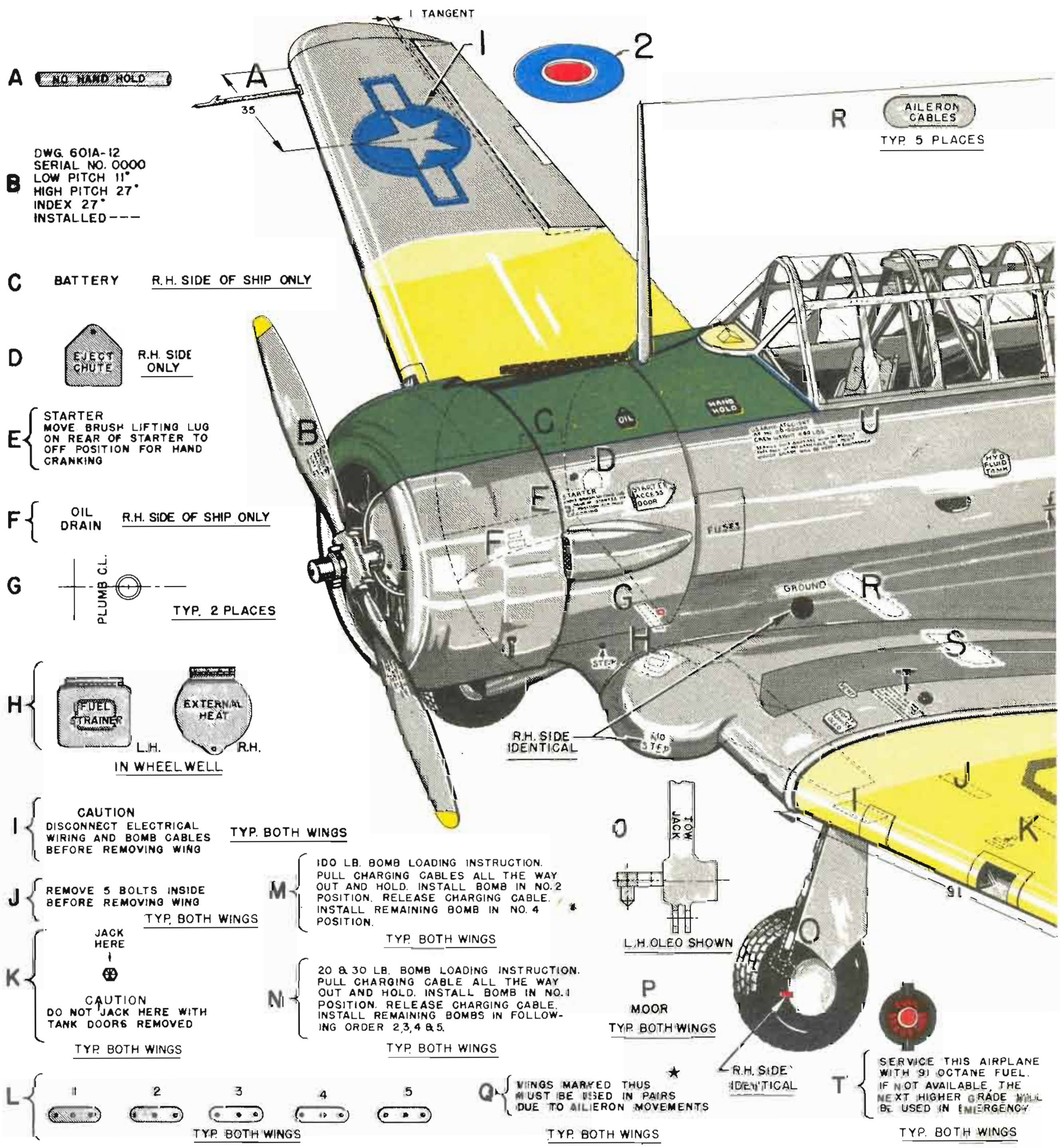


Struts, landing gear	Aluminum
Tail wheel fork	Aluminum
Tanks, exterior	Aluminum
Walkways	Black
Wheels	Aluminum
Wings, exterior	Aluminum
Wings, interior and interior parts	No finish*

*Finish for corrosion-prevention shall be in accordance with the detail sections listed below. Whenever the peculiarity of a particular part or assembly prohibits the employment of the specified finish, the part or assembly shall be given as high a degree of protection as is consistent with its proper functioning for its intended use.

NOTE

Finishes for the Navy airplanes shall be the same as for the Army airplanes except as noted below, in final finishes only. All pre-finish treatments, e.g., priming, protective treatment for magnesium, cadmium plating, etc., and all finishes not noted are the same as those for the Army airplanes.

2. FINISH AND FINISH MATERIAL SPECIFICATIONS.

a. The following publications, of the issue specified in the U. S. Army Materials and Processes Specifications Bulletin 23 in effect at the date of the contract, shall govern this specification except as specifically excepted in detail below:

ARMY AIR FORCES SPECIFICATIONS:

14115	Surfacer; Wood, Liquid

ARMY-NAVY AERONAUTICAL SPECIFICATIONS:

AN-S-17	Sealer; Wood, Liquid
AN-E-3	Aircraft Enamel
AN-1-9	Insignia for aircraft
AN-P-32	Zinc Plating**
AN-P-39	Chromium Plating
AN-C-52	Corrosion-Preventive Compound (AT-6D and SNJ-5 Only)
AN-QQ-P-421	Cadmium Plating
AN-TT-T-256	Thinner, Dope and Lacquer (AT-6D and SNJ-5 Only)
AN-TT-A-461	Aluminum Paste
AN-TT-D-514	Dope, Cellulose Nitrate, Clear
AN-TT-D-551	Dope, Cellulose Nitrate, Clear (For Aluminum Dope)
AN-TT-L-51	Lacquer, Cellulose Nitrate
AN-TT-P-656	Primer, Zinc Chromate*

*Zinc chromate primer may be tinted with a suitable tinting material at the discretion of the contractor.

**Zinc Plating may be used in lieu of cadmium plating on all parts except:

(1) Control cable terminals.

(2) Steel sheets 0.0625″ or thinner used structurally.

U. S. ARMY SPECIFICATIONS:

3-100	Finishes for metal parts**
98-20007	Cleaning prior to finishing
98-20010	Protective treatment for magnesium
98-24105	Marking for aircraft

**Yellow-Green finish shall be formulated with a suitable tinting material.

FEDERAL SPECIFICATIONS:

JJJ-0-336	Raw Linseed Oil

3. FINISH CODE.

The following code of finishes applicable to this airplane and conforming in detail to the above finish specification, is used in specifying the complete finish and color on all North American Aviation, Inc., drawings.

CODE

F—Finish, prefix designation.
A—Aluminum and aluminum alloys.
C—Copper and copper alloys.
G—General.
M—Magnesium and magnesium alloys.
P—Plastics.
S—Steel.
T—Textile.
W—Wood.
Examples: FS-20—Finish No. 20 for steel.

4. ALUMINUM AND ALUMINUM ALLOYS.

FA-0-GENERAL.

Do not anodize

FA-20-INTERIOR OF CLOSED MEMBERS.

Do not anodize
No finish required

FA-21-INTERIOR SURFACES, PARTS AND OPEN MEMBERS.

Do not anodize

PRIME:

One coat zinc chromate primer. ALCLAD 2S, 3S, 52S, 53S, 43 AND 356 shall receive no primer except when subseqnently to be finished with lacquer.
Carburetor air scoop interior shall receive no prime regardless of alloy.

FINISH:

Ailerons, Elevators, Rudder, and/or Parts Attaching:

ALCLAD 2S, 3S, 52S, 53S, 43, AND 356: No further requirements. OTHER SURFACES CONTACTING DOPED FABRIC shall receive one coat of zinc chromate primer.

Bolting Angle Cover Strip:

No further requirements.

Carburetor Air Scoop:

Shall not be finished on the interior.

Cockpits, Baggage Compartment, and/or Parts Attaching:

Yellow-green finish.

Cockpit Enclosure:

Finish entire frame (53S and corner castings) by buffing.

Fuselage Rear of Baggage Compartment, Wings, and Tail Group:

No further requirements.

Landing Light Compartment:

Flat black lacquer.

Wheel Wells:

OTHER SURFACES: Two coats clear lacquer containing a minimum of 4 ounces of aluminum paste per gallon of spraying material.

FA-23-ENGINE COMPARTMENT SURFACES.

Do not anodize.

PRIME:

One coat zinc chomate primer. ALCLAD 2S, 3S, 52S, 53S, 43 AND 356 shall receive no primer or other finish.

FINISH:

No further requirements.

FA-25-EXTERIOR SURFACES, PARTS, AND MEMBERS.

Do not anodize.

PRIME:

One coat zinc chomate primer. ALCLAD 2S, 3S, 52S, 53S, 43 AND 356 shall receive no primer or other finish except where it forms a part of a finished member or surface.

FINISH:

Anti-glare:

Flat bronze-green lacquer No. 9.

Cowling, Fairing, Fuselage, Landing Gear, Tail Group, Wings and/or Parts Attaching:

Two coats clear lacquer containing a minimum of 4 ounces of aluminum paste per gallon of spraying material.

Exception:

ALCLAD 2S, 3S, 52S, 53S, 43 AND 356 shall receive no finish.

Propeller:

Rear surface (4 inches from tip to hub): Two coats flat black lacquer.

Tips (tip to 4 inches from tip): Two coats No. 48 identification yellow painted on both sides.

FA-28-INSTRUMENT PANELS.

Do not anodize

PRIME:

One coat zinc chromate primer.

FINISH:

Direct Lighting Portion:

Flat black lacquer.

Indirect Lighting Portion:

Gloss white lacquer.

FA-29-ELECTRICAL AND RADIO JUNCTION BOXES AND CONDUIT.

Do not anodize.
Do not prime

FINISH:

Boxes and Conduit in Cockpits and Baggage Compartment Only:

Yellow-green finish.

Others:

No finish required.

5. COPPER AND COPPER ALLOYS.

FC-0-GENERAL.

AN Standard Parts:

Finish, as specified on AN standard drawings.

Brass and Bronze Parts (Other Than AN Standard Parts):

All brass or bronze parts contacting dissimilar metals shall be cadmium plated.

Exceptions:

Brass or bronze nuts and screws in the vicinity of the compass shall not be cadmium plated. Internal brass or bronze parts contacting hydraulic fluid or anti-icing fluid shall not be cadmium plated.

Brass or bronze turnbuckles and safety lockwire shall not be cadmium plated.

Bus bars, fuse clips, terminals and similar electrical parts shall not be cadmium plated.

FC-20-COPPER LINES.

No finish required.

FC-23-DISSIMILAR METALS.

Cadmium Plate

PRIME:

Dissimilar metals shall be protected in accordance with FG-5.

6. GENERAL FINISHES.

FG-0-CHROMIUM PLATE.

INTERNAL STEEL PARTS contacting hydraulic fluid, and communicating to exterior except corrosion-resistant steel shall be hard chromium plated.

FG-2-CONTROL CABLES.

Corrosion-Resistant Steel Control Cables and Terminals:
No protective treatment required.

Tinned or Galvanized Steel Control Cables:
Dip in AN-C-52 compound.

Carbon and Low Alloy Steel Swaged Cable Terminals:
Cadmium plate prior to swaging. Dip in AN-C-52 compound subsequent to swaging.

FG-5-DISSIMILAR METALS.
PRIME:

Dissimilar metals shall be insulated from mutual contact by one coat of zinc chromate primer applied to either of the contacting surfaces.

Exceptions:
Cadmium plated nut plates in contact with alclad require no prime.
Electrical bonding contacts shall not be primed.
Bearing surfaces shall not be primed.
Bolts, screws, nuts, and similar fasteners require no prime coat.

FINISH:

Finish to match adjacent surfaces.

FG-7-STEPS (PLATES):

Steps made from magnesium alloy shall be finished in accordance with FM-20.

Steps made of aluminum or aluminum alloy shall be finished in accordance with FA-25.

FG-8-WALKWAYS.

Cover with No. 30 carborundum grits applied either with Plyosyn cement or as TRI-M-ITE No. 30 Grit Wet-or-Dry cloth walkway material (Minnesota Mining and Manufacturing Company), or equivalent, attached with suitable cement.

FG-10-COIL SPRINGS and FG-11-FLAT SPRINGS.

Do not cadmium plate.

PRIME:

One coat zinc chromate primer.

Exception:
Springs contacting hydraulic fluid shall not be primed or otherwise finished.

FINISH:

Cockpits and Baggage Compartment:
Yellow-green finish.

Fuselage Rear of Baggage Compartment:
No further requirements.

Wings and Tail Group:
No further requirements.

FG-12-HEATING AND VENTILATION DUCTS.

HEATER TUBES covered with insulating material shall be treated with a suitable fire, water, oil, and fuel-resistant material.

FG-13-ARMAMENT PROTECTION.

EJECTION CHUTES, GUN BARRELS, AND BLAST TUBES shall be weather sealed by covering with suitable water-resistant temporary dust covers.

FG-21-MARKINGS: LINES (refer to chart in section VIII).

FG-22-MARKINGS: CABLES, CRANKS, AND HORNS (refer to chart in section IV, paragraph 11).

FG-23-MARKINGS: MISCELLANEOUS (refer to figures .... and ....).

FG-24-MARKINGS: ENGINE DISCONNECT POINTS (refer to chart in section IV, paragraph 6).

7. MAGNESIUM AND MAGNESIUM ALLOYS.

FM-0-GENERAL.
Protective treatment (Spec. 98-20010).

PRIME:
Two coats zinc chromate primer.

FM-20-EXTERIOR SURFACES, PARTS, AND MEMBERS.
Protective treatment (Spec. 98-20010).

PRIME:

Two coats zinc chromate primer.

FINISH:

Anti-glare:
Flat bronze-green lacquer No. 9.

Cowling, Fairing, Fuselage, Landing Gear, Tail Group, Wings, and/or Parts Attaching (including Flaps and Flap Bays):
Clear lacquer containing a minimum of four ounces of aluminum paste per gallon of spraying material.

FM-23-ENGINE COMPARTMENT SURFACES, PARTS, AND MEMBERS PROTECTIVE TREATMENT (Spec. 98-20010).

PRIME:

Two coats zinc chromate primer.

FINISH:

No further requirements.

FM-25-INTERIOR SURFACES, PARTS, AND MEMBERS PROTECTIVE TREATMENT (Spec. 98-20010).

PRIME:

Two coats zinc chromate primer.

FINISH:

Cockpits, Baggage Compartment, and/or Parts Attaching:

One coat yellow-green finish.

Fuselage Rear of Baggage Compartment, Wings, and Tail Group:

No further requirements.

Landing Light Compartment:

Flat black lacquer.

Wheel Wells:

No further requirements.

NOTE

For AT-6D and SNJ-5 Airplanes: One coat clear lacquer containing a minimum of 4 ounces of aluminum paste per gallon of spraying material.

8. PLASTICS.

FP-21-INTERIOR SURFACES, PARTS, AND MEMBERS.

FINISH:

One finish coat to match adjacent surfaces.

Exception:

Parts not normally visible require no finish.

FP-23-EXTERIOR SURFACES, PARTS, AND MEMBERS.

FINISH:

One coat clear lacquer containing a minimum of 4 ounces of aluminum paste per gallon of spraying material.

FP-24-INTERIOR OF CLOSED MEMBERS.

No finish required.

9. STEEL.

FS-0-GENERAL.

Corrosion-resistant steel shall not be plated, primed nor finished.

Cadmium Plate (Spec. AN-QQ-P-421).

Exception:

Parts contacting hydraulic fluid shall not be cadmium plated.

FS-20-EXTERIOR SURFACES, PARTS, AND OPEN MEMBERS THAT CAN BE PLATED.

Corrosion-resistant steel shall not be plated, primed nor finished.

Cadmium plate (Spec. AN-QQ-P-421).

Do not prime.

Exceptions:

Parts subsequently finished shall receive one coat zinc chromate primer.

Dissimilar metals shall be protected as per FG-5.

FINISH:

Anti-glare:

Flat bronze-green lacquer No. 9.

Cowling, Fuselage, Landing Gear, Tail Group, Wings, and/or Parts Attaching (including Flaps and Flap Bays:

No further requirements.

FS-21-EXTERIOR CLOSED MEMBERS THAT CAN BE PLATED.

Corrosion-resistant steel shall not be plated, primed, or finished.

Cadmium plate (Spec. AN-QQ-P-421).

Interior of Members:

Fill with hot (165°F) raw linseed oil, drain thoroughly and close with cadmium plated self-tapping screws.

Exception:

Flash welded parts require no oiling.

Do not prime.

Exception:

Dissimilar metals shall be protected in accordance with FG-5.

FINISH:

Cowling, Fuselage, Landing Gear, Tail Group, Wings and/or Parts Attaching (including Flaps and Flap Bays:

No further requirements.

FS-22-EXTERIOR CLOSED MEMBERS THAT CANNOT BE PLATED.

Corrosion-resistant steel shall not be primed or finished.

Interior of Members:

Fill with hot (165°F) raw linseed oil, drain thoroughly, and close with cadmium plated self-tapping screws.

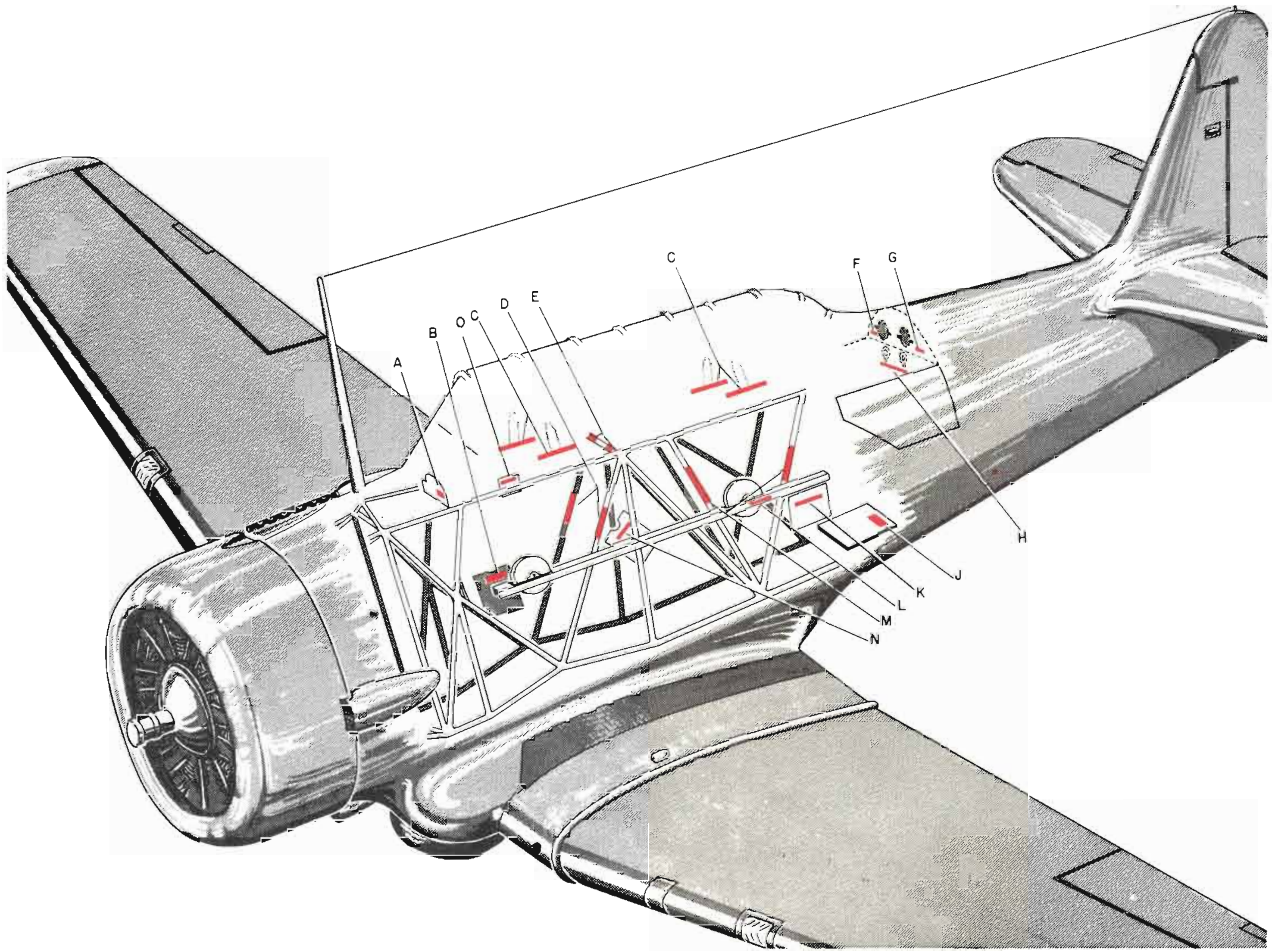
Exception:

Flash welded parts require no oiling.

Exterior of Members:

PRIME:

One coat zinc chromate primer.



A ⅛ in. "Service this airplane with 91 octane fuel only. If not available, the next higher grade will be used in emergency."
B ½ in. "Map and data case, keys inside."
C ½ in. "Emergency release handle."
D ½ in. "Hood. ⟶"
E ½ in. "Level."
F ½ in. "Front."
G ½ in. "Rear."
H ½ in. "Mooring rings."
J ½ in. "R3002 radio shelf on camera rails."
K ½ in. "Map case."
L ½ in. "Down only."
M ½ in. "Gun and fus. level."
N "Flight report."
O "Arm rest."

Figure 363 — Interior Airplane Markings

FINISH:

Cowling, Fuselage, Landing Gear, Tail Group, Wings and/or Parts Attaching (including Flaps and Flap Bays):

Two coats clear lacquer containing a minimum of 4 ounces of aluminum paste per gallon of spraying material.

FS-23-ENGINE COMPARTMENT SURFACES.

Corrosion-resistant steel shall not be plated, primed or finished.

Interior of Closed Members:

Fill with hot raw linseed oil, drain thoroughly, and close with cadmium plated self-tapping screws.

Exception:

Flash welded parts require no oiling.

Interior of Open Members:

One coat zinc chromate primer.

Exterior of Members:

Cadmium Plate (Spec. AN-QQ-P-421).

Exception:

Do not plate motor mount.
Do not prime.

Exception:

Dissimilar metals shall be protected in accordance with FG-5.

Motor mount shall receive one coat of zinc chromate primer.

FINISH:

No further finish.

FS-26-INTERIOR SURFACES, PARTS, AND OPEN MEMBERS THAT CAN BE PLATED.

Corrosion-resistant steel shall not be plated, primed, or finished.

Cadmium plate (Spec. AN-QQ-P-421).
Do not prime.

Exceptions:

Parts subsequently finished, other than with yellow-green, shall receive one coat zinc chromate primer.

Dissimilar metals shall be protected in accordance with FG-5.

FINISH:

Cockpits, Baggage Compartment, and/or Parts Attaching:

Yellow-green finish.

Fuselage Rear of Baggage Compartment, Wings, and Tail Group:

No further requirements.

Landing Light Compartment:

Flat black lacquer.

Wheel Wells:

No further requirements.

FS-27-INTERIOR CLOSED MEMBERS THAT CANNOT BE PLATED.

Corrosion-resistant steel shall not be primed or finished.

Interior of Members:

Fill with hot (165°F) raw linseed oil, drain thoroughly, and close with cadmium plated self-tapping screws.

Exception:

Flash welded parts require no oiling.

PRIME:

One coat zinc chromate primer.

FINISH:

Cockpits, Baggage Compartment, and/or Parts Attaching:

Yellow-green finish.

Fuselage Rear of Baggage Compartment, Wings, and Tail Group:

No further requirements.

Landing Light Compartment:

Flat black lacquer.

Wheel Wells:

No further requirements.

NOTE

For AT-6D and SNJ-5 Airplanes: One coat lacquer containing a minimum of 4 ounces of aluminum paste per gallon of spraying material.

FS-28-INTERIOR CLOSED MEMBERS THAT CAN BE PLATED.

Corrosion-resistant steel shall not be plated, primed or finished.

Interior of Members:

Fill with hot (165°F) raw linseed oil, drain thoroughly, and close with cadmium plated self-tapping screws.

Exception:

Flash welded parts require no oiling.

Exterior of Members:

Cadmium plate.

DO NOT PRIME.

Exceptions:

Parts subsequently finished, other than with yellow-green, shall receive one coat zinc chromate primer. Dissimilar metals shall be protected in accordance with FG-5.

FINISH:

Cockpits, Baggage Compartment and/or Parts Attaching:

Yellow-green finish.

Fuselage Rear of Baggage Compartment, Wings, and Tail Group:
No further requirements.

Landing Light Compartment:
Flat black lacquer.

Wheel Wells:
No further requirements.

FS-29-INTERIOR OPEN MEMBERS THAT CANNOT BE PLATED.
PRIME:
Zinc chromate primer (one coat).

FINISH:
FINISH TO MATCH ADJOINING SURFACES.

FS-30 EXTERIOR OPEN MEMBERS THAT CANNOT BE PLATED.

PRIME:
Zinc chromate primer (one coat).

FINISH:
FINISH TO MATCH ADJOINING SURFACES.

10. TEXTILES.

FT-20-TANK PADS AND STRAPS.
Cover with "Tolex 205 DC-FP" cloth (Textile Leather Corp.), or equivalent.

FT-21-WINGS AND/OR TAIL SURFACES EXCEPT RUDDER.
And

FT-23-RUDDER.
Ailerons, Elevators, and Rudder:
Two brush coats and one spray coat of clear nitrate dope followed by two spray coats of clear nitrate dope containing a minimum of 6 ounces of aluminum paste per gallon of spraying material.

FT-24-ANTENNA MAST.
Three coats of clear dope followed by two coats clear dope containing a minimum of 5 ounces of aluminum paste per gallon of spraying material.

FT-25-COTTON WEBBING AND FABRIC.
No treatment required.

11. WOOD.

FW-21-INTERIOR PARTS, SURFACES, AND MEMBERS.
Sealer:
One coat sealer (Specification AN-S-17).

Filler:
One brush coat of filler (Wipe-on No. 1398 or equivalent) on all open grain woods, and for sealing of all nail holes, etc., regardless of wood type. Where filler is not required a second coat of sealer shall be applied.

FINISH:
One finish coat to match adjacent surfaces. Finish coat shall be one of the following:
Enamel, Aircraft (Specification AN-E-3).
Lacquer, Cellulose Nitrate (Specification AN-TT-L-51).

Exceptions:
Finish color on pilot's seat shall be flat bronze-green No. 9.

FINISH FOR FLOORBOARD SHALL BE AS FOLLOWS:
One coat clear sealer.
Two coats clear floorboard varnish (underside requires one varnish coat only over sealer).

FW-23-EXTERIOR PARTS, SURFACES, AND MEMBERS.
MONOCOQUE AND STABILIZERS:
Sealer:
Two coats sealer (Spec. AN-S-17).

Adhesive:
One coat clear dope.

Fabric:
Grade A fabric.

Dope:
Four coats clear dope.

FINISH:
Two coats of clear dope containing a minimum of 6 ounces of aluminum paste per gallon of spraying material.
Small Surfaces Other Than Monocoque and Stabilizers:

Sealer:
Two coats sealer (Spec. AN-S-17).

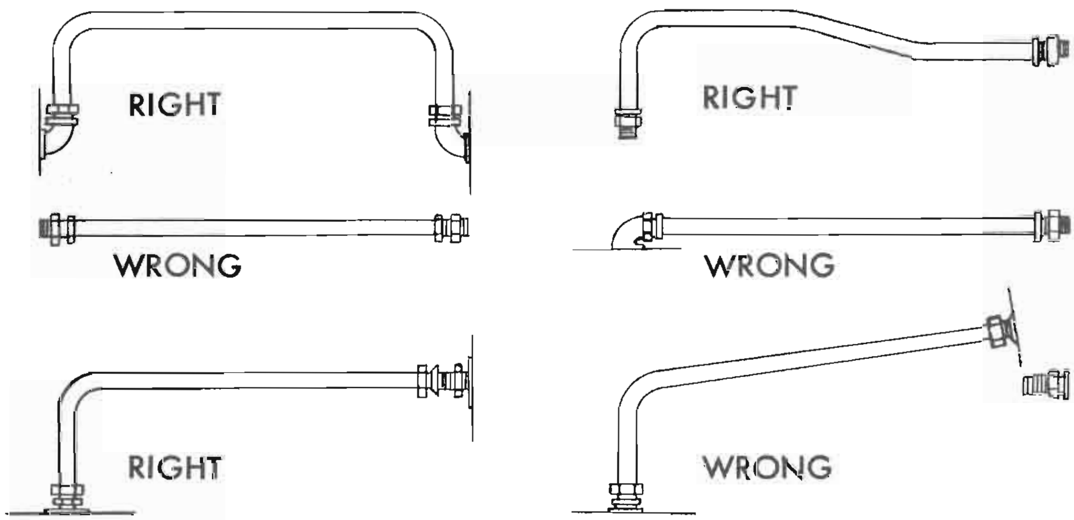
Filler:
One coat filler (Wipe-on No. 1398 or equivalent).

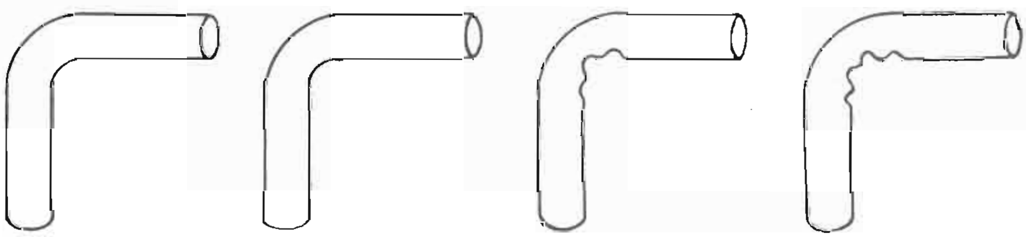
Surfacer:
One coat surfacer (Spec. 14115).

FINISH:
One coat clear lacquer pigmented with 8 ounces of aluminum paste per gallon of unthinned enamel.

FW-24-INTERIOR OF CLOSED MEMBERS.
Sealer:
Two coats sealer (Spec. AN-S-17). Second coat may be aluminized with 8 ounces of aluminum paste per gallon of unthinned sealer.

SECTION VIII
TUBING CHARTS





PERFECT BEND

FLATTENED BEND
Caused by having mandrel not far enough forward in tube or by working without a mandrel.

KINKED AND FLATTENED BEND
Caused by slipping of the tube in the bender.

WRINKLED BEND
Sometimes produced when thin-walled tube is bent without a supporting mandrel.

MINIMUM BEND RADII
(Soft Aluminum Alloy Tubes)

TUBE O.D.	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4
RADII	7/16	9/16	11/16	15/16	1 3/8	1 1/2	2	2 1/2

Figure 364 — Tube Bending Chart

LINE COLOR CODING.

a. Width of each color in the marking band shall be approximately ½".

b. Cellulose tape in the appropriate colors shall be used for the marking band.

c. The following colors shall be used as the means of identification for lines:

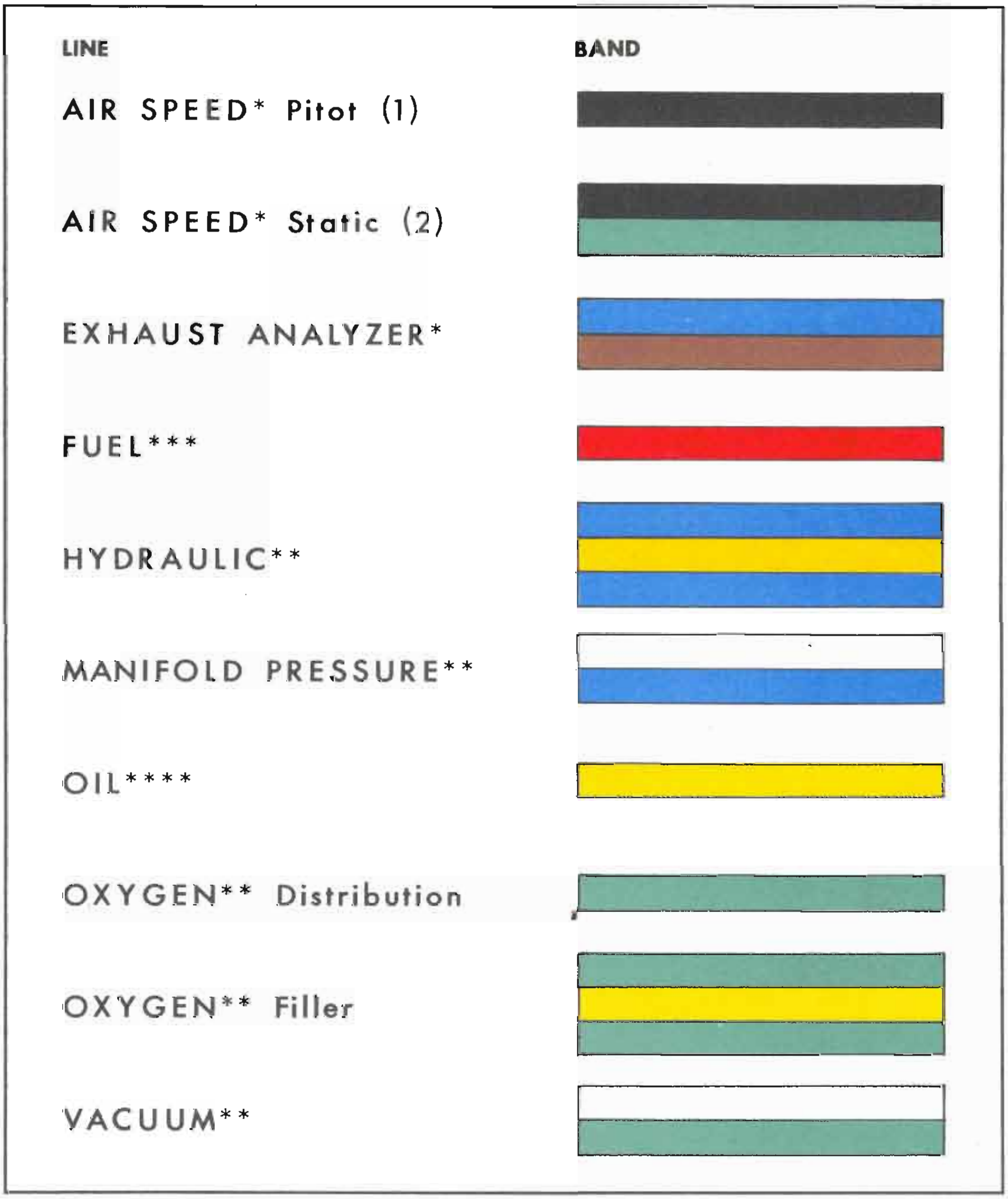


Figure 365 — Line Color Coding

*Each side of all union connections.
**Near each union.
***Near each union and on each side of every flexible connection.
****Near each end.

(1) "P" to be stamped on all B-Nuts on Pitot line.

(2) "S" to be stamped on all B-Nuts on Static line.

SECTION IX
CHARTS AND TABLES

TABLE 1

WRENCH LOADS ON BOLTS

Excessive tightening of a nut produces a stretching or distortion of the threaded portion, which may lead eventually to the failure of the bolt. To eliminate the possibility of such damage, it is necessary that the twist or torque moment be accurately controlled and held below certain maximum limits, but above minimum limits necessary to secure fastening of parts.

In applying the specified torque loads, effort should be made to stop just inside the prescribed low limit, thus leaving sufficient reserve to enable further tightening to secure alignment of cotter holes without exceeding the specified upper limit. A nut should not be backed off to secure cotter alignment.

Torque moments to be applied to steel bolts having a tensile strength of 125,000 pounds per square inch are as follows:

Bolt Size	*Pound-Inches*	*Pound-Feet*
3/16 inch	35 to 50	3 to 4
1/4 inch	55 to 90	5 to 7
5/16 inch	90 to 150	8 to 12
3/8 inch	200 to 350	17 to 29
7/16 inch	350 to 600	30 to 50
1/2 inch	500 to 850	42 to 70
5/8 inch	850 to 1300	71 to 108
3/4 inch	1200 to 1750	100 to 146

The above torques or moments are to apply when used with standard steel nuts without lubrication. If threads are lubricated the above torques should be reduced 30 percent.

Torque moments to be applied to 24ST aluminum-alloy aircraft bolts are as follows:

Bolt Size	*Pound-Inches*	*Pound-Feet*
3/16 inch No. 10	10 to 14	
1/4 inch	20 to 35	2 to 3
5/16 inch	50 to 75	4 to 6
3/8 inch	80 to 110	7 to 9
7/16 inch	100 to 140	9 to 11
5/8 inch	300 to 460	24 to 38

The above torques are to apply when used with AN-365 nuts and antisieze paste (zinc dust and petroleum jelly).

TABLE 2

METRIC UNITS

AMERICAN		BRITISH
Multiply	*by*	*to Obtain*
U.S. Gallons (gal)	0.833	(Imp. gal) Imperial Gallons
U.S. Gallons	3.785	(l) Liters
Miles per hour (mph)	1.609	(kmph) Kilometers per Hour
Miles per hour	0.8684	Knots
Miles	1.609	(km) Kilometers
Miles	0.8684	Nautical Miles
Feet (ft)	0.3048	(m) Meters
Inches (in.)	2.45	(cm) Centimeters
Pounds (lb)	0.4536	(kg) Kilograms
Pounds per sq in. (lb/sq in.)	0.0703	(kg/sq cm) Kilograms per Square Centimeter
Inches in Mercury (in. Hg)	2.54	(cm Hg) Centimeters of Mercury
Horsepower (hp)	1.014	(m.h.p.) Metric Horsepower
Degrees Centigrade (°C) plus or minus	17.8—1.8	Degrees Fahrenheit

TABLE 3

AIRPLANE BLOCK NUMBERS. — Following is a list of block numbers for AT-6C, SNJ-4, AT-6D and SNJ-5 airplanes. The airplane serial numbers given are for the first airplane in that particular series.

Airplanes previous to	*Airplane Type*	*Serial Numbers of First Airplane in Series*
Block 1-NT	AT-6C	AC-41-32073
	AT-6C	EX-100
	SNJ-4	05527
	SNJ-4	09817
Block 1-NT	AT-6C	AC-41-32303
	AT-6C	EX-365
	SNJ-4	10144
	SNJ-4	26427
Block 5-NT	AT-6C	AC-41-33068
	AT-6C	AC-42-3884
	AT-6C	EX-585
	SNJ-4	26869

Airplanes previous to	*Airplane Type*	*Serial Numbers of First Airplane in Series*
Block 10-NT	AT-6C	AC-42-4064
	AT-6C	AC-42-48772
	AT-6C	EX-628
	SNJ-4	27139
Block 15-NT	AT-6C	AC-42-49005
	AT-6C	AC-42-43847
	AT-6C	EX-729
	SNJ-4	27627
	SNJ-4	51350
Block 1-NT	AT-6D	AC-42-44426
	AT-6D	EX-849
	SNJ-5	51661

TABLE 4

CONVERSION LIST NORTH AMERICAN STANDARD PARTS.—Following is a Conversion List noting the old and new North American standard part numbers.

Old No.	*New No.*
B251	1H1
B310	1N1
B981	2W6
B983	2W2
B985	2W1
B1000	2H6
B1009	4B14
B1017	2L5
B1054	4B2
B1055	4B3
B1056	4B4
B1057	4B5
B1058	4B6
B1059	4B7
B1060	4B8
B1061	4B9
B1062	4B10
B1063	4B11
B1064	4B13
B1068	5P2
B1070	4S3
B1071	4S4
B1074	5B11
B1078	3C1
B1079	5C1
B1082	2C1
B1084	5B6
B1086	5B7
B1089	2L4
B1094	2F1
B1097	5P3
B1100	2W8
B1102	2W3
B1103	4S1
B1104	4C1
B1105	6C17
B1111	6C15
B1113	6C14
B1116	6C13
B1117	6C12
B1118	6C11
B1121	6C10
B1123	6C9
B1132	2L2
B1133	2L1
B1134	3S6
B1135	5R8
B1136	5R7
B1140	3P1
B1141	7B1
B1142	7B2
B1144	4C2
B1148	2H3
B1149	8B2
B1153	4R3
B1154	4R2
B1155	1C24
B1158	2H2
B1160	3C3
B1161	3C2
B1167	6C6
B1169	2H1
B1170	2B1
B1171	7B3
B1172	6S1
B1173	5B8
B1174	5B2
B1175	5B3
B1176	3B2
B1178	3C4
B1180	5C2
B1181	2C15
B1184	1R6
B1185	5B5
B1188	6C5
B1192	8E1
B1194	2P1
B1195	1R4
B1196	5C3
B1201	2C16
B1204	4B1
B1205	2L3
B1206	6C16
B1207	5S2
B1209	5S3
B1210	1W4
B1211	2C17
B1212	1R5
B1213	1W2
B1214	1W3
B1217	5R5
B1221	5P1
B1222	1F2
B1223	1P2
B1226	5B10
B1227	2B1
B1228	2H4
B1230	1W1
B1231	2W5
B1232	6C8
B1233	6B1
B1234	2S5
B1235	1G3
B1236	1G2
B1238	1B1
B1240	2C2
B1243	6B2
B1244	5B9
B1245	6C7
B1246	1A1
B1247	5R4
B1248	7S6
B1249	5C4
B1251	7S2
B1252	3F2
B1253	1B3
B1254	1B2
B1256	4S2
B1257	1C1
B1258	2C8
B1259	6C4
B1260	4B12
B1261	2C3
B1262	2C4
B1263	2C5
B1264	2C6
B1265	2C7
B1268	5S1
B1269	5B4
B1272	2C9
B1276	1T3
B1277	1T1
B1278	3G1
B1281	3F1
B1282	5R6
B1284	1T2
B1285	2P2
B1286	7S1
B1287	7S4
B1289	7S5
B1295	1P3
B1297	1N2
B1298	5R3
B1299	6C3
B1304	6B3
B1305	2C10
B1306	2C11
B1309	5P5
B1310	2W4
B1311	2L6
B1312	6C2
B1314	7S8
B1315	3R3
B1316	2C13
B1319	2C12
B1320	5P8
B1321	3C5
B1322	5P7
B1323	5P6
B1325	1G1
B1326	5R2
B1327	1F1
B1328	2C14
B1331	2S1
B1332	3B1
B1333	3R1
B1334	5R1
B1335	2S2
B1336	2S4
B1337	2S3
B1338	7S7
B1339	7S3
B1340	3R2
B1341	5P4
B1343	9B1
B1344	2P3
B1346	1R7
B1348	3W1
B1349	2G3
B1350	2G2
B1351	2G1
B1352	5P9
B1355	5B12
B1356	4R1
B1357	1G4
B1358	1C20
B1359	1C21
B1360	1C22
B1361	1C23
B1362	8B1
B1363	2H7
B1364	2H8
B1365	3R4
B1366	4P1
B1367	7S9
B1368	7S10
B1369	5B1
B1370	2R2
B1371	2R3
B1372	2R4
B1373	6R1
B1374	3G2
B1375	2F2
B1376	5C5
B1377	3S5
B1378	3S4
B1379	3S2
B1380	3S3
B1381	3F3
B1382	2L7
B1383	2C18
B1384	7S11
B1385	6R2
B1386	3H1
B1387	1R1
B1388	1R2
B1389	1R3
B1390	1G5
B1442	6C1
B5000	1D1
B5001	1D2
B5002	1D3
B5003	1D4
B5004	1D5
B5005	1D6
B5006	1D7
B5007	1D8
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B5010	1D11
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B5045	1D46
B5046	1D47
B5047	1D48
B5048	1D49
B5049	1D50
B5050	1D51
B5051	1D52
B5052	1D53
B5053	1D54

Old No.	New No.	Old No.	New No.	Old No.	New No.	Old No.	New No.	Old No.	New No.	Old No.	New No.
B5054	1D55	B5113	1D114	C163	2E3	C249	5E3	C321	2E21	C385	7E34
B5055	1D56	B5114	1D115	C164	2E4	C250	1E87	C322	3E12	C386	7E2
B5056	1D57	B5115	1D116	C165	2E5	C251	7E20	C324	6E63	C387	1S9
B5057	1D58	B5116	1D117	C166	2E6	C252	7E19	C325	1E74	C388	1S8
B5058	1D59	B5117	1D118	C167	2E7	C253	1S22	C326	1E73	C389	7E1
B5059	1D60	B5118	1D119	C170	2E15	C254	2E9	C327	1E72	C390	2E25
B5060	1D61	B5120	1D121	C171	1C15	C255	1S21	C328	7E29	C401	2E26
B5061	1D62	B5121	1D122	C172	1E109	C259	6E68	C329	7E5	C402	2E27
B5062	1D63	C106	1C19	C173	1E108	C260	1E86	C330	1C11	C404	1E60
B5063	1D64	C107	1S14	C174	1E107	C261	1E85	C331	7E15	C405	4E16
B5064	1D65	C108	1E116	C175	1E106	C262	1E84	C332	5E17	C407	1E59
B5065	1D66	C109	6E39	C176	1E105	C263	1E83	C333	5E18	C408	1C9
B5066	1D67	C110	6E19	C177	1E104	C264	7E16	C335	6E62	C409	1C8
B5067	1D68	C111	1S83	C178	1E103	C265	1S61	C336	5E12	C410	2E28
B5068	1D69	C112	3E1	C179	1E102	C266	1S62	C337	2E22	C411	6E56
B5069	1D70	C113	6E20	C180	1E2	C267	1S20	C338	1S19	C412	2E29
B5070	1D71	C114	1E115	C181	1S30	C268	6E67	C339	5E5	C413	6E7
B5071	1D72	C115	2E10	C182	1C14	C269	6E73	C340	1E71	C414	6E55
B5072	1D73	C116	1E114	C184	1C13	C270	5E15	C341	1E70	C415	6E8
B5073	1D74	C117	3E2	C186	7E32	C273	4E5	C342	1E69	C416	6E54
B5074	1D75	C119	1S41	C192	6E72	C274	4E6	C343	4E12	C417	1S7
B5075	1D76	C120	1E113	C193	4E3	C275	7E14	C344	6E61	C418	1E58
B5076	1D77	C121	6E70	C194	3E8	C276	4E7	C345	1S18	C419	5E20
B5077	1D78	C122	2E11	C196	1S29	C277	2E19	C346	1E68	C420	6E53
B5078	1D79	S123	1S40	C197	1S28	C278	6E66	C347	1E67	C421	5E21
B5079	1D80	C124	1S39	C198	2E16	C279	1E82	C348	1E66	C422	4E17
B5080	1D81	C125	1S38	C199	1S27	C280	4E8	C349	1E65	C423	1E57
B5081	1D82	C126	1S37	C200	1S26	C281	7E36	C350	1E64	C424	1E56
B5082	1D83	C127	1S36	C201	3E9	C282	6E71	C351	6E60	C425	1E55
B5083	1D84	C128	3E3	C202	5E1	C283	4E9	C352	4E13	C426	1E54
B5084	1D85	C130	2E12	C203	1E101	C287	1E81	C353	1S17	C427	7E35
B5085	1D86	C131	1S35	C204	1E100	C288	1E80	C354	4E14	C429	5E22
B5086	1D87	C132	1C18	C205	1E99	C289	3E10	C355	1S16	C431	1E53
B5087	1D88	C133	1C17	C206	1E98	C290	6E1	C356	1E63	C432	6E52
B5088	1D89	C134	1C16	C207	4E4	C291	6E2	C357	1S15	C435	1E52
B5089	1D90	C135	1S34	C209	1C12	C292	6E3	C359	7E26	C436	1C7
B5090	1D91	C136	1S33	C211	2E8	C293	6E4	C361	1E62	C437	1C6
B5091	1D92	C141	1E112	C214	1E97	C294	7E13	C362	1E61	C438	5E23
B5092	1D93	C142	1E111	C216	1E96	C295	1E79	C363	6E59	C439	2E30
B5094	1D95	C143	3E4	C217	1E95	C296	5E4	C364	1S13	C441	5E24
B5095	1D96	C144	1S32	C220	1E94	C297	7E30	C365	2E23	C442	5E25
B5096	1D97	C145	1S31	C224	3P2	C299	1E78	C366	1E4	C443	5E6
B5097	1D98	C146	1H2	C225	5E2	C300	1E77	C367	1C10	C444	5E7
B5098	1D99	C147	2P4	C226	1S25	C301	1E118	C369	5E19	C445	5E8
B5099	1D100	C148	1E110	C227	1E93	C303	5E16	C370	6E58	C446	1C5
B5100	1D101	C150	1E1	C228	1E92	C304	6E65	C371	1S12	C447	1E51
B5101	1D102	C151	7E10	C229	1E91	C305	2E20	C372	4E15	C448	3E14
B5102	1D103	C152	7E9	C230	1E90	C307	6E16	C373	1S3	C449	2E31
B5103	1D104	C153	5E10	C231	1E89	C308	6E17	C374	1S11	C450	1E50
B5104	1D105	C154	5E11	C232	1S24	C309	6E5	C375	1S10	C451	1C4
B5105	1D106	C155	2E13	C233	7E6	C310	6E6	C376	6E57	C452	6E24
B5106	1D107	C156	3E5	C234	1S23	C312	6E64	C377	7E21	C453	6E48
B5107	1D108	C157	3E6	C235	1E88	C313	3E11	C378	2E24	C454	6E47
B5108	1D109	C158	3E7	C236	1E76	C314	6E74	C379	3E13	C455	6E46
B5109	1D110	C159	6E69	C237	2E17	C317	7E24	C381	7E4	C456	6E22
B5110	1D111	C160	4E2	C238	2E18	C318	1E75	C382	7E3	C457	6E23
B5111	1D112	C161	2E14	C239	1E3	C319	4E10	C383	7E33	C458	6E45
B5112	1D113	C162	2E2	C245	1E117	C320	4E11	C384	7E8	C459	6E21

Old No. — *New No.*

C460—2E1
C464—6E49
C465—6E50
C466—6E51
C467—5E26
C469—6E25
C470—6E26
C471—6E27
C472—6E44
C473—3E15
C474—3E16
C475—1C3
C477—5E9
C478—1E49
C479—1E48
C480—6E43
C481—4E18
C482—4E19
C483—4E20
C484—2E32
C486—4E21
C487—4E22
C488—1E47
C489—5E14
C490—5E13
C491—1S6
C492—6E9
C493—6E10
C494—6E11
C495—6E12
C496—1S5
C497—1S4
C498—1E46
C499—4E23
C502—6E42
C503—6E41
C504—7E11
C505—1E45
C506—1E44
C507—1E43
C508—6E28
C513—3E17
C514—4E24
C515—2E33
C517—4E25
C518—1E42
C519—1E41
C521—7E27
C524—6E13
C525—6E14
C526—6E33
C527—6E15
C528—1E40
C529—1E39
C530—1E38
C531—1E37
C532—6E38
C533—2E34

Old No. — *New No.*

C534—6E37
C535—4E1
C536—2E35
C537—1E36
C538—1E35
C539—4E26
C540—6E36
C541—4E27
C542—4E28
C543—4E29
C544—1E34
C545—1E33
C546—4E30
C547—1E32
C548—1E31
C549—1E30
C550—1E29
C551—1C2
C555—7E37
C556—1E28
C557—1E5
C558—1E27
C559—1E26
C560—1E25
C561—1E24
C562—1E23
C563—4E31
C564—1E22
C565—1E21
C566—1E20
C567—6E29
C569—1E19
C570—4E32
C571—1E18
C572—1E17
C573—7E28
C574—1E16
C575—2E36
C576—1E15
C577—6E30
C578—4E33
C579—1E14
C580—1E13
C582—2E37
C583—5E27
C584—7E18
C585—7E23
C586—7E22
C588—1E12
C590—4E34
C591—6E31
C592—6E35
C593—4E35
C596—6E34
C597—1E11
C598—2E38
C599—7E12
C600—1E10

Old No. — *New No.*

C601—7E25
C603—1E9
C604—7E7
C605—2E39
C606—4E36
C607—4E37
C609—6E18
C610—2T2
C611—2T1
C612—1S42
C613—2E40
C614—1S68
C615—1S69
C616—1S70
C617—1S71
C618—1S72
C619—1S73
C620—6E75
C621—7E31
C623—1E7
C624—1E8
C625—7E17
C626—1E6
C627—6E32
C628—7E38
C629—1E119
C631—1E120
C632—4E38
C633—3E18
C634—1S43
C635—1S44
C636—1S45
C637—1S46
C638—1S47
C640—1E121
C641—1S2
C642—1S1
C643—1E122
C644—4E39
C645—1S48
C646—1S49
C649—1S51
C650—1S52
C651—1S53
C652—1S54
C653—1S55
C654—6E77
C656—1S56
C657—6E78
C658—1S58
C659—6E76
C660—1S63
C663—1E123
C664—1E124
C666—1E125
C667—4E40
C668—1S59
C669—1S60

Old No. — *New No.*

C670—4E41
C671—1S64
C672—1S65
C673—1S66
C674—1S67

Old No. — *New No.*

C675—1S74
C676—1S75
C677—1S76
C678—1S77
C679—1S78

Old No. — *New No.*

C680—1S79
C681—1S80
C682—1S81
C683—1S82
C684—1S84

TABLE 5

APPLICABLE TECHNICAL ORDER LIST.—Following is a list of technical orders applicable to the airplane which may be used in conjunction with the handbook text for general information.

GENERAL

00-20A	The Army Air Forces Visual Inspection System.
00-25-4	Aircraft Maintenance Procedure and Overhaul of Engines.
01-1-13	Operation of Airplane Equipped with Air Filters.
01-1-23	Cleaning of Carburetor Air Filters.
01-1-31	Packing Airplanes and Airplane Parts for Shipment.
01-1-50	Towing, Mooring and Handling of Airplanes.
01-1-70	Removal of Carburetor Air Screens.
02-1-1	Preparation of Engines for Storage.
02-1-8	Restrictions on Removal of Engines.
02-1-22	Pre-oiling of Aircraft Engines.
02-1-29	Ground Operation Instructions for Aircraft Engines.
03-1-1	Periodic Inspection of Accessories in Storage.
03-1-12	Repair and Cleaning of Non-Self Sealing Fuel and Oil Tanks.
03-5AA-1	Handbook of Instructions—Aircraft Engine Generators and Control Boxes.
03-5CA-1	Handbook of Instructions—Aircraft Engine Starters and Starter Motors (Eclipse).
03-5D-4	Magnetos—Type VAG.
03-10B-1	Operation and Service Instructions—Aircraft Carburetors (Float type) Stromberg.
03-20CA-2	Service and Overhaul Instructions with Parts Catalog. Constant Speed Propeller Governors and Controls — Hydromatic. Constant Speed Propeller Governors and Controls (Hamilton).
03-20CB-2	Handbook Service and Overhaul Instructions with Parts Catalog — Controllable Propeller (Two—Position and Constant Speed).
05-3A-2	Handbook of Service and Overhaul Instructions—Fuel Mixture Indicators.

FUSELAGE

01-1-8	Ventilation of Airplanes in Hot Weather.
22-1-3	Repairs of Wood Constructed Wings, Control Surfaces and Fuselage Members.
23-5-2	Welding of Steel Tubular Structure.
23-5-3	Welding, Machining and Forming Corrosion-Resistant Steels and Inconel.
23-15-1	Repair and Manufacturing Practices.
23-20-1	Repair and Maintenance of Plexiglas and other Plastic Sheets.
24-1-2	Brazing and Welding Compounds (Flux).
24-1-3	Desiccant, Corrosion-preventive (Indicating).
S-22-2	Woods—Class 22.

LANDING GEAR

03-25-1	Handbook of Instructions with Parts Catalog—Master Cylinders and Compensating Pressure Control Air Valve.
03-25-2	Operation of Brake Pedals on Power Operated Brakes.
03-25-6	Care of Pneumatic Shock Struts.
03-25-7	Removal of Wheel and Brake Fairings.
03-25A-4	Handbook of Instructions with Parts Catalog — Smooth Contour Tail Wheels (Variety)
03-25A-6	Tail or Nose Wheels (Hayes).
03-25A-7	Handbook of Instructions with Parts Catalog Nose and Tail Wheels.
03-25B-1	Handbook of Instructions with Parts Catalog—Landing Wheels (Hayes).
03-25E-1	Air-Oil Shock Absorber Struts.
03-25E-2	Handbook of Instructions with Parts Catalog, Nose, Tail and Landing Gear Struts.

SURFACE CONTROLS

01-1-29	Use of Surface Control Locks and Inspection of Surface Controls.
01-1-57	Lubrication of Control Cables.

HYDRAULICS

03-30-4	Identification, Disposition and Use of Hydraulic Packing Rings.
03-30CC-3	Handbook of Instructions with Parts Catalog—Gear-type Engine Driven Oil Pumps.
03-30CJ-1	Handbook of Instructions with Parts Catalog—Gear-type Hydraulic Pumps.

ELECTRICAL SYSTEMS

01-1-52	Connection of External Power Sources to the Electrical System of the Airplane.
03-5-1	Handbook of Instructions with Parts Catalog, Types B-1 and C-1 Battery Circuit Solenoid Switches.
03-5-9	Handbook of Instructions with Parts Catalog—Booster Coil Types A-1 and C-1.
03-5AB-2	Generator Control Panels Types A-1 and A-2.
03-5AD-2	Handbook of Instructions with Parts Catalog—Generator Voltage Regulator.
03-5AD-6	Handbook of Instructions with Parts Catalog—Generator Current Control Switch Relays.
03-5AF-1	Handbook of Instructions with Parts Catalog Voltage Regulators.
03-5AF-3	Handbook of Instructions with Parts Catalog — Relay Switch Generator Current Control.
03-5B-1	Handbook of Instructions Storage Batteries.
03-5DA-2	Service Instructions Aircraft Magnetos.
03-5E-1	Spark Plug Use and Reconditioning.
03-5G-7	Inverter—Electronic.

INSTRUMENTS

05-3AA-1	Handbook of Instructions with Parts Catalog Type A-7 Fuel Mixture Indicator (Cambridge).
05-3AB-1	Handbook of Instructions with Parts Catalog Types B-6, B-6A Fuel Mixture Indicator.
05-3C-1	Handbook of Instructions with Parts Catalog, Fuel Mixture Indicator Types A-7, B-5 and B-6.
05-5B-2	Handbook of Instructions with Parts Catalog Type E-12 Electric Tachometer.
05-10-2	Handbook of Service and Overhaul Instructions, Airspeed Indicator.
05-15-9	Handbook of Instructions with Parts Catalog, Pilot's Compass Type B-16.
05-20-2	Handbook of Instructions with Parts Catalog—Bank and Turn Indicator.
05-20-9	Handbook of Instructions with Parts Catalog—Gyro Horizon.
05-20-10	Handbook of Instructions with Parts Catalog—Directional Gyro.
05-20-27	Handbook of Instructions with Parts Catalog—Type C-2 Rate of Climb Indicators.
05-30-5	Handbook of Overhaul Instructions with Parts Catalog Altimeters — Type C-12, C-13.
05-40-3	Thermocouple Thermometers.
05-40A-5	Handbook of Instructions with Parts List —Thermometers—Free Air and Carburetor Air.
05-70-2	Handbook of Instructions — Pressure Gages.
05-70C-1	Handbook of Instructions with Parts Catalog—Types D-9, D-10 and AN5770-1—Manifold Pressure Gages.

05-75-1	Handbook of Instructions with Parts Catalog—Engine Gage Units.
05-80-1	Handbook of Instructions with Parts Catalog—Suction Gages.

RADIO AND INTERPHONE

08-10-13	Preliminary Handbook of Instructions for Interphone Equipment RC-26 and RC-27.
08-10-36	Handbook of Instructions for Radio Set SCR-AL-183 and Radio Set SCR-AL-283.
08-10-50	Handbook of Instructions Operation and Maintenance Radio Set SCR-274-N.
08-10-87	Handbook of Instructions RC-39-B and RC-43-B, Marker Beacon Receiving Equipment.

ARMAMENT

11-1-28	Cleaning, Lubrication and Maintenance of .30 Caliber Aircraft Machine Guns.
11-10-9	Description and Service Instructions for Adapters on Flexible Mounted Model M-2 .30 Caliber Aircraft Machine Guns.
11-10-14	Handbook of Instructions with Parts Catalog—Single Mount Gun Adapter.
11-25-6	Securing of Tail Fin Assembly on all Mark Series Demolition Bombs.
11-25-11	Methods of Arming Bombs.
11-35-5	Installation, Inspection and Use N3B Gun Sight.

PHOTOGRAPHIC

10-1-2	Filter Units.
10-1-3	Viewfinder.
10-1-45	Type B-2 Intervalometer.
10-10-24	K-3B Aerial Camera.
10-10AC-9	Type K-17 Aerial Camera.

OXYGEN

03-50-1	Use of Oxygen.
03-50-2	Charging Oxygen Cylinders.
03-50-4	Oxygen Cylinders.
03-50C-3	Low Pressure Oxygen Cylinders.
03-50-9	Safety Precautions for Combat.
03-50-10	Adapters, Army, Navy and British Oxygen Systems.
03-50A-1	A-6, A-8, A-8A, A-9 and A-9A Regulators.
03-50A-4	Reworking Types A-8 and A-9 Regulators.
03-50A-5	A-12 Demand Oxygen Regulators.
03-50A-6	A-13 Demand Oxygen Regulators.
03-50B-1	Type A-10 Revised Oxygen Mask.

COLD WEATHER

00-60-3	Instructions for Arctic Operation.

SECTION X
SERVICE INSPECTIONS

GENERAL

The work outlined in this section consists of periodic inspection, cleaning, servicing, lubricating adjusting, and such maintenance as organization facilities permit.

Inspection and maintenance requirements given herein are to be considered the minimum requirements. If, for any reason, the inspection and maintenance requirements prescribed herein are insufficient, local authority should not hesitate to increase the scope and frequency of inspections.

No airplane will remain idle more than 6 days without a DAILY INSPECTION (including engine warm-up) unless in "in storage" status undergoing engine change, or in the engineering shops and not being used for flight.

No airplane will be allowed to remain idle more than 1 month without a 25-HOUR INSPECTION, irrespective of its flying time, except airplanes in depots undergoing overhaul and airplanes in "in storage" status.

No airplane will be allowed to remain more than 3 months without a 50-HOUR INSPECTION, irrespective of its flying time, except airplanes in depots undergoing overhaul and airplanes in "in storage" status.

PREFLIGHT INSPECTION

The preflight inspection is a check of the complete airplane prior to the first flight of the day (including engine warm-up).

AFTER-FLIGHT INSPECTION

The after-flight inspection is a complete check of the airplane to determine its general condition and to detect malfunctioning which occurred during the last flight. It also includes the servicing of the airplane.

DAILY INSPECTION

The daily inspection is to determine the general condition of the complete airplane. It is designed to detect aggravated conditions, maladjustments, breaks, etc., but is not designed to be sufficiently thorough and searching as to detect slight wear and early stages of deterioration.

25-Hour (Navy 30-Hour) Inspection

The first 25-hour inspection will be accomplished between the 20th and 30th flying hours of the aircraft. Subsequent 25-hour inspections will be accomplished at the 50-hour inspection periods and also between the 20th and 30th flying hours following the completion of the 50-hour inspection.

50-Hour (Navy 60-Hour) Inspection

The first 50-hour inspection will be accomplished between the 40th and 60th flying hours of the aircraft. Subsequent 50-hour inspections will be accomplished between the 40th and 60th flying hours following the completion of the last previous 50-hour inspection.

100-Hour (Navy 120-Hour) and Subsequent Inspections

The 100-hour, 200-hour, and 300-hour, etc. (Navy 120-hour, 240-hour, and 360-hour, etc.) inspections will be accomplished at the second, fourth, sixth, etc., 50-hour (Navy 60-hour) inspection periods.

NOTE

The following is an example of how flying hours will be computed to determine when the various inspections will be due for accomplishment: It will be assumed that the first 25-hour inspection is completed at the 28th flying hour of the aircraft. (However, the time of completion of the first 25-hour inspection will not be used for calculating when the second 25-hour inspection period will be due.) The second 25-hour inspection will be accomplished with the first 50-hour inspection. It is further assumed that the first 50-hour inspection and the second 25-hour inspection are completed when the aircraft has 54 hours of flying. The third 25-hour inspection will then be due for accomplishment at the 79th hour (54 plus 25), but may be accomplished between the 74th and the 84th hours; the second 50-hour, the fourth 25-hour and the first 100-hour inspections will be due at the 104th hour (54 plus 50), but may be accomplished between the 94th and the 114th hours, etc.

At Engine Change Inspection

This inspection is to be performed at each engine change at which time all special instructions and maintenance work prescribed by technical instructions will be accomplished.

25-Hour After Engine Change Inspection

("Shake-down Inspection.") This inspection is to be accomplished between 20 and 30 flying hours after engine change.

INDEX TO COLUMN NUMBERS

The inspections outlined in this section are arranged to correspond with the columns on Army Air Forces Form 41B, the corresponding column numbers being found to the left of the pertinent paragraphs. The following index is provided for convenience in locating the inspections specified for the various components of the airplane.

Column
10—Preflight Inspection
11—Bombing
12—Gunnery
13—Tow Target
14—Chemical
15—Communications
16—Photographic
17—Navigation
18—Special Inspections
19—Daily Inspections (Power Plant)
20—Engine Controls
21—Engine Instruments
22—Ignition and Electrical
23—Fuel System
24—Oil System
25—Cooling System
26—Valves
27—Manifolds and Superchargers
28—Propellers and Accessories
29—Power Plant—General
30—Daily Inspections (Airplane—General)
31—Cockpits and Cabins
32—Flight Control Mechanism
33—Movable Surfaces
34—Fixed Surfaces
35—Fuel Tanks
36—Tail Wheel Gear
37—Landing Gear
38—Wheels and Brakes
39—Hydraulic System
40—Fuselage
41—Oxygen Equipment
42—Night Flying Equipment
43—Airplane—General
44—Navigation Instruments
45—Remarks
46—Batteries

Results of these inspections will be recorded on Maintenance Inspection Record, Army Air Forces Form No. 41B, which is maintained for each airplane.

PREFLIGHT INSPECTION

Col 10

WARNING

Do not tow the airplane unless a crew member rides in the pilot's compartment to operate the brakes.

BEFORE STARTING ENGINE

Head the airplane into the wind.

Figure 366 — Wheel Chocks in Position

See that wheel chocks are in proper position.

Check condition and position of static ground wire forward of the tail wheel.

Remove the cover from the airspeed tube.

Examine the Airplane Flight Report for completeness. If incomplete, make the necessary entries to complete it.

Note whether routine inspections are due. If due, and they cannot be made, see that the proper symbols are entered to indicate the omission of the inspections.

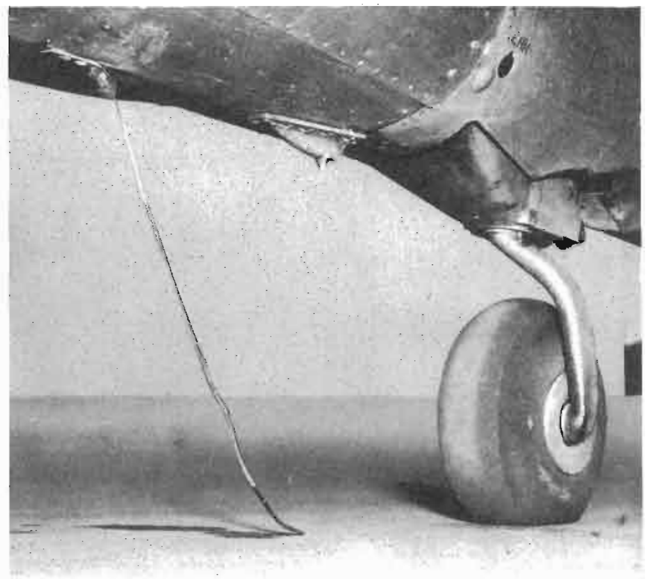


Figure 367 — Static Ground Wire Installed

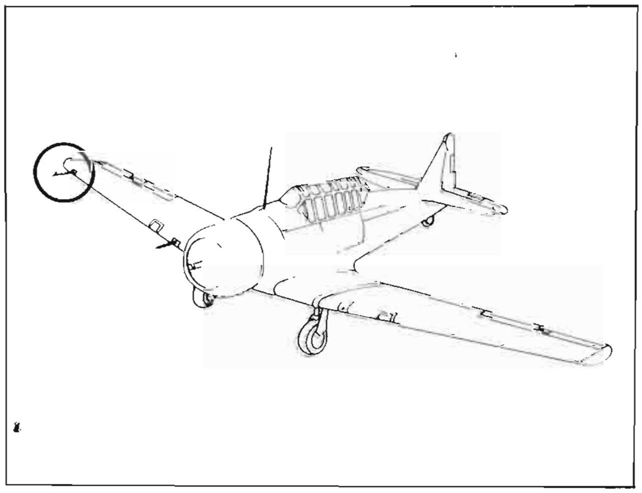


Figure 368 — Airspeed Tube Installed

REPLENISHMENT SPECIFICATIONS

Description	*Capacity*		*Replenishment*
FUEL	U.S. gal	Imperial gal	
Left wing tank	55.2	46.0	
Right wing tank	55.2	46.0	
NOTE (AT-6 only)			Specification No. AN-F-25, 91 octane.
Left wing compartment	89.0	74.0	
Right wing compartment	89.0	74.0	

REPLENISHMENT SPECIFICATIONS (Cont'd)

Description	*Capacity*		*Replenishment*
	U.S. gal	Imperial gal	
ENGINE OIL TANK	10.2	8.5	Specification No. AN-VV-O-446: In summer temperature use grade 1120, SAE No. 60; in winter temp. use grade 1120, SAE No. 50.
NOTE (AT-6 only)			
Normal	10.8	8.97	
Overload	15.5	12.9	
HYDRAULIC FLUID TANK	.77	.64	Hydraulic fluid, AAF Specification No. 3580. Fill tank to overflowing.
MASTER BRAKE CYLINDER	Fill to overflowing		Hydraulic fluid, AAF Specification No. 3586 Grade B.
BATTERY	12-volt, 68 ampere-hours		Add distilled or drinkable water as required.
NOTE (AT-6D only) BATTERY	24-volt, 34 ampere-hours		
OXYGEN CYLINDERS			Fill High-Pressure System Cylinders to Pressure of 1800 lb/sq in. Fill Low-Pressure System Cylinders to Pressure of 400 lb/sq in.

LANDING GEAR (See figure 369)	
Shock strut fluid	Hydraulic fluid, AAF Specification No. 3580M. Fill to level of filler opening.
Shock strut inflation	Inflate so that extension is 1-3/8-2 inches.
Tires—27-inch diameter smooth contour	Inflate to deflection marks on sidewall (under normal load conditions 30 lb/sq in.)
TAIL WHEEL GEAR (See figure 370)	
Shock strut fluid	Hydraulic Fluid, AAF Specification No. 3580M.
Shock strut inflation	Inflate so that extension is 3-1/4 inches.
Tire—12.5-inch diameter smooth contour	Inflate to deflection marks on sidewall (under normal load conditions 30 lb/sq in.)

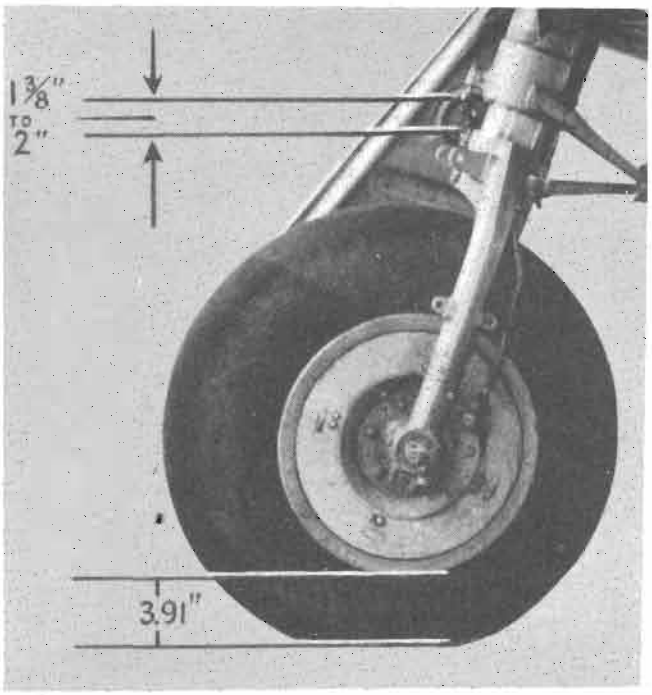


Figure 369 — Landing Gear Strut and Tire Inflation

Col 10

FUEL AND OIL TANKS

Check the supply of fuel and oil in the tanks; enter the quantities on the Airplane Flight Report, Form No. 1A. This check must be made on the day the airplane is to be flown, prior to the first flight of the day. Checks made on a previous day cannot be considered part of the preflight inspection prescribed by these instructions.

Replenish fuel tanks and oil tank if necessary. See that filler caps are properly secured. (See "REPLENISHMENT SPECIFICATIONS.")

Drain the fuel strainer unit; drain a small amount of fuel from the fuel tank sumps.

Col 10

LANDING GEAR

Inspect the main landing gear and tail wheel gear for damage or obvious defects.

WHEELS.—Inspect wheels for distorted rim flanges or ribs and security of retaining nuts, bolts, and cotter pins.

TIRES.—Inspect tires for proper inflation. (See REPLENISHMENT SPECIFICATIONS.) The de-

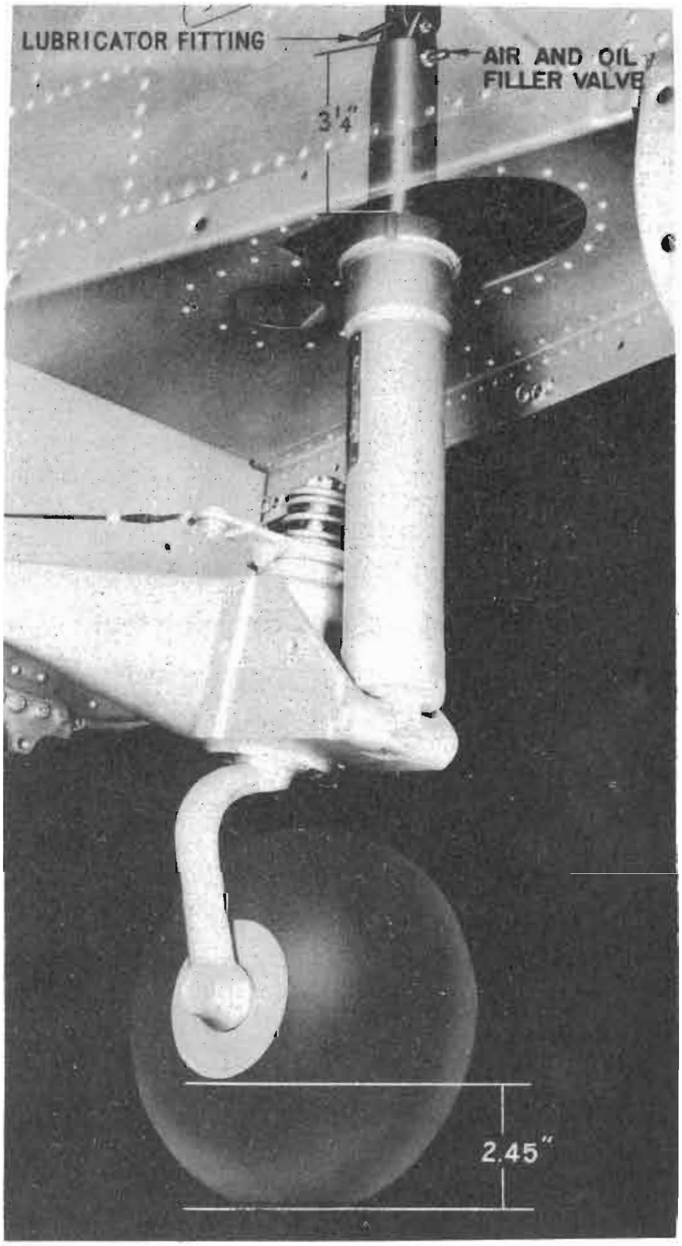


Figure 370 — Tail Wheel Gear Strut and Tire Inflation

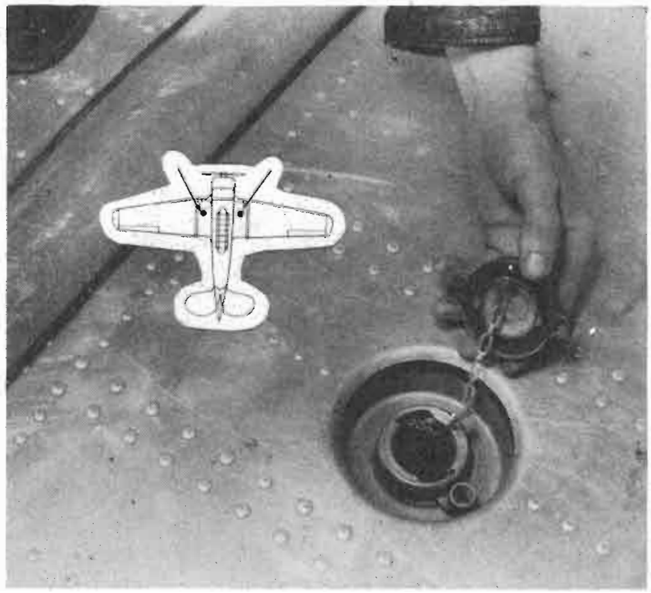


Figure 371 — Fuel Tank Filler Opening

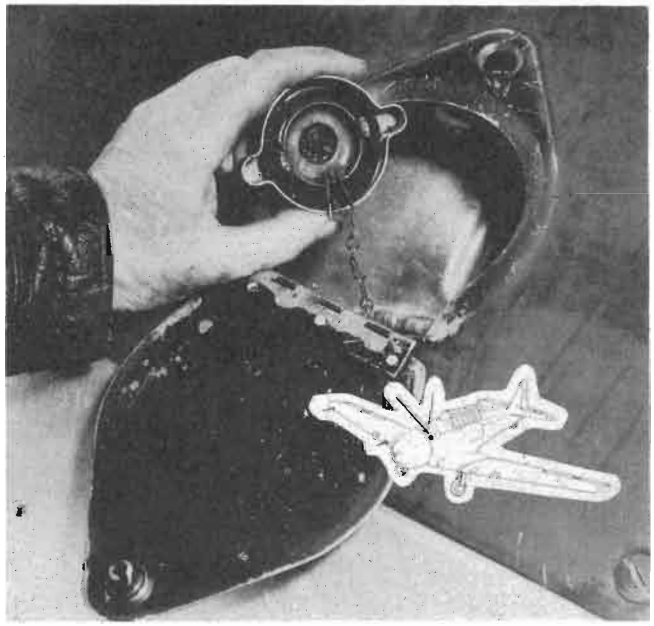


Figure 372 — Engine Oil Tank Filler Access

Col 10

flection marks on the sides should just touch the ground line when the airplane is in the three-point position on hard level ground. Access to the tire valve is gained by removing the Dzus-fastened outside wheel fairing. Under normal loading conditions, 30 pounds per square inch will be the approximate requirement.

SHOCK STRUTS.—Wipe off any ice, mud, dust, or sand from the exposed part of the shock strut piston tubes by means of a cloth saturated with the same kind of hydraulic fluid used in the strut.

Col 10

NOTE

When operating the airplane during low temperatures, cleaning of the piston tube may be accomplished more easily if done immediately after landing.

Check the main landing gear and tail wheel shock struts for proper fluid level and inflation. Fill and inflate according to REPLENISHMENT SPECIFICATIONS TABLE.

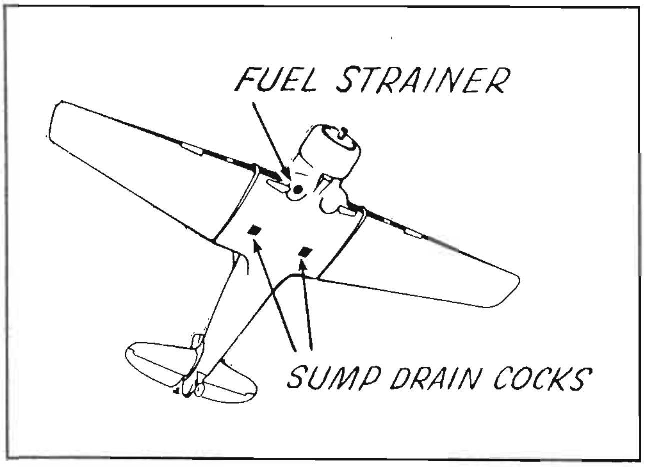


Figure 373 — Fuel Strainer and Fuel Sump Drain Cock

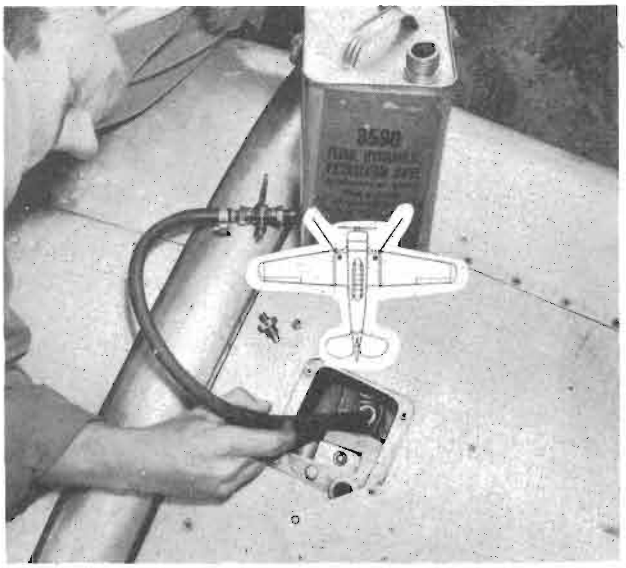


Figure 374 — Filling Main Landing Gear Shock Struts

Col 10

HYDRAULIC SYSTEM

Check the level of fluid in the hydraulic fluid reservoir and replenish, if necessary. (See REPLENISHMENT SPECIFICATIONS TABLE.)

IGNITION AND ELECTRICAL

Verify that ignition switch is "OFF."

Check for presence of the hand starter crank in the baggage compartment.

FIXED AND MOVABLE SURFACES

Inspect wings, ailerons, wing flaps, elevators, rudder, and stabilizers, for obvious defects. Check all screws which attach wing tip to wing panel for security of fastening.

Ascertain that all access doors are properly installed, and secure.

Figure 375 — Filling Hydraulic Tank

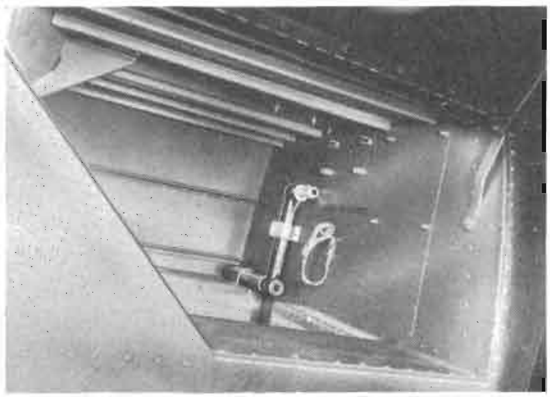


Figure 376 — Hand Starter Crank (Stowed)

Col 10

BATTERY

SPECIFIC GRAVITY CHECK.—Take hydrometer readings on two cells of the battery.

The following specific gravity readings are for new batteries at 80°F with the electrolyte level 3/8 inch above the top of the protector.

State of charge	*Specific Gravity*
Fully charged	1.275 to 1.300
1/3 discharged (replace with fully charged battery if below this reading)	1.240
2/3 discharged (not sufficient capacity for satisfactory operation)	1.200
Completely discharged	1.150

ADDING WATER TO BATTERY.—Add clean, drinkable water (or distilled water if readily available) to the battery. If the electrolyte level can be seen and specific gravity readings can be taken with hydrometer, do not add water.

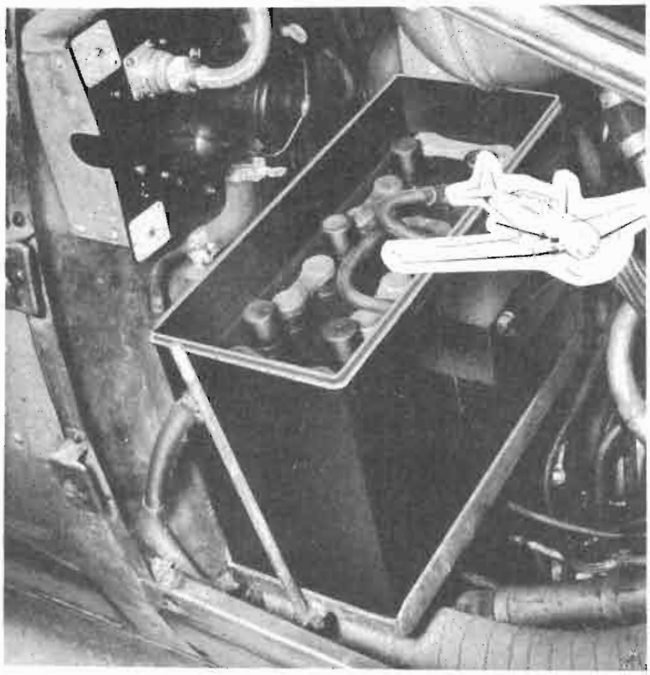


Figure 377 — Storage Battery Installed

Col 10

CAUTION

When adding water do not bring the electrolyte level higher than 3/8 in. above the protector as the electrolyte will leak out the vents when the airplane is in operation.

If battery is exposed to temperatures below freezing, do not add water unless the battery is to be charged immediately after adding. Charging will cause water to mix thoroughly with electrolyte. Otherwise, water will stay on top and freeze.

AIRPLANE — GENERAL

See that all cowling, and inspection doors and covers are properly fastened.

FUSELAGE

Inspect the general condition of the fuselage; check for any tears or cuts in the metal covering and for broken structural members as indicated by displacement or distortion.

See that 100 pounds of ballast or baggage is placed and properly secured in the baggage compartment when the airplane is to be flown with rear cockpit empty.

WARNING

Do not stow miscellaneous cargo in the airplane without the approval of the flight engineer.

Col 10

COCKPITS

Clean the windshield and cockpit enclosure panels and rear view mirror.

CAUTION

Use only soap and water, kerosene or naphtha for cleaning transparent plastic panels. Never use benzene, acetone, or lacquer thinners, as they dissolve plastic. Abrasive cleaners of any kind will scratch the panels and impair vision. Use a clean cloth.

See that there is nothing in the cockpits or at the various stations that will interfere with the controls, and check generally for security of all cockpit equipment. When not in use, the rear cockpit control stick should be stowed at the left side of the cockpit.

FLIGHT CONTROL MECHANISM

Ascertain that the surface control lock located in the front cockpit is unlocked and secure in its stowed position.

Rotate the control stick in a wide circle to check for full and free movement.

Press the rudder pedal for full left turn; then press for full right turn.

Look out of the cockpit to see that the control surfaces follow the movements of the controls correctly.

Carefully search every corner of each cockpit for loose articles of any kind which might interfere with the operation of the controls when in the air.

Set the rudder and elevator trim tabs for normal take-off position, or at the position specified by the pilot.

If the rear cockpit is not to be occupied, ascertain that the control stick is locked in the stowed position.

INSTRUMENTS

GENERAL.—Prior to starting engine, check instruments for broken or loose cover glasses and other visible defects. Particular attention will be given cover glasses that have been marked to indicate proper operating limits. Mark them, if necessary, in accordance with instructions in section IV, paragraph *10*.

NOTE

Each installed aircraft instrument, if it is not already marked to identify its purpose, will be properly identified by either a name or data plate, or a drawing number.

Col 10

Clean all instrument cover glasses with a clean cloth. Special care should be exercised with the individually lighted instruments, as scratches, finger prints, etc., on the cover glasses disturb the lighting.

AIRSPEED INDICATOR.—See that pointer indicates zero, or value of wind velocity component in direction of aircraft heading.

RATE OF CLIMB INDICATOR.—Check pointer for zero setting. Check by tapping instrument lightly with fingers to eliminate possible friction.

ALTIMETER.—See that the marker setting plus the heading of the pointer minus the scale correction is equal to the pressure altitude at the position of the altimeter. Set it to station altitude, or as directed by the pilot.

COMPASS.—Check compass for discoloration of the liquid and for evidence of bubbles.

CLOCK.—See that clock is wound, is running, and is correct according to operations office time.

INSTRUMENT BOARDS. — Check shockproof instrument boards for flexibility.

INSTRUMENT LIGHTING SYSTEM.—Inspect lamps in the instrument lighting system, including individually lighted instruments; replace those found defective. If this does not correct the trouble, check lighting connections, wiring, and power source.

FUEL SYSTEM

THROTTLE AND MIXTURE CONTROLS.—Operate the throttle and mixture control rods before starting engine to see that they are free.

FUEL SELECTOR CONTROL.—Turn fuel cock control handle one complete revolution to determine that it turns freely.

CAUTION

Always set fuel cock by "click and feel." If the engine is not running, when the control is turned to a desired setting and if the control engages properly, a decided "click" can be heard; if the engine is running, the engagement can be felt through the control handle. Should any pronounced binding be indicated, check the connecting linkage for correct alignment.

FUEL PRESSURE SIGNAL.—Check the wobble pump, fuel pressure gage, and signal lamp of the fuel pressure signal for proper operation. Turn on the master battery switch. With the engine not running, the signal lamp should glow steadily. Use the hand fuel pump to obtain fuel pressure. Note the pressure necessary to extinguish the lamp.

Col 10

CAUTION

Place idle cut-off in the "OFF" position before operating the hand pump.

If the pressure required to extinguish the lamp is not 2-1/4 pounds per square inch, the necessary adjustments will be accomplished. Continue to operate the pump until normal operating pressure of 3 pounds per square inch is obtained.

NOTE

The fuel pressure relief valve should be checked and adjusted for the output of the engine-driven fuel pump.

FIRE EXTINGUISHER

Check for the presence of the fire extinguisher on the left side of the rear cockpit.

MISCELLANEOUS

FIRST AID KIT.—Check the first aid kit to determine items required for replacement. Required items will be obtained by requisition from the local medical officer.

MAP AND DATA CASE.—Check contents.

FLIGHT REPORT HOLDER.—Check contents.

CHART CASE.—Check contents.

PILOT'S CHECK LIST.—See that the Pilot's Check List is accessible to the pilot.

OXYGEN SYSTEM

HIGH PRESSURE SYSTEM.—Check the oxygen supply as indicated by the cylinder pressure. The amount of oxygen contained in either cylinder is directly proportional to the pressure, as shown in the following table.

State of charge	*Low-Pressure*	*High-Pressure*
Full	400	1800
4/5	330	1480
3/5	260	1160
1/2	225	1000
2/5	190	840
1/5	120	520
Empty	50	200

Open the regulator valve temporarily to determine oxygen flow. Check the flow at frequent intervals with ground flow check meter.

Inspect the mask to determine any defects in the face piece or rebreather bag.

Check the bayonet connection. Be sure the gasket is in place and that the bayonet connects readily to the regulator outlet.

Check the suspension to determine the proper adjustments and fitting to the helmet.

Col 10

LOW PRESSURE DEMAND SYSTEM.—Check all parts of the mask to see if it is in good shape and ready for instant use. The mask must be clean. Try it on in the airplane; check for leaks by holding the thumb over the quick disconnect fitting, inhaling normally.

Be sure that the rubber gasket is in place on the male quick disconnect fitting.

Be sure the male quick disconnect fits snugly in the female connection of the hose from the regulator at your station and at any other station you may use, as well as in the portable units. A pull of about 10 pounds should be required to separate the two. If it does not fit tightly, pry open the prongs on the male with a knife blade until the required adjustment is made.

Inspect the hose from the regulator for any damages, such as tears, holes, and kinks. Be sure all clamps are firmly in place.

Clip the oxygen supply hose by means of its spring clip onto the clothing or parachute harness close enough to the face to permit free head movement without kinking or pulling of the corrugated mask hose. It is advisable that a fabric tab to hold the clip be sewed to the clothing in the proper place.

Be sure the knurled collar at the outlet elbow of the regulator is tight so that the elbow does not turn. Examine the regulator for any damage; particularly see that the diaphragm is not ruptured or distorted.

Open the emergency valve on the regulator and see that you get a large flow. *Never block the outlet when the emergency valve is open;* otherwise, the regulator may be damaged and the diaphragm blown out. Turn off the emergency valve firmly.

Turn the Auto-Mix to the "OFF" position, breathe normally through the regulator, and see that the flow indicator is functioning properly. Turn the Auto-Mix to the "ON" position.

Be sure the working pressure of the system is 400 pounds per square inch as shown on the pressure gage.

PORTABLE EQUIPMENT.—If portable equipment is provided, be sure the cylinders are filled to 400 pounds per square inch and that they are checked for proper functioning.

Bail-out or emergency equipment should be filled to 1800 pounds per square inch and ready for instant use.

INSTRUMENT FLYING HOOD

Before each flight during which the instrument flying hood is to be used, inspect the hood for security of attachment of the pivot arms and the shock cord attachment hooks. Operate the hood a few times, making certain that it does not hang or fold unevenly.

NIGHT FLYING EQUIPMENT — PYROTECHNICS

LIGHTS.—Check landing lights, navigation lights, cockpit lights, and lamp rheostats for proper operation. Replace any defective lamps.

FLARES (AT-6 only).—Check M-8 parachute flares for any visible indication of damage, proper anchorage of hangwire swivel loop and security of engagement of carrying hooks or bands with the carrying mechanism. If, for any reason, flares are not installed on airplanes equipped for flare installations, or if at any time during the day the flares are removed, a notation that the flares are not installed will be entered in the space for remarks on the back of Form 1, for the information of pilots on subsequent flights.

DURING ENGINE WARM-UP

GENERAL.—Personnel shall be familiar with the correct operation of the engine and propeller.

WARNING

> If fuel has been spilled during refueling operations, move the airplane a safe distance from the location before starting engine.
>
> Except in an emergency, the engine will not be operated on the ground for warming up or testing purposes unless wheel chocks are in place. The engine will not be left running unless a pilot or qualified mechanic is seated in the pilot's cockpit.

For instruction on starting, operating, and stopping the engine on the ground, refer to section III.

Ascertain that the ignition switch is "Off."

Pull the propeller through several turns if the engine has been idle for more than 2 hours. If fuel or oil is present in any combustion chamber (as evidenced by excessive compression), remove all liquid from the cylinder and intake pipes, and dry spark plugs thoroughly before replacing.

IGNITION AND ELECTRICAL

GENERAL.—The functioning of the various units of the starting and electrical systems should be checked when starting and warming up the engine. If functioning is found to be unsatisfactory, a detailed inspection should be made to determine the cause.

GENERATOR.—During the engine ground check, with generator main line switch "ON," check

Col 10 ammeter (and voltmeter on 12-volt airplane) for "charge."

NOTE

On 24-volt airplane the charge may vary from 5 to 50 amperes depending upon condition of the battery and the airplane's electrical load.

IGNITION.—Check operation of engine on right and left magneto switch position, noting loss of rpm on each magneto.

WARNING

When operating on single magneto, the manifold pressure must not exceed maximum cruising manifold pressure to avoid detonation.

During ignition check, the propeller governor must be set to take-off speed, and the throttle adjusted to give cruising speed or less. It is important to turn switch back to "BOTH" and leave in that position until the engine has picked up the loss in rpm resulting from operating on one magneto, before testing for loss of rpm on the other magneto.

Normal loss in rpm when operating on one magneto should not exceed 100 rpm.

NOTE

This check should be made in as short a time as possible and should not exceed 15 seconds.

IGNITION SWITCH.—With the engine running at about one-third throttle (or approximately 700 rpm), turn the ignition switch momentarily to the "OFF" position. If the engine does not entirely cease firing, defective functioning of the switch or connections, probably the ground connection, is indicated. For this test the engine must not be excessively hot, and the period during which the switch is off must be brief so that the engine does not slow down too much.

WARNING

If the engine does not cease firing when the switch is placed in the "OFF" position, it will be necessary to stop the engine by placing the fuel mixture control in "Idle-Cutoff" position. After the engine stops, do not touch the propeller until the difficulty has been found and corrected. The engine may start or "kick over" and cause death or serious injury.

PROPELLER

If vibration is noted or reported, check the blade angle setting. If necessary, check the track of each blade.

Col 10 Operate the propeller control from full increase to full decrease rpm and return, noting that propeller and governor operation is satisfactory as indicated by the change in engine rpm.

ENGINE INSTRUMENTS

GENERAL.—Check engine instruments for proper operation, excessive pointer oscillation, and note whether the readings are consistent with the stage of warm-up.

ENGINE GAGE UNIT.—Check the engine gage unit for readings consistent with engine requirements. The required fuel pressure, oil pressure, and oil temperature are as follows:

Condition	*Fuel Pressure* PSI	*Oil Pressure* PSI	*Oil Temp.* °C
Desired	3-4	70-90	50-70
Maximum	4	100	95
Minimum	3	50	
Idling	3	15	

VACUUM GAGE.—Check the vacuum gage reading with the engine running at 1000 rpm or more. Turn the vacuum control valve handle to "Vacuum Pump On" and note the reading. Gage should read 3.75 in. Hg to 4.25 in. Hg.

MANIFOLD PRESSURE GAGE.—Check the manifold pressure gage by gunning the engine. Needle should move freely to the left. Check against barometer if practicable. In event of malfunctioning, check all connections for leaks.

With engine at idling speed, drain manifold pressure gage by opening the shut-off cock for a few seconds to clear the line of liquids and vapors.

FUEL SYSTEM

Check functioning of the engine on each fuel tank. The required fuel pressure of 3 to 4 pounds must be obtained when operating on either tank. The fuel selector valve control should turn readily when shifting from one tank to another.

CARBURETOR

Check the operation of the carburetor air heater.

NAVIGATION INSTRUMENTS

Check navigation instruments for adequate suction from vacuum pump. With flight and turn indicators uncaged, and gyro operating under rated

Col 10 suction, the horizon bar and card should settle to indicate the attitude of the airplane on the ground within 2 minutes after suction is turned on.

Col 11

AUXILIARY EQUIPMENT

BOMBING EQUIPMENT

GENERAL.—Frequent inspection of bomb racks and shackles should be accomplished. Where necessary, the bomb racks should be removed to accomplish the inspection properly.

NOTE

> The bomb racks or shackles should not be lubricated at any time, as this will cause the accumulation of foreign matter and consequent malfunction of the mechanism.

Inspect the rack and shackle frames for bent, twisted, or deformed parts tending to cause malfunction.

Inspect the arming and releasing mechanisms for general condition, wear, burrs, corrosion, etc. Keep the contact surfaces smooth and polished. Hooks and retainers should operate freely and have sufficient clearance all around in frames.

Ascertain that carrying surfaces of carrying hooks are parallel to lower surface of the wing in the engaged position.

Inspect bomb control cables for general condition, fraying, and security of attachment.

Inspect all springs for corrosion. Note especially, the condition of the latch and trigger springs.

Inspect all clevis pins. Determine if pin holes have elongated under load or wear.

Inspect the lever of the bomb shackles for full and free movement and the dog spring for sufficient strength to engage the dog with the link. Dog should snap into engagement with link when the lever is held up and support hooks are moved to the engaged position.

Inspect the arming wire lever and retainer springs for proper tension. Strength of each spring should be such that it will support a 3-pound weight at the arming lever, but will not hold a 4-pound weight. In testing, engage a round steel ring, .080 inch in diameter with a loop $\frac{11}{16}$ inch inside diameter, with the arming wire levers and retainer. Prior to flight in which the bombing equipment will be used, check to make certain there is no interference between the sides of the support hooks, and the rack and shackle frames.

Inspect bomb racks for accumulation of grease and dirt; if necessary, wash with kerosene (insofar as possible without removing the racks).

When operating from muddy fields, the bomb rack assemblies should be cleaned prior to each loading and their operation checked.

Col 11 TESTING RELEASE MECHANISM.—Move the bomb control handle to "SALVO," pull down and release the charging cable of the racks, and determine if the operating shaft to which the cable is attached operates freely without drag or binding. Check the operation of the support hooks as follows:

1. Move the bomb release handle to the "SALVO" position and then to the "SELECTIVE" position.
2. Pull down firmly on the rack charger cable extending through the rack cover-plate, and engage the inboard support hook. Release the charger cable. If operating shaft does not remain in charged position, disengage the support hook by pushing inboard on the lower end of the trigger. Access to the trigger is gained through the inboard end of the support hook slot in the rack cover-plate.
3. Repeat the foregoing procedure 2., pulling down more firmly on the charging cable. If, after repeated attempts to engage the first support hook, the charger cable does not remain in the charged position, thoroughly inspect the rack for accumulation of foreign matter or possible damage. If necessary, replace the rack.
4. After preceding procedure 3. is properly accomplished, engage the remaining support hooks.
5. Turn the gun and bomb selector switch to the "LEFT-HAND RACK" position, and the safety switch to "ON."
6. Press the button switch, located on the front control stick, once for each support hook to be released.
7. Ascertain that all support hooks have been properly released.

Repeat the foregoing procedures 1 to 7 inclusive. Then move the bomb release control handle to the "SALVO" position.

Failure of any support hook to open properly should be thoroughly investigated. The rigging of the cables should be cnecked first.

With the arm-safe control handle in the "ARMED" or "SAFE" position, ascertain that the arming levers are locked, or unlocked, respectively, by attempting manually to disengage the arming levers.

Col 12

GUNNERY

SYNCHRONIZER.—Inspect synchronizer unit for security of mounting, proper operation, and position of zero shot.

GUN SIGHTS.—Clean reflector and shield assembly over main lens of type N-3B or N-2A fixed gun sight. Determine that reflector is securely

Col 12 held in its support. See that gun sight body is held firmly in its mount and no shake or wobble is present.

Check electrical connector for good contact. Determine whether rheostat functions to turn sight lamp on and off and controls the intensity of the light satisfactorily.

See that the pattern of the reticle is reflected properly in the reflector.

See that the sight bases of the flexible gun are clamped securely in place and that the sights are installed in their bases.

GUNS.—Check the roller in the fuselage gun feed chute for smoothness of operation. Inspect the ammunition boxes and feed chutes for cleanliness.

Inspect the gun for excess carbon deposits. Inspect the gun mechanism for rust-preventive or foreign-material deposits. See that the gun adjusting screws are screwed tight against the buffer discs in the backplate. Test the functioning of the gun with dummy cartridges.

Test the functioning of the operating slide (fixed guns only) or the retracting slide (flexible gun only).

See that the metallic belt link chutes are in good condition and in proper alignment.

Check the security of installation and the operation of the solenoid for the wing gun. Check the charging cable for ease of operation.

Use oil, Specification No. AXS-777, for lubricating the aircraft machine guns. This is a thin rust-preventive oil to be used primarily for lubricating at low temperatures and must not be considered as a preservative. Hence, in a warm humid atmosphere, metal surfaces covered with Specification No. AXS-777 oil will not be suitably protected against rusting. Renew every 48 hours.

Use sperm oil, U.S. Army Specification No. 2-45, for preserving the bore between firings, after the barrel has been cleaned. This oil has preservative as well as lubricating properties, and it should be used where permissible. If sperm oil is not available, engine oil, SAE 10 or any light grade machine oil, may be used in an emergency.

For all caliber .30 machine guns, under all service conditions, use oil, U.S. Army Specification No. AXS-777.

NOTE

These oils are to be used regardless of the ground temperature.

Oil all bearing surfaces of gun, taking particular care to oil the exterior of the barrel at the breech end.

Oil the cover extractor spring, the cover extractor cam, the cover detent pawl, the cocking lever, the groove in the bolt for belt feed lever, the groove

Col 12 in barrel extension to take bolt ribs, the breech lock cam, the switch, the extractor cam, the sear mechanism, and the ways of the belt feed slide.

CAUTION

Take care not to use an excess of oil, because low temperatures will thicken the oil and may cause the gun to malfunction. The parts are best oiled by wiping with a well-oiled, lint-free rag.

All guns which are not protected with rust-preventive compound must be inspected periodically for signs of rust. The interval between inspections will depend upon local climatic conditions.

Col 15

COMMUNICATIONS

GENERAL.—Make visual inspection of antennas. Check form 1A for any remarks pertaining to communications equipment. Correct any defects noted and not previously corrected, and indicate the corrective action taken. Make simultaneously the following visual and operating inspection of equipment:

Check visually the securing of all equipment and its component parts.

Test mechanical ease of operation and absence of excessive mechanical looseness of controls on all equipment, with all receivers turned on and tuned to a signal. Check for presence of undesired dynamotor overload indicated by low rpm. Turn off equipment when test is completed.

FRONT COCKPIT.—Check operation of SCR-( )-183 or SCR-274-N COMMAND SET as follows:

RECEIVER OPERATING TEST.

NOTE

On SCR-274-N set, all receivers except the one being tested should be turned off.

Make receiver operating test on "CW" and "VOICE" on all bands, full and reduced volume. Check for presence of excessive noise, accuracy of dial calibration, and action of gain control.

Check operation of BC-( )-229 RECEIVER on automatic volume control position, full and reduced volume, checking for AVC action, presence of excessive noises, and action of audio level control. (Leave "INCREASE OUTPUT" control fully clockwise, low frequency receiver turned on for further test of other equipment; "HI-LO" switch in "LO" position if SCR-( )-183 set is installed.)

TRANSMITTER OPERATING TEST.—Make transmitter operating test. Observe presence of sidetone and indication of radiated carrier and of modulation, as shown on antenna current meter. (Leave transmitter turned on for "VOICE" operation for further test on other equipment.)

Col 15 FILTER SWITCH BOX.—Check operation of the filter switch box for rejection of radio range code signals on "VOICE" position, rejection of voice signals on "RANGE" position, and presence of radio range and voice signals on "BOTH" position.

INTERPHONE JACK BOX.—Check interphone jack box in front cockpit for presence of command receiver output on "RADIO" position, action of volume control, presence of voice on "INTERPHONE" position. Test head set and microphone cords for intermittent contact.

REAR COCKPIT.—Check BC-327 CONTROL BOX and the INTERPHONE BOX BC-335 for presence of command receiver output on "RADIO" position and action of volume control, presence of sidetone on "INTERPHONE" position. Test head set and microphone cords for intermittent contact. (Turn off equipment unless ready for take-off.)

Col 16

PHOTOGRAPHIC

Inspect the photographic installation for proper operation and general condition, making any necessary minor adjustments.

Inspect all removable equipment for security of attachment.

Check camera for cleanliness; lubricate as necessary according to section III.

Immediately before take-off, see that the camera doors are closed and the view finder opening cover is removed.

Col 19

AFTER-FLIGHT INSPECTION

OIL DILUTION

Before stopping the engine when a cold weather start is anticipated, dilute the oil by means of the oil dilution control, as described in the following paragraphs.

Operate engine at 1000 to 1200 rpm.

Maintain oil temperature below 50°C (122°F) and oil pressure above 15 pounds per square inch.

Dilute engine oil as follows for ground temperatures shown:

4° to —12°C (40° to 10°F)	3 minutes
—12° to —29°C (10° to —20°F)	6 minutes
—29° to —46°C (—20° to —50°F)	9 minutes

Add 1 minute dilution for each additional 5°C (9°F) below —46°C (—51°F).

Col 19 For the last 2 minutes of the dilution, operate propeller pitch control to get change of 400 rpm. Repeat three times.

NOTE

A slight amount of oil leakage may occur through the propeller blade packings when the airplane is standing, following oil dilution. This leakage is not objectionable; no action is required unless it becomes excessive or persists in flight.

Col 11

BOMBING EQUIPMENT

Check the bomb racks for any remaining bombs.

Col 12

GUNNERY

Unload the guns completely; remove the belts from the ammunition containers.

Clean the bores and all of the working parts. If this cannot be done at once, oil the gun carefully to prevent rust.

Release the firing pin spring.

The armorer must get a detailed account from the gunners or pilot, of the operation of the guns in the air. If stoppages have occurred, their cause must be determined and corrected immediately.

At the first opportunity, dismount the guns. Clean, oil, and inspect all of the parts. Make needed repairs and replacements.

On assembling the guns, check their operation with dummy cartridges. Release the firing pin springs after making certain that their functioning and adjustments are correct.

Col 19

POWER PLANT — GENERAL

Remove sufficient cowling to permit checking for fuel and oil leaks within the engine section, and for any failures of wires, lines, connections, attachments, exhaust pipes, and collectors, etc.

Col 30

AIR-SPEED TUBE

See that the air-speed head protection cover is installed.

OXYGEN EQUIPMENT

HIGH-PRESSURE SYSTEM.—Check the regulator valve to be sure it is shut off.

Inspect mask for any defects.

Wash mask and wipe dry. (Turn rebreather bag inside out to facilitate drying.) It is essential that masks be kept in sanitary condition to prevent spread of infections.

WARNING

Never use oil, or any substance containing oil, on or near oxygen equipment, as

Col 30 spontaneous combustion and explosion are certain to occur.

LOW-PRESSURE DEMAND SYSTEM. — Keep mask in clean, sanitary condition by frequent washing.

Change strap adjustment only to take up natural stretch slack.

Be sure all oxygen equipment is in proper condition before leaving the airplane. If any difficulties have developed during flight, take necessary steps to have them corrected.

If your final pressure is less than 100 pounds per square inch, be sure that the supply warning light is on.

NIGHT FLYING EQUIPMENT

Check racks for released flares (AT-6 only).

SURFACES

Apply control surface locks.

Col 15

COMMUNICATIONS

Check Form 1A for any entries pertaining to communications equipment. Correct any defect noted; indicate by appropriate entries corrective action taken. Make visual inspection of antennas and all communications equipment and associated wiring.

DAILY INSPECTION

Col 19

PROPELLER AND ACCESSORIES

Make sure ignition switch is "OFF"; then inspect the propeller for bent or damaged blades.

NOTE

As soon as possible after a propeller strikes or is struck by any object, the propeller will be carefully examined for possible damage. On the completion of each flight during which bullets pass through the propeller track, an examination for possible bullet damage will be made. A propeller involved in an accident will not be used before it is first disassembled and the parts carefully inspected for damage and misalignment. All steel parts will be magnafluxed. The aluminum-alloy blades, if otherwise serviceable, will be given a general etching.

Inspect propeller blades for nicks, scratches, looseness, etc.

Check constant speed propeller governor for external oil leaks around the governor base head.

See that the controllable propeller cylinder cap, hub barrel nuts, and counterweight caps are tight and safetied.

Figure 378 — Inspecting Propeller

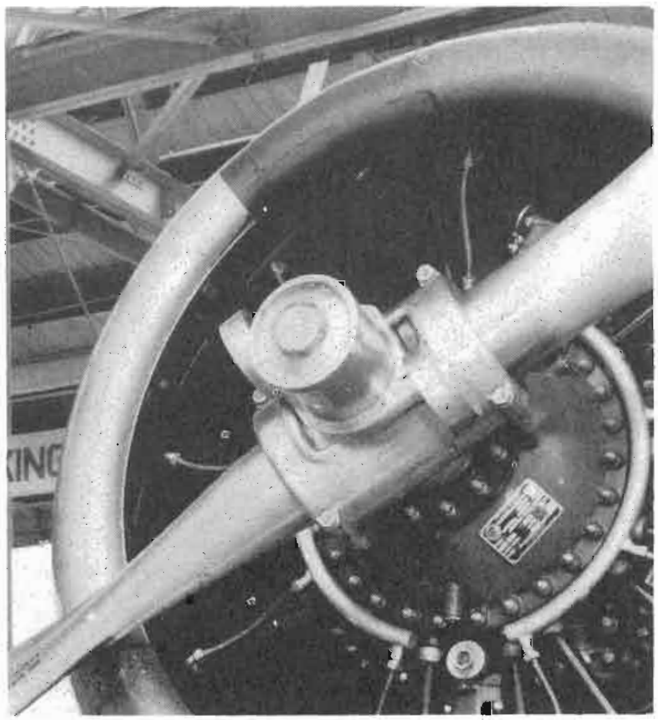


Figure 379 — Propeller Cylinder and Counterweights

Col 19 Check propeller controls for lost motion.

At the completion of each day's flying, thoroughly coat all outside surfaces of the propeller blades and hub with clean engine oil. (Exposed surfaces of blades and hubs installed but not in daily use will also be coated with clean engine oil as often as required to prevent corrosion.)

NOTE

Coating of metallic propeller blades and hubs with engine oil protects the exposed

Col 19

surfaces of propeller from rust and corrosion. The oil also seeps into cracks that exist in the blade or hub, making otherwise obscure cracks stand out, thus facilitating inspection.

Check the propeller for oil leakage. If grease should appear at the barrel ends, it is an indication that a grease retainer is not functioning properly and should be replaced. However, a check should be made to insure that the grease is not surplus grease which has been forced into the hub shell during the lubricating periods.

ENGINE SECTION

GENERAL.—Determine whether engine is due for overhaul (650 flying hours for R-1340-47 and R-1340-49 engines; 700 flying hours for R-1340-AN-1 engines).

Examine the exterior of the engine carefully for loose nuts or other abnormal conditions, paying particular attention to the propeller hub fastening exhaust manifold, accessory attachments, and engine mount.

If there are any signs of oil leakage around the rocker box covers, examine the valve gear lubricating tubes and fittings for signs of leakage.

Inspect for evidence of engine throwing oil.

When the engine is not to be operated for a period of 30 days or more, the exhaust manifold and exhaust valves should be thoroughly sprayed inside and out with rust-preventive compound.

Check the manifolds for security of attachment and blown gaskets.

Check intake pipes for security of attachment and leaking gaskets.

VENTS AND LINES.—Inspect oil, fuel and battery vents, and overflow lines for security of anchorage, clogging breaks or kinks, and to see that lines extend below cowling. Excessive flow from the engine-driven fuel pump gland drain line is warning to remove the pump for repairs.

COWLING.—Inspect engine section cowling for security of attachment. See that cowling is not rubbing cooling fins. Check for broken or damaged baffles. Excessive tightness of turnbuckle screws on ring cowl installation when the engine is cold, is likely to cause failure of the screws or bracket attachments, when the engine becomes heated and expands. The screws should be drawn up so the cowl is snug, but not tight, when the engine is cold.

ENGINE CONTROLS

Inspect carburetor air heater, throttle, mixture, and propeller control assemblies for proper functioning, operating range, tightness, proper safetying, and for general condition.

Col 19

ENGINE INSTRUMENTS

GENERAL.—Check cover glasses of all instruments for looseness and cracks.

ENGINE GAGE UNIT.—Check engine gage unit for pointer tolerance at zero. Tolerance for fuel pressure gage is plus minus 0.2 pound. Tolerance for oil pressure gage is plus minus 5.0 pounds. Tolerance for thermometer is plus minus 3 degrees of existing engine temperature. If excessive errors exist, replace with spare unit from stock.

Check lamp (AT-6 airplanes only) of type B-2 engine gage unit. If lighting fails, lamp has probably burned out. Replace with new lamp. If installation of new lamp does not remedy trouble, check wiring and electrical plug connector which attaches cable to instrument.

TACHOMETER.—Check cover glass of chronometric tachometer for looseness and cracks. Check for correct and discernible operation markings. Check the pointer for tolerance at zero (—15 rpm). Check the light for proper operation (AT-6 only).

IGNITION AND ELECTRICAL

See that the ignition terminals are secure and the retaining posts tight.

Check security of all ignition wires.

Inspect starter, generators, coils, switches, and solenoids for cracked housings or flanges, for security of mounting, tightness of housing bolts, and safetying of all attaching of connecting bolts. Replace starter if cracks appear in housing or flanges, and tighten or safety bolts as required.

The presence of engine oil in starter gear case and around the flywheel often results in starter failure, particularly in cold weather. When, on inspection, this condition is found to exist, the starter should be removed and replaced with a serviceable unit.

Check the general condition of the manual starting control mechanism.

Check booster coil for proper operation.

Replace engine section cowling; check for security.

FUEL SYSTEM

DRAINS, STRAINERS, AND VENTS.—Drain all fuel strainers (including tank drains) and resafety. If operating from wet or muddy fields, inspect the fuel tank vent line ends for cleanliness to prevent the tanks from collapsing as fuel is consumed.

FUEL PUMPS.—Inspect fuel pumps for security of mounting and safety wiring.

Col 19 THROTTLE AND MIXTURE CONTROLS.—Inspect throttle and mixture control connections to see that they are tight and properly safetied.

CARBURETOR AIR FILTER.—Inspect the filter for contamination and for proper lubrication. If

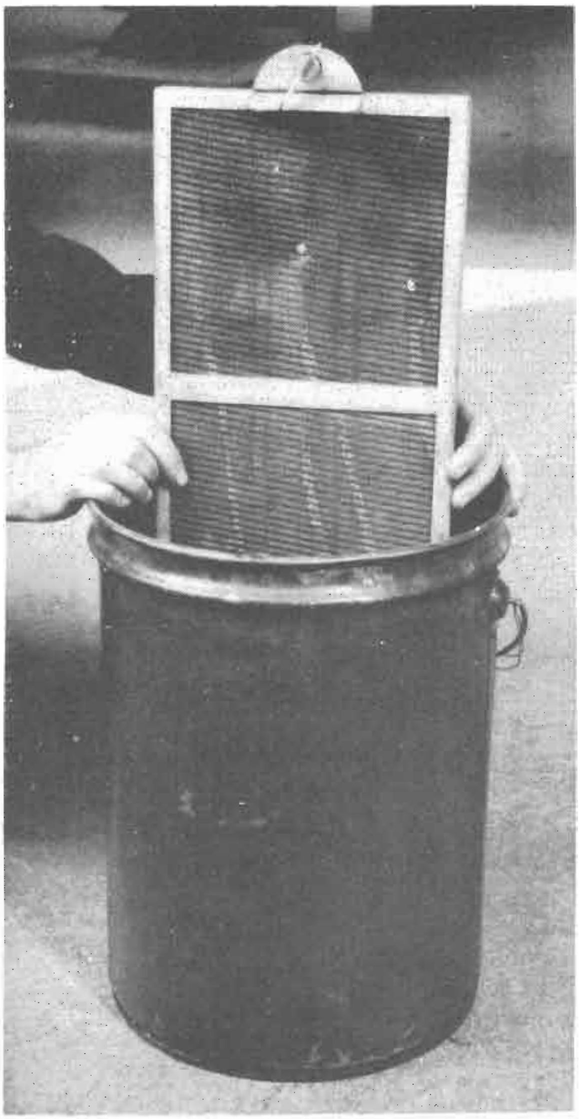


Figure 380 — Cleaning Carburetor Air Filter

Col 19 inspection reveals evidence of dirt or insufficient lubrication, remove and wash in gasoline or other suitable volatile cleaning fluid. While cleaning, rock the filter element or agitate the cleaning fluid to insure removal of dirt from the innermost part of the element. Immerse element in a mixture composed of one part corrosion-preventive compound, Specification No. AN-VV-C-576, and three parts of lubricating oil, Specification No. AN-VV-O-446, grade 1120, for a period of 2 to 5 minutes. Drain the element from 2 to 4 hours to remove excess oil prior to reinstallation.

Col 19

NOTE

It is imperative that, after washing in gasoline or volatile cleaning fluid, the element be thoroughly dried prior to immersing in oil; otherwise, the air filter will not be properly coated, resulting in impaired cleaning efficiency.

CARBURETOR LINES AND FUEL LINES.—With the fuel "ON" and the pressure built up, inspect carburetor and fuel line connections for leakage, particularly at drain plugs, passage plugs, and parting surface of body castings. Check carburetor for security of mounting; inspect all carburetor safety wiring.

NOTE

Every 12 hours, check fuel systems which *have not been treated* for use of aromatic fuels for deterioration and defective parts. Every 30 days, replace diaphragm and seals in fuel pumps of fuel systems which have not been treated for use of aromatic fuels. Every 30 days, check fuel systems which *have been treated* for use of aromatic fuels for correct and discernible identification marking.

OIL SYSTEM

DRAINS.—Inspect all drain plugs and drain cocks for proper safetying.

OIL COOLER.—Determine if engine oil temperatures have been satisfactory during period subsequent to last inspection.

Check all connections, including drain plug, for tightness.

Check all valve attaching bolts and regulator mounting bolts for tightness.

Check core tubes for obstructions to air flow.

Check air ducts for obstructions, tightness, and conformity with original design.

LANDING GEAR

Col 30 Inspect the air-oil shock struts for evidence of air of fluid leakage indicated by abnormal deflection.

Inspect the shock strut structural members, operating mechanism, lockpins, up-position latches, fairing, air-filler caps, and all attaching fittings for damage, general condition, and security.

After every 10 hours of operation, remove the cover-plate from the upper wing surface immediately over the landing-gear shock strut, and lubricate the lockpin and lockpin fitting by thoroughly wiping the pin and fitting with a clean cloth saturated with lubricating oil, Specification No. AN-O-6.

Col 30

NOTE

Do not put grease in the lubricator fitting located in the boss at the top of the strut even though a fitting is installed there.

Use the oil sparingly; a thin film is all that is necessary. It is important to keep the lockpin and fitting as free as possible from dirt, grease, oil, or anything else that might attract dirt. A

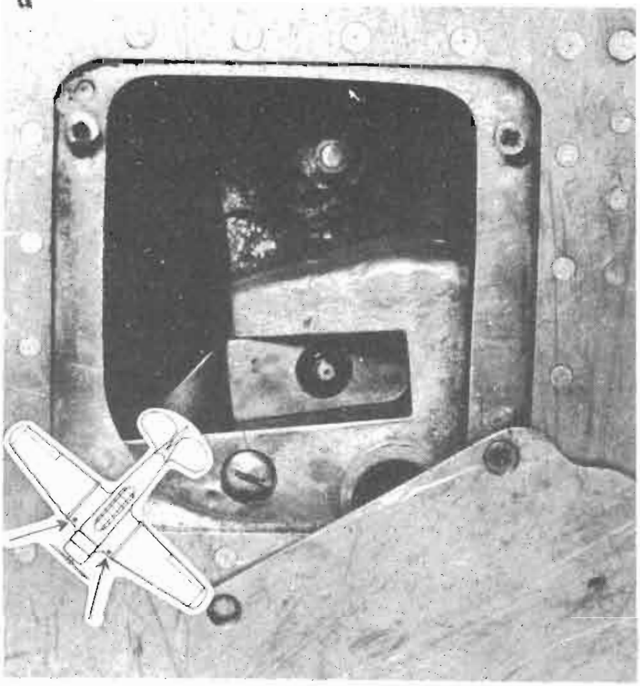


Figure 381 — Main Landing Gear Lock Pin

Col 30

few drops of oil applied around the edges of the boss at the top of the shock strut will penetrate sufficiently, making it unnecessary to retract the gear each time the lock units are lubricated.

TAIL WHEEL GEAR

Inspect tail wheel assembly for freedom from mud, grass, etc., worn or loose shoe, and condition of shock strut; that is, whether tail is supported in proper position.

Inspect air-oil shock absorber struts for evidence of leakage of fluid or loss of pressure.

WHEELS AND BRAKES

Inspect wheel fairings for security of attachments, dents, or bends that may cause binding or chafing against wheel or tires. Keep fairings free of mud, grass, etc.

Inspect for distorted rim flanges and ribs, and for security of retaining nuts, bolts, and cotterpins.

Inspect tires for proper inflation (approximately 30 pounds under normal load condition).

Col 30

HYDRAULIC SYSTEM

Inspect hydraulic units for leakage; replace packings as soon as leakage develops.

Special 10-Hour Inspection

Turn the handle of the manually operated Cuno oil strainer, which is attached to the control shelf on the left side of the rear cockpit, one complete turn at least once every 10 hours of engine operation.

Col 15

COMMUNICATIONS

GENERAL.—Check Form 1A for any entries pertaining to communications equipment. Correct any defect noted and not previously corrected; and indicate by appropriate entries, corrective action taken.

ANTENNAS.—Visually inspect shock links and springs for tension and deterioration. Check antenna wire for nicks and replace any antenna found defective. Check marker beacon antenna lead-in for tightness, and insulators for chipped, cracked, or dirty condition.

EQUIPMENT.—Make simultaneous visual and operating inspection of all equipment as follows:

Check for proper securing of all equipment. Check all cordage and plugs.

Test mechanical ease of operation and absence of mechanical looseness of controls on all equipment checked during the operating inspection. Check for presence of undesired dynamotor overload, indicated by low rpm. Turn off equipment when tests are completed.

Check for presence and correctness of applicable Radio Facility Charts and other required Technical Orders of the O8-15 series, and for presence of Technical Order Instruction Books for installed communications equipment.

FRONT COCKPIT.—Check Command Set SCR-( )-183 or SCR-274-N.

RECEIVER OPERATING TEST.—Check receiver tubes to determine if they are properly seated in their sockets.

Check receiver type BC-( )-229, if installed, for adjustment of antenna alignment condenser on high frequency end of high frequency band. Make adjustment with set operating on manual volume control, while listening to a relatively weak signal.

Check receivers type BC-453-A and BC-454-A, if installed, for antenna circuit alignment by setting gain control at maximum, function switch on "CW," receiver tuned to the highest frequency, and "ALIGN INPUT" knob adjusted for maximum background noise. (Switch this receiver

Col 15 "OFF" and perform a similar check on the other receiver.)

Make receiver operating test on "CW" and "VOICE" on all bands, full and reduced volume.

NOTE

On the SCR-274-N set, all receivers except the one being tested should be turned off.

Test signal strength of a known station with interphone jack box volume control full-on, presence of undesired oscillations, presence of excessive noise, accuracy of dial calibration, action of gain control, over-all sensitivity throughout all bands.

Test operation of receiver type BC-( )-229 on automatic volume control position, full and reduced volume, checking for AVC action, presence of excessive noise, and action of audio level control. Test for intermittent contacts, receiver operative, while subjecting receiver, junction box, antenna switching relay, dynamotor, and associated plugs and cordage to jarring. (Leave "INCREASE OUTPUT" control fully clockwise, low frequency receiver turned on for further test of other equipment. "HI-LO" switch in "LO" position if SCR-( )-183 is installed.)

TRANSMITTER OPERATING TEST.—Check transmitter tubes to determine if they are properly seated in their sockets.

Check for presence of sidetone and for indication of radiated carrier and modulation as shown on antenna current meter. Check on "CW" and "TONE" position for indication of sidetone. Test for intermittent contacts, transmitter operative, while subjecting transmitter, junction box, antenna switching relay, dynamotor, and associated plugs and cordage to jarring.

FILTER SWITCH BOX.—Test for rejection of radio range code signals on "VOICE" position, rejection of voice signals on "RANGE" position, and presence of radio range 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.

MARKER BEACON RECEIVER (if installed).—Check operation of indicator light when test oscillator set on 3000-cycles modulation is brought into proximity with marker beacon antenna.

REAR COCKPIT

BC-327 CONTROL BOX AND INTERPHONE BOX BC-335.—Test for presence of command receiver output on "RADIO" position, action of volume control, and presence of side-tone on "INTERPHONE" position. Test headset and microphone cords for intermittent contact. (Turn off equipment unless ready for take-off.)

Col 30

NAVIGATION INSTRUMENTS

MAGNETIC COMPASS.—Check magnetic compass for broken or loose cover glass, or other visible defects.

Clean the compass cover glass with a clean cloth. Special care must be exercised where individually lighted instruments are employed since scratches, fingerprints, etc., on the cover glass disturb the lighting. Replace any defective lamps.

Visually inspect compass for discoloration of liquid and evidence of bubbles.

FREE AIR THERMOMETER.—Inspect the cover glass for looseness and cracks. Check light of type C-6 thermometer (AT-6 only). See that thermometer reading is consistent with atmospheric or hangar temperature.

SUCTION GAGES.—Inspect for security of mounting, broken or loose crystals, loose dials, and loose pointers.

ALTIMETERS.—A general inspection shall be made to see if the altimeters are properly mounted, that the cover glasses are clean and intact, and that the air-speed tube has not been damaged.

COCKPITS

Inspect for cleanliness, condition and functioning of mechanisms on sliding enclosures, windows, hatches, emergency exits, etc., including proper operation of latches and locking devices.

Visually inspect the installed safety belts; replace if there is any indication of defects or deterioration. Check the fabric and leather parts carefully for cuts or fraying. Check the latching device for free operation, and for bent or damaged parts. Check all attaching parts and fittings for security of fastening.

Check the date the belt was last tested; if over the specified six months period, the belt will be removed and tested, or replaced by one tested within the specified time period.

SPECIAL NOTE

Reed and Prince screws are not used on the airplane. However, a frequent check of Phillips head screws should be made to ascertain that a driver for Reed and Prince screws has not been used, which should be noted by damage to the head of the screw.

MOVABLE SURFACES

Inspect the control surfaces for security of attachment, lost motion, and for full and free movement. Inspect for holes and any visible damage.

Col 30 Inspect for presence of foreign matter in the gap forward of the hinge between the elevator trim tabs and the elevator.

FIXED SURFACES

Inspect the wing metal covering. Note the general condition of the internal structure as indicated by any displacement or distortion of the metal covering.

Check inspection doors for proper operation and security of attachment.

Clean the walkways of dirt, oil, grease, etc.

Inspect the empennage components for their general condition, holes, or other visible damage that may have occurred. Note the general condition of the ribs as indicated by any displacement of the fabric covering or distortion of the metal covering.

FUSELAGE

Inspect for loose objects (foreign or otherwise) likely to obstruct movement of controls and flight control surfaces.

Inspect for general condition, tears, or cuts in metal covering, dents, evidence of leaks, broken structural members as evidenced by distortion of covering, and abrasions to paint or protective coating. Abrasions should be retouched immediately to prevent corrosion.

Ascertain that the life preserver cushions and the parachutes are in good condition and are securely stowed in their proper positions.

Make certain that the small drain holes at the bottom of the fuselage rear section bulkheads are open.

Check to see that the urinary equipment is intact and securely in place.

HAND FIRE EXTINGUISHER

Make sure that the extinguisher is fully charged. If it leaks, replace it. Check for obstruction in the nozzle hole. Check to see that dated inspection tag is attached. Check for security of attachment of mounting bracket. The extinguisher should fit securely in bracket and yet be easily removed.

Col 12

GUNNERY

Check the ammunition boxes for dented or split sides.

Check the feed chutes and ejection chutes for burrs or dents.

Check the gun for burrs on edge of the chamber.

Check the gun for cleanliness in the bore and in all of the working parts.

Col 12 Inspect all of the gun parts for needed repairs or replacements.

Check the wing gun charging cable and all of the cable pulleys for broken or damaged parts.

Col 42

NIGHT FLYING EQUIPMENT

(AT-6 only.) Remove and inspect installed flares. Inspect for wear of carrying hook, damage to the case, sealing of the cardboard case, frayed or broken hang-wire, looseness of lower body cover, broken sealing wires, and corrosion.

Check flare carrying and release mechanism for proper operation.

NOTE

> In case appreciable deterioration is detected or there is doubt as to the serviceability of the flare, it should be submitted to the post ordnance officer for inspection and disposition.

PERIODIC INSPECTIONS

Col 12

GUNNERY

50-Hour Inspection

GENERAL.—Maintenance inspection will be performed on all gunnery at 50-hour periods, or at intervals of not to exceed 30 days, whether equipment has been used or not.

GUN MOUNTS.—Make a complete inspection of working and structural parts. Thoroughly clean and adjust operating mechanisms. Inspect related accessories for security of attachment and operation.

CONTROLS.—Inspect gun controls to determine serviceability and proper relation of control equipment to the gun and the gun mount.

GUN SIGHT.—Check gun sight for harmonization with respect to flight line and reflector for cracks or chips. Determine setting of guns with respect to flight line.

SYNCHRONIZER UNIT.—(Type E-4.) The type E-4 synchronizing system will be given a complete inspection by personnel familiar with the installation and functioning of the system and its various component parts. If non-standard, worn, or otherwise defective parts are found during any inspection, they will be replaced by serviceable standard parts.

CAUTION

> In each instance after completing inspection and replacement of parts, assemblies, etc., and the adjustment of such parts and assemblies, the entire system will be checked and all additional adjustments required will be made to correctly time the zero shot and obtain proper firing.

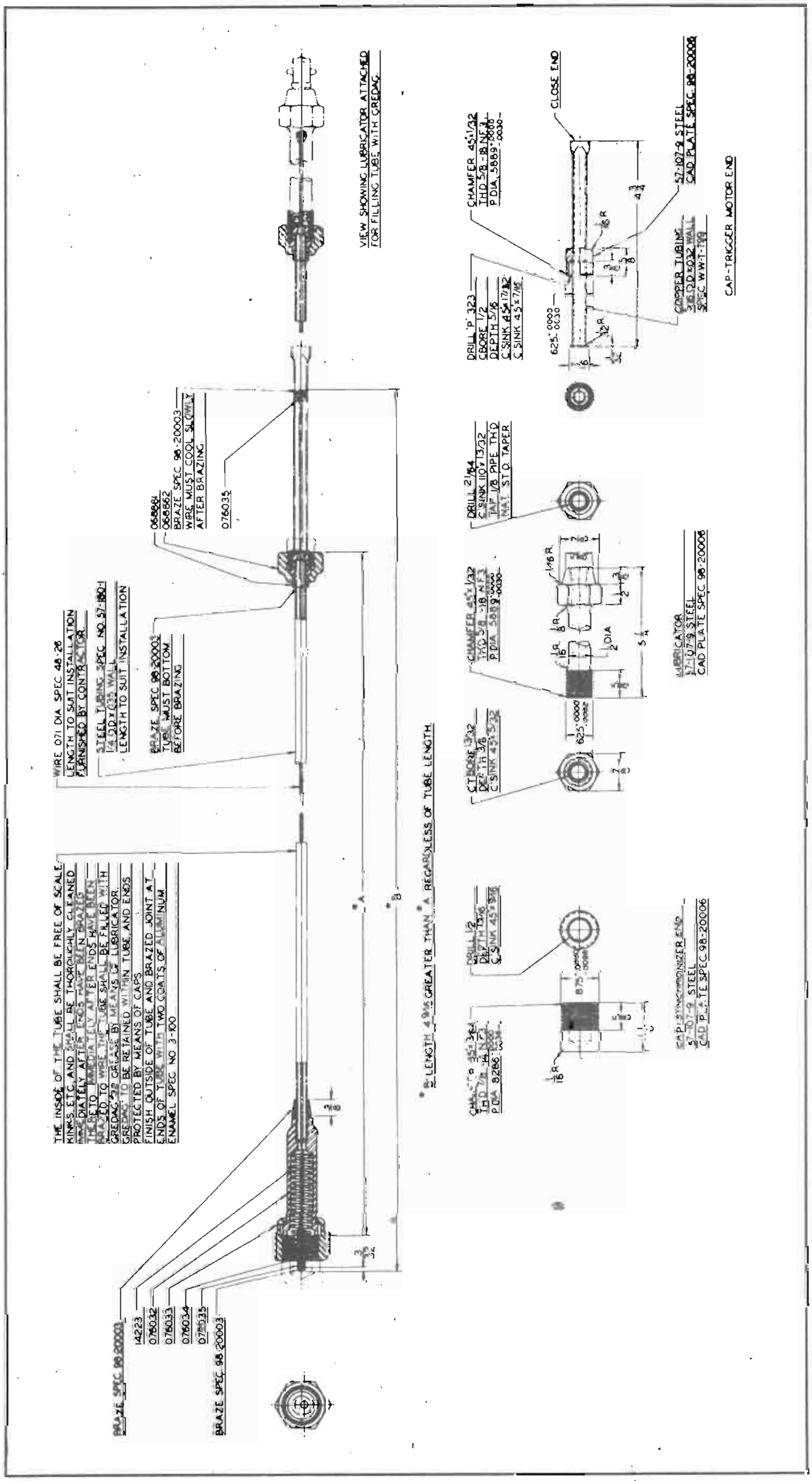


Figure 382 — Installation Impulse Tube and Wire Ends Assembly

Col 12 IMPULSE GENERATOR UNIT.—Remove the impulse generator from the engine and completely disassemble it.

Thoroughly clean all parts; inspect for wear and other defects of the cam, camshaft, cam follower, gear, bearings, housing, and other parts. Excessive wear of the cam and cam follower where the two parts make contact is the most common defect, requiring replacement of parts.

Check the clearance between the cam and cam follower when the follower is locked in the inoperative position. If necessary, adjust to obtain the required .002-to-.005-inch clearance.

Check for $\frac{1}{64}$- to $\frac{1}{32}$-inch overtravel of the trigger motor.

After completing the inspection, required replacements, and adjustments, reassemble the impulse generator, lubricate all working parts, and reinstall on the engine. At any time that an impulse unit and a control unit are not connected to an impulse generator, a plug and a cap will be installed on the impulse generator to close the respective openings.

IMPULSE WIRE AND TUBE ASSEMBLY.—Inspect the tube and the brazed joints at each end for cracks and other defects. Dents, kinks, and flattened sections are defects requiring replacements of the tube.

See that the unit is securely attached to both ends.

Generously lubricate the impulse unit with Gredag No. 32 grease, by means of the lubricator shown in figure 382.

TRIGGER MOTOR ASSEMBLY.—See that all working parts are properly lubricated with gun oil. Check the trigger motor for the correct overtravel of $\frac{1}{64}$ to $\frac{1}{32}$ inch. This amount of overtravel will be obtained after the bolt assembly has been moved to the side of the receiver opposite the trigger motor and after the firing pin has been released.

Col 15

COMMUNICATIONS

25-Hour Inspection

This inspection shall be a daily inspection conducted under supervision of competent supervisory communications personnel designated by local authority. The objective is 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.

Col 15

COMMUNICATIONS

100-Hour Inspection

GENERAL.—Check Form 1A for any entries pertaining to communications equipment. Correct any defect noted not previously corrected, and indicate by appropriate entries corrective action taken. Check for presence and correctness of applicable Radio Facility Charts and other required Technical Orders of the 08-15 series.

ANTENNAS.—Visually inspect shock links and springs for tension and deterioration. Clean and check all exterior fixed wire antennas for nicks. If a reddish brown powder appears around the splices and ties, replace the antenna. Clean insulators and inspect for cracks or chips. Check marker beacon lead-in nut for tightness. Check marker beacon transmission line for continuity to ground (with antenna plug installed in receiver, should be a fraction of an ohm). Check marker beacon antenna for length (75-½ inches plus minus ⅛ inch overall from insulator eye to insulator eye). The lead-in is tapped off center (40 inches plus minus ⅛ inch from lead-in tap to one insulator eye).

FRONT COCKPIT.

COMMAND RECEIVER AND TRANSMITTER CONTROL BOXES.—Inspect for proper action of switches, clean contacts on key, switches, and jacks. Check tightness of control knobs and handles. Check for broken or corroded connections, and loose or dirty plug socket contacts.

INTERPHONE JACK BOX AND FILTER SWITCH BOX.—Check for proper action of switches, dirty or loose switch, jack, and plug contacts, broken or corroded connections, deterioration of any parts, loose control knobs, corrosion and oxidation of microphone and headset cord plug contacts, and condition of cord-holding clips. Check operation on both "RADIO" and "INTERPHONE" positions. Check condition of all setscrews holding the control shaft and fittings to make sure they are well-seated and show no tendency to loosen up. A wrench, 35, is clipped inside interphone control box BC-334 for tightening the No. 8 hexagonal-socket setscrews used.

COMMAND SET SCR-( )-183 (early airplanes).—Remove chassis from case and inspect for loose or dirty tube and plug socket contacts, loose or dirty coil set contacts, broken or corroded joints, deterioration of any parts, and cleanliness of chassis. Remove, test, and replace all tubes in same sockets and replace case with all screws.

Col 15 Check dynamotor to include removal of end bells; inspect for presence of carbon dust and dirt, short chipped, cracked or sticking brushes, and freedom of movement of armature. If a commutator or brushes show signs of excessive wear, replace dynamotor.

NOTE

Clean only with compressed air or clean, dry rag. Do not use cleaning fluids. Do not use sandpaper or abrasive on commutator. If operation is unsatisfactory after cleaning and run-in. replace dynamotor.

Check ANTENNA SWITCHING RELAY for loose armature bearings, dirty relay contacts, broken or corroded joints, loose or dirty plug socket contacts. Install above equipment.

Check JUNCTION BOX for tightness of all electrical connections, corrosion of fuse clips and fuse end caps, presence of undesired voltage drop across fuse load, presence of spare fuses of a specified rating, serviceability of spare fuses tested under load, presence of undesired looseness of relay armature, presence of dirty relay contacts, proper action of relay.

Check COMMAND TRANSMITTER adjustment *with a d.c. plate current milliammeter* to determine if transmitter antenna circuit is properly tuned for assigned operating frequency and proper percentage of modulation is attained. To accomplish this, proceed as follows:

1. Insert d.c. plate current meter in power amplifier plate circuit jack.

2. Tune align output knob for minimum reading on meter.

3. Release switch, remove coil set, change tap, and repeat above operation, comparing minimum values of plate current obtained.

4. Repeat above operation until antenna coupling tap required for highest minimum reading is determined. This should correspond with maximum value of antenna current obtainable.

5. Release switch and plug milliammeter into MOD-OSC plate circuit jack. Computing from the two readings, obtain the total plate current drawn by all tubes.

6. If computed figure is in excess of 120 milliamperes with a 14.25-volt or a 28.5-volt power input, readjust coupling tap in a direction away from base of coil, and retune antenna circuit with align output knob until amplifier d.c. plate current peak is obtained.

7. Repeat operations 5. and 6. until a total plate current (with a 14.25-volt or 28.5-volt power input) of 110 to 120 milliamperes is obtained. This will enable the transmitter to operate most efficiently with regard to modulated carrier output

Col 15 and minimum frequency change with change in outside atmosphere.

If no d.c. plate current milliammeter is available, the TRANSMITTER may be adjusted as follows:

1. Adjust antenna coupling tap for maximum peak value of antenna current obtained by totaling the align output knob through peak antenna current value for each setting of the coupling tap.

2. If necessary, repeat above operation until peak value is approximately five percent less than that obtained in operation 1.

To check adjustment of TRANSMITTER with crystal coil unit, proceed as follows:

1. Set frequency control for frequency of crystal in accordance with calibration chart on coil set.

2. Insert d.c. plate current ammeter in power amplifier plate circuit jack.

3. Press microphone switch and observe milliammeter.

4. Tune align output knob for minimum reading on meter.

5. Release switch, remove coil set, change tap, and repeat above operation, comparing minimum values of plate current obtained.

6. Repeat operation 5. until antenna coupling tap required for highest minimum reading is determined.

7. Release switch; plug milliammeter into MOD-OSC jack. Take plate current reading; compute total value of plate current drawn by all tubes. If in excess of 110-120 milliamperes with a 14.25- or a 28.5-volt input, readjust frequency control in an increasing numerical direction until total plate current reading obtained by addition of simultaneous readings from the two jacks equals 110 to 120 milliamperes.

Check neutralization of TRANSMITTER. Open power amplifier plate circuit by placing a plug in power amplifier plate circuit jack. Use an RF milliammeter in series with antenna to obtain minimum current indication.

NOTE

If no RF milliammeter is available, check neutralizing capacitor for minimum dip on antenna current meter.

If neutralization adjustments were performed, retune transmitter.

Check operating frequency (if crystal coil unit not being used) with a frequency meter.

Check TRANSMITTER dial setting against calibration chart; if readings do not coincide, readjust compensating or "trimming" condenser. (Check with SCR-211-( ).)

Check operation of COMMAND RECEIVER by testing adjustment of receiver antenna alignment condenser on high frequency end of high frequency band, set operating on manual volume control, while listening to a relatively weak signal.

Col 15 Make operating test on manual volume control position, both high and low bands of dual coil, full and reduced volume, observing:

Signal strength of a known station.

Undesired presence of oscillations.

Undesired presence of excessive noise.

Accuracy of dial calibration.

Action of gain control.

Over-all sensitivity throughout bands.

Undesired presence of intermittent contacts when receiver control box and associated plugs and cordage are subjected to jarring.

Make operating test on automatic volume control position, full and reduced volume, checking for AVC action, presence of excessive noise, and action of audio level control.

Check operation of COMMAND TRANSMITTER on "VOICE" position and observe:

1. Indication of radiated carrier and of modulation, shown on antenna current meter.

2. Presence of sidetone.

3. Undesired presence of intermittent contact when control box and associated plugs and cordage are subjected to jarring.

Make operating test on "CW" and "TONE" positions, observing indication of sidetone.

Check COMMAND SET for intermittent contacts, *receiver operative,* while subjecting transmitter, junction box, antenna switching relay, dynamotor, and associated plugs and cordage to jarring.

Check COMMAND SET for intermittent contacts, *transmitter operative,* while subjecting transmitter, junction box, antenna switching relay, dynamotor, and associated plugs and cordage to jarring.

COMMAND SET SCR-( )-274-N set (if installed).—Check receivers as follows:

1. Remove transmitter, receiver and modulator unit. Remove all covers from chassis of each unit. 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 removed and replace any defective tubes. Make sure all tubes are firmly seated in their sockets and that grid caps are firmly attached. Should the master oscillator or a power amplifier tube be replaced, it will be necessary to retune the transmitter completely.

2. Remove the end bells from the receiver and transmitter dynamotors. Make inspection for carbon dust and dirt. Check for short, chipped, cracked or sticking brushes. Examine brushes to see that they have "worn in" properly and are free from hard spots on the contact surfaces. If commutator or brushes show signs of excessive wear, replace the dynamotor. Replace and safety dynamotor end bells.

3. Reinstall and safety the respective units.

Col 15 4. Check for correspondence of receiver dials with the reading of the remote tuning dials; correct them, if necessary.

5. Make antenna alignment check as follows:

Set the "CW," "OFF," "MCW," power switch controlling the first receiver to "CW."

Check to see that the "A TEL-B TEL" switch of the same control box section is set at "A-TEL," and plug a headset into an "A-TEL" jack.

Set the gain control knob to maximum gain position.

Tune the receiver to the highest frequency.

Align the antenna input circuit for maximum background noise, using the "ALIGN INPUT" knob on the front of the receiver.

Switch the receiver off and perform a similar operation on the other receiver.

6. Make an aural check on the operation of each receiver by listening to signals on "CW" at maximum gain while tuning through the entire band. All receivers except the one being tested should be turned off.

Check COMMAND TRANSMITTER of SCR-274-N set as follows:

1. Check for presence of carrier modulation, indicated by antenna current meter.

2. Check the assigned operating frequency with the frequency meter.

3. If retuning is necessary, observe the following operations (transmitter power off):

Set the "FREQUENCY" control dial to the desired transmitting frequency. (If the calibration accuracy of the transmitter has not been checked, read paragraph on TRANSMITTER FREQUENCY CHECK before continuing further.)

Set the "ANT. COUPLING" control to about 3 on scale.

Throw toggle switch on antenna relay unit BC-442-A to "LOCAL."

Set radio control box BC-451-A emission switch to "CW," and selector switch to No. 1 or No. 2, depending on which transmitter is being tuned.

Turn on "TRANS. POWER" switch (neither microphone button nor the key should be closed), and allow a 15-second warm-up period.

Lock the key on top of the control box by rotating it clockwise.

Resonate the antenna circuit by adjusting the "ANTENNA INDUCTANCE" for maximum antenna current. (Maximum series inductance is in circuit when the contact button behind the transparent window is in the extreme right-hand position.) This adjustment should be made with the "ANT. COUPLING" at a lower setting than that which gives the highest antenna current.

Vary the "ANT. COUPLING" until maximum "CW" antenna current is indicated on the RF ammeter of the antenna relay unit, with the switch in the "LOCAL" position.

Col 15 Retrim the "ANT. INDUCTANCE" tuning for maximum "CW" antenna current.

Lock all controls; switch the antenna relay unit to "REMOTE."

Each transmitter has a special frequency checking circuit which includes a plug-in crystal resonator (it does not control the frequency). *The frequency of the crystal supplied with this transmitter is 3.5 megacycles.*

TRANSMITTER FREQUENCY CHECK.

The frequency may be checked by observing the following steps:

Open hinged cover (at top rear of transmitter) to such an angle that the reflection of the entire resonance indicator screen of tube VT-138 may be seen.

Tune the transmitter to the LOWEST frequency which will cause the shadow on the VT-138 tube to open up to a sharp maximum in the width of

Col 15 the shadow. The indicated dial frequency should not correspond with that of the crystal. If it does not, set the dial on the nominal frequency of the crystal and trim the master oscillator to make it so. This trimmer is adjusted with a small metal screw driver inserted through the hole in the top of the transmitter, which is covered with a metal slide. (A clockwise rotation of this trimming control lowers the transmitter frequency.) The calibration engraved on the frequency dial of the transmitter will then be correct at all parts of the dial.

NOTE

Always perform the above operation whenever a tube is changed in the transmitter and especially so if a new master-oscillator VT-137 is installed. When properly calibrated, the frequency emitted by a transmitter is within ±.03 per cent

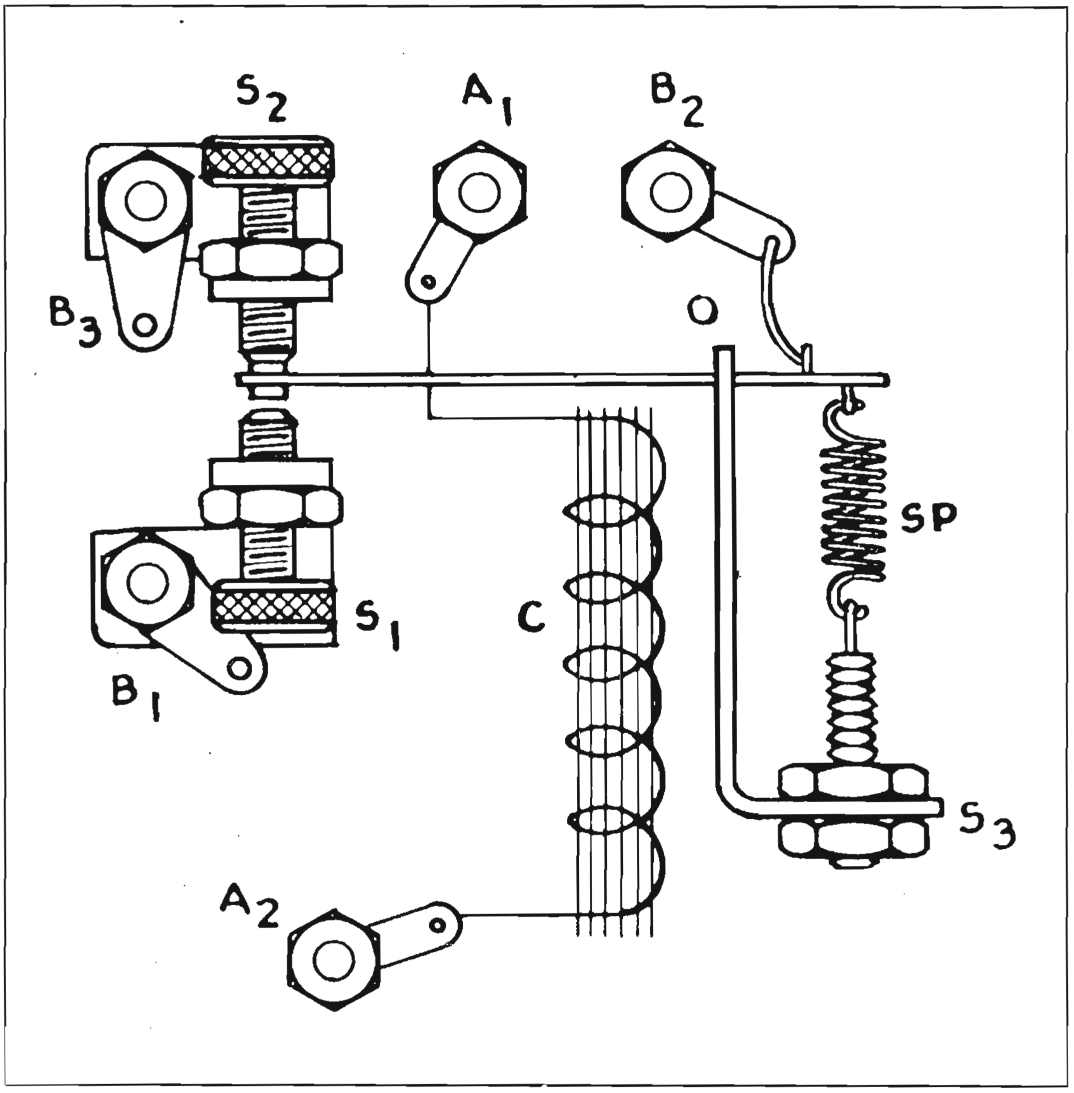


Figure 383 — Marker Beacon Receiver Adjustment

Col 15 of the frequency indicated by the dial unless otherwise noted by a notice in yellow ink stamped on the transmitter dial, in which case the calibration accuracy cannot be depended upon closer than the figure in the notice.

Subject the transmitter and the modulator unit to jarring, watching antenna current meter for evidence of loose elements or connections.

Make operational check by contacting tower or another airplane.

Check MARKER BEACON RECEIVER (if installed) as follows:

Test marker beacon receiver tubes in the best available type of tube tester. They may be tested roughly on the model 685 tube checker. Replace any defective tubes, reinstall good tubes in identical sockets from which they were removed.

NOTE

When testing VT-104, adapter "B" must be used in the octal socket of model 685 checker.

The relay should be checked by the following procedure:

Turn marker beacon receiver on; allow about 40 seconds for tubes to heat. Connect test indicator BE-67 to the receiver by means of cord CD-200. The switch on the panel of the test indicator should be held in the momentary contact or "ADJUST RELAY" position while the control knob is turned to vary the relay current. The current required to close the relay is normally 0.4 milliamperes. A deviation of 10 percent is permissible. As the current is reduced, the relay releases at 0.2 milliamperes. If the indicator lamp fails to light, remove receiver from case and check lamp circuit relay contacts. Clean relay contacts or replace lamp, if necessary.

The RELAY is readjusted as follows: (see figure 383.)

Insert a thickness gage of 2- or 3-mils thickness between the armature and relay coil pole pieces. Release screw S1 and exert a slight pressure on the armature directly above the pole piece. Turn the Screw S1 until contact is just made and the indicator light goes "ON." Lock screw S1 in place, compensating for effect of lash in threads. Still exerting very light pressure against the armature, make sure that the gage can be withdrawn easily. This insures that there is no flexing of the armature and that the air gap is 2 or 3 mils. Adjust the tension of the armature spring SP by

Col 15 means of screw S3 until release occurs at 0.2 milliamperes of relay current and lock screw adjustment S3. Screw S2 should now be adjusted so that the relay closing current is 0.4 milliamperes. A deviation of 10 percent is allowable for both closing and release currents. However, it is important that the difference between the two should not be less than 0.2 milliamperes for the best performance.

To check the receiver tuning with test set I-76, place oscillator (BC-376) on the ground to the side of the airplane about 10 to 20 feet from the marker beacon receiving antenna. The test oscillator antenna should be extended to its full length and set parallel to the marker beacon antenna. The test oscillator battery switch should be turned on the modulation set for 3000 cycles. Plug the test indicator (BE-67), which is also a part of test set I-76, into the jack on the front of the receiver marked "RELAY." Set the switch on the test indicator to the "Tune Receiver" position, and the milliammeter will indicate the receiver output current when the latter is properly aligned. If the output is extremely weak, tune the receiver as follows:

Adjust, with a 1/8 inch blade screw driver, the screw adjustments in this order for a maximum response on the output meter; "DET," "R.F.," it is desirable to check from one to the other a couple of times and then tune "DET" last. Be sure that the "ANT" capacitor is tuned to strongest response point and is not left a minimum capacity. This tuning should always be made with the receiver chassis in its case. Moving objects should be kept away from the vicinity of the antenna during the check.

Check INTERPHONE AMPLIFIER as follows:

1. Test amplifier tube.
2. Check to insure that there is no interference between the cover assembly and the wiring.
3. Check for dirty or loose plug contacts.
4. Broken or corroded connections.
5. Check interphone dynamotor, remove end bells, and inspect for presence of carbon dust and dirt, short, chipped, cracked, or sticking brushes. Examine brushes to see that they have "worn in" properly and are free from hard spots in the contact surfaces. If brushes or commutator show signs of excessive wear, replace dynamotor. Check for free movement of armature.

REAR COCKPIT.

Check INTERPHONE JACK BOX for:

1. Proper action of switch.
2. Dirty or loose switch, jack and plug contacts.
3. Broken or corroded connections.
4. Deterioration of any parts.

Col 15 5. Loose control knobs.

6. Intermittent contacts on microphone and headset cords, and for corrosion and oxidization of plug contacts and condition of cord holding clips.

7. Operation on "RADIO" and "INTERPHONE" positions.

8. Examine all setscrews holding the control shaft and fittings to make sure they are well seated and show no tendency to loosen up. A wrench, 35, is clipped inside interphone control box BC-334 for tightening the No. 8 hexagonal-socket setscrews used.

9. Turn off equipment.

Col 16

PHOTOGRAPHIC

50-Hour Inspection

Inspect the camera support tube springs for even tension, and lubricate them with mineral grease. Inspect the wiring in the power junction box for loose connections and insulation.

Inspect the intervalometer warning light jewel for any dust that may have accumulated, and the lamp for discoloration or broken filament.

Inspect the rubber tubing around the opening for general condition, security of attachment, and for uniformity of seal when closed. Lubricate hinges and latches.

Inspect camera doors for security of attachment and ease of operation.

Col 20

ENGINE CONTROLS

25-Hour Inspection

Inspect entire control installation from levers in cockpit through all rods and cables, linkage, support brackets and pulleys. Inspect for full and free movement, lost motion, bent rods, frayed cables (not more than six broken wires in any 1-inch length of cable), loose, broken, or misaligned pulleys, loose or missing bolts, nuts, screws, cotter pins, etc. See that linkage is properly adjusted. Controls should operate with uniform tension throughout their full range.

Clean and lubricate all moving connections and bell cranks, throttle, mixture, carburetor heater, and propeller controls with oil, grade 1080, Specification No. AN-VV-O-446.

NOTE

Do not lubricate the engine control quadrants. Lubricants would neutralize the action of the friction discs, which prevent the controls from creeping.

See that all adjustment or position locking devices function properly, and that all levers are adjusted to prevent creeping.

Figure 384 — Fuel Mixture Analyzer

Col 20

ENGINE INSTRUMENTS

25-Hour Inspection

FUEL MIXTURE INDICATOR (type A-2, in AT-6 only.)—Make the following tests on the instrument after every 25 hours of operation.

MECHANICAL ZERO TEST.—With the current off, the pointer should rest at the line marked "A" on the scale. If the pointer does not rest at "A", it may be adjusted by turning the adjusting screw located on the face of the indicator. Tap indicator lightly when making this adjustment.

ELECTRICAL ZERO TEST.—An accurate electrical adjustment depends upon a balanced humidity condition existing between the wick and filter chamber. To secure this condition, the following procedure must be followed.

Remove the filter cap and filter. Place a cloth, saturated with water in the filter housing.

Remove wick assembly and saturate with clean water. Remove all excess water from the bottom of the wick assembly nut before replacing in the analyzer assembly.

Turn on the current; allow a period of 20 minutes for the humidity of the filter, wick, and bridge chambers to come to equilibrium.

After the 20-minute period, the pointer of the indicator should rest at the line marked "A". If adjustment is necessary, it may be accomplished by means of the electrical zero adjustment on top of the analysis cell box. Unscrew the potentiometer

Col 20 cap nut and make the required adjustment. Lock the potentiometer cap nut in position. In order to relieve any possible pivot friction, tap the meter lightly during this operation.

Remove the damp cloth from the filter chamber and replace with the filter.

With the Corprene gasket on the filter housing, screw the filter housing cap into position. The instrument is ready for operation.

Col 21

ENGINE INSTRUMENTS

50-Hour Inspection

GENERAL.—Check markings of all instruments to see that they are legible and in accord with the latest applicable instructions. When necessary, remove old markings and repaint as prescribed in this section, para. 10.

Check all instruments for security of mounting and tightness of connections. Check electrical instruments for condition of insulation. Check pressure gage lines and connections for leaks.

Check instrument panel for defective shock mounting, bonding on panel, lines, and instruments.

CARBURETOR MIXTURE THERMOMETER.—With battery switch "OFF," check indicator for normal zero position. If it is found that the pointer is not on zero, adjust to zero by means of the small screw found at the front of the instrument. By means of a small screw driver, rotate the screw slowly towards right or left until the instrument is on its normal zero.

THERMOCOUPLE INDICATOR. — Inspect the indicator for chipped luminous markings, security of mounting, and tightness of connections (including electrical connections). Check cable for condition of insulation.

ZERO ADJUSTMENT.—Check the thermocouple indicator as to its zero position. If an adjustment for zero position is necessary, disconnect the indicator from the thermocouple circuit at the indicator studs or at the thermocouple screw connections. Then, by means of a small screw driver, rotate the zero adjusting screw, located in the glass face of the indicator, to the right or left until the pointer indicates the temperature of the instrument on the dial. The instrument temperature can be determined by using a check thermometer. Sufficient time should be allowed for the instrument to come to the same temperature as the cockpit. The reading should be taken after 15 to 30 minutes time has elapsed to obtain steady conditions. After setting the adjusting screw, close the circuit at the point previously broken, and the indicator will indicate correctly the temperature at the thermocouple.

Col 21

NOTE

When inspection of these indicators shows evidence that moisture has leaked around the zero adjusting screw or cover glass into the case, the indicator should be replaced and sent to the depot for necessary servicing.

TACHOMETER.—Check flexible drive shaft of tachometer for proper anchorage and for tightness of connections at engine and instrument. Check dial and pointer for luminosity.

MANIFOLD PRESSURE GAGE.—Check reading of manifold pressure gage with station barometer. If reading differs by more than 0.4 in. Hg. from that of station barometer, remove instrument and replace with serviceable unit.

FUEL MIXTURE INDICATOR (type B-5 and type A-7).—Inspect the instrument for broken or loose cover glass, for security of mounting, and for discolored or chipped luminous markings. Inspect tubes and connections for leaks, security, flexibility, and anchorage. Inspect electrical connections for security. Inspect pointer for proper electrical and mechanical zero position, and filter for cleanliness as described in the following paragraphs.

MECHANICAL ZERO ADJUSTMENT.—With the current supply off, the galvanometer pointer should rest at the line marked "A" on the scale. If it does not, it should be brought to this position by turning the small adjusting screw below the instrument scale. Lightly tap indicator while this adjustment is being made.

ELECTRICAL ZERO ADJUSTMENT.—Verify adjustment of mechanical zero as outlined above, then proceed as follows: unscrew vapor plug which contains wick that must be kept moist at all times. Soak the wick in clean water, shake off excess water, and replace in vapor plug. The vapor plug has a minute pinhole in a countersink near the base. This must be kept free of dirt and other foreign material at all times.

Remove the filter cover and metal wool. Let them air for 10 minutes. Replace the wool with a clean, damp rag slightly wrung out and replace cover. Allow to stand thus for about 30 minutes.

Turn the current on. The pointer should settle at the line "A" within 30 seconds. If it does not settle at the line "A," adjustment is made by turning the knob of the rheostat on the analysis cell.

After adjustment has been made, the wet cloth should be removed and the metal wool and cover replaced.

CLEANING FILTER.—Remove the filter material from the analysis cell and wash out with benzene, and then with water. Shake out the excess water before replacing. Press in the wool so that the inlet pipe is not covered. If the wool has

Col 21 become distorted and difficult to handle, it should be replaced with a new wool cartridge.

CAUTION

Care must be exercised to use only specified noncorrosive filter wool, as ordinary wool will oxidize and pulverize, resulting in cell failures.

Examine and clean out the sampling nipples.

FUEL MIXTURE INDICATOR (type A-2, in AT-6 only). — Inspect instrument for chipped luminous markings, security of mounting, and tightness of connections, including electrical connections.

Remove the filter and filter screen from the filter housing. Saturate the filter and screen in gasoline; if they are found to be excessively corroded, they must be replaced with new parts.

Remove all corrosion and foreign matter from the nozzles, edges, and the interior of the filter chamber.

Clean out the wick assembly. The capillary hole is cleaned by inserting a 0.010-inch wire into the hole and working it back and forth. The porcelain holder should be inspected to ascertain that it is free from cracks.

CAUTION

Do not clean out the filter chamber with air under high pressure, as this may damage the resistance units in the cell block.

Clean the sampling lines by running an old tachometer shaft through them, rotating it by means of a hand drill. Check the sampling tubes in the exhaust to see that they are not clogged or burnt off. Check the sampling lines for cracks and restrictions.

TACHOMETER.—The tachometer shaft should be disassembled, inspected for wear and defects, and lubricated only at the time of each engine change unless local conditions warrant more frequent action. Inspect and lubricate the shaft as follows.

REMOVING SHAFT.—Disconnect both ends of the tachometer shaft.

CAUTION

Exercise extreme care in handling and installing the assembled drive shaft and casing, as these parts are susceptible to damage through improper handling. During handling, the assembled shaft and casing must not be bent in a circle of less than 6-inch diameter at any time.

Remove the washer at the engine end, and pull inner shaft out of the casing from the instrument end.

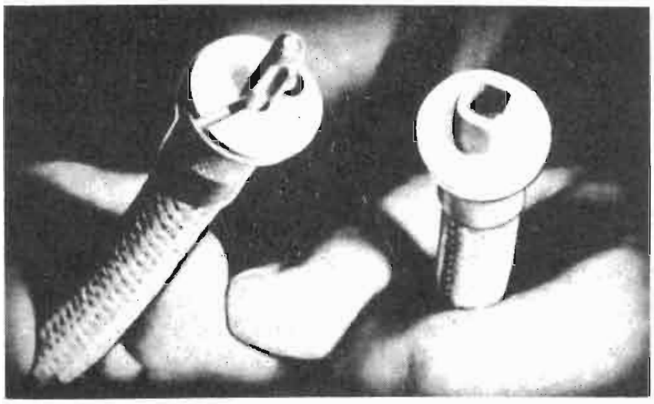


Figure 385 — Ends of Tachometer Shaft

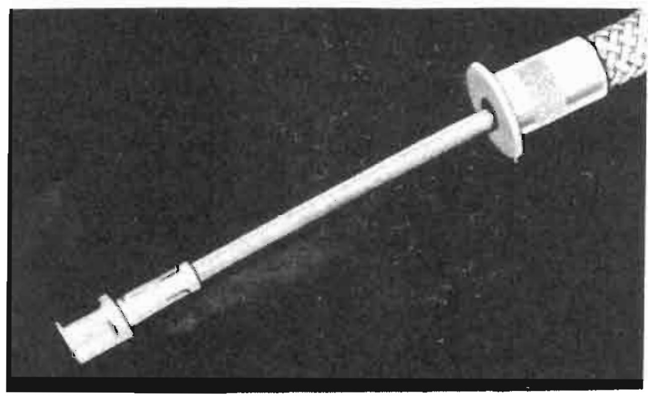


Figure 386 — View Showing Shaft Partly Removed

Col 21 Inspect both the inner shaft and the casing for wear and corrosion, and replace with a complete assembly if either part is found to be excessively worn.

LUBRICATING SHAFT. — Lubricate shaft with a light coat of low-temperature grease, Specification No. AN-G-3, prior to reinstallation in the casing.

Reinstall the washer on the shaft, exercising care not to break the washer when installing.

A yellow dot on each end fitting of all shafts lubricated with AN-G-3 grease indicates that the shaft is suitable for use in Arctic weather.

When completely installed, the key end of the drive shaft should protrude beyond the face of the casing end not less than $\frac{9}{16}$ inch nor more than $1\frac{1}{4}$ inches. If protrusion is more than $1\frac{1}{4}$ inches, lengthen casing by flexing and pulling along its length to eliminate small bends and kinks. If further adjustment is necessary, twist casing slightly.

TESTING SHAFT FOR FREE ROTATION.— Secure tachometer shaft casing to the airplane structure at frequent intervals to prevent vibration or whipping, and test to see that it rotates

Col 21 freely before connecting to the engine and tachometer.

After the test for free rotation of the shaft with both ends disconnected, connect instrument end of shaft securely to tachometer; test for free rotation of shaft from the engine-driven end. If the shaft binds, check for misalignment of the shaft-drive fittings with the instrument-drive fitting. Correct the difficulty by loosening the connection nut and realigning the shaft.

TESTING FOR POINTER OSCILLATION.—Test tachometer for pointer oscillation by driving shaft either by the engine or by an electric motor. If oscillation occurs, realign the shaft-drive fitting with the instrument-drive fitting.

At Engine Change

THERMOMETERS.—Each installed aircraft thermometer will be inspected at every engine change to see that the purpose for which it is being used is clearly marked on the indicator.

Col 22

IGNITION AND ELECTRICAL

50-Hour Inspection

GENERAL.—Inspect all wiring for proper anchorage of conduit nuts, bonding leads and terminal box covers, condition of connections and insulation, terminals, exposed ends and contacts, including ground connections. See that no leads are anchored to the fuel lines or engine controls, or are swinging free in such a manner as to cause undue wear or fatigue.

NOTE

Whenever resoldering any part of the ignition manifold assembly, use lead and silver solder in a 1/8-inch diameter rod, U.S. Army Specification No. 57-99-1.

Inspect all flexible and rigid conduits for dents, scratches, and other blemishes.

Inspect the interior of all circuit breaker boxes (fuse boxes on 12-volt airplanes), switch boxes, and junction boxes for cleanliness, neatly installed wires, and any moisture due to condensation.

Inspect all circuit breakers for security of connection, for cleanliness and serviceability of contact surfaces.

Check the active and spare fuses and lamps for serviceability and for correct value (12-volt airplanes).

STARTER.—Inspect the starter for security of mounting, and loose electrical connections. Inspect the housing for cracks or breaks, and for tightness of bolts.

Inspect starter motor brushes to see that they are bearing on commutator and do not bind the brush

Col 22 holder. Worn brushes should be replaced. Inspect brush springs for proper tension. Inspect commutator for evidence of dust or roughness; clean, if necessary.

Test starter for proper functioning by closing starter switch, allowing the starter to build up to normal rpm, and then opening the starter switch. The starter should run not less than 3 minutes when the starter clutch is not engaged.

WARNING

The ignition switch should be "OFF" when this test is made. Be careful that the starter clutch does not "engage."

Inspect hand cranking extension, bracket, and supports for security of mounting and general condition.

See that safety wire is installed where necessary.

CONTROL PANEL (12-volt airplane).—Inspect the control panel for security of mount, excessive arcing, cleanliness. See that safety wire is installed where necessary.

Inspect terminals, cables, and connections for general condition.

Inspect the vibration absorption mounts to see that they are in serviceable condition.

Inspect the condition of the contact points. Dirt generally can be removed by inserting a piece of clean paper between the contacts, pressing the contacts together, and pulling out the paper. Be sure not to leave paper lint between the contacts, as this will reduce the voltage. Snapping the contacts by opening and letting the spring snap them shut may help to remove lint.

CAUTION

When inspecting the contacts, the line switch should be open.

Check the voltage regulator element for 14.25 volt (28.5 volts for 24-volt system) setting with no load as set at initial installation.

GENERATOR.—Inspect the generator for security of mounting. See that all connections and terminals are in good condition. See that safety wire is installed where necessary. When tightening generator front head screws, be sure that screws do not bottom in the yoke.

If the commutator is rough and dirty, smooth with No. 000 sandpaper. If badly scored, pitted, or eccentric, replace generator with a serviceable unit. Remove the generator brush bands and check brushes for wear, sticking, loose connections, and for excessive arcing between brushes and commutator. Clean generator and replace worn brushes.

Should the presence of oil be noted in the generator at any inspection, remove the generator and check engine oil seal for leakage.

Col 22

IGNITION SHIELDING. — Inspect for proper anchorage and security of union nuts.

MAGNETOS.—Remove breaker cover and clean breaker housing. Inspect magnetos for damaged cam followers, damaged breaker felts or cushions, weak or broken breaker arm springs (use gage to check tension), worn or loose cams or cam bearings, and security of mounting. Replace breaker assembly, if necessary, with serviceable unit.

Check condition and adjustment of the breaker contact points; adjust, if necessary, following instructions in section IV, paragraph 6 *b.* (3).

Check the magneto cooling tubes for security of attachment, distortion, and cleanliness.

DISTRIBUTOR.—Remove coil cover and radio shield with distributor block. Inspect magneto distributor for cracked head or rotor, sticking or broken brush, signs of arcing. Using a screw driver, check mounting screws for tightness. Replace head, brush, or rotor as required.

Look at the lubrication felt attached to the cam follower of the distributor. If the felt is soft and oil shows on the surface when it is squeezed between the fingers, no additional lubrication is needed. If the felt is dry, apply a small amount of oil to the portion of the felt attached to the cam follower main spring. When possible, choose a time for oiling when the engine and magneto are warm. Never permit oil to reach the breaker points, as this would cause pitting, rapid wear, and interference with magneto operation.

NOTE

Use just enough oil to make the felt soft and for oil to be brought to the surface by squeezing. Do not apply all the oil it will hold.

100-Hour Inspection

SPARK PLUGS.—Remove all spark plugs and replace with new or reconditioned plugs of the same type. Refer to section IV, para. 6, for instructions on lubricating and installing spark plugs.

BOOSTER COIL.—Inspect for security of mounting and proper adjustment of vibrating contacts.

STARTER.—Adjust the starter engaging solenoid cable so that it will positively engage the starter to the engine. See that safety wire is installed where necessary. Inspect switches and solenoids for security of mounting and connections, particularly at "ground" wire or lead. Inspect wiring for proper anchorage and safetying of connections.

Col 22

250-Hour Inspection

FLUORESCENT LIGHTING.—Check inverters and auxiliary boxes for outputs, and satisfactory operation and starting of the lamp assemblies.

Check lamp assemblies for satisfactory operation. If ends of lamps are dark, replace. Check lamp starting switch for satisfactory operation.

500-Hour Inspection

FLUORESCENT LIGHTING.—Replace the vibrator element of inverter. Check for operation.

Remove inverter. Remove bottom cover and check all screws for tightness. Inspect all accessible wiring and connections. In the event the inverter is found defective, it should be replaced with a serviceable unit.

The type 340 vibrator should be used for the effective life and replaced with serviceable unit upon failure, as indicated by repeated blowing of fuses.

Replace lamps and check for operation. Change the lamp starting switch if operation of same is sluggish.

No replacement or other maintenance should be required for the auxiliary boxes, as no moving parts or contact points are used.

At Engine Change

Remove the starter and forward to depot for overhaul.

Col 23

FUEL SYSTEM

25-Hour Inspection

GENERAL.—Inspect the lower surface of the airplane center section for evidence of fuel leakage, particularly along the seams of the access covers. Leakage is usually detected by the presence of stains caused by dye used in aviation gasoline.

Inspect electrical bonding of the fuel system.

CARBURETOR.—Lubricate throttle shaft bearing, exposed economizer, and accelerating pump operating parts, using oil, general purpose, Specification No. AN-O-6.

Inspect parting surface between body casting for leakage, and test parting screws for tightness with a suitable screw driver.

Remove float chamber and fuel passage drain plug. Remove fuel strainer plug and strainer, and clean. Flush out water and sediment by allowing fuel to flow through strainer and drain plug opening. Remove air intake if it interferes with removal of drain plugs or strainers. Strainer assemblies, strainer plugs, or plugs marked "Drain" should be replaced if found unserviceable.

FUEL LINES.—With fuel "ON" and pressure built up, inspect all fuel lines for leaks, particu-

Col 23 larly at connections and sharp bends. Inspect lines for crack, security of line anchorage, wear due to loose clamps, vibration, or chafing. Inspect hose connections for condition, and hose connections and hose clamps for tightness.

FUEL STRAINERS.—Remove and clean all fuel strainers. Inspect for breaks and tears. Flush out water and sediment by allowing fuel to flow through strainers and drain plug drains. Clean the strainer bodies. Replace the strainers, the plugs, and drain valves, and resafety.

RELIEF VALVE.—Inspect vent opening in relief or bypass valve cover plug by inserting the appropriate sized drill or wire into the vent opening. Inspect for security of mounting, leaks, and proper operation.

DRAIN LINES.—Inspect all fuel overflow or drain lines for security of mounting, kinks, breaks or stoppage. Note whether overflow or drain lines extend beyond the cowling. This is necessary to avoid fuel vapors collecting inside the cowling, fuselage, or wing. Clean strainer bodies, and inspect for breaks or tears. Drain all fuel strainers that are not drained daily.

HAND PUMP.—Lubricate hand fuel pump bell crank, mounted on left forward side of fire wall, with medium grade cup grease, Specification No. AN-G-3.

50-Hour Inspection

FUEL GAGES.—Inspect the fuel-level gages for leakage, signs of corrosion, and security of attachment. Check the general condition of the fuel gage gaskets.

ENGINE-DRIVEN FUEL PUMP.—Inspect pump for proper operation and signs of leakage. Remove shaft from the fuel pump flexible drive assembly, inspect for wear, and replace if necessary. Lubricate with grease, Specification No. AN-G-5.

DRAIN LINES.—Inspect all fuel overflow and drain lines for security of mounting, kinks, breaks or stoppages.

FUEL SELECTOR CONTROL. — Inspect fuel cock control for conditions that would cause binding or excessive backlash. Inspect general condition of universal joints, cock-stem yokes, yoke pins, yoke-driven lugs, dial and handle assemblies, rivets, taper pins, gear boxes, spindles, shafts, and cables. Check for interference with other parts. Permissible backlash is 15 degrees for short controls with one universal joint, and 30 degrees for more complicated systems.

Excessive "drag" or friction in the fuel cock control is indicated by stiffness and binding of the

Col 23 control when the indicator handle is turned. Whenever this condition occurs, the control linkage will be disconnected at the fuel cock yoke, and both the control linkage and fuel cock assembly will be checked for freedom of movement. "Drag" in the fuel cock assembly can be determined by turning the cock stem yoke with the fingers.

CAUTION

> Whenever fuel cock controls are disconnected or fuel cock assemblies are removed or replaced, the reassembly of parts must be carefully checked to insure that the valve ports open to the positions indicated by the control handle pointer.

100-Hour Inspection

ENGINE-DRIVEN FUEL PUMP.—Fill the seal chamber of the pump approximately half full of grease, Specification No. VV-G-681. Apply through Alemite or Zerk fitting in one of the $\frac{1}{8}$-inch pipe tapped connections next to the engine pad.

At Engine Change

Check the fuel gages for corrosion, proper adjustment, and general condition. Inspect gage mechanism for security of connections, and ease of operation.

Remove the fuel gages for inspection at the first evidence of malfunctioning, or when tanks are cleaned and repaired. Inspect gage mechanism for security of connections and ease of operation, corrosion and worn parts, and general condition of floats. When reinstalling the gages, dry and calibrate them. Replace old gaskets, and seal gaskets with Parker "Sealube," or equivalent.

Inspect the stops on the hand fuel pump bell crank to see that the pump travel is limited to 90 degrees with no bottoming being obtained on either end of the pump stroke.

Col 24

OIL SYSTEM

25-Hour Inspection

OIL LINES.—Inspect oil lines for leaks (particularly at connections and passages through fire wall or other structure), security of attachment, dents, cracks, chafing, etc. Inspect hose connections and hose clamps for general condition and for proper location of clamps.

OIL COOLER.—Inspect for security of mounting, general condition, and evidence of clogging.

50-Hour Inspection

VENT LINES.—Inspect oil system vent lines for clogging, kinks, and for security of anchorage.

Col 24

OIL SCREENS.—Remove and clean all removable oil screens and strainers. Inspect strainers for breaks and tears.

OIL DILUTION SYSTEM.—Inspect oil dilution control linkage to insure that the linkage does not bind at any point. It should be so adjusted that the dilution valve will close completely. Check the operation of the oil dilution system. Disconnect the dilution line from the solenoid at Y-fitting; plug outlet on "Y"; and with fuel pressure maintained by the hand pump, operate the system from the cockpit. See if there is any leakage of fuel through the disconnected line.

OIL TANKS.—Inspect oil tank for security of mounting, signs of leakage (particularly at seams), condition of padding and proper location of padding between the tank and support straps, and proper anchorage of oil lines leading from the tank.

At Engine Change

OIL TANK.—Drain, clean, and inspect the oil tank at each engine change to prevent contamination of the airplane oil system with dirt, metal particles, and other foreign material. To drain the oil system, it is necessary to remove the lower right section of the removable engine compartment cowl assembly. Place a suitable receptacle under the oil drain line and open the Y-drain valve located on the right side of the engine compartment.

Disconnect oil lines, remove hose connections, and inspect for any trapped debris, and thoroughly flush the system with kerosene, Specification No. VV-K-211.

Because of the baffling in the oil tanks, a complete inspection of the tank for dirt, sludge, and metal particles is impossible. Therefore, during the flushing operation, the oil outlet at the bottom of the hopper will be disconnected, and kerosene poured through the tank until all traces of dirt and debris have been eliminated.

NOTE

At each fourth engine change, or, at the discretion of the local engineering officer, at any intermediate engine change, and at all engine changes made necessary by an internal engine failure of a type to cause the circulation of metal particles through the oil system, the oil tank will be removed and cleaned. Cleaning and flushing will be accomplished with hot kerosene. Shake the tank violently during the cleaning.

CAUTION

When using kerosene in the cleaning operation, precautions against fire hazard must be carefully observed.

Col 24

OIL TEMPERATURE REGULATORS.—Oil temperature regulators will be thoroughly cleaned at each engine change. In the event of engine change resulting from an internal engine failure, the oil temperature regulator will be replaced.

PRE-OILING THE ENGINE.—Prior to ground testing the engine, after engine change, fill the oil tank one-half full of oil Specification No. AN-VV-O-446, grade 1120, or to a point where the oil level in the tank will be level with, or higher than, the oil inlet connection to the engine.

Remove all front spark plugs from the engine.

Spray a quantity of oil into all cylinders above the horizontal center line.

Remove the pressure relief valve and cap.

Remove the plug from the low pressure side of the propeller governor pad.

Place the mixture control in *"Idle Cut-off."*

Place fuel valve in the "OFF" position.

Connect the hose from a separate servicing tank to inlet of oil pump; at the same time, rotate the propeller until oil is expelled at the pressure relief valve opening.

Reinstall the oil pressure relief valve and cap.

Turn the propeller until a steady flow of oil is noted at the plug hole located at the base of the governor pad.

Reinstall the plug at the governor pad.

Reinstall spark plugs.

Disconnect the oil servicing tank hose and connect the airplane oil tank inlet connection, making sure that a steady flow of oil is coming from the connection, and that there is no obstruction or air in the line when the connection is made.

Col 28

PROPELLER AND ACCESSORIES

25-Hour Inspection

COUNTERWEIGHT SHAFT.—Thoroughly coat the counterweight shaft bearings with grease, high melting point, Specification No. AN-G-4.

NOTE

The counterweight shaft can be lubricated through the slot in the counterweight without removing the cap. If the counterweight cap is removed, care will be exercised to insure that the location of stop nuts on the adjusting screw is not disturbed as any change in the stop nuts will affect the angle setting of the propeller blades.

Col 28

PROPELLER PISTON.—Clean and lubricate the exposed portion of the piston with clean engine oil, Specification No. AN-VV-O-446.

Check propeller piston, retaining lock, and clamp ring nuts for looseness.

50-Hour Inspection

GENERAL. — Check the propeller piston for looseness. Tighten piston as required, and secure. If the propeller hub piston requires frequent tightening to maintain proper tightness, the propeller will be removed and the cause ascertained.

Examine the exterior of all parts of the propeller for cracks, bends, nicks, and other damage. Examine the entire leading edge, trailing edge, and tip portion of the blades carefully with a magnifying glass for development of cracks. When the condition of the blades warrants, perform local etching.

Check for deterioration of marking on both the blades and hub. Propeller hubs having the identification marks stamped into the metal will be examined for cracks around the markings.

Inspect for grease in hub and counterweight bearing, and refill as outlined in the following paragraphs.

LUBRICATING SPIDER HUB.—Use grease, aluminum soap, Specification No. AN-G-4, to lubricate the spider hub.

NOTE

When operating under extremely low temperature conditions, Mobile Grease No. 1, or Sinclair, Hamilton Standard Propeller Grease, winter grade, may be used.

Check governor and cockpit control installation for security of mounting, and for proper operation.

At Engine Change

The propeller will normally be overhauled at each engine change at which the propeller has operated more than 500 hours since the last previous overhaul. However, when the condition of the propeller warrants, a maximum operating time of 1750 hours between overhauls may be authorized. The authorization and final determination of the condition and serviceability of a propeller will be a responsibility of the engineering officer of the respective operating organization. Consideration will be given to actual inspection of the propeller, particularly the counterweight bearings, shafts, and bearings, to the operating conditions peculiar to the station, and to reports submitted by pilots on previous flights.

Col 29

POWER PLANT — GENERAL

25-Hour Inspection

With engine ring cowls left on, make a rigid inspection of entire engine and mountings. Check engine ring cowl supports and engine mounting lugs for tightness of bolts and condition of rubber bushing:

50-Hour Inspection

Remove all engine section cowling, including engine ring cowl, and open all inspection doors.

Check all clamps, bondings, taping and safetying of all lines, and all rods within the engine section.

Inspect engine mount for cracks, particularly at welds, tightness of mounting clamps and bolts, proper protective coating, and tightness of brace wires.

Inspect cylinders for cracks and broken or damaged fins.

See that deflectors are properly fastened and do not rub fins.

100-Hour Inspection

ROCKER LUBRICATING TUBES.—Check tubes for signs of abrasion or leakage; check the fittings for tightness. This item may be omitted on alternate inspection periods.

ROCKER ARMS.—Rocker arms should oscillate freely. If any binding or restricted movement is found, rockers should be removed and bearings inspected. Inspect rocker arms for cracks, signs of interference with adjacent parts, and excessive end and side play. Clearance between rocker shaft bushings and side of rocker arms should not exceed .015 inch.

ROCKER BOX GASKETS.—Extreme care should be exercised in replacing rocker box covers, as a slightly damaged gasket will cause leakage of oil. Be sure none are torn. Do not tighten nuts enough to distort caps.

400-Hour Inspection

VALVES.—Make a complete detail inspection and adjustment of the valve mechanism after 400 hours of engine operation. If the engine operating time is extended beyond the normal specified 700 hours, inspection and adjustment of valves will be accomplished after 700 hours and 1050 hours of engine operation. Refer to section IV, paragraph 6. b. (4), for adjustment of valve clearances.

At Engine Change

EXHAUST ROCKER BOXES.—Prior to initial operation of the engine, fill upper rocker boxes with engine oil, grade 1120, Specification AN-VV-O-446. It is only necessary to place oil in the exhaust rocker boxes of the cylinders above the horizontal line; the oil will drain into the rocker boxes of the cylinders below the horizontal line.

Col 29 VIBRATION ABSORBERS.—Replace rubber vibration absorbers if condition or flying time warrant. Lightly coat the interior of fittings, metal spacers, and washers with castor oil, Specification No. AN-JJJ-O-316, prior to the assembly of rubber grommets in the engine mount.

NOTE

Make 1500-hour replacement of rubber engine mount grommets at engine change nearest 1500-hour period.

The primary purpose of the vibration absorbing elements in engine mount installations is to produce a natural period of vibration or resonance below that of the engine at the lowest possible cruising rpm. The maximum absorbing characteristics are obtained when the engine mount vibration absorber bolts are so tightened that the engine is restrained from any fore-and-aft motion, but is permitted to move or rotate in a torsional direction. Tighten the bolts of the engine mount to 450-500 inch-pounds. Excessive tightening reduces the flexibility of the mount and tends to bring the natural period of resonance of the engine mount above that of the engine at minimum cruising rpm, which is undesirable.

25-Hours After Engine Change

SPECIAL INSPECTION

VALVES.—Inspect and adjust valves, if necessary, as indicated by rough engine operation which cannot be traced to other sources.

PUSH RODS.—Mark push rods with an electric pencil to indicate their location. If removed, replace in same location. If new ones are installed, mark location prior to installation.

ROCKER BOX GASKETS.—Check condition of rocker box cover gaskets before closing rocker boxes.

THRUST BEARING NUT.—Tighten thrust bearing nut, if necessary, with proper wrench, using 600 foot pound torque.

Col 31

COCKPITS AND CABINS

25-Hour Inspection

Inspect the seats for security of attachment, including supports and brackets, condition and functioning of brackets, and of the adjusting mechanism, and breaks or cracks in the seat or back, which might foul any part of the parachute harness or clothing.

Inspect the elastic cords on the front and rear cockpit seats for wear, deterioration, and proper tension.

Col 31 Lubricate the seat and adjusting mechanism support tubes, and rear cockpit seat rotation lock plunger, with light lubricating oil, if necessary.

Operate the cockpit enclosure emergency escape window latches, and push the window panels free to ascertain that the release mechanism functions properly and that the panels are free.

NOTE

After the panels have been reinstalled, ascertain that the enclosure mechanism plungers are properly engaged at both top and bottom and that the release handles are properly safetied with .016 brass wire.

Inspect the windshield and the fixed and sliding sections of the enclosure for the condition of the frame and security of attachment, breaks or cracks in the transparent sheet panels, and the condition and operation of the sliding sections and the gunner's hood.

Clean the cockpit enclosure tracks; lubricate them with a light application of refined paraffin wax, U. S. Army Specification No. 2-63B. Do not lubricate the tracks with grease or oil, as these lubricants attract foreign matter, which increase tendency to malfunction and wear.

Inspect the condition and operation of the cockpit heating and ventilating system. Check for leaks in the heating system.

Col 32

FLIGHT CONTROL MECHANISM

25-Hour Inspection

RUDDER CONTROLS.—Inspect rudder pedals for proper condition and functioning of parts, and cleanliness and condition of post pedal bearings. Inspect rudder pedal adjustments for proper operation.

Inspect entire rudder control assembly for lost motion and condition of pedal adjusting mechanism. If lost motion exists, or if full motion of the rudder cannot be secured without binding, thoroughly check the entire system to locate and correct the trouble.

CAUTION

Check rudder to left and to right for proper limit. For AT-6C airplanes with serial numbers 42-49005 to 42-49069 and serial numbers 42-43847 to 42-44425, and for all AT-6D airplanes, the rudder travel is 30° to left and 30° to right.

For all other airplanes of the AT-6 series the rudder travel is 35° to left and 35° to right.

See that the rudder is in neutral when rudder pedals are in neutral position.

Inspect for proper safetying at all joints and connections, frayed cables (not more than six broken wires per inch of cable), misaligned, bent, loose, Col 32 or broken pulleys or brackets, and freedom from interference between rudder and elevator in extreme positions.

Lubricate each rudder and brake pedal assembly at three Zerk fittings provided, with lubricating grease, Specification No. AN-G-3.

ELEVATOR AND AILERON CONTROLS.—Inspect for proper condition and functioning of all parts, security of control sticks, proper safetying of all attachments, and lost motion. If lost motion or binding exists, or if full movement of ailerons and elevators cannot be secured, rigidly inspect the entire system to locate and correct the trouble. Inspect all rods, bearings, pulleys, and cables for lost motion, proper safetying of all joints and attachments, frayed cables, and misaligned, bent, loose, or broken pulleys or brackets.

With control stick in neutral position, see that elevators are in neutral position.

See that the rear stick is either properly secured in its socket, or in the stowing socket in the cockpit, and that it is in such condition that it can be quickly inserted in or removed from the control socket.

FLIGHT CONTROL LINKAGE.—Inspect the flight control linkage (that is, the rudder, tail wheel, elevator and aileron cables, pulleys, guides, and fittings) for frayed cables, bent rods, loose fittings, turnbuckles, bolts or nuts, loose brackets, broken or misaligned pulleys or fairing, and proper alignment of all moving parts. Notice particularly, that the cables are not chafing structural members, and that they pass freely through holes or slots in fuselage or wing covering provided. All accessible parts will be wiped clean and lubricated where needed.

Inspect flap push-pull rod lower roller neoprene covering for wear, and ascertain that all rollers, upper and lower, rotate freely and are not excessively worn. Lubricate flap control tube guide lower roller assemblies and spacers by applying lubricating oil, Specification No. AN-O-6.

Lubricate clevis bolts and clevises at ends of aileron, elevator and rudder control cables, with lubricating oil, Specification No. AN-O-6.

Clean and lubricate elevator and rudder tab control screws in elevator and rudder, with lubricating grease, Specification No. AN-G-3. These screws can be reached through the center hinge openings in elevator and rudder.

Lubricate plunger on surface control lock mechanism by applying a thin coat of lubricating grease, Specification No. AN-G-3.

Col 32 TAB CONTROLS AND LINKAGE.—While the mechanism is being operated from the cockpit, inspect for freedom of operation, full trim tab travel when control is fully extended, security and proper safetying of cables, drums, operating screws and attachment fittings, and condition of cables, pulleys, and fair-leads.

If lost motion exists, or if full motion of the tabs cannot be secured without binding, rigidly inspect the entire system to locate and correct the trouble. Whenever a control cable has been replaced, see that it is installed so as to change angle of trim tab in accordance with standard movement of control.

Lubricate the rudder and elevator trim tab drums and actuating screws with lubricating grease, Specification No. AN-G-3. A Zerk fitting is provided for each drum. Access doors to the drums are located at the leading edge of the respective control surfaces directly forward of each tab.

All accessible parts, except cables, will be wiped clean.

FLAP CONTROL MECHANISM.—Test for proper functioning. Note that cockpit indicators are functioning, and correctly show the position of flaps.

Inspect for security and proper safetying of all rods and lock nuts, and attachment fittings. Check condition of position indicator cables, pulleys, and fair-leads, and signs of interference with other parts and assemblies. See that all moving parts are free from foreign matter and that the flap panels properly close in the "UP" position.

Lubricate the flap control handles at Zerk fittings provided, and flap operating cylinder yoke and collar at four Zerk fittings, with lubricating grease, Specification No. AN-G-3.

If lost motion exists, or if full movement of the flaps cannot be secured without binding, rigidly inspect the entire system to locate and correct the trouble.

Inspect the flap push-pull rod guide rollers for signs of wear. Replace those worn. Inspect the small rubber stops located between the wing and flap panels for general condition and security of attachment. They should be attached with suitable cement.

50-Hour Inspection

Clean and lubricate all control cables where they pass over control pulleys and through fair-leads. In areas where atmospheric conditions are conducive to forming corrosion, cables will be covered with heavy rust-preventative compound, Specification No. AN-C-52.

Inspect for the neutral static position of ailerons (1/4 inch, or 1 degree below trailing edge of wing) with the control stick locked in the neutral position.

Col 32 Lubricate the two flap push-pull rod universal joints and flap turnbuckles with light lubricating oil, if necessary.

Inspect the aileron cables for a proper tension of 45 pounds. In the event it is necessary to readjust the cable tension, make sure that the aileron movement has not been altered.

Inspect for proper tension of the elevator and rudder cables. The tension on each elevator cable should be 45 pounds, on the tail wheel cables 20 pounds when the tail wheel strut is properly inflated to 3¼ inches, and on each rudder cable forward of the idler arm 55 pounds. Trim tab control cables should have a tension of 20 pounds.

Lubricate the plunger of the surface control lock mechanism with grease, Specification AN-G-3.

Lubricate the rudder pedal adjustment slides and rear cockpit control stick lock plunger with grease, Specification No. AN-G-3.

100-Hour Inspection

Check the tension of control cables; if adjustments are necessary, refer to section IV, para. 11.

Col 33

MOVABLE SURFACES

25-Hour Inspection

Inspect the rudder, elevators, ailerons, flaps, and booster tabs for full and free movement, warping, damaged or loose structural members, condition of the fabric and metal covering, and rivets loose or pulling through the metal.

Inspect the control horns, control rods, and hinges of the ailerons, flaps and tabs for bends, breaks, security of attachment, worn or loose hinge pins, and safetying.

Check and make sure that the following drain holes are open: grommet drains located on the lower surface of the ailerons; small drain holes located at the trailing edge of the aileron and at the trim tab cut-out; small drain holes located near the aileron and flap attachment points on the lower surface of the wing.

Col 34

FIXED SURFACES

50-Hour Inspection

WING AND CENTER SECTION.—Inspect the outer wing panels and center section for torn or loose metal covering, and loose rivets or rivets pulling through the metal.

Inspect the outer panel and center section attachment points for security, cracks, elongated bolt holes, and clogged grommet drains. When removing the cover assemblies at the outer panel bolting angles, inspect the neoprene strips for damage and

Col 34 signs of deterioration, in which event they should be replaced. When replacing the cover assemblies, make certain the neoprene strips are cemented to the cover assembly.

Inspect the wing tips for cracks and security of attachment.

Insofar as possible, inspect the interior of the wing for signs of corrosion and damaged structural members.

NOTE

The portion of the center section housing the fuel tanks must be inspected when the tank doors are removed at the 300-hour inspection period.

EMPENNAGE.—Remove the rear sections of empennage-to-fuselage fairing; and, insofar as possible, inspect the interior of the stabilizer and fin for signs of corrosion and damaged structural members.

Inspect the empennage attachment points for signs of corrosion and damaged structural members. Inspect the empennage attachment points for security, cracks, and elongated bolt holes. Check the general condition and security of attachment of the empennage fairing.

Inspect for a minimum of ¼ inch clearance between the fixed and controllable surfaces of the empennage.

Col 35

FUEL TANKS

50-Hour Inspection

REMOVABLE FUEL TANKS.—Inspect fuel tanks for signs of leakage and proper anchorage of fuel lines leading from the compartments or tanks. With fuel tank covers removed, inspect fuel tank straps and pads for general condition and security of attachment.

WARNING

Excessive tightening of straps may damage tanks.

BUILT-IN FUEL COMPARTMENTS.—(AT-6 only.)—Check the fuel compartments for signs of leakage at points listed below:

Check gaskets at access doors, filler flanges, fuel gage tapping rings, compartment drain flanges, and sump castings.

Check fuselage attachment fittings, cable bracket attaching plate nuts, fuel line support tube backing plate, vent line fittings, drain line fittings, and sump fairing attaching brackets.

300-Hour Inspection

Remove circular clip and retainer from top of each corrosion-resistant cartridge drain plug at sump, Col 35 and refill with chemically pure potassium chromate crystals, No. 12 mesh size. The crystals shall be free of all powder and should not pass through the holes in the cartridge. Care should be exercised in handling plugs so as not to crack crystals.

At Engine Change

Drain fuel system and remove access covers at each wing compartment or tank.

Clean, inspect, and repair compartments or tanks, as specified in section IV, paragraph 9.

Clean and inspect sump strainers for general condition.

Inspect flapper valves for deterioration and improper functioning. Replace those found defective.

If fuel sumps are removed, use new gaskets when reinstalling.

Inspect compartment or tank vent lines for internal cleanliness, general condition and security of attachment, and cracks, particularly at bends. Check for signs of wear or chafing, proper protection against wear or chafing, and presence of clips and rubber grommets where required.

Col 36

TAIL WHEEL GEAR

25-Hour Inspection

Inspect the entire tail wheel assembly, including the shock strut, bearing post, trunnion support, extension fitting, points of attachment, fairing, etc., for general condition, damage, and security.

Check the action of the tail wheel swivel mechanism. Make certain that the tail wheel is capable of full swivel (360 degrees) from its engaged position, without restriction.

Check the tail wheel lock for proper operation.

Inspect the tail wheel cable rollers in the aft section of the fuselage for general condition and freedom of operation. If grooved excessively, replace them.

Lubricate the shock strut attachment to the fuselage and the tail wheel extension fitting with high-pressure grease at the Zerk fitting provided at each end of the strut.

Lubricate the tail wheel support attachment to the fuselage with high-pressure grease at the two Zerk fittings provided.

50-Hour Inspection

Inspect the tail wheel lock control cable, pulleys, and fair-leads for general condition of wear and security of attachment.

Check for weak or broken tail wheel lock springs.

Check for cracks and dents in the fairing and for condition of the access door and fairing fasteners.

Remove the fairing attached to the tail wheel

Col 36 housing by means of six screws and inspect the screws on the tail wheel knuckle assembly for tightness.

Lubricate the tail wheel gear in accordance with the lubrication diagram, figure 38, section III.

Col 37

MAIN LANDING GEAR

25-Hour Inspection

Make a thorough inspection of the strut assembly landing-gear shock cylinder at the upper end fitting for signs of cracks or flaws. If either exists, the strut assembly will be replaced.

NOTE

> If there is any doubt in distinguishing between a surface scratch and a possible crack, the strut will be removed and given a magnaflux inspection.

Inspect the oleo shock strut pivot pins, actuating arms, and lockpins, and the retracted position latch mechanisms for fractures, damage, security of attachment, bent rods, etc.

Check the landing-gear position indicator cables and warning horn switches for general condition and security of attachment, and proper adjustment.

Retract the landing gear and thoroughly clean the lockpin of all dirt and grease, especially the down-position lock fitting. This is extremely important, as dirt amounting to more than .005 inch obstruction on the inboard face of fitting may prevent the lockpin from locking behind the boss on the top of the shock strut. The down-position lock fitting should be lubricated with light oil only, as instructed in the 10-hour inspection. Adjust the down-position locking pin to 1 inch travel.

Lubricate the nine Zerk fittings on each landing-gear leg assembly and retracting cylinder linkage, and also the two Zerk fittings at each up-position latch assembly, with high-pressure grease. Do not put grease in the lubricator fitting located in the boss at the top of the shock strut, even though there is a fitting installed.

50-Hour Inspection

Jack up the airplane and operate the landing-gear retracting mechanism. Check the lockpins, latches, indicators, etc., for proper adjustment and operation. For instructions on the adjustment of lockpins, refer to section IV, para. 4. Check the tolerances between the lockpin and the strut locking boss; .007 inch maximum and .002 minimum, when the landing gear is in the locked position.

Also, check the tolerances between the outboard side of the boss and the lock fitting; .005 inch maximum and .003 inch minimum.

Thoroughly inspect the condition of all structural members, attachment fittings, retracting and

Col 37 lock mechanisms, flexible brake lines, etc., for damage, wear, fractures, security, fraying of the position indicator cables, etc.

Check the landing-gear warning switches for proper clearance between the toggle switch lever and the actuating disc with a feeler gage measuring .006 inch.

If necessary, lubricate the switch actuating rod, located within the landing-gear position indicator switch box, at the guide and lubricate the guide at its two bearings with graphite grease. Do not grease excessively. Exercise care to prevent the grease from contacting the switches.

Col 38

WHEELS AND BRAKES

25-Hour (Navy 30-Hour) Inspection

Inspect the landing-gear wheels for bent or distorted rims, and for security of the retaining nuts, bolts, and cotters.

Inspect the brake control cables, pulleys, and fairleads for damage, wear, and security of attachment.

Inspect the master brake cylinder vent line for cleanliness.

Inspect the brake shoes for proper clearance (.010 inch minimum). (For instructions on adjustment of brakes, refer to section IV, paragraph 4.)

Test the foot brakes and parking brake for proper operation, and insure that the brake shoes do not drag when the brake pedals are released. The foot pressure necessary to apply the brakes should be equal for each pedal and together brakes should hold the airplane at full throttle.

CAUTION

Brake pedals should be adjusted so as to allow an appreciable amount of travel before the brakes take hold. This is to prevent accidental application of the brakes by the pilot.

Inspect the brake cylinder and fittings of the hydraulic brake system for leaks and security of attachment.

Inspect the flexible and rigid lines of the brake system for chafing, leaks, and security of attachment.

Check fluid level in master brake cylinder. Refill, if necessary, with hydraulic fluid, Specification No. 3586. The filler plug for the master brake cylinder is located on the forward side of the fire wall.

Check the brake hydraulic system for signs of air in the fluid. This condition is indicated by a spongy feeling when the brakes are applied. Bleed the brake system to eliminate air. (For bleeding procedure, refer to section IV, paragraph 4.)

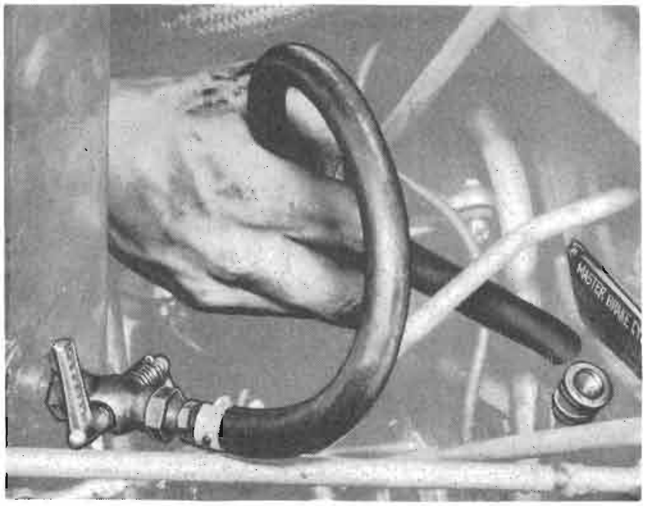


Figure 387 — Filling Master Brake Cylinder

Col 38

50-Hour (Navy 60-Hour) Inspection

TIRES.—Inspect the inner tubes and valves for general condition and damage. If there is evidence of damage or leaks, remove and inspect the landing-gear and tail wheel tires. Check the casings inside and out for cuts, breaks, ruptures, blisters, loose cords, wear, or any serious physical damage.

WHEELS.—Visually inspect the wheels for cracks. If a wheel is cracked or badly distorted, replace it, as it cannot be safely repaired.

Check the wheel rims for signs of cracks or damage. If a rim is corroded, it should be cleaned. The protective coat of paint should be renewed if worn through.

Check the wheels for excessive side play and shake in the bearings.

Remove the wheels and inspect for damaged bearings, races, axles, and other defects.

CAUTION

Do not apply brakes with wheels removed.

Examine the brake linings for wear and the drums for scoring; wipe all dirt, oil, and foreign particles from the brake shoes and mechanism; apply a few drops of medium lubricating oil to all parts of the brake linkage which rotate or slide. Wipe the brake free of all excess oil. Replace all defective parts.

Lubricate the main landing gear wheel bearings with grease, AAF Specification No. 3560.

Do not grease excessively, but carefully work grease into the rollers of the bearings. Do not

Col 38 permit the grease to come in contact with the brake lining. Make certain that the felt retaining washers are in good condition so that the grease will not work out from the hub into the brake drum.

BEARING ADJUSTMENT.—Install wheel and wheel bearing adjusting nut on axle. Be sure there is no drag. Then with the wheel spinning, tighten the adjusting nut slowly until a bearing drag on the spinning wheel is noticeable. Back off the nut to the next castellation, and lock in position with cotter pin. *Brake drag* should not be confused with *bearing tightness* while rotating the wheel during bearing adjustment. Check for side play. Bearings will not be adjusted too tightly, as cracked bearing cups may result.

100-Hour (Navy 120-Hour) Inspection

TAIL WHEEL BEARINGS. — The tail wheel bearings and tail wheel spindle bearings should be removed, cleaned, inspected, and lubricated with high melting point grease, AAF Specification No. 3560, after every 100 hours of operation. A suitable grease solvent should be used to remove the old grease from the bearings and parts. Inspect the bearings for damaged rollers, races, and other defects. Replace any defective parts and repack the bearings. Only the bearings and bearing cavities should be packed with lubricant. No lubricant should be applied in the center of the hub between the bearings or in the outer dust cap.

Col 39

HYDRAULIC SYSTEM

25-Hour Inspection

GENERAL.—Thoroughly inspect all units and lines of the hydraulic system for leaks at the joints, wear, damage, and security. Make certain the lines are not twisted or damaged at connections. Give the flexible line in the engine section particular attention.

NOTE

Excessive leakage of fluid from the operating cylinders will necessitate replacement of worn packing cups and rings. (For replacement procedure, see section IV, paragraph 12.)

WING FLAP MECHANISM.—Operate the wing flaps by using the hand hydraulic pump, and make sure that the flaps and position indicator function correctly.

CAUTION

Make certain that the landing gear control handle is left in the "DOWN" position when carrying out this operation.

LINES AND FITTINGS.—Check the attachment of the hydraulic lines to the fuselage and engine

Col 39 mount for security and wear, including grommets, neoprene or butadiene sheet, clips, hose, U-volts, washers, blocks, and sheet metal at the hydraulic line attachment fittings. Replace those found defective. If necessary lubricate the hydraulic pressure control lever at the Zerk fittings provided.

PRESSURE CONTROL VALVE.—With the engine pump operating, or by means of an auxiliary pump, engage the pressure control lever, and check the operation of the hydraulic pressure control valve. Check the time required for the lever to return to its disengaged position as indicated by the pressure dropping to zero. The time-lag should be about 2 minutes when the system is warm, but not hot. If the valve remains engaged for too long or too short a period, adjustment may be made in the front cockpit by means of a bolt at the base of the lever assembly which limits the levers' travel. Screwing in on the bolt shortens the travel; hence, the period of engagement. A lock nut is provided to secure the adjustment.

PRESSURE RELIEF VALVE.—With the engine running at 1200 rpm, check the proper operation of the hydraulic relief valve by engaging the pressure control lever and observing that the pressure gage reads approximately 1000 pounds per square inch, at which point the valve should operate to relieve excess pressure.

PRESSURE RELIEF VALVE ADJUSTMENT.—The pressure relief valve is incorporated in the general control unit under the left-side shelf. The relief valve adjusting screw is located on the rear end center of the control unit.

To adjust valve, back off on large hexagonal nut approximately 1-½ turns. Then with engine running at 1200 rpm, engage pressure control, and adjust threaded stem until pressure of 1000 pounds per square inch is indicated on pressure gage in cockpit. Adjust *in* to increase pressure, and *out* to decrease it. When proper pressure is obtained, hold stem from turning, tighten hexagonal nut, and safety with lock wire. See figure 219.

50-Hour Inspection

Clean Cuno hydraulic oil strainer as follows. Turn handle several times. Remove plug at bottom of strainer and drain out approximately ½ pint of oil. Replace plug and refill reservoir.

At the time of the first 50-hour inspection, the engine-driven oil pump should be removed, and the freedom of motion of the rotating parts should be tested by turning the drive coupling with the fingers. In the event that one pump has been replaced by another between 50-hour inspections, the latter pump should be given this test at the time of the 50-hour inspection falling nearest the time at which the pump has been in service 50

Col 39

hours. If excessive resistance to rotation of the moving parts of the engine-driven oil pump is found, the pump should be returned to the depot for overhaul.

100-Hour Inspection

See that all pipe connections to hydraulic pump are tight, and that all mounting nuts are drawn up tight and properly safetied.

Remove Cuno hydraulic oil strainer from airplane and disassemble sump from head and cartridge. Inspect as follows.

All cartridges should rotate through 360 degrees with maximum torque variation of 50 per cent. Hard spots or points of catching are cause for rejection.

All cleaner blades must be straight and flat. They should not show angular displacement in the plane of the discs in excess of 8 degrees from the mid-position when the cartridge is rotated. Bent or torn blades, unless such bending is limited to the extreme edge of the part of the blade most remote from the discs, is cause for rejection. In an emergency, a torn or badly bent blade may be carefully removed, making sure that all parts are recovered and that no other parts are damaged; the filter may be used until a replacement is available, provided no other cause for rejection exists.

All discs must be flat, evenly spaced, and free from burrs or nicks.

500-Hour Inspection

HYDRAULIC PRESSURE RELIEF VALVE.—Inspect for proper release pressure. If adjustment is necessary refer to instructions in section IV, paragraph 12.

At Engine Change

Remove the engine-driven hydraulic pump for overhaul at the time the engine is removed for overhaul. This is to apply even if the pump has been installed in place of a defective pump between engine overhauls.

25-Hours After Engine Change

HYDRAULIC PUMP.—At the time of first 25-hour inspection of engine, or after new pump installation, the pump will be removed and the freedom of motion of rotating parts tested by turning the drive coupling with the fingers. In the event that excessive resistance to rotation of the drive coupling is found, the pump will be returned to the depot for overhaul.

Check the intake pipe packing nuts for tightness. If evidence of leakage is found, tighten the nuts.

Col 40

FUSELAGE

50-Hour Inspection

Inspect the accessible parts of the exterior and interior fuselage for bent tubes and stringers in the fuselage frame, and for cracks in the tubing and rear fuselage section monocoque structure.

Check for loose members, bolts, rivets, and for proper attachment of inspection doors.

Note the condition of the metal covering and protective coatings, particularly when operating airplane near salt water.

Check the rubber strips at the cockpit enclosure, at the cowling forward of the windshield, and at the baggage compartment door for security of attachment, deterioration, watertightness, and wear.

Make certain the small drain holes at the bottom of the fuselage rear section bulkheads are open.

Lubricate the baggage compartment lock plungers and mechanism.

Col 43

AIRPLANE — GENERAL

25-Hour Inspection

HEATING AND VENTILATING SYSTEM.—Inspect entire heating and ventilating system for leaks and proper operation of control mechanism.

50-Hour Inspection

AIRCRAFT DATA CASE.—Check contents of aircraft data case against Technical Order No. 00-1 to determine whether latest issues of required Technical Orders are on hand. Check case for security of cover fastenings to avoid spilling of contents during maneuvers.

100-Hour Inspection

VACUUM PUMP.—Check for security of mounting. Examine relief valve screen. If dirty, remove the valve and loosen the screen assembly with a wrench. Clean the screen assembly in gasoline and replace.

Remove safety valve guide and wash it in a suitable cleaning fluid. If the valve disc is worn, dress it carefully with a flat oilstone. Test the spring tension by measuring the force required to compress it to 1-1/8 inches length. The force must be at least 3 to 7 pounds.

If the oil separator has a removable screen, the oil outlet fittings and screens will be removed and cleaned in a suitable cleaning fluid. If oil separator does not have a removable screen, it should be removed, thoroughly washed and cleaned with a volatile cleaning solvent, and then dried with compressed air.

If the pump is intended for internal venting, re-

Col 43 move the special hex-head vent plug marked "PRESS" located near the mounting flange, and clean the air passages in the plug.

At Engine Change

Replace engine-driven vacuum pump.

25-Hours After Engine Change

Check engine-driven vacuum pump for security of mounting. Examine relief valves screen; if dirty, remove the valve and loosen the screen assembly with a wrench. Clean in gasoline and replace.

Col 44

NAVIGATION INSTRUMENTS

50-Hour Inspection

GENERAL.—Inspect all instruments for chipped luminous marking, security of mounting, and tightness of connections (including electrical connections).

Check instrument boards for defective vibration absorbing units and support brackets. Check bonding of boards, lines, and instruments.

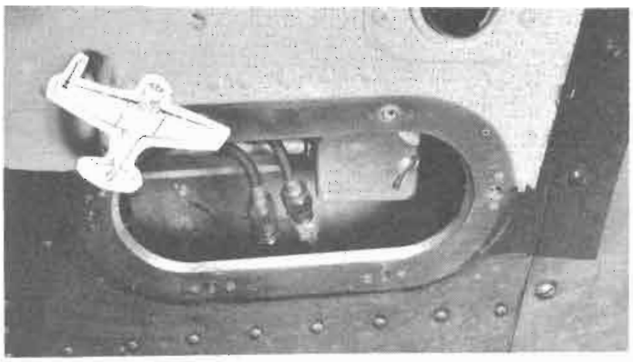


Figure 388 — Airspeed Lines Drain Sumps

Col 44 AIRSPEED LINES.—Inspect airspeed lines for security of mounting and tightness of connections. Drain airspeed lines. The access door to the drain sumps is located in the right outer wing panel at the bolting angle just forward of the front spar. Check airspeed head for security of mounting, and for general condition. Clean holes in airspeed head with soft copper wire. Check electrical heating element. The reading at the terminals of the airspeed tube should not be less than 10.5 volts (21 volts for airplanes with 24-volt source) with engine not running.

VACUUM PRESSURE LINES.—Check vacuum pressure and static lines for leaks, obstructions, and security of mounting.

FLIGHT INDICATOR.—Clean screens, if necessary.

Col 44

NOTE

The frequency of cleaning intake screens and air filters of flight indicators will depend upon service conditions; however, this maintenance should be accomplished every 500 hours or at depot inspection. To clean the intake screen at the rear of the case, remove the screen guard and lift out with a scriber. Clean with benzine, dry, and replace.

CAUTION

Be sure to replace all five screws. Failure to do so will cause air to leak into the instrument with a subsequent loss of vacuum.

TURN INDICATOR.—Clean screens, if necessary.

NOTE

The frequency of cleaning intake screens and air filters of turn indicators will depend upon service conditions; however, this maintenance should be accomplished approximately every 500 hours or at depot inspection of the airplane. When found necessary, as determined through experience at the various stations, this work will be accomplished at more frequent intervals. To clean the intake screen on the bottom of the case, lift out the snap ring and screen with a scriber. DO NOT REMOVE ANY SCREWS. Clean the screen with benzine, dry, and replace.

MAGNETIC COMPASS.—Note if compass is to be swung. Inspect instrument for security of mounting, leakage and discoloration of fluid, defective lighting, broken glass, unbalanced card, or any defect which might impair the visibility or render the compass inoperative.

ALTIMETER.—In addition to a general inspection of the altimeter installation, tubing, connections, and lighting system, a careful check of the zero setting adjustment should be made. This check shall not be made until at least 12 hours after the airplane has been flown. Check the altimeter for proper setting, as follows:

ALTIMETER ZERO SETTING ADJUSTMENT.—Take the portable altimeter to the control tower, and set pointers to read the surveyed elevation of the station altimeter above sea level. Vibrate the instrument before taking the reading. The pressure scale of the portable altimeter should read the existing "altimeter setting." If it does not, loosen the zero setting adjustment screw just to the left of the setting knob, and displace it to the left. Do not remove screw. Then, with the

Col 44

pointers still reading the elevation, pull out on the setting knob, and turn it until the pressure scale does read the existing altimeter setting. Check this carefully and vibrate the instrument. Then push the knob in, move the screw back to the right, and tighten it. The portable altimeter now reads correctly for the existing altimeter setting, and the scale correction is "zero" for this pressure.

Carry the portable altimeter to the altimeter in the airplane, being sure to leave the pressure scale set to the existing altimeter setting. Set the reference markers on the airplane altimeter to "zero," read the pointer indication, and determine the scale correction for this pressure altitude. Now vibrate and read the portable altimeter, and subtract the correction which has just been determined for the airplane's altimeter, from this reading. Next set the pointers of the airplane altimeter to read this value, tapping the instrument sufficiently to remove all friction. The pressure scale of the airplane's altimeter should read the existing altimeter setting as set on the pressure scale of the portable altimeter.

If, after this procedure, the airplane's altimeter does not indicate the existing altimeter setting, loosen the adjusting screw to the left of the knob (do not remove the screw), and displace it to the left. Then pull out on the knob and turn it until the pressure scale does read the existing altimeter setting, keeping the pointers on the corrected reading determined in the preceding paragraph. Tap the altimeter during this procedure to remove the friction. If the pointers read properly, and the pressure scale reads the existing altimeter setting, move the screw back to the right, and tighten. The airplane's altimeter is now set to the proper correction on its scale correction card, and all the other corrections appearing thereon should be applicable for other altitudes.

NOTE

Scale correction cards will not be prepared from data obtained during tests with open mercurial manometers, or so-called "master" altimeters. Correction cards will be prepared ONLY from data obtained during tests against standard mercurial barometers at army air forces depots, or during original acceptance tests.

BANK AND TURN INDICATOR.—Remove bank and turn indicator. Remove plug under the word "OIL" on the right side of the case. With a fine wire (.015 inch) to guide the oil, lubricate with eight drops of gyro instrument oil, Specification No. AN-O-4, if in temperature above freezing. If below freezing, use eight drops of a mixture of one-third compass liquid, Specification No. AN-VV-C-551 and two-thirds gyro instrument oil, Specification No. AN-O-4. Remove drain plug at bottom of instrument near front, and drain accumulation of oil and water.

Col 44

Check instrument suction connections. The air inlet system, which is located on the top of the instrument case at the rear, should be removed and cleaned. The drain plug, which is located on the top of the instrument case at the rear, should be removed and cleaned. The drain plug, which is located on the bottom of the instrument near the front, should be removed to allow collections of oil and water to drain out of the instrument.

Ground test the suction of the instrument under normal cruising rpm of the engine. To make this test, connect the type F-1 or F-2 suction gage to the pressure test connection on the instrument or on the bank and turn vacuum control valve. The suction should be between 1.80 and 2.05 inches Hg. The source of the suction may be the vacuum pump on the engine or portable test equipment.

100-Hour Inspection

AIRSPEED INDICATOR. — Check installation of airspeed indicator for loose glass, loose pointer, loose dial, and loose pitot and static connections. If check for leaks in airspeed tube installation discloses a leak in the airspeed indicator, test the instrument separately in accordance with the *leak test* described in the following paragraphs.

PITOT LINES LEAK TEST.—With the instruments connected to the pitot and static lines, put a rubber tubing over the pitot opening of the pitot-static tube, and close the drain holes. Apply sufficient pressure to give an indication of approximately 150 mph, and pinch off the tube. The indication of the airspeed indicator should hold steady. If the hand returns to zero, check each connection for leaks.

STATIC LINES LEAK TEST.—Check the static tube lines with the aid of a fixture similar to the one shown in figure 389. Attach the fixture over the static openings of the pitot-static tube as indicated. Press a piece of rubber tubing onto the fitting, and carefully apply sufficient suction to bring the indications of the instrument to full scale deflection. If the pointer returns to zero at a rate faster than 3 mph, the connections should be checked for leaks. If, after tightening all connections, the pointer continues to drop when suction is applied as previously described, the leak is probably around the cover glass of an instrument connected to the static line. Locate and remove the defective instrument.

COMPENSATING MAGNETIC COMPASS.

NOTE

In order to assure proper functioning of the airplane compasses, a check must be made to determine if high fields of mag-

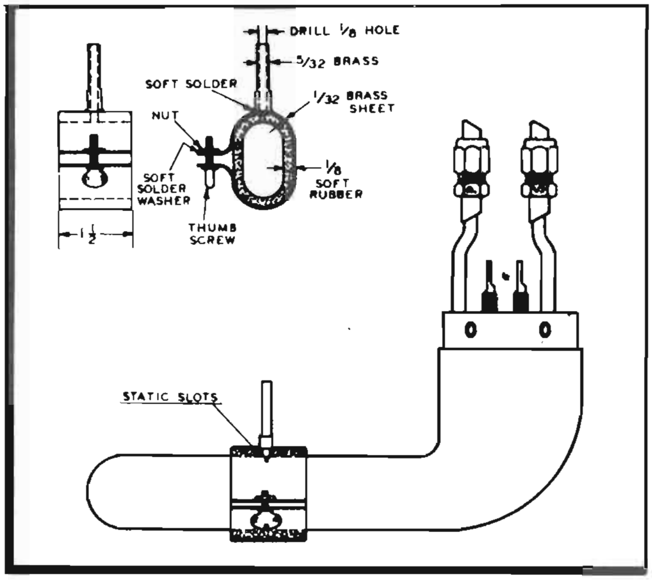


Figure 389 — Fixture Used in Testing Static Lines for Leaks

Col 44

netism exist, in the chrome-molybdenum steel fuselage tubing. (For instructions, refer to section IV, paragraph *10.)*

The compass must be compensated and swung by the coefficient method. The coefficient method of compensation and swinging permits the deviations to be analyzed and corrected in the proper manner. The five coefficients are designated *"A," "B," "C," "D,"* and *"E."* Normally, compass compensating personnel need be concerned with only the first three: *"A," "B,"* and *"C."*

In order to determine these coefficients and analyze the deviations, it is necessary to determine the actual deviations present when the aircraft is on certain headings. The headings are invariably Magnetic North, Magnetic Northeast, Magnetic East, Magnetic Southeast, Magnetic South, Magnetic Southwest, Magnetic West, and Magnetic Northwest.

The five coefficients are as follows:

Coefficient "A" is the algebraic sum of deviations on North, East, South, and West, divided by 4. That is,

$$\frac{\text{Dev. on N.} + \text{Dev. on E.} + \text{Dev. on S.} + \text{Dev. on W.}}{4}$$

Coefficient "B" is the deviation on East minus, algebraically, the deviation on West, divided by 2.

$$\frac{\text{Dev. on E.} - \text{Dev. on W.}}{2}$$

Coefficient "C" is the deviation on North minus algebraically, the deviation on South, divided by 2.

$$\frac{\text{Dev. on N.} - \text{Dev. on S.}}{2}$$

Col 44

Coefficient "D" is the deviation on Northeast minus the deviation on Southeast plus the deviation on Southwest minus the deviation on Northwest, the algebraic result being divided by 4.

$$\frac{\text{Dev. on NE} - \text{Dev. on SE} + \text{Dev. on SW} - \text{Dev. on NW}}{4}$$

Coefficient "E" is the deviation on North minus the deviation on East plus the deviation on South minus the deviation on West, the algebraic result being divided by 4.

$$\frac{\text{Dev. on N} - \text{Dev. on E} + \text{Dev. on S} - \text{Dev on W.}}{4}$$

NOTE

All additions and subtractions are algebraic.

$+(+) = +$, $+(-) = -$, $-(+) = -$, and $-(-) = +$

With the aircraft's head on Magnetic North, add *coefficient "C"* algebraically to the compass reading on that heading to determine what the instrument should indicate when compensated. Adjust the compass to indicate compensated value. With the aircraft's head on Magnetic East, add *coefficient "B"* algebraically to the compass reading to determine what the instrument should indicate when compensated. Make the compass indicate the compensated value. If the compensation of North is inadvertently altered when the aircraft's head is Magnetic East, the compensation of North must be redone. (Reset the N-S compensation for zero effect before starting again.)

With the aircraft on any heading, add *coefficient "A"* algebraically to the reading of the compass reading of that heading to determine what the instrument should read when compensated. Make the compass indicate the compensated value by rotating it bodily, clockwise if *coefficient "A"* is positive, or counterclockwise if *coefficient "A"* is negative. Secure the compass. When the pilot's compass is mounted on an instrument board, the correction for *coefficient "A"* is impractical and may be omitted.

Place the aircraft's head on the cardinal and quadrantal magnetic headings, and enter the magnetic headings and compass readings in their proper spaces on AAF Form No. 57 under "Residual Swing."

NOTE

Compensating of compass will be accomplished at the end of each 100 hours of flying time, at each change of engine or electrical equipment likely to affect compass—or at least once during each 3-month period.

Col 46

BATTERY

25-Hour Inspection

Check specific gravity of all cells. Replace battery in any specific gravity readings, corrected for temperature, are below 1.240 or above 1.310. Replace battery if a difference of 20 points or more is found between any cells.

Inspect battery leads for condition of insulation. Inspect and tighten terminals.

CAUTION

Always disconnect NEGATIVE or GROUND terminal FIRST when disconnecting battery terminals.

Remove corrosion by brushing with a stiff (but not wire) brush. Wash with a solution of ordinary sodium bicarbonate and water (1 pound per gallon) and rinse with water. Dry, and apply a thin coat of terminal grease or Vaseline to the metal terminals.

Col 46

If lead-plating is scraped from any parts, such as washers or wing nuts during cleaning, replace the damaged parts.

Keep vent caps in place during cleaning, and examine them after cleaning to make sure the gas-escape holes are clear.

Check mounting bolts for tightness; check vent and drain tubes for freedom from obstructions. This may be done by disconnecting the hose connections at the battery, inserting a small tube and blowing through the line.

CAUTION

Do not put mouth directly to the drain tube, as severe acid burns may result.

200-Hour Inspection

Remove battery from airplane for testing.

APPENDIX I

SPECIAL COLD WEATHER EQUIPMENT

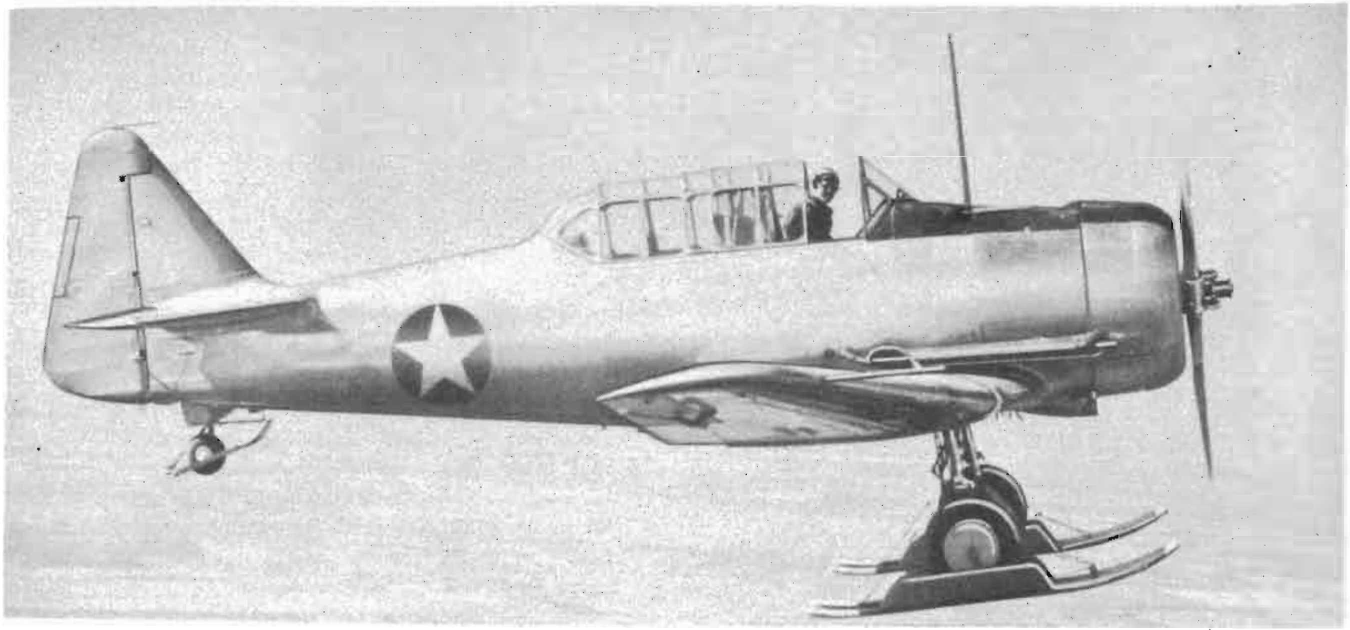
1. GENERAL.

The special cold weather equipment discussed in the following paragraphs was installed on a group of 14 airplanes which were intended for service under extreme winter conditions. This equipment consists principally of landing skis, a British-type cockpit heating system, and various units which insure the dependable operation of the power plant. On regular production airplanes, skis may be installed at the three landing points in such a manner that the conventional wheel gear may be used in option to the skis, depending on service requirements. Auxiliary spindles added to the three wheel axle shafts, with permanent mounting lugs on the fork castings, furnish attachment points for the ski installation. Landing and drag wires, rigged with elastic shock cord, permit a variable angle of attack of all three skis according to the position of the airplane at landing and take-off. The skis are of composite structure, the body being of laminated spruce plywood tipped with a heavy gage metal sheath. Openings through the skis proper allow sufficient protrusion of the wheel traction surfaces for hard surface landings. This ski installation eliminates the gear retraction feature of the airplane as it was not designed to permit inclusion of the ski equipment into the center section. Metal covers are installed over the wheel well openings to retain the smooth undersurface of the center section. The British-type cockpit heating system does not replace the standard hot and cold air ventilating system installed on all production airplanes. The two operate as separate units. Other special equipment includes manually controlled engine cowl nose shutters which help to maintain proper engine temperatures, and an engine cover used to facilitate warming of the engine prior to flight. The engine valve push rods are lagged to protect oil in the housings while an oil tank immersion heater has been installed to prevent congealing of the special type engine oil when the airplane is on the ground. A battery cart external plug, permitting the introduction of electrical power from an outside source, has been installed to supplement the function of the battery when the airplane is on the ground and the engine is to be started. Only two flight instruments, the oil pressure gage and the bank and turn indicator, demand special lubrication.

2. LANDING SKIS.

a. GENERAL.—*(See figure 390.)*—The main landing gear skis are retractable approximately 5 inches. This retraction is accomplished by the same operating lever which normally operates the landing gear. The landing gear is locked in the extended position with the skis installed, and any movement of the retracting lever operates the skis only. The skis are automatically locked in the down position hydraulically with the lever in the landing gear "DOWN" position, and are locked in the "UP" position with the lever in the landing gear "UP" position. Raising and lowering of the skis to permit use of either skis or wheels is accomplished hydraulically by diversion of the gear retraction system to the ski actuating system. Normal landing gear operation may be restored by reinstalling the vertical landing gear lock operating link, (located inside the forward end of the left side panel) and reinstalling the hydraulic lines to the landing gear actuating cylinder.

b. MAIN LANDING GEAR SKI INSTALLATION.—*(See figure 391.)*—The main landing gear skis are at-



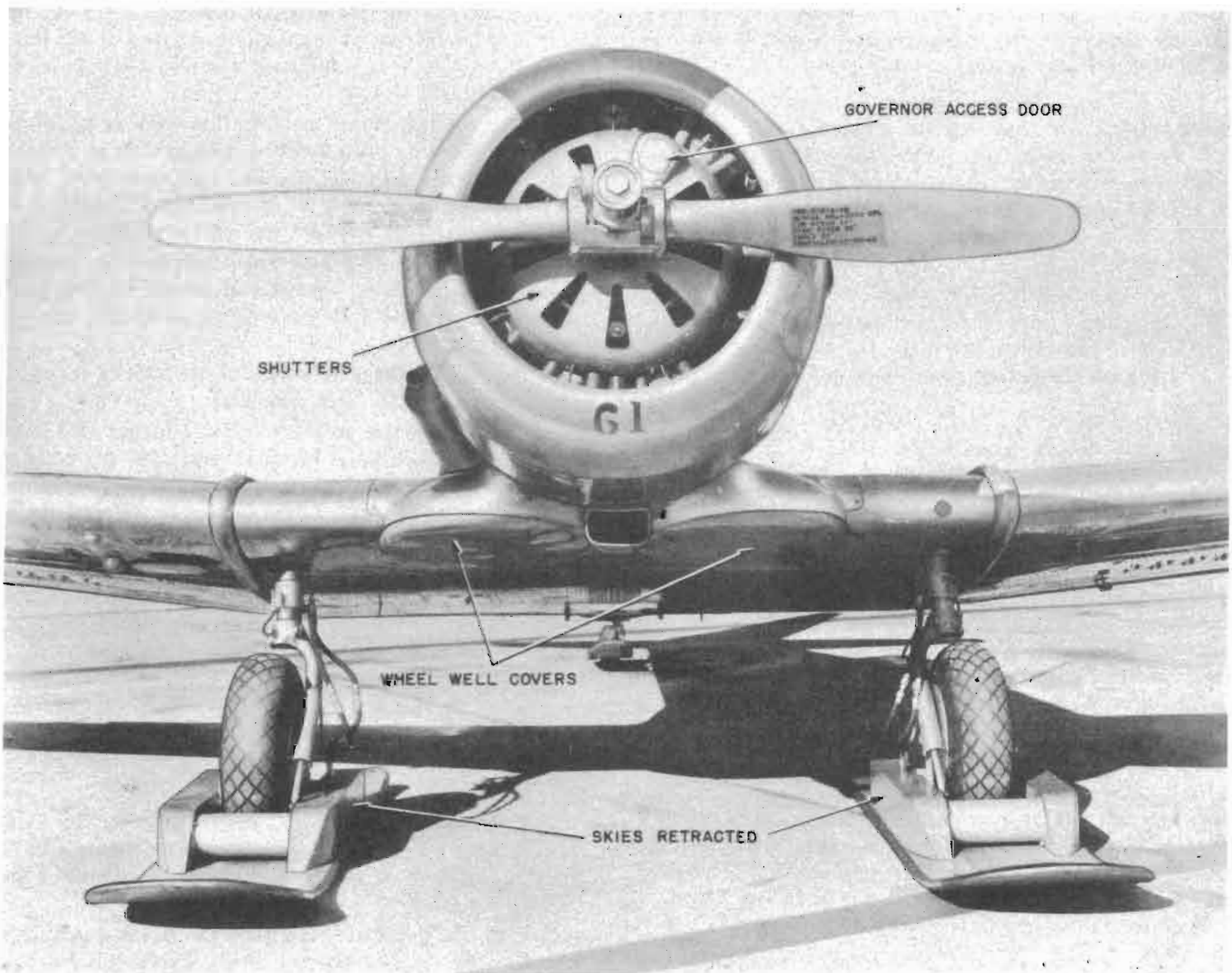


Figure 390 — Landing Skis

tached by means of pivot points at the outboard side of each wheel by clevis fittings on auxiliary spindles extending out of the wheel axle shafts and inboard of each wheel by the permanent clevis fittings at the base of the shock strut for casting. (See figures 392 and 393.) The following instructions, representing the procedure used by the airplane manufacturer in installing skis on AT-6C airplanes, are suggested to ground crew personnel:

(1) Ascertain that the airplane has been properly jacked at the jack points outboard of the wing center section. The tail should be weighted down.

(2) Place the landing-gear control handle in emergency lock-down position.

(3) Drain the hydraulic fluid at disconnect blocks forward of the fire wall.

(4) Disconnect the lines from each landing-gear operating strut (one aft port and one forward port on each cylinder).

(5) Remove the two lines to each cylinder thus disconnected, by disconnecting the opposite end of each at the unions at the wing bolting angle. Leave the operating cylinder in its extended position.

(6) Disconnect and remove the landing-gear down-lock control rod that extends from the bell crank on the operating linkage at the left front side of the wing center section front spar in the wheel bay. This will leave the spring-loaded lockpin in lock-down position of the main landing gear.

NOTE

All parts removed from the airplane that are not to be reinstalled may be stowed in the baggage compartment as loose equipment.

(7) Remove the main wheel dust covers and the main axle covers from outboard ends of each axle. (Hold these aside as they are to be reworked and reinstalled.)

(8) Remove the plugs from the ends of each axle shaft.

(9) Detach the main landing gear fairing connecting rods from the strut castings, and remove both fairings from their hinges at the castings at the inboard side of each wing bolting angle. Replace all attaching bolts, nuts, and washers removed from the fairing assemblies. DO NOT LEAVE UNNECESSARY RAW STOCK ON THE AIRPLANE.

(10) Remove the jack pads from the inboard side of each axle. (This operation may be accomplished at a later time when it is necessary to remove the knuckle bolts in order to remove the axle shafts.) The gear retraction system will now be ready for installation of the ski-retracting mechanism.

(11) Remove the landing-wheel assemblies from their axles as complete units, and clean all packing grease from the axles.

NOTE

The skis must be installed on the main landing-gear at attachment points outboard and inboard of each wheel. The outboard point of attachment is provided by the clevis fittings on the auxiliary spindles. The inboard point of attachment is provided by the permanent clevis fittings at the base of the shock strut fork castings. Before accomplishing this installation, it will be necessary to rework the main landing-gear forks. To do this continue the next instruction.

(12) Insert auxiliary spindles into the outboard ends of the wheel axle shafts, with the clevis fittings in direct alignment with the permanent clevis fittings at the bottom of the fork castings. The distance between the outboard clevis and the inboard clevis on each wheel should be approximately 11¾ inches, measured at the inside of each mean flange. The exact distance should be determined from the hinge fittings on each ski.

(13) Holding the auxiliary spindles in the desired position, locate centers for drilling the axle shafts from the pilot holes in the auxiliary spindles (two holes on each spindle).

(14) The auxiliary spindles are now ready to be removed, and the pilot holes opened to .156 inch diameter from each side. All drilling will have to be done in a drill press because of the heat-treat hardness of both the auxiliary spindles and the axle shafts.

(15) The landing gear axle shaft may be removed from the fork casting by removal of the knuckle bolts that also hold the jack pads in place on the inboard side of each axle.

(16) Drill the axle shafts at the center locations approximately .156 inch diameter.

(17) Insert the auxiliary spindle in the axle shaft with the .156 inch holes in alignment, open the holes to $^{19}/_{64}$ inch (.296), and then ream to .3125 minus .0010 plus .0005 with a fluted reamer in the drill press. Maintain alignment of clevises.

(18) Using the special $^{5}/_{16}$ x 1-$^{21}/_{32}$ pins furnished as installation equipment, secure the auxiliary spindles inside the axle shafts, and peen or punch-stake the ends of the pins to prevent their falling out.

CAUTION

Maintain a smooth radius of the axle shaft; do not hammer on it excessively, as this is the bearing surface of the landing wheels.

(19) Using the original cotter holes in the axles as pilots, drill holes through the center of each spindle so that the hub retaining nuts may be recottered on reassembly.

(20) Reinstall the wheels on the landing gear. For purposes of installation, the clevis fittings on extreme end of auxiliary spindles have to be removed and the wheels slipped over the spindles.

(21) Drill $1\frac{1}{2}$ inch diameter holes in the exact centers of the main wheel dust covers and the main axle covers and reinstall on outboard of each axle.

(22) Reinstall the clevis fittings on ends of auxiliary spindles.

(23) The skis may then be attached at the clevis fittings on either side of the wheels. The outboard clevis is fitted to a stationary bracket fitting on outboard side of each ski, and the inboard clevis is fitted to the linkage which accomplishes the ski raising operation. For attachment, use the AN10-15 bolts, which have been reworked from $1\frac{5}{8}$ inch long to $\frac{1}{4}$ inch, and AN320-10 castellated nuts; cotter. The following sequence of operations is recommended for proper rigging and adjustment of skis:

(24) Attach the base of the spring-loaded, cylinder-enclosed rigger to the single-flange mounting "E" at the front of each landing-gear fork casting. With the rigger pointed toward the front of the ski, attach the plunger arm to the flange mounting "F" outboard of the front transverse cylinder located between the inboard and outboard box housings. Adjust the rigger at a static 2 degree up angle from the airplane horizontal reference line. This 2 degree setting is in agreement with the 2 degree angle of incidence at the wing root.

(25) Anchor the turnbuckle ends of the two .156 x 39-inch flexible steel cable drag wires to the front inboard attachment lugs at the top of each fork casting "A" by means of two $2\frac{3}{4}$-inch connecting links. Use AN8-11 bolts, AC365-820 nuts, and AN960-816 washers at the mounting lugs and AN8 bolts, AC365-820 nuts and AN960-816 washers at the cable terminal. Extend drag wires to the lower attachment points of fittings "B" on the inboard top surface of each ski. Use AN8 bolts, AC365-820 nuts and AN960-816 washers. Cotter all bolts for security. By means of the turnbuckles adjust the cables to allow a 20-degree up movement and a 25-degree down movement of the ski tips. Measurements should be based on the airplane horizontal reference line and should be taken with a protractor.

(26) To install the two .156 x 23-inch flexible steel cable drag wires follow the same procedure as that of the landing wires. However, to install landing wire connecting links to the attachment lugs (located opposite the drag cable attachment lugs at the top of each fork casting) "C" the torque scissors-link retaining bolts have to be removed from each strut and AN8-11 bolts, AC365-820 nuts and AN960-816 washers substituted. Install the connecting links on the inboard of the fork casting with the hydraulic brake hose clamp reinstalled over the link, tighten and cotter. Extend cables to the flange mountings of the rear transverse cylinders located between the inboard and outboard box housings "D." Adjust the cables to allow a 25-degree "UP" travel and a 20-degree "DOWN" travel of each ski. Take measurements in the same manner as that of the preceding installation.

(27) Install the two .188 x 26-inch elastic shock cords along the drag wires by anchoring one terminal of each by AN115-32 shackles to fittings "D" on the rear surface of each ski. The opposite ends are attached and adjusted in the same manner as those of the front shock cords. The opposing tension should be balanced to maintain the 2 degree setting, as specified for purpose of flight. As the raising and lowering of the skis is accomplished by the actuating strut and lever linkage furnished with the skis, the hydraulic installation may be completed now that the operating linkage has been connected. A ratchet valve is connected to the ski actuating strut in a manner corresponding to the installation of the flap ratchet valve on the flap actuating strut. Connect the hydraulic hose and lines to the ski raising mechanism according to the original functions, that is, gear down, ski down; gear up, ski up. This will enable the cockpit control handle to operate the skis in the same position selections as it operates the retraction of the landing gear. As the skis are to be in "DOWN" position (piston retracted) for flight purposes the ratchet valve should be so connected as to allow the thermal relief valve to function on ski-down position of the operating cylinder (piston extended). For reference, check installation of the flap ratchet valve. Observe the procedure following for correct installation:

(28) Locate one triangular mounting flange inboard of each shock strut by removing the retaining bolts of the upper scissors torque link at the flange on the base of the shock strut cylinder. The center line of the two holes will be parallel to the airplane.

(29) Locate one oblong mounting flange inboard of each shock strut on the flange at the rear of the shock strut fork opposite the attachment point of the rigger strut. The center line of the two holes will be perpendicular to the airplane.

(30) Extend two "S" shaped lines from the disconnected gear retraction system at the two unions at each wing bolting angle to unions mounted in the flange on the scissors arm retaining bolt of each landing gear strut.

(31) Extend two AC39G1030-6-18 rubber hoses from the line unions on each strut to unions mounted in the flange on the rear of the shock strut fork opposite the attachment point of the rigger strut.

(32) Extend two AC39G1030-6-18 rubber hoses from the two previously mentioned hose unions of each strut to the top ports of the ratchet valve.

(33) Inspect for proper routing of the lines and inspect all connections on B-nuts and unions.

(34) Fill hydraulic reservoir and operate hydraulic system to check for proper selection of ski raising mechanism from the control handle in front cockpit.

c. TAIL LANDING GEAR SKI INSTALLATION. —*(See figures 391 and 394.)*—The tail wheel landing ski is attached by means of an auxiliary spindle extending out both ends of the tail wheel axle shaft into mating fittings on the skis. The wheel in this installation is in a stationary exposed position through the ski and cannot be retracted above the ski landing surface. Rework and installation are accomplished together as the installation progresses. Proceed as follows:

(1) Remove the tail wheel post at the knuckle joint bearing in the support housing.

(2) Remove tail wheel dust cover, and drill a $1\frac{1}{16}$-inch diameter hole in the exact center to allow for extension of the auxiliary spindle.

(3) Remove the tail wheel hub cap and the plug from the opposite end of the axle shaft at the elbow, and stow both parts in the baggage compartment.

(4) Remove the tail wheel from its axle for ease in handling during the rework of the fork casting.

(5) Insert the adapter bushings as furnished with the ski kit into each end of the axle shaft.

(6) Locate the attachment point of the rigging support by measuring 1 inch down from the underside of the flange at the base of the knuckle trunnion shaft along the outboard side of the radius formed by the leg of the fork casting, and center punch for a lead hole.

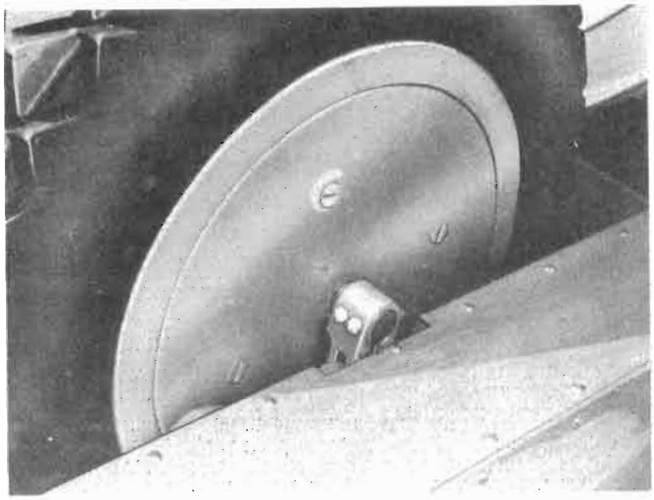


Figure 392 — Ski Attachment Outboard of Wheel

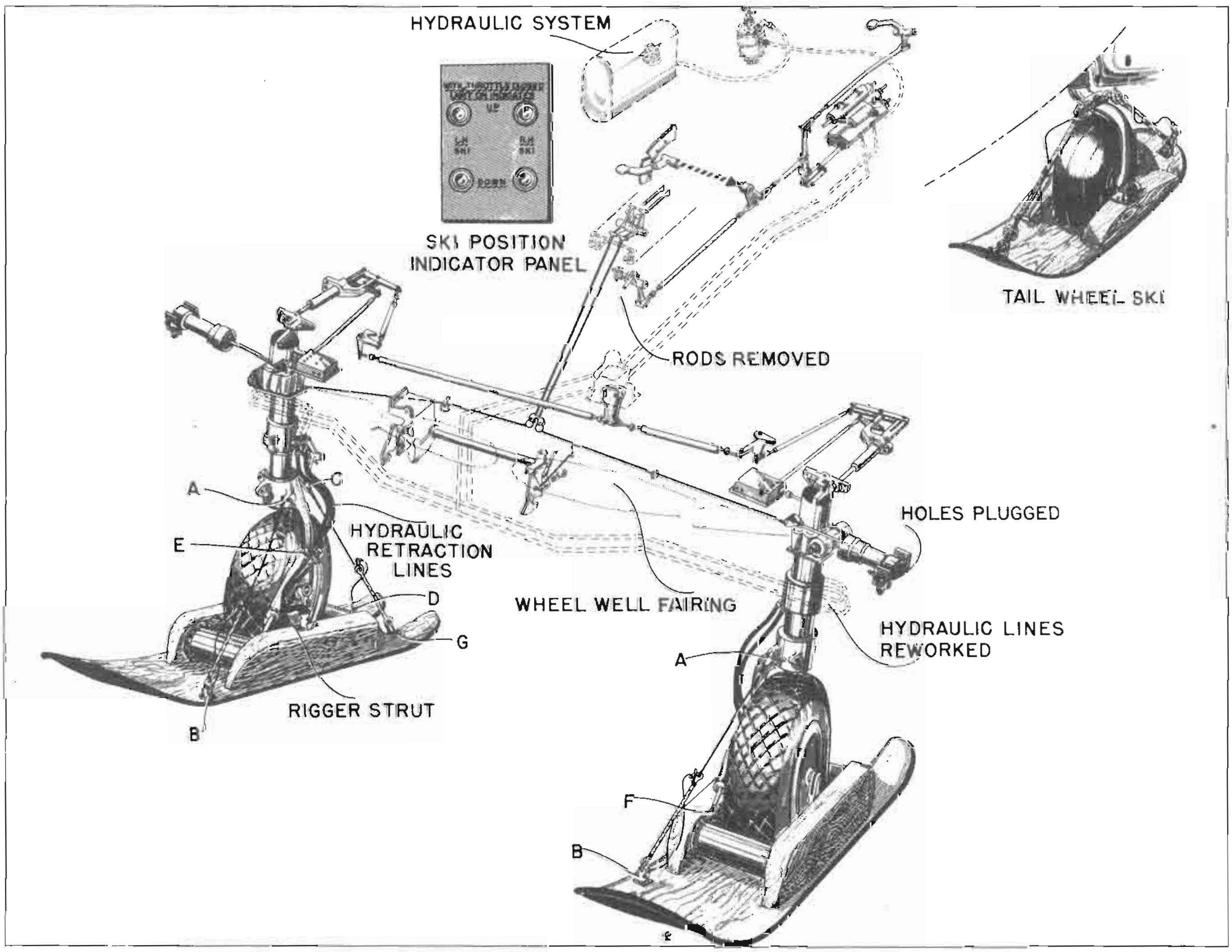


Figure 391 — Landing Gear Ski Installation Diagram

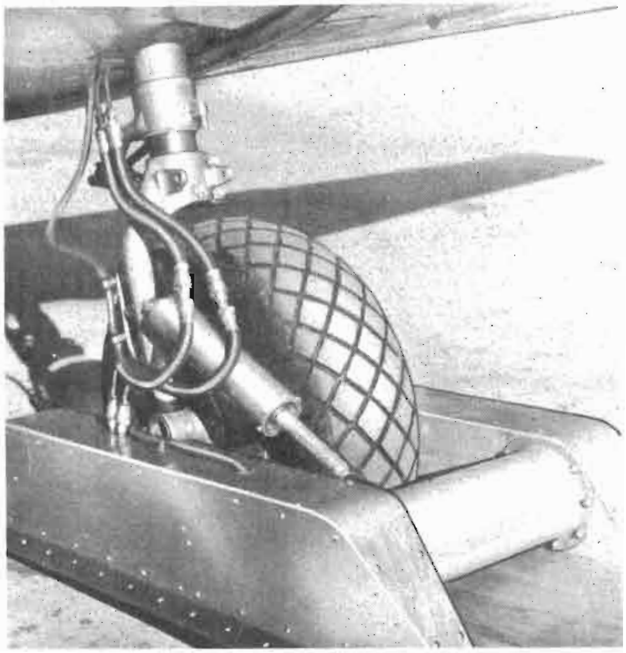


Figure 393 — Ski Attachment Inboard of Wheel

Drill a No. 19 hole at a 90-degree angle of the topside contour of the casting surface upon which the location of this hole was determined. Enlarge the pilot hole with a 1/4-inch (.250) drill. Spot face the inside contour 9/16-inch diameter to provide seat for a washer (.010 minimum corner radius on cutter). Now attach the 3 1/4 x 7/8-inch arm at the top surface of the radius formed by the fork casting by inserting one AN4-16 bolt through the casting, use one AN960-416 washer and one AC365-428 nut.

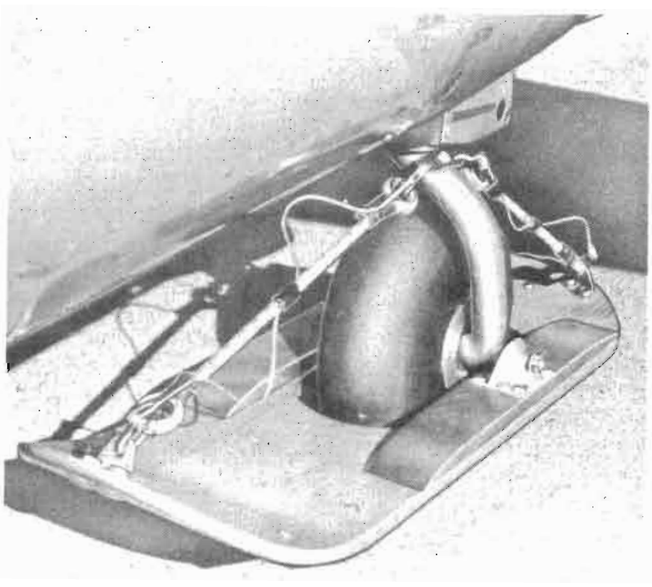


Figure 394 — Tail Wheel Ski

(7) Replace the tail wheel on its axle, and secure installation with the two 1 1/4-inch special locknuts furnished as part of the ski installation equipment. Jam lock nuts against each other, do not tighten bearing excessively. The lock nuts are substituted for the original castellated nut and cotter, as there is no way of cottering after the auxiliary spindle is inserted through the axle shaft.

(8) Line-ream the adapter bushings to .4375 minus .0005, plus .0010. Insert the 10-11/16 inch spindle through the adapters to check alignment. The spindle should be able to slip freely through the bushings and yet permit no play or misalignment.

(9) Line-ream the matching bushings on the ski attachment fittings to the same tolerance as that of the adapter bushings. Check alignment of ski brackets to the tail gear axle shaft so as to determine the amount of shimming that may be necessary in order to obtain perfect alignment. The ski should be able to rotate freely on the auxiliary spindle. Several trial fits may be necessary before ski is ready for final installation.

(10) After the desired fit is obtained, insert the spindle through the right ski bracket into the axle shaft at the elbow end of the tail gear axle shaft, and place one AN960-716 washer over the spindle where it extends through the extreme end of the axle shaft (this washer acts as a spacer for the tail wheel dust cover).

(11) Replace the dust cover and push spindle on through the left bracket; secure with one AN960-716 washer, one AN320-7 sheer nut, and one AN380-2-3 cotter at each end of the spindle. Run nuts on each edge, keeping equal edge distances. Use as many washers as necessary to obtain proper cotter location.

(12) Add attaching rings to both ends of the arm located on the tail post and to the fittings on the top surface of each end of the ski. The eyelet lugs of the upper rings should be pointed toward the same side as that to which the arm is attached on the knuckle post. The eyelet lugs of the lower rings should be pointed upward. This arrangement will prevent cables from fouling at the attachment points.

(13) Extend the .125 x 18-1/2 inch flexible steel cable from the upper eyelet to the lower front eyelet. Extend the .125 x 14-inch flexible steel cable from the upper rear eyelet to the lower rear eyelet.

(14) Extend the .50 x 16-inch elastic shock cord to correspond with the front cable, and the .50 x 17-inch elastic shock cord to correspond with the rear cable. Anchor the shock cord ends to the attaching rings. The cable lengths are such that after all rigging is completed, the ski should be at a static position parallel to the ground static line. The cables allow a 22-degree "UP" travel and a 23-degree "DOWN" travel of the ski tip. As these cables are not adjustable by means of a turnbuckle, different settings may be obtained by loosening the arm above the tail wheel at the knuckle fork and resetting the angle of attachment.

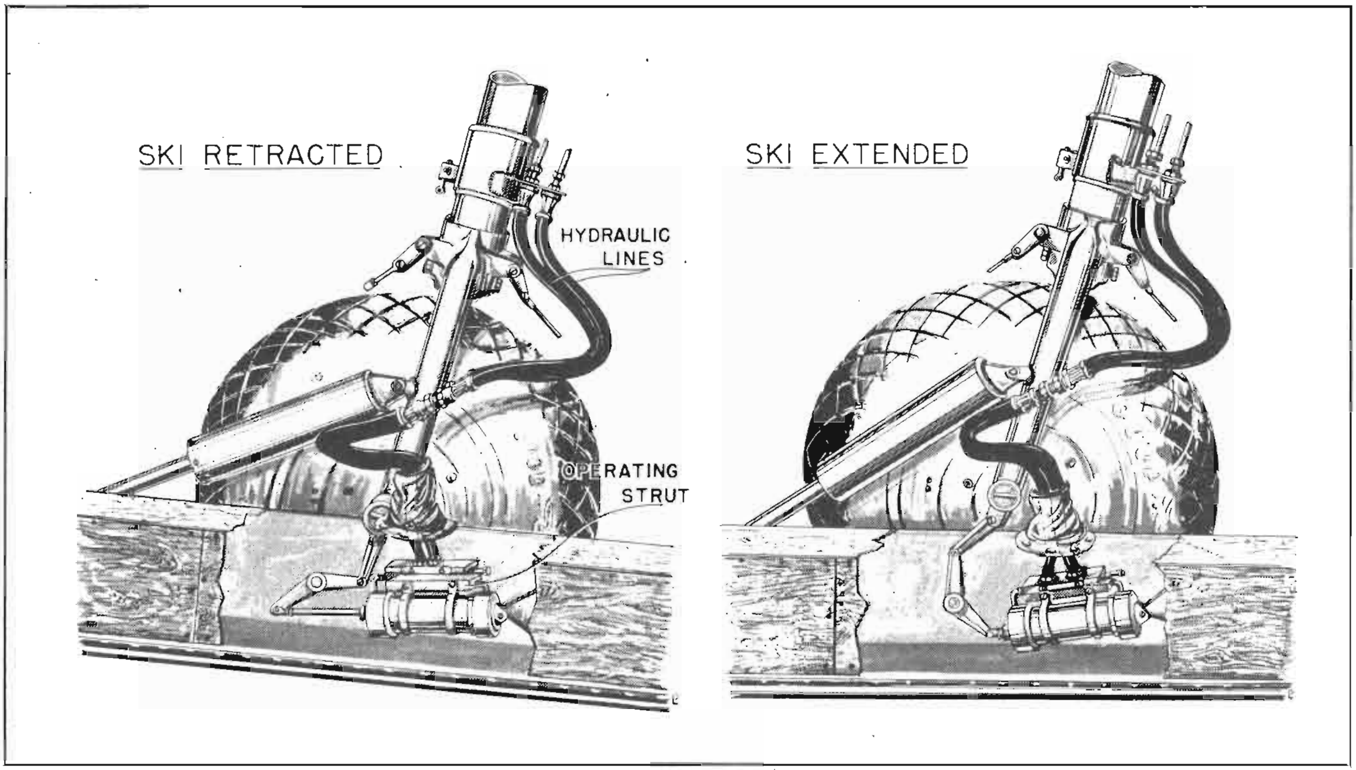


Figure 395 — Landing Gear Ski Position Diagram

Figure 396 — Landing Gear Ski Position Indicator Lights

(15) When the correct setting has been obtained, each cable is to be lagged with friction tape at two points to each corresponding shock cord. The points for lagging can best be determined by marking off each cable and shock cord into equal thirds (two points on each cable). Tape the cables to the shock cord in agreement with the position into which it would fall whenever the cables are in tension. This will prevent fouling of the cables whenever tension is released at landing and take-off.

(16) Lubricate the auxiliary spindle lightly with a graphite grease.

(17) Tail wheel landing gears equipped with a single piece of aluminum fairing, enclosing the attaching point of the tail gear shock strut at the rear of the tail wheel knuckle housing, shall need such fairings enlarged at the original cut-out on the underside for rotation of the rigging attachment arm. Enlarge the cut-out to the extreme edge of the bottom surface. This will be within 1/8-inch of the radius formed at the sidewall and cut back to an overall measure of 3-1/4 inches from the front of the boot. Maintain a radius of 1 1/4 inches at the two corners of the cut-out. Fit boot back into place on the knuckle housing, and rotate wheel 360 degrees to check clearance of the arm. If clearance is insufficient, a larger cut-out is permissible up to 1/2 inch. Crimp a 3/4 inch edge distance at the rear of the cut-out into the boot (the crimp should graduate to 1/4 inch in depth at inside edge of cut-out). This should allow no interference of rotation of the rigging attachment arm.

d. SKI POSITION INDICATOR SYSTEM.—*(See figure 395.)*—This airplane is equipped with an electrical ski position indicator system. The mechanical position indicator used on the gear retraction system is rendered inoperative with skis installed, as is the landing gear warning horn. The contact switch on the throttle control, which formerly operated the landing gear warning horn, is now an integral unit in the operation of the ski position indicator lights. With the throttle closed to the normal landing position, the indicator lights located on the auxiliary panel on the right side of the front cockpit indicate the position of each ski. (See figure 396.) Indication is made on both the fully extended and fully retracted position. Like the landing-gear warning device, the indicator lights operate only on a dual contact to complete the operating circuit. This warning system provides visual indications only. To install the ski position indicator system, observe the following instructions:

(1) Enclose all electrical wiring in waterproof sheathing.

(2) Establish wiring connections to terminals in relay junction box.

(3) Route through grommets in covers of inboard ski fairings. Leave the covers loose, as they are not to be secured until all connections are completed and checked.

(4) Extend wiring along top inboard edge of fairing covers and attach at one place with rubber protected clamp.

(5) Route wiring up hydraulic brake line until a convenient junction with ski hydraulic hoses may be made. Attach at two points to brake line with rubber protected clamps.

(6) Follow wiring along the ski hydraulic hoses into landing-gear wheel well. Attach at one place to hydraulic line just above hose unions.

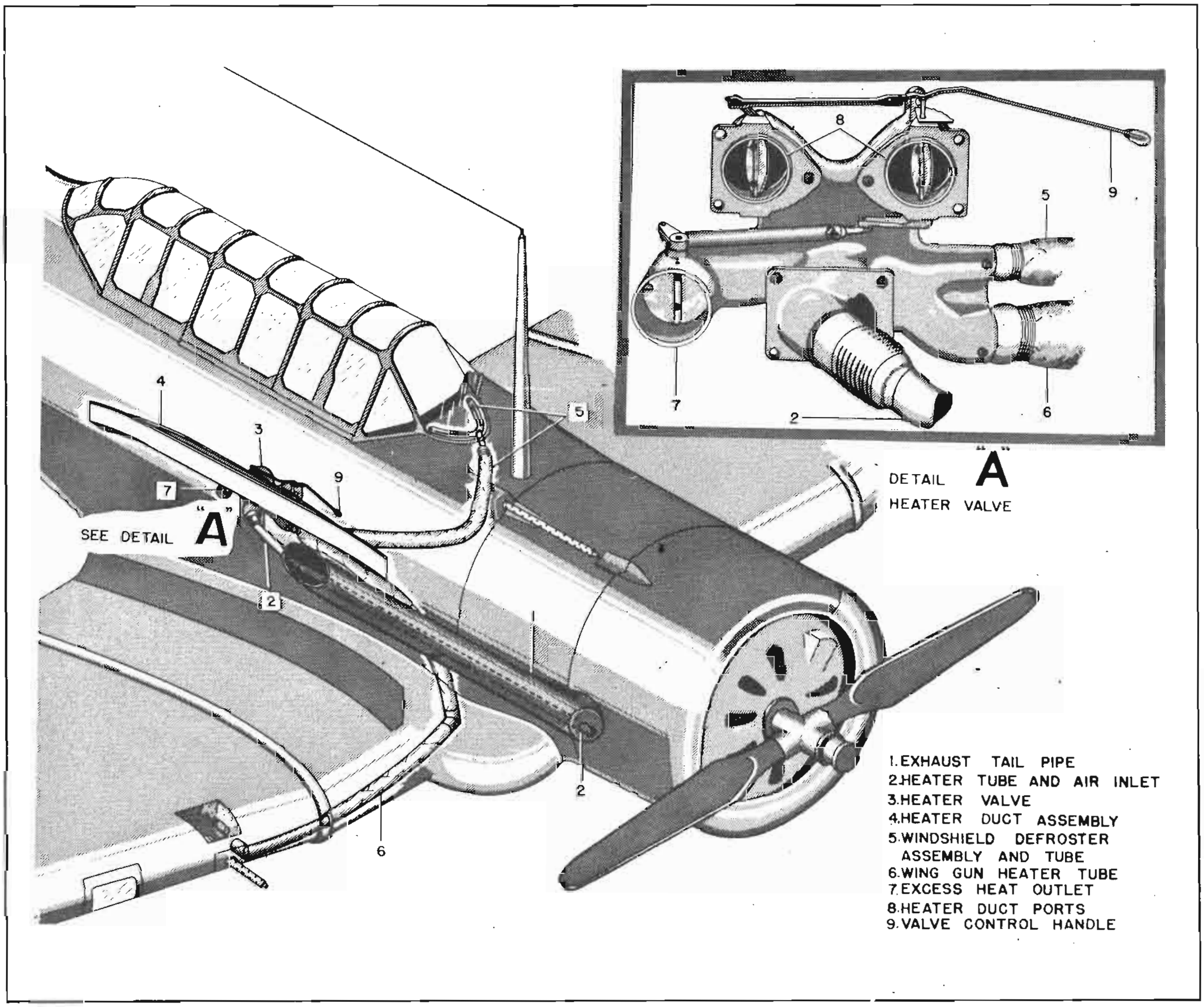


Figure 397 — Heating System Diagram

(7) Replace the inboard covers over the ski fairings.

(8) Place the canvas boot down over the hydraulic hose cut-outs in the fairing covers, and secure in place with the ring collar.

(9) Install the fairings over the center section landing-gear well.

3. HEATING SYSTEM.

a. GENERAL.—*(See figure 397.)*—On airplanes provided with special winterization equipment, the installation of a British-type cockpit heating system not only sends air to both cockpits, but also defrosts the windshield and conducts heat to the wing gun bay to prevent congealing of oil on machine gun parts.

b. COCKPIT HEATING.—Heated air is conducted to the front cockpit by means of a heater tube located within and running the full length of an elongated exhaust tail-pipe, which extends from behind the right side of the engine cowling to a point just outside the front cockpit. (See figure 398.) Both the heater tube and the exhaust tail-pipe are made of corrosion-resistant steel tubing. The former receives its air from an opening at the front of the exhaust pipe outside the engine cowling. Exhaust gases in the surrounding tail-pipe warm the air inside the heater tube, the aft end of which protrudes from the inboard wall of the exhaust pipe near the exhaust outlet. After leaving the exhaust pipe, the heater tube passes through the fuselage side panel to connect with a heater valve assembly located on the right side panel in the front cockpit below the

Figure 398 — Heater Tube and Exhaust Tail-pipe

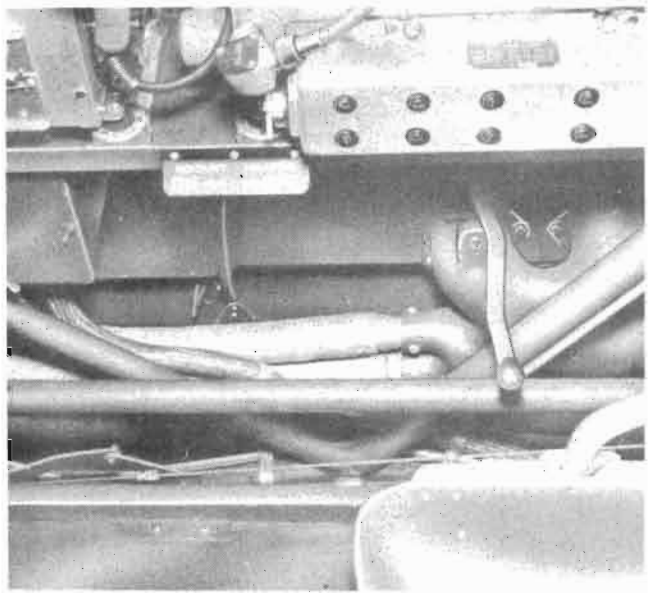


Figure 399 — Heater Valve

radio shelf. (See figure 399.) A small access door is provided in the right side panel of all production airplanes to accommodate the entrance of the heater tube when this type heating system is to be installed. Air entering the heater valve is admitted by the manually operated valve control handle into two 24ST Alclad ducts. One duct supplies heat to the front cockpit and the other does the same for the rear cockpit. The heat outlet for each duct curves inboard. The outboard side of each duct is insulated with asbestos millboard.

c. WINDSHIELD DEFROSTING. — *(See figure 397.)*—The windshield may be defrosted by means of a flexible aluminum-alloy tube which extends from the heater valve at the right side of the front cockpit to a semicircular nozzle at the base of the windshield. The tube is insulated with skyfelt and sends heat to the windshield by manual operation of the heater valve control handle.

d. WING GUN HEATING.—*(See figure 397.)*—Heated air is supplied to the wing machine gun by a flexible aluminum-alloy tube which extends from the heater valve in the front cockpit to the center section and from there to the gun's position in the right outer panel. The tube is insulated with skyfelt and terminates at its connection with a heater duct in the gun bay. Manual operation of the heater valve control handle sends heat through the tube.

4. POWER PLANT.

a. ENGINE COWL NOSE SHUTTERS.—*(See figures 390, 398 and 399.)*—Part of the special winterization equipment acting to maintain proper engine temperatures are full closing engine cowl nose shutters so installed as to be manually operated by a flexible push-pull Arens control. The control knob is located in the front cockpit below the instrument panel to the right of the gun sight. (See figure 396.) When the knob is pulled, the shutters open; when it is pushed, the shutters close. Creeping of the control, which would change the position of the shutters, is prevented by a friction lock. The button release for this lock is installed on the control knob and must be pushed in when the control is operated to position the shutters. The nose shutter assembly consists essentially of two cowlings, of which one fits inside the other with a clearance of 1/8 inch between them. The outside cowling is secured by studs on the engine nose-section around the propeller shaft. The inside cowling, its edges beaded at both its outer and inner circumferences, turns on rollers which are mounted on an angle assembly attached to the outside cowling. The rollers are located toward the outer edge of the outside cowling and contact the same edge of the inside cowling. The inner edge of the latter cowling turns on and is supported by bearing blocks attached to the outside cowling. Both cowlings contain the same number of equally-spaced shutter openings. When the openings in both cowlings are in direct alignment, the shutter assembly is in the fully open position. The shutter assembly is fully closed when the inside cowling is rotated to the extent that its openings are completely out of alignment with those of the outside cowling. The Arens control, by which the pilot regulates the shutters, is attached to a bracket assembly on the inside cowling.

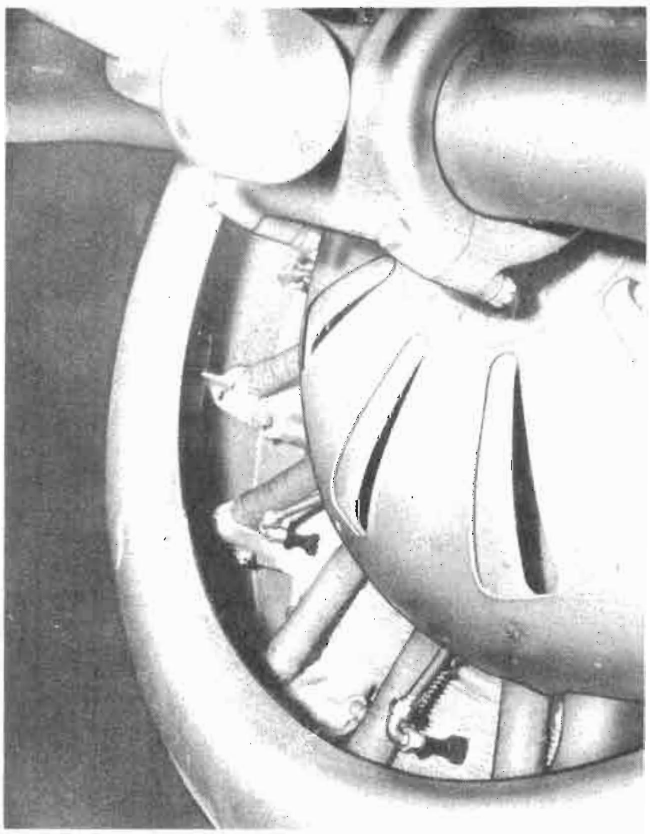


Figure 400 — Engine Cowl Nose Shutters and Engine Push Rod Lagging

b. ENGINE VALVE PUSH ROD LAGGING.—*(See figure 400.)*—The engine push rod housing of airplanes equipped with special winterization facilities are lagged with woven asbestos tape and winterproofed with clear varnish. The ends of the lagging are secured with wire. Protection afforded by the lagging prevents the congealing of oil in the housings and the malfunction of push rods.

c. ENGINE COVER.—*(See figure 401.)*—To facilitate the warming of the engine under conditions of extreme cold, specially winterized airplanes have been equipped with an engine cover which encloses the propeller hub and extends aft to the fire wall to include the rear accessory section. The cover is made of waterproof fabric and is provided with a sleeve which accommodates a 4¼-inch heater tube for use in heating the front engine section. A heater tube may be inserted through a hinged access door located inside the right wheel well opening to warm the rear engine accessory section. Another access door in the right wheel well cover must first be removed to accomplish this operation.

d. OIL TANK IMMERSION HEATER.—*(See figure 402.)*—For cold weather operation of the airplane an immersion oil heater is installed in the oil tank. The purpose of this heater is to prevent the congealing of oil in the tank when the airplane is not in use, but is held in alert against any anticipated or emergency starting of the engine. The heater is provided with an external electrical plug, which may be reached by opening the access door marked for this purpose and located at the left side engine accessory cowl panel. Any available electrical power of a utility nature may be used. If the heater is to be used, it is put into operation as soon as possible after stopping the engine, and is left in operation until the engine is started again.

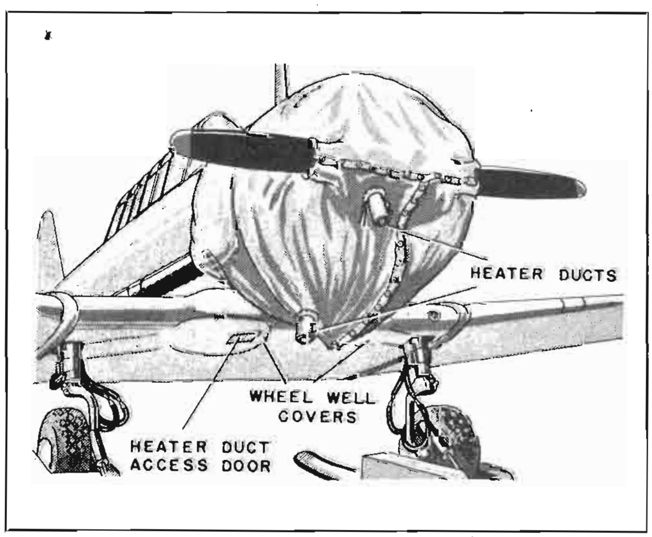


Figure 401 — Engine Cover

e. WINTER GRADE ENGINE OIL.—In specially winterized airplanes regular engine oil has been replaced with oil per Specification No. AN-VV-O-446A, grade 1100A.

f. BATTERY CART EXTERNAL PLUG.—To spare the battery of the airplane when starting the engine in cold weather, an external power receptacle is installed in the left side of the engine compartment. The receptacle may be reached by opening the door located on the left side of the engine accessory panel. The battery disconnect switch located on the front cockpit switch box must be on before the receptacle can be used.

5. LUBRICATION OF INSTRUMENTS.

a. GENERAL.—Only the two flight instruments listed below require special lubrication when operating under winter conditions. The following discussion is intended for the cold weather lubrication of these instruments alone. Any further information concerning the lubrication of flight instruments may be found in the applicable technical order.

b. LIGHT OIL IN PRESSURE GAGE LINE.—During cold weather operation of the airplane (temperatures below 0°C (32°F)), congealing of engine oil in the oil pressure gage line may cause the gage to be sluggish when the engine is started. To alleviate this condition hydraulic fluid, petroleum base, Specification No. AN-VV-O-366A, has been placed in the oil pressure gage line. Normally the fluid mixes with the engine oil very slowly, and 60 to 90 days may elapse before the gage again begins to operate sluggishly. When sluggishness is noted upon starting a cold engine, the gage line should be filled as before.

c. BANK AND TURN INDICATOR.—For operating conditions in which atmospheric temperatures are below freezing (0°C) (+32°F), add 8 drops of a mixture of one-third aircraft compass liquid, Specification No. AN-VV-C-551, and two-thirds gyro instrument oil, Specification No. 3563. Care should be exercised that all of the oil is inserted in the rotor pivot. A fine wire, approximately .015-inch in diameter, or an eyedropper, should be used to guide the oil into the hole in the pivot. Any excess of spilled oil may be a source of unsatisfactory operation. This lubrication should be performed at the 100-hour inspection AFTER the bank and turn indicator has been removed from the airplane.

6. STANDARD EQUIPMENT.

a. GENERAL.—The following items, which are already installed on production airplanes and which contribute to the efficiency of the airplane in cold weather operation, are adequately discussed in their respective sections:

Oil radiator shutters	Fuel tank drain
Oil dilution system	Carburetor air mixture thermometers
Carburetor heat	Oil tank sump drain

Non-channeling grease, capable of withstanding the rigors of cold weather, is used throughout the control system of the airplane.

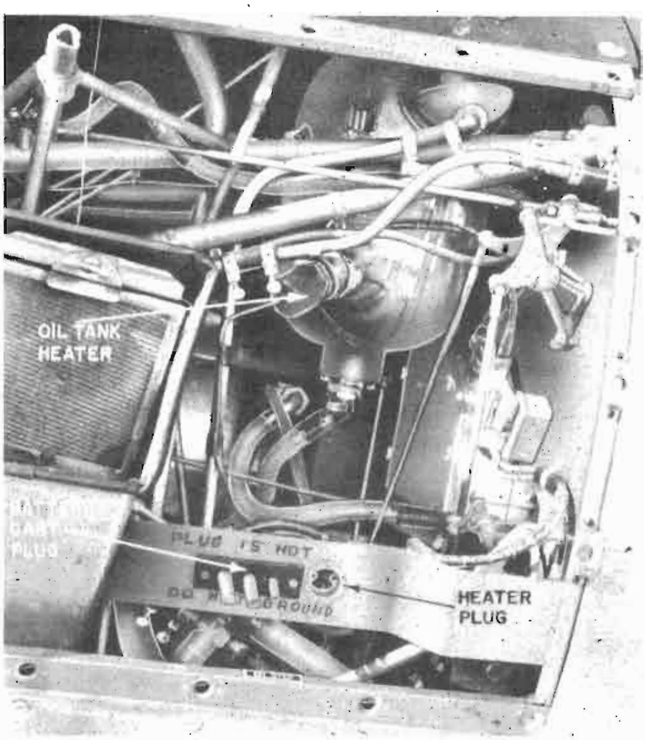


Figure 402 — Tank Immersion Heater and Battery External Plug