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PILOT'S FLIGHT OPERATING INSTRUCTIONS

ARMY MODEL P-61A AIRPLANE

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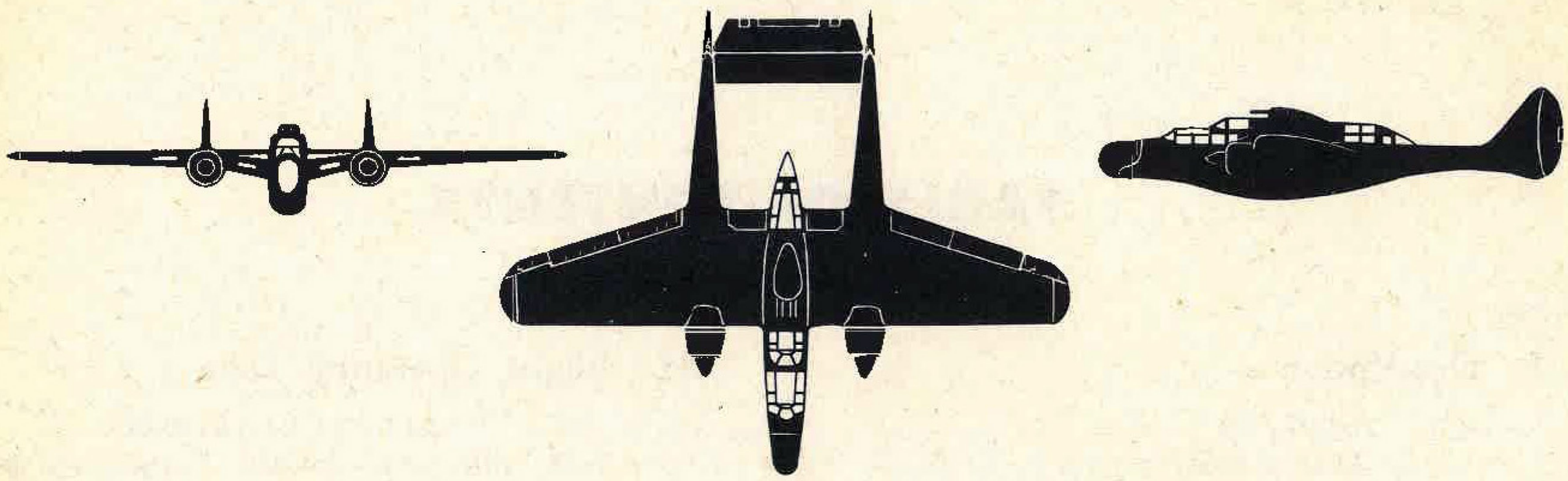


Figure 1 –Three-quarter Rear View of P-61A

1. AIRPLANE.

a. **GENERAL.**—The P-61A night interceptor pursuit, manufactured by Northrop Aircraft, Inc., is an all-metal, twin-engine, three-place midwing monoplane with two tail booms, fully retractable tricycle landing gear and heavy armament. The three-man crew—a pilot, gunner and radio operator-gunner—is fully enclosed in a crew nacelle located between the two engine nacelles. The airplane is designed for operation at night or during periods of poor visibility. Overall dimensions are:

Span	66 feet,
Length	48 feet, 11 inches
Height	14 feet, 8 inches

b. **WING GROUP.**—The wing is a stressed skin, two-spar cantilever structure composed of two inner panels, two outer panels and two tip panels bolted together by internal fittings accessible through removable doors. The two spars continue through the crew nacelle.

c. **TAIL GROUP.**—The tail group consists of two fins and two rudders, connected by a stabilizer and an elevator. The entire tail group is supported by two monocoque tail booms attached to the engine nacelles.

d. **CREW NACELLE.**—General arrangement of the crew nacelle is illustrated in Fig. 6.

(1) **ACCESS.**—The pilot and gunner enter their compartments by a ladder through the front entrance door located within the nose wheel well. To close the front entrance door first press the button plate which folds the ladder, then pull up the front entrance door and turn the locking handle. The radio operator enters his compartment through the rear entrance door beneath the aft end of the crew nacelle. This is lowered by pressing the large button just forward of the tail cone. When the rear entrance ladder is pulled up and the door closed, it locks automatically.

e. **LANDING GEAR GROUP.**

(1) **MAIN GEAR.**—The main gear consists of two wheel and brake assemblies and two shock strut assemblies which retract aft and up into the engine nacelles. In the retracted position hydraulically operated doors cover the wheel wells.

(2) **NOSE GEAR.**—The nose gear is a single strut, half-fork type gear which folds aft and up into the crew nacelle by hydraulic action. Mechanically operated doors seal the opening after retraction.

(3) **BRAKES.**—Dual hydraulic disc type brakes are installed on each main gear wheel.

2. ARMOR PROTECTION.

a. DESCRIPTION.—The crew and ammunition boxes are protected from .30 and .50 caliber machine gun fire by a number of armor plates, bullet-resistant glass plates and deflector plates.

3. POWER PLANT.

a. DESCRIPTION.—The airplane is powered by two Pratt & Whitney model R-2800-10 two-stage, two-speed supercharged engines designed to operate on 100 octane fuel (Spec. AN-VV-R-781). Each engine is equipped with a type PT-13-G2 injection carburetor.

(1) RATIO.

Compression ratio	6.65:1
Main blower gear ratio	7.80:1
Auxiliary blower LOW gear ratio	6.46:1
Auxiliary blower HIGH gear ratio	7.93:1
Propeller gear ratio	.500

(2) OIL PRESSURE.

Desired, at 2000 rpm at 60° C (140° F)	75-80 psi
Maximum, at 2000 rpm at 60° C (140° F)	90 psi
Minimum, at rated rpm at 100° C (212° F)	75 psi
Minimum, at 2100 rpm at 85° C (185° F)	60 psi
Minimum, at 1200 rpm at 85° C (185° F)	50 psi
Minimum, at idling	25 psi

(3) OIL TEMPERATURES.

Minimum, for take-off and flight	40° C (104° F)
Desired	60 to 75° C (140° to 167° F)
Maximum, level flight	85° C (185° F)
Maximum, climb	100° C (212° F)

(4) FUEL PRESSURE.

Desired	16 psi
Allowable	15-17 psi
Minimum	7 psi

(5) For additional engine data see Specific Engine Flight Chart in Section III.

b. PROPELLER.—Two Curtiss Electric, full feathering four-bladed propellers, 12′ 2″ in diameter, are installed. Propeller blade angle is controlled automatically or by manual selection. When controlled automatically, the governor holds a constant engine speed which is determined by the propeller control lever on the throttle quadrant. When controlled manually, the blade angle may be varied by movement of the selector switch INCREASE or DECREASE rpm. The propeller control panel is illustrated in Fig. 8.

(1) PROPELLER CIRCUIT BREAKERS.

The two propeller circuit breakers should be set to the ON position at all times.

NOTE

The circuit breakers used are of the PUSH-BUTTON type which cannot be opened by hand after the initial setting but may be reset manually when opened by an excessive overload. When a circuit breaker opens because of an overload on the propeller circuit, the propeller blades remain at a fixed angle setting. It is essential that the circuit breaker be reset to the ON position. The push-button type of circuit breaker is designed to carry extremely high loads when holding the button FULL-IN. Careful use of this feature may prove valuable in obtaining a satisfactory blade setting when a continuous overload exists in the propeller circuit.

(2) AUTOMATIC CONSTANT SPEED CONTROL is the normal position for the selector switch and should be used for all types of operations.

(3) SELECTIVE FIXED PITCH CONTROL is an auxiliary form of control that may be used when fixed pitch propeller operation is desired or in the event the automatic constant speed control becomes inoperative. With the selector set for FIXED PITCH, the propellers operate as fixed pitch propellers. When required, the blade angle setting can be changed by momentarily holding the selector switch levers either in the INCREASE or DECREASE rpm position until the desired rpm is obtained. As soon as released, the switch levers will spring back to FIXED PITCH. When this occurs, the blades remain fixed at the established angle setting and the propellers will operate as fixed pitch propellers.

c. FUEL SYSTEM.

(1) Fuel is carried in four self-sealing tanks having a total capacity of 630 U.S. (522 Imp.) gallons. The two inboard tanks are located between the spars in the inner wing, capacity 115 U.S. (95 Imp.) gallons each. The two outboard tanks are located in the upper portion of the engine nacelles, capacity 200 U.S. (166 Imp.) gallons each. In an emergency fuel may be taken from any tank desired. (Figs. 2 and 9.)

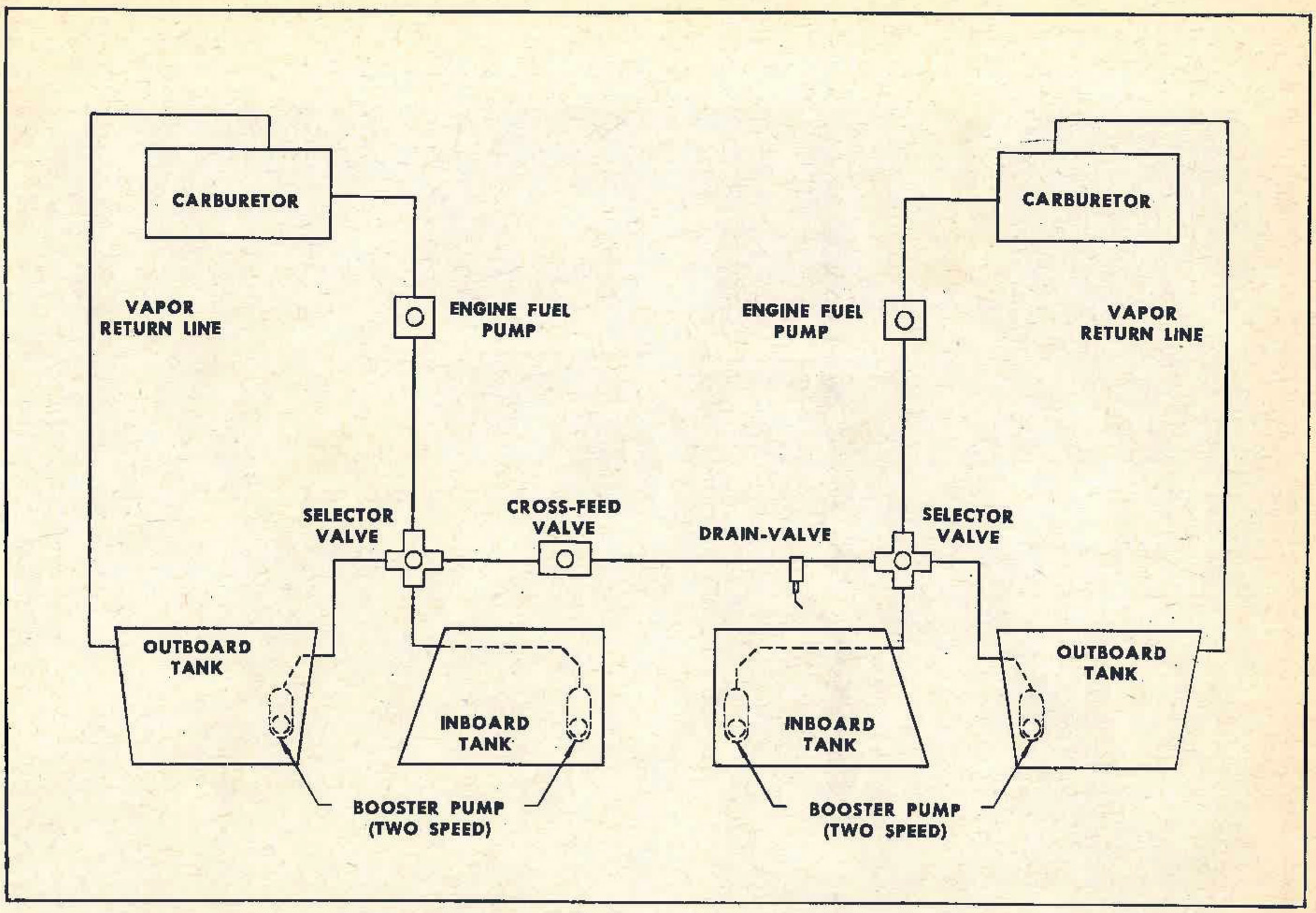


Figure 2 —Simplified Fuel System Diagram

(2) The fuel tank filler necks, reached through access doors, are located on each tank and are closed by hinged covers. Each tank is equipped with an electrically operated, variable speed, fuel booster pump to supply fuel to the engine driven fuel pumps. These booster pumps may be set to OFF, LOW or HIGH. A selective fuel quantity gage system is used by which a single indicator shows the amount of fuel in the tank selected.

d. **FUEL TRANSFER SYSTEM.**—A cross feed valve, mounted on the front spar within the crew nacelle, is cable operated from the cockpit and provides a means of transferring fuel from one tank to another on opposite sides of the airplane.

e. **OIL SYSTEM.**—Oil is carried in two 22 U.S. (18.3 Imp.) gallon self-sealing tanks located one in each outer wing panel. The oil tank filler neck is under a hinged access door and is closed by a screw cap. (Fig. 10.)

4. EQUIPMENT.

a. **AUTOMATIC PILOT.**—The airplane is equipped with a Type A-3A Automatic Pilot operated by pressure from the main hydraulic system. The gyro instruments are operated from vacuum pumps driven by the engine.

b. **SEATS.**—The pilot's seat may be adjusted vertically and moved abeam. It is hinged to tilt back to facilitate entrance and exit. The gunner and radio operator are each provided with a special seat which includes a remotely controlled gun turret sighting station.

WARNING

The gunner's seat locks in firing position by means of floor flanges and should not be moved during flight.

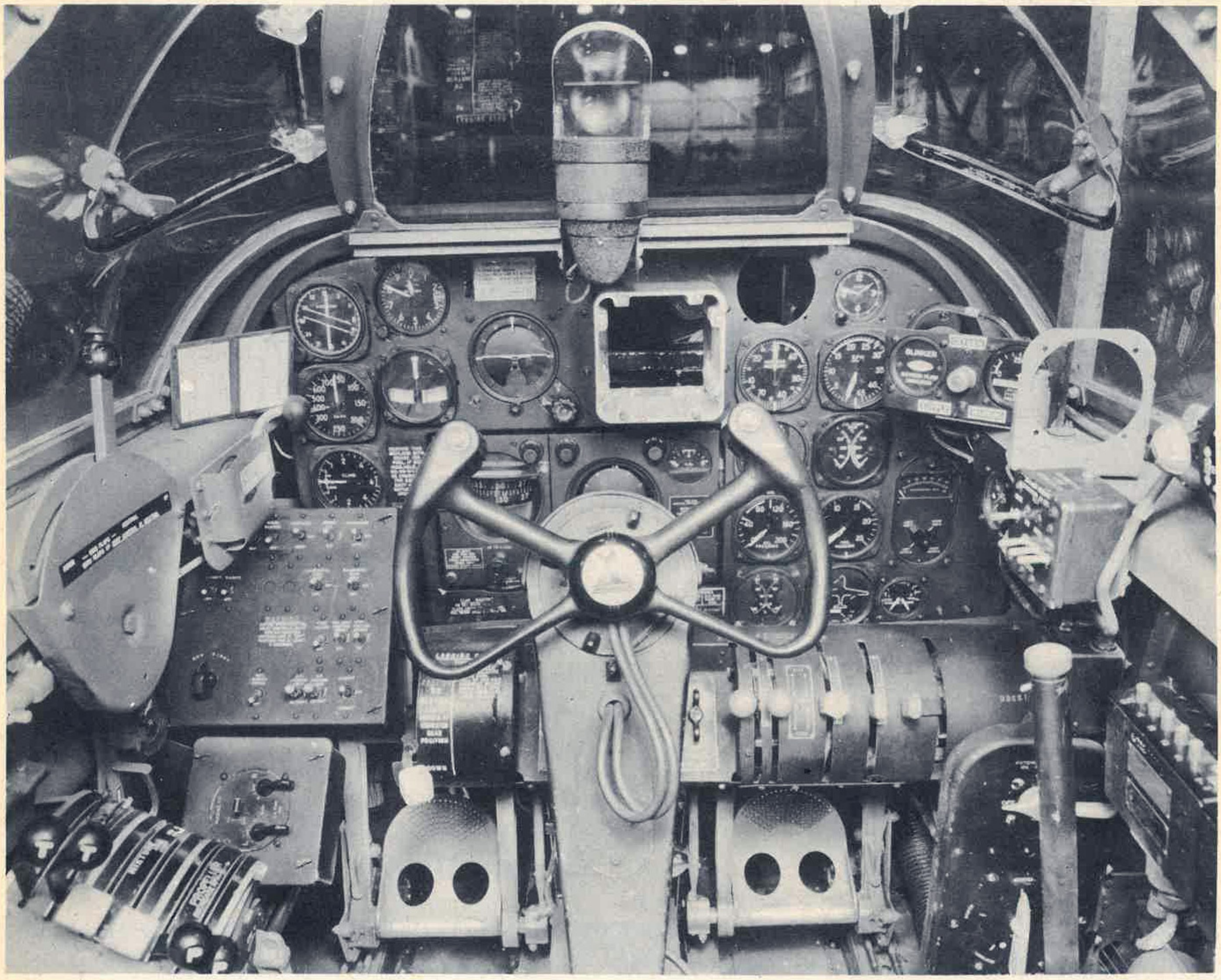


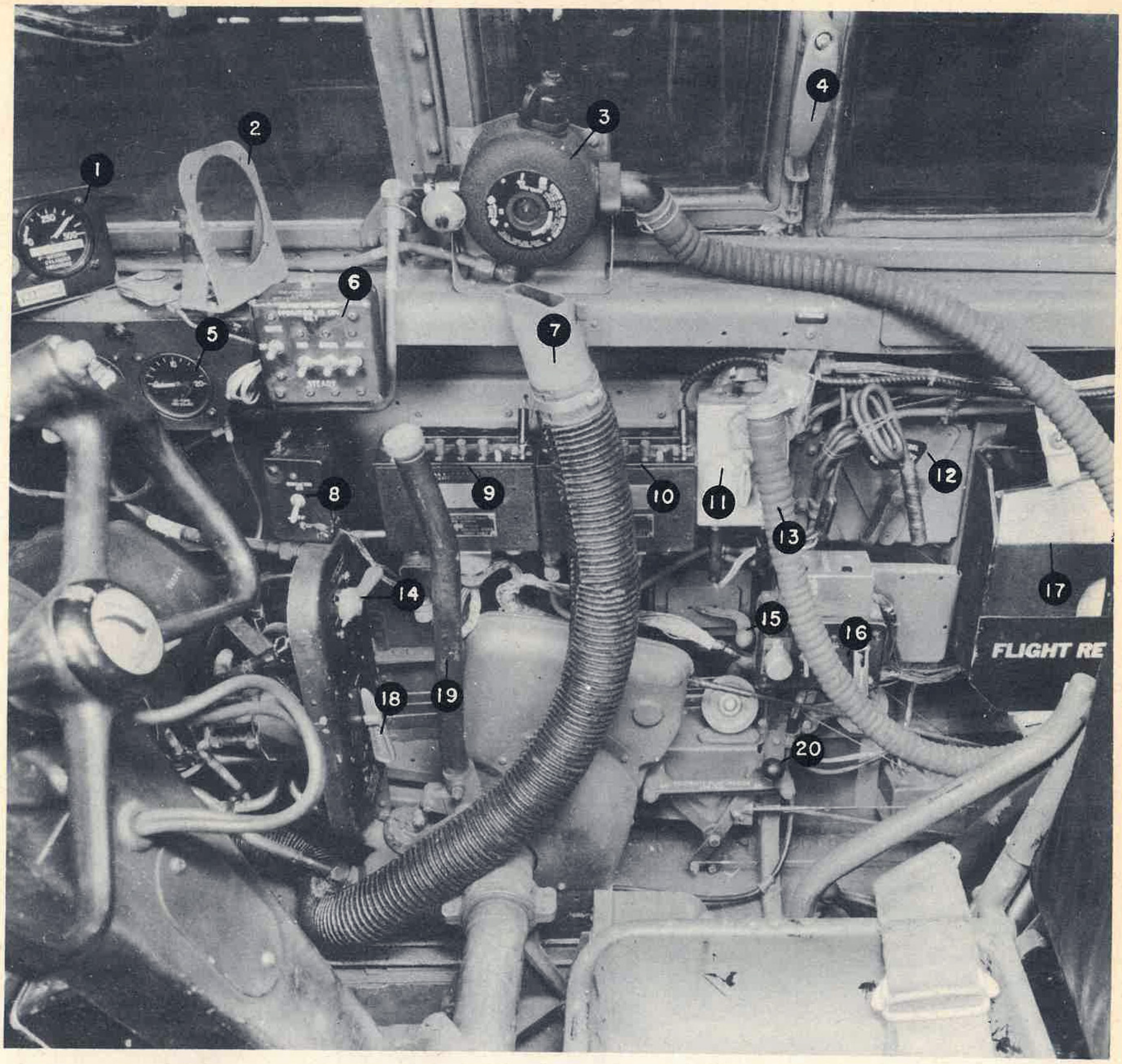
Figure 3 —Pilot's Instrument Panel

The radio operator's seat may be moved in flight and is provided with floor flanges for both firing and radio operating positions. To assume rear gunner's position, radio operator's seat must be rotated through 180° and moved aft on track. It is then aligned with floor flanges and locked.

c. **HEATING AND VENTILATING.**—An individual heater for each member of the crew and one to heat the guns and cannon are provided. A hand operated louvre-type ventilator is located on the right side of the crew nacelle in each compartment to provide cold air. (Fig. 11.)

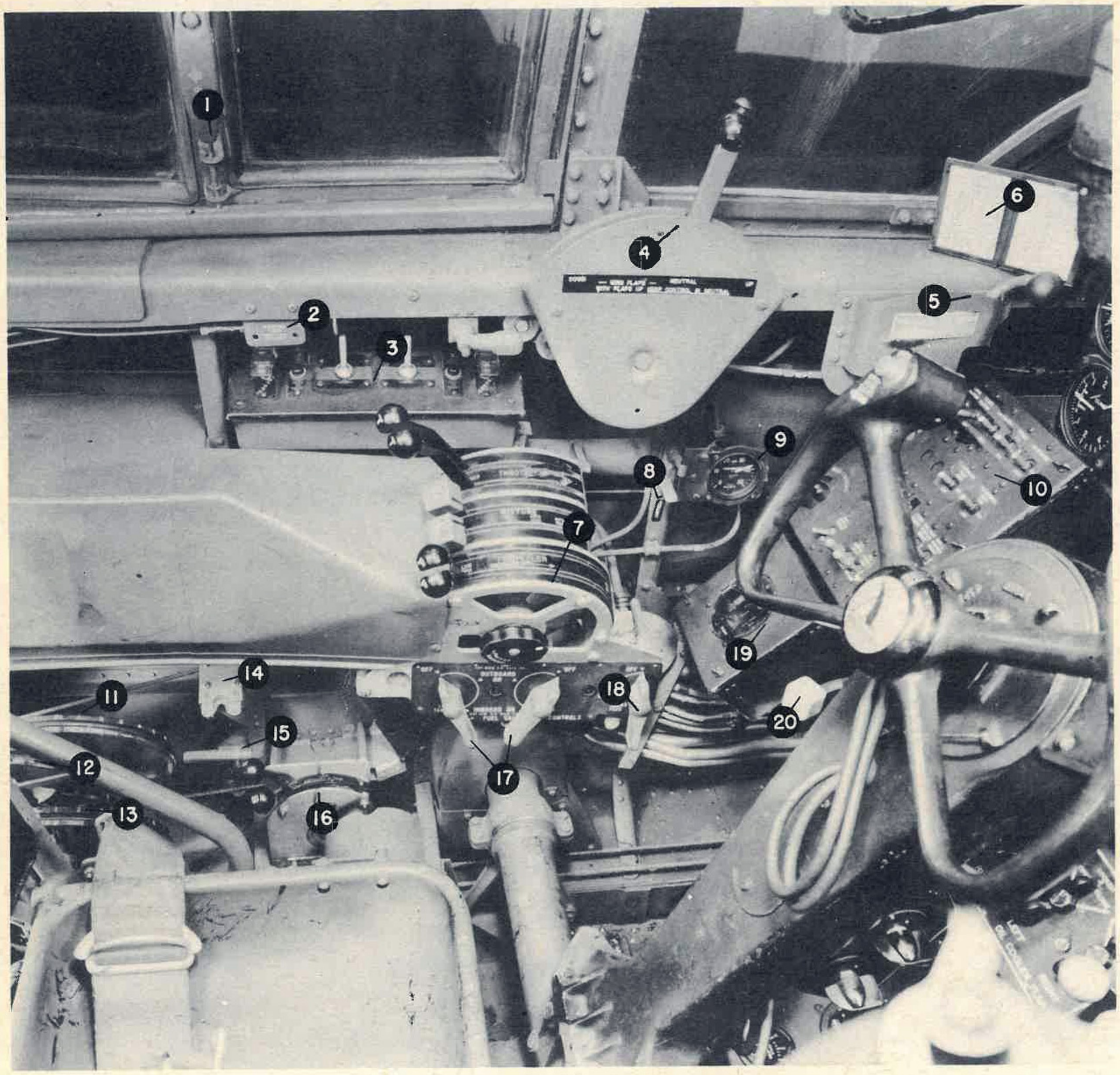
d. **PYROTECHNIC EQUIPMENT.**—A type M-8 Very Pistol, signal cartridges and parachute flares are carried in the gunner's compartment in a container fixed to the bulkhead aft of the gunner's seat.

e. **FIRE EXTINGUISHERS.**—A two-pound capacity carbon dioxide hand fire extinguisher is clipped to the bulkhead at the aft end of the gunner's compartment near the left-hand cockpit rail. A one-quart carbon tetrachloride hand fire extinguisher is located in each main landing gear wheel well.



1. OXYGEN PRESSURE GAGE
2. RADIO CONTACTOR SUPPORT
3. OXYGEN REGULATOR
4. RIGHT WINDOW LATCH
5. DE-ICER AIR PRESSURE GAGE
6. RECOGNITION LIGHT CONTROL BOX
7. WINDSHIELD HOT AIR DEFROSTER TUBE
8. RADIO CONTACTOR SWITCH BOX
9. COMMAND RADIO CONTROL BOX SCR-522 NO.1 (BC-602
10. LIAISON RADIO CONTROL BOX SCR--522 NO.2
11. INTERPHONE JACK BOX
12. DE-ICER VALVE CONTROL
13. OXYGEN TUBE
14. AUTOMATIC PILOT PRESSURE VALVE
15. PILOT'S VENTILATOR
16. IDENTIFICATION RADIO CONTROL BOX SCR-695
17. FLIGHT DATA CASE
18. HYDRAULIC HAND PUMP SELECTOR VALVE
19. HYDRAULIC HAND PUMP HANDLE
20. AUTOMATIC PILOT MASTER CONTROL

Figure 4 —Pilot's Controls—Right



1. LEFT WINDOW LATCH
2. LANDING GEAR WARNING HORN RELEASE
3. PILOT'S PROPELLER CONTROL PANEL
4. FLAP CONTROL LEVER
5. EMERGENCY AIR BRAKE LEVER
6. CORRECTION CARD HOLDER
7. ENGINE CONTROL QUADRANT
8. PEN LIGHT HOLDER
9. EMERGENCY AIR BRAKE PRESSURE GAGE
10. PILOT'S ELECTRIC SWITCH
11. AILERON TRIM TAB WHEEL
12. ELEVATOR TRIM TAB WHEEL
13. RUDDER TRIM TAB WHEEL
14. EMERGENCY RELEASE HANDLE SUPPORT
15. MAIN LANDING GEAR EMERGENCY RELEASE
16. SUPERCHARGER CONTROLS
17. FUEL SELECTOR VALVE CONTROL
18. FUEL TANK CROSS FLOW VALVE CONTROL
19. BOX ASSEMBLY IGNITION SWITCH
20. LANDING GEAR SELECTOR VALVE

Figure 5 —Pilot's Controls—Left

f. **FIRST AID KITS.**—Two first aid kits are furnished. One is attached to the forward side of the gunner's armor plate. The second is located to the left and aft of the radio operator's access door.

g. **GUN CAMERA.**—A type N-2 camera is located on the bottom centerline of the crew nacelle nose section. The lens is behind a small window in the pitot static tube support. The camera overrun control, mounted in the nose wheel well can be set before take-off so that the camera will continue in operation for 1/20 to 3 seconds after the cannon firing switch has been released.

h. **MISCELLANEOUS EQUIPMENT.**—A safety belt, pen-type flash light, polaroid goggles and relief tube are furnished for each member of the crew. A data case is installed in the radio operator's compartment and a map case in the flight control report holder in the pilot's compartment. A standard airplane emergency kit and four type D-1 mooring kits are furnished with each airplane. A pilot's blind flying hood is provided with every fifth airplane.

i. **OXYGEN, COMMUNICATION AND GUNNERY EQUIPMENT** are discussed in Section V.

5. FLIGHT AND POWER PLANT CONTROLS.

a. FLIGHT CONTROLS.

(1) FLAPS.—A series of six flaps of the trailing edge slotted type are mounted two on each outer wing panel and one on each inner wing panel. They are hydraulically operated by a remotely controlled selector valve. The valve is operated manually by means of a control cable. The control handle is located in the pilot's cockpit on the left-hand rail. Mechanically operated locks hold the outer wing flaps in the retracted position. The locks are similar in operation to a conventional landing gear up lock and positively restrict oscillation in both up and down directions. The latch is spring loaded closed and is released by a single cable connected to an arm on the selector valve. Full flap deflection is 60°.

(2) AILERONS.—The ailerons consist of a combination of the conventional type and four spoiler panels linked to the aileron control system. The spoiler panels work in unison with the ailerons. The entire system is controlled by the wheel in the cockpit and is entirely conventional in operation.

(3) RUDDER.—The rudders are conventionally controlled. Each rudder has an independent control system. In the event of damage to one of the rudder control systems, normal control of the airplane can be maintained by the system remaining intact.

(4) ELEVATOR.—The elevator has two complete cable control systems either one of which is sufficient in case of damage to the other. Controls are conventional.

(5) TRIM TABS.—Cable operated trim tab controls are located to the left of the pilot's seat.

(a) **AILERON.**—The left aileron trim tab is controllable from the cockpit. The right aileron booster tab is adjustable on the ground only.

(b) **RUDDER.**—Conventional.

(c) **ELEVATOR.**—In addition to the conventional elevator trim tab there are two non-adjustable spring tabs which provide boost and reduce control forces particularly at high speeds.

(6) AUTO PILOT ENGAGING LEVER. Right of pilot's seat on the floor.

(7) FLIGHT CONTROL LOCK LEVER. Right and aft of pilot's seat on the floor. (Fig. 12.)

(8) LANDING GEAR CONTROLS.

(a) **SELECTOR VALVE.**—Square knob forward and to left of flight control column.

1. **MAIN GEAR OPERATION.**—Main gear retraction is by hydraulic control. Extension is aided by a bungee system consisting of an air bottle for each gear and required valves and lines. The up and down position latches are hydraulically operated and include an emergency cable release.

2. **NOSE GEAR OPERATION.**—Nose gear action is hydraulic. The up and down latches are mechanically operated from the landing gear selector valve.

3. **LANDING GEAR POSITION INDICATOR.**—The attitude of the landing gear up and down position latches is pictorially illustrated by a position indicator on the instrument panel.

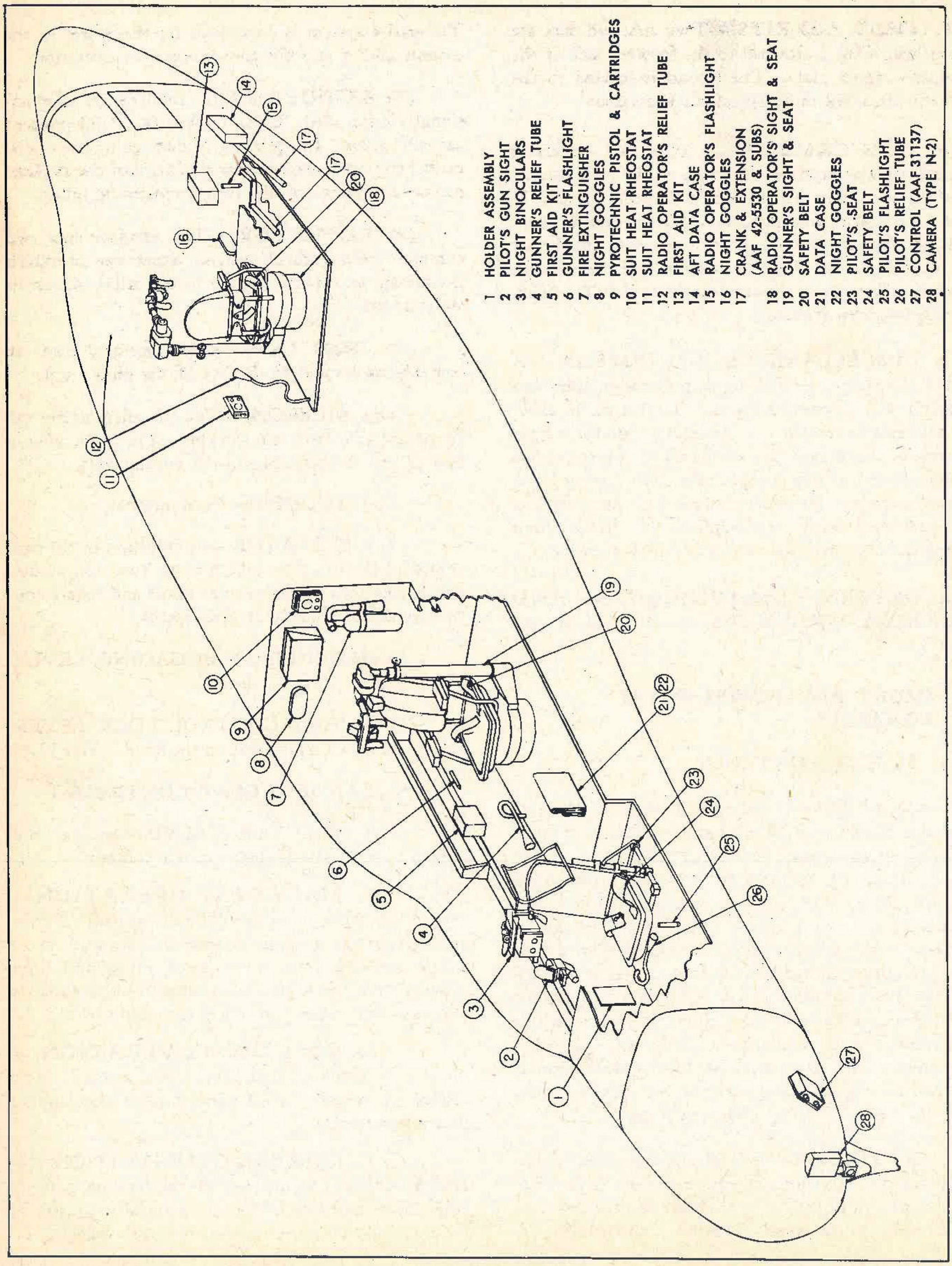


Figure 6 — Crew Nacelle Equipment

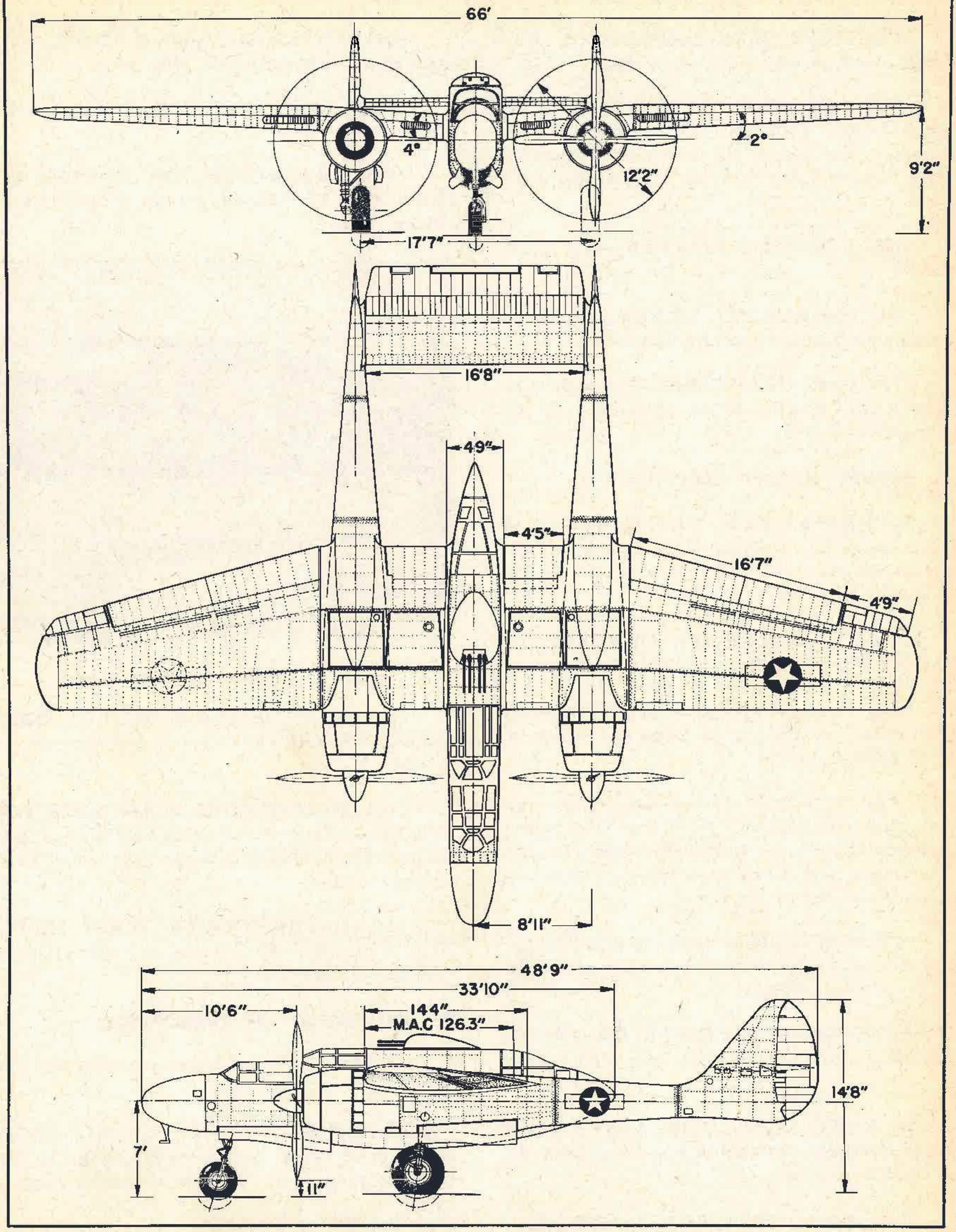


Figure 7 — Leading Dimensions

(b) **MAIN GEAR EMERGENCY RELEASE.**—Left of pilot's seat on the floor.

(c) **LANDING GEAR WARNING HORN THROTTLE SWITCH.**—Aft of throttle quadrant to the left of the pilot's seat. Opening throttle automatically reinstates the warning horn system.

(d) **LANDING BRAKES.**—On rudder pedals.

(e) **EMERGENCY BRAKE LEVER.**—Attached to cockpit rail at left front corner.

(f) **PARKING BRAKES.**—Lever between rudder pedals. Parking brakes are released by depressing brake pedals.

b. POWER PLANT CONTROLS.

(1) THROTTLE CONTROL.—The throttle quadrant including throttle, mixture and propeller governor controls, is to the left of the pilot's seat. (Fig. 13.)

(2) SUPERCHARGER CONTROLS.—Below and aft of throttle quadrant on the floor.

(a) During long flights blower should be shifted once every three hours to prevent accumulation of sludge in system.

(b) To shift blower to next higher stage, reduce manifold pressure 2″ to 5″ and move blower clutch control quickly to next higher stage. To shift to next lower stage, simply move blower clutch control quickly to desired position.

(c) Cycles of blower shifting should not be repeated at less than 3 minute intervals to allow dissipation of generated heat.

(3) PROPELLER CONTROLS (ELECTRICAL).—Left of pilot's seat just below cockpit rail.

(4) FUEL SELECTOR AND CROSS FEED VALVE CONTROLS.—Immediately below throttle quadrant. (Fig. 14.)

(5) PILOT'S ELECTRICAL PANEL.—Left front corner of cockpit. (Fig. 15.)

(6) IGNITION SWITCH PANEL.—Beneath pilot's electrical panel. (Fig. 16.)

(7) MASTER SAFETY SWITCH.—On ignition switch panel.

(8) CARBURETOR AIR HEATER SELECTOR VALVES.—Forward of flight control column.

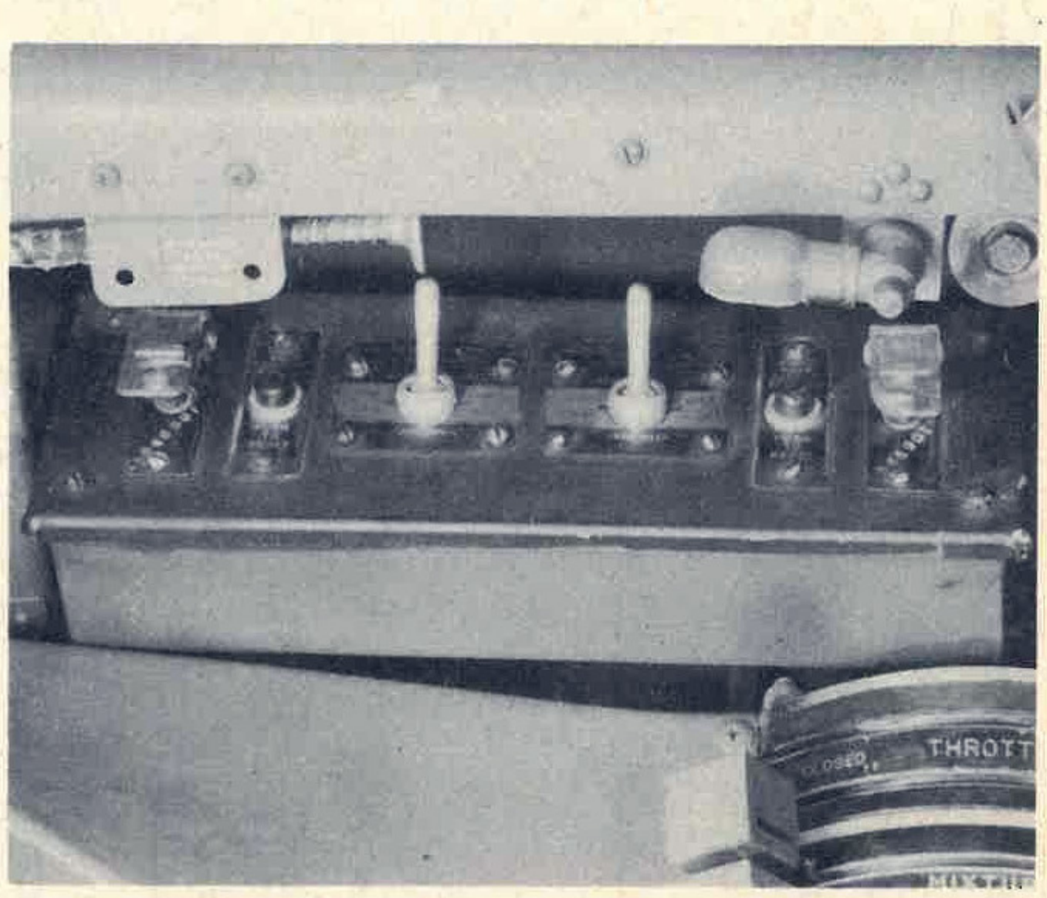


Figure 8 —Propeller Control Panel

(9) OIL COOLER AIR OUTLET DOOR SELECTOR VALVES.—Forward of flight control column.

(10) ENGINE COWL FLAPS SELECTOR VALVES.—Forward and to the right of flight control column (hex. knob for upper flaps, round knobs for lower flaps).

(11) INTERCOOLER FLAPS SELECTOR VALVES.—Oval knobs to right of engine cowl flaps selector valves.

6. MOVEMENT OF PERSONNEL.

a. **PILOT.**—The pilot remains in his seat during flight.

b. **GUNNER.**—The gunner remains in his seat during flight except in an emergency when he may leave the gunner's seat and take the pilot's position.

c. **RADIO OPERATOR.**—The radio operator may also act as rear gunner. See Section V.

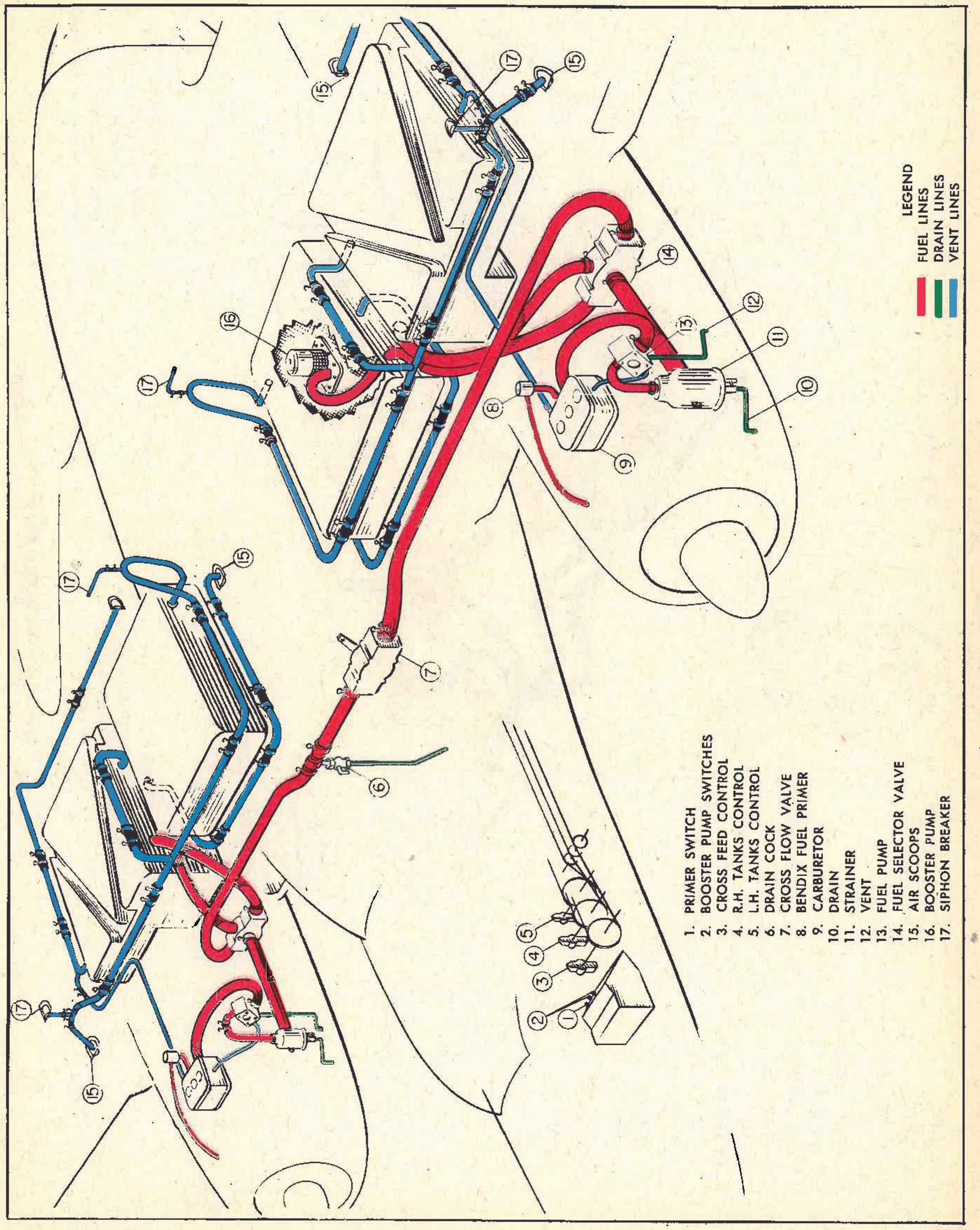


Figure 9.—Fuel System Diagram

1. OIL DILUTION VALVE
2. OIL IN
3. OIL OUT
4. OIL HOPPER
5. OIL FILTLER CAP
6. OIL TANK
7. OIL TEMP. REGULATOR
8. OIL COOLER
9. COOLER DRAIN
10. OVERFLOW
11. OIL SUMP
12. SUMP DRAIN

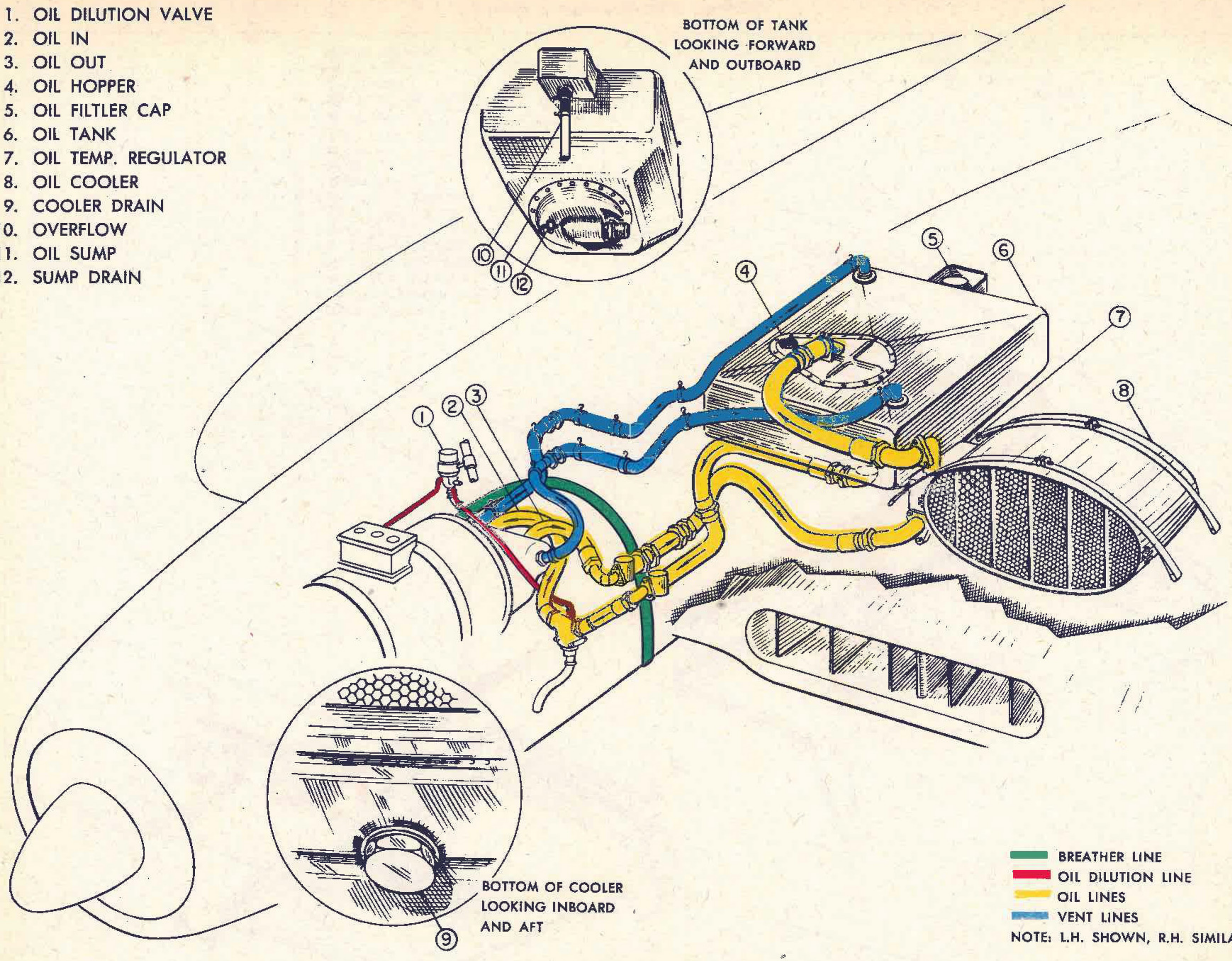
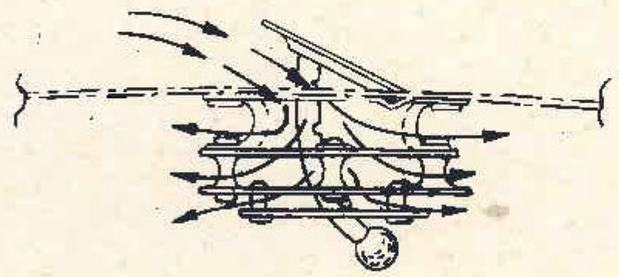


Figure 10 — Oil System Diagram

1. PILOT'S & GUNNER'S HEATER SWITCH
2. PILOT'S HEATER
3. GUNNER'S HEATER
4. RADIO OPER. & TURRET GUNS HEATER SWITCH
5. RADIO OPERATOR'S HEATER
6. TURRET GUNS HEATER
7. PRESSURE CUT-OFF SWITCH
8. PILOT'S VENT
9. GUNNER'S VENT
10. RADIO OPER. VENT
11. HEATER DUCT.
12. TURRET GUNS EJECTION CHUTE



TYPICAL VENT

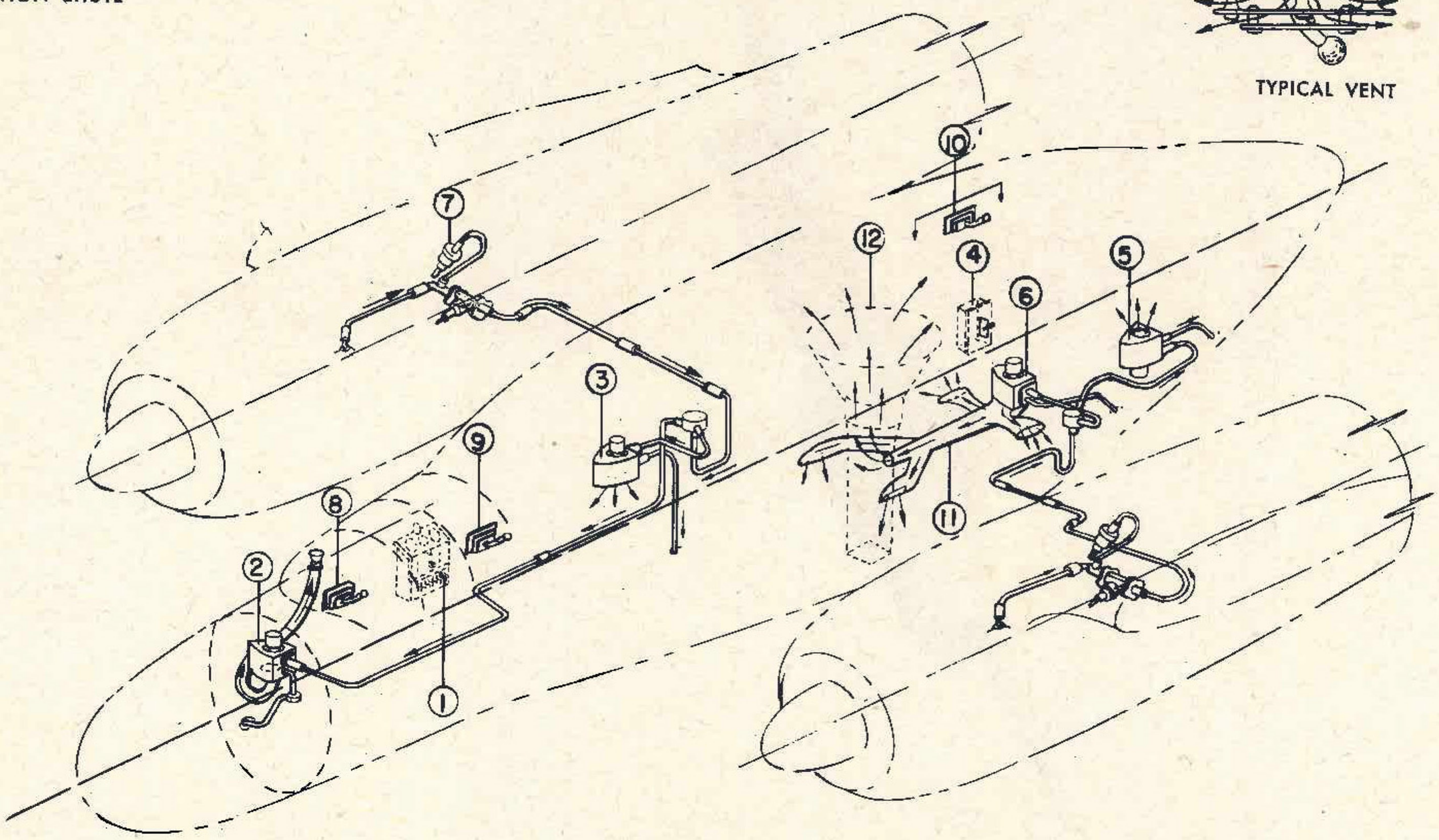
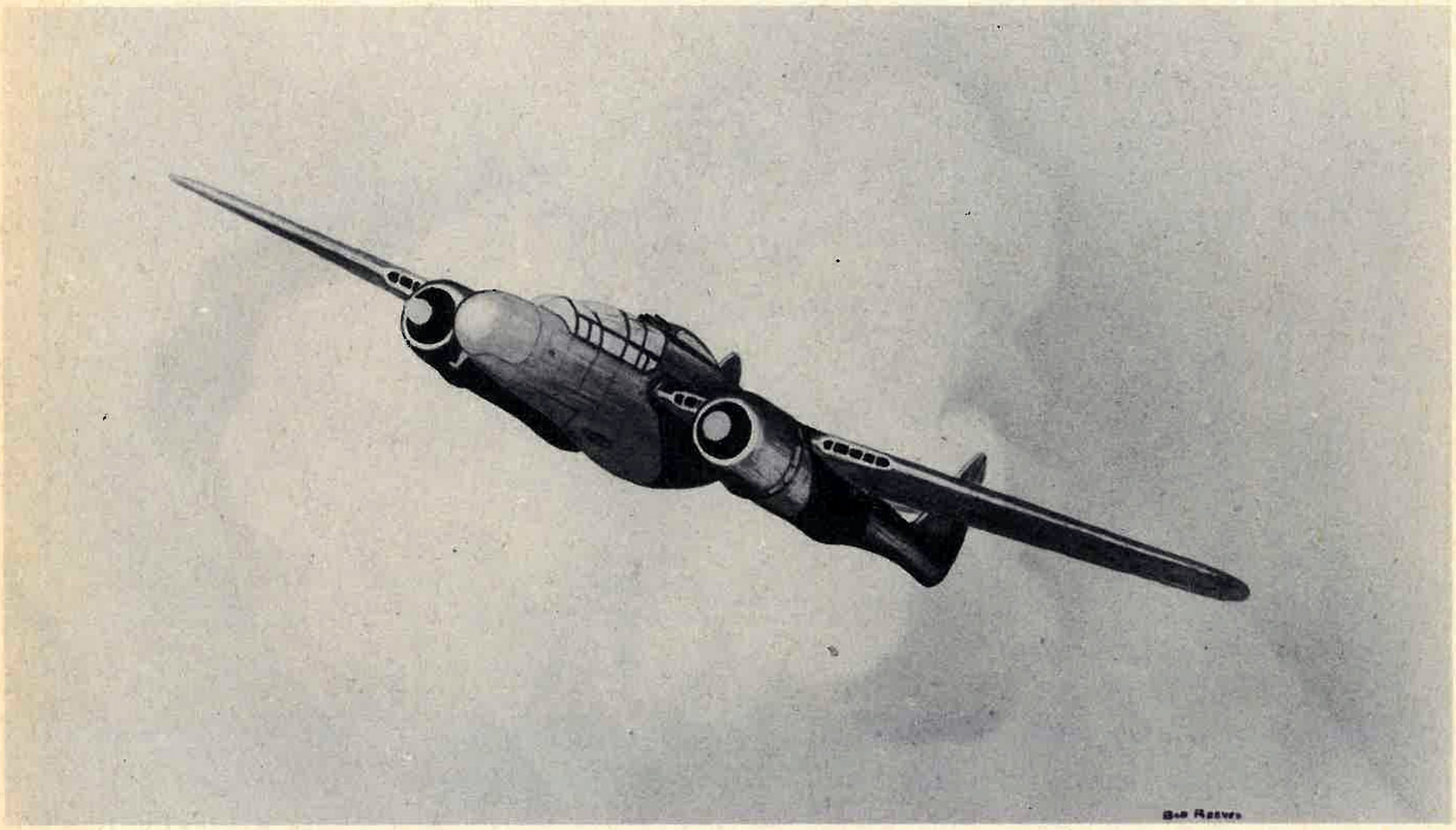


Figure 11 —Heating and Ventilating System



1. BEFORE ENTERING THE PILOT'S COMPARTMENT.

a. **WEIGHT AND BALANCE.**—The pilot must determine gross weight and C.G. of the airplane. This is best done by reference to the Weight and Balance Data Handbook (AN 01-1-40) located in the pilot's data case. No cargo compartment is provided nor are provisions made for cargo storage.

b. Make the following checks before entering the airplane:

(1) Nose gear towing pin engaged (red cap on).

(2) Check emergency landing gear systems for proper pressure. Gages are located in each of the three wheel wells.

Main Gear	750 psi
Nose Gear	700 psi

(3) Pitot tube cover removed.

c. Pilot's entrance is gained through the nose wheel well. With the nose wheel down, the door and ladder may be lowered from the ground by turning the handle on the aft end of the door. A key is provided for ground use.

2. ON ENTERING THE PILOT'S COMPARTMENT.

a. Check the following items of night flying equipment as outlined:

(1) FLUORESCENT INSTRUMENT LIGHTING.—A type C-5 fluorescent light which causes the instrument faces to glow in the darkness is located on each side of the cockpit. A check may be made for proper operation of this "black light" equipment in daylight by rotating the knurled caps on the light approximately 90° thereby causing the emission of conventional light rays.

(2) POSITION AND RECOGNITION LIGHT.—The following lamps will normally be visible in daylight and may be checked by a visual inspection:

	Location
2 White position lights	Rudder trailing edge
1 Red position light	Left wing tip
1 Green position light	Right wing tip
1 White recognition light	Right wing upper surface
1 Red recognition light	Right wing lower surface
1 Green recognition light	Right wing lower surface
1 Amber recognition light	Right wing lower surface

The position lights are controlled by an ON - OFF - DIM toggle switch on the electrical control panel. The recognition lights are controlled by an individual switch box on the upper right side of the cockpit from which the desired color combinations may be selected.

(3) LANDING LIGHTS.—An electrically retractable landing light is mounted on the under-surface of each outer wing panel. The landing light switches are located on the pilot's switch panel. For testing purposes the landing lights should be switched on for a minimum time.

b. Perform the following inspections for all flights.

(1) Examine the Airplane Flight Report for completeness and make required entries.

(2) See that the cockpit is clean and free from anything that might shift in flight and interfere with the controls.

(3) Check all instruments for proper pointer position and broken or loose cover glasses. Note markings on dials indicating proper operating circuits.

(4) Check the quantities of fuel in all tanks by checking gages against entries in Airplane Flight Report.

(5) Check clock against operation's office time and wind if necessary.

(6) Set altimeter to desired reading.

(7) Tap the rate-of-climb indicator to insure accurate reading.

(8) See that fuel pressure gage, oil pressure gage, and tachometer read ZERO.

(9) Check oxygen pressure gage if altitude flying is contemplated. A pressure of 425 psi indicates a full supply.

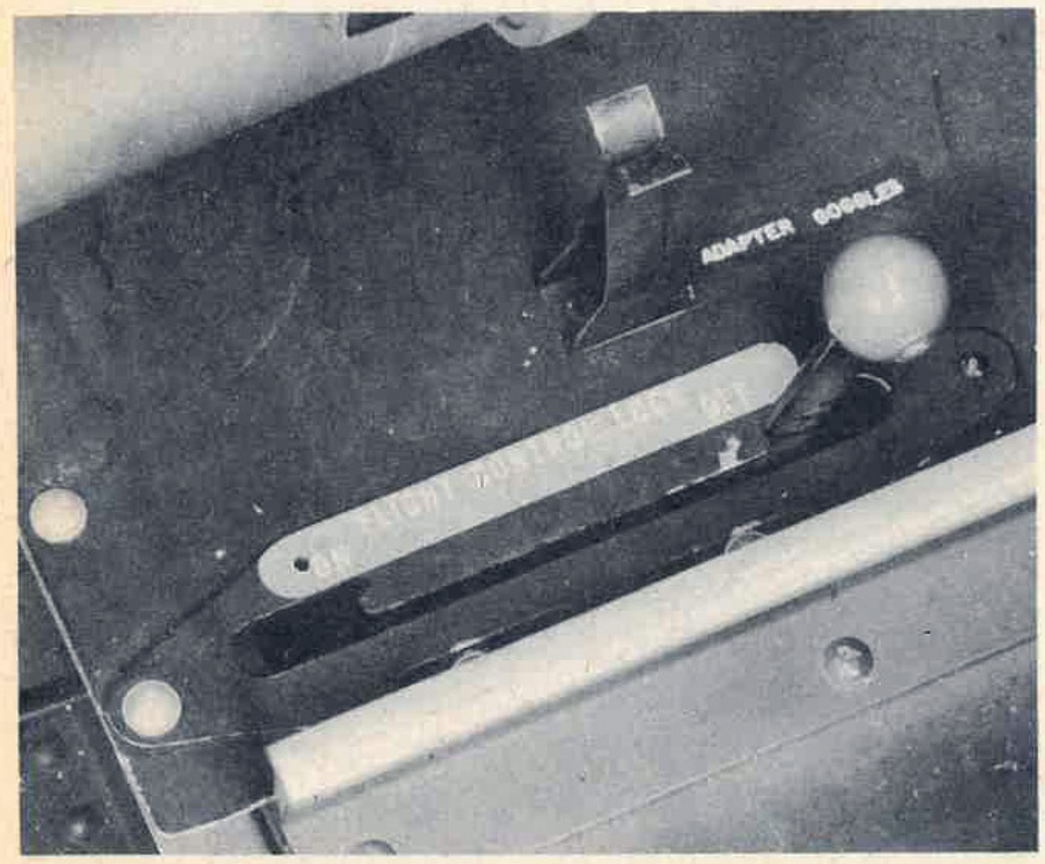


Figure 12.—Flight Control Lock

(10) Check emergency air brake pressure (425 to 450 psi).

(11) Disengage surface control lock.

(12) Head airplane into wind. Set parking brakes. See that chocks are in place.

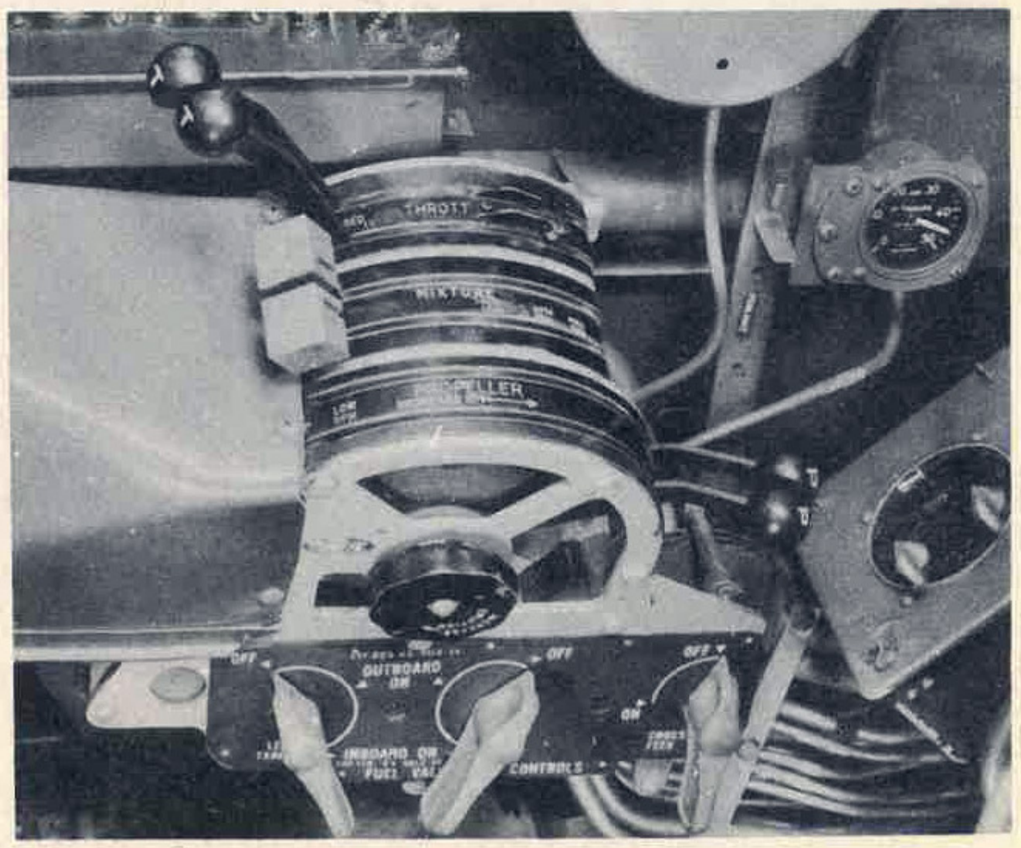


Figure 13 – Throttle Quadrant

3. FUEL SYSTEM MANAGEMENT.

a. CONTROLS.

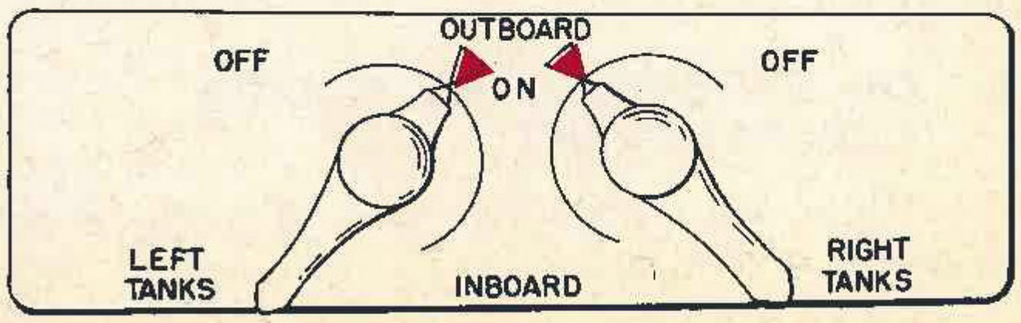
(1) Mixture controls are on throttle quadrant to left of pilot's seat. (Fig. 13.)

(2) Fuel selector valve and tank cross feed valve controls are mounted just below the throttle quadrant to the left of the pilot's seat. (Fig. 14.)

(3) Fuel booster pump switches are located on the pilot's switch panel. (Fig. 16.)

b. USE OF TANKS.

(1) **NORMAL.**—Under normal conditions, the two outboard tanks will be emptied first, the left outboard tank supplying fuel to the left engine and the right outboard tank to the right engine. (Fig. 2.)



(2) EMERGENCY.—In an emergency, fuel may be used from any tank desired for either or both engines:

(a) To operate both engines from a single tank:

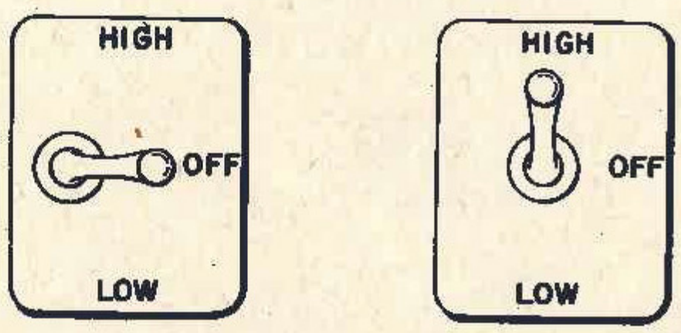
1. Turn fuel selector valve switch to tank desired.

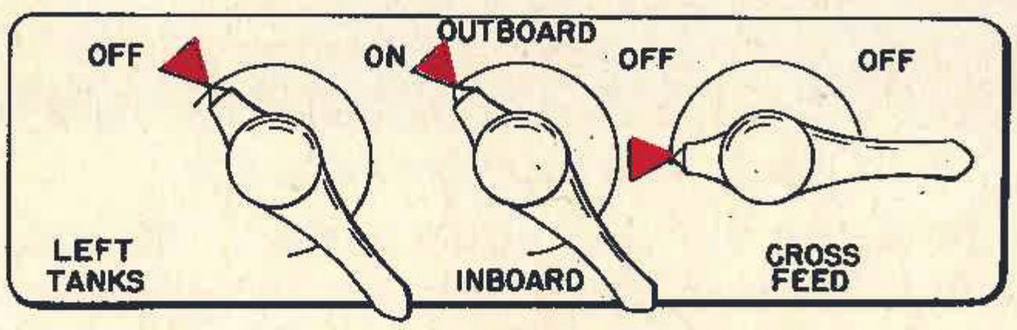
2. Turn fuel booster pump on that side to HIGH.

3. Turn cross feed valve ON.

4. Turn other fuel selector valve switch to OFF.

5. Turn other fuel booster pump OFF.





To Operate Both Engines from Right Outboard Tank

(b) To operate an engine from an opposite tank (right-hand engine from left-hand tank or left-hand engine from right-hand tank) for single engine operation:

1. Turn fuel selector valve switch to tank desired.

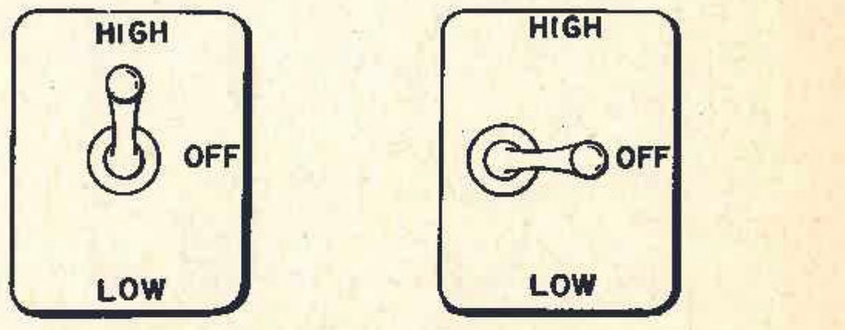
2. Turn fuel booster pump on that side to HIGH.

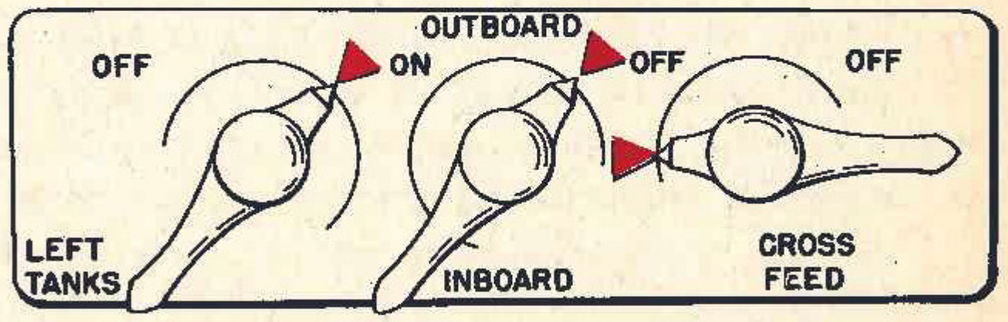
3. Turn cross feed valve ON.

4. Turn other fuel selector valve switch OFF.

5. Turn other fuel booster pump OFF.

6. Place mixture control for inoperative engine in IDLE CUT-OFF.





To Operate Right-Hand Engine from Left Outboard Tank

(c) To transfer fuel from tank on one side of the airplane to tank on the other side:

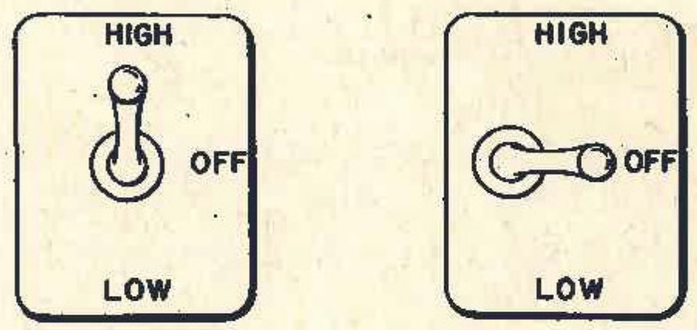
1. Turn one selector valve to the tank to be drained.

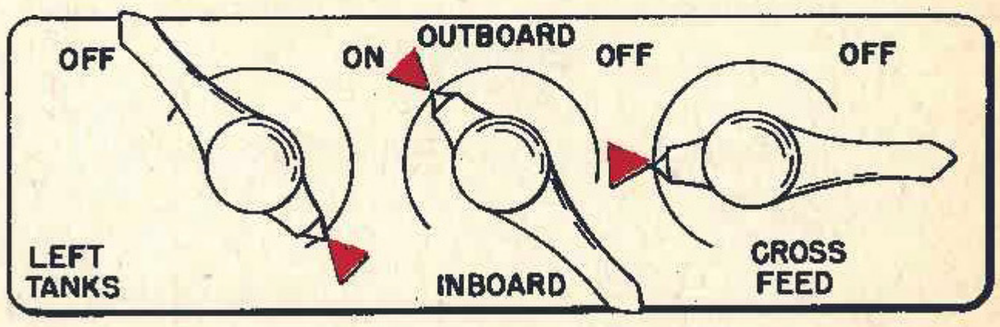
2. Turn the other selector valve to the tank which is to receive fuel.

3. Open the cross feed valve.

4. Turn booster pump switch for tank to be emptied to HIGH. Turn other booster pump switch OFF.

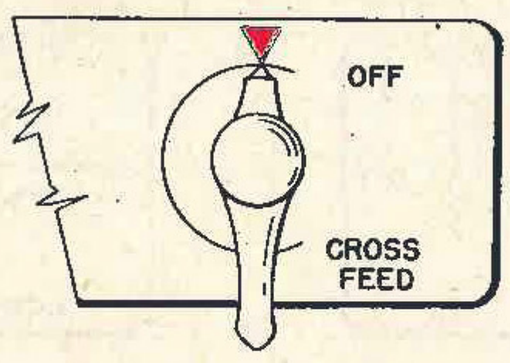
5. When transfer is complete, reset the booster pump switches and selector valves for normal operation and close the cross feed valve.



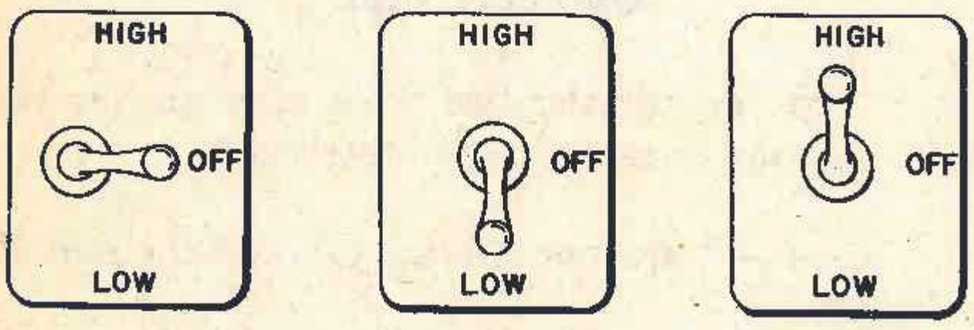


To Transfer Fuel from Left Inboard to Right Outboard Tank

c. **CROSS FEED VALVES.**—For all normal operations the cross feed valve is OFF.



d. **FUEL BOOSTER PUMP SWITCHES.**—The pump switches should be placed in HIGH to obtain ample fuel pressure for high altitude maneuvers. For "hovering" flight, the fuel booster pump need not be used. The LOW position should be used for all normal flight operations requiring additional pressure to the engine fuel pumps.



Hovering Flight ***Normal Flight*** ***High Altitude***

4. STARTING ENGINES.

The engines should be started by performing the following operations in sequence:

a. A one-quart capacity, hand operated fire extinguisher is located in each main gear well. They are to be removed from the wells before starting the engines so that they will be immediately available in case of fire.

b. Ignition switches OFF.

c. If the engine has been inoperative for more than two hours, pull the propeller by hand through four or five revolutions. This is necessary in both summer and winter operations.

WARNING

Be sure master switch is OFF *before touching propeller.*

d. Close all circuit breakers on generator panel and in turret compartment (except cockpit heater and auxiliary radio) and turn ON generators.

e. Set throttle approximately ¼ open.

f. Propeller control lever to full INCREASE RPM, seltctor switch AUTOMATIC.

g. Supercharger NEUTRAL.

h. Oil cooler shutters CLOSED.

i. Carburetor air COLD. The engine should not be started with carburetor heat on because of probable damage to the induction system in case of backfire.

j. Intercooler exit flaps CLOSED.

k. Upper and lower cowl flaps OPEN.

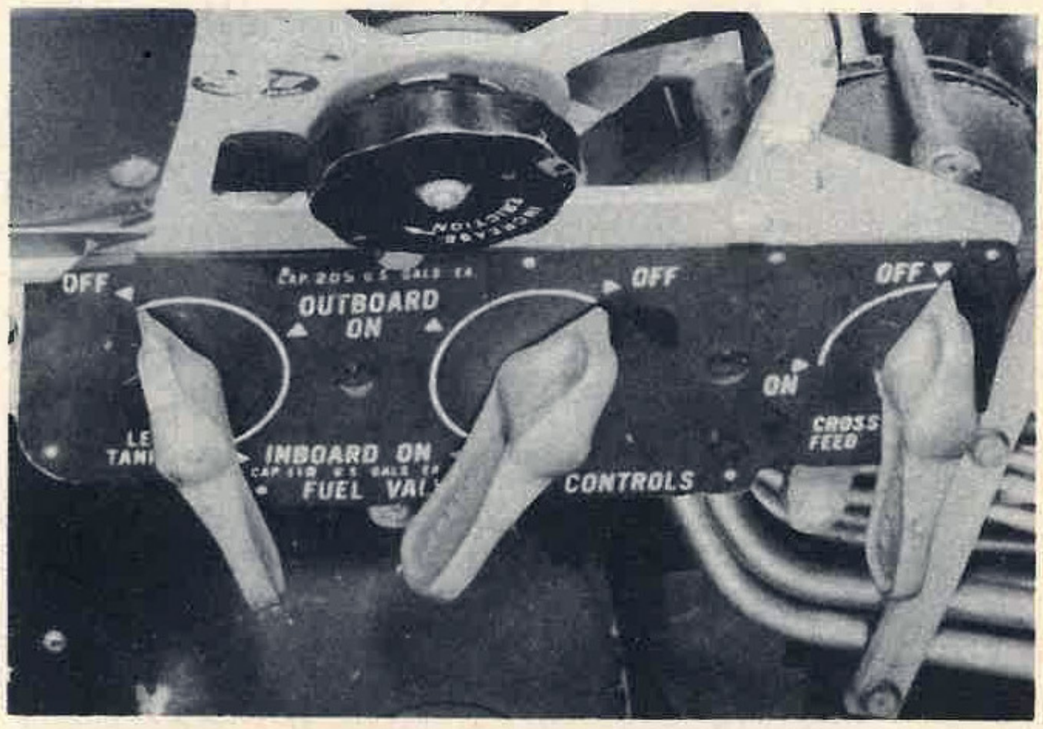


Figure 14 —Fuel Valve Controls

l. Set the fuel tank selector valves to the tanks desired. The cross-feed valve must be OFF when starting engines. If it is desired to run both engines from a single tank, place the cross-feed valve in the ON position AFTER the engines have been started.

m. Turn ON both battery switches.

NOTE

When external source of electrical power, such as battery cart, is used for starting, battery switches and generator switches should be OFF until after external source of power is disconnected.

n. See that all unnecessary light and electrical switches are off, to avoid an excessive load on the batteries when starting the engines.

o. Master switch ON, ignition switch to BOTH.

p. Mixture controls in IDLE CUT-OFF.

q. Perform the following operations for starting each engine individually.

(1) Fuel booster pump switch LOW.

(2) Hold primer and starter switches up together to prime the engine and energize the starter simultaneously. The amount of priming required depends upon engine temperature (atmosphere temperature in the case of cold engines) and varies from no prime with a warm engine to approximately 10 seconds with a cold engine. The natural tendency to over-prime in warm weather and under-prime in cold weather must be avoided. Excessive priming will load the cylinders with raw gasoline, make the engine difficult to start, and tend to wash the oil from the cylinder walls. Under-priming usually results in backfiring through the intake system with the attendant fire hazards.

(3) Hold starter switch on START until the starter noise reaches highest pitch (approximately 30 seconds) then flip it down to MESH.

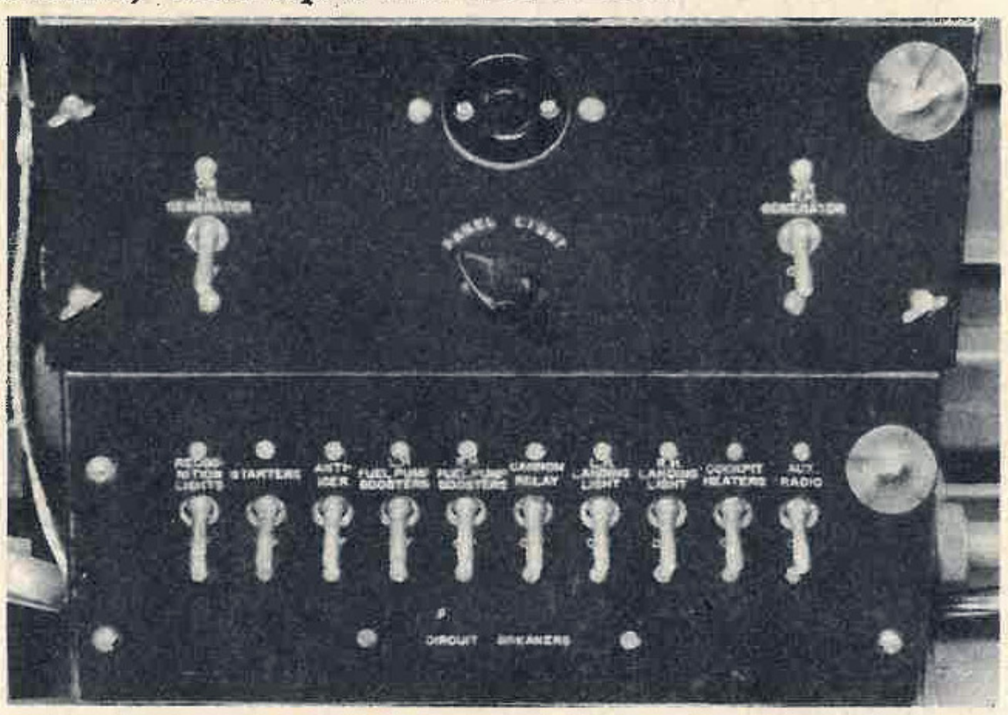


Figure 15 — Generator Control Panel

(4) The engine should start within two revolutions of the propeller. When the engine fires, place mixture control in AUTO RICH and reduce throttle opening to run engine as slowly as possible until oil pressure is indicated.

WARNING

Do NOT *pump the throttle or mixture control.*

(5) Should the engine fail to start, make certain the starter jaws are disengaged before beginning another start. Jaws may be disengaged by turning the propeller by hand one-half turn in either direction.

WARNING

Be certain ignition is OFF *before touching propeller.*

CAUTION

Do not operate the starter either manually or electrically while the jaws are engaged.

(6) If the electric starter motor should fail, turn the starter flywheel to a speed of 90-100 rpm with the hand crank and extension shaft. The crank hole is located in the lower right portion of each engine accessory cowl. The hand crank is stowed in the left wheel well.

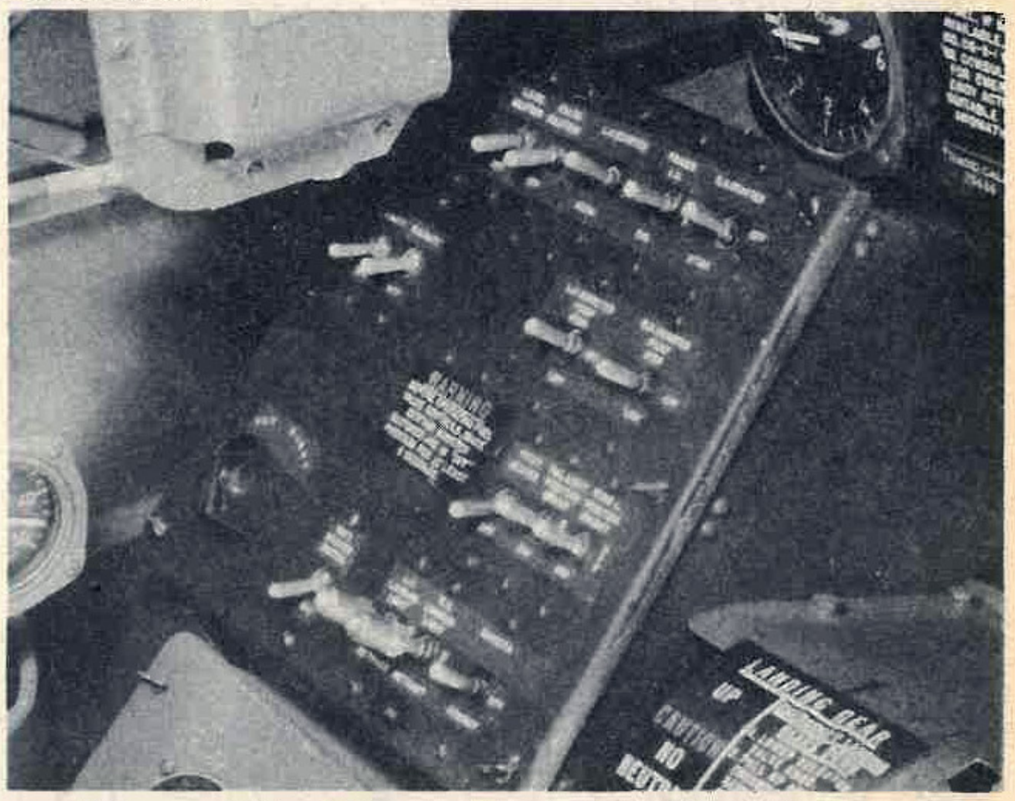


Figure 16 — Pilot's Electrical Switch Panel

5. ENGINE WARM UP.

a. Throttle the engines to 600-700 rpm until the oil pressure gages indicate a steady pressure. Keep the propeller governor control levers in the HIGH rpm position.

CAUTION

If the oil pressure gages do not indicate pressure within 30 seconds, stop engine and investigate.

b. Fuel booster pumps OFF. Fuel pressure 15-17 lbs.

c. Run the engines at 600-800 rpm for the first half minute, then open the throttle to 1000 rpm. The oil pressure relief valves are fitted with a temperature

control that forces the oil when cold through the engines under pressure as high as 300 psi. This will normally drop to 25 psi at idling speed when an oil inlet temperature of about 40° C (104° F) is obtained.

d. If the oil pressures are too high or fluctuate or fall back when the engine rpm is increased, a cold, viscous oil is indicated and may be corrected by operating the oil dilution control. Use this method only if time and extreme temperature conditions do not permit engine warm-up in the normal manner. While using the oil dilution system, close observation of oil pressures is necessary to prevent over-dilution, resulting in low oil pressure.

e. When the oil inlet temperature reaches approximately 40° C (104° F), open oil cooler doors as desired. For average operation, one-half open will be sufficient for take-off.

f. Keep engine cowl flaps open.

WARNING

Do not attempt to warm the engines more quickly by closing the cowl flaps during cold weather. To do so may cause burning of the ignition systems at the spark plug elbows.

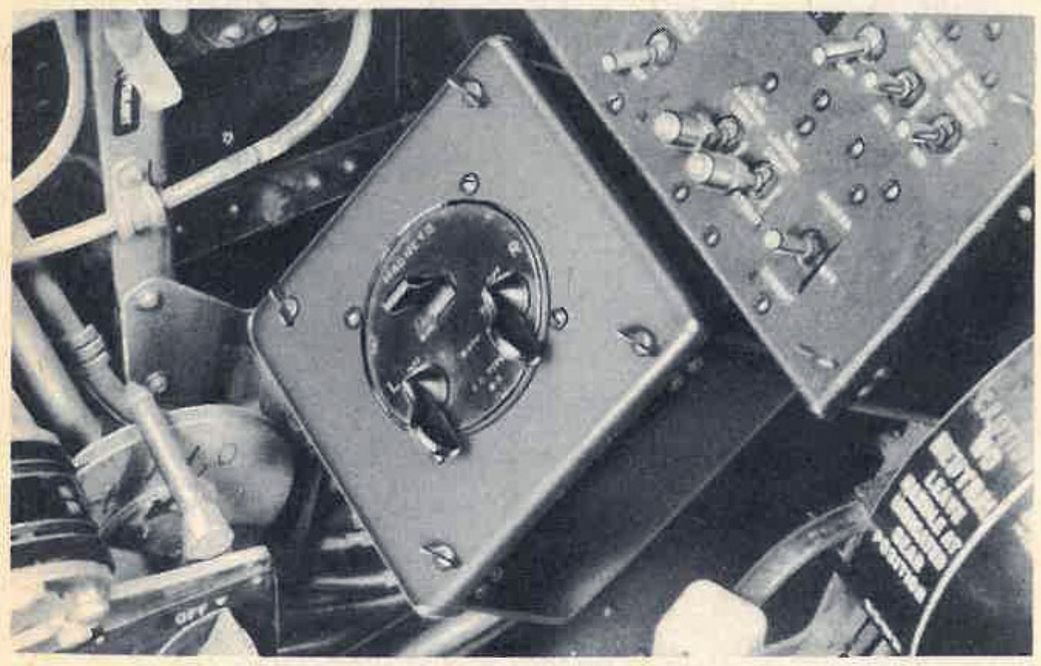


Figure 17 —Pilot's Ignition Switch Panel

g. Warm the supercharger clutch mechanism by shifting the ratio selector valve handles from NEUTRAL to LOW and then from LOW to HIGH and again from HIGH to NEUTRAL. Shifts between positions should be made quickly. The complete cycle of shifting should not be repeated at intervals of less than 3 minutes. A shorter interval will not permit dissipation of the heat generated in the clutches during shifting.

WARNING

Do not exceed 1000 rpm when using supercharger. Return to neutral before advancing throttle.

h. Continue warm-up at 1000-1200 rpm until oil pressures are maintained without fluctuating between 35 and 80 psi (depending on engine temperature) and until oil temperatures rise above 40° C (104° F).

i. When oil inlet temperature has risen above 40° C (104° F) the throttles may be opened to approximately 30" Hg absolute manifold pressure with the propellers in HIGH rpm position. At or near sea level, approximately 30" Hg with the propellers in HIGH rpm position should produce about 2100 rpm on the ground. Do not operate the engines above 1000 rpm until the oil inlet temperature exceeds 40° C (104° F).

j. With the propeller governors set at HIGH rpm, and the mixture controls set at AUTO RICH, open the throttles to 30" Hg and test each engine for operation on each magneto. In switching from both magnetos to one, the normal drop-off should not exceed 100 rpm. Caution should always be used to return the switch from one magneto to BOTH for a short interval before turning to the other. Otherwise the spark plugs not firing may become fouled by running on one magneto. The difference in drop-off from both to either left or right magneto should not exceed 30 to 40 rpm. It should be remembered that the loss in rpm when operating with one or two magnetos varies. Do not operate an engine on one magneto longer than 15 seconds.

WARNING

Do not exceed 232° C (450°) cylinder head temperature during ground operations.

k. With the generator switches ON and the engines running at 2000 rpm the ammeters should indicate CHARGE. If not, and the pointers appear to move freely, stop the engines and inspect the voltage regulator for maladjustment.

l. With the generator switches ON, move the voltage switch first to one engine and then the other. The voltage pointers should move freely and indicate 28.5 volts at no load.

m. After the engines have been completely warmed up, they should be stopped rather than idled for prolonged periods when an immediate take-off is not planned. Prolonged idling at or below 800 rpm may result in fouled spark plugs. With an occasional run-up for cleaning out, short periods of idling at 600 to 800 rpm are feasible.

n. Engine speeds to be avoided.

(1) Avoid continuous operation at 1700 and 2000 rpm.

(2) If excessive motion of power plant is experienced at idling speed (600 to 800 rpm) or warm-up speed (1000 rpm) advance throttle slightly.

6. ACCESSORY CHECK.

a. Check cowl flaps, intercooler exit flaps, and oil cooler flaps for operation.

b. Check engine instruments for operation, excessive pointer oscillation, and proper readings consistent with the stage of warm-up.

CAUTION

Leave fuel cross-feed valve in the OFF *position. This valve is intended for emergency use only.*

c. Test fuel and oil pressures and functioning of engines on all fuel tanks. See that the liquidometer quantity gage registers the correct amount of fuel in the tanks.

d. The following check of the propeller automatic operation should be made when the engine has reached proper operating temperature.

(1) With the selector switch in automatic and the propeller control lever in the take-off position, open throttle until engine turns approximately 1900 rpm. Move selector switch to manual "DECREASE RPM" position and hold until engine speed falls off at least 200 rpm. Then shift to "INCREASE RPM" until engine speed returns to previous value. Return selector to "AUTOMATIC."

(2) Pull the propeller control lever back until a reduction of not more than 200 rpm is noted. At this setting, the propeller should hold the engine at a steady speed without surges or other irregularities.

(3) Return propeller control lever to the take-off position and see that the original rpm is resumed. If it is, the propeller is operating normally and is ready for flight.

NOTE

Make this check for both propellers.

e. Engage the automatic pilot and check for satisfactory operation of all controls. The hydraulic pressure gage should register 110-125 psi and the vacuum gage on the face of the automatic pilot should indicate 4½ " Hg.

f. Operate the de-icer inflating equipment and note whether all shoes inflate and deflate properly.

g. Check operation of radio and interphone equipment.

WARNING

Do not operate landing gear selector valve.

7. EMERGENCY TAKE-OFF.

a. If the airplane has been on the alert, the engines will have been started and will be warm and ready for take-off. The pilot will proceed with a routine take-off, using care not to exceed 53.5" Hg manifold pressure.

b. If an emergency take-off with cold engines is necessary, observe the following procedure:

(1) Start engines. If on taxiing into position low or fluctuating oil pressures are observed, dilute the oil as necessary to relieve this condition. Keep on diluting until a steady pressure is maintained. If fluctuation continues beyond a reasonable period of dilution, drop the rpm and continue the warm-up.

(2) Fuel pressure should be at least 15 psi.

(3) Set wing flaps for take-off. Leave cowl flaps less than ⅓ open to speed warm-up. Proceed with take-off. Do not exceed 53.5" Hg manifold pressure.

8. TAXIING INSTRUCTIONS.

a. The airplane has no objectionable taxiing characteristics.

b. Nose gear towing pin engaged (red cap on).

c. Avoid unnecessary use of brakes while taxiing. In any case, the brakes should not be allowed to drag.

d. Turns may be accomplished by the use of the outboard engine.

e. Taxi with flaps up.

f. If the cylinders become hot because of hard taxiing, permit the engine to idle a short time until it cools to 205° C (400° F).

9. TAKE-OFF.

a. BEFORE TAKE-OFF.

(1) Automatic pilot OFF.

(2) Turret stowed (guns forward and at zero elevation).

(3) Cockpit heaters OFF.

(4) Battery and generator switches ON.

(5) Check surface controls for free movement. Look at control surfaces.

(6) Aileron and rudder trim ZERO. Elevator trim as desired for load.

(7) Entrance hatches closed and locked.

(8) De-icer control lever OFF; anti-icer switch OFF.

(9) Adjust rudder pedals to required leg length by pressing outboard on spring loaded-adjustment plates.

(10) Fuel booster pumps both on HIGH. Fuel pressure 15-19 psi. Selector valves to tanks desired.

CAUTION

Be sure cross-feed valve is OFF.

(11) Check fuel supply.

(12) Propeller safety switches ON, selector switches AUTOMATIC, and propeller control levers in TAKE-OFF position (2700 rpm).

(13) Mixture AUTO RICH.

(14) Supercharger NEUTRAL.

(15) Oil cooler flaps open as desired. Recommended ½ open for normal operations.

(16) Carburetor air heat COLD or as required.

(17) Intercooler exit flaps CLOSED.

(18) Wing flaps neutral to ⅓ down as desired and depending on length of runway.

CAUTION

Always set wing flaps from ZERO.

(19) Emergency hydraulic selector valve NEUTRAL.

(20) Pilot's static pressure selector valve AIRSPEED TUBE position.

(21) Uncage gyro instruments.

(22) Oil temperature 40-90° C (104-194° F).

(23) Oil pressure 75-90 psi at 2000 rpm.

(24) Cylinder head temperature 120-205° C (248-401° F).

(25) Hydraulic and accumulator pressure 800-1100 psi.

(26) Upper cowl flaps closed.

(27) Lower cowl flaps open as required (½ normal).

b. **TAKE-OFF LIMITS.**—2700 rpm, 53.5 Hg MP (5 minutes), cylinder heads 260° (500° F) maximum.

c. The best take-off over an obstacle is made by holding the nose wheel down until take-off speed is attained.

d. At normal gross weight the best take-off speed is 100-110 mph.

10. ENGINE FAILURE DURING TAKE-OFF.

a. If the airplane has not left the ground, close both throttles and attempt to bring the airplane to a stop.

b. If off the ground and without room to land:

(1) Set feather switch of useless propeller to FEATHER.

(2) If necessary for directional control reduce power of live engine slightly.

(3) Retract landing gear.

(4) Carefully build up flying speed and altitude.

(5) Close cowl flaps on inoperative engine.

(6) Set mixture control on dead engine to IDLE CUT-OFF.

(7) Shut off fuel and ignition on useless engine.

11. CLIMB.

a. Climb with full military power is limited to 15 minutes.

b. Best climbing speeds.—The speed for best rate of climb for the airplane is about 140 mph ias. However, to assure proper oil cooling, climbing at about 160 mph ias is recommended.

c. Landing gear and wing flaps UP.

d. Mixture AUTO RICH.

e. Oil Pressure.

Military	75-100 psi
Rated	75-95 psi
Desired	75-90 psi

f. Adjust cowl flaps and oil cooler shutters as desired.

g. Oil temperatures.

Military	40-100° C (104-212° F)
Rated	60-85° C (140-185° F)
Desired	60-85° C (140-185° F)

h. Fuel Pressure—15-17 psi.

i. Carburetor air heat as required.

WARNING

Maximum safe carburetor air temperature in auxiliary stage supercharger 32° C (89° F). Carburetor pre-heat is not used in auxiliary stage.

j. **BLOWERS.**

(1) To shift blowers to next higher stage, reduce manifold pressure 4-5" and move blower clutch control quickly to next higher stage. To shift to next lower stage, simply move blower clutch control quickly to desired position.

CLIMB

Operating Condition	Max. Man. Pressure	Altitude	Blower Ratio	RPM	Cyl. Head Temp. Max.
Military Power (15 min.)	53.5 54.5 51.5	0-6500 6500-19000 19000 Up	Neutral Low High	2700	260° C. (500° F.)
Rated Power	43.5 47.5 48.0	0-8000 8000-19500 19500 Up	Neutral Low High	2550	260° C. (500° F.)
Desired Climb	34.5 36.5 37.5	0-13000 13000-23000 23000 Up	Neutral Low High	2325	232° C. (449° F.)

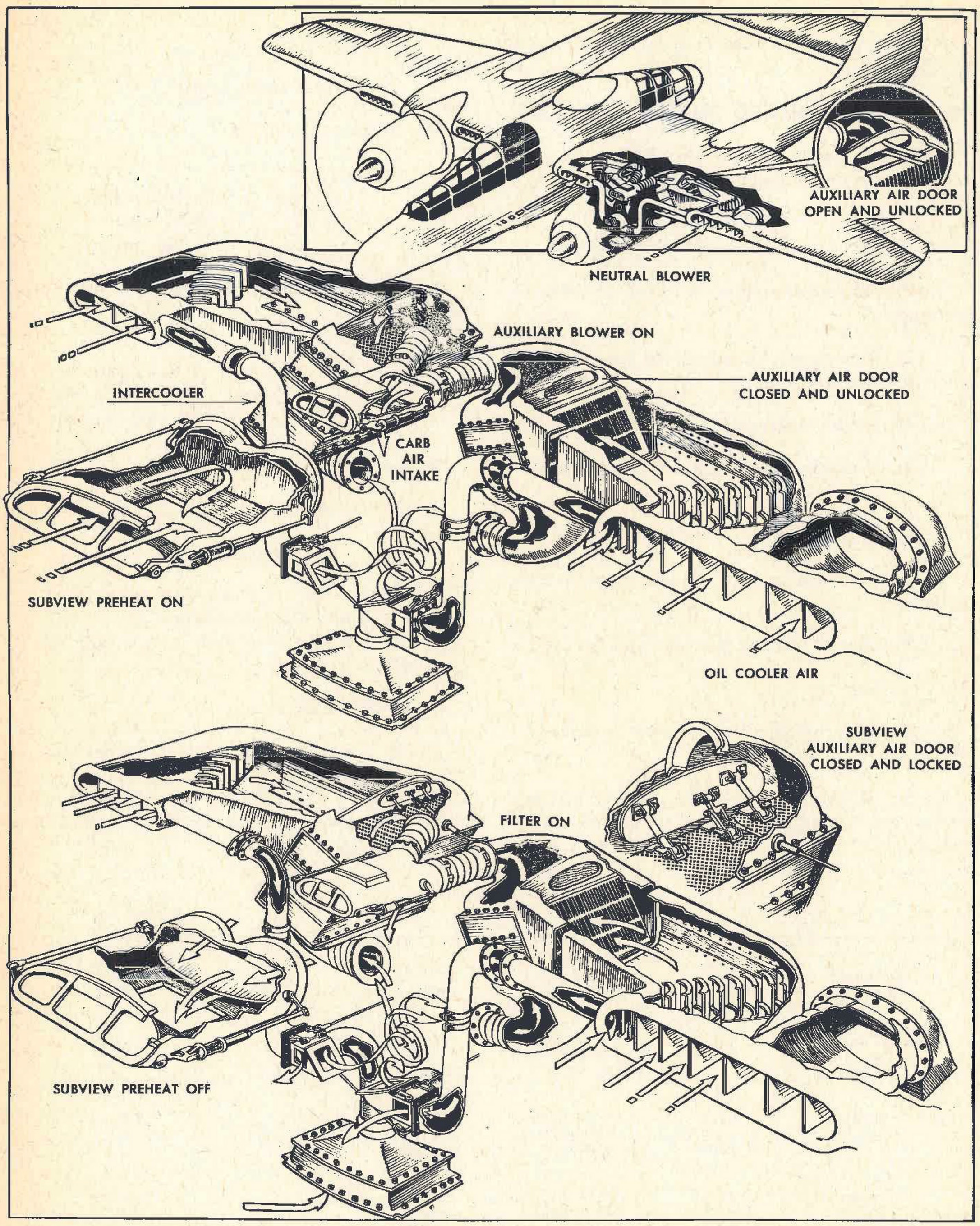


Figure 18 — Induction System

CAUTION

Do not pause while shifting blower.

(2) Intercooler flaps CLOSED unless carburetor air temperature exceeds 45° C (113° F).

k. During climbs, cruising, and maneuvers the propeller should continue to be operated in AUTOMATIC and the engine speed regulated by adjusting the propeller control levers.

12. PERFORMANCE.

The maximum performance of the Airplane can be obtained only by operating at the limiting conditions in every factor. Maximum power must be used when necessary. Weight must be kept at a minimum for the particular mission under consideration and the handling characteristics at the maximum performance must be familiar to the pilot.

Maximum power depends upon roughly, three things: The mechanical ability of the engine; second, the combustion characteristics of the fuel and cylinder which limits the boost which may be used without detonation; and the third, the cooling characteristics of the airplane installation. The intercooling affects the power in that it limits the boost that can be used without running the risk of detonation and secondarily, in the loss of efficiency due to running with warm air instead of cold.

Pilots should not hesitate, in order to obtain maximum performance to operate at 260° C cylinder head temperature, 100° C oil temperature, and 40° C carburetor air temperature. *All cowl and intercooler flaps should be kept fully closed, and oil cooler flaps should be just cracked open,* as long as the above maximum temperatures are not exceeded. It is obvious that the high speed capabilities of an airplane will not be realized if an over-conservative attitude is held relative to temperature ranges, and cooling flaps are allowed to remain open to create performance killing drag.

It is to be understood, of course, that the above comments apply to emergency conditions, and not to every day flying.

13. GENERAL FLYING CHARACTERISTICS.

a. CRUISING

Operating Condition	RPM	Max. Man. Pressure	Altitude	Blower Ratio	Mixture
Recommended Cruising	2150	29	0-17000 17000-26000 26000 Up	Neutral Low High	Auto Lean
Maximum Cruising	2230	32.0 33.0 33.5	0-11000 11000-24000 24000 Up	Neutral Low High	Auto Lean

(1) Carburetor air heat as required.

(2) Oil temperature 60-75° C (140-167° F).

(3) Oil pressure 60-90 psi.

(4) Fuel pressure 15-17 psi.

(5) Cylinder head temperature 232° C (449° F).

(6) Intercooler flaps CLOSED.

(7) Volts 28 to 28.5; amperes 40 maximum.

(8) During prolonged flights the supercharger shift lever should be shifted once every three hours if tactical conditions permit. This will prevent accumulation of sludge which will cause malfunctioning of the blower clutches.

b. The airplane exhibits a high degree of stability about all three axes. Lowering the flaps makes the airplane somewhat nose heavy in trim.

NOTE

The spoiler type ailerons are less effective for small deflections with flaps down than the conventional type.

Increase in engine power will have some effect upon longitudinal trim.

c. **AUTOMATIC PILOT. (Fig. 19)**

(1) OPERATION.

(a) Turn on auto pilot pressure valve.

(b) Check auto pilot pressure (100-125 psi).

(c) Trim ship, then line up indices.

(d) Turn on auto pilot.

(e) Regulate speed control valves as desired.

(2) Do not permit the automatic pilot to control the airplane under the following flying conditions:

(a) In extremely turbulent air.

(b) When de-icers are operating.

(c) At less than 140 mph ias.

(d) When either engine is not functioning properly.

(3) Suction 3.75 - 4.25 Hg.

d. Do not use electric booster pump to draw the last few gallons of fuel from the tank.

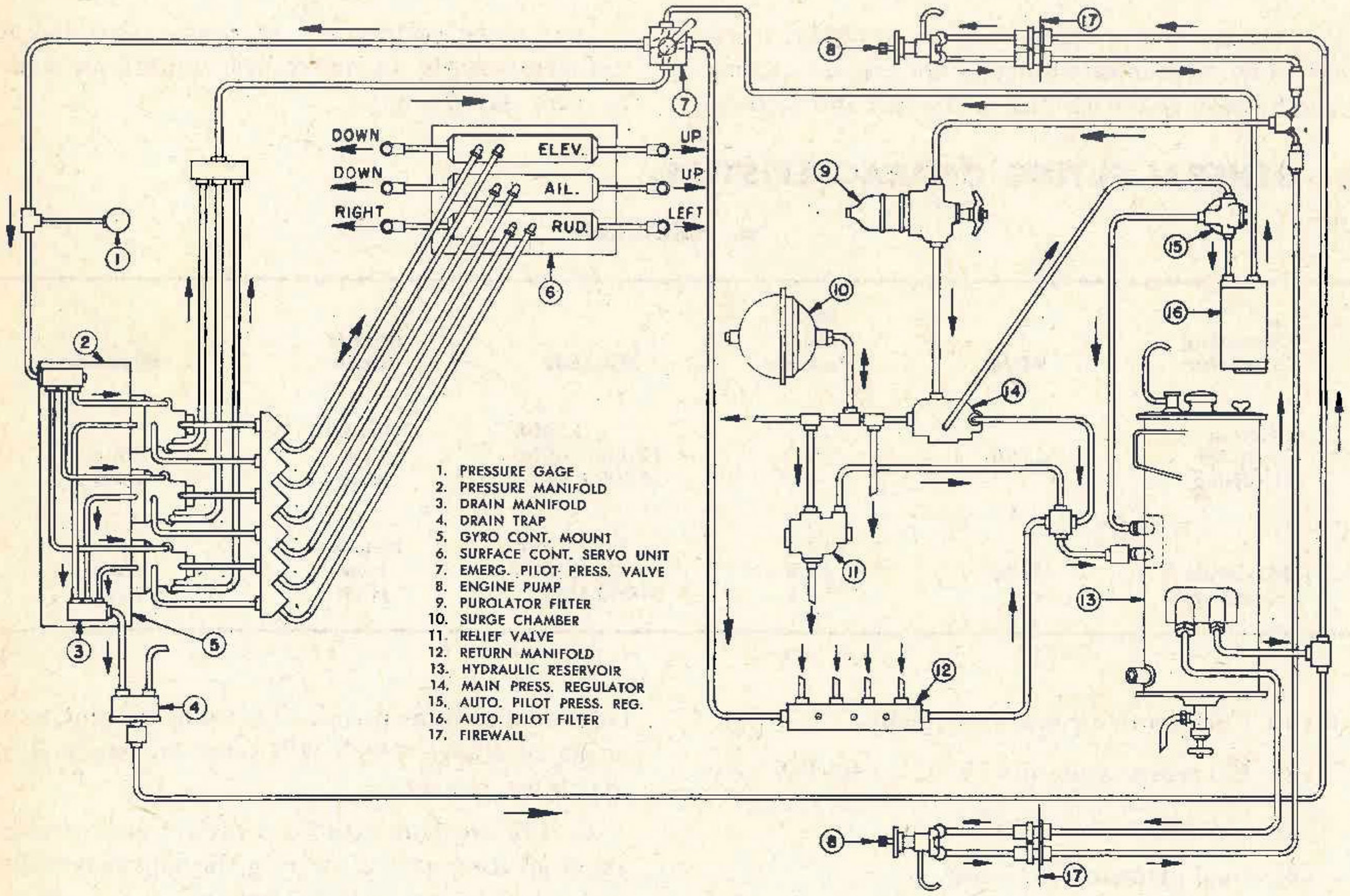


Figure 19—Auto Pilot System

NOTE

Watch the fuel supply! No tank should be permitted to run entirely dry. Fuel gages are accurate when the airplane is in level flight or on the ground.

e. Do not exceed 175 mph ias with flaps full down.

f. To increase or reduce power:

(1) Increase engine power as follows:

(a) Adjust mixture control to AUTO RICH if more than cruising power is desired.

(b) Adjust propeller control to obtain the desired rpm.

(c) Adjust throttle control to obtain desired manifold pressure.

(2) Decrease engine power as follows:

(a) Adjust throttle control to obtain desired manifold pressure.

(b) Adjust propeller control to obtain the desired rpm.

(c) Readjust throttle controls if necessary.

(d) Adjust mixture controls to the desired position.

14. MANEUVERS PROHIBITED.

a. THE FOLLOWING MANEUVERS WILL NOT BE PERMITTED:

Outside Loop
Inverted Flight
Normal Spin
Inverted Spin
Snap Rolls

15. STALLS.

a. The airplane possesses good stall characteristics both with flaps DOWN and with flaps UP, with power OFF or with any amount of power applied to either or both engines. In all cases, the stall results in dropping of the nose straight forward without a rolling tendency.

b. APPROXIMATE STALLING SPEEDS.

Flaps up, power off	100 mph, ias
Flaps up, cruising power (30" Hg, 2200 rpm)	90 mph, ias
Flaps down 60°, power off	80 mph, ias
Flaps down 60°, normal rated power	75 mph, ias
Flaps and gear down, power off	80 mph, ias

c. In stalls occurring with one engine inoperative, rudder forces to compensate for yaw are high, requiring 80% to 100% full rudder deflection. No aileron deflection is necessary to hold the ship level laterally at cruising power. At military power 5% to 10% aileron deflection is required. With gear and flaps down 75% to 90% aileron deflection is necessary.

d. Ample warning of an impending stall occurs in the form of strong tail buffeting.

e. Up to and in the stall, elevator, rudder, and aileron controls are slow but positively effective. No deflection of the controls is necessary to prevent roll in the stall once the controls have been set to produce stall.

NOTE

Because this ship has such unusually excellent stall characteristics, it is recommended that pilots investigate normal stalls and also single-engine stalls. Use caution to maintain plenty of altitude because rate of descent in stalls is exceedingly high.

16. SPINS.

e. There is no tendency for the airplane to spin inadvertently either in the cruising or landing attitude. Preliminary tests indicate that the airplane will re-

cover from a spin up to the half-turn mark almost instantly by relaxing pressure on either rudder or elevator controls.

b. With gear and flaps up the airplane falls off slowly and deliberately. At the end of a 180° turn, the nose of the airplane will be nearly straight down. Rate of descent is high, although forward velocity does not increase appreciably during a half turn.

c. With gear and flaps down, spinning characteristics are similar to those of the airplane in the clean condition. In addition, continuous and fairly severe buffeting occurs and the spin is oscillatory in nature. Recovery is considerably slower than in the clean condition.

d. Deliberate spins are prohibited.

CAUTION

Very high control forces, coupled with extremely high rate of descent, may be expected in a developed spin.

17. ACROBATICS.

a. The following maneuvers will be permitted in the normal load condition at a gross weight of not more than 28,217 lbs. At a load greater than this, no maneuvers or acrobatics of any type will be permitted.

Normal Loop

Immelman

Chandelle

Slow Rolls (Speed not more than 350 mph ias)

18. DIVING.

a. **LIMITS.**
Maximum diving rpm 3060.
Maximum diving speed 380 mph ias.

b. In comparison with other types, the airplane will pick up speed normally when placed in a dive.

19. APPROACH AND LANDING.

a. During a descent from altitude at which use of the auxiliary blower was necessary, shift to NEUTRAL as soon as practicable.

b. **BEFORE LANDING THE AIRPLANE, PERFORM THE FOLLOWING OPERATIONS:**

(1) Automatic pilot OFF.

(2) De-icer and anti-icer OFF.

(3) Gun turret stowed.

(4) Fuel selector valves to fullest tanks.

CAUTION

Cross-feed valve must be OFF.

(5) Fuel booster pumps HIGH.

(6) Hydraulic and accumulator pressure 800-1100 psi.

(7) Supercharger NEUTRAL.

(8) Mixture FULL RICH.

(9) The propellers should be set for automatic operation and the propeller control levers set for 2400 rpm. With this setting the propellers will operate satisfactorily in the event that landing is deferred.

(10) Cowl flaps as necessary.

(11) Landing gear DOWN. Check by indicator and sight.

WARNING

Landing gear must NOT BE *lowered at more than 175 mph, ias.*

(12) Cockpit heaters OFF.

(13) Flaps DOWN.

WARNING

Flaps should NOT BE *placed in this position at more than 175 mph, ias.*

WARNING

Do not lower the landing lights at more than 140 mph, ias.

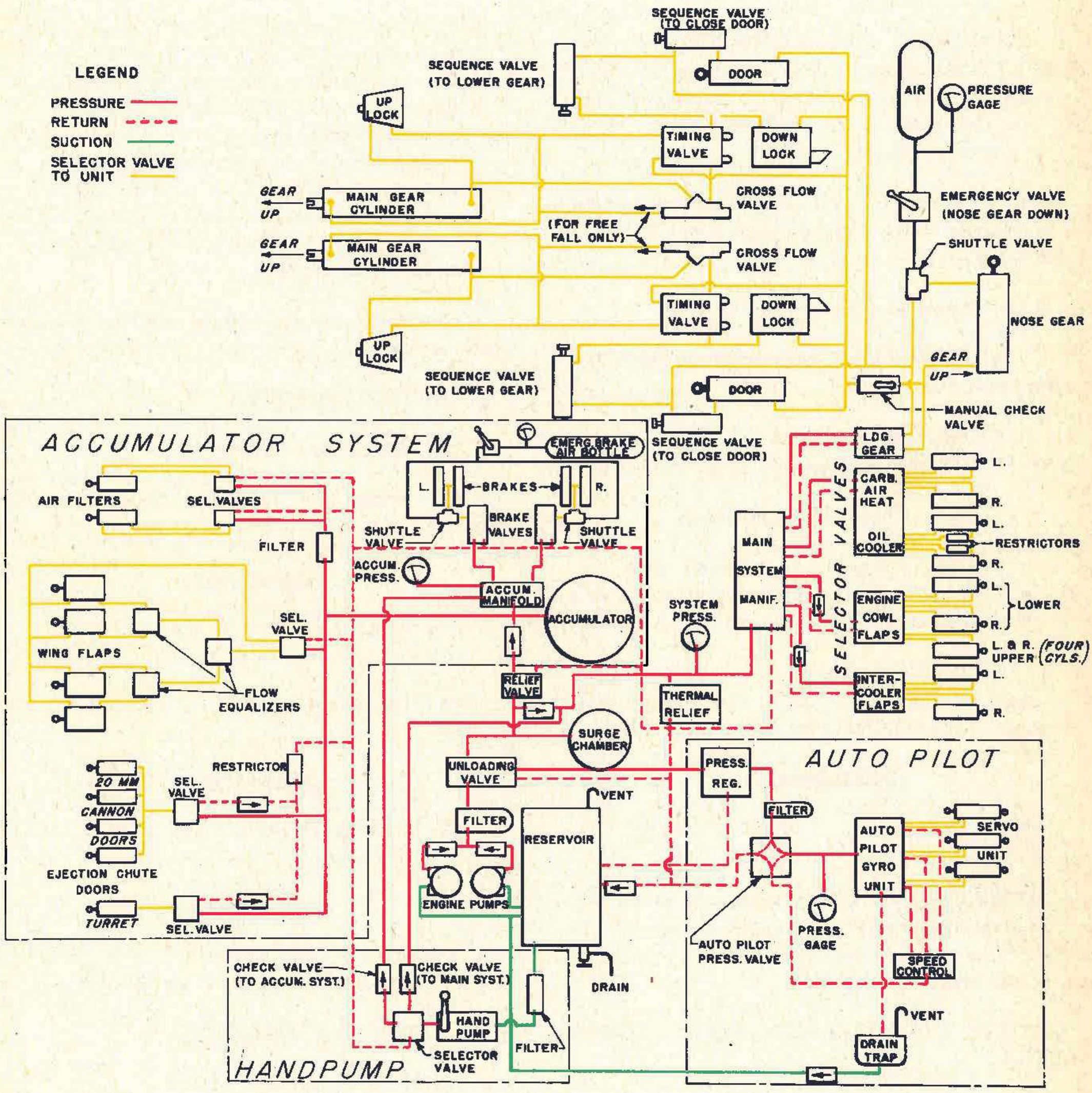


Figure 20 — Hydraulic System

c. **BEST LANDING SPEEDS.**

Power on	75 mph, ias
Power off	80 mph, ias

d. **LANDING WITH ONE ENGINE INOPERATIVE.**—Single-engine approach and landing technique is largely a matter of training, experience, and the desire of the individual pilot. However, it is recommended that:

(1) If the dead engine can be used, even at the risk of possible further damage, start it and operate it at reduced power.

(2) If the dead engine cannot be used:

(a) Make a fairly high approach with partial flap deflection.

(b) Maintain safe speed and altitude until it is certain that there is no danger of under-shooting.

(c) Deflect flaps 40° (two-thirds).

(d) The decision to "go around again" because of possible over-shooting should be made at a time when airplane still has a safe margin of altitude.

(e) If it is necessary to go around again, raise gear immediately. Apply power gradually, "bleed" flaps up as desired as soon as speed permits.

WARNING

Do not make turn with inoperative engine down.

e. **CROSS WIND LANDING.**—Same as normal landing. The tricycle gear and the weight of the airplane reduce danger from landing in a reasonably strong cross wind.

f. **TAKE-OFF IF LANDING IS NOT COMPLETED.**

(1) Open throttles gradually to approximately 40" Hg.

(2) Retract landing gear immediately.

(3) Apply more power by increasing both rpm and manifold pressure as desired and if necessary.

(4) Retract flaps when adequate speed has been obtained.

NOTE

The first 20° of flap deflection provides the most advantageous lift over drag ratio for slow speed flight. The remaining 40° flap deflection, while it does increase the maximum lift, primarily increases drag. It is recommended that the flaps be raised to 20° (one-third deflection) as soon as feasible and that the remaining 20° be raised after forward speed has increased sufficiently to provide a safe margin.

(5) Open lower cowl flaps as necessary for adequate cooling.

g. **AFTER LANDING.**

(1) All engine cowl flaps OPEN.

(2) Wing flaps UP after landing run has stopped.

CAUTION

If wing flaps are raised during landing run, brakes may be robbed of hydraulic pressure.

(3) Do not apply full brakes immediately after landing.

WARNING

Do not allow landing lights to burn for more than three minutes.

WARNING

Immediately upon completion of landing run, position lamps must be turned OFF.

20. STOPPING ENGINES.

a. **NORMAL OPERATION.**

(1) If the cylinder head temperatures are high after landing, allow the engines to idle for a short time at approximately 1000-1200 rpm until the temperatures have dropped below 205° C (400° F). Mixture should be AUTO RICH and oil cooler air exit doors and ALL cowl flaps should be OPEN.

(2) To stop the engines, move the mixture control levers to IDLE CUT-OFF. When the engines have stopped, turn all switches OFF.

(3) Leave the mixture control levers in IDLE CUT-OFF and do not shut off the fuel tank selector valves.

(4) In anticipation of cold weather starting, the oil should be diluted BEFORE the engines are stopped and AFTER the cylinder head temperatures have dropped below 205° C (400° F).

(a) Operate each engine at 800 rpm.

(b) Maintain oil temperatures 5-50° C (40-122° F).

(c) For ground temperatures from 5 to —7° C (40 to 20° F), hold dilution switch ON four minutes, stop engines, release dilution switch.

(d) For temperatures —7 to —30° C (+20 to —20° F), dilute for a second four-minute period fifteen minutes after first dilution.

(e) For temperatures below —30° C (—20° F), dilute for a third four-minute period fifteen minutes after second dilution.

***b.* EMERGENCY OPERATION.**—If the IDLE CUT-OFF does not stop the engine, close the throttle, cut the ignition switch and slowly open the throttle wide as the engine stops. Have the IDLE CUT-OFF adjusted properly as soon as possible.

21. BEFORE LEAVING THE PILOT'S COMPARTMENT.

a. Gyro instruments caged.

b. Be sure that all switches are OFF.

c. Do not turn fuel selector valves OFF.

d. Set parking brake by depressing brake pedals and pulling up on parking brake lever. The parking brake will release automatically when pedals are again depressed.

CAUTION

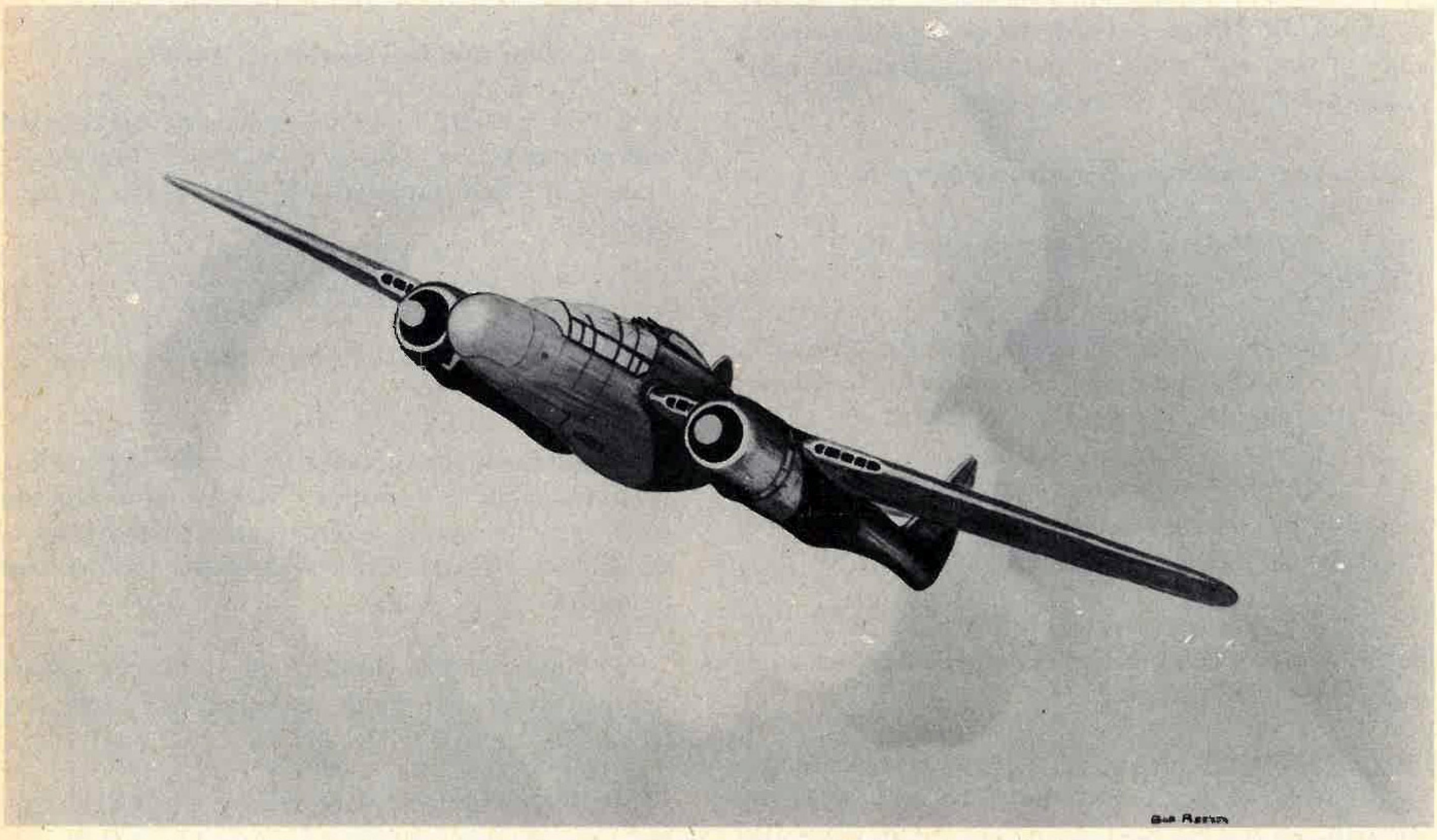
Do not use parking brakes when brakes are hot.

e. Set the flight control lock by moving the lever forward to the ON position. Gently move the controls until the spring-loaded lugs slip into place on the aileron, elevator and rudder cables, locking them in neutral.

f. Upper engine cowl flaps OPEN. In warm weather, leave all engine and accessory cowl flaps OPEN.

g. After leaving airplane, close and lock both front and rear entrance hatches.

Figure 21 — Auto Pilot Instruments



1. AIRSPEED LIMITATIONS.

WING FLAPS SHOULD NOT BE FULLY EXTENDED AT MORE THAN 175 MPH IAS.

LANDING GEAR SHOULD NOT BE EXTENDED AT MORE THAN 175 MPH IAS.

LANDING LIGHTS SHOULD NOT BE EXTENDED AT MORE THAN 140 MPH IAS.

MAXIMUM DIVING SPEED 380 MPH IAS.

DO NOT PERMIT AUTO PILOT TO CONTROL THE AIRPLANE AT LESS THAN 140 MPH IAS.

FORM ASC-512A

AIRPLANE MODELS

P-61A

SPECIFIC ENGINE FLIGHT CHART

ENGINE MODELS

(2) R-2800-10

CONDITION	FUEL PRESSURE (LB/SQ. IN.)	OIL PRESSURE (LB/SQ. IN.)	OIL TEMP. °C	OIL TEMP. °F	COOLANT TEMP. °C	COOLANT TEMP. °F		
DESIRED	16	75-80	60-75	140-167				
MAXIMUM	17	90	100	212				
MINIMUM	15	60	40	104				
IDLING	7	25						

MAX. PERMISSIBLE DIVING RPM: 3060

CONDITION	ALLOWABLE OIL CONSUMPTION
NORMAL RATED (MAX. CONT.)	32 U.S.QT/HR 53 IMP.PT/HR
MAX. CRUISE	22 U.S.QT/HR 37 IMP.PT/HR
MIN. SPECIFIC	18 U.S.QT/HR 30 IMP.PT/HR

OIL GRADE: (S) AN-VV-O-446 (W) AN-VV-O-446

SUPERCHARGER TYPE:

FUEL GRADE: OCTANE

OPERATING CONDITION	RPM	MANIFOLD PRESSURE (BOOST)	HORSE-POWER	CRITICAL ALTITUDE WITH RAM	CRITICAL ALTITUDE NO RAM	BLOWER	USE LOW BLOWER BELOW:	MIXTURE CONTROL POSITION	FUEL FLOW (GAL/HR/ENG.) U.S.	FUEL FLOW (GAL/HR/ENG.) IMP.	MAXIMUM CYL. TEMP. °C	MAXIMUM CYL. TEMP. °F	MAXIMUM DURATION (MINUTES)
TAKE-OFF	2700	54.0	2000		1500	Neut.		Auto Rich	300	250	260	500	15
WAR EMERGENCY	Not Applicable												
MILITARY	2700	52.5 54.0 53.0	2000 1800 1650		1500 13,500 20,000	Neut. Lo Hi		Auto Rich	300 295 270	250 246 225	260	500	15
NORMAL RATED (MAX. CONT.)	2550	44.0 49.5 49.5	1675 1625 1550		5500 15000 21500	Neut. Lo Hi		Auto Rich	225 240 230	188 200 192	260	500	
MAXIMUM CRUISE	2230	32.0 33.0 33.5	1125 1090 1045		12200 22000 27300	Neut. Lo Hi		Auto Lean	110 115 110	92 96 92	232	451	
MINIMUM SPECIFIC CONSUMPTION	1450 1750 2050	31.5 32.0 33.5	660 800 925		5000 15000 25000	Neut. Lo Hi		Auto Lean	65 75 105	54 63 88	232	451	

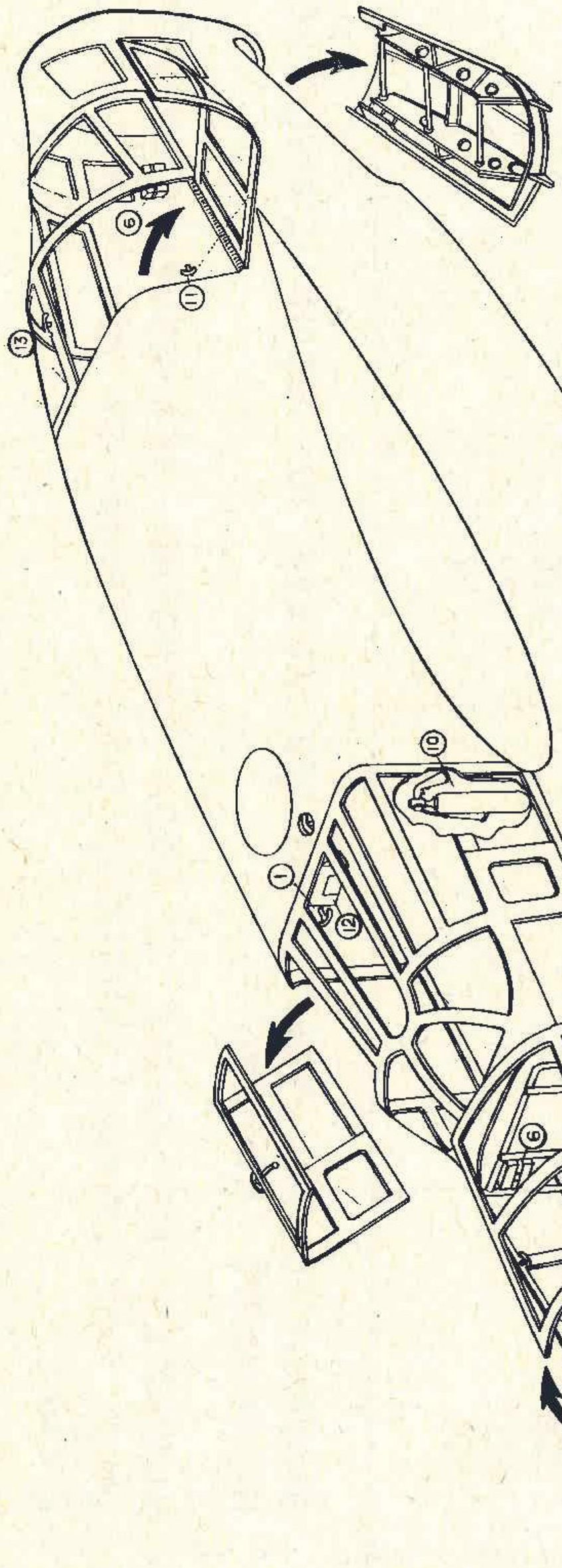
REMARKS: Avoid continuous cruising at engine speeds below that at which generator cuts in (approximately 1400 rpm).

CALIBRATED INDICATED AIRSPEED (MPH)	INSTALLATION ERRORS *			
	FLAPS UP		FLAPS DOWN	
	AIRSPEED (MPH)	ALT. (FT.)**	AIRSPEED(MPH)	ALT(FT.)**
100			5	33
120	8	78	3	25
140	8	81	0	3
160	8	86		
180	8	90		
200	8	96		
220	8	104		
240	8	114		
260	7	126		
280	7	141		
300	7	157		

* SUBTRACT ERROR FROM CALIBRATED VALUES TO OBTAIN CORRECTED INSTRUMENT READING.

** ALTIMETER APPLICABLE AT NACA STANDARD SEA-LEVEL CONDITION ONLY. FOR OTHER CONDITIONS DIVIDE ERROR BY AIR DENSITY RATIO.

AIRSPEED CORRECTION CHART.



1 EMERG. ENCL. REL. HANDLES
2 EMERG. HYD. SELECTOR VALVE
3 EMERG. HYD. HAND PUMP
4 MASTER SWITCH
5 EMERG. AIR BRAKE
6 FIRST AID KIT
7 PROP. FEATHERING SWITCH
8 WARNING BELL SWITCH
9 EMERG. LDG. GEAR RELEASE
10 FIRE EXTINGUISHER
11 RADIO OPER'S DOOR RELEASE
12 SIGNAL PISTOL & CARTRIDGES
13 CLAM SHELL RELEASE
14 DESTRUCTOR

NOTE

A ONE QUART TYPE A-2 HAND OPERATED FIRE EXTINGUISHER (FOR GROUND USE) IS ACCESSIBLE THROUGH EACH MAIN WHEEL WELL OPENING.

Figure 22 – Emergency Equipment and Exits

1. EMERGENCY EXITS. (Fig. 22)

a. **RADIO OPERATOR'S EMERGENCY EXIT.**—The radio operator's entrance door is released by pulling sharply on the red emergency release handle and AT THE SAME TIME pulling on the normal release. This removes the hinge pins, allowing the door to drop free to be carried away by the airstream. The emergency release handle is located on the lower left side of the radio operator's compartment. (Fig. 23.)

b. **PILOT'S AND GUNNER'S EMERGENCY EXIT.**—The right-hand portion of the forward cockpit, aft of the gunner's windshield, is released to fly away by pulling sharply on the emergency release handle. The pilot and gunner crawl through the opening onto the inner wing.

(1) The gunner's seat is opposite the emergency exit and gives him immediate access to it.

(2) To reach the emergency exit, the pilot should release his seat to tilt backward by pressing the adjustment lever on the back of the seat, behind his right shoulder. This permits him to move quickly aft to the emergency exit.

(3) If the gunner's armor plate is locked in position, it may be released by pressing the spring-loaded handle at the bottom center of the armor plate and sliding the bolt to the right. The armor plate is then free to swing out of the way.

(4) Both pilot and gunner should leave the airplane by sliding head first and face down over the leading edge of the inner wing.

c. When the pilot makes the decision to abandon the airplane the crew should be warned by sounding the alarm bell according to a prearranged signal. All members of the crew should thoroughly understand the use and meaning of the alarm bell.

(1) The warning bell operating switch is located beside the left cockpit rail between the gunner's and pilot's positions. It is accessible to both gunner and pilot.

(2) There are two warning bells; one beneath the radio operator's table on the right side of the crew nacelle, the other on the right side of the crew nacelle near the gunner's seat.

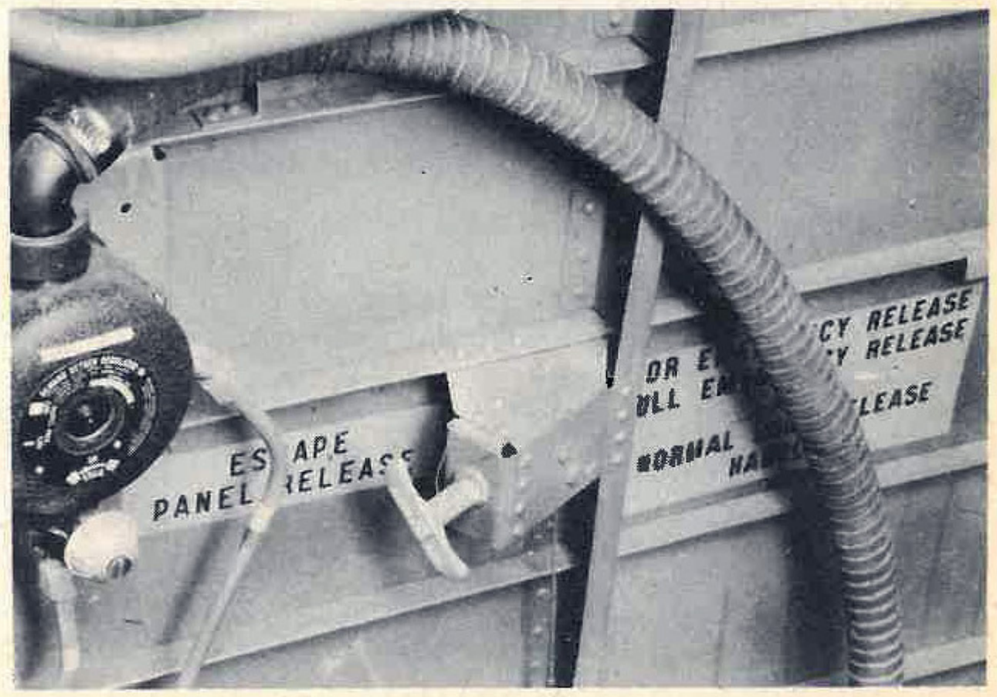


Figure 23 — Radio Operator's Emergency Release

2. HYDRAULIC SYSTEM FAILURE. (Fig. 20)

a. Hydraulic system failure may be caused by a leak in one of the lines or units, or failure of the engine-driven hydraulic pumps. Usually the failure will be indicated by low pressure gage reading (normal 850-1000 psi).

b. In case of failure of the hydraulic system, all hydraulic equipment except the auto pilot may be operated by the hand pump for a short time unless the fluid leaks out faster than the hand pump can supply pressure.

NOTE

Normally it will be advisable to save the hand pump for flap and brake operation during landing.

(1) If a leak occurs in the main system, the fluid in the accumulator and about one-third of the fluid in the main reservoir will be available for emergency operation.

(2) The hand pump is located to the right of the control column and the hand pump selector valve immediately in front of the hand pump handle. (Fig. 24.)

Figure 24 — Hydraulic Hand Pump Selector Valve

(3) TO OPERATE HAND PUMP.

(a) Turn hand pump selector valve to either SYSTEM or ACCUMULATOR as required.

NOTE

Both the wing flap system and brake system operate from the accumulator.

(b) Pump vigorously to produce the required pressure.

(c) Fluid is forced from the pump to a selector valve from which it may be directed to the main system (landing gear, carburetor air heat, oil cooler doors, engine cowl flaps, intercooler flaps) or to the accumulator system (wing flaps, landing gear brakes, ejection chute doors, carburetor air filters).

(d) When the hand pump is not in use, the selector valve should be turned to neutral.

c. EMERGENCY OPERATION OF LANDING GEAR. (Fig. 25.)

(1) In event of failure of the main hydraulic system, lower the selector valve knob and with hand pump selector valve on SYSTEM, operate hand pump until wheels are all locked DOWN. If this method fails, leave selector valve knob DOWN, and PULL the landing gear emergency release handle to extend the gear. Hold the handle up until the nose gear is locked down, then RELEASE.

3. GEAR-UP LANDING.

a. If it is necessary to make a gear-up landing, proceed as follows:

(1) If time and other conditions permit, fire all 20 mm cannon ammunition.

(2) Fully extend wing flaps.

(3) Make approach just above stalling speed.

(4) Turn master switch OFF before the airplane touches the ground.

(5) Land at slowest practical speed.

(6) Precautions against fire must be taken immediately after landing.

(7) First aid kits are stowed in both the forward and aft compartments. (Fig. 22.)

4. BRAKE FAILURE.

a. Brakes are normally operated by fluid from the accumulator hydraulic system and regulated from the pilot's foot pedals.

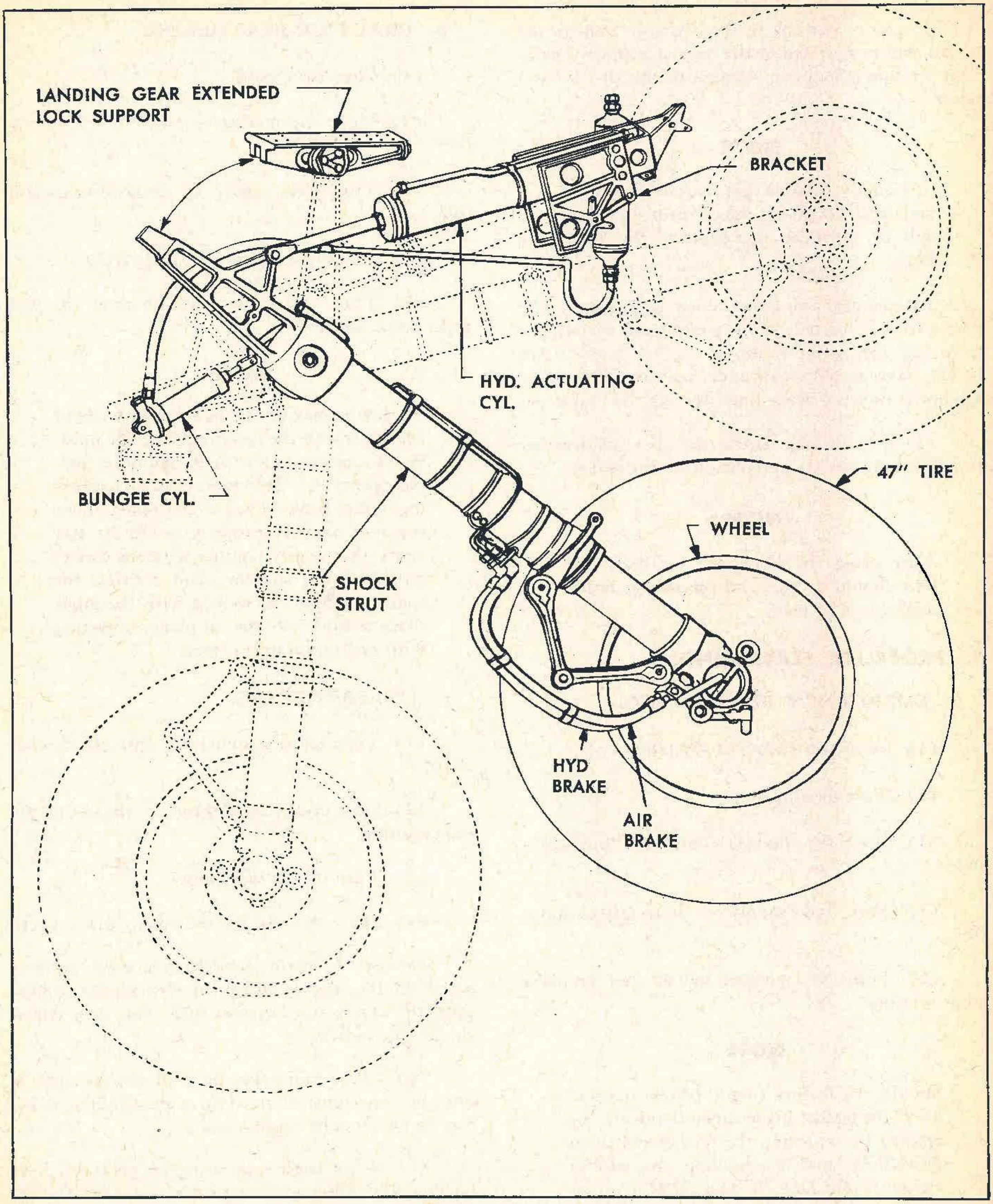


Figure 25 — Main Gear Hydraulic Operation

b. In case of damage to the hydraulic system, the brakes may be operated in the normal manner if sufficient pressure is built up through the use of the hand pump.

NOTE

It is highly possible that hydraulic pressure built up through the use of the hand pump will be expended in operating the wing flaps.

c. An emergency air brake system is provided. The release lever is located on the cockpit rail toward the front left corner. Operation of the EMERGENCY AIR BRAKE lever introduces air under pressure from a storage bottle into the brake lines, forcing the brakes on.

(1) The storage bottle contains sufficient air for approximately six applications of the brakes.

NOTE

After using the emergency air brake the lines should be bled and the storage bottle refilled to 425 psi.

5. PROPELLER FEATHERING.

a. EMERGENCY FEATHERING.

(1) Set feather switch to FEATHER.

(2) Close the throttle.

(3) Move the mixture control to IDLE CUT-OFF.

(4) Turn fuel supply to inoperative engine OFF.

(5) Turn OFF ignition switch after propeller stops rotating.

NOTE

Should the feather circuit become inoperative, the feather blade angle setting may be reached by returning the feather switch to *NORMAL* and by holding the selector switch in the *DECREASE RPM* position until the feather blade angle setting is reached.

b. PRACTICE FEATHERING.

(1) Close the throttle.

(2) Move the mixture control to IDLE CUT-OFF.

(3) Turn fuel supply to inoperative engine OFF.

(4) Set feathering switch to FEATHER.

(5) Turn OFF ignition switch after the propeller stops rotating.

NOTE

Feathering may be used at any time without restrictions on the propeller as to the number of consecutive feathering and unfeathering operations. However, practice feathering in flight should not be attempted unless the pilot has been properly CHECKED OUT and is thoroughly familiar with the correct procedure for stopping and starting the engine in flight, as well as with the flight characteristics of the airplane operating with one inoperative engine.

c. UNFEATHERING.

(1) Turn ignition switch ON with the throttle closed.

(2) Set propeller control lever to the DECREASE RPM position.

(3) Turn ON the fuel supply.

(4) Move the mixture control to FULL RICH.

(5) Set feathering switch to normal position and hold the selector switch in the INCREASE RPM until the engine speed reaches 800 rpm, then release the selector switch.

(6) If the engine has been allowed to cool, it must be thoroughly warmed up at about 800 rpm before being brought up to speed.

(7) When engine operating temperatures have been reached, place selector switches in AUTOMATIC, adjust mixture, throttle, and propeller control levers to the desired power and engine rpm.

6. ENGINE FAILURE DURING FLIGHT.

a. With one engine off and propeller windmilling, the live engine pulling military power and rudder trim neutral, the airplane can be controlled down to its normal stalling speed (gear and flaps up) of 102 mph ias. Under the same conditions with gear and flaps down, it can be controlled down to its stalling speed of 80 mph ias. The ability of the pilot to "catch" the airplane and maintain directional and lateral control under conditions of military power and slow forward speeds, coupled with sudden engine failure, will depend upon the speed and accuracy with which the pilot can apply the necessary corrective control deflections. Under normal conditions of flight, it will not be necessary to reduce the power of the live engine. Therefore, on inoperative engine:

(1) Set feathering switch to FEATHER.

(2) Move mixture control to IDLE CUT-OFF.

(3) Close cowl flaps.

(4) Turn ignition switch OFF.

(5) Place live engine in AUTO RICH.

WARNING

Avoid violent maneuvers. Do not make steep turns with inoperative engine down.

b. If, for any reason, forward speed falls below the minimum for control, regain speed by losing altitude and not by applying additional power.

7. FUEL SYSTEM FAILURE IN FLIGHT. (Fig. 9)

a. **FUEL PUMP FAILURE.**—The fuel booster pump should maintain a fuel pressure sufficient for normal engine operation.

b. **BOOSTER PUMP FAILURE.**—If engine fails, turn the selector valve to another tank and restart the engine.

c. **FAILURE OF BOTH FUEL AND BOOSTER PUMPS ON ONE ENGINE.**

(1) Turn ON cross feed valve.

(2) Turn booster pump on operating engine to HIGH.

(3) Restart engine.

d. **TANK ALLOWED TO RUN DRY.**

(1) Turn selector valve to a full tank.

(2) If both tanks on one side are dry, turn on cross-feed valve.

(3) Restart engine.

e. **BROKEN FUEL LINE.**

(1) Turn mixture control to IDLE CUT-OFF and booster pump OFF on side where break occurs.

(2) Turn selector valve OFF.

NOTE

If cross feed valve is on turn it OFF.

(3) Feather the propeller on the affected engine.

(4) When propeller stops rotating cut ignition switch on the inoperative engine.

(5) Operate the airplane on one engine. Watch for evidence of fire.

8. OIL SYSTEM FAILURE DURING FLIGHT. (Fig. 10)

a. Turn mixture control to IDLE CUT-OFF.

b. Turn selector valve OFF until the gas is needed in the other engine.

c. Turn booster pump OFF.

d. Feather propeller on affected engine. When propeller stops rotating, cut ignition switch.

e. Operate on one engine.

9. FIRES IN FLIGHT.

a. **ENGINE FIRES.**

(1) If the fire is in the engine nacelle, close the cowl flaps in an effort to smother the fire.

(2) If the fire is not controlled, shut off gasoline supply to affected engine and open throttle.

b. **WING FIRES.**

(1) Turn all switches controlling landing or navigation lights OFF.

(2) Attempt to extinguish the fire by sideslipping.

c. **CREW NACELLE FIRES.**

(1) Close all windows and ventilators.

(2) If electrical fire, turn master switch OFF. If leaking fuel or hydraulic line, shut off valves.

(3) Put fire extinguisher into use immediately. It is adequate for fighting fires only in the earliest stages.

P-61

10. DITCHING.

a. **PREPARATIONS FOR DITCHING.**

(1) Preparation for ditching must not be left until the final moment. The nature of the operation is such that adequate time must be allowed to conclude proper arrangements in advance. If the correct steps are taken the safety of the crew and the ultimate chances for rescue will be greatly enhanced.

(2) If the pilot reasonably believes that it will be necessary to ditch the airplane, the SOS signal, time, and position should be given. This distress call should be made well in advance of actual ditching. If conditions make it unnecessary to carry out the operation the call can always be cancelled.

(3) If time permits, all ammunition in the airplane should be fired. This is a safety measure that also serves to lighten the airplane.

(4) Both fore and aft entrance doors and the landing gear doors should be checked to be certain that they are securely closed and fastened. The radio operator's clam shell, the forward emergency exit, and the pilot's access door should be opened just before the airplane is set on the water. This does away with the possibility of jamming upon impact because it is imperative that the crew leave the airplane without delay.

(5) All bright internal lights should be turned off in order to accustom the eyes to darkness. After ditching, all lights should be turned on in order to assist search in the event the airplane floats.

(6) It is absolutely essential that the airplane be ditched while there is sufficient fuel to permit a power-on landing. Final decision to ditch the plane should be made when at least enough fuel for fifteen minutes' operation remains, unless the pilot is certain that he can reach land. Use of power assures adequate control and ability to flatten out the plane for proper alighting on water.

b. **THE APPROACH.**

(1) The conditions of wind and water surface are of extreme importance in carrying out the ditching operation. The sea is deceptive, especially when viewed from any height. It is necessary that the pilot use care in making his observations and exercise judgment in determining the procedure he is to follow.

(a) **CALM SEA.**—A calm sea is invariably accompanied by little or no wind. This condition requires that the approach be made at the lowest possible ias. A calm sea is deceptive and judgment of height is difficult. Any floating object, bit of sea weed, or ripple will be useful in aiding height determination.

(b) **WAVES.**—Waves always move with the wind except when close inshore or in fast flowing currents. Waves are the direct result of wind which creates and maintains them and wind direction will be nearly at right angles to the line of wave crests. From a low altitude, it will be possible to observe direction of drift and of wind-blown spray.

(c) **SWELLS.**—Swells, as distinct from waves, are undulating movements of the surface. They have no breaking crests and do not necessarily move with the wind. When a heavy wind is across the swell, the pilot must land along the swell and as nearly into the wind as possible.

(d) **WIND.**—Determination of wind direction is a matter of observation and experience. A pilot should develop, through practice, his ability to determine wind direction and velocity.

c. LANDING.

(1) Landing gear must NOT be extended. Flaps may be lowered as much as 20° in order to reduce landing speed.

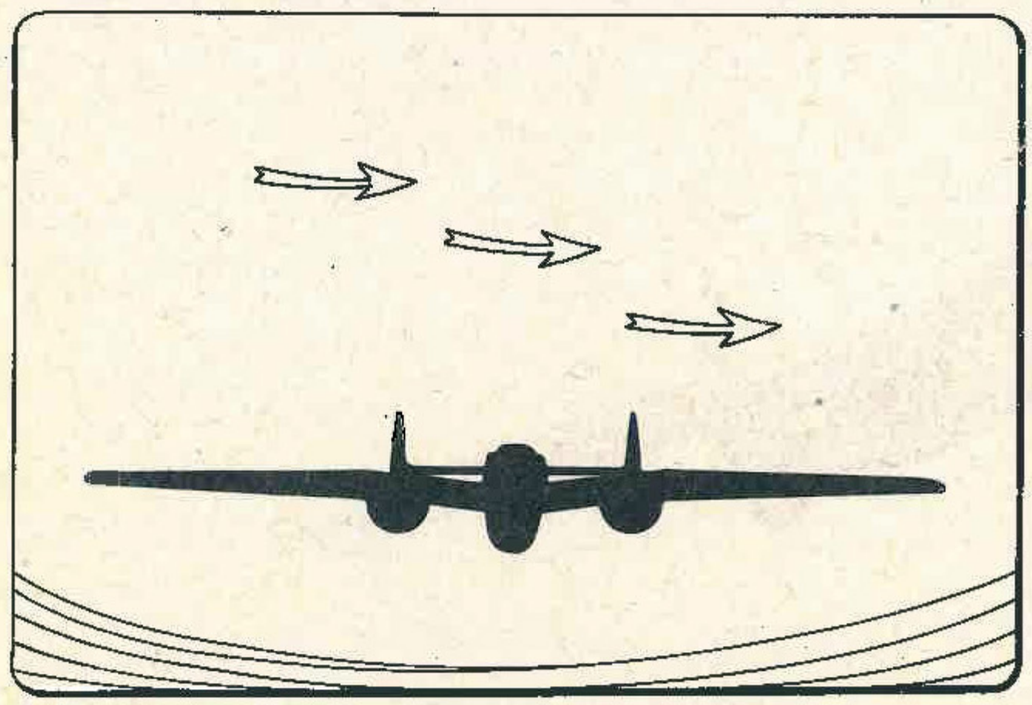
(2) The airplane should alight with the tail down. There will be a slight primary impact as the rear of the airplane strikes, followed by a severe impact and rapid stop. The higher the rate of speed at which the airplane is landed, the more severe the impact and the greater the danger of structural collapse. If the landing is made too fast, the plane will tend to bounce, greatly increasing the danger of collapse.

(3) In a crosswind approach along a swell, the airplane should be ditched on the upslope of the swell.

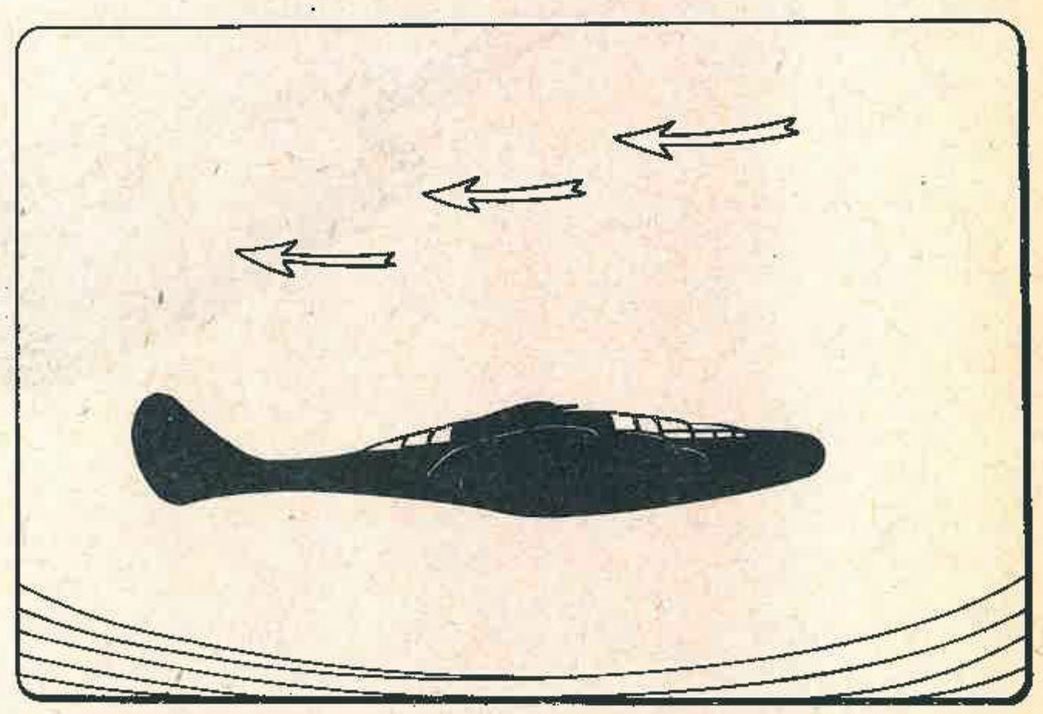
(4) In a steep swell, the pilot should ditch along the top of the swell unless there is a very strong crosswind. In ditching across the swell, the airplane should be put down on an upslope toward the top.

d. ABANDONING THE AIRPLANE.

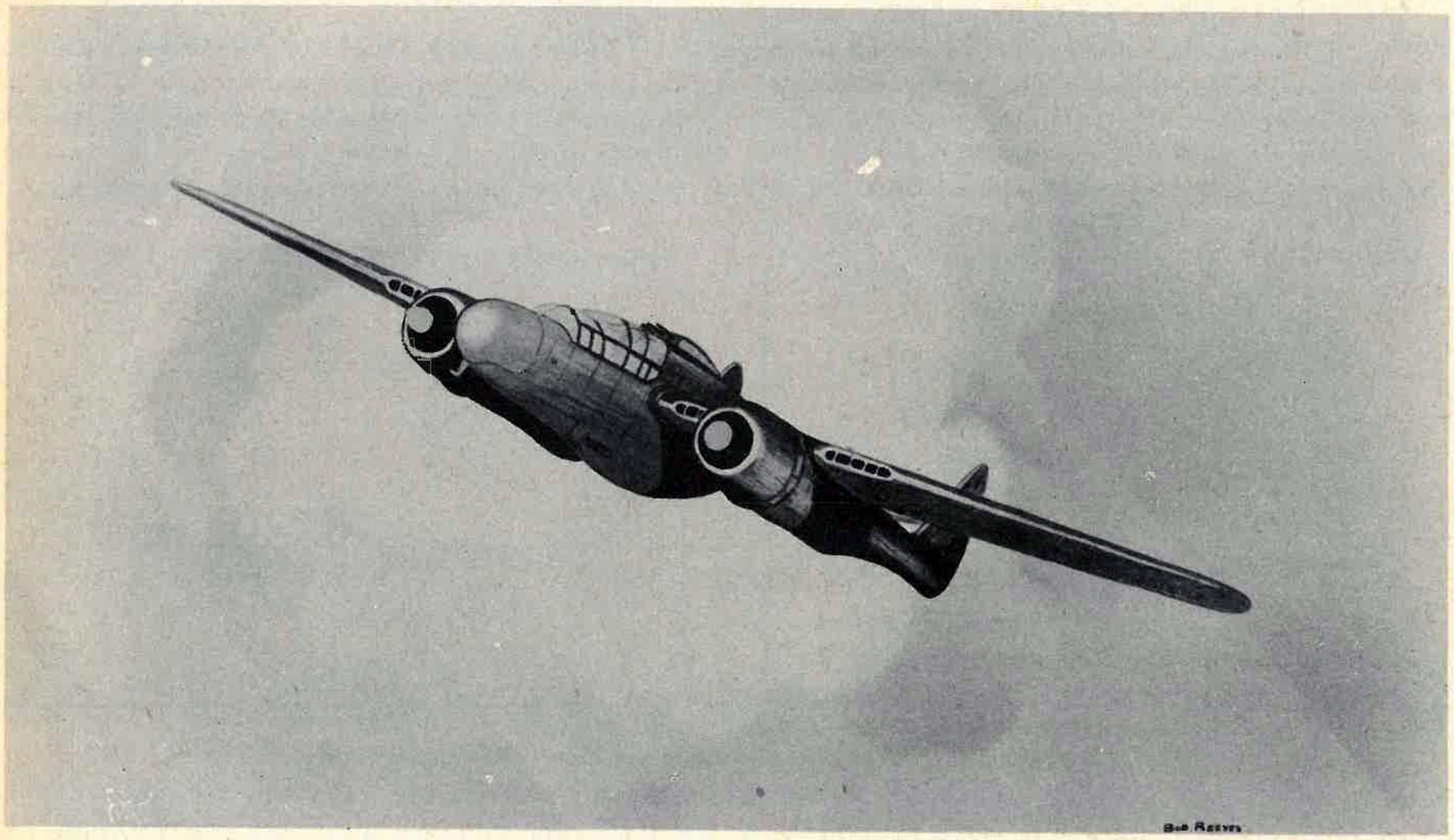
(1) The crew should be prepared to abandon the airplane as soon as it has come to rest. The radio operator will leave through his clam shell opening, the gunner through the forward emergency exit, and the pilot through the pilot's compartment access door.



Light Wind Across Swell



Heavy Wind Across Swell



Bob Reeves

1. GUNNER'S COMPARTMENT.

a. The gunner's compartment is located immediately behind the pilot's compartment in the forward portion of the crew nacelle. Access is gained through the forward entrance door in the nose wheel well.

b. **EMERGENCY EXIT.**—(Fig. 22.) The enclosure panel immediately to the right of the gunner is released to provide an emergency exit.

c. **GUNNER'S OPERATIONAL EQUIPMENT.**—(Fig. 26.)

(1) **SUIT HEATER.**—The suit heater rheostat is located aft and to the left of the gunner.

(2) **GUNNER'S HEATER.**—The gunner's heater is located to the right of the gunner and is controlled by a circuit breaker on the generator control panel.

(3) Gunner's oxygen, communications, and armament equipment discussed in paragraphs 3, 4, and 5 of this section.

2. RADIO OPERATOR'S COMPARTMENT. (Fig. 27)

a. The radio operator's compartment is located in the aft end of the crew nacelle. It is entered through the rear entrance door located in the bottom of the crew nacelle immediately in the front of the tail cone.

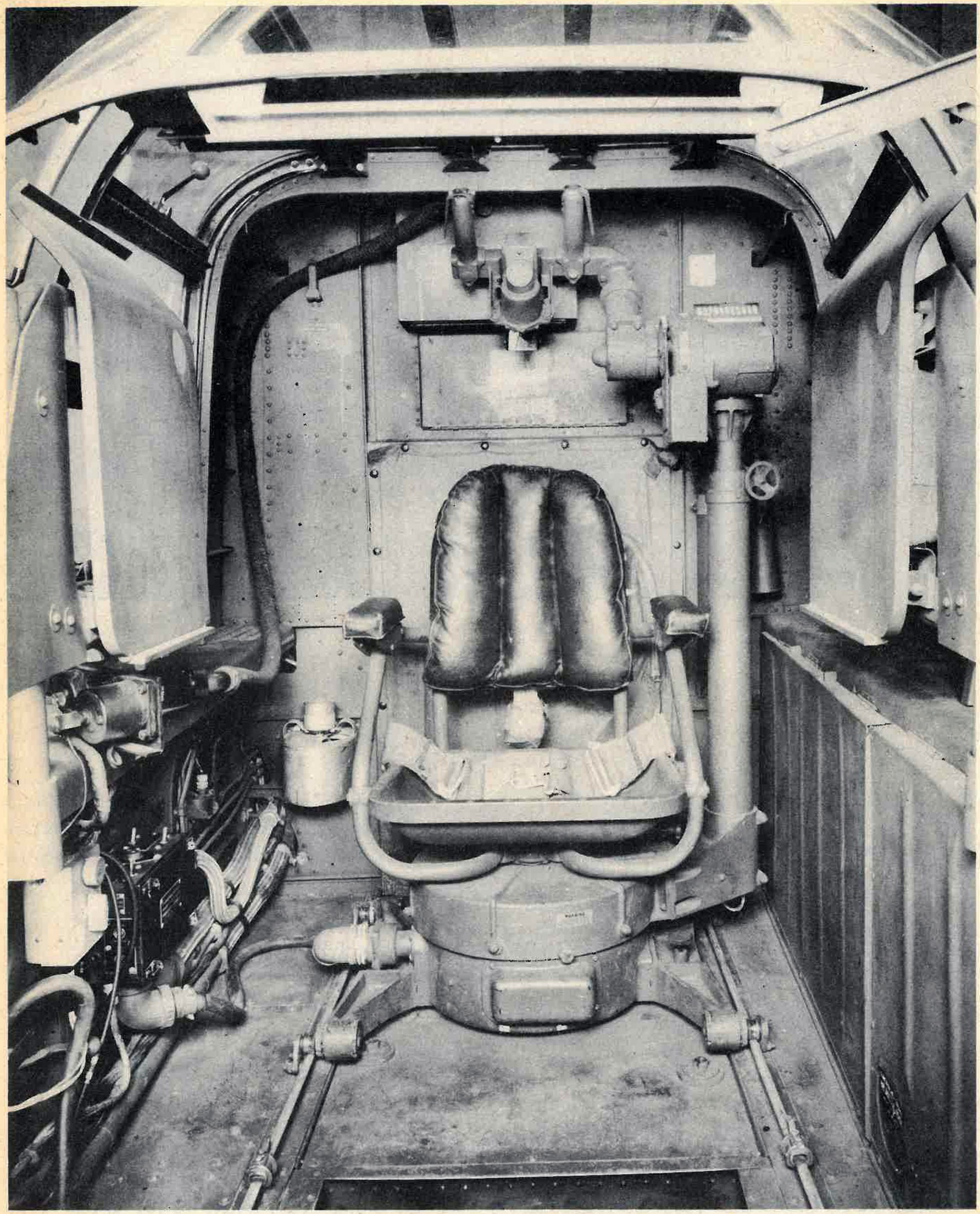


Figure 26 — Gunner's Controls

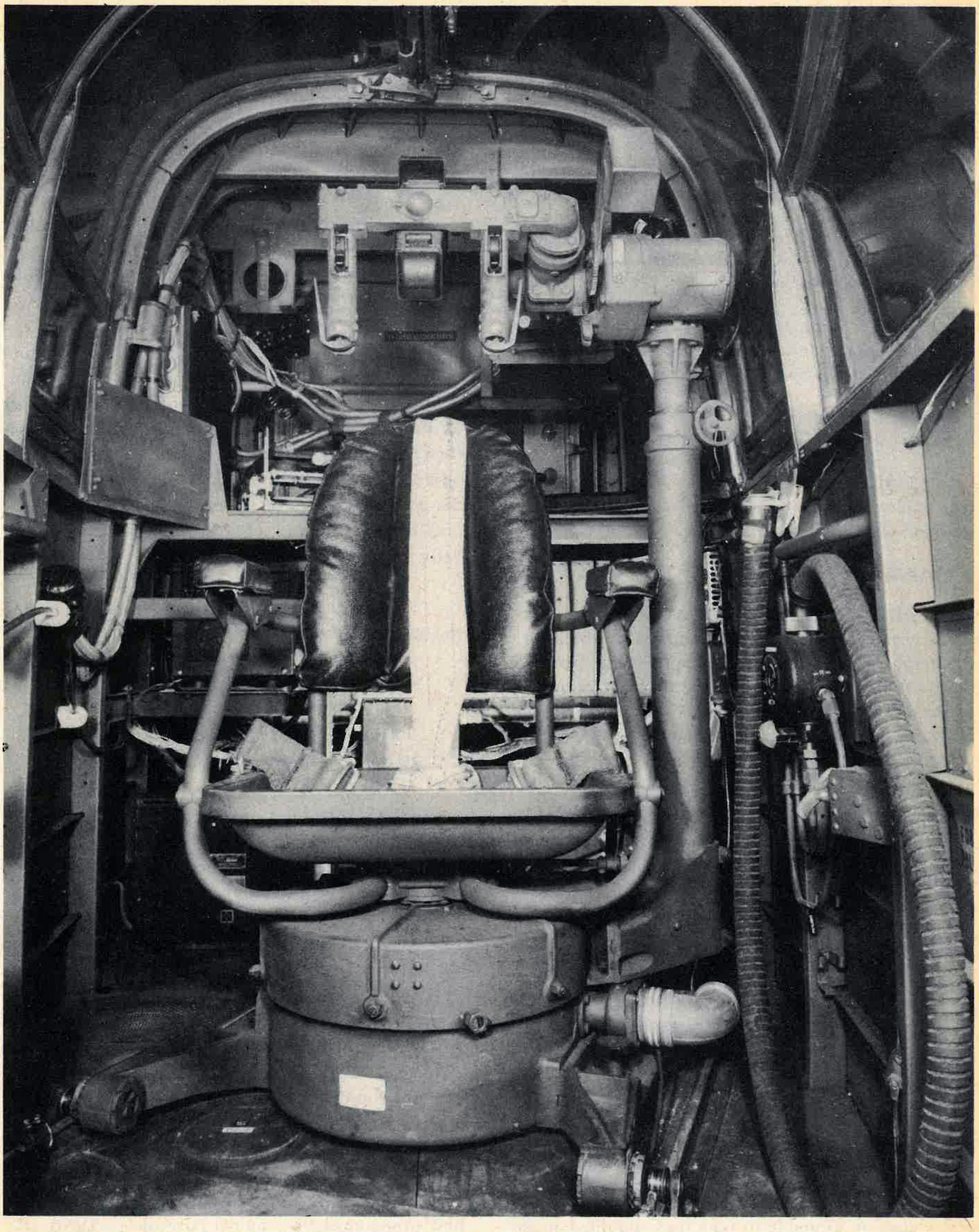


Figure 27 — Radio Operator's Controls

b. **EMERGENCY EXIT.**—(Fig. 22.) The rear entrance door is also the radio operator's emergency exit. The emergency release handle is on the right side of the compartment about 10" below the cockpit rail. A sharp pull on the handle removes the hinge pins at the forward end of the door, allowing it to fall free. Normal release handle must be pulled at the same time.

c. **RADIO OPERATOR'S OPERATIONAL EQUIPMENT.**—(Fig. 27.)

(1) The radio operator's heater is located beneath the floor of his compartment. It is controlled by a switch on the radio junction box.

(2) Radio operator's suit heat rheostat is located beneath the table at the right of the cockpit.

(3) Radio operator's armament, oxygen, and communications equipment are discussed in paragraphs 3, 4, and 5 of this Section.

3. ARMAMENT.

a. **PILOT'S GUN SIGHT.**—The pilot is provided with a Lynn Gunsight mounted on the pilot's coaming above the instrument panel. The principle of operation of the gun sight is the apparent projection of the reticle image in space by the action of a lens and reflector. The sight lamp is operated by a switch located on the right side of the gunsight. (Fig 28.)

Figure 28 — Pilot's Sight Assembly

b. **NIGHT BINOCULAR.**—A night binocular is mounted on an arm and swung into place aft of the pilot's armor glass. It is stowed at left of the gunner's armor glass by sliding it aft on a track mounted on the cockpit rail.

c. **FIXED CANNON.**—The airplane is equipped with four 20 MM Type M-2 fixed cannon mounted on supports beneath the crew nacelle floor structure. Each cannon is provided with a Chatellerault power feed mounted on the receiver body of the cannon.

(1) Fire is controlled electrically by a safety switch located on the pilot's switch panel and a firing switch button mounted on the right side of the pilot's control wheel.

(2) Each cannon is provided with a 200-round capacity ammunition box. The inboard cannon ammunition boxes are located behind the front wing spar on the crew nacelle floor and are accessible from their forward end from the gunner's compartment. The outboard cannon ammunition boxes, reached through doors on the outside of the crew nacelle, are accessible only from the ground. The cannon are charged manually on the ground.

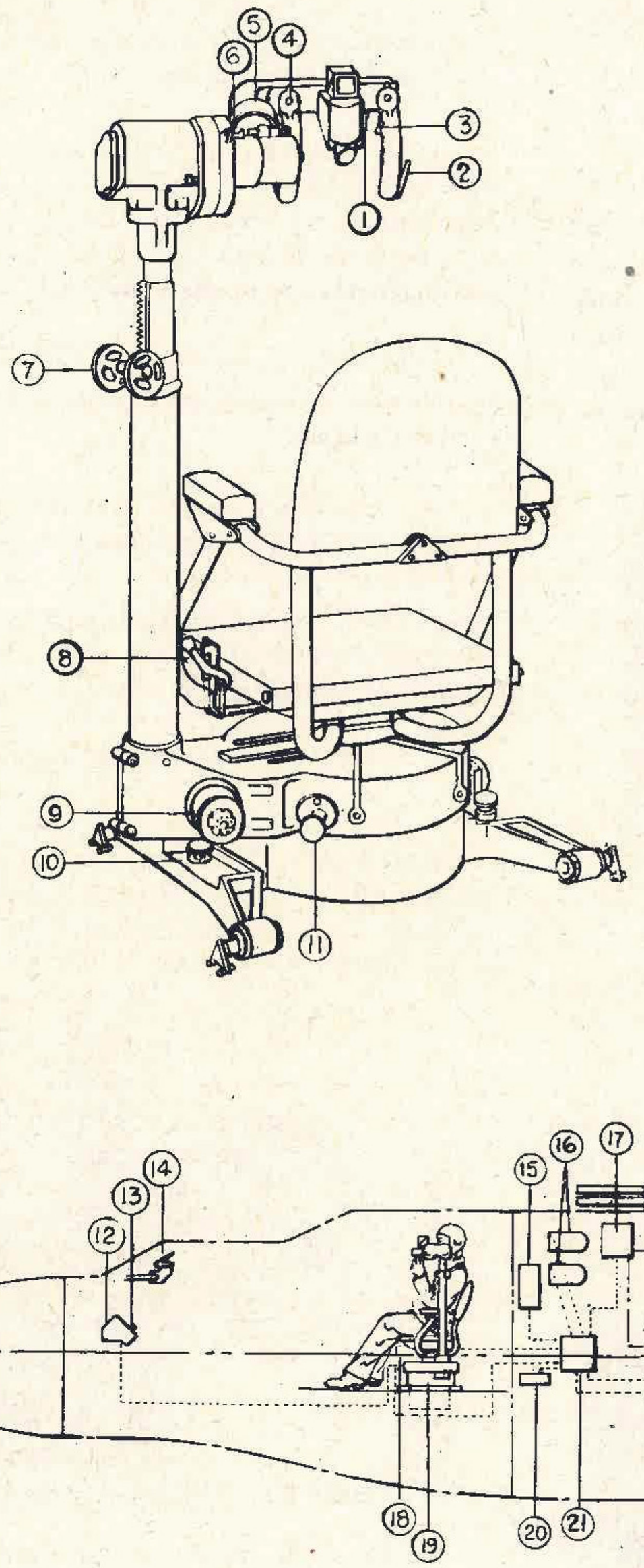
(3) If one or more of the cannon should jam, the others will continue to operate.

CAUTION

The pilot should not turn the safety switch to the ON *position until he is ready to fire. Safety switch must be in the* OFF *position before landing.*

d. **GUNNER'S AND RADIO OPERATOR'S SIGHTS.**—The gunner and radio operator are provided with seats which include sighting stations for the control of the four fifty-caliber machine guns mounted in the power-driven turret. (Fig. 29.)

(1) Adjustments are provided to fit the sight to the needs of the individual gunner. To adjust the sight to the required eye level, release the locking wheel near the top of the support column and turn the adjusting wheel until the desired position is obtained. Retighten the locking wheel. (Fig. 32.) To adjust the sight to the proper distance from the gunner's eye, loosen the collar and set screw on the elevation arm and adjust until the required position is secured. Retighten the collar and set screw.



1 SIGHT LAMP SWITCH
2 GRIP
3 FIRING TRIGGER
4 INTER-PHONE SWITCH
5 HUB ASSEMBLY
6 ELEVATION GEAR
7 WHEEL ASSEMBLY
8 SEAT CONTROL LEVER
9 RHEOSTAT
10 SIGHT LOCKING KNOB
11 STOWAGE LOCK
12 ELECTRIC CONTROL BOX
13 TURRET GUN SWITCH
14 PILOT'S GUN SIGHT
15 JUNCTION BOX
16 AMPLIDYNES
17 SERVO AMPLIFIER
18 MAIN TURRET CONTROL BOX
19 GUNNER'S SIGHTING STATION
20 DYNAMOTOR
21 TURRET CONTROL JCT. BOX
22 JUNCTION BOX
23 RADIO OPRS. SGTG. STATION

Figure 29 — Sighting Stations Diagram

(2) MOVING THE SIGHT.

NOTE

The gunner's sight should not be moved during flight.

(a) To move sight fore and aft, pull up and turn locking knobs (Fig. 30), one of which is located on each leg. The sight will now slide on the track within the limits of the track bumpers. The forward sight locks in the firing position only. The rear sight can be locked in both the firing and radio operating positions.

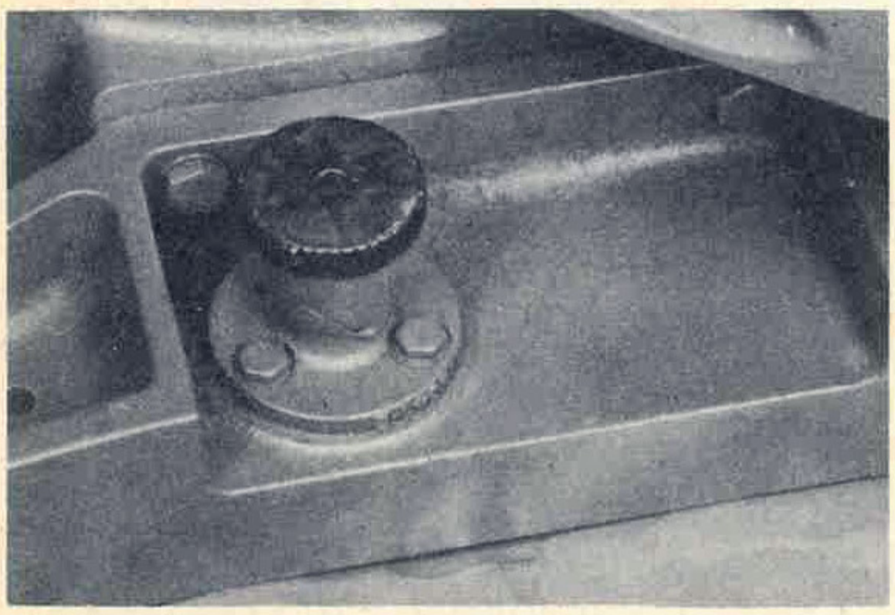


Figure 30 — Sight Locking Knob

(b) To rotate the sight, pull out the stowage locking knob and turn it 180°. The sight may now be rotated through 350°.

(c) To rotate the seat only, lift up the lever at left of seat and place it in a latched position. The seat is now free to rotate through 360°. Release the lever to unlatch and move seat until it snaps into a locked position (0° or 180°). (Fig. 31.)

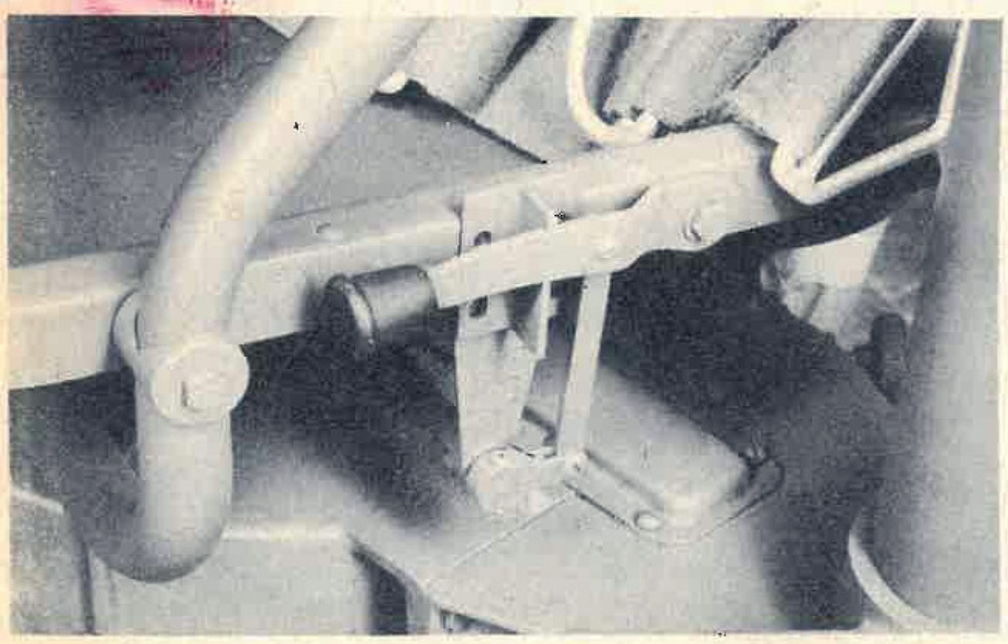


Figure 31 — Seat Adjusting Lever

NOTE

Normally it will not be necessary to move the SEAT during flight.

(3) The sight lamp is adjusted by pressing the snap switch located on the right side of the gun sight and turning the rheostat, mounted on the housing arm, until the desired intensity of light is obtained on the image reflected in the sight reticle.

(4) The turret operating power supply switches are mounted on a panel to the right of the forward gunner.

(a) Turn on the DYNAMOTOR SWITCH at least 30 seconds before any other circuit is closed.

(b) After a sufficient lapse of time, turn on the amplidyne switch which starts the azimuth and elevation amplifying generators.

(c) Turn on the safety switch.

(d) The turret is controlled by hand action trigger assemblies located on the side of each grip on both sighting stations. They are operated by hand pressure. Pressure on either or both provides complete control over the turret. (Fig. 33.)

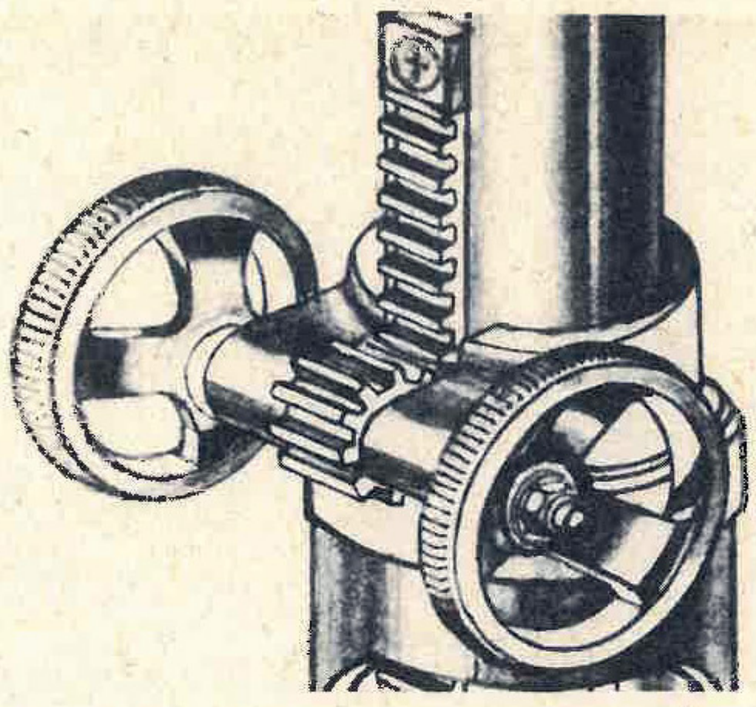


Figure 32 — Sight Adjusting Wheels

(e) The turret guns are fired by depressing the trigger switch located on the side of the grip away from the operator. There is a trigger switch on each grip. All four turret guns are fired by any trigger.

(f) The button switch on the left grip provides interphone connection.

CAUTION

Turn safety switch to OFF *when not in use.*

(5) When the pilot requires use of the turret guns for ground strafing, he signals the gunner to place the guns in the dead ahead position and to turn off the power supply. This permits the pilot to fire the guns by using the pilot's firing switch located on the pilot's electrical panel and the control column wheel right-hand trigger switch.

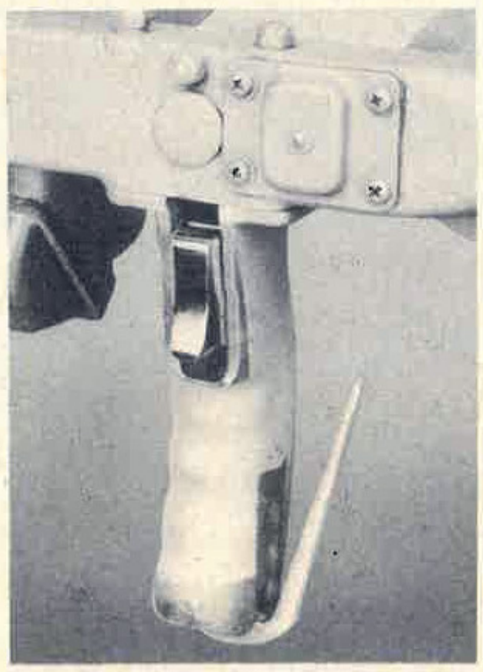


Figure 33 — Sight Grip Controls

(6) STOWING THE SIGHT.

CAUTION

See that the dynamotor and amplidyne switches are in the OFF *position before stowing sight.*

(a) To place the elevation unit in its stowed position, lift the elevation arm until the stowage pin passes the stop and snaps into the locking clip.

(b) To stow the azimuth unit, rotate the housing to approximately zero degrees azimuth position and turn stowage locking knobs 180° to released position. If the locking pin does not snap into the keeper, rotate the housing slowly back and forth until it locks.

4. OXYGEN EQUIPMENT. (Fig. 34)

a. Each member of the crew is provided with individual oxygen inhalation apparatus located on the right side of the crew nacelle in each compartment.

b. The oxygen is carried in twelve low pressure oxygen cylinders (Type D-2), six in each engine nacelle aft of the wheel well at the tail boom attaching angle.

c. Three demand oxygen regulators (Type A-12), located one in each compartment just above the right cockpit rail, supply the required mixture and volume of oxygen automatically.

d. Three pressure gages (Type K-1) and three pressure signal and lamp assemblies (Type C-1) indicate a loss of pressure because of exhaustion of the system and signal the necessity of returning to a lower altitude at which oxygen will not be required. (Fig. 35.)

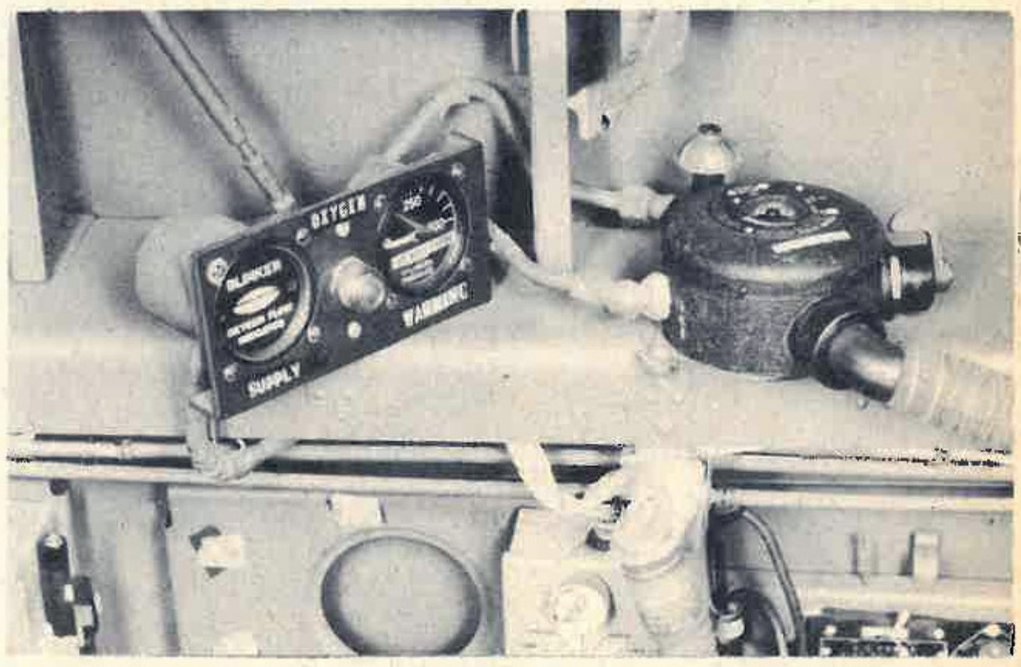


Figure 34 — Oxygen Control Unit

e. A filler valve for replenishing the oxygen system is located on the lower left side of the crew nacelle beneath the wing trailing edge. A British adapter is attached to the valve.

f. A pressure of 425 lbs. indicates a full oxygen system. This is approximately a five-hour supply for each member of the crew. (Fig. 36.)

CAUTION

Extreme caution must be observed to insure that oxygen equipment does not become contaminated with oil or grease. Fire or explosion may result when even slight traces of oil or grease come into contact with oxygen under pressure.

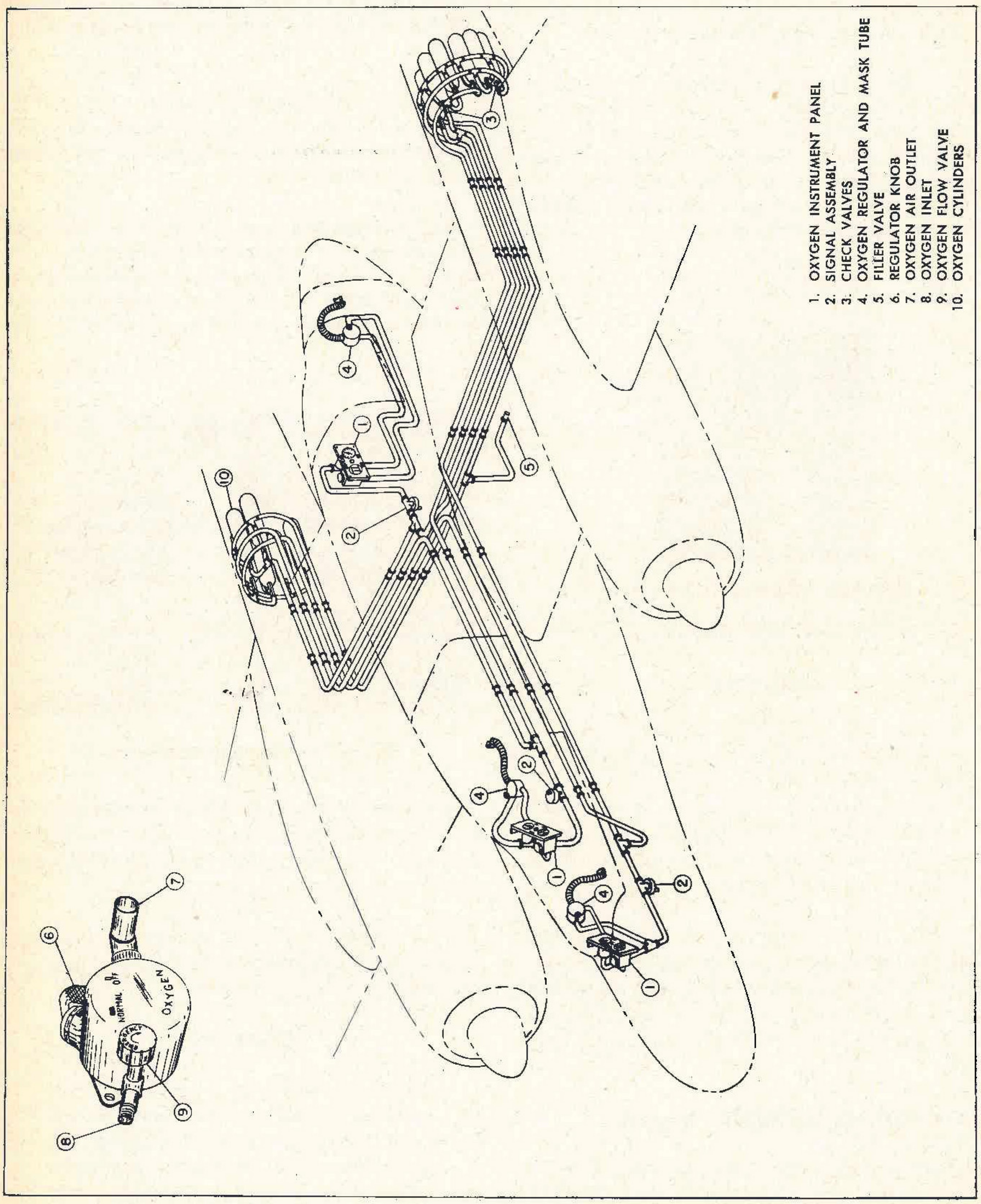


Figure 35 — Oxygen System

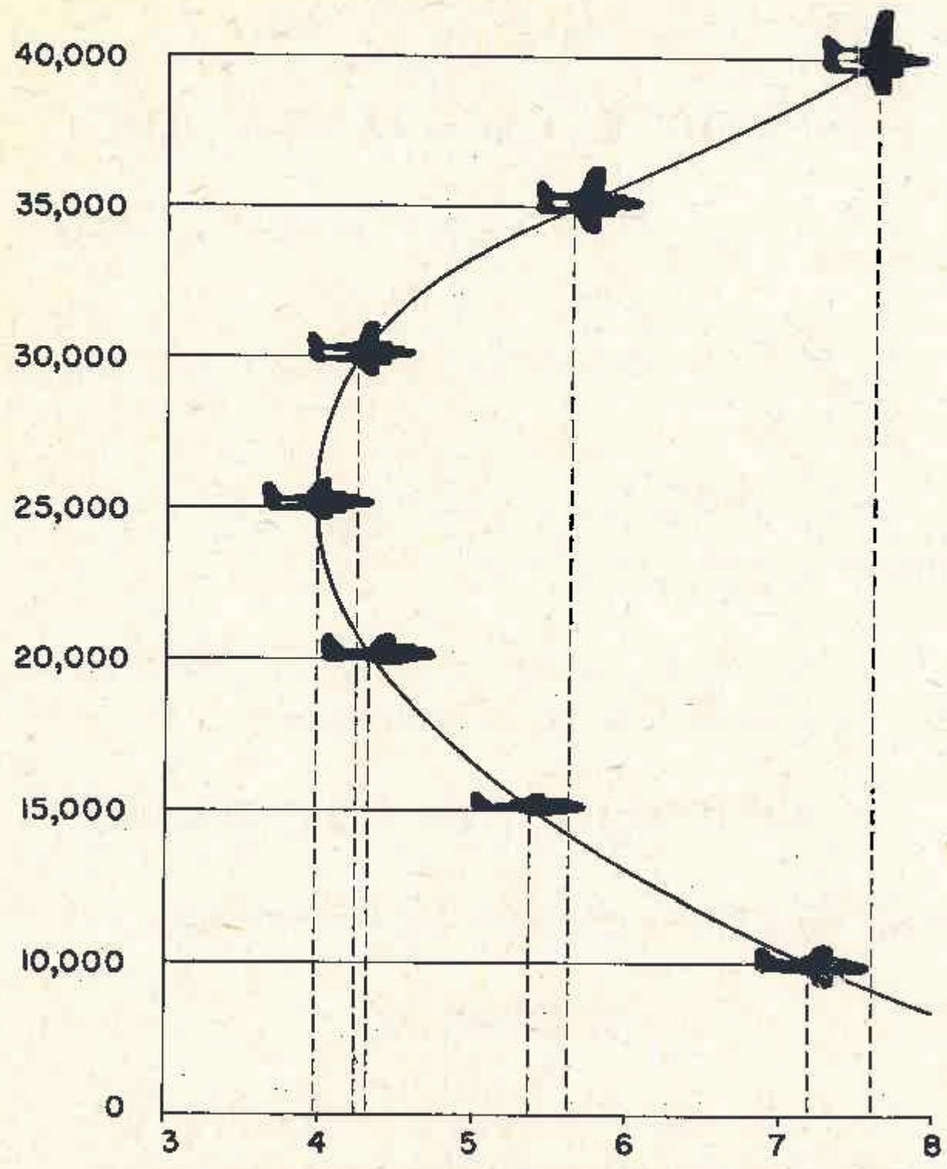


Figure 36 — Oxygen Consumption Chart

5. COMMUNICATIONS EQUIPMENT.

a. **GENERAL DESCRIPTION.**—Provisions have been made for the installation of several complete sets of radio equipment in the airplane, some of which are interchangeable as alternate installations. The provisions for all sets are a permanent part of the airplane structure.

(1) The pilot's radio pushbutton will operate whatever equipment is designated by the selector switch on Jack Box BC-366.

(2) A four-way switch is installed in the cover of the radio operator's microphone junction box. This switch is marked INTERPHONE, SPECIAL, NORMAL, and OFF. In the SPECIAL position, the "Tip" circuit of the foot switch is connected with the pilot's trigger switch. In the NORMAL position, the "Tip" circuit of the floor switch is connected to plug PL-68 that plugs into the radio operator's BC-366 Jack Box. In this position the radio operator can operate any equipment he may select on BC-366 Jack Box. In the OFF position the "Tip" circuit to the microphone is open. The OFF position is required in order that the radio operator can use the combination interphone-sidetone facility of either SCR-522 set without turning on the transmitter (with selector switch in either COMP or LIA position).

b. **COMMAND SET.**—Provisions have been made for the installation of SCR-274-N equipment and two sets of SCR-522-( ) equipment. These provisions are a permanent part of the airplane structure. Two complete sets of SCR-522-( ) equipment are installed.

(1) The SCR-522-( ) equipment consists of a transmitter-receiver assembly. One set is installed on the left side of the radio operator's floor, the other between the two forward 20 mm cannon beneath the crew nacelle floor.

(2) These radio sets provide two-way transmission between aircraft in flight and between aircraft and ground stations. Operation may take place on any of four crystal-controlled channels lying within the frequency range 100-156 mc. Remote control only is provided.

(3) **PRE-FLIGHT TESTS.**—Prior to take-off of airplane, be sure that all plugs and cable leads are properly connected and that the AUDIO, RELAY, and GAIN controls are properly adjusted. In order not to drain the airplane's storage battery excessively, a battery cart should be used to operate the communications equipment when the engines are not running.

(a) The AUDIO and RELAY controls are located at the left of the receiver panel and the GAIN control at the left of the transmitter panel. These controls are reached by removing the cover from the transmitter-receiver assembly case.

(4) **NORMAL OPERATION.**—All controls used in normal operation except the push-to-talk switch are located on the panel of the radio control box (BC-602-A).

(a) The five red push buttons on the radio control box are the means by which channels are selected and power turned on or off. When the OFF button is depressed the dynamotor is stopped. The five push buttons are so interconnected that not more than one can be in the depressed position at any given time.

(b) The T-R-REM switch is wired fast in the REM position. In this position the transmitter-receiver control is transferred to a push-to-talk switch.

NOTE

Should the wire be broken or removed, the following conditions will prevail. In the T position the transmitter is placed in continuous operation and in the R position the receiver is placed in continuous operation.

(c) Interphone communication is available at all times from the RC-36 interphone equipment.

(d) The four green lights indicate the channel in operation and the white light opposite the T-R-REM switch glows when the equipment is in the receive position. All lamps are lighted during the process of channel selection. A dimmer-mask is provided to reduce lamp glare and is operated by means of the small lever tab opposite the OFF button.

(5) TRANSMISSION.

(a) To start equipment, press push button A, B, C, or D, depending on channel to be used.

(b) Allow approximately one minute for vacuum tubes to warm up.

(c) Select transmitter on BC-366 box.

(d) Depress mike button.

(e) Speak into microphone.

(6) RECEPTION.

(a) To start equipment, press button A, B, C, or D.

(b) Select receiver on BC-366 box.

(7) PUSH-TO-TALK OPERATION.

(a) Place the T-R-REM switch in REM position.

(b) To start equipment, press push button A, B, C, or D.

(c) Under these conditions, the receiver is normally in operation.

(d) To transmit, depress the push-to-talk switch and speak into the microphone.

(8) STOPPING THE EQUIPMENT.—

To stop the equipment, press the OFF button.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. A dangerous potential exists on both the transmitter and receiver whenever the equipment is in either the transmit or receive condition.

c. IDENTIFICATION EQUIPMENT.

(1) Provisions have been made for the installation of SCR-695-( ) equipment for the identification of the airplane in flight. The provisions are a permanent part of the airplane structure.

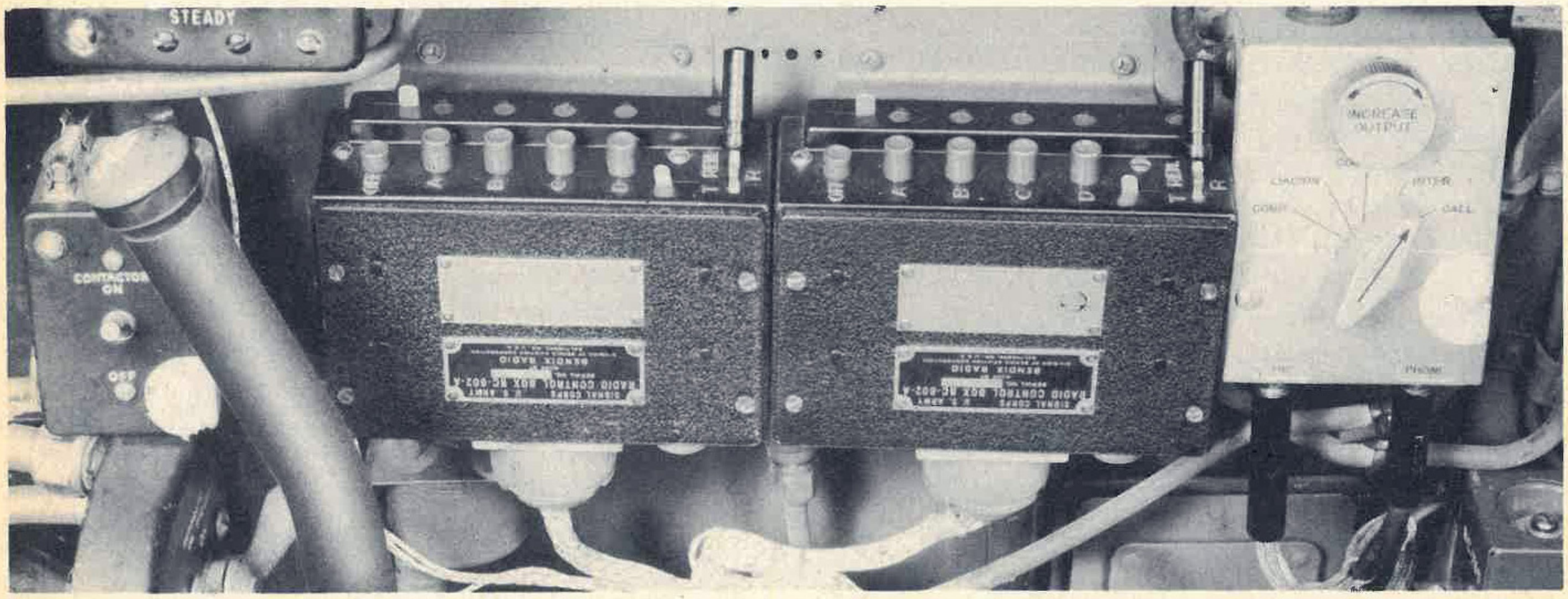


Figure 37 — Pilot's Radio Controls

(2) This equipment consists of a radio receiver, RC-255-A radio control equipment, and a destructor unit.

(3) Radio control equipment RC-255-A, consisting of a power control box and a selector control box, is mounted on a bracket near the left forward top corner of the radio operator's compartment, above the table.

(4) The pilot's remote controls for equipment SCR-695-( ) consist of four switches mounted on a bracket on the right of the pilot's cockpit. The 695 POWER switch is an ON-OFF toggle switch. The switch marked EMERGENCY is a remote emergency signal ON-OFF toggle switch. The other two switches are marked 695-G. One is an ON-OFF toggle switch for the G band operating mechanism and the other a push button type ON-OFF switch for a time control of the G band.

(5) OPERATION OF SCR-695-( ) EQUIPMENT.

(a) To start the equipment throw the ON-OFF switch on the RC-225-A control box or the pilot's remote control to ON.

(b) Set the six-position switch on the selector control box to the position specified by the Communications Officer-in-Charge. In the absence of specific information, set the selector switch to position "1."

(c) Directions will be given as to the use of the G band switches.

(d) Details concerning the use of the emergency switch can be obtained from the Communications Officer-in-Charge.

(e) When the airplane is ready to take off, or preferably, as soon as it is in the air, insert the destructor plug in the destructor unit.

1. The destructor is designed to destroy radio receiver BC-966-( ) for reasons of secrecy, should this become necessary while operating the airplane. The detonator is set off when a voltage of the required value or higher is placed across its terminals. This will occur if the inertia switch is operated or if the two buttons marked DANGER on switch box BC-765 are depressed simultaneously. (Fig. 38.)

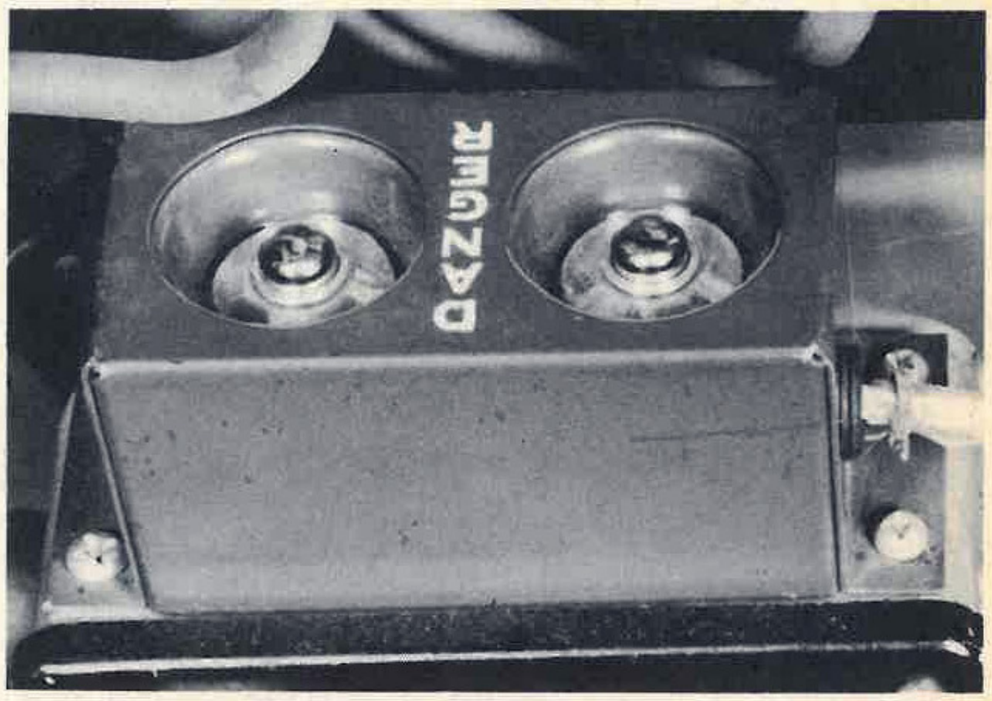


Figure 38 — Destructor Switch

WARNING

Improper handling of the destructor circuit may result in bodily harm.

2. When the airplane is on the ground for any length of time, the destructor plug should be disconnected from the destructor unit.

3. Always test the destructor circuit to make certain there is no voltage at the plug before attaching to the destructor unit.

4. With the destructor plug removed and the inertia switch tripped the warning lights should light. With the inertia switch reset, the two DANGER buttons should be depressed simultaneously. Again the warning lights should light. After testing, set the switches including the inertia switch for proper operating conditions as indicated by absence of light from the lamps. When the inertia switch has been finally reset, its side should be rapped sharply with the knuckles. If correctly set, the switch should not be released thereby.

WARNING

The plug should never be inserted in the destructor when the warning lights are lighted.

(f) To stop the SCR-695-( ) equipment, throw all switches to the OFF position.

(g) Remove the destructor plug from the destructor unit as soon as the airplane lands in friendly territory.

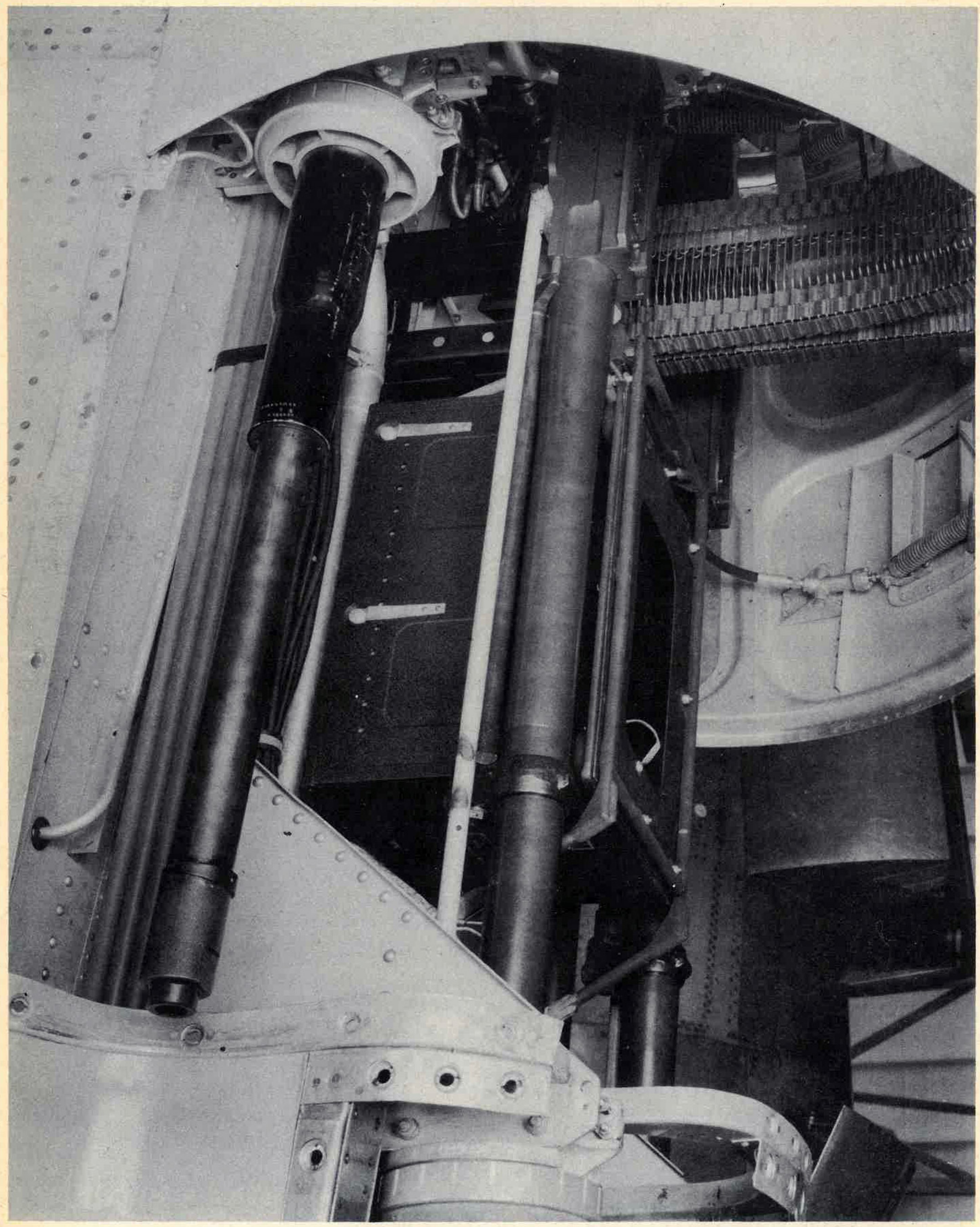


Figure 39 — Radio Installations

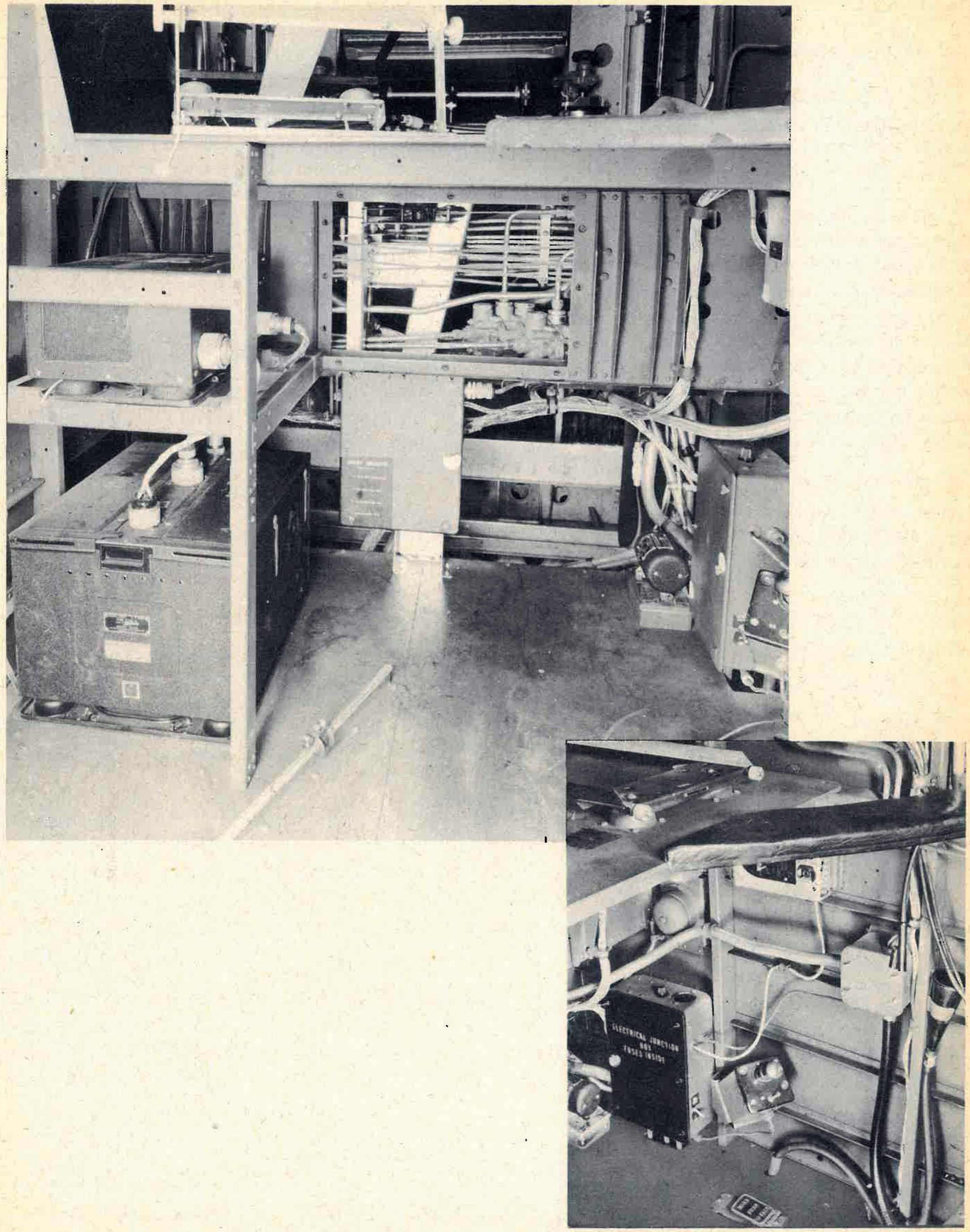


Figure 40 — Radio Installations

d. **INTERPHONE EQUIPMENT.**

(1) The pilot's trigger switch will connect the pilot by interphone with all members of the crew regardless of respective position of the individual interphone selector switches on the BC-366 Jack Boxes.

(2) Equipment RC-36 is designed for interplane communication between the three interphone stations and includes switching facilities whereby the operation of two complete radio sets and one additional receiver can be partially controlled. The system consists of one jack box (BC-366) located in the compartment of each crew member below the right cockpit rail and an interphone amplifier (BC-357) located on the right side of the radio operator's compartment just below the table.

(3) The jack box provides a five-position selector switch assembly which connects the microphone and headset circuits to either the command set, interphone system or call, as indicated. The LIAISON (No. 2 SCR-522) and COMP (Range Receiver) positions are inoperative.

e. **RADAR EQUIPMENT.**—The SCR-720 equipment is mounted in the extreme nose of the airplane. Information concerning the operation of this equipment will be covered by separate documents available to the operating organization personnel.

f. **MICROPHONES.**—Each crew member is provided with a variable sensitive microphone T-30Q and headset HS-33.

NOTE

When the throat microphone is being used for either interphone or radio communication, it must be adjusted so that its two circular elements are held *snugly* against each side of the throat just above the Adam's apple. Speak *slowly*, DISTINCTLY, and in a *normal* tone of voice. Shouting will seriously distort the voice signal.

APPENDIX I
UNITED STATES-BRITISH GLOSSARY OF NOMENCLATURE

UNITED STATES	BRITISH
Accumulator	Pressure Reservoir
Airplane	Aeroplane
Antenna	Aerial
Battery (Electrical)	Accumulator
Cowling or Cockpit Enclosure	Cockpit Enclosure
Drag	Longitudinal Force, Drag or Head Resistance
Drift	Drift-Angle
Empennage or Tail	Tail Unit
Engine or Power Plant	Aero-Engine
Engine Section	Power Plant or Power Egg
Exit	Egress or Exit
Feathering	Feathering
Flare, Signal	Signal Star or Signal Projectile
Gasoline	Petrol or Fuel
Gear, Landing	Alighting Gear, Undercarriage or Chassis
Gear, Retractable Landing	Retractable Undercarriage or Retractile Undercarriage
Generator	Dynamo
Bullet-Proof Glass	Armour Glass
Ground	Earth or Ground
Horizon, Gyro or Artificial	Artificial Horizon
Interphone	Inter-Communication
Lean	Weak
Left	Port
Lights, Position	Navigation Lights
Manifold Pressure	Boost
Operator, Radio	Wireless Operator
Right	Starboard
Set, Command	Pilot Controller Set
Speed, Indicated Air	Air-Speed-Indicator Reading
Stabilizer or Horizontal Stabilizer	Tail Plane
Stabilizer, Vertical	Fin
Tab, Trim	Trimming Tab
Tire	Tyre or Tire
Windshield	Windscreen
Wing	Main Plane

SPEC. AN-H-8 DEC. 18, 1942 | FORM ACS-510

AIRPLANE MODELS
P-61A

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODELS
(2) R-2800-10

TAKE-OFF DISTANCE (IN FEET)

GROSS WEIGHT (IN LBS.)	HEAD WIND		HARD SURFACE RUNWAY						SOD-TURF RUNWAY						SOFT SURFACE RUNWAY					
	AT SEA LEVEL				AT 3000 FT.		AT 6000 FT.		AT SEA LEVEL		AT 3000 FT.		AT 6000 FT.		AT SEA LEVEL		AT 3000 FT.		AT 6000 FT.	
	MPH	KNOTS	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.
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	17	15	1050	1800	1050	1850	1750	2700	1050	1800	1300	2100	1850	2800	1100	1850	1450	2250	2200	3150
	34	30	650	1250	750	1400	1200	2000	700	1300	850	1500	1250	2050	700	1300	950	1600	1500	2300
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	17	15	1100	1900	1350	2200	1900	2900	1200	2000	1400	2250	2000	3000	1350	2150	1600	2450	2400	3400
	34	30	750	1400	900	1600	1300	2150	750	1400	950	1650	1400	2250	850	1500	1050	1750	1650	2500
	51	45	400	900	550	1100	800	1450	450	950	550	1100	850	1500	500	1000	650	1200	1000	1650
29000	0	0	1750	2700	2050	3050	2850	4050	1800	2750	2150	3150	3050	4250	2100	3050	2500	3600	3700	4950
	17	15	1250	2050	1450	2350	2100	3150	1300	2100	1550	2450	2250	3300	1450	2250	1750	2650	2700	3850
	34	30	800	1450	1000	1750	1400	2300	800	1450	1050	1800	1500	2400	950	1600	1200	1950	1800	2700
	51	45	450	950	600	1200	900	1600	450	950	600	1200	950	1650	550	1050	700	1300	1150	1850

NOTE: INCREASE DISTANCE 10% FOR EACH 10°C ABOVE 0°C (10% FOR EACH 20°F ABOVE 32° F)

ENGINE LIMITS FOR TAKE-OFF 2700 RPM & 54.0 IN. Hg

FIRST 15 MIN. 2700 RPM & 53.5 IN. Hg

CLIMB DATA

COMBAT MISSIONS USE 2550 RPM & 47 IN. Hg

FERRY MISSIONS USE 2230 RPM & 32 IN. Hg

GROSS WEIGHT IN LBS.	TYPE OF CLIMB	S. L. TO 3000 FT. ALT.				5000 FT. ALT.						15000 FT. ALT.						25000 FT. ALT.						30000 FT. ALT.						BLOWER CHANGE
		BEST I.A.S.*		FT/MIN	TIME FROM S. L.	BEST I.A.S.*		FT/MIN	TIME FROM S. L.	FUEL From S.L.		BEST I.A.S.*		FT/MIN	TIME FROM S. L.	FUEL From S.L.		BEST I.A.S.*		FT/MIN	TIME FROM S. L.	FUEL From S.L.		BEST I.A.S.*		FT/MIN	TIME FROM S. L.	FUEL From S.L.		
		MPH	KNOTS			MPH	KNOTS			U. S.	IMP.	MPH	KNOTS			U. S.	IMP.	MPH	KNOTS			U. S.	IMP.	MPH	KNOTS			U. S.	IMP.	
27000	COMBAT	172		2500	2	167		2000	3	100		163		1800	10	150		162		1350	16	215		154		700	23	280		
	FERRY	141		800	3	146		850	6	93		145		800	18	135		140		550	37	200								*
28000	COMBAT	172		2400	2	167		2100	3	100		163		1700	10	150		162		1200	17	225		154		600	25	295		
	FERRY	141		750	4	146		800	7	95		146		750	25	141		140		500	43	220								*
29000	COMBAT	172		2300	2	167		2000	3	100		163		1600	11	160		162		1100	18	235		154		500	28	315		
	FERRY	141		700	4	146		700	7	95		146		650	22	150		140		400	50	250								*

NOTE: INCREASED ELAPSED CLIMBING TIME 10% FOR EACH 10°C ABOVE 0°C FREE AIR TEMPERATURE (10% FOR EACH 20°F ABOVE 32°F) FUEL INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE

* COMBAT CLIMB — SHIFT TO AUX. LOW AT 5000, TO AUX. HIGH AT 19000'

* FERRY CLIMB — SHIFT TO AUX. LOW AT 12000, TO AUX. HIGH AT 23000'

LANDING DISTANCE (IN FEET)

GROSS WEIGHT IN LBS.	BEST I.A.S.* APPROACH		HARD DRY SURFACE						FIRM DRY SOD						WET OR SLIPPERY					
			AT SEA LEVEL		AT 3000 FT.		AT 6000 FT.		AT SEA LEVEL		AT 3000 FT.		AT 6000 FT.		AT SEA LEVEL		AT 3000 FT.		AT 6000 FT.	
	MPH	KNOTS	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL
24250	100	87	1900	1300	2050	1400	2200	1550	2100	1500	2350	1700	2450	1800	4950	4350	5350	4700	5850	5200
28000	106	93	2150	1500	2300	1600	2500	1800	2400	1750	2600	1900	2750	2050	5650	5000	6100	5400	6700	6000

NOTE: FOR GROUND TEMPERATURES ABOVE 35°C (95°F) INCREASE APPROACH I.A.S. 10% AND ALLOW 20% INCREASE IN GROUND ROLL

REMARKS TAKE-OFF DISTANCE GIVEN FOR FLAPS DEFLECTED 20°
LANDING DISTANCE GIVEN FOR FLAPS DEFLECTED 60°
COMBAT CLIMB — AUTO. RICH
FERRY CLIMB — AUTO. LEAN

* CALIBRATED INDICATED AIR SPEED
SEE SEC. III

LEGEND
I.A.S.: Indicated Air Speed
MPH: Miles Per Hour
S.L.: Sea Level
U.S.: U. S. Gallons

NOTE: All Distances are Average

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

MODEL(S): P-61A

ENGINE(S): (2) R-2800-10

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 25000 TO 29000 POUNDS

EXTERNAL LOAD ITEMS: NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
WAR MAX.		Not	Applicable			
MILITARY POWER	2700	52.5 54.0 53.0	NEUTRAL Aux. LO. AUX. HI.	A.R.	15 Min	600 590 540
NORMAL RATED	2550	44.0 49.5 49.5	NEUTRAL AUX. LO AUX. HI.	A.R.		450 480 460

INSTRUCTIONS FOR USING CHART: Select figure in FUEL column equal to or less than amount of fuel to be used for cruising. Move horizontally to left or right and select RANGE value equal to or greater than the statute or nautical air miles to be flown. Vertically below and opposite desired cruising altitude (ALT.) read optimum R. P. M., I. A. S. and MIXTURE setting required.

NOTES: Column I is for emergency high speed cruising only. Columns II, III, IV and V give progressive increase in range at a sacrifice in speed. Manifold pressure (M. P.), gallons per hour (G. P. H.) and true airspeed (T. A. S.) are approximate values for reference. For efficiency maintain indicated airspeed (I. A. S.) hourly. Adjust RPM slightly if necessary to avoid exceeding manifold pressure more than 3 in. Hg.

I				FUEL	II		III		IV		FUEL	V	
RANGE IN AIR MILES				U. S.	RANGE IN AIR MILES		RANGE IN AIR MILES		RANGE IN AIR MILES		U. S.	RANGE IN AIR MILES	
STATUTE		NAUTICAL		GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
AT SL.	AT 20,000	AT SL.	AT 20,000	646	○ 66 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT ○						646		
390	450	340	390	580	670	580	750	650	870	750	580		
370	420	320	360	550	630	550	710	620	820	710	550		
330	390	290	340	500	570	490	650	560	750	650	500		
300	350	260	300	450	520	450	580	500	670	580	450		
270	310	230	270	400	480	400	520	450	600	520	400		
230	270	200	230	350	400	350	450	390	520	450	350		
200	230	170	200	300	340	290	390	340	450	390	300		
170	190	150	160	250	290	250	320	280	370	320	250		
130	150	110	130	200	230	190	260	230	300	260	200		
100	110	90	100	150	170	150	190	170	220	190	150		
70	80	60	70	100	110	100	130	110	150	130	100		

MAXIMUM CONTINUOUS						ALT.	OPERATING DATA						OPERATING DATA						OPERATING DATA						ALT.	MAXIMUM RANGE					
R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																			40000						
						35000																			35000						
2550	191	A.R.	35	320	319	30000																			30000						
2550	228	A.R.	43.5	395	347	25000	2230	160	A.L.	F.T.	210	245													25000						
2550	256	A.R.	50	460	355	20000	2150	201	A.L.	F.T.	230	270	2000	169	A.L.	F.T.	180	240							20000						
2550	269	A.R.	50	480	346	15000	2150	207	A.L.	36	230	270	2230	182	A.L.	F.T.	180	240	2100	164	A.L.	F.T.	150	230	15000						
2550	276	A.R.	50.5	480	327	10000	2230	225	A.L.	F.T.	230	270	2000	202	A.L.	F.T.	180	245	1750	172	A.L.	F.T.	130	210	10000						
2550	287	A.R.	44	450	316	5000	2110	232	A.L.	36	230	260	1850	219	A.L.	F.T.	190	245	1600	187	A.L.	F.T.	140	210	5000						
2550	295	A.R.	46	450	302	S. L.	1950	232	A.L.	36.5	220	240	1650	212	A.L.	36	170	220	1550	182	A.L.	31.3	125	190	S. L.						

NOTES

○ ALLOW 66 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQ'D.

Use Aux. lo above solid line
Aux. hi above double line

Use fuel from outb'd tanks first

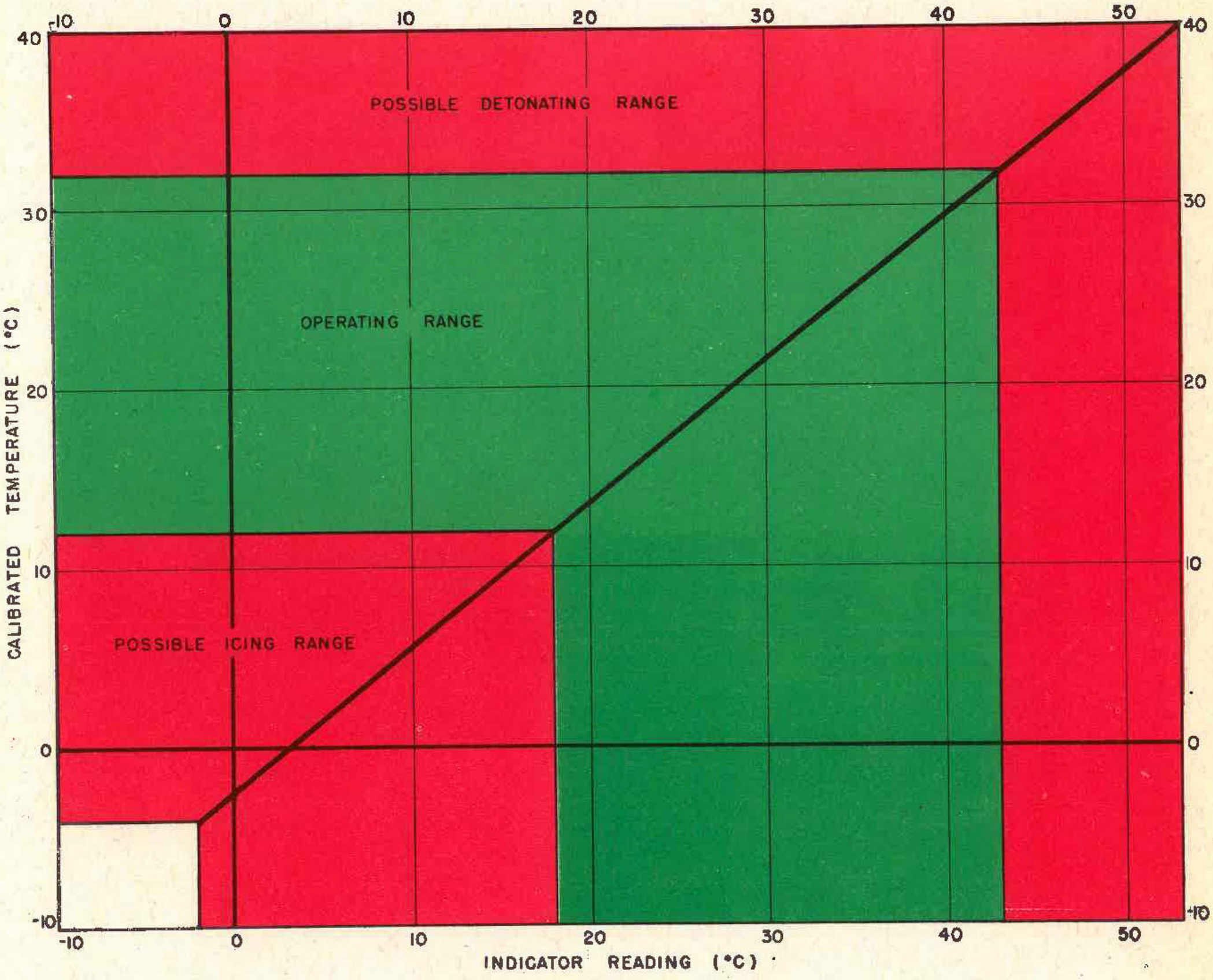
EXAMPLE

AT 29,000 LB. GROSS WT. WITH 450 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 196 GAL.) TO FLY 500 STAT. AIRMILES AT 10,000 FT. ALT. MAINTAIN 2230 RPM AND 225 MPH IND. AIRSPEED WITH MIXTURE SET Auto Lean

LEGEND

I. A. S.: INDICATED AIRSPEED
M. P.: MANIFOLD PRESSURE
G. P. H.: U. S. GAL. PER HOUR
T. A. S.: TRUE AIRSPEED
S.L.: SEA LEVEL
F. T.: FULL THROTTLE
F. R.: FULL RICH
A. R.: AUTO-RICH
A. L.: AUTO-LEAN
C. L.: CRUISING LEAN

RED FIGURES ARE PRELIMINARY, SUBJECT TO REVISION AFTER FLIGHT CHECK



CARBURETOR TEMPERATURE CHART

3. The carburetor air temperature is indicated by a bulb that projects into the induction airstream just above the carburetor. This system does not measure the actual temperature in the carburetor but its reading has been calibrated in a series of flight tests against the actual carburetor air temperature. The results of this calibration are shown in above chart. This chart also shows the recommended operating range, the probable icing range and the range in which there is danger of detonation. The operating limits marked on the instrument dial have been corrected for the calibration error and, therefore, can be used without further correction on the part of the pilot.

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