AN 01-5MC-1

Pilot's Handbook

for

NAVY MODEL

PBY-6A Airplane

THIS PUBLICATION SUPERSEDES AN 01-5MC-1 DATED 1 OCTOBER 1945

PUBLISHED UNDER JOINT AUTHORITY OF THE COMMANDING GENERAL,
ARMY AIR FORCES, AND THE CHIEF OF THE BUREAU OF AERONAUTICS

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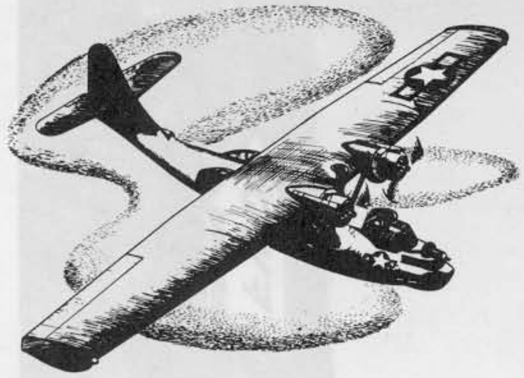

SECTION I
DESCRIPTION

1. AIRPLANE—DESCRIPTION AND GENERAL ARRANGEMENT.

This airplane is an all metal, two engine amphibian, with a flying boat hull 62 ft, 10⅝ in. long, equipped with retractable tricycle type landing gear. It is powered by two Pratt and Whitney R-1830-92 engines.

Wing span is 104 ft. The wing is mounted on a superstructure built up from the hull, and is braced by four struts, two on each side, extending from the hull to the under surface of the wing. Wing main center and outer panels are aluminum alloy, beam and truss, stressed skin construction, with detachable trailing edges made of braced aluminum alloy ribs covered with doped fabric. Leading edges of both center and outer panel are all metal, and are detachable. Main panel and leading and trailing edge structures incorporate ducts for the heat anti-icing system, which derives its heat from the engine exhaust. The wing also incorporates the engine nacelles, fuel and oil tanks and the two retractable auxiliary floats and their operating mechanism.

The two ailerons and their trailing edge fairings are constructed of braced metal ribs, fabric covered. The port aileron has a metal trim tab which may be adjusted by the pilot during flight.

The tail group consists of a stabilizer, elevators with controllable tabs, a fin, and a rudder with a controllable tab. The stabilizer and upper fin assembly is bolted to the lower fin, which is the aft portion of the hull. The stabilizer is all metal. Rudder and elevators are metal frames, fabric covered. The trim tabs are of metal construction and may be adjusted by the pilot during flight.

The hull is divided into five main watertight compartments, separated by four main bulkheads equipped with watertight doors. The bomber's compartment is in the nose of the hull. Immediately aft of the bomber's compartment is the pilot's compartment which extends aft as far as the first watertight bulkhead.

Radio operator's and navigator's compartment is aft of the pilot's compartment. Radio and radar operators occupy the starboard side of the compartment. The navigator is stationed on the port side of the same compartment. The engineer's station is in the superstructure which supports the wing. The compartment immediately below the engineer's station contains the galley stove and food locker. This compartment is narrow because of the indentations of the landing wheel wells. The crew quarters are aft of the galley compartment and contains the auxiliary power unit. The gun blisters and tail compartment are aft of the crew's quarters.

2. LOCATIONS AND ARRANGEMENT OF FLIGHT CONTROLS.

a. BOMBER'S COMPARTMENT.—There are no flight controls located in the bomber's compartment.

b. PILOT'S COMPARTMENT.
(See figure 1.)

(1) SURFACE CONTROLS. *(See figures 15 to 19 incl.)*—Dual surface controls are provided for pilot and copilot. Rudder control is in the form of two sets of pedals. Elevator control is in the form of a movable yoke. This yoke consists of two vertical supports on either side of the cockpit, and a horizontal bar parallel to the instrument panel, joining the tops of the two vertical members. Elevator control is achieved by moving the yoke forward or aft in the conventional control stick movements.

Aileron controls, consisting of two hand wheels mounted on the horizontal yoke bar at the pilot's and copilot's positions, are linked together by a chain and cable loop which runs over a sprocket on each wheel shaft. The hand wheels turn 267° each side of neutral.

The aileron tab is controlled by a hand wheel located on the pilot's instrument panel beam. This wheel turns in either direction; movement of the tab is indicated on a dial.

The rudder and elevator tab controls are in one housing located overhead in the ceiling of the pilot's compartment. The knob at the bottom is for the rudder

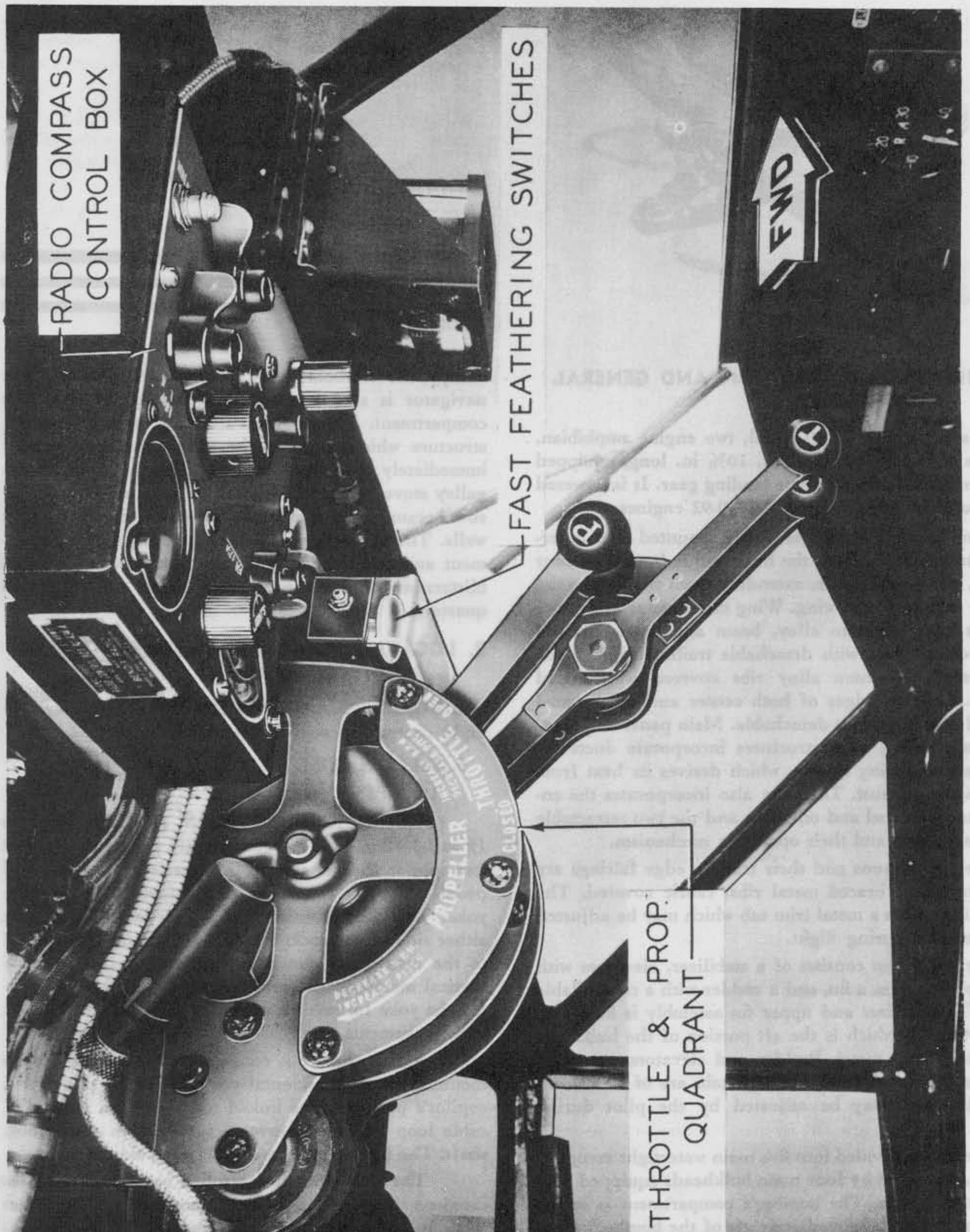

Figure 1—General View of Pilot's Compartment

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Three-Quarters Rear View

Three-Quarters Front View

tab, and is operated by turning the knob in the direction trim correction is required. The elevator tab control cranks are accessible to both pilot and copilot and act as dual controls. These cranks may be moved clockwise or counterclockwise; a dial on the face of the housing indicates movement of the tabs.

(2) LANDING GEAR AND BRAKE CONTROLS.
(See figure 4.)

(a) DESCRIPTION.

1. LANDING GEAR CONTROLS.—Operating control for the hydraulic landing gear lowering and retracting mechanism is a selector valve handle and lock located at the bottom of the main instrument panel on the pilot's side.

2. BRAKE CONTROLS.—Pedals to operate the landing wheel brakes are mounted on the top of the rudder pedals.

3. PARKING BRAKE.—*(See Section II, paragraph 21.)*

(b) LANDING GEAR OPERATION.

1. TO LOWER GEAR:

a. Turn control handle to "DOWN" position. Be sure that lever safety catch clicks into place, locking handle in "DOWN" position.

b. Turn indicator light switch on instrument panel to "W" position. Landing gear down light will show when main and nose wheels are all down and latched. Time required for lowering gear is approx. 15-18 seconds. If manifold pressure is decreased below 15 inches Hg, the float warning lights on both engineer's and pilot's panel will show red, indicating that the floats are up.

2. TO RAISE GEAR:

a. Pull lock knob on landing gear control handle to release handle.

b. Turn handle to "UP" position.

Note

The two lights indicating "MAIN LANDING GEAR UP" and "NOSE WHEEL DOOR LOCKED" will not show until the main wheels are both securely latched and the nose wheel doors are closed and latched. Time required to raise gear is approx. 35-40 seconds.

CAUTION

Gear control lever must be either all the way up or all the way down at all times; do not allow it to remain in any intermediate position.

(3) POWER PLANT CONTROLS.
(See figure 1.)

(a) THROTTLE CONTROL. — The throttle control levers are located on the ceiling of the pilot's compartment approximately at the center of the airplane.

(b) PROPELLER CONTROL.—The propeller governor control levers are located alongside and to the right of the throttle control levers, propeller feathering switches, ahead of the propeller governor levers. All other power plant controls are in the engineer's compartment.

(4) AUTOMATIC PILOT CONTROLS. *(See figures 2 and 3.)*—The Sperry Mark 3 automatic pilot is in the center cut-out of the main instrument panel. The main four way oil valve for the system is on the port side of the hull, just forward of the pilot's seat. The servo speed control valves are at the bottom of the automatic pilot panel. The "ON-OFF" control handle is over the bulkhead door just aft of the pilot's seat. The rudder control transfer valve is located on the port side, below the pilot's instrument panel.

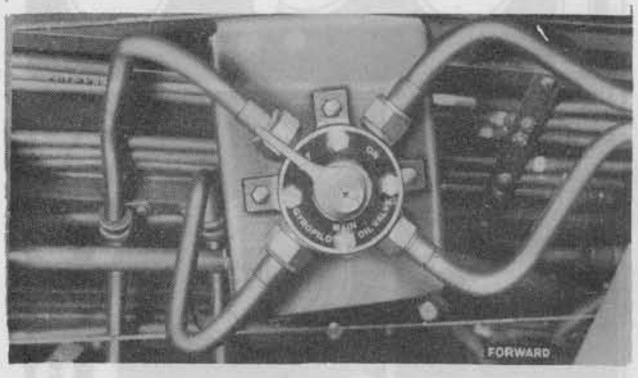


Figure 2—Four-Way Oil Valve

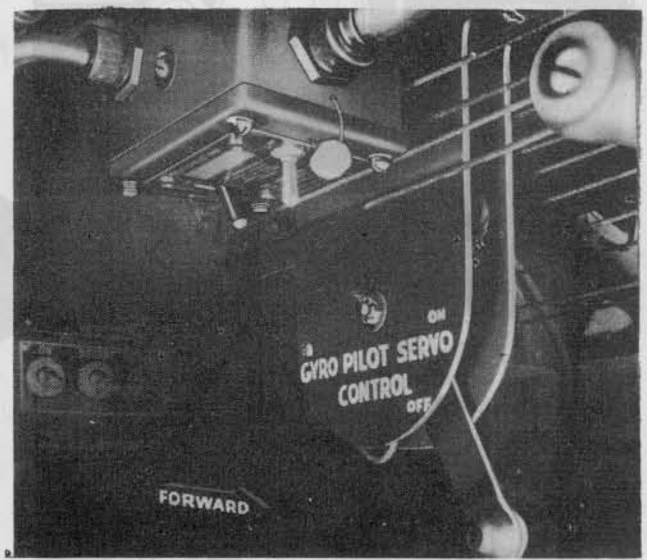
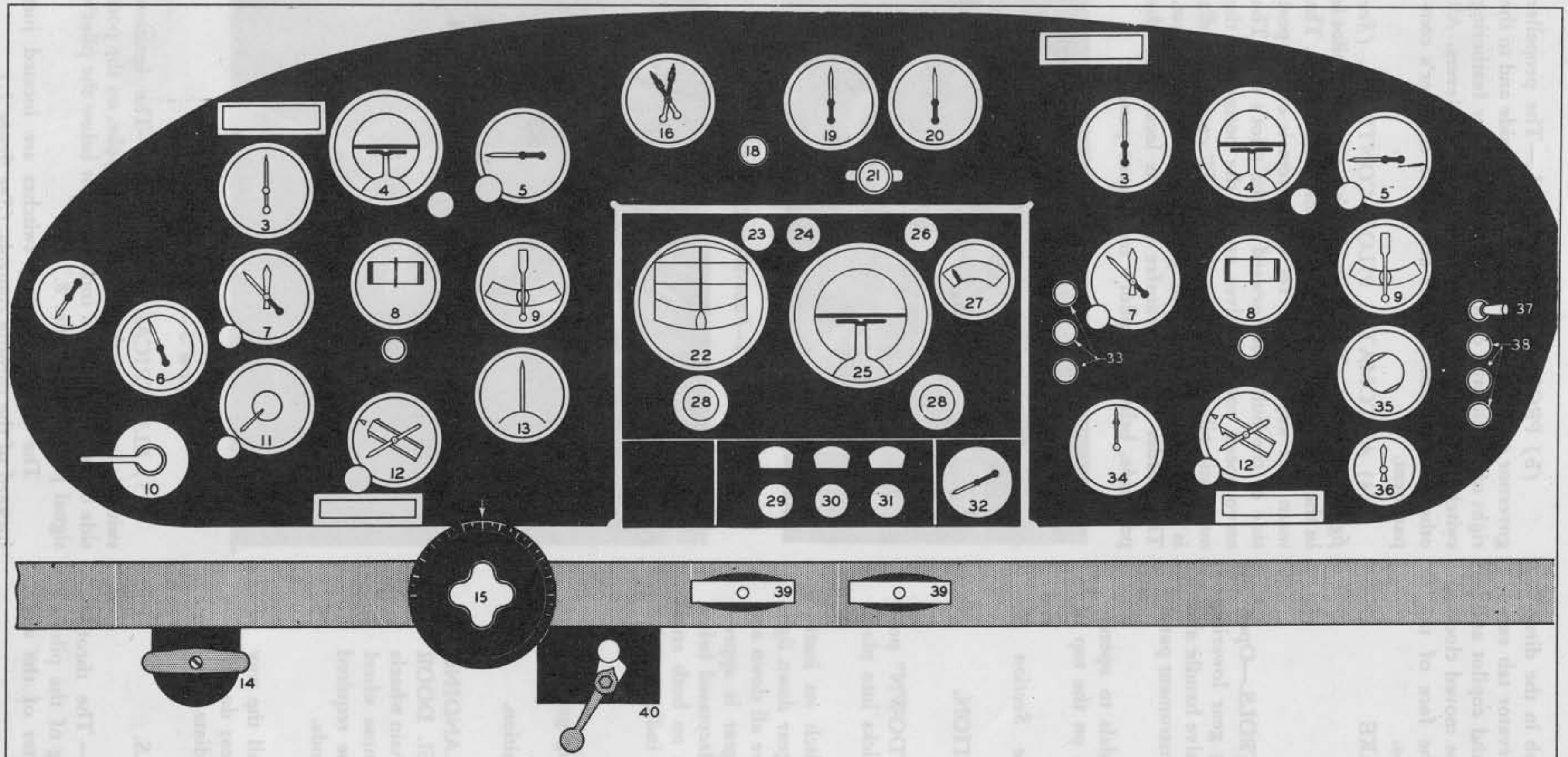


Figure 3—Auto-Pilot Control

(5) ELECTRICAL CONTROLS.—The ignition switch is located on the pilot's control yoke, on the port side of the pilot's visual indicator, just below the pilot's signal panel. *(See figure 8.)*

The Fast Feathering switches are located just forward of the throttle controls. *(See figure 1.)*



1. SUCTION GAGE
3. AIRSPEED INDICATOR
4. GYRO HORIZON INDICATOR
5. RATE OF CLIMB INDICATOR
6. RADIO COMPASS
7. ALTIMETER
8. DIRECTIONAL GYRO
9. TURN AND BANK INDICATOR
10. VACUUM SELECTOR VALVE
11. RADIO ALTIMETER
12. REMOTE INDICATING COMPASS
13. PILOT'S DIRECTION INDICATOR
14. RUDDER CONTROL TRANSFER VALVE
15. AILERON TAB CONTROL
16. DUAL TACHOMETER AND SYNCHRONIZER
18. MARKER BEACON LIGHT
19. L. ENG. MANIFOLD PRESSURE GAGE
20. R. ENG. MANIFOLD PRESSURE GAGE
21. FLOAT WARNING LIGHT
22. GYROPILOT DIRECTIONAL GYRO
23. RUDDER CONTROL KNOB
24. AILERON CONTROL KNOB
25. CLIMB AND BANK INDICATOR
26. ELEVATOR CONTROL KNOB
27. GYROPILOT SUCTION GAGE
28. CAGING KNOB
29. GYRO RUDDER SPEED CONTROL VALVE
30. GYRO AILERON SPEED CONTROL VALVE
31. GYRO ELEVATOR SPEED CONTROL VALVE
32. GYROPILOT OIL PRESSURE GAGE
33. RADIO ALTIMETER LIGHTS
34. CLOCK
35. RADIO ALTIMETER SELECTOR SWITCH
36. HYDRAULIC PRESSURE GAGE
37. LANDING GEAR WARNING LIGHT SWITCH
38. LANDING GEAR WARNING LIGHTS
39. EMERGENCY BOMB RELEASE
40. LANDING GEAR SELECTOR VALVE

Figure 4—Pilot's Instrument Panel

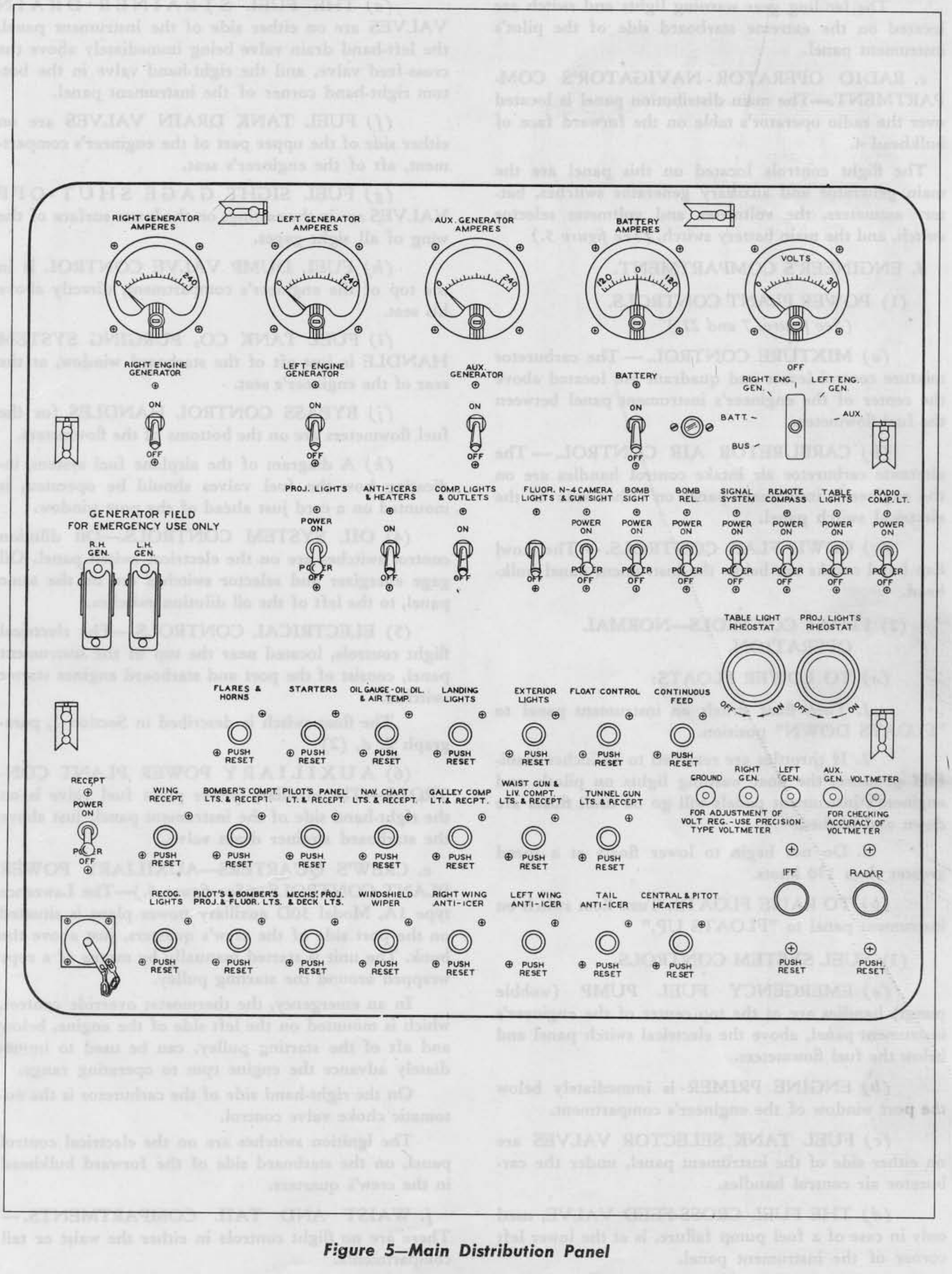


Figure 5—Main Distribution Panel

The landing gear warning lights and switch are located on the extreme starboard side of the pilot's instrument panel.

c. RADIO OPERATOR - NAVIGATOR'S COMPARTMENT.—The main distribution panel is located over the radio operator's table on the forward face of bulkhead 4.

The flight controls located on this panel are the main generator and auxiliary generator switches, battery ammeters, the voltmeter and voltmeter selector switch, and the main battery switch. *(See figure 5.)*

d. ENGINEER'S COMPARTMENT.

(1) POWER PLANT CONTROLS. *(See figures 7 and 21.)*

(a) MIXTURE CONTROL. — The carburetor mixture control levers and quadrant are located above the center of the engineer's instrument panel between the fuel flowmeters.

(b) CARBURETOR AIR CONTROL. — The alternate carburetor air intake control handles are on the engineer's instrument panel on either side of the electrical switch panel.

(c) COWL FLAP CONTROLS. — The cowl flap hand cranks are below the instrument panel bulkhead.

(2) FLOAT CONTROLS—NORMAL OPERATION.

(a) TO LOWER FLOATS:

1. Turn float switch on instrument panel to "FLOATS DOWN" position.

2. If throttles are retarded to 15 inches manifold pressure, the float warning lights on pilot's and engineer's instrument panels will go on until floats are down and latched.

3. Do not begin to lower floats at a speed greater than 130 knots.

(b) TO RAISE FLOATS: Turn float switch on instrument panel to "FLOATS UP."

(3) FUEL SYSTEM CONTROLS.

(a) EMERGENCY FUEL PUMP (wobble pump) handles are at the top center of the engineer's instrument panel, above the electrical switch panel and below the fuel flowmeters.

(b) ENGINE PRIMER is immediately below the port window of the engineer's compartment.

(c) FUEL TANK SELECTOR VALVES are on either side of the instrument panel, under the carburetor air control handles.

(d) THE FUEL CROSS-FEED VALVE, used only in case of a fuel pump failure, is at the lower left corner of the instrument panel.

(e) THE FUEL STRAINER DRAIN VALVES are on either side of the instrument panel, the left-hand drain valve being immediately above the cross-feed valve, and the right-hand valve in the bottom right-hand corner of the instrument panel.

(f) FUEL TANK DRAIN VALVES are on either side of the upper part of the engineer's compartment, aft of the engineer's seat.

(g) FUEL SIGHT GAGE SHUT-OFF VALVES are in the castings on the lower surface of the wing of all sight gages.

(h) FUEL DUMP VALVE CONTROL is in the top of the engineer's compartment, directly above his seat.

(i) FUEL TANK CO_2 PURGING SYSTEM HANDLE is just aft of the starboard window, at the rear of the engineer's seat.

(j) BYPASS CONTROL HANDLES for the fuel flowmeters are on the bottoms of the flowmeters.

(k) A diagram of the airplane fuel system, indicating how the fuel valves should be operated, is mounted on a card just ahead of the port window.

(4) OIL SYSTEM CONTROLS.—Oil dilution control switches are on the electrical switch panel. Oil gage energizer and selector switches are on the same panel, to the left of the oil dilution switches.

(5) ELECTRICAL CONTROLS.—The electrical flight controls, located near the top of the instrument panel, consist of the port and starboard engines starter switches.

The float switch is described in Section I, paragraph 2, *d,* (2)

(6) AUXILIARY POWER PLANT CONTROLS.—The auxiliary power plant fuel valve is on the right-hand side of the instrument panel, just above the starboard strainer drain valve.

e. CREW'S QUARTERS—AUXILIARY POWER PLANT CONTROLS. *(See figure 6.)*—The Lawrance type 1A, Model 30D auxiliary power plant is situated on the port side of the crew's quarters, just above the bunk. The unit is started manually by means of a rope wrapped around the starting pulley.

In an emergency, the thermostat override control, which is mounted on the left side of the engine, below and aft of the starting pulley, can be used to immediately advance the engine rpm to operating range.

On the right-hand side of the carburetor is the automatic choke valve control.

The ignition switches are on the electrical control panel, on the starboard side of the forward bulkhead in the crew's quarters.

f. WAIST AND TAIL COMPARTMENTS.—There are no flight controls in either the waist or tail compartments.

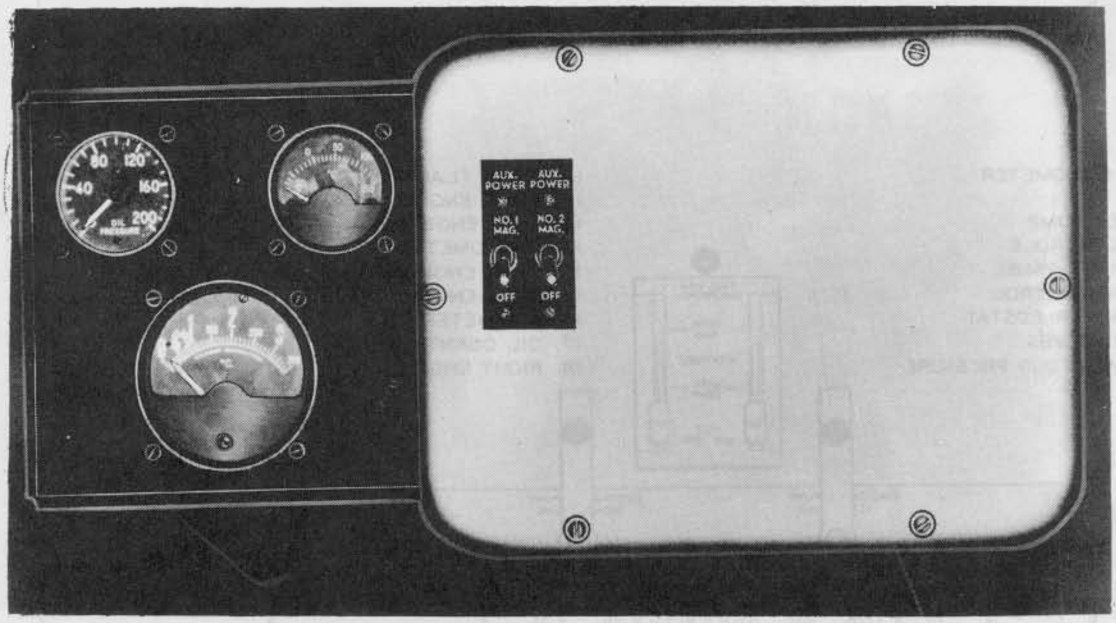


Figure 6—Auxiliary Power Plant Control Panel

3. LOCATIONS AND ARRANGEMENT OF MISCELLANEOUS CONTROLS.

a. NOSE COMPARTMENT.

(1) ELECTRICAL CONTROLS.—The bomber's switch panel is located above and to the port side of the nose window. The panel is "L" shaped and extends back along the port side. On this panel are located: the gun sight power circuit breaker; projector light rheostat; firing key and utility receptacles; bomb release, bomb sight, manual, automatic, nose fuse and tail fuse switches.

The intervalometer is located on the port side, aft and below the bomber's switch panel. On this panel are located the intervalometer unit, pin jacks, and control switches. *(See figure 59.)*

(2) INTERPHONE CONTROLS. — The bombardier's station box for the interphone system is located on the starboard side, forward and near station 0.33.

(3) ANCHOR GEAR. *(See figure 22.)*—The anchor gear is stowed in a box on the port side of the hull between beltframe 0.33 and bulkhead 1. The reel is inside the anchor box.

Two men are required to cast and weigh anchor. One man is stationed inside the bomber's compartment. The other, equipped with a safety belt, is stationed on the mooring platform outside of the ship.

Note

Complete anchor handling instructions are printed on the inner face of the anchor compartment door, where it can be read by the man on the mooring platform, when the door is opened.

b. PILOT'S COMPARTMENT.

(1) WINDSHIELD SPRAY AND WIPER.—A hand pump with which to spray the windshields with alcohol anti-icing solution is located outboard of the instrument panel on the copilot's side. The pump handle controls a selector valve for right or left windshield.

A speed control box for control of the Marquette electric windshield wiper is located in the ceiling of the pilot's compartment, aft of the tab controls.

(2) ANTI-ICING.

(a) PROPELLER.—A rheostat (graduated in gallons per hour) for controlling the speed and output of the propeller anti-icer pump is located on the pilot's switch panel. The control knob turns clockwise to increase the amount of fluid delivered to the propeller.

(b) WING.—Switches for controlling the hot air wing anti-icing equipment are on the pilot's switch panel, next to the anti-icer rheostat.

(3) VACUUM PUMP SELECTOR VALVE.—A vacuum pump selector valve is located at the bottom of the instrument panel on the pilot's side. This valve shuts off vacuum to automatic pilot and copilot's turn and bank indicator.

(4) PILOT'S AND COPILOT'S SEAT ADJUSTMENTS.—The pilot's and copilot's seat may be adjusted for tilt and for fore and aft position by releasing spring-loaded locking pins controlled by levers. The levers for the tilt adjustments are located on the forward parts of the seats.

(5) RUDDER PEDAL ADJUSTMENT.—Both sets of rudder pedals may be adjusted for fore and aft

1. OUTSIDE AIR THERMOMETER
2. CLOCK
3. EMERGENCY FUEL PUMP
4. FUEL MIXTURE CONTROLS
5. ENGINEER'S SWITCH PANEL
6. CARBURETOR AIR CONTROL
7. PROJECTOR LIGHTS RHEOSTAT
8. FUEL SELECTOR VALVES
9. RIGHT ENGINE MANIFOLD PRESSURE
10. COWL FLAP CONTROL CRANKS
11. RIGHT ENGINE GAGE UNIT
12. LEFT ENGINE GAGE UNIT
13. TACHOMETER
14. LEFT ENGINE MANIFOLD PRESSURE
15. LEFT ENGINE CYLINDER TEMPERATURE GAGE
16. ALTIMETER
17. OIL QUANTITY GAGE
18. RIGHT ENGINE CYLINDER TEMPERATURE GAGE

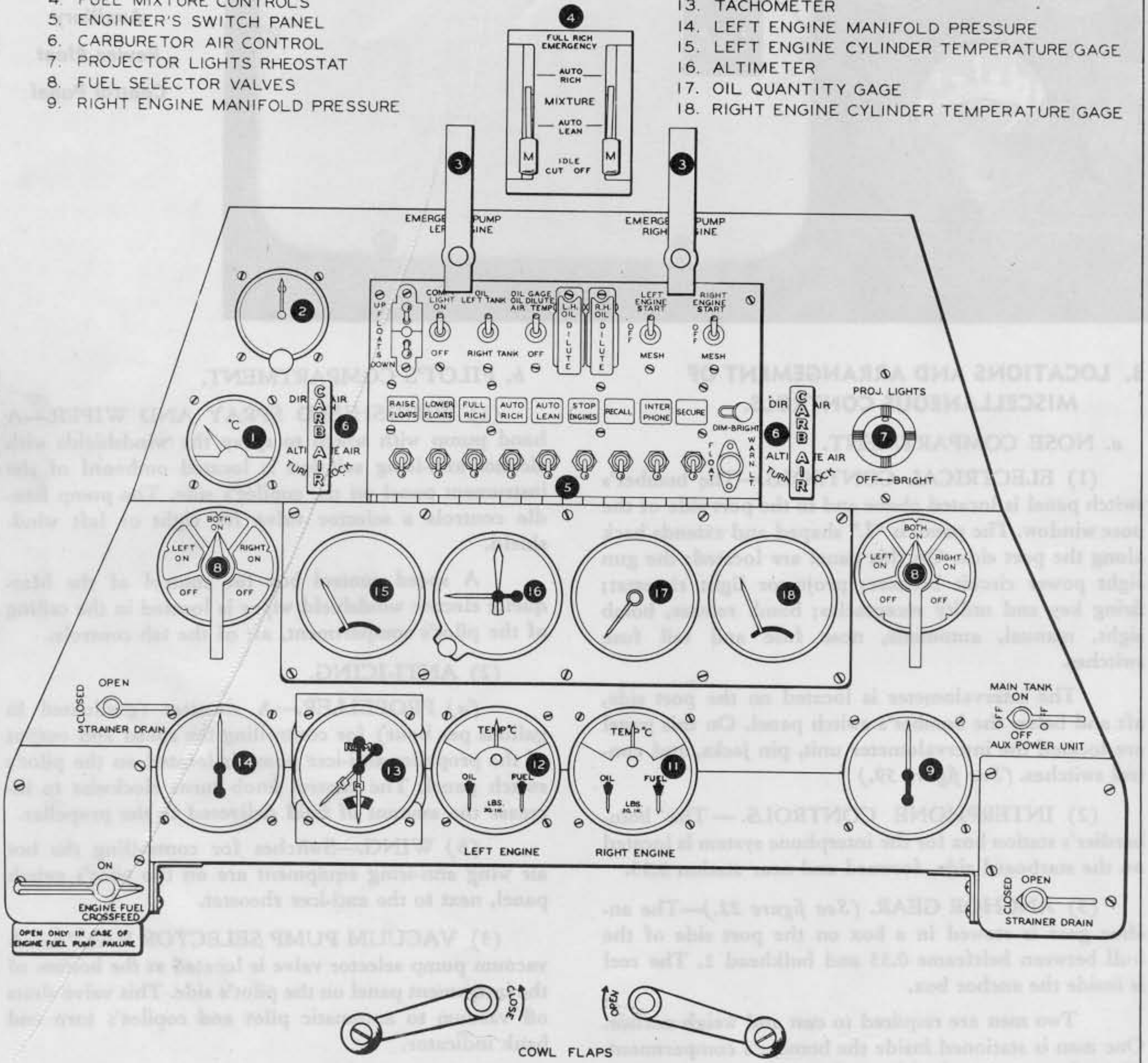


Figure 7—Engineer's Instrument Panel

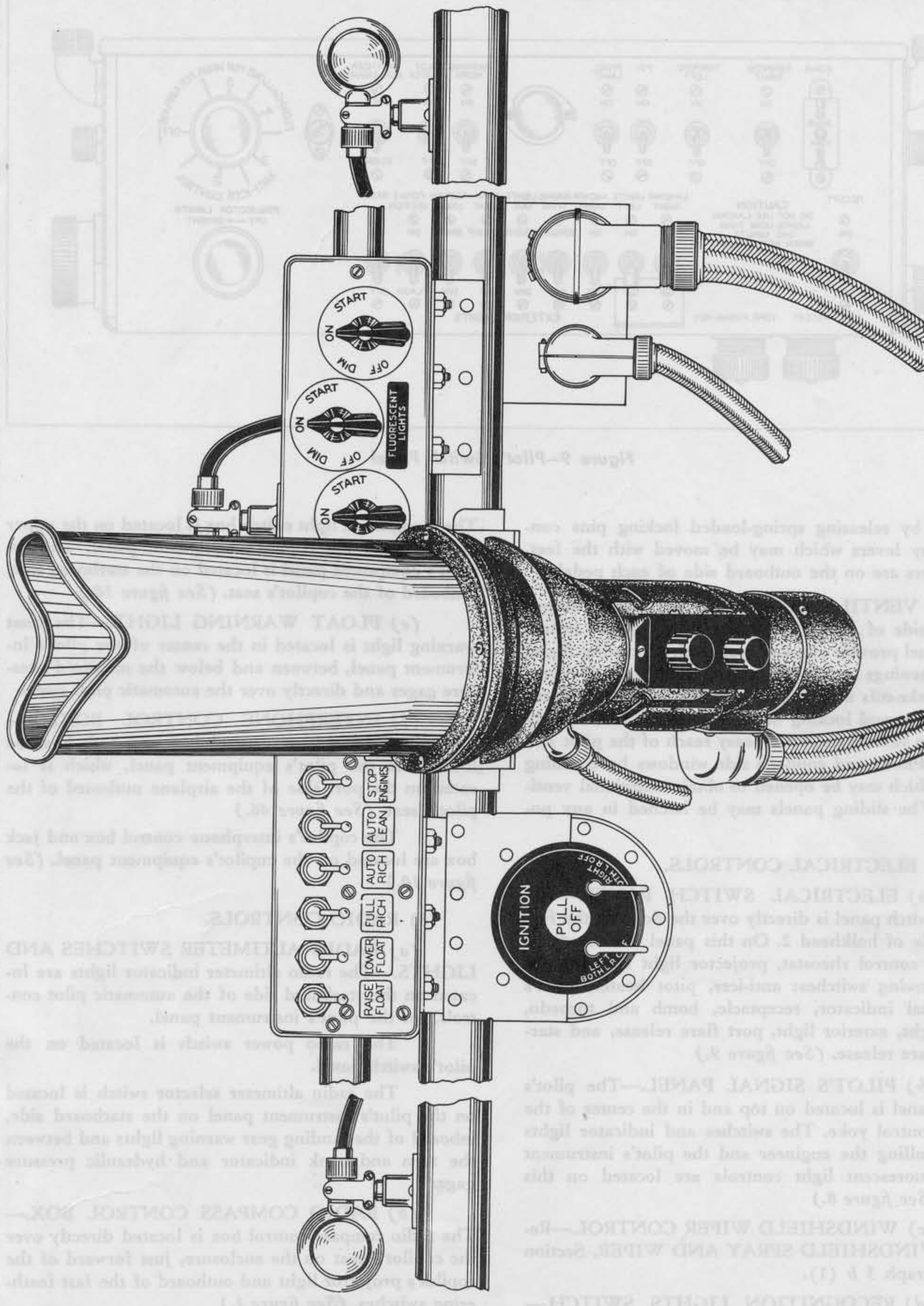


Figure 8—Pilot's Control Yoke

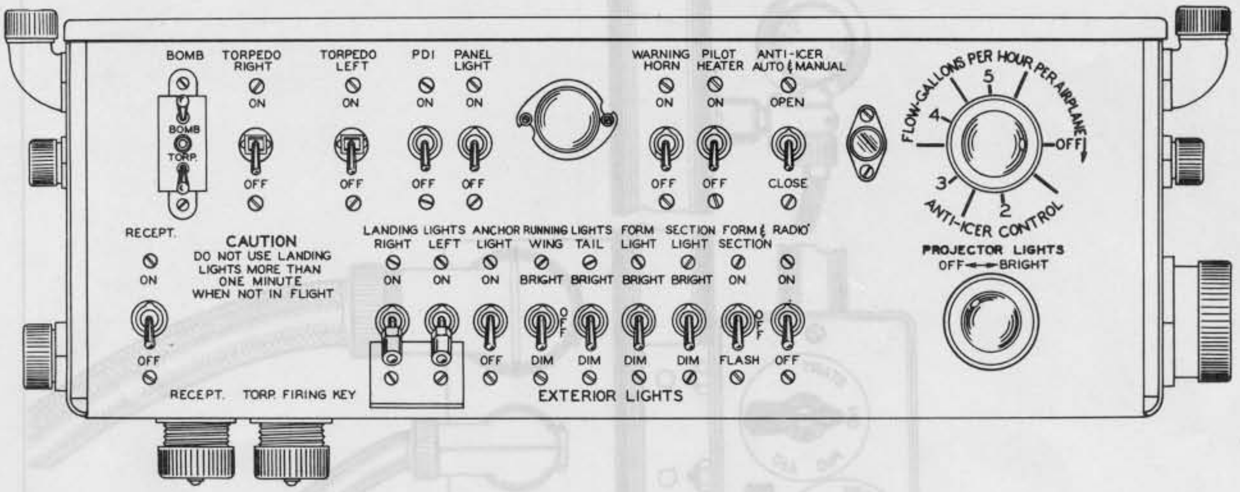


Figure 9—Pilot's Switch Panel

position by releasing spring-loaded locking pins controlled by levers which may be moved with the feet. The levers are on the outboard side of each pedal.

(6) VENTILATION CONTROLS. — Openings in each side of the hull immediately aft of the instrument panel provide admission of fresh air during flight. These openings are closed with watertight hinged covers during take-offs and landings. Knobs controlling opening, closing and locking of the covers are immediately aft of the ventilators, within easy reach of the pilot and copilot. Pilot's and copilot's side windows have sliding panels which may be opened to obtain additional ventilation. The sliding panels may be latched in any position.

(7) ELECTRICAL CONTROLS.

(a) ELECTRICAL SWITCH PANEL.—The pilot's switch panel is directly over the door on the forward side of bulkhead 2. On this panel is located the anti-icer control rheostat, projector light rheostat and the following switches: anti-icer, pitot heater, pilot's directional indicator, receptacle, bomb and torpedo, panel light, exterior light, port flare release, and starboard flare release. *(See figure 9.)*

(b) PILOT'S SIGNAL PANEL.—The pilot's signal panel is located on top and in the center of the pilot's control yoke. The switches and indicator lights for signalling the engineer and the pilot's instrument panel fluorescent light controls are located on this panel. *(See figure 8.)*

(c) WINDSHIELD WIPER CONTROL.—Refer to WINDSHIELD SPRAY AND WIPER, Section I, paragraph 3 *b* (1).

(d) RECOGNITION LIGHTS SWITCH.—The recognition light switch box is located on the upper aft corner of the copilot's equipment panel. The copilot's equipment panel is located on the starboard side, outboard of the copilot's seat. *(See figure 10.)*

(e) FLOAT WARNING LIGHT.—The float warning light is located in the center of the pilot's instrument panel, between and below the manifold pressure gages and directly over the automatic pilot panel.

(f) INTERPHONE CONTROL BOXES.—The pilot's interphone control box and jack box are located on the pilot's equipment panel, which is located on the port side of the airplane outboard of the pilot's seat. *(See figure 46.)*

The copilot's interphone control box and jack box are located on the copilot's equipment panel. *(See figure 10.)*

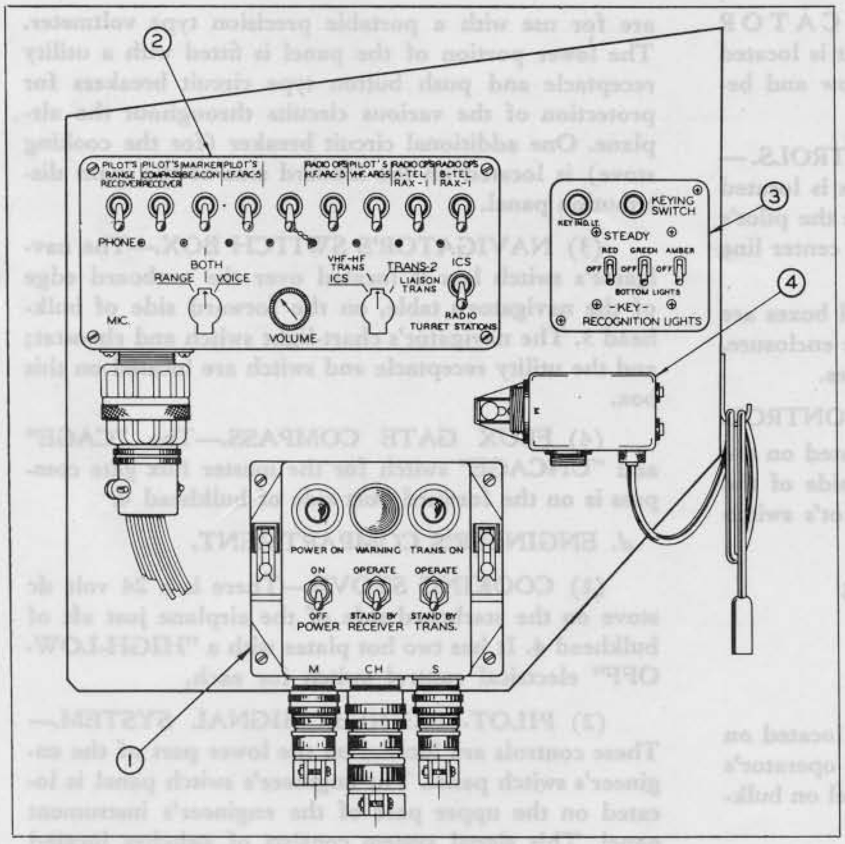
(8) RADIO CONTROLS.

(a) RADIO ALTIMETER SWITCHES AND LIGHTS.—The radio altimeter indicator lights are located on the starboard side of the automatic pilot controls, on the pilot's instrument panel.

The radio power switch is located on the pilot's switch panel.

The radio altimeter selector switch is located on the pilot's instrument panel on the starboard side, inboard of the landing gear warning lights and between the turn and bank indicator and hydraulic pressure gage.

(b) RADIO COMPASS CONTROL BOX.—The radio compass control box is located directly over the copilot's seat on the enclosure, just forward of the copilot's projector light and outboard of the fast feathering switches. *(See figure 1.)*



1. IFF Identification Box
2. Interphone Control Box
3. Recognition Light Switch Box
4. Jack Box

Figure 10—Copilot's Equipment Panel

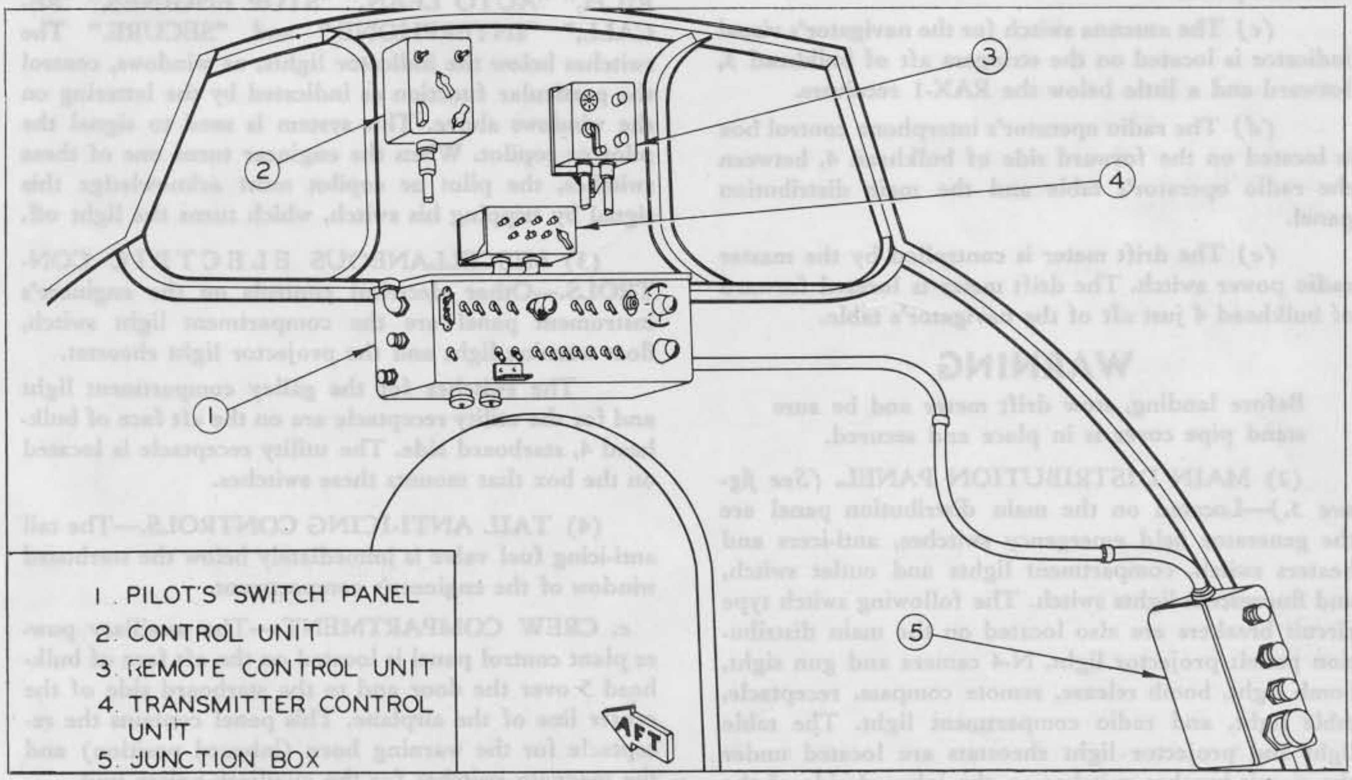


Figure 11—Radio Controls on Bulkhead 2

(*c*) MARKER BEACON INDICATOR LIGHT.—The marker beacon indicator light is located above the automatic pilot controls and below and between the manifold pressure gages.

(*d*) PILOT'S COMMAND CONTROLS.—The pilot's command transmitter control box is located on the forward face of bulkhead two, above the pilot's switch panel and to the starboard side of the center line of the airplane. *(See figure 11.)*

Two pilot's command receiver control boxes are mounted directly over the pilot's seat on the enclosure, to the port side of the fast feathering switches.

(*e*) PILOT'S NAVIGATIONAL CONTROL.—The pilot's navigational control box is located on the forward side of bulkhead two on the port side of the center line of the airplane and over the pilot's switch panel.

c. RADIO OPERATOR-NAVIGATOR'S COMPARTMENT. *(See figure 40.)*

(1) RADIO CONTROLS.

(*a*) The master radio power switch is located on the radio operator's power box. The radio operator's power box is under the main distribution panel on bulkhead 4.

(*b*) The radio operator's key is located on the aft edge of the radio operator's table, inboard side. The radio operator's table is located below the main distribution panel.

(*c*) The antenna switch for the navigator's visual indicator is located on the stringers aft of bulkhead 3, forward and a little below the RAX-1 receivers.

(*d*) The radio operator's interphone control box is located on the forward side of bulkhead 4, between the radio operator's table and the main distribution panel.

(*e*) The drift meter is controlled by the master radio power switch. The drift meter is located forward of bulkhead 4 just aft of the navigator's table.

WARNING

Before landing, stow drift meter and be sure stand pipe cover is in place and secured.

(2) MAIN DISTRIBUTION PANEL. *(See figure 5.)*—Located on the main distribution panel are the generator field emergency switches, anti-icers and heaters switch, compartment lights and outlet switch, and fluorescent lights switch. The following switch type circuit breakers are also located on the main distribution panel: projector light, N-4 camera and gun sight, bomb sight, bomb release, remote compass, receptacle, table light, and radio compartment light. The table light and projector light rheostats are located under the circuit breaker switches on the inboard side of the panel. Below the rheostat are located five pin jacks that are for use with a portable precision type voltmeter. The lower portion of the panel is fitted with a utility receptacle and push button type circuit breakers for protection of the various circuits throughout the airplane. One additional circuit breaker (for the cooking stove) is located on the inboard side of the main distribution panel.

(3) NAVIGATOR'S SWITCH BOX.—The navigator's switch box is located over the outboard edge of the navigator's table, on the forward side of bulkhead 3. The navigator's chart-light switch and rheostat; and the utility receptacle and switch are located on this box.

(4) FLUX GATE COMPASS.—The "CAGE" and "UNCAGE" switch for the master flux gate compass is on the forward port side of bulkhead 4.

d. ENGINEER'S COMPARTMENT.

(1) COOKING STOVE.—There is a 24 volt dc stove on the starboard side of the airplane just aft of bulkhead 4. It has two hot plates with a "HIGH-LOW-OFF" electrical control switch for each.

(2) PILOT-ENGINEER SIGNAL SYSTEM.—These controls are located on the lower part of the engineer's switch panel. The engineer's switch panel is located on the upper part of the engineer's instrument panel. This signal system consists of switches located below small openings which are covered with ground glass and lettered as follows: "RAISE FLOATS," "LOWER FLOATS," "FULL RICH," "AUTO RICH," "AUTO LEAN," "STOP ENGINES," "RECALL," "INTERPHONE," and "SECURE." The switches below the indicator lights, or windows, control the particular function as indicated by the lettering on the windows above. This system is used to signal the pilot or copilot. When the engineer turns one of these switches, the pilot or copilot must acknowledge this signal by tripping his switch, which turns the light off.

(3) MISCELLANEOUS ELECTRIC CONTROLS.—Other electrical controls on the engineer's instrument panel are the compartment light switch, float warning light and the projector light rheostat.

The switches for the galley compartment light and for the utility receptacle are on the aft face of bulkhead 4, starboard side. The utility receptacle is located on the box that mounts these switches.

(4) TAIL ANTI-ICING CONTROLS.—The tail anti-icing fuel valve is immediately below the starboard window of the engineer's compartment.

e. CREW COMPARTMENT.—The auxiliary power plant control panel is located on the aft face of bulkhead 5 over the door and to the starboard side of the center line of the airplane. This panel contains the receptacle for the warning horn (inboard position) and the magneto switches for the auxiliary power unit.

On the forward face of bulkhead 6, on the port side near the top of the door, are located the switches for the crew compartment light and for the utility receptacle. The utility receptacle is mounted on the box that mounts the switches.

f. WAIST COMPARTMENT.

(1) The heat anti-icing damper control switch and indicator light is located on the forward side of bulkhead 7 above the door, just left of the center line of the airplane. *(See figure 12.)*

(2) The switches for the waist gun compartment light and for the utility receptacle are located on the aft side of bulkhead 6, on the port side near the top of the door. The utility receptacle is located inboard of these switches.

(3) The waist gunner's switch boxes are located on the longerons below the blisters, forward of the gun mounts on port and starboard sides. On these boxes are located the switches for the continuous feed motors and the switches for the gun-camera receptacles. A push button circuit breaker is located on these boxes for the illuminated gun sight. The receptacle for the gun-camera is located on the aft end of each box.

(4) A blister pump, located immediately aft of each waist gun blister, is used to inflate the water seals of the blisters. *(See figure 13.)*

The blister locking handle, located beneath the pump, operates the water seal outlet valve and the blister locking pin. The plunger of the water seal outlet valve rides on a cam actuated by the handle. The locking pin is actuated by a sector containing a slotted hole

Figure 12—Tail Anti-Icer Controls

and attached to the handle. Directions for operating the waterseal are posted on the port and starboard sides of bulkhead 7, on the forward face.

g. TAIL COMPARTMENT.

(1) The tail anti-icer switch box is located on the aft face of bulkhead 7 over the door on the port side. On this box are located the switches for the tunnel gunner's compartment light and for the utility receptacle. The utility receptacle is located below the switches on this box.

(2) The switch for the tail camera is located on the tail camera switch box. The tail camera switch box is mounted on the port side of the tunnel gunner's door on the stringers.

4. INSTRUMENTS.

a. BOMBER'S COMPARTMENT.—The following flight and navigation instruments are located on the bomber's instrument panel:

- Air Speed Indicator
- Altimeter
- Free Air Thermometer
- Inclinometer

b. PILOT'S COMPARTMENT. *(See figure 1.)*—The pilot has the following flight and navigation instruments on his side of the main instrument panel:

- Air Speed Indicator
- Altimeter
- Directional Gyro
- Gyro Horizon
- Pilot's Directional Indicator
- Radio Altimeter
- Radio Compass
- Rate of Climb Indicator
- Remote Compass Indicator
- Turn and Bank Indicator

The copilot has the following flight and navigation instruments on his side of the main instrument panel:

- Air Speed Indicator
- Altimeter
- Directional Gyro
- Gyro Horizon
- Rate of Climb Indicator
- Remote Compass Indicator
- Turn and Bank Indicator

The Mark 3 Sperry automatic pilot control panel located in the center of the main instrument panel contains the following instruments:

- Bank and Climb Gyro Control Unit
- Directional Gyro Control Unit

The following engine instruments are located in the center of the main instrument panel above the Sperry Mark 3 automatic pilot control units:

- Dual Tachometer
- Manifold Pressure Gage (two)

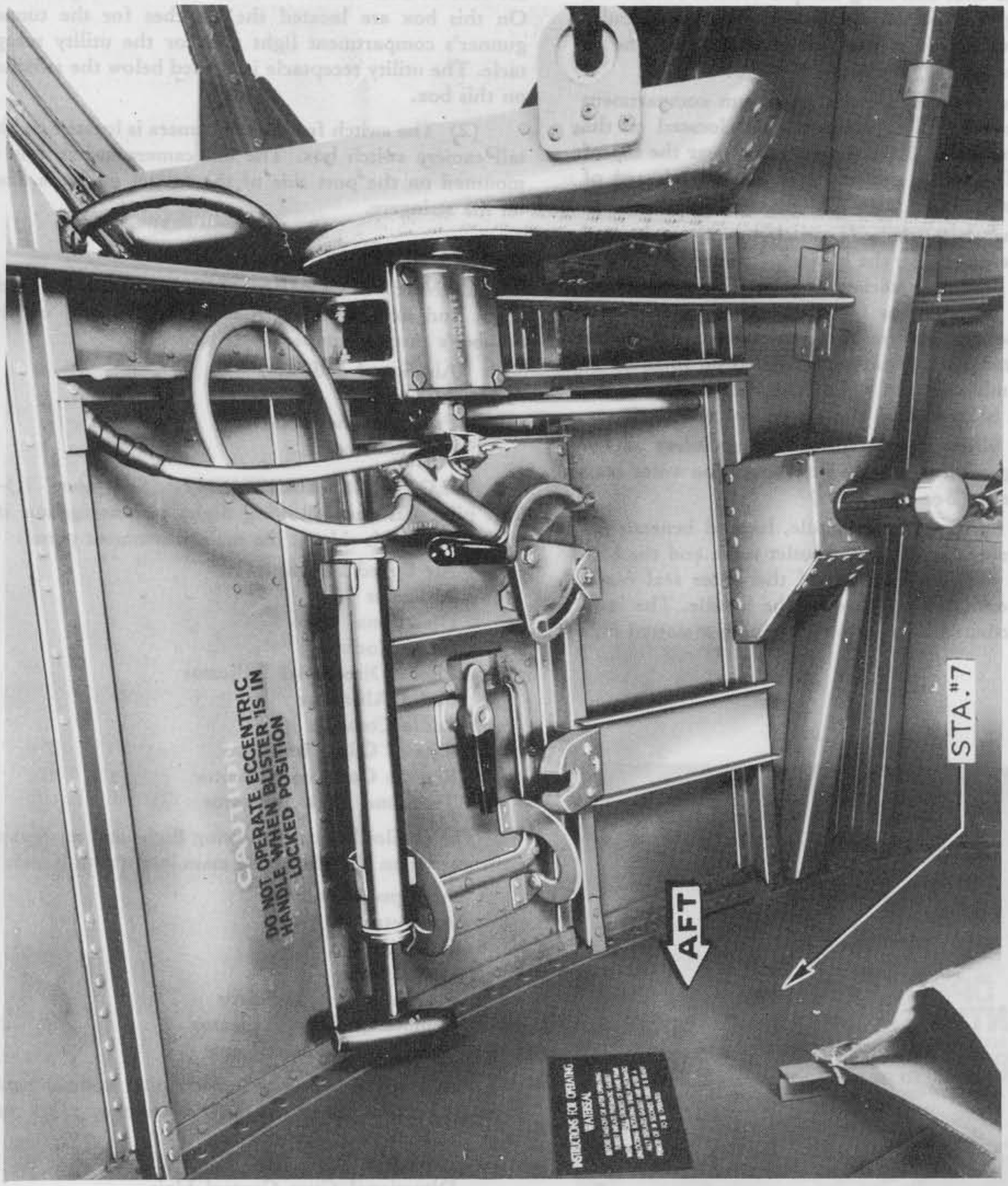


Figure 13—Waterseal Inflation Mechanism for Waist Gun Blister

Other instruments located in the pilots' compartment are:

Suction Gage—located on pilot's side of main instrument panel.

Hydraulic Pressure Gage—located on copilot's side of main instrument panel.

Oil Pressure Gage—located on bottom of automatic pilot panel.

Clock—located on copilot's side of main instrument panel.

Mark 8 Compass—located on center line of ceiling of pilot's compartment.

c. RADIO OPERATOR - NAVIGATOR'S COMPARTMENT.—The following instruments are located on the navigator's instrument panel:

Air Speed Indicator
Air Thermometer
Altimeter
Clock
Fluxgate compass master indicator

Navigator's compass is located on the navigator's table.

d. ENGINEER'S COMPARTMENT. *(See figure 7.)*—The engineer has the following engine, fuel and oil instruments located on his instrument panel:

Cylinder Temperature Gages (two)
Dual Tachometer (one)
Engine Gage Unit—incorporating oil temperature, oil pressure and fuel pressure gages (two)
Manifold Pressure Gages (two)
Oil Quantity Gage (one)

Other engine, fuel and oil instruments located in the engineer's compartment include:

Fuel Flowmeters (two)—located above engineer's instrument panel
Quantity Sight Gages (two)—located below front and rear wing spars
Inclinometer (including tilt charts)—located on starboard wall

Additional instruments in engineer's compartment are:

Altimeter—located on instrument panel
Clock—located on instrument panel
Outside Air Thermometer—located on instrument panel
Anti-Icer Temperature Thermometer (three)—located on port wall

e. CREW'S QUARTERS.—A cylinder temperature thermometer and an oil pressure gage are located on the auxiliary power unit instrument panel located on the aft face of bulkhead 5.

f. WAIST COMPARTMENT.—There are no instruments in the waist compartment.

g. TAIL COMPARTMENT.—There are no instruments in the tail compartment.

5. GUNFIRE PROTECTION FOR PERSONNEL AND EQUIPMENT.

(See figure 14.)

Gunfire protection for personnel and equipment includes:

a. PILOT'S AND COPILOT'S ARMOR.—Homogeneous armor plate to protect pilot and copilot from gunfire from the rear is on pilot's and copilot's seat.

b. SIDE WAIST GUNNER'S ARMOR.—Face hardened armor plate is attached to each gun to protect the gunner.

c. TUNNEL GUNNER'S ARMOR.—Homogeneous armor plate in the aft part of the hull is to protect the gunner from fire from the rear. Airplanes with Buaer Serial No. 64016 and on are not equipped with this armor plate.

d. SUMP ARMOR.—Homogeneous armor plate is installed at bulkhead 5, at the rear spar, and on the two sides of the superstructure to protect fuel sumps.

6. MOVEMENT OF FLIGHT PERSONNEL.

(See figures 20 and 42.)

Unrestricted movement of flight personnel from one end of the ship to the other is made possible by the central passageway. The watertight bulkhead doors should be left open, except in an emergency.

WARNING

Escape from the airplane during flight may be made through the waist gun blisters or the tunnel gun hatch.

When the airplane is on land or water, the hatches in the top of the bow turret and the pilot's compartment are available as additional escape hatches.

In operating the airplane, the pilot and flight engineer coordinate their activities through the interphone, or by means of the signal light system described in paragraph 2 of this section. The radio operator is responsible for checking the line switches and generator and battery bus switches on the main power distribution panel aft of his table.

The crew positions during cruising are as follows:

One man at pilot's position
One man at copilot's position
One man at navigator's position
One man at radio position
One man at engineer's position
One man in bunk
One man at radar position
One man at bow gunner's position

The battle positions of the crew are as follows:

One man at bow position
One man at pilot's position
One man at radio position
One man at engineer's position
Two men at waist gun positions
One man at tunnel gun position
One man at the radar position

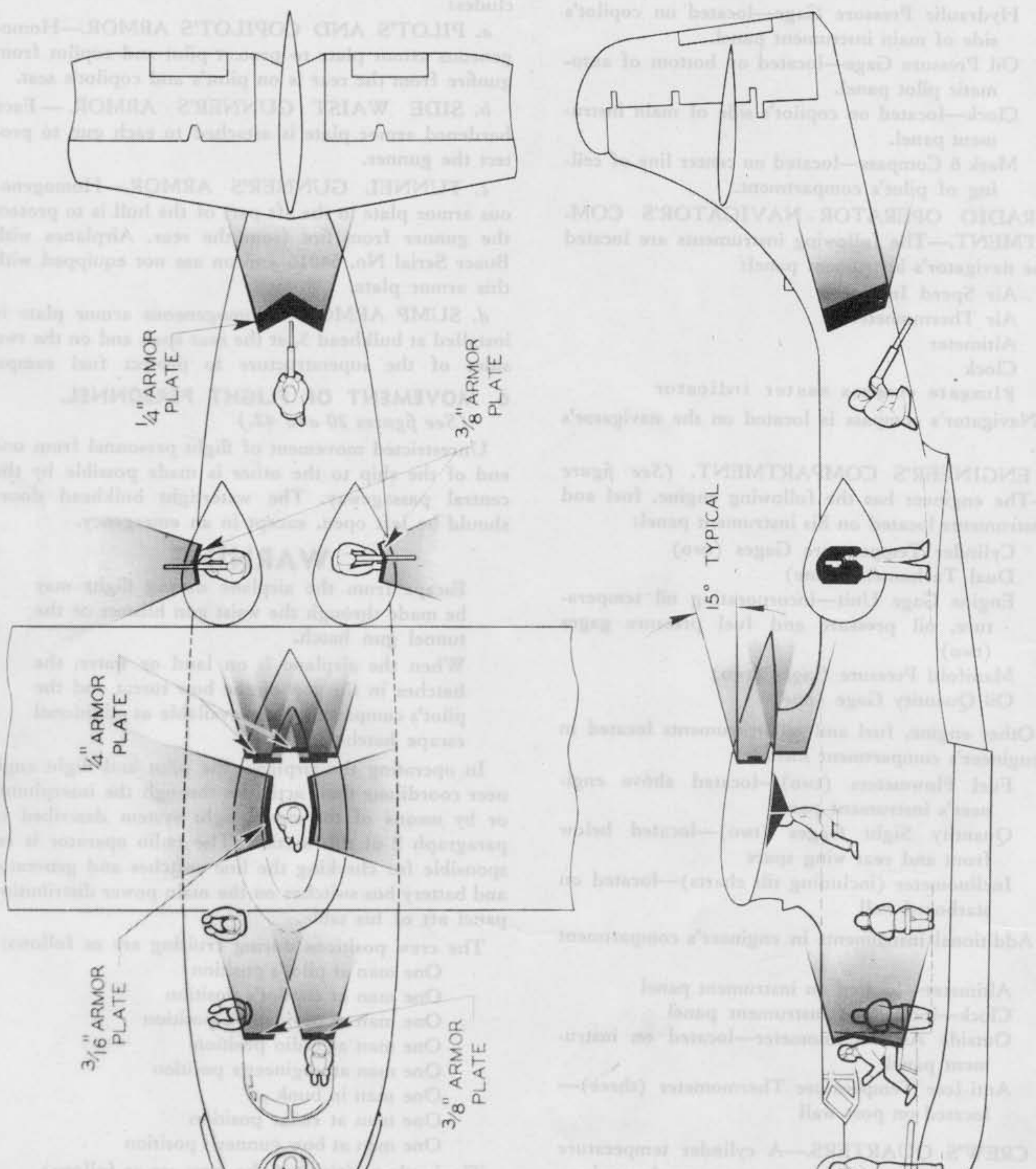


Figure 14—Angles of Armor Protection

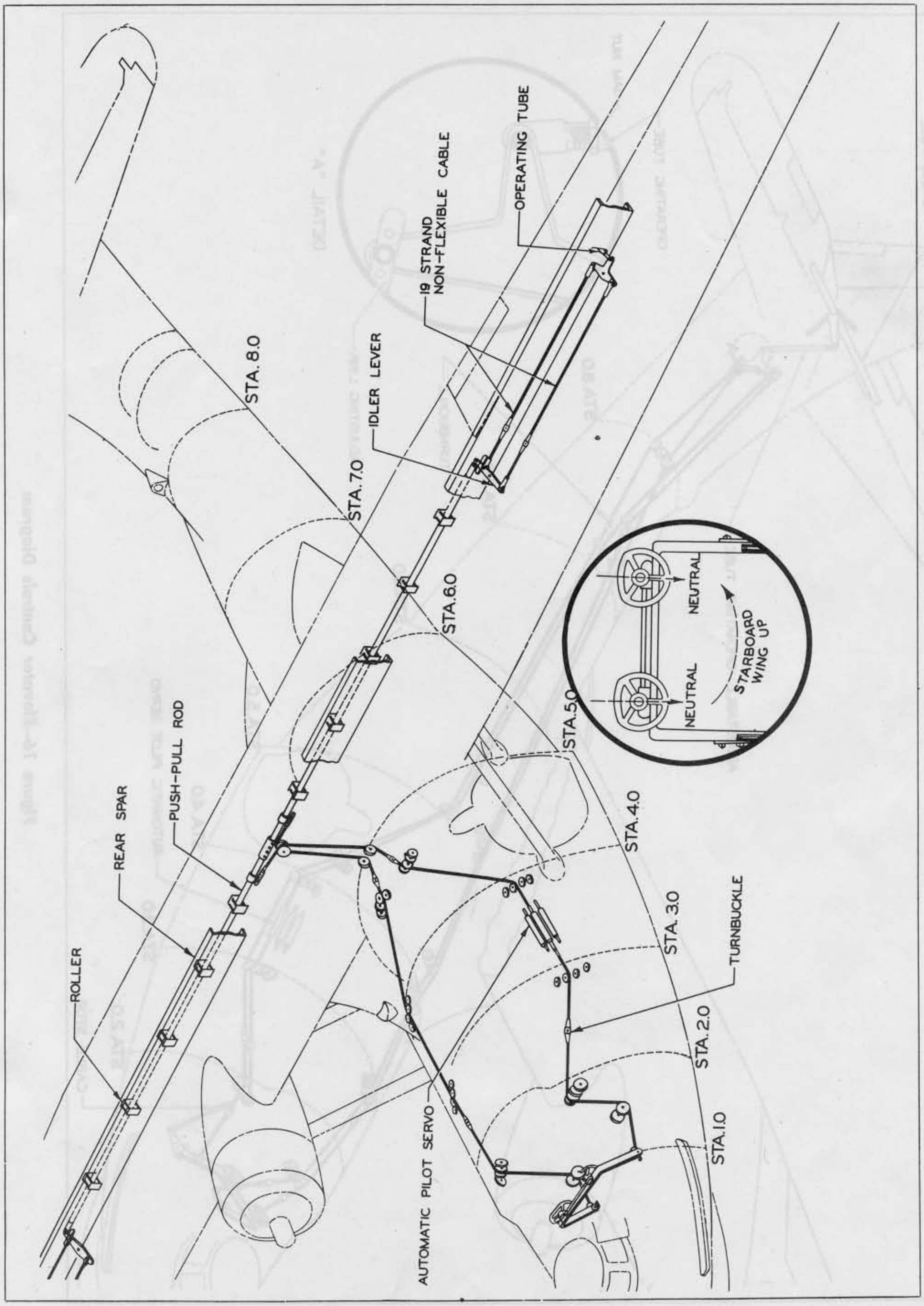


Figure 15—Aileron Controls Diagram

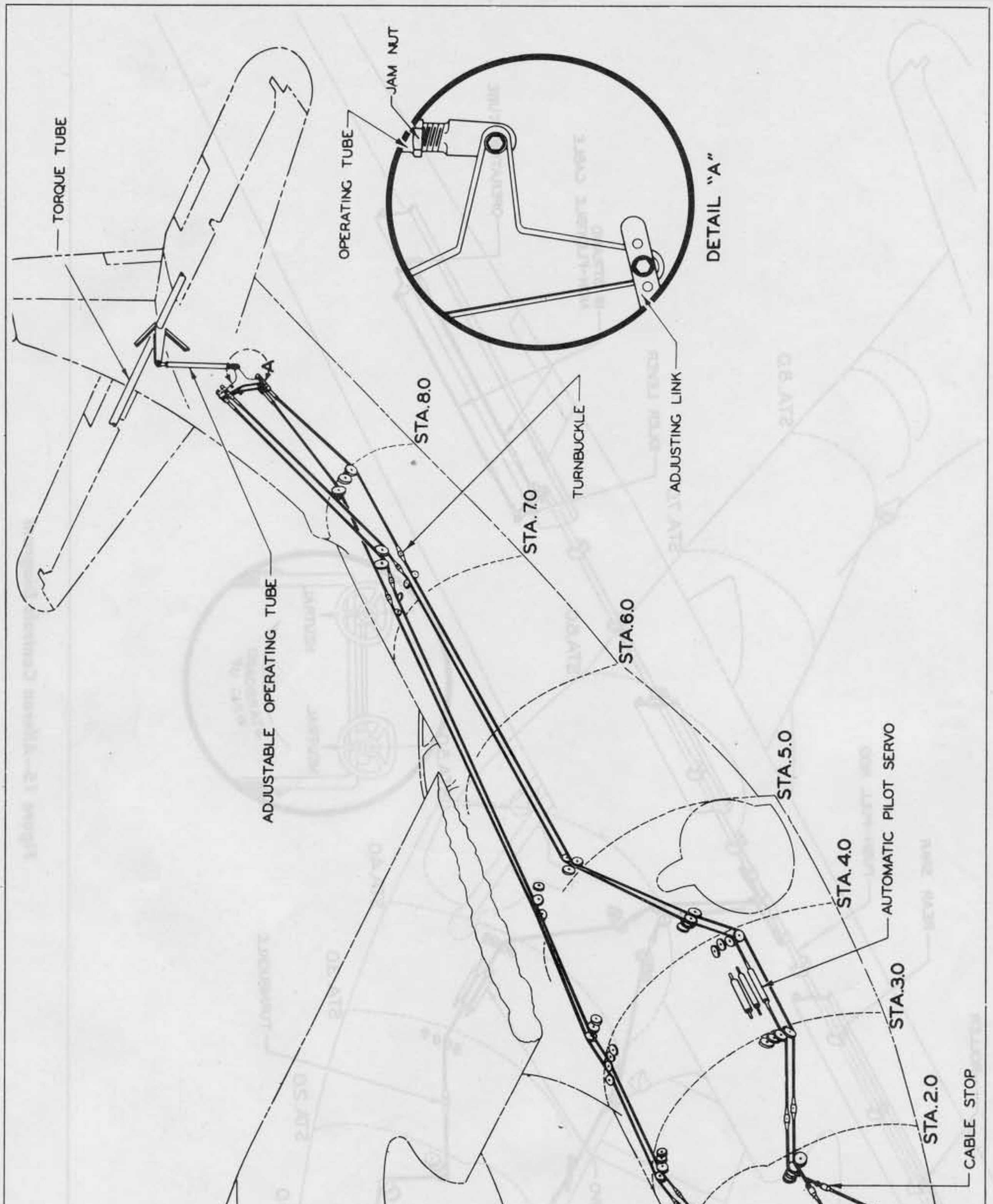


Figure 16—Elevator Controls Diagram

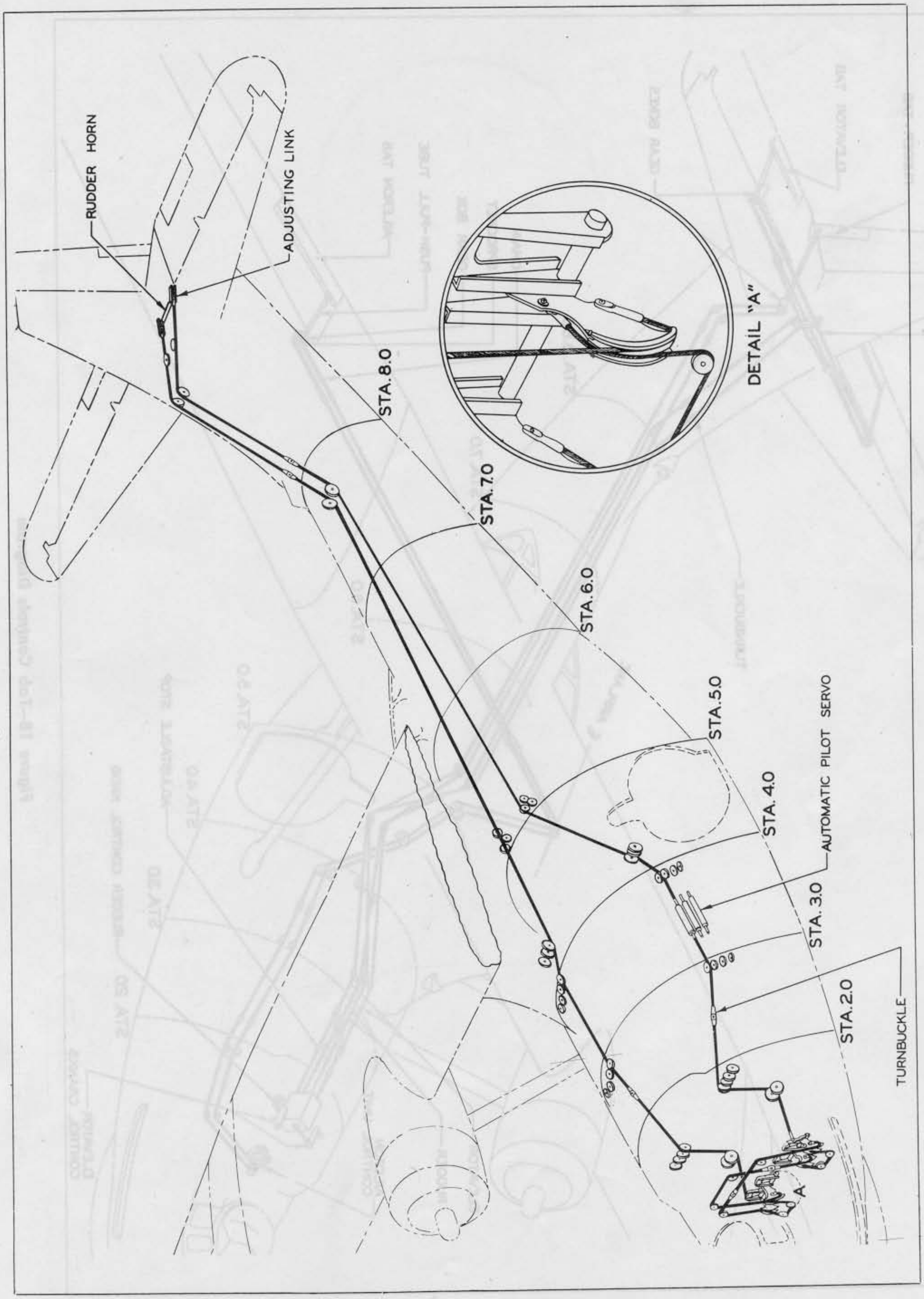


Figure 17—Rudder Controls Diagram

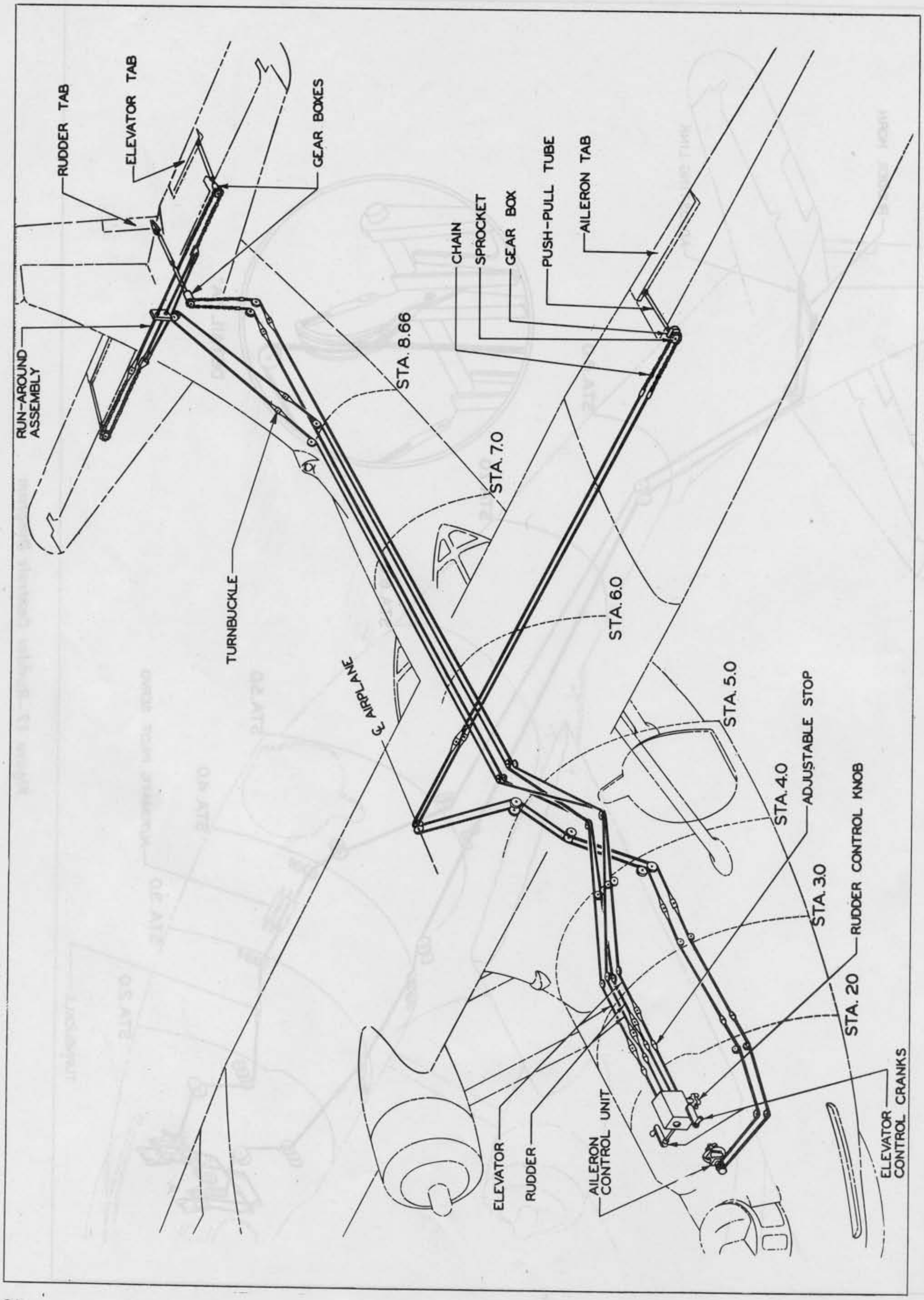


Figure 18—Tab Controls Diagram

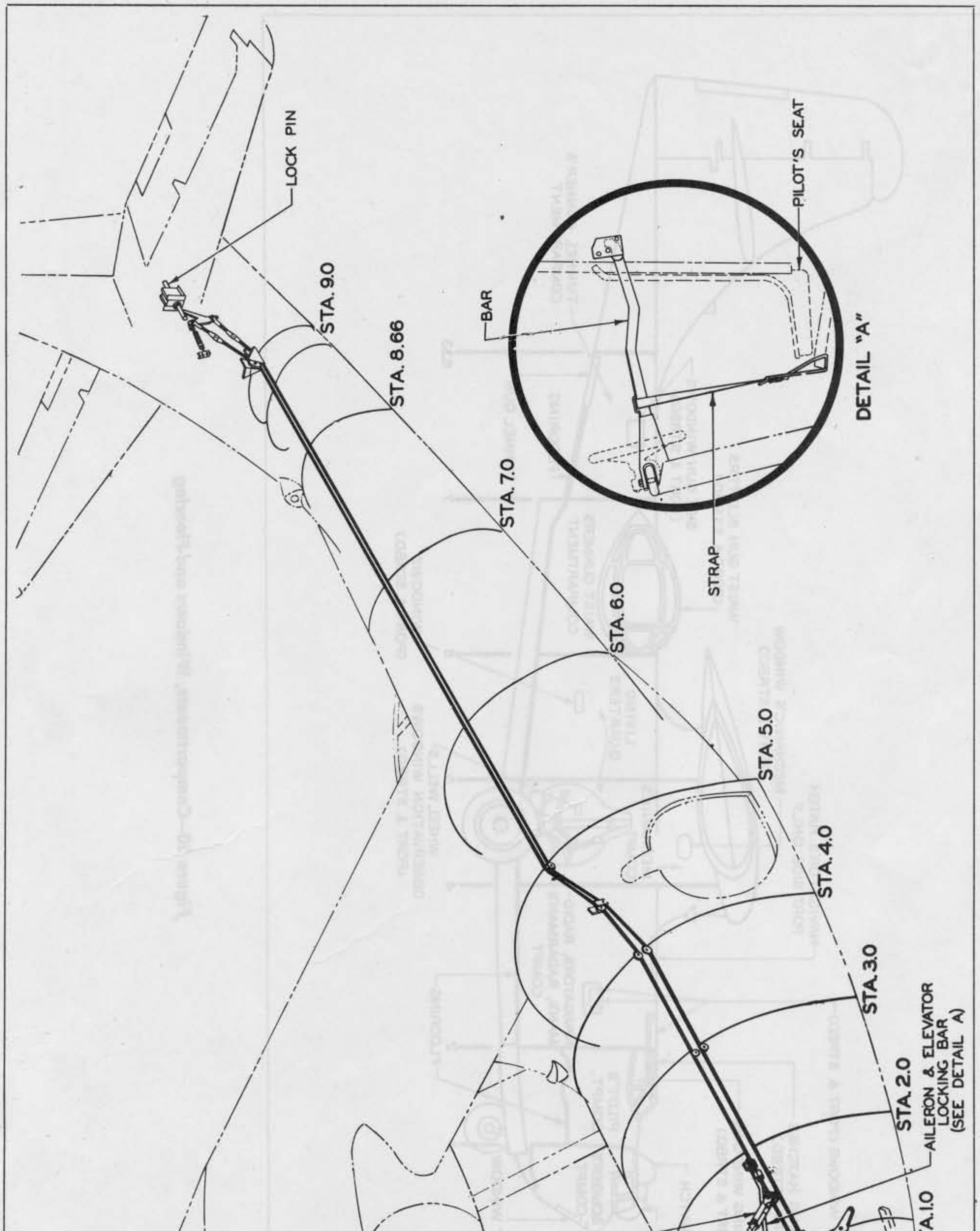


Figure 19—Controls Lock Diagram

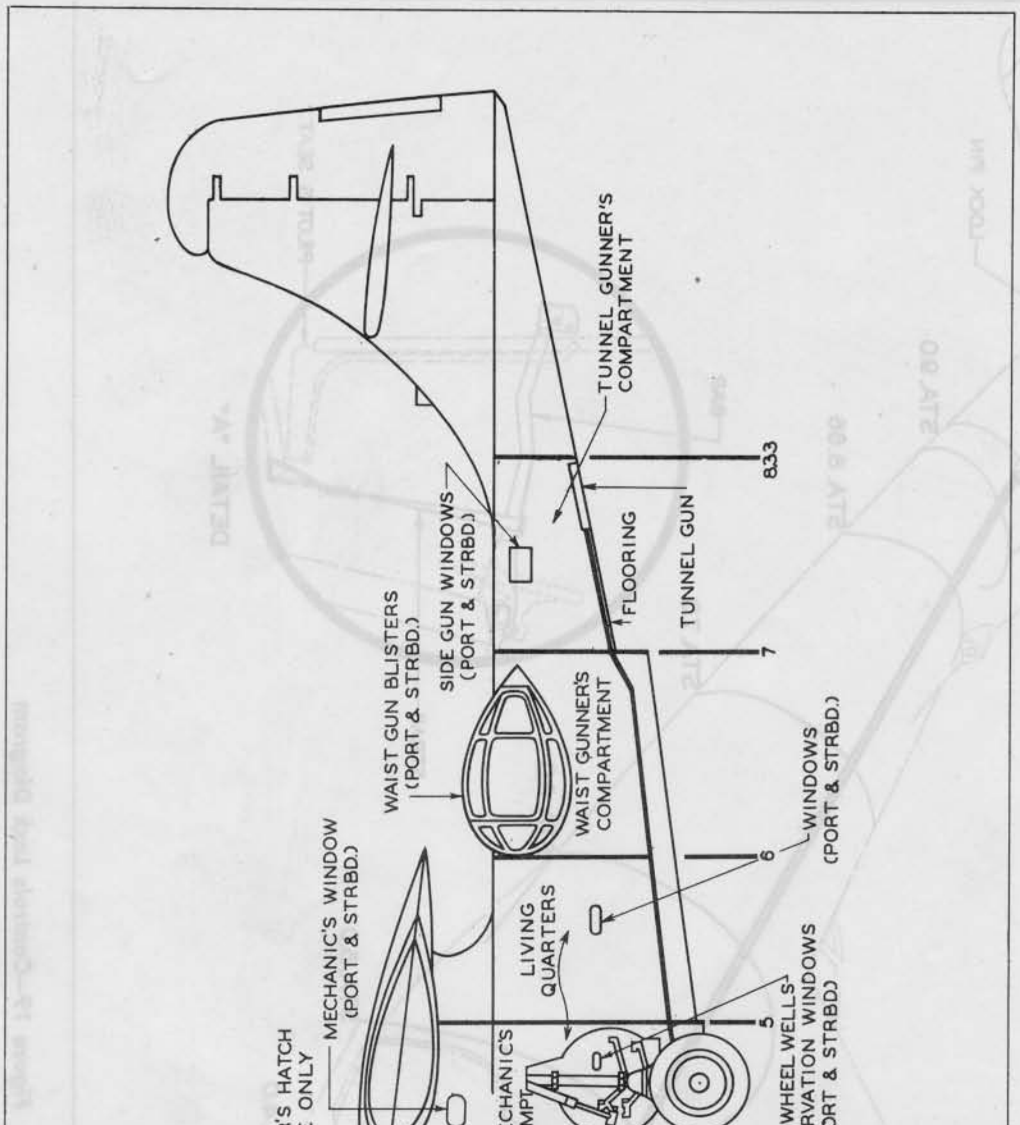


Figure 20—Compartments, Windows and Flooring

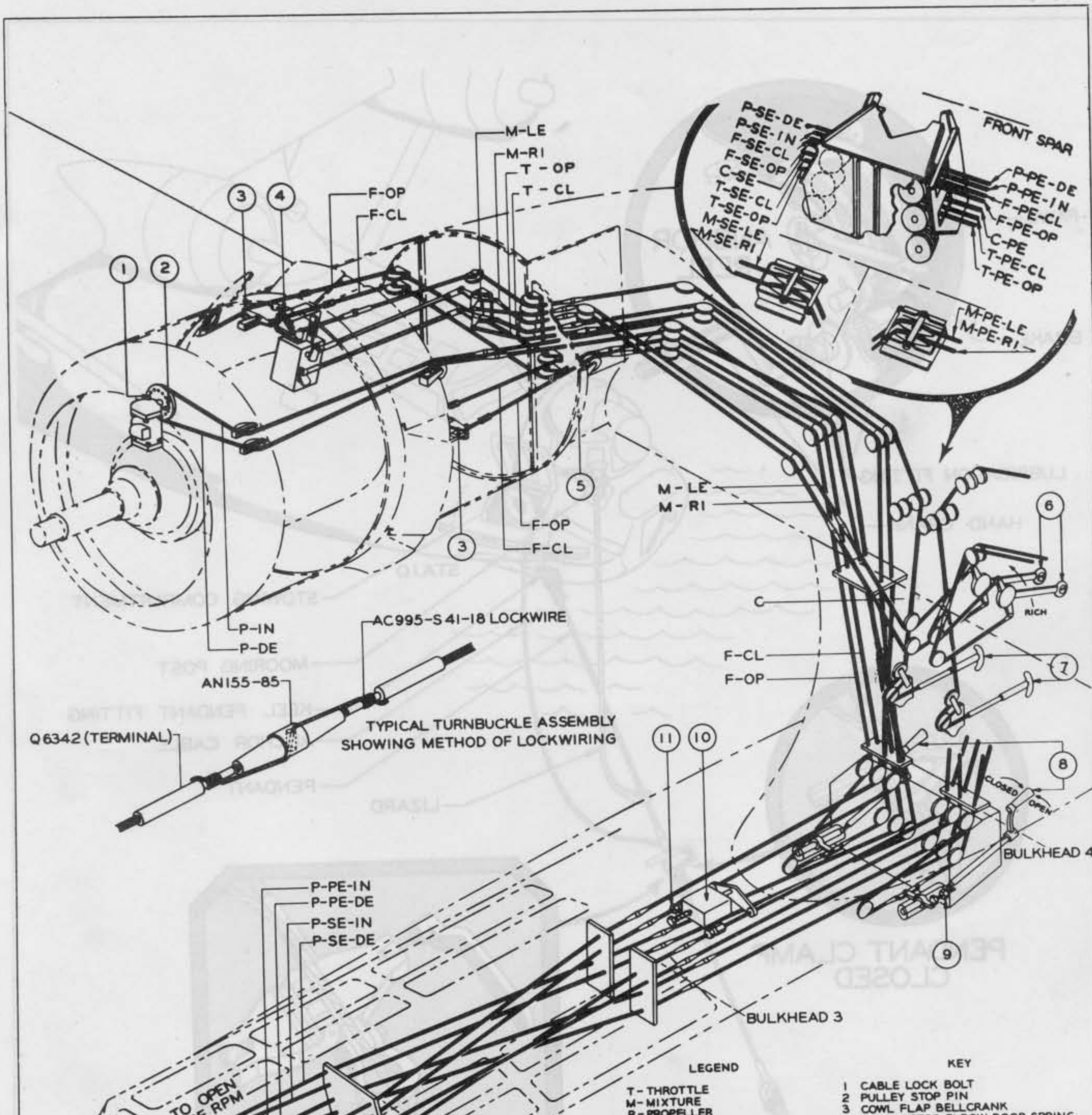


Figure 21—Power Plant Controls

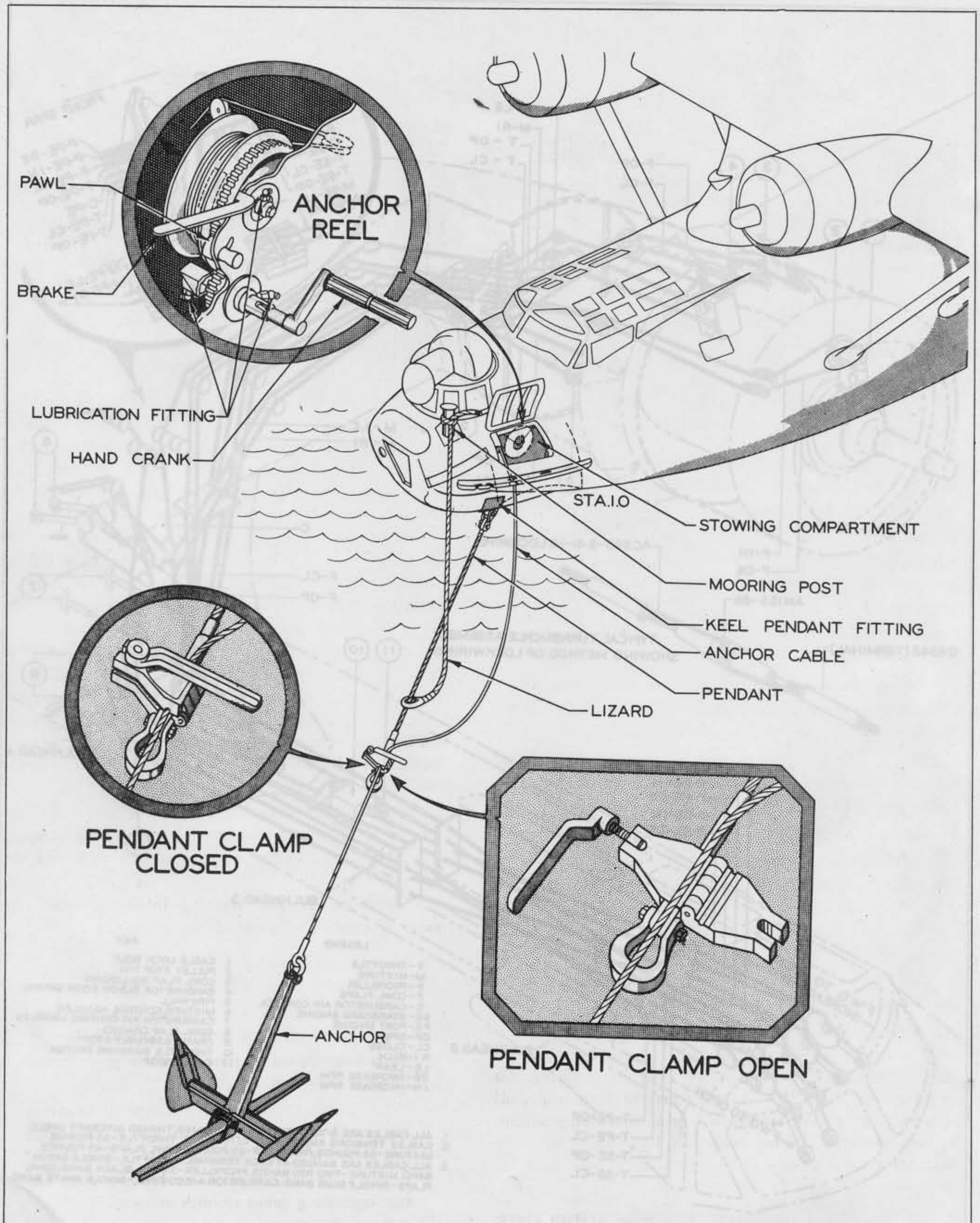
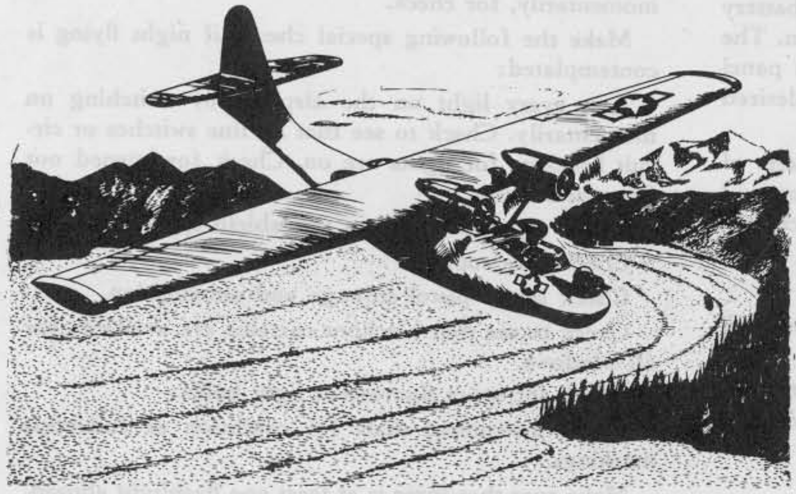


Figure 22—Anchor Gear Details



SECTION II
PILOT'S OPERATING INSTRUCTIONS

1. BEFORE ENTERING THE PILOT'S COMPARTMENT.

a. OUTSIDE THE AIRPLANE.—Check to see that all engine covers, enclosure covers, etc., are removed and properly stowed.

If airplane is on land, check to see that wheel chocks are in place. Check to see that nose wheel is in a straight line with the keel. If airplane is moved during preparation for flight, repeat this check. Check to see that external nose and main landing gear locks have been removed.

Inflate main wheels to a pressure of 55 pounds, or if tires have deflection markers, inflate until deflection marker just touches the supporting surface.

The main gear shock struts are properly inflated when the distance from the gland nut in the cylinder to the red line on the piston is one and one-half inches.

Inflate nose wheel tire to a pressure of 35 pounds.

The nose gear shock strut is properly inflated when the distance from the gland nut in the cylinder to the red line on the piston is two inches.

See that all ice and snow is removed from wing and tail surfaces.

See that pitot head covers are removed. If pitot heads are iced over, turn on pitot heaters.

Entrance to the airplane on either land or water is gained through the waist gun blisters. Aft of each blister a step is held flush with the hull by a spring. To use, turn the step clockwise a quarter turn and pull outward; the spring latches it in the extended position. A rear entrance ladder, which is hung over the side just aft of the blister, is stowed inside, and may be used after initial entrance is gained.

Check supply of fluid in hydraulic system reservoir located in the starboard nacelle.

b. INSIDE THE AIRPLANE.—If the airplane is entered at night, the waist gun compartment light switch, to the left of the door on the aft face of bulkhead 6, should be tried. Lights will go on if compartment light master switch and battery switch, both located on the main distribution panel, are set to the "ON" position; otherwise, no lights will work until someone goes forward and turns on the power.

Soon after going aboard, the auxiliary power unit should be started. This will insure ample power supply for lights, radio, cooking, etc. When the auxiliary power unit is started, be sure to open compartment ventilators overhead and see that they are left open until time for take-off.

If airplane has been out of service for several hours and is in water, search hull interior for signs of leaks. Any accumulated bilge water should be pumped out by use of the bilge pump and hose which are located forward of bulkhead 6 on the starboard side underneath the bunks.

Check gross weight and loading, and stow loads for proper balance as indicated by a balance computer. An instruction handbook is furnished with the computer.

Check to see that nothing interferes with movement of controls. Secure all loose gear.

OVERLOAD CAUTIONS

Do not exceed maximum allowable load.

Do not move C.G. so far as to endanger control or stability (see balance computer).

Stow load so as to prevent shifting or interference with controls.

Avoid concentrated loads on portions of structure not designed to bear them: i.e., flooring, midpoints of truss member, etc.

Avoid overloading plane or landing gear unless operating from smooth runway.

After rough water operations, particularly at gross weights in excess of 29,000 lbs, careful inspections should be made for any material damage.

Check fuel and oil quantity. Three switches must be operated to read oil tanks liquidometer. The battery switch on the main distribution panel must be on. The switch marked "OIL GAGE" on the mechanics panel must be on, and the selector switch turned to desired tank.

Fuel quantity may be checked by the two sets of sight gages, located in the mechanics compartment, and the proper conversion chart supplied with each airplane. *(See figure 27.)*

Check propeller anti-icing fluid reservoir.

Check supply of oil in auxiliary power unit oil tank.

Check batteries with hydrometer and voltmeter. Hydrometer reading should be 1250 or more. Voltage should be 24 volts or more.

Check conditions of all fire extinguishers.

Check fuel tank vapor dilution system to see if CO_2 cylinders are fully charged and red blow-out discs are intact.

Check supply of spare lamps and fuses.

Check food and water stowage, first aid kits, life jackets, life raft, parachutes, smoke grenades, and float lights.

Check supply of chemical toilet bags and toilet paper.

Make ground checks of radio, radar, and interphone equipment.

With the switch for remote compass indicators on, be sure that both dials read the same.

Check ammunition supply and flares. Be sure that flare doors operate properly.

Check condition of water seals on gun blisters.

Check all transparent windows and enclosures for visibility.

See that tail anti-icing air scoop is closed (push handle on bulkhead 7 all the way in).

See that all anti-icer switches are off.

Examine all logbooks and see if entries are up to date.

See that all cowling is properly fastened and that all inspection doors and covers are secured.

Check for presence of engine handcrank.

Check for presence of hydraulic pump handle and emergency landing gear "DOWN LATCH" lever.

2. ON ENTERING THE PILOT'S COMPARTMENT.

Check individual oxygen units. (See instructions given in Section V, paragraph 2.)

Unlock surface controls and stow control yoke locking bar. *(See figure 23.)* Check for freedom of action. Release parking brake.

Switch on all the pilot-engineer signal lights, first from the pilot's control yoke, then from the engineer's instrument panel, and check for burned out lamps.

Switch landing gear indicator light to "INDICATE," momentarily, for check.

Make the following special checks if night flying is contemplated:

Test every light on the airplane by switching on momentarily. Check to see that all line switches or circuit breakers for lights are on. Check for burned out fuses and bulbs.

Check supply of fluid in windshield spray reservoir.

Check flare supply.

Check signal pistol stowage and ammunition.

Check to see that blackout curtains are available for all windows.

Check for spare fluorescent light bulbs.

Check instrument dials for condition of luminous markings.

Make sure that there is at least one flashlight aboard.

Make check of all radio and interphone controls in pilot's compartment.

Be sure automatic pilot is turned off.

Adjust tab setting according to loading.

Work engine controls to check for freedom of action and leave set in proper positions for starting engines, as follows:

Propellers—Maximum rpm position
Cowl Flaps—Open
Mixture Control—"IDLE CUT-OFF"
Throttles—Approximately 800-1000 rpm

Order airplane headed into the wind. If airplane is on land, set parking brakes before starting engines. Check hydraulic system pressure gage to be sure there is at least 800 pounds pressure for brakes.

Check all instruments for proper pointer position. Check for dirty or broken cover glasses. Dirty glasses should be cleaned with a soft cloth.

Set altimeter to station altitude.

Set rate of climb indicator to zero.

Wind and set all clocks and navigation watches.

Check air speed indicator to see that pointer indicates zero, or value of wind velocity component in direction aircraft is heading.

Check gyro instruments uncaged.

Before engines are started, check for air in automatic pilot hydraulic system.

Engage automatic pilot and attempt to move manual controls.

Controls should not be resilient (springy) when a moderate pressure is applied.

Note

Do not mistake stretching of cables for air in the hydraulic system. If in doubt, note whether there is any movement of the follow-up indices of the control units when pressure is applied.

Test windshield wipers to be sure that they work.

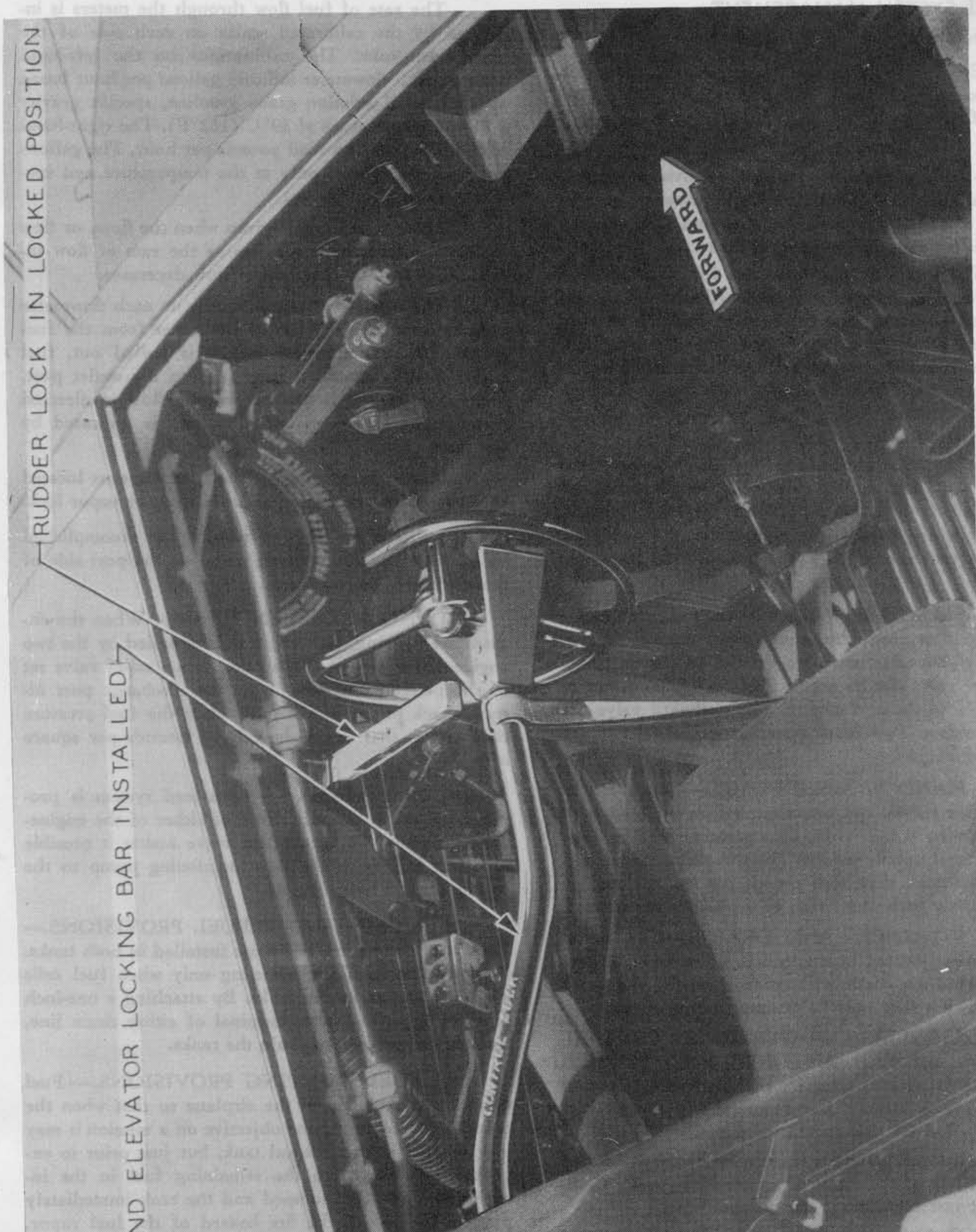


Figure 23—View of Pilot's Compartment Showing Controls Locked

3. FUEL SYSTEM MANAGEMENT.

(See figure 26.)

a. DESCRIPTION.—The wing center section contains two integrally built sealed chambers with a total usable fuel capacity of 1750 U. S. (1457 Imperial) gallons.

(1) SELF-SEALING CELLS.—Provision is made for installation of self-sealing cells in either or both of the two chambers. A tank dumping and CO_2 purging system is installed in the integral tanks.

The fuel tank plan provides for installation of five self-sealing cells in the starboard tank of all odd numbered airplanes, and in the port tank of all even numbered airplanes as they leave the factory. Cells can be installed however in both tanks, or may be completely removed, as required. The cells fit into the tank (left or right) for which they are designed, and are not interchangeable.

When cells are installed on one side only, the maximum capacity of the cells plus the remaining integral tank is 1497 U. S. (1242.5 Imperial) gallons. When cells are installed in both tanks, the maximum capacity (water-borne) is 1244 U. S. (1032.5 Imperial) gallons.

(2) SELECTOR VALVES. *(See figure 24.)*—The fuel flow from the tanks to the engines is controlled by the selector valves on the engineer's panel. The port valve can be set to feed fuel from either or both tanks to the port engine. The starboard valve can be set to feed fuel from either or both tanks to the starboard engine.

(3) HAND WOBBLE PUMPS.—Connected to the selector valves, and also mounted on the engineer's panel, are the A.E.L. units, incorporating strainers and the two hand wobble pumps. The wobble pump handles are so designed that both pumps can be operated simultaneously with one hand, or separately, as desired.

(4) STRAINERS AND DRAINS.—The strainers are incorporated in the A.E.L. units and are provided with drain cocks, with controls on the engineer's panel, so that they may be drained during flight.

(5) AUXILIARY POWER UNIT, CENTRAL HEATER, and TAIL ANTI-ICER FUEL SUPPLY.—A separate selector valve for the auxiliary power unit fuel supply is located just below the starboard fuel selector valve on the engineer's panel.

A shut-off valve for the central heater is located on the ceiling of the Radio Operator-Navigator's Compartment just forward of the aft bulkhead.

A shut-off valve, filter, and pressure regulator for the tail anti-icer fuel supply are located under the starboard window of the engineer's compartment.

(6) FLOWMETERS.—Two direct-indicating type flowmeters, with bypass controls are mounted at the top of the engineer's control panel.

The rate of fuel flow through the meters is indicated by the calibrated scales on each side of the transparent tube. The calibrations on the left-hand scale of each flowmeter indicate gallons per hour based on the use of aviation grade gasoline, specific gravity 0.71 at a temperature of 39°C (102°F). The right-hand scale is calibrated to read pounds per hour. The gallons per hour is accurate only at the temperature and specific gravity given above.

The rate reading is given when the float, or flow indicator within the tube, rises as the rate of flow increases, or drops as the rate of flow decreases.

The bypass valve and handle on each flowmeter permits complete isolation of the meter from the fuel system. When the bypass handle is pulled out, fuel passes directly from the inlet port to the outlet port. When the handle is pushed in, the flow is directed through the flowmeter and flow rate is indicated by the float.

In the upper fittings of the flowmeters are located vent valves for use in case of air-binding or vapor lock.

(7) PRIMER.—Engine priming is accomplished by means of a hand priming pump on the port side of the engineer's compartment.

(8) ENGINE-DRIVEN PUMPS.—When the engines are running, fuel pressure is supplied by the two engine-driven pumps. Each pump has a relief valve set to short-circuit fuel flow from the discharge port directly back to the intake port, when the fuel pressure rises higher than approximately 18 pounds per square inch.

(9) CROSS-FEED.—A cross-feed system is provided for use in case of failure of either of the engine-driven pumps. The cross-feed valve makes it possible to direct fuel from the one functioning pump to the carburetors on both engines.

(10) DRAIN AND REFUEL PROVISIONS.—Tank drain and refuel lines are installed in both tanks. They can be used for refueling only when fuel cells are not installed in the tanks. By attaching a one-inch pipe fitting to the outer terminal of either drain line, the line can be used to drain the tanks.

(11) FUEL DUMPING PROVISIONS. — Fuel dumping is provided in the airplane so that when the plane is proceeding to the objective on a mission it may use the fuel in the integral tank, but just prior to encountering enemy fire the remaining fuel in the integral tank may be dumped and the tank immediately purged, because of the fire hazard of the fuel vapor. The dump valve is operated by a lever and cable. The lever is located directly over the engineer's head. Fuel can be dumped only from integral tanks. Dump valves and ducts are installed on the starboard sides of all even numbered airplanes, and on the port sides of all odd numbered airplanes as they leave the factory.

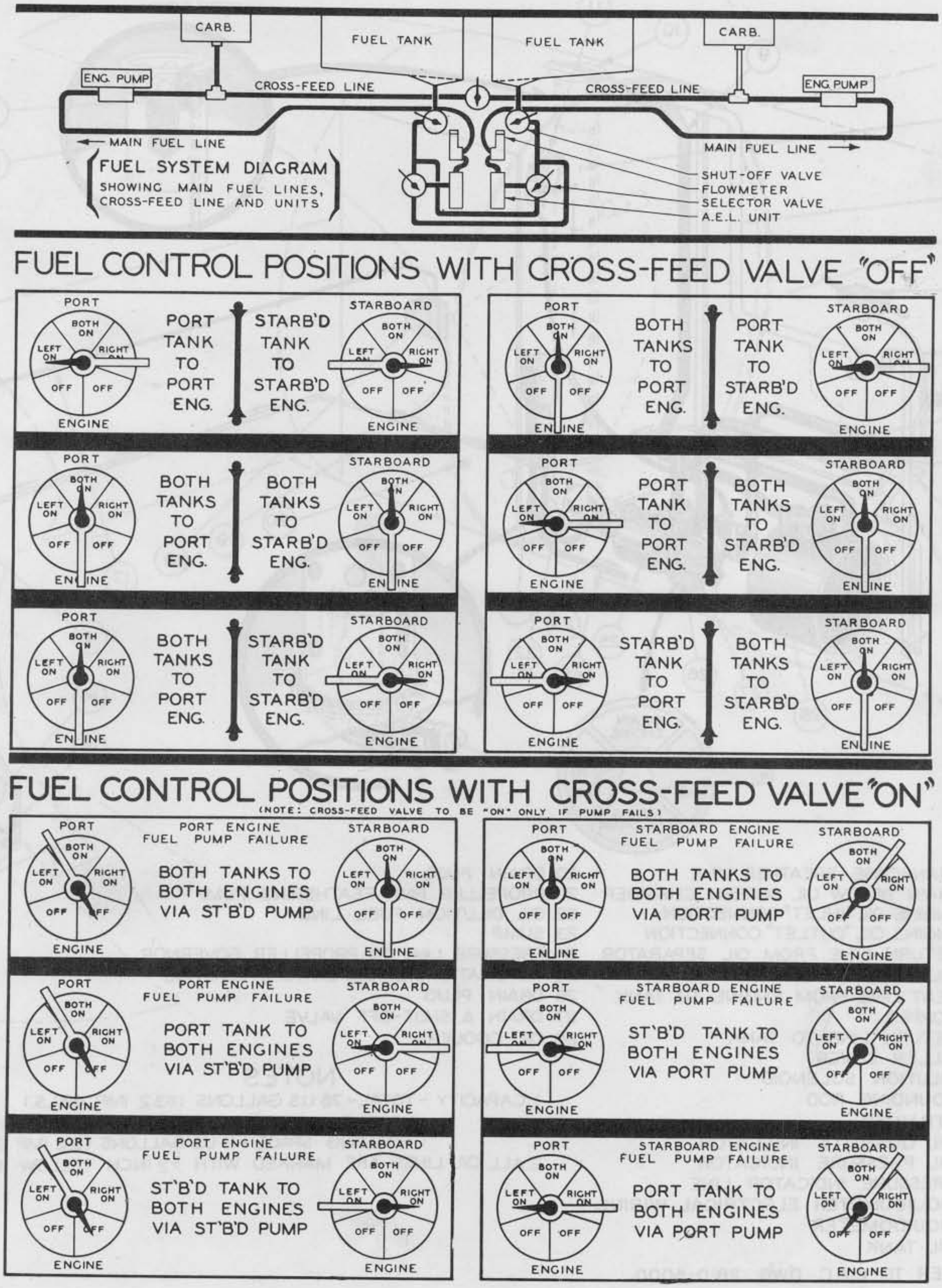
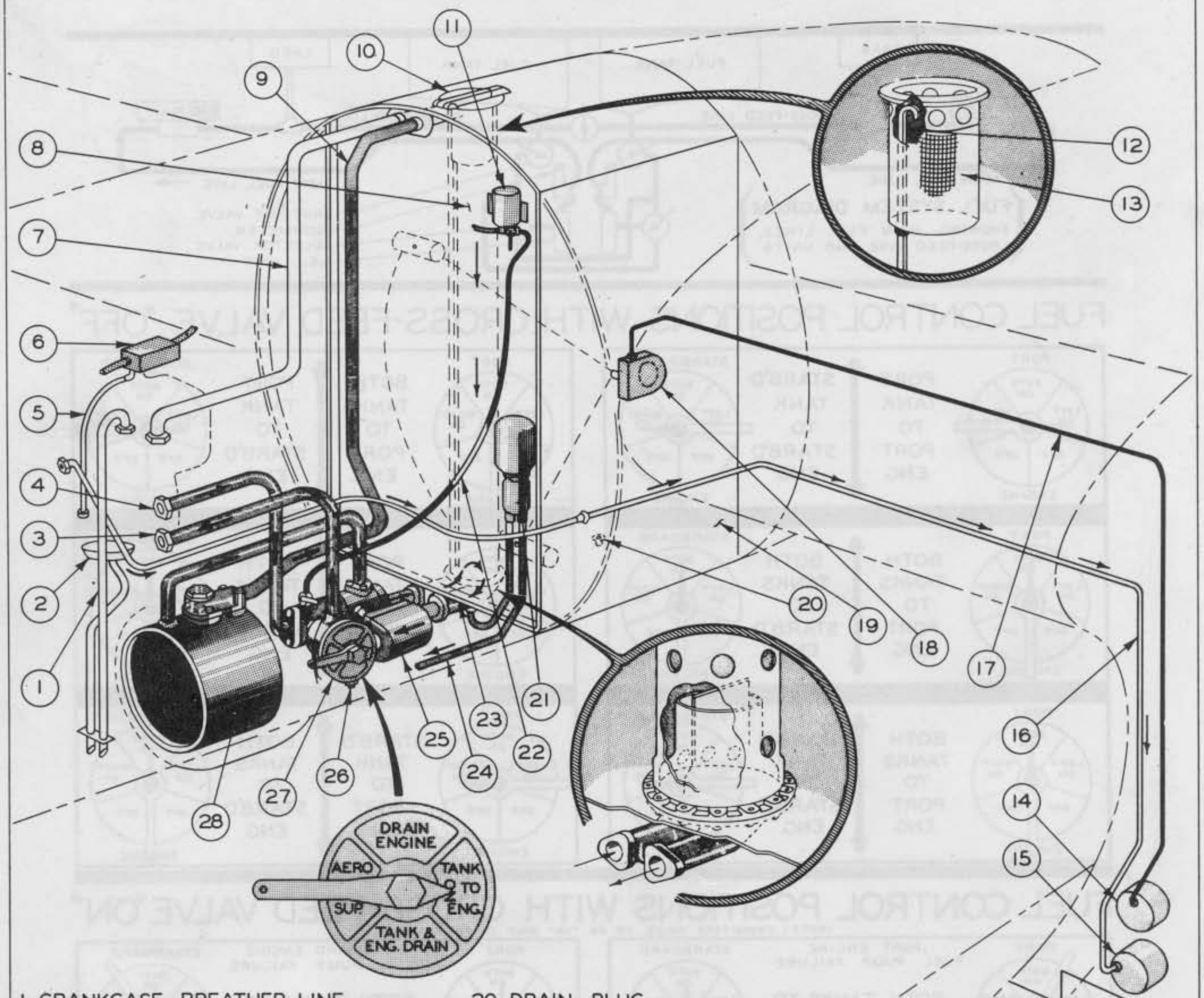


Figure 24—Fuel Selector Valve Position Chart



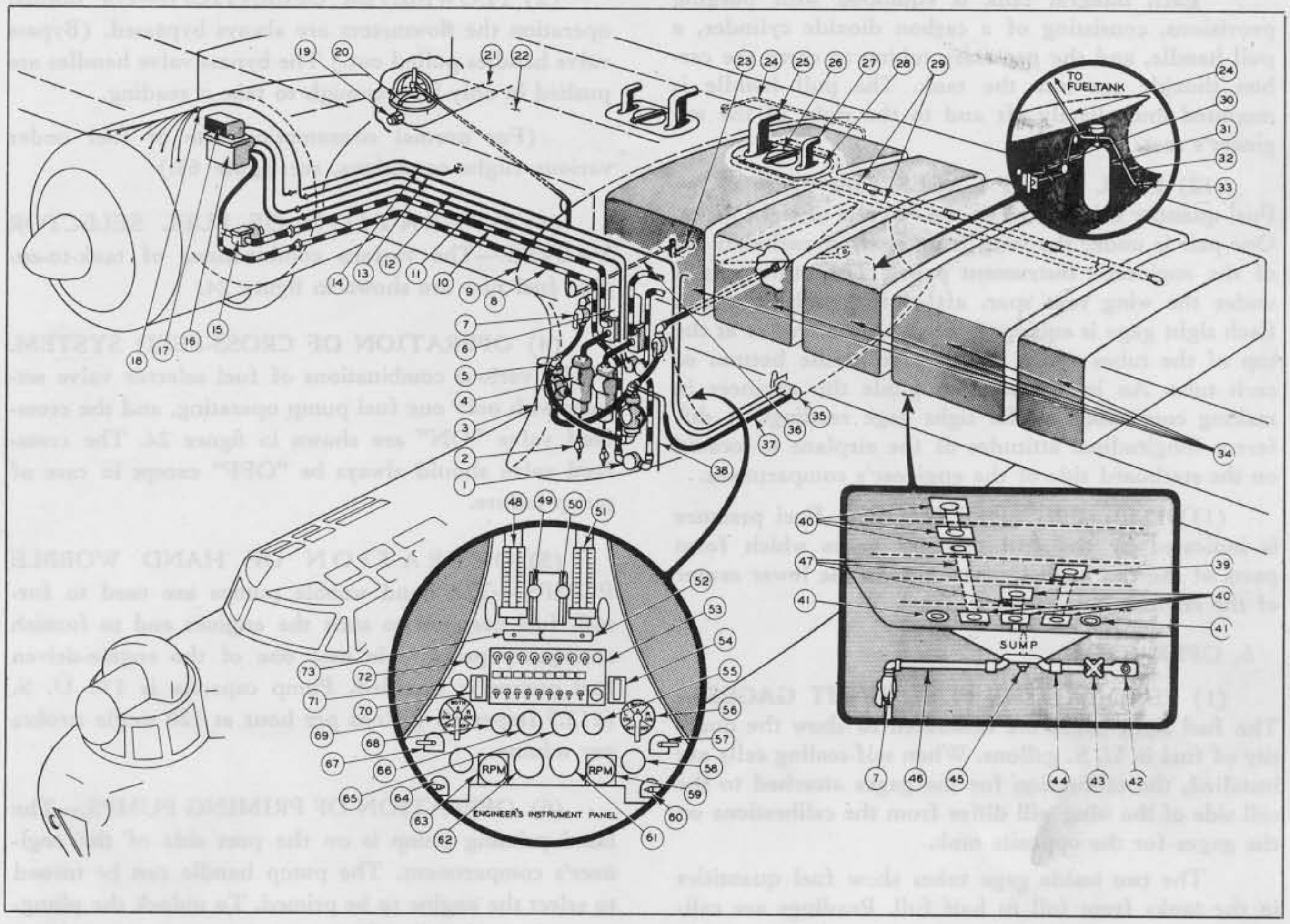
1. CRANKCASE BREATHER LINE
2. DRAIN BELOW OIL SCREEN CHAMBER
3. ENGINE OIL "INLET" CONNECTION
4. ENGINE OIL "OUTLET" CONNECTION
5. RETURN LINE FROM OIL SEPARATOR
6. OIL SEPARATOR
7. VENT LINE FROM ENGINE TO TANK
8. HOPPER
9. RETURN LINE TO TANK
10. FILLER COVER
11. DILUTION SOLENOID
12. SOUNDING ROD
13. STRAINER
14. OIL QUANTITY INDICATOR
15. OIL PRESSURE INDICATOR
16. PRESSURE INDICATOR LINE
17. LIQUIDOMETER ELECTRICAL WIRING
18. LIQUIDOMETER
19. OIL TANK
20. DRAIN PLUG
21. PROPELLER FAST FEATHERING PUMP
22. OIL DILUTION FUEL LINE
23. SUMP
24. PRESSURE LINE TO PROPELLER GOVERNOR
25. AUTOMATIC OIL TEMPERATURE CONTROL
26. DRAIN PLUG
27. DRAIN & SHUT-OFF VALVE
28. OIL COOLER

REFER TO C.A.C. DWG. 28-0-5000

NOTES

1. CAPACITY :- TOTAL - 76 U.S. GALLONS (63.2 IMP. GALS.)
   USABLE - 65 U.S. GALLONS (54.1 IMP. GALS.)
   FOAMING SPACE - 11 U.S. GALLONS (9.2 IMP. GALS.)
2. ALL OIL LINES ARE MARKED WITH 1/2 INCH YELLOW BANDS

Figure 25—Oil System Diagram



1. Cross-feed Selector Valve
2. Strainer Drain Valve
3. Aux. Power Unit Fuel Line
4. A.E.L. Unit
5. Fuel Selector Cock
6. Flowmeter
7. Main Fuel Shut-off Valve
8. Cross-feed Fuel Line
9. Center Line of Wing
10. Main Fuel Line to Engine
11. Fuel Pressure Line
12. Vent Line to Pressure Gage
13. Engine Primer Line
14. Vent Line—Tank to Carburetor
15. Engine—Driven Fuel Pump
16. Carburetor
17. Carburetor Elbow Scoop
18. Primer Line Spider
19. Check Valve—Dump Duct
20. Dump Valve
21. Dump Duct
22. Integral Fuel Tank
23. Dump Valve Control Lever
24. Vapor Dilution Line
25. Vent Stand Pipe—S.S. Cells
26. Filler Neck Cover
27. Vent Stand Pipe—Tank
28. Fuel Tank Manhole Cover
29. S.S. Cells Vent Tubes
30. Purging Cylinder Pull Handle
31. Purging Cylinder
32. Pressure—Relief Line
33. Pressure Relief Disk
34. Self-Sealing Fuel Cells
35. Primer Pump
36. Dump Valve Control Cable
37. Fuel Line to Primer Pump
38. Fuel Line to Central Heater
39. Fuel Cell Manifold Inspect'n Window
40. Fuel Cell Manifold Access Doors
41. Sight Gage Inspection Window
42. Main Tank Drain Outlet
43. Shut-off Valve—Tank Drain
44. Main Tank Drain and Refueling
45. Sump Drain Plug
46. Main Fuel Line From Sump
47. S.S. Cell Manifold Lines
48. Port Flowmeter
49. Port Fuel Mixture Control
50. Starboard Fuel Mixture Control
51. Starboard Flowmeter
52. Starboard Wobble Pump Handle
53. Engineer-Pilot Visual Signal Panel
54. Starboard Carburetor Air Control
55. Starboard Eng. Cyl. Temp. Gage
56. Starboard Fuel Selector
57. Aux. Power Unit Selector
58. Starboard Eng. Manifold Press. Gage
59. Starboard Tachometer
60. Starboard Strainer Drain Selector
61. Starboard Fuel and Oil Press. Gage
62. Port Fuel and Oil Pressure Gage
63. Port Tachometer
64. Cross-feed Selector
65. Oil Quantity Gage
66. Altimeter
67. Port Strainer Drain Selector
68. Port Engine Cylinder Temp. Gage
69. Port Fuel Selector
70. Port Carburetor Air Control
71. Outside Air Temperature Gage
72. Clock
73. Port Wobble Pump Handle

Figure 26—Fuel System Diagram

Each integral tank is equipped with purging provisions, consisting of a carbon dioxide cylinder, a pull handle, and the necessary tubing to carry the carbon dioxide gas into the tank. The pull handle is mounted immediately aft and to the right of the engineer's seat.

(12) FUEL SIGHT GAGES. *(See figure 27.)*—Fuel quantity is indicated by the two sets of sight gages. One pair is under the wing front spar, immediately aft of the engineer's instrument panel. The other pair is under the wing rear spar, aft of the engineer's seat. Each sight gage is equipped with a shut-off valve at the top of the tubes and a drain valve in the bottom of each tube. An inclinometer to guide the engineer in making corrections to the sight gage readings at different longitudinal attitudes of the airplane is located on the starboard side of the engineer's compartment.

(13) FUEL PRESSURE GAGES.—Fuel pressure is indicated by the fuel pressure gages which form parts of the two engine gage units on the lower center of the engineer's instrument panel.

b. OPERATION.

(1) READING THE FUEL SIGHT GAGES.—The fuel sight gages are calibrated to show the quantity of fuel in U. S. gallons. When self-sealing cells are installed, the calibration for the gages attached to the cell side of the wing will differ from the calibrations on the gages for the opposite tank.

The two inside gage tubes show fuel quantities in the tanks from full to half full. Readings are calibrated at the center of the gage plate for the inside tubes. The two outside tubes indicate fuel quantities from the half full to empty ranges. Readings are taken from the outside calibrations on the plate.

Gage scales are calibrated to read correctly the contents of tanks or cells when the chord line is at an angle of 3½ degrees to the ground line. The rear gage only, is to be used after fuel has dropped to 100 U. S. (83.25 Imperial) gallons in the integral tank, or 75 U. S. (62.5 Imperial) gallons in the cells.

Use of the inclinometer, mounted on the starboard side of the engineer's compartment, and use of the tilt charts above the inclinometer, are required to make accurate readings of the sight gages.

Example

Forward gage reads 500 gallons. Rear gage reads 600 gallons. Inclinometer shows airplane tilted at 7°. Tilt chart for front gage shows correction for 500 gallons (reading at 7° tilt) is 545 gallons. Tilt chart for rear gage shows correction for 600 gallons (reading at 7° tilt) is 545 gallons also. Actual quantity of fuel is therefore, 545 gallons.

(2) FLOWMETER OPERATION.—For normal operation the flowmeters are always bypassed. (Bypass valve handles pulled out.) The bypass valve handles are pushed in only long enough to take a reading.

(For normal consumption rate of fuel under various flight conditions, see figure 63.)

(3) OPERATION OF FUEL SELECTOR VALVES.—The various combinations of tank-to-engine fuel flow are shown in figure 24.

(4) OPERATION OF CROSS-FEED SYSTEM.—The various combinations of fuel selector valve settings with only one fuel pump operating, and the cross-feed valve "ON" are shown in figure 24. The cross-feed valve should always be "OFF" except in case of pump failure.

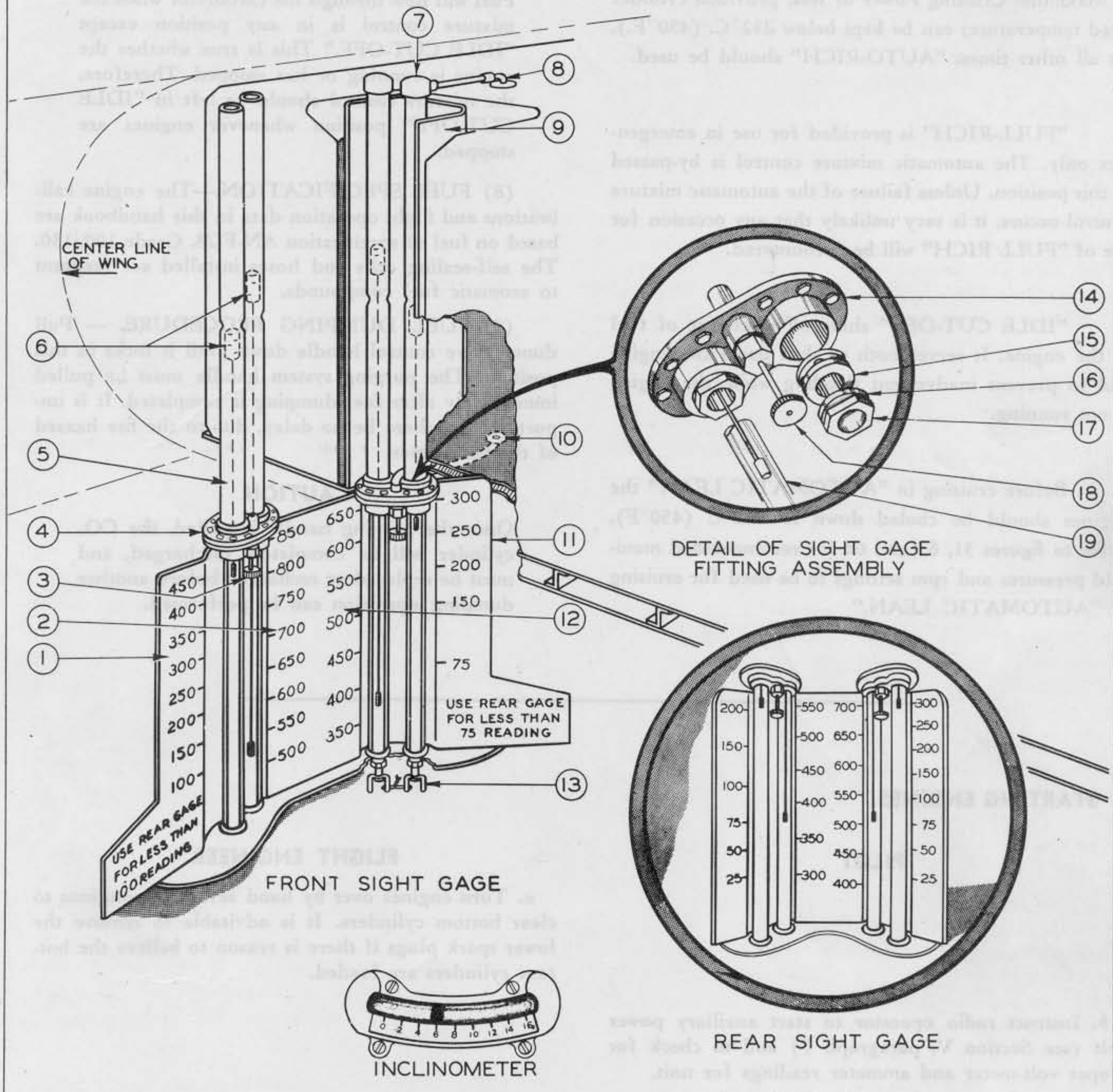
(5) OPERATION OF HAND WOBBLE PUMPS.—The hand wobble pumps are used to furnish fuel pressure to start the engines and to furnish emergency pressure in case one of the engine-driven fuel pumps is disabled. Pump capacity is 135 U. S. (112.5 Imperial) gallons per hour at 120 single strokes per minute.

(6) OPERATION OF PRIMING PUMPS.—The hand priming pump is on the port side of the engineer's compartment. The pump handle can be turned to select the engine to be primed. To unlock the plunger, push the handle all the way down; turn to right or left "ON," as desired. Plunger may then be pulled back for the stroke.

Number of priming strokes required for starting will vary from no prime with a hot engine to six, eight, or more strokes with very cold engines. Excessive priming will load the cylinders with raw gasoline, making it difficult to start the engine. Underpriming is usually indicated by backfiring of the engine through the intake system, with attendant hazards.

Always make certain that the primer pump is locked in "OFF" position before engine is started. A vacuum check prevents suction of fuel into the engine if the primer is accidentally left in the "ON" position; the engineer should check to see that the plunger is locked "OFF" as a safety precaution. To shut off, push the handle all the way in and turn to "OFF."

(7) MIXTURE CONTROL. — The engines are equipped with Bendix-Stromberg carburetors of the PD-12H series, having automatic mixture control which may be set for "FULL RICH," "AUTOMATIC RICH," "AUTOMATIC LEAN," or "IDLE CUT-OFF."



1. CALIBRATIONS FOR HALF FULL TO EMPTY READINGS (INTEGRAL TANK)
2. CALIBRATIONS FOR FULL TO HALF FULL READINGS (INTEGRAL TANK)
3. SHUT-OFF NEEDLE VALVE TURN BUTTON
4. SIGHT GAGE FITTING AT BOTTOM OF TANK.
5. STAND PIPE TUBE IN TANK
6. FLOATS
7. NIPPLE CAP FOR STANDPIPES WHEN S.S. CELLS INSTALLED
8. SIGHT GAGE VENT CONNECTION, TOP OF NO. I CELL
9. STANDPIPE GUARD
10. FUEL OUTLET TO SIGHT GAGES, BOTTOM CELL NO. I
11. CALIBRATIONS FOR HALF-FULL TO EMPTY READINGS (S.S. FUEL INSTALLATIONS)
12. CALIBRATIONS FOR FULL TO HALF FULL READINGS (S.S. FUEL INSTALLATIONS)
13. TUBE DRAIN PLUGS (LOCK WIRED)
14. FLANGE FITTING UNDER SURFACE OF WING
15. PACKING NUT
16. WASHER
17. NUT
18. SHUT-OFF TURN BUTTON
19. PLEXIGLAS SIGHT GAGE TUBE

Figure 27—Fuel Sight Gauges

"AUTO-LEAN" should be used when cruising at Maximum Cruising Power or less, provided cylinder head temperatures can be kept below 232°C. (450°F.). At all other times, "AUTO-RICH" should be used.

"FULL-RICH" is provided for use in emergencies only. The automatic mixture control is by-passed in this position. Unless failure of the automatic mixture control occurs, it is very unlikely that any occasion for use of "FULL RICH" will be encountered.

"IDLE CUT-OFF" shuts off discharge of fuel to the engine. It serves both to shut down the engine and to prevent inadvertent flooding while the engine is not running.

Before cruising in "AUTOMATIC LEAN" the engines should be cooled down to 232°C (450°F). Refer to figures 31, 63 and 64 for recommended manifold pressures and rpm settings to be used for cruising in "AUTOMATIC LEAN."

CAUTION

Fuel will flow through the carburetor when the mixture control is in any position except "IDLE CUT-OFF." This is true whether the engine is running or has stopped. Therefore, the mixture control should be left in "IDLE CUT-OFF" position whenever engines are stopped.

(8) FUEL SPECIFICATION.—The engine calibrations and flight operation data in this handbook are based on fuel of specification AN-F-28, Grade 100/130. The self-sealing cells and hoses installed are resistant to aromatic fuel compounds.

(9) FUEL DUMPING PROCEDURE. — Pull dump valve control handle down until it locks in this position. The purging system handle must be pulled immediately after fuel dumping is completed. It is important that there be no delay, due to the fire hazard of the fuel vapor.

CAUTION

Once the purging handle is pulled, the CO_2 cylinder will be completely discharged, and must be replaced or recharged before another dumping operation can be performed.

4. STARTING ENGINES.

PILOT

b. Instruct radio operator to start auxiliary power unit (see Section V, paragraph 7) and to check for proper volt-meter and ammeter readings for unit.

c. Set propeller in "LOW PITCH" (high rpm).

d. Set interphone control switch in "ICS" position.

e. Signal flight engineer to prepare to start starboard engine. Hydraulic pump is connected with this engine.

FLIGHT ENGINEER

a. Turn engines over by hand several revolutions to clear bottom cylinders. It is advisable to remove the lower spark plugs if there is reason to believe the bottom cylinders are loaded.

f. MIXTURE CONTROL.—Set in "IDLE CUT-OFF" position.

g. COWL FLAPS.—Set fully open.

h. FUEL VALVES.—Set fuel valves for "LEFT ON" and "RIGHT ON."

i. Check for current at starters by momentarily turning starter switch to "START" position and listening for slowdown of A. P. U. or sound of starter.

PILOT / **FLIGHT ENGINEER**

j. CARBURETOR AIR CONTROLS.—Set in "DIRECT" position.

k. THROTTLE.—Set at 800 to 1000 rpm position.

l. PRIME WITH PRIME PUMP.—As many as six or eight strokes of the primer may be necessary if engine is cold.

m. FUEL PRESSURE.—Fuel pressure should be 10 to 15 pounds per square inch with hand wobble pump.

n. Energize starter 12 to 15 seconds by holding starter switch in "START" position.

o. Signal pilot for "CONTACT."

p. Close individual engine ignition switch on signal from engineer.

q. Engage starter by moving switch to "MESH" position.

r. MIXTURE CONTROL. — Shift to "AUTOMATIC RICH" without hesitation as soon as engine starts firing. If engine stops, return to "IDLE CUT-OFF" immediately.

s. Notify pilot when oil pressure is up. If not up in 30 seconds, notify pilot and shut engine off.

t. FAILURE TO START.—If engine does not start almost immediately (three seconds), repeat use of hand primer and wobble pump.

u. FLOODED ENGINE.—Flooding is generally indicated by a discharge of fuel from the engine blower case drain, or by presence of raw gasoline in the exhaust. To clean engine, discontinue use of wobble pump, request pilot to open throttle wide, and turn engine over with starter.

v. THROTTLE.—If engine is flooded, open throttle wide at request from engineer.

CAUTION

Be prepared to retard throttle quickly in case engine fires. If engineer opens mixture control and resumes pumping with wobble pump, engine might run away if throttles are open.

w. FUEL PRESSURE.—As soon as engine starts, move mixture control to "AUTO RICH," continuing to operate wobble pump vigorously until the engine runs smoothly, and automatically builds up fuel pressure of 16 to 18 pounds per square inch.

x. THROTTLE.—As soon as engine starts, adjust throttle as low as possible for the first 30 seconds after starting. Stand by for engineer's report on oil pressure.

y. PRIMER.—Be sure primer pump handle is locked after engine has started.

z. THROTTLE.—After the first half minute, adjust the throttle to about 1000 rpm.

5. ENGINE WARM-UP AND ACCESSORY CHECK.

PILOT / FLIGHT ENGINEER

a. COWL FLAPS.—Leave open under all conditions. Do not attempt to accelerate warm-up by closing cowl flaps.

b. Warm up engine at 1000 rpm if oil pressure is up. Propeller should be in highest rpm position.

c. Check oil pressure at 1000 rpm. It should be 40 pounds minimum.

d. After oil is warm (40°C or above) check oil pressure at 1500 rpm. Minimum pressure should be 65 pounds; maximum should be 105 pounds.

e. CHECK PROPELLER OPERATION.—Pull propeller governor control back to extreme high pitch (low rpm). Move slowly forward again to extreme low pitch (high rpm). Check operation of feathering mechanism by feathering and unfeathering once.

f. Check carburetor air control to "DIRECT" position except when there is danger of icing, or sand or dust is blowing.

g. Check the drop in revolutions for each engine when moving the magneto switches from "BOTH" to "LEFT" or to "RIGHT." (Check at 2000 rpm and 25 inches Hg) Drop in rpm may be 50 to 75 (100 rpm maximum). After checking one magneto, switch to "BOTH" for a few seconds before checking the other magneto. Make magneto check in as short a time as practicable. Check center (emergency) switch momentarily off.

h. Make idle mixture check with throttle set for 600 rpm. Move the mixture control lever smoothly and steadily into the "IDLE CUT-OFF" position and observe the tachometer for any change in rpm. Return the mixture control lever to the "AUTO RICH" position before the engine cuts out. A rise of more than 10 rpm indicates too rich an idle mixture, and no change or a drop in rpm indicates that the mixture is too lean. A rise of 5 to 10 rpm is recommended in order to permit idling at low speeds without danger of fouling plugs and at the same time to afford good acceleration characteristics.

i. Check to see if floats are down and locked when on water.

j. THROTTLE.—Set throttle for 2000 rpm and request engineer to check engine instruments. Because engine cooling on the ground is usually insufficient at this speed, instrument check should be made in as short a time as possible.

k. Taxi into water at this point if water take-off is contemplated.

l. Second mechanic should secure ladder and close hatches if on water.

m. OIL PRESSURE.—Oil pressure should be 85 (+15, −5) pounds at 2000 rpm.

n. FUEL PRESSURE.—Fuel pressure should be from 16 to 18 pounds.

o. CYLINDER TEMPERATURE.—Do not exceed 232°C (450°F) during ground check.

p. HYDRAULIC PRESSURE GAGE—The hydraulic pressure gage should read 800 to 1000 pounds.

q. If there is sufficient time, have canvas scoop rigged to tail anti-icer air scoop, and check operation of tail anti-icer.

PILOT

r. AUTOMATIC PILOT.—Check automatic pilot as follows:

(1) Vacuum gage should read 3.75 to 5 inches Hg.

(2) See that four-way oil valve, to pilot's left, is "ON," and that oil pressure gage shows pressure (150 pounds at 1000 rpm engine speed).

(3) Uncage bank and climb gyro. (Turn caging knob counter-clockwise as far as it will go.)

(4) Set and uncage directional gyro control. (Push caging knob in and turn to set lower card to desired heading, then pull knob out.)

(5) Turn rudder knob on directional gyro control to align upper card with lower card.

(6) Turn aileron knob until follow-up index on top of bank and climb gyro dial matches zero point on banking scale.

Note

If airplane is on the water, one float or the other will be down and the airplane will be tilted laterally; the number of degrees will be indicated by the inclinometer under the directional gyro. Aileron index should be set for same number of degrees deflection.

Warn pilot to discontinue ground check of automatic pilot system if engine cylinder temperatures and oil temperatures are rising above safe limits.

(7) Turn elevator knob until the follow-up index matches the elevator alignment index at the side of the bank and climb gyro dial.

CAUTION

Do not align follow-up index with the horizon bar.

(8) Make sure that surface controls operate freely. Engage automatic pilot with "ON-OFF" lever at top of pilot's compartment. Move lever SLOWLY all the way "ON."

(9) Oil pressure on gage should read 150 ($\pm$10) pounds.

(10) Check operation of automatic pilot by rotating rudder knob each way. The servo speed control valve settings will determine the speed of control.

(11) Check for air in automatic pilot hydraulic system. Controls should not be resilient (springy) when a moderate pressure is applied to them, but should feel as though locked. If air is present, remove it.

Note

Do not confuse stretching of cable with the presence of air in the hydraulic system. If in doubt, note whether there is any movement of the follow-up indices of the control units. Stretching of the cable will not cause these indices to move.

(12) Check to see if automatic pilot can be overpowered manually without excessive force on the controls.

(13) Disengage automatic pilot.

(14) GYRO HORIZON AND DIRECTIONAL GYRO.—Check gyro instruments not included in automatic pilot control panel. Uncage gyro horizon and check to see that there is no precession, and that instruments indications will be that of the airplane's position. Set and uncage directional gyro. (See instructions above for directional gyro on automatic pilot panel.) Check for instrument drift of not more than 3° in 15 minutes.

PILOT

u. If immediate take-off is contemplated, order all hatches and ventilators secured. If on water, make sure anchor gear is stowed, mooring lines clear, and gun blister waterseals inflated. If on land, see that wheel chocks are removed, entrance ladders stowed, and that nose wheel is pointed straight ahead.

v. Determine if continued use of auxiliary power unit will be necessary, and, if not, shut off unit.

w. If on land, check to see that floats are up and securely latched. If on water, check to see that floats are securely latched in down position.

x. Check with someone aft to see that tail anti-icer air scoop is closed, and that anti-icer switch is off. See that temporary canvas scoop is removed and stowed.

FLIGHT ENGINEER

s. Request radioman to switch on main engine generators and batteries and to read meters to check for proper power output (28 to 28.5 volts with no load).

t. Check operation of galley stove by turning one hot plate on "HIGH" position and the other on "LOW" position, and note the differences in heat; then reverse switches and repeat check.

6. EMERGENCY TAKE-OFF.

(See Section IV, paragraph 3.)

7. ENGINE AND AÇESSORIES OPERATION GROUND TEST.

(See Section II, paragraph 5.)

8. TAXIING INSTRUCTIONS.

a. GENERAL.—Taxiing should not be done at very low or very high rpm. No restriction can be placed on taxiing rpm, but it should be noted that a large part of ignition trouble may be due to overheating the installation by taxiing at high speeds.

Automatic rich mixture is to be used for ground operation.

Cowl flaps should be open for all taxiing operations.

In using engines, a little power applied for longer periods is better than repeated short surges of power, which tend to empty the accelerator pump if sufficient time is not allowed for the pump to refill.

b. LAND TAXIING.—The landing gear may be used for taxiing into and from the water.

Taxiing on land should be done without brakes wherever possible, as application of brakes for long periods will cause overheating.

WARNING

Emergency hydraulic hand pump handle must be in operating position before taxiing.

Sudden applications of either brake or power should be avoided, as they tend to jerk the nose wheel around, and may damage the gear.

The nose wheel is free to swivel a maximum of 30° each way; the airplane can be turned either way while taxiing at a fast rate, without showing a tendency to ground loop, even in wet weather. However, turns should be anticipated sooner than with conventional gear by speeding the outside motor well before the turn and applying the inside brake easily, if necessary.

CAUTION

In making small radius turns avoid locking inside wheel with resultant tearing of rubber.

One of the main points to consider in taxiing tricycle installations is to avoid starting movement contrary to the direction in which the nose wheel is turned. Pilots should note the position of the nose wheel before entering the airplane. If it is turned sidewise over 30° or caught in a rut, the wheel should be straightened before attempting to taxi. If turned only slightly, the pilot should begin his taxiing in the direction the nose wheel points in order to start it castering. After the nose wheel has begun to caster, the plane may be turned in the desired direction. Pilots should start taxiing with not more than the minimum amount of throttle required to start motion. This is necessary to avoid applying heavy loads on a canted nose wheel. Particular care must be exercised when operating in muddy ground, soft sand, or deep snow.

The nose wheel is dampened against shimmying, and none should be tolerated, since it can be cured by proper servicing. Before each day's first land take-off the airplane should be taxied for some distance in a straight line to test the nose wheel for shimmying tendencies.

The main landing gear is located at approximately 41.6 per cent of the mean aerodynamic chord. Center of gravity locations forward of this point obviously will have no tendency to rock the airplane and lift the nose wheel off the ground. Brakes should not be used during a take-off run. Course corrections should be made with slight throttle changes.

CAUTION

If the brakes have been used to any great extent prior to taxiing to the line, it is advisable to allow them to cool before applying the parking brakes.

c. WATER TAXIING.—Water taxiing is possible at higher rpm settings than on land because of the constant drag of the water.

9. TAKE-OFF.

a. LAND TAKE-OFF.—Tricycle-geared planes will not take themselves off. When elevator control is gained, the nose wheel should be lifted from the ground, and the run continued on the main wheels until take-off speed is reached.

The take-off speed varies with the gross weight of the airplane. At 27,000 pounds, the take-off speed is 63 knots, and at 34,000 pounds, it is 71 knots.

Maximum recommended gross weight for take-off from a smooth, prepared runway is 34,000 pounds, but with a jettisonable load of approximately 2000 pounds the maximum is 36,400 pounds. Appropriate reductions of weight down to 26,000 pounds must be made for less favorable conditions.

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CHECK-OFF LIST—LAND

PILOT

(1) Check elevator, rudder, and aileron tab settings.

(2) Check emergency hydraulic hand pump handle in operating positions.

(3) Move landing gear indicator switch to "INDICATOR LIGHT." (See figure 28.)

(4) Check to make certain rudder control is unlocked and rudder operates freely.

(5) Check automatic-pilot "OFF."

FLIGHT ENGINEER

(6) Check "FLOATS UP."

(7) Check oil pressure and oil temperature normal. Minimum temperature should be 40°C (104°F).

(8) MIXTURE CONTROL.—Set at "AUTOMATIC RICH."

(9) CARBURETOR AIR CONTROL.—Set for "DIRECT" air except when ice or sleet conditions require "ALTERNATE" setting.

(10) Cowl Flaps should be set at "OPEN" in order that cylinder temperature before take-off will not exceed 232°C (450°F).

(11) Report to pilot when ready.

PILOT

(12) Propellers should be set for 2700 rpm (maximum 2750 rpm, surge). Manifold pressure should be 48 inches Hg maximum (100/130 octane fuel).

FLIGHT ENGINEER

(13) COWL FLAPS.—Adjust to maintain cylinder temperature not to exceed 260°C (500°F) in climb for one hour or 232°C (450°F) for cruising; 20°C (68°F) or more below the maximum for each condition is preferred.

PILOT

(14) Reduce rpm immediately after take-off to 2550. Maintain 42 inches Hg manifold pressure.

(15) Raise wheels as soon as possible after take-off.

(16) Check "WHEELS UP" and "WHEEL DOOR LOCKED" by moving indicator light switch to "INDICATE."

(17) Move landing gear indicator switch to "WARNING LIGHT."

FLIGHT ENGINEER

(18) If auxiliary power unit is being used, have ventilators in crew's quarters opened after take-off is completed.

PILOT

(19) Turn off lights which do not show functional parts.

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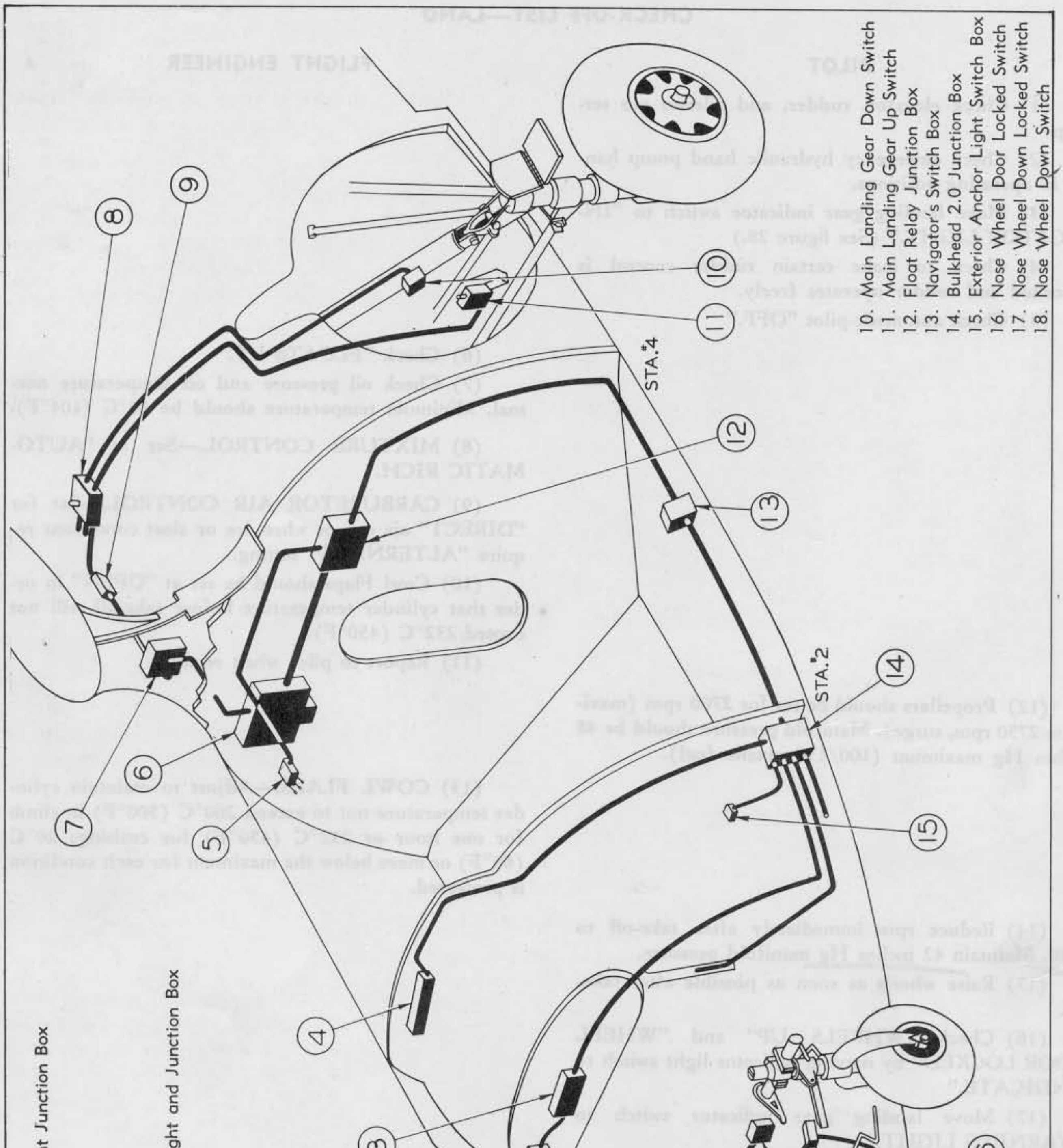


Figure 28—Landing Gear Indicator System

b. WATER TAKE-OFF.—This take-off speed varies with the gross weight of the airplane. At 27,000 pounds, the take-off speed is 63 knots, and at 34,000 pounds it is 71 knots.

Maximum recommended gross weight for rough operation is 27,300 pounds; for smooth water operation, 34,000 pounds. At gross weights in excess of 30,000 pounds, the limiting weight which may be taken off safely will depend on hydrodynamic considerations.

CHECK-OFF LIST—WATER.

PILOT	FLIGHT ENGINEER
(1) Check elevator, rudder, and aileron tab settings.	
(2) Check to make certain rudder control is unlocked and rudder operates freely.	
(3) Check automatic pilot "OFF."	
(4) Check wing anti-icers off. Signal navigator to close central heater outside air duct. Signal crew member to turn off tail anti-icer and close air scoop. Crew member to check all hatches and openings closed and bomber's window cover in place.	
(5) Check to see if landing gear is up and locked by moving indicator light switch to "INDICATE."	
	(6) Check "FLOATS DOWN."
	(7) Check oil pressure and oil temperature normal. Minimum temperature should be 40°C (104°F).
	(8) MIXTURE CONTROL.—Set at "AUTOMATIC RICH."
	(9) CARBURETOR AIR CONTROL.—Set for "DIRECT" air except when ice or sleet conditions require "ALTERNATE" setting.
	(10) COWL FLAPS should be set at "OPEN" in order that cylinder temperatures before take-off will not exceed 232°C (450°F).
	(11) Report to pilot when ready.
(12) Propeller should be set for 2700 rpm (maximum 2750 rpm, surge). Manifold pressure should be 48 inches Hg maximum (100/130 octane fuel).	
	(13) COWL FLAPS.—Adjust to maintain cylinder temperatures not to exceed 260°C (500°F) in climb for one hour or 232°C (450°F) for cruising; 20°C (68°F) or more below the maximum for each condition is preferred.
(14) Reduce rpm immediately after take-off to 2550. Maintain 42 inches Hg manifold pressure.	
	(15) If auxiliary power unit is being used, have ventilators in crew's quarters opened after take-off is completed.

10. ENGINE FAILURE DURING TAKE-OFF.

(See Section IV, paragraph 4.)

11. CLIMB AND HIGH SPEED LEVEL FLIGHT.

For maximum performance (rated power) the propeller should be governed to 2550 rpm, the mixture control set at "AUTOMATIC RICH," and the manifold pressure reduced gradually from 42 inches Hg at Sea Level to 39.5 inches Hg or Full Throttle at 7000 ft.

After a long climb, or after going to a higher power in cold weather, momentarily reduce the propeller pitch (increase rpm) to permit hot engine oil to clear out of the mechanism.

12. GENERAL FLYING CHARACTERISTICS.

The airplane is stable over a wide range of center of gravity locations; however, care should be exercised to operate controls smoothly when flying with the center of gravity near the limits of its range.

At high speeds, the elevators become "heavy," helping to prevent sudden extreme application of the elevator control, which might prove damaging to the structure.

Banks up to 60° can be made safely.

It is good practice to slow down to 100 knots in extremely turbulent air.

a. FLIGHT RESTRICTIONS.—Do not exceed an engine speed of 2700 rpm (five minutes only). However, 3060 rpm is permitted for 30 seconds in a dive.

Do not exceed an engine speed of 2550 rpm for continuous flight.

Do not operate engines in excess of 67% power with the mixture control in the "AUTOMATIC LEAN" position.

Do not operate automatic pilot when one or more engines are not delivering normal power. It is not necessary to disengage the automatic pilot when encountering rough or turbulent air. If necessary, adjust the speed control valves to improve operation. Under extremely turbulent conditions, follow through manually on the controls and assist the automatic pilot if necessary.

Do not use the automatic pilot when flying at less than an indicated air speed of 85 knots.

Do not operate the airplane under control of the automatic pilot without at least one rated pilot "on watch."

Restricted speeds and accelerations for gross weights in excess of 26,000 pounds are given in Section III, paragraph 2.

b. ELEVATOR TRIM.—Five degrees deflection of the elevator trim tab is usually sufficient to trim the airplane in any power condition, including landing gear or floats extended.

c. CRUISING.—While cruising operations may be conducted at any engine power below normal rated power, in order to obtain low fuel consumption it is recommended that all cruising operations be conducted below 700 horsepower. When cruising at 700 horsepower the engine speed should be 2170 rpm, which results in 140 bmep; the mixture control should be in the "AUTO RICH" position. When cruising below maximum cruising power, the speed should be adjusted so as not to exceed 140 bmep, and the mixture control should be in the "AUTO LEAN" position. The cylinder head temperature limit of 232°C (450°F) must not be exceeded during cruising operation. *(Refer to figure 62.)*

13. PROHIBITED MANEUVERS.

Loop	Wing Over
Roll	Vertical Turn
Chandelle	Inverted Flight
Immelmann Turn	Spin

14. STALLS.

a. STALL CHARACTERISTICS.—With or without power, the airplane settles as it approaches the stall. The stall is very gradual, showing no tendencies to whip.

Indication of approaching stall is a slight tail shake, increasing as the stall becomes more evident. Both lateral and directional stability are completely maintained throughout the stall. No shake or loss of control is noticed either in the rudder or aileron. The airplane does not have any severe stalling characteristics. In a normal power-on or power-off stall, the airplane merely mushes down and the recovery is almost instantaneous. However, in more abrupt stalls, a pronounced nose-down fall-off is noticed. The stalling characteristics of any airplane depend upon such items as cowl flap position, landing gear and float position, and the power settings.

b. STALLING SPEEDS.

(1) CLEAN CONDITION (FLOATS UP — GEAR UP) GROSS WEIGHT 27,000 LBS.

(a) With cowl flaps a quarter open and power on, the indicated stalling speed is approximately 53 knots, with a sinking rate of 300 ft/min.

(b) With cowl flaps a quarter open and power off, the indicated stalling speed is approximately 55 knots with a sinking rate of 300 to 400 ft/min.

The pilot must overcome any tendency to pull nose up before sufficient air speed has been obtained. Below is a table of stalling speeds, with power on, for various load conditions:

Gross Wt. Lbs.	*Approximate Minimum Stalling Speed (Floats and Gear Up) Knots*	*Approximate Minimum Stalling Speed (Floats and Gear Down) Knots*
23,000	49	51
27,000	53	55
34,000	60	63

(2) DIRTY CONDITION (FLOATS DOWN—GEAR DOWN).

(a) With cowl flaps a quarter open and power off, the indicated stalling speed is approximately 58 knots with a sinking rate of 400 ft/min.

(b) With cowl flaps a quarter open and power on, the indicated stalling speed is approximately 55 knots, with a sinking rate of 300 ft/min.

In general, the stalling characteristics are very good and require very little effort on the pilot's part during the stall and during recovery. Stalling speeds vary directly with the gross weight of the airplane.

15. SPINS.

This airplane shows no tendency to spin from a slow or steeply banked turn.

When one engine is inoperative, too short a turn toward the dead engine provokes a spin.

If a spin has not progressed too far, recovery may be assisted by increasing power of the engine on the inside of the turn and decreasing power of the engine on the outside of the turn, as well as applying the usual nose-down and opposite aileron and rudder controls. In recovery from a spin, there must be no abrupt movement of the controls.

16. ACROBATICS.

All acrobatics are prohibited in this type of airplane.

17. DIVING.

With a gross weight of 27,000 pounds, airplane must not be pulled out at more than three g's.

Maximum engine overspeed is 3060 rpm for 30 seconds.

Place mixture control in "AUTOMATIC RICH" before diving.

Close cowl flaps to prevent too rapid cooling of the engines.

Control trim should be maintained with the idea of keeping tail surface forces to a minimum. Trim the airplane to be slightly nose-heavy in dive, rather than tail-heavy. If airplane were trimmed tail-heavy, there would be an inherent tendency to pull up. This condition might lead to pulling up the elevator too suddenly.

Air loads build up rapidly on a large airplane. For this reason, any abrupt movement of the controls should be avoided.

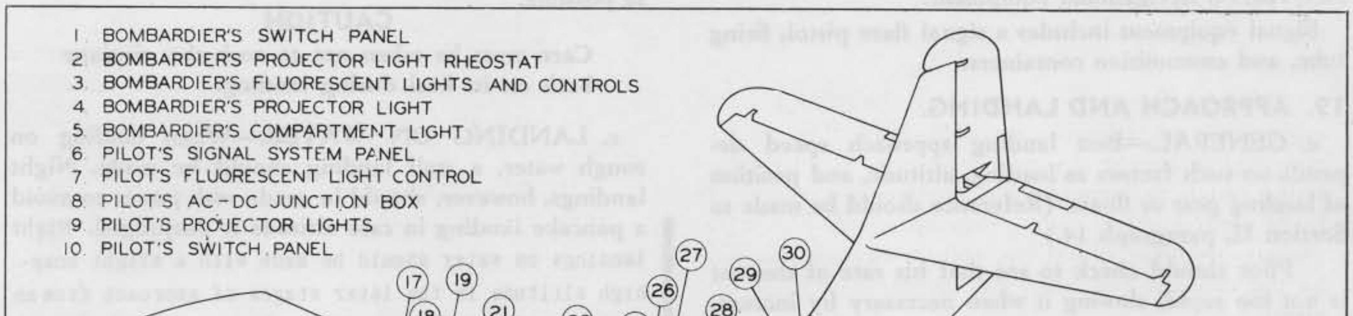


Figure 29—Interior Lights Diagram

NOTE.—THE LIMITATIONS AND RESTRICTIONS ON THIS AIRPLANE ARE SUBJECT TO CHANGE AND THE LATEST SERVICE INSTRUCTIONS AND APPLICABLE TECHNICAL ORDERS MUST BE CONSULTED.

18. NIGHT FLYING.

(See figures 29 and 30.)

Projector lights are provided for night flying, as well as fluorescent and filament lights, and blackout curtains. Projector lights are located in the three forward compartments. Fluorescent lights are located in the bomber's and pilot's compartments. The usual compartment lights and extension light receptacles are also provided.

Exterior lights include running, tail, formation, recognition, section, landing, and anchor lights.

CAUTION

When the airplane is not in motion, if landing lights are operated more than five seconds, they will overheat and must be replaced.

Also included in the airplane is the AN/APN-4 and AN/ARN-8 navigational equipment.

Signal equipment includes a signal flare pistol, firing tube, and ammunition containers.

19. APPROACH AND LANDING.

a. GENERAL.—Best landing approach speed depends on such factors as loading, altitude, and position of landing gear or floats. (Reference should be made to Section II, paragraph 14.)

Pilot should check to see that his rate of descent is not too rapid, slowing it when necessary by increasing power and nosing up within safe indicated air speed limits.

Sufficient speed above stalling speed should be maintained to insure maneuverability, particularly under bad visibility conditions. Set propeller for take-off rpm (low pitch).

When flying a heavy airplane it should be remembered that a body tends to maintain motion in a straight path; therefore, if a steep glide is being made with accompanying high rate of descent, it takes time and a considerable force to flare out this rate of descent and change the motion to one parallel to the ground. With a rate of descent of over 500 feet per minute, it cannot reasonably be expected to start the flare five to ten feet above the ground and make a soft landing.

It is desirable to have the cowl flaps closed during glides to prevent rapid cooling of the engines; however, a one-third open cowl flap position may be desirable during the final approach if there is a possibility of high power suddenly being needed to continue flight.

During long glides at part or closed throttle, when low air temperatures prevail, occasional operation of the propeller and throttle controls is recommended in order to prevent congealing of the oil in the propeller cylinder. This operation is recommended because a pitch change introduces hot oil into the cylinder.

b. LANDING ON LAND.—The airplane shows no tendency to ground loop in a cross wind, but any drift should be taken out before making ground contact.

Maximum speed at which landing gear should be lowered is 120 knots.

Landing on a smooth, prepared runway is permissible with gross weights up to 34,000 pounds. Lighter weights down to 26,000 pounds are recommended when landing on less favorable terrain under normal conditions.

Landings should ordinarily be made on the main wheels, with the nose wheel held off. After contact, the nose wheel should be held where it is until some speed is lost before easing it down to the runway. This procedure tends to keep the airplane in a high drag attitude as long as possible and to reduce the amount of braking required. However, the tail should not be held down until all control is lost, as this practice will result in dropping the nose violently. For the same reason, brakes should not be applied until all three wheels are on the ground, and the airplane has slowed as much as possible.

CAUTION

Care must be taken not to rock the airplane back on its keel during landing.

c. LANDING ON WATER.—When landing on rough water, a stall landing should be made. Night landings, however, should be made with power to avoid a pancake landing in case altitude is misjudged. Night landings on water should be made with a slight nose-high altitude in the later stages of approach from an altitude of 200 feet on down, with an IAS of 76-83 knots. Power should be used to control rate of descent not exceeding 250 feet per minute.

Maximum speed at which floats should be lowered is 120 knots.

The airplane has a tendency to porpoise if landed at slow speeds. Minimum speeds should be observed. However, if the airplane is landed at an excessive speed, the nose has a tendency to dig into the water.

Maximum gross weight recommended for rough water landing is 27,300 pounds; for smooth water, 34,000 pounds. At gross weights in excess of 30,000 pounds the limiting weight which may be landed safely depends on hydrodynamic considerations.

d. TAKE-OFF PROCEDURE IF LANDING NOT COMPLETED.

(1) Set props in high rpm position.

(2) Advance throttle.

(3) Trim ship for take-off.

(4) Open cowl flaps.

e. PROCEDURE IF ENGINE FAILS ON LANDING.

(Refer to Section IV, paragraph 5.)

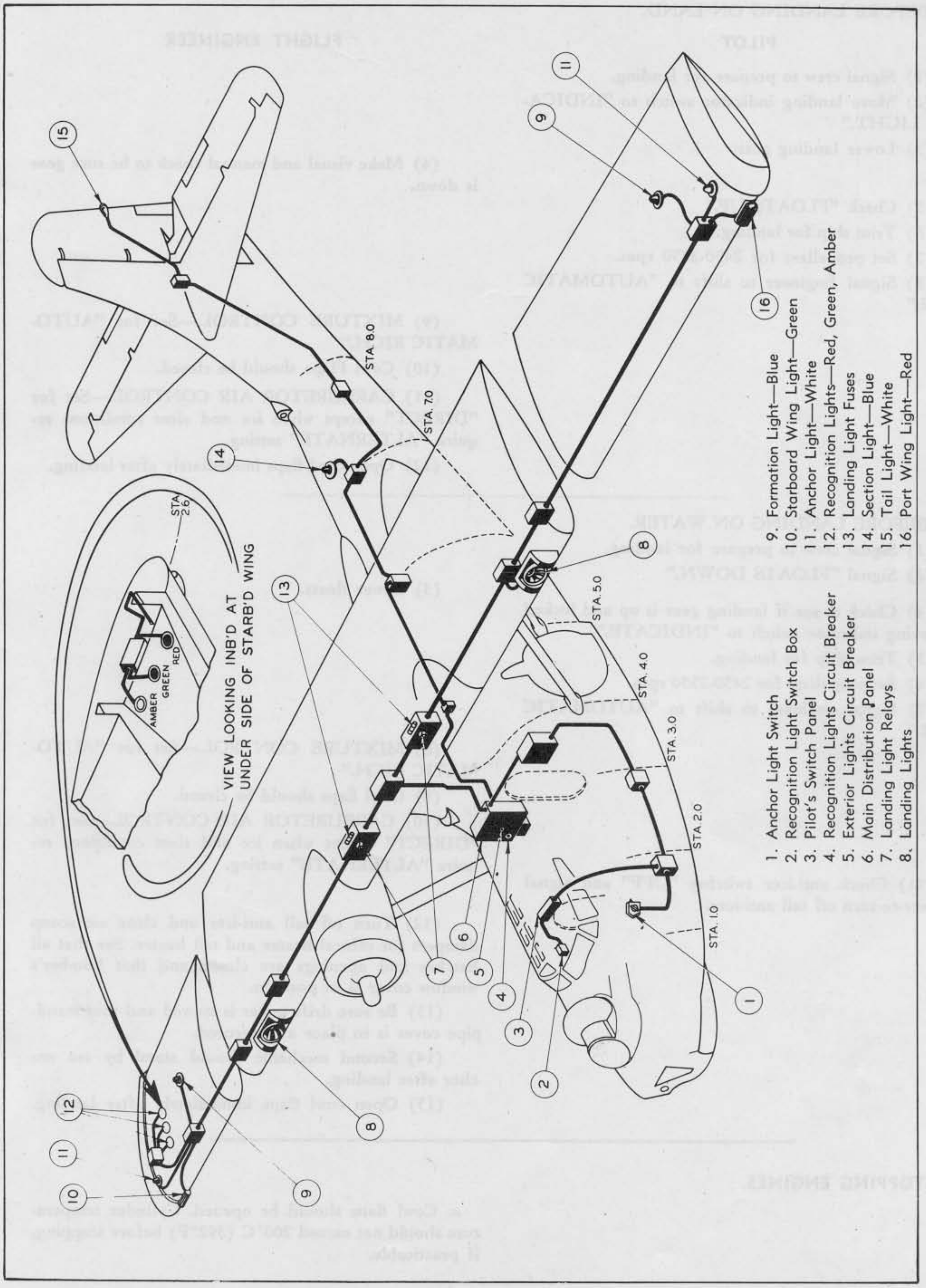


Figure 30—Exterior Lights Diagram

f. BEFORE LANDING ON LAND.

PILOT / **FLIGHT ENGINEER**

(1) Signal crew to prepare for landing.

(2) Move landing indicator switch to "INDICATOR LIGHT."

(3) Lower landing gear.

(4) Make visual and manual check to be sure gear is down.

(5) Check "FLOATS UP."

(6) Trim ship for landing.

(7) Set propellers for 2450-2550 rpm.

(8) Signal Engineer to shift to "AUTOMATIC RICH."

(9) MIXTURE CONTROL.—Set for "AUTOMATIC RICH."

(10) Cowl Flaps should be closed.

(11) CARBURETOR AIR CONTROL.—Set for "DIRECT" except when ice and sleet conditions require "ALTERNATE" setting.

(12) Open cowl flaps immediately after landing.

g. BEFORE LANDING ON WATER.

(1) Signal crew to prepare for landing.

(2) Signal "FLOATS DOWN."

(3) Lower floats.

(4) Check to see if landing gear is up and locked by moving indicator switch to "INDICATE."

(5) Trim ship for landing.

(6) Set propellers for 2450-2550 rpm.

(7) Signal engineer to shift to "AUTOMATIC RICH."

(8) MIXTURE CONTROL.—Set for "AUTOMATIC RICH."

(9) Cowl flaps should be closed.

(10) CARBURETOR AIR CONTROL.—Set for "DIRECT" except when ice and sleet conditions require "ALTERNATE" setting.

(11) Check anti-icer switches "OFF" and signal engineer to turn off tail anti-icer.

(12) Turn off tail anti-icer and close air scoop dampers for central heater and tail heater. See that all hatches and openings are closed and that bomber's window cover is in position.

(13) Be sure drift meter is stowed and that standpipe cover is in place and secured.

(14) Second mechanic should stand by sea anchor after landing.

(15) Open cowl flaps immediately after landing.

20. STOPPING ENGINES.

a. Cowl flaps should be opened. Cylinder temperature should not exceed 200°C (392°F) before stopping, if practicable.

PILOT

b. Throttles should be opened to 1000 rpm. (Cut switches if necessary when coming up to buoy or beach.)

c. Set propeller control in low pitch ("HIGH RPM").

d. Signal engineer to stop engines.

f. Cut switches after engines stop.

g. Signal "SECURE" after plane is beached or secured to buoy.

h. Instruct radio operator to secure lights and interphones.

i. Place landing gear indicator switch in center position.

j. Put on rudder locks and control yoke locks.

k. Install battens on control surfaces.

FLIGHT ENGINEER

e. Put mixture control in "IDLE CUT-OFF" position.

Note

STOPPING AUXILIARY POWER UNIT

Except in an emergency, the auxiliary power unit should always be stopped by shutting off the fuel supply, rather than by turning off the ignition switches.

21. BEFORE LEAVING THE PILOT'S COMPARTMENT.

Check to see that cowl flaps are open.

Check to see that ignition switches are both off.

Check to see that propellers are left in high rpm (low pitch).

Check with engineer to see that mixture control is in "IDLE CUT-OFF" and that fuel selector valves are off.

Lock the controls by the following procedure: First remove control lock from stowage and place aft end in socket located on forward face of bulkhead 2, just outboard of the pilot's seat. Move control yoke to neutral position so that pins at forward end of control lock fall into holes in the control yoke. These holes are located on either side of the pilot's control wheel on the top surface of the yoke.

To release rudder lock pull latch which is located approximately at the center of the rudder lock handle and move handle aft until it is approximately adjacent to the side of the airplane. The rudder lock is located to the left of the pilot, against the side of the airplane and is marked "RUDDER LOCK." (See figure 23.)

Check to see that automatic pilot is off.

If on land, set parking brakes after waiting for brakes to cool to normal temperature. Parking brakes are located to the right of the copilot. To set the brake, press down brake pedals and pull handle down.

Turn out lights.

★ ★ ★

POWER PLANT CHART

AIRCRAFT MODEL(S) PBY-6A | PROPELLER(S) 3 BLADE 12'-0" DIA. | ENGINE MODEL(S) R-1830-92

GAUGE READING	FUEL PRESS.	OIL PRESS.	OIL TEMP.	COOLANT TEMP.		OIL[1] CONS.
DESIRED MAXIMUM	17 18	85 100	65 100			
MINIMUM IDLING	16 12	65 25				

MAXIMUM PERMISSABLE DIVING RPM: 3060
MINIMUM RECOMMENDED CRUISE RPM: 1550
MAXIMUM RECOMMENDED TURBO RPM:

OIL GRADE: (S) 1120 (W) 1100 AN-VV-O-446
FUEL GRADE: 100/130, SPEC AN-F-28

WAR EMERGENCY (COMBAT EMERGENCY)			MILITARY POWER (NON-COMBAT EMERGENCY)			OPERATING CONDITION			NORMAL RATED (MAXIMUM CONTINUOUS)			MAXIMUM CRUISE (NORMAL OPERATION)		
MINUTES			5 MINUTES 260°C			TIME LIMIT MAX. CYL. HD. TEMP.			1 HR 260°C UNLIMITED 232°C			UNLIMITED 232°C		
			AUTO-RICH			MIXTURE			AUTO-RICH			AUTO-LEAN		
			2700			R. P. M.			2550			2170		
MANIF. PRESS.	SUPER-CHARGER	FUEL[2] Gal/Min	MANIF. PRESS.	SUPER-CHARGER	FUEL[2] Gal/Min	STD. TEMP. °C	PRESSURE ALTITUDE	STD. TEMP. °F	MANIF. PRESS.	SUPER-CHARGER	FUEL GPH[3]	MANIF. PRESS.	SUPER-CHARGER	FUEL GPH[3]
						-24.6	20,000 FT.	-12.3				F.T.		38
						-22.7	19,000 FT.	-8.7				F.T.		39
						-20.7	18,000 FT.	-5.2				F.T.		40
						-18.7	17,000 FT.	-1.6				F.T.		42
			F.T.	BLOWER	1.6	-16.7	16,000 FT.	2.0	F.T.	BLOWER	83	F.T.	BLOWER	44
			F.T.		1.7	-14.7	15,000 FT.	5.5	F.T.		89	F.T.		46
			F.T.		1.8	-12.7	14,000 FT.	9.1	F.T.		93	F.T.		47
			F.T.	SPEED	1.9	-10.8	13,000 FT.	12.6	F.T.	SPEED	99	F.T.	SPEED	52
			F.T.		1.9	-8.8	12,000 FT.	16.2	F.T.		106	F.T.		56
			F.T.		2.0	-6.8	11,000 FT.	19.8	F.T.		111	F.T.		60
			F.T.	-SINGLE	2.0	-4.8	10,000 FT.	23.4	F.T.	-SINGLE	120	30.2	-SINGLE	64
			F.T.		2.1	-2.8	9,000 FT.	26.9	F.T.		124	30.5		63
			F.T.		2.2	-0.8	8,000 FT.	30.5	F.T.		133	30.7		63
			F.T.	STAGE	2.3	1.1	7,000 FT.	34.0	39.5	STAGE	135	31.0	STAGE	62
			F.T.		2.4	3.1	6,000 FT.	37.6	39.5		134	31.3		60
			45		2.6	5.1	5,000 FT.	41.1	39.5		132	31.7		60
			45	SINGLE	2.5	7.1	4,000 FT.	44.7	39.5	SINGLE	131	32.0	SINGLE	60
			45		2.5	9.1	3,000 FT.	48.2	39.5		130	32.3		60
			45		2.4	11.0	2,000 FT.	51.8	39.5		129	32.7		60
			45		2.4	13.0	1,000 FT.	55.4	39.5		126	33.0		60
			45		2.3	15.0	SEA LEVEL	59.0	39.5		124	33.2		60

GENERAL NOTES

(1) OIL CONSUMPTION: MAXIMUM U.S. QUART PER HOUR PER ENGINE.
(2) *Gal/Min:* APPROXIMATE U.S. GALLON PER *MINUTE* PER ENGINE
(3) GPH: APPROXIMATE U.S. GALLON PER HOUR PER ENGINE.
F.T.: MEANS FULL THROTTLE OPERATION.
VALUES ARE FOR LEVEL FLIGHT WITH RAM.

FOR COMPLETE CRUISING DATA SEE APPENDIX I
NOTE: TO DETERMINE CONSUMPTION IN BRITISH IMPERIAL UNITS, MULTIPLY BY 10 THEN DIVIDE BY 12. RED FIGURES ARE PRELIMINARY SUBJECT TO REVISION AFTER FLIGHT CHECK.

TAKE-OFF CONDITIONS: 48 IN., 2700 RPM, AUTO-RICH, DIRECT AIR, 260° MAX. CYL. TEMP.

CONDITIONS TO AVOID:

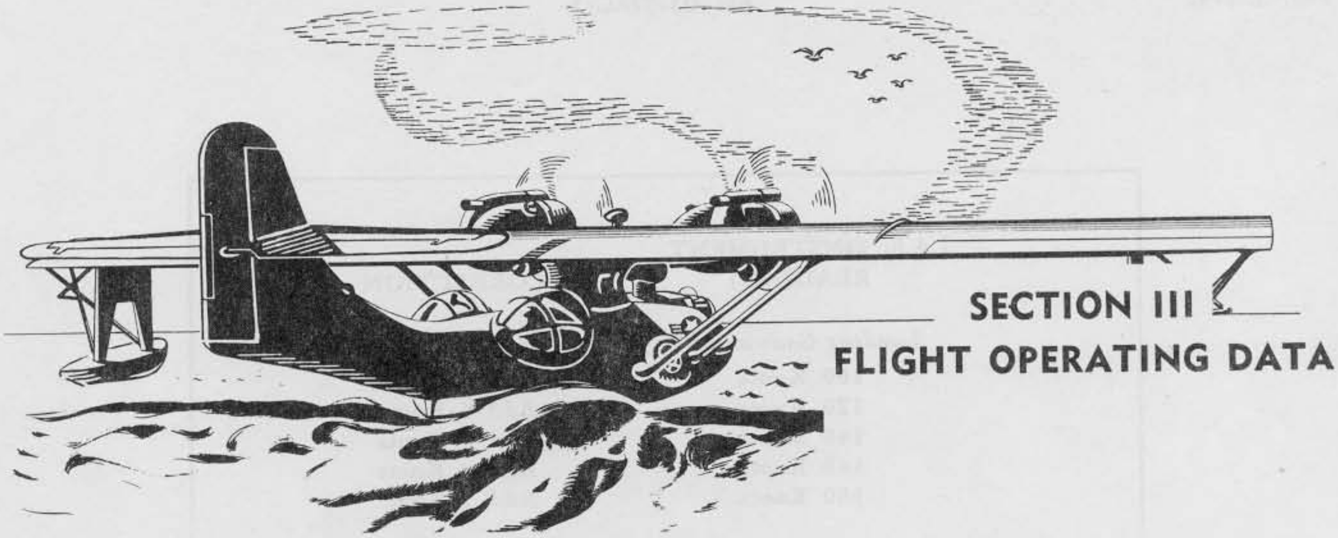
SPECIAL NOTES

AAFMC-526
4-1-44

DATA AS OF AUG. 1945 BASED ON OPERATING LIMITS CHART DATED MAY 1943 & FLIGHT TEST FUEL CONSUMPTIONS

WF-5-31-44-10M

Figure 31 — Power Plant Chart



SECTION III
FLIGHT OPERATING DATA

1. ENGINE PERFORMANCE RATINGS.

(See figure 31.)

In general, the ratings of the engine have been established as near the high limits as possible. The engine ratings are limited or bounded by three main criteria; brake horsepower, brake mean effective pressure, and speed. These ratings as set forth in the engine specification may be defined as follows:

a. TAKE-OFF RATING.—This is the maximum power and engine speed permissible for take-off. It should not be maintained longer than necessary to clear obstructions, after which the power should be reduced to normal rated power or less.

b. MILITARY RATING.—This is the maximum power permitted with less regard for long life of the engine than for immediate tactical needs. Military rating, comparable to Take-Off Power with manifold pressures modified to suit altitude conditions, may be used for five minutes.

c. NORMAL RATING (Maximum Continuous.)—This is frequently referred to as either "Normal Maximum Rating" or "Maximum-Except Take-Off Power." This is the maximum power at which an engine may be operated continuously for emergency (such as single engine) or high performance operation in climb or level flight. This rating is considered 100 per cent power and speed as a basis from which other operating conditions are calculated.

d. MAXIMUM CRUISE RATING.—This rating limits both the maximum power and maximum rpm permissible for continuous operation with the mixture control in "AUTOMATIC LEAN." The Specific Engine Flight Chart shows the maximum rpm at which the maximum cruising bmep may be maintained.

e. MINIMUM SPECIFIC CONSUMPTION.—Under most conditions of cruising operation, it is neither necessary nor desirable to use the maximum cruising power available from the engine. In such instances maximum engine efficiency and, as a rule, propeller efficiency is attained by maintaining the maximum permissible cruising torque or brake mean effective pressure as set forth on the bmep Cruising Chart. *(See figure 64.)* Other power and speed combinations may be selected from the Engine Operating Limits Curve and lower values may be extrapolated. *(See figure 66.)*

2. AIR SPEED LIMITATIONS.

(These limitations and restrictions are subject to change, and the latest service instructions and applicable technical orders must be consulted.)

a. MAXIMUM SPEEDS AND ACCELERATIONS.—Restricted speeds for gross weights in excess of 26,000 pounds are given in the table below. The restricted speed for any load in extremely rough air is 110 knots.

Gross Weight *(Pounds)*	Permissible Accelerations *(Positive)*	*(Negative)*	Permissible Speed *(Knots—Indicated)*
26,000	3.2 g	1.6 g	190
28,000	2.9 g	1.5 g	175
30,000	2.7 g	1.4 g	165
32,000	2.5 g	1.3 g	155
34,000	2.3 g	1.2 g	145

I.A.S. (INSTRUMENT READING)	CORRECTION
Landing Gear and Wing Tip Floats Retracted	
100 Knots	Add 6 Knots
120 Knots	Add 6 Knots
140 Knots	Add 5 Knots
160 Knots	Add 4 Knots
180 Knots	Add 1 Knot
Landing Gear Down—Wing Tip Floats Retracted	
60 Knots	No Correction
70 Knots	Add 2 Knots
80 Knots	Add 4 Knots
90 Knots	Add 5 Knots
Landing Gear Retracted—Wing Tip Floats Down	
60 Knots	Substract 2 Knots
70 Knots	No Correction
80 Knots	Add 3 Knots
90 Knots	Add 4 Knots

Figure 32—Air Speed Installation Correction Table

In unusually rough air the permissible speeds listed above are further progressively reduced according to the degree of turbulence. Under extremely adverse conditions a speed range of 100 to 110 knots is recommended. This is considered to be the most favorable range for extremely rough air, based on control and strength limitations.

In addition to the above restrictions on acceleration and speed, increasing care in methods of operations is considered essential at the higher gross weights. Turns should be more moderate and all control movements should be smoother than when operating at lower gross weights.

The maximum recommended gross weights for take-off and landing are:

Operations from rough water and ordinary fields ....27,300 pounds
Operations from smooth water and smooth prepared runways 34,000 pounds
Take-off from smooth prepared runways with jettisonable load of approximately 2000 pounds 36,400 pounds

Floats should not be lowered at indicated speeds greater than 120 knots.

Landing gear should not be lowered at speeds greater than 120 knots.

b. MINIMUM SPEEDS.—Do not operate the automatic pilot at indicated air speed of less than 85 knots.

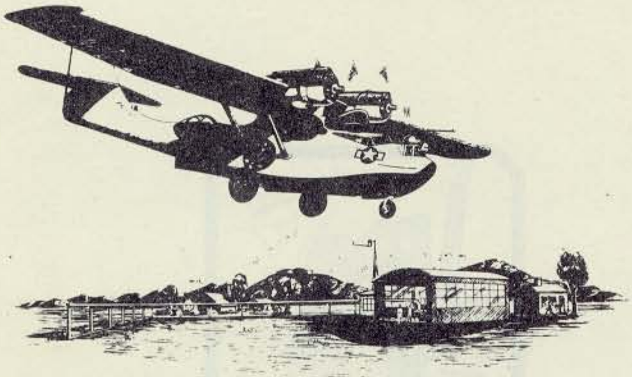
For stalling speed at various gross weights see Section II, paragraph 14.

3. AIR SPEED INSTALLATION CORRECTION TABLE.

(See figure 32.)

4. BALANCE COMPUTER DESIGNATION.

The balance computer used on this airplane is known as the "LOAD ADJUSTER" and is used with the AN 01-1B-40 weight handbook.



SECTION IV
EMERGENCY OPERATING INSTRUCTIONS

1. EMERGENCY OPERATION OF LANDING GEAR.

(See figures 33 and 34.)

a. If gear fails to lower when handle is pushed down, check hydraulic pressure gage. If gage shows over 1000 pounds pressure, return handle to "UP" position and repeat attempt to lower gear. If gear does not lower on second attempt, leave gear handle locked in "DOWN" position and:

b. Release the main wheel up-locks by pulling out the "Tee" handles at the main wheel wells and turning handles a quarter turn.

c. Work gear down by rocking the airplane approximately 14° to each side.

d. Use the emergency "DOWN-LATCH" lever to straighten out the main support struts and latch the gear in the down position. To do this, first insert emergency "DOWN-LATCH" lever through access door provided in side of wheel well, and engage the handle end of the lever over the bolt provided on the auxiliary keel. With the handle end of lever supported by the bolt, guide the outboard end of the lever into the strut socket located just above the pivot point in the strut.

e. Push firmly on the lever to straighten out the strut and the gear will latch down. Repeat the same operation for gear on opposite side.

f. Unlock nose wheel doors by pushing door lock handle aft, thus releasing the door lock pins. The door lock handle is located on the starboard side, forward of bulkhead 1.

g. Insert hydraulic hand pump handle (stowed on the forward starboard face of bulkhead 2) in the aft end of the port door torque tube (located aft of bulkhead 2) and push inboard (clockwise). Rotate until starboard door torque tube has turned sufficiently to allow insertion of the emergency "DOWN-LATCH" lever handle.

h. Insert emergency "DOWN-LATCH" lever handle in the aft end of the starboard door torque tube and push inboard (counter-clockwise). This rotates the torque tube and thus opens the nose wheel well doors.

i. Lock torque tube in "DOORS OPEN" position by swinging locking link inboard over the lug on the torque tube end fitting. Insert locking pin and retain with safety pin.

j. Remove the aft cover plug of the nose wheel and insert emergency lever through the hole. Strike the end of the up-latch sharply to unlatch the nose gear.

k. Attach the emergency lever to the torque tube between the packing nut and the jack fitting, so that the ratchet pawl fits into the teeth of the jack fitting. Using the lever as a ratchet, force the gear into the down position. To lock, use a slow, heavy push.

l. Remove the forward plug of the wheel well cover to examine the down-latch, and use emergency "DOWN-LATCH" lever to determine if the down-latch is locked. If it is locked, the red collar on the lever will not extend above the hole in the cover, and the oleo strut will be vertical and against the down bumper.

CAUTION

Before operating gear again, be sure to release the emergency door lock pin.

If the landing gear failure is due to failure of starboard engine or engine driven hydraulic pump, and not to loss of fluid caused by leaking reservoir or lines, the gear may be lowered with pressure supplied by the hand pump. Latch control handle in "DOWN" position before operating pump. Be sure to check "LANDING GEAR WARNING" indicator lights. To raise gear latch control handle in "UP" position and operate hand pump as described above.

2. EMERGENCY OPERATION OF FLOATS.

(See figures 35 and 36.)

a. TO LOWER FLOATS:

(1) Remove hand crank from stowage on starboard side of bulkhead 4 below engineer's seat.

(2) Engage crank in socket marked "FAST" and crank counterclockwise. The socket is located in center of bulkhead below engineer's seat.

b. TO RAISE FLOATS:

(1) Insert crank in socket marked "FAST" and turn clockwise until load gets too heavy to operate easily.

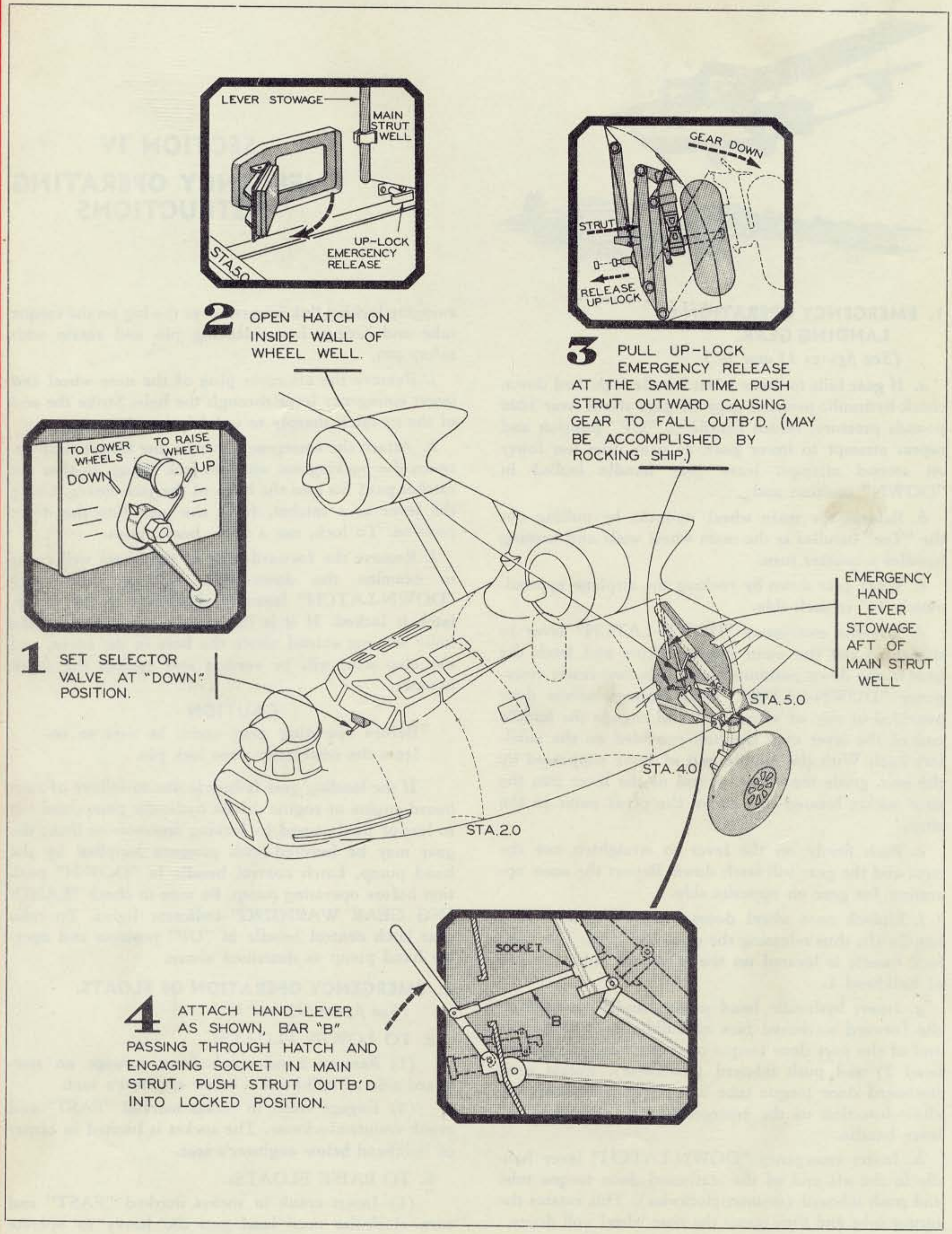


Figure 33—Emergency Lowering of Main Landing Gear

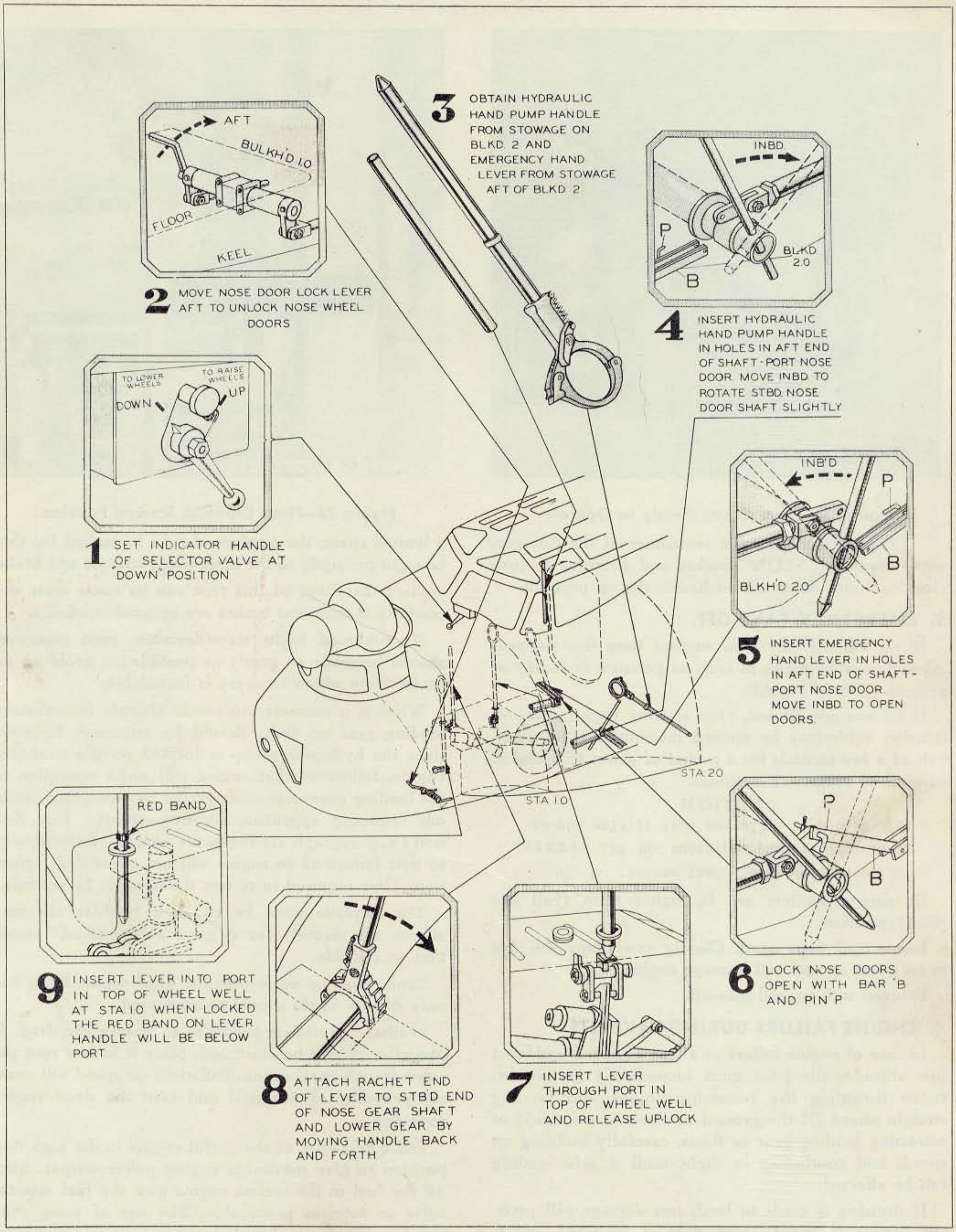


Figure 34—Emergency Lowering of Nose Gear

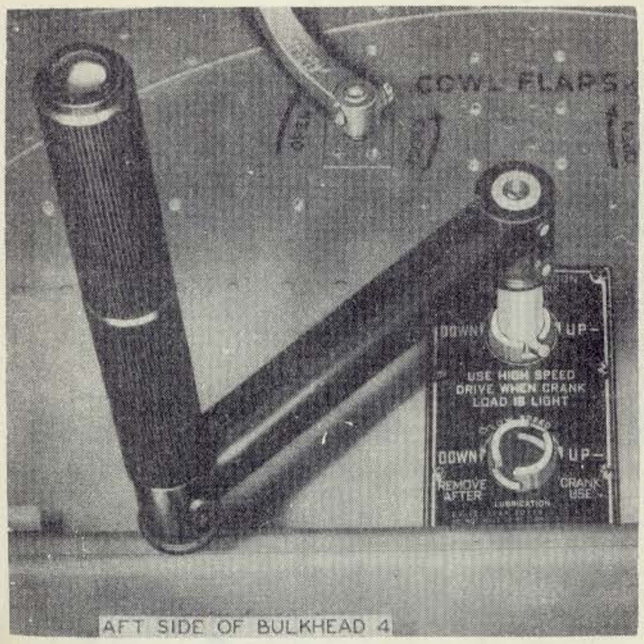


Figure 35—Float Crank Ready to Operate

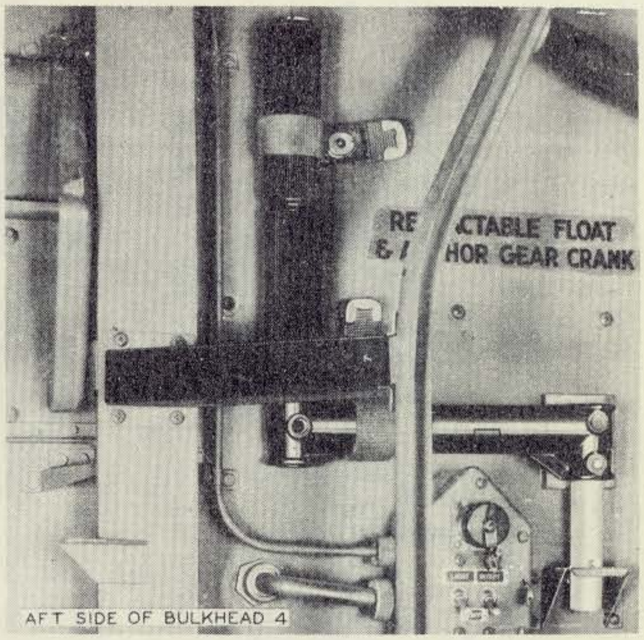


Figure 36—Float Crank in Stowed Position

(2) To raise floats the remainder of the distance, move crank to "SLOW" socket and continue to turn clockwise until floats are latched in the up position.

3. EMERGENCY TAKE-OFF.

If oil was diluted when engines were last stopped, take-off may be made as soon as pressure is steady at around 65 to 75 pounds.

If oil was not diluted, after starting engines, the oil dilution valve may be opened intermittently at intervals of a few seconds for a period of about 15 seconds, or until oil pressure is constant.

CAUTION

This method is suggested only if time and extreme temperature conditions do not permit engine warm-up in a normal manner.

Be sure propellers are in highest rpm (full low pitch) position.

Leave cowl flaps open. Closing cowl flaps will not assist warm-up and will damage engine.

Proceed with normal take-off.

4. ENGINE FAILURE DURING TAKE-OFF.

In case of engine failure at a low air speed and/or a low altitude, the pilot must immediately choose between throttling the remaining engine and landing straight ahead (if the ground or water is suitable); or retracting landing gear or floats, carefully building up speed, and continuing in flight until a safe landing can be effected.

If decision is made to land, less damage will probably result if the landing gear is retracted, unless there is a perfect field ahead.

If the landing is to be made on good terrain, but in a limited space, the airplane should be stalled in; then brought promptly to the three-point attitude and brakes applied. Landings of this type can be made most successfully if tires and brakes are in good condition.

If continued flight is undertaken, each maneuver should be made as gently as possible, to avoid an attitude from which recovery is impossible.

When it is necessary to obtain altitude immediately, landing gear or floats should be retracted; however, since the hydraulic pump is located on the starboard engine, failure of that engine will make retraction of the landing gear impossible except by emergency methods requiring approximately five minutes. (See Section IV, paragraph 1.) Floats are controlled electrically, so that failure of an engine will not affect their operation. Time required to retract the floats is 20 seconds.

The airplane must be trimmed (rudder tab first, aileron tab second) for as good a "hands off" condition as possible.

Banks must be made with the dead engine high, and only shallow banks should be attempted.

Feather the useless propeller to reduce the drag. If propeller cannot be feathered, place it in low rpm position to reduce vibration. Sufficient air speed will cause the propeller to windmill and turn the dead engine over fast.

Leave propeller of the useful engine in the high rpm position to give maximum engine power output. Shut off the fuel to the useless engine with the fuel selector valve as soon as practicable. The use of more than rated power at any altitude must be kept to a minimum to avoid overheating and detonation which will result in damage to, if not complete failure of, the remaining engine. The use of a rich mixture will help slightly to keep engine cylinder temperatures down.

When landing, rapid settling of the airplane must be anticipated, particularly at the time that landing gear or floats are lowered. Before landing is attempted, the pilot should gain all the altitude possible, and where practical, simulate landing procedure by lowering wheels or floats and reducing power. Lowering of the wheels by use of the emergency hand pump will require approximately three minutes. (See Section IV, paragraph 1.)

5. ENGINE FAILURE DURING LANDING.

If engines fail on landing, the procedure recommended is as follows:

Take care not to lose air speed.

Trim rudder and aileron tabs. "HANDS-OFF" trim, if possible.

Place the propeller in the low rpm position, if possible.

Feather the useless propeller as soon as possible. If propeller cannot be feathered it should be allowed to windmill in the low rpm position.

Shut off fuel to the dead engine, and shut off the fuel selector valve as soon as practical.

Place the propeller of the good engine in high rpm position if power is needed to reach the landing spot. (Do not exceed maximum permissible engine overspeed of 3,060 rpm for 30 seconds.)

Rapid settling of the airplane must be anticipated.

If the landing gear or floats have not been lowered at the time of engine failure, considerable loss of altitude may be expected when they are lowered. If the starboard engine fails, the hydraulic system pump will be inoperative, and landing gear must be lowered by emergency methods requiring approximately three minutes. (See Section IV, paragraph 1.) If conditions permit, altitude should be attained and a few landings simulated at a safe altitude.

6. MISCELLANEOUS EMERGENCY MEASURES.

a. EMERGENCY LANDING ON LAND—WHEELS UP.—In the event the landing gear fails to lower prior to landing and cannot be lowered by emergency means, a normal power-on landing should be made.

If landing is to be attempted on clear terrain, floats should be lowered.

If landing on terrain where any obstructions exist, such as brush or trees, floats should be up.

b. EMERGENCY ESCAPE HATCHES. *(See figure 37.)*—The only safe escape available in flight is through the waist gun blisters or the tunnel gun hatch. The only other escapes are through the bow turret manhole, the pilot's compartment hatch and the navigator's hatch, but are only suitable for use on the water.

c. DITCHING.—No ditching procedure has been established for this airplane. Crew members should remain at their respective stations until landing is effected.

d. LIFE RAFT.—A Mark VII, Type D, seven man life raft is stowed on the forward face of bulkhead 7 on the port side. It is held in place by two straps with quick release buckles. (See figure 37.)

To remove the life raft for use:

(1) Unbuckle the two retaining straps.

(2) Throw the complete assembly through the blister opening.

(3) Pull the rip cord. This action should open the CO_2 gas container and automatically inflate the life raft.

CAUTION

If the life raft fails to inflate automatically on pulling the rip cord, the CO_2 containers must be opened manually.

Emergency provisions and equipment are contained in the life raft. A snubbing rope is attached to the structure of the airplane and to the life raft to prevent it from drifting away. After the raft is occupied, the snubbing rope should be released as soon as possible.

e. FIRE EXTINGUISHERS. *(See figure 37.)*—Four CO_2 shatterproof type fire extinguishers are located in the airplane.

(1) One five pound capacity portable fire extinguisher is located on the port forward side of bulkhead 4.

(2) One two pound capacity hand fire extinguisher is located on the starboard aft side of bulkhead 2.

(3) One two pound capacity hand fire extinguisher is located on the face of starboard shear web, between bulkheads 4 and 5.

(4) One two pound capacity hand fire extinguisher is located on aft face of bulkhead 6 below watertight door at center of ship.

Note

Full instructions for use and maintenance are written on each fire extinguisher.

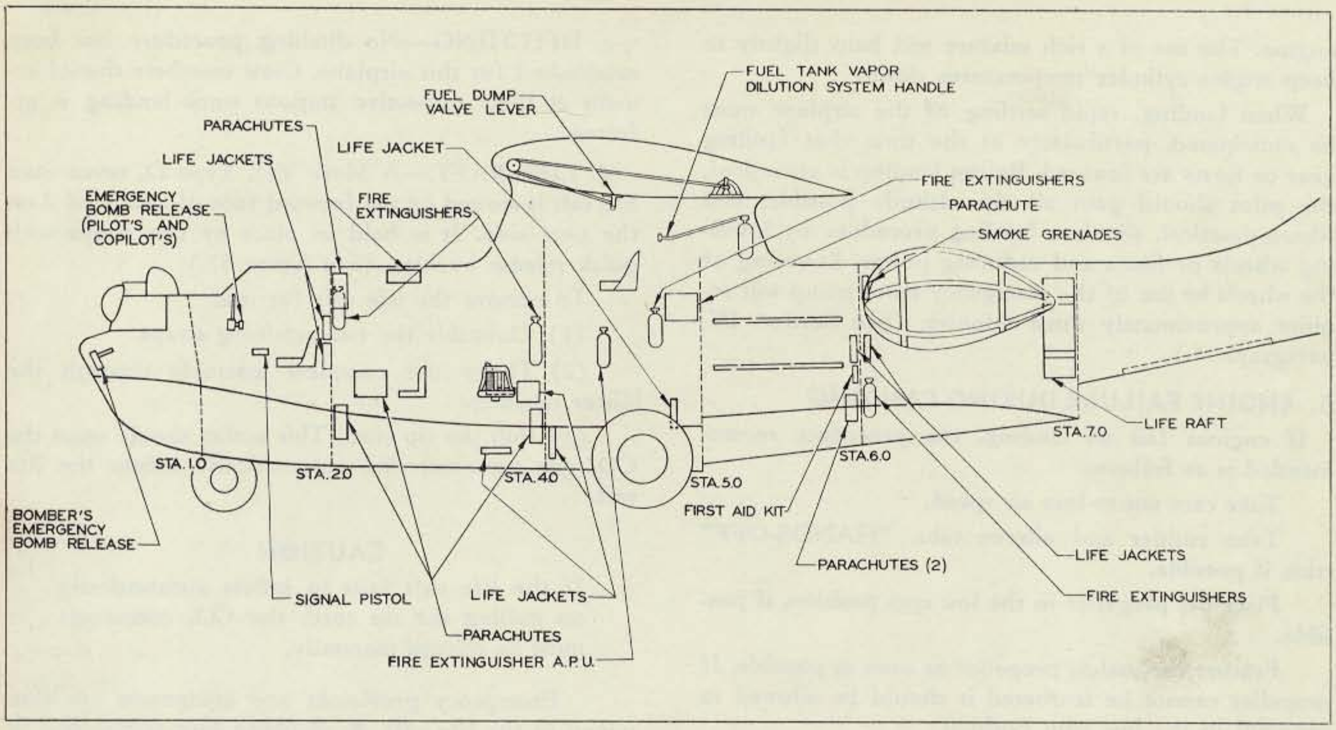
f. LIFE JACKETS AND PARACHUTES. *(See figure 37.)*

(1) LIFE JACKETS.—Eight life jackets are located in the airplane at the following positions:

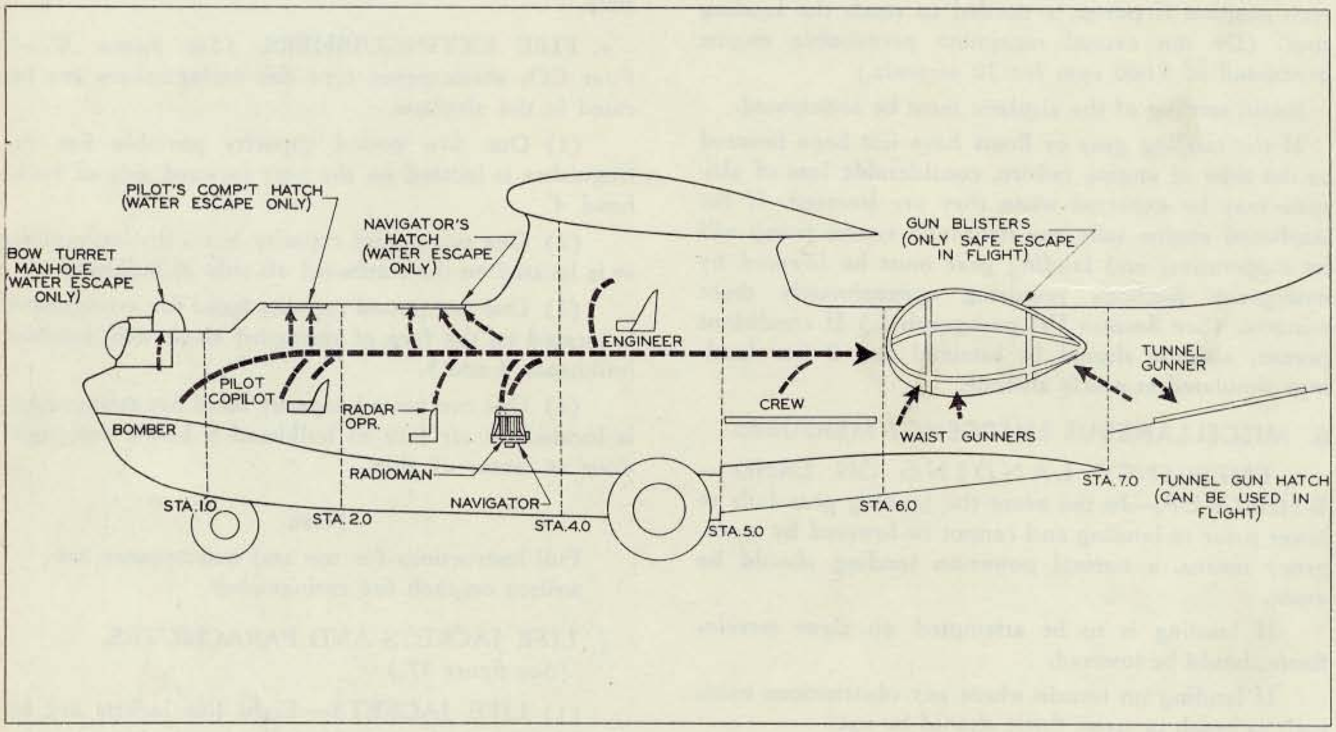
(a) One on the forward port face of bulkhead 6 and one on the aft port face of bulkhead 6.

(b) One on the aft face of bulkhead 4 at the center of the airplane below the watertight door.

(c) Two on the forward starboard face of bulkhead 2 behind the copilot's seat.



Emergency Equipment Locations



Emergency Escape Routes

Figure 37—Emergency Equipment and Escape Routes

(d) One on the bottom of the airplane forward of bulkhead 4 on the starboard side.

(e) One on the forward side of the aft food locker, which is on the forward starboard side of bulkhead 5.

(f) One attached to the door of the radio operator's locker, located forward of bulkhead 4.

(2) PARACHUTES.—Eight parachutes are located in the airplane at the following positions:

(a) Two on forward face of bulkhead 6 near the floor; one on the port and one on the starboard side.

(b) One between bulkheads 4 and 5 on shear web, starboard side, near the top.

(c) One on forward face of bulkhead 4 at center line of ship below watertight door.

(d) One forward of beltframe 3.0 on port side at top of airplane.

(e) Two on the aft face of bulkhead 2 at center of ship; one is above the watertight bulkhead door and one below.

(f) One on the forward inboard edge of the navigator's table.

(3) ASSIGNMENT OF LIFE JACKETS AND PARACHUTES.—Each member of the crew should be assigned a certain life jacket and parachute, and shown their locations before flight, to prevent confusion in case of emergency.

g. FIRST AID KIT.—The first aid kit is located on the upper forward port side of bulkhead 6. Complete instructions for use of contents are contained inside the kit. Check to see that the seal on the kit has not been broken.

h. BILGE AND REFUELING PUMP.—A combination bilge and refueling pump is stowed on the hull bottom between beltframe 5.75 and bulkhead 6, on the starboard side of the ship.

(1) BUAER SERIAL NOS. 46639-46698 INCL., 46724.—The unit installed on this block of airplanes consists of two pumps, (one for fuel and one for bilge water) and an electric motor.

(a) To operate as a refueling unit proceed as follows:

1. Remove unit from its stowage and plug electrical cable into any convenient utility receptacle.

2. Attach fuel hose (nozzle section) to fuel pump outlet. The fuel pump is located by an arrow on control housing. Attach second length of fuel hose to fuel pump inlet.

3. Pull control handle out and over to refueling pump side.

4. With pump and hose in refueling position, start pump by moving push rod switch, located at the base of the electric lead-in box, to "ON" position.

(b) To use the unit as a bilge pump proceed as follows:

1. Remove unit from its stowage and plug electrical cable into any convenient utility receptacle.

2. Attach water hose to bilge pump outlet. The bilge pump is located by an arrow on control housing. Attach second length of water hose to bilge pump inlet.

3. Cock control handle toward bilge pump before starting motor.

4. With pump and hose in bilging position, start pump by moving push rod switch, located at the base of the electric lead-in box, to "ON" position.

Capacity of refueling pump is 1500 gallons per hour, and of bilge pump is 840 gallons per hour.

(2) BUAER SERIAL NOS. 63993 AND ON.—The latest bilge and refueling pump consists of a combination pump and electric motor. A suction hose and a discharge hose come with the unit.

(a) With the discharge hose attached to the "OUT" port and the suction hose attached to the "IN" port of the unit, operate as a fuel pump as follows:

1. Statically ground the suction hose, the unit, and the discharge hose.

2. Prime the pump with two quarts of fuel thru the discharge port and then connect the discharge hose.

3. Attach one connector of the electric cable assembly to the unit, plug the other into the proper airplane receptacle and open the nozzle to the first position. As flow starts the nozzle may be fully opened.

(b) To use the unit as a bilge pump proceed as follows:

1. Remove the strainer in the nozzle tube.

2. Proceed as instructed above for fueling.

3. After use, remove and clean suction strainer assembly and clean and flush unit.

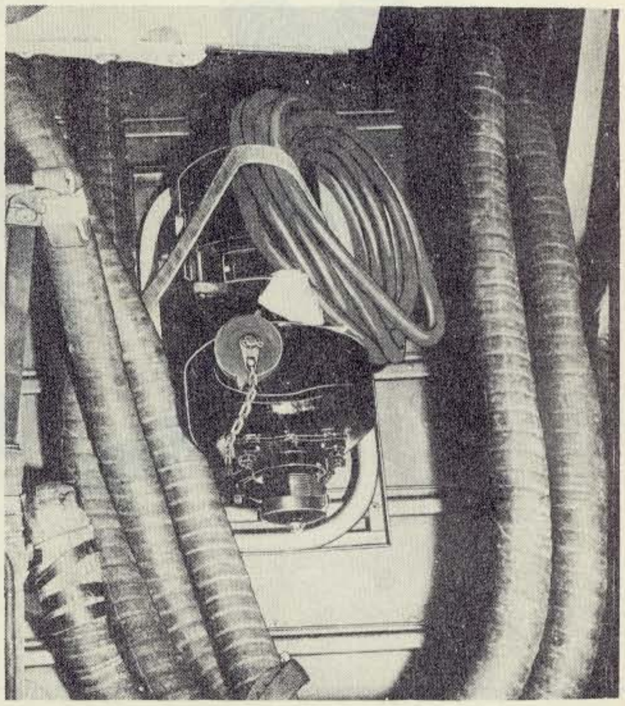


Figure 38—Bilge and Refueling Pump

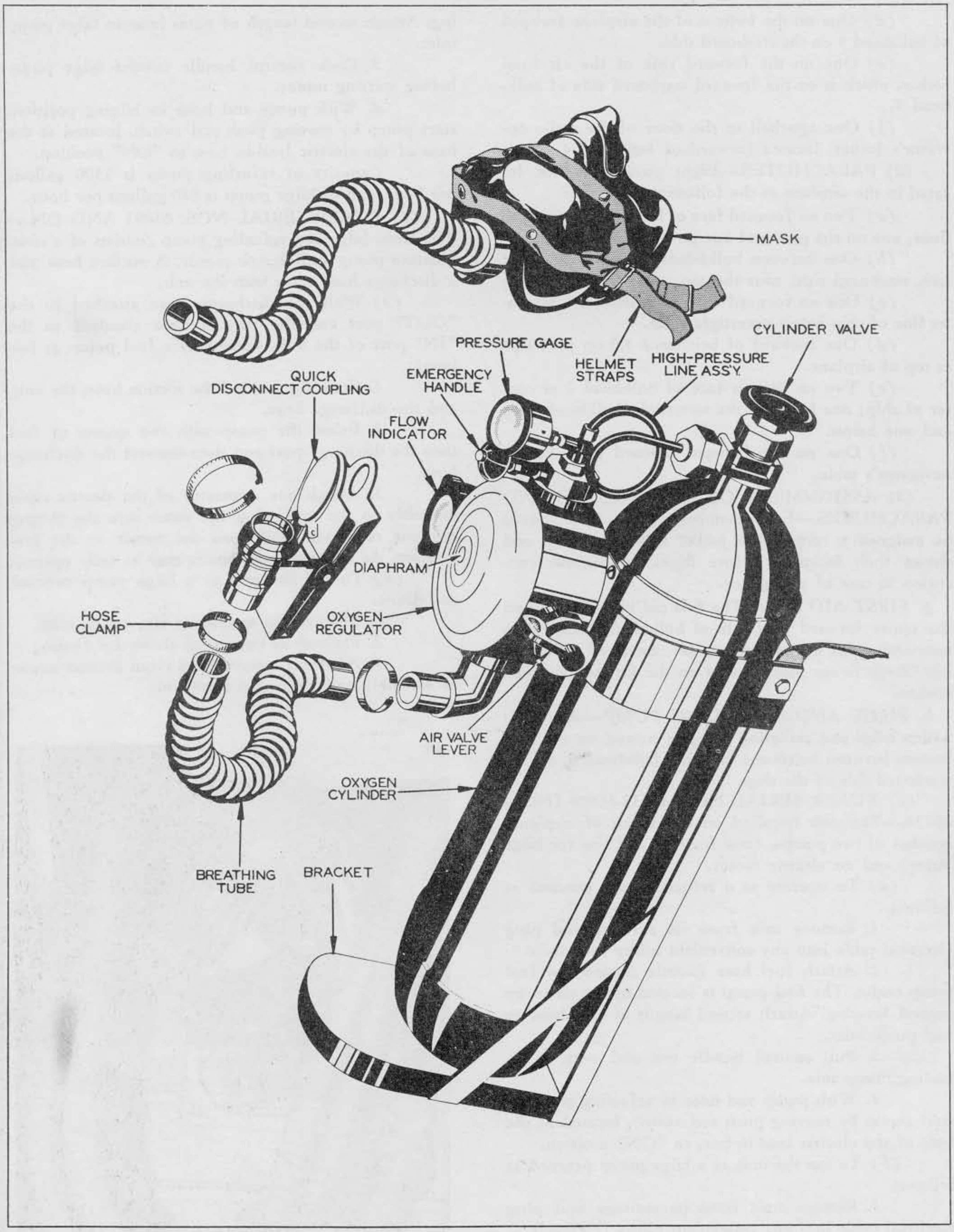
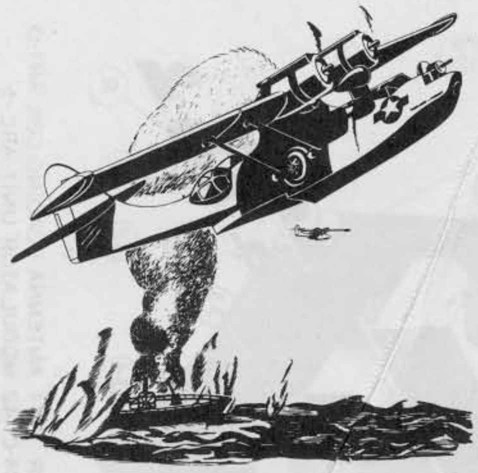


Figure 39—Diluter—Demand Oxygen Equipment—Portable Type



SECTION V
OPERATIONAL EQUIPMENT

1. REMOTE COMPARTMENTS.

a. Bomber's Compartment.

b. Engineer's Compartment.

c. Controls in Radio Operator-Navigator's Compartment.

d. Crew's Quarters.

e. Waist Gun Compartment.

f. Tail Compartment.

2. OPERATION OF OXYGEN EQUIPMENT.

(See figure 39.)

This airplane carries two portable individual supply type diluter-demand oxygen units, which have their own integral supply system, oxygen regulators and flow indicators. Mountings for these units are placed at the pilot's, co-pilot's and engineer's stations. The units may be carried to the various parts of the airplane as required.

CHECK LIST

This check list is to be used prior to take-off whenever there may be a possibility of flight to oxygen altitudes.

a. Close emergency valve.

b. Open cylinder valve, allowing at least 10 seconds for pressure in line to equalize. Pressure gage should read 1800 $\pm$ 50 pounds per square inch if the cylinder is fully charged.

c. Close cylinder valve after a few minutes, observe pressure gage and simultaneously open cylinder valve. If gage pointer jumps, leakage is indicated.

d. If leakage is indicated, test further. Open cylinder valve, carefully noting pressure gage reading, then close cylinder valve. If gage pointer drops more than 100 pounds per square inch in five minutes, there is excessive leakage and the unit must be repaired prior to use.

e. Check mask fit by placing thumb over end of mask tube and inhale lightly. If there is no leakage, mask will adhere tightly to face due to suction created. If mask leaks, tighten mask suspension straps and adjust nose wire.

WARNING

Do not use mask that leaks.

f. Couple mask securely to breathing tube by means of quick-disconnect coupling.

CAUTION

Mating parts of coupling must be fully engaged, and not "cocked."

g. Open cylinder valve. Depress diaphragm knob through hole in center of regulator case, and feel flow of oxygen into the mask; then release diaphragm knob. Breathe several times, observing oxygen flow indicator for "blink", verifying the positive flow of oxygen.

Note

Since the amount of added oxygen is very small at sea level, the oxygen flow indicator may not operate while the plane is on the ground. In this case, turn air-valve to "OFF" or to "ONE-HUNDRED PER CENT OXYGEN", and test again. If oxygen flow indicator operation is now satisfactory, re-set air-valve to "ON" or "NORMAL OXYGEN", in which setting adequate oxygen flow and "blinker" operation will be assured at oxygen use altitudes.

h. Check emergency valve by turning counterclockwise slowly until oxygen flows vigorously into mask, then close emergency valve.

OPERATING INSTRUCTIONS

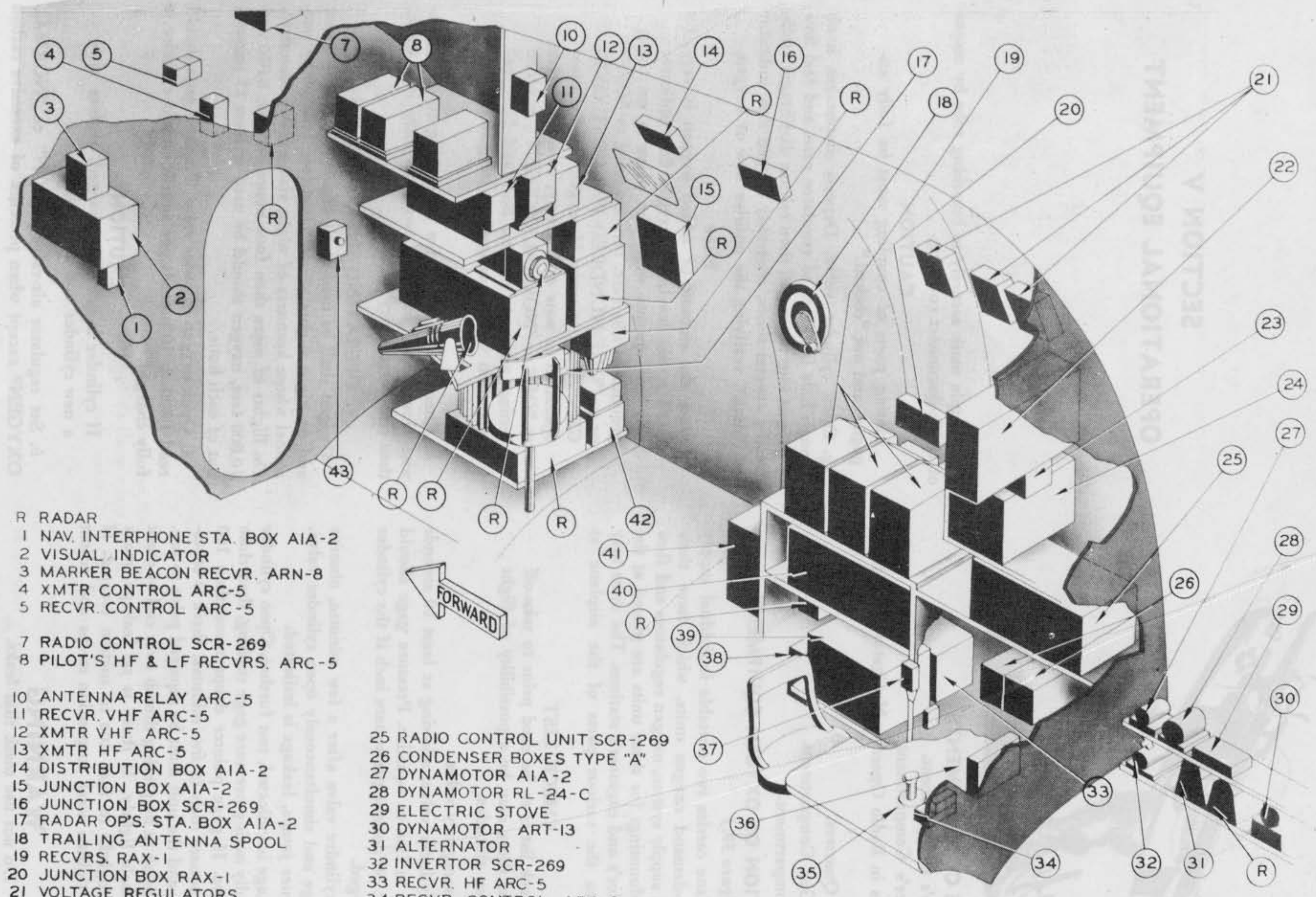
Oxygen shall be used at all flights above 10,000 feet and on night flights above 5,000 feet (except by personnel whose keenness of night vision is not essential). On flights of more than four hours between 8,000 and 10,000 feet, oxygen should be used at least 15 minutes out of each hour.

a. Open oxygen cylinder valve. Pressure gage should read 1,800 $\pm$ 50 pounds per square inch if cylinder is fully charged.

CAUTION

If cylinder is not fully charged, replace with a new cylinder and re-check.

b. Set regulator air-valve to "ON" or "NORMAL OXYGEN" except when presence of excessive carbon



R RADAR
1 NAV. INTERPHONE STA. BOX AIA-2
2 VISUAL INDICATOR
3 MARKER BEACON RECVR. ARN-8
4 XMTR CONTROL ARC-5
5 RECVR. CONTROL ARC-5

7 RADIO CONTROL SCR-269
8 PILOT'S HF & LF RECVRS. ARC-5

10 ANTENNA RELAY ARC-5
11 RECVR. VHF ARC-5
12 XMTR VHF ARC-5
13 XMTR HF ARC-5
14 DISTRIBUTION BOX AIA-2
15 JUNCTION BOX AIA-2
16 JUNCTION BOX SCR-269
17 RADAR OP'S. STA. BOX AIA-2
18 TRAILING ANTENNA SPOOL
19 RECVRS. RAX-1
20 JUNCTION BOX RAX-1
21 VOLTAGE REGULATORS
22 MAIN DISTRIBUTION PANEL
23 RADIO OP'S POWER & SWITCH BOX
24 FREQUENCY INDICATOR LM-14
25 RADIO CONTROL UNIT SCR-269
26 CONDENSER BOXES TYPE "A"
27 DYNAMOTOR AIA-2
28 DYNAMOTOR RL-24-C
29 ELECTRIC STOVE
30 DYNAMOTOR ART-13
31 ALTERNATOR
32 INVERTOR SCR-269
33 RECVR. HF ARC-5
34 RECVR. CONTROL ARC-5
35 XMTR KEY ART-13
36 RADIO OP'S. CONTROL BOX AIA-2
37 INTERPHONE BOX ARC-5
38 ANTENNA SHUNT CAPICATOR
39 INTERPHONE AMPLIFIER RL-24-C
40 XMTR ART-13
41 ANTENNA LOADING COIL ART-13
42 MODULATOR UNIT ARC-5
43 PILOT'S RADIO POWER BOX

Figure 40—Radio Equipment in Radio Operator's Compartment

monoxide is suspected, then set to "OFF" or "100 PER CENT OXYGEN."

c. Put on oxygen mask and couple securely to breathing tube by means of quick-disconnect coupling.

CAUTION

Be sure that quick-disconnect coupling is fully engaged.

d. Check mask fit as outlined in "Check List" by squeezing mask tube.

CAUTION

Never check mask fit by squeezing mask tube while Emergency Valve is "ON."

e. Depress diaphragm knob through hole in center of regulator case and feel flow of oxygen into mask; then release diaphragm knob. Breathe several times, observing oxygen flow indicator (if installed) for "blink," which verifies the positive flow of oxygen.

Note

Do not use oxygen supply below 300 pounds per square inch, except in an emergency.

f. Upon completion of oxygen usage, close cylinder valve.

WARNING

Use emergency valve only if regulator becomes inoperative or anoxia is suspected.

3. OPERATION OF COMMUNICATION EQUIPMENT.

a. GENERAL.—The radio navigation, communication, and other electronic equipment installed in the PBY-6A airplane consists of the following equipment:

EQUIPMENT	PURPOSE
AN/ARC-5 (Pilot Controlled)	Provides: Reception on tunable LF range and MHF receivers; reception on pre-tuned VHF command receiver transmission on pre-tuned MHF and VHF transmitters: In addition three MHF alternate transmitter units are provided in storage racks.
SCR 269F/G (Pilot Controlled)	Automatic Radio Compass provides aural and visual indications.
AN/ARN-8 (Pilot Controlled)	Marker Beacon receiver, provides aural and visual indications.
AN/AIA-2 (Pilot and Radioman Controlled)	Provides audio distribution and control of receiver outputs and transmitter sidetone.
RAX-1 (Radioman Controlled)	Provides LF-MHF-HF liaison reception.
AN-ARC-5 (Radioman Controlled)	Provides tunable MHF reception—for emergency or special use.
AN/ART-13 (ATC) (Radioman Controlled)	Provides pre-tuned LF-MHF-HF high power liaison transmission.
LM-14 (Radioman Controlled)	Frequency meter; provides means of checking frequency of radio signals.
AN/APN-1 (Pilot Controlled)	Provides direct indication of altitude.

Note

Provisions have been made for the following types of radar equipment: AN/APX-2, AN/APS-3 and ABA-1 as an alternate for AN/APX-2.

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. Do not change tubes or make adjustments inside equipment with the high voltage on, etc.

The equipment is located as follows: *(See figures 40 and 41.)*

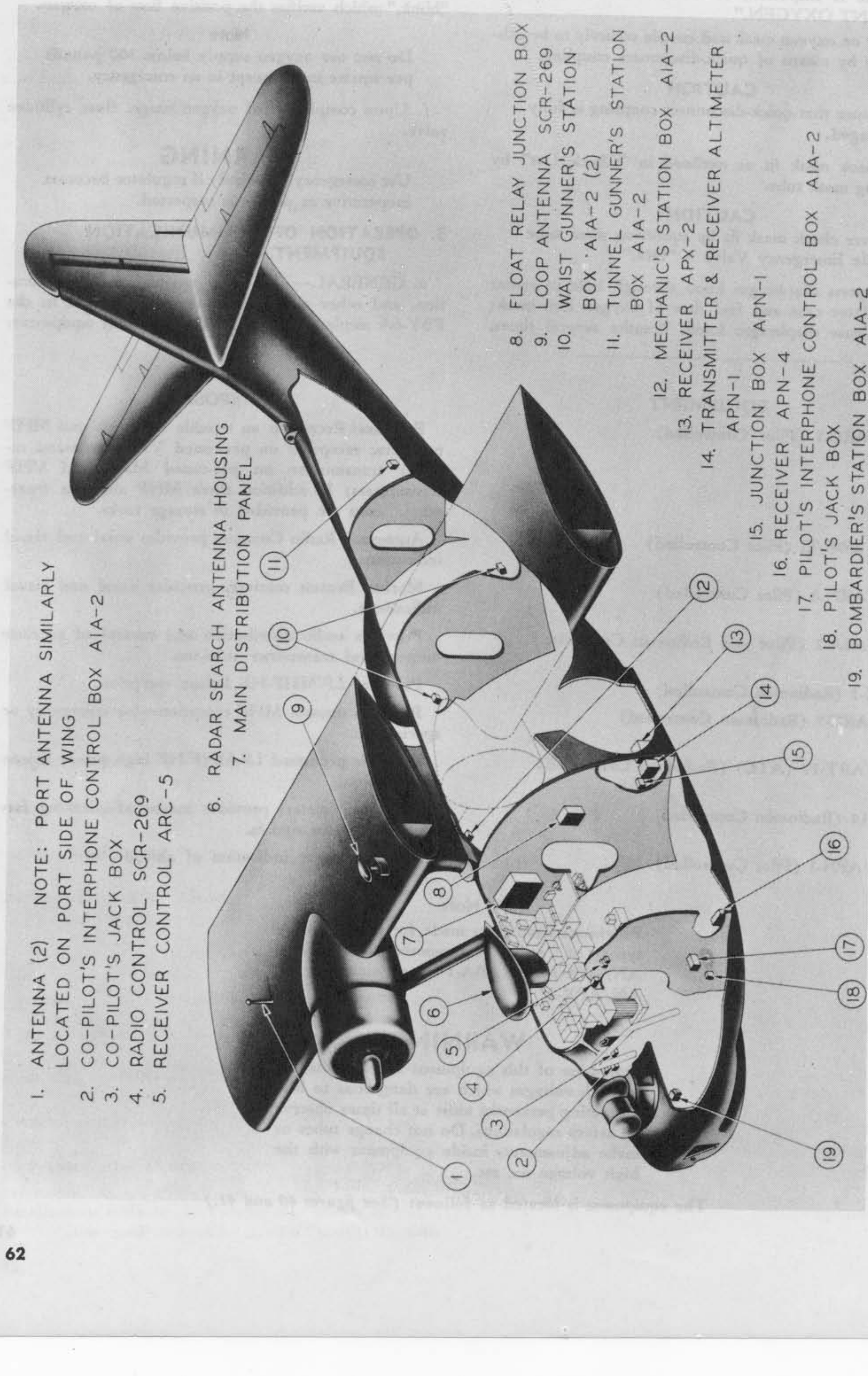


Figure 41—Radio Equipment Outside of Radio Operator's Compartment

AN/ARC-5 COMMAND EQUIPMENT

EQUIPMENT	LOCATION
.19 to 9.1 Megacycle Receivers.	One (.19-.55) megacycle receiver and one (3-6) megacycle receiver located on the aft starboard side of bulkhead 2 over radar operator's rack. Both are located on the forward part of the rack. One (3-6) megacycle receiver located outboard of the interphone amplifier on lower portion of radio operator's rack. Three additional (.19-.55), (1.3-3), and (6-9.1) megacycle receivers stowed on rack on top of the food locker, which is forward of bulkhead 5 on the starboard side of the airplane.
2.1 to 9.1 Megacycle Transmitters.	One (3-4) megacycle transmitter located on the top and outboard part of the radar operator's rack. Four additional (2.1-3) (4-5.3) (5.3-7), and (7-9.1) megacycle transmitters stowed aft of bulkhead 4 under the rack which contains the dynamotors.
Very High Frequency (VHF) Transmitter and Receiver.	Located on top of the radar operator's rack. The receiver located in inboard position and the transmitter located adjacent to and outboard of the receiver.
Transmitter Control Box for VHF and (2.1-9.1) Megacycle Transmitters.	Located on the forward face of bulkhead 2 above the pilot's switch panel and on the center line of the airplane.
Receiver Control Boxes for (.19-9.1) Megacycle Receivers.	Two receiver control boxes located directly over the pilot's seat on the port side of the fast feathering switches. The control for the receiver on the radio operator's rack is located on the forward face of bulkhead 4 under the main distribution panel and inboard of the radio power junction box.
Modulator and Dynamotor.	On the starboard side between bulkhead 2 and station 2.5 near the skin line and just above the chine.
Antenna Relay Unit.	On the aft side of the channel which hangs from beltframe 2.5 over the radar operator's station. This channel supports the aft end of the rack which supports the low frequency receivers.
Jack Boxes.	One on the pilot's equipment panel beside the pilot's seat. One on the copilot's equipment panel beside the copilot's seat. One below the radio operator's table on the inboard face of the vertical angle which supports the table.

RAX-1 LIAISON RECEIVING EQUIPMENT

Receivers.	On top of the radio operator's rack.
Junction Box.	Outboard of the radio operator's rack between stations 3.33 and 3.66.

AN/ART-13 LIAISON TRANSMITTING EQUIPMENT

Transmitter.	Below RAX-1 liaison receivers on radio operator's rack.
Antenna Loading Coil.	Aft of bulkhead 3 and forward of radio operator's rack.
Antenna Shunt Capacitor.	On lower part of radio operator's rack, between antenna loading coil and station 3.33.
Dynamotor.	On aft end of dynamotor rack, which is on starboard side, aft of bulkhead 4.1, inboard of shear web.

RL-24C INTERPHONE AMPLIFIER

Amplifier.	On aft part of radio operator's rack, under the ART-13 transmitter.
Dynamotor.	Aft of AIA-2 dynamotor, on top of dynamotor rack.

AN/AIA-2 INTERPHONE DISTRIBUTION SYSTEM

Control Boxes.	Pilot's—On pilot's equipment panel.
	Copilot's—On copilot's equipment panel.
	Radio Operator's—Over radio operator's table, forward side of bulkhead 4.
Station Boxes.	Bombardier's—Starboard and forward of station 0.33.
	Navigator's—Over navigator's table and on lower aft part of rack which supports AN/APN-4 indicator.
	Radar Operator's—Lower aft part of radar operator's table, outboard of sliding writing table.
	Engineer's—Port side of compartment opposite engineer's seat.
	Port Waist Gunner's—Under longeron which runs fore and aft under blister approximately 12 inches forward of the gun post.
	Starboard Waist Gunner's—Same as port waist gunner's only on starboard side.
	Tunnel Gunner's—Port side, forward of station 7.5, outboard and slightly aft of flare release tube.
Junction Box.	Between station 2.5 and bulkhead 3 on starboard side, forward of radio operator's rack and below the window.
Dynamotor.	Top forward position on dynamotor rack.
Interphone Distribution Box.	Starboard and forward of bulkhead 3 over radar operator's seat.

AN/ARN-8 NAVIGATIONAL EQUIPMENT

Receiver.	Above navigator's visual indicator on the rack aft of bulkhead 2, above navigator's table.
Indicator Light.	Above automatic pilot controls and below and between the manifold pressure gages on pilot's instrument panel.

AN/APN-4 NAVIGATIONAL EQUIPMENT

Receiver.	Port side under navigator's table, just forward of station 2.5.
Visual Indicator.	Over the navigator's table, under the AN/ARN-8 receiver.

SCR-269F/G NAVIGATIONAL EQUIPMENT

Receiver.	On top aft section of radio operator's rack, forward of bulkhead 4 and outboard of main distribution panel.
Control Box.	Over the copilot's seat forward of copilot's projector light and outboard of fast feathering switches.
Indicator.	On pilot's instrument panel (on port side) above vacuum control valve.
Junction Box.	Above and outboard of radio operator's rack and aft of station 3.33.
Inverter.	On forward part of dynamotor rack under AIA-2 and RL-24C dynamotors.

AN/APN-1 NAVIGATIONAL EQUIPMENT

Transmitter-Receiver.	**Aft of bulkhead 4 on port side of airplane on a bracket built up from bottom of airplane.**
Power Junction Box.	**Aft side of bulkhead 4 between bulkhead 4 and the transmitter-receiver.**
Indicator Lights.	**Starboard side of automatic pilot controls on pilot's instrument panel.**
Selector Switch.	**Starboard side of pilot's instrument panel inboard of landing gear warning lights and between turn and bank indicator and hydraulic pressure gage.**
Indicator.	**Port side of pilot's instrument panel, outboard and slightly above remote compass indicator, inboard and above vacuum control valve.**

LM-14 FREQUENCY METER

LM-14 Frequency Meter.	**On rack forward and outboard of main distribution panel and above radio operator's rack.**

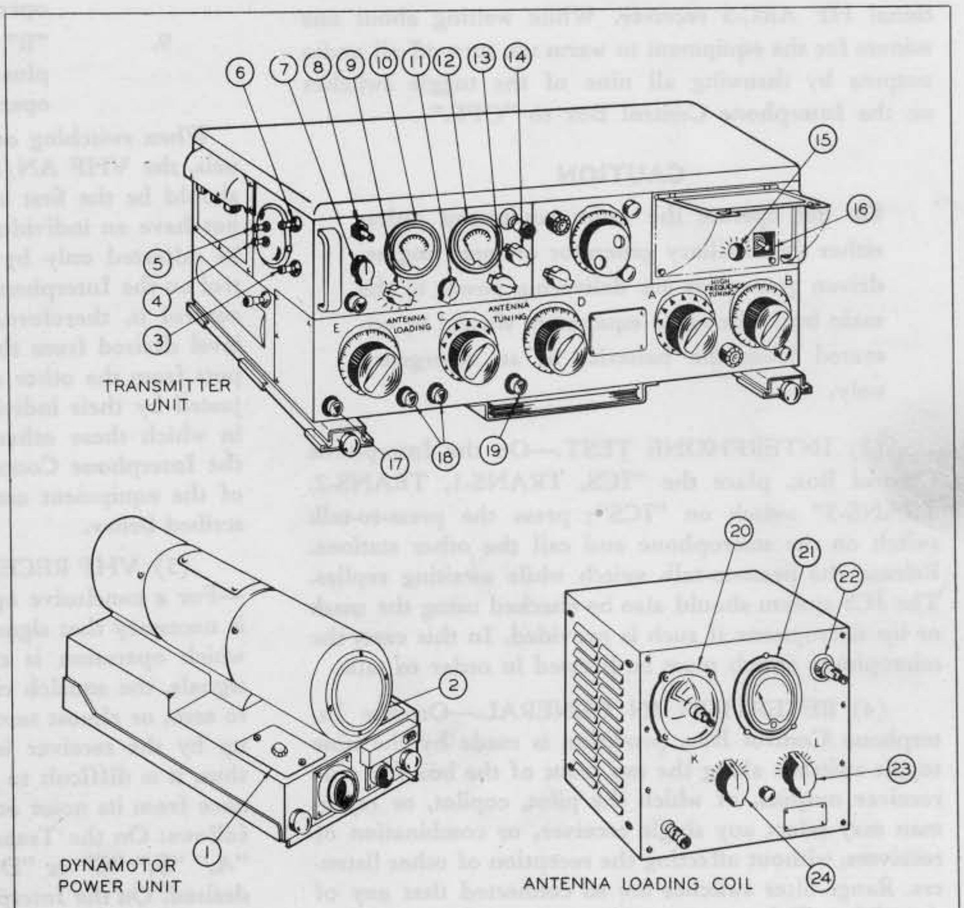


Figure 42—
AN/ART-13 Transmitter

1. Dynamotor Reset
2. Transmitter Reset
3. Loading Coil
4. Cone Terminal
5. Antenna Terminal
6. Antenna Receiver
7. Local Remote Switch
8. Test Switch
9. Channel Selector Switch
10. Antenna Ammeter
11. Meter Selector Switch
12. Volt-Ammeter
13. Power Level Switch
14. Emission Selector Switch
15. Side Tone Gain Control
16. Microphone Selector Switch
17. Keylock
18. Side Tone Jacks
19. Microphone Jack
20. Antenna Terminal
21. Antenna Ammeter
22. Transmitter Terminal
23. Control L
24. Control K

★ ★ ★

b. PILOT'S AND COPILOT'S OPERATING INSTRUCTIONS.

(1) UPON ENTERING COCKPIT.—Plug the headset into the phone extension cord leading to the Jack Box. Make certain that the microphone and headset plugs are fully engaged in the Jack Box. If the use of a mask or lip microphone is anticipated, connect either one to the mask microphone extension cord leading to the Jack Box.

(2) POWER FOR RADIO.—With only the Battery Switch on, power will be supplied to the ICS equipment and the ARN-8 Marker Beacon receiver. With the Battery Switch on, engines running, and generator charging, turn on the Pilot's Radio Master Switch. This supplies power to all additional pilot-operated equipment (ARC-5 and SCR-269-F or SCR-269-G). Meanwhile, the radioman will have turned on his Master Switch, which supplies power to the RAX-1 receivers, ART-13 (ATC) transmitter, and an additional HF ARC-5 receiver. While waiting about one minute for the equipment to warm up, turn off all audio outputs by throwing all nine of the toggle switches on the Interphone Control Box to "OFF."

CAUTION

Do not operate the radio equipment unless either the auxiliary generator or main engine-driven generators are delivering power to the main bus. The radio equipment should be operated from the batteries in an emergency only.

(3) INTERPHONE TEST.—On the Interphone Control Box, place the "ICS, TRANS-1, TRANS-2, TRANS-3" switch on "ICS"; press the press-to-talk switch on the microphone and call the other stations. Release the press-to-talk switch while awaiting replies. The ICS system should also be checked using the mask or lip microphone if such is provided. In this case, the microphone switch must be pressed in order to talk.

(4) RECEPTION IN GENERAL.—On the Interphone Control Box, provision is made by the nine toggle switches along the top front of the box for nine receiver outputs, of which the pilot, copilot, or radioman may select any single receiver, or combination of receivers, without affecting the reception of other listeners. Range-filter switches are so connected that any of the above flight crew members may select RANGE, VOICE, or BOTH from either of two range frequency receivers without affecting other crew members. To select any receiver, the pilot, copilot, or radioman has only to turn on the switch associated with that receiver. If either the LF ARC-5 Receiver or the SCR-269-F/G Receiver is selected, he may then use the range-filter switch to select RANGE, VOICE, or BOTH. The following table gives the outputs controlled by each of the nine switches.

SWITCH NO. (left to right)	EQUIPMENT OUTPUT
1.	LF AN/ARC-5 with range filter—pilot tuned.
2.	SCR-269-F/G Radio Compass with range filter—pilot tuned.
3.	AN/ARN-8 Marker Beacon Receiver —no tuning required.
4.	HF AN/ARC-5 plus transmitter sidetone—pilot tuned.
5.	Not used.
6.	HF AN/ARC-5—radio operator tuned.
7.	VHF AN/ARC-5 plus transmitter sidetone—pilot tuned.
8.	"A" channel from RAX-1 Receivers plus ART-13 (ATC) sidetone—radio operator tuned.
9.	"B" channel from RAX-1 Receivers plus ART-13 (ATC) sidetone—radio operator tuned.

When switching on one or more of the above channels, the VHF AN/ARC-5 equipment (Switch No. 7) should be the first to be set up. This equipment does not have an individual volume control. Its output can be adjusted only by means of the "VOLUME" control on the Interphone Control Box. The setting of this control is, therefore, governed entirely by the audio level desired from the VHF Receiver. The audio outputs from the other equipment must necessarily be adjusted by their individual volume controls. The order in which these other equipments are switched on at the Interphone Control Box is not important. Tuning of the equipment associated with each receiver is described below.

(5) VHF RECEIVER (VHF UNIT OF ARC-5).—For a conclusive operating test of the equipment, it is necessary that signals be present on the channels on which operation is contemplated. In the absence of signals, the squelch circuit reduces the receiver output to zero, or almost zero, so that most of the noise picked up by the receiver is not passed to the headphones; thus, it is difficult to properly gauge receiver performance from its noise output. The tuning procedure is as follows: On the Transmitter Control Box, push button "A," "B," "C" or "D" according to the VHF channel desired. On the Interphone Control Box turn on Switch No. 7. Advance the "VOLUME" control for normal reception if a signal is present. It is good practice to set high for good operation of the rest of the equipment. If a signal is not present, push one of the other "A," "B," "C," or "D" buttons to obtain a channel on which a signal is present in order to check receiver operation and to adjust the "VOLUME" control. Allow six seconds for the channel shifting mechanism to op-

erate, after pushing the button, before attempting to check reception. If no signals can be heard on any of the VHF channels, set the "VOLUME" control at maximum (full clockwise). Turn off Switch No. 7 on the Interphone Control Box and set up the remaining receivers on which reception is contemplated.

(6) RANGE RECEIVER (LF UNIT OF ARC-5).—On the Interphone Control Box, turn on switch No. 1. Throw the "RANGE, BOTH, VOICE" switch to "BOTH." On the LF Receiver Control Box, throw the "CW-VOICE" switch to "VOICE." Advance the "SENSITIVITY" control until normal background noise is heard. Tune in the desired station and re-adjust the "SENSITIVITY" control for normal operation. Normally, CW reception will not be used on this receiver, but weak signals can be found more readily if the "CW-VOICE" switch is thrown to "CW" during the search. The switch should be thrown to "VOICE" for actual reception. For radio-range flying, the "SENSITIVITY" control should be set to the minimum value required for reception in order to avoid an incorrect course indication. When voice reception only is desired from the range station, the "RANGE, BOTH, VOICE" switch on the Interphone Control Box may be set on "VOICE." For all other signals this switch may be left on "BOTH." The "RANGE" position of the switch is available for complete elimination of voice signals, if desired. When satisfied with operation, turn off switch No. 1 on the Interphone Control Box.

(7) AUTOMATIC RADIO COMPASS (SCR-269F or SCR-269-G).

(a) PRELIMINARY TUNING.—On the Interphone Control Box, turn on switch No. 2. Tune the "RANGE-BOTH-VOICE" switch to "BOTH." On the Radio Compass Control Box, set the "OFF-COMP-ANT-LOOP" switch to "ANT."

Note

When first tuning for a station always use the "ANT" position because when the equipment is on "COMP" position, the automatic volume control is in the circuit and it is difficult to tune accurately for maximum signal intensity by sound or by use of the tuning meter. Preliminary tuning on the "LOOP" is also undesirable, because the loop may be in the null position with reference to the desired station and the station may not be heard at all.

Turn the band selector control to the desired frequency band. Tune in the desired station by means of the "TUNING" crank and rotate back and forth for maximum deflection of the tuning meter and preferably for maximum signal strength to make sure that the desired station is properly tuned in. If the tuning meter fluctuates (as on range stations), disregard it and tune for maximum signal strength. Listen for station identification to be sure the correct station is being received. (For aural identification of CW signals, the "CW-VOICE" switch on the Radio Compass Receiver in the Radio Operator's compartment should be thrown to "CW".) Upon completion of preliminary tuning, the following types of operation may be utilized:

(b) AUTOMATIC DIRECTION FINDING AND HOMING.—Upon completion of preliminary tuning, turn the "OFF-COMP-ANT-LOOP" switch to "COMP." Adjust the "AUDIO" control on the Radio Compass Control Box for satisfactory volume.

Note

Occasionally, the azimuth needle of the Radio Compass Bearing Indicator (located on pilot's instrument panel) will spin violently when the "OFF-COMP-ANT-LOOP" switch is turned to "COMP." When this occurs, immediately switch to the "ANT" position and wait for the needle to stop. Then turn back to "COMP." Repeat if necessary. Tuning to another station will have no effect since this rapid spinning is caused within the set itself. Loss of the phasing antenna will cause a relatively slow rotation of the needle. When this occurs, aural null procedure (operation on "LOOP") must be used.

When the Radio Compass is operating properly on "COMP," the Radio Compass Bearing Indicator needle indicates bearing of the station relative to the heading of the airplane. For homing, it is merely necessary to swing the plane until the needle is on zero. This type of operation will bring the plane to the radio station regardless of drift; but, if drift is present, the path will be a curved line. If the station being homed on is a range station, do not attempt to fly the range aurally at the same time because in the "COMP" position the automatic volume control is in operation and will cause a broad "on-course" aural indication.

(c) LOOP OPERATION.—Upon completion of preliminary tuning, turn the "OFF-COMP-ANT-LOOP" switch to "LOOP." By means of the "LOOP L-R" switch, rotate the loop to obtain a null (minimum signal). The loop may be rotated quickly or slowly depending on whether the "LOOP L-R" switch is depressed or not as it is turned to "L" or "R." It must be realized that a high signal heard in the headset provides a sharp null while a low signal results in a wide null. If the null is wide, advance the "VOLUME" control (clockwise). When the null has been narrowed as much as possible by use of the "VOLUME" control, the bearing can be closely determined by splitting the null width on the azimuth dial. The null can be determined by listening or by noting the dip in the tuning meter deflection.

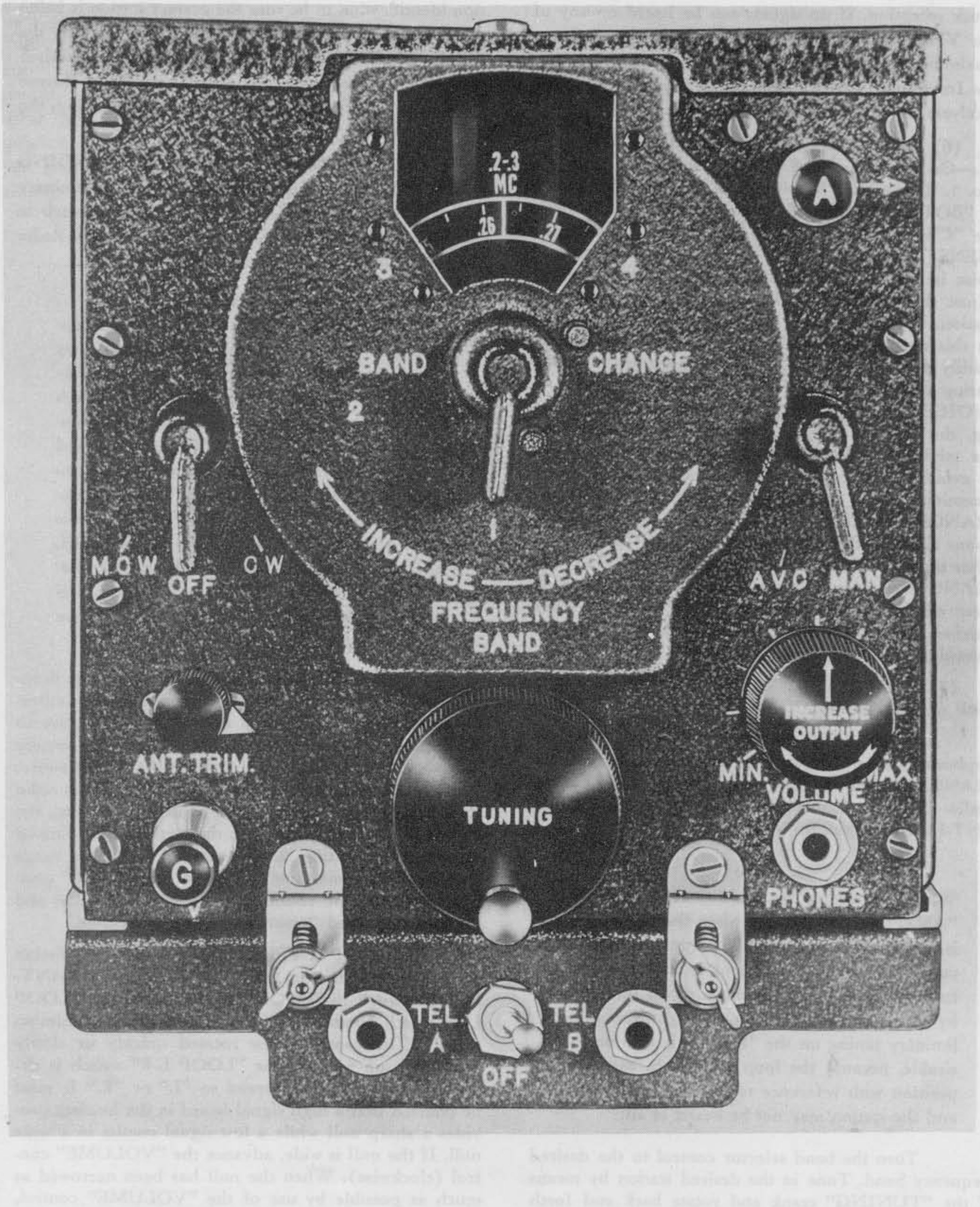


Figure 43—RAX-1 Receiver

CAUTION

The bearing obtained from the bearing indicator is subject to 180° ambiguity.

(*d*) RANGE AND GENERAL RECEPTION.—Tune in the signal as described in subparagraph (7), (*a*) above. In flying radio ranges, certain precautions must be taken. For the most reliable aural reception of radio range signals, retain the "OFF-COMP-ANT-LOOP" switch on "ANT." If precipitation static causes poor reception, turn the switch to "LOOP" and rotate the loop to the maximum signal position by use of the "LOOP L-R" switch. However, do not rely on the signals received on "LOOP" when near the station because the "A" and "N" are often reversed, and the cone of silence may be difficult to detect. Do not use "COMP" position as the automatic volume control is then in the circuit and will cause a broad "on-course" indication. Fades and builds of signal strength will be very difficult to detect on this position. A range filter is available for use on this receiver and is controlled by the "RANGE-BOTH-VOICE" switch on the Interphone Control Box.

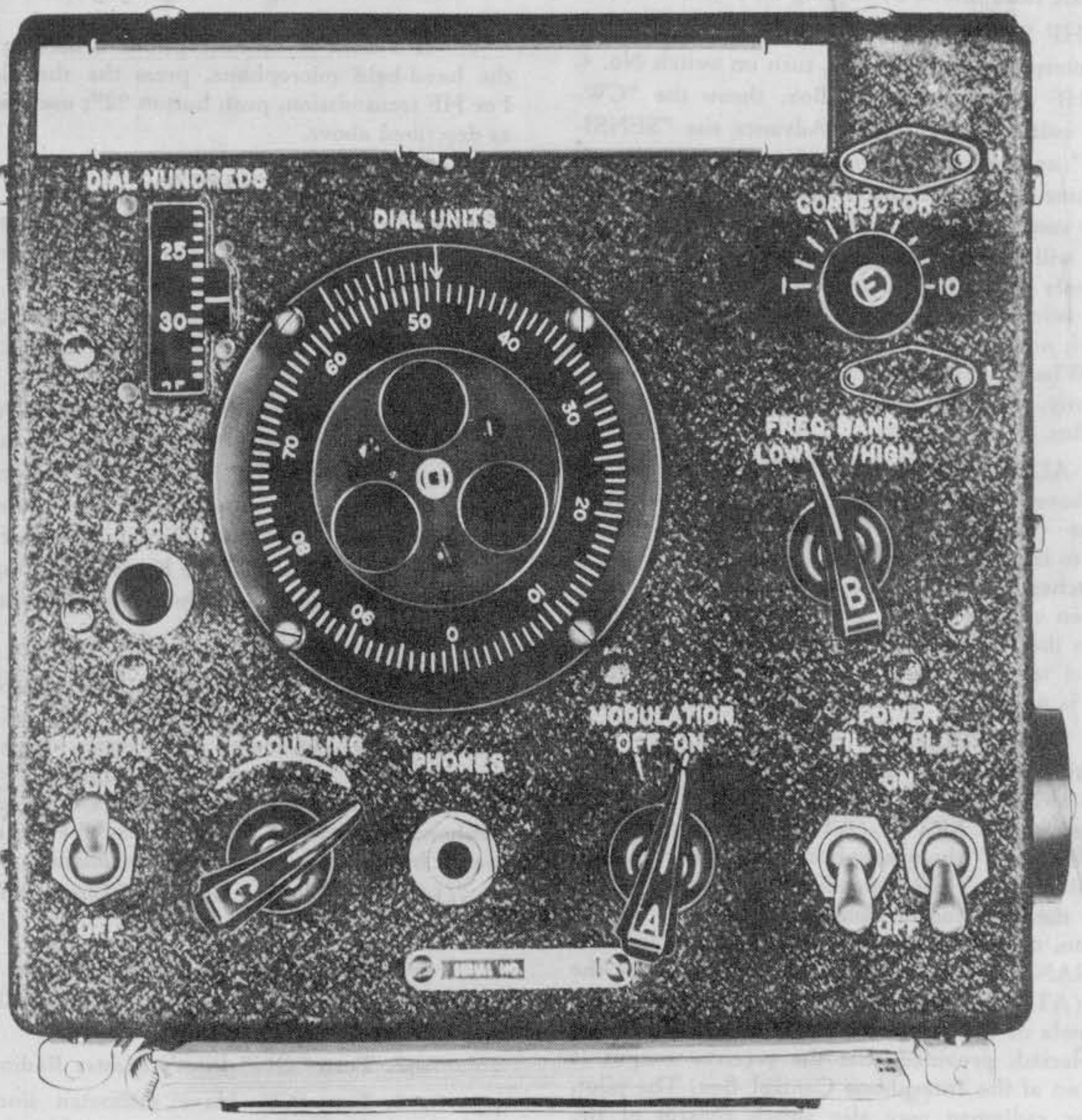


Figure 44—LM-14 Frequency Meter

(e) For more complete operating instructions on this equipment, see Instruction Book for Operation and Maintenance of Radio Compass SCR-269-F (AAF T.O. No. 08-10-110) or Handbook of Maintenance Instructions for Radio Compass SCR-269-G (AAF T.O. No. 08-10-175).

(f) When satisfied that the equipment is functioning satisfactorily, turn off switch No. 2 on the Interphone Control Box.

(8) MARKER BEACON RECEIVER.—No adjustments of this receiver are necessary by plane personnel. It operates the Marker Beacon Indicator light on the pilot's instrument panel, regardless of the position of Switch No. 3 on the Interphone Control Box. The audio output signal from this receiver may be heard in the headphones by turning on switch No. 3.

(9) HF RECEIVER (HF UNIT OF ARC-5).—On the Interphone Control Box, turn on switch No. 4. On the HF Receiver Control Box, throw the "CW-VOICE" switch to "VOICE." Advance the "SENSITIVITY" control until normal background noise is heard. Tune in the desired station and readjust the sensitivity control for normal operation. Normally, CW reception will not be used on this receiver, but weak voice signals can be found more readily if the "CW-VOICE" switch is thrown to "CW" during the search. The switch must be thrown to "VOICE" for actual reception. When satisfied that the receiver is operating satisfactorily, turn off switch No. 4 on the Interphone Control Box.

(10) ADDITIONAL CHANNELS.—In addition to the above facilities, three receiver channels from equipment tuned by the Radio Operator can be switched to the headphones at the Interphone Control Box. Switches No. 6, No. 8 and No. 9 provide reception on an additional HF ARC-5 Receiver, Channel "A" from the RAX-1 receivers and channel "B" from the RAX-1 receivers respectively. The tuning of these receivers is performed by the radio operator.

(11) TRANSMISSION IN GENERAL. — The four-position switch on the Interphone Control Box serves to switch the microphone to ICS, the ARC-5 equipment, or the ART-13 (ATC) equipment. In position "TRANS-1," the microphone controls the ARC-5 equipment HF or VHF depending on the channel selected by the Transmitter Control Box. On "TRANS-2" position, no transmitter is provided in this installation. "TRANS-3" position provides for control of the ART-13 (ATC) transmitter. Sidetone is provided thru the channels of the receiver associated with the transmitter selected, provided that the receiver output is switched on at the Interphone Control Box. The pilot, copilot, or radioman may also switch control of the VHF transmitter to members of the gun crew. To do this, he throws his "OFF-RADIO TURRET STATIONS" switch to "RADIO TURRET STATIONS." When the switch is thrown to this position, any member of either the flight or gun crew may use the VHF transmitter. With the switch thrown to "OFF," the gun crew is restricted to use of the interphone only.

(12) ARC-5 TRANSMISSION.—On the Interphone Control Box, place the four-position switch on "TRANS-1." On the Transmitter Control Unit, make sure the rotary switch is set on "VOICE." For VHF transmission, push buttons "A," "B," "C," or "D" to obtain the desired channel. Wait six seconds after operating pushbutton, then press the press-to-talk switch on the hand-held microphone and commence transmission.

WARNING

The instructions on all transmission are subject to local limitations regarding radio silence.

If a mask or lip microphone is used in place of the hand-held microphone, press the throttle switch. For HF transmission, push button "2"; use microphone as described above.

CAUTION

On the transmitter control box no button in the second row should be pushed within six seconds after pushing button "A," "B," "C" or "D." If this caution is not observed, the band selector motor will continue to run and dangerously overheat. A symptom of a continuously running motor is a "dead" VHF receiver. The motor may be stopped by pressing button "A," "B," "C," or "D." Button "3" should never be pushed because no radio transmission will take place in spite of the fact that sidetone will be heard. No transmitter is provided for this button in this installation.

(13) ART-13 (ATC) TRANSMISSION.—Operation of this transmitter requires the cooperation of the radio operator, who makes all necessary transmitter adjustments. The pilot then obtains control of the transmitter by placing the four-position switch on the Interphone Control Box on "TRANS-3." Press the press-to-talk button and commence transmission.

(14) The following Check-Off-List is provided for the pilots:

(a) BEFORE TAKE-OFF.

1. Plug in headset and mask or lip microphone if used.

2. Turn "ON" Pilot's Master Radio Switch.

3. Test ICS. Have radioman line up his equipment.

4. Set up VHF receiver first.

5. Set up remaining receiving equipment.

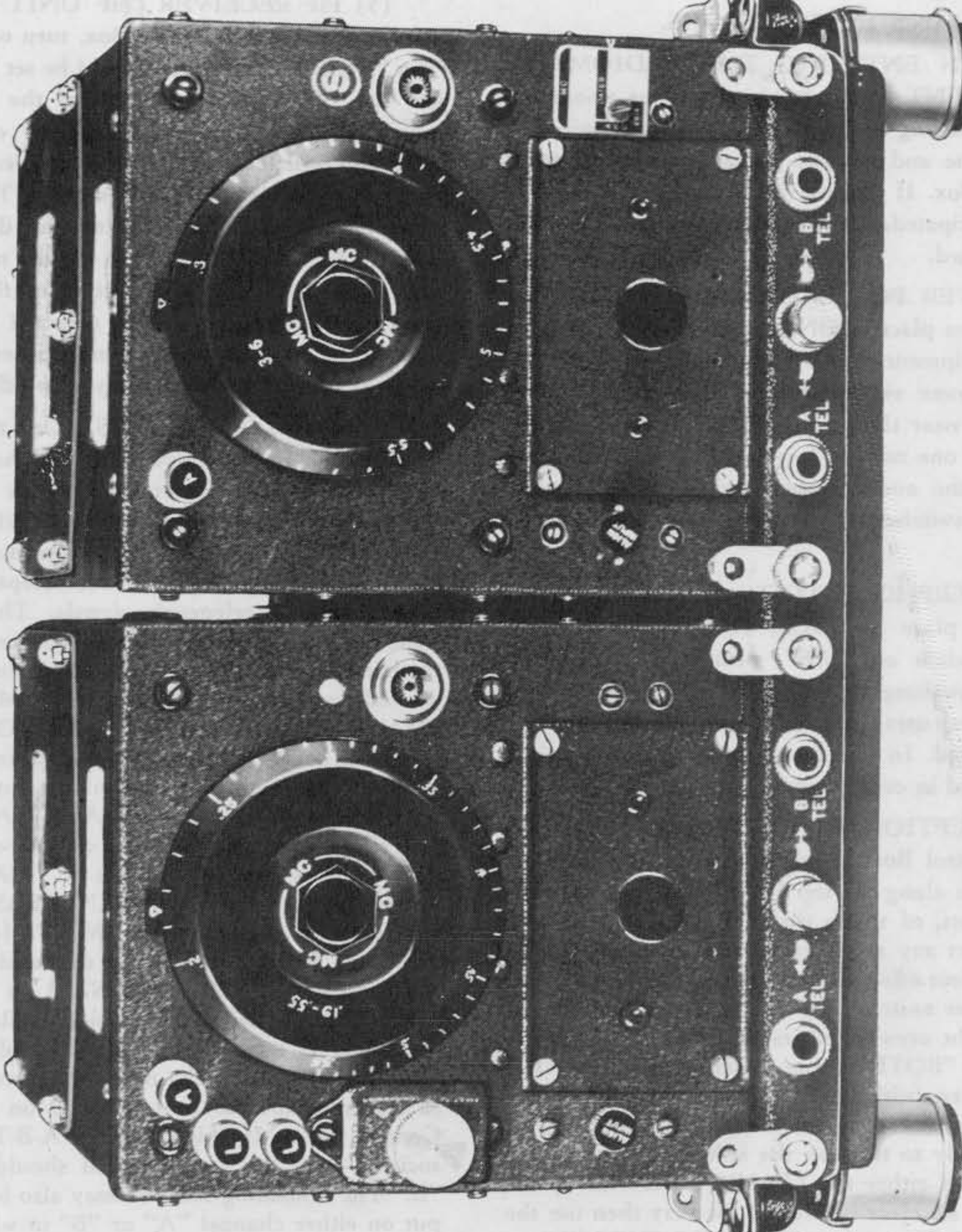


Figure 45—AN/ARC-5 Receiving Equipment

6. Each pilot should then select the channels he intends to use by means of the switches on his individual Interphone Control Box.

7. Set up transmitting equipment on channels most likely to be used.

(b) AFTER LANDING.—Turn "OFF" Radio Master Switch.

c. RADIOMAN'S INSTRUCTIONS.

(1) UPON ENTERING THE RADIOMAN'S COMPARTMENT.—Plug headset into the phone extension cord leading to the Jack Box. Make certain that the microphone and headset plugs are fully engaged in the Jack Box. If the use of a mask or lip microphone is anticipated, connect either one to the mask microphone cord.

(2) POWER FOR RADIO.—After the Battery switch has been placed "ON," power to the radioman controlled equipment will be supplied by turning "ON" the Radio Power switch located in the Radioman's compartment, near the main distribution panel. While waiting about one minute for the equipment to warm up, turn off the audio outputs by throwing all nine of the toggle switches on the Interphone Control Box to "OFF."

(3) INTERPHONE TEST.—On the Interphone Control Box, place the "ICS, TRANS-1, TRANS-2, TRANS-3" switch on "ICS"; press the press-to-talk switch while awaiting replies. The ICS system should also be checked using the mask or lip microphone if such is provided. In this case, the microphone switch must be pressed in order to talk.

(4) RECEPTION IN GENERAL.—On the Interphone Control Box, provision is made by the nine toggle switches along the top front of the box for nine receiver outputs, of which the pilot, copilot, or radioman may select any single receiver, or combination of receivers, without affecting the reception of other listeners. Range-filter switches are so connected that any of the above flight crew members may select "RANGE," "VOICE," or "BOTH" from either of two range frequency receivers without affecting other crew members. To select any receiver, the pilot, copilot, or radioman has only to turn on the switch associated with that receiver. If either the LF ARC-5 Receiver or the SCR-269-F/G Receiver is selected, he may then use the range-filter switch to select "RANGE," "VOICE," or "BOTH."

When switching on one or more of the channels, the VHF AN/ARC-5 equipment (Switch No. 7) should be the first to be set up. This equipment does not have an individual volume control. Its output can be adjusted only by means of the "VOLUME" control on the Interphone Control Box. The setting of this control is, therefore, governed entirely by the audio level desired from the VHF Receiver. The audio outputs from the other equipment must necessarily be adjusted by their individual volume controls. The order in which these other equipments are switched on at the Interphone Control Box is not important. Tuning of the equipment associated with each receiver is described below:

(5) HF RECEIVER (HF UNIT OF ARC-5).—On the Interphone Control Box, turn on switch No. 6. The "VOLUME" control should be set near maximum. On the HF Receiver Unit, turn the "CW-VOICE" switch to "CW" for reception of continuous-wave telegraph signals or to "VOICE" for reception of voice or tone-modulated telegraph signals. Tune to the desired frequency as indicated on the dial. Adjust the "SENSITIVITY" control to obtain maximum tolerable noise level; the AVC action of the receiver will keep the audio output nearly constant for wide variation in signal strength. When satisfied that this receiver is operating satisfactorily turn off switch No. 6.

(6) RAX-1 RECEIVERS.—On the Interphone Control Box, turn on Switch No. 8 (Channel "A" from RAX-1 Receivers). Select the receiver which includes the desired frequency and turn the "MCW-OFF-CW" switch to "CW" for reception of continuous-wave telegraph signals or to "MCW" for reception of voice or tone-modulated telegraph signals. Throw the "A-B TEL" switch just below the tuning crank to "A." Set the band selector switch to the band which includes the desired frequency. Shift the "AVC-MAN" switch to "MAN," advance the "INCREASE OUTPUT" control until background noise is heard and then tune in the desired station by means of the tuning crank. For voice reception turn the "AVC-MAN" switch to "AVC"; for continuous-wave or tone-modulated telegraph signals retain the switch on "MAN." It may be necessary to readjust the "INCREASE OUTPUT" control when shifting from "MAN" for "AVC" and vice versa. When satisfied that the receiver is operating satisfactorily turn off switch No. 8 on the Interphone Control Box. The signal remains available for use by the pilots at their Interphone Control Boxes. In the same fashion one of the other receivers may be set up to deliver output to Switch No. 9 on the Interphone Control Boxes. In this case the "A-B-TEL" switch associated with the receiver used should be thrown to "B." The remaining receiver may also be tuned up and put on either channel "A" or "B" in which case it will parallel one of the other receivers or it may be left off the lines feeding the Interphone Control Boxes by throwing its associated "A-B TEL" switch to "OFF," in which case the receiver will be in a standby status. When satisfied the receiver or receivers on channel "B" are functioning satisfactorily turn off Switch No. 9 if it is not desired to listen to these signals; the signals remain available at the pilot's Interphone Control Boxes.

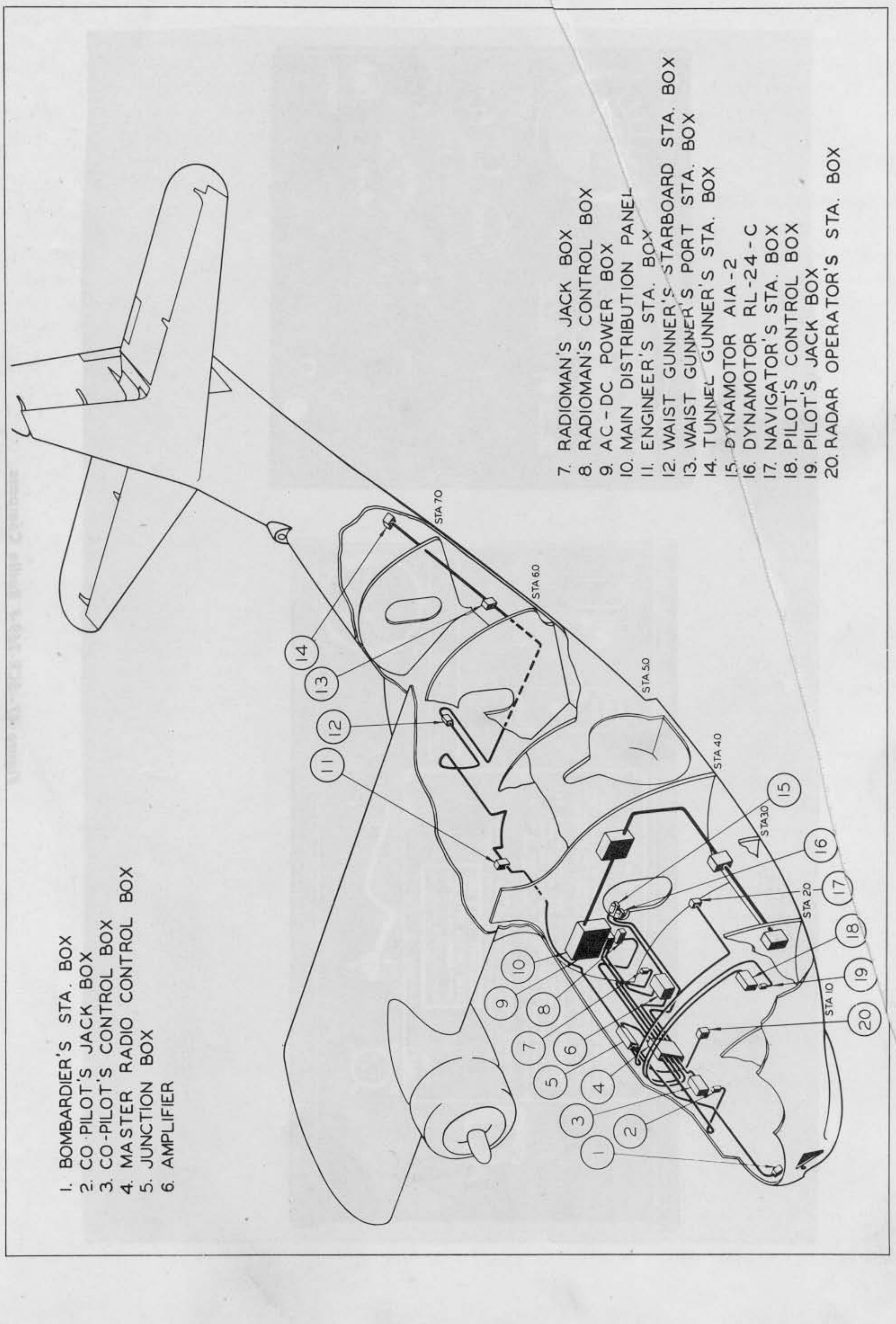


Figure 46—AN/AIA-2 Interphone System

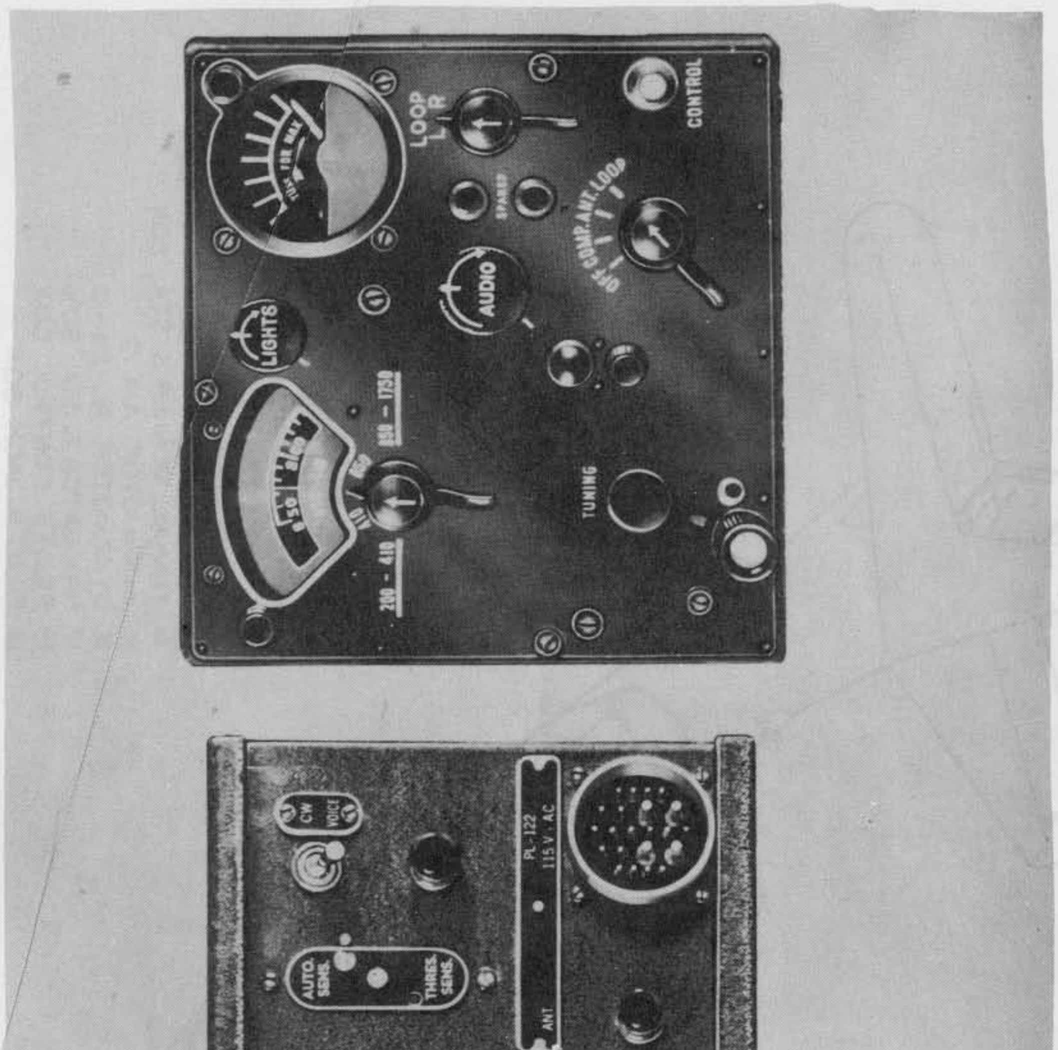


Figure 47—SCR-269-F Radio Compass

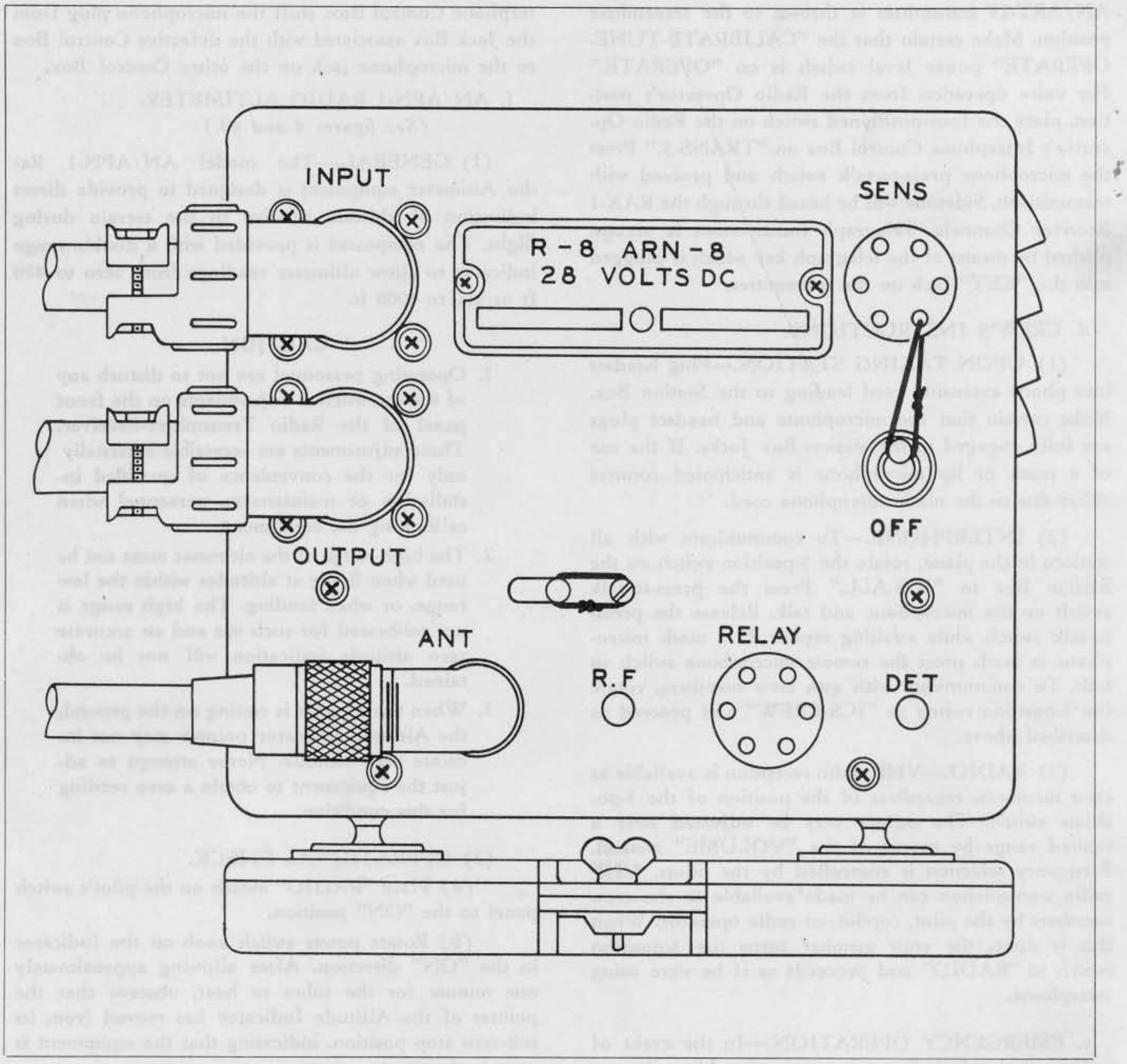


Figure 48—AN/ARN-8 Marker Beacon

(7) TRANSMISSION IN GENERAL.—See subparagraphs *b*, (11) and *b*, (13) under PILOT'S AND COPILOT'S INSTRUCTIONS. Note that the Radio Operator is responsible for frequency selection on the ART-13 (ATC) transmitter. Voice operation, on the channel so selected, may be carried on from any one of the Interphone Control Boxes.

(8) ART-13 (ATC) TRANSMITTER.—On the Transmitter Panel, make certain that the "LOCAL-REMOTE" switch is on "LOCAL." Place the "EMISSION" selector switch on "VOICE," "CW" or "MCW" in accordance with the type of emission desired. Set the "CHANNEL" switch on the channel desired; the calibration card on the panel shows the frequencies corresponding to the "CHANNEL" switch positions. It takes about 25 seconds for the band shifting mechanism to complete the operation. For operation on LF, it will be necessary to let out the trailing wire to the proper length previously determined for that frequency and transmitter adjustment. Make certain that the trailing wire Antenna switch provided for switching the Antenna from LORAN RECEIVER to the

AN/ART-13 transmitter is thrown to the transmitter position. Make certain that the "CALIBRATE-TUNE-OPERATE" power level switch is on "OPERATE." For voice operation from the Radio Operator's position, place the four-positioned switch on the Radio Operator's Interphone Control Box on "TRANS-3." Press the microphone press-to-talk switch and proceed with transmission. Sidetone will be heard through the RAX-1 Receiver Channels. Telegraph transmission is accomplished by means of the telegraph key which is plugged into the "KEY" jack on the transmitter.

d. CREW'S INSTRUCTIONS.

(1) UPON TAKING STATION.—Plug headset into phone extension cord leading to the Station Box. Make certain that the microphone and headset plugs are fully engaged in the station Box Jacks. If the use of a mask or lip microphone is anticipated connect either one to the mask microphone cord.

(2) INTERPHONE.—To communicate with all stations in the plane, rotate the 3-position switch on the Station Box to "ICS-ALL." Press the press-to-talk switch on the microphone and talk. Release the press-to-talk switch while awaiting replies. If a mask microphone is used, press the remote microphone switch to talk. To communicate with gun crew members, rotate the 3-position switch to "ICS-CREW" and proceed as described above.

(3) RADIO.—VHF radio reception is available to crew members, regardless of the position of the 3-position switch. The output may be adjusted over a limited range by means of the "VOLUME" control. Frequency selection is controlled by the pilots. VHF radio transmission can be made available to the crew members by the pilot, copilot, or radio operator. When this is done, the crew member turns the 3-position switch to "RADIO" and proceeds as if he were using interphone.

e. EMERGENCY OPERATION.—In the event of failure of the Jack Box, or associated cabling, it may be possible to continue use of the Interphone Control Box by shifting the microphone and headset plugs from the jack box to the emergency jacks in the left end of the Interphone Control Box. This emergency connection permits radio operation but interphone operation is not possible. In the event of failure of either of the pilot's Interphone Control Boxes, partial emergency operation can be utilized depending on the nature of the failure. If the failure is such as to cause loss of radio reception thru the defective Interphone Control Box, yet reception is normal on the other Control Box, the headset plug can be shifted from the Jack Box associated with the defective Control Box to the headset jack on the other Control Box. Interphone reception is not available thru this emergency jack. If the failure prevents transmission via the defective Interphone Control Box, shift the microphone plug from the Jack Box associated with the defective Control Box to the microphone jack on the other Control Box.

f. AN/APN-1 RADIO ALTIMETER.

(See figures 4 and 49.)

(1) GENERAL.—The model AN/APN-1 Radio Altimeter equipment is designed to provide direct indication of altitude relative to the terrain during flight. The equipment is provided with a double range indicator to allow altimeter readings from zero to 400 ft or 400 to 4000 ft.

CAUTION

1. Operating personnel are not to disturb any of the screwdriver adjustments on the front panel of the Radio Transmitter-Receiver. These adjustments are accessible externally only for the convenience of qualified installation or maintenance personnel when calibrating the equipment.
2. The high range of the altimeter must not be used when flying at altitudes within the low range, or when landing. The high range is not calibrated for such use and an accurate zero altitude indication will not be obtained.
3. When the aircraft is resting on the ground, the Altitude Indicator pointer may not indicate zero altitude. Never attempt to adjust the equipment to obtain a zero reading for this condition.

(2) OPERATIONAL CHECK.

(a) Place "RADIO" switch on the pilot's switch panel to the "ON" position.

(b) Rotate power switch knob on the Indicator in the "ON" direction. After allowing approximately one minute for the tubes to heat, observe that the pointer of the Altitude Indicator has moved from its sub-zero stop position, indicating that the equipment is energized.

(c) Place the "RANGE" switch on the Altitude Indicator to the high range or low range, depending upon the altitude of the airplane. (See second paragraph of CAUTION note following (2) *(a)* above.)

(d) Rotate the Altitude Limit Switch to the desired altitude setting. This setting determines the altitude at which the Radio Transmitter-Receiver will actuate the Altitude Limit Indicator lights.

(e) Altitude Indicator will give true indications of altitude, over the entire range of the equipment, when flying over rough or uneven terrain, or when flying through bumpy air.

(3) ALTITUDE LIMIT INDICATOR.—This auxiliary device relieves the pilot of the constant attention to the Altitude Indicator scale. It consists of

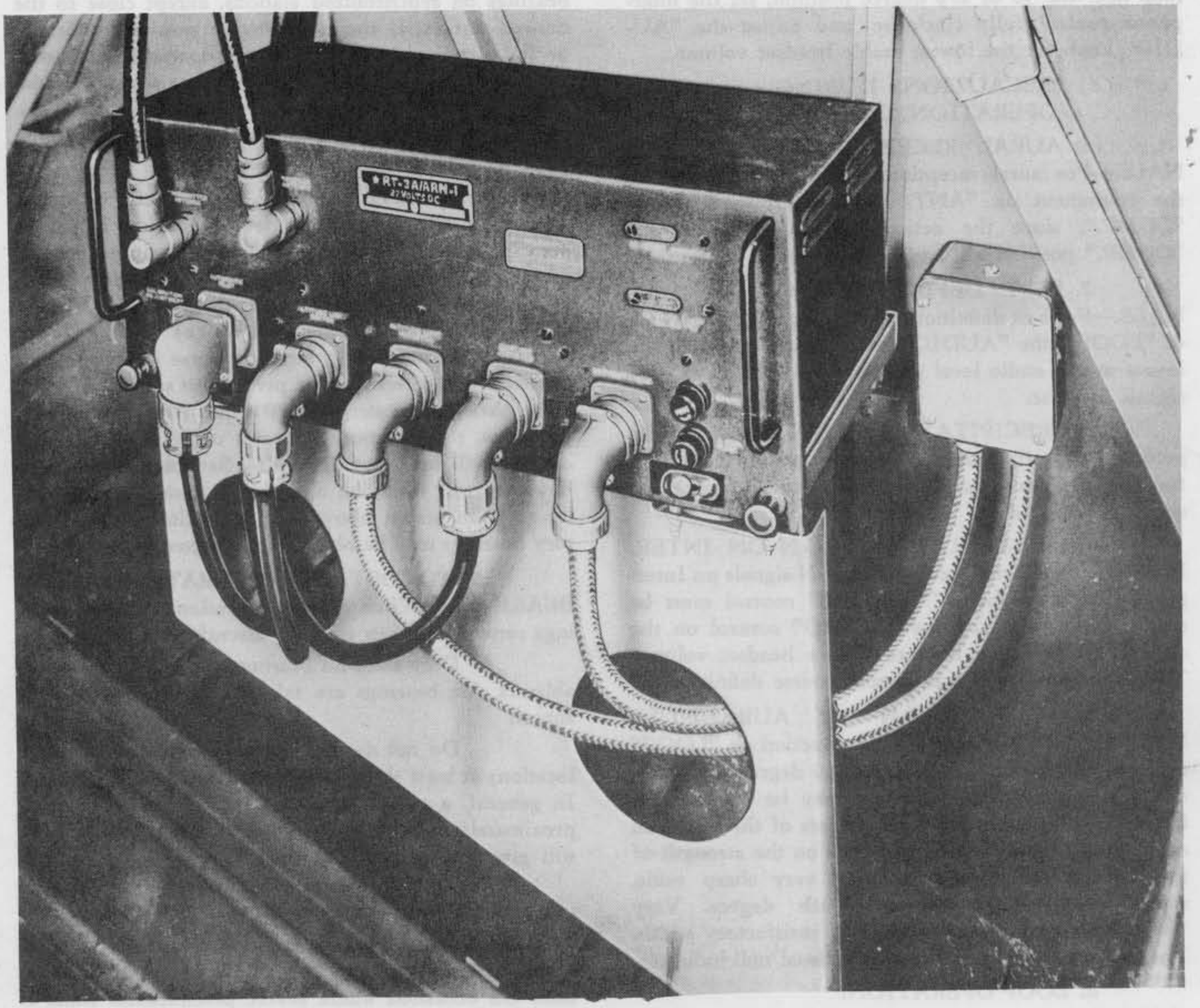


Figure 49—Radio Altimeter Transceiver

three colored lamps, one of which is illuminated for each of the three conditions of relay contact operation.

(*a*) RED.—Indicates flight below the preset altitude control range determined by the Altitude Limit Switch setting.

(*b*) WHITE.—Indicates flight within the preset altitude control range.

(*c*) GREEN.—Indicates flight above the preset altitude control range.

(4) FUSES.—The AN/APN-1 Altimeter equipment is protected against damage from short-circuits by a fuse of three-ampere rating located at the lower right-hand corner of the front panel of the Radio Transmitter-Receiver. A spare fuse of corresponding rating is provided in an adjacent receptacle.

CAUTION

If necessary to make any substitution for the fuses (type 4AG Littlefuse) which are supplied with the equipment and spare parts, use "slow-blowing" fuses of the same current capacity if available. If not available, substitute fuses of the next higher current rating for TEMPORARY EMERGENCY USE ONLY.

signals on "LOOP," it is necessary to maintain the loop near the 90 or 270 degree position, set the interphone control fully clockwise, and adjust the "AUDIO" knob for the lowest usable headset volume.

(*d*) PRECAUTIONS DURING OPERATION.

1. AURAL RECEPTION OF A-N SIGNALS.—For aural reception of A-N signals, operate the equipment on "ANT." or "LOOP" instead of "COMP.", since the action of the AVC in the "COMP." position will cause broad course indications.

2. BEST DEFINITIONS OF A-N SIGNALS.—For best definitions of A-N signals on "ANT." or "LOOP", the "AUDIO" control must be set to the lowest usable audio level and must be reduced as A-N signals increase.

3. PRECIPITATION STATIC.—During periods of precipitation static, operate on "LOOP"; for best reception, rotate the loop until a maximum signal is obtained.

4. AURAL RECEPTION ON INTERPHONE.—For aural reception of A-N signals on Interphone, the Interphone "VOLUME" control must be set fully clockwise and the "AUDIO" control on the compass control box used to reduce headset volume. This is essential to obtain proper course definition.

5. DIRECTION BY AURAL-NULL METHOD.—When determining direction on "LOOP" by aural-null method, there is an 180 degree ambiguity and the direction of the station may be 180 degrees from the null obtained. The broadness of the null with aural-null direction finding depends on the strength of the signal. Strong fields produce very sharp nulls, sometimes as small as one tenth degree. Vary "AUDIO" control until null is of satisfactory width. The tuning meter may be used as a visual null indicator.

6. LOOP OPERATION.

a. If the loop should be in the null position when flying on a radio range course, the signal may fade in and out and possibly be mistaken for a cone of silence.

b. Cone of silence indications are not reliable on loop type radio range stations, when the radio compass is operating on "LOOP". The signal may increase in volume to a strong surge when directly over the station instead of indicating a silent zone.

7. SELECT RADIO STATIONS PROVIDING STABLE BEARING.—Tune equipment carefully. If an interfering signal is heard in the headset, it is probably causing an error in bearing. To check, tune a few kilocycles either side of resonance. A change in bearing with tuning indicates an interfering signal. If station interference exists, select another station or proceed by other means of navigation until closer to the desired station. Care must be exercised when taking bearings on stations broadcasting the same program, as they may be mistaken for another station. Avoid taking bearings on synchronized stations, except close to the desired station. If the radio station stops transmitting, or fades, especially code stations operating in a network, bearings might be taken on other stations of the same frequency, thus causing errors. Do not use a station for bearings unless it can be identified by the headset signal on "COMP." operation.

8. NIGHT EFFECT.—Night effect, or reflection of the radio wave from the sky, is always present. It may be recognized by a fluctuation in bearings. The remedy is: either (a) increase altitude, thereby increasing the strength of the direct wave; (b) take an average of the fluctuations; or (c) select a lower frequency station. Night effect is worse at sunrise and sunset. Night effect may be present on stations at 1750 kc at distances greater than 20 miles. As the frequency decreases, the distance increases, until, at 200 kc the distance will be about 200 miles. Satisfactory bearings, however, will often be obtained at much greater distances than stated above, and sometimes, unsatisfactory bearings may be obtained at shorter distances.

9. TO OBTAIN ACCURATE STATION BEARINGS.—When close to a station, accurate bearings cannot be taken with the aircraft in a steep bank.

Only head-on bearings are entirely dependable. If side bearings are taken, keep the wings horizontal.

Do not depend on two stations for a fix of location; at least three station bearings should be used. In general, a set of stations with bearings spaces approximately at equal intervals throughout 360 degrees will give best accuracy.

10. OPERATION UNDER ADVERSE WEATHER CONDITIONS.—This equipment should provide compass bearings during conditions of moderate precipitation static which interrupt normal reception. On occasions where severe precipitation static is present, especially when discharges occur from parts of the aircraft surfaces, it will be necessary to operate on "LOOP" position. In this position, satisfactory reception and aural-null direction finding will be possible most of the time. The type of precipitation static existing in air mass fronts at different temperatures can be avoided by crossing the air mass front at right angles and then proceeding on desired course instead of flying along the air mass front.

11. "CW-VOICE" AND "COMP." OPERATIONS.—When receiving modulated signals, intelligibility is greatly reduced as the "CW-VOICE" switch is set to "CW". Operation of the equipment when the function switch is set to "COMP." is not affected by the position of the "CW-VOICE" switch.

12. "MOUNTAIN EFFECT".—Erroneous or fluctuating bearings, in some instances, are produced by reflection of radio waves from the mountains. This phenomenon is called "MOUNTAIN EFFECT". Because of this effect, bearings taken when flying over mountainous terrain should not be relied upon explicitly.

(2) AN/APN-1 RADIO ALTIMETER.
(See figures 4 and 48.)

(a) GENERAL.—The model AN/APN-1 Radio Altimeter equipment is designed to provide direct indication of altitude relative to the terrain during flight. The equipment is provided with a double range indicator to allow altimeter readings from zero to 400 ft or 400 to 4000 ft.

CAUTION

1. Operating personnel are not to disturb any of the screwdriver adjustments on the front panel of the Radio Transmitter-Receiver. These adjustments are accessible externally only for the convenience of qualified installation or maintenance personnel when calibrating the equipment.
2. The high range of the altimeter must not be used when flying at altitudes within the low range, or when landing. The high range is not calibrated for such use and an accurate zero altitude indication will not be obtained.
3. When the aircraft is resting on the ground, the Altitude Indicator pointer may not indicate zero altitude. Never attempt to adjust the equipment to obtain a zero reading for this condition.

(b) OPERATIONAL CHECK.

1. Place "RADIO" switch on the pilot's switch panel to the "ON" position.

2. Rotate power switch knob on the Indicator in the "ON" direction. After allowing approximately one minute for the tubes to heat, observe that the pointer of the Altitude Indicator has moved from its sub-zero stop position, indicating that the equipment is energized.

3. Place the "RANGE" switch on the Altitude Indicator to the high range or low range, depending upon the altitude of the airplane. (See second paragraph of CAUTION note following (2) *(a)* above.)

4. Rotate the Altitude Limit Switch to the desired altitude setting. This setting determines the altitude at which the Radio Transmitter-Receiver will actuate the Altitude Limit Indicator lights.

5. Altitude Indicator will give true indications of altitude, over the entire range of the equipment, when flying over rough or uneven terrain, or when flying through bumpy air.

(c) ALTITUDE LIMIT INDICATOR.—This auxiliary device relieves the pilot of the constant attention to the Altitude Indicator scale. It consists of three colored lamps, one of which is illuminated for each of the three conditions of relay contact operation.

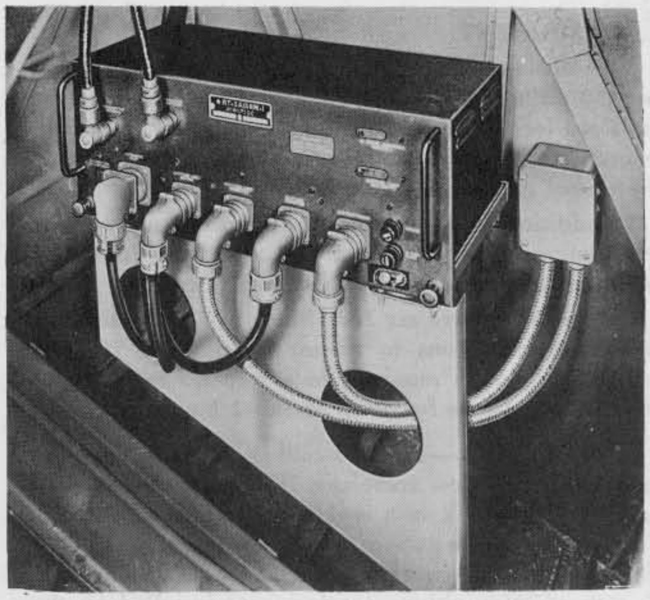


Figure 48—Radio Altimeter Transceiver

1. RED.—Indicates flight below the preset altitude control range determined by the Altitude Limit Switch setting.

2. WHITE.—Indicates flight within the preset altitude control range.

3. GREEN.—Indicates flight above the preset altitude control range.

(d) FUSES.—The AN/APN-1 Altimeter equipment is protected against damage from short-circuits by a fuse of three-ampere rating located at the lower right-hand corner of the front panel of the Radio Transmitter-Receiver. A spare fuse of corresponding rating is provided in an adjacent receptacle.

CAUTION

If necessary to make any substitution for the fuses (type 4AG Littlefuse) which are supplied with the equipment and spare parts, use "slow-blowing" fuses of the same current capacity if available. If not available, substitute fuses of the next higher current rating for TEMPORARY EMERGENCY USE ONLY.

(3) AN/ARN MARKER BEACON RECEIVER.
(See figure 49.)

(a) GENERAL.—The AN/ARN-8 receiver is a fixed tuned receiver providing two audio outputs and one visual output. It operates on a frequency of 75 megacycles. The first audio output is heard by the co-pilot and radioman, and the second is heard by the pilot. The two received signals differ only in their modulation frequency. In addition, the received signal actuates an indicator light on the pilot's instrument panel. The pilot thus receives both an aural and visual indication when the airplane passes over the marker beacon transmitting station.

. ARMAMENT.

The airplane is equipped with three .30 caliber and two .50 caliber machine guns. Two .30 caliber machine guns are located in the bow enclosure, one .50 caliber in each of the side waist blisters, and one .30 caliber in the tunnel gun position.

In addition, provisions are made to mount two blisters equipped with ball and socket mounts for a .30 caliber gun in the tunnel gun compartment.

On the wing there are four Mark 51-7 internal bomb racks and provisions to mount four Mark 51-7 external bomb racks mounted in a torpedo rack. There are also provisions for four Mark 42 bomb racks.

a. BOW GUN.—Two .30 caliber machine guns are mounted in the bow enclosure. The guns are installed on a plexiglas shell in a revolving circular windshield. To the right of the gunner, provisions are made to stow four ammunition containers of 350 rounds capacity. Two more ammunition containers are installed on the mount, making a total of 2100 rounds of ammunition.

To stow guns:

Rotate the windshield until the guns are pointed directly forward.

Lock the enclosure with the function lock located to the left of the gun mount.

Depress the guns until they hit the stop.

Pass the strap that is fastened to the enclosure bulkhead underneath the adapter and pull up tight.

The bow guns are readied for firing by unfastening the stowage strap. *(See figure 50.)*

During take-off and landings the bow enclosure is kept watertight by inflating sealing tubes by a hand pump located to the left of the gunner. Instructions for operating the hand pump are located near the hand pump. A valve for releasing the air in the sealing tubes is integral with the latch.

b. SIDE WAIST GUNS. *(See figure 51.)*—One .50 caliber machine gun is located in each of the side waist blisters between bulkheads 6 and 7. Provisions are made for 956 rounds of ammunition for the two side waist guns.

A firing guard is provided for each side gun to prevent the gun from being fired into the tail, or the aft portion of the hull. The firing guard is a three-quarter inch steel tube attached to the hull just below the blister. When the rotating shield of the gun blister is raised for firing the gun, the firing guard is lifted and attached to the clamp on the rotating shield. Before the gun blister is closed, the firing guard must be placed in its stowed position. *(See figure 52.)*

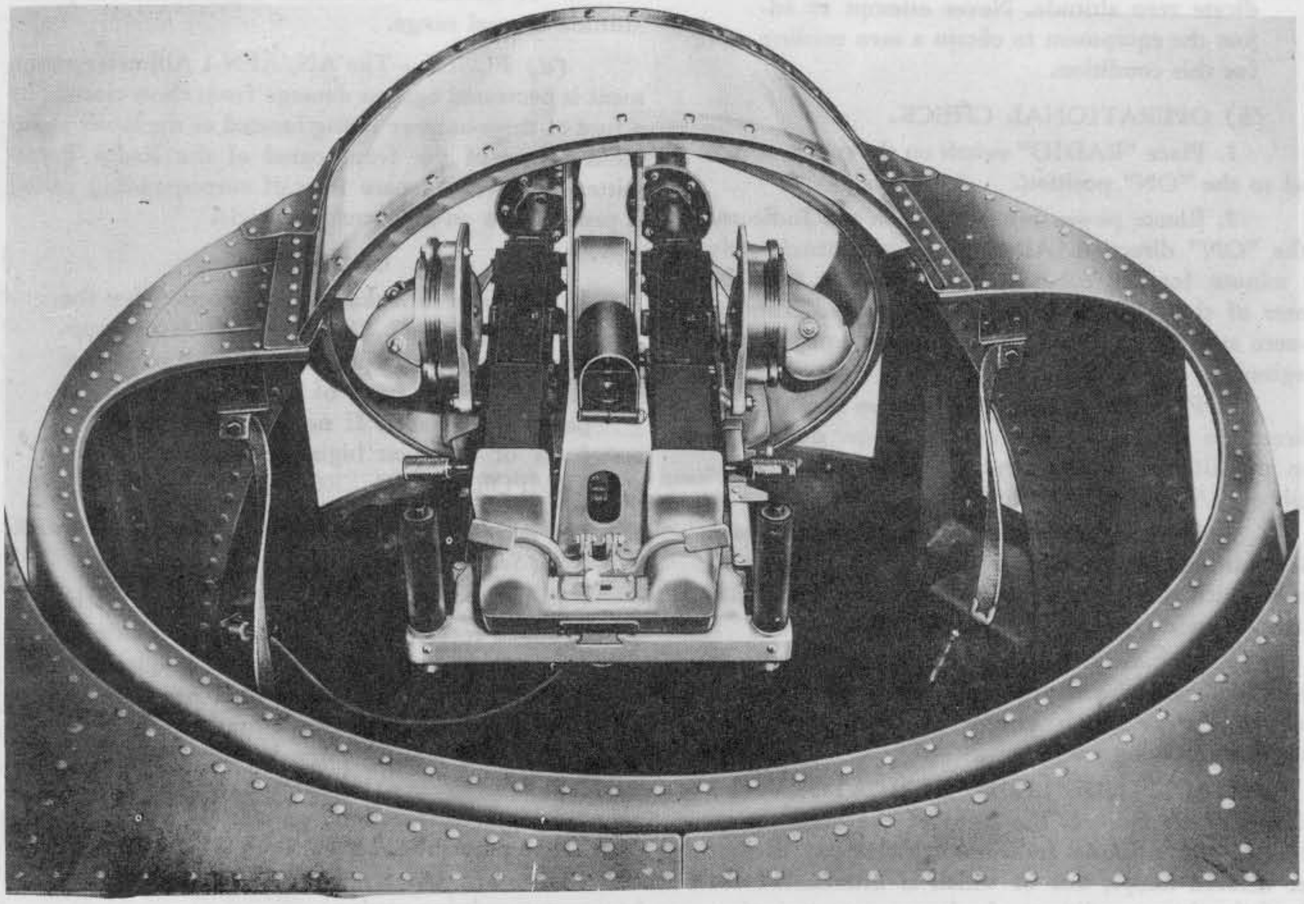


Figure 50—Bow Guns in Firing Position

Figure 51—Side Waist Guns Firing

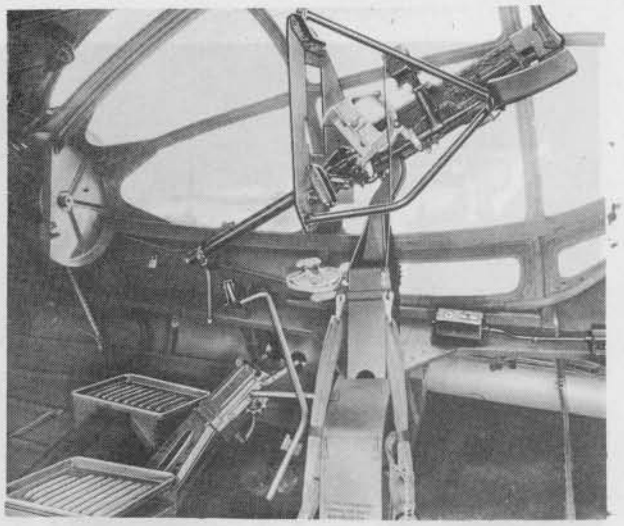


Figure 52—Side Waist Guns Stowed

The gun is stowed on the mount in a fore and aft position. The muzzle rests in a cradle and is secured with a metal strap. To stow the gun:

Swing the gun inside the airplane with the muzzle pointing aft.

Close and lock rotating shield of gun blister.

Secure the muzzle with the metal strap.

When closed, the transparent gun blisters are kept watertight by the same method used for the bow gun enclosure.

Switches controlling the Mark 9 gun sight, continuous feed ammunition boosters *(See figure 55)* and gun camera are on either side of the hull, forward of the gun posts. Before either the gun sight or gun camera will operate, the switch on the main distribution panel must be on.

c. TUNNEL GUN. *(See figures 53 and 54.)*—This gun was installed only in the following airplanes: 46639-46698 Incl., 46724, 63993-64015 Incl.

To place the gun in firing position:

Unlatch the spade grip.

Swing the gun and stirrup up and out of the stowed position.

Unfasten the toggle lock holding stirrup to Vee brace.

Lower stirrup from vertical position.

Screw the locking nut tight.

To place the gun in stowed position:

Unscrew the locking nut.

Swing the stirrup into vertical position.

Fasten the stirrup to Vee brace with the toggle lock.

Swing the gun and stirrup above the Vee brace hinge into stowed position at port side of hull.

Place barrel in stowage hook and latch spade grip in place.

Unfasten tunnel door, swing it down into horizontal position, and latch the door.

A gun camera receptacle and switches are on the port side of the hull, adjacent to the latch. The switch on the main distribution panel must be on before power will feed through the receptacle.

Provision for 500 rounds of ammunition is provided.

d. CAMERAS.—Provision is made at the two waist guns and the tunnel gun for the installation of a G.S.A.P. camera. To allow for adjustment when boresighting, the camera mount has oversize holes which permit sufficient movement of the camera to bring the line of sight of the camera parallel with the axis of the gun. After the camera is properly aligned, it is secured by tightening and safetying the bolts.

Provision is made for the installation of a torpedo training camera immediately forward of station 1.66 on top of the pilot's enclosure and for a K25A bomb assessment camera may also be installed at the tunnel position.

e. BOMB EQUIPMENT.

(1) BOMB AND TORPEDO RACKS. — The service bomb rack installation consists of four Mark 51-7 bomb racks. The racks are mounted inside the center section of the wing near the lower skin surface. They are placed two on each side of the airplane, outboard of the nacelles. Access to the racks is through openings in the bottom of the wing. These racks remain installed in the airplane at all times, even though external racks are installed for carrying torpedoes, depth bombs, or 100 pound bombs. On the bomber's switch panel these four racks are referred to as "MARK 51 INTERNAL."

External bomb racks are installed to carry torpedoes or depth bombs. These racks are mounted outside and below the center section of the wing, one on

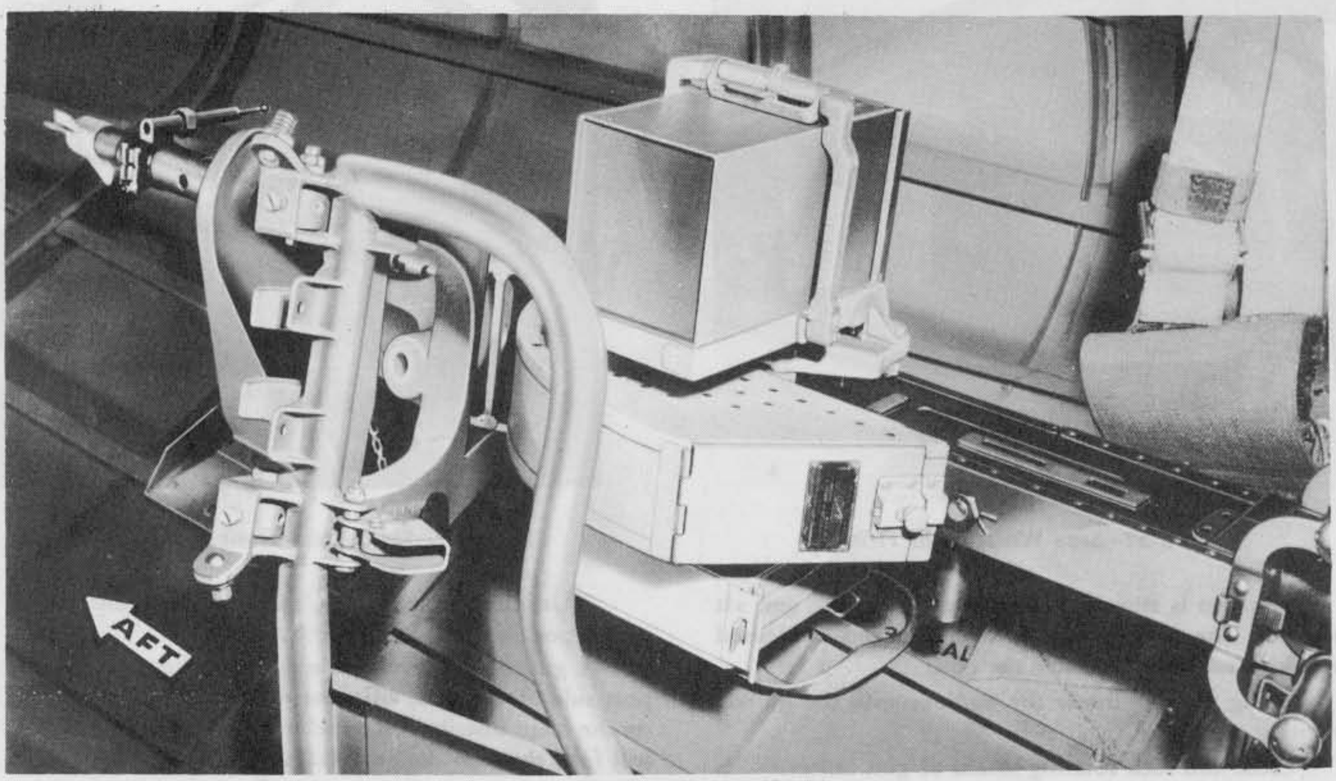


Figure 53—Tunnel Gun Stowed

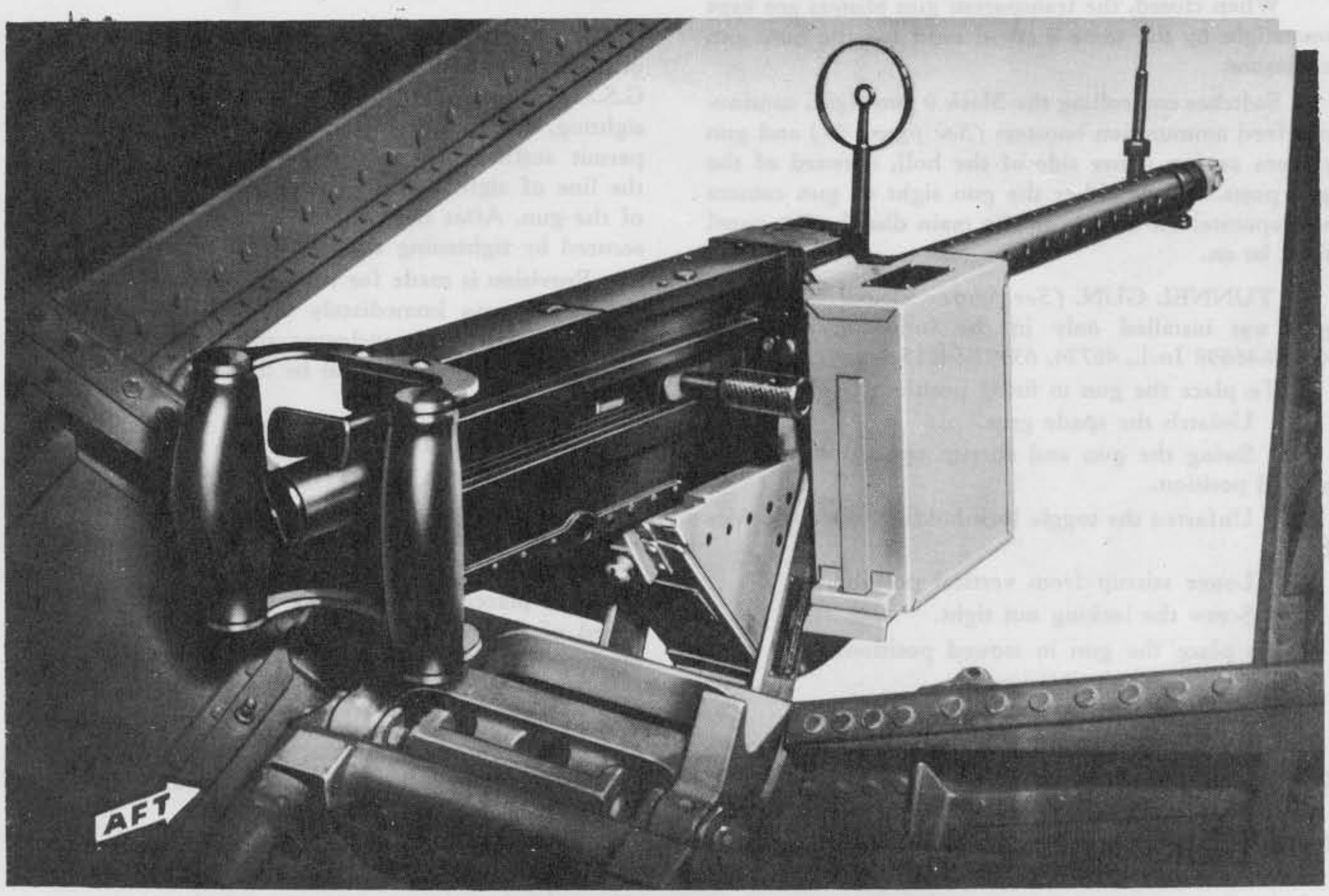
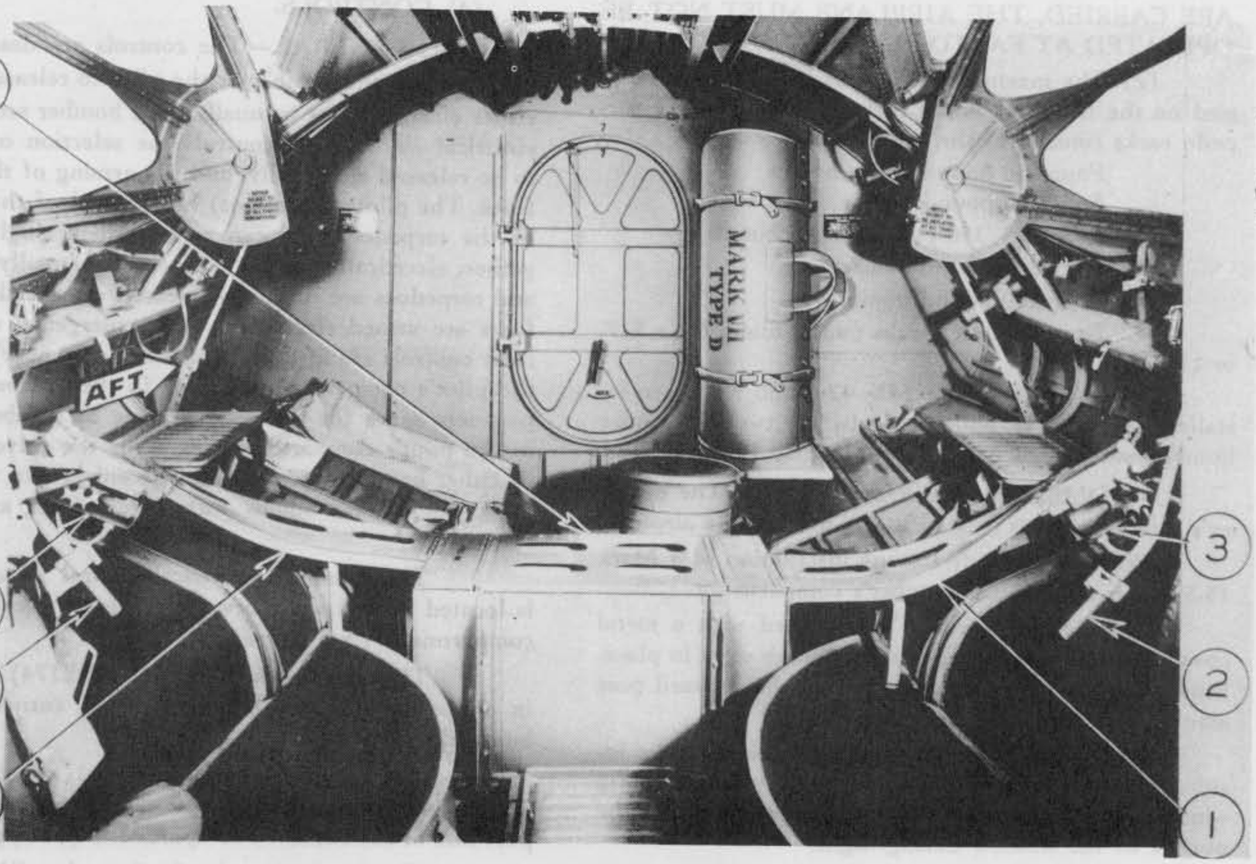


Figure 54—Tunnel Gun—Ready



1. Ammunition Feed Chutes
2. Firing Guards
3. Assist Motors
4. Ammunition Magazine

Figure 55—Side Gun Feed Mechanism

each side of the airplane, outboard of the wing struts, and inboard of the internal bomb racks. These racks are not normally carried but installed only for a particular mission. *(See figure 56.)*

Each external bomb rack assembly consists essentially of members for attaching two Mark 51-7 bomb racks to the wing, together with the necessary electrical and manual control connections and splash fairings.

For the torpedo installation chocks, a starting lanyard attaching angle, and stop bolt installations are required. Each assembly carries one 1935 pound torpedo, Mark 13 or Mark 13-1, with air stabilizer.

In addition to the Mark 51-7 racks, provision is made for the installation of four Mark 42 practice racks. These racks are installed only for particular missions, and are not normally installed on the airplane. They are suspended externally beneath the wing, two in tandem on each side of the center line. Three 100 pound bombs per rack, or twelve in all, are carried on the Mark 42 racks.

The installation positions of the external racks, both Mark 42 and Mark 51-7 are marked on the underside of the wing.

(2) BOMB LOADS.—Because of structural limitations the maximum bomb load SHALL NOT EXCEED 6,400 pounds. The maximum load of 6,400 pounds may be made up of a combination of the following:

***(a)* A load of two torpedoes MK 13 or MK 13-1 (1935 pounds with stabilizers), or two mines MK 25 (2000 pounds), MK 12-1 or MK 12-4 (1600 pounds) may be carried on the torpedo racks.**

***(b)* The maximum bomb load to be carried on the MK 51-7 INTERNAL wing racks may consist of any of the following:**

***Four 1600 pound bombs**
Four 1000 pound bombs
Four 1000 pound mines (MK 13 or MK 26)
Four 650 pound depth bombs
Four 500 pound bombs
Four 325/350 pound depth bombs
Four 250 pound bombs
Four 100 pound bombs
Four practice bombs (water-filled, MKs 5, 7, or 11)

***IF ONE OR MORE 1600 POUND BOMBS**

ARE CARRIED, THE AIRPLANE MUST NOT BE OPERATED AT FACTORS EXCEEDING 4.1 G.

(c) The maximum bomb load that may be carried on the MK 51-7 bomb racks mounted on the torpedo racks consists of the following:

Four 650 pound depth bombs
Four 500 pound bombs
Four 325/350 pound depth bombs
Four 250 pound bombs
Four 100 pound bombs
Four practice bombs (water-filled, MKs 5, 7, or 11)

(d) When the four MK 42 bomb racks are installed twelve 100 pound bombs or twelve practice bombs (water-filled MKs 7, or 15) may be carried.

(3) BOMBER'S COMPARTMENT.—The bomber's compartment is located in the nose of the airplane.

Provision is made for the installation of a Mark 15-5 bomb sight in the bomber's compartment.

The sighting window is provided with a metal cover that can be removed with the bomb sight in place. Stowage for the cover is provided on the forward port side of bulkhead 2.

A handhole, with a cover removable on the inside, is located immediately to the right of the sighting window. The handhole permits the bomber to clean the outside of the window during flight.

A bomber's instrument panel is located on the starboard side of the sighting window. Mounted on it are a free air thermometer, a lateral inclinometer, an air speed indicator and an altimeter. *(See figure 57.)*

(4) CONTROLS.

(a) GENERAL.—The controls are designed to permit either the bomber or the pilot to release bombs, either electrically or manually. The bomber sets up the electrical circuits and controls the selection of bombs to be released electrically, and the arming of the bomb fuses. The pilot (or copilot) has control of the release of the torpedoes. He can release them singly or together, electrically, or both together manually. Bombs and torpedoes are normally released electrically. Bomb fuses are armed electrically. The emergency salvo release controls are installed both in the bomber's and in the pilot's compartments. Those in the bomber's compartment serve for the salvo release of bombs. Those in the pilot's compartment serve for the salvo release of either bombs or torpedoes. The emergency salvo release will release bombs with fuses either armed or safe.

The bomber's electrical central switch panel is located in the port, forward corner of the bomber's compartment. *(See figure 58.)*

The bomber's firing key (NAF 1174) is stowed in a canvas bag in the port forward corner of the bomber's compartment.

The intervalometer, Mark 2-1, together with the intervalometer electrical panel, is mounted on the port side of the bomber's compartment. *(See figure 59.)*

The bomber's manual release handles are located on each side of the sighting window. The set on the port side controls the bomb racks on the port side of the airplane. The set on the starboard side controls

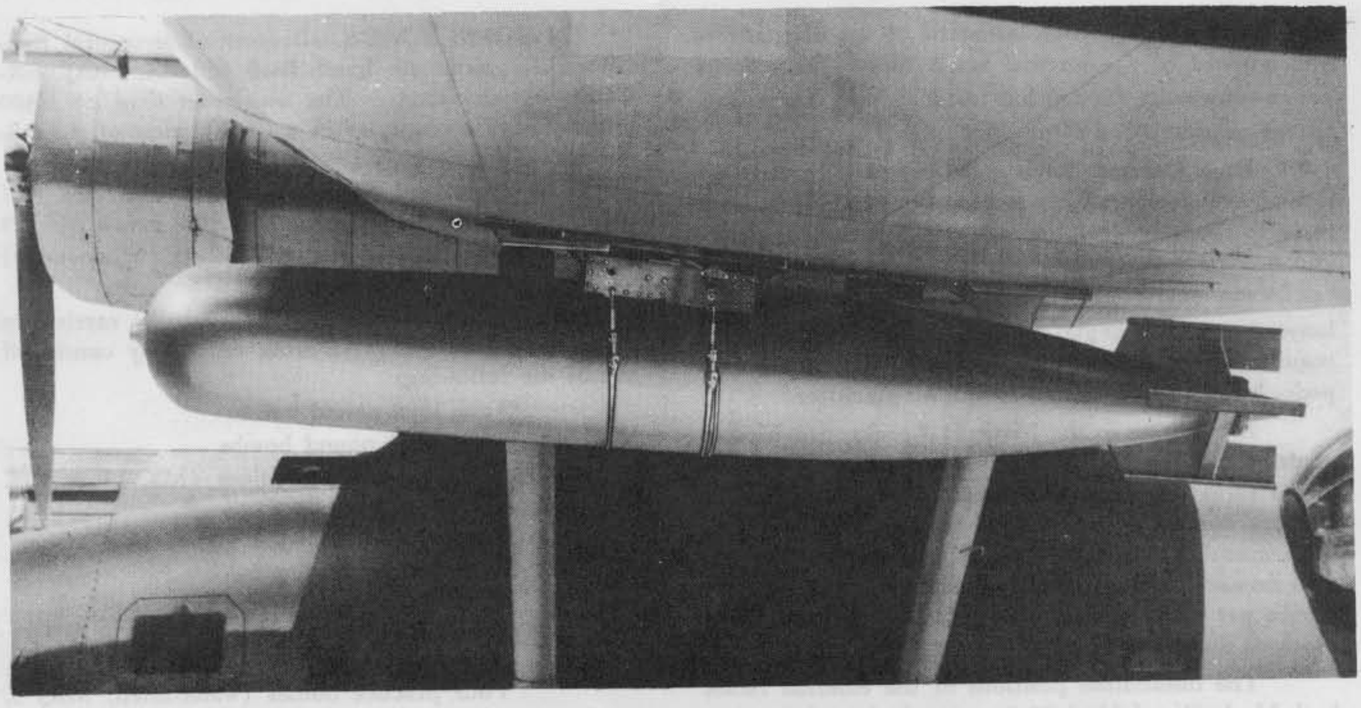


Figure 56—Torpedo Rack on Port Wing

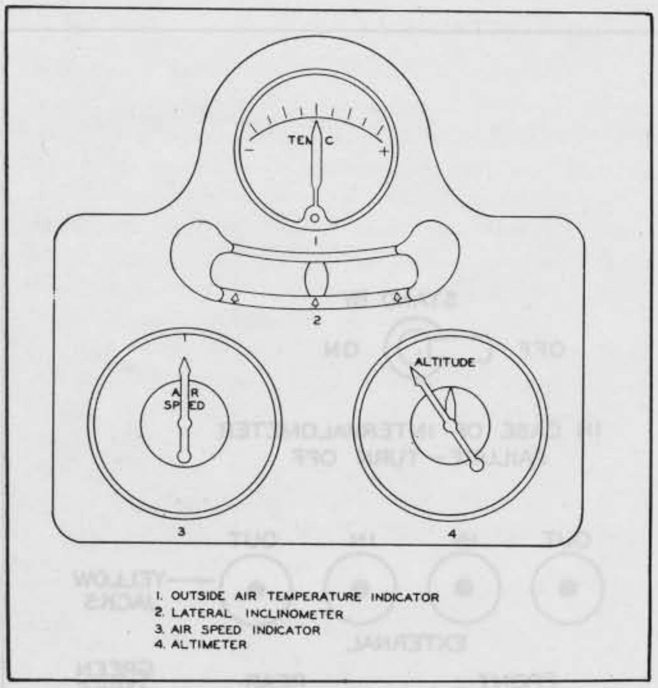


Figure 57—Bombardier's Instrument Panel

the bomb racks on the starboard side of the airplane.

The pilot's switch panel has three switches and a firing key receptacle for use in releasing bombs or torpedoes.

The pilot's emergency release handles are mounted just below the pilot's instrument panel, one on each side of the center line.

(b) ARMING AND RELEASE SYSTEM.

1. ELECTRICAL CONTROL.—Switches on the bomber's switch panel provide for arming the fuses on either the Mark 42 bomb racks or on the Mark 51-7 bomb racks.

The bomber has the choice of two methods of electrical release, automatic and manual electric. In the automatic release the bomb sight will initiate the electrical impulse, which starts the functioning of the release system. The manual electric release requires that the bomber operate his firing key to provide the electrical impulse.

The automatic and the manual electric release each will release bombs selectively (one bomb or a salvo of several bombs released by an electrical impulse) or in a train (a series of bombs released by one electrical impulse, which activates the intervalometer).

Switches on the bomber's switch panel permit the bomber to set up the circuit, so that one or more bombs will be released by any of the methods described above.

The intervalometer Mark 2-1 is a multiwire intervalometer. Its electrical mechanism provides for the release of bombs in train. The bombs are released successively so that their points of impact will be separated by that number of feet set by the bomber on the intervalometer.

The intervalometer assembly, in addition, includes electrical switches and jacks mounted on a panel and electrical wiring contained in the intervalometer box.

Four toggle switches are mounted on the upper left-hand corner of the intervalometer panel. From the left to right these control the circuits from the intervalometer to:

Port outboard internal Mark 51-7 bomb rack.

Port inboard internal Mark 51-7 bomb rack.

Starboard inboard internal Mark 51-7 bomb rack.

Starboard outboard internal Mark 51-7 bomb rack.

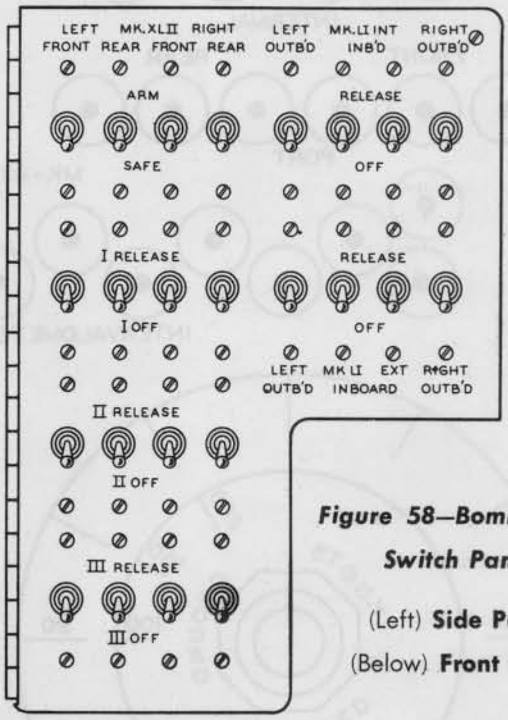
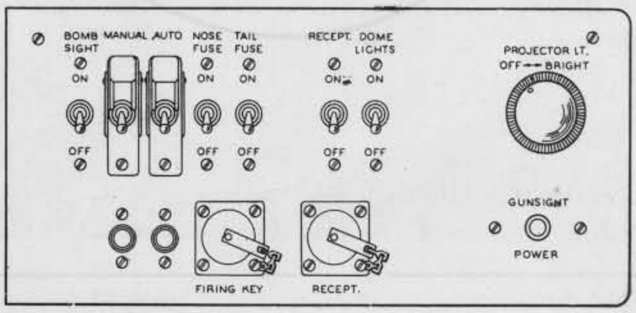


Figure 58—Bombardier's Switch Panels

(Left) **Side Panel**

(Below) **Front Panel**



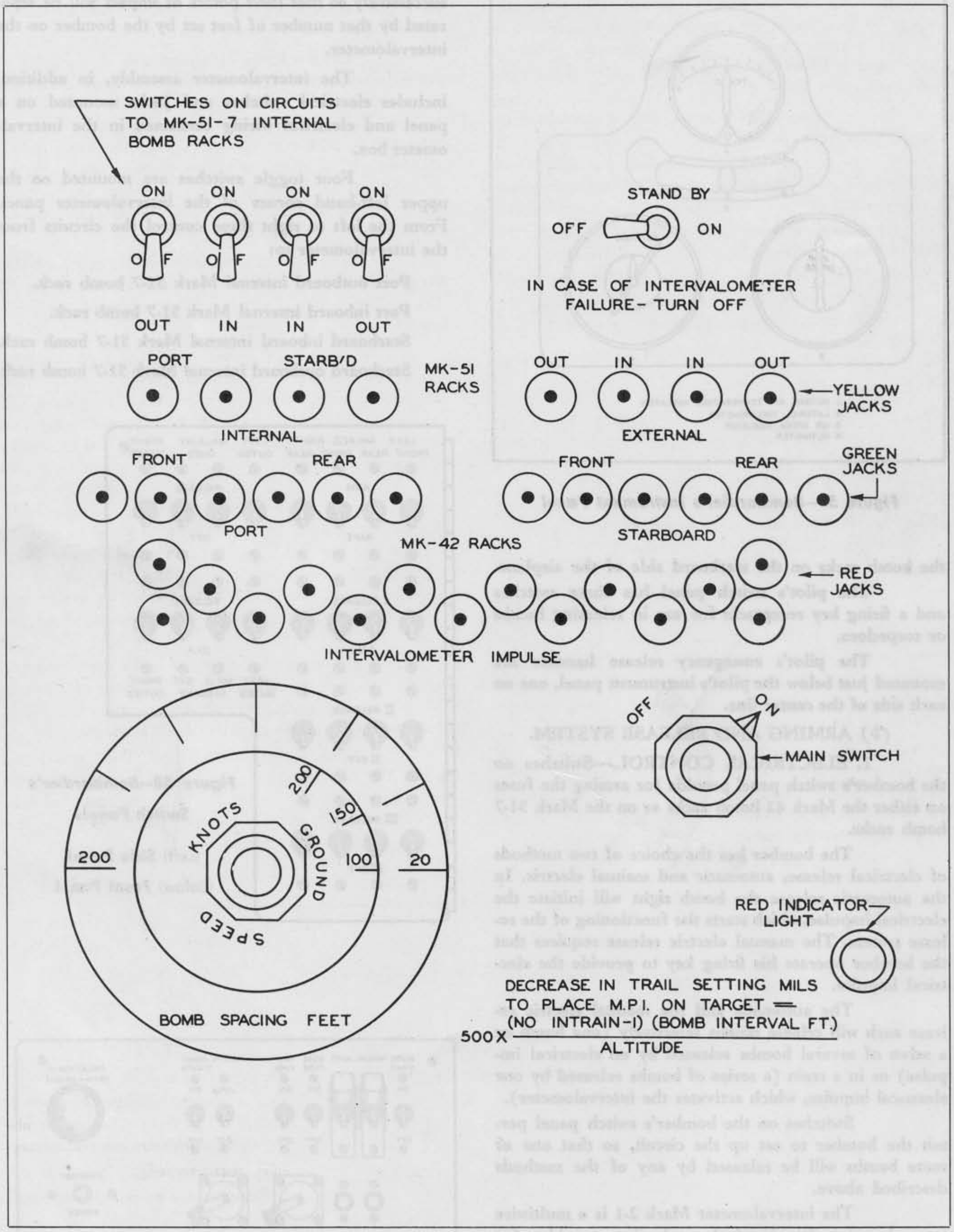


Figure 59—Intervalometer Panel

Electric circuits from the intervalometer proper to these racks are permanently installed, and to release one or more bombs from these racks by the intervalometer, it is only necessary to move the proper switches to the "ON" position.

Three sets of colored jacks are mounted on the intervalometer panel.

Eight yellow jacks are for the eight Mark 51-7 bomb racks. The panel is marked, indicating jack and its rack.

Twelve green jacks are for the 12 bomb positions on the Mark 42 bomb racks. The panel is marked, indicating jacks and their respective racks.

Fifteen red jacks are for the intervalometer impulses. These are not numbered, but operate in order as indicated below:

1 3	5	7	9	11		13 14	
2	4	6	8	10	12	15	

By the use of plugs and jumper wires, any intervalometer impulse jack can be connected to any bomb rack jack, thus allowing the release of bombs by the intervalometer from any racks and in any order. If jumpers are connected to intervalometer impulse jacks Nos. 1, 2, 3 and 4, the toggle switches for Mark 51-7 internal racks should be set to the "OFF" position.

In the upper right-hand corner of the intervalometer panel there is a stand-by switch. This switch is "ON" for normal operation of the intervalometer. In case of intervalometer failure, the switch is turned to the "OFF" position. This breaks the electrical circuit through the intervalometer, and reconnects the circuit from the firing key through the rack selector switches to the bomb racks.

On the right-hand side of the face of the intervalometer, there is a master switch marked "OFF" and "ON." This switch must be "ON" for operation of the intervalometer. A red indicator light is below and to the right of the switch. The indicator light shows when the electrical circuits are routed through the intervalometer and are energized.

On the lower left-hand side of the face of the intervalometer there are two concentric dials; the outer graduated in "Bomb Spacing Feet" from 20 to 200, and the inner graduation in "Ground Speed Knots" from 100 to 200. A knob for turning the inner dial is centered on the dial. By means of these dials, the intervalometer is set to send out electrical impulses so spaced that the impacts of the bombs released will be the desired distance apart.

After the proper switches are operated and the ground speed dial is set, the intervalometer operation will be activated either by a pressure of the firing key or by the bomb sight.

The pilot's switch panel has three switches which affect bomb and torpedo release. Two of these switches are for torpedo selection. Operating these will connect the circuit to either or both torpedo racks, so that the pilot can release the torpedoes. This operation of releasing torpedoes is under the pilot's control and is independent of the bomber. There is a double throw switch (with a red guard) marked "BOMB-TORPEDO." In the "BOMB" position, this switch sets up a circuit so that bombs can be released by the pilot, and cuts the bomber's firing key receptacle out of the circuit. In the "TORPEDO" position, the switch sets up a circuit so that torpedoes can be released by the pilot.

The pilot's switch panel has a receptacle for the pilot's firing key (NAF 1174). With the switches in proper position as explained above, operating the pilot's firing key will release either or both torpedoes.

With the "BOMB-TORPEDO" switch set to the "BOMB" position, the pilot can release bombs electrically, but only from the racks selected, and in the condition of fuse arming or safety, as set up by the bomber on his switch panel.

INTERVALOMETER TROUBLES

TROUBLE	CAUSE	REMEDY
Intervalometer fails to operate.	Electrical trouble in intervalometer.	Temporary remedy: Turn intervalometer main switch to "OFF" position. Operate bombing system without intervalometer. Permanent remedy: Remove and replace intervalometer. Have faulty intervalometer repaired.

2. MANUAL CONTROL.—The bomber's manual controls consist of two units; one to the left for the bomb racks on the port side of the airplane, and one to the right for the bomb racks on the starboard side of the airplane. Each unit has two handles connected by flexible cables to the bomb racks. The emergency release handle is marked "EMERGENCY RELEASE MARK 42 MARK 51." Pulling this handle will release all bombs on its side of the airplane in salvo. The Mark 42 safe and arming handle has two positions, marked "SAFE" and "MARK 42 ARMED." Pulling this handle to the armed position will arm the fuses of bombs carried on the Mark 42 racks. This handle is independent of the electrical fusing system.

The pilot's emergency release controls have two handles, mounted just below the pilot's instrument panel. One on the port side and one on the starboard side of the center line. The port handle controls bombs or torpedo on port side of the airplane and the starboard handle controls bombs or torpedo on starboard side of the airplane. The handle is connected by flexible cable and a cable splice plate to the bomber's emergency release cable.

A two inch pull on the cable is required to release the bombs. In adjusting the cables, turn the turnbuckles just enough to remove the slack in the cables and no more. Check to see that the emergency release handle is in the closed position, after the cables have been adjusted. Too great a tension on the cables may result in dropping bombs inadvertently.

3. BOMBING SYSTEM TROUBLES.

TROUBLE	CAUSE	REMEDY
Bomb rack fails to release.	If bomb cannot be released manually at rack, it is a bent, broken or rusted bomb rack. If bomb can be released manually at rack, it is a broken or stuck salvo release cable.	Remove rack and replace. Check cable. Replace broken section. Replace broken or warped pulley or bracket causing sticking.
	Electrical circuit interrupted.	Check switches and fuses. If this does not correct trouble, then check circuit for continuity. Correct any faults discovered.

5. OPERATION OF CENTRAL HEATER.

(See figure 60.)

The central heater, located under the navigator's table, supplies heater air for cabin heating, windshield defrosting and engine preheating. The heater burns a mixture of gasoline vapor and air, the gasoline being obtained from the main fuel tanks of the airplane.

a. CONTROLS.—Controls for the heater consist of the following:

A switch located on the main distribution panel, marked "ANTI-ICERS AND HEATERS."

A switch located on the junction box at the aft end of the heater, marked "BAT.-GEN."

A combustion control located above and near the forward end of the navigator's table to start and stop the heater.

An air scoop which selects air either from the slip stream during flight or from the cabin during ground operation. This air scoop is located aft and above the navigator's table.

An exciter button located on the bottom of the junction box at the forward end of the heater, to increase fuel flow into the heater.

There are three outlets with dampers for distribution of heated air. The navigator's outlet is under the navigator's table near the forward end. The pilot's outlet is at the pilot's left on bulkhead 2. The flight engineer's outlet is at the outboard end of the navigator's book case.

b. TO START HEATER.—Use the following procedure to start heater:

(1) Close outside scoop.

(2) Open fuel line shut-off valve.

(3) Throw A. P. U. generator switch "ON." (Switch to main generators when engines are started.) Place anti-icer and heater switch on. Place "BAT.-GEN." switch on "GEN."

(4) On combustion control, move control knob to "START" position. After a few minutes, when glow unit of heater is hot enough to ignite fuel, turn control switch to "RUN."

(5) Through heater observation glass observe that fire starts.

(6) If ignition is slow, momentarily press exciter button.

WARNING

Do not hold exciter button in.

(7) When air-borne, open outside scoop.

c. TO STOP HEATER.—Press control stop button on combustion control. The fire will burn out in 10 to 15 minutes.

CAUTION

Close air scoop before water landing.

6. OPERATION OF PROPELLER WING AND TAIL ANTI-ICING SYSTEM.

a. PROPELLER.—The anti-icer control for propeller anti-icing fluid is a rheostat, located on the pilot's switch panel. Operation of the propeller anti-icer is accomplished as follows:

(1) Turn on fluid supply valve. This valve is located below reservoir on the aft face of bulkhead 4, port side.

(2) Turn "MAIN BATTERY" switch on at main distribution panel.

(3) Turn "ANTI-ICERS AND HEATERS" switch on at main distribution panel.

(4) Turn "ANTI-ICER" control to desired rate of flow.

b. WING. *(See figure 9.)*—The wing anti-icing system is designed to prevent formation of ice on the surfaces, rather than to de-ice the surfaces after ice has started to form. It is therefore important to start operating the system BEFORE ICING CONDITIONS ARE ENCOUNTERED. Anti-icer temperature gages are to the left of the flight engineer's seat. Automatic thermostatic controls dump hot air from ducts when temperature rises to 150°C (302°F).

Operation of the wing anti-icer is accomplished as follows:

(1) Turn "MAIN BATTERY" switch on at main power distribution panel.

(2) Turn "ANTI-ICERS AND HEATER" switch on at main distribution panel.

(3) Place "WING ANTI-ICER" switch in "OPEN" position on pilot's switch panel. If temperature rises above 150°C (302°F) the automatic control has failed. The switch should then be operated manually "ON" and "OFF" to keep temperatures below 150°C (302°F).

(4) Place "WING ANTI-ICER" switch in "CLOSED" position to shut off hot air supply.

In the event the hot air ducts fail to operate on one side during icing conditions, the WING ANTI-ICER switch should be closed. Failure to do so would result in the formation of ice on one side only causing critical flight characteristics.

c. TAIL.—The tail anti-icing system like the wing anti-icing system, should be turned on BEFORE ICING CONDITIONS ARE ENCOUNTERED.

Controls for the tail anti-icer consist of a fuel shut-off valve, located at the right of the flight engineer, and a switch and damper control, located on the forward face of bulkhead 7.

Operation of the tail anti-icer is accomplished as follows:

(1) Turn "MAIN BATTERY" switch on at main distribution panel.

(2) Turn "ANTI-ICERS AND HEATER" switch on at main distribution panel.

(3) Open fuel valve in flight engineer's compartment.

(4) Turn anti-icer switch on at bulkhead 7.

(5) Pull damper control lock down and pull damper control fully out, 30 seconds after turning on switch at bulkhead 7.

To shut off heater:

(1) Close fuel valve in flight engineer's compartment.

(2) Turn off anti-icer switch at bulkhead 7.

(3) Move air scoop control to "CLOSED" position.

(4) Turn off switch at main distribution panel.

CAUTION

Damper must be closed during take-offs and landings. It must be fully open during operation of heater.

7. OPERATION OF AUXILIARY POWER UNIT.

(See figure 61.)

When preparing to start A.P.U., turn on fuel valve, which is located on the engineer's instrument panel. Make certain that A.P.U. generator switch, which is on the main distribution panel over the radio operator's table, is in the "OFF" position. Set the ignition switches in the "OFF" position. Engage the manual starter by depressing the starter rod handle and rotating the drum in a counter-clockwise direction. Then slowly turn the crankshaft through at least five revolutions by hand. Should it require undue effort to rotate the shaft, remove a spark plug from each cylinder to determine whether oil or gasoline has collected in the cylinders. Should any accumulation of oil or gasoline be found in the cylinders, the cause must be determined and remedied at once.

After the starting preparations have been completed, the engine should be started as follows:

Wrap the starting rope around the starter drum in a counter-clockwise direction.

Depress the manual starter rod handle; turn the drum slightly while the handle is being depressed; and, then, maintain a light tension to keep the starter gear engaged.

Turn the ignition switches to "ON" position.

Pull the rope through to spin the crankshaft. If the engine does not start at the first pull, repeat the process.

As soon as the engine starts, check the oil pressure gage to see that oil is being circulated under pressure.

CAUTION

If the gage does not register normal pressure (55-65 pounds) within 30 seconds after starting, the engine must be stopped immediately and the cause of the trouble determined.

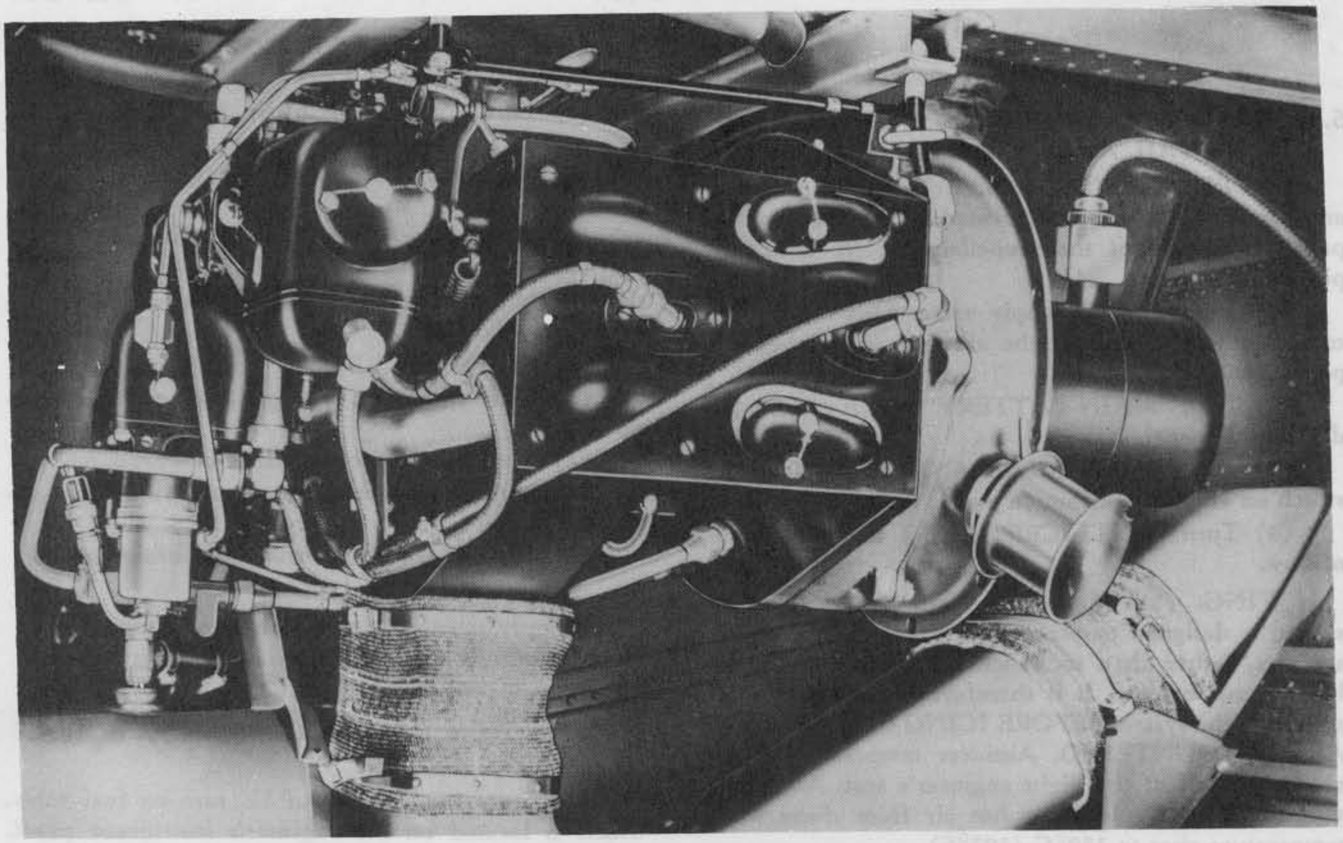


Figure 60—Central Heater

Figure 61—Auxiliary Power Unit

The engine will not attain its rated rpm immediately after starting because a thermostat in the crankcase is connected through a system of linkage to make the governor ineffective until the engine is thoroughly warmed up.

The following operating limits should not be exceeded: Head temperature 274° C (525° F), Oil temperature 88° C (190° F).

APPENDIX I

FLIGHT OPERATING CHARTS, TABLES CURVES AND DIAGRAMS

1. USE OF FLIGHT OPERATION INSTRUCTION CHARTS.

Flight Operation Instruction Charts include information concerning attainable range, and recommended power plant control settings for various combinations of gross weight, fuel load, altitude, and air speed. To avoid misuse or misinterpretation of the charts, cognizance should be taken of the following items:

a. The charted ranges make no allowance for starting, warm-up, take-off, and climb. Fuel consumed during these operations should be obtained from the Take-off, Climb, and Landing Chart. *(See figure 66 or 67.)* The horizontal miles flown in climbing to altitude have not been added to the range; likewise, no account has been taken of the greater mileage per gallon obtained during descent. No accounting of this latter factor is needed as it will approximately balance the fuel required for the landing operation.

b. The operating data included on any one chart should be used only when the gross weight is within the limits specified in the title block. *This is essential because ranges have been computed on this basis.* Ranges shown on the single-engine charts which list one propeller feathered as an external load item, are based on the conservative assumptions that the feathered propeller is Number 1 and that it is feathered the entire distance.

c. All data have been based on the maximum weight for which the chart is applicable. When gross weight is within the chart weight limits and less than the maximum (because of lighter initial weight or diminished fuel load), the air speed should be slightly greater than that listed on the chart. For conservatism, no account has been taken of this factor.

d. Experience has indicated that it is necessary to reduce reliable flight test range data by 5 percent to account for variations in service airplanes and in operating technique. These allowances have been made on the Flight Operation Instruction Charts by a corresponding increase in fuel consumption. *No allowance has been made for wind, navigational error, or other contingencies. No allowance has been made for combat or formation flight. Appropriate allowances for these items should be dictated by local doctrine.* The fuel quantity used in entering the charts, therefore, should be the fuel available after reaching flight altitude, less allowances appropriate for the mission.

2. FLIGHT PLANNING.

a. The following outline may be used as a guide to assist personnel in the use of Flight Operation Instruction Charts for flight planning purposes.

(1) Select the Flight Operation Instruction Chart with the gross weight limits which correspond to the gross weight of the airplane at take-off.

(2) Locate the largest figure entered under "GPH" (gallons per hour) in Column I ("Maximum Continuous") on lower half of chart.

(3) Multiply this figure by the number of hours desired for reserve fuel.

(4) Add the resulting figure to the number of gallons of gasoline required for starting, warm-up, take-off, and climb to the desired altitude. (See Take-off, Climb, and Landing Charts, figures 66 or 67.)

(5) Before starting the engines, subtract the above total from the number of gallons of fuel in the airplane. The figure obtained as a result of this computation will represent the amount of gasoline available for flight-planning purposes in the column headed "FUEL" on the "RANGE IN AIR MILES" section of the Flight Operation Instruction Chart.

(6) Select a figure listed in the fuel column equal to (or the next entry less than) the amount of available fuel as determined above.

(7) Read horizontally to the right or to the left, and select a range figure equal to (or greater than) the number of air miles (with no wind) to be flown. To convert for wind, determine what percent of the true air speed for the "no wind" condition is wind velocity, and reduce or increase the range by the same percentage.

(8) Read the operating data ("RPM," "MP," "MIXTURE," "GPH," and "MPH," or "KTS") vertically below the column "Range in Air Miles" and opposite the desired standard pressure altitude in the SAME NUMBERED COLUMN in which the above range figure appears. Operating values contained in the column in which the range figure appears will give the highest cruising speed possible at the desired range. However, the airplane may be flown using the operating data in any column of a higher range (higher column number). This will complete the flight plan at a sacrifice of speed but with an increase in fuel economy.

Note

The conditions having been picked off, the rpm is set first (in part throttle operation), and then manifold pressure is varied to give the desired air speed. At charted air speed and rpm the manifold pressure will be high in hot weather and low in cold weather, when compared with listed values. *Do not increase manifold pressure more than 2 inches above the tabulated value without raising the rpm.* In full-throttle operation, vary rpm to obtain desired air speed.

(9) The airplane and engine operating data tabulated below the "RANGE IN AIR MILES" figures in columns II, III, and IV are calculated to give constant miles per gallon at any standard pressure altitude listed, and at any gross weight. Ranges given

in column I ("MAXIMUM CONTINUOUS") and the range figures given in column V ("MAXIMUM AIR RANGE") are based on the altitude which gives the fewest miles per gallon.

(10) As the flight progresses and fuel is used, the airplane becomes lighter. *When the gross weight becomes less than the minimum limit specified on the chart being used, read the operating data from the column having the same number on the chart of the next lowest weights.* The approximate time (in hours) after take-off, when this transition occurs, can be found by taking the difference between the take-off gross weight and the minimum weight specified on the operation chart and by dividing by 6 times the gallons per hour. This information is listed with the operating data in the same numbered column selected, and at the altitude the flight is to be made. When a more accurate calculation is desired, the weight of fuel used in climb (6 times the number of gallons) should be subtracted from the take-off gross weight, and the time to climb added to determine the transition point after take-off. If the flight is of great duration, make this change in operating data several additional times; that is, as soon as the gross weight of the airplane falls into the next weight region. However, the total distance flown is the range first chosen.

(11) To approximate the flight duration in hours (no wind), divide the chosen air miles by an average of the true air speeds at which the flight is to be made. To allow for wind, change the above true air speeds to true ground speeds and, with the aid of a flight calculator or a navigator's triangle of velocities, divide the air miles by an average of the true ground speeds to get the duration in hours.

(12) Within the limits of the airplane, the fuel and the flying time required for a given mission depend largely on the speed desired. With all other factors remaining equal, speed is obtained at a range sacrifice, and range is obtained at a speed sacrifice. The speed is usually determined after considering the urgency of the flight plotted as against the range required. Deduct the calculated flight duration (in hours) from the desired arrival time to obtain the take-off time.

b. If the flight plan calls for a continuous flight, with the desired cruising power and air speed reasonably constant after take-off and climb, the required fuel and the flight time may be computed as a "single section flight."

c. If the original flight plan calls for a mission requiring changes in altitude, power, speed, and gross weight, or if one engine fails in flight, break down the total flight into a series of sections. Then put them together to make up the total flight and its requirements. Figure 69 (sheets 1 through 4) are charts for single-engine operation.

d. EXAMPLE.

Given Conditions:

Gross weight at take-off, 32,000 lb.

Gallons of fuel in the airplane, 1200 U.S. (999 Imp) gallons.

Range, 1,000 nautical miles.

Standard Pressure Altitude, 5,000 feet.

Reserve fuel, ½ hour at normal rated ("Maximum Continuous") power.

(1) Select the Flight Operation Instruction Chart with "CHART WEIGHT LIMITS: 32,000 to 30,000 POUNDS. *(See figure 68, sheet 2.)*

(2) The largest figure entered under "GPH" in column I is 283 U.S. (234 Imp) gallons per hour.

(3) Multiply 283 by ½ to obtain 141.5 (use 140 US) (117 Imp) gallons for reserve fuel.

(4) Refer to the Take-off, Climb and Landing Chart, figure 66, and pick out 85 US (71 Imp) gallons of fuel used for starting, warm-up, take-off, and climb to 5,000 feet altitude. Add 85 to 140 to obtain 225 US (188 Imp) gallons.

Note

The Take-off, Climb and Landing Charts list data for three variations of gross weight loading. Data for intermediate gross weights may be obtained by interpolation, but the heavier weight given should be used for conservatism.

(5) Subtract 225 US (188 Imp) gallons from 1200 US (999 Imp) gallons to obtain 975 US (811 Imp) gallons of fuel available for flight planning.

(6) In the column headed "FUEL," select 900 as the figure to be used for obtaining the range desired.

(7) Move horizontally to the right and read 1020 nautical (1170 statute) miles in column III for the range figure nearest the desired range of 1000 nautical miles.

(8) Read vertically below and opposite 5000 feet standard pressure altitude, the operating data in turn to be 2050 RPM, 31.5 MP, AL Mixture, 111 US (93 Imp) GPH, and 144 MPH (125 KTS) True Air Speed.

(9) Determine when the operating data should be changed to conform with that given on the chart of the next lowest weight limits (30,000 to 28,000 pounds, figure 68, sheet 3) by subtracting the weight of fuel used to climb (6 lb to the gal X 85 US gal = 510 lb) from the take-off gross weight to obtain 31,490 pounds. Subtract 30,000 pounds (minimum weight limit specified on chart) from 31,490 pounds and divide the difference of 1490 pounds by 6 times the fuel flow 1490 ÷ (6X111) = 2.24 hours, or 2 hours, 15 minutes. Add the time required to climb (9 minutes) to obtain 2 hours 24 minutes, or 2.4 hours, for the transition point time.

(10) Go to the chart of the next lowest gross weight limits (30,000 to 28,000 pounds) and under column III opposite 5,000 feet standard pressure altitude read in turn 2050 RPM, 31.5 MP, AL Mixture, 113 US GPH, and 148 MPH (128 KTS).

3. CRUISING CONTROL CHART. *(See figure 70.)*

The Cruising Control Chart is divided into four sections, namely Density Altitude, Air-speed Conversion, Power Settings, and Weight Correction. An analysis of each section as given below reveals the facts on which the chart is based, also how each contributes to the make-up and use of the complete chart.

a. DENSITY ALTITUDE.—Density Altitude describes the mass per unit volume of air at a standard pressure and temperature. Standard air at sea level has been accepted by agreement to have a temperature of 15° C (59° F) at a barometric pressure of 29.92 inches of mercury, or 1013 millibars. Air is a gas and its density varies with pressure and temperature. Since the physical properties of air vary with changes in altitude, standard air must also specify the conditions for each altitude above and below sea level. Thus, it has been assumed that the temperature decreases 1° C for every 504.6 feet increase in altitude above sea level up to a height of 35,332 feet, where the temperature is —55° C (—67° F). Above this altitude, the air is assumed to retain a constant temperature of —55° C. Standard air has therefore been defined and the physical relationships may be found in any Standard Atmosphere Table. Reference is made to N.A.C.A. Technical Report No. 218.

Usually, actual air differs from the calculated standard air. In order that the air density may be determined, a comparison must be made with conditions where the air density is already known. This is done by comparing the density of the air through which the flight is being made with the density of the air at a given pressure altitude when the temperature is standard.

The altimeter is set to a barometric pressure of 29.92 in. Hg, which is the barometric pressure at sea level at standard temperature, and the pressure altitude is then read. In this case, the pressure altitude reading represents the pressure due to the weight of the air above the altitude at which the flight is being made. Since the pressure altitude has been determined at standard temperature, and also because the density of the air under these conditions is known, a starting point has been established and the other factor, temperature, which affects density, may now be considered.

At standard temperature, the pressure altitude and density altitude are the same, and the air has a certain known density. When the temperature is higher than standard, the air expands and becomes less dense, and thus the density altitude is greater than the pressure altitude. Conversely, when the temperature is lower than standard, the air contracts and becomes more dense, and the density altitude is lower than the pressure altitude. Examples from figure 62 may help to clarify the use of the pressure altitude to density altitude conversion chart included on the left side of the composite cruising control chart.

Example 1.

Pressure Altitude = 4000 ft
Air Temperature = 47° C (117° F)
Density Altitude = 8500 ft

Example 2.

Pressure Altitude = 10,000 ft
Air Temperature = —32° C (—26° F)
Density Altitude = 6500 ft

Note

Pressure altitude is the altimeter reading when the barometric scale on the instrument is set to 29.92 in. Hg (1013 millibars). *By correcting the pressure altitude for temperature, the density of the air through which the flight is being made is determined and is expressed in terms of density altitude.*

The performance of the airplane (lift, drag, speed, power required, and power available) depends upon the density of the air. All aerodynamic calculations and all aerodynamic charts of the cruising control type are usually based upon standard conditions and, therefore, *the pressure altitude must be converted to density altitude for the proper use of the cruising control and other aerodynamic charts.*

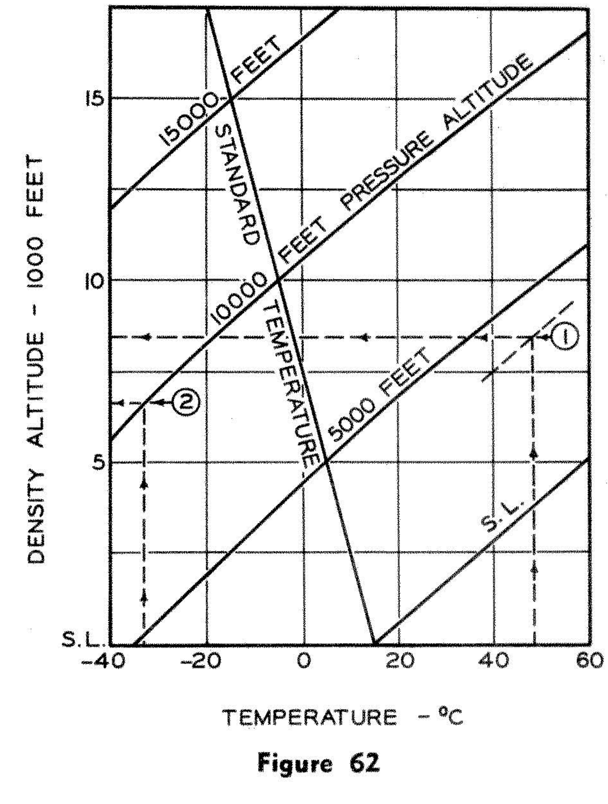


Figure 62

b. AIR-SPEED CONVERSION.—The next section of the chart to be considered is that portion dealing with the air-speed conversion. This is the main body of the cruising control chart directly to the right of the pressure altitude conversion chart. The vertical lines represent the true indicated (calibrated) air speed with the scale given at the top of the chart. The true air speed, or the speed in relation to the surface of the earth with no wind, is represented by the light diagonally curved lines sloping from the top left side of the chart to the lower right side of the chart. At sea level at standard temperature, the true air speed and true indicated air speed are the same.

This portion of the cruising control chart facilitates the conversion of true indicated air speed into true air speed as shown by the examples taken from figure 63.

(1) EXAMPLES.

Example 1.

True Indicated Air Speed = 110 knots
Density Altitude = 3000 ft
True Air Speed = 115 knots

Example 2.

True Indicated Air Speed = 135 knots
Density Altitude = 8000 ft
True Air Speed = 152 knots

The pilot's air-speed indicator reading must be corrected for installation and instrument errors to obtain true indicated air speed as given on the cruising control chart.

The conversion of indicated air speeds to calibrated air speeds results in making proper allowances for the effect of the disturbed flow of air around the pitot-static tube, and for the mechanical errors of the pitot-static tube and indicator. If there were no mechanical errors in the pitot-static tube and indicator, and if the pitot-static tube could be projected far enough forward of the airplane to reach a point where it would meet undisturbed air under all flight conditions, the necessity for calibrating air-speed indicator installations would cease to exist. It would then be possible to apply density corrections directly to the indicated air speed as read from the face of the air-speed indicator.

A typical air-speed installation correction table is given in section III. The error of the instrument of each airplane must be added or subtracted to this table for the final correction. Flight tests on each airplane should be conducted for an accurate calibration of the air-speed indicator.

(2) DEFINITIONS.

(a) INDICATED AIR SPEED.—Indicated air speed is the reading or indication of the air-speed indicator.

(b) TRUE INDICATED (CALIBRATED) AIR SPEED.—True indicated (calibrated) air speed is the reading of the air-speed indicator corrected for instrument and installation errors.

Note

The term "True Indicated Air Speed" is used on all charts in this appendix.

(c) TRUE AIR SPEED.—True air speed is the actual speed of the airplane with respect to the air, or the true indicated air speed corrected for effect of air density and compressibility. True air speed is identical with ground speed under "No Wind" conditions.

(d) GROUND SPEED.—Ground speed is the actual speed of the airplane with respect to the ground. This value includes the effect of the wind.

c. POWER SETTINGS.—The power lines are the heavy lines sloping toward the left superimposed on the air-speed conversion chart. These power lines give the power settings (rpm and manifold pressure), the fuel consumption in pounds per hour, and the speed-power relationship for the airplane.

The power settings given are recommended for obtaining the maximum efficiency from the engines

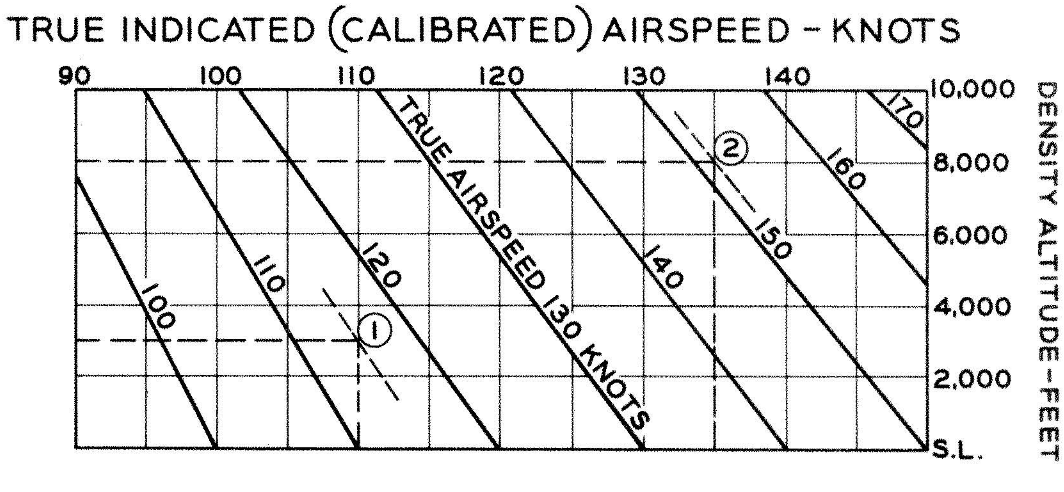


Figure 63

with a minimum amount of wear, and the optimum rpm considering propeller efficiency and specific fuel consumption in order that the resulting miles per gallon may be as high as possible. A relatively high rpm and low manifold pressure setting is easier on the engine; however, the engine will not develop the power of which it is capable and will have an excessive fuel consumption. On the other hand, a relatively low rpm and high manifold pressure setting will build up higher pressures within the cylinders than the engine is designed to withstand, and this will result in detonation and possibly blown cylinder heads, etc. It is evident that a compromise must be made between the rpm and manifold pressure settings to obtain the best performance, and, therefore, the power settings on the cruising control chart were determined for this purpose.

d. WEIGHT CORRECTION.—The fourth and last section comprising the cruising control chart includes the weight correction lines underneath the air-speed conversion section. The power lines mentioned above give the speed-power relationship only for the gross weight at which the chart is based. Consequently, corrections have to be made for variations in gross weight. The chart is based upon a gross weight of 24,000 pounds establishing the base line. The weight correction lines are applicable for any range of gross weights from 24,000 to 34,000 pounds.

The method for using the weight variation lines to correct for gross weight is illustrated in figure 64.

Increasing the weight increases the lift required to maintain the airplane in level flight. This in turn increases the angle of attack, thus increasing the drag reducing the speed for the same amount of power or increasing the power required to fly at the same speed. It is necessary, therefore, to adjust for gross weight to obtain the correct air speed or power.

The gross weight of an airplane in flight will decrease as the fuel is burned. This decrease in weight will increase the speed for a given power setting. If a constant air speed is desired, less power is required as the gross weight decreases. For steady cruising, it should not be necessary to set power oftener than each hour; every three hours will probably be satisfactory.

Combining the four sections as shown below, one may see the basis on which the composite cruising control chart is established.

Chart for Density Altitude	Power Required Curves Plotted on Background of Air-Speed Conversion Due to Altitude
	Chart for Weight Correction

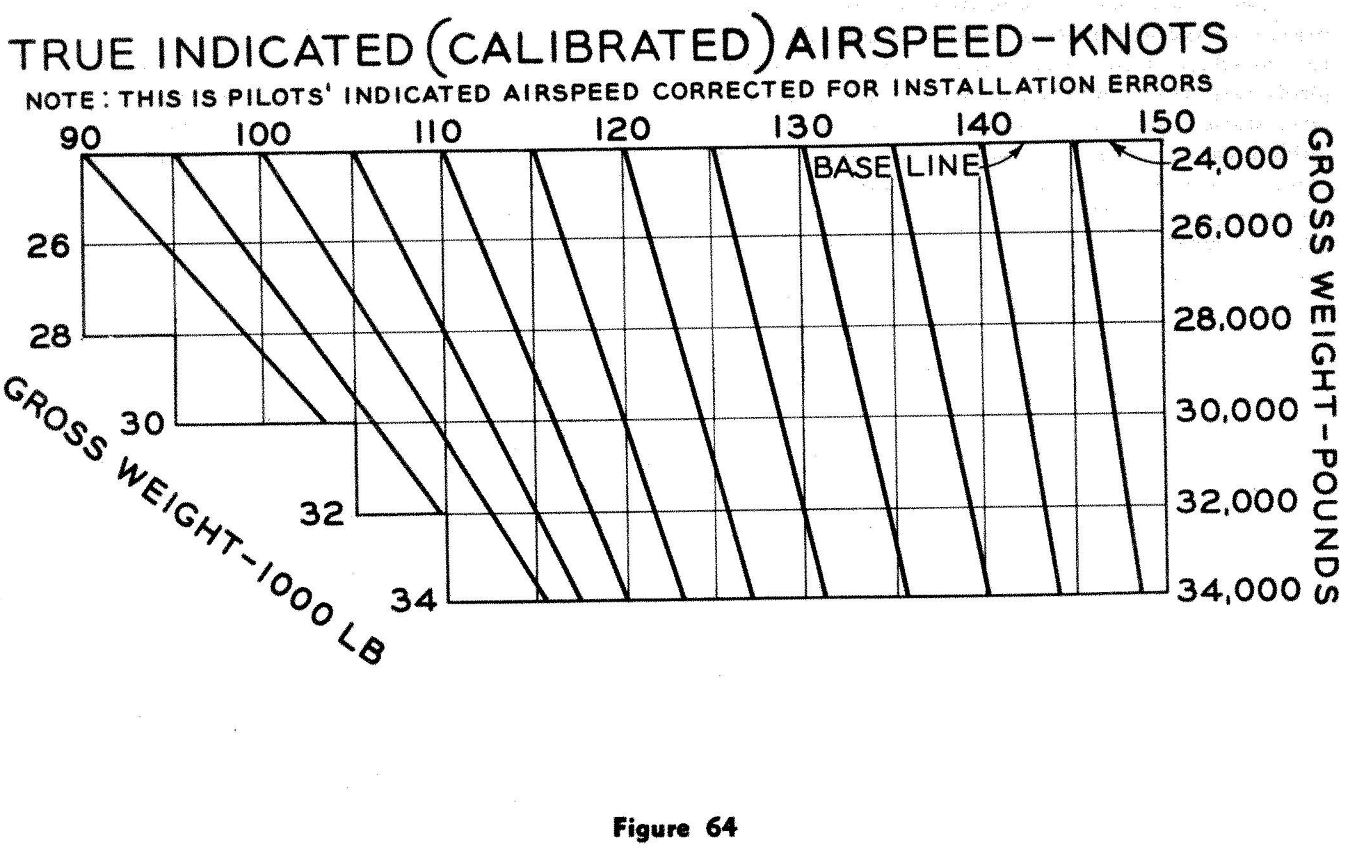


Figure 64

e. INSTRUCTIONS FOR USING THE CRUISING CONTROL CHART.—The Cruising Control Chart will give the power required to fly at a desired air speed or at the air speed for a selected power. Thus two methods may be employed in using the cruising control chart, depending upon which conditions of flight are chosen. Both methods are illustrated in the examples given below and in figure 65.

Case 1.

To determine Power Required for Any Desired Air Speed at Any Gross Weight and Any Altitude.

Solution:

Enter chart at outside air temperature (A) and follow arrows to pressure altitude (B), determining density altitude. Follow arrows horizontally across to desired or selected air speed (C). Project vertically down to base line at (D). Follow slope of weight variation lines to gross weight at (E). Project vertically up to density altitude at (F). True air speed and true indicated air speed are read at (C). The power required, fuel flow, rpm, and manifold pressure are found at (F).

Case 2.

To Determine Air Speed for Any Desired Power at Any Gross Weight and Any Altitude.

Solution:

For this method the procedure is just the reverse of that given in case (1), except for steps (A) and (B), which are used for determining the density altitude. In this case, the desired power is known at (F). Reverse the directions of the arrows, projecting vertically down to gross weight at (E), and following the slope of the weight variation lines to the base line at (D). Project vertically up to the density altitude at (C), and read true air speed or true indicated air speed.

f. EXAMPLES FOR ILLUSTRATING THE USE OF MODEL PBY-6A CRUISING CONTROL CHART.—On the chart, the manifold pressures are represented by the curved dotted lines in the auto-lean area and are given at increments of 5000 feet in the auto-rich region. As no control of the manifold pressures can be maintained when operating at full throttle, the manifold pressures in the area above the full throttle line are given as an indication of the

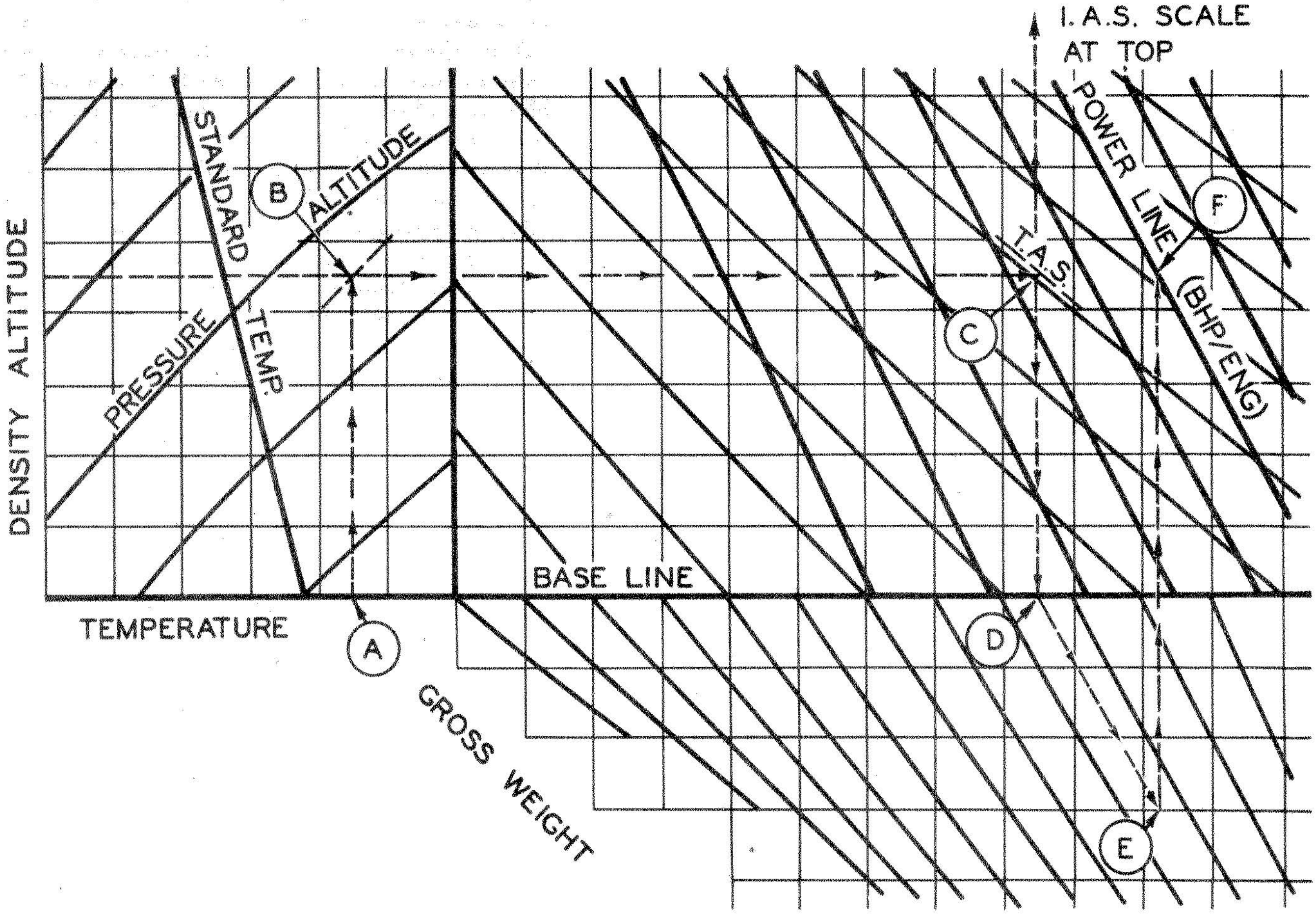


Figure 65

value of the gage reading at standard conditions and at the particular altitude, rpm, and brake horsepower shown on the chart.

The horsepower output of an engine is influenced by a great many factors. Only the three primary components of rpm, manifold pressure, and altitude are of paramount importance to the pilot. For a given rpm an engine will produce a certain amount of power, at a particular manifold pressure at sea level. As the altitude is increased, the same amount of power may be maintained by advancing the throttle a certain degree, which results in a new but lower manifold pressure, as shown on the cruising control chart. This procedure is repeated until no further advance in throttle position can be obtained, or until the throttle is fully open. The highest altitude at which a particular rpm and full throttle will give the same horsepower as the same rpm and part throttle at sea level is termed the critical altitude. Any further increase in altitude will result in a loss of horsepower and decrease in manifold pressure. Thus, to maintain the same horsepower at a higher altitude than the critical altitude for the first rpm, a shift to a higher rpm must be made. This process is continued as the altitude is increased until a limiting rpm is reached, such as 2550 rpm.

To illustrate, take for example the "600 BHP/ ENG" power line on the chart. At part throttle for any altitude from sea level to 7500 feet density altitude, the recommended rpm is given along the power line at 1860. To obtain 600 brake horsepower per engine at sea level, the throttle will be set to give 33.3 inches on the manifold pressure gage. If 700 brake horsepower is required at 2000 feet density altitude, the throttle will be set to give a gage reading of 32.7 inches. Thus, the manifold pressure is obtained by interpolating between the 32.0-inch manifold pressure line at 4000 feet density altitude and the 33.0-inch manifold pressure line at 1,000 feet. At 7500 feet density altitude, full throttle operation will result, and for 1860 rpm the manifold pressure will be 30.75 inches. This is also the critical altitude for 1860 rpm and 600 brake horsepower; therefore, to maintain 600 brake horsepower at density altitude higher than 7500 feet, a higher rpm must be used.

The new rpm is obtained from the constant rpm lines sloping from the top left to the lower right of the full throttle area on the chart. Thus, it can be seen on the chart that the 1950 rpm line intersects the 600 horsepower line at 10,000 feet density altitude, and the 2150 rpm line intersects the 600 horsepower line at 14,250 feet density altitude. If 600 horsepower is required at 12,500 feet density altitude, the correct rpm can be found by estimating or interpolating between the two rpm lines. In this case, this will be 2070 rpm. Thus at standard conditions and at the particular density altitude of 12,500 feet, 2070 rpm will result in 600 brake horsepower per engine at full throttle, and the manifold pressure will be approximately 27.5 inches Hg. Operation in auto-lean is permissible up to 2550 rpm and 700 bhp, provided 232° C (450° F) cylinder head temperature is not exceeded. Consequently, at 17,800 feet density altitude, the operating limit in auto-lean is reached for 700 brake horsepower.

Example 1.

Find power settings (brake horsepower per engine, rpm, manifold pressure, and fuel consumption), true indicated air speed, true air speed, and pilot's air-speed indicator reading for flying maximum range at 2000 feet pressure altitude, and outside air temperature at 23° C (73.4° F), at a gross weight of 30,000 lbs.

Solution:

Enter chart at outside air temperature of 23° C (73.4° F) and project vertically to pressure altitude of 2000 feet, determining density altitude of 3400 feet. Refer to the lower left corner of the chart; find the dotted line presenting the speed for maximum range, and enter at the intersection of the density altitude with the "Speed for Maximum Range" line. Project vertically down to base line and follow slope of weight variation line to 30,000 lbs, then project vertically up to 3400 feet density altitude and interpolate the brake horsepower per engine to be 530 bhp. Adjust the rpm to give a tachometer reading of 1640 by interpolating between 1700 rpm for 550 bhp, and 1550 rpm for 500 bhp. By referring to the "Standard Temperature" line, it can be seen that at 2000 feet pressure altitude the standard temperature should be 11° C (51.8° F). Actually, the airplane is flying in air which is 12° C (21.6°F) above standard. Assuming that the carburetor air temperature is the same as the outside air temperature, a correction for manifold pressure has to be made. A safe rule to observe is to increase manifold pressure 0.5 in. for each 6° C (10.8° F) rise (decrease 0.5 in. for each 6° C drop) of carburetor air temperature from standard. *This applies for part throttle operation only. Do not increase manifold pressure more than 2 in. without raising the rpm.* Consequently, as the air is 12° C (21.6° F) above standard and part throttle is being used, the manifold pressure should be adjusted for a 1.0 in. increase above the value of 32.3 in., as interpolated on the chart, or 33.3 in. for the gage reading. The fuel consumption, like the rpm is interpolated to be 76 gallons per hour. To find the true indicated air speed, read 103 knots at the intersection of the 3400-foot density altitude with the "Speed for Maximum Range" line. True air speed at 3400 feet density altitude is determined to be 108 knots (93.8 mph). To find the pilot's air-speed indicator reading, turn to the air-speed installation correction table given in section III. This table shows the instrument readings to be lower than the true indicated air speed. Therefore, the true indicated air speed is obtained by adding the correction to the instrument reading. Thus, the true indicated air speed obtained from the Cruising Control Chart will be greater than the instrument reading. To find what the instrument reading should be, it is necessary to subtract from the figure obtained on the Cruising Control Chart. In this case, subtract 6 knots for the position error from 103 to obtain 97 knots. The instrument error, depending upon the calibration of the indicator in each airplane, must also be added or subtracted to obtain the final figure. Jockey the power slightly as required, to obtain the airspeed indicator reading. Air speed will be low in hot weather, and high in cold, when compared to charted values. In part throttle operation, increase manifold pressure to increase speed, and in full throttle operation, increase speed by increasing rpm.

Example 2.

Find the air speed for a power setting of 2450 rpm and full throttle at a density altitude of 9600 feet and a gross weight of 28,000 lb.

Solution:

By looking at the chart, it can be seen that at 9600 feet density altitude and full throttle, 2450 rpm will give 900 brake horsepower per engine. Projecting vertically down to 28,000 lb gross weight, then parallel to the weight variation lines up to the base line, and finally vertically up to 9600 feet density altitude will give a true air speed of 151 knots (131.2 mph) and a true indicated air speed of 131 knots (113.8 mph).

4. ENGINE CALIBRATION CURVES.

(See figure 71.)

These curves can be used to set operating conditions or to determine engine power at any operating condition within the recommended operating limits of the engine. The horizontal dot-dash line indicates the limit for "AUTO-LEAN" mixture operation. Use "AUTO-RICH" mixture above this line. Part throttle conditions are those to the left of the oblique heavy dashed line, full throttle conditions are those to the right of these lines.

High Power — "A U T O - R I C H" Mixture (Part Throttle).

When high power climb is desired, operate along one of the constant manifold pressure-RPM lines (sloping lines labeled with manifold pressure and RPM). For constant rated power climb use 42 in. Hg at sea level, decreasing to 40 in. Hg at 5000 feet.

Select level flight condition from a point on one of the designated lines, or, if an intermediate condition is desired, any manifold pressure—RPM combination represented in the full throttle portions of the chart can be used for part throttle operation.

Cruising Power — "AUTO-LEAN" Mixture (Part Throttle).

For power conditions below the dot-dash line, the maximum recommended manifold pressures are independent of RPM.

To Determine Horsepower—Any Power Condition.

Knowing RPM and manifold pressure, spot the condition in the full throttle portion of the section of the chart.

Draw a line through the point determined parallel to the constant manifold pressure—RPM lines shown. Read horsepower at the intersection of this line with the observed pressure altitude. Correct horsepower in accordance with carburetor air temperature (on airplanes not equipped with carburetor air temperature gages use outside air temperature) by applying the following:

Add 1 percent for each 6°C (10.8°F) decrease of carburetor air temperature from the standard temperature for the observed pressure altitude.

Subtract 1 percent for each 6°C (10.8°F) rise of carburetor air temperature from standard.

★ ★ ★

AAFMC-527 4-1-44

AIRCRAFT MODEL(S) PBY-6A

ENGINE MODEL(S) R-1830-92

TAKE-OFF, CLIMB & LANDING CHART

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND M.P.H.	HEAD WIND KTS.	HARD SURFACE RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.
28,000	0	0	1100	2160	1290	2480	1550	2960	1180	2240	1400	2570	1670	3100	1450	2510	1730	2900	2110	3540
	12	10	820	1710	990	1965	1180	2375	870	1760	1070	2045	1270	2465	1080	1970	1320	2295	1610	2805
	23	20	650	1405	780	1610	950	1970	690	1445	840	1670	1020	2040	850	1605	1040	1870	1290	2310
	35	30	510	1150	620	1325	760	1615	550	1160	670	1375	820	1675	680	1320	830	1535	1040	1895
31,000	0	0	1410	2800	1640	3185	1930	3850	1540	2950	1780	3305	2140	4060	1940	3330	2300	3845	2880	4800
	12	10	1060	2225	1260	2660	1490	3105	1160	2325	1350	2650	1650	3265	1460	2625	1760	3060	2220	3835
	23	20	850	1840	1000	2100	1160	2530	930	1920	1080	2180	1290	2660	1170	2160	1410	2510	1740	3110
	35	30	680	1510	810	1820	980	2130	740	1570	860	1870	1080	2230	930	1760	1130	2140	1460	2610
34,000	0	0	1750	3590	2060	4120	2420	5065	1960	3800	2200	4260	2750	5395	2640	4480	3080	5140	3950	6595
	12	10	1340	2905	1590	3320	1890	4120	1500	3065	1700	3430	2140	4370	2020	3585	2380	4110	3080	5310
	23	20	1070	2380	1240	2710	1540	3430	1200	2510	1330	2800	1750	3640	1610	2920	1860	3330	2510	4400
	35	30	860	1980	1050	2280	1220	2800	970	2070	1120	2350	1380	2960	1300	2400	1560	2790	1980	3560

NOTE: INCREASE CHART DISTANCES AS FOLLOWS: 75°F + 10%; 100°F + 20%; 125°F + 30%; 150°F + 40%

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

OPTIMUM TAKE-OFF WITH 2700 RPM, 48 IN.HG. & 0 DEG.FLAP IS 80% OF CHART VALUES

CLIMB DATA

GROSS WEIGHT LB.	AT SEA LEVEL BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	GAL. OF FUEL USED	AT 5000 FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED	AT 10,000 FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED	AT 15,000 FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED	AT 20,000 FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED	AT FEET BEST I.A.S. MPH	KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FUEL USED
28,000	89	77	890	50	89	77	835	6.0	75	89	77	680	12.2	100	89	77	425	21.2	130	89	77	170	37.9	195					
31,000	93	81	740	50	93	81	690	7.25	80	93	81	530	14.9	110	93	81	280	27.3	155										
34,000	98	85	610	50	98	85	560	8.9	85	93	85	400	18.5	120	98	85	150	36.7	190										

POWER PLANT SETTINGS: (DETAILS ON FIG. SECTION III):

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

FUEL USED (U.S.GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST IAS APPROACH POWER OFF MPH	KTS	POWER ON MPH	KTS	HARD DRY SURFACE AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	FIRM DRY SOD AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	WET OR SLIPPERY AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.
26,000	83	72	77	67	980	2250	1080	2410	1170	2590	1150	2415	1250	2590	1370	2780	3900	5160	4260	5600	4680	6090
34,000	95	82	88	76	1290	2800	1410	3000	1540	3240	1500	3020	1650	3160	1800	3500	4580	6100	5000	6600	5480	7160

DATA AS OF OCT. 1944 BASED ON: CALCULATIONS

OPTIMUM LANDING IS 80% OF CHART VALUES

REMARKS:

NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS, MULTIPLY BY 10, THEN DIVIDE BY 12

LEGEND

I.A.S. : INDICATED AIRSPEED
M.P.H. : MILES PER HOUR
KTS. : KNOTS
F.P.M. : FEET PER MINUTE

Figure 66 — Take-off, Climb and Landing Chart, Operation on Land

AAFMC-527
4-1-44

AIRCRAFT MODEL (S)
PBY-6A

TAKE OFF, CLIMB & LANDING CHART
OPERATION AS SEAPLANE

ENGINE MODEL (S)
R-1830-92

NUMBER OF ENGINES OPERATING: 2

TAKE-OFF DISTANCE FEET
TAKE-OFF TIME SECONDS

GROSS WEIGHT LB.	HEAD WIND		FROM WATER					
			AT SEA LEVEL			AT 3000 FEET		
	M.P.H.	KTS.	RUN	TIME IN SEC.	TO CLEAR 50' OBJ.	RUN	TIME IN SEC.	TO CLEAR 50' OBJ.
28,000	0	0	2040	34	3100	2190	38	3360
	12	10	1360	28	2250	1510	31	2485
	23	20	905	23	1660	1080	26	1910
	35	30	550	18	1190	700	21	1405
31,000	0	0	2440	45	3830	2690	51	4235
	12	10	1700	38	2865	1975	44	3275
	23	20	1180	31	2170	1350	36	2450
	35	30	690	24	1520	850	29	1860
34,000	0	0	4625	65	6465	5125	73	7185
	12	10	3310	55	4875	2660	61	4390
	23	20	2225	45	3535	2440	50	3910
	35	30	1340	35	2440	1560	40	2790

NOTE: INCREASE CHART DISTANCES AS FOLLOWS: 75° F + 10%; 100° F + 20%; 125° F + 30%; 150° F + 40%;
DATA AS OF APRIL, 1945 BASED ON: CALCULATIONS
OPTIMUM TAKE-OFF WITH 2700 RPM. 48 IN. HG. & 0 DEG. FLAP IS 80% OF CHART VALUES
0 HEADWIND IS ASSUMED TO BE COEXISTENT WITH A CALM SEA

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST IAS APPROACH				ON WATER			
	POWER OFF		POWER ON		AT SEA LEVEL		AT 3000 FEET	
	M.P.H.	KTS	M.P.H.	KTS	ON THE STEP	TO CLEAR 50' OBJ.	ON THE STEP	TO CLEAR 50' OBJ.
26,000	83	72	77	67	1400	2670	1450	2780
34,000	95	82	88	76	2160	3670	2250	3840

DATA AS OF APRIL, 1945 BASED ON: CALCULATIONS
OPTIMUM LANDING IS 80% OF CHART VALUE

CLIMB DATA

GROSS WEIGHT LB.	AT SEA LEVEL				AT 5000 FEET					AT 10,000 FEET					AT 15,000 FEET					AT 20,000 FEET				
	BEST I.A.S.		RATE OF CLIMB	GAL. OF FUEL	BEST I.A.S.		RATE OF CLIMB	FROM SEA LEVEL		BEST I.A.S.		RATE OF CLIMB	FROM SEA LEVEL		BEST I.A.S.		RATE OF CLIMB	FROM SEA LEVEL		BEST I.A.S.		RATE OF CLIMB	FROM SEA LEVEL	
	M.P.H.	KTS.	F.P.M.	USED	M.P.H.	KTS.	F.P.M.	TIME MIN.	FUEL USED	M.P.H.	KTS.	F.P.M.	TIME MIN.	FUEL USED	M.P.H.	KTS.	F.P.M.	TIME MIN.	FUEL USED	M.P.H.	KTS.	F.P.M.	TIME MIN.	FUEL USED
28,000	89	77	890	50	89	77	835	6.0	75	89	77	680	12.2	100	89	77	425	21.2	130	89	77	170	37.9	195
31,000	93	81	740	50	93	81	690	7.25	80	93	81	530	14.9	110	93	81	280	27.3	155					
34,000	98	85	610	50	98	85	560	8.9	85	93	85	400	18.5	120	98	85	150	36.7	190					

POWER PLANT SETTINGS: (DETAILS ON FIG. 31 SECTION III):
DATA AS OF APRIL, 1945 BASED ON: CALCULATIONS

FUEL USED (U.S. GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE

REMARKS:
NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS, MULTIPLY BY 10, THEN DIVIDE BY 12.

LEGEND
I.A.S. : INDICATED AIRSPEED
M.P.H. : MILES PER HOUR
KTS. : KNOTS
F.P.M. : FEET PER MINUTE

Figure 67 — Take-off, Climb and Landing Chart, Operation on Water

AAFMC-528
4-1-44

WF-3-31-44-10M

AIRCRAFT MODEL(S) PBY-6A ENGINE(S): R-1830-92	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS NONE
	CHART WEIGHT LIMITS: 34000 TO 32000 POUNDS	NUMBER OF ENGINES OPERATING: TWO

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2700	48.0		A.R.	5 MIN	260	322

FOR DETAILS SEE POWER PLANT CHART (FIG. 31 SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING (1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)(1). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)

COLUMN I RANGE IN AIRMILES STATUTE	COLUMN I NAUTICAL	FUEL U.S. GAL.	COLUMN II STATUTE	COLUMN II NAUTICAL	COLUMN III STATUTE	COLUMN III NAUTICAL	COLUMN IV STATUTE	COLUMN IV NAUTICAL	FUEL U.S. GAL.	COLUMN V STATUTE	COLUMN V NAUTICAL
		1480							1480		
830	720	1400	1260	1090	1820	1580			1400	2080	1800
770	670	1300	1170	1010	1690	1470			1300	1910	1660
710	620	1200	1080	940	1560	1360			1200	1760	1530
650	560	1100	990	860	1430	1240			1100	1610	1400
590	510	1000	900	780	1300	1130			1000	1450	1260
530	460	900	810	700	1170	1020			900	1300	1130
470	410	800	720	620	1040	900			800	1150	1000
415	360	700	630	550	910	790			700	1000	870
355	310	600	540	470	780	680			600	850	740
295	255	500	450	390	650	570			500	700	610
235	205	400	360	310	520	450			400	550	480

MAXIMUM CONTINUOUS

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
15000	2550	F.T.	A.R.	186	167	145
10000	2550	F.T.	A.R.	250	175	152
7500	2550	F.T.	A.R.	276	176	153
5000	2550	40.0	A.R.	283	174	151
2500	2550	41.0	A.R.	283	170	148
S.L.	2550	42.0	A.R.	283	167	145

COLUMN II (.90 STAT. (.78 NAUT.) MI./GAL.)

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
15000						
10000	2300	30.5	A.R.	173	156	135
7500	2300	31.5	A.R.	174	157	136
5000	2300	32.5	A.R.	169	152	132
2500	2300	32.5	A.R.	163	148	128
S.L.	2250	32.5	A.R.	159	144	125

COLUMN III (1.30 STAT. (1.13 NAUT.) MI./GAL.)

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
15000						
10000						
7500						
5000	2000	31.5	A.L.	105	137	119
2500	2000	32.5	A.L.	104	135	117
S.L.	1950	33.5	A.L.	100	130	113

COLUMN IV (STAT. (NAUT.) MI./GAL.)

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
15000						
10000						
7500						
5000						
2500						
S.L.						

COLUMN V — MAXIMUM AIR RANGE

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
15000						
10000						
7500						
5000	1850	31.5	A.L.	91	127	110
2500	1800	32.5	A.L.	90	124	108
S.L.	1750	33.5	A.L.	87	121	105

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 67) PLUS ALLOWANCE FOR WIND, RESERVE, AND COMBAT AS REQUIRED.

EXAMPLE

AT 34,000 LB. GROSS WEIGHT WITH 1300 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 180 GAL.) TO FLY 1900 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 1850 RPM AND 31.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.L.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S.GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF AUG. 1945 BASED ON: FLIGHT TEST

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 68 (Sheet 1 of 5 Sheets) — Flight Operation Instruction Chart — Two Engines

AAFMC-528
4-1-44

FLIGHT OPERATION INSTRUCTION CHART

AIRCRAFT MODEL(S)
PBY-6A

ENGINE(S): R-1830-92

CHART WEIGHT LIMITS: 32,000 TO 30,000 POUNDS

EXTERNAL LOAD ITEMS
NONE

NUMBER OF ENGINES OPERATING: TWO

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.	FOR DETAILS SEE POWER PLANT CHART (FIG.3 I SECT.III)
WAR EMERG.								
MILITARY POWER	2700	48.0		A.R.	5 MIN	260	322	

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)(1). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S.GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
		1480	SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING(1)						1480		
830	720	1400	1260	1090	1820	1580	2030	1760	1400	2160	1870
770	670	1300	1170	1010	1690	1470	1890	1640	1300	1990	1730
710	620	1200	1080	940	1560	1360	1740	1510	1200	1830	1590
650	570	1100	990	860	1430	1240	1600	1390	1100	1670	1450
590	520	1000	900	780	1300	1130	1450	1260	1000	1510	1310
530	465	900	810	700	1170	1020	1310	1140	900	1350	1170
475	410	800	720	620	1040	900	1160	1010	800	1200	1040
415	360	700	630	550	910	790	1020	880	700	1050	910
355	310	600	540	470	780	680	870	760	600	890	770
295	260	500	450	390	650	570	730	630	500	740	640
240	205	400	360	310	520	450	580	500	400	590	510

MAXIMUM CONTINUOUS						PRESS ALT. FEET	(.90 STAT. (.78 NAUT.) MI./GAL.)						(1.30 STAT. (1.13 NAUT.) MI./GAL.)						(1.45 STAT. (1.26 NAUT.) MI./GAL.)						PRESS ALT. FEET	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.		R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.		R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.
2550	F.T.	A.R.	186	170	148	15000							2300	F.T.	A.L.	115	150	130							15000						
2550	F.T.	A.R.	250	176	153	10000	2300	31.0	A.R.	178	160	139	2050	F.T.	A.L.	110	143	124							10000						
2550	F.T.	A.R.	276	179	155	7500	2300	32.0	A.R.	176	158	137	2000	31.0	A.L.	110	143	124							7500						
2550	40.0	A.R.	283	176	153	5000	2300	32.5	A.R.	173	156	135	2050	31.5	A.L.	111	144	125	1850	31.5	A.L.	93	135	117	5000	1750	31.5	A.L.	86	127	110
2550	41.0	A.R.	283	173	150	2500	2300	32.5	A.R.	168	151	131	2000	32.5	A.L.	108	141	122	1800	32.5	A.L.	90	130	113	2500	1700	32.5	A.L.	84	124	108
2550	42.0	A.R.	283	168	146	S.L.	2300	33.0	A.R.	162	146	127	2000	33.5	A.L.	104	136	118	1800	33.5	A.L.	88	127	110	S.L.	1700	33.5	A.L.	82	121	105

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 67) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 32,000 LB. GROSS WEIGHT WITH 1300 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 180 GAL.) TO FLY 1950 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 1750 RPM AND 31.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.L.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S.GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF AUG. 1945 BASED ON: FLIGHT TEST

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

WF-3-81-44-10M

Figure 68 (Sheet 2 of 5 Sheets) — Flight Operation Instruction Chart — Two Engines

AAFMC-528
4-1-44

WF-8-81-44-10M

AIRCRAFT MODEL(S) PBY-6A ENGINE(S): R1830-92	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS NONE
	CHART WEIGHT LIMITS: 30,000 TO 28,000 POUNDS	NUMBER OF ENGINES OPERATING: TWO

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2700	48.0		A.R.	5 MIN.	260	322

FOR DETAILS SEE POWER PLANT CHART (FIG. 31 SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
		1000	SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)						1000		
540	470	900	810	700	1170	1020	1310	1140	900	1380	1200
480	415	800	720	620	1040	900	1160	1010	800	1230	1070
420	365	700	630	550	910	790	1020	880	700	1070	930
360	310	600	540	470	780	680	870	760	600	910	790
300	260	500	450	390	650	570	730	630	500	760	660
270	235	450	405	350	590	510	650	570	450	680	590
240	210	400	360	310	520	450	580	500	400	600	520
210	180	350	315	275	455	395	510	440	350	530	460
180	155	300	270	235	390	340	435	380	300	450	390
150	130	250	225	195	325	280	360	315	250	375	325
120	105	200	180	155	260	225	290	250	200	300	260

MAXIMUM CONTINUOUS						PRESS ALT. FEET	(.90 STAT. (.78 NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.		R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
2550	F.T.	A.R.	186	173	150	15000						
2550	F.T.	A.R.	250	177	154	10000	2300	31.5	A.R.	183	164	142
2550	F.T.	A.R.	276	180	156	7500	2300	32.0	A.R.	180	161	140
2550	40.0	A.R.	283	177	154	5000	2300	32.5	A.R.	175	158	137
2550	41.0	A.R.	283	174	151	2500	2300	33.0	A.R.	169	152	132
2550	42.0	A.R.	283	170	147	S.L.	2300	33.0	A.R.	165	149	129

PRESS ALT. FEET	(1.30 STAT. (1.13 NAUT.) MI./GAL.)						(1.45 STAT. (1.26 NAUT.) MI./GAL.)						PRESS ALT. FEET	MAXIMUM AIR RANGE					
	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.		R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
15000	2300	F.T.	A.L.	121	158	137							15000	2100	F.T.	A.L.	93	138	120
10000	2050	F.T.	A.L.	115	150	130							10000	1850	F.T.	A.L.	89	133	115
7500	2050	31.0	A.L.	114	149	129	1850	F.T.	A.L.	96	139	121	7500	1750	F.T.	A.L.	85	130	113
5000	2050	31.5	A.L.	113	148	128	1800	31.5	A.L.	97	141	122	5000	1650	31.5	A.L.	81	127	110
2500	2050	32.5	A.L.	110	143	124	1850	32.5	A.L.	94	136	118	2500	1650	32.5	A.L.	80	124	108
S.L.	2000	33.5	A.L.	107	139	121	1850	33.5	A.L.	91	133	115	S.L.	1600	33.5	A.L.	78	121	105

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 67) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 30,000 LB. GROSS WEIGHT WITH 800 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 200 GAL.) TO FLY 1200 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 1650 RPM AND 31.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.L.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF AUG. 1945 BASED ON: FLIGHT TEST

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 68 (Sheet 3 of 5 Sheets) — Flight Operation Instruction Chart — Two Engines

AAFMC-528 4-1-44

AIRCRAFT MODEL(S) PBY-6A ENGINE(S): R-1830-92	FLIGHT OPERATION INSTRUCTION CHART CHART WEIGHT LIMITS: 28,000 TO 26,000 POUNDS	EXTERNAL LOAD ITEMS NONE NUMBER OF ENGINES OPERATING: TWO

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2700	48.0		A.R.	5 MIN	260	322

FOR DETAILS SEE POWER PLANT CHART (FIG. 3 I SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)

COLUMN I STATUTE	COLUMN I NAUTICAL	FUEL U.S. GAL.	COLUMN II STATUTE	COLUMN II NAUTICAL	COLUMN III STATUTE	COLUMN III NAUTICAL	COLUMN IV STATUTE	COLUMN IV NAUTICAL	FUEL U.S. GAL.	COLUMN V STATUTE	COLUMN V NAUTICAL
		800							800		
420	365	700	630	550	910	790	1020	880	700	1120	970
360	315	600	540	470	780	680	870	760	600	950	820
300	260	500	450	390	650	570	730	630	500	780	680
270	235	450	405	350	590	510	650	570	450	700	610
240	210	400	360	310	520	450	580	500	400	620	540
210	185	350	315	275	455	395	510	440	350	550	475
180	155	300	270	235	390	340	435	380	300	465	405
150	130	250	225	195	325	280	360	315	250	390	340
120	105	200	180	155	260	225	290	250	200	310	270
90	80	150	135	115	195	170	220	190	150	230	200
60	50	100	90	80	130	115	145	125	100	150	130

MAXIMUM CONTINUOUS; COLUMN II (.90 STAT. (.78 NAUT.) MI./GAL.); COLUMN III (1.30 STAT. (1.13 NAUT.) MI./GAL.)

PRESS ALT. FEET	MAX. CONT. R.P.M.	M.P. INCHES	MIX-TURE	TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	(.90 STAT. (.78 NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIX-TURE	TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	(1.30 STAT. (1.13 NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIX-TURE	TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
15000	2550	F.T.	A.R.	186	175	152							2300	F.T.	A.L.	125	163	141
10000	2550	F.T.	A.R.	250	179	155	2300	31.5	A.R.	186	167	145	2100	F.T.	A.L.	118	153	133
7500	2550	F.T.	A.R.	276	181	157	2300	32.0	A.R.	180	163	141	2100	31.0	A.L.	117	152	132
5000	2550	40.0	A.R.	283	179	155	2300	32.5	A.R.	175	159	138	2100	31.5	A.L.	115	150	130
2500	2550	41.0	A.R.	283	175	152	2300	33.0	A.R.	171	154	134	2050	32.5	A.L.	112	145	126
S.L.	2550	42.0	A.R.	283	170	148	2300	33.0	A.R.	166	150	130	2050	33.5	A.L.	109	142	123

COLUMN IV (1.45 STAT. (1.26 NAUT.) MI./GAL.); COLUMN V MAXIMUM AIR RANGE

PRESS ALT. FEET	(1.45 STAT. (1.26 NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIX-TURE	TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	MAXIMUM AIR RANGE R.P.M.	M.P. INCHES	MIX-TURE	TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
15000	2250	F.T.	A.L.	107	156	135	2000	F.T.	A.L.	86	138	120
10000	1950	F.T.	A.L.	100	145	126	1800	F.T.	A.L.	85	133	115
7500	1900	31.0	A.L.	100	145	126	1700	F.T.	A.L.	82	130	113
5000	1950	31.5	A.L.	99	144	125	1600	31.5	A.L.	78	127	110
2500	1900	32.5	A.L.	96	139	121	1550	32.5	A.L.	77	124	108
S.L.	1850	33.5	A.L.	94	136	118	1550	33.5	A.L.	76	121	105

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG.67) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 28,000 LB. GROSS WEIGHT WITH 600 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 200 GAL.) TO FLY 950 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 1600 RPM AND 31.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.L.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S.GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF AUG. 1945 BASED ON: FLIGHT TEST

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 68 (Sheet 4 of 5 Sheets) — Flight Operation Instruction Chart — Two Engines

AAFMC-528 4-1-44

AIRCRAFT MODEL (S) PBY-6A

ENGINE (S): R-1830-92

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 26,000 TO 24,000 POUNDS

EXTERNAL LOAD ITEMS NONE

NUMBER OF ENGINES OPERATING: TWO

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2700	48.0		A.R.	5 MIN	260	322

FOR DETAILS SEE POWER PLANT CHART (FIG. 31 SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
		500	SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)						500		
275	235	450	405	350	590	510	650	570	450	730	630
245	210	400	360	310	520	450	580	500	400	650	560
210	185	350	315	275	455	395	510	440	350	570	490
185	160	300	270	235	390	340	435	380	300	485	420
150	130	250	225	195	325	280	360	315	250	405	350
120	105	200	180	155	260	225	290	250	200	320	280
90	80	150	135	115	195	170	220	190	150	240	210
60	50	100	90	80	130	115	145	125	100	160	140
30	25	50	45	40	65	55	70	65	50	80	70

MAXIMUM CONTINUOUS							PRESS	(.90 STAT. (.78 NAUT.) MI./GAL.)						
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.		ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	
2550	F.T.	A.R.	186	177	154		15000							
2550	F.T.	A.R.	250	181	157		10000	2350	32.0	A.R.	188	170	147	
2550	F.T.	A.R.	276	182	158		7500	2350	32.5	A.R.	185	166	144	
2550	40.0	A.R.	283	180	156		5000	2350	33.0	A.R.	180	163	141	
2550	41.0	A.R.	283	176	153		2500	2300	33.0	A.R.	173	156	135	
2550	42.0	A.R.	283	172	149		S.L.	2300	33.5	A.R.	168	151	131	

(1.30 STAT. (1.13 NAUT.) MI./GAL.)						(1.45 STAT. (1.26 NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
2350	F.T.	A.L.	128	166	144	2250	F.T.	A.L.	110	160	139	15000	1950	F.T.	A.L.	82	138	120
2100	F.T.	A.L.	121	158	137	2000	F.T.	A.L.	103	150	130	10000	1750	F.T.	A.L.	82	133	115
2100	31.0	A.L.	119	154	134	1950	31.0	A.L.	102	148	128	7500	1650	F.T.	A.L.	79	130	113
2100	31.5	A.L.	117	152	132	1950	31.5	A.L.	101	146	127	5000	1550	31.0	A.L.	75	127	110
2100	32.5	A.L.	113	148	128	1900	32.5	A.L.	98	142	123	2500	1550	32.0	A.L.	75	124	108
2050	33.5	A.L.	110	143	124	1900	33.5	A.L.	96	138	120	S.L.	1550	32.0	A.L.	74	121	105

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 67) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 26,000 LB. GROSS WEIGHT WITH 400 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 100 GAL.) TO FLY 650 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 1550 RPM AND 31.0 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.L.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF AUG. 1945 BASED ON: FLIGHT TEST

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

WF-3-31-44-10M

Figure 68 (Sheet 5 of 5 Sheets) — Flight Operation Instruction Chart — Two Engines

AAFMC-528
4-1-44

WF-8-31-44-10M

AIRCRAFT MODEL(S)	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS
PBY-6A		DEAD ENGINE PROPELLER FEATHERED
ENGINE(S): R-1830-92	CHART WEIGHT LIMITS: 28,000 TO 27,000 POUNDS	NUMBER OF ENGINES OPERATING: ONE

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2700	48.0		A.R.	5 MIN	260	161

FOR DETAILS SEE POWER PLANT CHART (FIG. 31 SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
		800		SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)					800		
600	520	700							700	640	550
510	445	600							600	540	465
425	370	500							500	440	385
380	330	450							450	400	345
340	295	400							400	350	305
300	260	350							350	305	265
255	220	300							300	260	225
215	185	250							250	215	185
175	150	200							200	175	150
125	110	150							150	125	110
85	75	100							100	85	75

MAXIMUM CONTINUOUS						PRESS ALT. FEET	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.		R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.
						6000						
2550	44.0	A.R.	134	115	100	4000						
2550	44.5	A.R.	134	115	100	2000	2500	43.0	A.R.	128	110	95
2550	45.0	A.R.	134	114	99	S.L.	2500	42.5	A.R.	124	107	93

COLUMN II (STAT. (NAUT.) MI./GAL.)						COLUMN III (STAT. (NAUT.) MI./GAL.)						COLUMN IV (STAT. (NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 67) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

(2) DATA ON THIS CHART ARE BASED ON TESTS MADE WITH WORN ENGINES AND THUS REPRESENT THE WORST SERVICE CONDITIONS, THEREFORE, VARIATIONS IN M.P. EXIST BETWEEN THIS CHART AND FIGURES 31 AND 71.

EXAMPLE

AT 28,000 LB. GROSS WEIGHT WITH 600 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 200 GAL.) TO FLY 500 STAT. AIRMILES AT 2000 FT. ALTITUDE MAINTAIN 2500 RPM AND 43.0 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.R.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF OCT. 1945 BASED ON: FLIGHT TEST AT NATC PATUXENT RIVER, MD.

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 69 (Sheet 1 of 4 Sheets) — Flight Operation Instruction Chart — One Engine

AAFMC-528
4-1-44

WF-3-31-44-10M

AIRCRAFT MODEL(S) PBY-6A ENGINE(S): R-1830-92	FLIGHT OPERATION INSTRUCTION CHART CHART WEIGHT LIMITS: 27,000 TO 28,000 POUNDS	EXTERNAL LOAD ITEMS DEAD ENGINE PROPELLER FEATHERED NUMBER OF ENGINES OPERATING: ONE

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2700	48.0		A.R.	5 MIN	260	161

FOR DETAILS SEE POWER PLANT CHART (FIG. 3 SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
		600	SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]						600		
440	380	500							500	460	400
395	340	450							450	415	360
350	305	400							400	365	315
310	265	350							350	315	275
265	230	300							300	270	235
220	190	250							250	225	195
175	150	200							200	180	155
135	115	150							150	135	115
85	75	100							100	85	75
45	40	50							50	45	40

MAXIMUM CONTINUOUS						PRESS	(STAT. (NAUT.) MI./GAL.)						(STAT. (NAUT.) MI./GAL.)						(STAT. (NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. MPH.	APPROX. T.A.S. KTS.
						6000																			6000						
2550	44.0	A.R.	134	120	104	4000																			4000	2500	41.5	A.R.	124	112	97
2550	44.5	A.R.	134	119	103	2000																			2000	2450	41.0	A.R.	120	107	93
2550	45.0	A.R.	134	118	102	S.L.																			S.L.	2450	41.0	A.R.	116	105	91

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 67) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

(2) DATA ON THIS CHART ARE BASED ON TESTS MADE WITH WORN ENGINES AND THUS REPRESENT THE WORST SERVICE CONDITIONS, THEREFORE, VARIATIONS IN M.P. EXIST BETWEEN THIS CHART AND FIGURES 9? AND 71.

EXAMPLE

AT 27,000 LB. GROSS WEIGHT WITH 400 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 200 GAL.) TO FLY 345 STAT. AIRMILES AT 2000 FT. ALTITUDE MAINTAIN 2450 RPM AND 41.0 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.R.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF OCT. 1945 BASED ON: FLIGHT TEST AT NATC PATUXENT RIVER, MD. RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 69 (Sheet 2 of 4 Sheets) — Flight Operation Instruction Chart — One Engine

AAFMC-528 4-1-44	AIRCRAFT MODEL (S) PBY-6A ENGINE (S): R-1830-92	**FLIGHT OPERATION INSTRUCTION CHART** CHART WEIGHT LIMITS: 26,000 TO 25,000 POUNDS	EXTERNAL LOAD ITEMS DEAD ENGINE PROPELLER FEATHERED NUMBER OF ENGINES OPERATING: ONE

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2700	48.0		A.R.	5 MIN	260	161

FOR DETAILS SEE POWER PLANT CHART (FIG. 31 SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING.(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
		500		SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)					500		
400	345	450							450	435	375
350	305	400							400	380	330
310	270	350							350	330	285
265	230	300							300	280	245
220	190	250							250	230	200
175	155	200							200	185	160
135	115	150							150	135	115
85	75	100							100	85	75
45	40	50							50	45	40

MAXIMUM CONTINUOUS						PRESS ALT. FEET	(STAT. (NAUT.) MI./GAL.)	(STAT. (NAUT.) MI./GAL.)	(STAT. (NAUT.) MI./GAL.)	PRESS ALT. FEET	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.		R.P.M. / M.P. INCHES / MIX-TURE / APPROX. TOT. G.P.H. / T.A.S. MPH. / KTS.	R.P.M. / M.P. INCHES / MIX-TURE / APPROX. TOT. G.P.H. / T.A.S. MPH. / KTS.	R.P.M. / M.P. INCHES / MIX-TURE / APPROX. TOT. G.P.H. / T.A.S. MPH. / KTS.		R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
2550	F.T.	A.R.	129	114	99	6000				6000	2450	39.5	A.R.	123	112	97
2550	44.0	A.R.	134	122	106	4000				4000	2450	39.5	A.R.	115	110	95
2550	44.5	A.R.	134	121	105	2000				2000	2400	39.0	A.R.	110	105	91
2550	44.5	A.R.	134	120	104	S.L.				S.L.	2400	39.0	A.R.	105	103	89

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 67) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

(2) DATA ON THIS CHART ARE BASED ON TEST MADE WITH WORN ENGINES AND THUS REPRESENT THE WORST SERVICE CONDITIONS, THEREFORE, VARIATIONS IN M.P. EXIST BETWEEN THIS CHART AND FIGURES 31 AND 71.

EXAMPLE

AT 26,000 LB. GROSS WEIGHT WITH 400 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 100 GAL.) TO FLY 350 STAT. AIRMILES AT 2000 FT. ALTITUDE MAINTAIN 2400 RPM AND 39.0 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.R.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF OCT. 1945 BASED ON: FLIGHT TEST AT NATC PATUXENT RIVER, MD.

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

WF-8-31-44-10M

Figure 69 (Sheet 3 of 4 Sheets) — Flight Operation Instruction Chart — One Engine

AAFMC-528
4-1-44

AIRCRAFT MODEL(S) PBY-6A ENGINE(S): R-1830-92	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS DEAD ENGINE PROPELLER FEATHERED
	CHART WEIGHT LIMITS: 25,000 TO 24,000 POUNDS	NUMBER OF ENGINES OPERATING: ONE

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2700	48.0		A.R.	5 MIN	260	161

FOR DETAILS SEE POWER PLANT CHART (FIG. 31 SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) 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. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
		400	SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING(1)						400		
320	280	350							350	345	300
270	240	300							300	285	255
230	200	250							250	240	210
180	160	200							200	195	170
135	120	150							150	150	130
90	80	100							100	100	85
45	40	50							50	55	45

MAXIMUM CONTINUOUS R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	PRESS ALT. FEET	MAXIMUM AIR RANGE R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.
2550	F.T.	A.R.	129	119	103	6000	2400	38.0	A.R.	112	110	95
2550	44.0	A.R.	134	125	108	4000	2400	37.5	A.R.	104	107	93
2550	44.5	A.R.	134	123	107	2000	2350	37.0	A.R.	100	104	90
2550	45.0	A.R.	134	122	106	S.L.	2350	37.0	A.R.	95	101	87

(STAT. (NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	(STAT. (NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.	(STAT. (NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. MPH.	T.A.S. KTS.

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 67) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.
(2) DATA ON THIS CHART ARE BASED ON TESTS MADE WITH WORN ENGINES AND THUS REPRESENT THE WORST SERVICE CONDITIONS. THEREFORE, VARIATIONS IN M.P. EXIST BETWEEN THIS CHART AND FIGURES 31 AND 71.

EXAMPLE

AT 25,000 LB. GROSS WEIGHT WITH 300 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 100 GAL.) TO FLY 275 STAT. AIRMILES AT 2000 FT. ALTITUDE MAINTAIN 2350 RPM AND 37.0 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.R.

LEGEND

ALT.	PRESSURE ALTITUDE	F.R.	FULL RICH
M.P.	MANIFOLD PRESSURE	A.R.	AUTO-RICH
GPH	U.S. GAL. PER HOUR	A.L.	AUTO-LEAN
TAS	TRUE AIRSPEED	C.L.	CRUISING LEAN
KTS.	KNOTS	M.L.	MANUAL LEAN
S.L.	SEA LEVEL	F.T.	FULL THROTTLE

DATA AS OF OCT. 1945 BASED ON: FLIGHT TEST AT NATC PATUXENT RIVER, MD.

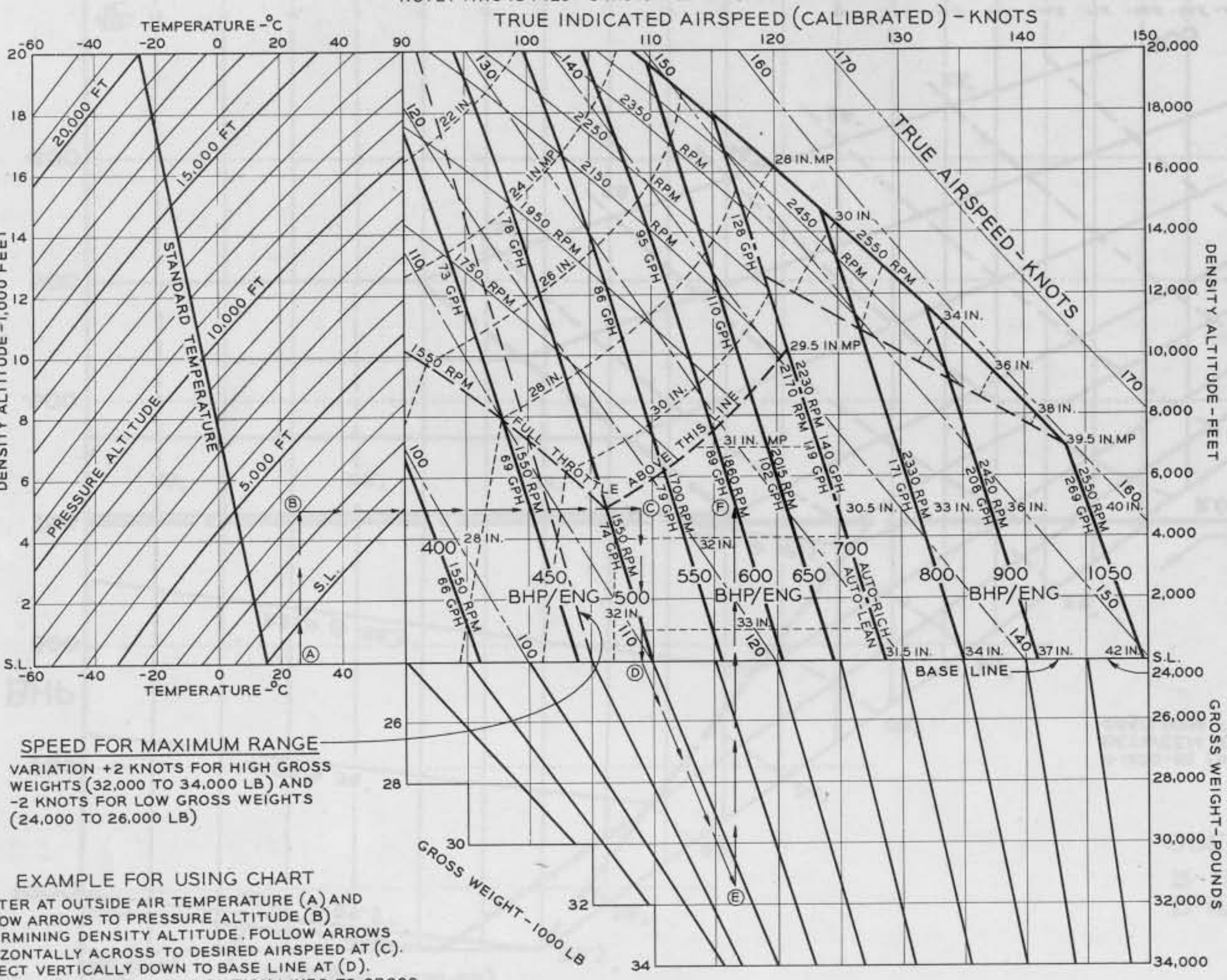
RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

WF-3-31-44-10M

Figure 69 (Sheet 4 of 4 Sheets) — Flight Operation Instruction Chart — One Engine

COMPOSITE CRUISING CONTROL CHART MODEL PBY-6A TWO-ENGINE OPERATION

NOTE: THIS IS PILOT'S INDICATED AIRSPEED CORRECTED FOR INSTALLATION ERRORS



FOR USE IN CRUISING FLIGHT

1. DETERMINE DENSITY ALTITUDE. SET POWER TO CHARTED VALUES AS GIVEN TO OBTAIN DESIRED AIRSPEED.
2. REMEMBER TO CORRECT AIRSPEED INDICATOR READING FOR INSTALLATION ERRORS TO OBTAIN TRUE INDICATED AIRSPEED.
3. PRESSURE ALTITUDE IS THE ALTIMETER READING WHEN THE BAROMETRIC SCALE ON THE INSTRUMENT IS SET TO 29.92 INCHES HG.
4. AIRSPEED WILL BE LOW IN HOT WEATHER, HIGH IN COLD, WHEN COMPARED TO CHARTED VALUES. JOCKEY POWER SLIGHTLY AS REQUIRED. INCREASE MANIFOLD PRESSURE TO INCREASE SPEED (PART THROTTLE OPERATION) UNTIL CHARTED AIRSPEED IS OBTAINED. INCREASE MANIFOLD PRESSURE 0.5 INCH FOR EACH 6°C RISE (DECREASE 0.5 INCH FOR EACH 6°C DROP) OF CARBURETOR AIR TEMPERATURE FROM STANDARD. DO NOT INCREASE MANIFOLD PRESSURE MORE THAN 2 INCHES WITHOUT RAISING RPM. FOR FULL THROTTLE OPERATION SET POWER BY RPM SPECIFIED ON CHART. IF RESULTING SPEED IS TOO LOW, INCREASE RPM.
5. IN NORMAL AUTO-LEAN OPERATION DO NOT EXCEED 232°C CYLINDER HEAD TEMPERATURE, 700 BHP OR 140 BMEP. USE AUTO-RICH FOR POWERS ABOVE 700 BHP.
6. MAXIMUM CONTINUOUS (NORMAL RATED) POWER IS 1050 BHP/ENG AT 232°C MAXIMUM CYLINDER HEAD TEMPERATURE OR LIMITED TO ONE HOUR AT 260°C CYLINDER HEAD TEMPERATURE.
7. TAKE-OFF POWER IS 1200 BHP/ENG AT 2700 RPM, 48 INCHES HG MANIFOLD PRESSURE, AUTO-RICH AND 260°C MAXIMUM CYLINDER HEAD TEMPERATURE FOR 5 MINUTES DURATION.

NOTE: CHART IS BASED ON FLIGHT TEST DATA AND NAVY ENGINE CALIBRATION CURVE.

SPEED FOR MAXIMUM RANGE

VARIATION +2 KNOTS FOR HIGH GROSS WEIGHTS (32,000 TO 34,000 LB) AND -2 KNOTS FOR LOW GROSS WEIGHTS (24,000 TO 26,000 LB)

EXAMPLE FOR USING CHART

ENTER AT OUTSIDE AIR TEMPERATURE (A) AND FOLLOW ARROWS TO PRESSURE ALTITUDE (B) DETERMINING DENSITY ALTITUDE. FOLLOW ARROWS HORIZONTALLY ACROSS TO DESIRED AIRSPEED AT (C). PROJECT VERTICALLY DOWN TO BASE LINE AT (D). FOLLOW SLOPE OF WEIGHT VARIATION LINES TO GROSS WEIGHT AT (E). PROJECT VERTICALLY UP TO DENSITY ALTITUDE AT (F). FUEL FLOW, RPM AND MANIFOLD PRESSURE ARE FOUND AT (F).

TO FIND AIRSPEED FOR A DESIRED POWER SETTING (F) AT A DENSITY ALTITUDE, REVERSE DIRECTION OF ARROWS GOING FROM (F) TO (E) TO (D) TO (C). TRUE AIRSPEED AND TRUE INDICATED AIRSPEED ARE FOUND AT (C).

Figure 70 — Cruising Control Chart

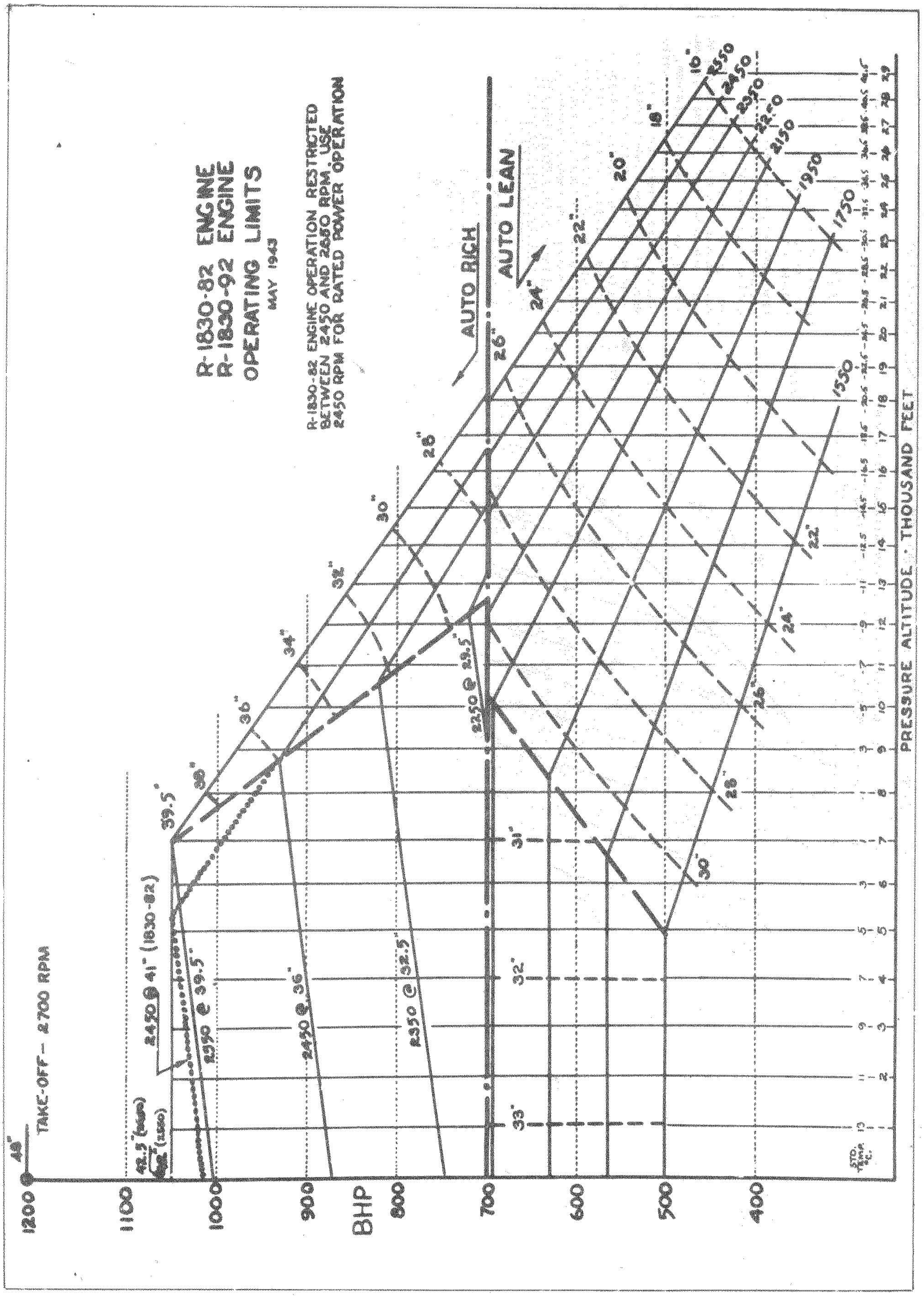


Figure 71 — Engine Calibration Curves