PILOT'S HANDBOOK of FLIGHT OPERATING INSTRUCTIONS

PBM-5 AIRPLANES

This publication shall not be carried in aircraft on combat missions or when there is a reasonable chance of its falling into the hands of the enemy.

Pilot's Handbook of Flight Operating Instructions

U. S. NAVY MODEL PBM-5 Airplane

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>
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LIST OF REVISED PAGES ISSUED

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

Title, authorization	
Addendum I	
Pages I, II	

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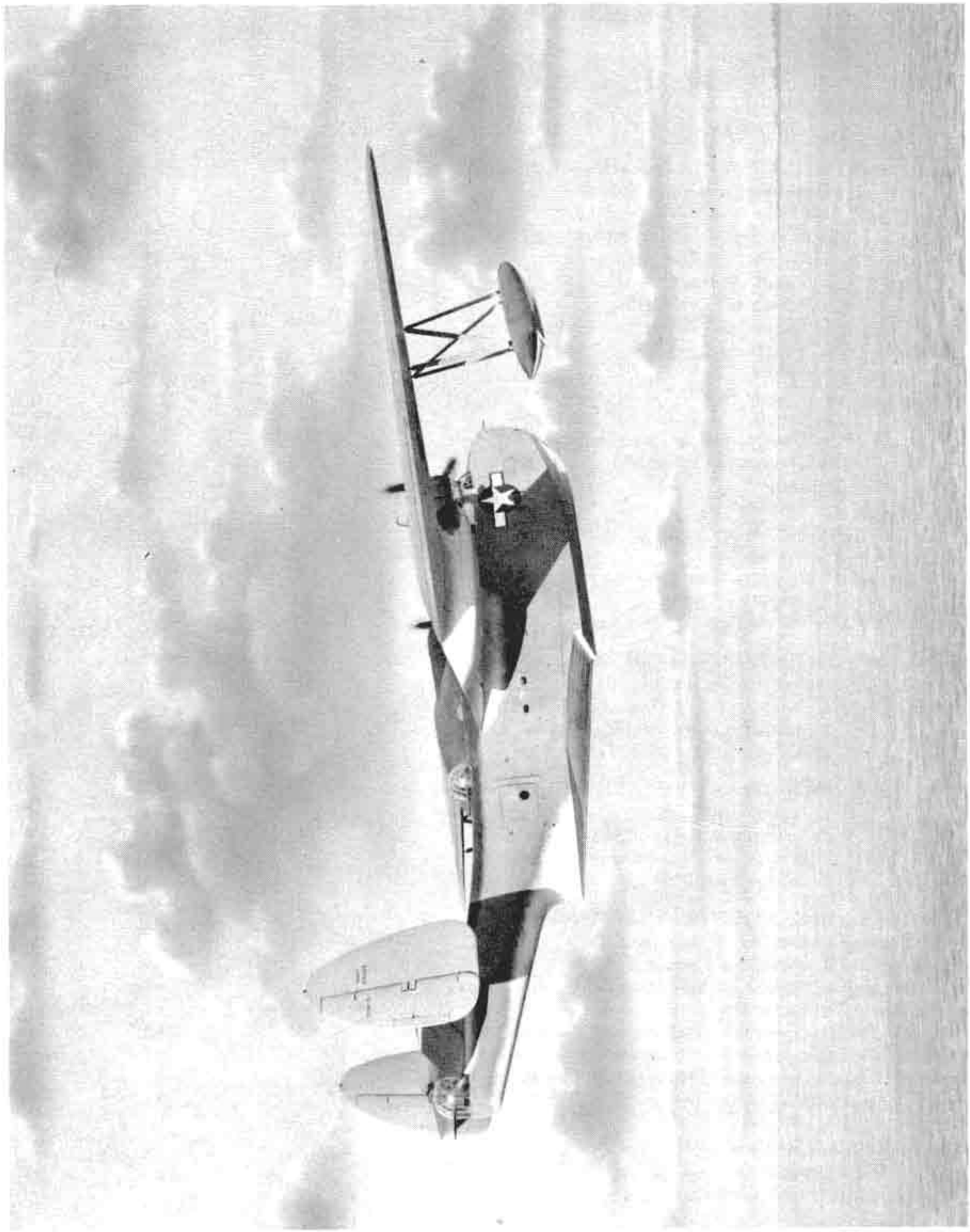


Figure 1 — Three-Quarter Rear View of PBM-5

SECTION I
DESCRIPTION

1. AIRPLANE.

a. GENERAL.—The PBM-5 is a two engine, high wing, medium range flying boat which may be used as a patrol, bomber, or torpedo airplane. The approximate overall dimensions are: length, 79 feet, 10 inches; height, 28 feet, 10 inches; and span 118 feet. The normal gross weight is 56,000 pounds.

b. ACCESS TO AIRPLANE.

(1) ON BEACH.—A waist hatch is provided in each side of the hull about 5 feet forward of the second step. Both hatches can be unlocked from the outside, and a short ladder is stowed in the aft hull compartment for reaching the hatch.

(2) IN WATER.—When the airplane is waterborne, access may be made through either the waist hatches as indicated in the preceding paragraph, or through the two bow hatches. The entrance hatch on the right side locks from the outside, while the anchor hatch on the left is secured from within.

c. HULL ARRANGEMENT. *(See figure 2.)*—The hull is divided into five water-tight compartments by bulkheads provided with water-tight doors. The bow compartment contains the bow turret and the bomber's station. Aft of the bow compartment to approximately three feet forward of the leading edge of the wing, the hull is divided into two floor levels. The upper floor is the flight deck which contains a raised pilot's control station at the forward end with seats for the pilot on the left and co-pilot on the right; a navigator's station on the left behind the pilot; a seat between the pilot and the navigator's table for the Radar operator; a radio operator's station on the right behind the co-pilot; and a flight engineer's station at the aft end of the flight deck. The lower level is the galley compartment. Directly aft of the flight deck is the fuel trunk and lavatory compartment. Beneath the center wing are two small compartments: The forward is the fuel tank compartment, and the aft is the officers' stateroom fitted with four bunks. Above the officers' stateroom is the auxiliary power plant and the navigator's hatch. Aft of the officers' stateroom is the after hull compartment containing the deck turret and waist gunner's stations. A tunnel from the after compartment provides access to the tail compartment which contains the tail turret.

d. MOVEMENT OF FLIGHT PERSONNEL.

(1) GENERAL.—A passageway extends from the bulkhead under the front spar down the center of the airplane to the tail turret. Forward of the front spar the passageway extends down the left side of the airplane to the galley compartment. A flight of steps leading to a door in the right-hand side of the passageway provides access to the flight deck just forward of the flight engineer's station. Two manholes in the bottom wing skin in the fuel tank compartment allow access to the center wing section and the bomb bays.

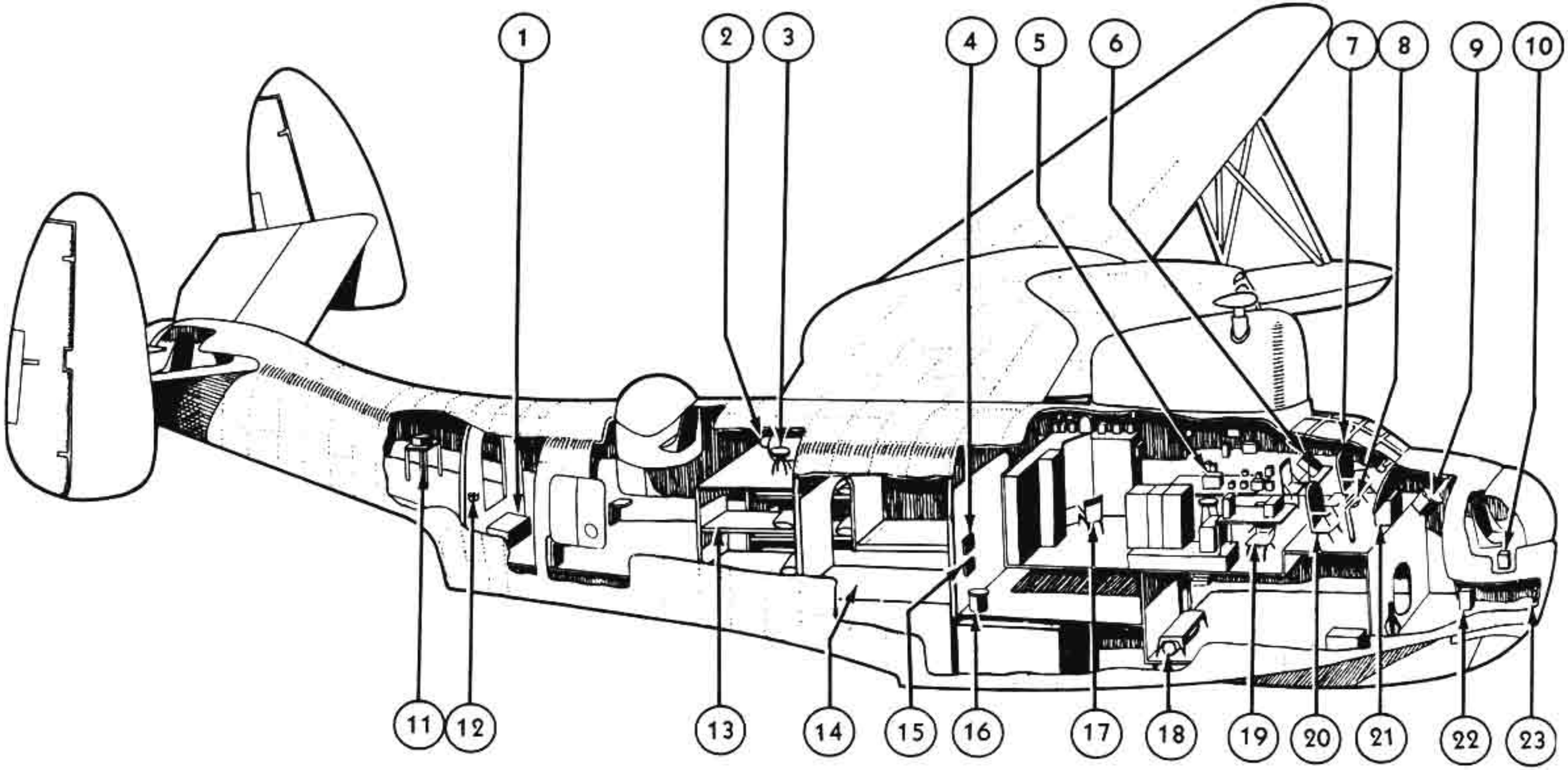
(2) MOVEMENT OF CREW IN FLIGHT.—During flight the crew members not actually on duty at an assigned station should refrain from fore and aft movement through the airplane as much as possible, since such movement causes a shift in the center of gravity and necessitates re-trimming the airplane for level flight. If the pilot must continually re-trim the airplane, average cruising speed will be less than is necessary, and during night or instrument weather flights it is very difficult for the pilot to control either his air speed or his altitude. In general, all crew members not actually on duty should ride in the galley compartment.

It is possible to gain an extra 5 knots airspeed for cruising flight by having the crew move forward until the center of gravity is located at about 25 percent MAC. On long cruising flights the pilot should endeavor to keep the elevator trim tab setting somewhere between zero and one degree nose-down by moving the crew members. A center of gravity of 25 to 26 percent MAC during cruising flight should give an elevator trim tab setting very close to zero degrees.

WARNING

Any center of gravity location forward of 28 percent MAC should be used for flight only. The pilot and the flight engineer should both check to make certain that the crew has moved aft and that the center of gravity is aft of 28 percent MAC before a landing is attempted.

The pilot should study the Weight and Balance Data Book and the load adjuster to determine the change in center of gravity location caused by moving one man from one compartment to another throughout the airplane. From the standpoint of controllability the center of gravity must always be aft of 28 percent MAC for all landings and take-offs. However, for level flight both the speed and stability of the airplane will be improved if the pilot moves the crew so that the center of gravity is kept around 25 to 26 percent MAC.



Ref. No.	Nomenclature
1	*Stove*
2	*Auxiliary Power Plant*
3	*Navigator's Astro Compass Stool*
4	*Toilet Bag Container*
5	*Navigator's Station*
6	*Radar Operator's Station*
7	*Pilot's Station*
8	*Control Column*
9	*Bow Heater*
10	*Bombardier's Instrument Panel*
11	*Camera Support*
12	*Flare Chutes*
13	*Bunks*
14	*Hull Fuel Tanks*

Ref. No.	Nomenclature
15	*Waste Paper Container*
16	*Toilet*
17	*Flight Engineer's Station*
18	*Water Breaker*
19	*Radio Operator's Station (Airplane Nos. 45405 to 45444)*
20	*Co-Pilot's Station*
21	*Pilot's Pedestal*
22	*Bombardier's Switch Panel*
23	*Inclinometer*
24	*Radio Operator's Station (Airplane No. 59000 and subsequent)*
25	*Radio Equipment Rack (Airplane No. 59000 and subsequent)*

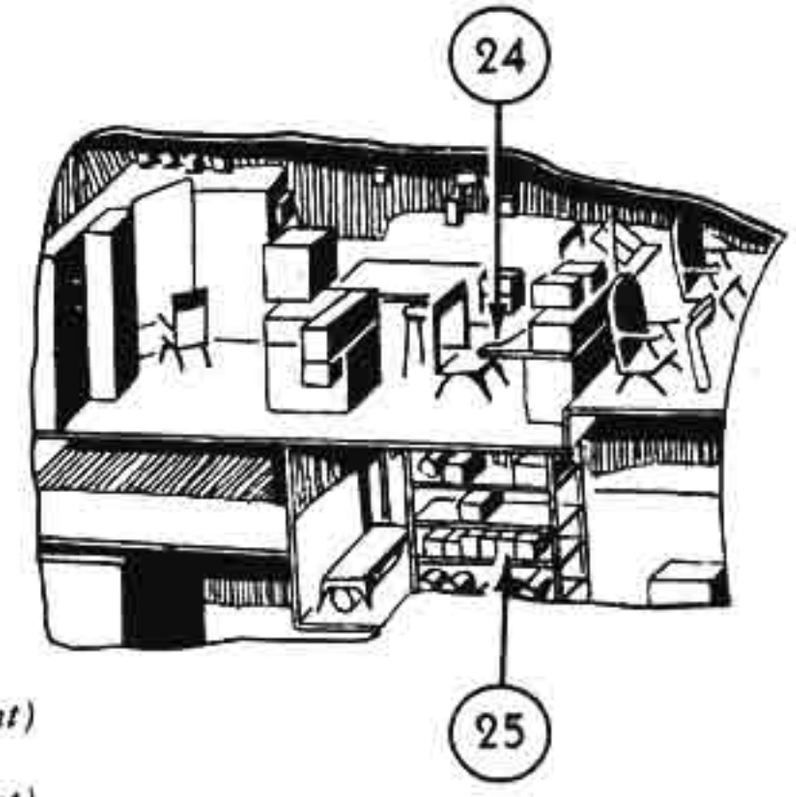


Figure 2 — Hull Contents Arrangement

e. ARMAMENT.

(1) GUNNERY EQUIPMENT.—Power operated turrets are provided at the bow, deck, and tail positions, each mounting two .50 caliber type M-2 machine guns. A hydraulically operated gun mount with a .50 caliber type M-2 machine gun is mounted at each waist hatch.

(2) BOMBING EQUIPMENT.—Bombs are carried in the bomb bays located in each nacelle. Provisions are made for carrying one torpedo below the wing inboard of each bomb bay. The electrical train and selective release controls are accessible to the bomber and provide for release of the bombs by either the bomber or the pilot after the circuits have been selected by the bomber. The electrical salvo release controls are accessible to the bomber only, while the pilot has the only controls for torpedo release and manual emergency bomb release. The bomb bay doors may be closed by either the pilot or the bomber.

(3) GUNFIRE PROTECTION.

(See figures 3 to 8.)

(a) PERSONNEL PROTECTION.—Armor plate for protection of personnel against gunfire consists of two pieces of armor plate behind the pilot's and co-pilot's seats, six pieces of armor plate at station 296 for the protection of crew members on the flight deck, one piece of armor plate on the aft section of each waist hatch door for the protection of the waist gunners, and face and body armor plate for the protection of each turret gunner.

(b) EQUIPMENT PROTECTION.—The personnel armor plate protection is so arranged as to protect vital equipment in the same general location as the personnel such as the pilot's and co-pilot's instrument panels, and the turret operating mechanisms. In addition two pieces of armor plate are provided to protect the upper and lower fuel trunks.

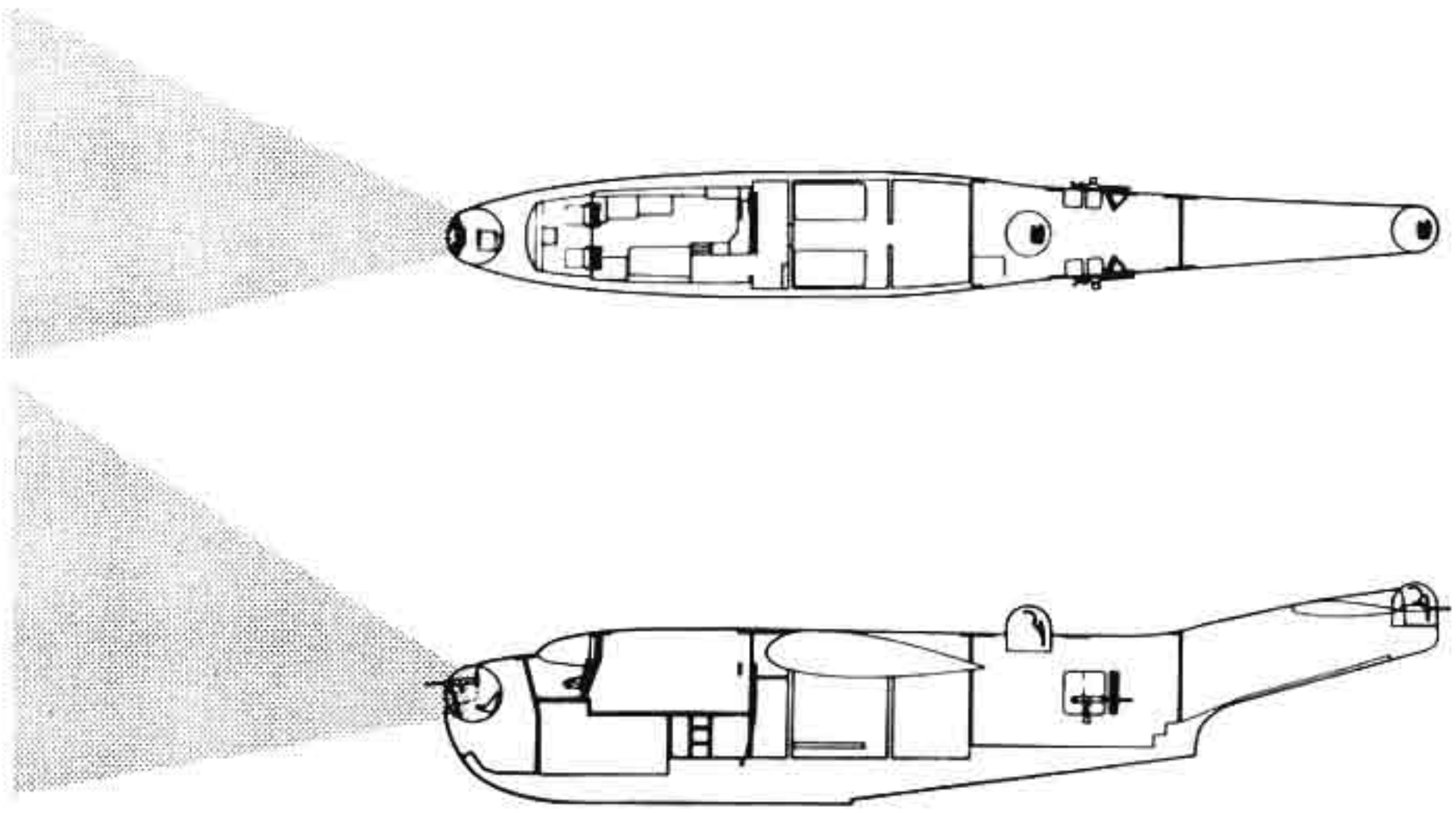


Figure 3 — Bow Turret Gunfire Protection

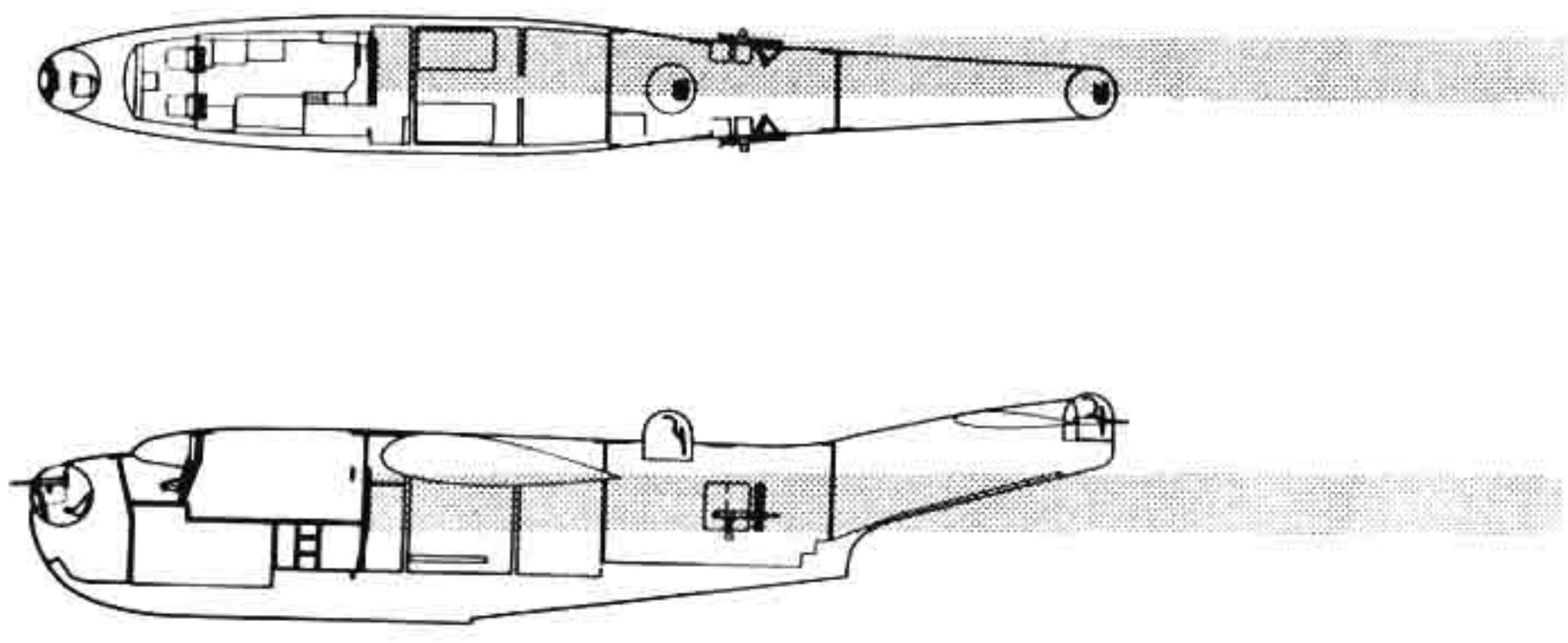


Figure 4 — Flight Deck Gunfire Protection

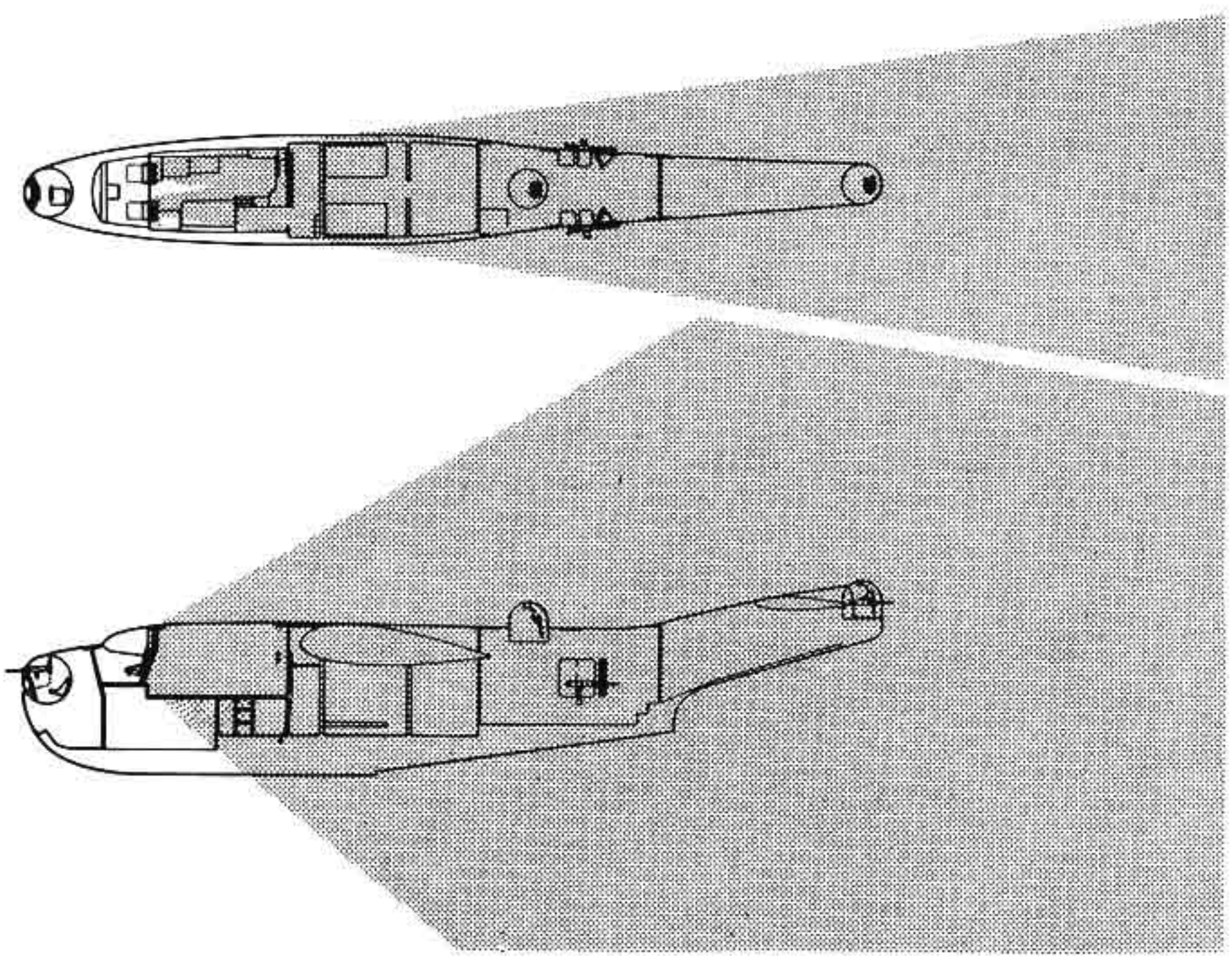


Figure 5 — Pilot and Co-Pilot Gunfire Protection

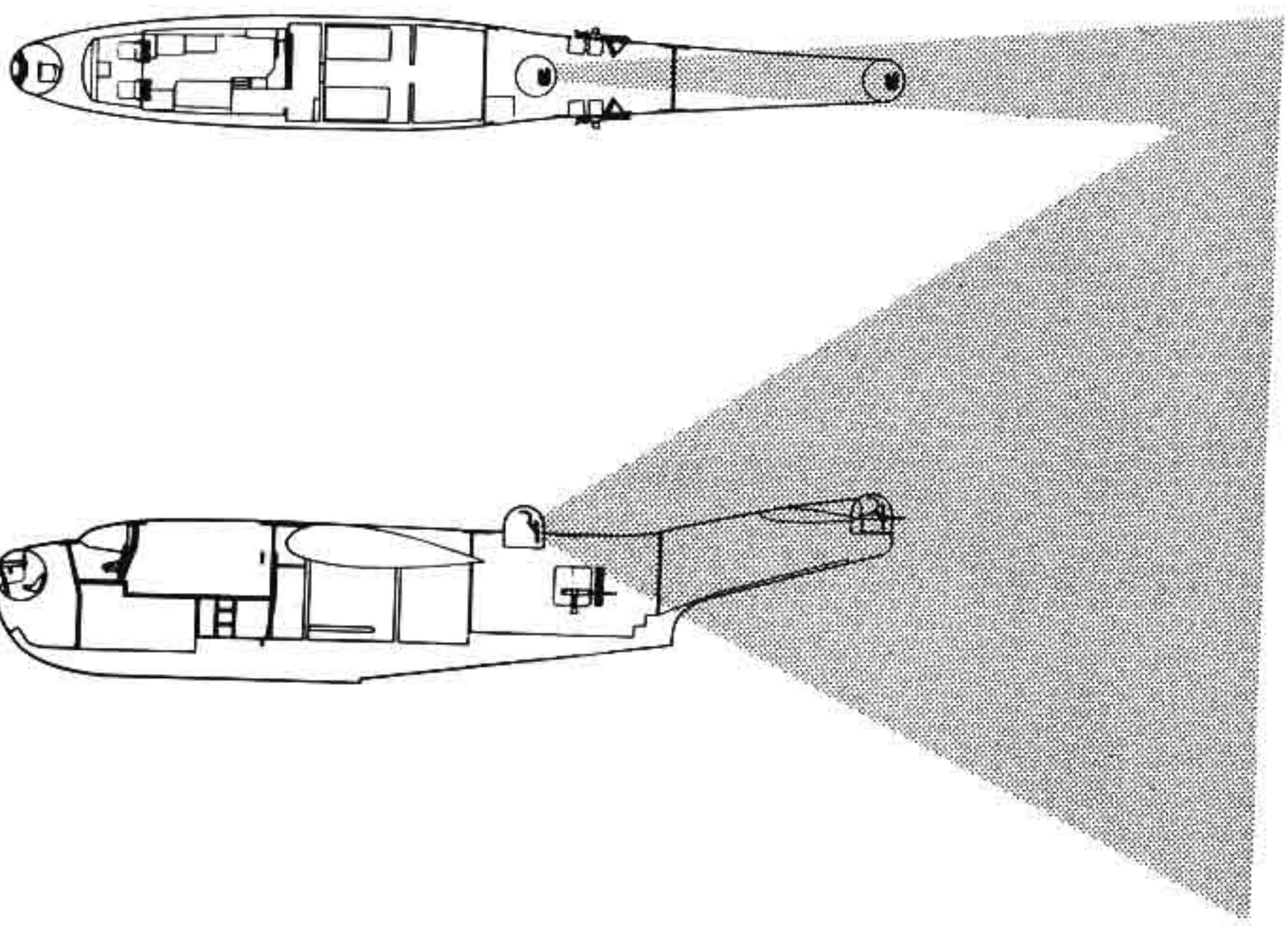
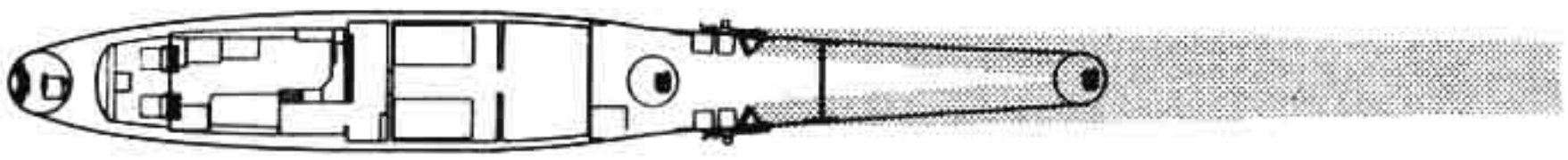


Figure 6 — Deck Turret Gunfire Protection



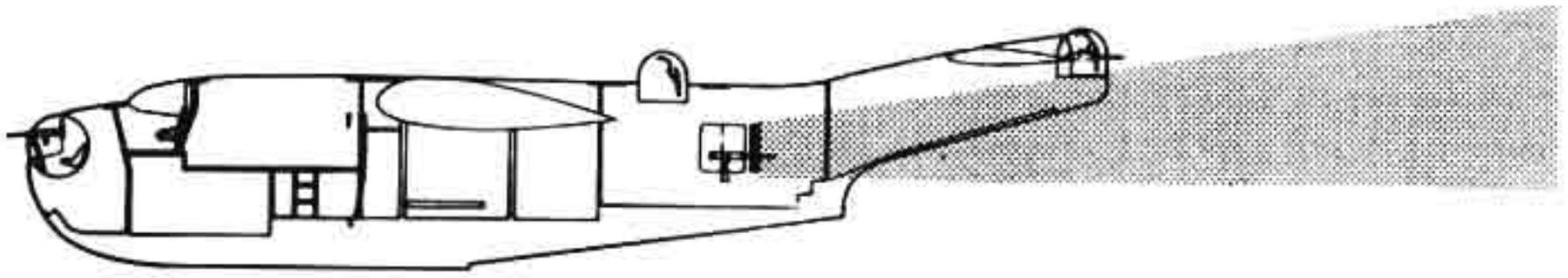
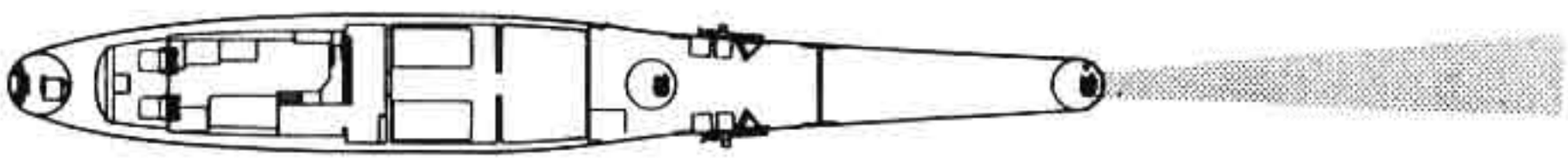


Figure 7 — Waist Gun Gunfire Protection



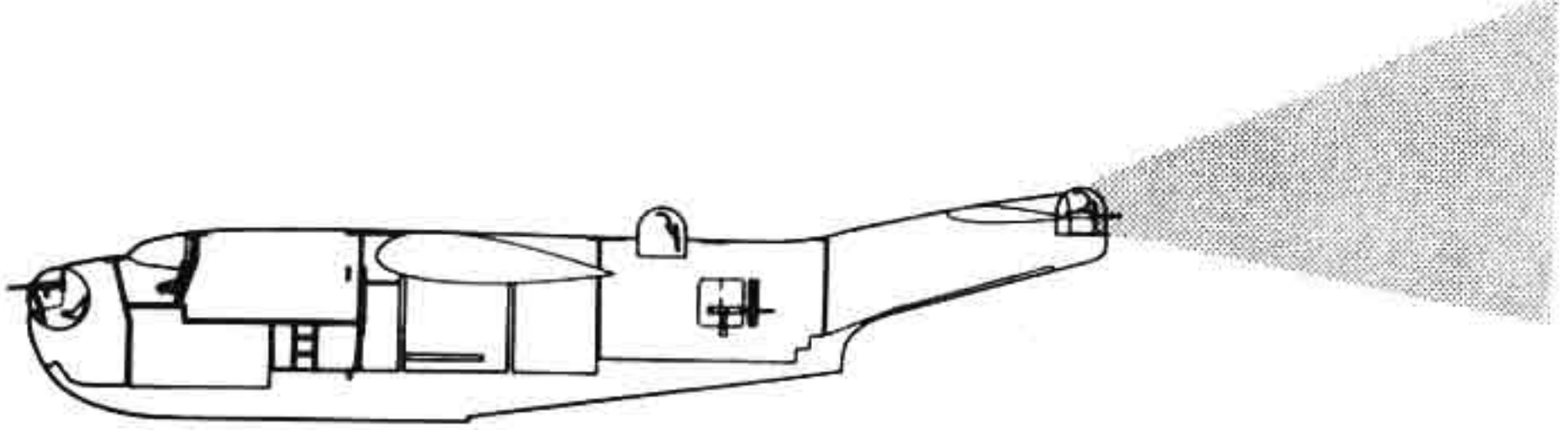


Figure 8 — Tail Turret Gunfire Protection

f. POWER PLANT.

(1) ENGINE.—The PBM-5 airplane is powered by two Pratt and Whitney, Model R-2800-22, engines, each developing 2100 hp at sea level. The engines incorporate a propeller reduction gearing of .450:1 and a Stromberg, Model PR58-E1, injection type carburetor.

Fuel: Grade 100/130, Specification AN-F-28

Oil: Grade 1120, Specification AN-VV-O-446a

(2) PROPELLERS. — The propellers are Curtiss electric, constant-speed, controllable-pitch, full-feathering, three-blade, hollow steel propellers, 15 feet, 6 inches in diameter.

(3) FUEL SYSTEM. *(See figures 9 to 12.)*

(a) Three main fuel spaces in the hull and one service cell in each wing comprise the normal fuel space. One droppable auxiliary fuel tank may be carried in each bomb bay. All cells with the exception of the auxiliary bomb bay tanks are Martin Mareng self-sealing fuel cells. The capacities of the tanks are as follows:

	U.S. Gal.	*Imp. Gal.*
Forward Hull Cell	273	227
Center Hull Cells	553	460
After Hull Cells	1372	1142
Wing Service Cells	504	419
Bomb Bay Tanks	794	660
	3496	2908

(b) For normal flight operations fuel flows from the wing service tanks through the main engine selector valves to the engine driven fuel pumps. The engine driven pumps supply fuel to the carburetors at a constant pressure of 17 pounds per square inch. A two speed booster pump on each wing service tank

provides the pressure required to start the engines as well as additional pressure for all engine operating conditions to prevent vapor troubles.

(c) Each wing service tank is equipped with a special liquidometer fuel gage. These gages automatically turn on the fuel transfer pumps and re-fill the wing tanks from the tank to which the hull tank selector valve is set. The fuel transfer pumps are set to deliver fuel from the hull tanks directly to the engines at a pressure of 17-1/2 pounds per square inch in the event of an engine-driven fuel pump failure.

(d) A vapor separator in the carburetor and a vapor return line to the wing service tank provide for the return of vapor in the carburetor strainer chamber to the wing tank. A failure of the vapor separator valve will permit 20 to 30 U.S. (16.7 to 25 Imperial) gallons of fuel per hour to return to the wing service tank.

(e) When droppable tanks are installed in the bomb bays a booster pump built into the bottom of each tank pumps fuel to the engine selector valve. The booster pump operates when the engine selector valve is set to "BOMB BAY TANK."

(f) A bilge system controlled by a bilge selector valve and operated with a hand pump in the fuel trunk section is provided to remove water and other foreign matter from the hull tanks.

(g) Two fuel jettisoning pumps controlled by switches on the flight engineer's control panel are capable of jettisoning 100 U.S. (83 Imperial) gallons per minute each from the center and aft hull tanks. Fuel to be jettisoned from other tanks must first be transferred to the center or aft hull tanks.

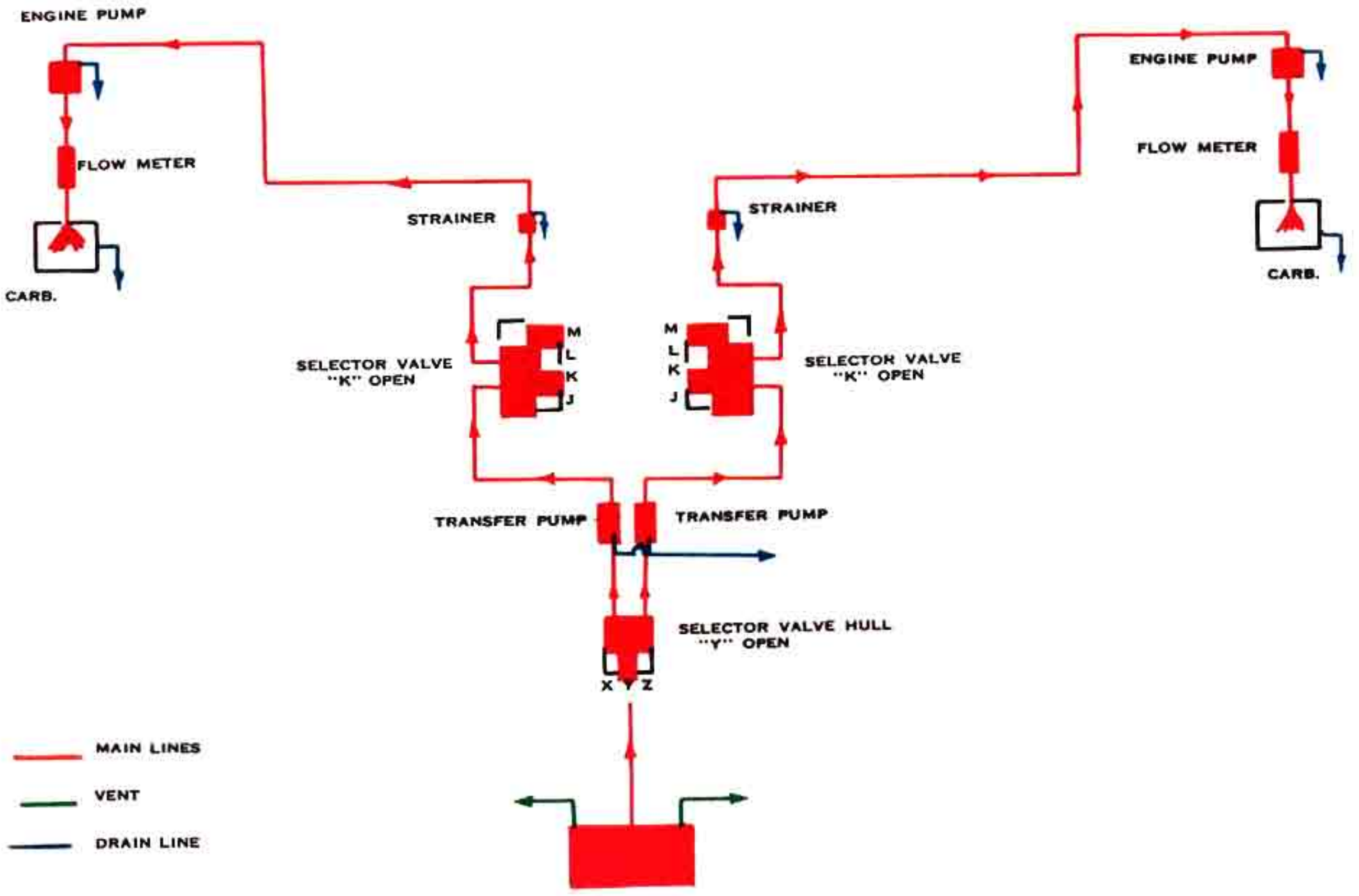


Figure 9 — Fuel System—Hull Tanks

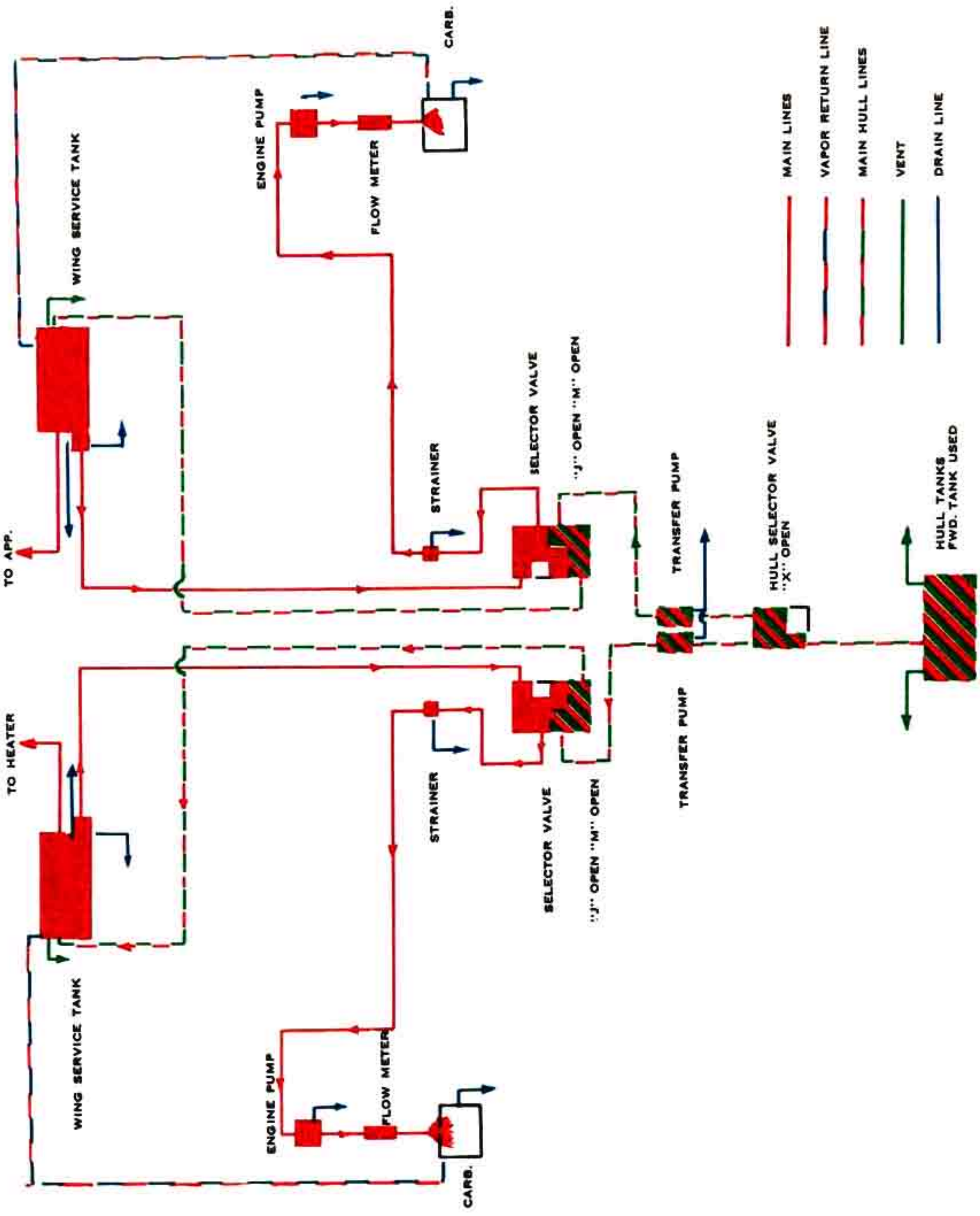


Figure 10 — Fuel System—Wing Service Tanks

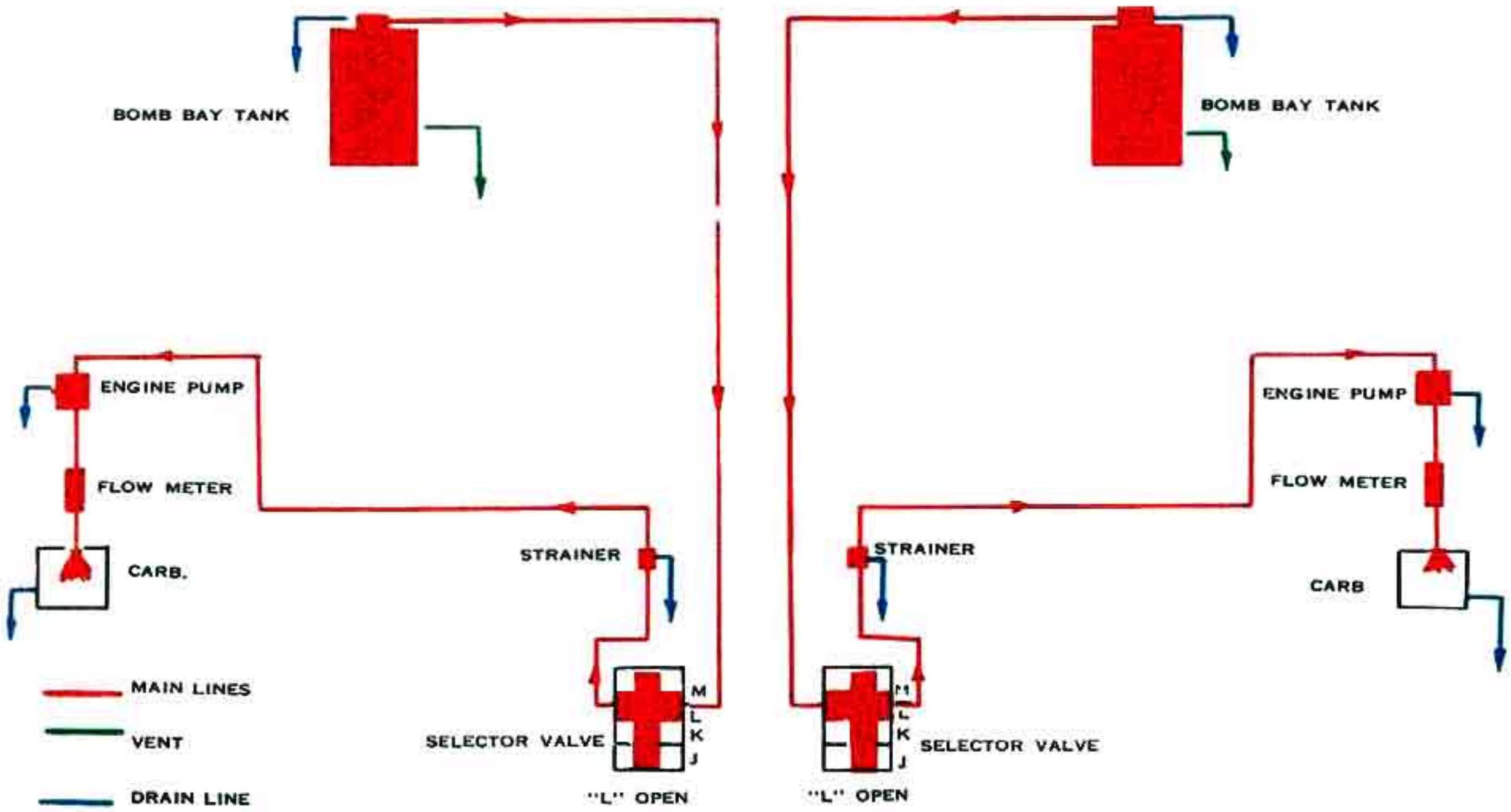


Figure 11 — Fuel System—Bomb Bay Tanks

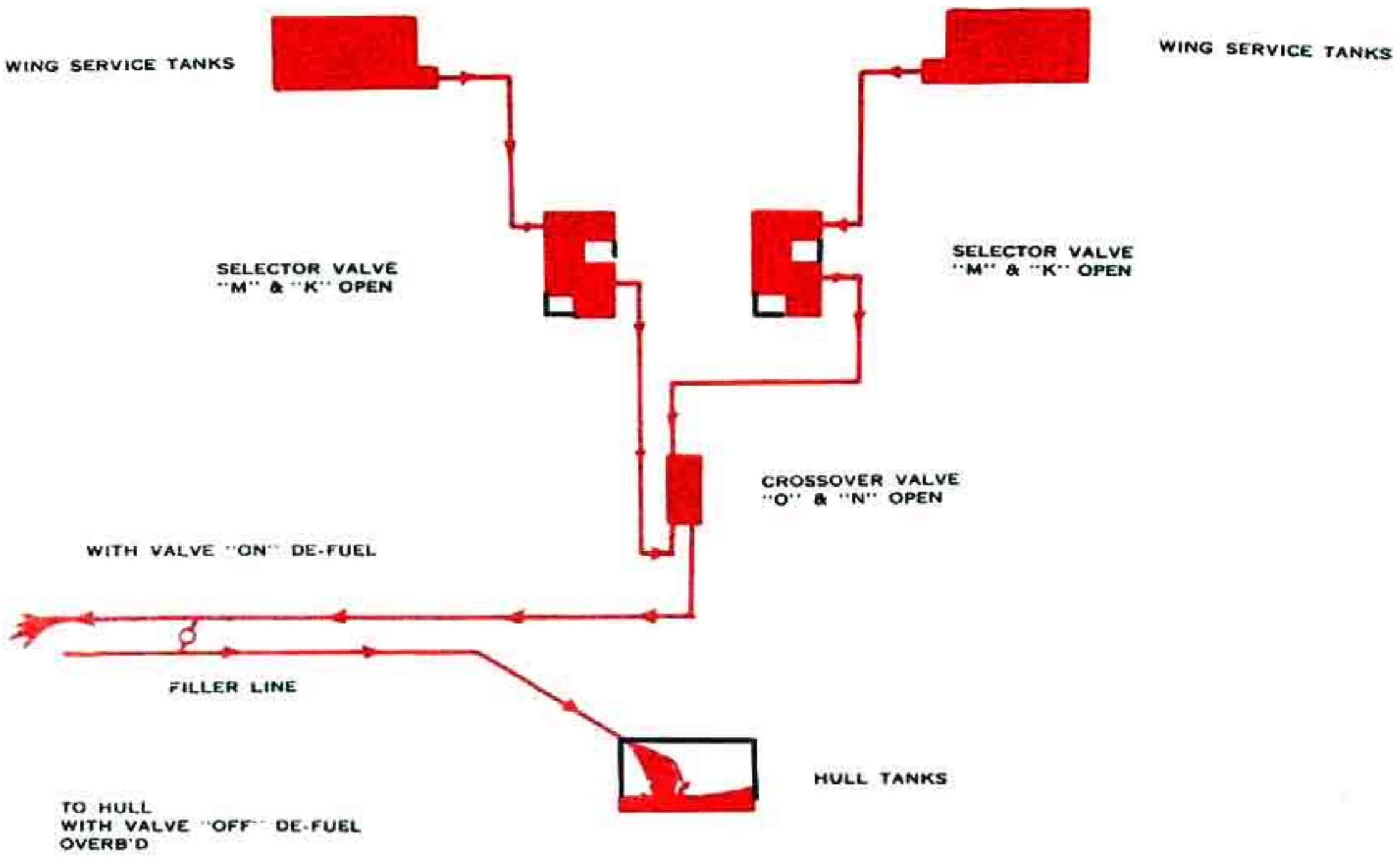


Figure 12 — Fuel System—De-Fueling

(4) OIL SYSTEM. *(See figure 13.)*

(a) The oil system for each engine includes an oil tank with a capacity of 75 U.S. (62.4 Imperial) gallons with an expansion space of 10 percent. Each tank contains a hopper to facilitate oil warm-up under cold weather conditions. A drain valve is located in the oil-in line to the engine on the forward side of the firewall for draining the entire oil system when required.

(b) During normal operation, the oil flows from the tank through the oil-in lines and drain valve to the engine. The engine-driven oil pump distributes the oil throughout the engine, and the scavenging pump returns the oil through the oil-out lines to the oil cooler control valve mechanism and the oil cooler where it is directed back to the oil tank. The temperature of the oil in the oil-out lines determines, through the oil cooler valve mechanism, whether the oil is returned to the hopper or to the main oil supply in the tank. The oil cooler valve also regulates the amount of oil going through the oil cooler and thereby regulates the oil temperature. The oil cooler duct is equipped with an oil cooler shutter to control the amount of air. The shutter may be controlled either manually or automatically as selected on the selector switch on the flight engineer's switch panel.

(c) An oil dilution system is used to dilute the oil under cold weather conditions. Fuel from the engine feed line, which must be under pressure from the wing tank booster pump, may be admitted into the oil-in line by means of a solenoid valve. A manual valve is in the same line to insure that fuel will not inadvertently dilute the oil. When the dilution valve is operated, a by-pass solenoid valve directs the hot oil in the oil-out line from the oil cooler to the oil tank hopper.

g. ELECTRICAL SYSTEM.—The electrical power supply is a 24 (28.5) volt d-c system with three main sources of energy; airplane batteries, engine driven generators, and auxiliary power plant driven generator. The power sources connect to a common distribution system which covers the entire airplane. Distribution is by a single positive "hot" wire only with the negative return by the common ground of the airplane structure. D-c to a-c inverters supply energy to special equipment requiring alternating current.

The positive leads from the three main sources of energy feed the main bus located in the flight engineer's switch panel. This bus is the main source of electrical energy from which wires go to all parts of the airplane through circuit breaker switches to the motors, lights, heaters and other electrical equipment.

Two main batteries and two auxiliary batteries are installed. Disconnect plugs are provided so that all four batteries or either pair may be connected into the electrical system.

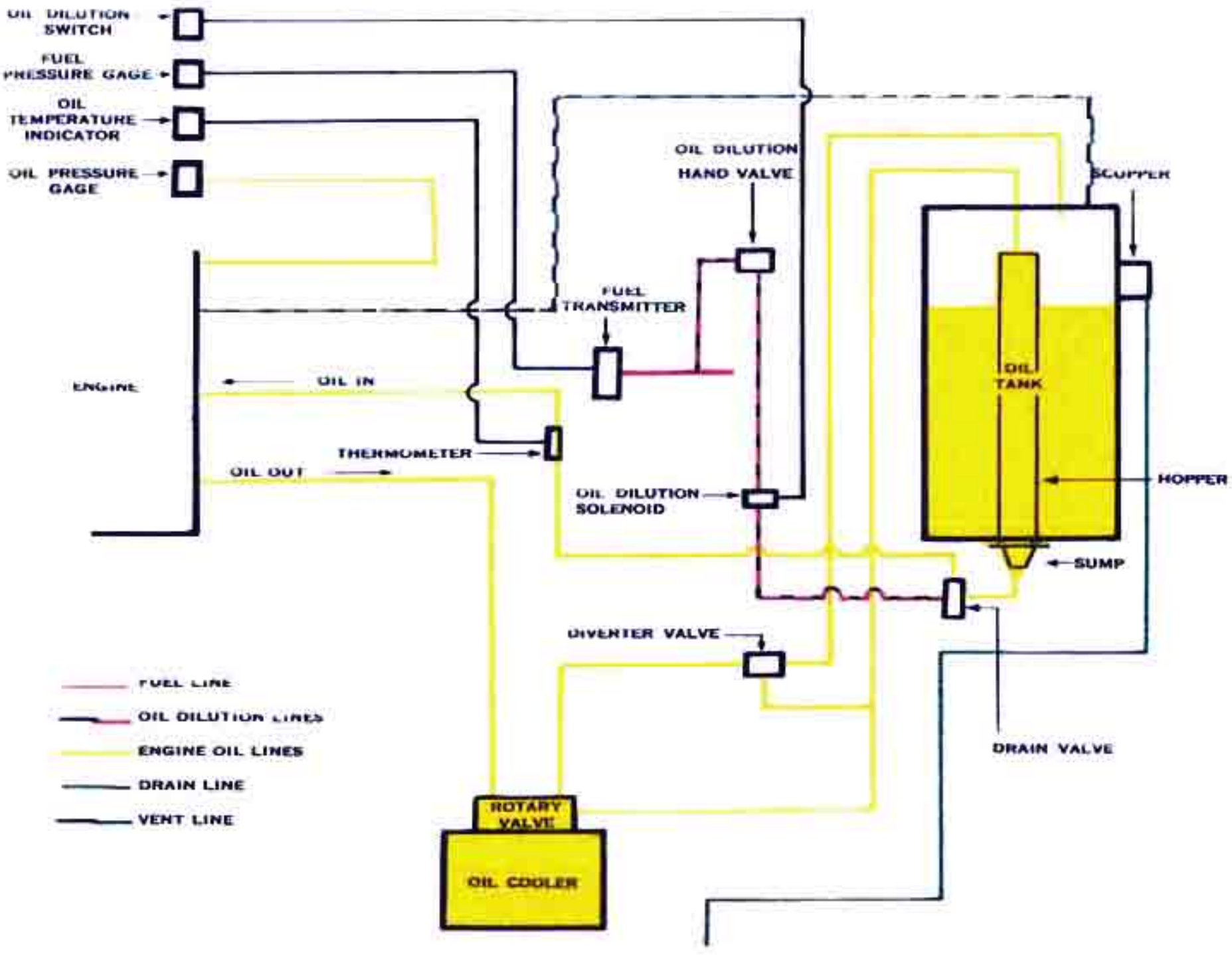


Figure 13 — Oil System

2. CONTROLS.

a. PILOT'S CONTROLS.

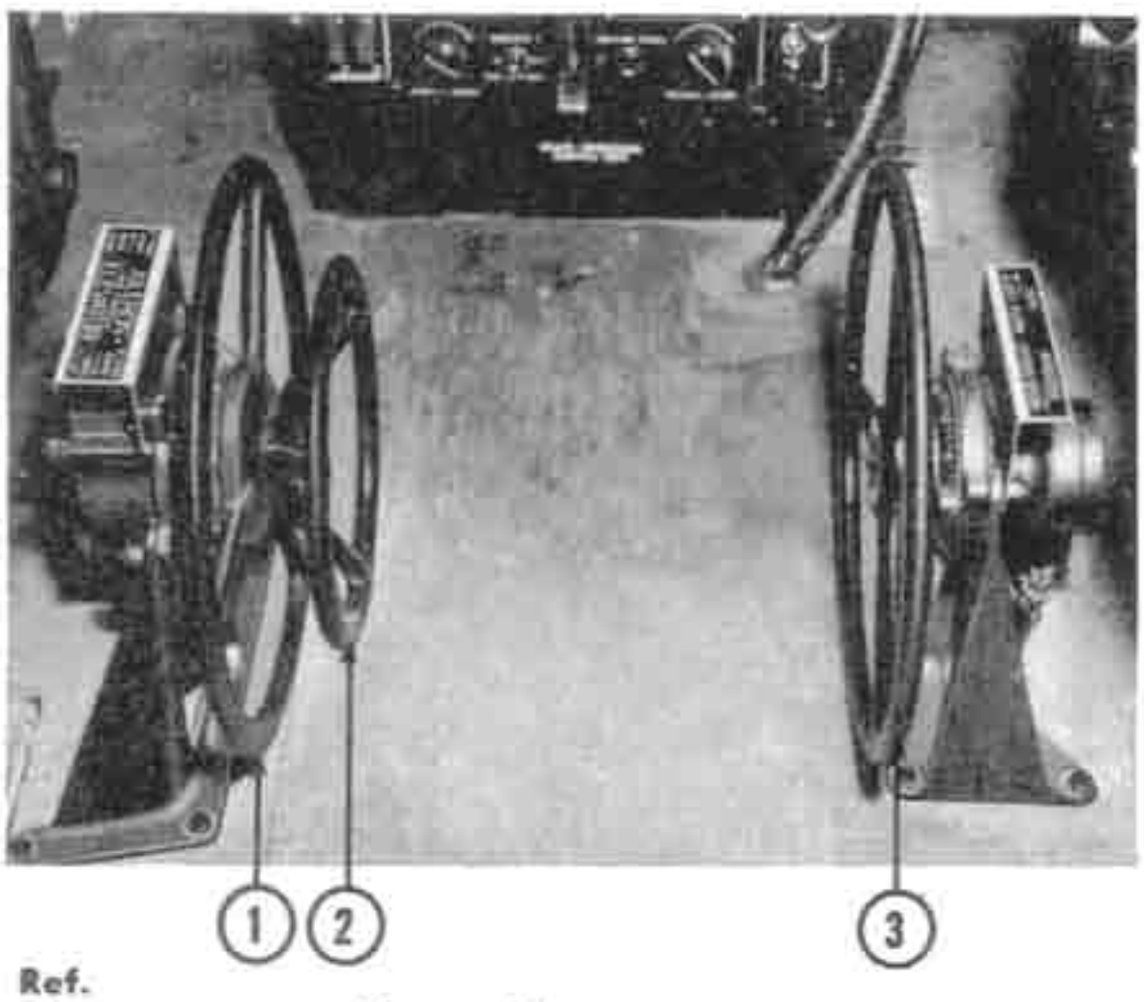
(1) SURFACE CONTROLS AND TRIM TABS.

(a) ELEVATORS AND AILERONS.—The elevators are controlled through conventional dual tubular columns with adjustable stops located under the pilot's flooring. The movement of the conventional aileron control wheels is limited by non-adjustable stops.

(b) RUDDERS.—The rudders are controlled by dual pedals. The pedals are not adjustable. The adjustable rudder stops are attached to the inner beams of the pilot's deck behind the pilot's right and the co-pilot's left pedal.

(c) WING FLAPS.—The wing flaps, actuated by an electric motor, are controlled by a three-position switch (figures 16 or 17-26) on the pilot's pedestal. A flap position indicator (figure 15-9) is located on the co-pilot's instrument panel. The wing flaps may be operated manually by the hand crank stowed in the aft compartment on bulkhead 20.

(d) TRIM TABS.—Three trim tab control wheels (figure 14) are located between the pilot's seats, and are mounted with their axes in an athwartship direction. The elevator and aileron trim tab controls are next to the pilot's seat and the rudder trim tab control wheel is located next to the co-pilot's seat. To gain increased stability the elevator tab action is of the anti-fletner or "leading tab" action allowing the tab a lead of .4 to 1 over the action of the elevator.



Ref. No.	Nomenclature
1	*Elevator Tab Control*
2	*Aileron Tab Control*
3	*Rudder Tab Control*

Figure 14 — Trim Tab Controls

(2) POWER PLANT CONTROLS.

(a) IGNITION SWITCHES.—The ignition switches (figures 16 or 17-1) are located on top of the pilot's pedestal. In order to start either engine the knob in the middle of the unit must be pushed in, and to cut the ignition to both engines simultaneously it is only necessary to pull the knob out. The switch for each engine has four positions "OFF," "L," "R," and "BOTH." With the switch on "BOTH," which is the normal operating position, the engine will operate from both left and right magnetos.

(b) THROTTLE CONTROL LEVERS. *(See figures 22-5 or 23-6.)*—The throttle control levers are located on the crown of the hull between the pilot and co-pilot. The length of the throttle levers is adjustable through a limited range. A friction screw located on the right of the throttle quadrant can be used to adjust the friction on the throttles and propeller governor controls as desired by the pilot. A friction release clutch is located on the left of the throttle quadrant and can be used to release all friction on the throttle for maneuvering on the water.

(3) PROPELLER CONTROLS.

(a) PROPELLER GOVERNOR CONTROL.—Lever-type governor control handles (figures 22-2 and 23-3) are located aft of the throttle control levers and in the same quadrant.

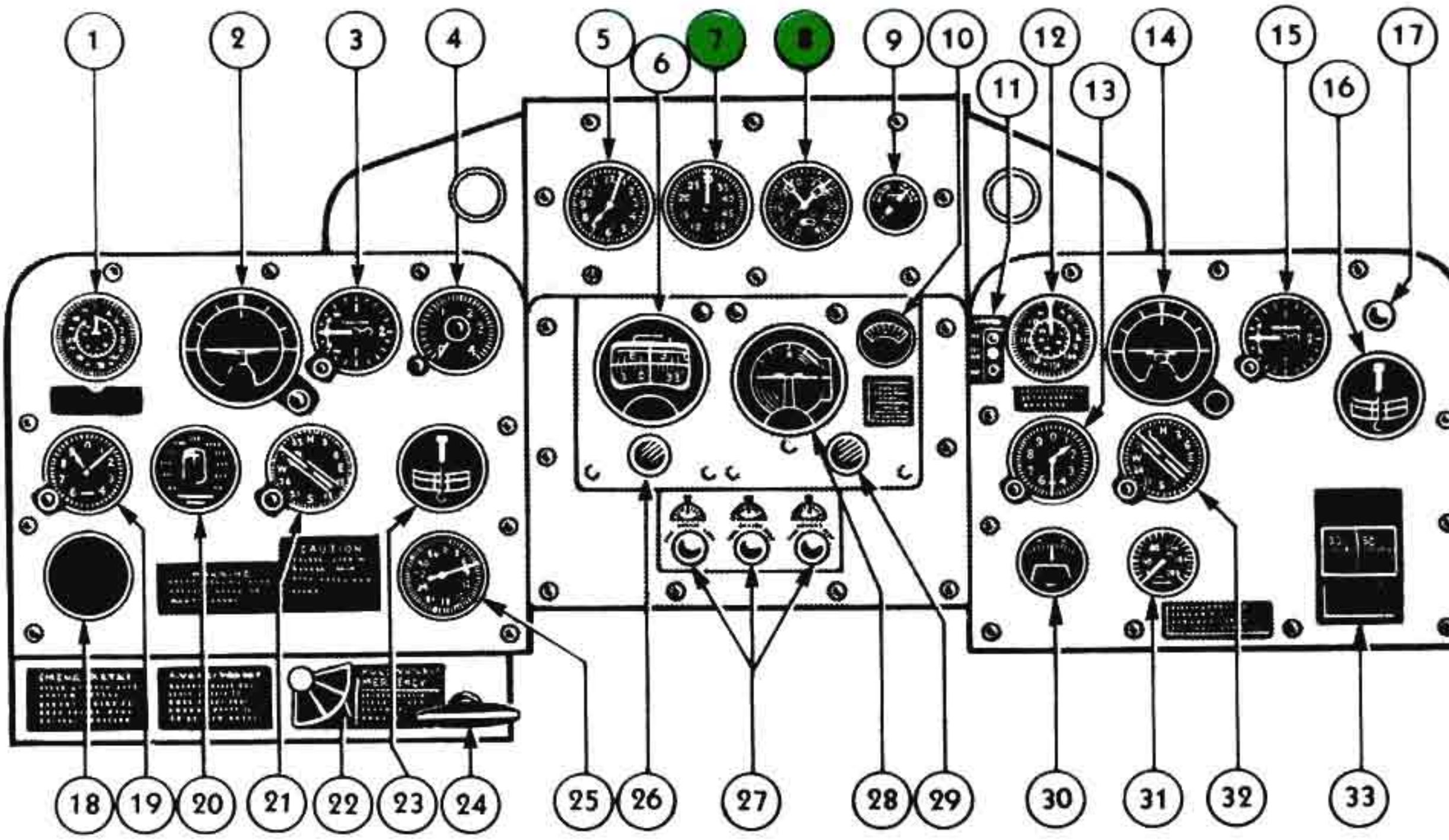
(b) CIRCUIT BREAKERS.—A propeller circuit breaker switch (figure 28-34) located on the flight engineer's panel must be in the "ON" position before either propeller circuit can be operated. A thermal circuit breaker button (figures 16 or 17-8 and 28) for each propeller is located on the pilot's pedestal near each selector switch. If a luminous red and white band appears on the push button indicating an overload, the circuit may be closed by depressing the button for several seconds.

Note

Under emergency conditions the circuit breaker can be overpowered to permit operation by holding the push button in, even though the overload continues to exist.

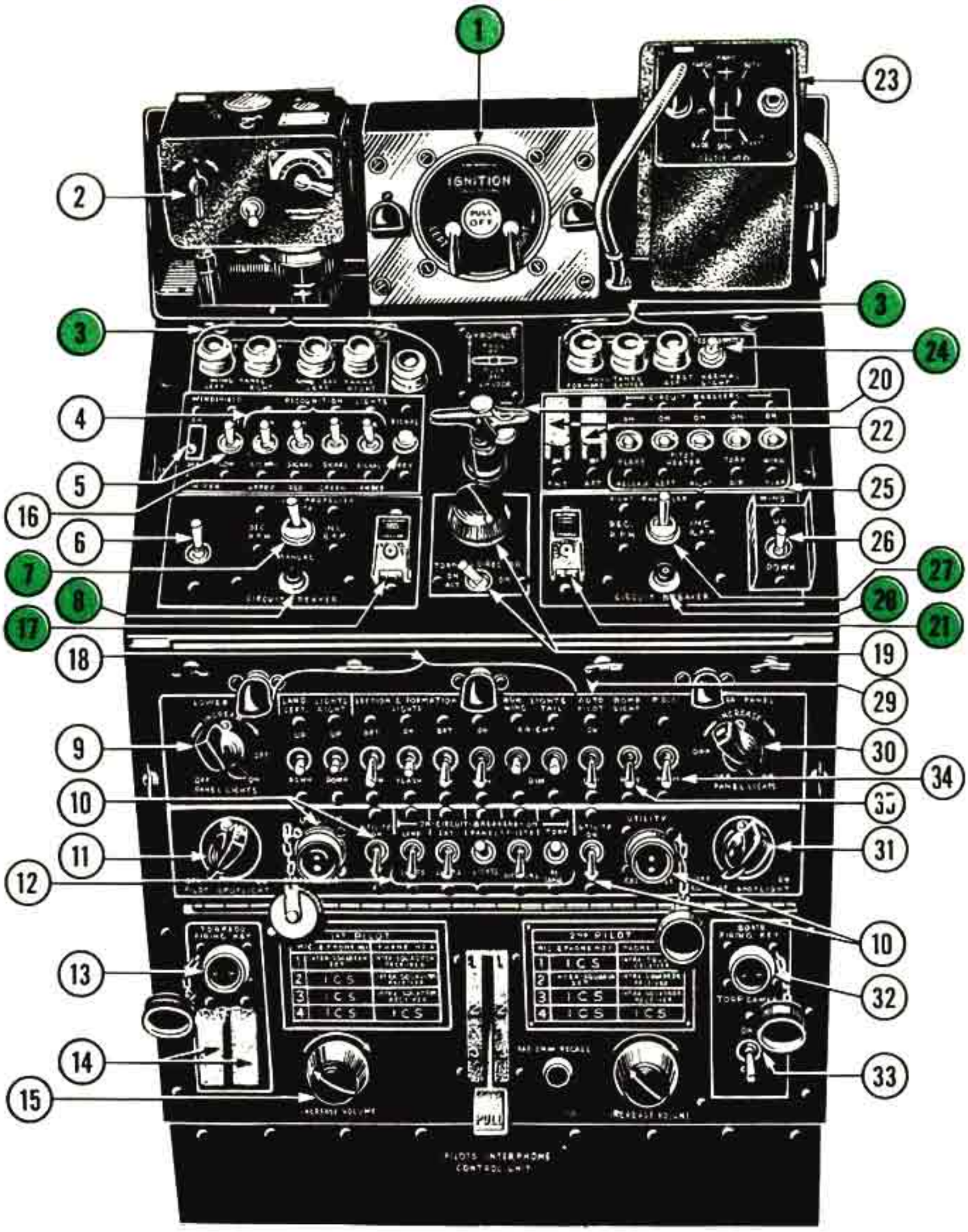
(c) SELECTOR SWITCHES.—Selector switches (figures 16 or 17-7 and 27) for each propeller are located on the pilot's pedestal and allow the propellers to operate in either "MANUAL" (fixed pitch) or "AUTOMATIC."

(d) FEATHER SWITCHES. — The feather switch (figures 16 or 17-17 and 21) for each propeller is located on the pilot's pedestal, and is used to feather the propeller when necessary. The propeller is unfeathered by placing the propeller selector switch to the "INC. RPM" position until the propeller is turning about 1000 rpm, and then placing the selector switch in the "AUTOMATIC" position.



Ref. No.	Nomenclature
1	*Airspeed Indicator*
2	*Gyro Horizon*
3	*Rate of Climb Indicator*
4	*Radio Altimeter Indicator*
5	*Clock*
6	*Gyro Compass*
7	*Dual Manifold Pressure Gage*
8	*Dual Tachometer and Syncroscope Indicator*
9	*Wing Flap Position Indicator*
10	*Vacuum Gage*
11	*Radio Altimeter Indicator Lights*
12	*Airspeed Indicator*
13	*Altimeter*
14	*Gyro Horizon*
15	*Rate of Climb Indicator*
16	*Turn and Bank Indicator*
17	*Marker Beacon Indicator*
18	*Blind Landing Indicator*
19	*Altimeter*
20	*Radio Altimeter Limit Switch*
21	*Remote Reading Compass Indicator*
22	*Manual Bomb Bay Door Selector*
23	*Turn and Bank Indicator*
24	*Manual Bomb Bay Jettison Control*
25	*Radio Compass Indicator (Airplane No. 59000 and subsequent)*
26	*Auto Pilot Caging Switch*
27	*Servo Speed Control Valves*
28	*Auto Pilot Artificial Horizon*
29	*Auto Pilot Caging Knob*
30	*Electric Air Temperature Indicator*
31	*Oil Pressure Gage*
32	*Remote Reading Compass Indicator*
33	*Mark 9 Compass*

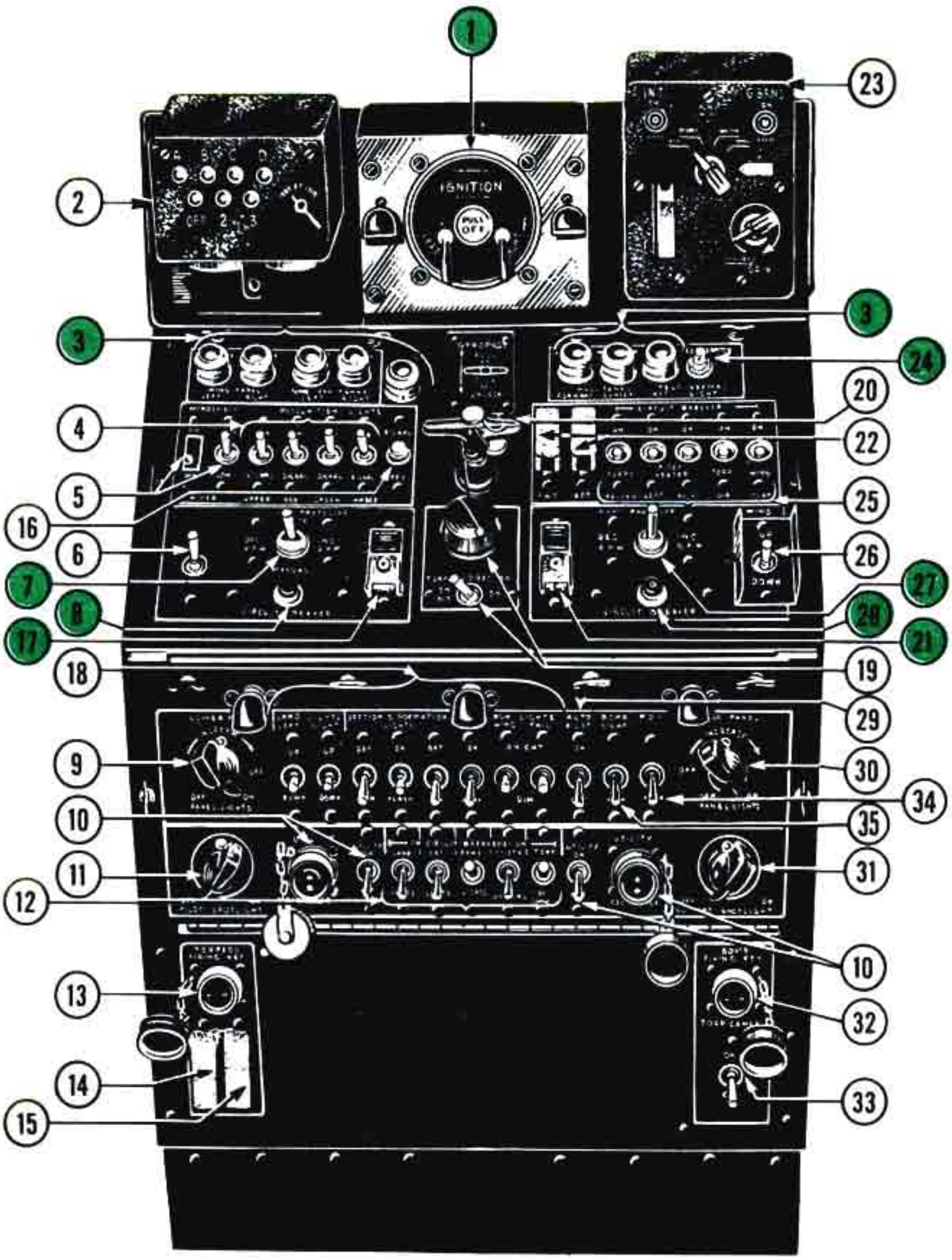
Figure 15 — Pilot's Instrument Panel



Ref. No.	Nomenclature
1	*Ignition Switches*
2	*ATA Control*
3	*Fuel Level Warning Lights*
4	*Recognition Light Switches*
5	*Windshield Wiper Switches*
6	*Pilot's Radio Power Switch*
7	*L.H. Propeller Selector Switch*
8	*L.H. Propeller Circuit Breaker Button*
9	*Lower Panel Light Switch and Rheostat*
10	*Utility Receptacle and Switch*
11	*Pilot's Fluorescent Light Switch*
12	*Circuit Breaker Switches*
13	*Torpedo Firing Key Receptacle*
14	*Torpedo Release Switches*
15	*Pilot's Interphone Control Box*
16	*Recognition Light Signal Key*
17	*L.H. Propeller Feather Switch*
18	*Exterior Lighting Switches*

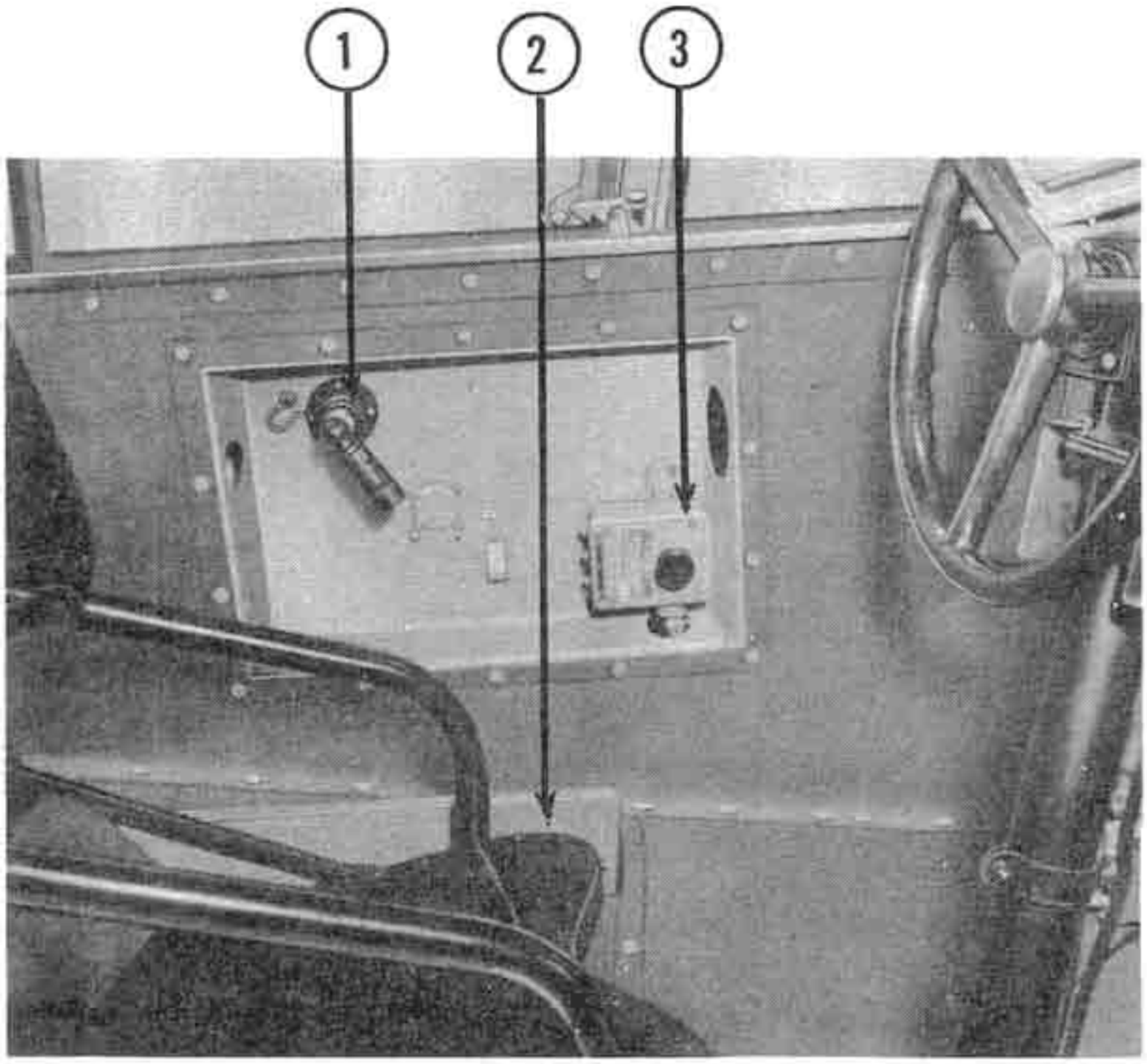
Ref. No.	Nomenclature
19	*Torpedo Director Switch and Rheostat*
20	*Automatic Pilot Lock*
21	*R.H. Propeller Feather Switch*
22	*Flare Release Switches*
23	*Beam Filter Control*
24	*Fuel Level Warning Light Test Switch*
25	*Circuit Breaker Switches*
26	*Wing Flap Control Switch*
27	*R.H. Propeller Selector Switch*
28	*R.H. Propeller Circuit Breaker Button*
29	*Automatic Pilot Switch*
30	*Co-Pilot's Fluorescent Light Switch*
31	*Co-Pilot's Spotlight Switch and Rheostat*
32	*Bomb Firing Key Receptacle*
33	*Torpedo Camera Switch*
34	*P. D. I. Switch*
35	*Bomb Sight Switch*

Figure 16 — Pilot's Pedestal (Airplanes Nos. 45405 to 45444)



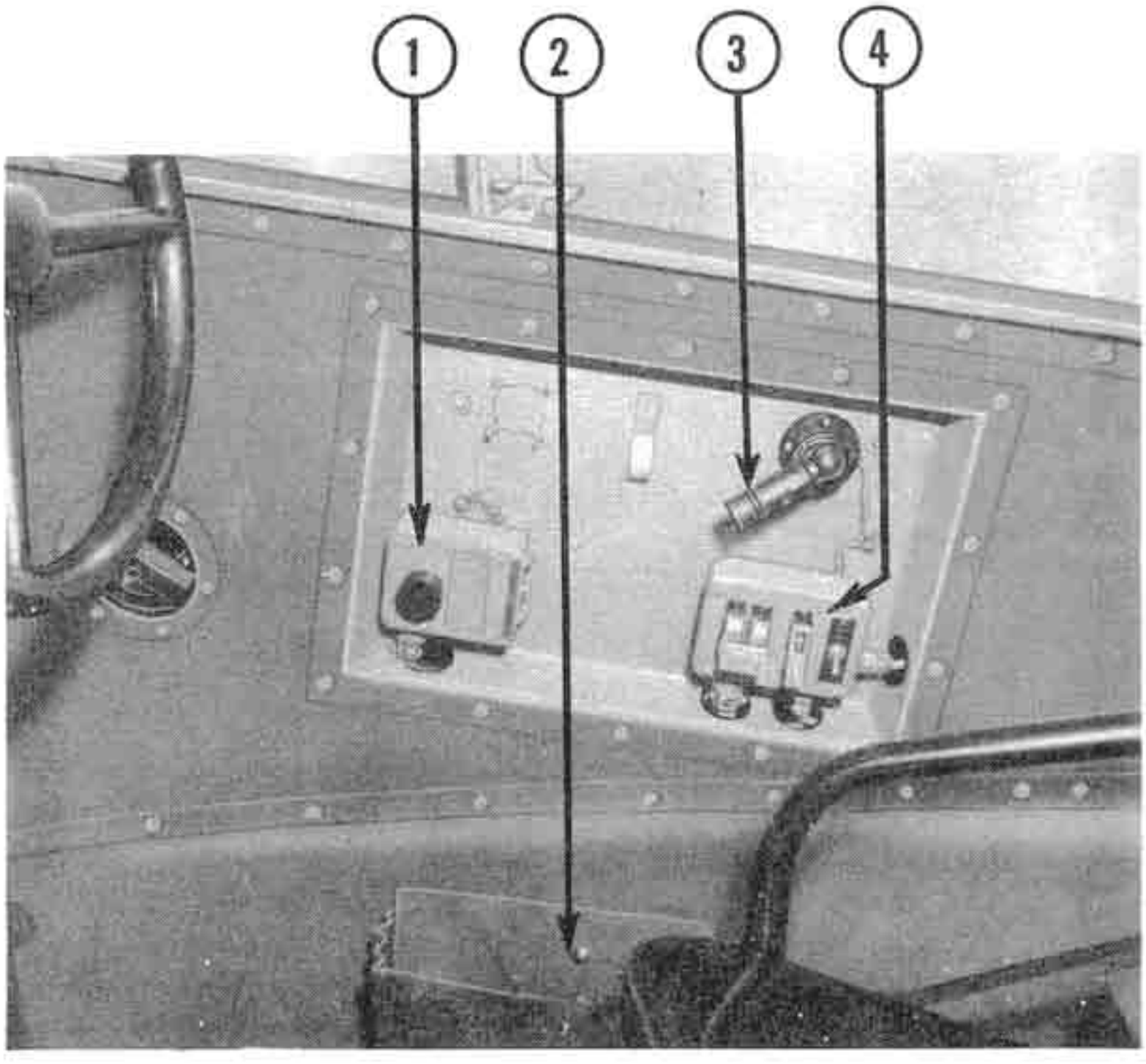
Ref. No.	Nomenclature	Ref. No.	Nomenclature
1	*Ignition Switches*	19	*Torpedo Director Switch and Rheostat*
2	*Intersquadron Transmitter Control*	20	*Automatic Pilot Lock*
3	*Fuel Level Warning Lights*	21	*R.H. Propeller Feather Switch*
4	*Recognition Light Switches*	22	*Flare Release Switches*
5	*Windshield Wiper Switches*	23	*AN/APX-2 Control*
6	*Pilot's Radio Power Switch*	24	*Fuel Level Warning Light Test Switch*
7	*L.H. Propeller Selector Switch*	25	*Circuit Breaker Switches*
8	*L.H. Propeller Circuit Breaker Button*	26	*Wing Flap Control Switch*
9	*Lower Panel Light Switch and Rheostat*	27	*R.H. Propeller Selector Switch*
10	*Utility Receptacle and Switch*	28	*R.H. Propeller Circuit Breaker Button*
11	*Pilot's Fluorescent Light Switch*	29	*Automatic Pilot Switch*
12	*Circuit Breaker Switches*	30	*Upper Panel Light Switch and Rheostat*
13	*Torpedo Firing Key Receptacle*	31	*Co-Pilot's Fluorescent Light Switch*
14	*Left Torpedo Release Switch*	32	*Bomb Firing Key Receptacle*
15	*Right Torpedo Release Switch*	33	*Torpedo Camera Switch*
16	*Recognition Light Signal Key*	34	*P.D.I. Switch*
17	*L.H. Propeller Feather Switch*	35	*Bomb Sight Switch*
18	*Exterior Lighting Switches*		

Figure 17 — Pilot's Pedestal (Airplane No. 59000 and Subsequent)



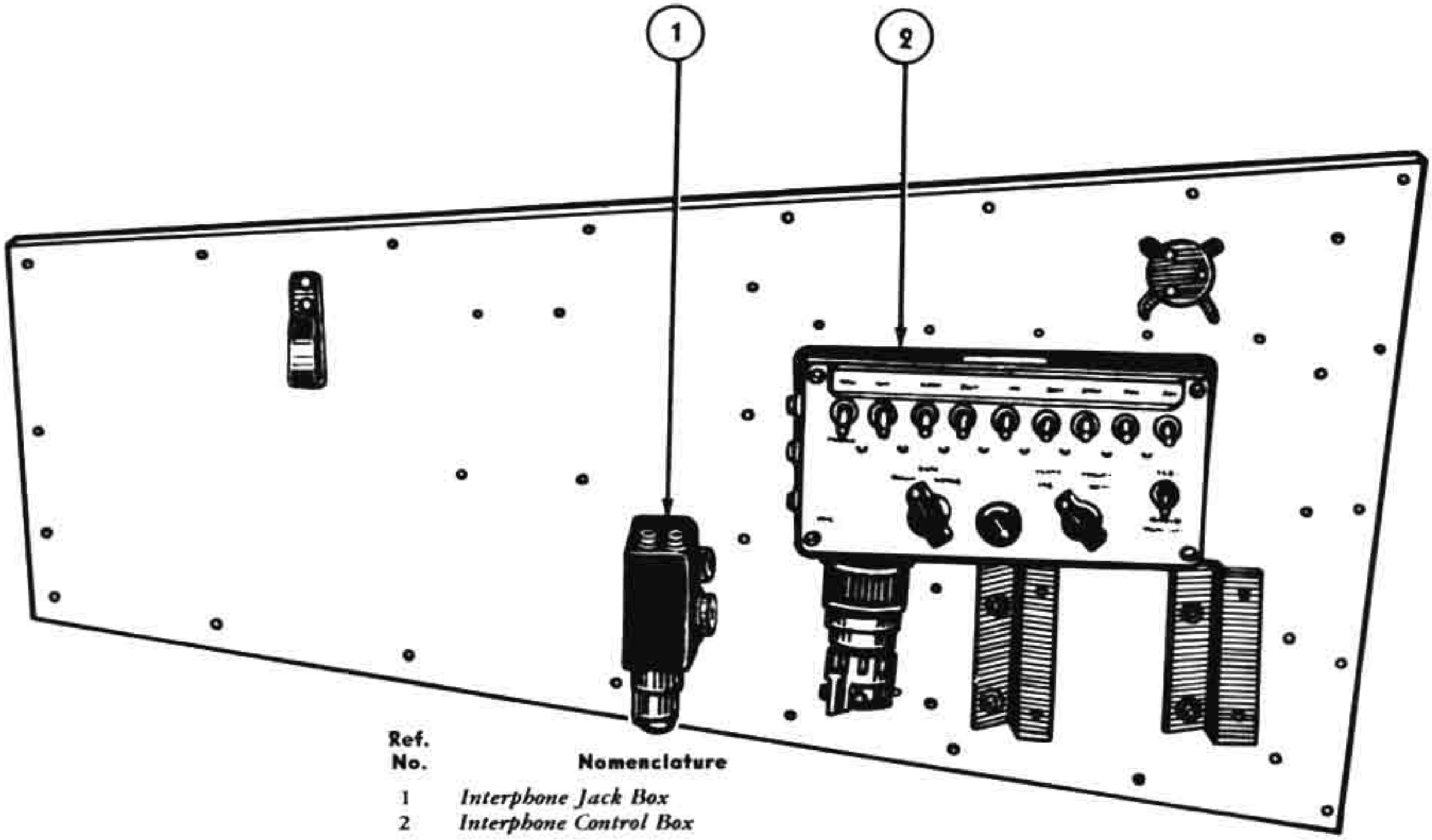
Ref. No.	Nomenclature
1	*Spotlight*
2	*Pilot's Data Case*
3	*Pilot's Station Box*

Figure 18
Pilot's Station—Left Side
(Airplanes Nos. 45405 to 45444)



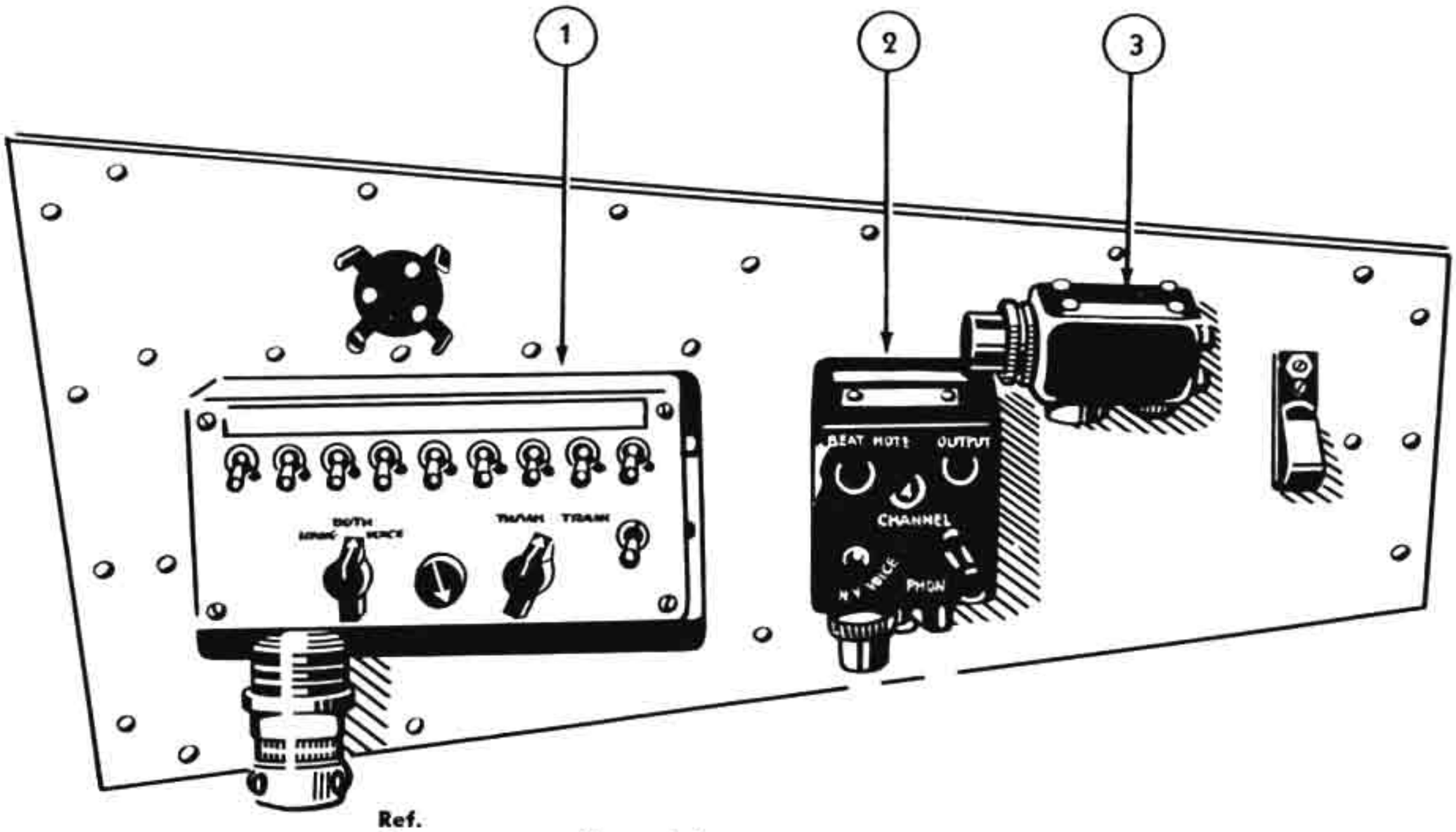
Ref. No.	Nomenclature
1	*Co-Pilot's Station Box*
2	*Map Case*
3	*Spotlight*
4	*IFF Controls*

Figure 19
Pilot's Station—Right Side
(Airplanes Nos. 45405 to 45444)



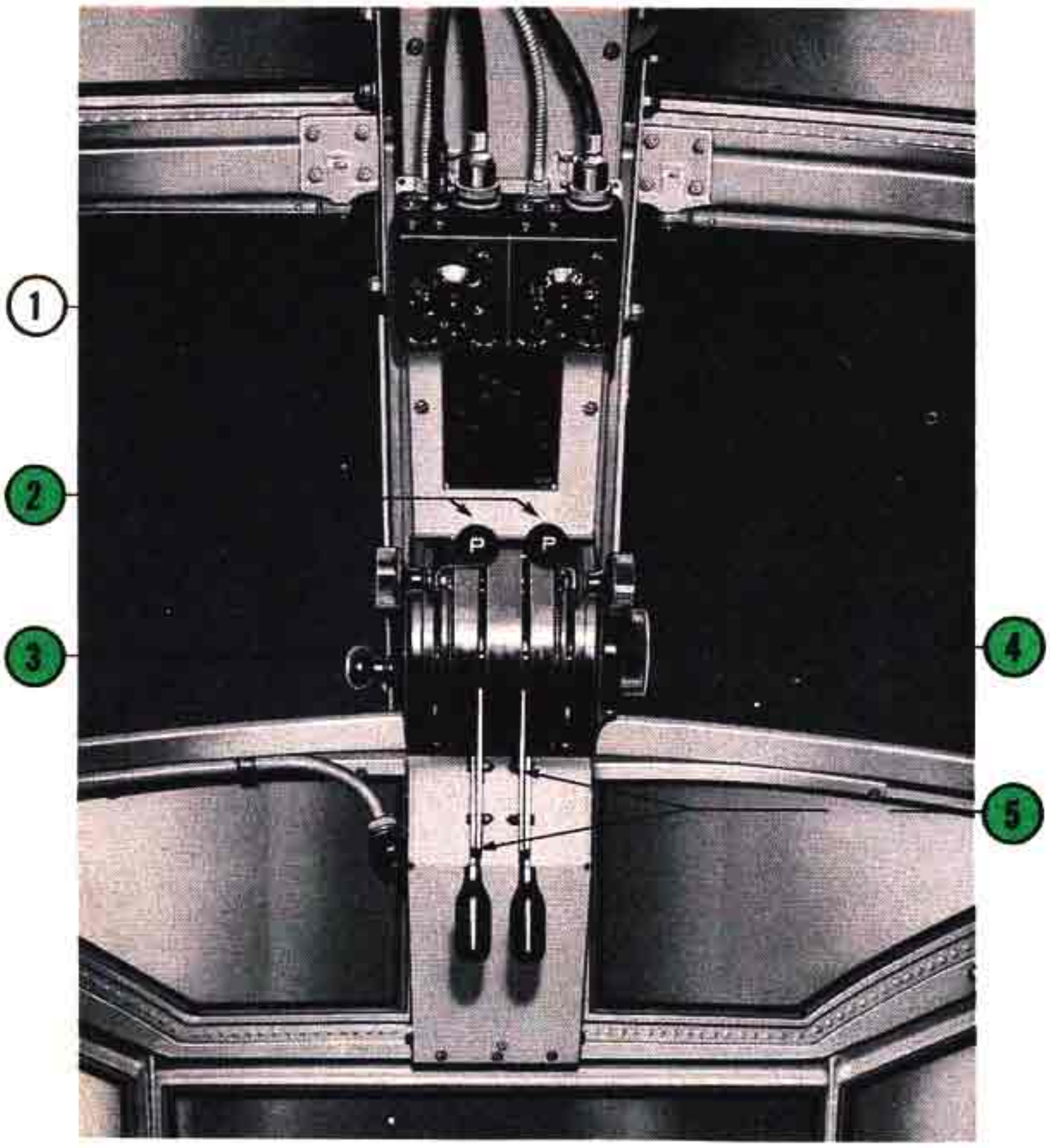
Ref. No.	Nomenclature
1	*Interphone Jack Box*
2	*Interphone Control Box*

Figure 20 — Pilot's Station—Left Side (Airplane No. 59000 and Subsequent)



Ref. No.	Nomenclature
1	*Interphone Control Box*
2	*AN/ARR-2 Control Box*
3	*Interphone Jack Box*

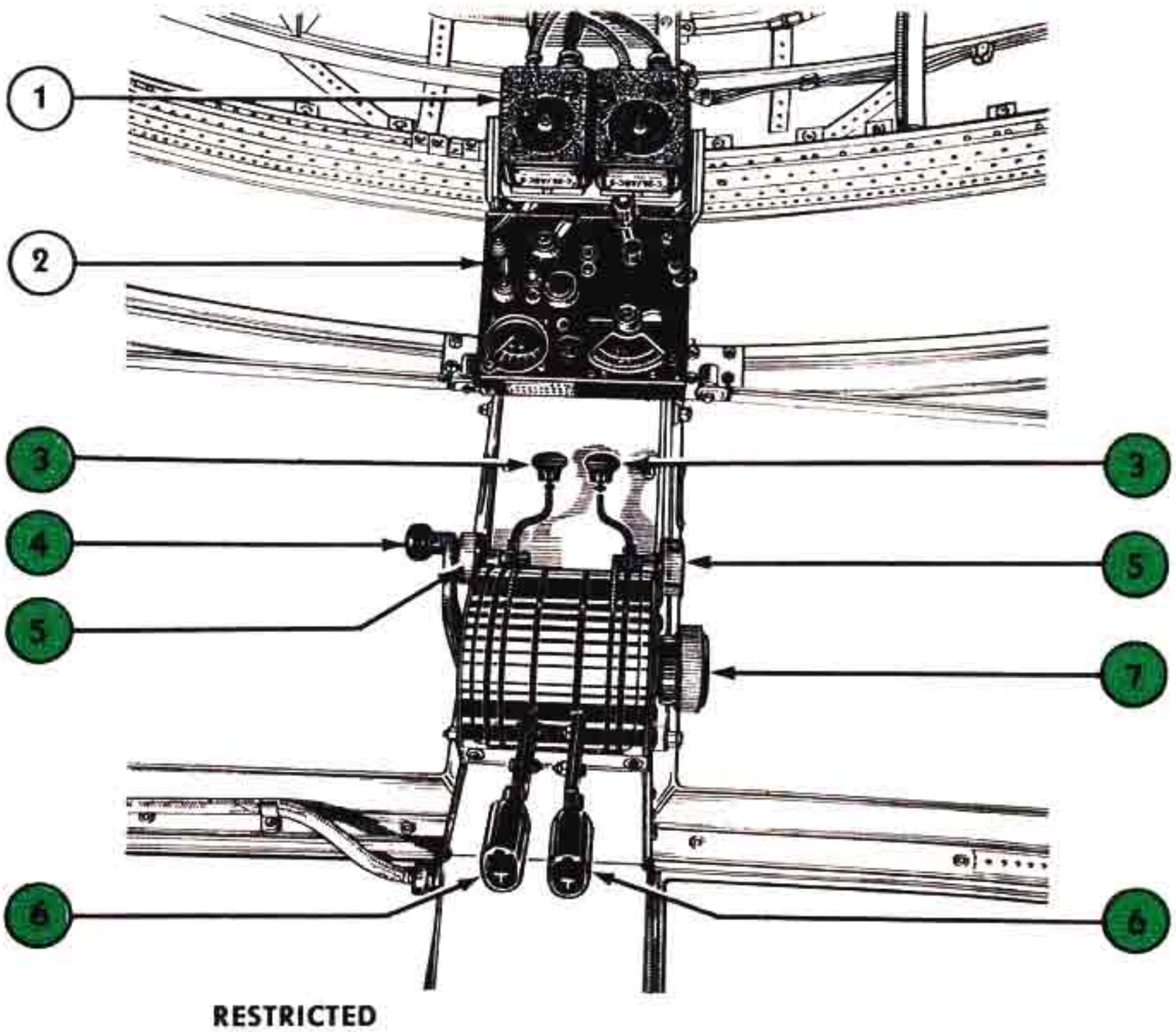
Figure 21 — Pilot's Station—Right Side (Airplane No. 59000 and Subsequent)



Ref. No.	Nomenclature
1	*ARA Controls*
2	*Propeller Governor Controls*
3	*Friction Release Clutch*
4	*Friction Adjustment Knob*
5	*Throttle Control Levers*

Figure 22

Pilot's Overhead Controls (Airplanes Nos. 45405 to 45444)



Ref. No.	Nomenclature
1	*AN/ARC-5 Remote Control Heads*
2	*SCR-269-G Control Box*
3	*Propeller Governor Control*
4	*Friction Release Clutch*
5	*Governor Adjustment Knob*
6	*Throttle Control Lever*
7	*Friction Adjustment Knob*

Figure 23

Pilot's Overhead Controls (Airplane No. 59000 and Subsequent)

Note

A propeller feathering circuit-breaker switch on the flight engineer's panel should be in the "ON" position at all times.

b. FLIGHT ENGINEER'S CONTROLS.

(1) MAIN POWER PLANT CONTROLS.

(a) MIXTURE CONTROL LEVERS. *(See figure 24-2.)*—The mixture control levers located on the engineer's control panel govern the ratios of fuel to the air that enter the engine from the carburetor. Three notches on the carburetor mixture control quadrant locate the various positions of the mixture control levers. The engineer can "feel" these notches by moving the mixture control lever through its full swing several times. Reading from bottom to top the mixture control positions are as follows:

1. The "AUTO RICH" position is to be used for all ground operation, take-off, landings, and operation when cooling in "AUTO LEAN" is inadequate. This position is located by the bottom notch.

2. The "AUTO LEAN" position is used for all cruising flight operations except when "AUTO RICH" is necessary to maintain adequate cooling. The second notch up from the bottom of the quadrant locates the "AUTO LEAN" position.

3. The "IDLE CUT-OFF" position is the top or third notch on the quadrant. This position is used when starting and stopping the engines. In starting the engines the mixture control lever should be in the "IDLE CUT-OFF" position until after the engine starts to fire. Fuel for starting the engine should be supplied by use of the primer switch.

(b) CARBURETOR AIR CONTROL LEVERS. *(See figure 24-1.)*—The carburetor air control levers control the air supply to the carburetor. The levers lock in both the "DIRECT" and "ALTERNATE" positions. Be sure that they are locked in the position being used. In the "DIRECT" position air is supplied to the carburetor from the air scoop above the carburetor. In the "ALTERNATE" position a door is opened which allows air from within the hood cowling to enter the carburetor. This prevents fouling and clogging of the induction system when icing conditions are encountered. In this position the available power is reduced because of increased carburetor air temperature and loss of ram. This position should be used ONLY when icing conditions are encountered.

CAUTION

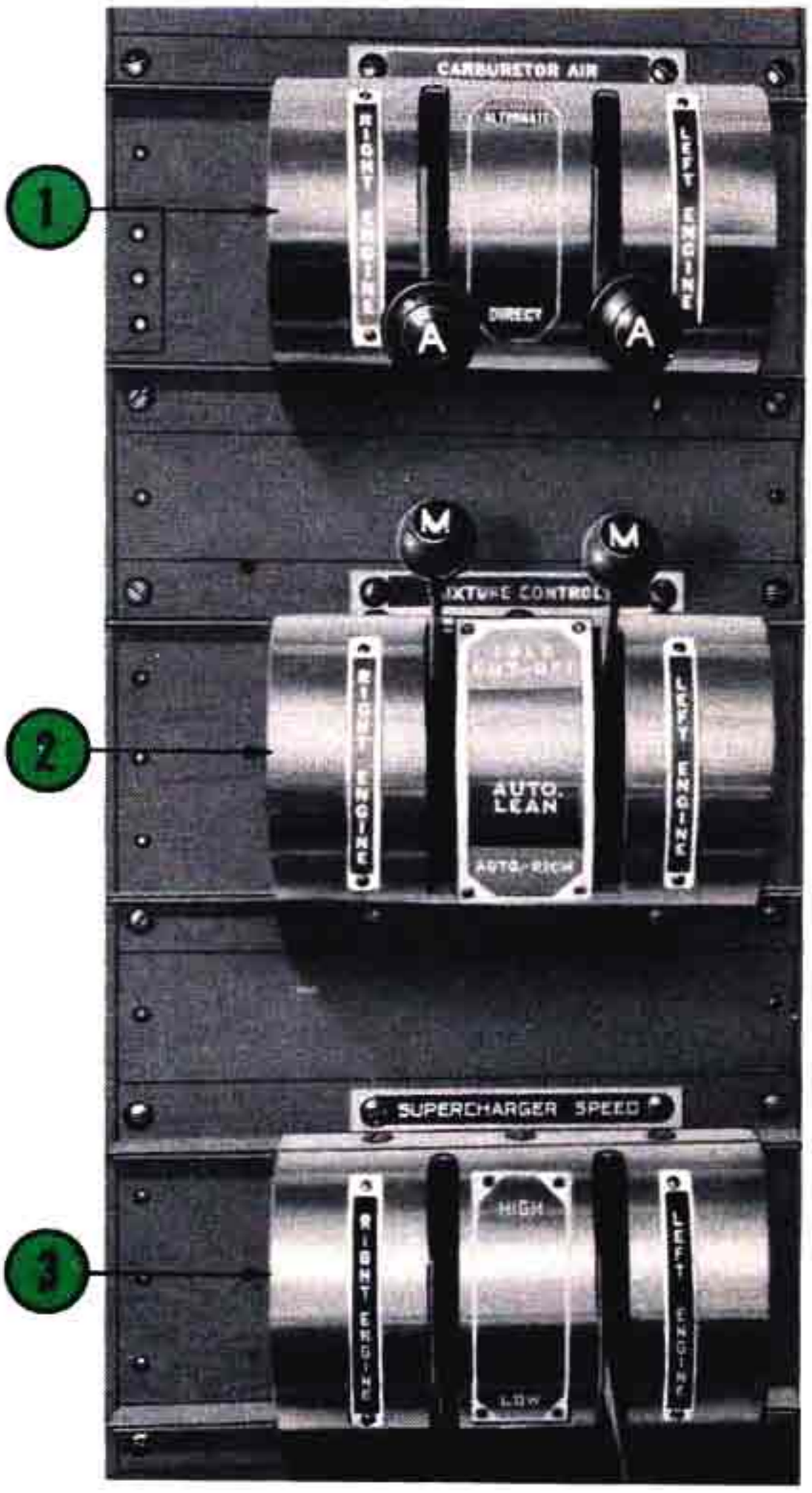
Do not take off with the carburetor air control levers in "ALTERNATE." If take-off must be made under icing conditions use the "ALTERNATE" position to clear the induction system just before the start of the take-off, and shift to "DIRECT" position for take-off run.

(c) SUPERCHARGER SPEED CONTROLS. *(See figure 24-3.)* — The supercharger speed control levers control the clutches which drive the supercharger impellers. The two positions are "HIGH" and "LOW." Be sure the levers are locked in the position being used.

CAUTION

Do not operate with levers in any intermediate position.

1. The superchargers should always be operated in low ratio unless the required power cannot be



Ref. No.	Nomenclature
1	*Carburetor Air Control*
2	*Mixture Control*
3	*Supercharger Speed Control*

Figure 24 — Power Plant Control Panel

obtained. The superchargers should never be operated in high ratio below 11,500 feet except for ground tests.

Note

Do not take off or dive with the levers in high blower.

2. When shifting from "LOW" to "HIGH" in flight, use the following procedure:

a. Adjust propellers so that the speed is not less than 1700 nor more than 1800 rpm.

b. Make sure that the manifold pressure is low enough so that it will not exceed the allowable manifold pressure after the ratio is changed.

c. Shift from "LOW" to "HIGH" in one quick continuous motion and lock.

d. Readjust manifold pressure and engine speed as desired.

CAUTION

During flight do not shift blower ratios oftener than once every 5 minutes except in an emergency, since it requires at least this period of time for the clutches to cool off.

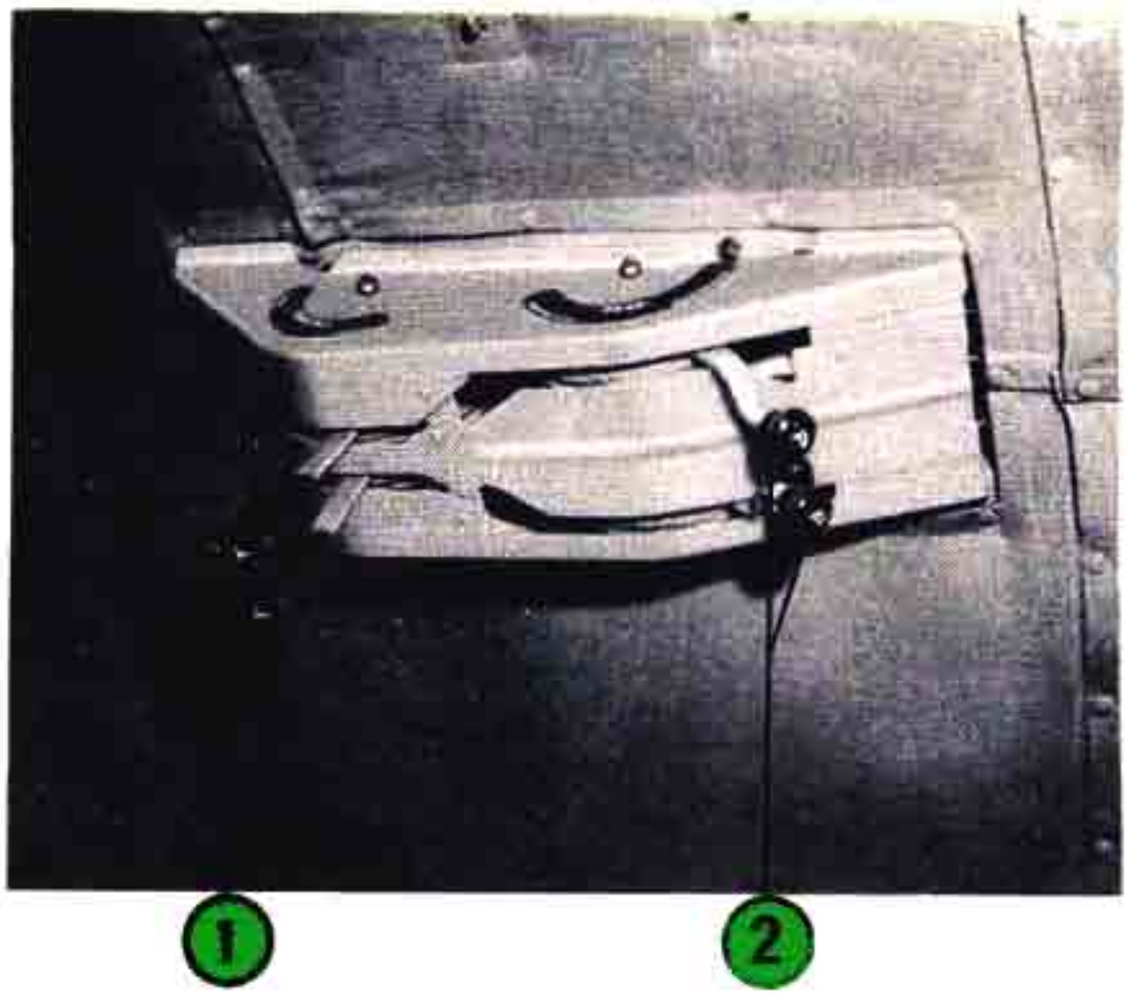
(d) COWL FLAP CONTROLS.

1. COWL FLAP SWITCHES. *(See figure 28-10 and 26.)*—The cowl flap switches controlling the cowl flap opening are located at the top of the flight engineer's switch panel. The cowl flap circuit-breaker switches located on the lower part of the flight engineer's switch panel must be in the "ON" position before the cowl flaps can be operated. A calibrated scale on the inboard side of each carburetor air scoop shows the cowl flap opening in degrees.

2. TEMPERATURE INDICATORS. *(See figure 27-1.)*—Three dual cylinder temperature indicators are provided: one for "GROUND," one for "TAXI," one for "FLIGHT." Each indicator is connected to the cylinder that normally becomes the hottest during each operation. Operation must at all times be governed by the hottest indication regardless of which indicator it is.

3. OPERATION.—The cowl flaps control the amount of air flowing over the engine cylinders and thus regulate the cylinder temperature. Every effort should be made to keep the head temperatures below the limits. A fixed opening for cowl flaps cannot be specified but they should be adjusted to the minimum opening required to maintain head temperatures below and not uncomfortably close to the limits. Openings of more than 30 degrees should be avoided in flight wherever possible as the added drag largely cancels out any benefit that may result from such large openings.

(e) THROTTLE CONTROL LEVERS. *(See figure 25-1.)* — Duplicate throttle control levers connected with those in the pilot's control station are mounted on the crown of the hull above the flight engineer's seat.



Ref. No.	Nomenclature
1	*Throttle Control Levers*
2	*Propeller Governor Control Levers*

Figure 25 — Flight Engineer's Propeller and Throttle Controls

(f) STARTER SWITCHES. *(See figure 28-1 and 7.)* — A start and mesh switch for each engine starter is located at the top of the flight engineer's electrical control panel.

(2) PROPELLER CONTROLS. *(See figure 25-2.)* —The propeller governor controls, which are connected with those in the pilot's control station, are mounted on the crown of the hull with the throttle control levers. Circuit-breaker switches for both the normal and feathering circuits are located on the flight engineer's switch panel.

(3) FUEL SYSTEM CONTROLS.

(a) ENGINE SELECTOR VALVES. *(See figure 26-5.)*—The main engine selector valves are located in the center of the fuel control panel and enable the flight engineer to feed fuel to the engines from either the wing service tanks, the hull tanks, or a bomb bay tank.

1. A transfer pump switch is connected to each valve drive shaft handle and operates the transfer pump as follows:

a. Selector valve set to "OFF"—no current can reach the transfer pump.

b. Selector valve set to "HULL TANK"—transfer pump turned on and operates directly from switch.

c. Selector valve set to "SERVICE TANK" —transfer pump is connected to wing tank switch and liquidometer gage in wing tank, and automatically refills wing tank when fuel level drops to 190 U. S. (158 Imperial) gallons when the wing tank switch is set to "AUTOMATIC."

Note

Wing service tank booster pumps are controlled by the booster pump switches but will not operate unless the engine selector valves are set to "SERVICE TANK."

d. Selector valve set to "BOMB BAY TANK"—bomb bay booster pump is turned on, no current can reach the transfer pump.

e. Selector valve set to "DRAIN WING TANK"—no current can reach the transfer pump.

2. As the control handle is turned a series of clicks will be felt. These clicks mark the open position of the valve for the various settings, and because of the backlash in the control linkage the click rather than the pointer should be depended upon for correct positioning of the valve.

(b) BOOSTER PUMP SWITCHES.—A fuel booster pump switch (figure 28-4) on the flight engineer's switch panel is provided for each fuel booster pump. When the main engine selector valve is set to "SERVICE TANK" the booster pump will operate if the switch is set to either "NORMAL" or "EMERGENCY."

1. The "NORMAL" position should be used at all times for ground or flight operation when operating on the wing service tanks.

2. The "EMERGENCY" position should be used when the failure of an engine-driven fuel pump necessitates the use of additional pressure, or when excessive fuel vapor formation at high altitude requires additional pressure to avoid erratic engine operation.

(c) FUEL TRANSFER PUMP CIRCUIT-BREAKER SWITCH. — The switch, located on the flight engineer's control panel, must be turned to "ON" before either transfer pump will operate.

(d) WING TANK SWITCHES. *(See figure 28-36.)*

1. During normal flight operations each transfer pump is operated by a switch having three positions, "AUTOMATIC," "OFF," and "MANUAL." A spring prevents the switch from remaining in "MANUAL" unless it is held there.

2. With the switch set to "AUTOMATIC" and the engine selector valve set to "SERVICE TANK," the transfer pump will refill the service tank every time the fuel level drops to 190 U. S. (158 Imperial) gallons.

(e) HULL TANK SELECTOR VALVE. *(See figure 26-2.)*—The hull tank selector valve is located immediately below the engine selector valves and controls the fuel from the three hull tanks to the wing service tanks.

(f) STRAINER AND WING TANK SUMP DRAIN VALVE. *(See figure 26-3.)*—This valve is used to drain water from the two-wing service tank sumps, from the two main engine fuel strainers, and from the auxiliary power plant fuel strainer.

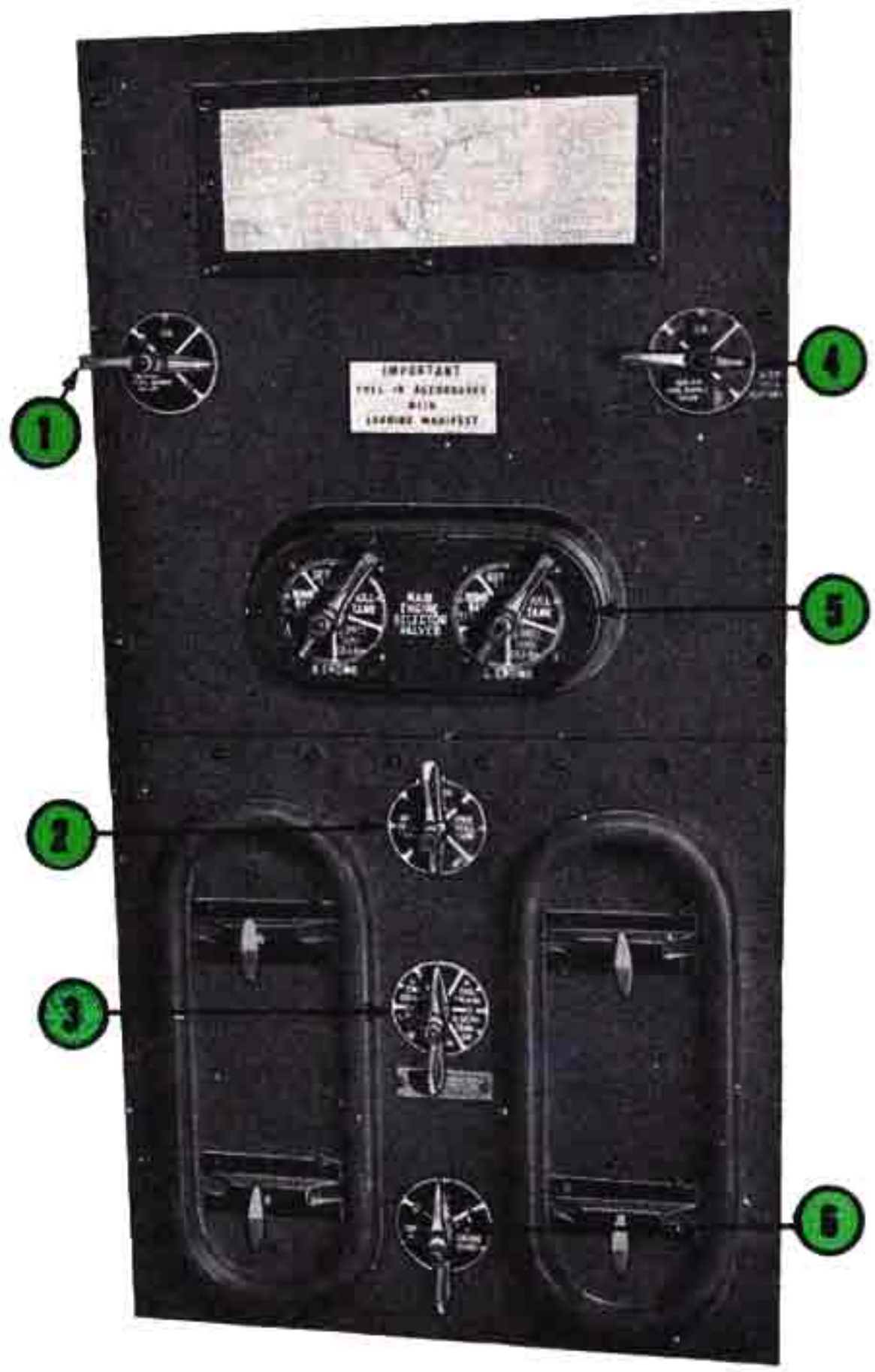
CAUTION

The strainer and wing tank sump drain valve should always be in the "OFF" position except when draining the sump or strainers.

(g) CROSSOVER VALVE. *(See figure 26-6.)* —The crossover valve is used only in case of failure of one or both transfer pumps or when defueling. There are three positions of the valve; "OFF," "CROSSOVER," and "DEFUEL HULL TANKS."

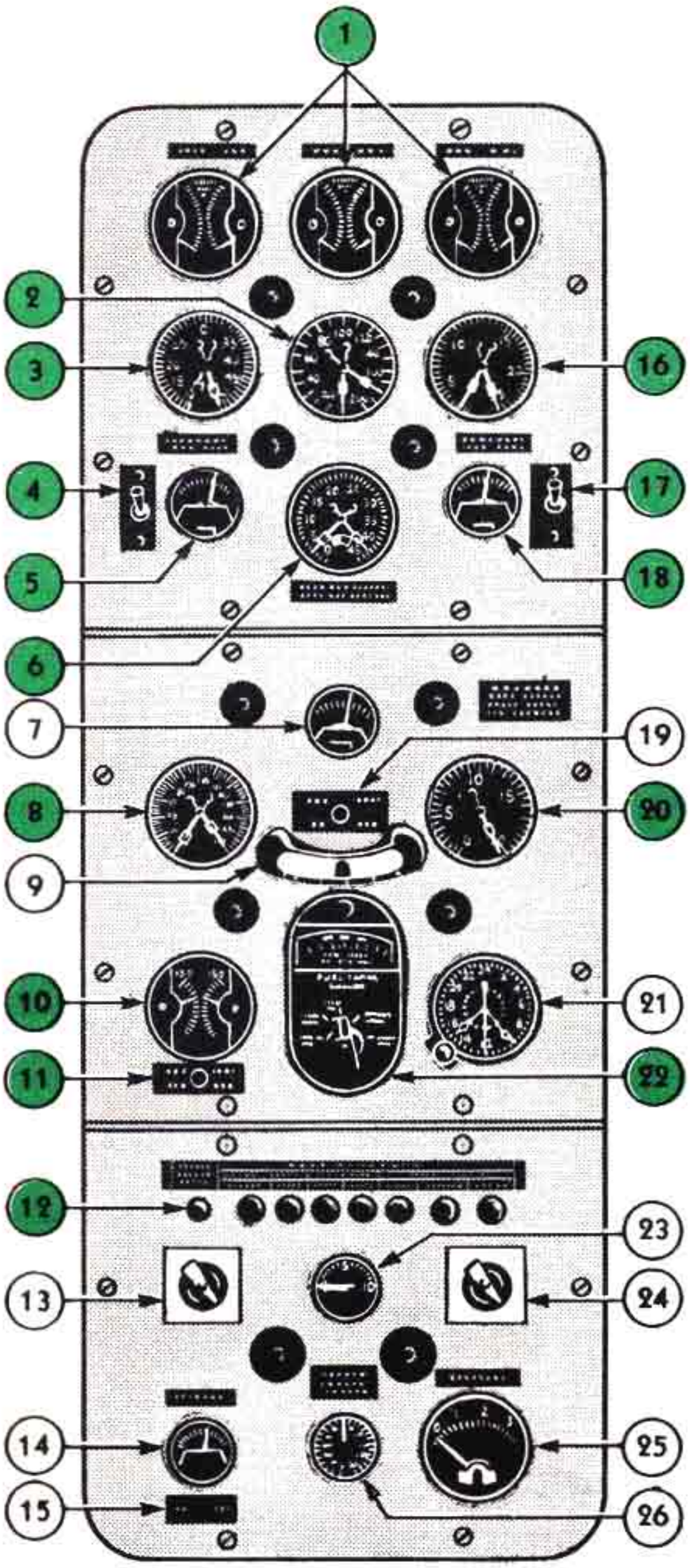
CAUTION

The crossover valve should always be in the "OFF" position except when in actual use.



Ref. No.	Nomenclature
1	*Heater Fuel Supply Valve*
2	*Hull Tank Selector Valve*
3	*Strainer and Wing Tank Sump Drain Valve*
4	*Auxiliary Power Plant Fuel Supply Valve*
5	*Main Engine Selector Valves*
6	*Crossover Valve*

Figure 26 — Fuel System Controls



Ref. No.	Nomenclature
1	*Dual Cylinder Head Temperature Indicator*
2	*Dual Oil Pressure Gage*
3	*Dual Manifold Pressure Gage*
4	*Left Engine Oil Temperature Thermometer Switch*
5	*Left Engine Oil Temperature Thermometer*
6	*Dual Tachometer Indicator With Synchroscope*
7	*Outside Air Thermometer*
8	*Dual Horsepower BMEP Indicator*
9	*Inclinometer*
10	*Carburetor Air Temperature Gage*
11	*Carburetor Air Temperature Gage Switch*
12	*Fuel Low Level Warning Lights and Test Button*
13	*Panel Light Rheostat*
14	*Auxiliary Power Plant Oil Temperature Gage*
15	*Auxiliary Power Plant Oil Temperature Gage Switch*
16	*Dual Fuel Pressure Gage*
17	*Right Engine Oil Temperature Thermometer Switch*
18	*Right Engine Oil Temperature Thermometer*
19	*Outside Air Thermometer Switch*
20	*Dual Fuel Flowmeter Indicator*
21	*Clock*
22	*Fuel Level Gage*
23	*De-Icer Pressure Gage*
24	*Panel Lights Rheostat*
25	*Auxiliary Power Plant Cylinder Head Temperature Gage*
26	*Auxiliary Power Plant Oil Pressure Indicator*

Figure 27 — Flight Engineer's Instrument Panel

(b) WARNING LIGHTS. *(See figure 28-33.)* —The two warning lights show red whenever the fuel-transfer pumps are running on an empty hull tank. A test switch is provided for checking the bulbs in the warning lights.

CAUTION

If a fuel transfer pump runs for 5 minutes on an empty tank it is apt to overheat and burn out.

(i) FUEL FLOWMETER. — A fuel flowmeter transmitter is located between each engine-driven pump and carburetor. The dual flowmeter indicator (figure 27-20) on the flight engineer's instrument panel is calibrated from 100 to 1000 pounds per hour. This instrument indicates the rate of fuel flow, not the quantity of fuel being used.

(4) OIL SYSTEM CONTROLS.

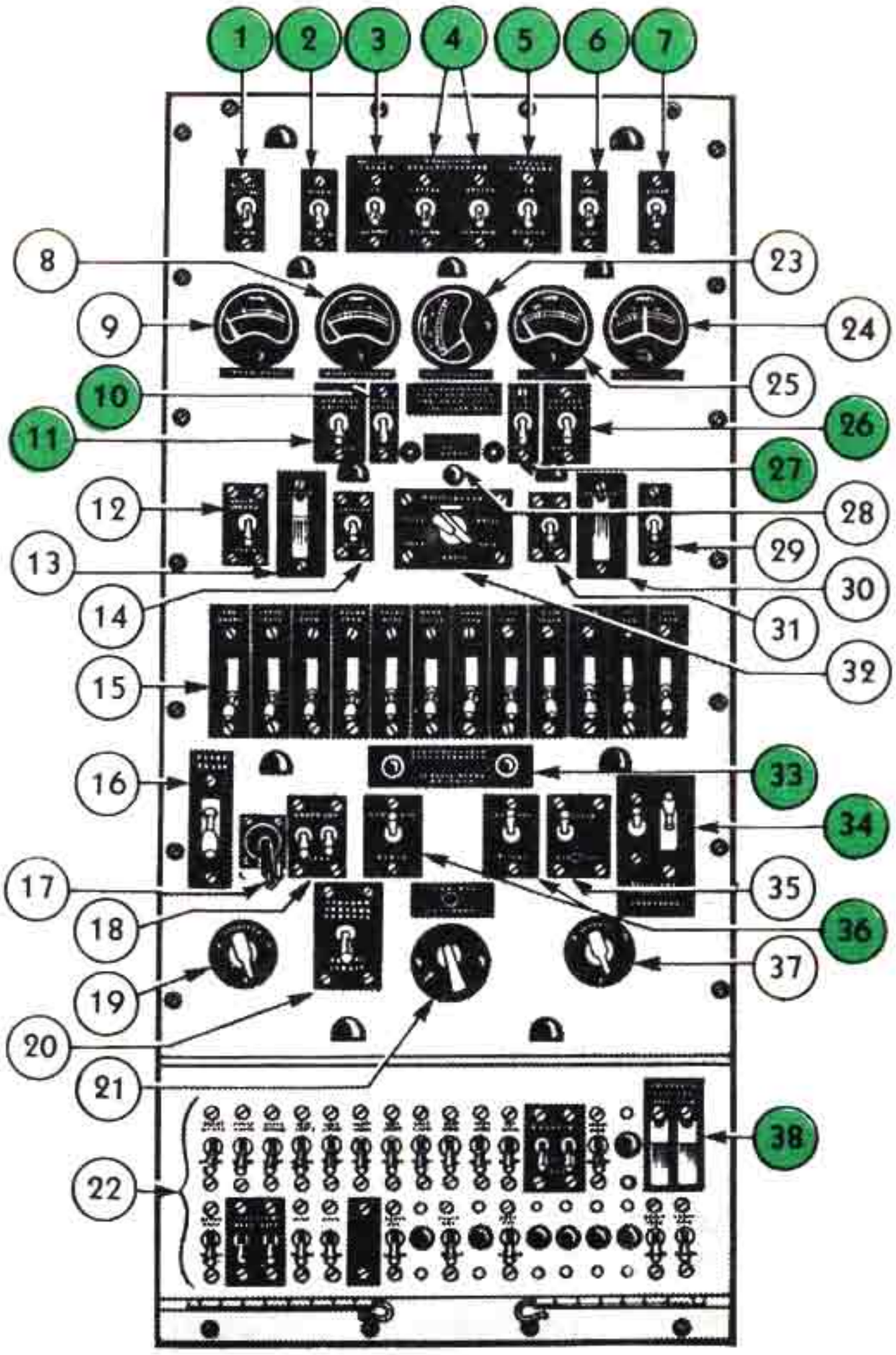
(a) GENERAL.—For normal flight the oil system operates automatically as described in Section I, paragraph 1, f, (4). An electric dual oil pressure gage on the flight engineer's instrument panel gives the oil pressure reading for both engines, normal oil pressure is 85 to 90 pounds. Two electric oil temperature gages are on the flight engineer's instrument panel. Normal operating oil temperatures should be from 60° to 85°C (140° to 185°F).

CAUTION

Do not operate the engines over 1200 to 1300 rpm until the oil temperature is at least 40°C (104°F).

1. The "CROSSOVER" setting of the valve is used when one of the transfer pumps fails to operate so that the one operating pump can supply fuel to both engine selector valves. This setting is also used when both pumps fail and the auxiliary hand pump is used.

2. When the valve is set to the "DEFUEL HULL TANK" position both fuel transfer pumps can be used to pump fuel from the hull tanks.



Ref. No.	Nomenclature
1	*Left Engine Starter Switch*
2	*Left Engine Primer Switch*
3	*Left Engine Oil Dilution Switch*
4	*Service Tank Fuel Booster Pump Switches*
5	*Right Engine Oil Dilution Switch*
6	*Right Engine Primer Switch*
7	*Right Engine Starter Switch*
8	*Left Generator Ammeter*
9	*Auxiliary Generator Ammeter*
10	*Left Cowl Flap Switch*
11	*Left Oil Cooler Flap Switch*
12	*Auxiliary Generator Switch*
13	*Left Generator Field Switch*
14	*Left Generator Switch*
15	*Main Bus Circuit Breaker Switches*
16	*Power Radio Switch (On Airplane No. 59000 and subsequent only)*
17	*Utility Receptacle*
18	*Utility Receptacle and Propeller De-Icer Switches*
19	*Anti-Icer Rheostat*
20	*Inverter Selector Switch (On Airplane No. 59000 and subsequent only)*
21	*Auxiliary Power Plant Ignition Switch*
22	*Circuit Breaker Switches*
23	*Voltmeter*
24	*Battery Ammeter*
25	*Right Generator Ammeter*
26	*Right Oil Cooler Flap Switch*
27	*Right Cowl Flap Switch*
28	*Power on Warning Light*
29	*Power Battery Switch*
30	*Right Generator Field Switch*
31	*Right Generator Switch*
32	*Voltmeter Selector Switch*
33	*Fuel Transfer Pump Warning Lights*
34	*Propeller Power Switches*
35	*Inverter Switch (On Airplanes Nos. 45405 to 45444 only)*
36	*Left and Right Wing Tank Switches*

Figure 28 — Flight Engineer's Switch Panel

(b) OIL DILUTION CONTROLS. — A manually operated shut-off cock is installed in the oil dilution fuel line for each engine. This cock is normally closed and safetied, and must be unsafetied and opened before oil dilution is begun. It is necessary to open the starter hand crank access door to gain access to this cock. A momentary contact toggle switch (figure 28-3 and 5) for each engine is installed on the flight engineer's electrical control panel for controlling the oil dilution solenoid valves. This system is protected by a circuit breaker which must be closed before the toggle switches can actuate the solenoid valves.

(c) OIL COOLER FLAPS CONTROLS. — Switches (figure 28-11 and 26) are provided on the flight engineer's switch panel to control the flaps in the oil cooler air outlet duct. The flaps should be closed for warm up and opened as required to maintain the oil temperatures within limits. Keep the flaps closed or nearly closed in outside air temperatures of 0°C (32°F) or less.

(5) ELECTRICAL SYSTEM CONTROLS. — The electrical control panel is located between the engine instrument panel and the engine control panel.

(a) POWER BATTERY SWITCH. *(See figure 28-29.)*—The power battery switch connects the batteries to the main bus and must be in the "ON" position when electricity is being used in any part of the airplane.

CAUTION

Do not try to start the main engines from the batteries.

(c) POWER-ON WARNING LIGHT. *(See figure 28-28.)* — Directly above the voltmeter selector switch is the power-on warning light which shows red whenever there is power on the main bus.

CAUTION

Do not leave the airplane with the power-on warning light burning.

(d) VOLTMETER SELECTOR SWITCH. *(See figure 28-32.)*—A selector switch is used to connect the battery, the main bus or any one of the three generators to the voltmeter when it is necessary to check the voltage at any one of these sources.

(e) AUXILIARY GENERATOR SWITCH. *(See figure 28-12.)* — The auxiliary generator switch connects the auxiliary power plant generator to the main bus. Power from the auxiliary generator cannot be used unless the switch is in the "ON" position.

(f) MAIN GENERATOR SWITCHES. *(See figure 28-14 and 31.)*—The main generator switches connect the right and left main engine-driven generators to the main bus.

Note

If the engine speed is reduced to such an extent that the generator voltage becomes less than the bus voltage, the generator cut-out will open automatically to prevent flow of current from the bus to the generator.

(9) GENERATOR FIELD SWITCHES. *(See figure 28-13 and 30.)* — A switch is provided to cut out each genrator field circuit. This switch should always be in the "ON" position unless the generator is shorted. In the event of a short circuit in the generator the switch should be moved to "OFF" to prevent burning up the generator with the resultant fire hazard.

SECTION II

FLIGHT OPERATING INSTRUCTIONS

1. BEFORE ENTERING AIRPLANE.

a. PILOT.—Check with operations or loading officer to ascertain the take-off center of gravity, expected landing center of gravity, and initial airplane gross weight, and obtain copy of loading manifest.

WARNING

Do not take off with center of gravity forward of 28 percent MAC.

b. FLIGHT ENGINEER.

(1) Make a general exterior check of both engine nacelles to make sure that engines and propellers are clear of obstructions, and that propellers are in low pitch position.

(2) Check that the cowling is secure.

(3) If the airplane is on the ground make sure that it is properly chocked.

2. ON ENTERING THE AIRPLANE.

a. PILOT.

(1) Assign personnel to unlock surface controls.

(a) Unlock the rudder and elevator surfaces by removing the key from the rudder quadrant on the stabilizer rear spar and the key from the lock link on the elevator jack shaft.

CAUTION

Use extreme care when unlocking rudder and elevator controls in high winds or gust conditions. Have a crew member hold the controls in neutral to prevent injury to the hands that would occur if the control should be swept against the bumper stops.

(b) Bring the rudder and elevator lock keys forward and insert the key that fits into the lock bar on the control columns. Turn the key to the unlocked position thereby releasing the locking yoke and locking the key in the lock bar.

(c) Place other key on clamp on lock bar and remove yoke and lock bar from control columns and place in stowed position outboard of flight engineer's fuel control panel.

(2) Check surface controls and tab controls for full throw and proper operation.

(3) Check propeller and throttle control for freedom of movement and proper action of friction release.

(4) Instruct flight engineer to turn on propeller circuit-breaker switches (figure 28-34) after the auxiliary power plant has been started.

(a) Check propeller selector switches (figures 16 and 17-7 and 27) in both "INC. RPM" and "DEC. RPM" positions. The propeller motor should run about half as fast in "INC. RPM" as in "DEC. RPM."

(b) Check the operation of the propeller feathering switches (figures 16 and 17-17 and 21) by partially feathering each propeller. Unfeather the propellers by holding the propeller selector switches on "INC. RPM."

(5) Check flaps for proper action of electric stops and check to see that flap switch (figures 16 and 17-26) will break the circuit at any intermediate position.

Note

After checking, always retract flaps and return switch to "OFF."

(6) Check radio transmitter and receiver.

(7) Check interphone on all positions.

(8) Check low level fuel warning lights. (See figures 16 and 17-3.)

b. FLIGHT ENGINEER.

CAUTION

Before turning on power battery switch (figure 28-29), insure that all other main bus switches are "OFF."

(1) Turn on power battery switch and check fuel and oil loads.

(2) Purge all hull fuel tanks of water with the hand bilge pump in the fuel trunk section. Drain main and auxiliary power plant fuel strainers, and drain all water from wing tanks.

(3) Start the auxiliary power plant.

(a) Turn auxiliary power plant over manually at least three full turns with ignition switch (figure 28-21) "OFF" and fuel valve (figure 26-4) "OFF."

(b) Throw the auxiliary power plant ignition switch "ON" and turn fuel valve to "ON."

(c) Instruct crew member to pull rope through to spin auxiliary power plant crankshaft.

WARNING

Do not use the generator for starting the auxiliary power plant. Start by hand only.

(d) As soon as the auxiliary power plant starts check the oil pressure gage. (See figure 27-26.) If the gage does not register 55 to 65 pounds per square inch within 30 seconds the engine should be stopped and the cause of the trouble determined.

Note

Normal oil-in temperature is 60°C (140°F) and should never exceed 88°C (190°F).

(e) As soon as the speed of the engine appears to be stabilized, check the auxiliary generator for voltage; if satisfactory, put the auxiliary power plant generator switch (figure 28-12) in the "ON" position.

(4) Place fire watch on top of center wing.

(5) Check cowl flap operation. Return to full open position.

(6) Check oil cooler shutter operation. Return to closed position.

(7) Check for smooth and proper mechanical operation of all engine fueling valves.

(8) Check all engine controls for freedom of movement. Check for correct over-travel or "pinch" of throttles, mixture controls, carburetor air controls, and propeller governor controls.

(9) Check that no excess amount of bilge water has accumulated in hull.

(10) Check that cowl flaps are full open prior to starting main engines.

(11) Check that oil dilution switches (figure 28-3 and 5) are turned to "OFF."

(12) Remove all control locks prior to starting engines.

c. SPECIAL CHECK FOR NIGHT FLIGHTS.

(1) Check operation of all running and formation lights.

(2) Check operation of landing lights.

WARNING

Do not operate landing light on ground for longer than 5 minutes.

(3) Check operation of pilot's and co-pilot's fluorescent lights.

(4) Check all spot and other interior lights.

(5) Check that portable spotlight is stowed aft of radio operator's table. Check operation of light.

(6) Check that glare curtains are stowed behind pilot's seat.

(7) With both forward and aft hull power switches on and no flares in flare tubes, check operation of flare release switches (figures 16 and 17-22) on pilot's pedestal.

3. FUEL SYSTEM MANAGEMENT.

(See figure 34.)

a. STARTING ENGINES.—To start the engines the fuel is used from the wing service tanks with the booster pump switches on the "NORMAL" position. Fuel is drawn from the wing service tanks by the fuel booster pumps which send it through the main engine selector valves and the by-passes in the engine-driven pumps to the carburetor.

b. TAKE-OFF, NORMAL FLIGHT, AND LANDING. — During normal operations fuel is used from the wing service tanks to their respective engines.

Note

The flight engineer should have both wing tanks full for take-off, and should fill both wing tanks after landing.

(1) BOOSTER PUMP OPERATION. — The booster pump switches should be in the "NORMAL" position at all times. The "EMERGENCY" position should be used when failure of an engine-driven pump or flight at high altitudes requires additional pressure.

(2) FUEL TRANSFER SYSTEM OPERATION. —For normal flight conditions the hull tank selector valve (figure 26-2) should be in the "ON" position, and the wing tank switches (figure 28-36) set to "AUTOMATIC." With the controls set in this position the transfer pumps will re-fill the wing tanks whenever the fuel level drops below 190 U. S. (158 Imperial) gallons.

c. FERRY FLIGHT—BOTH BOMB BAY TANKS INSTALLED.—At some point, to be determined from distance to be traveled, fuel already used from hull tanks, and distance to the nearest base, the pilot should direct the flight engineer to commence using fuel from the bomb bay tanks. When the flight engineer switches the engine selector valve to "BOMB BAY TANK," a switch in the valve automatically starts the bomb bay tank booster pump which supplies the fuel to the engine selector valve.

d. ONE BOMB BAY TANK INSTALLED, BOMBS IN THE OTHER BOMB BAY.—At some point during the flight, based on fuel already used from the hull tanks, fuel remaining in the hull tanks, and the distance to the nearest base, the pilot should direct the flight engineer to use fuel from the bomb bay tank. The flight engineer will then switch the engine selector valve corresponding to the side on which the bomb bay tank is carried to "BOMB BAY TANK" position. The flight engineer should warn the pilot when the fuel in the hull tanks is low since the fuel in the bomb bay tank cannot be used in the engine on the opposite side.

WARNING

If all the fuel in the hull tanks is used before the bomb bay tank fuel is used, it will be necessary to fly home on one engine.

e. FAILURE OF ENGINE-DRIVEN FUEL PUMP. —In the event of a failure of one or both engine-driven fuel pumps two alternate operating procedures are possible:

(1) The flight engineer will check that both engine selector valves are on "SERVICE TANK" and place the booster pump switch in the "EMERGENCY" position. The booster pump will then supply fuel to the carburetor through the engine selector valve and the by-pass in the engine-driven pump.

(2) An alternative method, which would not utilize the fuel in the wing tank on the side where the failure has occurred, would be to place the engine selector valve on the same side as the failure to "HULL TANK." The transfer pump on that side would then deliver fuel through the engine pump by-pass to the carburetor at a pressure of 17-1/2 pounds per square inch.

f. FAILURE OF FUEL TRANSFER PUMP.

(1) In the event one fuel transfer pump fails the wing service tank on the side where the failure occurs can be refilled by placing the engine selector valve on the side with the good pump to "HULL TANK" and the crossover valve to "CROSSOVER." With the engine selector valve on the side with the inoperative transfer pump set to "SERVICE TANK" the remaining transfer pump will supply fuel to its respective engine, and the excess fuel not needed by the engine will flow into the opposite wing service tank. When the wing service tank is full, both engine selector valves should be set to "SERVICE TANK" and the crossover valve should be set to "OFF."

WARNING

If either wing tank is overfilled, the excess fuel will flow overboard through the service tank vent line creating a serious fire hazard.

(2) If both transfer pumps fail and no fuel remains in the wing service tanks that can be used by the engines both engine selector valves should be set to

"HULL TANK" and the crossover valve to "CROSSOVER." If the air temperature is not high and the airplane is not above 6,000 to 7,000 feet the engine-driven pump will probably suck sufficient fuel from the hull tanks, *BUT* a man should stand by to operate the hand pump if necessary.

(3) If both transfer pumps fail and fuel is available in the wing service tanks the engine selector valves should be set to "SERVICE TANK." With the crossover valve set to "CROSSOVER" the wing service tanks may be refilled by use of the hand pump. (See figure 29.)

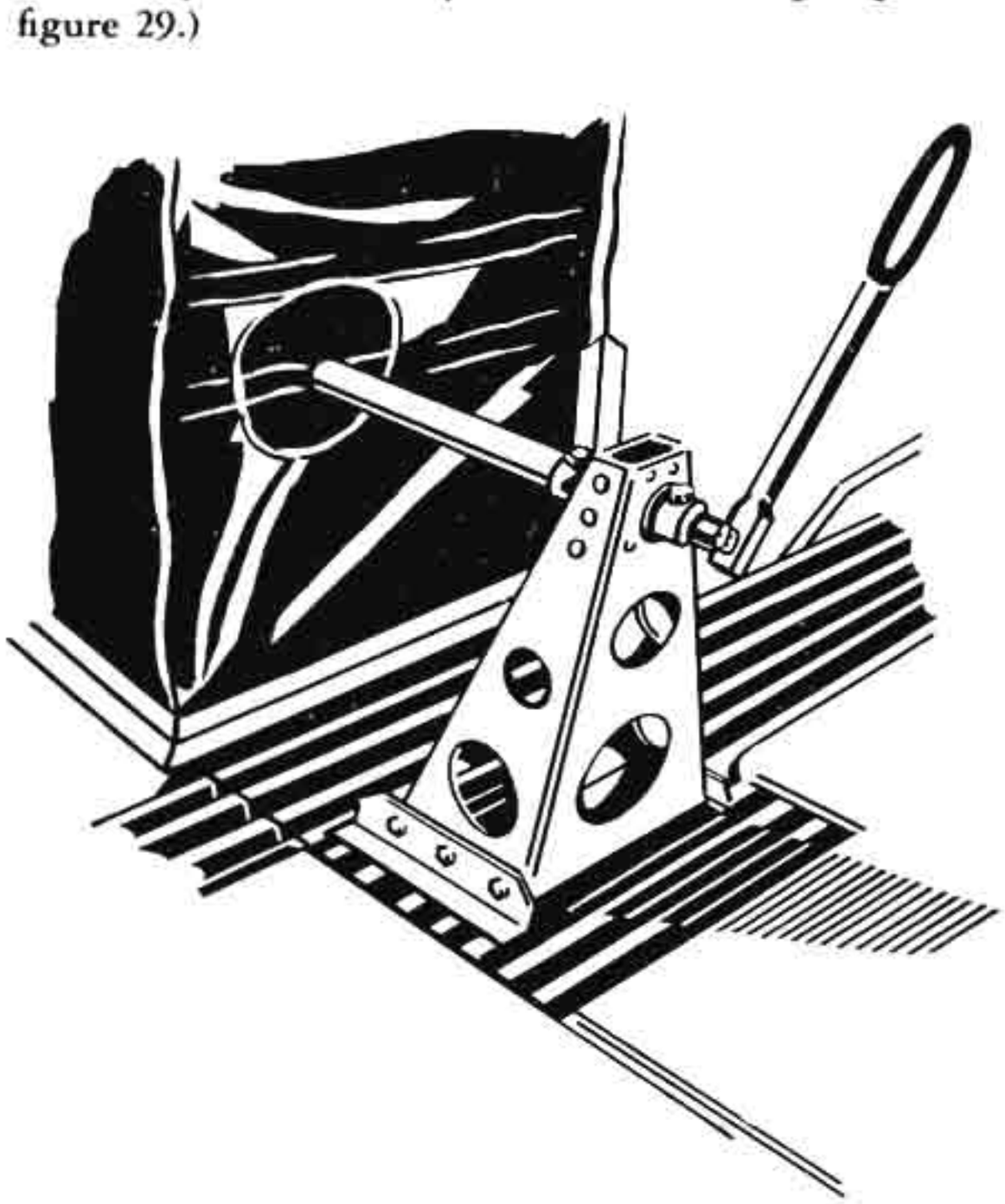


Figure 29 — Emergency Fuel Hand Pump

g. DE-FUELING.

(1) To de-fuel the wing service tanks set the engine selector valves to "SERVICE TANK DRAIN," and set the crossover valve to "DE-FUEL HULI TANK." If the fuel is to be de-fueled overboard the wing tank de-fueling valve (figure 30) on the main deck should be turned to "OFF" and the cap on the de-fuel outlet (figure 31-4) on the left side of the airplane should be removed and connection made to a line on a fuel salvage unit. If the wing service tanks are to be de-fueled into the aft hull tank the main engine selector and crossover valves are set as outlined above, but the cap is left on the de-fueling outlet and the wing tank de-fueling valve is set to "ON."

(2) To de-fuel the hull tanks overboard remove the cap from the de-fueling outlet and connect it to a fuel salvage unit. Set the wing tank de-fueling valve to "OFF," set the crossover valve to "DE-FUEL HULL TANK," and set the hull tank selector valve to the tank to be de-fueled. Turn the transfer pump switch

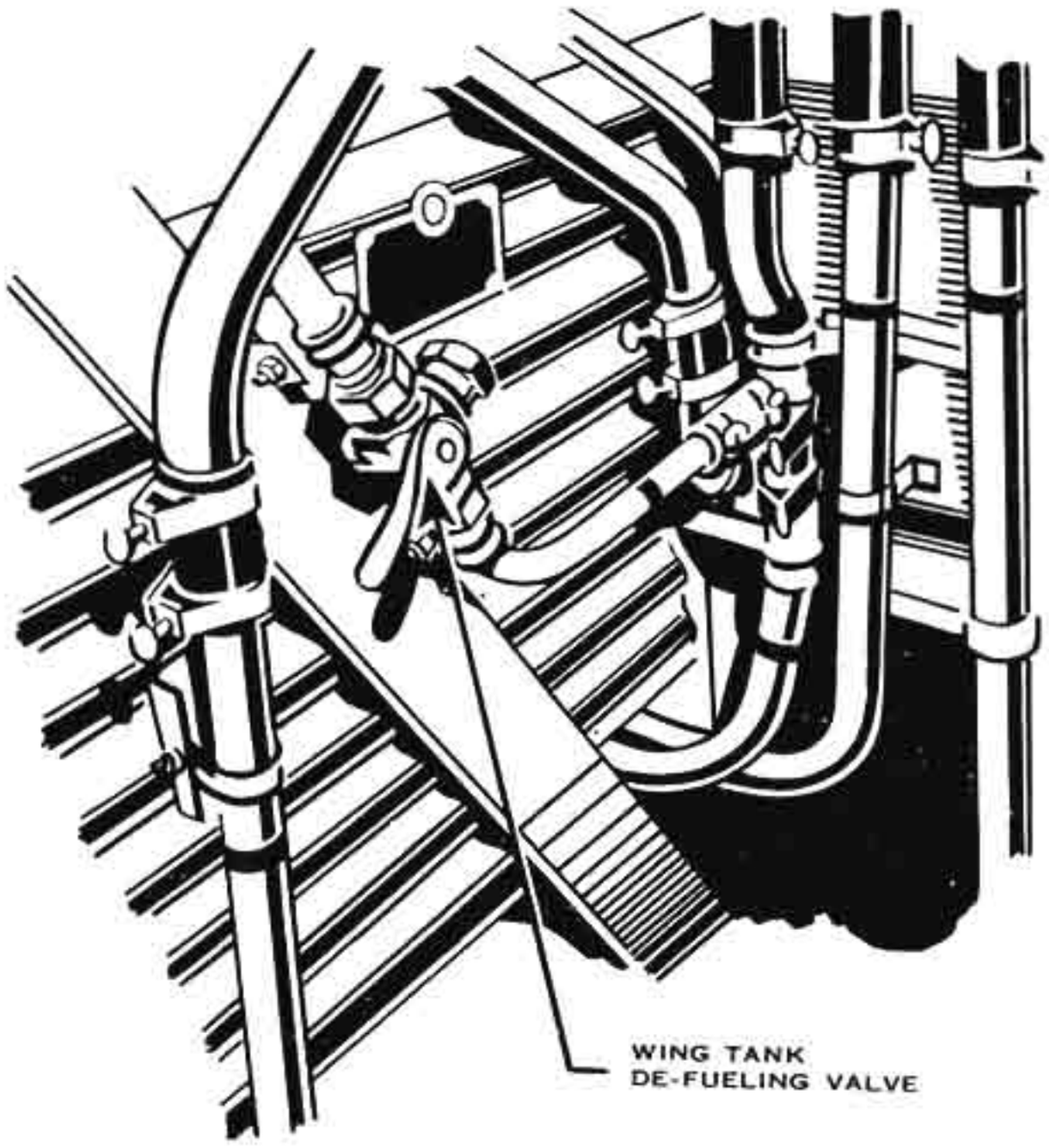
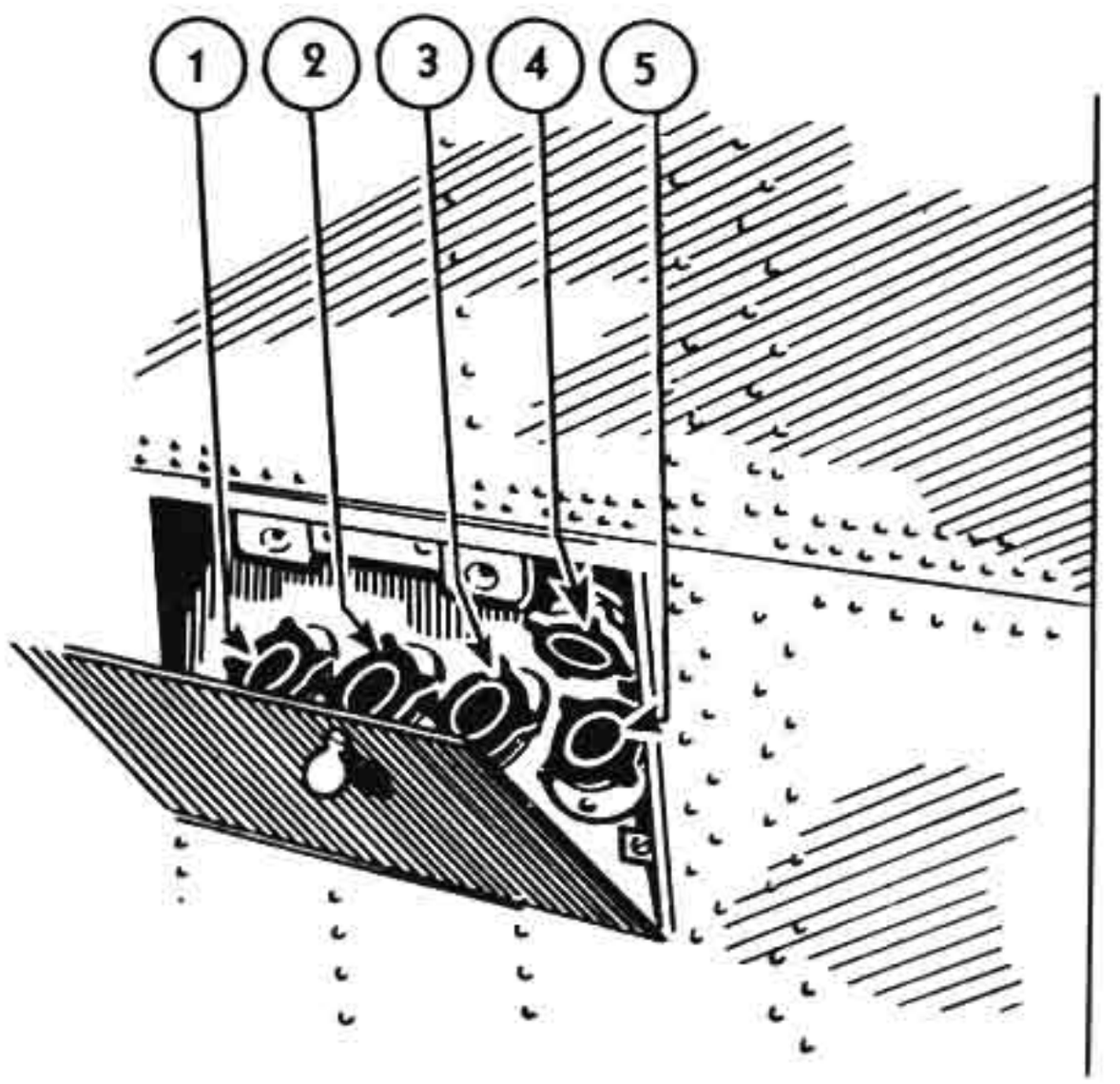


Figure 30 — Wing Tank De-Fueling Valve



Ref. No.	Nomenclature
1	*Forward Tank Fueling Connection*
2	*Center Tank Fueling Connection*
3	*Aft Tank Fueling Connection*
4	*De-Fueling Connection*
5	*Aft Tank Fueling Connection*

Figure 31 — Fueling and De-Fueling Connections

to "ON," set one engine selector valve to "HULL TANK," and the transfer pump will pump fuel to the fuel salvage unit.

(3) To de-fuel without the use of the transfer pumps, set the hull tank selector valve to the tank to be de-fueled and set the crossover valve to "DE-FUEL HULL TANK." Remove the cap from the de-fueling outlet (figure 31-4) and make a connection to a line from a fuel salvage unit. Check that the wing tank de-fueling valve (figure 30) is "OFF"; then operate the emergency hand pump until the tank is de-fueled.

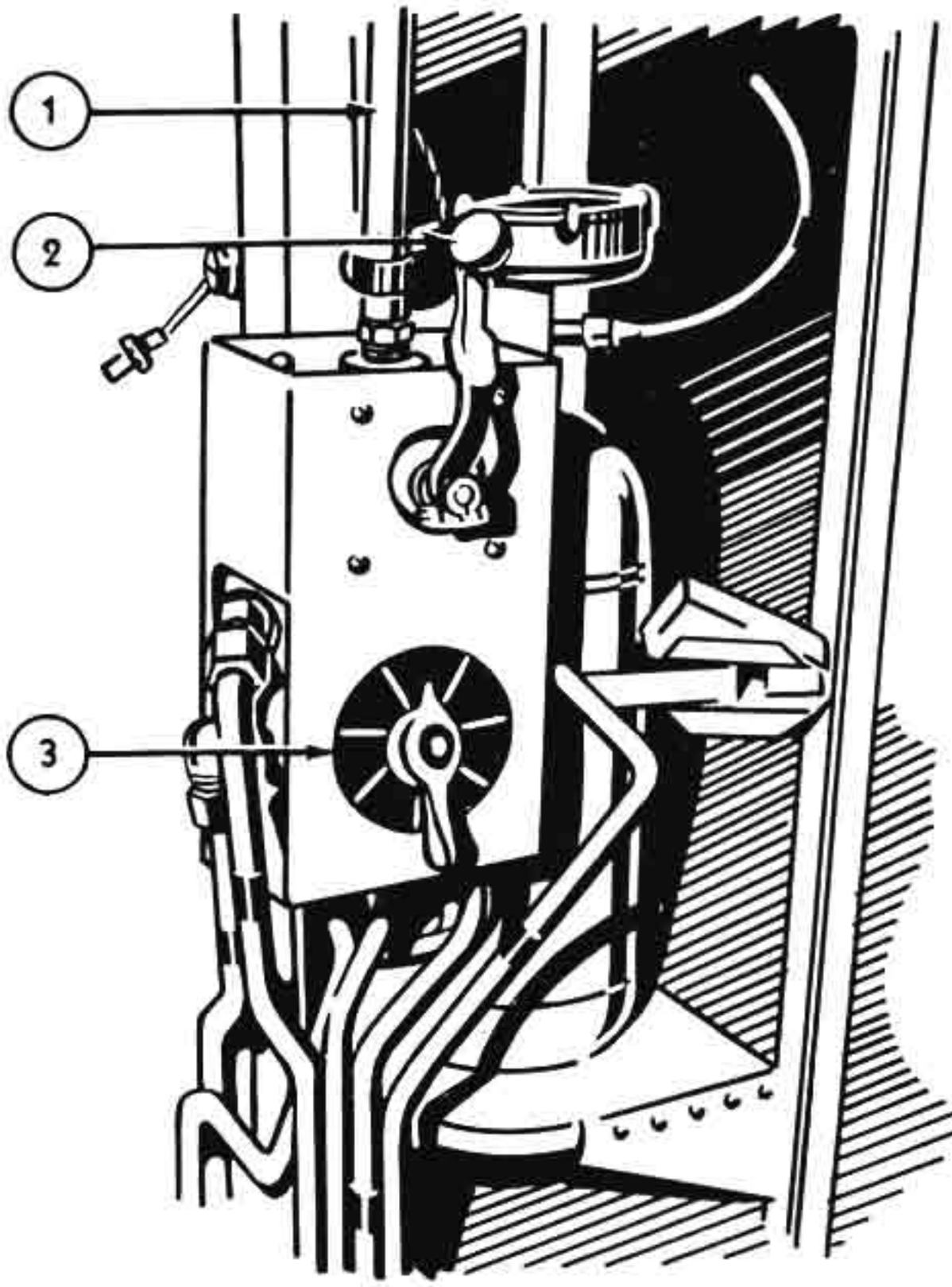
b. FUELING.—Remove the caps from the fueling connections (figure 31) on the left side of the hull and connect the filler lines as desired.

(1) Before filling the hull tanks the wing service tanks should be filled by use of the fuel transfer pumps. With the auxiliary power plant operating turn both engine selector valves to "SERVICE TANK," set the hull tank selector valve to any tank containing sufficient fuel to fill the wing tanks. Turn the transfer pump switches to "ON" and the wing tank switches to "AUTOMATIC." The pumps will then stop automatically when the wing service tanks are full.

(2) Fill the hull tanks from the fuel supply unit in accordance with the loading manifest.

i. OPERATION OF BILGING SYSTEM.—All hull tanks should be purged of water before every flight. Set the pointer on the bilge selector valve (figure 32-3) on the fuel trunk to the cell desired; then work the bilge pump handle (figure 32-2) at a rate of about 120 single strokes per minute. The cell will be purged through the bilge line which draws from the low point of each cell. Watch the flow indicator (figure 32-1) to the right of the bilge valve to determine whether water is present. Pump until gasoline is seen to flow; then continue to pump for three or four strokes to make sure that all water in the drain tube has been forced out. Repeat this operation for all cells and the fuel trunk until all are free from water and foreign matter.

j. OPERATION OF WING TANK AND STRAINER DRAIN SYSTEM. — Before starting the engines drain all water and foreign matter from the wing service tanks and the main engine and auxiliary power plant fuel strainers. Turn the strainer and service tank selector drain valve (figure 33) on the flight engineer's fuel control panel to the setting desired; and watch the flow indicator behind the left-hand door at the bottom of the flight engineer's fuel control panel to determine if water is present. Leave the valve open a few seconds after gasoline is seen to flow. Repeat this operation until both tanks and strainers have been drained of water and foreign matter.



Ref. No.	Nomenclature
1	*Flow Indicator*
2	*Bilge Pump Handle*
3	*Selector Valve Pointer*

Figure 32 — Bilge Selector Valve and Pump

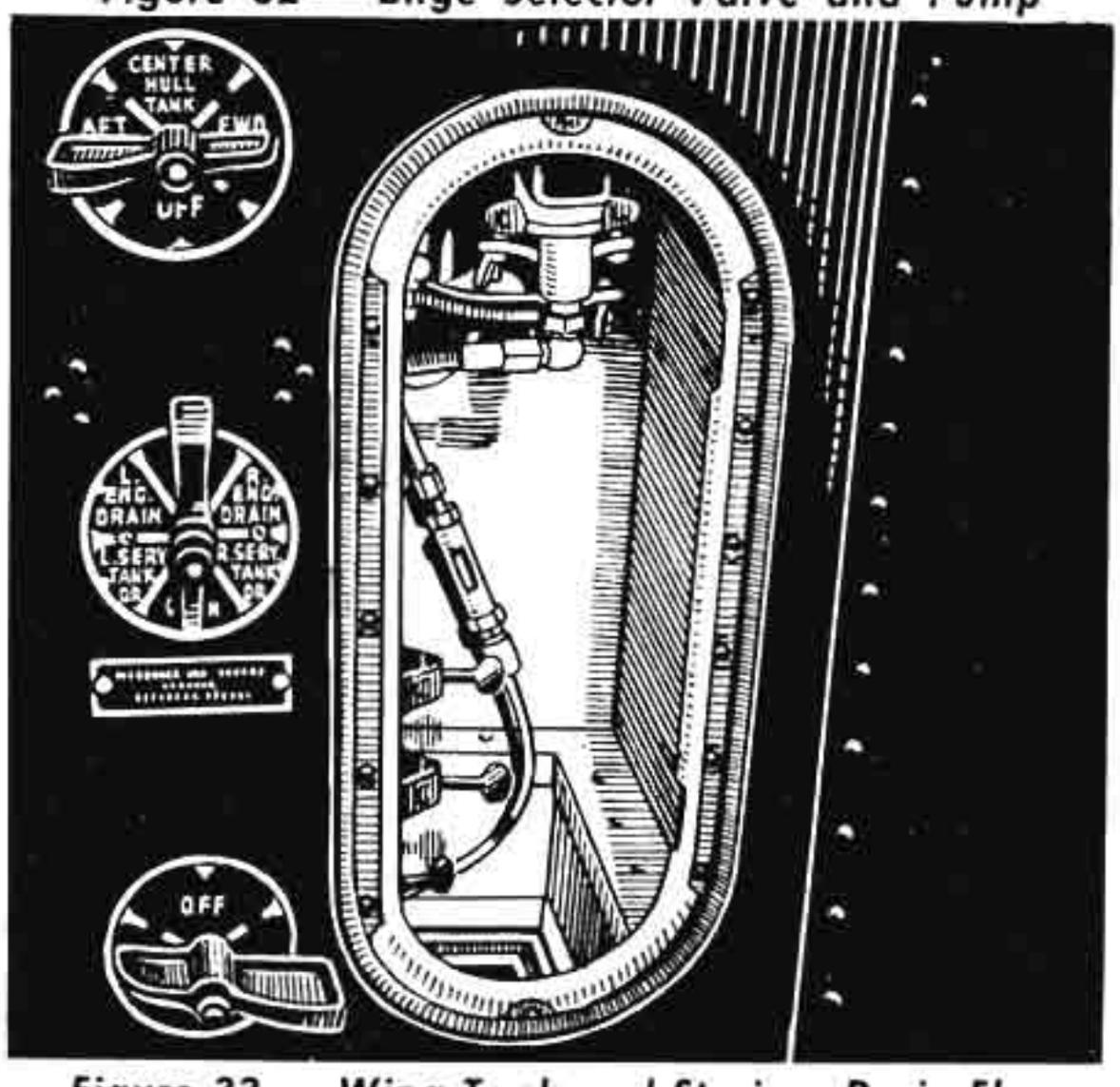
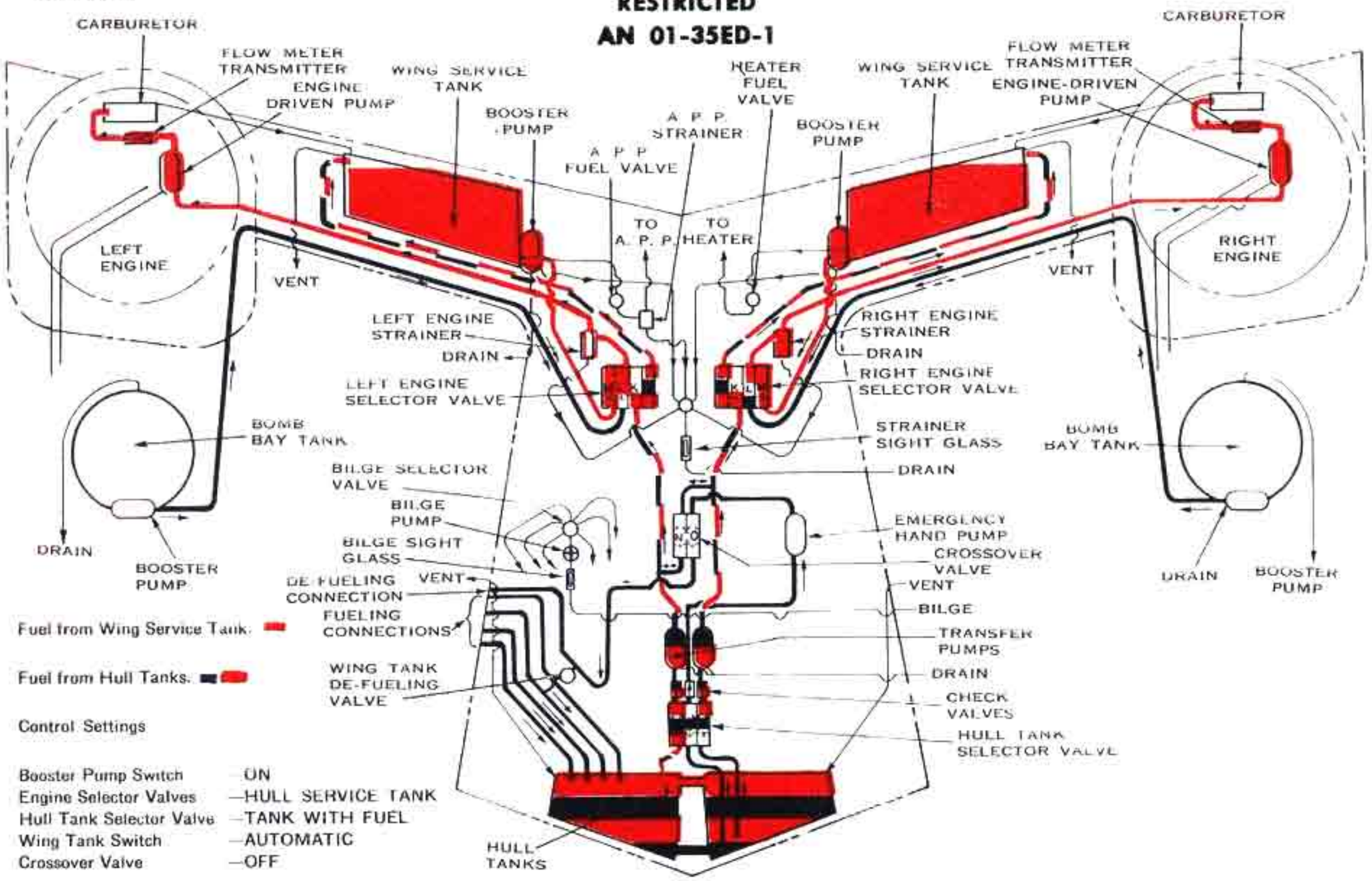
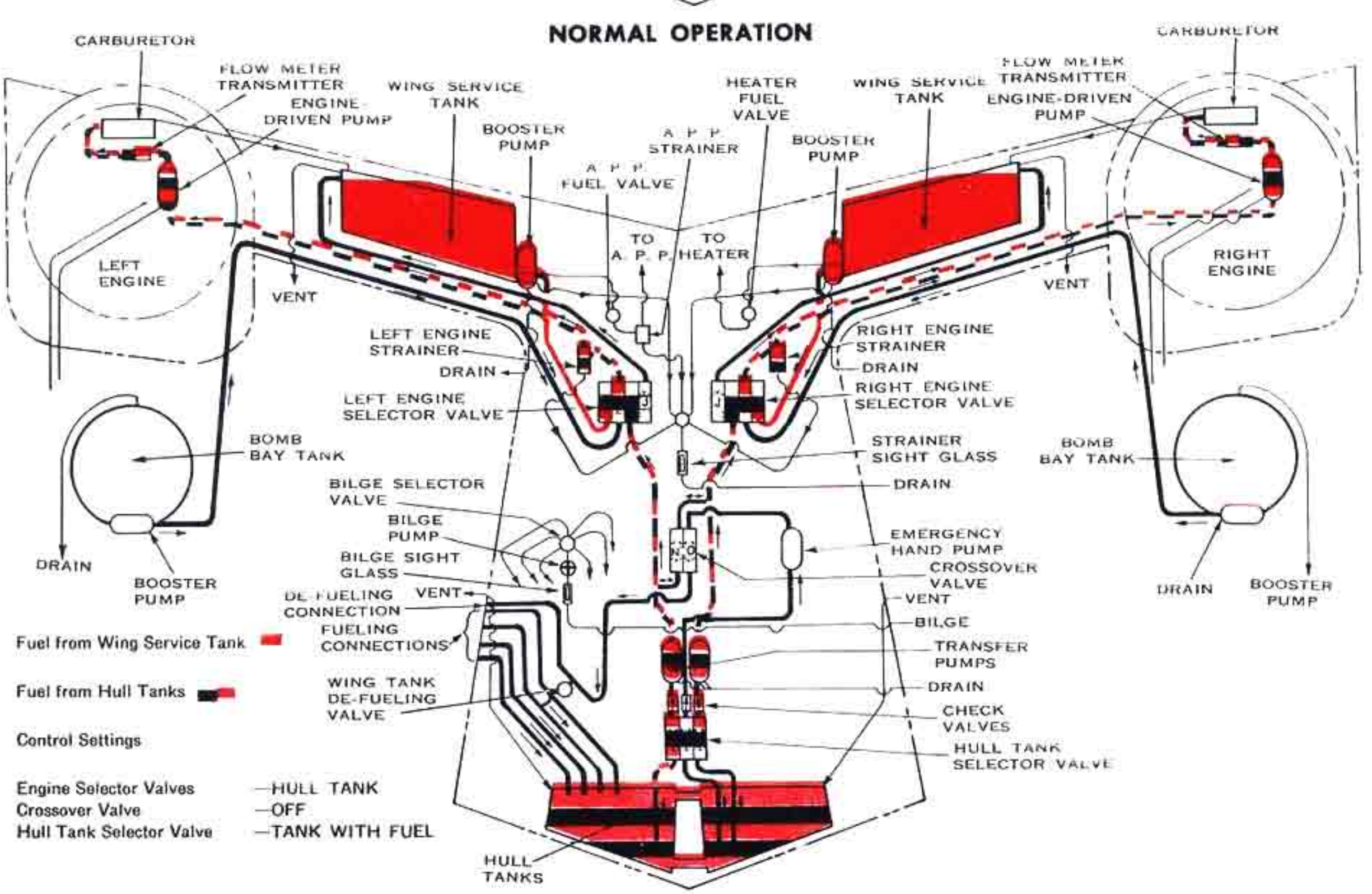


Figure 33 — Wing Tank and Strainer Drain Flow Indicator

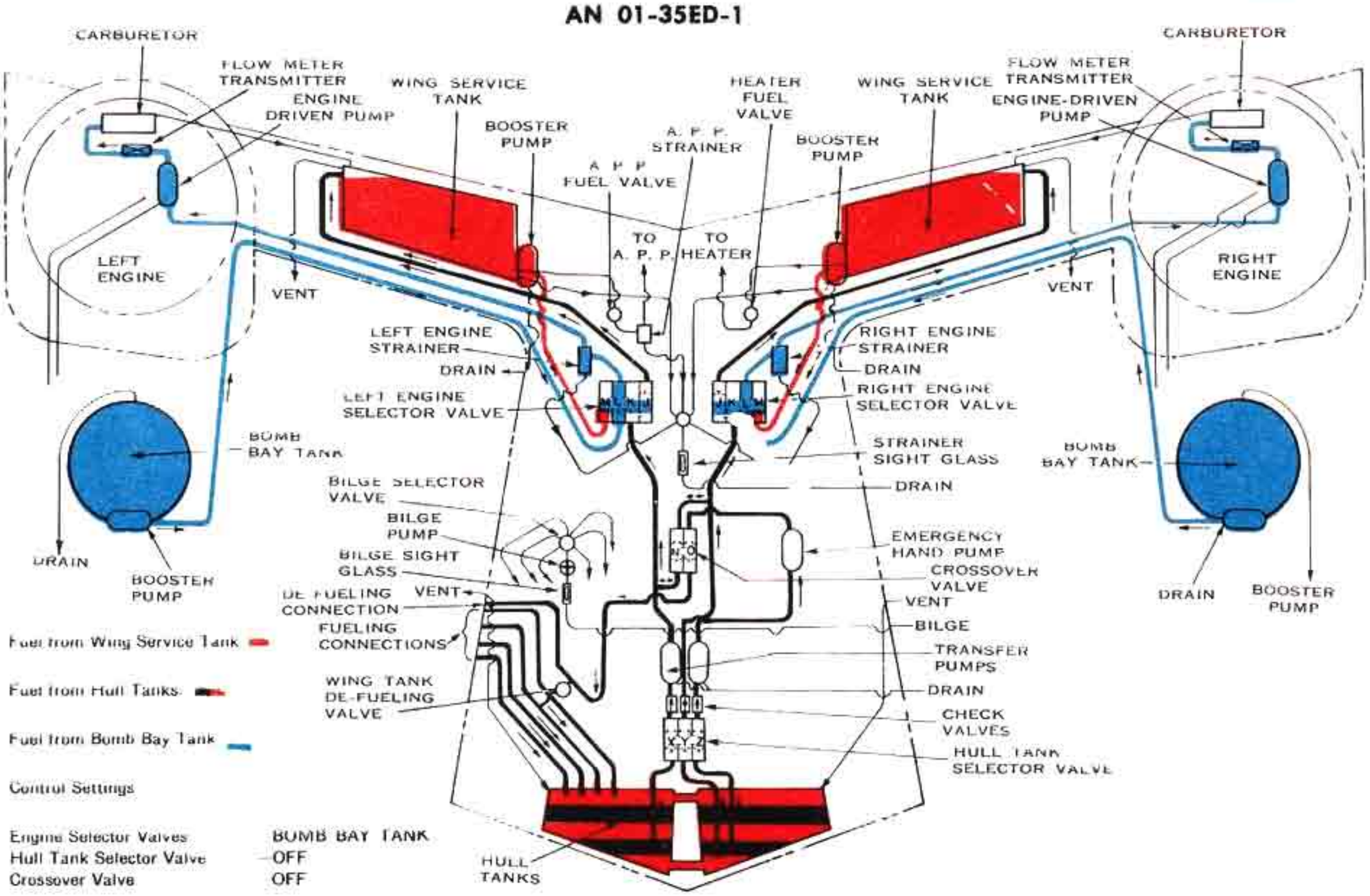


NORMAL OPERATION

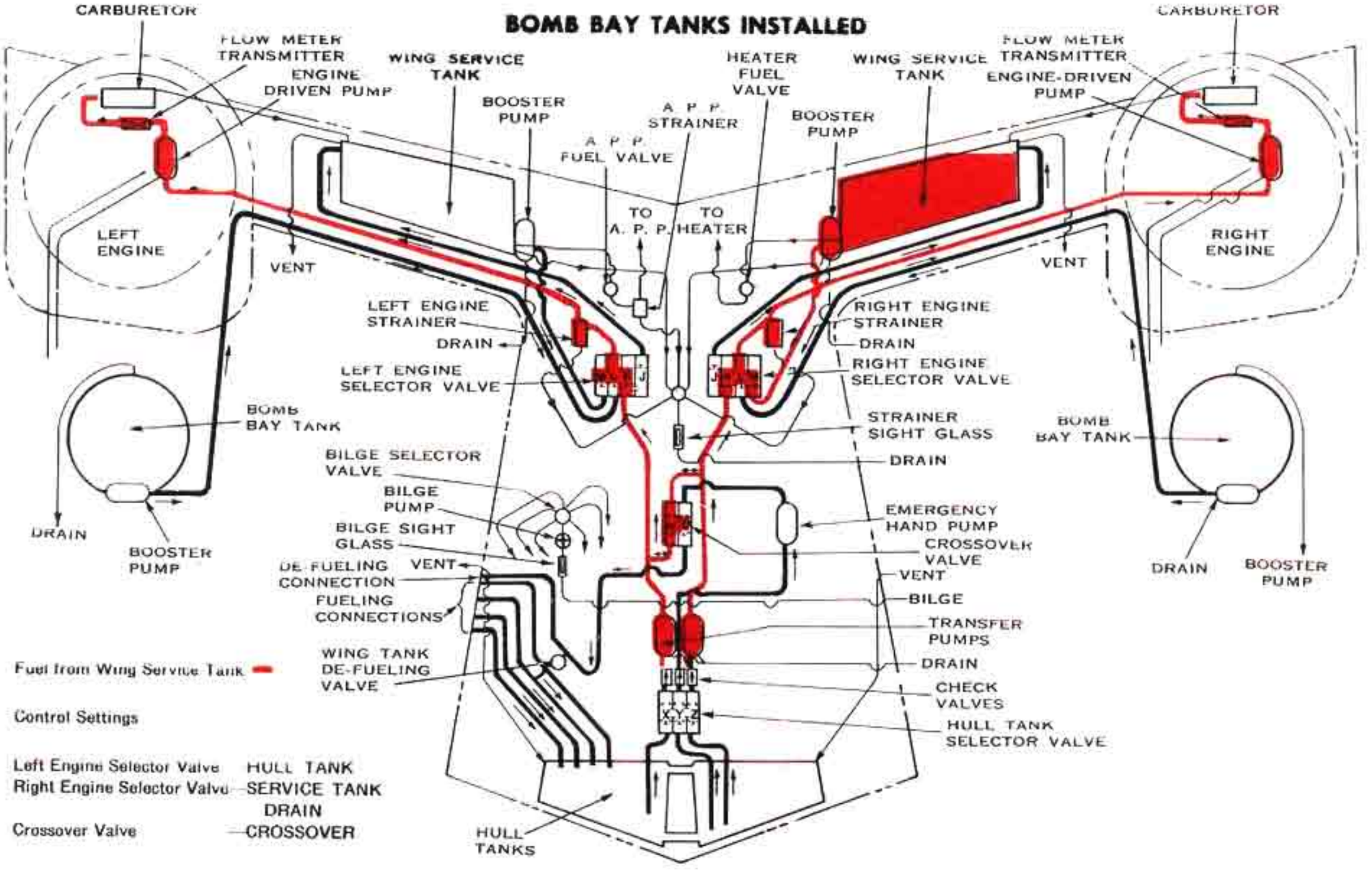


USING FUEL FROM HULL TANKS

Figure 34 (Sheet 1 of 5 Sheets) — Fuel Flow Diagram

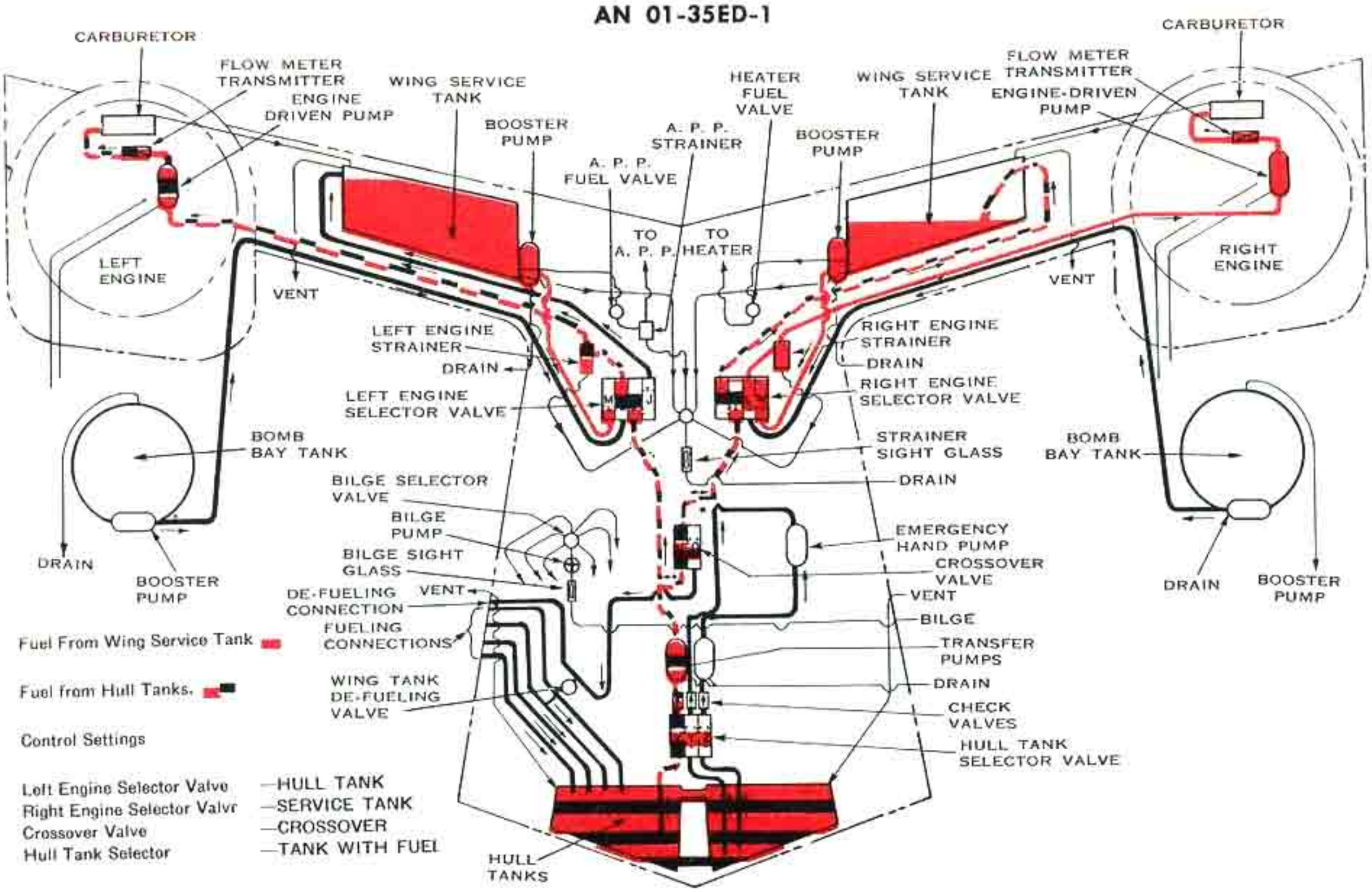


BOMB BAY TANKS INSTALLED

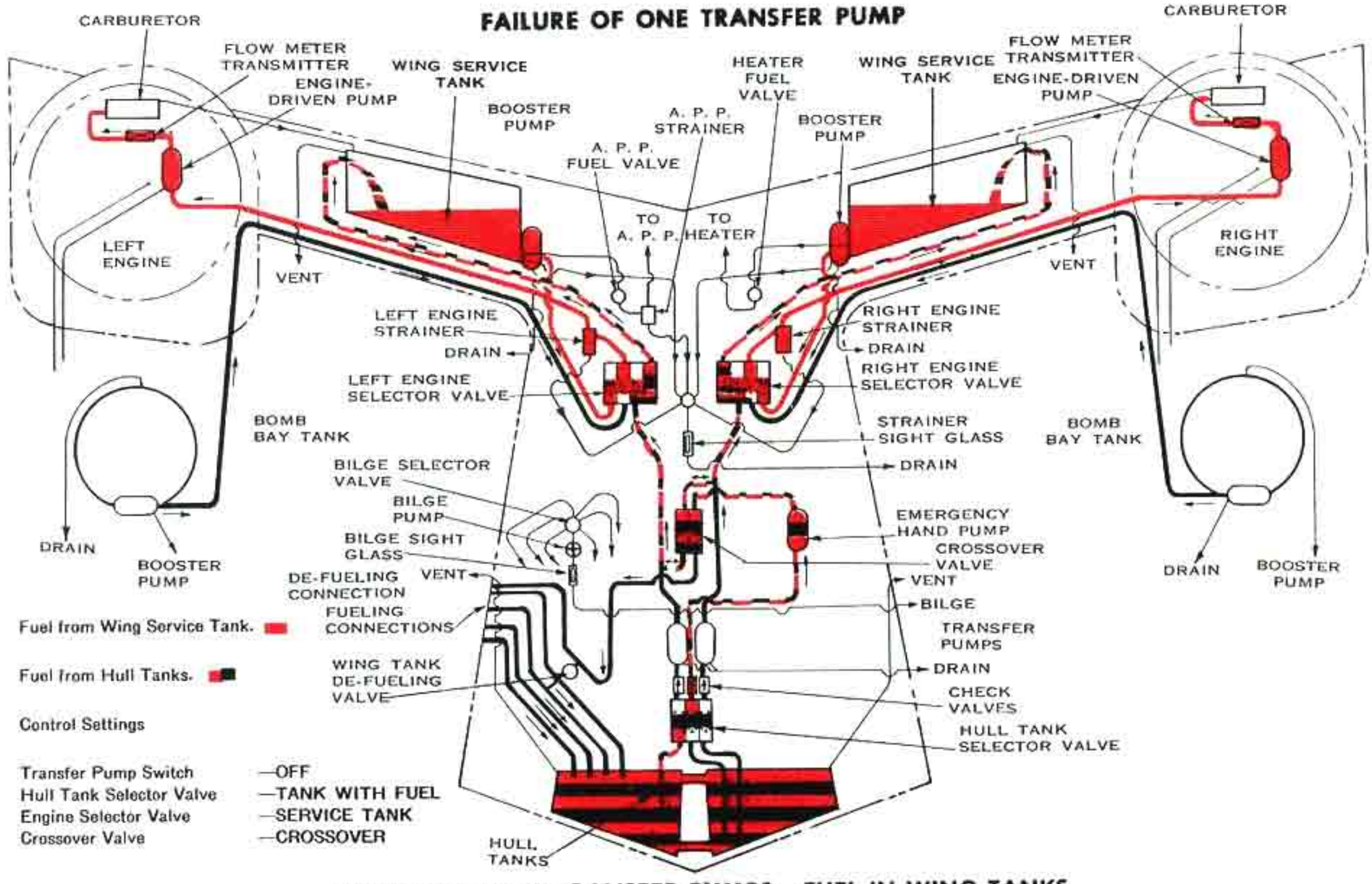


FUEL IN ONE WING TANK ONLY

Figure 34 (Sheet 2 of 5 Sheets) — Fuel Flow Diagram

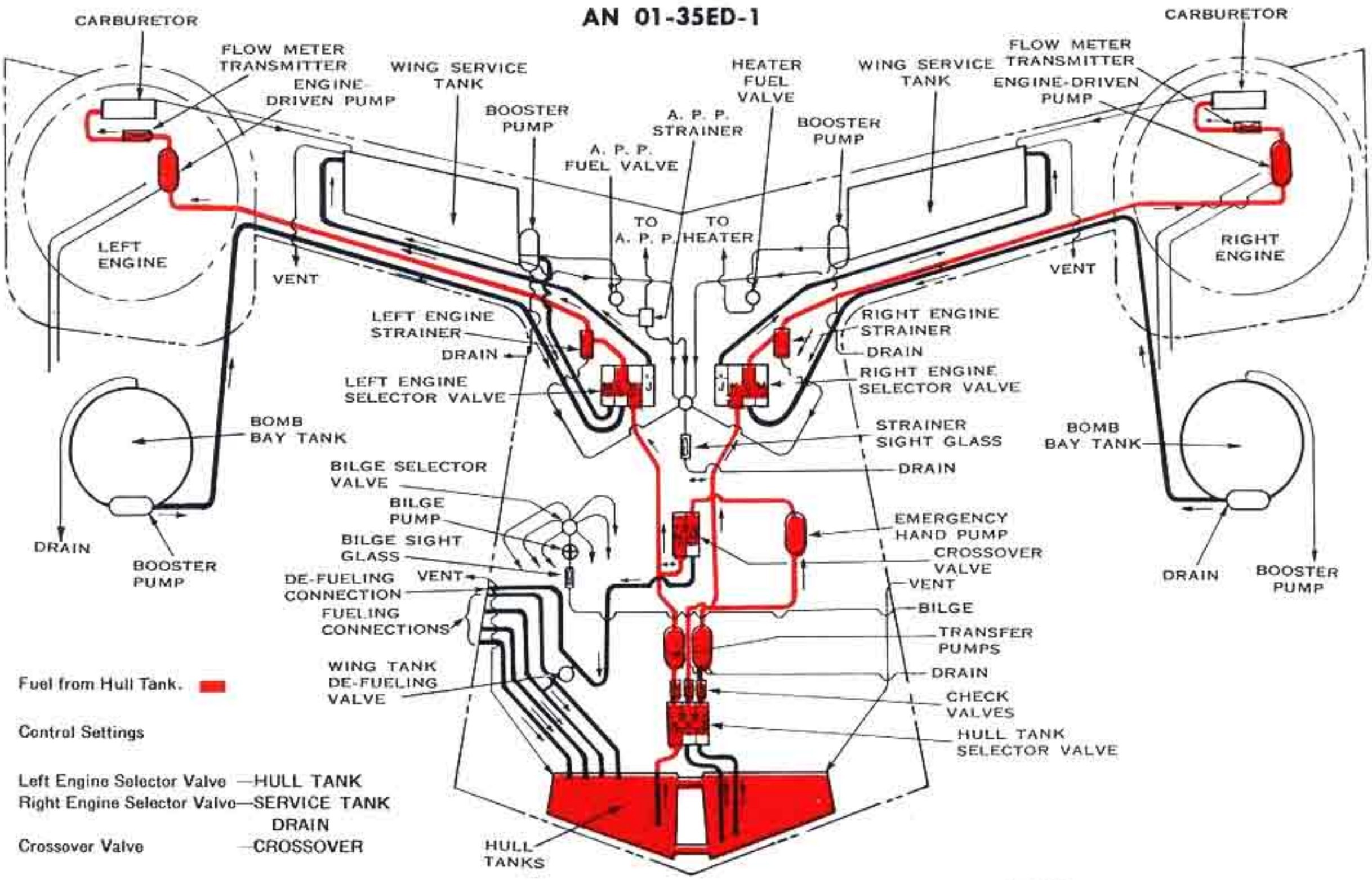


FAILURE OF ONE TRANSFER PUMP



FAILURE OF BOTH TRANSFER PUMPS—FUEL IN WING TANKS

Figure 34 (Sheet 3 of 5 Sheets) — Fuel Flow Diagram



Fuel from Hull Tank.

Control Settings

Left Engine Selector Valve —HULL TANK
Right Engine Selector Valve—SERVICE TANK
DRAIN
Crossover Valve —CROSSOVER

FAILURE OF BOTH TRANSFER PUMPS—NO FUEL IN WING TANKS

Fuel from Wing Tank.

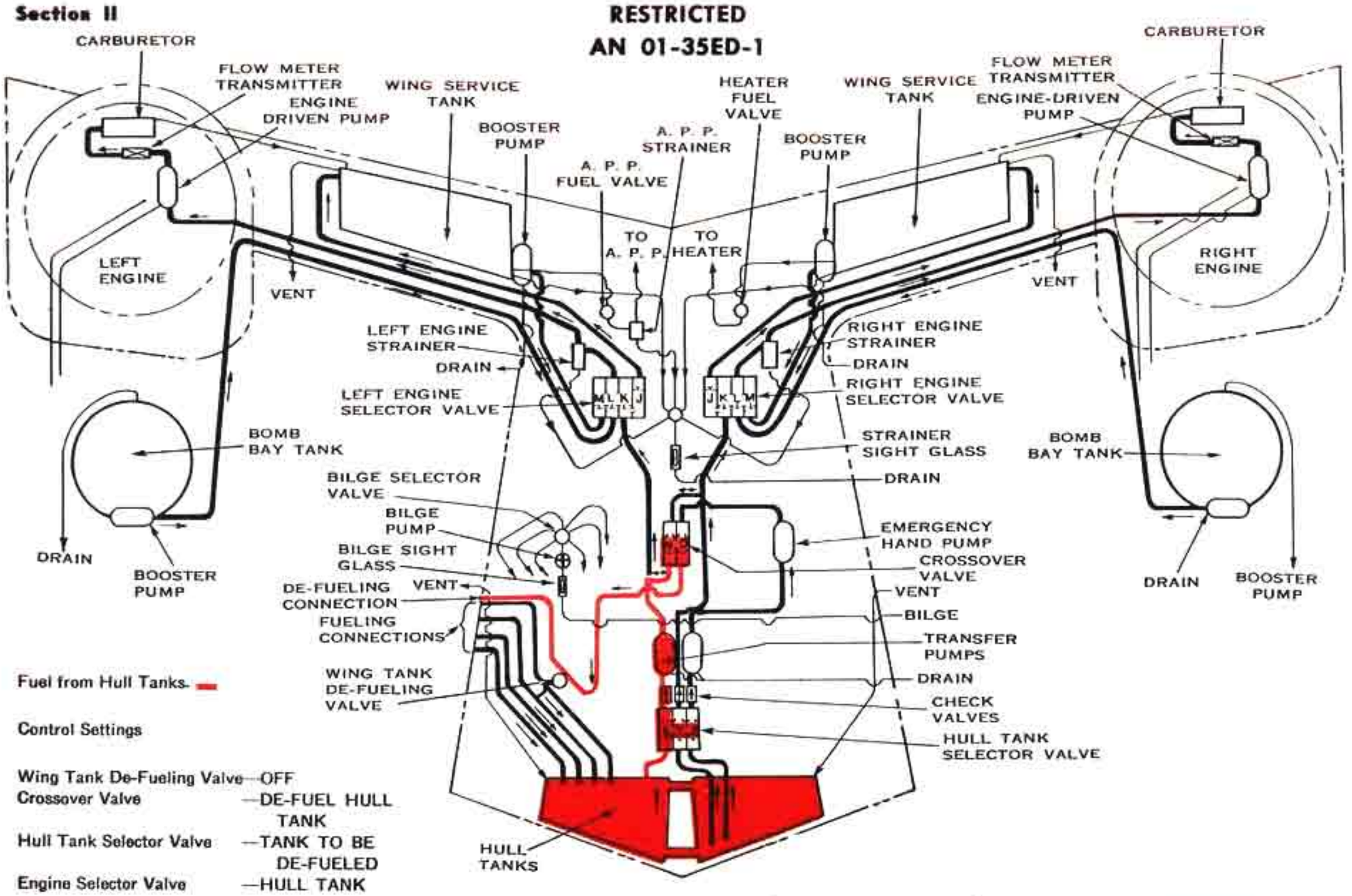
De-Fuel to Hull Tank.

Control Settings

Engine Selector Valve —SERVICE TANK DRAIN
Crossover Valve —DE-FUEL HULL TANK
Wing Tank De-Fueling Valve {OFF—To De-Fuel Overboard; ON—To De-Fuel to Aft Hull Tank Only}

DE-FUELING WING TANKS

Figure 34 (Sheet 4 of 5 Sheets) — Fuel Flow Diagram

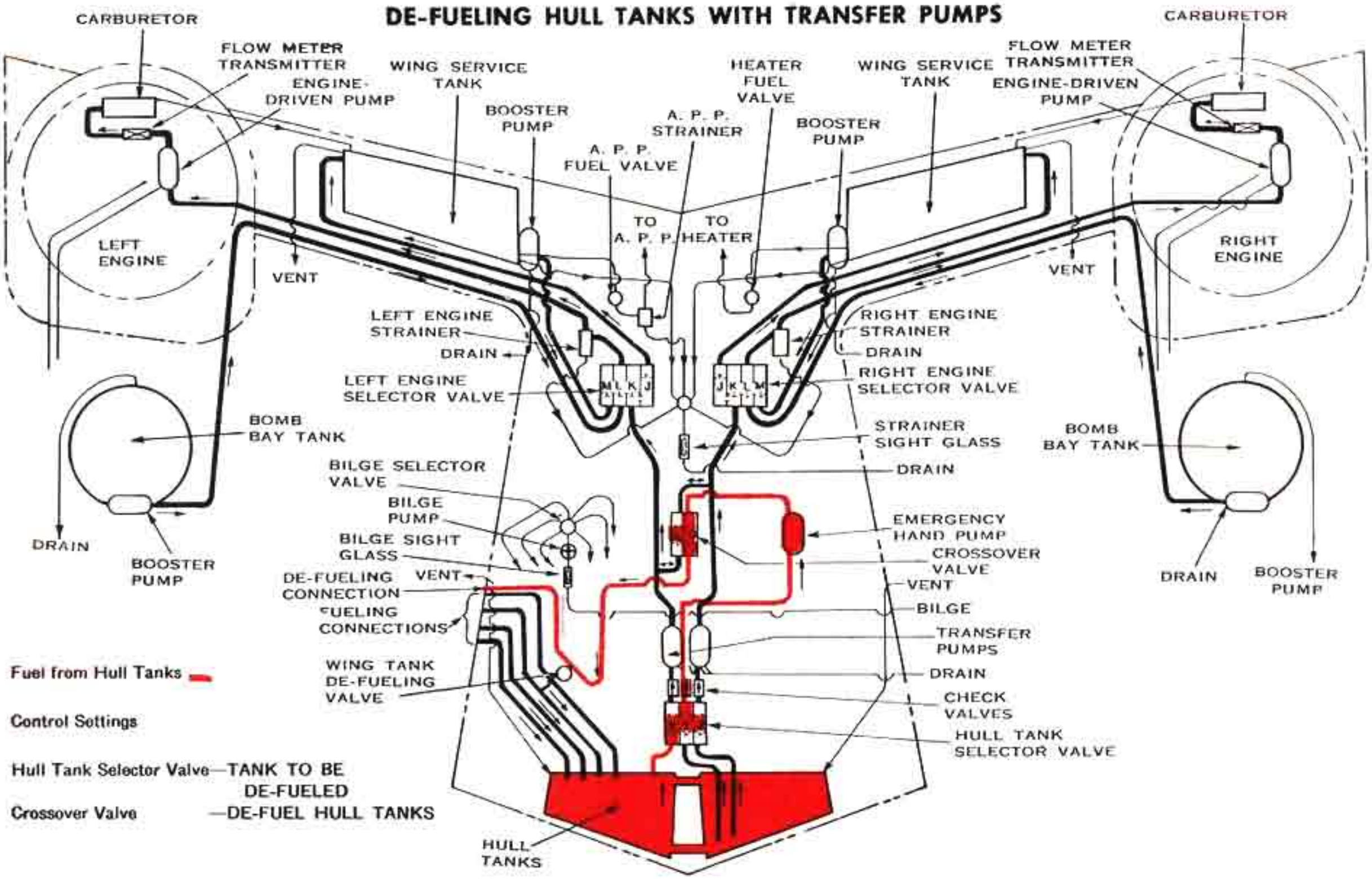


Fuel from Hull Tanks

Control Settings

Wing Tank De-Fueling Valve—OFF
Crossover Valve —DE-FUEL HULL TANK
Hull Tank Selector Valve —TANK TO BE DE-FUELED
Engine Selector Valve —HULL TANK

DE-FUELING HULL TANKS WITH TRANSFER PUMPS



Fuel from Hull Tanks

Control Settings

Hull Tank Selector Valve—TANK TO BE DE-FUELED
Crossover Valve —DE-FUEL HULL TANKS

DE-FUELING HULL TANKS WITH HAND PUMP

Figure 34 (Sheet 5 of 5 Sheets) — Fuel Flow Diagram

4. STARTING ENGINES.

PILOT

a. Check that flight engineer is ready to start engines.

f. Push master ignition switch in and turn ignition switch (figure 16 and 17-1) to "BOTH."

g. Turn propeller selector switch (figures 16 and 17-7 and 27) to "AUTO."

h. Move propeller governor control (figures 22-2 and 23-3) to full "INC. RPM" (low pitch).

Note

If propellers are not in low pitch run them down with the selector switch in "INC. RPM."

i. Set throttles for approximately 600 to 800 rpm.

FLIGHT ENGINEER

b. Check that pilot has ignition switches "OFF."

c. With the auxiliary power plant operating, and the controls in the following positions,

Ignition Switches	"OFF"
Fuel Valves	"OFF"
Mixture Control	"IDLE CUT OFF"
Auxiliary Generator Switch	"ON"
Battery Switch	"ON"
Carburetor Air Control	"DIRECT"
Cowl Flaps	"FULL OPEN"
Oil Cooler Flaps	"OPEN"
Supercharger Controls	"LOW,"

flick the starter switch (figure 28-1 or 7) first to "STARTER" and then to "MESH" at intervals of a few seconds until the propeller has turned through nine blade spaces.

Note

If unusual resistance to rotation is apparent, stop and investigate.

d. Turn the fuel booster pump switches (figure 28-4) to "NORMAL," and the inverter switch (figure 28-35) to "ON."

e. Turn engine selector valve (figure 26-5) to "SERVICE TANK" and check fuel pressure.

j. Check that pilot has ignition switch "ON," propeller selector switch to "AUTO," propeller governor handles to full "INC. RPM" and throttle set to approximately 600 to 800 rpm.

k. Energize starter for 15 to 20 seconds.

l. Push starter switch (figure 28-1 or 7) to "MESH," and at the same time push the primer switch "ON" and hold for 2 to 4 seconds. After the engine starts release the primer switch. Avoid excessive priming.

m. As soon as the engine starts firing, push the mixture control to "AUTO-RICH." Flick priming switch as necessary to keep engine running. If the engine does not continue to run, return the mixture control to "IDLE CUT-OFF" immediately.

PILOT

FLIGHT ENGINEER

Note

Do not put mixture control in "AUTO-RICH" until engine starts to fire as injection carburetor will tend to flood engine.

n. Check fuel and oil pressure.

Note

A sudden rise of oil pressure as high as 400 pounds (above indicator calibration) may occur momentarily when engines are started but is no cause for alarm.

o. Repeat above steps to start other engine.

5. ENGINE WARM-UP.

a. If oil was diluted at the end of the last operating period, a normal start and warm-up should be made.

CAUTION

Allow adequate warm-up before taking off with diluted oil except in cases of extreme emergency.

b. After starting, if excessively viscous oil is indicated by oil pressure that is too high, or fluctuates, or falls off when engine speed is increased, the dilution switch (figure 28-3 or 5) may be operated intermittently (not continuously) to correct the condition. This is not considered good practice and should be avoided except in emergencies.

c. As soon as engines are operating normally, advance throttles and warm-up at 1000 to 1200 rpm.

d. Engines are ready for check when head temperature reaches 120°C (248°F) and oil temperature reaches 40°C (104°F).

6. EMERGENCY TAKE-OFF.

a. In an emergency when it is necessary to take-off before the engines are properly warmed up, the engines can be flown as soon as they will take the throttle without backfire or hesitation.

Note

The minimum oil temperature for emergency take-off is 40°C (104°F). Oil pressure must be watched to avoid starving the engine.

b. After starting, if excessively viscous oil is indicated by oil pressure that is too high, or fluctuates, or falls off when engine speed is increased, the dilution switch (figure 28-3 or 5) may be operated intermittently (not continuously) to correct the condition. This is not considered good practice and should be avoided except in emergencies.

7. ENGINE AND ACCESSORIES GROUND TEST.

a. FUEL SYSTEM.

(1) While engines are being warmed up and other checks are being made, allow the engines to operate from 3 to 5 minutes on each tank until operation has been checked on all tanks.

(2) Check for proper operating fuel pressures: Carburetor fuel pressure at 17 pounds and transfer pump pressure at 17-1/2 pounds. Turn main engine selector valve (figure 26-5) to "HULL TANK" and check that pressure of hull transfer and engine pumps does not exceed carburetor limit of 18 pounds at 2000 rpm.

(3) Check for leaks in fuel trunk while system is in operation and under pressure.

b. PROPELLERS.

(1) Run each engine to 1600 rpm with propellers in "AUTO" and governor control in full "INC. RPM." position and check the following:

(a) Operate propeller selector switch (figures 16 and 17-7 and 27) in "DEC. RPM" until engine speed drops to 1400 rpm, release switch, note that speed remains at 1400 rpm momentarily, then operate switch in "INC. RPM" until speed rises to 1500 rpm, and release switch. Note that speed remains constant momentarily. Place switch in "AUTO" and note that speed returns to 1600 rpm.

(2) Run engine at 2000 rpm and push the governor control levers (figure 22-2 and 22-3) forward until a drop of 200 rpm is noted. Return governor control levers to full "INC. RMP" position and note that engine speed returns to 2000 rpm.

Note

Do not decrease rpm so that manifold pressure exceeds 30 inches Hg.

c. COWL FLAPS.—Operate both cowl flap switches (figures 28-10 and 27) and check that cowl flaps operate and will stop in any intermediate position.

CAUTION

Return cowl flaps to *full open* position.

d. SUPERCHARGER SPEED CONTROL. — With an oil inlet temperature of at least 40°C (104°F) and preferably 60°C (140°F) increase the engine speed to 1700 to 1800 rpm with the propeller governor control in full "INC. RPM."

(1) Shift the supercharger control levers (figure 24-3) from "LOW" to "HIGH" with one quick continuous movement. *Do not stop the movement in any intermediate position.*

(2) Indications of selector valve and clutch operation during shifts will appear in very slight changes in engine oil pressure, and in engine speed. An increase of approximately 1 inch Hg in manifold pressure is normal.

(3) Operate about two minutes in high blower and return the control to the "LOW" position.

Note

If more than one complete cycle of shifting is to be made, operate the engine at 1000 rpm or less for two minutes to permit heat generated during the shift to be dissipated from the clutches.

e. CARBURETOR.

(1) At 1800 rpm set carburetor mixture controls (figure 24-2) at "AUTO LEAN," and "AUTO RICH," and note that engines operate satisfactorily at each position. A reduction in fuel flow will indicate functioning of "AUTO LEAN" setting. Return control to "AUTO RICH" for further operation.

(2) Throw carburetor air control (figure 24-1) to "ALTERNATE" to check operation of doors. Return control to "DIRECT."

f. MAGNETOS.

(1) Check left and right magnetos on both engines by advancing throttles until manifold pressures are 30 inches Hg with 2200 rpm; turn ignition switch (figures 16 and 17-1) to "L." The engine speed drop should not exceed 100 rpm.

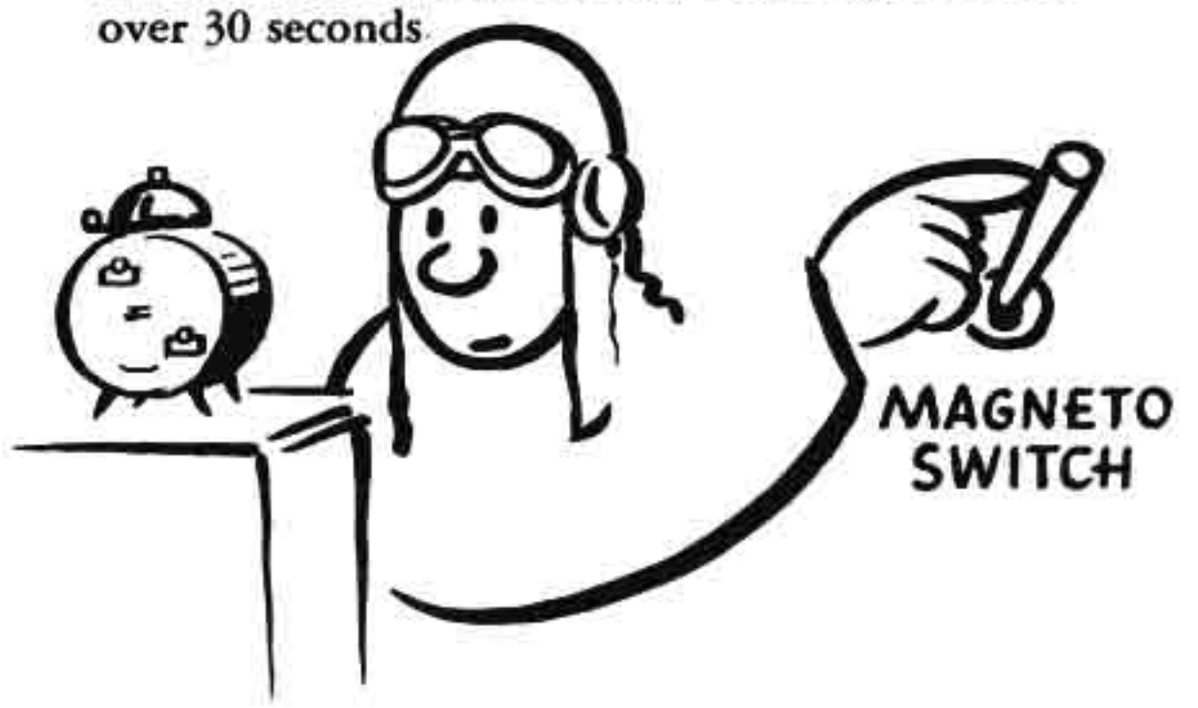
Note

If the magnetos are checked at a lower power the spark will be advanced from the 20-degree to the 35-degree position and there will be little or no drop in rpm when shifting from both to one magneto.

(2) Return the ignition switch to "BOTH" to allow the engine to clear and repeat the check with the ignition switch turned to "R." Return the switch to "BOTH," and make a similar check on the other engine.

WARNING

Do not hold switch on any one magneto for over 30 seconds.



(3) With engines at approximately 700 to 800 rpm, check magneto switches for cut-off—left and right engines and both engines.

(4) Check for proper operation of the automatic spark advance. Run the engine at 1700 to 2000 rpm and 20 to 28 inches Hg with the mixture in "AUTO RICH." Turn the ignition switch from "BOTH" to "L" or "R." If the engine speed remains about the same, the spark has advanced. If the engine speed drops off the spark has probably not advanced and should be investigated. Do not operate above 800 BHP until satisfactory functioning of this unit is determined.

g. GENERATORS.—Check delivery and voltage of right and left generators separately and in parallel.

(1) With one engine operating at 1700 rpm, power battery switch (figure 28-29) "ON" and auxiliary generator switch (figure 28-12) "OFF," turn the engine generator switch (figure 28-14 or 31) to "ON." Check that voltmeter (figure 28-23) reads approximately 28.5 volts and that the ammeter (figure 28-8 or 25) indicates the generator is delivering power. Repeat the check for the other engine.

(2) With both engines at 1700 rpm, power battery switch "ON" and auxiliary generator switch "OFF," turn both engine generator switches "ON" and check ammeters for proper delivery in accordance with placard on fuel system panel.

h. AUXILIARY POWER PLANT.—Check auxiliary generator for proper output, and check the auxiliary power plant for general operation.

i. INSTRUMENTS. — Check for proper operation and general condition of engine and flight instruments. Check that manifold gage and tachometer on pilot's instrument panel agree with those on flight engineer's panel.

j. WINDSHIELD WIPER.—Check operation of windshield wiper with water on glass.

k. DE-ICER AND ANTI-ICER.—If surface de-icer

and propeller anti-icer equipment is installed check for proper operation of both systems.

l. VACUUM PUMPS.—Check the operation of both vacuum pumps. Operate one engine at 1000 to 1200 rpm and idle the other at 400 to 500 rpm and check the vacuum gage (figure 15-10) for 3.5 to 5 inches Hg. Reverse the engine speeds and check the other pump.

m. AUTOMATIC PILOT.

(1) Check oil in reservoir. Replenish supply if oil is not visible through glass.

(2) Uncage bank and climb gyro.

(3) Set and uncage directional gyro.

(4) Turn automatic pilot switch (figures 16 and 17-29) to "ON."

(5) Check vacuum gage (figure 15-10) which should read 3.5 to 5 inches Hg.

(6) Check that servo speed valves (figure 15-27) are open 1 to 3 turns.

(7) Align rudder cards and aileron and elevator indices.

(8) Engage automatic pilot. Oil pressure gage figure 15-31) should read 140 pounds.

Note

If oil pressure drops or remains below 140 pounds it is an indication of low oil supply or clogged oil filter.

(9) Check for air in the hydraulic control system by moving the surface controls manually with the automatic pilot engaged. If the controls feel springy, air is present. To remove air from the system, disengage the automatic pilot and with the automatic pilot switch in the "ON" position move the controls from one extreme to the other—repeat as often as necessary, and hold controls at each extreme for 20 to 30 seconds.

(10) With automatic pilot engaged, check for overpowering of the automatic pilot.

(11) Disengage automatic pilot and turn automatic pilot switch to "OFF."

8. TAXYING INSTRUCTIONS.

(See figures 35, 36, and 37.)

a. GENERAL.

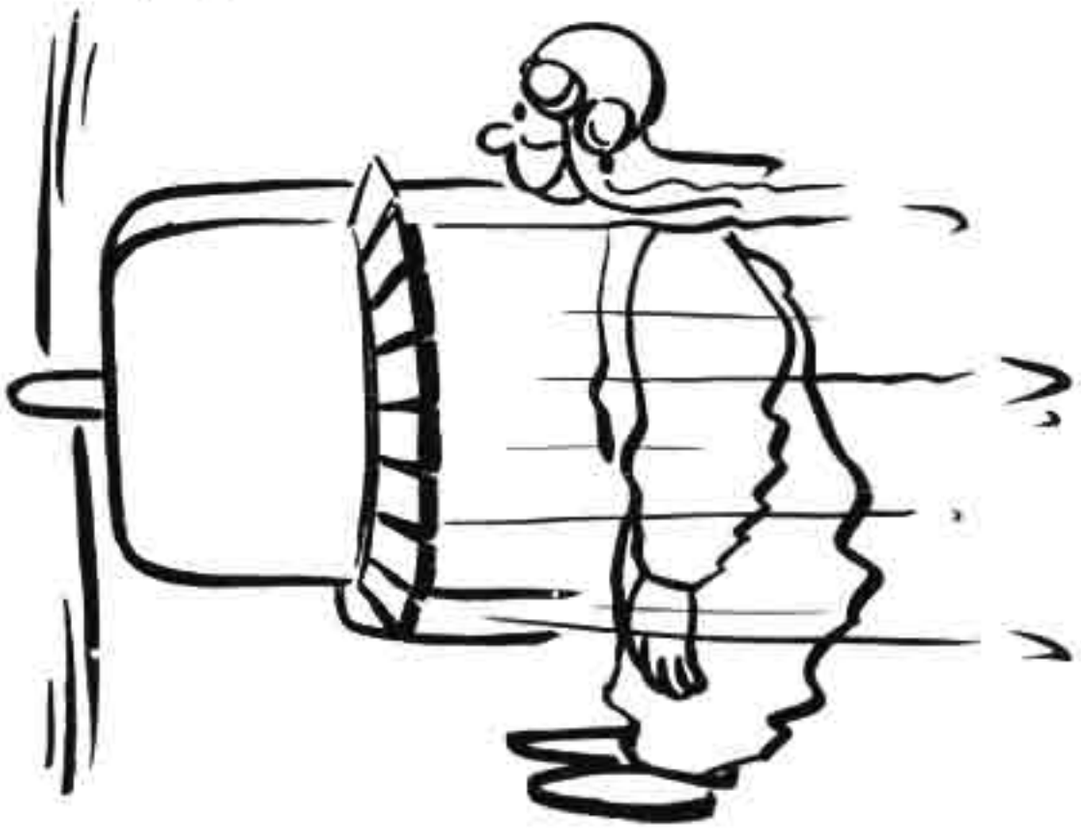
(1) All taxying that is not directly into the wind should be done with wing flaps in the full up position.

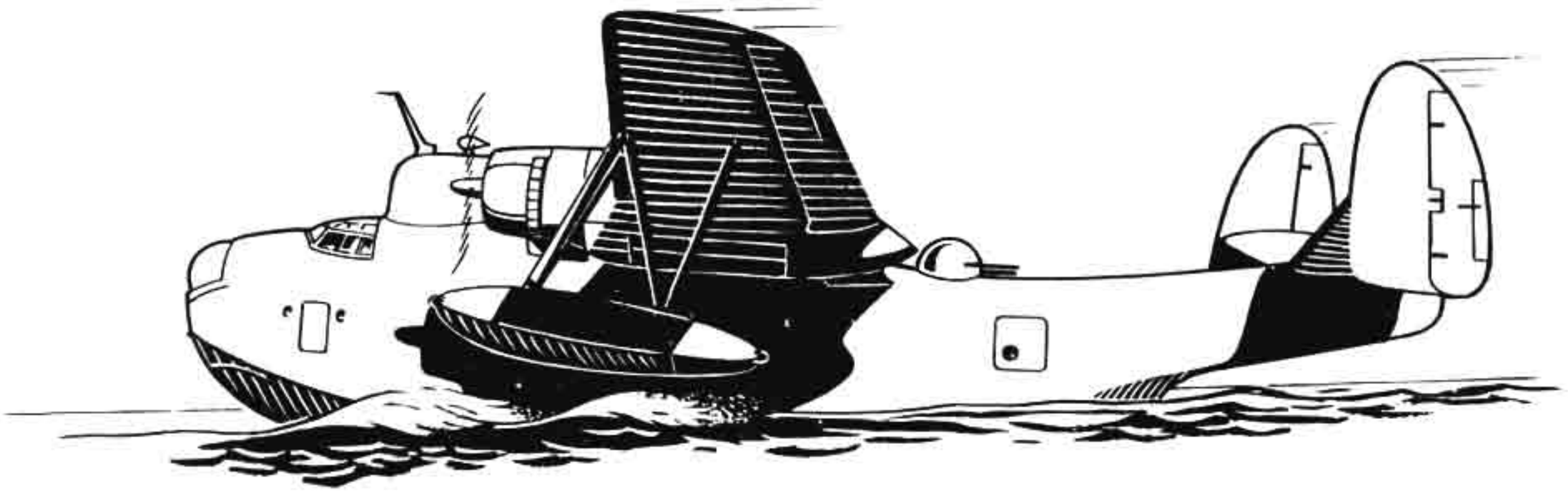
(2) To improve cooling conditions, long distance taxying should be done on the step whenever possible.

(3) Watch all cylinder head temperature gages for overheating.

CAUTION

Cowl flaps should always be full open for taxying.





1. Cowl flaps full open.
2. Wing flaps up.
3. Lowest speed which will still give adequate directional control.
4. In cross winds use unbalanced power to maintain general heading and rudder to hold exact heading.
5. For very slow down-wind taxi use short bursts of power but do not allow speed to build up.

Figure 35 — Off-Step Taxi

(4) The booster pump switches (figure 28-4) should be in the "NORMAL" position for all taxying operations.

b. OFF-STEP TAXI.

(1) Off-step taxi should in general be done at as low a speed as possible depending on wind and water conditions and the distance to be traveled. To improve cooling, taxying for long distances should be done on the step whenever possible. All taxying should be done with the cowl flaps wide open and the wing flaps full up. Since the cowl flaps were primarily designed to keep the engines cool on the ground, they should be wide open for all ground or taxying operations regardless of the cylinder head temperature.

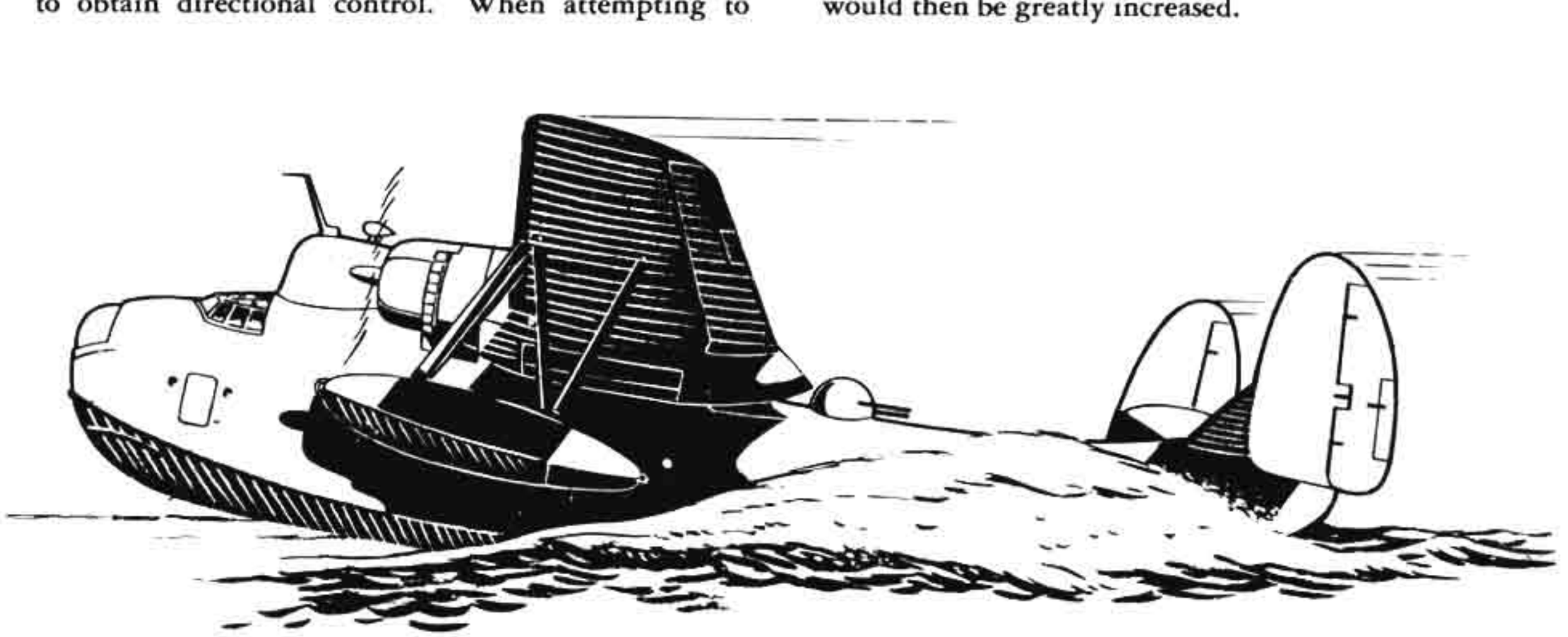
(2) If the wing flaps are down during off-step taxying they completely blanket the rudders and eliminate any possibility of direction control with the rudders. Whenever possible off-step taxying should be done by setting the engine power to hold the airplane on the approximate heading desired and using the rudder to hold the exact heading or make any corrections to the heading.

(3) When it is necessary to make a buoy approach downwind and then come around into the wind to make the buoy, great care must be taken to keep the speed as low as possible. There will be very little if any rudder control and it may be necessary to use slight bursts of power from one engine or the other to obtain directional control. When attempting to turn from a downwind heading to an upwind heading at very low speeds the airplane will show a marked tendency to retain a crosswind heading after the turn has been half completed. A little power on the downwind engine or a sea anchor on the upwind side will straighten the airplane out. It should be remembered, however, that too much power or too much speed can be dangerous as the airplane may get "in irons" and make completion of the turn very difficult.

c. GOING OVER THE HUMP.

(1) After power has been applied at the start of a take-off it will probably be found best to allow the airplane to seek its own trim angle until it is almost ready to go over on the step. With very heavy loads under no wind conditions it may be found best to leave the flaps up until after the airplane is on the step. If the flaps are down the rudder control will be impaired; however, with winds above 10 knots no difficulty will be encountered in getting on the step with heavy loads and the flaps down.

(2) As soon as planing speed is reached the airplane has a tendency to flop over or drop its nose very quickly. The pilot should apply a very slight back pressure to the controls and allow the nose to come down gently to the best on-step taxi attitude. If the airplane is allowed to flop over onto the step the trim angle will be too low and a mild porpoise will result. This mild porpoise can rapidly build up to dangerous proportions. At the same time the pilot should guard against holding the nose too high as take-off time would then be greatly increased.



1. Cowl flaps full open.
2. Wing flaps 20 degrees or as desired.
3. Elevator trim tab 2-1/2 to 4 degrees nose-up.
4. Rudder trim tab 1 to 2 degrees nose-right.
5. Do not attempt to pull nose-up.
6. Do not allow airplane to fall over on the step after attaining its maximum nose-up angle.
7. In cross-wind or down-wind taxi do not put the wing flaps down until after passing hump speed.

Figure 36 — Going Over Hump

d. ON-STEP TAXI AND TAKE-OFF.

(1) A pilot should practice taxying on the step upwind, downwind, and crosswind to learn the trim angle that gives the greatest acceleration and makes for easiest control. Once that trim angle has been found it should be used for all taxi and take-off operations.

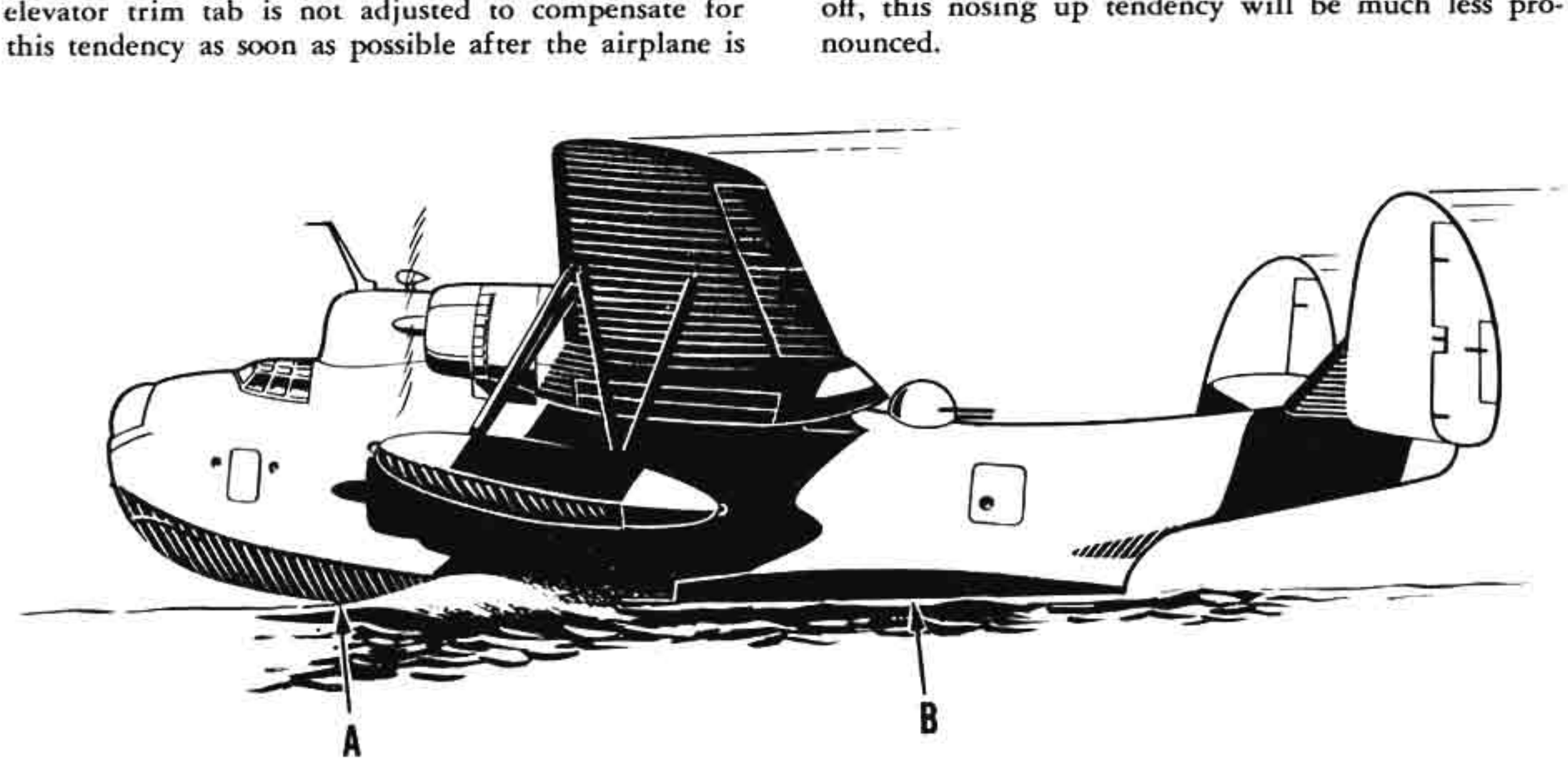
(2) If the nose is held too high, take-off performance is impaired not only because of a higher water resistance but also because of solid water from the first step hitting the afterbody and sucking the tail of the airplane downward which will eventually cause the airplane to break clear of the water prematurely. Another disadvantage of holding the nose too high on the take-off is the increased change in trim tab angle necessary to trim the airplane for flight.

(3) With the nose held too low during the take-off run, water resistance is again increased, and the nose may exhibit a tendency to suck down causing a bad porpoise.

(4) If the airplane has been properly trimmed and the on-step taxi angle is approximately correct there will not be a great change in trim tab angles required to trim for flight. Also, the nosing-up tendency and the resultant control loads will not be as great as where the nose was held too high during the take-off run.

(5) Immediately after breaking water on take-off a strong nosing-up tendency will be noted. If the elevator trim tab is not adjusted to compensate for this tendency as soon as possible after the airplane is

airborne the control load will possibly become too heavy for one pilot to handle. The elevator trim tab setting for flight with a normal center of gravity is about 4-1/2 degrees nose-down as compared with an on-step taxi setting for the same center of gravity of 2-1/2 to 4 degrees nose-up. If on take-off the nose has been held low and the airplane allowed to fly itself off, this nosing up tendency will be much less pronounced.



1. Trim airplane to ride easily with only first step in water.
2. If nose is too high the roach behind the first step will wet the afterbody at B and the resultant suction will pull the tail down further and result in a bad porpoise, or the airplane will pitch and get into the air, before flying speed has been attained.
3. If the nose is too low and water touches the keel at A the airplane will not accelerate fast enough and may even have a tendency to bury its nose. A bad porpose or a ground loop can be the result.

Figure 37 — On-Step Taxi

9. TAKE-OFF.

a. CHECK-OFF LISTS.

PILOT

(1) Loading manifest complies with center of gravity not forward of 28 percent MAC.

(2) Mooring gear secured.

(3) Bomb sight sliding doors secured.

(4) All hatches and water-tight doors closed.

(5) Flying controls unlocked.

(6) Driftmeter and radio standpipe closed.

(7) Propellers in "AUTO" for 2800 rpm, and pitch control set for full "INC. RPM."

(8) Crew at stations, belts fastened.

(9) Auxiliary power plant operating.

(10) When wing flaps are set 30 degrees set elevator trim tab 4 to 5 degrees nose up, set rudder tab 2 degrees nose right, and set aileron tab 0 degrees.

(11) Check circuit-breaker switches for correct "ON" or "OFF" settings.

***(a)* The following circuit-breaker switches should be "ON" for take-off:**

Wing Flap
Pilot's Instrument Indicator

***(b)* For night operation the following circuit-breaker switches should be "ON" in addition to those listed above:**

Flare Release
Pilot's Panel Lights
Landing Lights

***(c)* All other circuit-breaker switches should be "OFF."**

(2) Gross weight for rough water take-off not to exceed 48,000 pounds.

Note

The recommended maximum gross weight for smooth water operation is 60,000 pounds.

FLIGHT ENGINEER

(1) Both oil temperature switches set for "ON."

(2) Fuel and oil tank quantities correct.

(3) Cowl flaps full open.

(4) Oil cooler flaps full open.

(5) Both engine generator switches set for "ON."

(6) Check circuit breaker switches for "ON" or "OFF" settings.

***(a)* The following circuit breaker switches should be "ON" for take-off:**

Inverter
Cowl Flaps
Starter Relay
Power Battery
Wing Flap
Auxiliary Generator
Power Forward Hull
Propeller Power
Fuel Transfer Pumps
Fuel Gages
Radio Power

***(b)* For night operation the following circuit breakers should be "ON" in addition to those listed above:**

Panel and Flood Lights
Cabin Lights
Power Left Wing
Power Right Wing
Power Aft Hull
Navigator's Instruments

***(c)* All other circuit breaker switches should be "OFF."**

(6) De-icer switch set for "OFF."

(7) Both wing tank switches set for "AUTOMATIC."

(8) Inverter switch set for "ON."

(9) Mixture control set for "AUTO RICH."

(10) Carburetor air controls set for "DIRECT."

(11) Supercharger controls set for "LOW" ratio.

(12) Both main engine selector valves set for "SERVICE TANK." Booster pumps "NORMAL."

(13) Hull tank selector valve set to "FWD. HULL TANK," or next tank containing adequate fuel.

(14) Drain valve set for "OFF."

(15) Cross over and defuel valves set for "OFF."

(16) Test fuel tanks low level warning lights.

(17) Notify crew to go to take-off stations in accordance with loading manifest.

PILOT

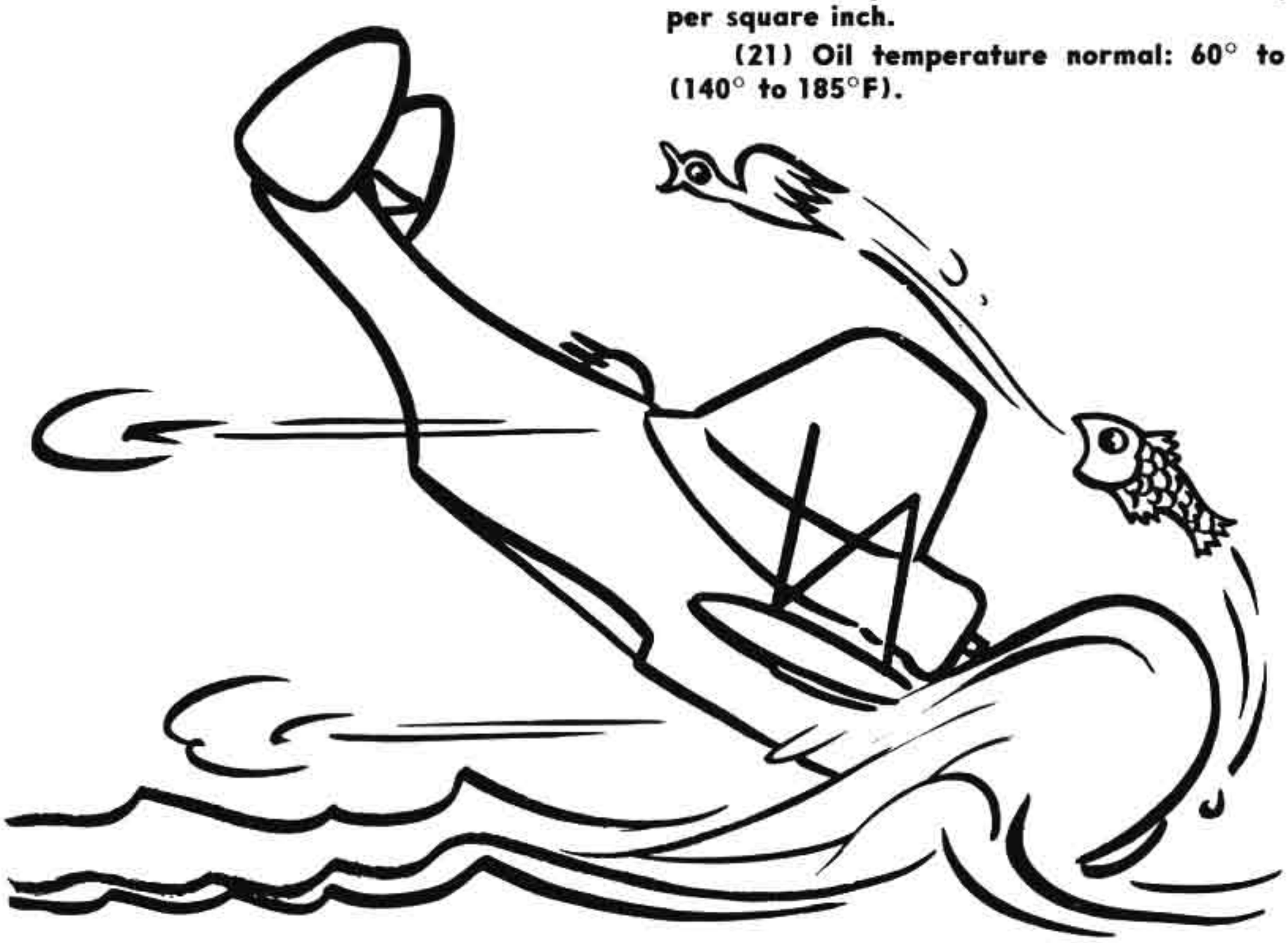
FLIGHT ENGINEER

(18) Wing tanks full.

(19) Fuel pressure normal: 17 pounds per square inch.

(20) Oil pressure normal: 85 to 90 pounds per square inch.

(21) Oil temperature normal: 60° to 85°C (140° to 185°F).



DON'T TAKE OFF WITH CENTER OF GRAVITY FORWARD OF 28 PERCENT MAC

PILOT

FLIGHT ENGINEER

b. Use throttles for directional control until airplane approaches hump speed. As hump speed is approached sufficient rudder and aileron control will be obtained to allow use of balanced power.

Note

With very heavy loads and calm weather (no wind) there will not be sufficient rudder control to hold a straight course while going through hump speed. Under these conditions it is best to leave full take-off power on both engines and allow the airplane to turn slightly while going over the hump. If power is reduced on one engine to control any turning tendencies it will only make it more difficult to obtain planing speeds.

c. During take-off watch the manifold pressure, engine rpm, fuel pressure, and oil pressure gages.

Note

If either engine fuel pressure starts to drop or if vapor lock troubles cause a power loss at take-off power, switch the booster pumps to "EMERGENCY."

PILOT

d. As the airplane goes over the hump and approaches planing speeds it will be found best to hold a slight back pressure on the yoke. Only hold this back pressure a few seconds.

WARNING

If the airplane is allowed to flop down on the step after planing speed is reached it will cause a mild porpoise.

e. Feel the airplane out and learn the best angle at which it handles and accelerates the best.

f. On rough water hold the nose a little higher than on glassy water.

g. For heavy loads try to have the center of gravity located between 30 and 31 percent MAC.

Note

With the center of gravity too far forward there will be a pronounced tendency to porpoise, and with the center of gravity too far aft it will take longer to get on the step and add to both pilot and engine fatigue.

h. If the airplane starts to porpoise cut back the power first, and don't wait until the airplane is jumping clear of the water to do it. Then review your take-off procedure to determine why you porpoised. Remember, it isn't necessary to porpoise on a take-off, and it is dangerous.

Note

The following will cause porpoising.

1. Center of gravity too far forward.
2. Elevator trim tab not properly set.
3. Nose too low.
4. Nose too high.
5. Allowing the airplane to flop over on the step.
6. Pushing the nose down to get on the step.

j. As soon as the airplane is airborne it will be necessary to roll the elevator trim tab to about 5 degrees nose down.

k. Do not allow manifold pressure to exceed 52.5 inches Hg.

l. As soon as practicable after take-off reduce engine speed to 2600 rpm and manifold pressure to 42 inches Hg.

Note

Take-off engine speed and manifold pressure of 2800 rpm and 52.5 inches Hg may be used for a maximum of 5 minutes only.

FLIGHT ENGINEER

i. During take-off run and initial climb the cowl flaps should be full open. As soon as power is reduced the cowl flaps should be closed to 20 degrees opening or less provided the cylinder head temperatures do not exceed 260°C (500°F) for rated power.

PILOT

m. When speed reaches 105 knots, raise the flaps. Flaps-up climbing speed is 120 knots.

WARNING

Do not exceed 108 knots with flaps down.

FLIGHT ENGINEER

10. ENGINE FAILURE DURING TAKE-OFF.

PILOT

b. If an engine failure occurs on take-off and before the flaps are pulled up there is very little the pilot can do except cut the other engine and land straight ahead.

c. If an engine failure occurs after flaps are up and climbing speed has been obtained, it will be possible to feather the propeller on the dead engine and continue the flight or at least glide to a clear landing area.

FLIGHT ENGINEER

a. Be certain that engine fuel pressure has not dropped. If fuel pressure drops, set booster pump switch to "EMERGENCY."

d. If engine failure is due to causes other than loss of fuel pressure and the pilot feathers the propeller on the dead engine the flight engineer should:

(1) Completely close cowl flaps on the dead engine.

(2) Cut fuel supply to dead engine.

(3) Close cowl flaps on good engine as much as possible and in any event close them to 20 degrees.

11. CLIMB.

a. At 2600 rpm reduce manifold pressure to 42 inches normal maximum at sea level or 39.5 inches normal maximum at 5000 feet (52 inches Hg at 2800 rpm take-off rating allowed for 5 minutes in emergency only).

b. Mixture "AUTO RICH."

c. Close cowl flaps partially. At normal rated power a cylinder head temperature of 260°C (500°F) is allowable for one hour, but must not be exceeded. Operating at or near the limit is not encouraged.

Note

During climbs the practice of flying at slightly greater than the recommended indicated air speeds for maximum climb will greatly improve cooling and will make very little difference in rate of climb.

d. Adjust propeller governor (2600 rpm normal maximum).

e. Retract wing flaps (zero-degree flap angle).

f. Trim for the best climbing speed.

g. During rated power climb a shift to high blower may be made above 12,500 feet if high power operation is desired.

WATCH HEAD TEMPERATURES

12. GENERAL FLYING CHARACTERISTICS.

a. CLIMB.

(1) As soon as possible after take-off the power should be reduced to at least 2600 rpm and 42 inches Hg. As soon as the speed can be brought up to between 100 and 105 knots the wing flaps should be retracted. When the wing flaps are fully retracted, climbing speed should be increased to approximately 120 knots. If the flight engineer failed to close the cowl flaps to 20 degrees or less after take-off the pilot will feel a slight buffeting.

(2) For all climbing operations it would be well to hold the speed as high as possible: approximately 120 knots. If too slow a climbing speed is used the airplane will tend to "mush" and the engines cannot be properly cooled.

b. MANEUVERS. — All acrobatic maneuvers are prohibited. Banks up to 60 degrees are allowed, provided the airplane's gross weight does not exceed 48,000 pounds. For gross weights in excess of 48,000 pounds turns should be restricted to gentle or moderate banks and no violent loads should be applied to the airplane.

c. CRUISING FLIGHT.

(1) On long cruises at level flight the speed of the airplane may be greatly impaired if the flight engineer does not handle the cowl flaps properly. For all flight conditions the cowl flaps should be kept as nearly closed as possible. For cruising flight the cowl flaps shall be open only enough to keep the cylinder head temperature from exceeding 232°C (450°F). Flying with cowl flaps wide open will not only reduce the speed of the airplane but will cause a slight buffeting.

(2) For either climb or level flight a cylinder head temperature of 260°C (500°F) is allowed for one hour at normal rated power. To remain within these limits the cowl flaps may have to be kept open about 20 degrees. Operating at or near the limiting head temperature is not encouraged.

(3) The R-2800-22 engines incorporate carburetor settings which permit in level flight only the use of "AUTO LEAN" up to normal rated power and rpm, provided the cylinder head temperatures do not exceed 232°C (450°F). The use of powers higher than normal rated are not permitted in "AUTO LEAN" under any circumstances; since the use of "AUTO LEAN" in higher powers than cruise is restricted to level flight (high speed), the use of "AUTO RICH" is generally preferable. Therefore, the use of "AUTO LEAN" at higher powers than cruise should be confined to conditions where range is a factor in conjunction with high powers.

(4) Cruising performance will be greatly improved if the pilot always endeavors to keep the elevator trim tab setting at or near zero degrees by instruc- any member of the crew not actually at assigned stations to move forward until the airplane flies level with the trim tab set at approximately zero degrees. The trim tab setting of zero degrees should correspond to a center of gravity location of about 25 percent MAC. Flying with this center of gravity location should give a speed increase of about 5 knots and the longitudinal and direction stability of the airplane is somewhat improved. The pilot should always remember to move the crew aft until the center of gravity is again aft of 28 percent MAC before a landing is attempted.

d. OPERATION OF AUTOMATIC PILOT.

(1) Trim airplane "hands-off."

(2) Open servo speed control valves (figure 15-27) for best operation—approximately three turns.

Note

In rough air it will be necessary to close speed valves to less than three turns.

(3) Turn automatic pilot switch (figures 16 and 17-29) "ON."

(4) Set rudder follow-up card to match directional gyro card by turning rudder knob.

(5) Set aileron follow-up index to match bank index by turning aileron knob.

(6) Set elevator follow-up index to match elevator alignment index by turning elevator knob.

CAUTION

Do not align elevator follow-up index horizon bar as relative movement between elevator alignment index and horizon bar is in opposite directions.

(7) Engage automatic pilot by slowly moving the lock lever (figures 16 and 17-20) to the "ON" position. By holding the controls, the pilot can feel when the automatic pilot is flying the airplane.

(8) To make course changes rotate the rudder knob slowly and smoothly in the direction desired. The proportional bank adapter will automatically crank in aileron and elevator movement.

CAUTION

Do not allow airplane to get too far out of trim. Do not forget that the automatic pilot can be overpowered.

(9) To make a caged turn:

(a) Cage directional gyro.

(b) Turn caging knob clockwise for left turn, counterclockwise for right turn.

CAUTION

Do not turn caging knob more than about 4 to 5 degrees, otherwise a violent turn will result.

(c) When new course is reached, uncage directional gyro.

13. MANEUVERS PROHIBITED.

All acrobatic maneuvers are prohibited.

14. STALLS.

a. The speeds indicated on the pilot's airspeed indicator at the stall on the PBM-5 airplanes are as follows:

STALL SPEEDS
PBM-5 (PRELIMINARY)

POWER ON—Flaps down at 56,000 pounds—69 knots
POWER ON—Flaps down at 38,000 pounds—57 knots
POWER OFF—Flaps down at 56,000 pounds—81 knots
POWER OFF—Flaps down at 38,000 pounds—67 knots

b. In general the airplane has a very indefinite stall with little or no tendency to fall off on a wing. Even after the stall it is possible to hold the nose up and let the airplane "mush." Flaps-down stall are not preceded by any great amount of warning, but the indefinite character of the stall and the ability to keep the nose up after stall accompanied by the absence of any rolling tendencies lessens the necessity for a stall warning.

15. SPINS.

Spins are prohibited. If the airplane goes into an inadvertent spin use a normal recovery procedure.

16. ACROBATICS.

All acrobatics are prohibited.

17. DIVING.

The permissible accelerations and speeds at various gross weights are tabulated below:

PBM-5 (PRELIMINARY)—
PERMISSIBLE ACCELERATIONS AND SPEEDS

GROSS WEIGHT POUNDS	*PERMISSIBLE ACCELERATION POSITIVE*	*NEGATIVE*	*PERMISSIBLE SPEED KNOTS (indicated)*
44,000	3.0g	1.5g	210
46,000	3.0g	1.5g	210
48,000	2.9g	1.4g	210
50,000	2.7g	1.4g	210
52,000	2.6g	1.3g	210
54,000	2.5g	1.3g	205
56,000	2.4g	1.2g	195

THE RESTRICTED SPEED WITH FLAPS EXTENDED IS 110 KNOTS INDICATED.

18. APPROACH AND LANDING.

a. CHECK-OFF LISTS.

PILOT

(1) Bombsight doors locked.

(2) Water-tight compartment doors closed.

(3) Wing flaps down as desired.

(4) Propellers set in automatic for approximately 2250 rpm.

(5) Crew at stations, belts fastened.

(6) Radio trailing antenna retracted and locked.

(7) Driftmeter retracted.

(8) All guns positioned and locked.

(9) All hatches and gun doors secured.

(10) Bomb bay doors closed.

(11) Flares removed from cans.

(12) Check crew at landing stations in accordance with loading manifest.

FLIGHT ENGINEER

(1) Cowl flaps closed.

(2) Mixture "AUTO RICH."

(3) Supercharger—"LOW."

(4) Carburetor air control in "DIRECT."

(5) Engine selector valves set to "SERVICE ANV."

(6) Booster pump switches "NORMAL."

(7) Surface de-icer "OFF."

(8) Notify crew to go to landing stations in accordance with loading manifest.

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b. CHECK LANDING CENTER OF GRAVITY.—With flaps full down and engine speed set for 2400 rpm, close throttles completely and see if airplane glides at 100 knots or less with elevator tabs set at zero.

WARNING

If under these conditions the hands-off gliding speed exceeds 100 knots, the center of gravity is forward of 28 percent MAC., move crew members aft until the hands-off gliding speed is 100 knots or less.

c. APPROACH AND LANDING.

(1) During a landing approach a gliding speed of 120 knots should be maintained until the pilot is ready to put the flaps down. Before lowering the flaps the pilot should be careful to reduce the airspeed to 108 knots. As the flaps go down the airspeed should be further reduced but in no case should it be lower than 95 knots.

(2) A flaps-down gliding speed of 95 to 100 knots should be maintained until the actual "flare-out" for the landing is started.

(3) In the actual landing the airplane may be either landed "hot" or a full stall made. In the case of a full or semi-stalled landing the airplane will show little or no tendency to leave the water unless the pilot continues to pull back on the yoke after the initial contact with the water. Power landings can be very satisfactorily made with flaps either 20 or 30 degrees down. However, the pilot should continue to "fly" the airplane until well after contact with the water has been made. The initial rate of descent for a power landing should not go over 200 feet per minute and the airplane should definitely be flying and not "mushing." If the airplane does "mush" down it will show a decided tendency to drop on the water from a height of about 20 feet instead of flying onto the water as it should.

d. IN CASE LANDING IS NOT COMPLETE.—Do not attempt to give the engines full power without resetting the elevator trim tab.

Note

If the elevator tab is set to zero degrees or some nose-up setting when full power is applied to the engines the airplane will have a bad nosing-up tendency which might result in a power-on stall.

19. STOPPING ENGINES.

a. With the cowl flaps wide open, carburetor air "DIRECT" mixture "AUTO RICH" run at 600 to 800 rpm until cylinder head temperatures are at 150°C (302°F) or less.

Note

After each flight while operating at 1700 to 1800 rpm shift the supercharger controls from "LOW" to "HIGH." Operate the supercharger in "HIGH" for about 2 minutes and return to the "LOW" position in order to desludge the supercharger clutches.

b. When the cylinder head temperatures drop, move the mixture controls to "IDLE CUT-OFF," and advance the throttles to the "FULL OPEN" position.

c. When the engines stop, turn off magneto switches and all fuel valves. Throw left and right switches to "OFF" and generator switches to "OFF." Leave the mixture controls, in "IDLE CUT-OFF" until the engine is started again.

d. If temperatures below —5°C (23°F) are forecast for the period before the next start, the lubricating oil should be diluted immediately before stopping in accordance with the following procedure:

(1) Open the starter hand crank door and unsafety and open the oil dilution shut-off cock located below.

(2) Place fire watch on top of center wing.

(3) Set the oil dilution circuit breaker to "ON."

(4) Hold engine speed constant at 800 rpm.

(5) Hold oil dilution switch "ON" 2 to 5 minutes. The warning light will show RED when the oil dilution solenoid valve is open. During last few seconds, move mixture control (figure 24-2) to "IDLE CUT-OFF" and advance throttles to "FULL OPEN" position. Release oil dilution switch when engine stops. Turn ignition switch (figures 16 and 17-1) "OFF" after propeller stops rotating.

(6) When diluting oil observe the following precautions:

(a) Do not over-dilute.

(b) Guard against fire.

(c) Dilute only when justified by forecast of temperatures below —5°C (23°F).

(d) Keep oil system free of sludge and water.

(e) Close and safety shut-off cock as soon as oil dilution is completed. Do not depend on the solenoid valve (operated by the oil dilution switch) to be free from leakage.

(f) Hold dilution switch "ON" until engine stops, except as follows: If oil pressure drops below 25 pounds per square inch before oil dilution period is ended, release oil dilution switch and move mixture control to "IDLE-CUT-OFF" immediately.

20. BEFORE LEAVING AIRPLANE.

a. Raise wing flaps.

b. Turn all fuel valves to "OFF.

c. Check fuel and oil loads.

d. Check that auxiliary power plant is off.

e. Turn all electrical circuits off.

f. Remove surface control locks from stowage outboard of flight engineer's fuel control panel and lock the surface controls as follows:

CAUTION

Check that the automatic pilot switch (figures 16 and 17-29) and lock (figures 16 and 17-20) are in their "OFF" positions before locking the surface controls.

(1) Set aileron controls in neutral and place lock bar in position between the elevator control columns. Place the tube end of the lock bar in the fitting on the co-pilot's column and bring the opposite end into position over the two pins on the pilot's column.

(2) Place the aileron locking yoke over the center spoke of the aileron control wheel and the elevator control column so that the prongs locate with the holes in the lock bar.

(3) While pushing firmly on the yoke and holding the lock bar in place, turn the locking key in the bar the full distance and withdraw it.

(4) Assign personnel to hold elevator and rudder controls in neutral, and take the key removed from the lock bar and the one chained to it aft, into the tail of the airplane. Insert one key into the rudder quadrant on the stabilizer rear spar, and the other through the lock link on the elevator jack shaft.

g. Secure all hatches.

h. If airplane is to be left on water, check bilge and see that anchor is holding and airplane is riding properly.

SECTION III
FLIGHT OPERATING DATA

1. SPECIFIC ENGINE FLIGHT CHART.
(See figure 38.)

Operating characteristics and limitations of the R-2800-22 engines with which this airplane is powered are given in tabular form for ready reference in the Specific Engine Flight Chart. For additional information refer to the Engine Calibration Curve. (See figure 77.)

2. AIRSPEED LIMITATIONS AND FLIGHT RESTRICTIONS.

a. Do not lower wing flaps above 108 knots IAS.

b. Gross weight for rough water take-off not to exceed 48,000 pounds. Recommended maximum gross weight for smooth water operation is 60,000 pounds.

STALL SPEEDS (INDICATED)
PBM-5 (PRELIMINARY)

POWER ON—Flaps down at 56,000 pounds—69 knots
POWER ON—Flaps down at 38,000 pounds—57 knots
POWER OFF—Flaps down at 56,000 pounds—81 knots
POWER OFF—Flaps down at 38,000 pounds—67 knots

3. BALANCE COMPUTER DESIGNATION.

Each airplane is equipped with a load adjuster and a Weight and Data Book. (AN-01-1-40.)

4. AIRSPEED CORRECTION TABLE.

Subtract the error shown in the second or third column from the indicator reading to obtain the calibrated airspeed.

MODEL PBM-5 PRELIMINARY
AIRSPEED ERROR TABULATION FOR
PILOT'S METER

(GROSS WEIGHT 46,500 LBS.)

Indicator Reading—Knots	*Error—Knots (Flaps Up)*	*Errors—Knots (Flaps Down)*
170	4.0	
160	3.6	
150	3.3	
140	3.0	
130	2.7	
120	2.4	
110	2.1	0.8
100	1.8	1.0
90	1.4	1.2
80	1.0	1.4
70		1.7

PBM-5 (PRELIMINARY)—PERMISSIBLE ACCELERATIONS AND SPEEDS

GROSS WEIGHT POUNDS	*PERMISSIBLE ACCELERATION POSITIVE*	*NEGATIVE*	*PERMISSIBLE SPEED KNOTS (indicated)*
44,000	3.0g	1.5g	210
46,000	3.0g	1.5g	210
48,000	2.9g	1.4g	210
50,000	2.7g	1.4g	210
52,000	2.6g	1.3g	210
54,000	2.5g	1.3g	205
56,000	2.4g	1.2g	195

THE RESTRICTED SPEED WITH FLAPS EXTENDED IS 110 KNOTS INDICATED.

SPEC. AN-H-8
DEC. 18, 1942

FORM ASC-512

SPECIFIC ENGINE FLIGHT CHART

AIRPLANE MODELS

PBM-5

SINGLE ENGINE OPERATION

ENGINE MODELS

R-2800-22

CONDITION	FUEL PRESSURE (LB/SQ. IN.)	OIL PRESSURE (LB/SQ. IN.)	OIL TEMP. °C	OIL TEMP. °F	COOLANT TEMP. °C	COOLANT TEMP. °F		
DESIRED	17	85, +5—0	60—75	140—167	—	—		
MAXIMUM	18	100	100	212	—	—		
MINIMUM	16	50	—	—	—	—		
IDLING	8-10	25	40	104	—	—		

MAX. PERMISSIBLE DIVING RPM: 3120

CONDITION	ALLOWABLE OIL CONSUMPTION
MAX. CONT.	33 U.S.QT/HR 53 IMP.PT/HR
MAX. CRUISE	16 U.S.QT/HR 26 IMP.PT/HR
MIN. SPECIFIC	— U.S.QT/HR — IMP.PT/HR

OIL GRADE: (S) 1120 (W) —

SUPERCHARGER TYPE: SINGLE STAGE, TWO-SPEED INTERNAL SUPERCHARGER

FUEL GRADE: 130 100 OCTANE

OPERATING CONDITION	RPM	MANIFOLD PRESSURE (BOOST)	HORSE-POWER	CRITICAL ALTITUDE WITH RAM	CRITICAL ALTITUDE NO RAM	BLOWER	USE LOW BLOWER BELOW:	MIXTURE CONTROL POSITION	FUEL FLOW (GAL/HR/ENG.) U.S.	FUEL FLOW (GAL/HR/ENG.) IMP.	MAXIMUM CYL. TEMP. °C	MAXIMUM CYL. TEMP. °F	MAXIMUM DURATION (MINUTES)
TAKE-OFF	2800	53	2100	—	Sea Level	Low	Do Not Use High Blower	A.R.	287	239	260	500	5
WAR EMERGENCY	—	—	—	—	—	—	—	—	—	—	—	—	—
MILITARY	2800 2800	52.5 47.0	2100 1600	—	4000 17000	Low High	11,800	A.R.	287 224	239 187	260	500	5
MAXIMUM CONTINUOUS	2600 2600	42.5 41.0	1700 1450	—	8000 17800	Low High	12,300	A.R.	204 190	170 158	232	450	NO LIMIT
MAXIMUM CRUISE	2250 2250	32.0 30.8	1140 975	—	12300 22700	Low High	16,500	A.L.	111 103	93 86	200	400	NO LIMIT
MINIMUM SPECIFIC CONSUMPTION	—	—	—	—	—	—	—	—	—	—	—	—	NO LIMIT

REMARKS:
1. MANIFOLD PRESSURES LISTED ARE MAXIMUM
2. FUEL AND OIL CONSUMPTIONS FOR ONE ENGINE ONLY
3. ALL POWERS ARE FOR OPERATING MIXTURES

RED FIGURES ARE PRELIMINARY, SUBJECT TO REVISION AFTER FLIGHT CHECK

WT-1-1-43-5M

Figure 38 — Specific Engine Flight Chart

SECTION IV
EMERGENCY OPERATING INSTRUCTIONS

1. EMERGENCY EXITS. *(See figure 39.)*

a. PARACHUTE EXITS.—The crew members should use the following exits while the airplane is in flight.

WARNING

If the airplane is flying nose down, do not open the parachute too quickly when leaving by the front exits. This will prevent the parachute from "ballooning" and entangling any structure.

(1) Bow turret gunner and bomber use either the front entrance hatch or anchor hatch.

(2) Pilot, co-pilot, radio operator, flight engineer, navigator and radar operator use the front entrance hatch or anchor hatch.

Note

If possible move aft to the waist hatches or auxiliary power plant hatch.

(3) Deck turret and waist gunners should use either the side waist hatches or the auxiliary power plant hatch.

(4) Tail turret gunner uses the empennage hatch.

b. CRASH LANDING EXITS.—The crew members should use the following exits in the event of a crash landing.

(1) Bow turret gunner—through the turret escape hatch.

(2) Bomber—through either the front entrance hatch or anchor hatch.

(3) Pilot and co-pilot—through the pilot's escape hatch.

(4) Navigator, radio operator, flight engineer and radar operator—through either the pilot's escape hatch, the front entrance hatch, or anchor hatch.

(5) Waist gunners—through either the side waist hatches, tunnel hatch, empennage hatch, or auxiliary power plant hatch.

(6) Deck and tail turret gunners—through the turret exit hatches.

2. EMERGENCY EQUIPMENT. *(See figure 39.)*

a. PARACHUTE STOWAGE.—There are provisions for stowage of 11 parachutes as follows:

(1) One parachute on the forward side of frame 5 in the bomber's compartment.

(2) One parachute on the left side of the flight deck ceiling forward of frame 9.

(3) One parachute on the left side of the flight deck below the aft end of the navigator's chart table.

(4) Three parachutes on the right side of the flight deck ceiling at the flight engineer's station.

(5) One parachute on the right side of the waist compartment aft of frame 24.

(6) One parachute on the right side of the waist compartment aft of frame 31.

(7) Two parachutes at frame 33, one on each side of the tunnel bulkhead.

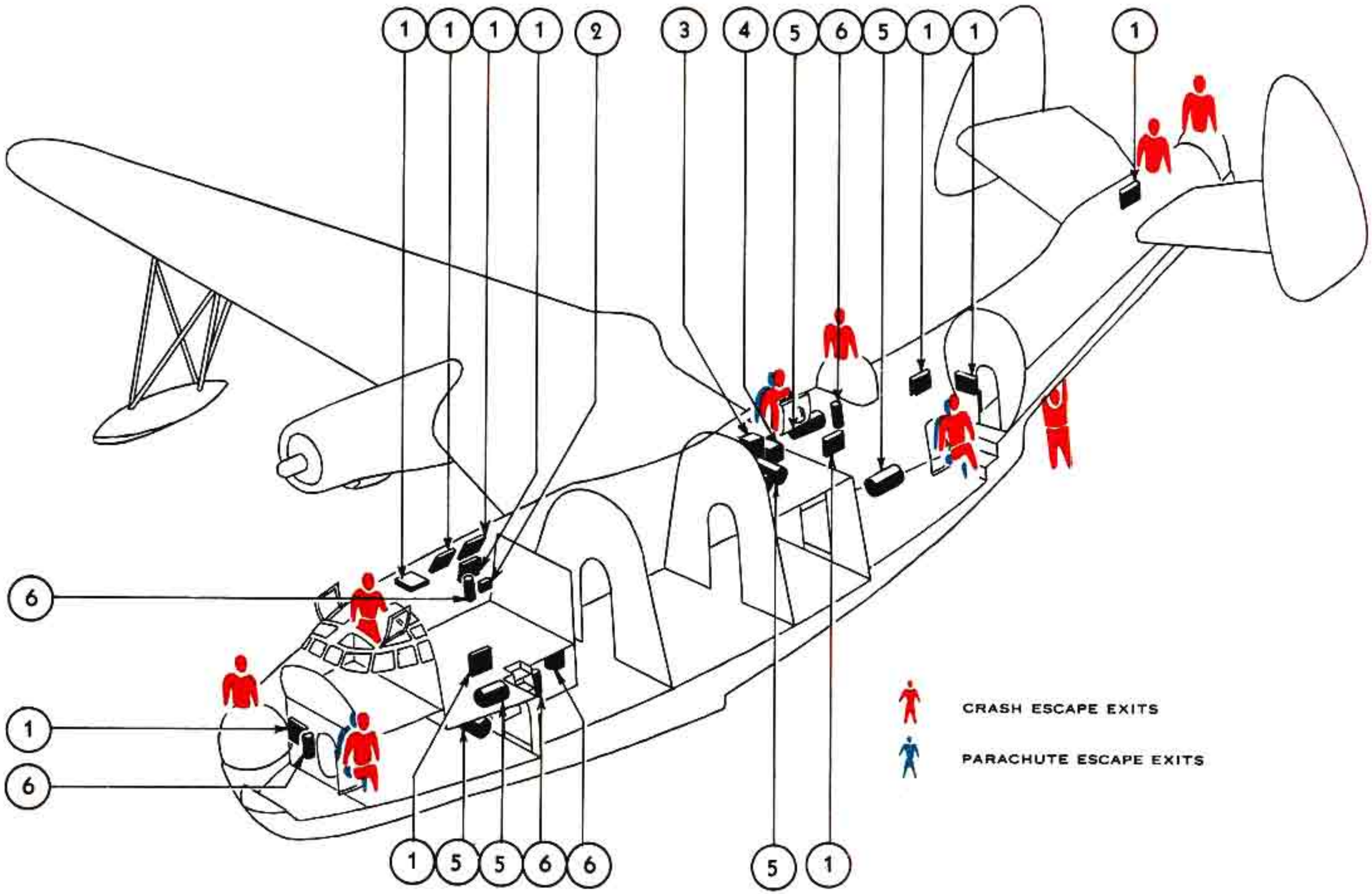
(8) One parachute on the right side of the airplane forward of the tail turret.

b. LIFE RAFT.—Three life rafts are stowed in the auxiliary power plant compartment.

c. FIRST AID KIT.—One first aid kit is stowed on the right side of the flight deck at the flight engineer's station.

d. EMERGENCY RATIONS.—Provisions have been made for stowage of emergency food supplies in the auxiliary power plant compartment.

e. WATER BREAKERS.—Emergency fresh water breakers of 4-1/2 gallons capacity each are provided at the following locations:



Ref. No.	Nomenclature
1	*Parachute Stowage*
2	*First Aid Kit*
3	*Life Raft Stowage*
4	*Emergency Rations*
5	*Water Breakers*
6	*Fire Extinguishers and Pyrotechnics*

Figure 39 — Emergency Exits and Equipment

(1) Two on the floor of the auxiliary power plant compartment.

(2) One on the crown of the auxiliary power plant compartment.

f. FIRE EXTINGUISHERS. Fire extinguishers are stowed at the following positions:

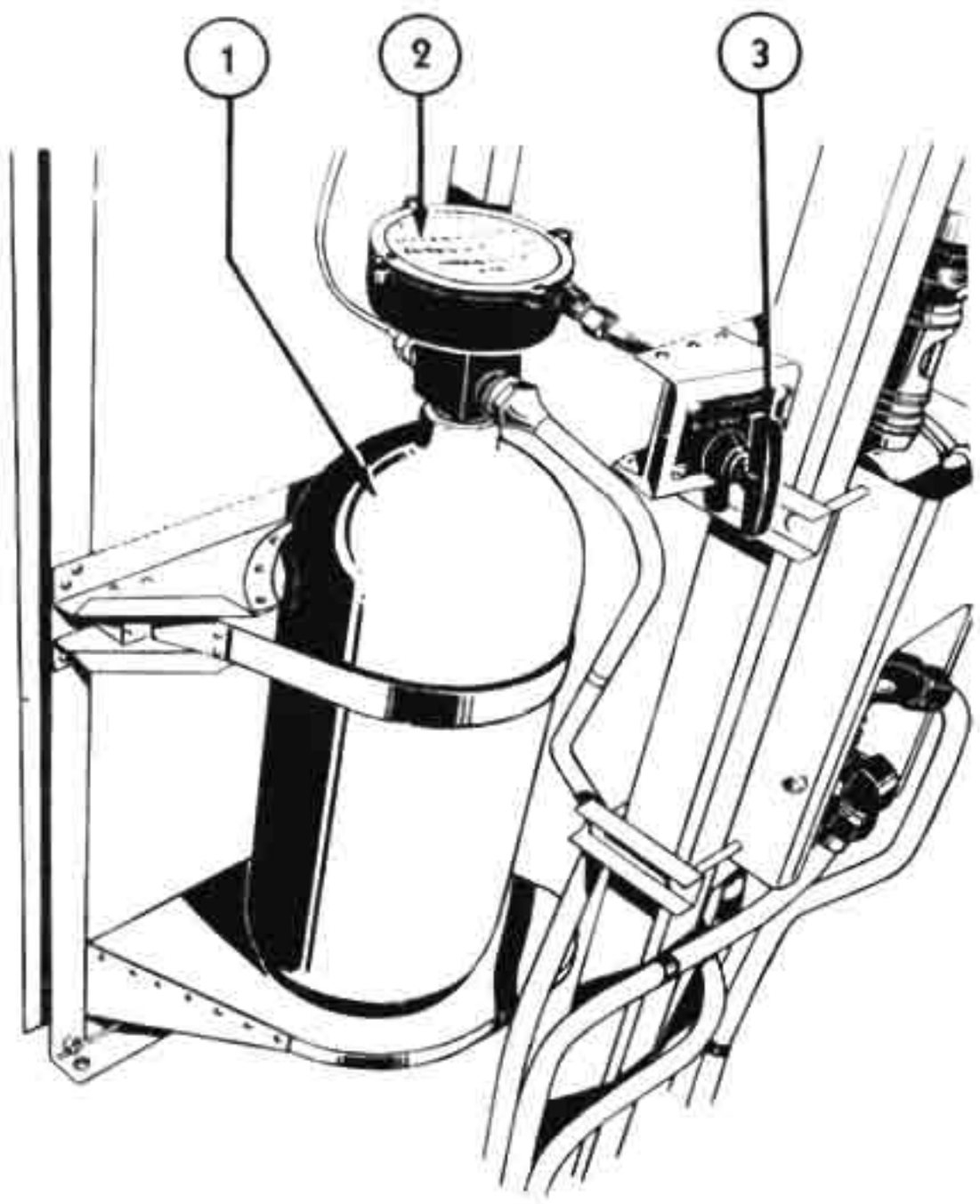
(1) One 2-pound portable CO_2 fire extinguisher in the bomber's compartment.

(2) One on the flight deck at the flight engineer's station.

(3) One in the aft hull compartment on the forward side of the deck turret structure.

(4) One 5-pound portable extinguisher in the passageway adjacent to the flight deck.

(5) A vapor dilution system used for fire prevention and not as an extinguisher is provided in the fuel tank area. When the airplane approaches a combat area, the control handle for the vapor dilution system (figure 40-3) should be pulled to allow the CO_2 gas to flood the hull fuel tank compartments. This reduces the danger of fire in this area if projectiles penetrate the fuel tanks.



Ref. No.	Nomenclature
1	*CO_2 Bottle*
2	*Vapor Dilution Valve*
3	*Vapor Dilution Valve Handle*

Figure 40 — Vapor Dilution Valve

g. PYROTECHNICS.

(1) LANDING FLARES.

(a) Two release containers are provided in the aft right side of the waist compartment for the release of Mark 4-1 flares.

(b) Built-in stowage racks are provided for two flares.

(c) To release landing flares:

1. Check that both forward and aft hull circuit breaker switches, located on the flight engineer's panel, are in the "ON" position.

2. Hold the toggle switch on the pilot's pedestal in the "ON" position for at least 2 seconds.

(2) SIGNAL PISTOL.

(a) One Mark 8 signal pistol is mounted in the crown of the flight deck on the left side, forward of the flight engineer's station.

(b) After a flight when the pistol has been fired, the blast tube hole in the outside skin should be covered with transparent tape.

(c) Stowage for 24 cartridges is provided on the crown of the flight deck on the right side.

b. AIRCRAFT FLOAT LIGHTS AND SMOKE GRENADES.

(1) Racks to hold 18 Mark 4 float lights are provided adjacent to the tunnel hatch.

(2) Provision for stowage of 2 H. C. smoke grenades, Mark 8, and one handle for holding the burning grenades is provided adjacent to the parachute flare release mechanism.

3. EMERGENCY OPERATION OF CONTROLS.

a. WING FLAPS. *(See figure 41.)*

(1) Remove the hand crank from its stowed position on bulkhead 20 in the auxiliary hull tank compartment.

WARNING

Insure wing flap switch is in "OFF" position.

(2) Insert the crank in the gear box located overhead in the center passageway just aft of frame 20.

(3) Turn the crank clockwise to lower the flaps and counterclockwise to raise the flaps.

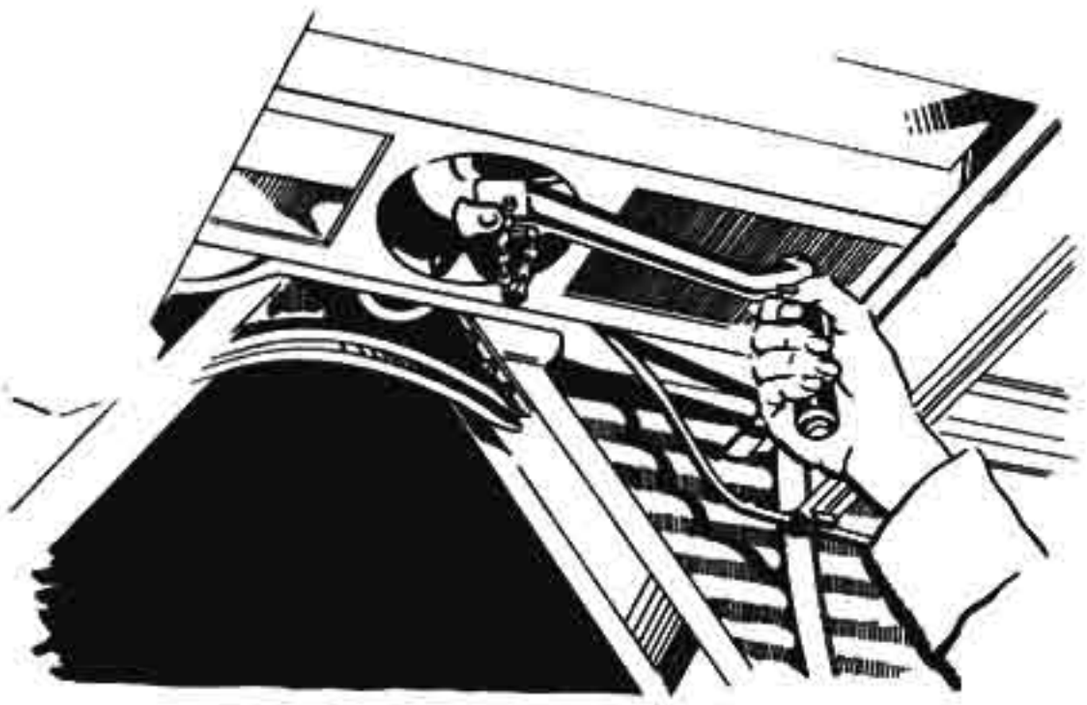


Figure 41 — Wing Flap Crank

b. BOMB BAY DOORS.—Operate the bomb bay doors in an emergency by setting the selector (figure 15-22) on the right side of the pilot's instrument panel to "DOORS" and pulling the release handle (figure 15-24) until it hits the mechanical stop.

c. BOMB JETTISON.

(1) Set the manual bomb bay door selector (figure 15-22) on the pilot's instrument panel to "EMERGENCY."

(2) Pull the manual bomb bay jettison control handle (figure 15-24) on the pilot's instrument panel out until it hits the mechanical stop.

Note

In this case, all bombs and bomb bay fuel tanks if installed in both bays will be dropped simultaneously.

d. FUEL JETTISON. *(See figure 42.)*

(1) BEFORE JETTISONING FUEL.

(a) Warn all crew members that fuel is to be jettisoned.

(b) Insure that all power to tail turret is off.

(c) Turn off all radio power.

(d) Check amount of fuel to be jettisoned.

(2) TO JETTISON FUEL:

(a) Insure that jettison valves for tanks to be dumped are open. The center hull tanks valve is located below the lower deck floor to right of keelson about midway between the front spar bulkhead and the watertight bulkhead. The after hull tanks valve is located below the lower deck flooring just to the right of the center line of the airplane, just aft of the rear spar bulkhead.

WARNING

The fuel jettison valves must be open at all times except when servicing the jettison pumps.

(b) Place jettison switches, located on flight engineer's electrical switch panel, for "CENTER" and/or "AFTER HULL" tanks to the "ON" position.

(c) Report to pilot that operation is under way.

(d) Note drop in fuel tank quantity gages as a check on performance of pumps.

WARNING

Never fly the airplane through any area in which fuel has been previously dumped.

(e) When jettisoning operation is completed, throw jettison switches located on the flight engineer's switch panel to "OFF."

(f) Calculate reduction in gross weight of airplane and compensate accordingly.

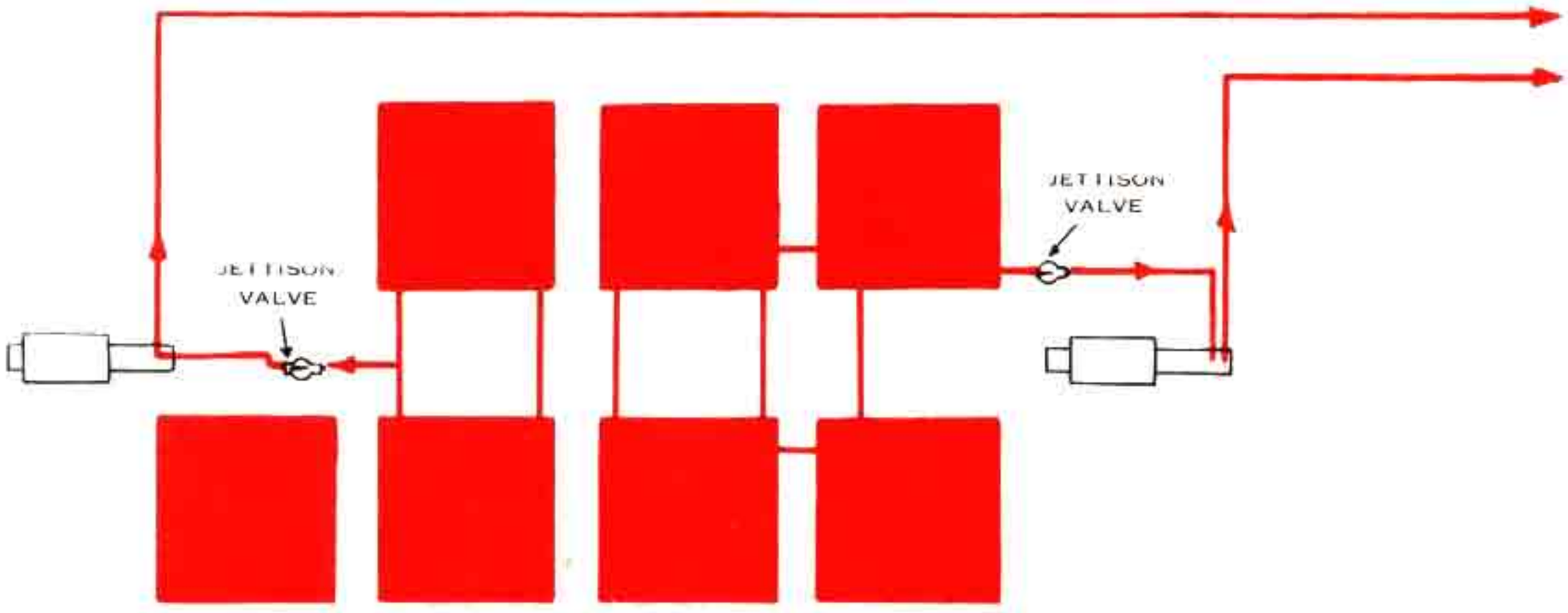
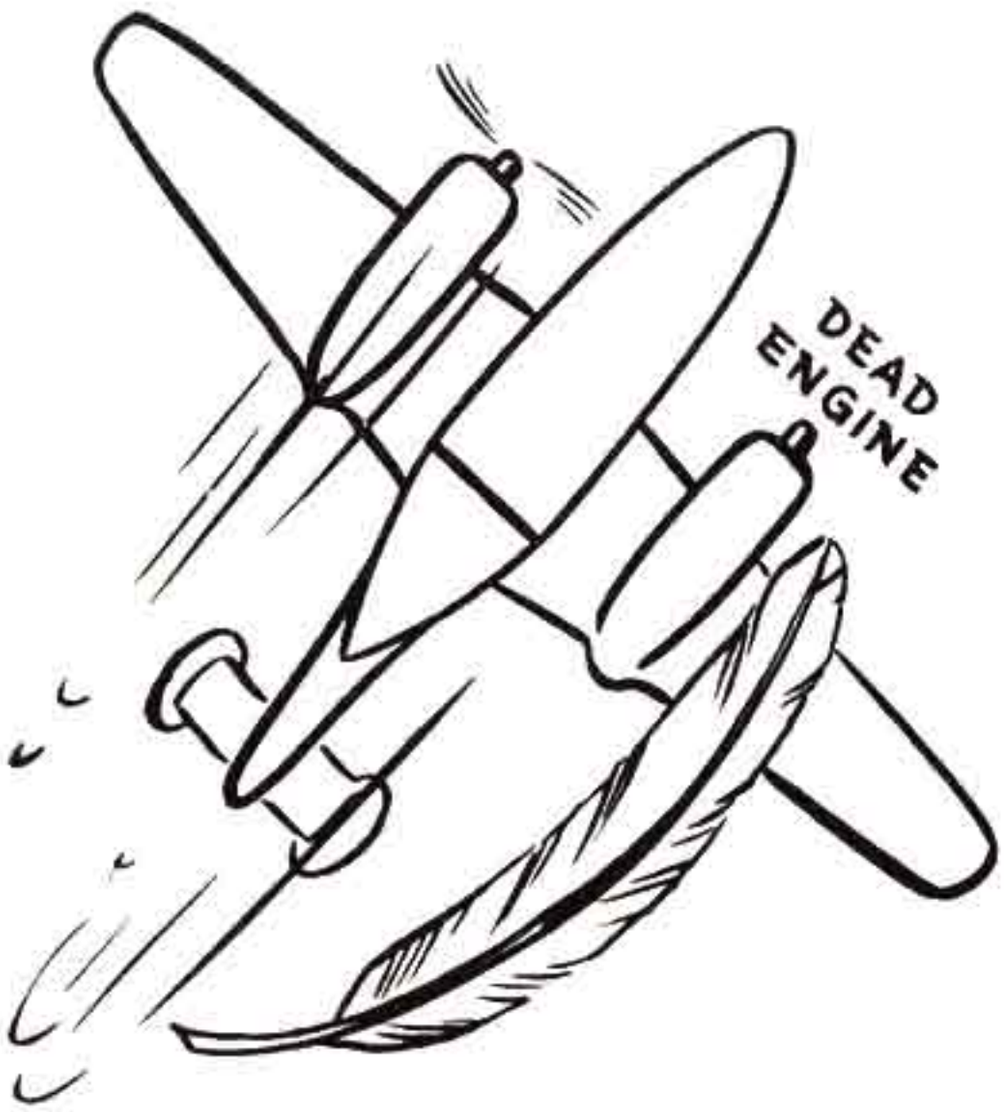


Figure 42 — Fuel Jettison System

4. ENGINE FAILURE DURING FLIGHT.

PILOT



FLIGHT ENGINEER

Note

Do not cut magneto switch until propeller has stopped windmilling.

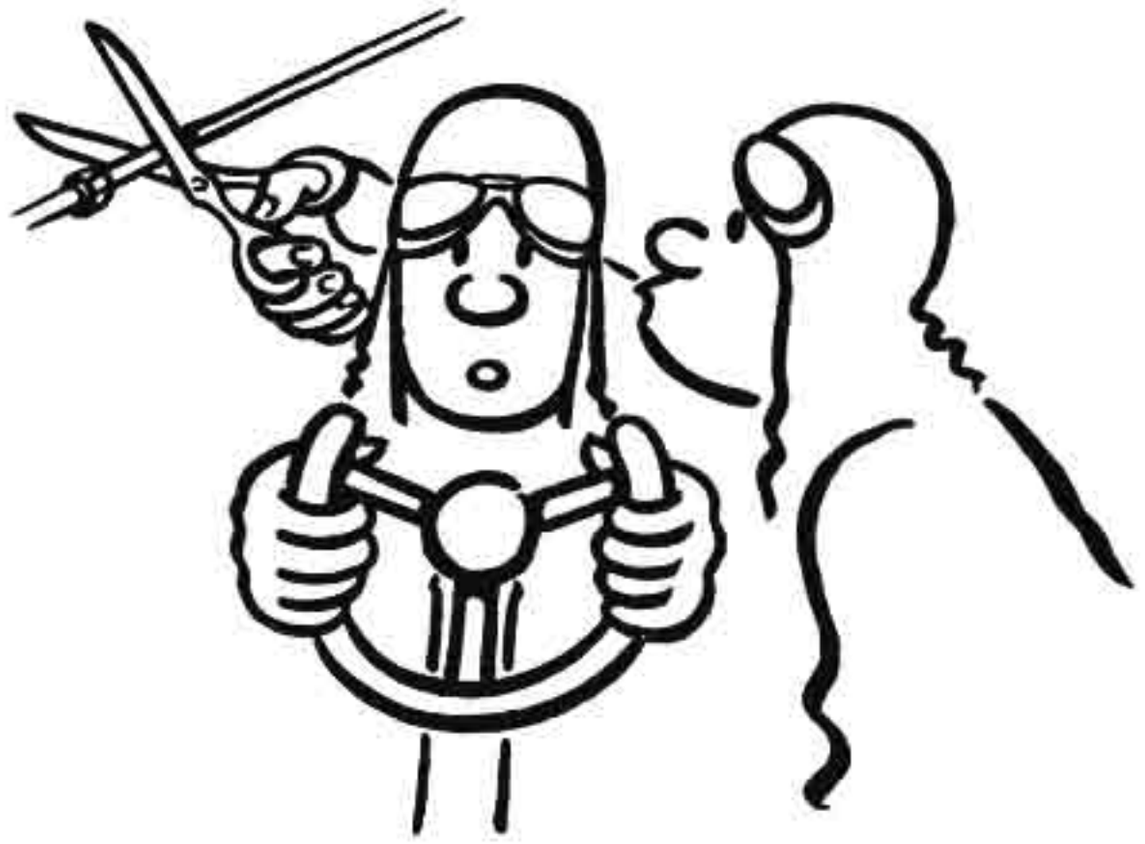
b. Place wing flaps in full up position.

FLIGHT ENGINEER

c. Cut fuel supply to dead engine.

WARNING

Do not cut fuel to an engine without first notifying pilot.



d. Close cowl flaps on dead engine.

e. Open flaps on good engine only enough to maintain cylinder head temperatures below limits.

---

f. Keep bomb bay doors closed if possible.

g. Entrance hatches, turret hatches and windows should be kept closed to reduce drag.

h. To reduce drag, fly airplane straight with as little skidding and slipping as possible.

i. Consult the Flight Operation Instruction Chart on cruising data for single engine operation.

Note

Remember that at lower altitudes the power available is increased and the power required is decreased.

j. Instruct members of crew to jettison bombs, gasoline, etc., to reduce weight if necessary to maintain a constant altitude.

k. In the event of accessory failure proceed as follows:

(1) ENGINE-DRIVEN FUEL PUMP.—Turn left or right booster pump switch to "EMERGENCY" depending on whether left or right fuel pump has failed. (See Section II, paragraph 3, f.)

(2) OIL PUMP FAILURE.—Advise pilot of failure, cut fuel supply to affected engine, and proceed with single engine operation.

(3) CARBURETOR FAILURE. — Proceed with single engine operation.

(4) PROPELLER GOVERNOR FAILURE.—Change from "AUTO" to "MANUAL" operation and set propeller rpm by means of propeller INC-DEC RPM switch. If the circuit is out completely, use as a fixed pitch propeller.

(5) WING TANK FAILURE.—Use as much of the fuel remaining in the tank as possible; then switch selector valve to "HULL TANKS," and turn booster pump switch to "OFF."

(6) TRANSFER PUMP FAILURE.

(a) Switch the crossover valve to "CROSSOVER" and turn the switch for the dead pump to "OFF." (See Section II, paragraph 3, g.)

Note

In event of dual failure set crossover valve to "CROSSOVER" and operate the emergency fuel hand pump (figure 29) to re-fill the service tanks.

SECTION V
OPERATIONAL EQUIPMENT

1. BOMBER'S COMPARTMENT.

a. BEFORE ENTERING BOMBER'S COMPARTMENT.

(1) Check that the power forward hull switch located on the flight engineer's switch panel is turned to "ON."

b. ON ENTERING BOMBER'S COMPARTMENT.

(1) Unfasten the clamps that hold the bombsight window cover in position. (See figure 43.)

(2) Lift the cover out of position using the handles on each side of the cover. (See figure 44.)

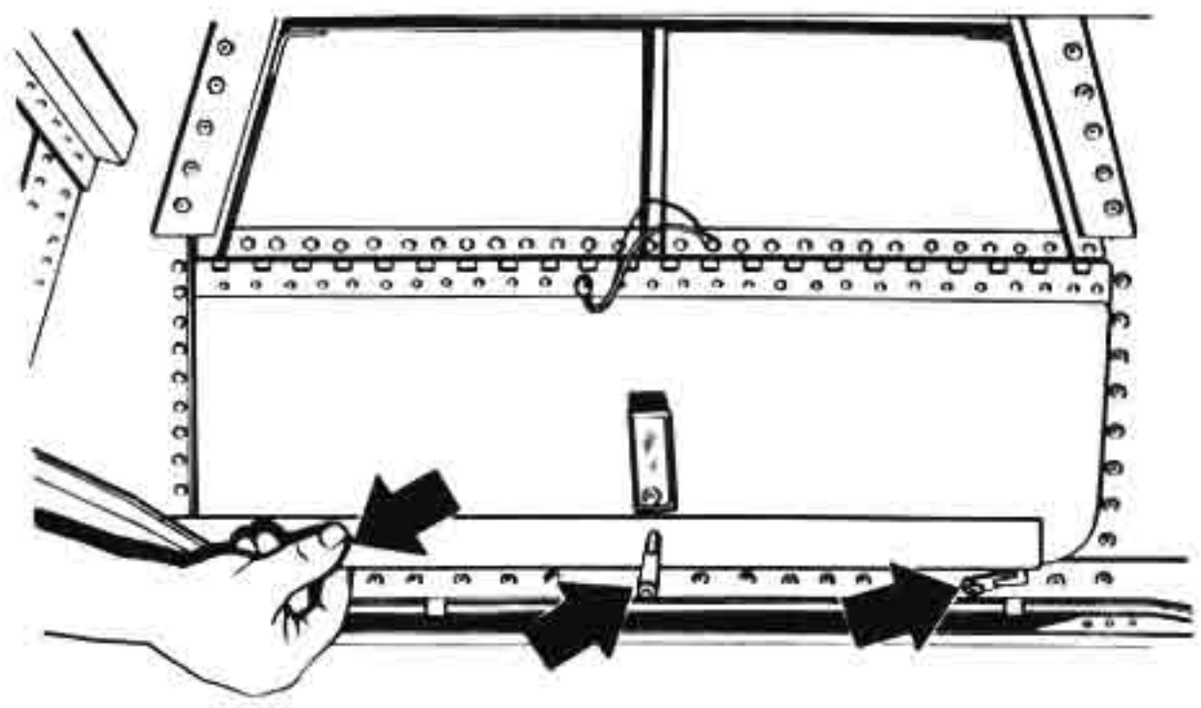


Figure 43 — Unfastening Bombsight Window Cover Flaps

Figure 44 — Removing Bombsight Window Cover

(3) The cover is stowed on the aft right side of bulkhead 5.

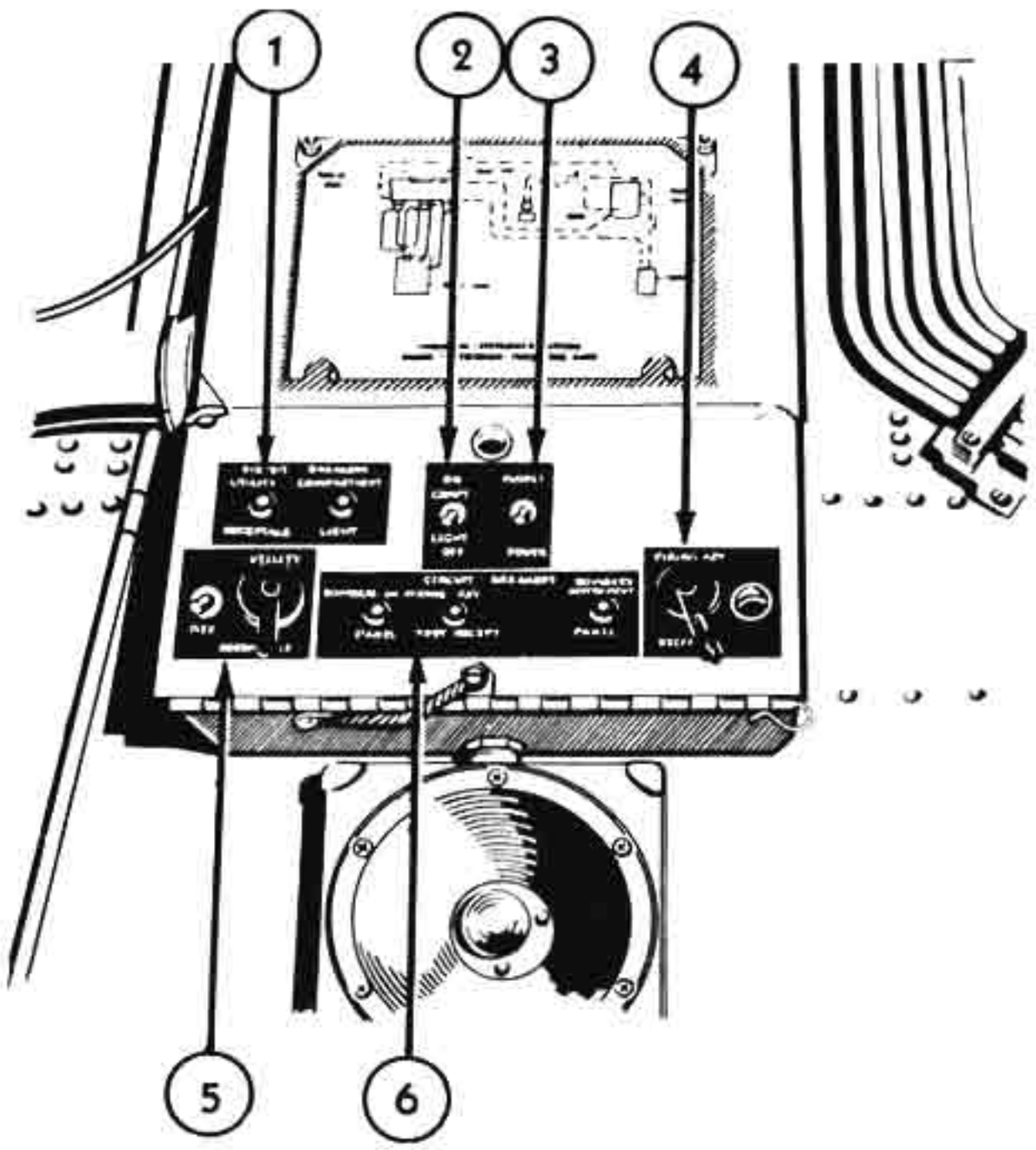
(4) Open the bombsight window doors after the airplane is airborne by using the following procedure:

(a) Give the crank in the nose of the airplane one turn. This will raise the locking pin.

(b) Open each door by pressing the button on top of the door handle and turning the crank.

WARNING

Before take-off the bomber must be sure the bomb bay doors are completely closed electrically.



Ref. No.	Nomenclature
1	*Circuit Breakers*
2	*Compartment Light Switch*
3	*Turret Power Switch*
4	*Firing Key Test Receptacle*
5	*Utility Receptacle and Switch*
6	*Circuit Breakers*

Figure 45 — Bomber's Junction Box

c. OPERATION OF BOMBER'S CONTROLS.

(1) Test the firing key. Use the plug in the junction box above the door on bulkhead 5. The light will indicate if the key is working. (See figure 45-4.)

(2) Turn "ON" the master switch. (See figure 46-5.)

(3) Turn "ON" the desired number of rail selector switches. (See figure 46-21.)

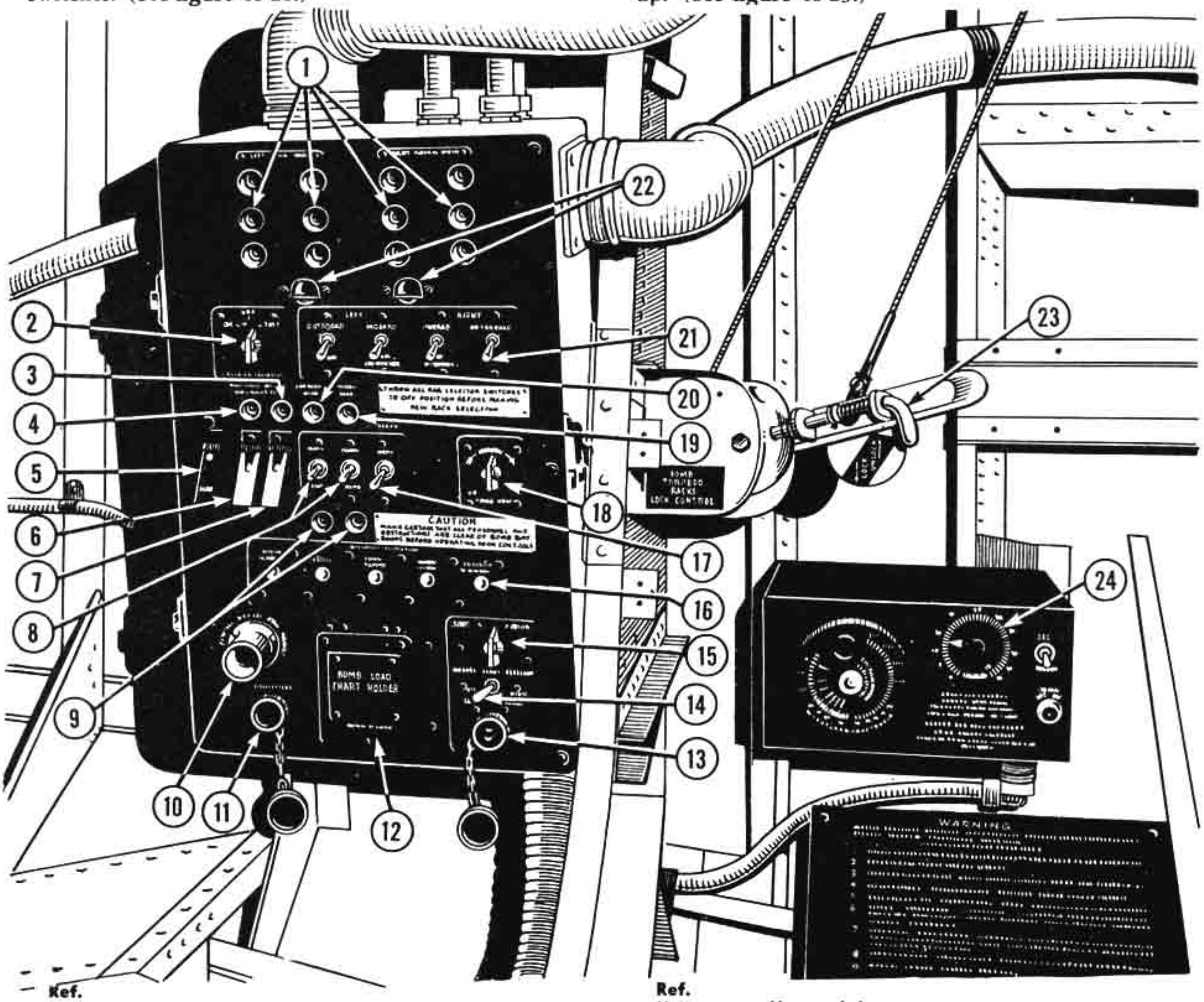
(4) Turn "ON" the bomb manual switch. (See figure 46-6.)

d. SELECTIVE RELEASE.

(1) Turn the intervalometer switch to "SELECT."

(2) Turn the pointer on the small dial to the number of bombs to be released.

(3) Unlock the bomb rack by throwing the lever up. (See figure 46-23.)



Ref. No.	Nomenclature
1	*Bomb Indicator Lights*
2	*Indicator Light Switch*
*3	*Automatic Bomb Release Switch Indicator Light*
4	*Manual Switch Indicator Light*
5	*Master Switch*
6	*Bomb Manual Switch*
*7	*Automatic Bomb Release Switch*
8	*Left and Right Bomb Bay Door Switches*
9	*Bomb Bay Door Indicator Lights—Open Position*
10	*Emergency Salvo Release Button*
11	*Firing Key Receptacle*
12	*Spare Lamp Container*

Ref. No.	Nomenclature
13	*Utility Receptacle*
14	*Utility Receptacle Switch*
15	*Bomb Fusing Switch*
16	*Circuit Breakers*
*17	*Stabilizer Power Switch*
18	*Panel Light Rheostat*
19	*Right Bomb Bay Door Indicator*
20	*Left Bomb Bay Door Indicator Light—Closed Position*
21	*Bomb Rail Selector Switches*
22	*Panel Lights*
23	*Bomb and Torpedo Rack Lock Handle*
24	*Intervalometer*

* *Not used on PBM-5*

Figure 46 — Bomber's Switch Panel

(4) To release the bombs: press the firing key.

e. TRAIN RELEASE.

(1) Test the firing key.

(2) Check that the power forward hull switch is turned to "ON."

(3) Turn "ON" the master switch.

(4) Turn "ON" the rail selector switches.

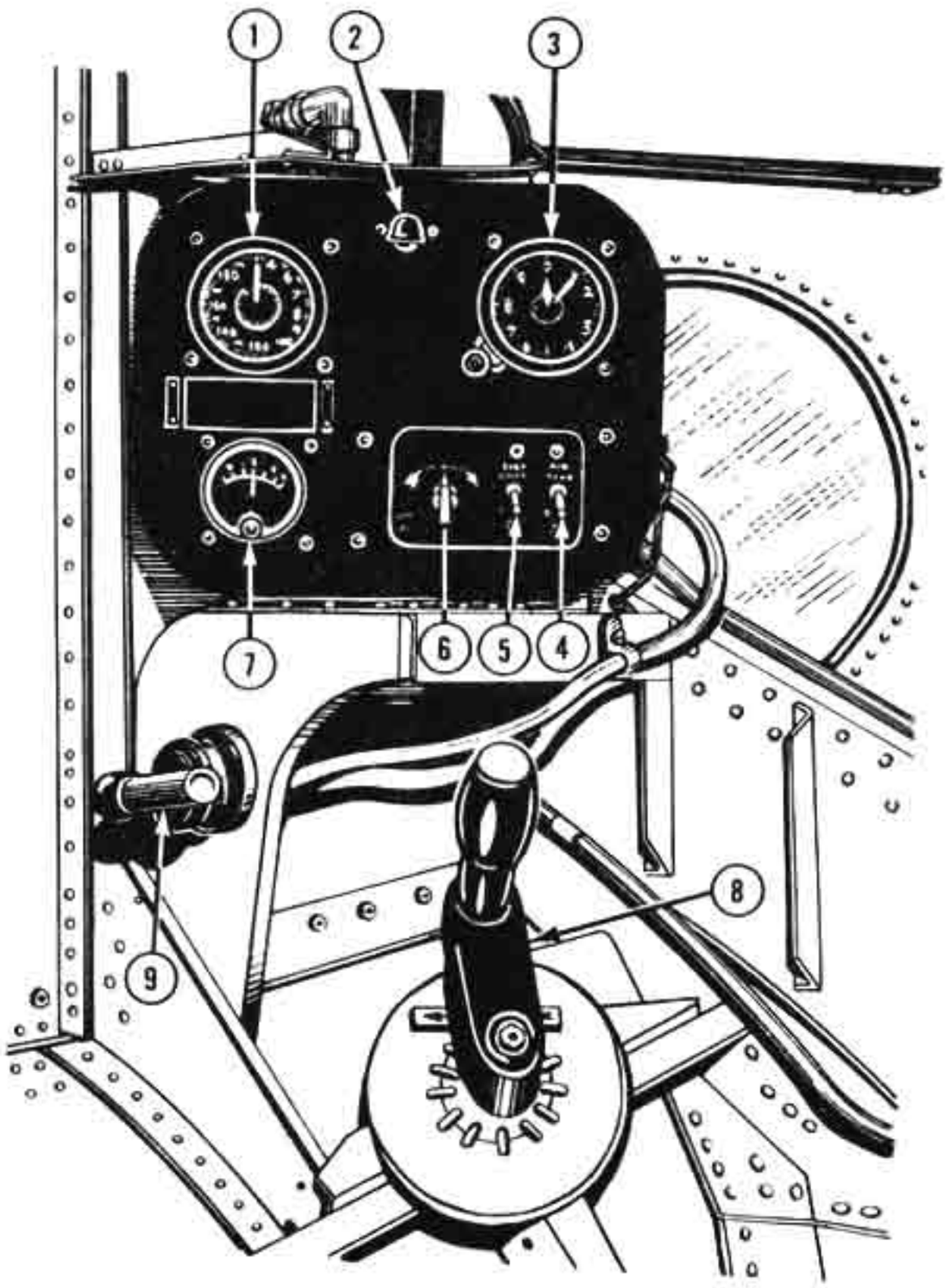
(5) Turn the intervalometer switch to "TRAIN."

(6) Turn the pointer on the small intervalometer dial to the number of bombs to be released.

(7) Use the large dial on the intervalometer to regulate the interval of dropping the bombs.

(8) Unlock the bomb rack.

(9) Press the firing key to release the bombs.



Ref. No.	Nomenclature
1	*Airspeed Indicator*
2	*Panel Light*
3	*Altimeter*
4	*Air Temperature Gage Switch*
5	*Spotlight Switch*
6	*Panel Light Rheostat*
7	*Air Temperature Gage*
8	*Bombsight Window Door Handle*
9	*Spotlight*

Figure 47 — Bomber's Instrument Panel

f. EMERGENCY RELEASE.

(1) Check that the power forward hull switch located on the flight engineer's panel is turned to "ON."

(2) Unlock the bomb racks.

(3) Press the button inside the emergency release hole to drop all bombs simultaneously.

Note

All bombs will be armed in this case.

g. OPERATION OF BOMB BAY DOORS.

(1) OPENING DOORS.

(a) The bomb bay doors will open electrically through the first impulse of the firing key.

(b) To open the doors electrically using the control on the bomber's switch panel:

1. Check that the power forward hull switch located on the flight engineer's panel is turned to "ON."

2. Turn "ON" the master switch.

3. Place the door switch located on the bomber's switch panel in the "OPEN" position.

(2) CLOSING THE DOORS.

(a) Check that the power forward hull switch is turned to "ON."

(b) Turn "ON" the master switch.

(c) Check that the left and right wing power switches are turned to "ON."

(d) Turn the indicator light switch to the "ON" position.

(e) Hold the door switch in the closed position until the indicator shows the doors to be closed.

(3) MANUAL OPERATION OF BOMB BAY DOORS.—Open or close the doors manually by means of the hand crank located in the center wing adjacent

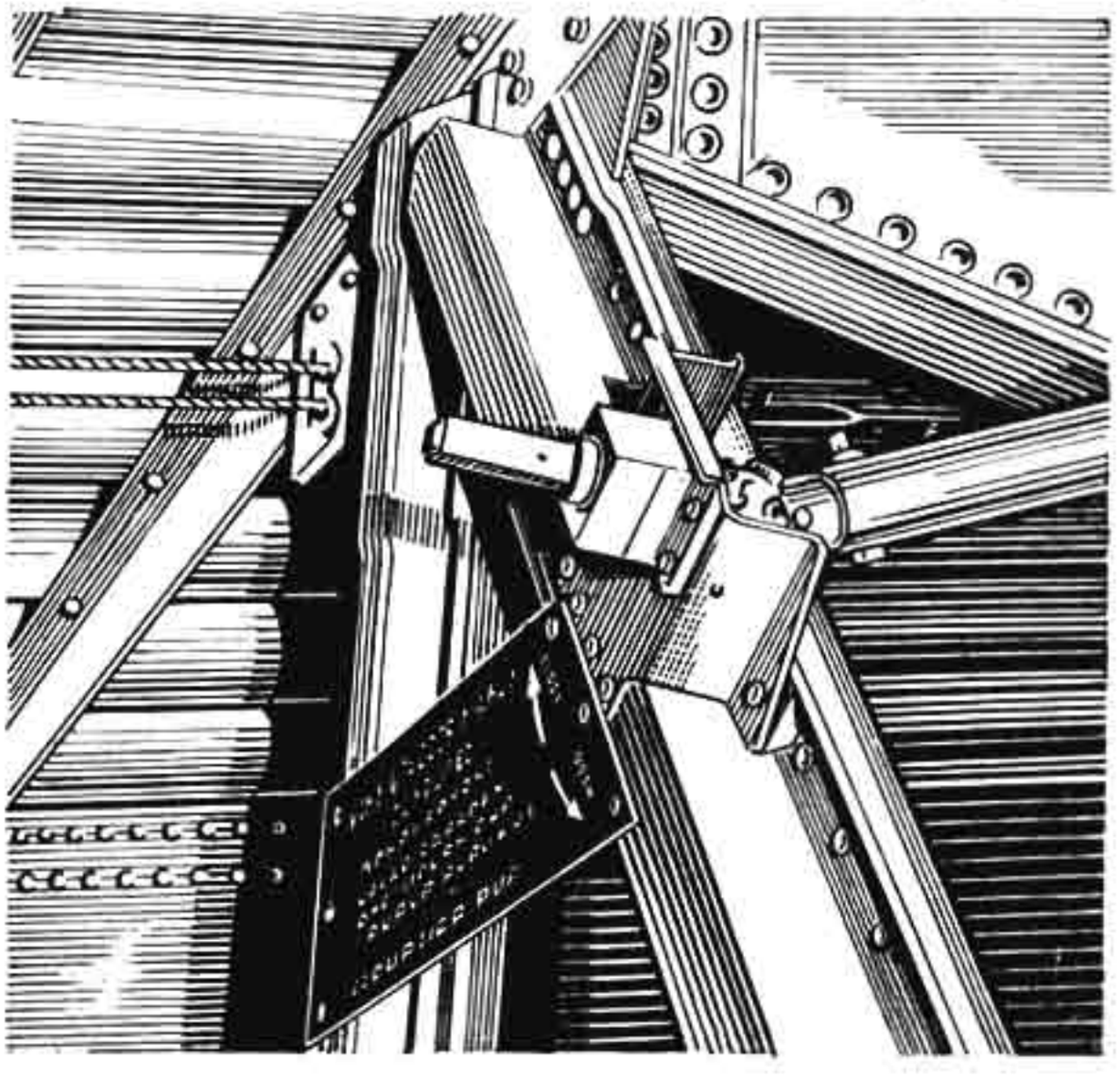


Figure 48 — Bomb Bay Door Hand Crank Attachment

to the bomb bay, access to which is gained through a manhole in the lower center wing from inside the hull. (See figure 48.)

CAUTION

It is very important to follow the instructions given on the placard at the hand crank. If these instructions are not followed it may result in cranking the bomb bay doors too far and cause jamming of the door operating mechanism. If the bomb bay door operating mechanism becomes jammed it will be impossible to release the bombs electrically. When the door operating mechanism becomes jammed, back off the hand crank until the red bolt in the goose neck lines up with the red arrow just over the sprocket.

Note

If the bomb bay doors fail to open electrically, they may be opened from the pilot's station by placing the manual selector to "DOORS" and pulling the release handle until it hits the mechanical stop. (See figure 49.) The doors will open and all bombs and bomb bay fuel tanks, if carried, will be jettisoned if the selector is set to "EMERGENCY."

Figure 49 — Pilot's Emergency Release

2. NAVIGATOR'S STATION.

a. GENERAL DESCRIPTION. — The navigator's station is located on the left side of the flight deck. A chart table for the navigator is located just forward of the entrance door. (See figure 51.)

b. FLIGHT INSTRUMENTS.

(1) The navigator's instrument panel located on the left side of the hull above the chart table, contains the following instruments.

(a) Airspeed indicator.

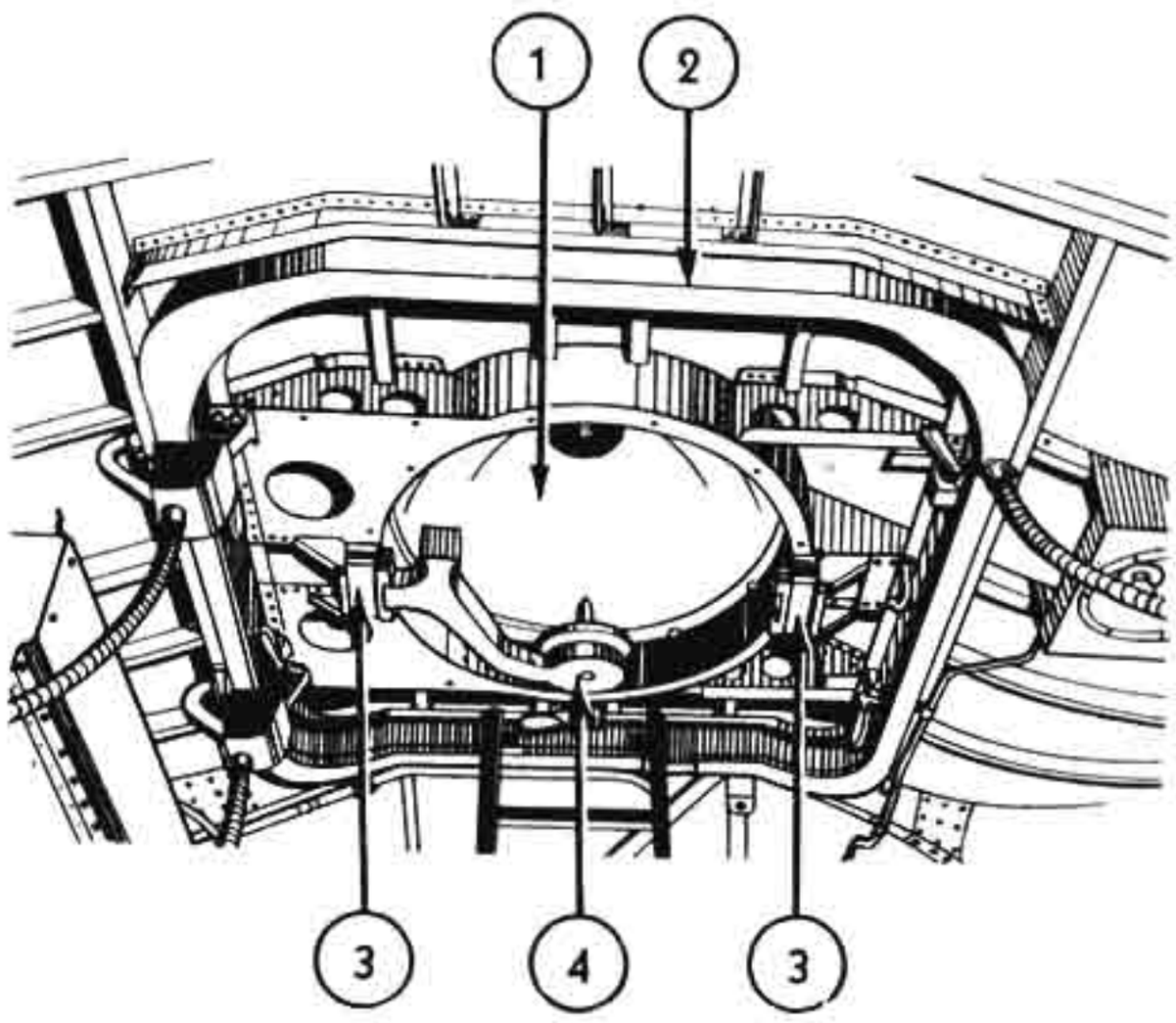
(b) Altimeter.

(c) Clock.

(2) A gyro fluxgate compass master indicator is also provided, although not mounted on the panel.

c. NAVIGATOR'S EQUIPMENT.

(1) An astro compass complete with standard and case is stowed on the auxiliary power plant floor on the left-hand side of the airplane just forward of the auxiliary power plant. The mounting bracket for the astro compass is stowed with the compass. Two adapter sockets on the navigator's hatch coaming in the auxiliary power plant and one on each side waist hatch are provided for the mounting of the astro compass mounting bracket provide for two positions of the astro compass at each adapter socket location. (See figure 50.)



Ref. No.	Nomenclature
1	*Astro Dome*
2	*Navigator's Hatch*
3	*Astro Compass Adapter Socket*
4	*Astro Compass Mounting Bracket*

Figure 50 — Navigator's Hatch

(2) A Mark 2-B or 2-C Pelorus drift sight is stowed on the left side of the tunnel compartment with provisions made for its use in the tunnel hatch.

(3) A Mark 6 drift sight is stowed on the right side of the fuel tank compartment just forward of the door and provisions made for its use in the standpipe in the same compartment.

WARNING

Be sure that the standpipe cover is in place for take-off and landing.

(4) One pair of binoculars is stowed on the shelf on the right-hand side of the galley compartment.

(5) An astrograph mount is provided for installation above the navigator's instrument panel.

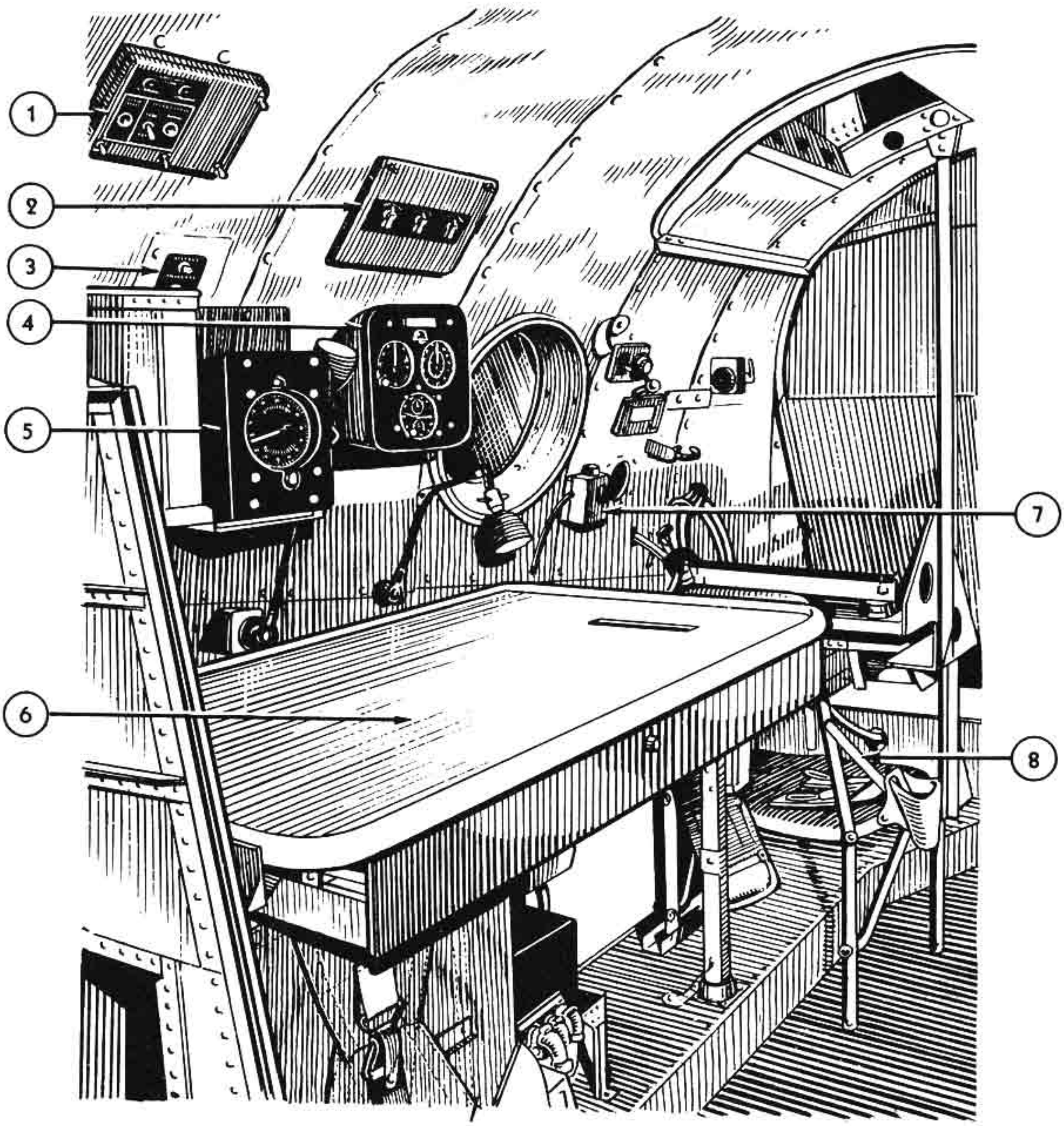
(6) Two navigation watches, one vector plotting machine, one Mark 5-A plotting board, and miscellaneous charts are stowed in the drawer beneath the chart table.

d. MISCELLANEOUS EQUIPMENT.

(1) A jack box for plugging into the interphone system is provided at the forward end of the navigator's table.

(2) The navigator's compass is lighted by a 24-volt light controlled by a plainly marked rheostat at the navigator's junction box. The junction box also contains two other rheostats, one of which controls the two table floodlights and the other controls the lighting of the navigator's instrument panel.

(3) A stowage sling for the navigator's parachute is provided on the left side of the flight deck, below the aft end of the chart table.



Ref. No.	Nomenclature
1	*ABK Fuse Box*
2	*Navigator's Junction Box*
3	*Gyro Fluxgate Compass Caging Switch*
4	*Navigator's Instrument Panel*
5	*Gyro Fluxgate Master Indicator*
6	*Navigator's Table*
7	*Radar Operator's Station Box*
8	*Radar Operator's Seat*

Figure 51 — Navigator's Station

e. OPERATION OF GYRO FLUXGATE COMPASS.

(1) Turn "ON" the inverter switch located on the flight engineer's switch panel.

(2) Turn "ON" the pilot switch on the fluxgate amplifier located under the navigator's table if the amplifier is equipped with a switch. A green light on the amplifier will indicate when the system is on.

Note

Some of the latter type amplifiers do not have an "ON-OFF" switch.

(3) Allow 10 minutes for the transmitter gyro to attain operating speed.

(4) After take-off and before taking the first reading, go through a complete caging cycle, from uncaged to caged then on to uncaged. The caging switch is located directly over the compass. (See figure 52.)

Note

Light will indicate when unit is caged.

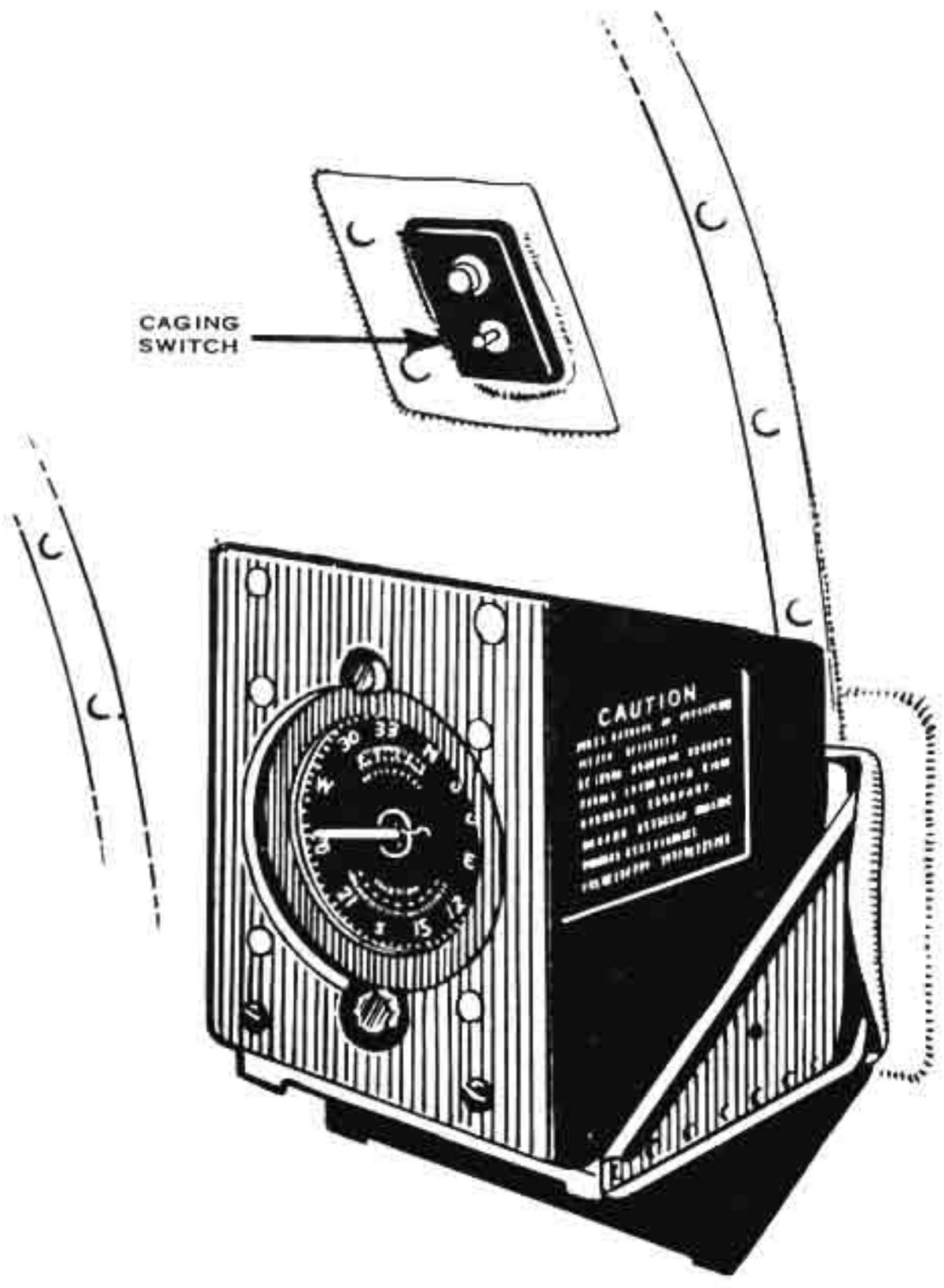


Figure 52 — Gyro Fluxgate Master Indicator and Caging Switch

f. READING THE COMPASS.

(1) Variation correction can be accomplished by rotating the knob on the bottom of the master indicator.

(2) The index marker on the bottom of the dial should be set to read the correct amount of easterly or westerly variation, as indicated by the position of the airplane with reference to the Isogonic chart.

(3) The master indicator pointer with variation correction set in will indicate true heading of the airplane.

g. TURNING OFF COMPASS.—When engines are not running, the compass may be turned "OFF" by the inverter switch located on the flight engineer's panel. If engines are running turn the compass "OFF" at the amplifier if the amplifier is equipped with a switch.

h. TESTING COMPASS IN FLIGHT.

(1) Keep the airplane on one heading.

(2) Execute a series of maneuvers such as a climb or dive.

(3) If the airplane does not exceed 65 degrees off the level flight attitude, the compass should remain constant on the heading.

(4) By "yawing" the airplane from right to left, the heading change should be indicated accurately and promptly.

i. POINTER OSCILLATION OR GAIN CONTROL.

(1) During long flights in areas where the horizontal component of the earth's magnetic field varies, the compass may become sluggish in weak horizontal fields or may oscillate in strong horizontal fields..

(2) To correct this, the gain control which is located on the aft end of the amplifier should be reset in flight by turning the switch clockwise to higher numbered positions or until the pointer of the compass oscillates on a given heading.

(3) Back the switch off one numbered position lower than the last position where oscillation is encountered, i.e., if the pointer is sluggish with the gain control set on position "3," it should be turned clockwise until the pointer barely oscillates on a given heading and then backed off one position counterclockwise.

(4) If the pointer oscillates on position "3," it should be backed off counterclockwise one position at a time until the pointer of the master indicator remains stationary on a given heading.

j. STANDBY COMPASS.—In the event the gyro fluxgate compass fails during flight it may be necessary to use the Mark 9 standby magnetic compass located on the lower right-hand side of the co-pilot's instrument panel. Since the magnetic compass is unreliable due to electrical equipment in its vicinity, it should be compensated with all electrical equipment in the bow off so that the reading will be reasonably reliable.

(1) Turn off *all* electrical equipment in the bow of the airplane by using the individual switches for each item of equipment.

CAUTION

Do not turn the power off by means of the circuit-breaker switches on the flight engineer's panel since the circuits may then be overloaded when the power is turned back on.

(2) After the compass has settled down set the bottom card on the gyro pilot directional gyro with the compass, and use the gyro as a directional gyro.

(3) Turn on the power to the equipment needed.

(4) Repeat the above procedure every 15 minutes.

3. RADIO OPERATOR'S STATION.

a. AIRPLANE NOS. 45405 TO 45444. *(See figure 53.)* — The radio operator's station is on the right side of the flight deck directly aft of the co-pilot's station. A swivel chair with a pilot's type safety belt is mounted on tracks in front of the radio operator's table. A stowage sling for the radio operator's parachute is located on the right side of the flight deck ceiling at the flight engineer's station.

b. AIRPLANE NO. 59000 AND SUBSEQUENT. *(See figures 54 and 55.)*—The radio operator's station is in the same relative position as earlier airplanes; however, the radio equipment is so located that the radio operator's table is placed athwartship so that the

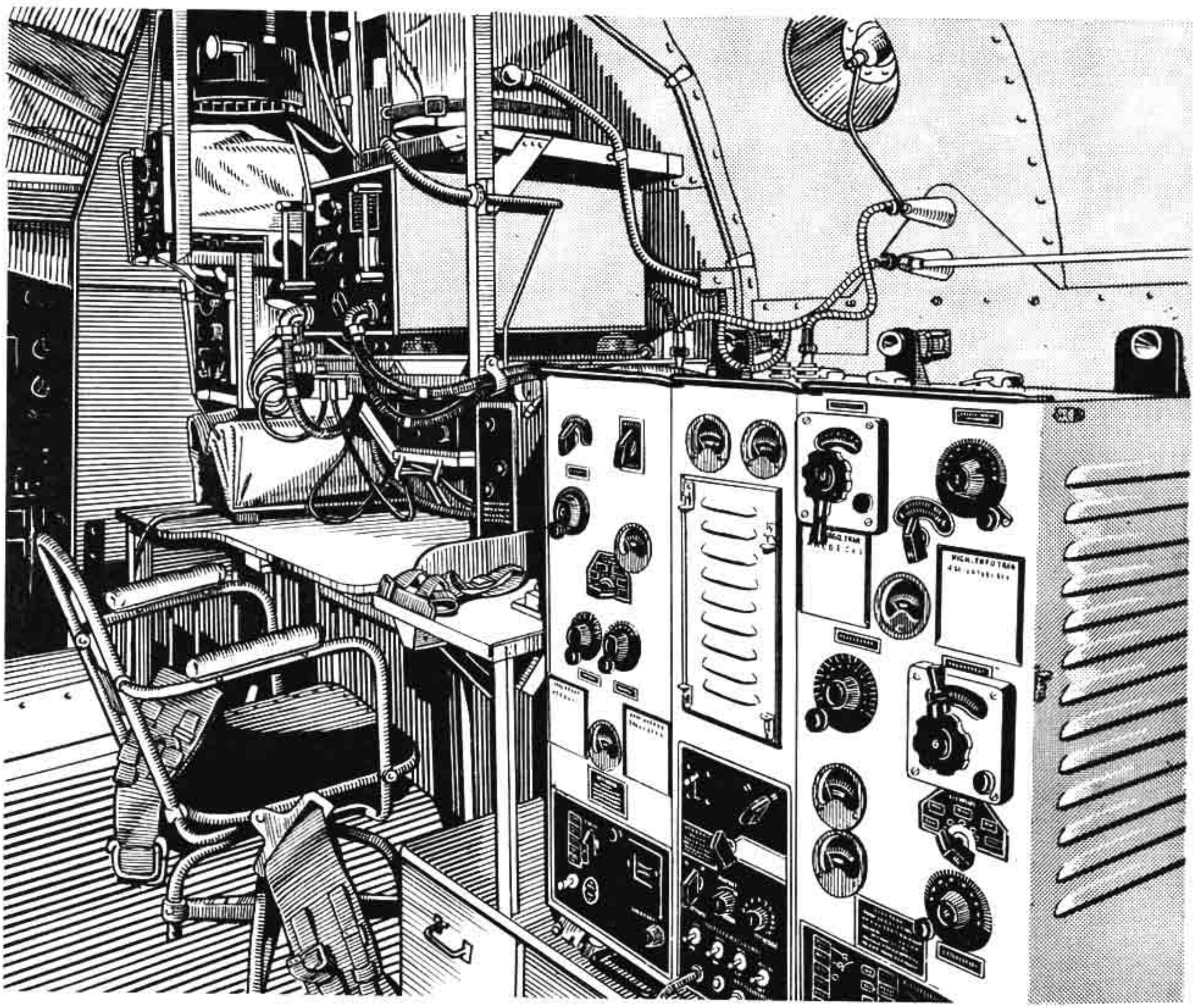
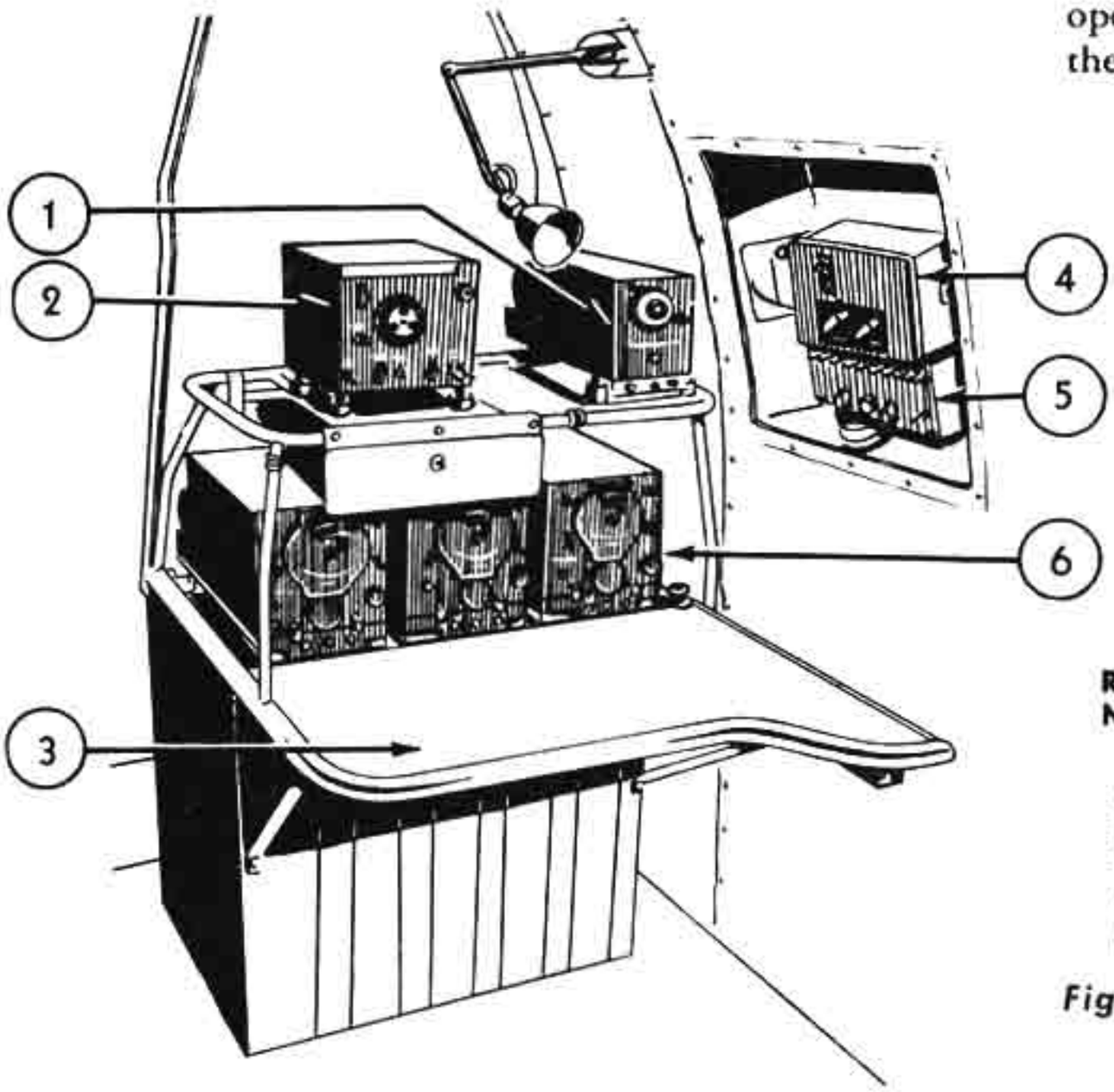


Figure 53 — Radio Operator's Station (Airplane Nos. 45405 to 45444)

radio operator now normally faces forward. Radio equipment not at the radio operator's station is placed on an equipment rack provided on the right side of the galley compartment.

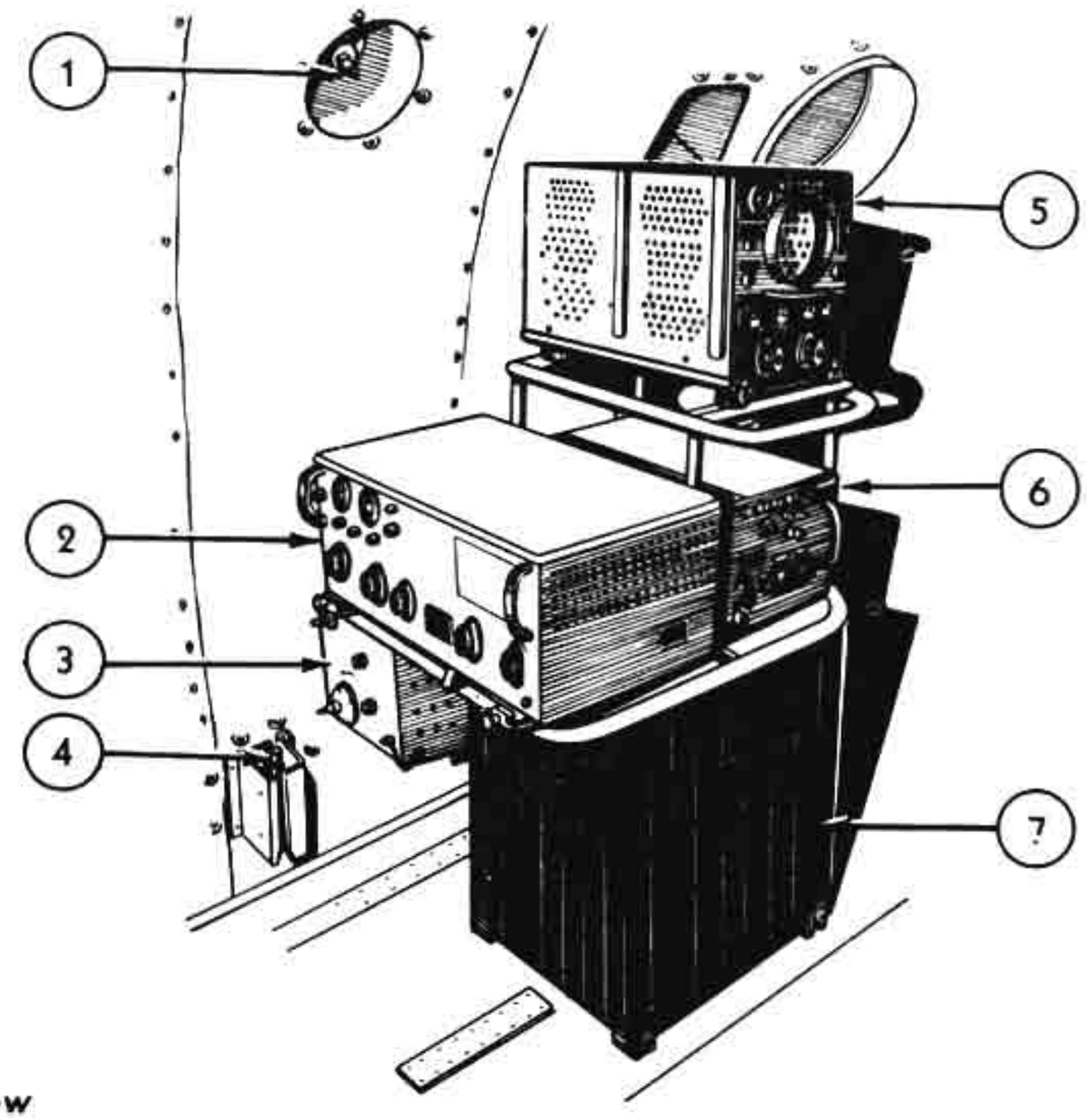
4. RADAR OPERATOR'S STATION.

A non-adjustable upholstered seat is provided facing forward on the left side of the flight deck forward of the navigator's chart table for use by the Radar operator. A pilot's type safety belt is provided. The Radar operator's parachute is stowed on the left aft side of the flight deck.



Ref. No.	Nomenclature
1	*ARC-5 VHF Receiver*
2	*LM10 Frequency Meter*
3	*Radio Operator's Table*
4	*Radio Operator's Rheostat and Switch Box*
5	*A1A-2 Interphone Control Box*
6	*RAX Receivers (High-Medium-Low Frequencies)*

Figure 54 — Radio Operator's Station—Forward View (Airplane No. 59000 and Subsequent)



Ref. No.	Nomenclature
1	*Liaison Transmitter Lead-In Insulator*
2	*ATC Transmitter*
3	*ATC Transmitter Loading Coil*
4	*Antenna Change-Over Switch*
5	*Loran Indicator*
6	*Loran Receiver*
7	*Mounting Cabinet and Spare Parts Locker*

Figure 55 — Radio Operator's Station—Aft View (Airplane No. 59000 and Subsequent)

5. OPERATION OF GUNNERY EQUIPMENT.

a. BOW TURRET—250SH-1A. (Airplane numbers 45405 to 45444.)

(1) BEFORE ENTERING TURRET. — Turn "ON" the bow turret circuit-breaker switch on the flight engineer's panel.

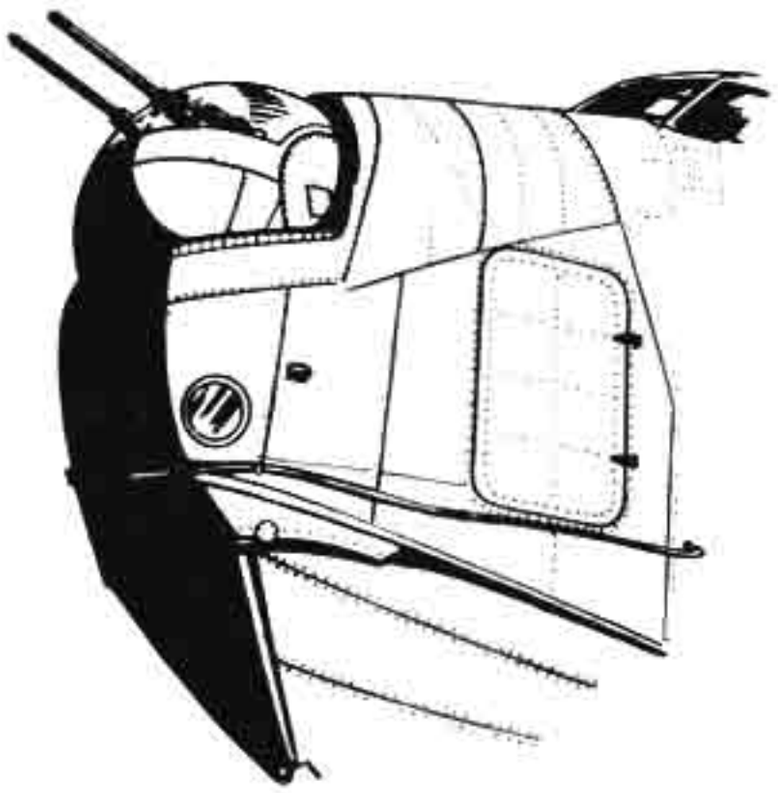


Figure 56 — Bow Turret

(2) ENTERING TURRET.

(a) Enter turret through the opening in the drain bag at bottom of the turret. (See figure 57.)

(b) Close the zipper entrance of the drain bag from inside the turret.

(c) When the spring latch on the left-hand side of the seat is pushed downward the seat rolls down in a horizontal position, and an easy pull forward locks the seat in a sitting position.

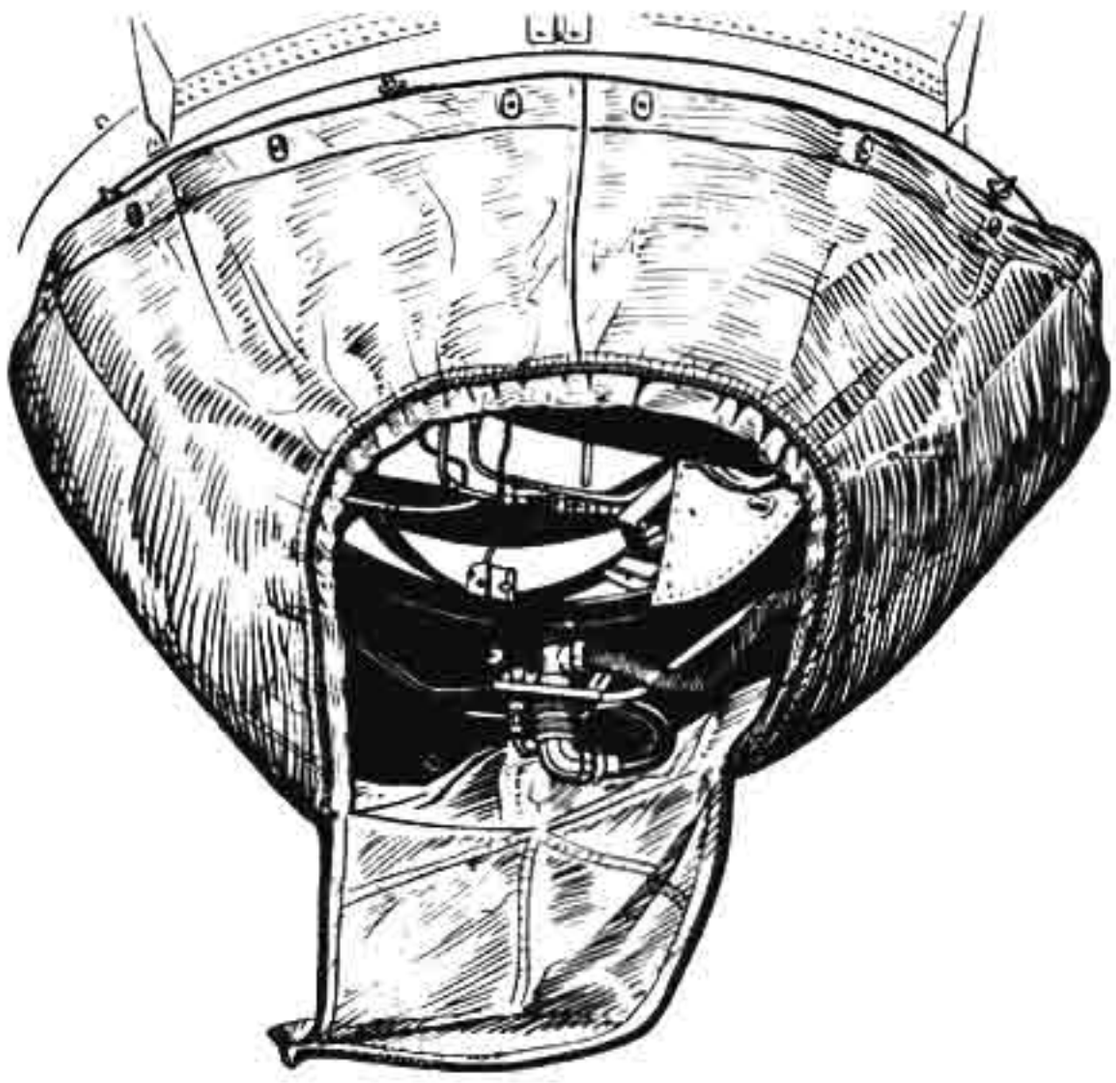


Figure 57 — Entrance to Bow Turret

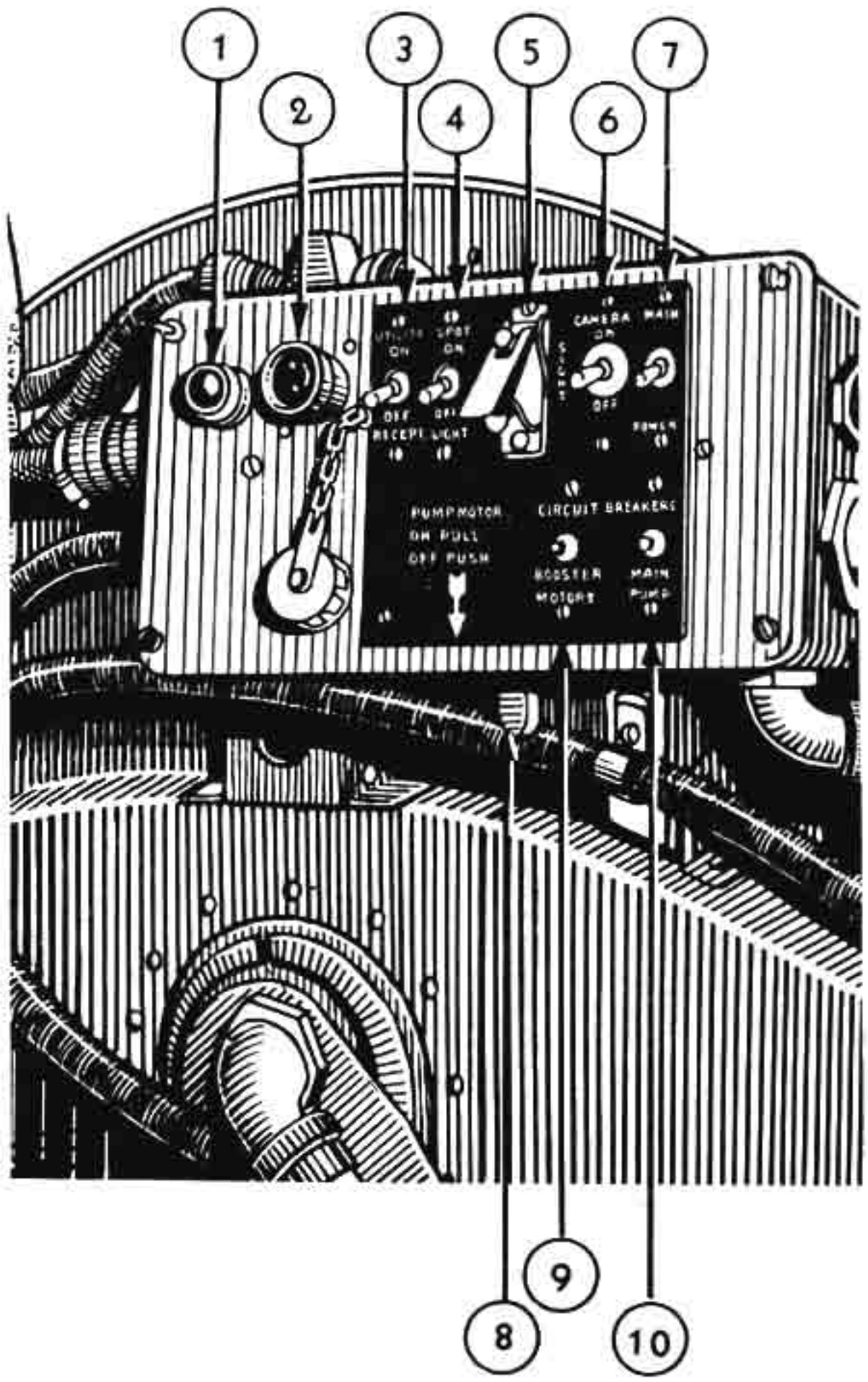
(d) Adjust and fasten the safety belt.

(3) OPERATION OF CONTROLS.

(a) Unlock the elevation lock on the left-hand elevating unit by pulling out and rotating the handle counterclockwise 90 degrees, slip into position. Ascertain that the lock handle on the left-hand side, is in a vertical unlocked position.

CAUTION

Do not unlock the elevation or azimuth lock except for test purposes unless in flight. Failure to lock in take-off or landing may cause extreme damage to airplane and turret.



Ref. No.	Nomenclature
1	*Power-On Warning Light*
2	*Utility Receptacle*
3	*Utility Receptacle Switch*
4	*Spotlight Switch*
5	*Gun Circuit and Sight Switch*
6	*Camera Switch*
7	*Main Power Switch*
8	*Pump Motor Switch*
9	*Booster Motors Circuit Breaker Reset Button*
10	*Main Pump Circuit Breaker Reset Button*

Figure 58 — Turret Control Panel (250SH-1A)

(b) Unlock the azimuth lock by pushing lever forward to the "OFF" position located left-hand side of turret.

(c) Turn the electric main power switch on the upper right-hand side of the panel to on. This will cause the red pilot light on the panel to light, indicating power is on.

(d) Pull the hydraulic pump motor switch located on the bottom flange of the panelboard to "ON." The pressure gage should read between 990 to 1030 pounds per square inch.

(e) Rotate the control handles up or down to depress or elevate the turret.

(f) Rotate the handles to the left or right to move the turret in azimuth. The degree of rotation of the handles determines the speed of movement of the turret.

(g) Turn the gun solenoid and sight switches located in the center of the panel to "ON." The gun may be fired by depressing either the left or right trigger switch (or both together) with the index fingers on the control handle grips.

(h) Relaxing the action switch will render the trigger switches automatically inoperative and stop the electric motor driven pump.

(4) LEAVING TURRET.

(a) To leave the turret, move it in azimuth and elevation until the guns are pointed forward and are horizontal.

(b) Lock the turret elevation lock situated on the left-hand side of the elevating unit.

(c) Lock the azimuth lock by pulling lever aft to "ON" position.

(d) Turn the hydraulic pump motor switch, gun solenoid switch, sight switch, and main power switch to "OFF."

Note

The turret may also be turned off at the junction box on bulkhead 5. (See figure 45.)

(e) Release the seat back by lifting it up over the catch and pushing the seat back and up along the track into its locked position.

(f) If the electric motor or wiring should be damaged, the emergency hand pump should be used. Sufficient pressure may be obtained by pumping the handle back and forth.

(g) Should an occasion arise necessitating the immediate lowering of the pressure, turn the hydraulic pump motor switch "OFF" and operate the control valve handle until the turret stops.

(5) SEAT.—The gunner's seat is provided with an adjustment mechanism by means of which the seat may be raised or lowered 1-1/2 inches from neutral. To operate the seat, grasp the handle beneath the front of the seat in the right hand and release the catch with the right thumb. Moving the handle up or down will cause the seat to raise or lower. Releasing the catch at the position desired will maintain the desired seat height.

(6) LOADING AMMUNITION.

(a) Remove the two ammunition doors to the front of the gunner, one on either side of the control unit, by removing the three pins holding each door in place.

(b) Slide the doors outboard and aft.

(c) Ammunition may now be loaded into the boxes. Continuous belts may be loaded by lapping back and forth across the box, until full.

(d) Drop a hard wire hook down through the top of the booster feed, and attach to the ammunition belt. Tie or secure the wire in some manner to the gun while connecting the ammunition below. Reach under the feed chute through the top of the ammunition box to attach the wire to the ammunition belt.

(e) When both boxes are full of ammunition and the wire is still attached, replace both ammunition doors.

(f) Pull the wire and belts up through the booster chutes until two or three rounds of ammunition have engaged the booster sprockets.

(g) Disengage the hard wire hook.

(h) Pull up enough ammunition to load each gun.

(7) CHARGING GUNS.

(a) A hydraulic gun charging system is installed in the turret and is connected to the main hydraulic system.

(b) The hydraulic charger control valve is located just above the gunner's left knee. By pressing the control knob all the way into the firing position, both guns will automatically be charged and ready to fire.

(c) If the control valve handle is turned to the "SAFE" position before depressing, when charging, the gun bolt will remain held in the back position providing access to remove a jam.

b. BOW TURRET—250SH-3. (Airplane number 59000 and subsequent.)

(1) GENERAL.—The Martin power turret is a spherical hydraulic self-contained unit mounted in the bow position. (See figure 56.) It is designed for the mounting of two .50-caliber model M-2 Browning aircraft machine guns. The turret travels 62 degrees in elevation and 48 degrees in depression from the horizontal center line of the airplane, and 90 degrees to either side of neutral in azimuth.

(2) CONTROLS.—Hand grips, with built-in gun triggers, action switches, control the turret in elevation, depression, and azimuth. The turret can also be operated manually in the event of power failure.

(3) BEFORE ENTERING TURRET. — Turn "ON" the bow turret circuit-breaker switch located on the flight engineer's switch panel.

(4) ENTERING TURRET.

(a) Enter turret through the opening in the drain bag at the bottom of the turret. (See figure 57.)

(b) Close the zipper entrance of the drain bag from inside the turret.

(c) When the spring latch on the left-hand side of the seat is pushed downward the seat rolls down in horizontal position, and an easy pull forward locks the seat in a sitting position.

(d) Adjust and fasten the safety belt.

(5) TURRET OPERATING INSTRUCTIONS.

(a) Turn main power switch (figure 59-21) on the right-hand turret panel to on. A red light will light indicating power is on.

WARNING

Stow the manual drive handles located on the left and right in the turret before operating the turret by power. A red warning light on the right-hand turret panel will light when handles are not in stowed position. Manual drive must be in stowed position at all times when pump motor switch is turned to "ON."

(b) Turn pump motor switch to "ON" located on junction box facing aft, and check high pressure gage; reading should be 990 to 1030 pounds per square inch. Check low pressure gage; reading should be 25 to 30 pounds per square inch.

(c) Grip handles on control and depress action switches. One or both levers depressed will enable operator to operator the turret. (See figure 59-2.) Turn the hand grips up to elevate and down to depress the turret. Rotate the hand grips right or left to operate the turret in azimuth.

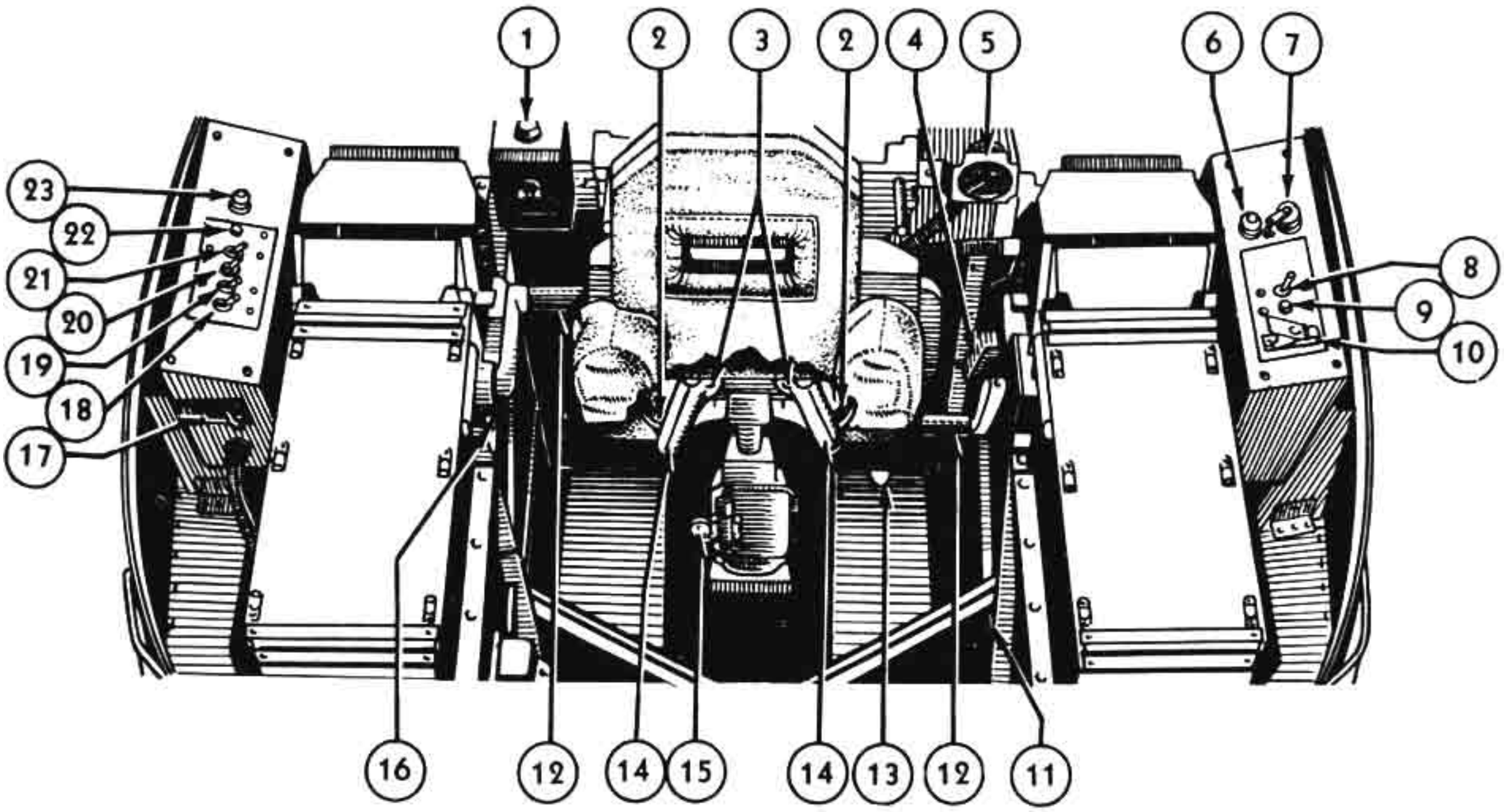
(d) The degree of rotation of the hand grips determines the speed of movement of the turret, and relaxing the action switches will render the trigger switches inoperative and stop the electric motor driven pump.

(e) Turn the camera switch on the left-hand panel to "ON."

(f) Turn the gun charger switch on the left-hand panel to "ON."

(g) Turn the gun sight switch in the right-hand panel to "ON."

(h) The dome light switch is located on left-hand turret panel.



Ref. No.	Nomenclature	Ref. No.	Nomenclature	Ref. No.	Nomenclature
1	*Interphone Box*	9	*Booster Circuit Breaker*	17	*Pump Switch*
2	*Action Switches*	10	*"Gun" and "Sight" Switch*	18	*Dome Light Switch*
3	*Microphone Switches*	11	*Elevation Clutch Lever*	19	*Charger Switch*
4	*Foot Pedal Stowage Handle*	12	*Manual Drive Handles*	20	*Camera Switch*
5	*High Pressure Gage*	13	*Foot Trigger*	21	*Main Power Switch*
6	*Red Warning Light*	14	*Control Handles*	22	*Main Power Circuit Breaker*
7	*Utility Receptacle*	15	*Low Pressure Gage*	23	*Power Indicating Light*
8	*Utility Receptacle Switch*	16	*Azimuth Clutch Handle*		

Figure 59 — Turret Controls—250SH-3

(i) The utility switch is located on right-hand turret panel.

(j) The booster circuit breaker is located on the right-hand turret panel; if booster motors cut out push the button on the circuit breaker to start booster motors. Repeat if necessary.

(k) The main power circuit breaker is located on the left-hand turret panel, if main power cuts out push the button on the circuit breaker to get electrical power in turret. Repeat if necessary.

(l) The interphone station box is forward of the upper left-hand corner.

(6) MANUAL DRIVE.—The manual drive is provided for auxiliary operation in case the hydraulic drive is damaged.

(a) Release the azimuth and elevation manual drive cranks from stowed position, and rotate both the right and left drive cranks in either direction until the manual drive engages.

1. The right-hand crank operates the turret in elevation.

2. The left-hand crank operates the turret in azimuth.

(b) The clutch lever for elevation drive is located at the right-hand side of the seat. Reach through opening in side of bulkhead.

1. Push clutch lever down for hydraulic operation.

2. Pull clutch lever up for manual operation.

(c) The clutch lever for azimuth is located on the upper left-hand side next to the azimuth drive handle.

1. Push clutch handle forward for hydraulic operation.

2. Pull clutch handle aft for manual operation.

(7) MECHANICAL FOOT TRIGGER. — In the event of power failure a foot trigger is provided to be used in conjunction with the manual turret drive system. The foot pedal is located conveniently for operation with the right foot, and is held in a retracted position by a compression spring.

(a) The stowage handle for the foot trigger is located in the front right-hand corner of the turret. Turn the stowage handle 90 degrees to the left and push down. The foot trigger is now ready for operation.

(b) Turn stowage handle 90 degrees to the left and lift up, the foot trigger is retracted and in stowed position.

(8) CHARGING THE GUNS.—The electric gun charging systems in these turrets are connected to the inboard side of the machine guns and operate automatically when the proper electric switches are turned on. They cannot be manually operated. On the right and left gun chargers are trigger switches provided to operate gun chargers independently by flipping up to "ON" position gun can be charged as desired.

(9) REMOVAL OF A CASUALTY.

(a) Turn off the electric power by using the single-pole double-throw switch located outside the turret. This will render the electric motor and the firing circuit inoperative.

(b) Open drain bag by pulling the zipper around its course.

(c) At the extreme bottom of the ball section, to the front of the gunner's entrance hatch, is found an emergency righting opening.

(d) Disengage elevation clutch at right-hand side of seat in the turret.

(e) Disengage azimuth clutch at upper left-hand side in the turret.

(f) The turret, by pushing or pulling, may now be trained by hand or elevated manually from the outside until the entrance opening is in the desired location.

(g) Remove the two wing nuts located on the seat supports under the track (one on each support).

(h) Be sure to support the seat, and gunner, while performing this operation.

(i) The seat track will now pivot down about its front attachment, and by lifting the seat over the catch in the track, both seat and the gunner can be removed. Or as an alternative, after following steps 1 to 5 inclusive, the following procedure may be followed:

(j) Reach into the turret and unfasten the gunner's safety belt, by pulling open the jiffy buckle.

(k) Push the seat back and up under the backrest, bracing the gunner during the operation.

(l) Gunner will slide down and out of turret.

c. DECK TURRET—250CH-1. (Airplane numbers 45404 to 45444.)

(1) BEFORE ENTERING TURRET.—Check that the deck turret circuit-breaker switch located on the flight engineer's panel is turned to "ON."

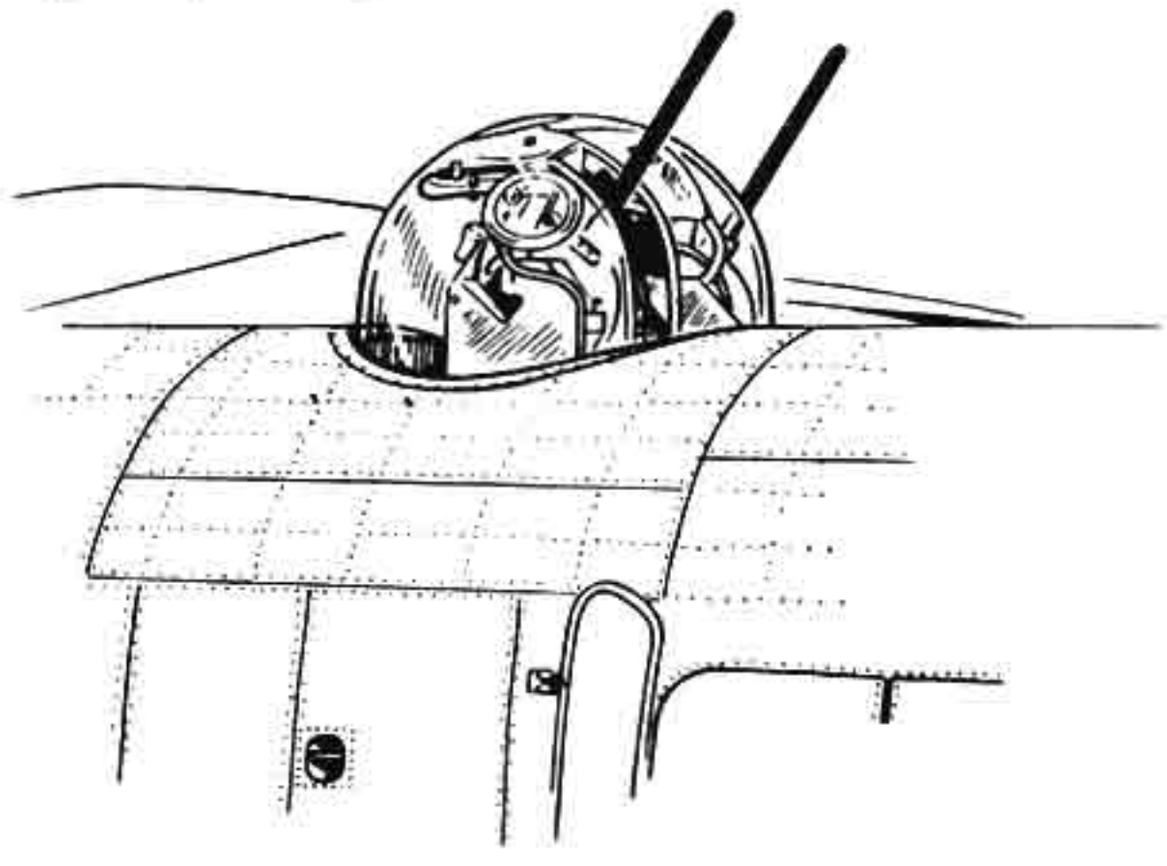


Figure 60 — Deck Turret

(2) ENTERING TURRET.

(a) Enter the turret head-first from the rear side of the ammunition box by ascending the two steps, using any convenient structure as a hand grip.

(b) While standing on top of the ammunition box covers, reach between the legs and pull the seat up until it locks over the right-hand seat bar.

(c) Sit down and fasten the safety belt.

(3) OPERATION OF CONTROLS.

(a) Observe if the red indicator light on the switch panel is on. If it is, it indicates that power has been turned on from outside the turret. If the light is not on, turn on the switch marked "MAIN POWER." This in turn will light the indicator light signifying that the current is on.

(b) Turn the utility camera, dome light, gun, and sight switches to "ON" as desired.

(c) Check to see that the pump switch located to the left of the gunner is in the "ON" position.

(d) Grasp the control grips in both hands and press down either or both action switches with the side of the hand. This will start the pump.

(e) Move the control handles up or down to depress or elevate the guns. Rotate the handles horizontally to move the turret in azimuth. The degree of rotation of the handles determines the speed of movement of the turret. The action switch must be held down in order to set the turret in motion.

(f) After turning "ON" the gun and sight switches, the guns are fired by depressing the trigger switches in the front of the control handle grips.

(g) To operate the camera turn the camera switch to "ON" and depress the firing trigger.

(4) LOADING AMMUNITION.

(a) Remove the foot plates at the top of the ammunition box by pulling aft on the spring latch pin under the foot plates.

(b) Remove the feed chute by removing the forward and aft safety pins in the chute.

(c) Ammunition may now be loaded into the boxes. Continuous belts may be loaded by lapping back and forth across the box until it is full.

(d) Reinstall the feed chute and its pins.

(e) Drop the ammunition threading sling down through the top of the booster feed. Lead the end down that has the opposite link to the last round at the top of the box so as to attach to the ammunition belt. Tie or secure the sling to the gun or booster while connecting the ammunition below. Reach under the feed chute through the opening at the footrest to couple up the threading sling.

(f) When both boxes are full and threading slings are attached replace the sliding foot plates.

(g) Pull the threading sling up through the booster chutes until two or three rounds of ammunition have engaged the booster sprockets.

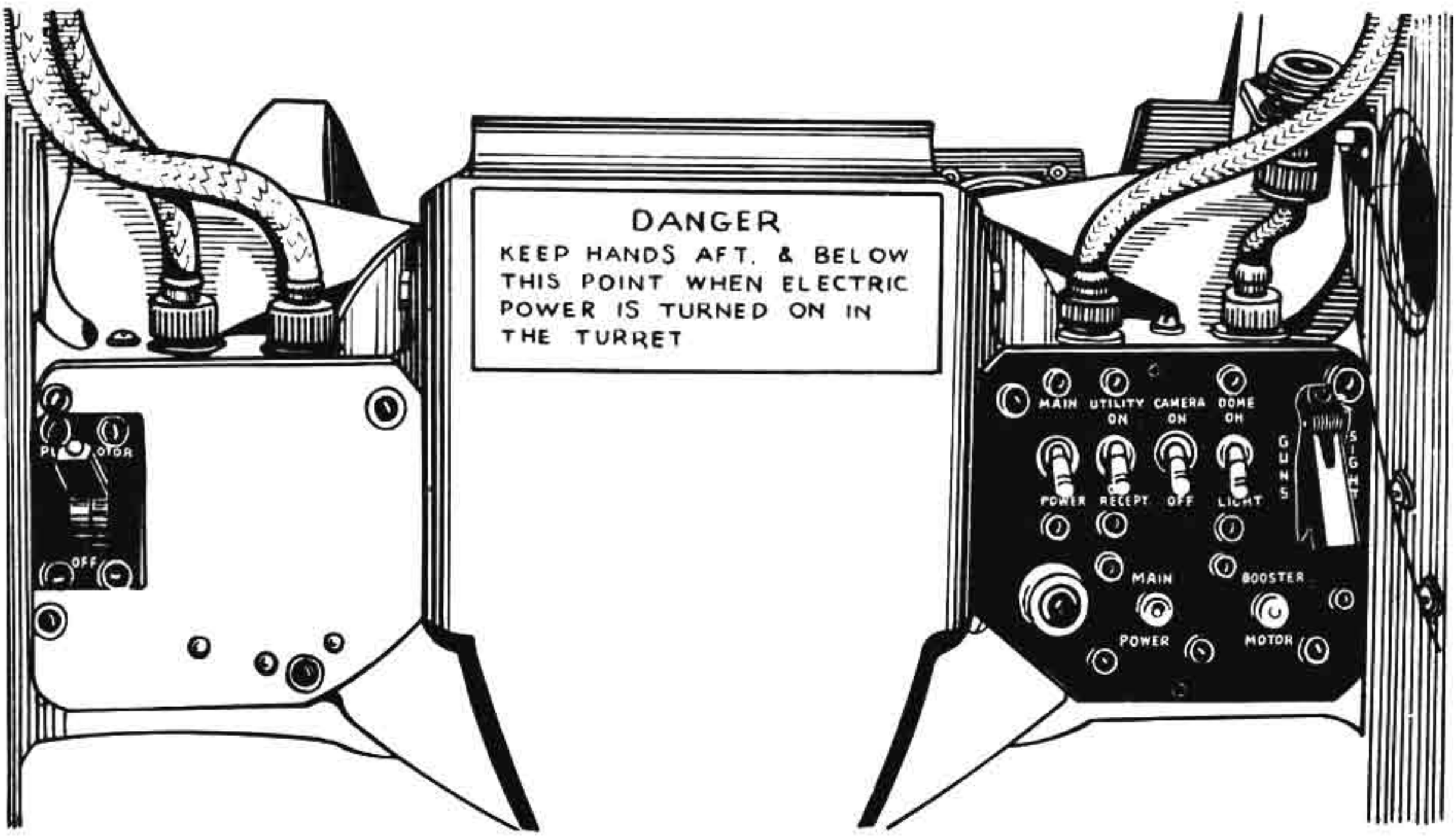


Figure 61 — Turret Control Panels—250CH-1 and 250CH-2

(h) Disengage the threading sling.

(i) Lift the cradle cover and gun cover.

(j) Pull up enough ammunition to be loaded into the gun.

(k) Close the gun cover and cradle cover.

(5) CHARGING THE GUNS.—See Section V, paragraph 5, a, (7).

(6) REMOVAL OF EMPTIES.

(a) Emptied and ejected cases and links are collected in boxes under each gun. A door at the back of the ejected case box is held in place by a spring latch. The door may be removed by pulling back on the spring latch.

(b) The empties may then be removed and the doors replaced.

d. DECK TURRET—250CH-1B. (AIRPLANE NUMBERS 59000 AND SUBSEQUENT.)

(1) GENERAL.—The Martin power turret is a cylindrical hydraulic self-contained unit mounted in the deck position. (See figure 60.) It is designed for the mounting of two .50-caliber model M-2 Browning aircraft machine guns. The guns travel 360 degrees in azimuth, 80 degrees in elevation, and 20 degrees in depression depending on the position the guns are pointed. The airplane is protected from its own gunfire by an interrupter.

(2) CONTROLS.—Hand grips, with built-in gun triggers, action switches, and microphone switch, control the turret in elevation, depression, and azimuth. The turret can also be operated manually in the event of power failure.

(3) BEFORE ENTERING TURRET.—Turn "ON" the deck turret circuit breaker switch located at the flight engineer's panel.

(4) ENTERING TURRET.

(a) Enter the turret head-first from aft side by ascending the two steps, using any convenient structure as a hand grip.

(b) While standing on top of the ammunition box covers, reach between the legs and pull the seat up until it locks over the right-hand seat bar.

(c) Sit down, adjust and fasten the safety belt in position.

Note

During take-off and landing be sure elevation and azimuth clutches are engaged for power drive, and that the turret is locked in azimuth with guns pointed forward.

(5) TURRET OPERATING INSTRUCTIONS.

(a) To operate the turret by power, turn the main power switch on in the turret. A red light will light indicating the power is "ON." The light and switch are located on the right-hand turret panel.

(b) Turn the pump switch located on the left-hand turret panel to "ON." Check high pressure gage; reading should be 740 to 780 pounds per square inch. Check low pressure gage; reading should be 25 to 30 pounds per square inch.

(c) Unlock the azimuth lock located at the aft right-hand side of the turret by pushing the knob to the right.

(d) Turn the camera, sight and gun switch located on the right-hand turret panel to "ON."

(e) Turn the gun charger switch located on the left-hand turret panel to "ON."

(f) The dome light switch is located on the left-hand turret panel.

Note

The emergency switches on the right-hand turret panel must be in an extreme down position to be "ON," when operating the turret by power.

(g) The emergency gun charger switch is located on the right-hand turret panel.

(h) The interphone junction box is located on the upper right-hand turret.

(i) The booster circuit breaker is located on the right-hand turret panel; if booster motors cut out, push the button on the circuit breaker to start booster motors. Repeat if necessary.

(j) The main power circuit breaker is located on the left-hand turret panel; if main power cuts out, push the button on the circuit breaker to get electrical power in turret. Repeat if necessary.

(k) Grip handles on controls and depress the action switches. One or both switches depressed will enable operator to operate the turret.

(l) Turn the hand grips up to elevate the guns and down to depress the guns. Rotate the hand grips right or left to operate the turret in azimuth.

(m) The degree of rotation of the hand grip determines the speed of movement of the gun and turret, and relaxing grip on both of the action switches will render the trigger switches inoperative and stop the electric motor-driven pump.

(6) MANUAL DRIVE.—The manual drive is provided for auxiliary operation in case the hydraulic drive is damaged.

Note

The emergency switch is provided to be used in conjunction with the foot trigger and manual drive and must be in the extreme up position for manual operation of the turret. To turn emergency switch "OFF" return to center position.

(a) The manual drive cranks are stowed in position to the left and right of the ammunition chute in front of gunner's seat. (See figure 69.)

(b) Release the azimuth and elevation manual drive cranks from stowed position.

(c) Turn pump switch "OFF."

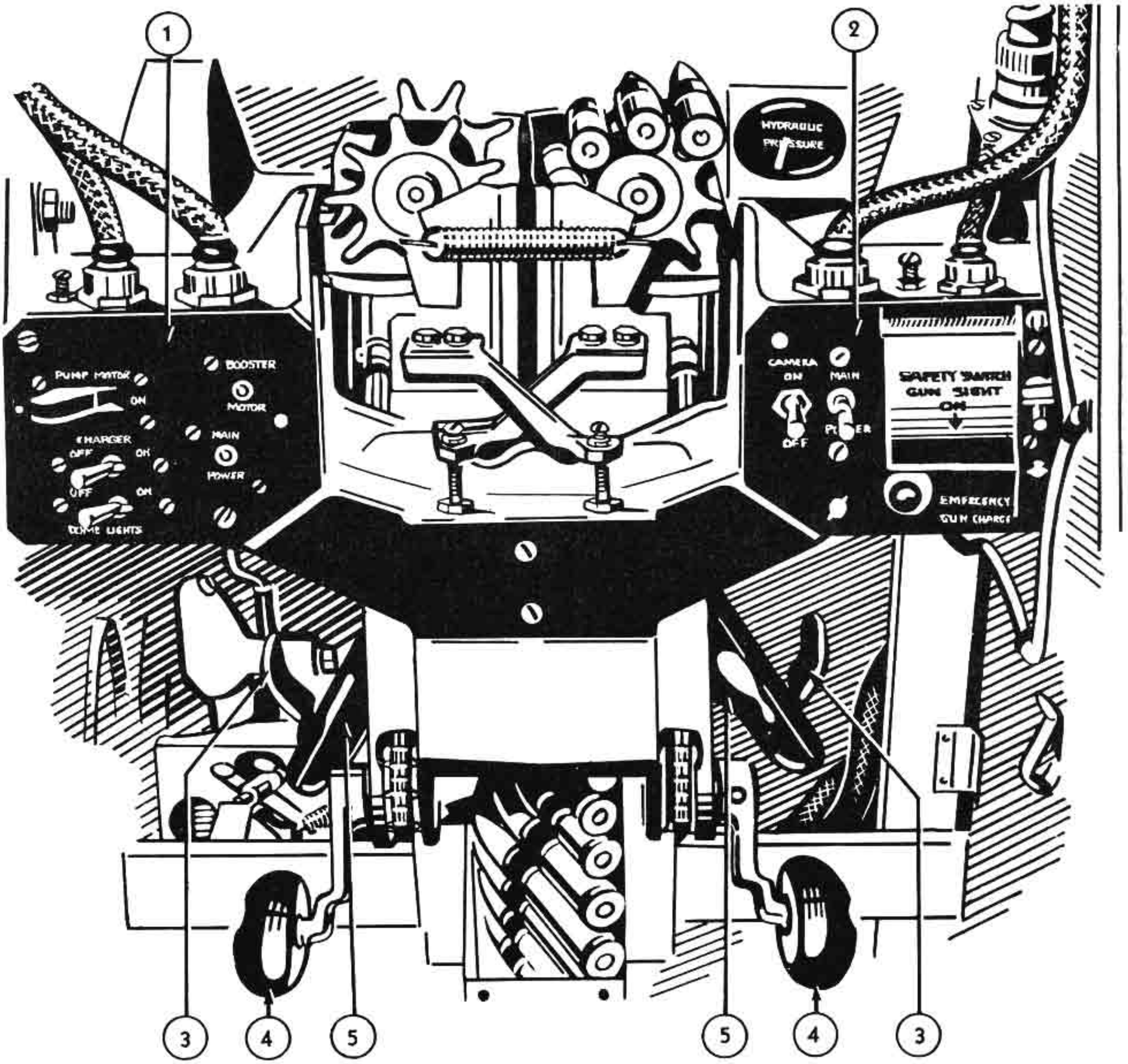
(d) Push the elevation clutch lever located in left-hand side of turret down for manual drive and rotate the left-hand elevation crank until clutch engages.

(e) Push the azimuth clutch lever located in the lower right-hand corner of the turret down for manual drive and rotate the right-hand azimuth crank until clutch engages.

(f) To operate turret by power, stow both crank handles and engage both clutches by pulling up clutch lever for hydraulic operation.

(7) MECHANICAL FOOT TRIGGER.—In the event of power failure a foot trigger is provided to be used in conjunction with the manual turret drive system.

(a) The foot pedal is stowed in the slot of the foot rest convenient for operation with the right foot.



Ref. No.	Nomenclature
1	*Left-Hand Switch Panel*
2	*Right-Hand Switch Panel*
3	*Action Switch*
4	*Manual Drive Cranks*
5	*Control Handles*

Figure 62 — Turret Controls—250CH-1B and 250CH-2B

Push aft with back of right foot, and mechanical foot trigger is now ready for operation.

(b) A press of the foot trigger fires both guns.

(c) To stow foot trigger, pull it up with toe of shoe to its vertical position.

(8) LOADING AMMUNITION.

(a) Remove the foot plates at the top of the ammunition box by pulling on the spring latch pin under the foot rest support channel and then sliding the foot plates aft and out.

(b) By removing the forward and aft safety pin in the feed chute, the chute may be removed.

(c) Ammunition may now be loaded into the boxes. Continuous belts are loaded by lapping back and forth across the box. Ammunition points forward in box.

(d) Reinstall the feed chute and its pins.

(e) Drop the ammunition loading belt down through the top of the booster feed. Lead the end having the opposite link to the last round at the top of the box down to attach it to the ammunition belt. Tie or secure the belt to the gun or booster while connecting the ammunition below. Reach under the feed chute through the opening at the foot rest, to couple up the loading belt.

(f) When both of the ammunition boxes are full and the loading belts are attached, replace the sliding foot plates.

(g) Pull the loading belt up through the booster chutes until two or three rounds of ammunition have engaged the booster sprockets.

(h) Disengage the loading belt.

(i) Lift the cradle cover and gun cover.

(j) Pull up enough ammunition to be loaded into the gun.

(k) Close the gun cover and cradle cover.

(9) CHARGING THE GUNS.—The electric gun charging system in these turrets is connected to the inboard side of the machine guns and operates automatically when the proper electric switches are turned on. They cannot be manually operated. Located on the right and left gun chargers, trigger switches are provided to operate the gun chargers independently. By flipping either switch up to "ON" position each individual gun can be charged as desired.

(10) REMOVING A CASUALTY.

(a) A red light in the turret indicates the power is on. Shut off the switch at junction box, located just outside the turret near the centerline of the airplane.

(b) Enter the turret from the rear side of the ammunition box, head first, using any convenient structure as a hand grip.

(c) See that the casualty's hands and arms are free from all units, such as guns, operating switches, etc.

(d) See that the casualty's feet and legs are free from the foot rest, ammunition boxes, etc.

(e) Determine, by the size and position of the casualty, and the amount of space to work in, if it is advisable to release the safety belt, or the gunner's seat first.

(f) To release the safety belt, reach in and with the fingers unsnap the jiffy snap by pulling away from the body.

(g) To drop the gunner's seat, depress the seat lock handle, located on the right-hand side under the seat, either forward or aft. This releases two spring catches, fitting over the right-hand adjustment bar, one forward and one aft on the seat.

(h) Lower seat slowly to allow the gunner to slide gently down and out of the turret.

e. TAIL TURRET—250-CH2 (AIRPLANE NUMBERS 45405 TO 45444.)

(1) BEFORE ENTERING COMPARTMENT.—Check to see that the tail turret circuit breaker switch located on the flight engineer's panel is turned to "ON."

(2) OPERATION OF CONTROLS.—See Section V, paragraph 5, a.

(3) LOADING AMMUNITION.

(a) Ammunition is loaded from the ammunition boxes into the ammunition tracks which are located on either side of the airplane.

(b) Move the ammunition belt up to the turret, by pulling it along the roller tracks.

(c) Drop the ammunition threading sling down through the top of the booster feed. Lead the end having the opposite link to the last round at the end of the track down and attach to the ammunition belt. Tie or secure the sling to the gun or booster, while connecting the ammunition below. Connect the threading sling to the ammunition belt.

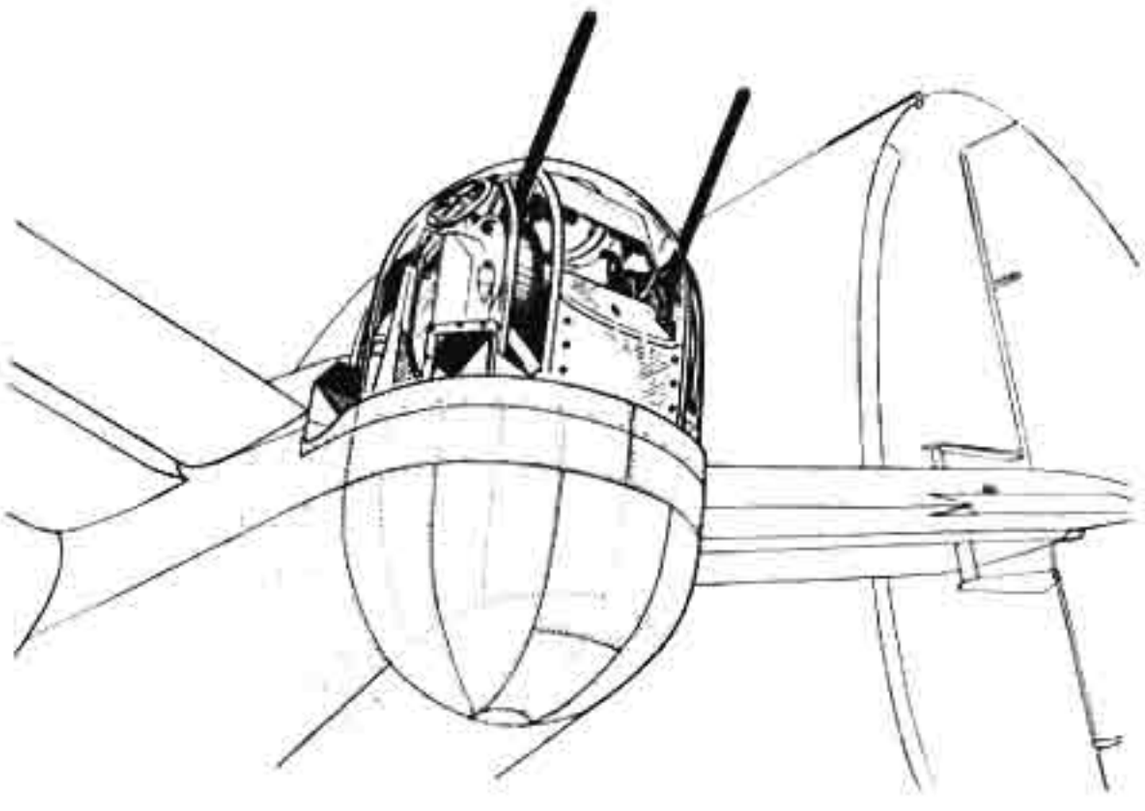


Figure 63 — Tail Turret

(d) Pull the threading sling up through the booster chutes until two or three rounds of ammunition are engaged by the booster sprockets.

(e) Disengage the threading sling.

(f) Lift the cradle cover and gun cover.

(g) Pull up enough ammunition to be loaded into the gun.

(4) CHARGING THE GUNS.—See Section V, paragraph 5, a, (7).

f. TAIL TURRET 250CH-2B. (AIRPLANE NUMBERS 59000 AND SUBSEQUENT.)

(1) GENERAL.—The Martin power turret is a cylindrical hydraulic self-contained unit which may be mounted in the tail position. (See figure 63.) It is designed for the mounting of two .50-caliber model M-2 Browning aircraft machine guns. The guns travel 60 degrees in elevation and 45 degrees in depression from the horizontal center line of the airplane, and 75 degrees to either side of neutral in azimuth.

(2) CONTROLS.—Hand grips, with built-in gun triggers, action switches and microphone switch control the turret in elevation, depression, and azimuth. The turret can also be operated manually in the event of power failure.

(3) BEFORE ENTERING TURRET.—Turn "ON" the tail turret circuit breaker switch located at the flight engineer's panel.

(4) ENTERING TURRET.

(a) Enter the turret from aft end head first and pull seat up until snap lock closes on left-hand bar.

(b) Adjust and fasten the safety belt in position.

Note

During take-off and landing, be sure the elevation and azimuth clutches are engaged for power drive, and that the turret is locked in azimuth with guns pointed aft.

(5) TURRET OPERATING INSTRUCTIONS.

(a) To operate the turret by power turn on the main power switch in the turret. A red light will light, indicating power is on. The light and switch are located on the right-hand turret panel.

(b) Turn the pump switch located on the left-hand turret panel to "ON."

1. Check high pressure gage; reading should be 740 to 780 pounds per square inch.

2. Check low pressure gage; reading should be 25 to 30 pounds per square inch.

(c) Unlock the azimuth lock located at the aft right-hand side of the turret by pulling the knob back.

(d) Turn the gun charger switch, located on the left-hand turret panel to "ON."

(e) The dome light switch is located on the left-hand turret panel.

(f) The emergency gun charger switch is located on the right-hand turret panel.

Note

The emergency switches on the right-hand turret panel must be in an extreme down position when operating turret by normal circuit power.

(g) The interphone junction box is located on the upper right-hand side of the turret structure.

(h) The booster circuit breaker is located on the left-hand turret panel; if booster motors cut out, push the button on the circuit breaker to start booster motors. Repeat if necessary.

(i) The main power circuit breaker is located on the left-hand turret panel, if main power cuts out, push the button on the circuit breaker to get electrical power in turret. Repeat if necessary.

(j) Grip handles on controls and depress action switches. One or both switches must be depressed before the turret can be operated. (See figure 62.)

(k) Turn the hand grip up to elevate the guns, and down to depress the guns. Rotate the hand grips right or left to operate the turret in azimuth. The degree of rotation of the hand grip determines the speed of movement of the gun and turret.

(l) Releasing the action switches will render the trigger switches inoperative and stop the electric motor driven pump.

(6) MANUAL DRIVE.—The manual drive is provided for auxiliary operation in case the hydraulic drive is damaged.

Note

The emergency switch is provided to be used in conjunction with the foot trigger and manual drive and must be in the extreme up position for manual operation of the turret. To turn emergency switch "OFF" return to center position.

(a) The manual drive cranks are stowed in positions to the left and right of the ammunition chute in front of the gunner's seat. (See figure 62.)

(b) Release the azimuth and elevation manual drive cranks from stowed position.

(c) Turn pump switch to "OFF."

(d) Push the elevation clutch lever, located in left-hand side of turret, down for manual drive and rotate the left-hand elevation crank until the clutch engages.

(e) Push the azimuth clutch lever, located in the lower right-hand corner of the turret, down for manual drive and rotate the right-hand azimuth crank until clutch engages.

(f) To operate turret by power after manual operation, stow both crank handles and engage both clutches by pulling up clutch lever for hydraulic operation.

(7) MECHANICAL FOOT TRIGGER.—In the event of power failure a foot trigger is provided to

be used in conjunction with the manual turret drive system.

(a) The foot pedal trigger, located conveniently for operation with the right foot is stowed in the slot of the foot rest. Push aft with back of right foot and the mechanical foot trigger is ready for operation.

(b) A press of the foot trigger fires both guns.

(c) To stow the foot trigger, push it back in slot of the foot rest.

(8) LOADING AMMUNITION.

(a) Ammunition is loaded from the ammunition boxes into the ammunition tracks located on either side of the airplane.

(b) Move the ammunition belt up to the turret by pulling it along the roller tracks.

(c) Drop the ammunition threading sling down through the top of the booster feed. Lead the end that has the opposite link to the last round at the end of the track down and attach to the ammunition belt. Tie or secure the belt to the gun or booster while connecting the ammunition below. Connect the threading belt to the ammunition belt.

(d) Pull the threading sling up through the booster chutes until two or three rounds of ammunition are engaged by the booster sprockets.

(e) Disengage the threading sling.

(f) Lift the cradle cover and gun cover.

(g) Pull up enough ammunition to be loaded into the gun.

(b) Close the gun and cradle covers.

(9) CHARGING THE GUNS.—The electric gun charging systems in these turrets are connected to the inboard side of the machine guns and operate automatically when the proper electric switches are turned on. They cannot be manually operated. Located on the right and left gun chargers trigger switches are provided to operate each of the gun chargers independently. By flipping up to "ON" position each gun can be charged as desired.

(10) REMOVING A CASUALTY.

(a) A red light in the turret indicates the power is on. Shut off the switch at junction box, located just outside the turret just to the right of the center line of the airplane.

(b) See that the casualty's hands and arms are free from all units, such as guns, operating switches, etc. See that the casualty's feet and legs are free from the foot rest, ammunition belts, etc.

(c) Determine, by the size and position of the casualty, and the amount of space to work in, if it is advisable to release the safety belt, or the gunner's seat first.

(d) To release the safety belt, reach in with the fingers and unsnap the jiffy snap by pulling away from the body.

(e) To drop the gunner's seat, depress the seat lock handle, located on the left-hand side under the seat, either forward or aft. This releases two spring catches, fitting over the left-hand adjustment bar, one forward and one aft on the seat. This will drop the seat from the right-hand side and leave it hinged to the left-hand adjustment bar.

(f) Use the knee as a support and gently lower the casualty to the deck.

(g) Take the casualty by the armpits and walking backward pull him gently from the turret.

g. SIDE WAIST GUNS. *(See figure 64.)*

(1) DESCRIPTION.—The side waist guns are located in the rear entrance hatches and consist of a left- and right-hand M-2 .50-caliber Browning aircraft machine gun for the respective hatches, the guns are mounted on a MK I hydraulic gun mount and are operated by a common hydraulic power unit with two lines connecting each gun to the hydraulic unit.

(2) OPERATION OF CONTROLS.

(a) Turn "ON" the hydraulic unit power switch located on top of the bulkhead at station 601.

(b) Turn "ON" the electric gun sight switch.

(c) Unlock the control grip by pulling down on the knurled knob, turning it 90 degrees and releasing it.

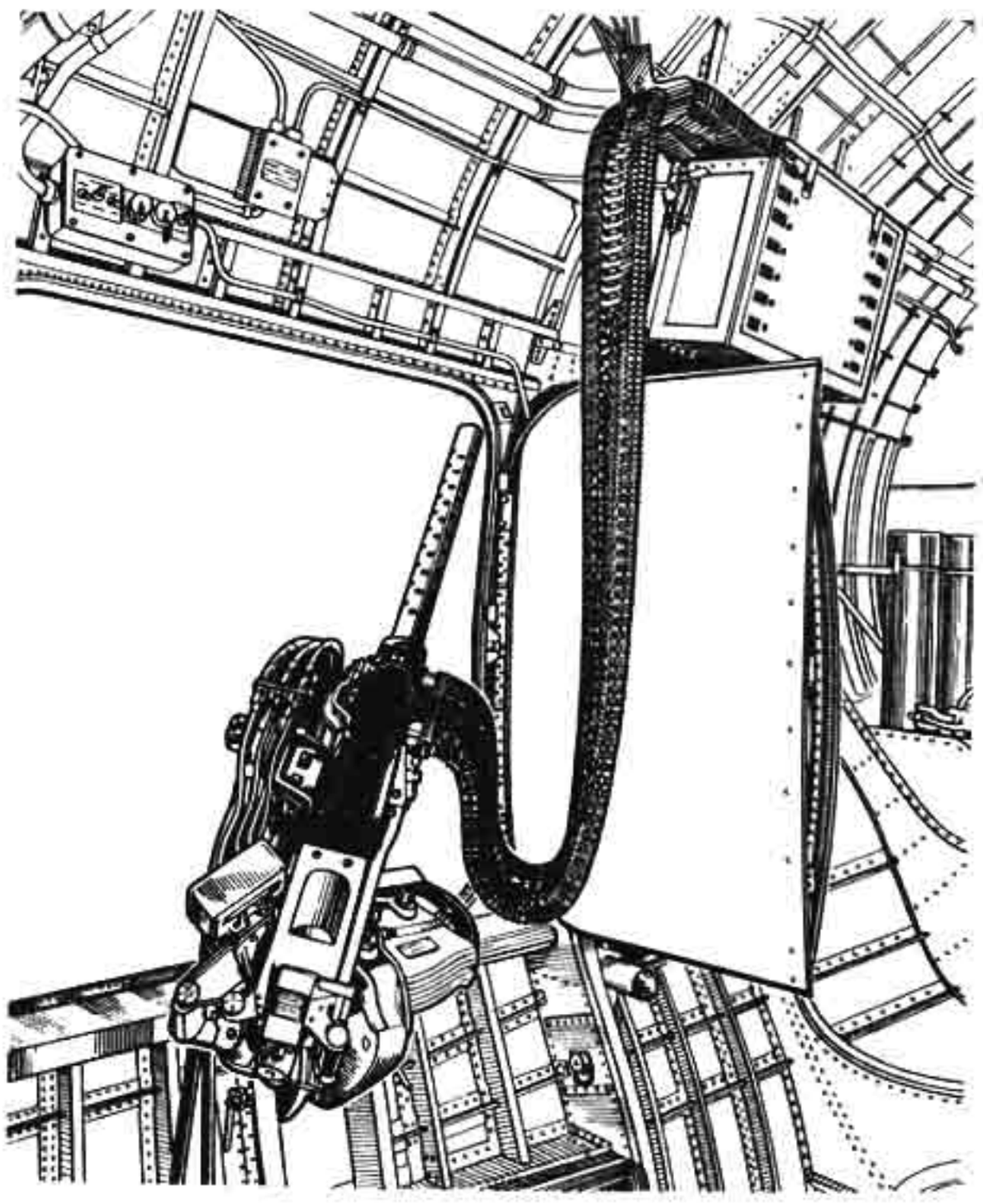


Figure 64 — Waist Gun Installed

(d) Swing the mount to the extreme azimuth and elevation positions to flex the hydraulic lines and purge the system of any air.

(e) Charge the gun by pulling back the charging handle on the right-hand side of the gun and then releasing it.

(f) Turn the trigger safety lock located on the back of the adapter to "FIRE." The firing trigger is located on the adapter in front of the right-hand grip.

(g) Ascertain that the dump valve lever is turned to the power control position.

(h) To operate the gun in azimuth, rotate the left control grip to the right or left. (See figure 65-7.)

(i) To operate the guns in elevation, move the left control grip forward or aft.

(j) To obtain the maximum up-fire angle, depress the plunger lifting lever, pull the entire mount back and release the lever, allowing the plungers to seat in the holes in the sill plate.

(k) To obtain the maximum down-fire angle, depress the plunger lifting lever, push the mount forward and release the lever, allowing the plungers to seat in the sill plate holes.

(l) Use the ring and post sight in the maximum down position.

(3) MANUAL OPERATION.—In the event of an electrical or hydraulic failure use the following procedure:

(a) Turn the dumping valve lever to the "DUMP" position. (See figure 65-1.)

(b) Operate the gun manually. The left control grip will not be effective except as a hand grip.

(4) AMMUNITION AND LOADING.

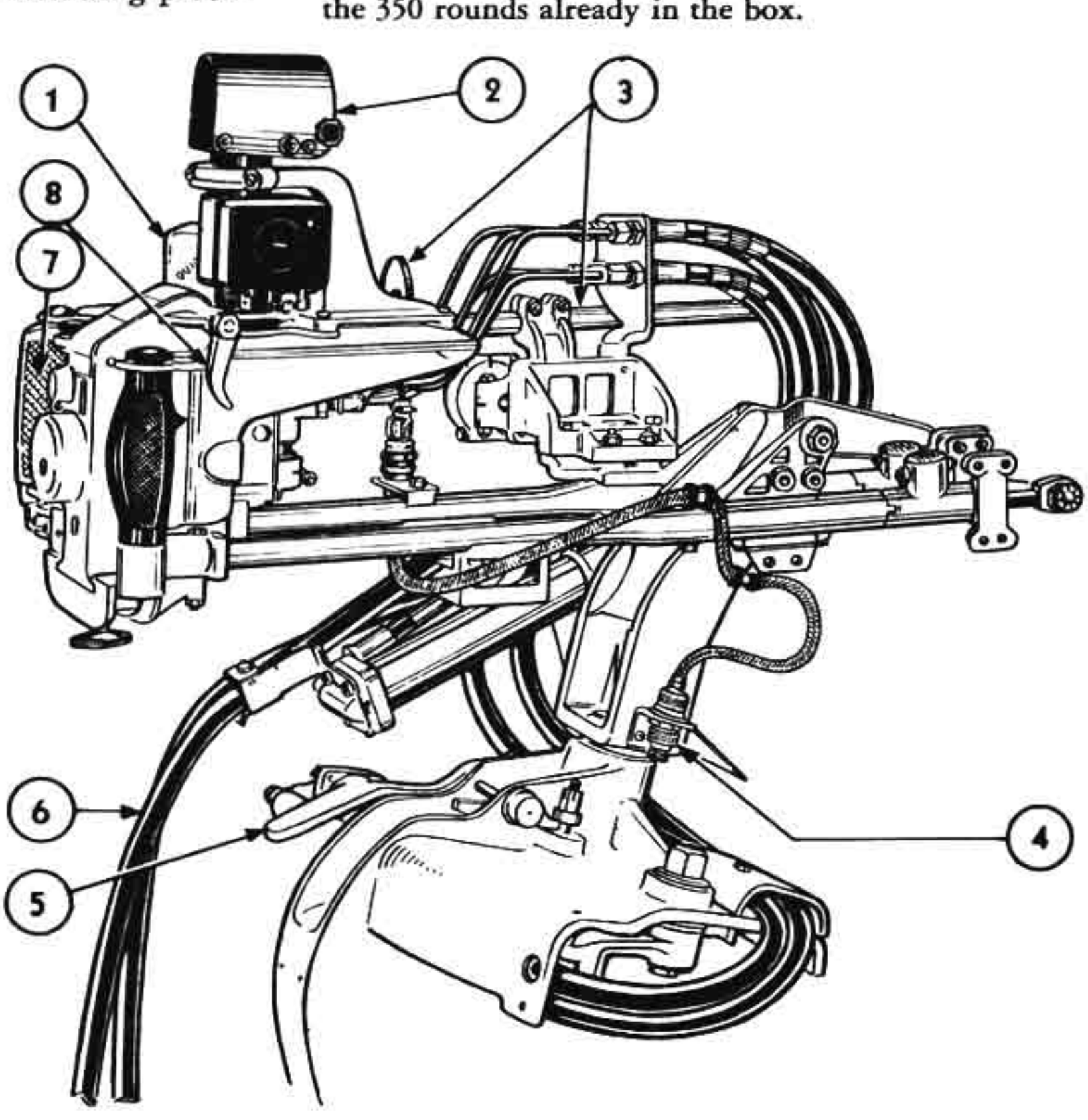
(a) The ammunition boxes are located above the hatch door; the box for the left gun being forward of the door, and the ammunition box for the right gun is located aft of the door.

(b) Each box contains 350 rounds of ammunition with continuous feed. The ammunition is restricted in a flexible track connected from the top of the ammunition box to the guns.

(c) The guns may be placed in their stowed position without the ammunition track being disconnected.

(d) To open the ammunition box, pull the locks located on the fore and aft sides at the top of the box. This will allow the entire box to swing downward to approximately a 45-degree angle. Cables located on the four aft sides of the box will hold the box in this position. Unsnap the four straps and lift the cover to fill the box. The hatch door on the right-hand side must be closed in order to fill the ammunition box.

(e) After the box has been filled, continue the rounds of ammunition through the flexible track. The track will carry 50 rounds of ammunition in excess of the 350 rounds already in the box.



Ref. No.	Nomenclature
1	*Dump Valve Control*
2	*Mark 9 Gun Sight*
3	*Auxiliary Ring and Post Sight*
4	*Gun Sight Plug*
5	*Lock Lever*
6	*Hydraulic Pressure and Return Lines*
7	*Elevation and Azimuth Control Handle*
8	*Trigger*

Figure 65 — Side Waist Gun Mount

6. OPERATION OF RADIO AND COMMUNICATION EQUIPMENT.

Note

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.

a. AIRPLANE NUMBERS 45405 TO 45444.—The PBM-5 radio units provide intercommunication between members of the crew, between crew and surface stations, and between crew and other crews of squadron. With these units the crew can measure the frequency of transmitted and received signals, take instrument landings, take bearings on externally located transmitters, fly the course beacon signals, and receive and transmit navigation and emergency signals.

(1) RADIO OPERATOR CONTROLLED COMMUNICATING RADIO EQUIPMENT.

(a) RAX COMMUNICATIONS RECEIVERS.

1. A section of the airplane's large "V" antenna installation is led into the antenna terminal board and from there to three RAX receivers. One foot above the forward end of the radio table is the intermediate wave receiver and directly above it is the short wave receiver. The long wave receiver is mounted on the forward end of the radio table. The lead-in from the antenna terminal board connects to the antenna circuit of the short wave receiver. The antenna circuits of the three RAX receivers are connected in series.

2. These receivers tune all frequencies covered by the G0-9 transmitter and tune the localizer signal beacon when being used in conjunction with the ZA instrument landing equipment. RAX receivers have internal dynamotors which get their energy from the radio operator's switch box. This energy is connected through the RAX junction box located on the aft side of the RAX supports to the left and in front of the radio operator.

3. To put the RAX receivers into operation check that the radio power switch on the flight engineer's panel is turned to "ON" and turn the on-off switch on the desired receiver to "ON." Turn the toggle switch on the desired receiver to "TEL B."

Note

The pilot's interphone selector switch (figure 67) must be in either position "1," "2," or "3" and the toggle switch designated RECEIVER B must be in the "IN" position.

(b) G0-9 COMMUNICATION TRANSMITTER.

1. Together with the RAX receiver system, the G0-9 makes up the general purpose communications system. It is located on a cabinet aft of the radio table. Its energy is supplied by a motor generator located in the galley compartment just forward of frame 11 on the left side of the airplane. The motor generator is driven by power from the flight engineer's panel. The G0-9 is capable of either MCW or CW emission, and several different frequencies may be selected using the built-in switching gear. The transmitting key is located on the aft end of the radio table.

2. Either of two antennas may be used with the G0-9 transmitter. A long section of the fixed "V" is used when on the water or when it is impractical to let out the trailing antenna. Greatest range is available when a long wire antenna can be trailed out of the bottom of the hull through a standpipe located aft of the transmitter. Overhead is a reel of weighted antenna wire complete with a handle for manipulation.

3. To put the G0-9 transmitter in operation first make the desired antenna connection by connecting the beaded antenna lead from the transmitter to the fixed antenna terminal or the trailing antenna terminal on the terminal board. If the lead is connected to the trailing antenna it will be necessary to connect the beaded lead at the foot of the trailing antenna standpipe to the trailing antenna counter terminal. Then check that the G0-9 power switch on the flight engineer's panel is in the "ON" position, and turn the power switch on the transmitter to "ON."

Note

In case the G0-9 dynamotor in the galley compartment does not operate, transfer the cable to the alternate dynamotor used for the radar equipment. These two dynamotors are identical and interchangeable.

(c) DZ DIRECTION FINDING EQUIPMENT.

1. A short, fixed horizontal, sense antenna located on top of the hull is attached by lead-in to the receiver, which is above the radio table. This antenna gives a positive reading to the loop indicator. The receiver is capable of tuning communication frequencies, and by changing the sense antenna to a longer one, can be used as a standby receiver. The receiver is powered by an internally filtered dynamotor which is located under the radio table.

2. On the top of the Radar Housing is located a streamlined case containing the rotatable loop. From the loop a cable plugs into the receiver and an extension drive for rotating the loop comes through the skin to within easy reach of the radio operator. On the lower end of the loop extension drive is the calibrated loop indicator from which bearings on outside transmitters can be read.

(2) PILOT CONTROLLED COMMUNICATING RADIO EQUIPMENT.

(a) ATA/ARA INTERSQUADRON COMMUNICATION EQUIPMENT.

1. A fixed horizontal antenna located on top of the hull is brought into the antenna relay which is located above and outboard of flight engineer's panel. This relay is connected to the transmitters and the receivers by two antenna wires.

2. The transmitter control box, located on top of the pilot's pedestal, may be used to select either transmitter. With the receiver control box located over the pilot's seat the receivers can be tuned by remote control. The receivers tune the squadron frequency as well as the radio range beam filter unit enabling the pilot to hear the radio range voice instructions through the range course signals. The transmitter microphone and the receiver phones connect to their respective units through the airplane interphone system. The transmitter modulator unit is located close to the transmitter.

3. The receiver, modulator, and transmitter have internal motor generators which get their power via a junction box from the flight engineer's panel located amidship.

4. There are provisions for mounting only two of the five transmitters and three of the receivers so that the units not in use must be stowed elsewhere.

WARNING

Check that all switches are turned to "OFF" before changing either the transmitters or receivers to prevent damage caused by arcing at the disconnect plugs.

5. To put the ATA/ARA equipment into operation the interphone must be operating and the radio power switch on the flight engineer's panel must be in the "ON" position. The transmitter is turned on at the pilot's control box (figure 67) and the receiver is turned on at the remote control unit (figure 22-1) mounted aft of the pilot's and co-pilot's windshields.

(3) PILOT CONTROLLED RADIO NAVIGATING AND INSTRUMENT LANDING EQUIPMENT.

(a) AN/ARR-1 (ZB-3) NAVIGATIONAL RECEIVER ADAPTER.

1. Model AN/ARR-1 (ZB-3) aircraft radio navigational receiver adapter equipment does not constitute a complete self-contained radio receiving unit but is designed for operation in conjunction with the intersquadron command radio.

2. The adapter is mounted outboard of the flight engineer's switch panel on the left side of the airplane. This equipment receives its power through a disconnect plug on the intersquadron command receiver.

3. The antenna is mounted on the center line of the airplane approximately 10 inches aft of the bow turret.

4. To put the adapter into operation check that the ARA units are "OFF" and connect the disconnect plug on the adapter to the ARA unit. Then, with the interphone operating, turn on the ARA.

(b) ZA INSTRUMENT LANDING EQUIPMENT.—Provisions, including wiring, are made for the installation of ZA instrument landing equipment which must be used in conjunction with a special ground transmitter and the RAX equipment. The control box when installed is located at the left of the pilot's station.

(c) AN/ARN-1 OR AN/APN-1 ABSOLUTE ALTIMETER.

1. The absolute altimeter constitutes a complete self-contained radio receiving and transmitting unit. One antenna for this unit is mounted on the "beaver tail" of each engine nacelle.

2. The tranceiver is mounted on the right side of the airplane between frames 21 and 22 in the auxiliary power plant compartment.

3. The altitude indicator (figure 15-4) and switching unit (figure 15-20) are mounted on the pilot's instrument panel. The pilot's indicating lights (figure 15-11) are mounted on the right side of the pilot's instrument panel.

4. To put the radio altimeter into operation check that the radio power switch is in the "ON" position, and turn the switch on the pilot's panel (figure 15-20) to the desired altitude.

(4) NON-COMMUNICATING RADIO EQUIPMENT.

(a) ABK AIRCRAFT RECOGNITION EQUIPMENT.

1. Provisions are made for mounting the ABK aircraft recognition receiver on the left side just aft of frame 33 and forward of the tunnel camera station. It receives its signals through a "whip" antenna mounted between frames 33A and 34 just to the left of the center line of the airplane. Provisions are made for mounting the control unit at the radio operator's station. The power supply is obtained from the radio operator's switch box.

2. The manual ABK radio emergency switches and the remote control switches are mounted on the right side of the co-pilot. The automatic inertia switch, which is mounted on the right and forward side of bulkhead 15 in the lavatory compartment, comes effective when this section of the airplane passes through a 9g acceleration.

(b) ABA-1 AIRCRAFT RECOGNITION EQUIPMENT.—Mounting provisions are made for the installation of ABA-1 aircraft recognition equipment. A circuit breaker switch is provided on the flight engineer's panel.

(c) LM-7 FREQUENCY METER.

1. The frequency meter is used to measure or check the frequency of radio signals. It is used in conjunction with its internal crystal oscillator, its calibration and instruction book, and a short antenna placed in the field. This meter is located above the aft end of the radio table. The frequency meter obtains its power from the nearby interphone junction box. The short antenna runs to the antenna terminal board above the aft end of the radio table.

2. To operate the frequency meter, check that the antenna lead from the frequency meter is connected to the RAX terminal on the antenna terminal board, and that the interphone and RAX receivers are operating; then turn the ON-OFF switch on the frequency meter to "ON."

3. ASG-1 RADAR EQUIPMENT.—Provisions for installation of ASG-1 radar equipment are provided.

(5) INTERPHONE SYSTEM. (RL-24C.)

(a) GENERAL.

1. This system affords two-way communication between all crew stations and extra service for the pilot, co-pilot, and radio operator. Crew station boxes and their locations are listed below.

2. The pilot, co-pilot, and radio operator have double headphone circuits enabling them to simultaneously or individually monitor interphone, intersquadron, and RAX receiver signals. Their station boxes carry circuits for talking to all crew members and for talking over the interphone and intersquadron transmitter. The navigator can listen to interphone and intersquadron signals separately or together and can transmit over both of these circuits. The radio operator, through the interphone control unit, can listen to any combination of signals from interphone, intersquadron or RAX receivers and transmit over either the interphone or the G0-9 transmitter. The interphone control unit is located above the radio table and contains the pilot-to-radio operator signal light, the interphone audio amplifier, the volume

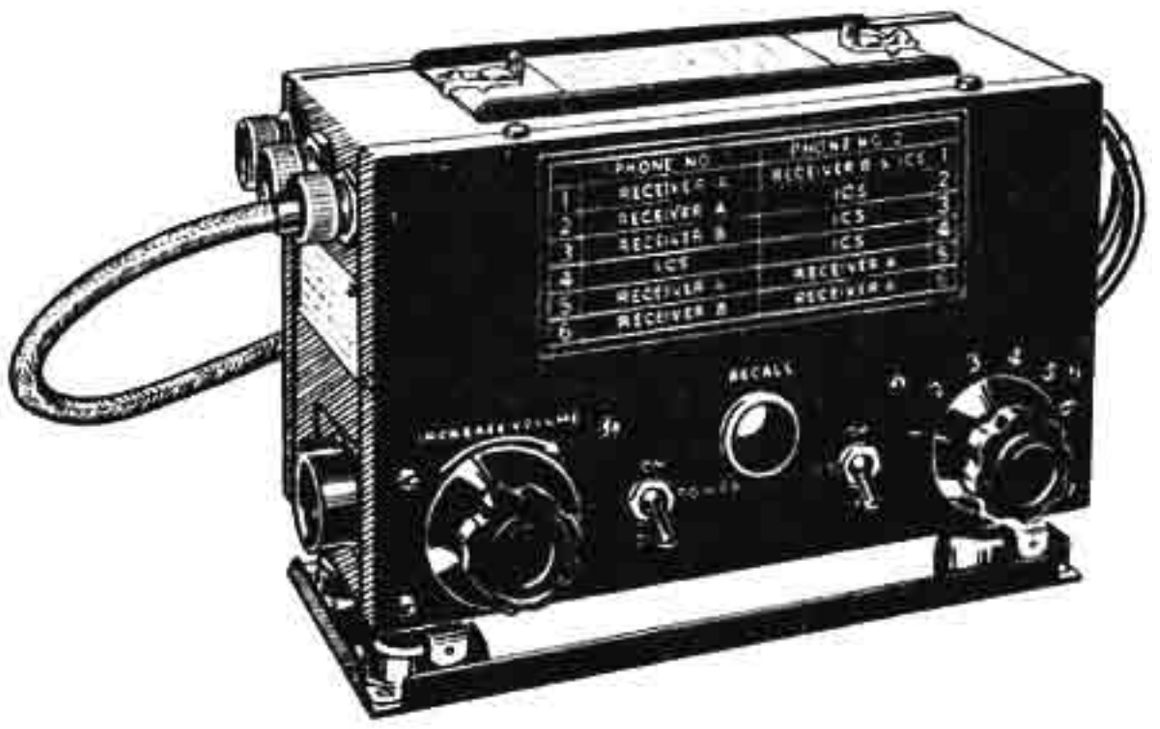


Figure 66 — Radio Operator's Control Box

control, the power "OFF-ON" switch, and the switching gear for mixing and selecting interphone and radio circuits.

3. All of the crew can communicate one with the other; however, only one at a time can talk. All station boxes are equipped with push-button switches for use with throat-type microphones and all but the pilot, co-pilot, and radio operator have individual volume controls. The pilot's control box, located between the pilot and co-pilot, contains an interphone volume control, a switch for attracting the radio operator's attention when he is disconnected from the interphone system, and switching gear to connect his station box into the desired circuit.

(b) OPERATION OF INTERPHONE EQUIPMENT.

1. RADIO OPERATOR'S STATION.

a. Check that the radio power switch on the flight engineer's panel is "ON."

b. Turn "ON" the power switch on the control box.

CREW STATION BOXES AND LOCATIONS

Bow Turret	In turret on left hand side.
Bomber's Compartment	Left side of Bomber's station just aft of instrument panel.
Galley	Aft side of frame 5 on center line of airplane.
Pilot	Outboard of pilot's left hand.
Co-pilot	Outboard of co-pilot's right hand.
Radio Operator's Station	Below forward end of radio table.
Radar Operator's Station	Outboard of Radar operator's left shoulder.
Navigator's Station	Below forward end of navigator's station.
Flight Engineer's Station	Right side of airplane opposite flight engineer's panels.
Stateroom Compartment	Forward end of stateroom.
Deck Turret	In turret on right hand side.
Right Waist Station	Right side of hull forward of hatch.
Left Waist Station	Left side of hull forward of hatch.
Tunnel Hatch	Right side of hull above and forward of tunnel hatch.
Tail Turret	In turret on right-hand side.

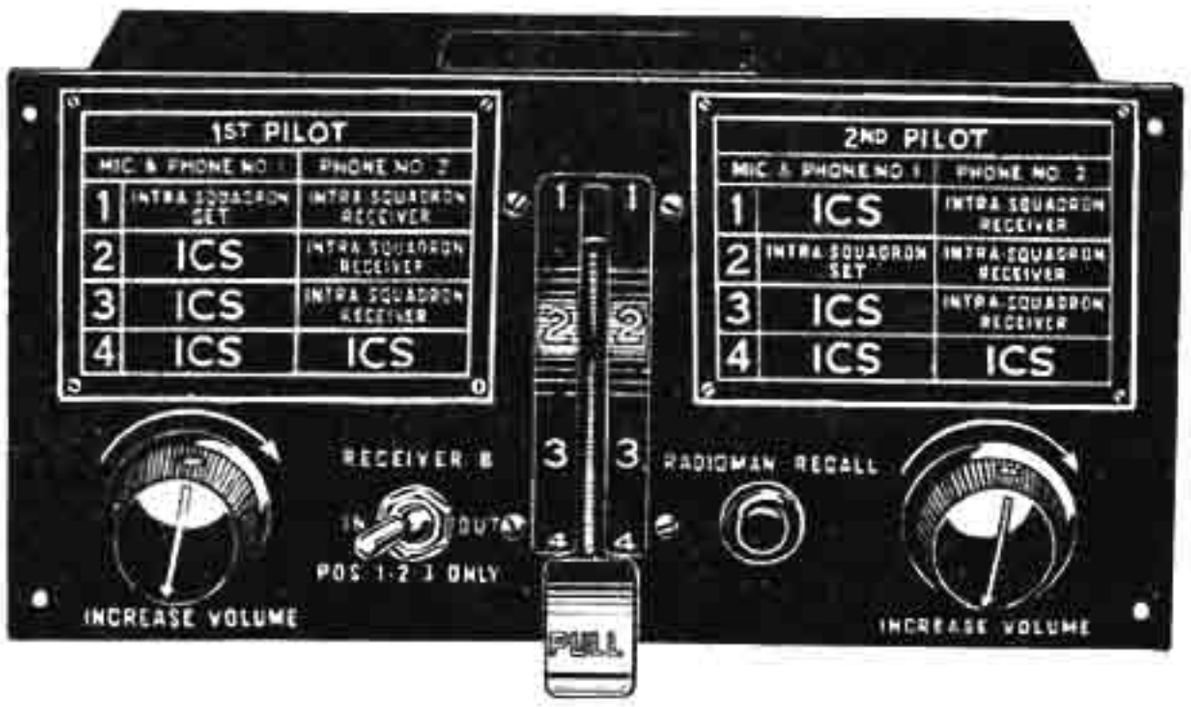


Figure 67 — Pilot's Control Box

c. Turn the control knob on the right-hand side of the control box for the desired operation as shown by the name plate on the control box.

d. To talk, press the push button on the microphone if provided, or if not, the push button on the station box.

e. To provide the pilot with the output of any "RAX" receiver throw the receiver output switch to "B" phone and the ICS selector switch to position "1," "2," or "3."

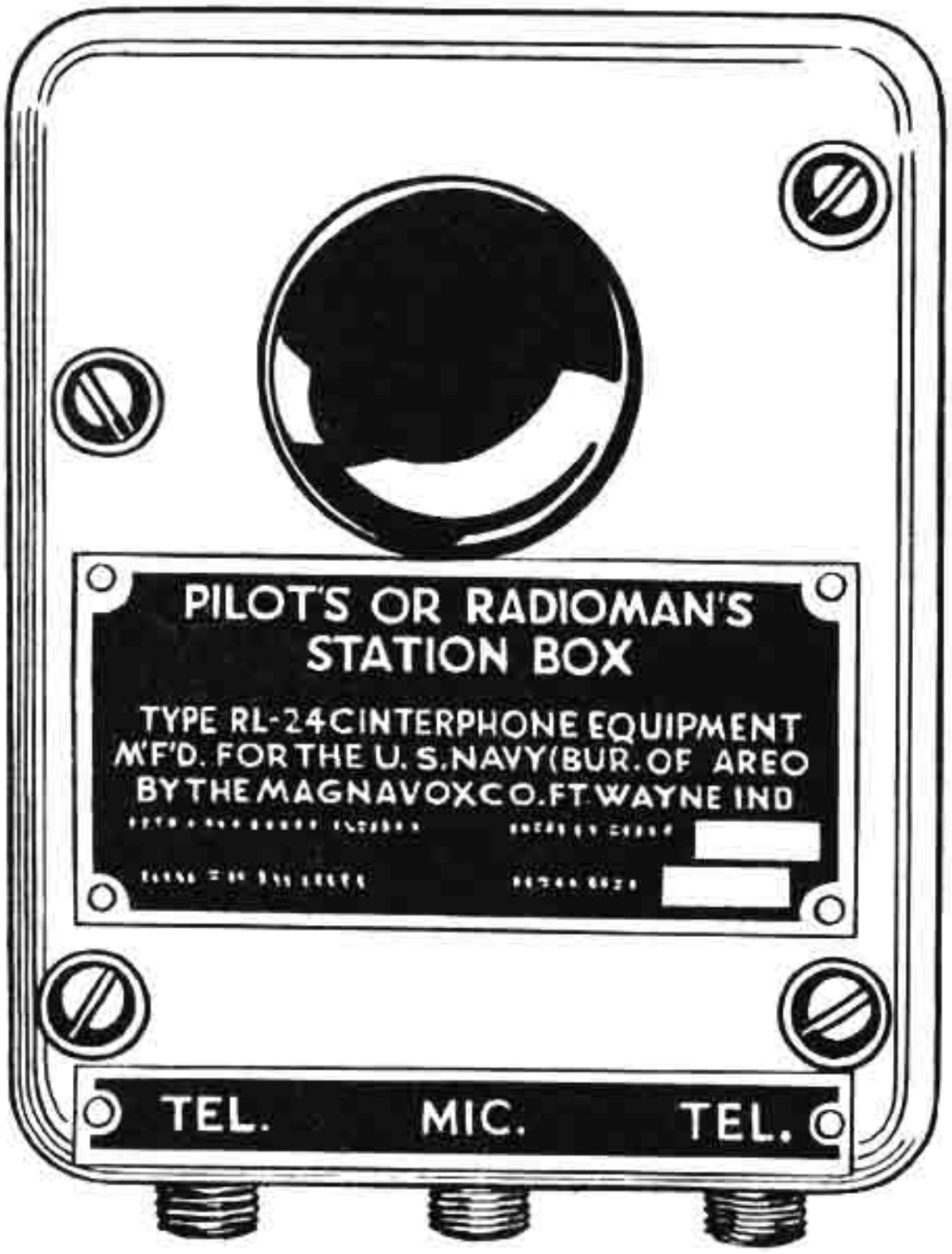


Figure 68 — Pilot and Radio Operator's Station Box

2. PILOT AND CO-PILOT'S STATION.

a. Move the selector switch on the pilot's control box downward for the desired operation, as indicated by the name plates on either side of the switch. After reaching the third position, the switch arm must be pulled outward to allow the arm to move to the fourth position. This movement also allows the arm to be moved upward without hesitating at any switch point or stop.

b. To talk, press the microphone button if provided, or if not the push button on the station box.

Figure 69 — Navigator's Station Box

Figure 70 — Crew Station Box

b. AIRPLANE NUMBER 59000 AND SUBSEQUENT.

(1) RADIO OPERATOR CONTROLLED COMMUNICATING EQUIPMENT.

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. Do not depend upon door switches or interlocks for protection but always shut down motor-generators or other power equipment. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors, etc. To avoid casualties, always discharge and ground circuits prior to touching them.

(a) RAX LIAISON RECEIVER.

1. DESCRIPTION.

a. RADIO RECEIVER UNIT NO. 1—TYPE CG-46115.

(1) The Radio Receiver No. 1 is a receiver of the superheterodyne type having one r-f (radio frequency) amplifier stage, a frequency converter stage, two i-f (intermediate-frequency) amplifier stages, a diode detector stage and an a-f (audio-frequency) amplifier stage. In addition, there is a separate AVC detector and a beat oscillator; these two additional functions are performed by the same tube which contains the main diode detector.

(2) This radio receiver unit tunes from 200 kc to 1500 kc in four bands as listed below:

	Signal Frequency
Band No. 1	200-300 kc
Band No. 2	300-500 kc
Band No. 3	500-900 kc
Band No. 4	900-1500 kc

b. RADIO RECEIVER NO. 2—TYPE CG-46116.

(1) The Radio Receiver No. 2 is a receiver of the superheterodyne type having two r-f amplifier stages, a frequency converter stage, three i-f amplifier stages, a diode detector stage and an a-f amplifier stage. In addition there is a separate AVC detector and beat oscillator, these two additional functions being performed by the same tube which contains the main diode detector.

(2) This radio receiver unit tunes from 1.5 mc to 9.0 mc in four bands as listed below.

	Signal Frequency
Band No. 1	1.5 - 2.4 mc
Band No. 2	2.4 - 3.8 mc
Band No. 3	3.8 - 6.0 mc
Band No. 4	6.0 - 9.0 mc

c. RADIO RECEIVER UNIT NO. 3—TYPE CG-46117.

(1) The Radio Receiver Unit No. 3 is a receiver of the superheterodyne type having two r-f amplifier stages, a frequency converter stage, three i-f amplifier stages, a diode detector stage and an a-f amplifier stage. In addition there are two additional functions being performed by the same tube which contains the main diode detector.

(2) This radio receiver tunes from 7.0 mc to 27.0 mc in five bands as listed below.

	Signal Frequency
Band No. 1	7.0 - 10.0 mc
Band No. 2	10.0 - 13.0 mc
Band No. 3	13.0 - 17.5 mc
Band No. 4	17.5 - 22.5 mc
Band No. 5	22.5 - 27.0 mc

2. OPERATION.—To introduce power into the RAX liaison receivers:

a. Close the "RADIO POWER" circuit-breaker switch (figure 28-16) on the flight engineer's panel.

b. Close the "RADIO POWER" switch (figure 54-4) on the radio operator's rheostat box.

(b) ATC LIAISON TRANSMITTER.

1. DESCRIPTION.—The Model ATC liaison transmitter consists of the transmitter unit, dynamotor power unit, one 200-600 kc low-frequency antenna loading coil with 250 feet of trailing antenna, and the necessary connecting cables. Operation on any one of 11 channels with VOICE, CW or MCW emissions is available.

2. OPERATION.—To introduce power into the ATC liaison transmitter:

a. Close the "RADIO POWER" circuit-breaker switch (figure 28-16) on the flight engineer's panel.

b. Close the "RADIO POWER" switch (figure 54-4) on the radio operator's rheostat box.

(c) AN/ARC-5 RECEIVER.

1. DESCRIPTION.—One Model AN/ARC-5 receiver is installed at the radio operator's position and is used as a stand-by or emergency receiver only.

2. OPERATION.—To introduce power into the Model AN/ARC-5 receiver:

a. Close the "RADIO POWER" circuit-breaker switch (figure 28-16) on the flight engineer's panel.

b. Close the "RADIO POWER" switch (figure 54-4) on the radio operator's rheostat box.

(2) PILOT CONTROLLED COMMUNICATING RADIO EQUIPMENT.

(a) AN/ARC-5 TRANSMITTING AND RECEIVING EQUIPMENT.

1. DESCRIPTION.—The Model AN/ARC-5 is a complete multi-channel radio transmitting and receiving set.

a. THE LF-MF-HF equipment is designed to transmit and receive voice, tone-modulated or continuous wave signals. The receivers cover the frequency range of .19 mc to 9.1 mc in five independent units any one, two, three or four of which may be installed and operated one at a time or simultaneously. The bands are .19-.55 mc, .52-1.5 mc, 1.5-3 mc, 3-6 mc, 6-9.1 mc. The transmitters cover the frequency range of 2.1 mc to 9.1 mc in five independent units, any one, two, three or four of which may be installed and operated one at a time depending on the requirements. The bands are 2.1-3 mc, 3-4 mc, 4-5.3 mc, 5.3-7 mc, 7-9.1 mc. Additional transmitter units covering the bands of 5-.8 mc, .8 to 1.3 mc and 1.3-2.1 mc are supplied for special purposes.

b. VHF EQUIPMENT.—The VHF equipment is designed to transmit and receive voice or tone-modulated signals. The VHF transmitter contains four crystal-controlled channels. The VHF receiver ordinarily operates on the same four frequencies as the VHF transmitter and is also crystal controlled.

2. OPERATION.—To introduce power into AN/ARC-5:

a. Close the "RADIO POWER" circuit-breaker switch (figure 28-16) on the flight engineer's panel.

b. Close the "RADIO POWER" switch (figure 17-6) on the top of the pilot's pedestal.

(b) SCR-269F RADIO COMPASS.

1. DESCRIPTION. — The Model SCR-269F radio compass is basically a radio receiver using a superheterodyne circuit with the additions of certain essential circuits necessary for radio compass operation. The frequency range of the equipment from 200 to 1750 kc is covered in three bands. Only the frequency band in use is visible on the tuning scale. The SCR-269F is a complete unit capable of providing:

a. Automatic bearing indication of the direction of arrival of radio frequency energy and simultaneous aural reception of modulated or unmodulated radio frequency energy;

b. Aural reception of modulated or unmodulated radio frequency energy using a loop antenna;

c. Aural reception of modulated or unmodulated radio frequency energy using a loop antenna;

d. Aural-null directional indications of the arrival of modulated or unmodulated radio frequency energy using a loop antenna.

2. OPERATION.—To introduce power into the SCR-269F radio compass:

a. Close the "RADIO POWER" circuit-breaker switch (figure 28-16) on the flight engineer's panel.

b. Close the "RADIO POWER" switch (figure 17-6) on the top of the pilot's pedestal.

(3) PILOT CONTROLLED RADIO NAVIGATING AND INSTRUMENT LANDING EQUIPMENT.

(a) AN/ARR-2 NAVIGATIONAL RECEIVER ADAPTER.

1. DESCRIPTION.

a. GENERAL.—The AN/ARR-2 is a radio receiving unit with equipment used to receive a particular type of ultra-high frequency signal for navigational purposes.

b. RADIO RECEIVER R-4/ARR-2. — The R-4/ARR-2 is a superheterodyne-type receiver. Six modulation frequency pre-set channels are available and may be selected by remote control.

c. CONTROL BOX C2/ARR-2. — The "OFF-NAV-VOICE" switch, the modulation frequency "CHANNEL" selector control, the "OUTPUT" control, the "BEAT-NOTE" control, the headphone jack are located on the front of the Model C2/ARR-2 control box. All controls necessary for operating the equipment on a single carrier frequency are contained in this unit.

d. MISCELLANEOUS. — A dynamotor, vacuum tubes, plugs and cables are provided to complete the installation. A test oscillator is also provided for testing purposes.

2. OPERATION.—To introduce power into AN/ARR-2:

a. Close the "RADIO POWER" circuit-breaker switch (figure 28-16) on the flight engineer's panel.

b. Close the "RADIO POWER" switch (figure 17-6) on the top of the pilot's pedestal.

(b) AN/APN-1 RADIO ALTIMETER.

1. DESCRIPTION.—The AN/APN-1 radio altimeter is designed to provide direct indication of altitude relative to the terrain during flight. It is provided with a double range indicator, and in addition to the power switch it is equipped with a range switch. This latter control is geared to a shutter which changes the scale numerals to correspond to the range for which the control is set.

2. OPERATION.—Power is supplied direct from the bus in the flight engineer's panel to the altimeter controls.

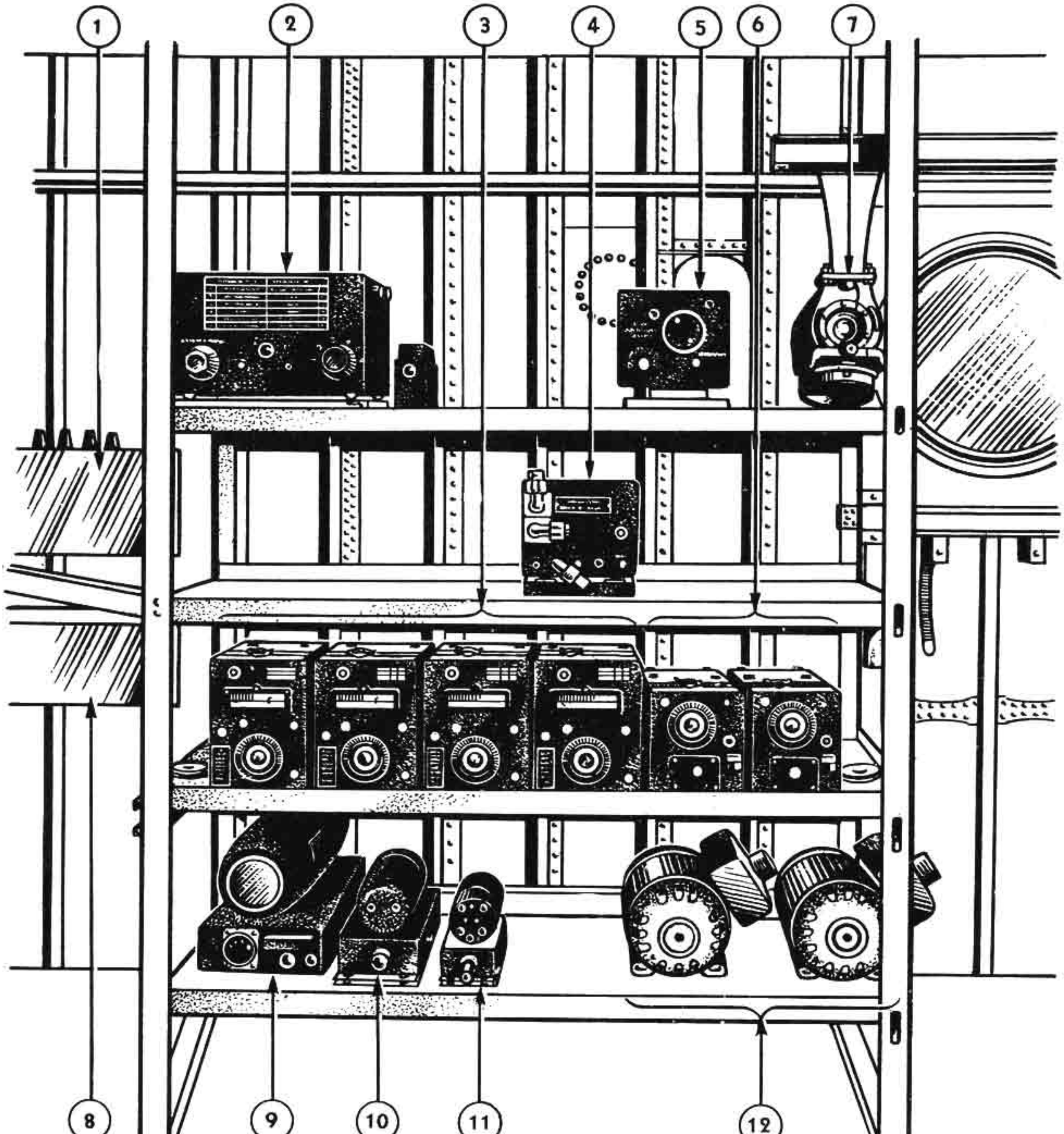
(4) NAVIGATOR CONTROLLED RADIO NAVIGATING EQUIPMENT.

(a) LORAN.—Provisions are made for the installation of the AN/APN-4 equipment aft of the radio operator's station so that it will be convenient to the navigator.

(5) NON-COMMUNICATING RADIO EQUIPMENT.

(a) AN/APX-2.—Provisions are made for the installation of the AN/APX-2 Recognition equipment.

(b) ABA-1.—Provisions are made for the installation of the ABA-1 Recognition equipment.



Ref. No.	Nomenclature
1	*Radio Compass and Inverter Junction Box*
2	*Radio Compass Amplifier*
3	*Intersquadron Transmitters (AN/ARC-5)*
4	*Marker Beacon Receiver (AN/ARN-8)*
5	*Liaison Transmitter Oscillator (ATC)*
6	*Intersquadron Transmitters (AN/ARC-5)*
7	*Torpedo Director*
8	*Interphone Junction Box*
9	*ATC Dynamotor*
10	*Interphone Dynamotors*
11	*Interphone Dynamotors*
12	*AC Inverters*

Figure 71 — Radio Rack in Galley Compartment

(c) AN/APS-2F.—Provisions are made for the installation of the AN/APS-2F equipment.

(d) LM-14 FREQUENCY METER.

1. DESCRIPTION.—The frequency meter is used to measure or check the frequency of radio signals. It is used in conjunction with its internal crystal oscillator, its calibration and instruction book and a short antenna placed in the field. This meter is located above the forward end of the radio table. The frequency meter obtains its power from the interphone amplifier. The short antenna runs to the RAX receiver.

2. OPERATION.—To operate the frequency meter, check to see that the antenna lead from the frequency meter is connected to the RAX terminal and that the interphone is operating; then turn the "ON-OFF" switch on the frequency meter to "ON" position.

(6) INTERPHONE (RL-24C Modified) AN/AIA-2.

(a) GENERAL DESCRIPTION.

1. PURPOSE OF EQUIPMENT.—The interphone equipment AN/AIA-2 consists of four basic units which provide an audio distribution and control system.

2. DESCRIPTION OF COMPONENTS.

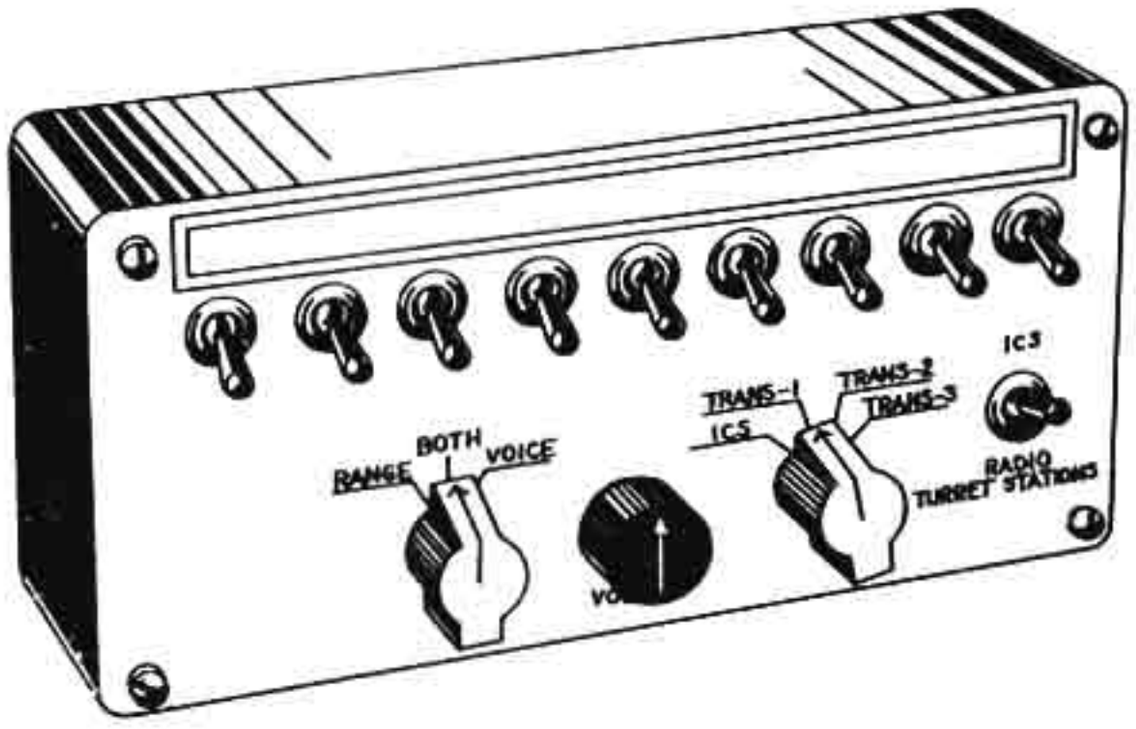
a. CONTROL BOX C-69/AIA-2. — The control box supplied for members of the flight crew has nine switches for receiver audio selection; a four position switch for selection of any of the three transmitters or the interphone; a switch for giving the crew control of the VHF transmitter; a range filter switch; and a volume control. A jack box is used in conjunction with each control box to provide outlet jacks for the microphone and headphones of that member of the flight crew.

b. STATION BOX C-70/AIA-2. — This station box is furnished for crew members as well as turret operators. The operation units of the box include a three-position switch for control of the VHF transmitter and interphone, a volume control and jacks for connection of microphone and headphones. Tie points are also furnished for the connection of a mask microphone and a "throttle" or remote switch.

c. JUNCTION BOX J-36/AIA-2. — The junction box provides interconnection for the units of Interphone Equipment AN/AIA-2 and other units of the plane's communication system. Located in this box are the range filters; the necessary relays for operation of the system; fuses for the relays isolation-amplifier filaments; and power unit. Connections to the box are made by standard AN-type plugs.

d. DYNAMOTOR UNIT DY-13/AIA-2. —The dynamotor unit supplies high voltage for the isolation amplifiers in control boxes C-69/AIA-2.

e. RL-24C MODIFIED INTERPHONE AMPLIFIER.—The Model 24RL-24C modified interphone amplifier is the main amplifier. The controls on the face of the panel are inoperative and the volume level is set by means of the R-6 in the J-36 junction box.



Receiver Selector Switch	Receiver
1	*Low Frequency*
2	*Radio Compass*
3	*Marker Beacon*
4	*High Frequency—Pilot*
5	*Homing*
6	*High Frequency—Radio Operator*
7	*Very High Frequency*
8	*RAX—A*
9	*RAX—B*

Figure 72 — Control Box—C-69/A1A-2

Figure 73 — Station Box—C-70/A1A-2

f. DM416 DYNAMOTOR OR EQUIVALENT.—The Model DM416 dynamotor or equivalent supplies the high voltage for the RL24C modified interphone amplifier as well as the Model LM10 crystal frequency meter.

(b) OPERATION.

1. CONTROL BOX C-69/AIA-2.

a. RECEPTION. — Provision is made by the nine separate switches (see figure 72) along the top front of the box for as many as nine receivers of which any member of flight crew may select any single receiver or combination of receivers without causing interference to the others. Range-filter switches (see figure 72) provided for two of the receivers are so connected that any of the flight crew may select RANGE, VOICE or BOTH from either receiver without affecting others of the crew. To select any receiver the crew member has only to turn on the switch associated with that receiver. If it is a range receiver he may then use the range-filter switch to select "RANGE," "VOICE," or "BOTH."

b. TRANSMISSION.—Control is provided by the four-position switch (see figure 72) for members of the flight crew to use interphone or any one of three transmitters. It is only necessary for the crew member to turn this switch to the function desired and operate by pushing his push-to-talk button. Sidetone is provided through channels of the receiver associated with that transmitter, providing that the switch for that receiver is in the "ON" position. Any of the flight crew may also switch control of the VHF transmitter to members of the crew. To do this he turns his ICS/RADIO TURRET STATIONS switch (see figure 72) to the "RADIO TURRET STATIONS" position. When the switch is turned in this position, any member of the crew may use the VHF radio transmitter. In the "ICS" position, on the contrary, the crew is restricted to use of the interphone only.

c. VOLUME CONTROL.—The action of the VOLUME control (see figure 72) is limited so that it can never be turned completely off.

2. STATION BOX C-70/AIA-2.

a. SWITCHING. — The three-position switch (see figure 73) is marked "RADIO," "ICS CREW," and "ICS ALL." This switch transfers both the microphone audio and push-to-talk control to the unit selected. In the "RADIO" position, these are transferred to the VHF radio. In this position, however, the transmitter is operative only when the ICS-RADIO TURRET STATIONS switch of some member of the flight crew is in the "RADIO TURRET STATIONS" position. In the "ICS CREW" position, he may communicate only with other members of the crew. However, in the "ICS ALL" position, he may communicate with the entire airplane's crew. Regardless of the position of this switch, the VHF radio receiver is heard by the members of this crew until someone in the airplane operates the interphone by pushing his push-to-talk button.

b. VOLUME CONTROL.—The action of the VOLUME control (see figure 73) is limited so that it can never be turned completely off.

c. SIGNAL SPOTLIGHT.—A mounting socket is provided on the outside of the hull between the pilot's and co-pilot's escape hatches for the mounting of the portable signal spotlight which is stowed on the platform just aft of the radio operator's table. The spotlight may be plugged in to either utility receptacle (figures 16 and 17-10) on the pilot's pedestal.

d. RECOGNITION LIGHTS.—Three lights, red, green, and amber are located on the bottom of the right wing tip, and one white light is located on the top of the right wing tip. The recognition lights may be operated continuously by turning their respective switches (see figures 16 and 17-4) to "ON," or they may be operated intermittently by turning the switches to "SIGNAL" and pressing the signal key.

7. OPERATION OF HEATING AND VENTILATING SYSTEM.

a. GENERAL.—The heating and ventilating system is composed of; a gasoline heater called the bow compartment heater, which is used to heat the flight deck and galley, defrost the windshield and bombsight or as a fan for circulating the air; a control unit used for operating the heater and fan; and the necessary ducts for distributing the heated air to the various compartments. The heater provides means for burning gasoline from the right wing service tank and for the transfer of resulting heat of combustion to the flight deck. The air circulating fan, which is part of the heater, can be operated independently without the heating unit in operation to provide flight deck ventilation.

b. OPERATION.

(1) STARTING THE HEATER.

(a) Before starting the heater, make sure a gasoline supply is available by turning on the control valve (figure 26-1) on the flight engineer's fuel trunk marked "HEATER."

(b) Pull out choke (figure 75-10) to its fullest extent.

(c) Press igniter switch button (figure 75-5) and red light will appear to indicate that the igniter circuit is in operation.

Note

The actual heating up of the igniter plug can be checked by observing the glow of the igniter at the sight glass (when provided). (See figure 75-13.)

(d) Turn the switch marked "HEATER" (figure 74) to the "ON" position approximately 25 sec-

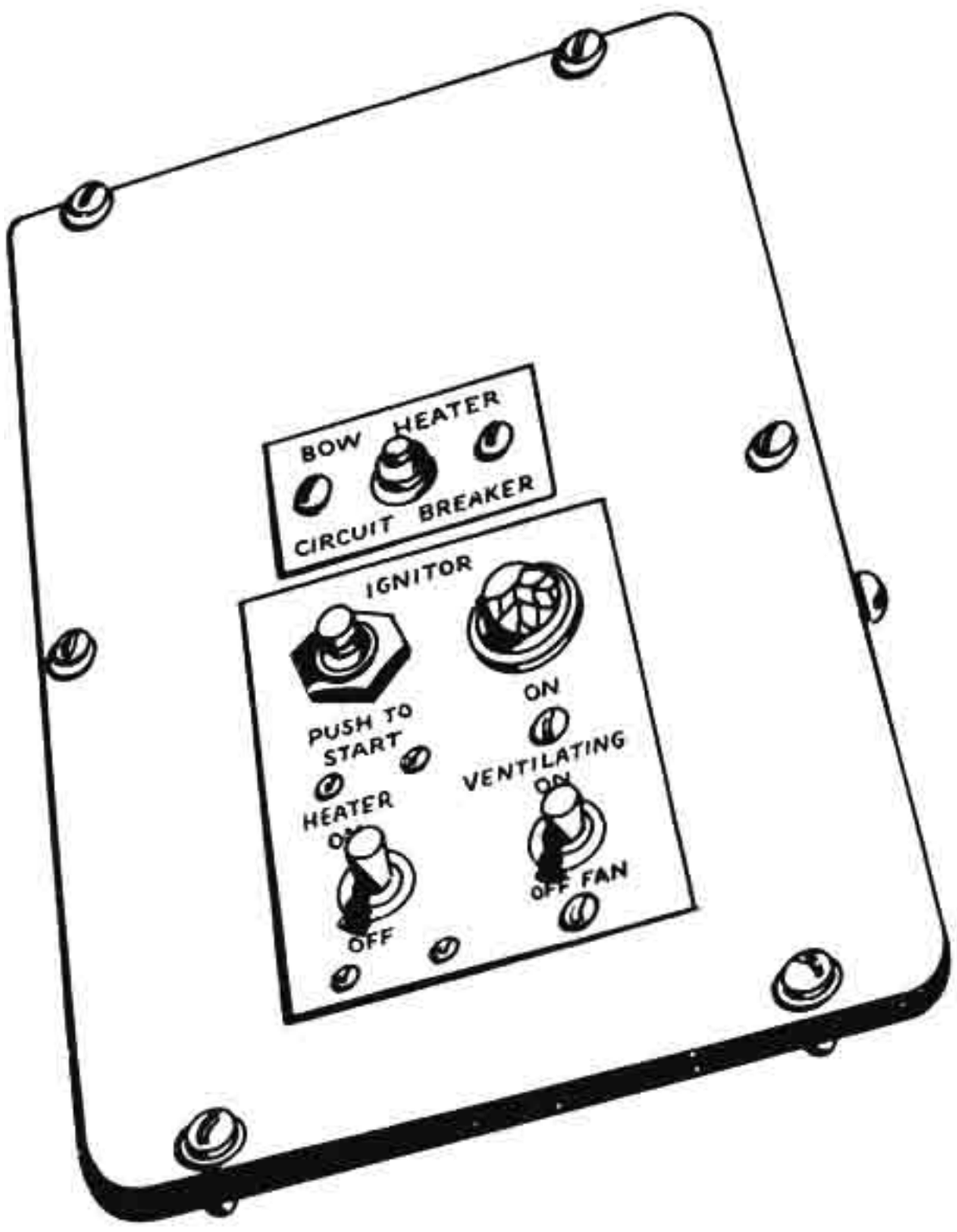


Figure 74 — Heater Control Panel—Forward Side of Bulkhead 5

onds later, at which time the igniter sight glass (when provided) should show a bright red glow.

Note

The automatic cut-out, built into the igniter switch, may cut out before the heater lights and it may be necessary to hold the igniter button depressed for a longer period of time to insure proper lighting.

(e) The heater starting switch (figure 74) is now turned on and the heater is in operation.

(f) The fuel pressure gage near the heater should read between 4-1/2 to 5-1/4 pounds with heater in operation and should be checked after heater starts.

(g) Warm air should be felt within a minute from the air outlet and the choke should now be gradually pushed into its normal position.

(h) If the red igniter circuit light (figure 74) is still on, pull out igniter button. (See figure 75-5.)

(i) The flame can be observed through the sight glass (figure 75-13) located on the face and lower side of the heater and should be of a bluish tint.

(2) SHUTTING OFF THE HEATER.

(a) Turn on the ventilating fan.

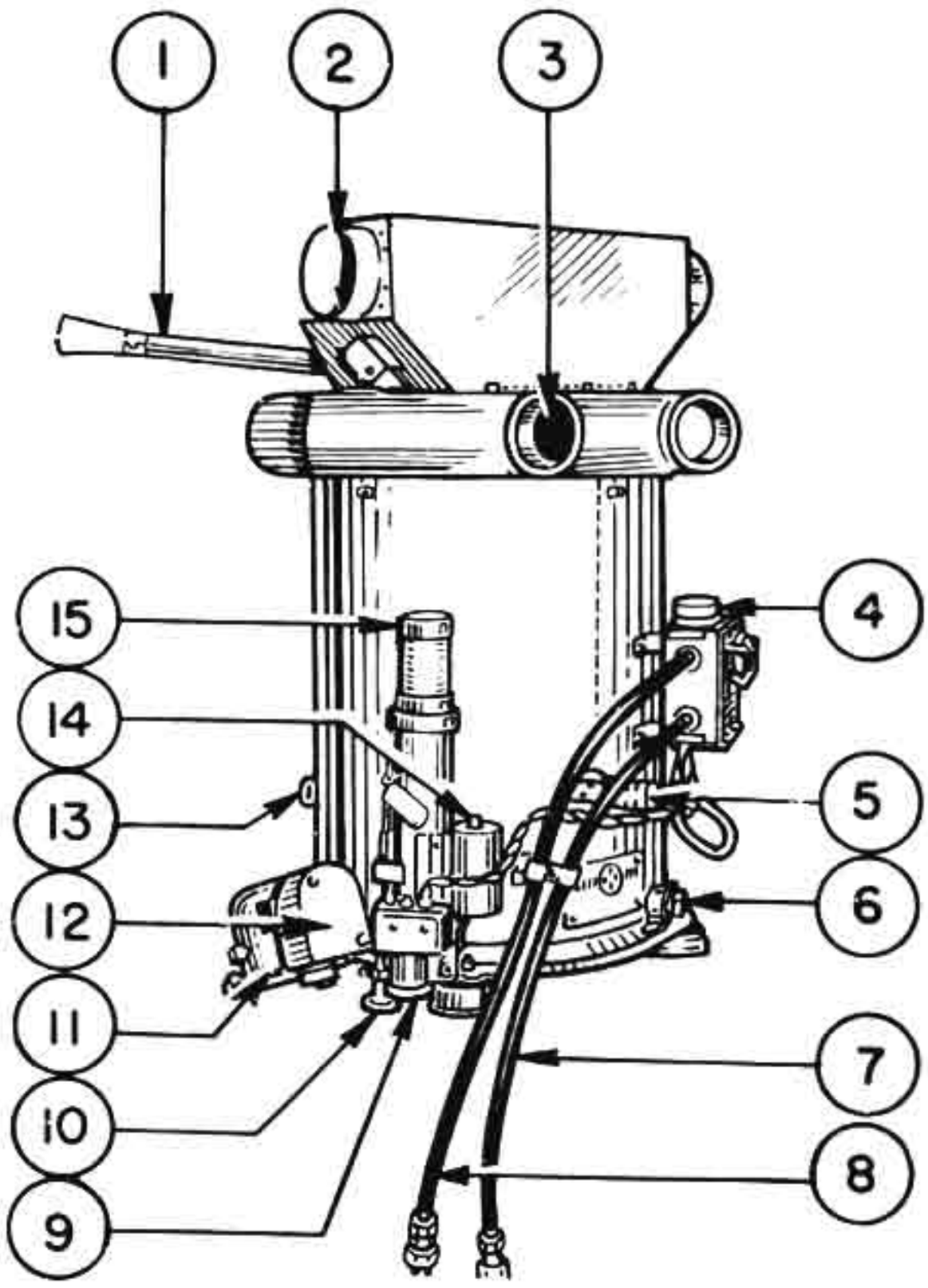
(b) Shut off the fuel.

(c) After the air from the heater has cooled off, turn off the ventilator fan.

(3) OPERATION OF HEATER FOR CIRCULATION OF COOL AIR.

(a) Turn the switch on the control panel (figure 74) marked "VENTILATION" to the "ON" position.

(4) OPERATION OF SAFETY DEVICES.—Maladjustment or improper operation of heater is guarded against by the incorporation of two safety devices—an overheat cut-off and a detector for excess gasoline.



Ref. No.	Nomenclature
1	*Braces*
2	*Air Distributor*
3	*Air Distributor*
4	*To Remote Heater-Control Panel*
5	*Ignitor*
6	*Fuel Inlet*
7	*Attaches to Solenoid Valve*
8	*Attaches to Overheat Cutoff*
9	*Excess Gasoline Detector*
10	*Choke Control*
11	*Exhaust Outlet*
12	*Overheat Cutoff*
13	*Sight Glass*
14	*Altitude Compensator*
15	*Firecheck and Air Inlet*

Figure 75 — Bow Heater Unit

Both devices incorporate a manual reset. Either will stop the entire heating unit, shutting off the gas supply through the solenoid valve, disconnecting the electrical circuit to the heater and stopping the motor.

(a) EXCESS GASOLINE DETECTOR. — The excess gasoline detector is installed in the combustion air inlet. If the choke is held down too long, excess gasoline may accumulate in the combustion air intake tube. The sensitive gasoline detector fuse will release and shut down the entire system by tripping an Ancro switch located directly above it. To start the heater again:

1. Put heater starting switch in "OFF" position.

2. Remove knurled fuse holder.

3. Drain out excess gasoline and wipe.

4. Insert a new fuse in holder.

5. Replace holder.

6. Press the reset button through the hole in the top of the detector housing.

7. Press button marked "VENTILATION" and run the heater for a short time.

8. Start heater in usual manner.

Note

A spare fuse container is held in place on the heater junction box.

(b) OVERHEAT CUT-OFF.—The overheat cut-off is mounted in the exhaust outlet. Should the temperature go higher than normal due to improper operation of heater, the overheat cut-off will function automatically to shut down the entire system by tripping an "ANCRO" switch. To start the heater again:

1. Put heater starting switch in "OFF" position.

2. Turn on "VENTILATION" switch and allow time for unit to cool.

3. Press reset button in.

4. Start heater in usual manner.

c. CAUSES OF FAILURE OF HEATER TO LIGHT.

(1) When the heater switch has been turned on, read the pressure gage. If no pressure is indicated:

(a) The fuel pump may not be operating.

(b) The manual gasoline shut-off valve may be closed.

(c) There may be dirt on the seat of the pressure relief valve.

(d) The solenoid gasoline valve may not have opened.

(2) If the pressure gage shows 4-1/2 or 5-1/2 pounds at the start, and when the heater switch is shut off, the pressure does not drop quickly to zero, it indicates either that the fuel spray orifice or the filters have become clogged.

(3) If the pressure quickly falls to zero when the heater switch is shut off, it indicates that the orifice is functioning properly and the igniter and its electrical circuit should be checked.

(4) If the fuel pressure and ignition are both in order check settings and freedom of movement of the air intake butterfly and choke valves.

d. ADJUSTMENTS FOR HEATER.—For proper combustion the flame near the ceramic ports should be well definited and of a bluish tint at or near sea level. At high altitudes, the flame may appear to be greenish. If the flame is yellow or diffused throughout the combustion chamber, the air-gas mixture is too rich. There are several causes:

(1) The butterfly valve in the air intake may be insufficiently open. To adjust the valve, turn the nut at the upper end of the altitude bellows control mount counterclockwise until the flame develops a bluish tint as mentioned above.

Note

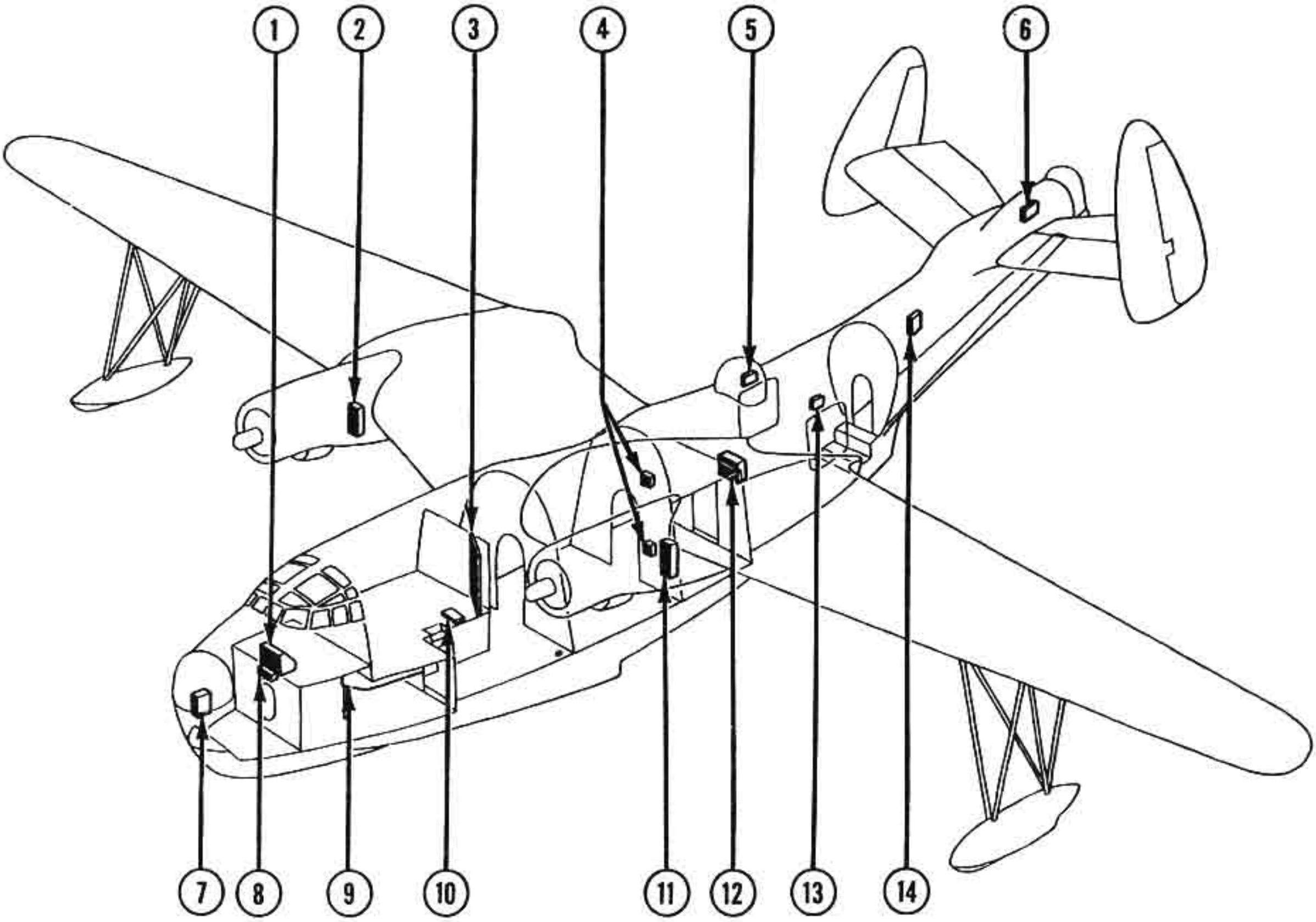
Adjustments should be made at sea level only, to prevent the altitude bellows from being unduly strained.

(2) The gasoline pressure may be too high. (Above 5 pounds per square inch.)

(3) There may be clogging of burner ports by accumulation of lead.

8. UTILITY RECEPTACLES.

Utility receptacles for the connection of electrically heated flying suits, bilge pumps, portable lights and other 24-volt electrical equipment are provided at all crew stations and elsewhere in the hull. (See figure 76.) An ON-OFF switch is provided for each receptacle.



Ref. No.	Nomenclature
1	*Pilot's Pedestal*
2	*Right Engine D.C. Junction Box*
3	*Flight Engineer's Switch Panel*
4	*Receptacle Box, Bulkhead 20*
5	*Right-Hand Waist Box*
6	*Tail Gunner's Box*
7	*Bomber's Switch Panel*
8	*Bomber's Circuit Breaker Panel*
9	*Electrical Duct, Frame 7*
10	*Electrical Duct, Frame 12-4/7*
11	*Left Engine D.C. Junction Box*
12	*Distribution Box, Bulkhead 24*
13	*Left-Hand Waist Gun*
14	*Tunnel Gunner's Box*

Figure 76 — Utility Receptacles

APPENDIX I
FLIGHT OPERATING CHARTS, TABLES, CURVES, AND DIAGRAMS

1. ENGINE CALIBRATION CURVES.
(See figure 77.)

a. 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 curves on Sheet (1) and Sheet (2) are for "AUTO LEAN" and "AUTO RICH" operation respectively. On both sheets the curves to the right are for HIGH BLOWER operation. Part throttle conditions are those to the left of the oblique heavy (limiting B.M.E.P.) line in both the LOW and HIGH BLOWER sections; full throttle conditions are those to the right of these lines.

b. HIGH POWER—RICH MIXTURE (PART THROTTLE). *(See figure 77, Sheet 2.)*

(1) 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 43.5 inches Hg at S.L. decreasing to 42.6 inches Hg at 8000 feet.

(2) 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.

c. CRUISING POWER—LEAN MIXTURE (PART THROTTLE).—For power conditions in AUTO LEAN (See figure 77, Sheet 1) same procedure as in HIGH POWER listed above is used.

d. TO DETERMINE HORSEPOWER—ANY POWER CONDITION.

(1) Knowing RPM and manifold pressure, spot the condition in the full throttle portion of the section of the chart for the blower ratio in which the engine is operating.

(2) Draw a line through the point determined parallel to the constant manifold pressure-RPM lines shown. Read HP at the intersection of this line with the observed pressure altitude.

e. PRESSURE ALTITUDE.

(1) Determine the amount the barometric pressure (altimeter window reading) is above or below 29.92 inches Hg.

(2) Add 100 feet for each 0.1 inch Hg below 29.92 subtract 100 feet for each 0.1 inch Hg above 29.92.

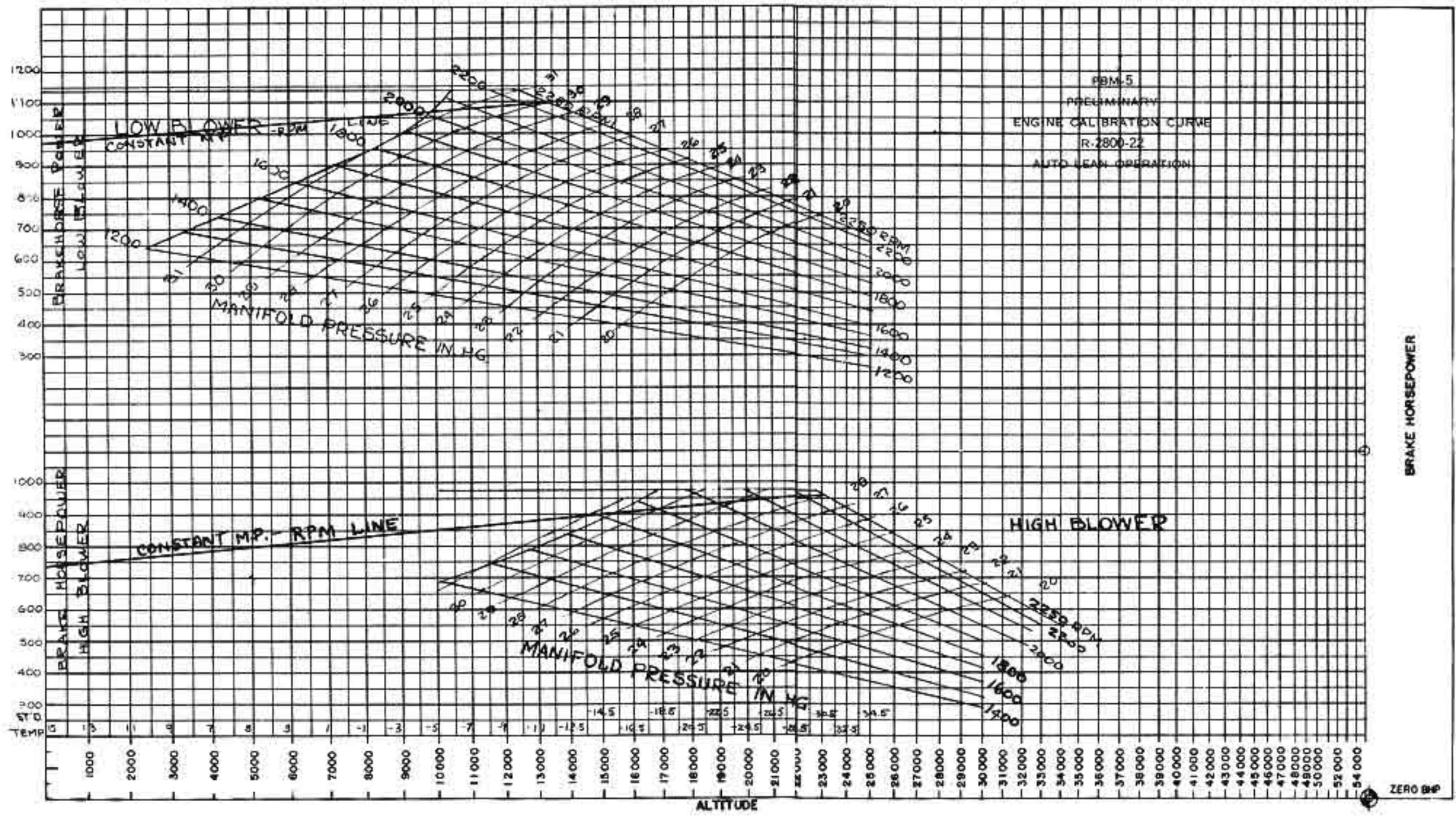


Figure 77 (Sheet 1 of 2 Sheets) — Engine Calibration Curve

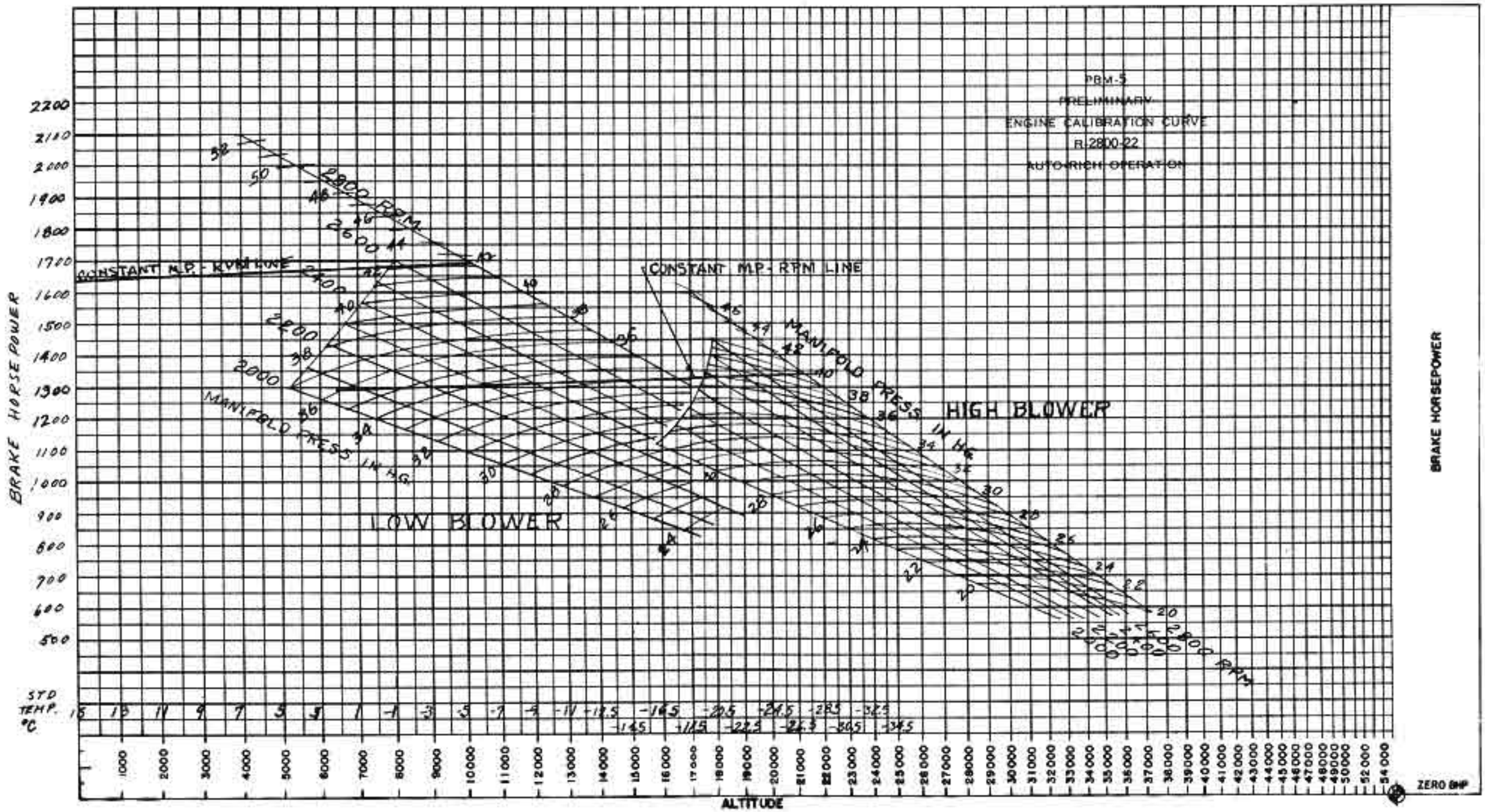


Figure 77 (Sheet 2 of 2Sheets) — Engine Calibration Curve

ADDENDUM I

TO

AN 01-35ED-1

PILOT'S HANDBOOK OF

FLIGHT OPERATING INSTRUCTIONS

FOR

U. S. NAVY MODEL PBM-5

Airplane Nos. 45405, 45407-45514, 59100-59146

This addendum supersedes the operating instructions contained in the Pilot's Handbook for the above numbered airplqnes and applies only while Hamilton Standard Hydromatic propellers are installed.

AUGUST 10, 1944

OPERATING INSTRUCTIONS FOR PBM-5 WITH HYDROMATIC PROPELLER

1. INTRODUCTION.

Hamilton Standard Hydromatic propellers, Model 33E60 with Model 6491 blades, will be installed as a temporary expedient on all PBM-5 airplanes until Curtiss Electric Propellers, Model C642S-B26 with Model 836-1C2-0 blades, are available. This change will affect airplane numbers 45405, 45407-45514, and 59100-59146, but the Hamilton Standard propellers will be replaced with Curtiss propellers when available. When electric propellers are installed, destroy this addendum.

The only control changes will be the removal of the Curtiss propeller selector switches, feathering switches, and circuit breaker re-set butttons from the pilot's pedestal and replacing them with the Hamilton feathering switches and the necessary wiring. (See figure A.) Other changes will be made in the power plant section forward of the firewall. The oil tank sump will be provided with an additional outlet for the propeller feathering system, and the engine oil outlet will be provided with a standpipe so that approximately 3 1/2 gallons of oil will be available at normal attitudes and 1 1/2 gallons during side slips for feathering the propeller. An electric propeller feathering pump will be installed, and the propeller governor control linkage will be altered to meet the requirements of the Hamilton installation. A circuit breaker switch will be installed on the flight engineer's switch panel next to the existing propeller switches to control the power to the feathering pump. (See figure B.)

2. GROUND TEST.

a. TEST OF GOVERNING ACTION.

(1) After completing the engine warm-up with the propeller governor in the extreme forward "INC. RPM" position, open the throttles to 1800 rpm and move the propeller governor control to the "DEC. RPM" position. Move the governor control several times between the "DEC. RPM" (high pitch) and the 1800 rpm position, allowing time for the engine speed to follow the propeller control to eliminate air from the system.

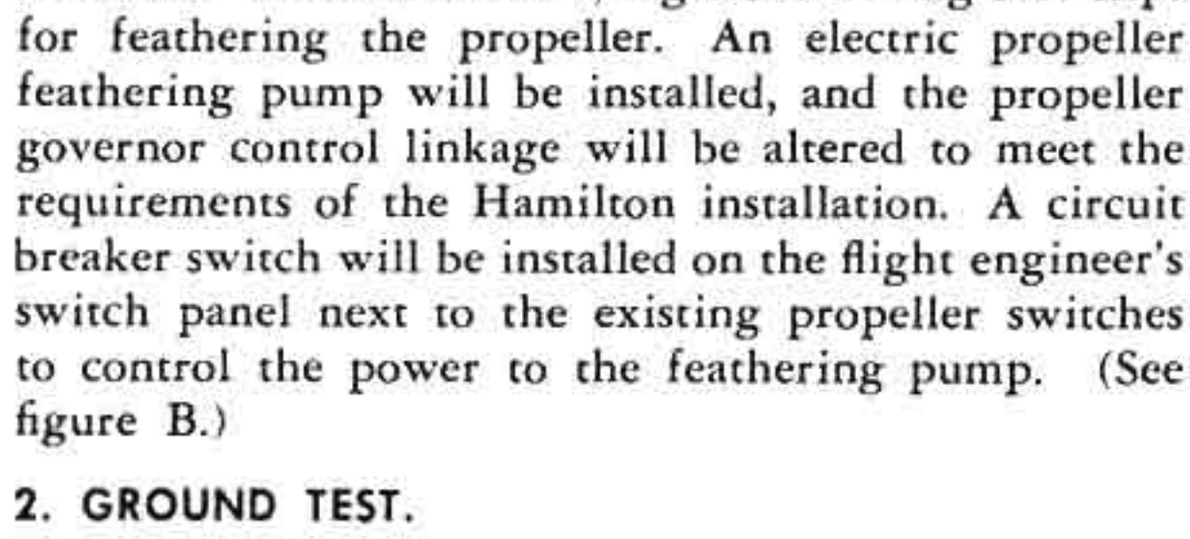


Figure A — Feathering Switches on Pilot's Pedestal

Note

Do not decrease rpm so that manifold pressure exceeds 30 inches.

(2) Check that the governor has control of the propeller through the operating range by moving the governor control from the full "INC. RPM" position to the full "DEC. RPM" position and noting the decrease in rpm.

b. MAGNETO CHECK.—With the propeller blades in the full "INC. RPM" position, and the throttle retarded enough so that the engine runs at less than 2800 rpm, any variation in power will produce a change in rpm. The magnetos may therefore be checked in the normal manner at full "INC. RPM," 2100 rpm, and 30 inches Hg. manifold pressure.

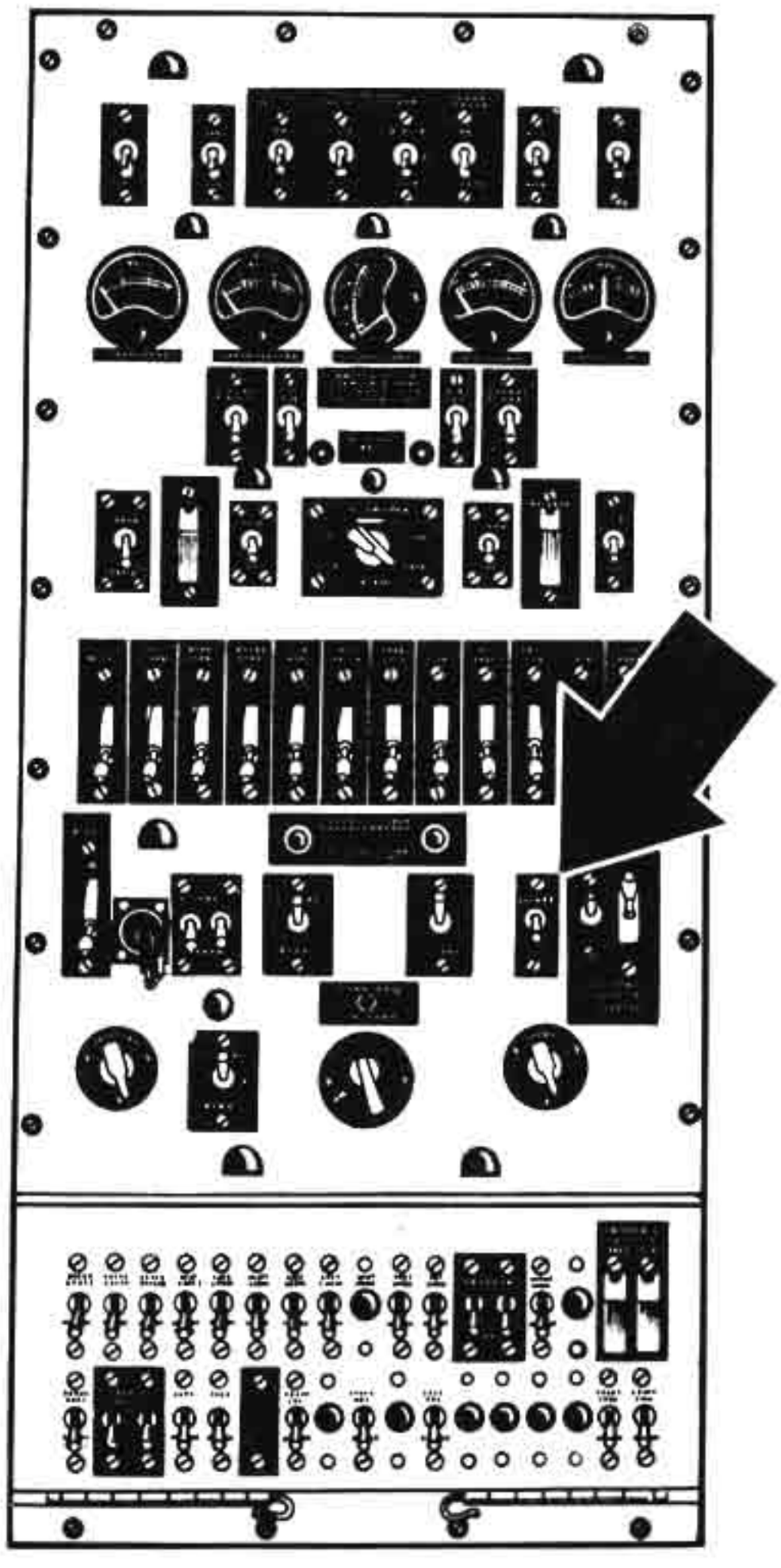


Figure B — Propeller Feathering Circuit Breaker Switch on Flight Engineer's Switch Panel

c. CHECK OF FEATHERING SYSTEM.

Note

It is not necessary to check the feathering system before each flight. Once every 60 hours is sufficient.

(1) After engines are warmed up and with the governor control set to the full "INC. RPM" position:

(2) Open throttle to a position where 1500 rpm is attained.

(3) Adjust the other engine to run at 1800 rpm. This will insure that one generator is charging sufficiently to furnish adequate electrical energy for the feathering operation.

(4) Close generator switch for engine which was adjusted to 1800 rpm.

(5) Depress feathering button on the engine being checked until a decrease in rpm is indicated.

(6) Release feathering button manually. The engine should then resume a speed of 1500 rpm after a short time.

(7) If the propeller does not respond in accordance with the foregoing procedure, the feathering system is not functioning properly and should be checked.

(8) Repeat this procedure for the other engine.

3. FEATHERING IN FLIGHT.

a. Close the throttle.

WARNING

The propeller feathering circuit breaker switch on the flight engineer's switch panel should be in the "ON" position at all times during flight.

b. Depress the propeller feathering switch on the inoperative engine.

WARNING

Do not feather the propeller on the good engine. If the wrong feathering switch is inadvertently closed the feathering action can be stopped and the propeller returned to constant speed control by manually reopening the feathering switch.

c. Advise the flight engineer to place the mixture control lever for the dead engine in the "IDLE-CUT-OFF" position, turn the engine selector valve for that engine to the "OFF" position, and close the cowl and oil cooler flaps on the dead engine.

d. Turn the ignition switch to "OFF" after the propeller has stopped turning.

4. UNFEATHERING IN FLIGHT.

a. Turn the ignition switch to "BOTH."

b. Set the propeller governor to the full "DEC. RPM." position.

c. Advise the flight engineer to turn the engine selector valve to "SERVICE TANK" with the fuel booster pump switch turned to "NORMAL," to place the mixture control in "AUTO RICH," and to adjust the cowl and oil cooler flaps as required.

d. Crack the throttle for starting the engine.

e. Depress the propeller feathering switch and keep it closed until the engine is running at approximately 800 rpm, then pull out switch.

f. Allow the engine to warm up at 1000 rpm until minimum temperatures are reached. Then set the propeller governor control for the desired rpm and advance the throttle gradually, watching for oil pressure fluctuations or other signs of insufficient warm-up.

5. OIL DILUTION.

While oil dilution is being performed during the last two minutes of the last oil dilution period, the throttle will be moved slowly forward from the position used for dilution to a position which will produce 26 inch Hg manifold pressure. The propeller governor control will be moved slowly from "INC. RPM" to "DEC. RPM" and back two or three times, and the throttle then slowly returned to the original position. This procedure will be executed twice before dilution is discontinued. Two feathering and unfeathering cycles should be made.

6. EMERGENCY OPERATION.

a. OIL LINE FAILURE.—In case of an oil leak between the governor and the propeller, the propeller governor control should be placed in the full "INC. RPM" position. The engine must be throttled until the speed is at some point below 2800 rpm. Under these conditions, the oil to the propeller is cut off by the pilot valve in the governor unit and the blades go to full low pitch.

b. PROPELLER GOVERNOR FAILURE.—A propeller governor failure will result in loss of control over the propeller pitch. The propeller, under the action of the blade centrifugal twisting moment and engine oil pressure, will bring the blades to the low pitch position, and a change in the thottle setting or air speed will immediately affect engine speed. Throttle down the engine with the inoperative propeller to keep the engine speed at 2800 rpm or below, provided this gives enough power to maintain flight. If more power is required, use whatever rpm is necessary to maintain flight, remembering that 3120 rpm for 30 seconds is the overspeed limit except for such emergencies.

c. FAILURE OF PROPELLER TO REMAIN FEATHERED.—When the propeller begins to unfeather immediately after reaching the full feathered position, the feathering switch should be manually pulled out. Hold it out for two to three seconds, and then close it again. After the second closing, the propeller will again feather. When the feathered position is reached, as indicated by the cessation of windmilling, the feathering switch should be manually pulled out to prevent any further unfeathering action.