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# Pilot's Handbook

*for*

## *NAVY MODEL*
## JRM-1
## Airplane

THIS PUBLICATION SUPERSEDES AN 01-35CA-1 DATED 15 JANUARY 1946

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*15 May 1946*

*Revised 15 November 1947*

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| *Page No.* | *Date of Latest Revision* | *Page No.* | *Date of Latest Revision* | *Page No.* | *Date of Latest Revision* |
|---|---|---|---|---|---|
| 3 | 15 Nov. 1947 | 41 | 15 Nov. 1947 | 74 | 15 Nov. 1947 |
| 4 | 15 Nov. 1947 | 42 | 15 Nov. 1947 | 75 | 15 Nov. 1947 |
| 8 | 15 Nov. 1947 | 43 | 15 Nov. 1947 | 76 | 15 Nov. 1947 |
| 10 | 15 Nov. 1947 | 46B | 15 Nov. 1947 | 77 | 15 Nov. 1947 |
| 19 | 15 Nov. 1947 | 52 | 15 Nov. 1947 | 78 | 15 Nov. 1947 |
| 23 | 15 Nov. 1947 | 52A | 15 Nov. 1947 | 79 | 15 Nov. 1947 |
| 30 | 15 Nov. 1947 | 52B | 15 Nov. 1947 | 80 | 15 Nov. 1947 |
| 30A | 15 Nov. 1947 | 53 | 15 Nov. 1947 | 81 | 15 Nov. 1947 |
| 32 | 15 Nov. 1947 | 66 | 15 Nov. 1947 | 82 | 15 Nov. 1947 |
| 32A | 15 Nov. 1947 | 67 | 15 Nov. 1947 | 83 | 15 Nov. 1947 |
| 33 | 15 Nov. 1947 | 68A | 15 Nov. 1947 | 84 | 15 Nov. 1947 |
| 35 | 15 Nov. 1947 | 69 | 15 Nov. 1947 | 85 | 15 Nov. 1947 |
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GPO 728172

# TABLE OF CONTENTS

*Figure 1-1—The JRM-1 Airplane*

# SECTION I
# DESCRIPTION

## 1-1. THE AIRPLANE.

1-2. GENERAL DESCRIPTION OF AIRPLANE. The JRM-1 is a four-engine high wing long range flying boat designed for cargo and personnel transportation. Each airplane contains provisions for operating as a cargo transport, troop carrier, or personnel and casualty transport. The normal gross weight is 145,000 pounds and the approximate dimensions are as follows:

| | |
|---|---|
| Length | 120 feet |
| Height | 48 feet |
| Span | 200 feet |
| Beam of Hull | 13-1/2 feet |
| Height of Pilot's Eyes Above Water Line (145,000 lb.) | 11 feet |
| Draft (145,000 lb.) | 5-1/2 feet |

1-3. CREW. Provisions are made for a normal operating crew of eleven: Plane Commander, First Pilot, Second Pilot, Navigator, Flight Engineer, Assistant Flight Engineer, two Flight Mechanics, two Radiomen, and an Orderly.

1-4. HULL ARRANGEMENT. *(See figure 1-2.)* The hull interior is arranged to provide the following compartments:

a. The bow compartment located in the bow of the airplane containing anchoring and mooring facilities.

b. The baggage compartment located on the main deck aft of the bow compartment for stowage of baggage or other cargo.

c. The galley and entrance compartment on the main deck aft of the baggage compartment containing the forward entrance hatch, the stairs to the flight deck on the right-hand side, and the galley on the left-hand side.

d. The forward cargo compartment on the main deck aft of the entrance and galley compartments containing the fume-tight fuel compartment on the aft left-hand side.

e. The flight deck located above the main deck forward of the wing containing the pilot's and copilot's stations at the forward end, the navigator's and flight engineer's stations on the left side, and the radio operator's station on the right side. Four bunks and the flight deck escape hatch are located on the right side opposite the flight engineer's station. A fixed astro dome is located in the crown of the hull at the navigator's station.

f. The main cargo compartment located immediately below the wing has a large cargo hatch on each side of the hull.

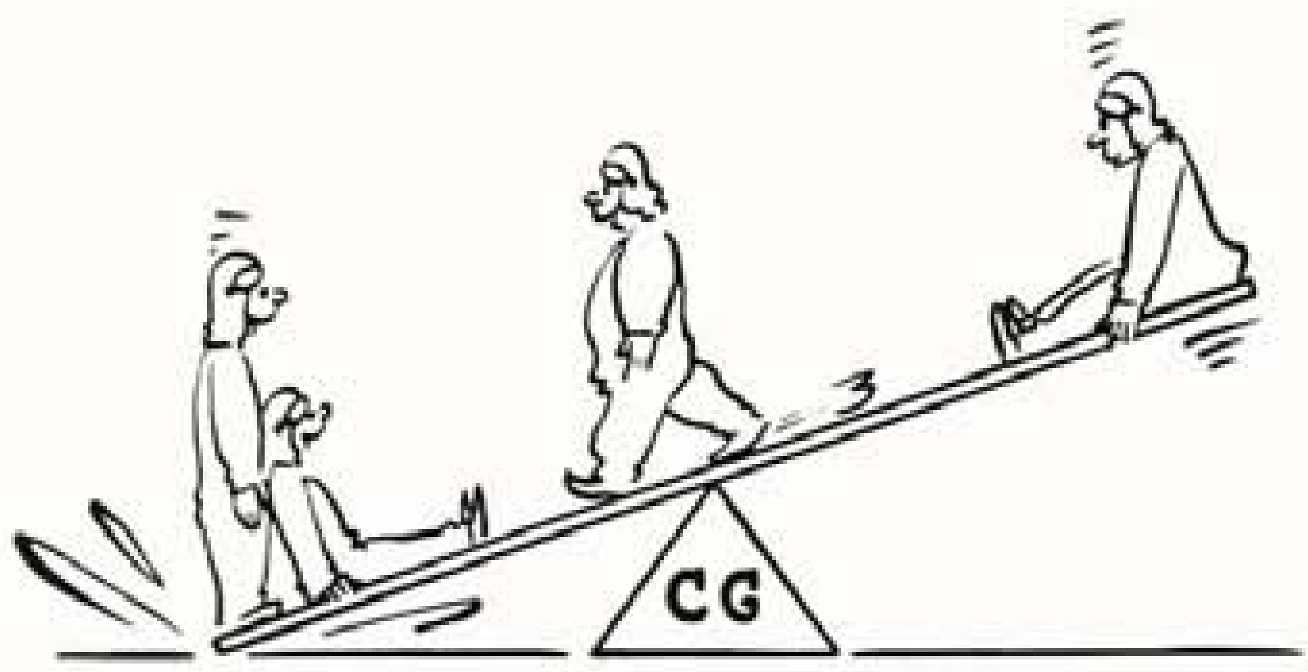
g. The middle cargo compartment located on the main deck immediately aft of the main cargo compartment.

h. The aft cargo compartment located aft of the middle cargo compartment forward of the stairs to the upper deck.

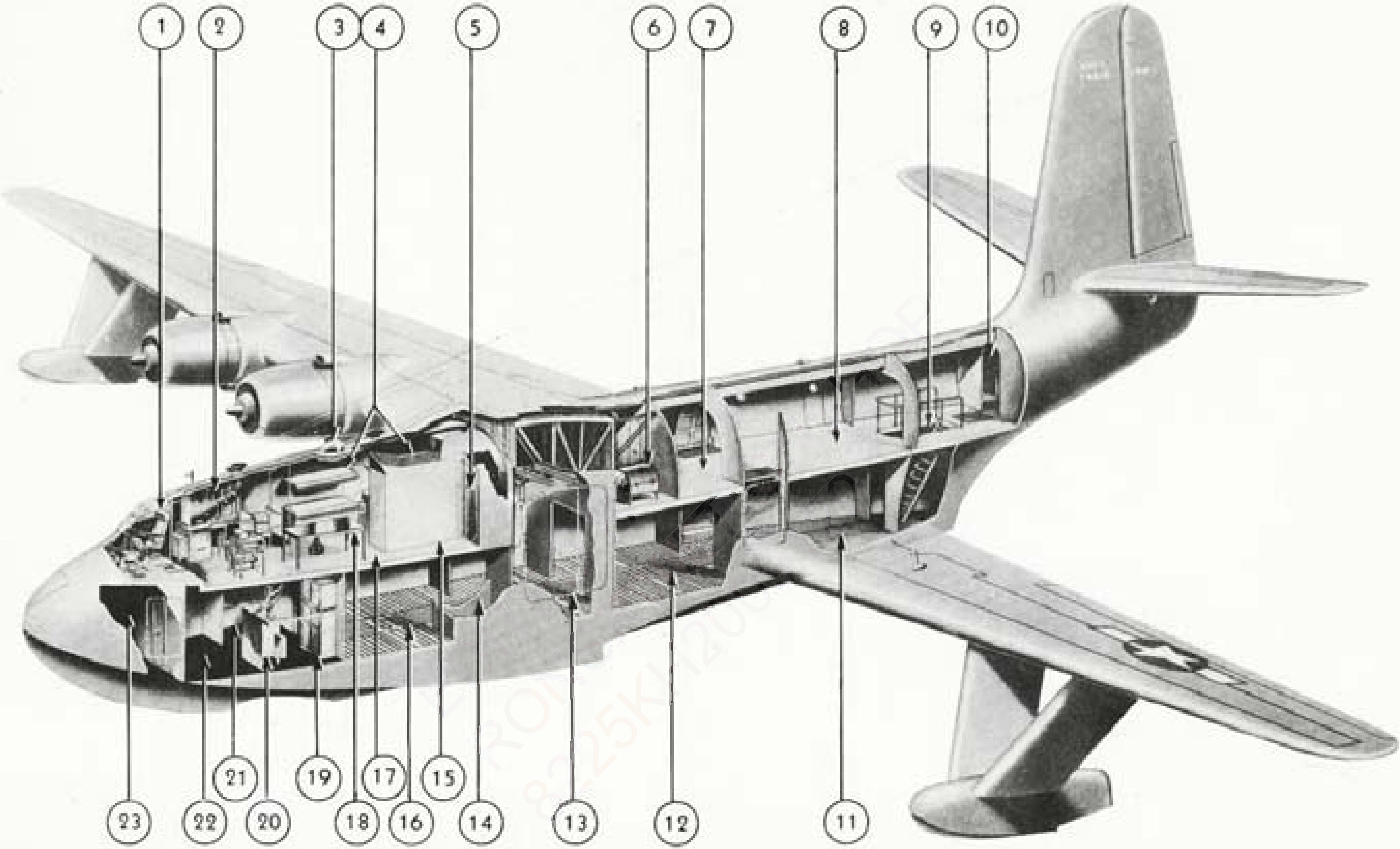
i. The upper deck extends from the aft end of the main cargo compartment to the stern. The forward section contains the auxiliary power plant compartment, the aft crew quarters with four fixed bunks, and a space for personnel or light cargo. The aft section of the upper deck from the stair well to the stern contains toilet and lavatory facilities and a lookout station near the stern. A walkway is provided through the center wing for passage between the upper deck and the flight deck.

1-5. MOVEMENT OF CREW IN FLIGHT. Passage is possible through the entire length of the hull on the main deck unless cargo obstructs the way. Movement of personnel from the flight deck to the upper deck may be accomplished through the passageway in the center wing. A passageway is also provided in the wings for access to the nacelles during flight.

**Note**




Crew movement in flight must be made with full consideration given to their effect on the location of the center of gravity.




1 Pilots' Stations
2 Radio Operator's Station
3 Astro Dome
4 Bunks
5 Upper Fuel Trunk
6 Auxiliary Power Plant
7 Aft Crew Quarters
8 Upper Deck Cargo Space
9 Ladder
10 Head
11 Aft Cargo Compartment
12 Middle Cargo Compartment
13 Main Cargo Compartment
14 Re-Fueling Compartment
15 Flight Engineer's Station
16 Forward Cargo Compartment
17 Flight Deck
18 Navigator's Station
19 Refrigerator
20 Galley
21 Galley and Entrance Compartment
22 Baggage Compartment
23 Anchor Compartment

*Figure 1-2—Hull Contents Arrangement*

## 1-6. FLIGHT CONTROLS.

1-7. DESCRIPTION OF FLIGHT CONTROLS. Conventional dual column and wheel elevator and aileron controls are provided, as well as conventional pedal type rudder controls, for the pilot and copilot. A hydraulic booster system is incorporated in the elevator and rudder controls to reduce control forces for the pilots.

1-8. ELEVATOR AND RUDDER CONTROLS. Although standard column elevator and pedal rudder controls are provided, a hydraulic booster system assumes approximately 76 percent of the force required to move the elevators and 80 percent of the force to move the rudder.

1-9. The flight control booster system derives its power from two electrically driven constant displacement hydraulic pumps. The variable pressure system will develop approximately 100 pounds pressure at no load to a maximum of 1500 to 1600 pounds pressure at full load.

1-10. Put the booster system into operation by throwing both booster motor power circuit breaker switches on the flight engineer's lower switch panel to their "ON" positions, and then throwing either one or both of the booster switches to the "ON" position. Normally, only one of the booster pumps should be operated while the other will be reserved for standby operation. During take-off and landing operations, however, both pumps will be operated.

1-11. For operation of the surface controls without boost, manually operated bypass valves are provided in the pressure lines to the cylinders to relieve the pressure. The elevator valve is at frame 66 on the left-hand side of the airplane, and the rudder valve is on the lower corrugation of the stabilizer.

1-12. WING FLAP CONTROLS. The hydraulically actuated wing flaps are controlled by a switch on the right side of the pilot's pedestal. Throw the switch to the "DOWN" position to lower the flaps and return the switch to the "OFF" position when the desired angle up to the maximum of 40 degrees has been reached as shown on the wing flap position indicator on the pilot's instrument panel. To raise the flaps, hold the switch in the "UP" position until the desired flap position has been reached, then release the switch and it will return to the "OFF" position. When the switch is placed in the "TAKE-OFF-APPROACH" position, the flaps will go to 20-degrees down position. After each complete flap up and down operating cycle allow a 3-minute cooling period. The hydraulic pump that provides the flap power is controlled by the wing flap motor switch on the flight engineer's switch panel. The wing flap pressure gage on the flight engineer's fuel control panel should register 1350 to 1500 pounds per square inch.

1-13. ELEVATOR TRIM TAB CONTROLS. The elevator trim tab controls are located on the pilot's pedestal. One control wheel is located on each side of the pedestal so that either the pilot or copilot can adjust the tabs from 15 degrees up to 20 degrees down position. A calibrated dial on each control wheel shows the tab setting.

1-14. ELEVATOR BALANCE TAB CONTROL. The balance motion of the elevator tabs is electrically controlled by a switch on the pilot's pedestal. The balance action may be adjusted from 75 percent leading tab to 10 percent lagging tab to obtain the proper elevator forces at different loading conditions. In general, the following tab settings should be used:

| *CG LOCATION* | *TAB SETTING* |
|---|---|
| 26% MAC | 10% LEAD |
| 28% MAC | 15% LEAD |
| 30% MAC | 20% LEAD |
| 33% MAC | 40% LEAD |
| 36% MAC | 75% LEAD |

**CAUTION**

In the event of a failure of the flight control booster system, the tab ratio should not be adjusted toward the lag position by more than 10 percent in tab ratio. If the boost fails while using a balance tab setting of 75 percent lead with a center of gravity location of 36 percent MAC, do not reduce the tab setting to less than 65 percent lead. Although the elevator forces will be extremely high in this condition, all normal flight maneuvers, including landings may be accomplished.

1-15. AILERON AND RUDDER TRIM TAB CONTROLS. The aileron and rudder trim tab controls are incorporated in a combination unit on the aft face of the pilot's pedestal. The aileron control is the smaller of the two hand wheels and provides trim changes from 20 degrees up to 20 degrees down as shown on the calibrated dial on the wheel. The larger of the two wheels controls the rudder trim tab and provides for trimming from 20 degrees nose-right to 20 degrees nose-left. The balance action of both the aileron and rudder tabs is adjustable only when the airplane is on the ground.

## 1-16. POWER PLANT.

1-17. DESCRIPTION OF POWER PLANT. Four Wright Cyclone 18 (R-3350-8), two row radial engines, consisting of two rows of nine cylinders each, power the JRM-1 airplanes. Features on the engine are the low tension ignition system, cast aluminum heads with aluminum finned cylinder barrels, two-speed supercharger, all rearward exhausts and integral torquemeter. The propellers are Curtiss Electric controllable pitch, full feathering, four bladed, 16 feet 8 inches in diameter.

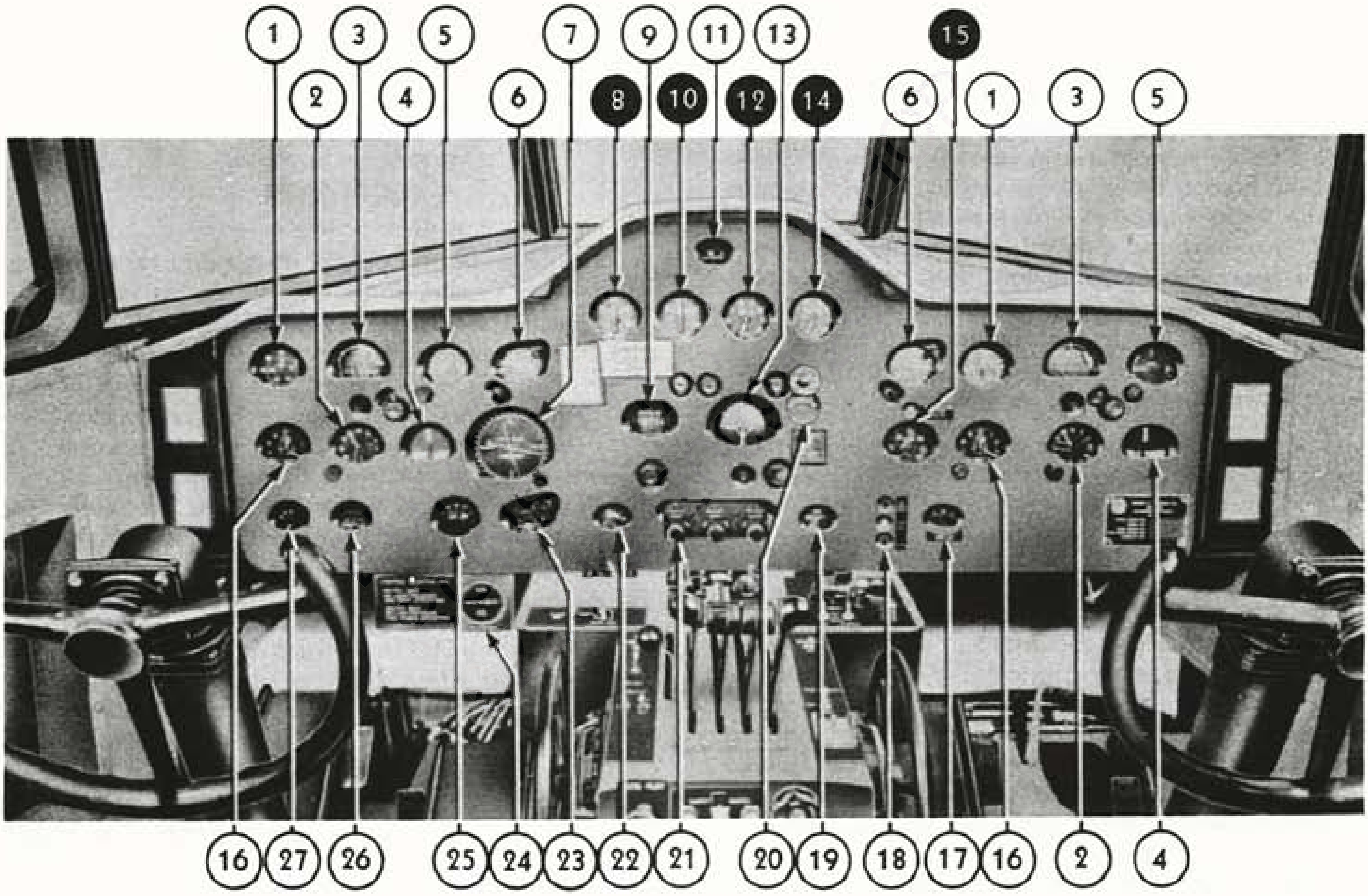
1-18. THROTTLE CONTROLS. Duplicate throttle controls for each engine are provided on the pilot's pedestal and at the flight engineer's station. A fifth lever on the left side of the pilot's pedestal provides friction adjustment on the controls. No friction adjustment is provided at the flight engineer's station.

1-19. MIXTURE CONTROLS. The mixture controls at the flight engineer's station have three positions: "IDLE CUT-OFF," "NORMAL," and "RICH." Adjust the knurled nut on the control to provide the proper friction so that the control will not creep. The "IDLE CUT-OFF" position is used for starting and stopping the engines and at all times when the engines are not operating. Use the "NORMAL" position for cruising at 2130 rpm and below. Use the "RICH" position for all ground operation, and all flight operation except when cruising at 2130 rpm and below. Refer to Power Plant Chart (figure 3-1) and the Engine Calibration Curve (figure A-5) for more complete information.

**Note**

> The control must be positioned by "feel." Do not operate in any intermediate position above 2130 rpm.

1-20. SUPERCHARGER CONTROLS.

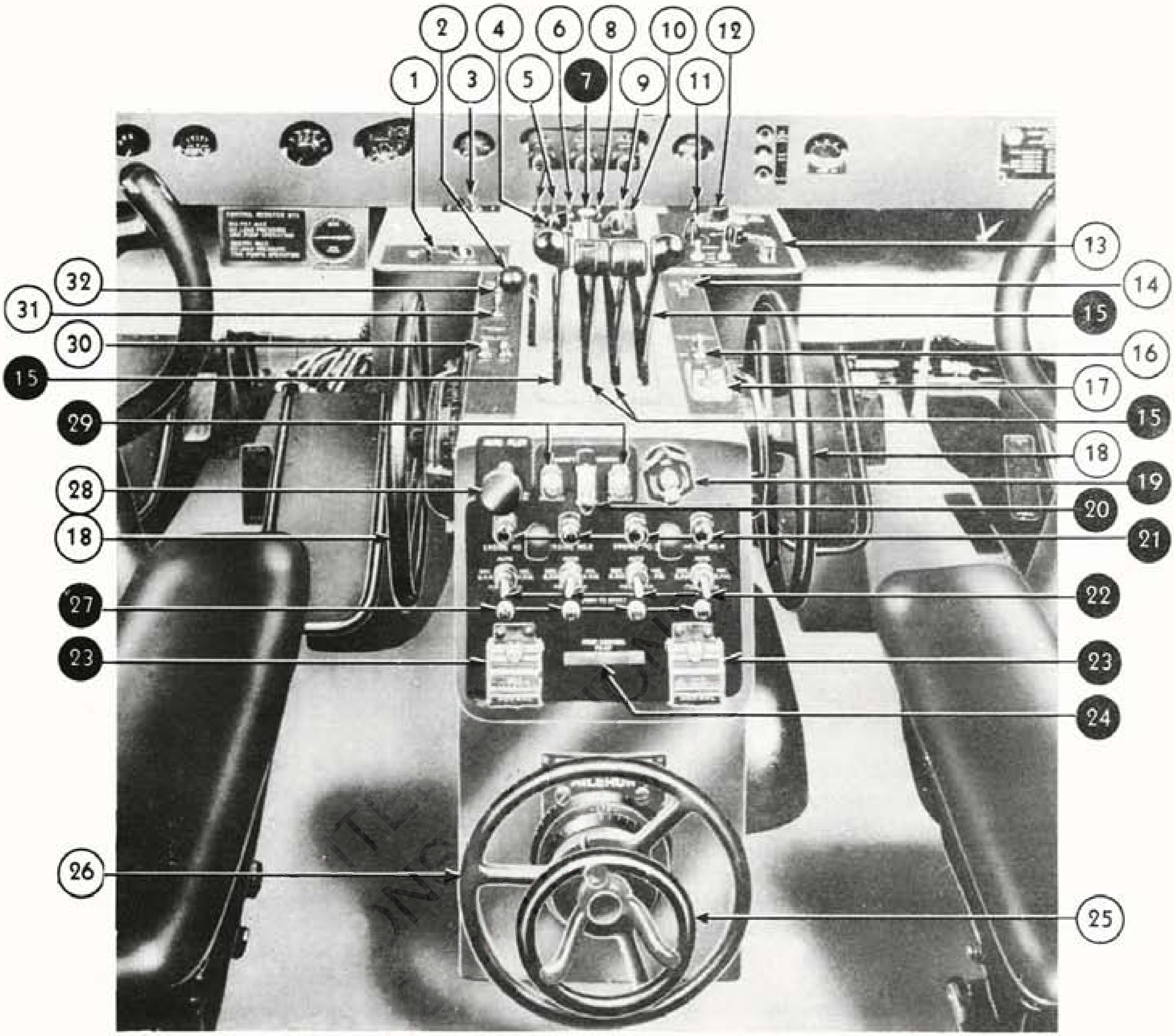



| | | | | | |
|---|---|---|---|---|---|
| 1 | Airspeed Indicator | 10 | Manifold Pressure Indicator (Engines 3 and 4) | 18 | Radio Altimeter Indicator Lights |
| 2 | Gyro Fluxgate Compass Indicator | 11 | Mark VIII Compass | 19 | Auto Pilot Oil Pressure Gage |
| 3 | Gyro Horizon | 12 | Tachometer (Engines 1 and 2) | 20 | Auto Pilot Vacuum Gage |
| 4 | Turn and Bank Indicator | 13 | Bank and Climb Gyro | 21 | Servo Speed Control Valves |
| 5 | Rate of Climb Indicator | 14 | Tachometer (Engines 3 and 4) | 22 | Wing Flap Position Indicator |
| 6 | Clock | 15 | Propeller Synchronizer Tachometer | 23 | Radio Altimeter Indicator |
| 7 | Radio Compass Indicator | 16 | Altimeter | 24 | Hydraulic Pressure Gage |
| 8 | Manifold Pressure Indicator (Engines 1 and 2) | 17 | Free Air Temperature Indicator | 25 | Radio Altimeter Limit Switch |
| 9 | Directional Gyro | | | 26 | Elevator Balance Tab Position Indicator |
| | | | | 27 | Instrument Vacuum Gage |

***Figure 1-3—Pilot's Instrument Panel***

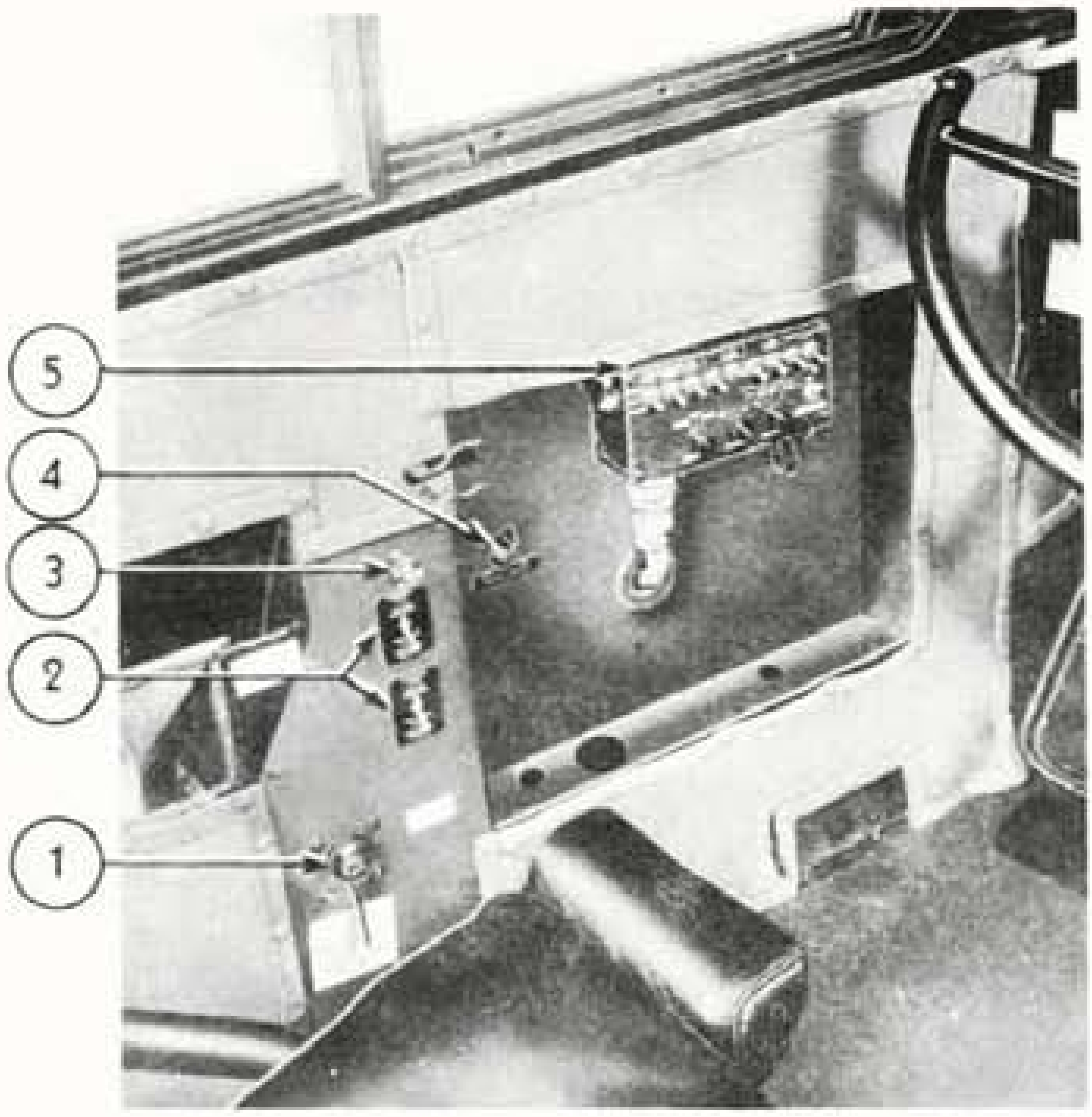
Aircraft equipped with modified engines (two-speed superchargers) have the supercharger controls connected. The two positions are LOW and HIGH. Shifts from one position to the other should be made smoothly and rapily, without hesitation. Except during shifts, keep the levers locked in the position being used. Allow at least five minutes to elapse between shifts, unless an emergency requires shifting sooner. Desludging is not necessary.

Shifts may be made from LOW to HIGH, or from HIGH to LOW at any engine speed from the lowest cruising RPM up to rated (2400) RPM, provided the manifold pressure after the shift does not exceed the approved limit for the engine speed and altitude at which the shift is performed. Long life of the supercharger drive is favored by shifting at no higher engine speed than necessary, therefore shifts should be made at as low engine speeds as tactical considerations permit. Before shifting from LOW to HIGH, reduce manifold pressure several inches, and check any tendency of manifold pressure to rise excessively after the shift by retarding throttle as necessary. Shifts may be made at military (2600)RPM, but only when justified by emergencies or tactical requirements.



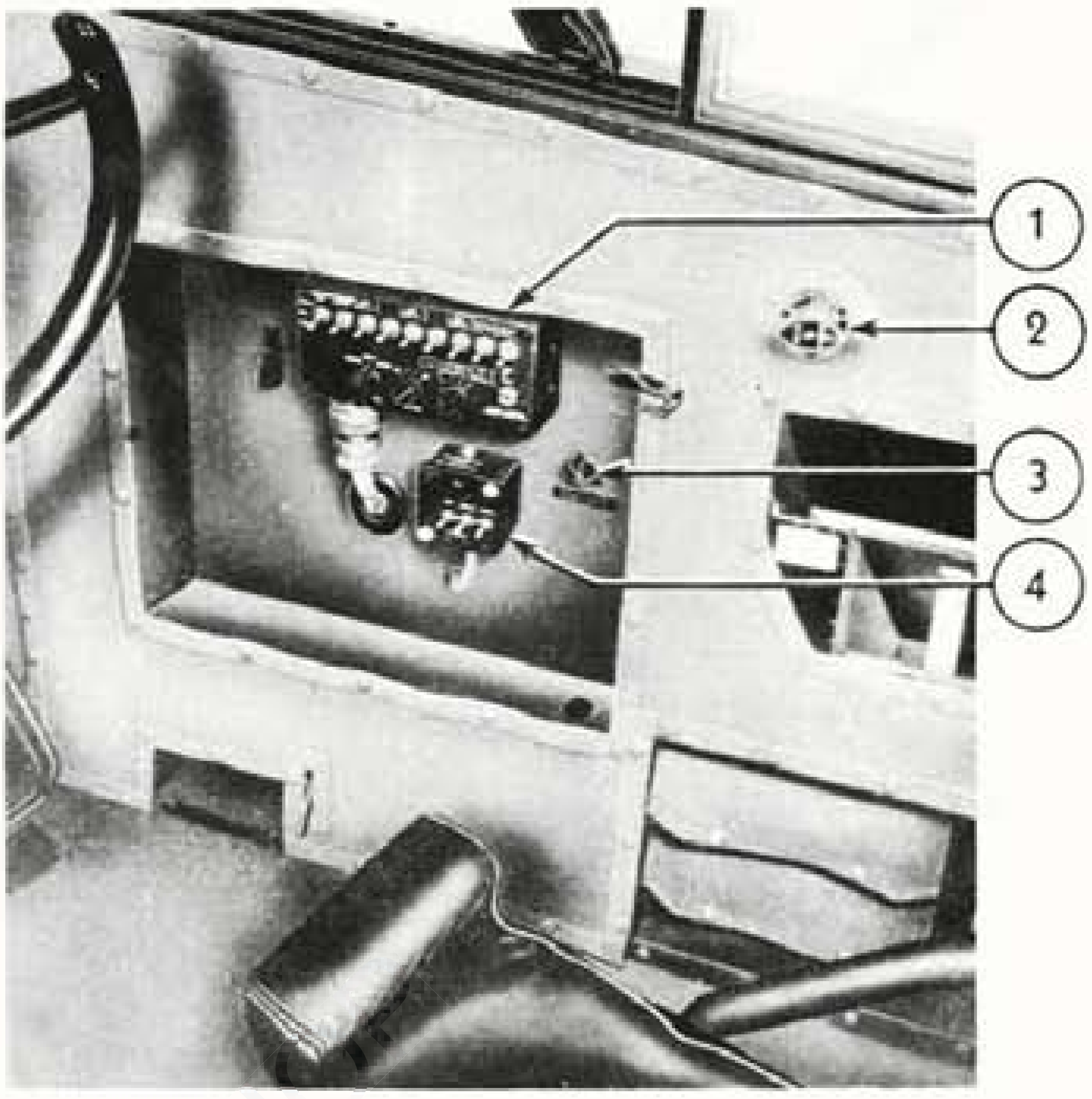

1 ARC-1 Radio Transmitter Control
2 Throttle Friction Control
3 Master Radio Switch
4 Instrument Panel Lights Rheostat
5 Landing Lights Switches
6 Anchor Lights Switches
7 Ignition Switch
8 Running Lights Switch
9 Position Lights Switch
10 Propeller Panel Lights Rheostat
11 Utility Receptacle Switch
12 ATC Radio Transmitter Control
13 IFF Radio Control
14 Floodlight Switch
15 Throttle Control
16 Elevator Balance Tab Switch
17 Wing Flap Position Switch
18 Elevator Trim Tab Control
19 Propeller Synchronizer Control
20 Propeller Reverse Pitch Safety Switch
21 Propeller Auto Indicator Lights
22 Propeller Selector Switches
23 Propeller Reverse Control Switches
24 Propeller Control Throw-Over Switch
25 Aileron Trim Tab Control
26 Rudder Trim Tab Control
27 Propeller Circuit Breaker Re-set Buttons
28 Auto-Pilot On-Off Control
29 Propeller Reverse Pitch Indicating Lights
30 Auto-Pilot Booster Circuit Breaker Switches
31 Windshield Wiper Switch
32 Windshield Anti-Icer Switch

***Figure 1-4—Pilot's Pedestal***




1 Vacuum Crossover Valve
2 Pitot Static Alternate Source Switches
3 Windshield Anti-Icer Throttle Valve
4 Panel Light Rheostat
5 Interphone—Radio control box

*Figure 1-5—Pilot's Station*




1 Interphone—Radio control box
2 Windshield Washer Pump
3 Panel Light Rheostat
4 Recognition Light Switch Box

*Figure 1-6—Copilot's Station*

1-21. CARBURETOR AIR CONTROLS. The carbureter air controls provide control of the air supply to the carburetor. The controls lock in either the "DIRECT" or "ALTERNATE" position. Be sure that they are locked in the position being used. Release the lock by pulling up on the cross-bar while moving the grip. Use the "DIRECT" position for take-off and at all other times, except when icing conditions are anticipated. Use the "ALTERNATE" position when icing conditions are expected or encountered. If possible, throw the control to "ALTERNATE" before icing commences since the temperature of the alternate air though high enough to prevent icing may not be high enough to melt ice already formed. The "ALTERNATE" position should be used in all cases where potential icing conditions exist although it does cause a slight loss of power at full throttle.

**CAUTION**

If a 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 run; then shift to "DIRECT."

1-22. COWL FLAPS CONTROLS. The electrically actuated cowl flaps are controlled by switches on the flight engineer's switch panel. Check that the circuit breaker switches for the cowl and oil cooler flap systems are in the "ON" position, then hold the cowl flap switch in the "OPEN" or "CLOSE" position as desired; release the switch when the desired position is reached as shown on the indicator on the overhead instrument panel. The cowl flaps must be full open for *all* ground operations and open only enough during flight to keep the cylinder head temperatures below the limits shown in the Power Plant Chart. (See figure 3-1.)

1-23. IGNITION SWITCHES. The ignition switches on the pilot's pedestal and the flight engineer's switch panel are a standard type. The center knob controls the ignition to all four engines and must be in before any engine will operate. To cut the ignition to all four engines simultaneously, pull the knob out. The ignition switch for each engine has four positions: "OFF," "R," "L" and "BOTH." The "BOTH" position is the normal operating position since the "L" and "R" positions are used for checking only.

1-24. STARTER SWITCHES. The starter switch for each engine is located on the flight engineer's switch panel. Since direct cranking starters are used, the switch has only two positions: "OFF" and "DIRECT CRANK." Do not operate the starter switch unless an external power source is connected or at least one auxiliary power plant is operating. The starter relay circuit breaker switch on the flight engineer's switch panel must be in the "ON" position before the starter switches will actuate the starters.


1 CW Phone Throw-Over Switch
2 ARC-5 Radio Receiver Controls
3 Automatic Radio Compass Controls
4 Spotlight

***Figure 1-7—Pilot's Overhead Controls***

**CAUTION**

Do not operate the starter switch for more than one minute continuously or starter will overheat. Allow starter to cool for 5 minutes before operating the switch again. As a general rule, an engine should start within 30 seconds after the starter is actuated, and if a start is not accomplished within this time the engine should be checked for the cause of the difficulty.

1-25. CYLINDER HEAD TEMPERATURE GAGES. The cylinder head temperature gages on the flight engineer's instrument panel are connected to the two cylinders on each engine that normally become the hottest during taxying and flight, however the hottest indication should be used in any case.

1-26. HORSEPOWER INDICATORS. The horsepower indicator for each engine indicates Brake Mean Effective Pressure (BMEP) and Brake Horsepower (BHP). In order to read the "BHP" scale set the sub-dial calibrated in rpm to the prevailing rpm of the engine by turning the knob at the lower left-hand corner of the indicator. BHP may then be read directly from the outer scale.

1-27. PROPELLER CONTROLS. The propellers are controlled through a proportional synchronizer control system which automatically controls the speed of each engine and maintains all engines at the same speed. The speed of the engines is proportional to the master motor which may be set to control the engines at any desired operating speed.

1-28. PROPELLER POWER SWITCHES. The normal and booster propeller power switches must both be in the "ON" position for all operations.

1-29. PROPELLER CONTROL CHANGE-OVER SWITCH. The change-over switch on the pilot's pedestal allows the pilot to select whether the control of the propeller selector switches will be at the pilot's pedestal or the flight engineer's station. A green light at the flight engineer's station glows when the switch is in the "PILOT" position.

1-30. PROPELLER SELECTOR SWITCHES. The propeller selector switches at both the pilot's and flight engineer's stations provide for operation of the propellers in either automatic or fixed pitch. All flight operations should be made with the selector switch in the "AUTO" position. The selective fixed pitch positions of "DEC. RPM" and "INC. RPM" are used for various ground operations and if the constant speed control becomes inoperative.

1-31. PROPELLER MASTER UNIT SWITCH. The master unit switch on the flight engineer's panel connects the master motor to the power supply. This switch must be in the "ON" position for all operations.

1-32. PROPELLER SYNCHRONIZER CONTROL KNOBS. The propeller synchronizer control knobs at the pilot's and flight engineer's stations control the speed of all engines when the propeller selector switches are in the "AUTO" position.

1-33. PROPELLER FEATHER SWITCHES. The feather circuits are entirely independent of all other circuits so that emergency feathering may be accomplished regardless of the position of all other propeller switches. When the feather switch is placed to the "FEATHER" position, the feather circuit is energized and the normal circuit is simultaneously broken. The propeller will then change to the feather angle and stop at that point.

**Note**

The feather switches are located at the flight engineer's panel and provide fast feathering. The pilot can also feather by holding the selector switch in the "DEC. RPM" position until the blades reach the feather angle. This can only be done with the feather switch in the "NORMAL" position and will give normal pitch change rate instead of fast rate.

1-34. PROPELLER REVERSE PITCH SWITCHES. The reverse safety switch and the two reverse-normal switches on the pilot's pedestal control the reversible pitch of the two inboard propellers. Reduce engine speed to idling before operating the reverse-normal switch. Throw the reverse safety switch to the "ON" position when reversing pitch. When the tel-light indicates that the reverse pitch position has been reached, throw the reverse safety switch to the "OFF" position and leave it off for all reverse operations. Operation of the engines with propellers in reverse pitch may be conducted up to and including take-off power *provided maximum cylinder head temperatures are not exceeded.*

## 1-35. FUEL SYSTEM.

1-36. DESCRIPTION OF FUEL SYSTEM. *(See figure 1-9.)* Fuel is carried in six integral hull tanks and two wing service tanks with the following capacities:

| TANK | TYPE | CAPACITY US | CAPACITY Imp. |
|---|---|---|---|
| Forward Hull (2) | Metal | 5240 | 4365 |
| Center Hull (2) | Metal | 3880 | 3232 |
| Rear Hull (2) | Metal | 2880 | 2399 |
| Wing Service (2) | Mareng | 1220 | 1016 |
| Total Capacity | | 13220 | 11012 |

1-37. FUEL SPECIFICATION. Use fuel specification AN-F-48, grade 100/130.

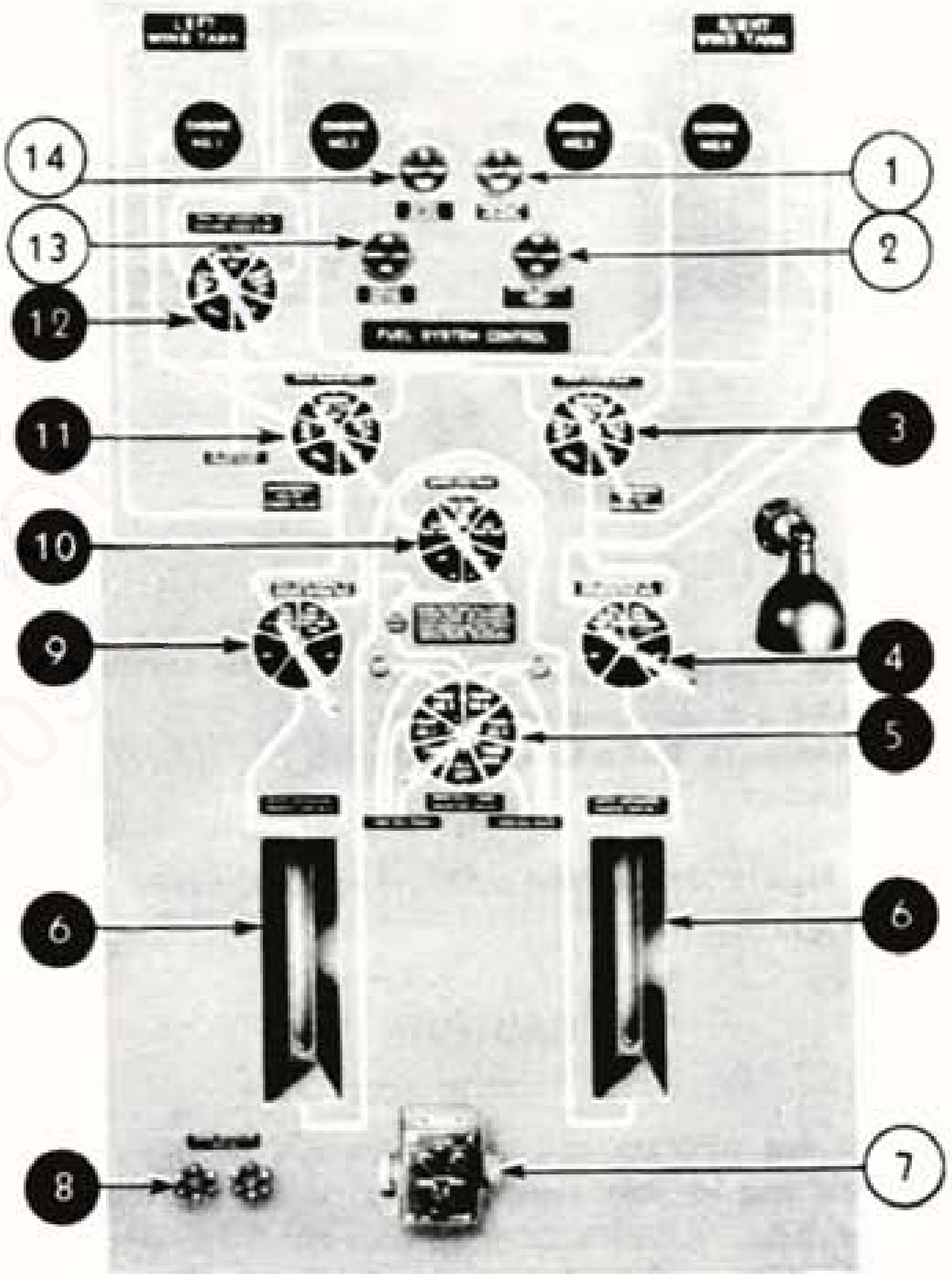
1-38. NORMAL OPERATION OF FUEL SYSTEM. During normal operations, fuel flows from the wing service tanks through the engine selector valves to the engines. The engine driven pumps deliver fuel to the carburetors at a constant pressure of 17 ± 1 pounds. At the same time the hull transfer pumps will refill the wing service tanks whenever the fuel level drops to 525 US (437 Imperial) gallons.

1-39. ENGINE SELECTOR VALVES. The engine selector valves, one for the inboard engines and one for the outboard engines, provide selection of fuel to either one or both of the engines that each valve controls.

1-40. HULL - TANK - SUPPLY - TO - ENGINES - OR - WING - TANK VALVES. These valves direct the fuel from the hull tanks to the wing service tanks or to the engine selector valve and thence to the engines. During normal operation these valves should be set to "HULL TANKS TO LEFT WING TANK" and "HULL TANK TO RIGHT WING TANK" to refill the wing service tanks whenever they go below 525 US (437 Imperial) gallons. In this position, a switch, incorporated in the control, is closed to feed current to the fuel transfer pump through the fuel transfer pump control switch which should be in the "AUTOMATIC" position. With the controls in the "HULL TANKS TO ENGINES 1 AND 4" and "HULL TANKS TO ENGINES 2 AND 3" positions, fuel is directed from the hull tanks to the engine selector valves and thence to the engines. In this position, the switch controlling current to the transfer pumps through the transfer pump control switch is opened, and a circuit is completed feeding current directly to the fuel transfer pump.

1-41. MAIN HULL TANK SELECTOR VALVE. The main hull tank selector valve provides selection of fuel from any one of the six hull tanks.

1-42. CROSS FEED VALVE. The cross feed valve permits supplying both wing tanks with one transfer pump. It also provides for de-fueling the wing tanks and for the use of the emergency hand pump. When the control is moved out of either "OFF" position, it




1. Wing Flap Hydraulic Pressure Gage
2. Surface De-Icer Pressure Gage
3. Propeller Anti-Icer Pressure Gage
4. Flight Control Booster Hydraulic Pressure Gage
5. Engine Selector Valve (2 and 3)
6. Hull-Tanks-Supply-to-Engines or Wing-Tanks Valve (2 and 3)
7. Main Hull Tank Selector Valve
8. Water Separator Sight Gage
9. Light Bulb Stowage
10. Water Separator Drain Valves
11. Hull-Tanks-Supply-to-Engines or Wing-Tanks Valve (1 and 4)
12. Cross Feed Valve
13. Engine Selector Valve (1 and 4)
14. Auxiliary Power Plant Fuel Valve

*Figure 1-8—Flight Engineer's Fuel Control Panel*

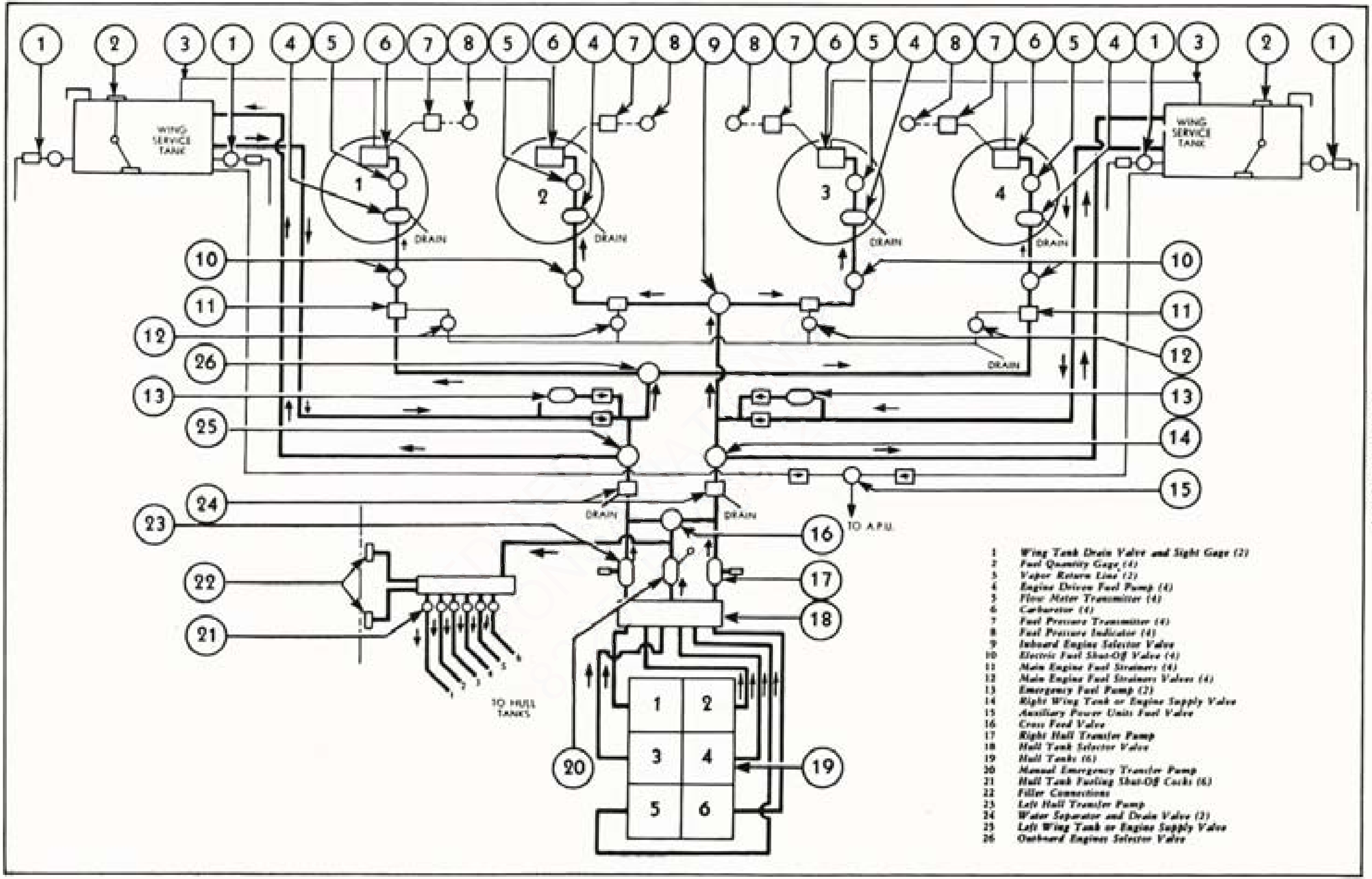



Figure 1-9—Fuel System

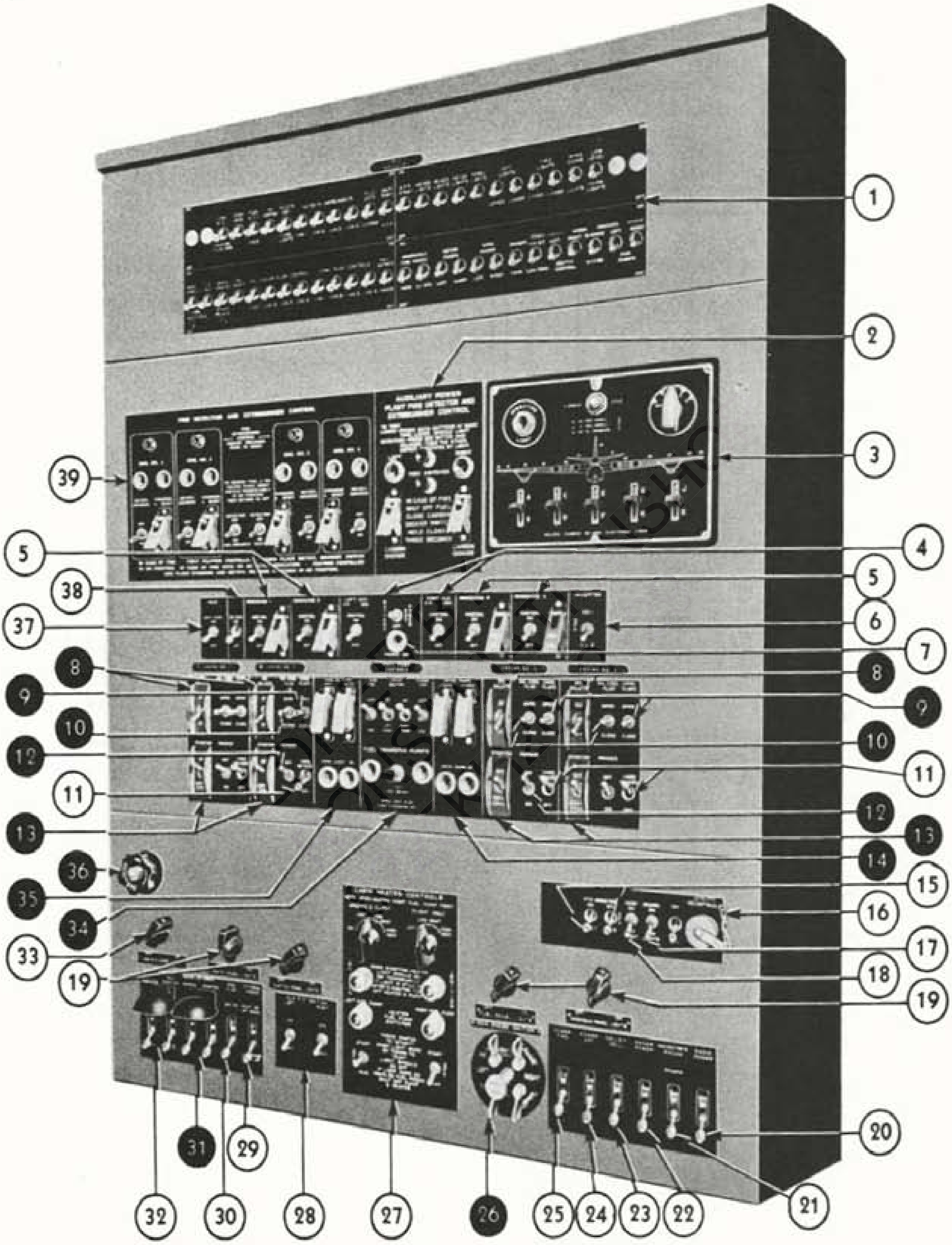



*Figure 1-10—Flight Engineer's Switch Panel*

**Key to Figure 1-10**

1 Circuit Breaker Switches
2 Auxiliary Power Plant Fire Detector and Extinguisher Control
3 Electronic De-Icer Timer
4 Auxiliary Power Plant Generator Control Switches
5 Main Generator Control and Field Cut-Out Switches
6 Inverter Transfer Switch
7 External Power Switch
8 Oil Dilution Switch
9 Cowl Flaps Switch
10 Oil Cooler Flaps Switch
11 Carburetor De-Icer Switch
12 Primer Switch
13 Starter Switch
14 Defuel Pumps Switches and Indicator Lights
15 Surface Controls Hydraulic Booster Switches
16 Utility Receptacle and Switch
17 Desk Light Switch
18 Boarding Light Switch
19 Panel Lights Rheostats
20 Radio Power Switch
21 Navigator's Radar Power Switch
22 Radar Power Switch
23 Galley Grill Switch
24 Aft Power Switch
25 Forward Power Switch
26 Main Engine Ignition Switch
27 Cabin Heater Control Panel
28 Auxiliary Power Plant Ignition Switches
29 External Power Circuit Breaker Switch
30 Wing Flap Motor Circuit Breaker Switch
31 Propeller Normal Circuit Breaker Switch
32 Hydraulic Booster Motors Circuit Breaker Switch
33 Engineer's Dome Light Switch
34 Fuel Transfer Pumps Switches and Indicator Lights
35 Emergency Engine Fuel Pumps Switches and Indicator Lights
36 Propeller Synchronizer Control
37 Propeller Anti-Icer Switch
38 De-Icer Circuit Breaker Switch
39 Main Engine Fire Detector and Extinguisher Control Panel

automatically opens a switch breaking the automatic circuit to the hull transfer pumps so that the transfer pumps must then be operated by holding the transfer pump control switch in the "MANUAL" position.

**WARNING**

When refilling the wing tanks with the control switch in "MANUAL," observe the fuel gage of the tank being filled to prevent overflow and the resultant fire hazard.

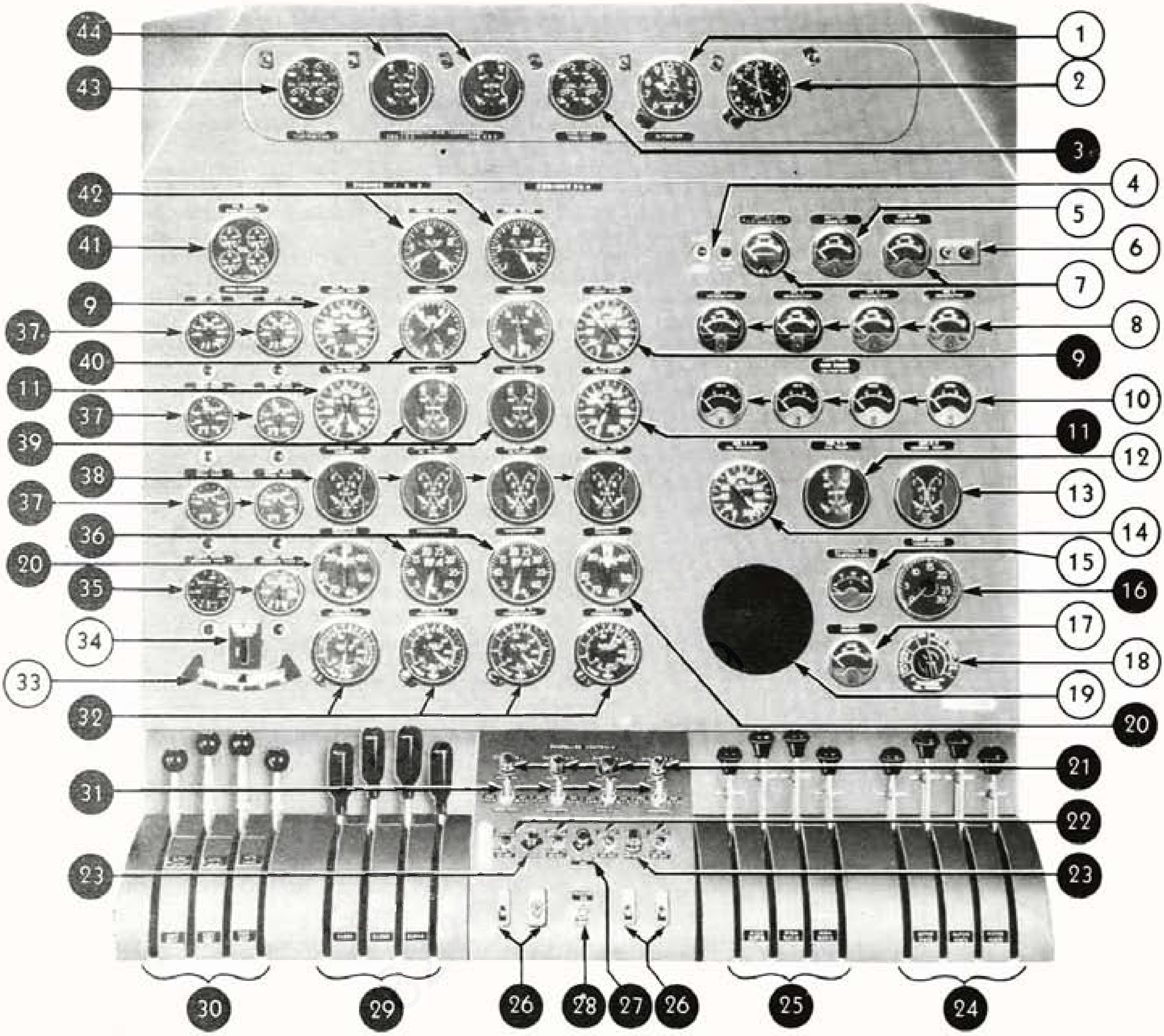
1-43. FUEL TRANSFER PUMP SWITCHES. There is a circuit breaker switch and a control switch for each pump located on the flight engineer's switch panel. The circuit breaker switches must be "ON" for all pump operation. With the control switch in the "AUTOMATIC" position, the transfer pumps will refill the wing tanks whenever the fuel level drops to 525 US (437 Imperial) gallons. However, if the hull-tank-supply-to-engines-or-wing-tank valves are in the respective "HULL TANKS TO ENGINES" positions or if the cross feed valve is not in the "OFF" position, the automatic circuit is broken. With the hull-tank-supply-to-engines-or-wing-tank valves in the respective "HULL TANKS TO ENGINE" positions, the transfer pumps will operate regardless of the position of the control switches provided the circuit breaker switches are in the "ON" positions. Use the "MANUAL" position of the control switch whenever the cross feed valve is out of the "OFF" position or when the automatic circuit is inoperative.

1-44. The two warning lights on the flight engineer's switch panel will light if the transfer pumps are receiving no fuel from the hull tank to which the main hull tank selector valve is set. If the lights go on, immediately change the setting of the hull tank selector valve to a tank with fuel.

1-45. EMERGENCY PUMPS SWITCHES. The two emergency fuel pumps on the lines from the wing tanks to the engine selector valves provide fuel pressure for starting the engines, for oil dilution, for engine operation if an engine driven fuel pump fails, or at any time erratic engine operation indicates the possibility of vapor lock in the system. The switches should be in the "ON" position for starting, take-off, and landing. The pumps are interconnected with the oil dilution switches so that they operate with their switches in the "OFF" position whenever the oil dilution switches are operated. Red indicator lights go on whenever the pumps are operating.

1-46. DE-FUEL PUMP SWITCHES. The two de-fuel pump switches on the flight engineer's switch panel control the operation of the de-fueling pumps for fuel dumping. (See paragraph 4-23.)

1-47. FUELING SHUT-OFF COCKS. Shut-off cocks on each hull tank line from the fueling manifold in the refueling compartment provide selection of tanks for fueling as well as determination of hull tanks to which fuel is transferred. These valves should always be closed except when refueling or transferring fuel.



1 Altimeter
2 Clock
3 Cowl Flaps Position Indicator
4 Carbon Monoxide Indicator and Re-set Button
5 Battery Ammeter
6 Voltage Test Jacks
7 Auxiliary Power Plant Ammeters
8 Main Engine Generator Ammeters
9 Main Engine Front Pump Oil Pressure Gage
10 Main Engine Generator Voltmeters
11 Main Engine Rear Pump Oil Pressure Gage
12 Auxiliary Power Plant Oil Temperature Indicator
13 Auxiliary Power Plant Cylinder Head Temperature Indicator
14 Auxiliary Power Plant Oil Pressure Indicator
15 Free Air Temperature Indicator
16 Propeller Synchronizer Tachometer
17 Voltmeter
18 Voltmeter Selector Switch
19 Sighting Pane
20 Manifold Pressure Gage
21 Propeller Auto Indicator Lights
22 Propeller Circuit Breaker Re-set Buttons
23 Reverse Pitch Indicator Lights
24 Carburetor Air Controls
25 Supercharger Speed Controls
26 Propeller Feather Switches
27 Pilot's Control "ON" Indicator Light
28 Propeller Master Unit Switch
29 Throttle Controls
30 Mixture Controls
31 Propeller Selector Switches
32 Horsepower Indicators
33 Inclinometer
34 Low Fuel Warning Lights Test Switch
35 Wing Service Tank Fuel Quantity Gages
36 Tachometers
37 Hull Tank Fuel Quantity Gages
38 Cylinder Head Temperature Gages
39 Oil Temperature Gages
40 Fuel Pressure Gages
41 Oil Quantity Indicator
42 Fuel Flow Indicator
43 Oil Cooler Flap Position Indicator
44 Carburetor Air Temperature Indicators

***Figure 1-11—Flight Engineer's Instrument Panel***

1-48. FUEL AND OIL SHUT-OFF SWITCH. A fuel and oil shut-off switch for each engine is located on the flight engineer's fire detector and extinguisher control panel. These switches are for emergency use only and actuate shut-off valves in the fuel and oil lines aft of the firewall in each nacelle.

1-49. EMERGENCY HAND FUEL PUMP. An emergency hand fuel pump is provided in the refueling compartment to transfer fuel in the event of failure of the hull transfer pumps. Use the pump to refill the wing tanks—not to supply the engines. Set the hull tank selector valve to a tank with fuel, turn the cross feed valve to the desired wing tank, and turn the hull-tank-supply-to-engine-or-wing-tank valve to "HULL TANK TO WING TANK" and pump until the wing tank is full.

**WARNING**

Do not overfill wing tanks as overflow causes a definite fire hazard.

1-50. WATER SEPARATORS. A water separator is located on each line between the hull transfer pump and the hull-tank-to-engine-or-wing-tank valve. Sight gages on the flight engineer's fuel control panel show the amount of water present in the separator. Since a float shuts off the fuel flow in the line when the separator becomes full of water, the flight engineer must keep the separators well drained. Drain valves are located on the flight engineer's fuel control panel.

**Note**

If the water separator float shuts off the fuel flow, turn the transfer pump "OFF" and *then* drain the separator to prevent the fuel pressure from holding the float in the closed position.

1-51. ENGINE STRAINER DRAIN. A drain cock for each engine strainer is located in the upper fuel trunk behind the flight engineer's fuel control panel. Drain the strainers before every flight and whenever erratic engine operation indicates a possible fuel line obstruction.

1-52. HULL TANK BILGING SYSTEM. A selector valve and hand bilge pump are located in the refueling compartment to remove water from the hull tanks. A sight glass in the overboard line shows when the water has been removed. The bilge pump may also be used to transfer fuel between hull tanks.

## 1-53. OIL SYSTEM.

1-54. DESCRIPTION OF OIL SYSTEM. *(See figure 1-12.)* An individual oil system is provided for each engine with manual transfer provisions between the inboard and outboard systems in each wing. No provisions are made for transfer between wings. The capacity of each tank is 146 US (122 Imperial) gallons with an expansion space of 15 gallons.

1-55. OIL SPECIFICATION. Use oil specification, AN-O-8, grade 1120.

1-56. NORMAL OPERATION OF OIL SYSTEM. During normal operation, oil leaves the tank at the sump at the bottom of the tank and enters the engine through the oil-in line. After being circulated through the engine, the oil is directed through the oil-out line, to the temperature regulating valve on the oil cooler; then, depending on the temperature of the oil, the temperature regulating valve directs the oil either through the cooler or to the warm-up chamber of the oil tank. When oil is passed through the cooler, it enters the oil tank outside of the warm-up chamber.

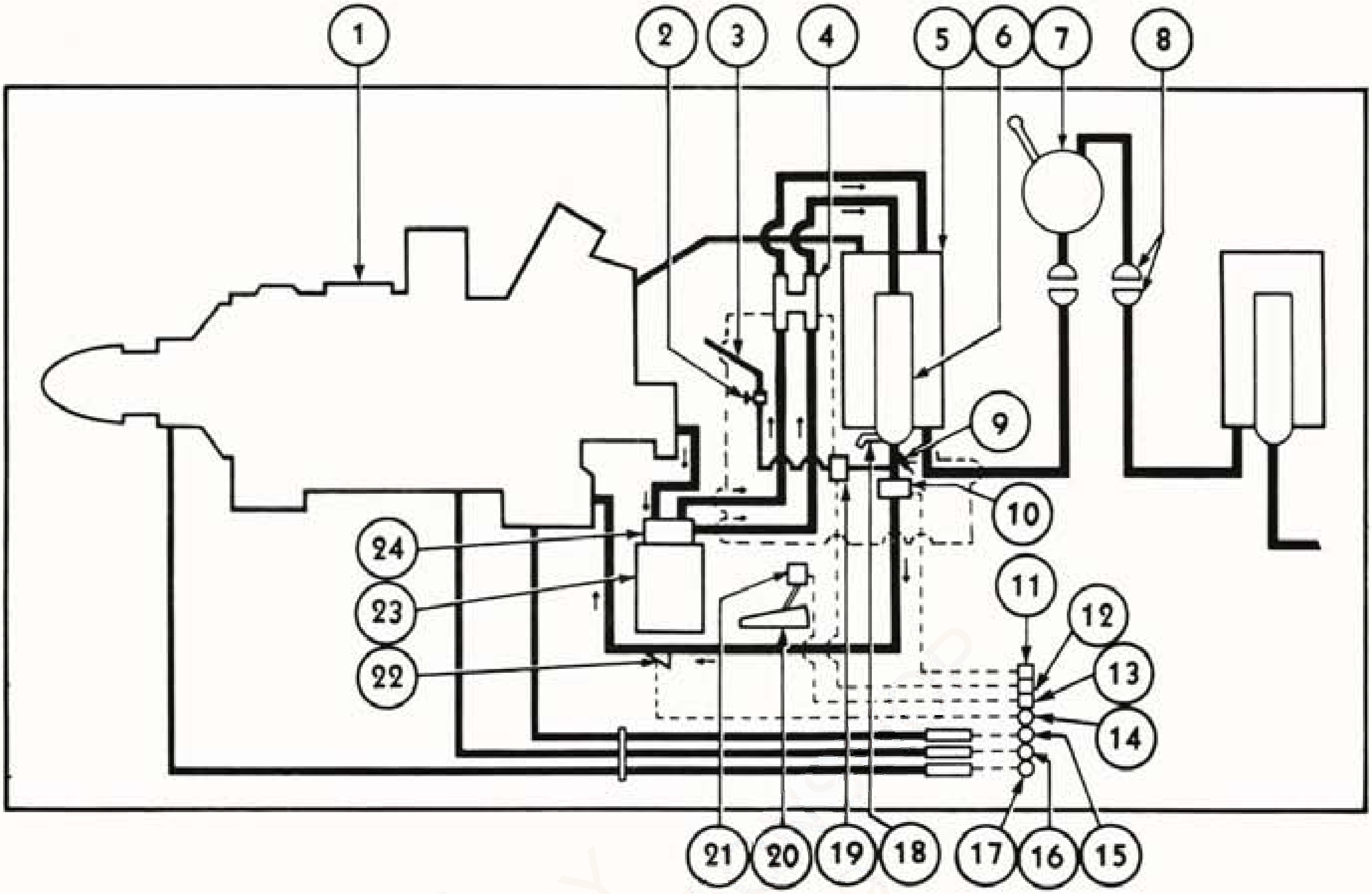
1-56A. OPERATION OF THE OIL SYSTEM DURING WARM-UP. An automatic thermoswitch is provided to reduce the warm-up time to approximately 7 to 10 minutes. The thermoswitch is installed in the oil-in line near the oil shut-off valve and operates the diverter valve to return all oil to the warm-up chamber in the oil tank until the oil leaving the tank reaches a temperature of 60°C (140°F). Thus, until the oil in the warm-up chamber is entirely warmed up, all oil will be returned to the chamber regardless of the action of the temperature regulating valve on the oil cooler. A small fluctuation of temperature (3°C) will be noticed on the service gage. The fluctuation of oil pressure due to the different viscosities of the warm and cold oil will cause a pressure fluctuation of 6 to 10 pounds to show on the front gage and 3 to 5 pounds on the rear gage. This is normal to the operation of the fast warm up system. After all of the oil in the tank has reached a temperature of 60°C (140°F) the thermoswitch is inoperative and the system will act as a normal two return system.

1-56B. A limit switch actuated by the mixture control breaks the circuit from the thermoswitch when the control is in the "IDLE CUT-OFF" position. This is a safety measure to prevent prolonged operation of the solenoid at the diverter valve if the engine is inoperative.

1-57. OIL COOLER FLAPS SWITCHES. The oil cooler flap switch for each engine controls the opening in the oil cooler duct, thus regulating the amount of air passing through the oil cooler. The flap should be closed for starting and open only enough during flight to keep the temperature within limits.

1-58. FUEL AND OIL SHUT-OFF SWITCH. *(See paragraph 1-48.)*

1-59. OIL DILUTION SWITCHES. The oil dilution switches on the flight engineer's switch panel operate a solenoid valve allowing fuel from the fuel line to




| | | | | | |
|---|---|---|---|---|---|
| 1 | Engine | 9 | Thermoswitch | 17 | Horsepower Indicator |
| 2 | Oil Dilution Hand Valve | 10 | Oil Shut-Off Valve | 18 | Drain Valve |
| 3 | Oil Dilution Line | 11 | Fuel and Oil Shut-Off Switch | 19 | Oil Dilution Solenoid Valve |
| 4 | Diverter Valve | 12 | Oil Dilution Switch | 20 | Oil Cooler Flap |
| 5 | Oil Tank | 13 | Oil Cooler Flap Switch | 21 | Oil Cooler Flap Motor |
| 6 | Oil Warm-Up Chamber | 14 | Oil Temperature Indicator | 22 | Thermometer |
| 7 | Transfer Pump | 15 | Oil Pressure Gage—Rear | 23 | Oil Cooler |
| 8 | Pump Connections | 16 | Oil Pressure Gage—Front | 24 | Oil Cooler Valve |

*Figure 1-12—Oil System*

the carburetor to enter the oil-in line just aft of the fire wall. The switch also turns on the emergency fuel pump so that sufficient pressure will be available. A diverter valve between the return oil line to the oil tank and the bypass line to the warm-up chamber directs the diluted oil from the oil cooler to the quick warm-up chamber.

**Note**

The manual shut-off cock between the main fuel line and the oil dilution solenoid located just aft of each fire wall between the first and second frames is safetied in the "CLOSED" position at all times to prevent fuel seeping through the solenoid valve and must be opened before dilution.

1-60. OIL TRANSFER PUMP. A portable hand operated pump is stowed in the left center wing for use in transferring oil between the two oil tanks in either wing. The lower hose on the pump is the suction line—the upper hose the pressure line. Since the pump hoses are fitted with quick disconnect fittings that mate with the fittings on the oil transfer lines, the pump can be connected to transfer oil in either direction. The pump is capable of transferring 9-1/6 US (7.84 Imperial) gallons per minute when operated at a rate of 120 strokes per minute.

## 1-61. ELECTRICAL SYSTEM.

1-62. DESCRIPTION OF ELECTRICAL SYSTEM. Twenty-eight volt direct current is supplied by four engine driven generators and two auxiliary power plant driven generators. Two 24-volt batteries, used primarily for starting the auxiliary power plants and for operating the recognition, boarding, and anchor lights, are charged during flight by the generators. Voltage regulators control the output of all generators, and reverse current relays and reverse current circuit breakers keep the generators or batteries from discharging back to a generator whose output is less than that of the other generators or the batteries. Control and regulation of the electrical system is centralized at the flight engineer's station.

1-63. BATTERY SWITCH. The battery switch has three positions. In the "OFF" position the battery is not connected to the main bus, but battery power is available for operating the recognition, boarding, and anchor lights. When the switch is thrown to the "BATTERY" position, battery power energizes the battery relay thus connecting the batteries to the main bus. The battery switch must always be in the "BATTERY" position when the generators are connected to the main bus to keep the batteries charged. Use the "EXT. POWER" position of the battery switch whenever an external source of power is connected to the airplane. This will conserve battery power since the external power is then used to close the battery relay. To charge low batteries without removing them from the airplane, connect an external power source and throw the switch to "EXT. POWER."

**CAUTION**

Do not attempt to start the main engines from the batteries. Before *any* loads other than recognition, boarding, and anchor lights are put on the main bus, either one or both of the auxiliary generators should be connected to the main bus.

1-64. GENERATOR CONTROL SWITCHES. The output of the four engine driven generators is controlled by the generator control switches. Throw the generator control switches to "ON" after the engines are brought up to speed for the take-off run. When the engines are operating at approximately 1150 rpm or more, the generators are capable of delivering their full rated load; however, at lower engine speeds, the reverse current relay may chatter causing damage to the relay. For this reason, the operation of the generator control switches in the "ON" position shall be normally limited to flight conditions. If the engine speed is to be maintained above 1150 rpm, check that the voltage of the generator is between 27.5 and 28.5 volts before throwing the switch to "ON."

1-65. GENERATOR FIELD SWITCHES. The generator field switches are placed beside the generator control switches for each engine driven generator. Each switch is provided with a safety guard that keeps the switch in the "ON" position. These switches should always be in the "ON" position, unless the generator is shorted. In the event of a short circuit in the generator or the power line to the main bus, which will be indicated by fluctuations of both the ammeter and voltmeter, lift the switch guard and throw the switch to "OFF" to cut the generator field circuit and prevent fire.

1-66. INVERTER SWITCH. Two inverters are incorporated in the airplane electrical system, either one of which can supply sufficient alternating current to operate the following a-c equipment:

- Main Engine Oil Pressure Gages
- Main Engine Fuel Pressure Gages
- Main Engine Manifold Pressure Gages
- Main Engine Torque Meters
- Main Engine Fuel Flowmeters
- Auxiliary Power Plant Oil Pressure Gages
- Flux Gate Compass
- Pilot's Instrument Panel Lights
- Communications Equipment

Throw the inverter switch to the "No. 1" position before starting the auxiliary power plant so that the oil pressure can be checked. Leave the switch in that position for all operating conditions. If the a-c power fails, throw the switch to the "No. 2" position so that current from the alternate inverter may be utilized.

1-67. EXTERNAL POWER RECEPTACLE. A standard external power receptacle is located forward of the fuel compartment in the forward cargo compartment for the connection of an external 28-volt power source.

**CAUTION**

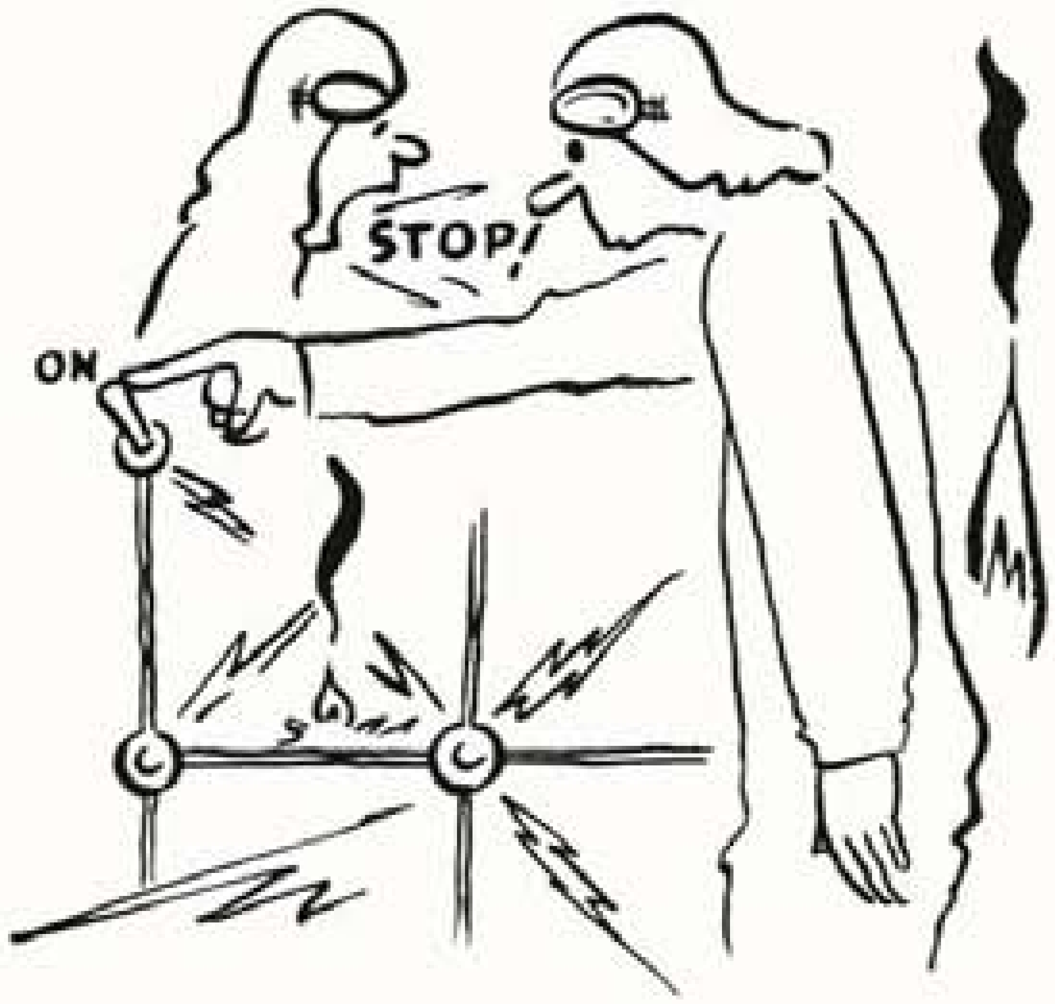
Since the external power connects directly to the main bus, be sure that *all* power switches including the battery power switch and the external power breaker switch are off before making the connection to prevent arcing at the receptacle. When the plug is firmly engaged, close the external power breaker switch and place the battery power switch in the "EXTERNAL POWER" position.

1-68. VOLTMETERS. Five d-c voltmeters are provided on the flight engineer's instrument panel: one voltmeter for each of the engine driven generators, and one master voltmeter that can be switched to any one of the six generators or the battery.

1-69. AMMETERS. There are seven ammeters on the flight engineer's instrument panel: one for each of the six generators and one for the battery.

1-70. CIRCUIT BREAKER SWITCHES. Circuit breaker switches on the flight engineer's switch panel are provided to protect the electrical equipment from shorts and overloads. The circuit breaker switches for the various items of electrical equipment must be in the "ON" position before the equipment can be operated. If the switch goes to the "OFF" position, it indicates an overload in that particular circuit. The switch cannot be reset to the "ON" position until the condition causing the short or overload has been corrected.

**WARNING**




Do not hold a circuit breaker switch in the "ON" position or serious damage to the electrical system involved will result with the probability of fire breaking out.

## 1-71. AUXILIARY CONTROLS.

1-72. AUTOMATIC PILOT. The type S-3 automatic pilot provides complete automatic control for lateral, longitudinal, and directional motions of the airplane. The directional gyro control unit and the bank-and-climb gyro control unit are mounted in the center of the pilot's instrument panel providing continuous indications of the movements of the airplane, whether the airplane is being flown by automatic or manual control. The servo speed control valves on the pilot's instrument panel regulate the rate of response with which the automatic pilot operates the rudder, ailerons, and elevator. No "caged" turns should be made with this automatic pilot, since there is no proportional bank adapter in the system.

1-73. Vacuum for the gyros is provided by engine driven vacuum pumps that provide vacuum whenever engines 2 and 4 are operating. The vacuum gage on the bank-and-turn gyro control unit should read 3.7 to 4.5 inches Hg for proper operation.

1-74. Hydraulic pressure for the automatic pilot is provided by either one of two electrically operated hydraulic pumps. Use pump No. 1 to operate the system and maintain pump No. 2 for standby operation. The pumps are controlled by switches on the pilot's pedestal. The automatic pilot is engaged by pulling out on the on-off control on the aft face of the pilot's pedestal.

1-75. SURFACE DE-ICER SYSTEM. The surface deicing system removes ice formations on the leading edges of the wing, stabilizer, and fin by pulsating boots. The system derives its pressure from the four engine driven vacuum pumps, and its suction is taken from the vacuum pumps on engines 1 and 3. The cycles of inflation of the boots are controlled by an electronic timer. All controls for the de-icer system are located at the flight engineer's station. Refer to paragraphs 6-1 through 6-3 for operating instructions.

1-76. CARBURETOR ANTI-ICING SYSTEMS. Three carburetor anti-icing systems are provided. One system is for the two inboard carburetors and one for each of the outboard carburetors. A pump is provided for each carburetor with a switch on the flight engineer's switch panel. When the switch is placed in the "ON" position, the anti-icing fluid is metered to the carburetor at a rate of 17.8 US (14.6 Imperial) gallons per hour. The two pumps for the inboard carburetors draw from a common reservoir with a capacity of 37.2 US (30.9 Imperial) gallons. Each outboard pump draws from an individual reservoir having a capacity of 18.6 US (15.4 Imperial) gallons.

1-77. PROPELLER AND WINDSHIELD ANTI-ICING SYSTEM. All four propellers and the pilot's and copilot's windshields are supplied with anti-icer fluid by one pump drawing from a reservoir of 37.2 US (30.9 Imperial) gallons capacity. The pump is controlled by a switch on the flight engineer's switch panel which opens a solenoid in the propeller line, and by a switch on the pilot's pedestal which opens a solenoid in the windshield line. The amount of fluid sprayed on the windshield is controlled by a valve located to the left of the pilot. The system will deliver 2 US (1.7 Imperial) gallons of fluid per hour to each propeller.

**CAUTION**


Never operate the wiper ot. dry glass. A dry wiper scratches.

1-78. WINDSHIELD DEFROSTER PANELS. The pilot's and copilot's windshields are equipped with removable defroster panels. Hot air from the heater is blown into the space between the panel and the windshield, thus removing fog from the inner surface and ice from the outer surface of the windshield.

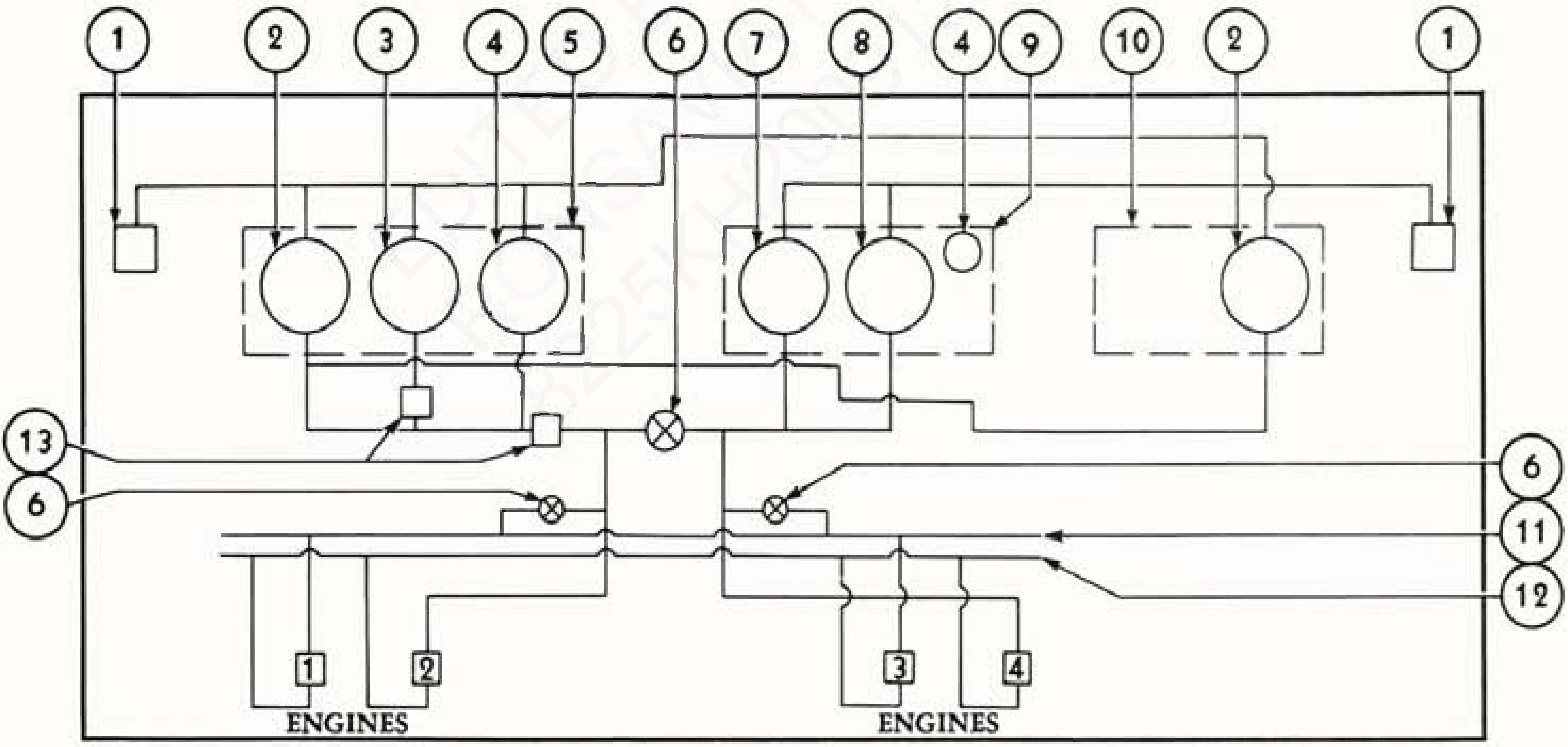
1-79. WINDSHIELD WIPER CONTROL. The windshield wiper switch on the top left side of the pilot's pedestal controls the operation of the motor that actuates both the pilot's and copilot's windshield wiper blades. In changing the switch from the "FAST" to the "SLOW" position or vice versa, leave the switch in the "OFF" position until the blades stop, then move to "SLOW" or "FAST" as desired, because changing the speed reverses the motor.

1-80. WINDSHIELD WASHER. A water container of 1.2 US (1 Imperial) quart capacity with a manual pump is provided for washing salt spray or other dirt off of the windshield while in flight. Since the system utilizes the windshield anti-icer distribution system to put the water on the windshield, the anti-icer control valve must be "OFF" while washing the windshield. To operate the pump which is located to the right of the copilot, press the handle in to unlock, then turn the handle to the horizontal position and pump to wash the right side of the windshield or to the vertical position and pump to wash the left side. Operate the windshield wiper to remove the water. Lock the pump by pressing the handle all the way in and turning it to the "OFF" position.

## 1-81. MISCELLANEOUS CONTROLS.

1-82. SURFACE CONTROL LOCKS. The aileron controls are locked by a bar and yoke that attaches to the control columns. The rudder and elevator controls are locked with two keys in the tail section. Since removing the keys from the elevator and rudder controls unlocks them and the same keys must be used to unlock the aileron control bar and yoke, the controls cannot remain locked without the pilot's knowledge. The locking bar, yoke, and keys are stowed at the flight engineer's station.

1-83. PILOTS' SEATS. The pilots' seats are adjustable vertically for 7 inches in 1/2-inch increments and fore and aft for 9 inches. The back may be tilted for comfort. Elevation adjustment is made by pulling the elevation lock lever on the right front side of the seat and raising or lowering it as desired. The position of




| | | | |
|---|---|---|---|
| 1 | Air Filter | 7 | Directional Gyro |
| 2 | Gyro Horizon | 8 | Bank and Climb Indicator |
| 3 | Turn and Bank Indicator | 9 | Auto-Pilot Panel |
| 4 | Vacuum Gage | 10 | Copilot's Panel |
| 5 | Pilot's Instrument Panel | 11 | De-Icer Vacuum Manifold |
| 6 | Vacuum Shut-Off Valve | 12 | De-Icer Pressure Manifold |
| | | 13 | Adjustable Restrictor Valves |

*Figure 1-13—Vacuum System*

the seat in the track is changed by pushing the lever on the aft left side of the seat and sliding the seat fore or aft as desired. The back tilt is changed by releasing the lever on the right rear side of the seat and adjusting the tilt as desired. The standard shoulder type harness is released by pushing on the end and lifting the lever on the forward left side.

1-84. VACUUM SYSTEM. *(See figure 1-13.)* Vacuum for operation of the automatic pilot, instruments, and surface de-icers, and pressure for the surface de-icers are provided by four engine driven vacuum pumps. The pumps on engines 1 and 3 normally supply vacuum for the de-icer system while the pumps on engines 2 and 4 supply vacuum for the instruments and the automatic pilot. The pressure side of all four pumps is led into the de-icer system. Instrument vacuum is indicated on the gage on the pilot's instrument panel. No vacuum gage is provided for the de-icer system, but the pressure is indicated on a gage on the flight engineer's fuel control panel.

1-85. If either the normal instrument vacuum supply (engine No. 4 pump) or the automatic pilot supply (engine No. 2 pump) should fail, both the instruments and the automatic pilot may be operated by the one remaining source by turning the vacuum selector valve to the pilot's left to the "OPEN" position. If both engine No. 2 and engine No. 4 pumps fail, the vacuum from either or both of the two remaining pumps can be utilized by opening either one or both of the shut-off valves in the right-hand center wing.

1-86. AUXILIARY POWER PLANTS. Two Andover type V-32 auxiliary power plants of 175 amperes capacity each are provided in the auxiliary power plant compartment to be used for ground operation of the electrical system, for starting the main engines, and for standby power sources during take-off and landing. When the auxiliary generator switch is turned on the generator is automatically connected parallel to any other airplane power source connected to the main bus at that time. Therefore the auxiliary generators operate in parallel with each other, the airplane batteries, or any of the engine-driven generators. Fuel for the auxiliary power plants is drawn from either one or both wing tanks depending on the setting of the auxiliary power plant fuel selector valve on the flight engineer's fuel control panel. An additional shut-off valve is provided on each auxiliary power plant stand. Two ignition switches are provided for each unit, one on the flight engineer's switch panel, the other on the unit, both of which must be turned to "ON" before the unit will operate. The units may be started electrically by motoring the generator. The governor control and choke lever on the unit controls the choke when moved to the left of the "IDLE" position and the speed when moved to the right of the "IDLE" position.

1-87. PORTABLE BILGING AND REFUELING PUMP. A portable electric pump with a capacity of 50 US (41.6 Imperial) gallons per minute is stowed in the lower deck on the left side of the aft stair well. The pump with a 30-foot electric cable and a 10-foot and a 30-foot hose may be used for pumping bilge from the hull or wing tip floats or for refueling. Connect the pump to any convenient utility receptacle, prime with two quarts of the fluid to be pumped, and throw the switch on the utility receptacle to "ON" to operate.

# SECTION II
# NORMAL OPERATING INSTRUCTIONS

## 2-1. BEFORE ENTERING THE AIRPLANE.

2-2. FLIGHT LIMITATIONS AND RESTRICTIONS. These limitations may be supplemented or superseded by instructions included in Service Publications.

a. Do not exceed 115 knots IAS with flaps extended.

b. Do not take-off with center of gravity outside the following locations:

| *Gross Weight (Pounds)* | *Fwd. of % MAC* | *Aft of % MAC* |
|---|---|---|
| up to 145,000 | 26 | 36 |
| at 150,000 | 27 | 34 |
| at 155,000 | 28 | 32 |

c. Do not exceed 200 knots IAS.

d. Do not exceed 150 knots IAS in rough air.

e. Do not exceed 100 knots IAS with full rudder displacement.

f. Do not exceed the following accelerations:

JRM-1
PERMISSIBLE ACCELERATIONS

| Gross Weight (Pounds) | Permissible Accelerations |
|---|---|
| 145,000 | 2.80 g |
| 155,000 | 2.71 g |

2-3. PILOT. Check with operations or loading officer to ascertain the gross weight and center of gravity for take-off and check anticipated loading for landing. Loading data are furnished in Handbook of Weight and Balance Data, AN 01-1B-40, and supplemented by a load adjuster.

2-4. FLIGHT ENGINEER. Check the following exterior items before entering the airplane:

a. Check that bow, stern, and brest lines are properly rigged and secure.

b. Make a visual exterior check of engine nacelles to make sure that engines and propellers are clear of obstructions and that propellers are in full low pitch.

c. Check that all cowling is installed and secure.

d. If the airplane is beached, make sure that it is properly chocked.

2-5. ACCESS TO AIRPLANE. Entrance is normally made through the forward entrance hatch on the right side of the hull. This door and the main cargo doors are the only ones operable from outside, and both lock with the same key. The aft cargo and entrance hatches on each side of the rear cargo compartment may also be used for entrance if they are first opened from within. These hatches slide upward for opening and must be used in either the full open or full closed position to prevent damage to the tracks.

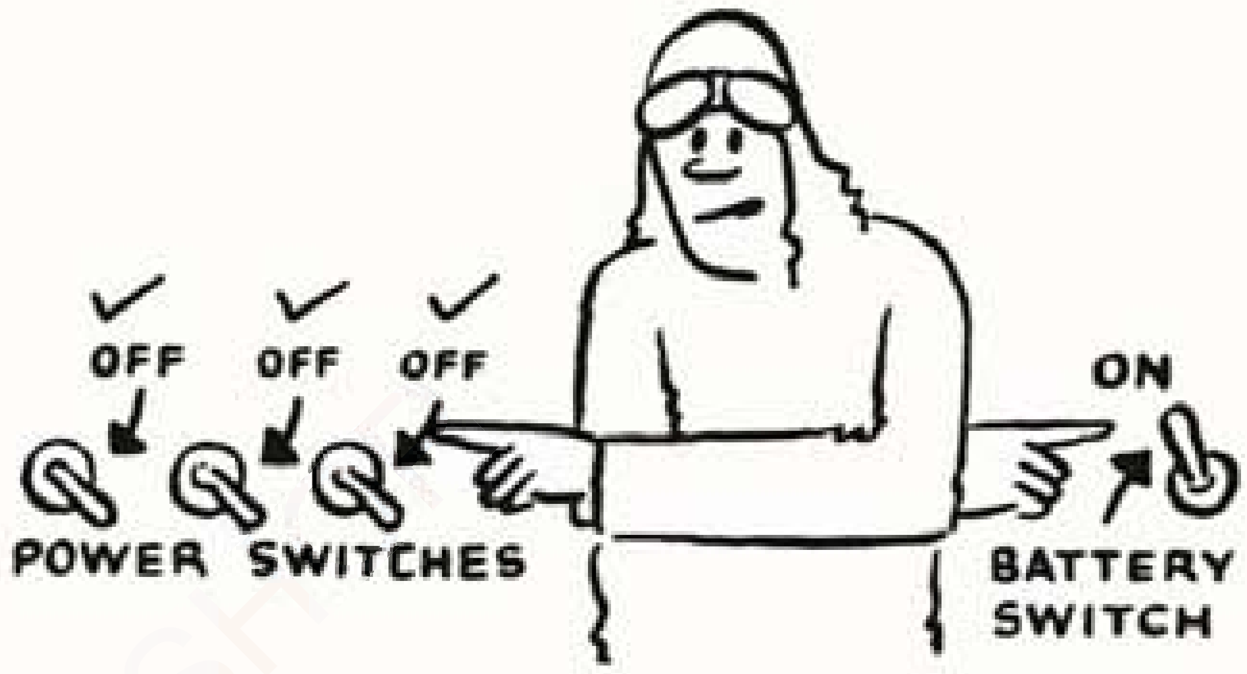
## 2-6. ON ENTERING THE AIRPLANE.

PILOT / FLIGHT ENGINEER

a. (Pilot) Assign personnel to unlock surface controls. Refer to paragraphs 2-97 through 2-99.

b. (Flight Engineer) Turn battery and inverter switches to "ON."

**CAUTION**




Before turning battery switch to "ON," check that all other power switches are "OFF."

c. (Flight Engineer) Start auxiliary power plants. Refer to paragraphs 2-92 through 2-94. As soon as the units are warmed up, check the auxiliary generator for voltage; if satisfactory, throw the auxiliary power plant generator switches on the flight engineer's switch panel to the "ON" position.

d. (Pilot) Check that flight engineer has auxiliary power plants operating.

e. (Flight Engineer) Throw the flight controls booster power circuit breaker switches to their "ON" positions, throw each booster switch to the "ON" position, and check the booster pressure at 100 pounds.

f. (Flight Engineer) Throw wing flap motor switch to "ON" and check wing flap hydraulic pressure gage at 1350 to 1500 pounds.

g. (Pilot) With the flight controls booster system and flap motor operating, check all surface and tab controls for full throw and free movement. Assign personnel to visually check movement of the surfaces.

**Note**

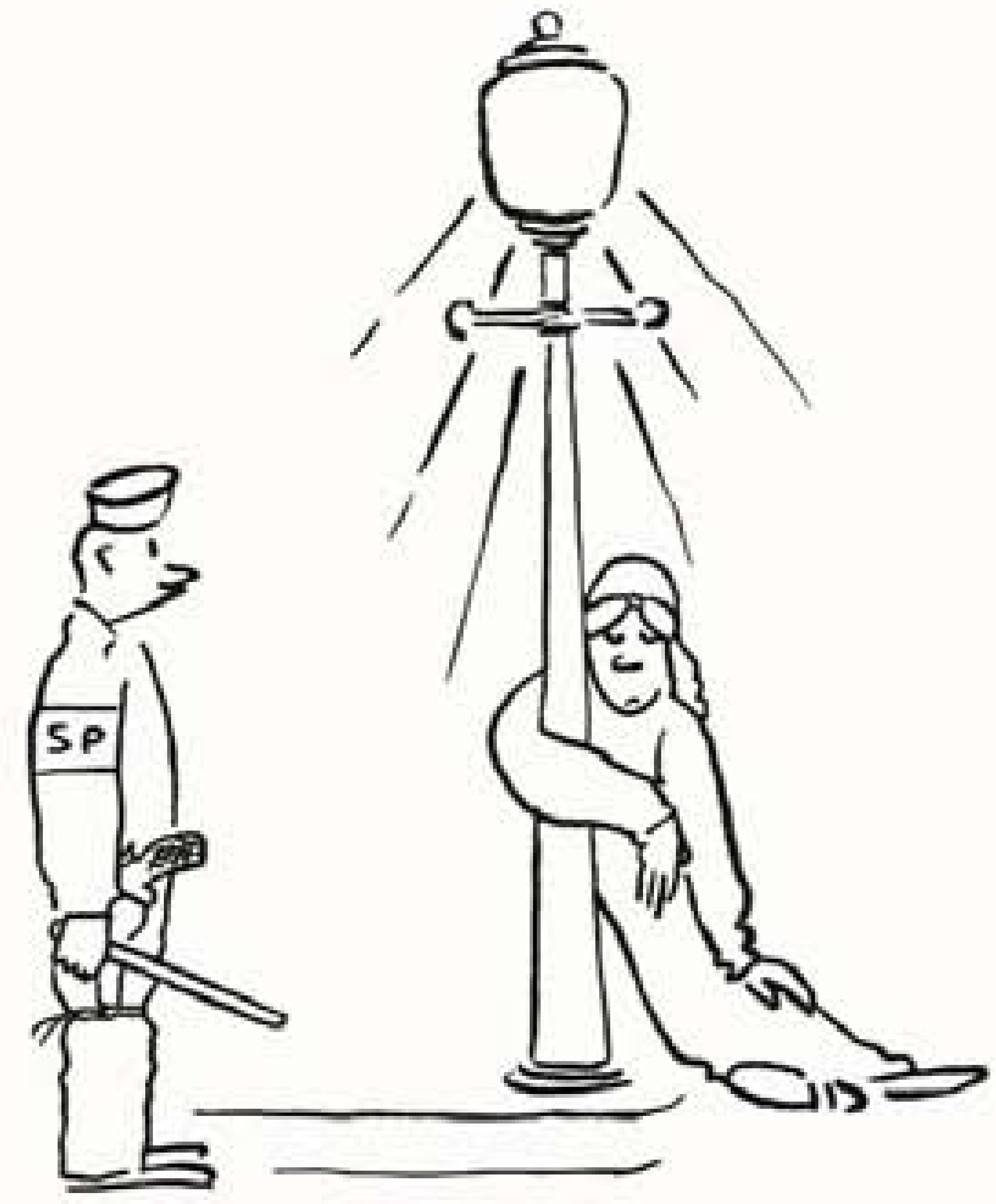
Check that the flight controls booster bypass valves are in the closed position.

h. (Flight Engineer) Make a visual mechanical inspection of the entire airplane both inside and out for airworthiness. Make sure that cowling and all inspection doors are secured and that pitot covers are removed.

i. (Pilot) Check throttle controls for freedom of movement and proper action of friction control.

| PILOT | FLIGHT ENGINEER |
|---|---|
| j. Instruct flight engineer to turn the normal and booster propeller switches to the "ON" position. | |
| | k. Turn normal and booster propeller switches to "ON." |
| l. Check propeller selector switches in both "INC. RPM" and "DEC. RPM" positions. | |
| | m. Check the operation of the feather switches by partially feathering each propeller. |
| n. Unfeather the propellers by holding the propeller selector switch in the "INC. RPM" position. | |
| o. After completing the propeller check, throw the propeller control change-over switch to the "FLIGHT ENGINEER" position. | |
| | p. Check and log fuel and engine oil quantities aboard. |
| | q. Check that anti-icer and water tanks are filled. |
| | r. Drain water from separators and bilge *all* hull tanks. Drain engine fuel strainers. |
| s. Check interphone on all stations and check operation of radio transmitter and receiver. | |
| t. Check operation of enunciator system. | |
| u. Check that ignition switches are in their "OFF" positions. | |
| v. Check that the propeller reverse safety switch is in the "OFF" position and the reverse-normal switch is in the "NORMAL" position. | |
| w. Check with beaching crew chief that the airplane is properly secured and cleared for starting and run-up. If at buoy, check that boats are clear of propellers and that bow man is ready to cast off. | |
| | x. Start heaters if necessary. Refer to paragraph 5-53. |
| | y. Check that bilges have been pumped. |
| | z. Test operate *all* warning lights. |
| | aa. Check that emergency equipment is aboard and in place. Refer to paragraphs 4-5 through 4-11. |
| | ab. Check that cockpit windows and navigator's dome are clean. |
| | ac. Check oxygen system. Refer to paragraph 5-48. |
| | ad. Check cowl flap operation. Return to the open position. |
| | ae. Check oil cooler flap operation. Return to the closed position. |
| | af. Check fot smooth and proper mechanical operation of *all* engine fuel valves. |
| | ag. Check all engine controls for freedom of movement. Check for correct over-travel or pinch of throttles, mixture controls, and carburetor air controls. |

## 2-7. SPECIAL CHECK FOR NIGHT FLIGHTS.




a. Check operation of navigation and running lights.

b. Check operation of landing lights.

c. Check operation of flare release mechanism. Refer to paragraph 4-10.

d. Check all instrument panel and other interior lights.

e. Check that portable signal light is properly stowed in the cabinet in the auxiliary power plant compartment. Check operation of light.

## 2-8. OIL SYSTEM MANAGEMENT.

2-9. NORMAL OPERATION OF OIL SYSTEM. The oil system on the JRM-1 is a two-line return system, with the cold return line returning the oil to the hopper which is integral with the tank and the hot return line returning the oil to the tank proper.

2-10. The fast warm up system reduces the time required to raise the oil to the normal operating temperature. (See paragraph 1-56A.) During the warm-up the oil temperature on the flight engineer's gage will fluctuate approximately 3°C and the oil pressure will fluctuate 6 to 10 pounds on the front gage and 3 to 5 pounds on the rear gage because of the cycling action of the warm-up system. The normal warm-up period is reduced to approximately 10 minutes, and it will require approximately 25 minutes to warm up all the oil in the tank (140 US Gallons).

### NOTE

The quick warm-up system in no way affects the oil dilution system.

2-11. The Power Plant Chart (figure 3-1) gives the limiting pressures and temperatures and should be used as a guide at all times. Caution should be exercised upon starting that oil pressure should be showing within 5 seconds. If not, stop engine and investigate to ascertain that there are no stoppages in the line and both front and rear pump inlet lines are filled with oil.

2-12. The oil cooler flaps should be kept in the closed position until the oil reaches a satisfactory operating temperature. Then open the flaps as required.

2-13. The oil cooler temperature valve is adjusted to give an oil-in temperature of approximately 75°C (167°F) which is satisfactory for all normal operations. If at any time readjustment is necessary, it may be accomplished by backing off the lock nut and the screws holding the plate. Each mark on the plate represents a change of 5.5°C in temperature. Turn clockwise to increase temperature and anti-clockwise to reduce temperature.

2-14. In case of a long glide or at low cruise power, the oil cooler flaps should be closed slightly more than required for normal operation. Not only will this keep the oil at a slightly higher temperature, but it will also reduce the possibilities of the oil in the cooler congealing.

2-15. If congealing should occur, it can be noticed by a sudden rise in oil temperature and often by a fluctuation of oil pressure. The cooler can usually be decongealed by closing the oil cooler flap fully and running the engines at a higher rpm while flying at the slowest speed possible. This enables a maximum flow of oil through the cooler with the minimum amount of air passing across it. After the cooler has thawed out, normal operation may be resumed.

2-16. OPERATION OF OIL TRANSFER SYSTEM. If the inboard or outboard oil quantity becomes critically low, transfer a portion of the oil to the low tank in the same wing by use of the hand pump stowed in the left center wing. Connect the lower hose (suction line) on the pump to the full tank transfer fitting and the upper hose (pressure line) on the pump to the low tank transfer fitting.

**Note**

Operate the pump until the desired amount of oil has been transferred.

## 2-17. FUEL SYSTEM MANAGEMENT.

2-18. OPERATION OF FUEL SYSTEM. *(See figure 2-1.)* For all normal operating conditions, use fuel from the wing tanks to the engines by setting the engine selector valves to their respective "ENGINES" positions. The hull transfer pumps will automatically refill the wing service tanks to 600 US (499 Imperial) gallons whenever the fuel falls to 525 US (437 Imperial) gallons if the hull-tank-supply-to-engines-or-wing-tank valves are set to the respective "HULL TANK TO WING TANK" positions, the hull tank selector valve is set to a tank containing fuel, and the hull transfer pump switch is set to "AUTOMATIC."

2-19. FUEL TRANSFER SYSTEM. The transfer system will operate automatically to transfer fuel from the hull tanks to the wing tanks as described in the preceding paragraph; however, in the event of a failure of one transfer pump, the remaining pump has sufficient capacity to keep both wing tanks full. (See figure 2-2.) In order to use the remaining transfer pump to fill both wing tanks, place the cross feed valve to the "CROSS FEED ON BOTH WING TANKS" position and hold the transfer pump switch in the "MANUAL" position until both wing tanks are refilled.

2-20. The transfer pumps may also be used to feed fuel directly to the engines. (See figures 2-3, 2-4, and 2-5.) In this event a switch operated by the selector valve closes, completing a direct circuit to the transfer pump.

2-21. If it is necessary to transfer fuel from one hull tank to another, set the hull tank selector valve to the tank to be emptied, set the hull-tank-supply-to-engines or wing-tank valves to "OFF," set the cross feed valve to "CROSS FEED ON BOTH WING TANKS," open the fuel shut-off cock on the fuel manifold in the fueling compartment for the tank to be filled and operate either fuel transfer pump switch in the "MANUAL" position until the desired amount of fuel has been transferred. (See figure 2-6.)

2-22. SEQUENCE OF USING FUEL. The sequence of using fuel from the hull tanks will be specified by the operations or loading officer under normal conditions. If, however, no specific instructions are given, use fuel from the tanks in the following order:

a. When the airplane is fueled for general cargo loadings, use fuel from (1) Forward Tanks, (2) Aft Tanks, (3) Middle Tanks.

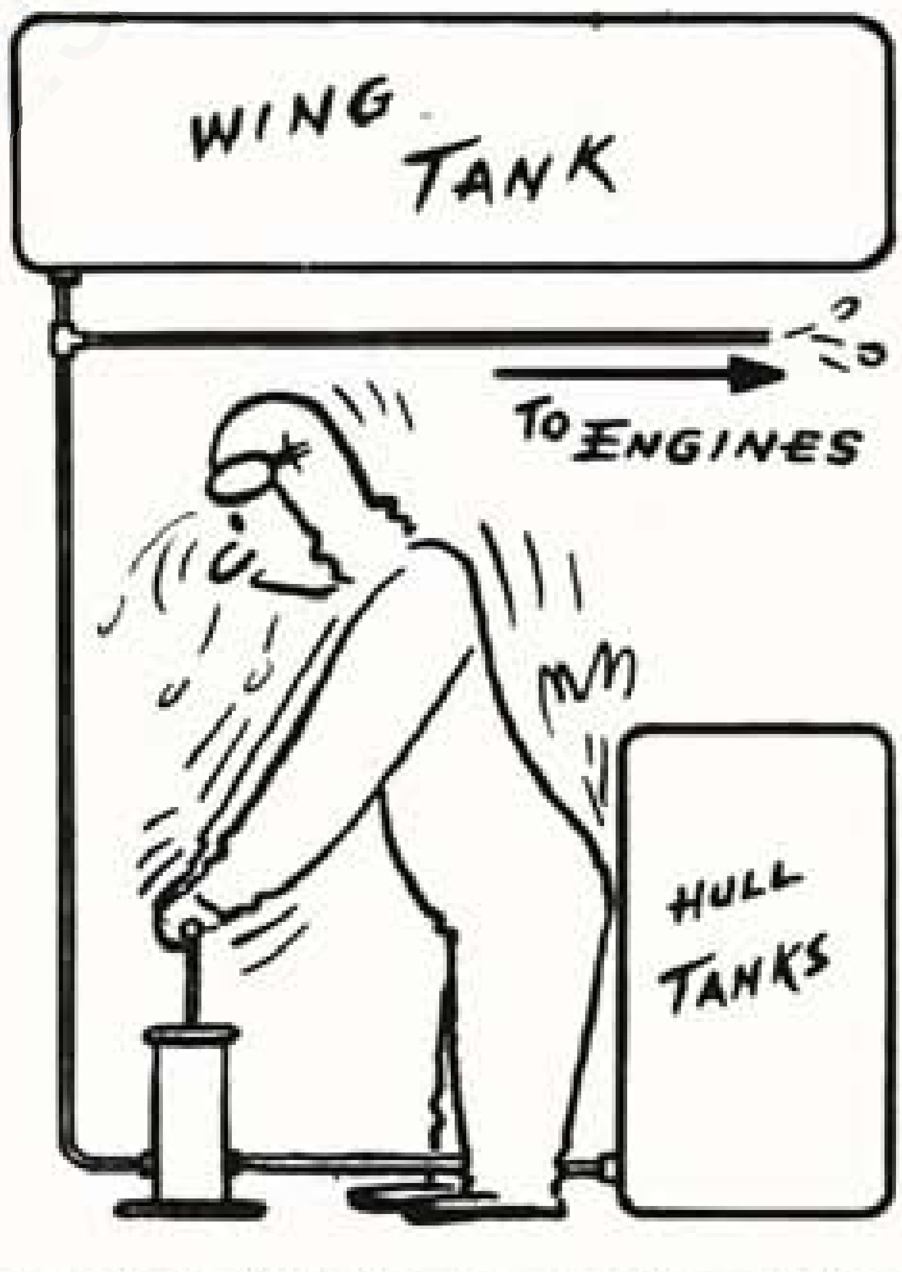
b. When the airplane is fueled for troop and casualty loadings use fuel from (1) Aft Tanks, (2) Middle Tanks, (3) Forward Tanks.

2-23. EMERGENCY HAND TRANSFER PUMP. In the event of failure of both hull transfer pumps, use the hand pump in the refueling compartment to refill the wing service tanks. (See figure 2-7.) The pump has a capacity of approximately 800 US (666 Imperial) gallons per hour at 120 strokes per minute.

2-23A. EMERGENCY TRANSFER OF FUEL WITH BILGE PUMP. *(See figure 4-3A.)* The fuel bilging pump may be used to transfer fuel from one hull tank to another by setting the bilge selector valve to the tank from which fuel is to be drawn, setting the selector valve to "MANIFOLD," opening the hull tank shut-off cock for the tank to be refilled, and pumping the bilge pump. The pump has a capacity of approximately 800 US (666 Imperial) gallons per hour at 120 strokes per minute. For additional instructions refer to paragraph 4-24A.

2-24. USING FUEL FROM ONE WING TANK IN FOUR ENGINES. *(See figure 2-8.)* If one wing tank fuel supply fails and it is desired to use fuel from the operable wing tank source in all four engines, place the cross feed valve in the "CROSS FEED ON BOTH WING TANKS" position and operate with the emergency fuel pump switch on the side with the usable tank in the "ON" position.

**Note**




When using fuel from one wing tank to all four engines, it is impossible to refill the wing tank from the hull tanks.

2-25. OPERATION OF EMERGENCY FUEL PUMP. Place the emergency fuel pump switches in the "ON" position for starting the engines—the pressure gage should indicate 17 ± 1 pounds pressure. The switches should also be "ON" for take-off, landing, and during flight whenever erratic engine operation would indicate the presence of vapor lock. If an engine driven fuel pump should fail, turn on the emergency pump supplying that engine.

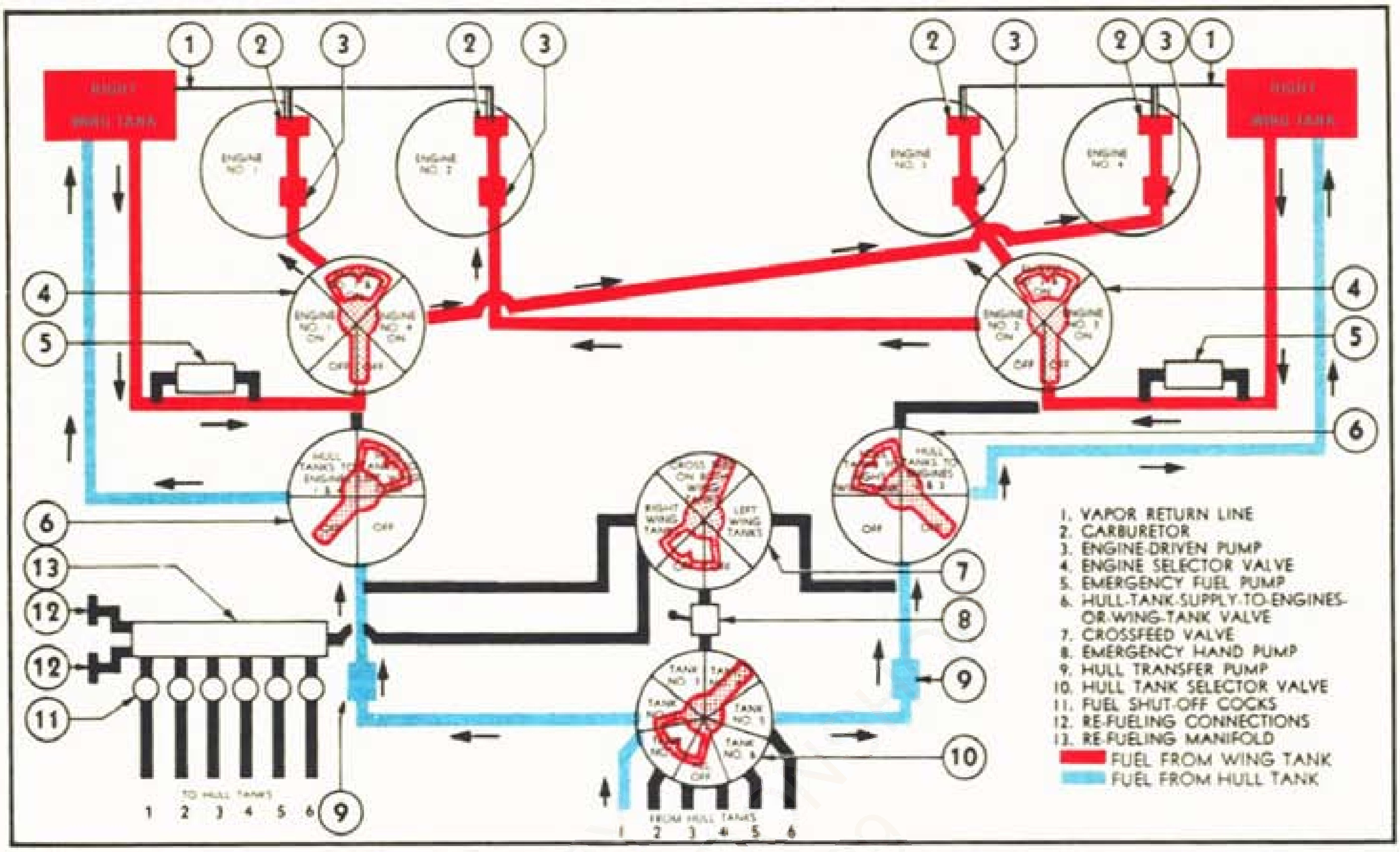



*Figure 2-1—Schematic Fuel Flow Diagram—Normal Operation*

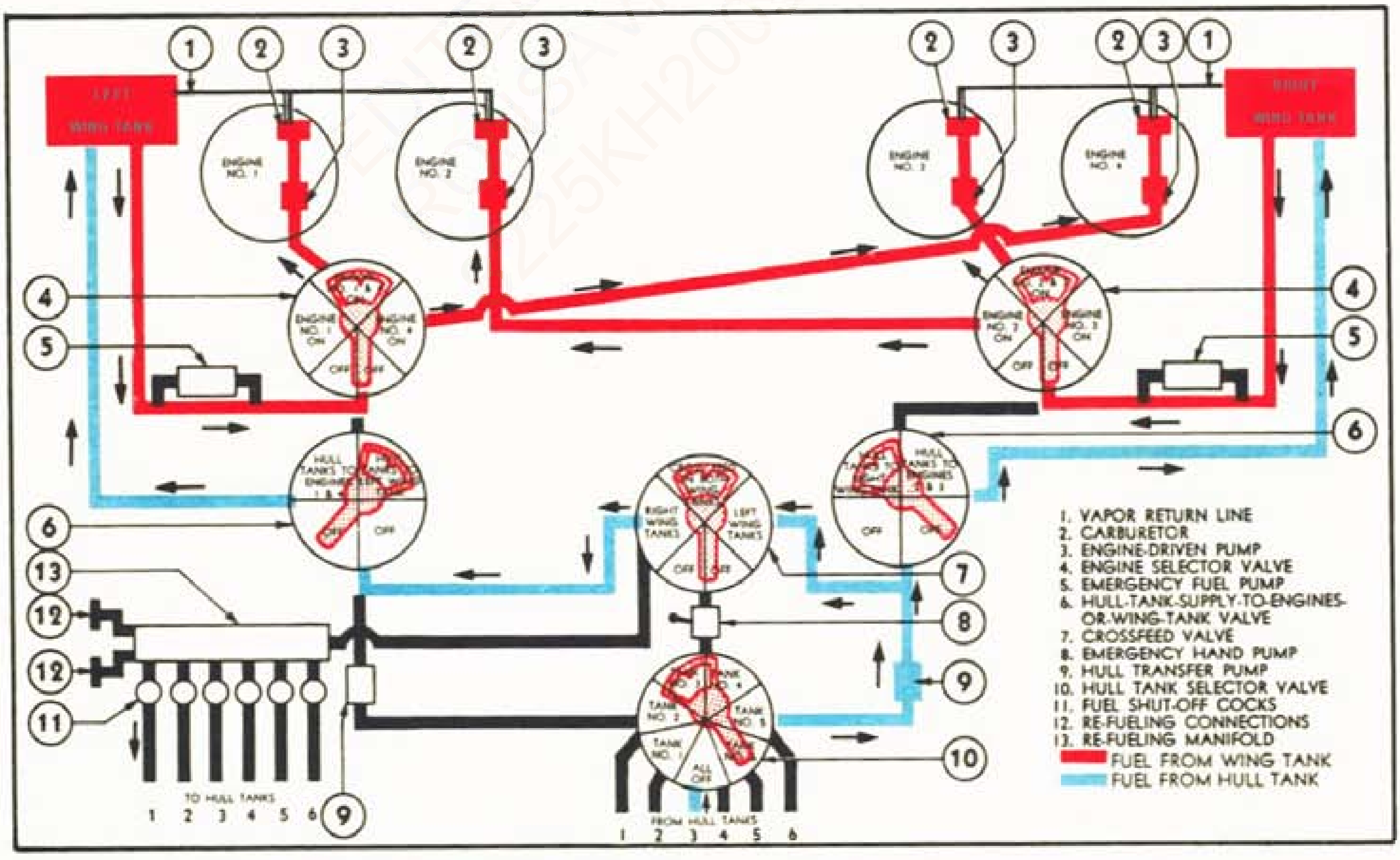



*Figure 2-2—Schematic Fuel Flow Diagram—One Transfer Pump Inoperative*

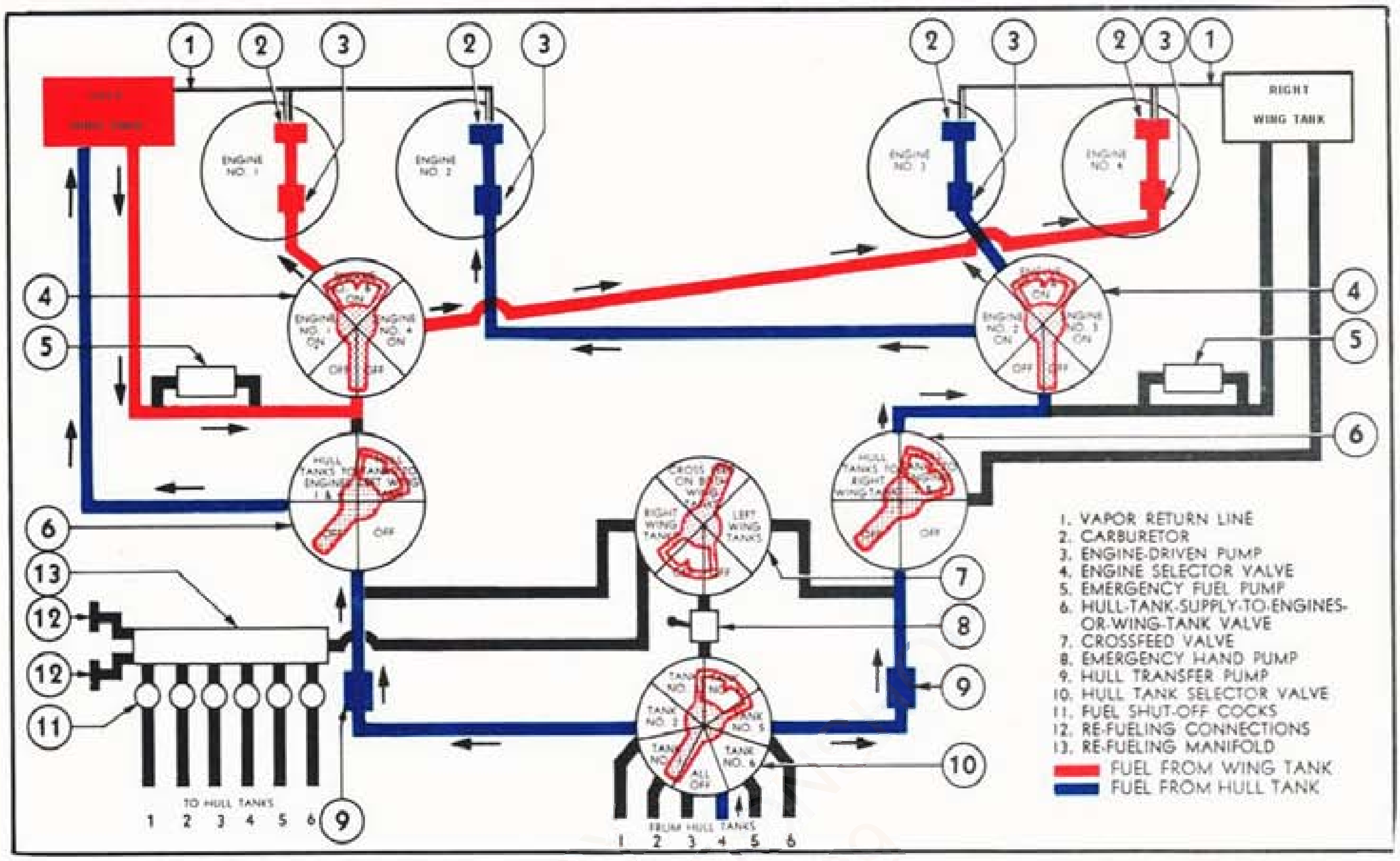



*Figure 2-3—Schematic Fuel Flow Diagram—One Wing Tank Inoperative*

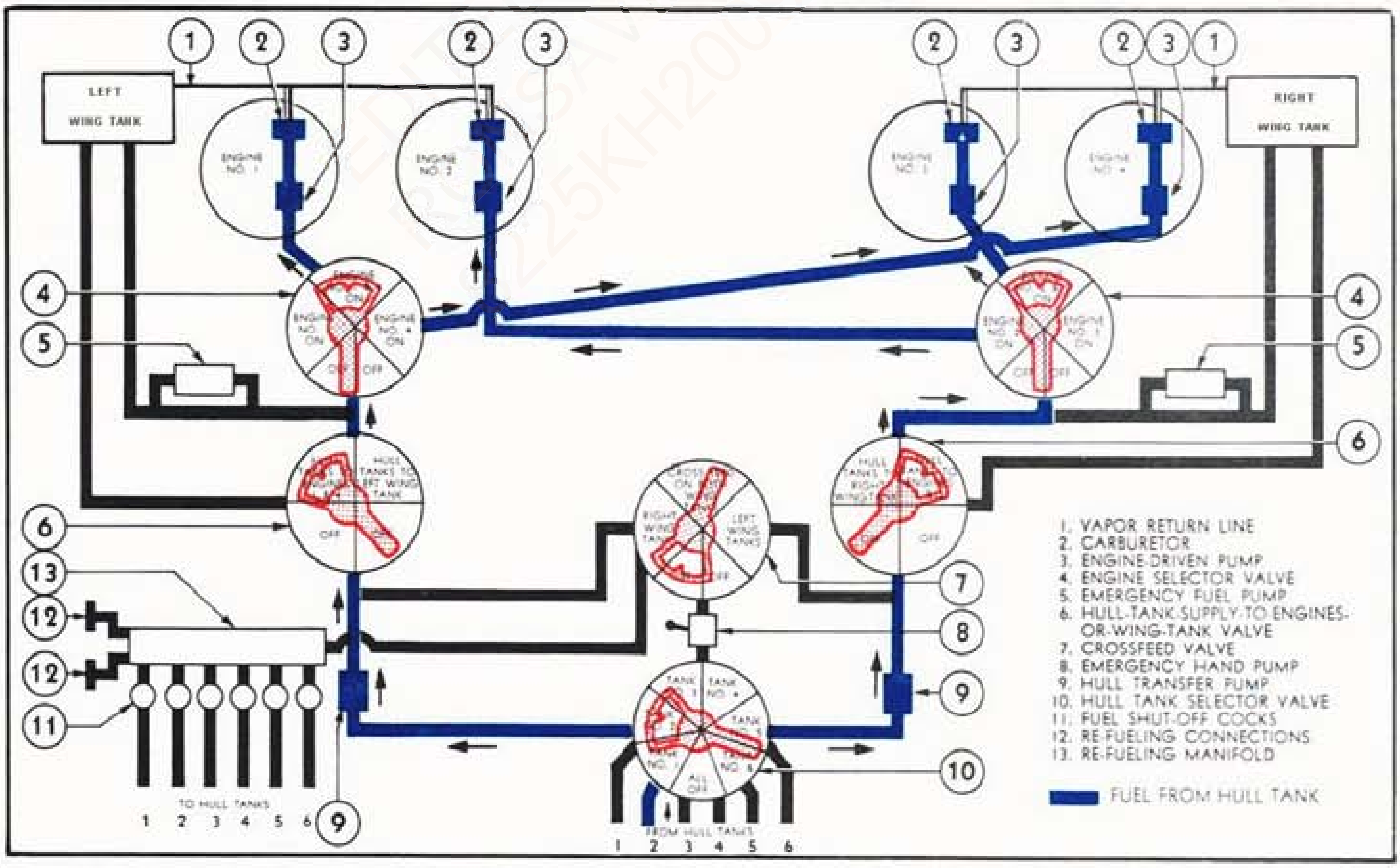



*Figure 2-4—Schematic Fuel Flow Diagram—Both Wing Tanks Inoperative*

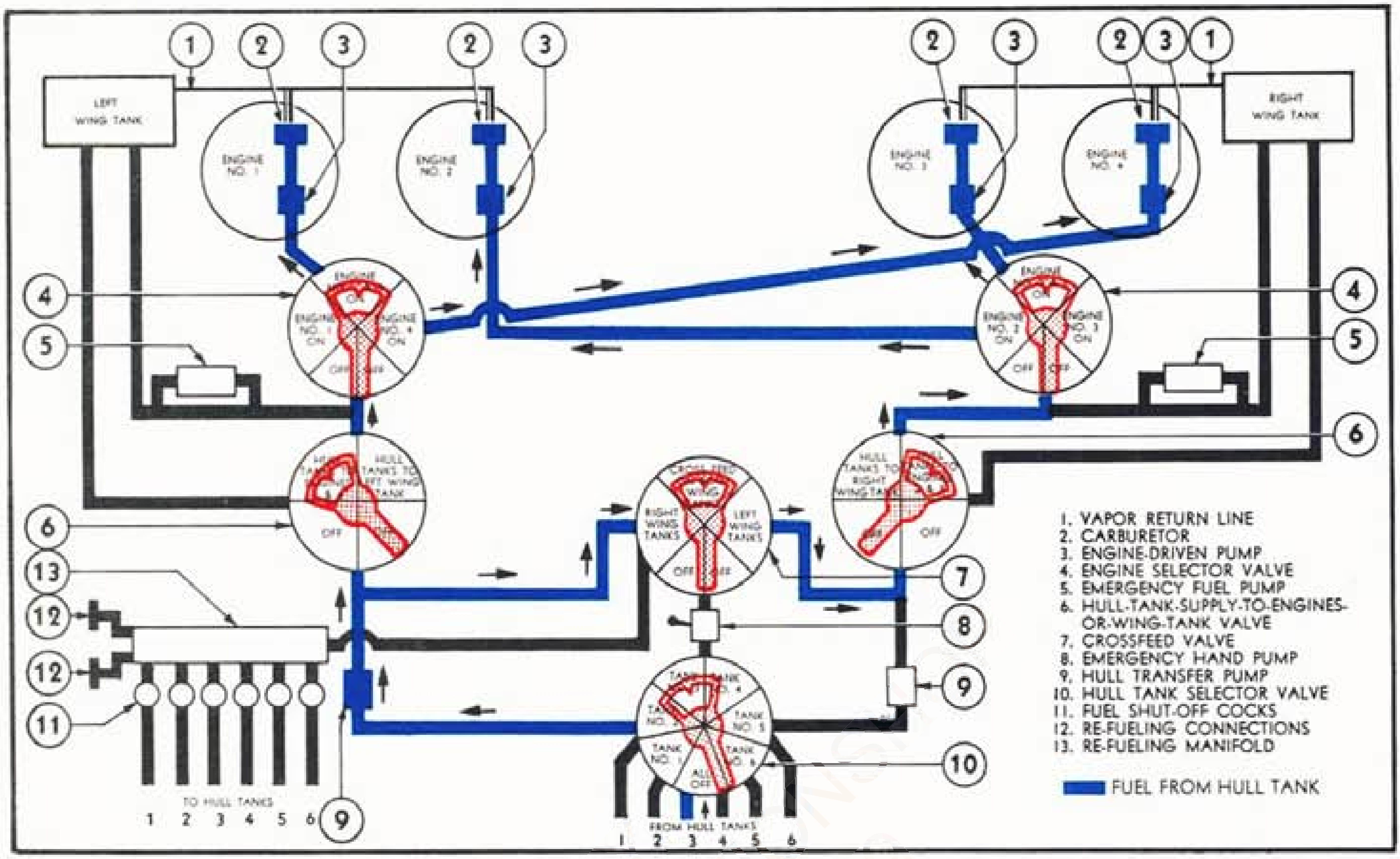



*Figure 2-5—Schematic Fuel Flow Diagram—Both Wing Tanks and One Transfer Pump Inoperative*

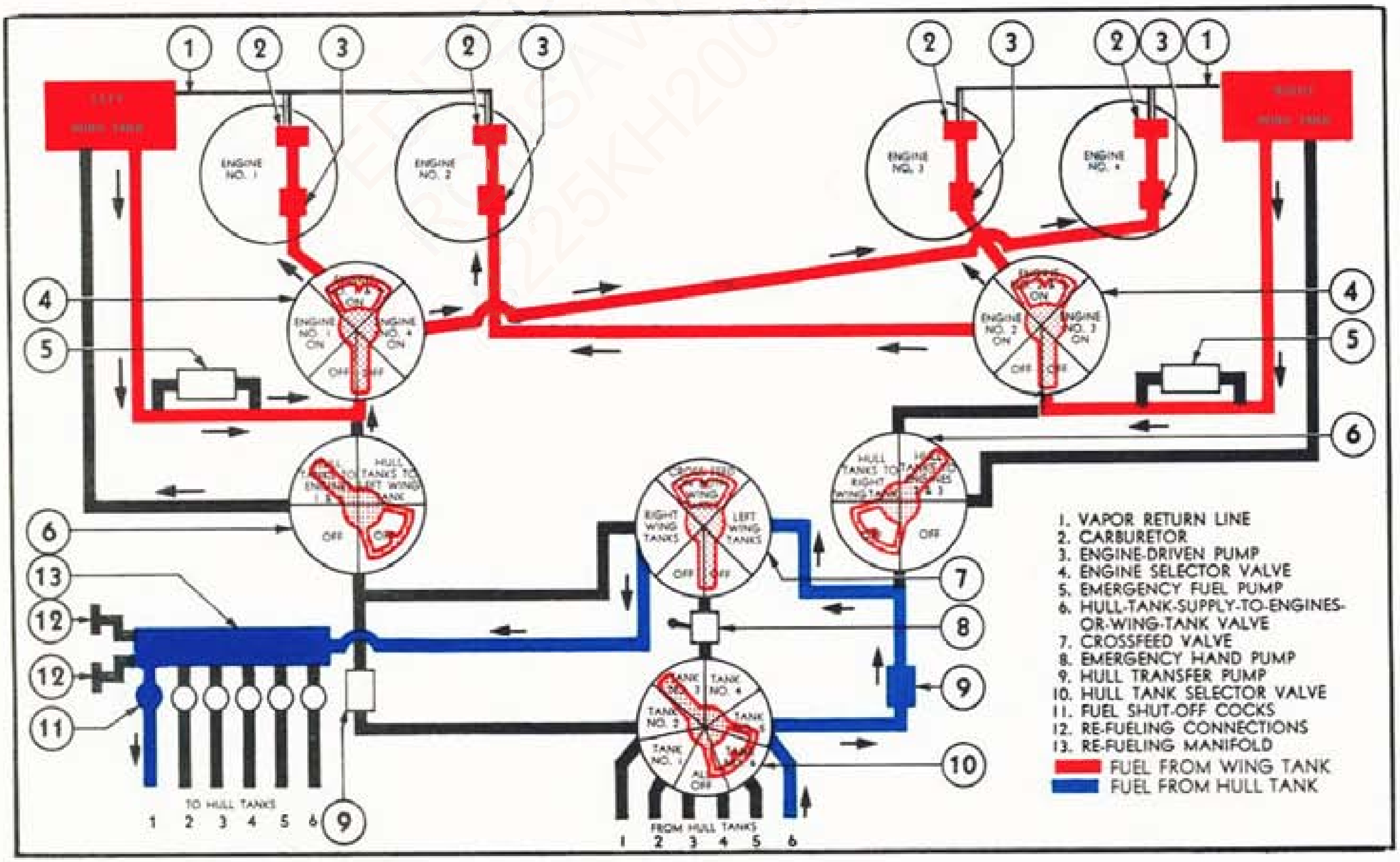



*Figure 2-6—Schematic Fuel Flow Diagram—Transferring Hull Tank Fuel*

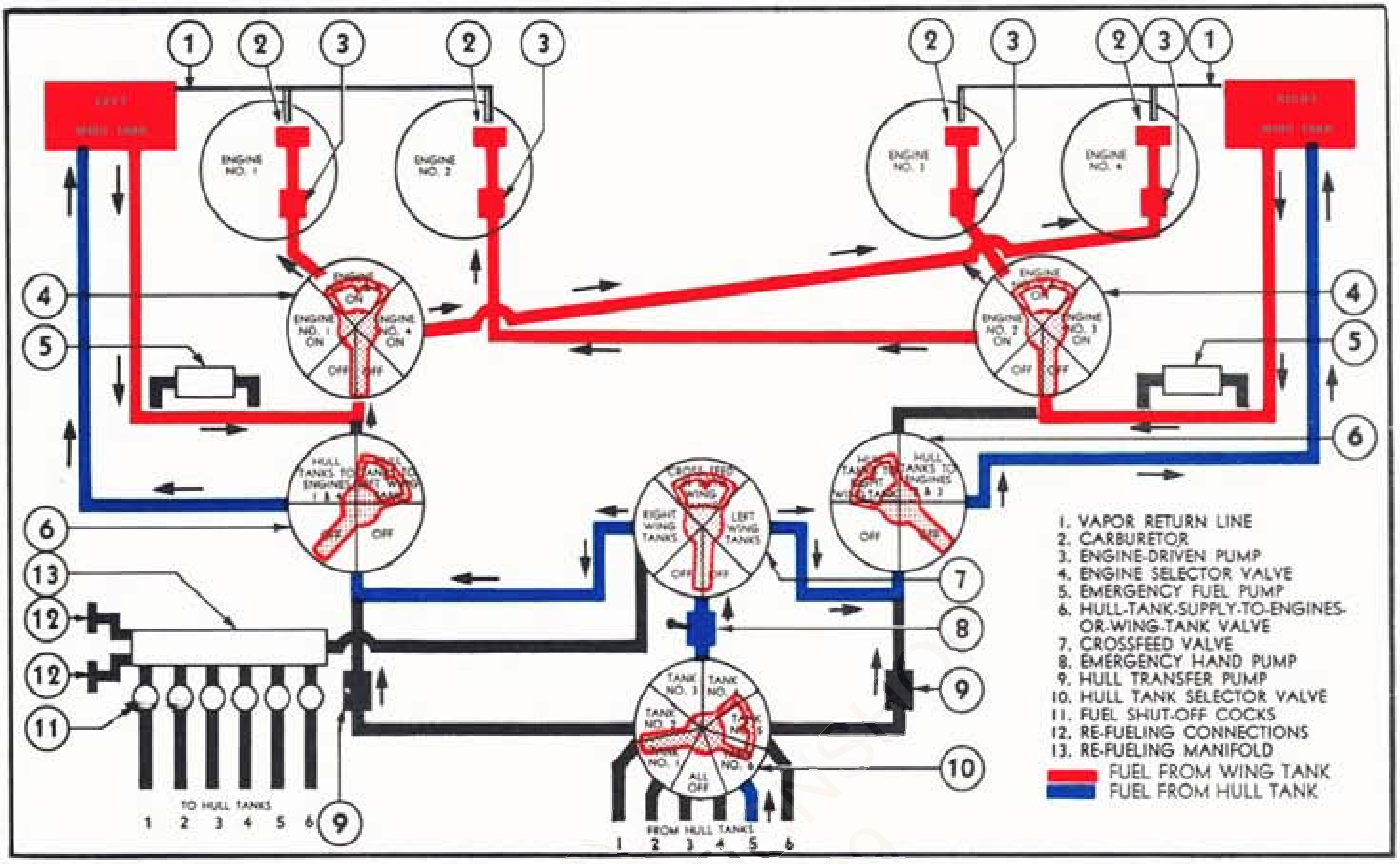



*Figure 2-7—Schematic Fuel Flow Diagram—Both Transfer Pumps Inoperative*

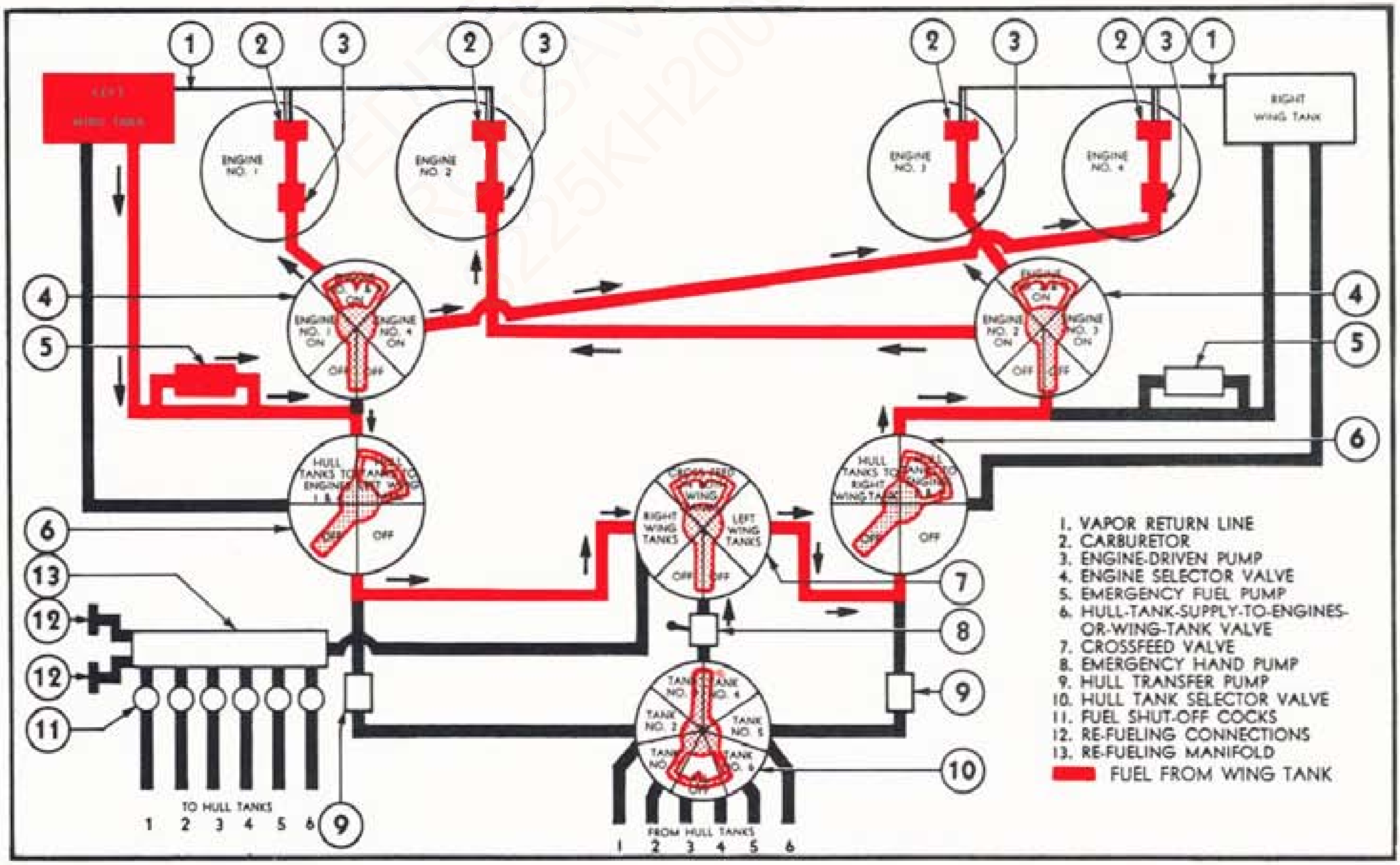



*Figure 2-8—Schematic Fuel Flow Diagram—One Wing Tank Failure, No Hull Tank Fuel*

## 2-26. STARTING ENGINES.

2-27. CHECK LIST BEFORE STARTING.

a. Airplane headed into wind.

b. Propeller turned through at least eight blade spaces with ignition switch "OFF," and throttle full open.

c. Auxiliary power plant operating.

d. Cowl flaps full open.

e. Oil cooler flaps full closed.

f. Controls set as follows:

| | |
|---|---|
| Propeller control change-over switch | "ENGINEER" |
| Propeller reverse-normal switch | "NORMAL" |
| Supercharger | "LOW" (two-speed modified engines only) |
| Auxiliary generator switches | "ON" |
| Inverter switch | "NO. 1" |
| Emergency pump switches | "ON" |
| Fuel pressure | 17 ± 1 lb. |
| Propeller master unit switch | "ON" |
| Propeller selector switches | "AUTO" |
| Propeller synchronizer control | Full "INC. RPM" |
| Propeller power switch | "NORMAL" |
| Carburetor air controls | "DIRECT" |
| Mixture controls | "IDLE CUT-OFF" |
| Throttles | 1200 rpm maximum |
| Engine fuel selector valves | On all engines |

2-28. STARTING PROCEDURE. Obtain engine starting sequence from pilot.

**Note**

When starting engines while at dock, the slack in the mooring lines will be taken up, and the airplane will be moved away from the dock with considerable less tendency to swing into the dock if the inboard engines are started first. Start the engine on the dock side first.

a. Head airplane into the wind for starting and all ground operations and instruct personnel to man bow and aft stations.

b. With the ignition switches "OFF" and the throttle in the full "OPEN" position, flick the starter switch at intervals of a few seconds until the propeller has inched through at least twelve blade spaces. If unusual resistance to rotation is apparent, stop and investigate.

c. Adjust cowl flaps to their full open position and oil cooler flaps to their full closed position.

d. Set the mixture controls to "IDLE CUT-OFF," the carburetor air controls to "DIRECT," and open throttles to a position corresponding to a maximum of 1200 rpm.

e. Set right engine selector valve to "ENGINE NO. 2 AND 3 ON," set left engine selector valve to "ENGINE NO. 1 AND 4 ON," and turn both emergency fuel pump switches to "ON." Check fuel pressure at 17 ± 1 pounds.

f. Push the starter switch to "DIRECT CRANK."

g. After the propeller has made two revolutions, turn the ignition switch to "BOTH," and prime intermittently until the engine fires. As a general rule, an engine should start within 30 seconds after the starter is actuated. If a start is not accomplished within this time, the engine should be checked for the cause of the difficulty.

**CAUTION**

Do not crank for more than 1 minute continuously or starter will overheat. Allow 5 minutes for starter to cool before making another attempt.

h. When the engine fires, move the mixture control to the "AUTO RICH" position. Stand by to return mixture control to "IDLE CUT-OFF" immediately if engine cuts out.

**CAUTION**

Do not pump the throttle to obtain smooth operation. This practice causes a wide, rapid variation of the fuel-air ratio and may result in serious backfiring during the starting operation

i. During the starting procedure, the first engineer will make the start, and the second engineer will verbally report the oil pressure indication. Stop the engines if the following oil pressures are not reached in 10 seconds:

| | |
|---|---|
| Front gage | 15 lb/sq in. |
| Rear gage | 40 lb/sq in. |

j. During the entire starting procedure, the pilot will keep a constant watch for fire. If fire is noted, the pilot will report it to the engineer.

k. In case of fire on starting, the engineer will put the mixture control in "IDLE CUT-OFF," open the throttle wide, and leave the ignition switch on. If necessary, operate the engine fire extinguishers as outlined in paragraph 4-3.

## 2-29. WARM-UP.

a. Conduct a thorough warm-up at approximately 1200 rpm before making any performance checks or before taxying to take-off. Do not close the cowl flaps in an attempt to shorten the warm-up period. This may result in cylinder fin cracking, burning of the ignition insulation, or other difficulties.

**CAUTION**

Do not exceed a cylinder head temperature of 232°C (450°F) for ground operations.

b. Continue the warm-up and keep the oil cooler flaps closed until the oil inlet temperature reaches the normal operating limits as specified in the Power Plant Chart (figure 3-1). Open them as required to maintain these limits for all other operations.

c. Open the throttle to obtain not more than 30 inches manifold pressure. If the oil pressures drop or fluctuate as engine speed is increased, extend the warm-up period.

**2-30. GROUND TEST.**

2-31. GENERAL INSTRUCTIONS FOR GROUND TEST.

a. Check with ground crew for all clear to run engines up. If a taxi run-up is to be made, check that area is free of boats or other obstructions.

b. Run two engines up at a time; outboard engines together and inboard engines together. If the airplane is on the beach, run up only one engine at a time.

c. Conduct all ground tests, unless otherwise instructed, with cowl flaps full open, mixture control in "AUTO RICH," and propeller synchronizer control in the full "INC. RPM" position.

2-32. FUEL SYSTEM CHECK. 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 combination until operation has been checked on all tanks.

a. Check for proper operation of engine driven fuel pumps. Run engines at 2000 rpm with emergency fuel pump switches in the "OFF" position, and check that the fuel pressure gage registers within the limits shown on the Power Plant Chart. (See figure 3-1.)

b. Check for leaks in upper fuel trunk and refueling compartment while system is in operation and under pressure.

2-33. PROPELLER CHECK. Advance throttle to 1500 rpm and perform the following checks:

a. Operate the propeller selector switch in the "DEC. RPM" position until engine speed drops to 1300 rpm; release switch and note that speed remains at 1300 rpm; then operate switch in the "INC. RPM" position until speed rises to 1400 rpm and release switch.

b. Note that speed remains constant at 1400 rpm. Place switch in the "AUTO" position and note that speed returns to 1500 rpm.

c. Advance throttle to 2000 rpm, adjust propeller synchronizer control to 1800 rpm. Note that engine speed decreases to 1800 rpm. Return synchronizer control to the full "INC. RPM" position and note that engine speed returns to 2000 rpm.

**Note**

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

2-33A. SUPERCHARGER CHECK (For two-speed engines only):

a. Advance throttle until engine turns approximately 1700 RPM.

b. Shift supercharger control lever to HIGH and lock.

c. Open throttle to 30 in. Hg. manifold pressure. Read tachometer.

d. Shift supercharger control lever to LOW and lock. A sudden decrease in manifold pressure indicates that the two-speed mechanism is working properly. As a further check, if desired, open throttle to restore 30 in. Hg. manifold pressure. Engine speed should then be appreciably higher than at the same manifold pressure in HIGH.

e. Do not repeat shift cycle at less than five minute intervals.

2-34. IGNITION SYSTEM CHECK.

a. Reduce engine speed to approximately 700 rpm. Turn the ignition switch to "OFF" momentarily and check that the engine stops firing. Return the switch to the "BOTH" position.

**Note**

This check to be made on ground only.

b. With the propeller synchronizer control in the full "INC RPM" position, open the throttle to give 28 to 30 inches Hg manifold pressure and note the engine speed.

c. Place the ignition switch in the "LEFT" position and note the engine speed.

d. Return the switch to the "BOTH" position to stabilize the speed.

e. Place the switch in the "RIGHT" position, note the engine speed, and return the switch to the "BOTH" position.

f. Atmospheric conditions will influence the drop-off in rpm obtained during the check, but a drop of 100 rpm or less is considered normal provided no engine roughness is encountered.

2-35. CARBURETOR CHECK. Idle the engine at approximately 600 rpm with the emergency fuel pump switch in the "ON" position. When the engine speed has stabilized, move the mixture control smoothly and steadily into the "IDLE CUT-OFF" position while watching the tachometer closely for any change in rpm. Return the mixture control to the "AUTO RICH" position before the engine cuts out. A rise of more than 10 rpm indicates too rich an idle mixture, and no change or a drop in rpm indicates that the mixture is too lean. A rise of 5 to 10 rpm is recommended in order to permit idling at low speeds without danger of fouling plugs and at the same time to afford good acceleration characteristics.

2-36. ELECTRICAL SYSTEM CHECK. At engine speeds above 1200 rpm, check delivery and voltage of all four engine driven generators separately and in parallel.

a. Each generator should register 27.5 to 28.5 volts.

b. All four generators should parallel within 40 amperes.

2-37. VACUUM SYSTEM CHECK. CHheck the vacuum gage on the pilot's instrument panel 3.7- to 4.5-inches Hg and check the de-icer pressure gage on the flight engineer's fuel control panel for 7 to 7.5 pounds per square inch.

2-38. INSTRUMENT CHECK. Check all instruments for general condition and operation.

a. Check that pilot's and flight engineer's tachometers and manifold pressure indicators agree.

b. Set altimeters to station pressure.

c. Set clocks to Greenwich Civil Time.

d. Check automatic pilot. Refer to paragraph 2-101 for details of preflight check.

## 2-39. SCRAMBLE TAKE-OFF.

2-40. Do not attempt to take off without completing a proper warm-up and functional check. The dangers coincident with taking off an airplane of this class without proper safety precautions are too great to justify the practice.

## 2-41. TAXIING INSTRUCTIONS.

2-41A. GENERAL. All taxiing that is not directly into the wind should be done with wing flaps in the full up position. Cowl flaps should always be full open for taxiing. Taxiing should be done on the step whenever practicable.

2-41B. OFF-STEP TAXIING. Off-step taxiing should in general be done at as low a speed as possible so that too much power will not be carried on the engines for a long period of time. Whenever possible set the engine power to hold the approximate heading desired and use the rudder to make any correction to the heading.

**Note**

In case of downwind or crosswind taxiing the outboard engines are very effective in guiding the airplane.

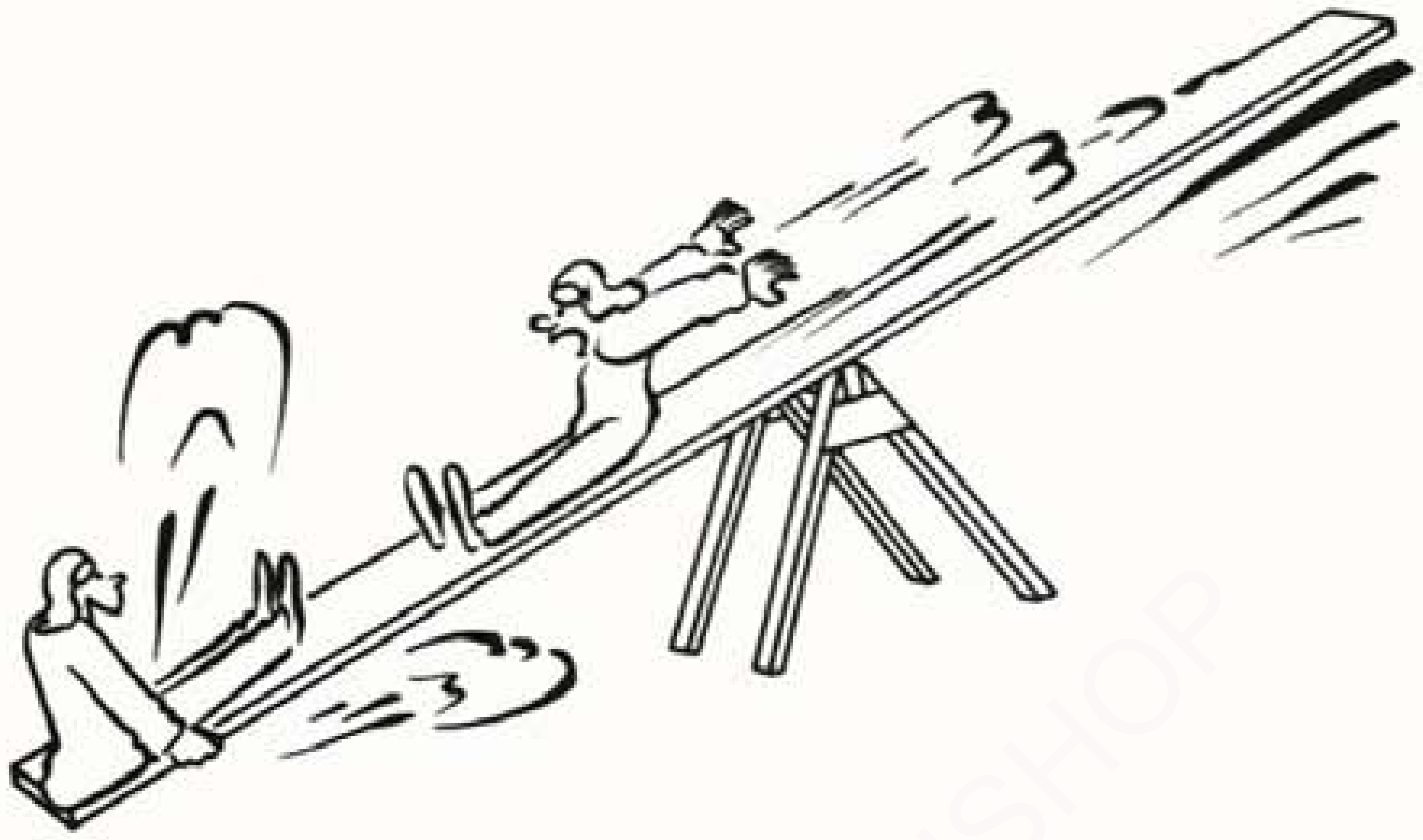
2-41C. When the wind velocity is over 25 knots it may be necessary to reverse either or both of the inboard engines to assist in maneuvering. Engine cooling while on the water is very efficient and under all normal operations it is not necessary to limit the time or power used on the inboard engines while in reverse pitch. The reversible props on the inboard engines make slow maneuvering and buoy approaches easy to execute.

2-41D. GOING OVER THE HUMP. 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 the hump. With heavy loads and no wind conditions it may be found best not to lower the flaps until the ship is ready to go on the step. With very heavy loads the pilot may cut down the time used to get on the step if he will "pump" the elevators causing a slight porpoise. This will raise the bow out of the water so that the ship will go over the hump more readily. This procedure should be used with moderation, however, under all normal conditions a porpoise may be readily and easily stopped. 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 on the control 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.

2-41E. ON-STEP TAXI AND TAKE-OFF. A pilot should practice taxiing on the step upwind, downwind, and crosswind to learn the trim angle that gives the greatest acceleration and makes for easiest control. 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 tends to cause the airplane to break clear of the water prematurely. 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. If the elevator tab ratio is set as recommended the elevator forces will be satisfactory with the manual trim tab set at 0 degrees.

## 2-42. TAKE-OFF.

**CAUTION**



Do not take off with center of gravity forward of 26 percent MAC or aft of 36 percent MAC, at 145,000 pounds.

## 2-43. TAKE-OFF CHECK LISTS.

### PILOT

a. Receive watertight integrity reports from *all* stations.

b. Repeat ignition system check prior to take-off. Refer to paragraph 2-34.

c. Check flight controls for proper operation. Flight control boost system operating, bypass valves closed.

d. Check trim tab settings.

e. Check percent of elevator balance tab ratio.

f. Check propeller change-over switch in the "PILOT" position, propeller normal-reverse switches in "NORMAL" position, propeller selector switch in "AUTO" position, and propeller synchronizer control set to 2600 rpm.

g. Gyro instruments set and uncaged.

h. Receive report from flight engineer that his check has been completed and airplane is ready for take-off.

### FLIGHT ENGINEER

a. Passengers seated with belts fastened.

b. Engine selector valves set for fuel from wing tanks to all engines.

c. Water separators drained.

d. Emergency fuel booster pump switches "ON."

e. Fuel pressure 17 ± 1 pounds.

f. Both auxiliary power plants operating and generator switches "ON."

g. Mixture controls in "RICH."

h. Oil pressures and temperatures within limits shown in the Power Plant Chart. (See figure 3-1.)

i. Carburetor air controls in the "DIRECT" position.

j. Supercharger controls—"LOW."

k. Cowl flaps open.

l. Oil cooler flaps open.

m. Flight control booster switches "ON," pressure normal.

n. Wing flap motor switch "ON," pressure 1350 to 1500 pounds.

## 2-44. TAKE-OFF PROCEDURE.

| PILOT | COPILOT | FLIGHT ENGINEER |
|---|---|---|
| a. Advance throttles steadily to take-off power (47.5 inches Hg. for single-speed unmodified engines, 50.0 inches Hg. for two-speed modified engines). Do not exceed take-off power limits or hold take-off power for longer than 5 minutes.<br>**Note**<br>Do not take-off with less than full power since this results in improper cooling and a hazardous and prolonged take-off. | | |
| | b. Make final adjustments to throttle and adjust friction control. Check tachometers at 2600 rpm and make adjustments. | |
| | | c. Observe all instruments for normal operation. Advise pilot of any indications of malfunctioning. |
| | d. Stand by for signal from pilot to lower flaps. | |
| e. Signal to copilot to lower flaps. | | |
| | f. Lower flaps to 20 degrees. | |
| | g. Stand by for signal to make adjustments to controls. | |
| h. Signal copilot to make necessary adjustments to flaps, tabs, and power settings. Reduce power when clear of immediate take-off obstacles and obtain the desired climbing settings. | | |
| | i. Reduce power on signal from pilot by first retarding throttle and then setting propeller synchronizer control. | |
| | | j. During take-off run and initial climb, the cowl flaps should be full open. As soon as power is reduced, close the cowl flaps to maintain temperatures within the limits on the Power Plant Chart. (See figure 3-1.) |
| | k. Raise flaps gradually in 10-degree increments.<br>**WARNING**<br>Do not exceed 115 knots with flaps down. | |

## 2-45. ENGINE FAILURE DURING TAKE-OFF.

2-46. MINIMUM SPEEDS FOR CONTINUING FLIGHT. The minimum air speed for continuing flight with one outboard engine inoperative is at least 85 knots, and for best performance 100 knots is desirable. Under all other conditions discontinue flight.

2-47. PROCEDURE FOR ENGINE FAILURE.

a. Disengage automatic pilot.

b. Feather propeller on dead engine. (Paragraph 4-29).

c. Shut off fuel and close cowl flaps on dead engine.

d. Apply power necessary to operating engines, to maintain level flight.

**Note**

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

e. Fly the airplane with as little slipping and skidding as possible in order to reduce drag.

f. Open cowl flaps on good engines only enough to maintain cylinder head temperatures below limits.

g. Consult the flight operation instruction charts on cruising data for partial engine operation.

h. Instruct members of crew to jettison cargo, gasoline, etc., to reduce weight if necessary to maintain a desired altitude.

## 2-48. CLIMB.

2-49. CLIMB PROCEDURE.

| PILOT | FLIGHT ENGINEER |
|---|---|
| a. When three-engine air speed has been reached, reduce throttle and adjust propeller synchronizer control to rated power (44.5 inches Hg and 2400 rpm).<br><br>**Note**<br>Consult Take-Off, Climb, and Landing Chart (figure A-1) for best climb speed. | |
| | b. Check engine instruments continually and adjust cowl flaps and oil cooler flaps as required. |
| c. When a safe altitude is reached, trim for best air speed as indicated in the Take-Off, Climb, and Landing Chart. (See figure A-1.) | |
| | d. Turn auxiliary power plants off at approximately 1000 feet if they are no longer needed. Refer to paragraph 2-96. |
| | e. As soon as climb conditions have stabilized, visually check engine cowlings for indications of impending engine trouble. Check entire airplane for general condition and airworthiness. |
| f. When initial climb is completed and climb to cruising altitude is stabilized, signal flight engineer to take over throttles. | |
| | g. Adjust throttles to maintain correct manifold pressure as indicated on the Power Plant Chart. (See figure 3-1.) |

2-50. LEVEL OFF TO CRUISING ALTITUDE.

| PILOT | FLIGHT ENGINEER |
|---|---|
| a. Level off several hundred feet above the desired cruising altitude so that the desired altitude can be approached from above.<br>b. Signal flight engineer to reduce power settings to cruising condition. | |

| PILOT | FLIGHT ENGINEER |
|---|---|
| | c. Reduce throttle and propeller synchronizer control to proper cruising conditions determined from the Flight Operation Instruction Charts. (See figure A-2.) |
| d. Check ignition system as outlined in paragraph 2-34 with propeller selector switch in "MANUAL." Advise flight engineer when check is to be made. | |
| | e. When the airplane has leveled off, turn the emergency fuel pump switches to the "OFF" position. |
| | f. Readjust power for cruising after the ignition check has been made. |
| g. Approach cruising altitude slowly while making necessary trim tab adjustments. | |

**2-51. GENERAL FLYING CHARACTERISTICS.**

2-52. CHANGES IN POWER SETTINGS. Changes in power settings will follow normal procedure:

| | |
|---|---|
| a. Increase Power | (1) Increase rpm |
| | (2) Advance throttle |
| b. Decrease Power | (1) Retard throttle |
| | (2) Decrease rpm |

2-51A. BLOWER SHIFTS.

a. Before shifting from "LOW" to "HIGH," reduce manifold pressure several inches. If manifold pressure tends to rise excessively after the shift, check tendency by retarding throttle as necessary.

b. Shifts may be made from "HIGH" to "LOW" without moving throttle.

c. All routine shifts should be made at 2400 rpm or less, preferably at the lowest engine speed consistent with tactical requirements. In emergencies, or when required by tactical considerations, shifts may be made at 2600 rpm; such shifts should be kept to a minimum.

d. When making a shift, move control lever smoothly and rapidly, without hesitation, to the other position. Except during shift, keep lever locked in position being used.

2-53. CRUISING CONTROL. Refer to Appendix I of this Handbook for proper power settings and mixture adjustments for cruising control. The flight engineer will make the necessary power adjustments as the weight of the airplane decreases. He will advise the pilot and navigator of the power changes so that they may anticipate the change in conditions.

2-54. TRIM CHANGES. The operation and effectiveness of the elevator, rudder, and aileron trim tabs is satisfactory. Trim changes are normal except with flaps. The airplane becomes increasingly tail heavy as the flaps are lowered.

2-55. STABILITY.

2-55A. For center of gravity positions between 26 and 36 percent MAC inclusive, the airplane displays positive static and dynamic control fixed and control free longitudinal stability.

**Note**

The pilot should be cautioned against changing the elevator tab ratio to decrease elevator forces because this will reduce the longitudinal stability. If the tab ratio is reduced excessively in an attempt to lower the elevator forces the stability can be reduced to a dangerous degree. This is particularly important when the boost system is not operating. In the event of boost failure it is far better to have high elevator forces than an unstable airplane.

2-55B. Lateral stability, both static and dynamic, with fixed or free controls, is positive in all configurations.

2-55C. Directional stability, both static and dynamic, with fixed or free controls, is positive in all configurations.

2-55D. Elevator control forces and effectiveness are satisfactory with boost on for center of gravity locations within the recommended limits. Without boost the elevator forces are excessive. (Refer to paragraph 2-55A.)

2-55E. Lateral control forces and effectiveness are satisfactory except that:

a. At the landing configuration stall there is a tendency for the ailerons to snatch to the right causing the airplane to roll to the right.

b. In rough air the ailerons exhibit a small amplitude, short period, steady oscillation.

2-55F. With rudder boost on, control forces and effectiveness are satisfactory for all configurations. Directional control for asymmetric power conditions resulting from the loss of one engine is adequate.

Directional control with two engines on one side inoperative is adequate for the clean configuration *provided power in excess of that allowed for maximum cruise is not applied.* Without boost, the rudder forces are excessive and this method of operation is unsatisfactory at all airspeeds.

**2-56. SPINS.**

2-57. Spins are prohibited. Avoid any flight attitude from which a spin may result. If the airplane goes into an inadvertent spin, use a normal recovery procedure.

**2-58. PERMISSIBLE ACROBATICS.**

2-59. All acrobatics are prohibited in this airplane.

**2-60. STALLS.**

2-61. STALL SPEEDS. The calculated power-off stall speeds are as follows:

| *Gross Weight* | *Flaps* | *M.P.H.* | *Knots* |
|---|---|---|---|
| 145,000 | 0° | 100 | 87 |
| 115,000 | 0° | 88 | 77 |
| 145,000 | 40° | 87 | 76 |
| 115,000 | 40° | 77 | 67 |

2-62. STALL CHARACTERISTICS. The stall characteristics are good with a warning buffeting of the tail surfaces at about 4 knots above the power-off stall speeds with the flaps up. With flaps full down, the buffeting and stall occur almost simultaneously. The airplane "mushes" at the stall with no tendency to fall off to one side.

**Note**

At the landing configuration stall there is a tendency for the ailerons to snatch to the right causing the airplane to roll to the right.

**2-63. DIVING.**

2-64. DIVING LIMITATIONS. Do not exceed airspeeds and accelerations given in paragraph 2-2.

2-65. DIVING CHARACTERISTICS. Diving characteristics are normal.

## 2-66. NIGHT FLYING.

2-67. RUNNING LIGHTS. Seven running lights are located as follows:

| | |
|---|---|
| GREEN | Right Wing Tip |
| RED | Left Wing Tip |
| | Tail |
| WHITE | Tail |
| | Upper Hull |
| | Right Underwing |
| | Left Underwing |

2-68. These lights are controlled by two switches on the pilot's pedestal and a motor-driven flasher mechanism in the baggage compartment. The switches are operated as follows:

a. Place the steady-off-flash switch in the "STEADY" position and the right and left wing tip lights and the white tail light will burn.

b. Place the steady-off-flash switch in the "FLASH" position and the right and left wing tip lights and the white tail light will flash together in alternate with the red tail light.

c. Place the steady-off-flash switch in the "FLASH" position and the off-flash switch in the "FLASH" position, and the two wing tip lights and white tail light flash as a group alternating with the group consisting of the red tail light, left and right underwing lights, and the upper hull light.

2-69. RECOGNITION LIGHTS. The recognition lights consisting of one red, one green, and one amber light located under the right wing between the two nacelles are controlled from the switch box to the right of the copilot. Power is supplied directly from the battery through a circuit breaker switch on the flight engineer's switch panel.

2-70. The recognition light switch box contains a keying button and three switches having "STEADY," "OFF," and "KEY" positions, each switch controlling one light. Each light may be operated independently regardless of the position of the other two switches.

a. Place the individual light switches in the "STEADY" position, and the corresponding light will burn.

b. Place the individual light switches in the "KEY" position and the keying button will light the corresponding lights.

2-71. ANCHOR LIGHTS. The five anchor lights, one on each wing tip, one on each antenna mast, and one on the tail are controlled by a switch on the pilot's pedestal connected in parallel with a switch in the entrance compartment. Both control switches must be "OFF" to turn the lights out. The lights receive their power directly from the battery through a circuit breaker switch on the flight engineer's switch panel.

2-72. LANDING LIGHTS. Two retractable landing lights located outboard of the engines are controlled by individual switches on the pilot's pedestal.

2-73. BOARDING LIGHTS. The 15 red boarding lights are located as follows:

| | |
|---|---|
| Forward Cargo Compartment | 2 |
| Flight Deck | 1 |
| Entrance Compartment | 1 |
| Baggage Compartment | 1 |
| Anchor Compartment | 1 |
| Aft Cargo Compartment | 2 |
| Upper Deck Cargo Compartment | 2 |
| Tail Section | 1 |
| Crew Quarters | 1 |
| Auxiliary Power Plant Compartment | 1 |
| Main Cargo Compartment | 1 |
| Middle Cargo Compartment | 1 |

2-74. Power for these lights comes directly from the battery and is controlled by any one of four switches which are located one on either side of the aft cargo compartment, one in the entrance compartment, and one on the flight engineer's switch panel.

**Note**

Boarding lights are not to be left on the batteries for more than a few minutes, the time required to reach the flight deck or other compartments for local lighting.

2-75. PANEL LIGHTS. Seven red panel lights on the flight engineer's panel are controlled by a rheostat as are the two red lights on the pilot's propeller control panel on the pedestal.

2-76. ANTI-GLARE FLOOD LIGHTS. Two white anti-glare flood lights controlled by a switch on the pilot's pedestal are provided for the pilot.

2-77. FLOOD LIGHTS. Two red lights on the engineer's instrument panel are controlled by a rheostat on the switch panel. Rheostats on the flight engineer's switch panel control the red flood lights on the switch panel and fuel panel. A white flood light controlled by a switch is located above the basin in the lavatory.

2-78. BERTH LIGHTS. Four berth lights in the flight deck and four in the aft crew quarters are controlled by switches for each light.

2-79. DOME LIGHTS. Fifty dome lights located throughout the airplane are controlled by conveniently located switches or rheostats.

## 2-80. APPROACH AND LANDING.

### 2-81. LANDING CHECK LISTS.

#### PILOT

a. Receive reports from *all* stations on watertight integrity.
b. Check ignition.
c. Set altimeter to station pressure.
d. Receive report from flight engineer that his check is completed.
e. Propeller change-over switch in "PILOT" position.
f. Propeller synchronizer set to 2200 to 2400 rpm.
g. Flaps down at 115 knots maximum.

#### FLIGHT ENGINEER

a. Auxiliary power plants operating and generator switches "ON."
b. Surface control booster switches both "ON" and pressure normal.
c. Wing flap motor on and pressure 1350 to 1500 pounds.
d. Fuel from both wing tanks to all engines.
e. Emergency fuel pump switches "ON."
f. Cowl flaps closed.
g. Oil cooler flaps as required.
h. Carburetor air control in the "DIRECT" position.
i. Mixture controls in "RICH" position.
j. Supercharger controls in "LOW" position.

### 2-82. LANDING PROCEDURE.

| PILOT | COPILOT | FLIGHT ENGINEER |
|---|---|---|
| a. When 10 minutes out, signal flight engineer to start auxiliary power plant, and check gross weight and center of gravity.<br><br>**WARNING**<br><br>Do not land with center of gravity forward of 26 percent MAC or aft of 36 percent MAC, at 145,000 pounds. | | |
| | | b. Start auxiliary power plants. Refer to paragraph 2-93. |
| | | c. Orderly passes word that passengers are seated with life jackets on and safety belts secured. |
| d. Receive watertight integrity report from all stations. | | |
| | | e. Set controls as follows:<br><br>Mixture "RICH"<br>Supercharger "LOW"<br><br>Carburetor Air "DIRECT"<br><br>Emergency Fuel Pump Switches "ON"<br><br>Both Surface Control Booster Switches "ON"<br><br>Wing Flap Motor Switch "ON" |

| PILOT | COPILOT | FLIGHT ENGINEER |
|---|---|---|
| | | Cowl flaps closed. |
| | | Oil cooler flaps as required. |
| | | f. Check instruments for normal operation of engines, surface control booster, and wing flap systems. |
| | g. Receive report from flight engineer that his check is complete. | |
| h. Set propeller change-over switch to "PILOT" and set propeller synchronizer control to 2200 to 2400 rpm. | | |
| | i. Stand by for further adjustment of power and for signal to lower flaps. | |
| j. Maintain a low cruising speed by adjusting throttles to reduce power. | | |
| | | k. During approach and landing, maintain a constant watch of all instruments. Advise pilot of any unusual conditions. |
| l. Pass word to lower flaps at 115 knots IAS or below. | | |
| | m. Lower flaps to 20 degrees for approach, 40 degrees for landing. | |
| n. When airplane is on the water, signal copilot to raise flaps and reduce power. | | |
| | | o. As soon as the airplane is on the water, open cowl flaps full open. |
| | p. Raise flaps and reduce power on signal from pilot. | |
| | | q. Instruct personnel to man bow station. |
| r. Taxi in to pick up mooring. | | |
| | | s. Bow man reports when bow line is secured. |
| | | t. Turn emergency pump switches to "OFF." |
| | | u. Cut engines on order from pilot. |

2-83. RECOMMENDED APPROACH SPEEDS. The recommended approach speeds are as follows:

APPROACH SPEEDS

| *Gross Weight* | *Flaps* | *Power On* | | *Power Off* | |
|---|---|---|---|---|---|
| | | *M.P.H.* | *Knots* | *M.P.H.* | *Knots* |
| 145,000 | 0° | 125 | 109 | 132 | 115 |
| 115,000 | 0° | 122 | 106 | 128 | 111 |
| 80,000 | 0° | 101 | 88 | 106 | 92 |
| 145,000 | 40° | 112 | 97 | 118 | 102 |
| 115,000 | 40° | 100 | 87 | 105 | 91 |
| 80,000 | 40° | 83 | 72 | 88 | 76 |

2-84. LANDING WITH PARTIAL POWER PLANT FAILURE.

**Note**

Although conditions and locality may make it necessary to use an impromptu procedure, the following procedure is recommended:

a. Check the center of gravity for desirable position.

b. Have the flight engineer make his usual prelanding checks.

c. Start the final approach at an adequate distance from the landing spot and at a sufficient altitude so that it will not be necessary to make any trim changes under 500 feet.

d. Obtain an airspeed slightly above (4-9 knots), the recommended approach speed given in paragraph 2-83.

e. Above 500 feet reduce rudder trim to approximately half of the amount required for level flight, if power failure is on only one engine or two engines on one side.

f. Lower flaps to the approach position.

g. Make a normal "fast step" landing. Flaps may be lowered to 40 degrees, or landing may be made with flaps in approach position, if desired.

**Note**

If sufficient altitude and water is available a full power-off landing is recommended. With full wing flaps a power-off glide of 110 knots should be set up before reaching 500 feet.

2-85. CROSS WIND LANDING. Cross wind landings should be avoided as much as possible. However, if it is necessary, a satisfactory landing may be executed, by using the following procedure:

a. Maintain normal approach speed.

b. At start of final approach correct for drift by crabbing into the wind.

c. Recover from drift correction just before touching water.

d. If unable to maintain straight course by use of rudder alone, unbalanced power may be applied.

2-86. MINIMUM RUN LANDING. By making a full stall, power-off landing with full flaps, a maximum run will be accomplished. The landing run may be shortened if at the end of the run 'full-up' elevator is held until the ship has stopped. In an extreme emergency, the inboard engines may be reversed after contact with water is made, provided the manifold pressure is not allowed to exceed 20 inches Hg.

2-87. TAKE-OFF IF LANDING IS NOT COMPLETED.

a. Advance throttles and rpm until take-off power is attained.

**Note**

Do not let the airspeed drop below the recommended "Power-on" approach speed.

b. After a minimum airspeed of 100 knots has been attained, slowly retract the wing flaps.

**Note**

Remember that for all normal center of gravity locations additional nose-up trim will be necessary as the flaps are retracted.

c. Reduce power and proceed with normal climb.

**2-88. STOPPING OF ENGINES.**

2-89. NORMAL STOPPING PROCEDURE.

a. Place the propeller change-over switch to the "ENGINEER" position.

b. Return inboard propellers from reverse.

c. Set the propeller synchronizer control to the full "INC. RPM" position.

d. If the engine is warm, idle until the cylinder head temperatures drop below 150°C (302°F) or to a temperature consistent with existing atmospheric conditions.

e. Immediately before shutting down, scavenge the crankcase oil by opening the throttle to give a maximum of 1000 to 1200 rpm for at least 30 seconds.

f. Place the mixture control in "IDLE CUT-OFF."

g. Turn the ignition switch to "OFF" when the propeller has stopped turning.

h. Turn the engine selector valve off for that engine.

i. Leave cowl flaps *full open.*

2-90. COLD WEATHER STOPPING. If temperatures below 2°C (36°F) are forecast for the period before the next start, the lubrication oil shall be diluted immediately before stopping in accordance with the procedure in paragraph 6-4.

## 2-91. BEFORE LEAVING THE AIRPLANE.

| PILOT | FLIGHT ENGINEER |
| --- | --- |
| a. Wing flaps up. | a. All fuel control valves in "OFF" positions. |
| b. Assign personnel to lock surface controls. Refer to paragraph 2-98. | b. Check fuel and oil loads. |
| c. Check that ignition switches are "OFF." | c. Check that auxiliary power plants are off. |
| | d. Turn *all* electrical circuits off. |
| | e. If airplane is to be left on the water, check bilge and mooring lines. |
| | f. Secure *all* hatches. |
| | g. If airplane is to be left on water overnight, turn anchor light switch to "ON." |

## 2-92. OPERATION OF AUXILIARY POWER PLANT.

### 2-93. STARTING AUXILIARY POWER PLANT.

a. Check that oil level is up to "F" mark on indicator (bayonet gage).

b. Open the ventilator door in the floor of the compartment.

c. Turn auxiliary power plant ignition switches to "ON."

**Note**

Both the switch on the flight engineer's switch panel and the switch on the unit must be on before the unit will operate.

d. Turn the auxiliary power plant fuel control to "BOTH TANKS ON."

e. Place the governor control and choke lever in the "IDLE" position and hold the start switch on the unit in the "ON" position; release the switch when the engine starts.

**Note**

Little or no choking will be necessary at temperatures above 10°C (50°F). At lower temperatures, it may be necessary to choke fully (move the governor control and choke lever to the extreme left), and run with the choke partially closed until the engine warms up.

f. After the engine has warmed up, place the governor control and choke lever in the "RUN" position.

**CAUTION**

Do not place the governor control and choke lever in the "RUN" position *before* the engine has warmed up.

g. Oil pressure should be indicated on the gage in the auxiliary power plant compartment or on the gage on the flight engineer's instrument panel within 30 seconds after starting. If no pressure is indicated within this time, shut down and investigate.

h. Do not run unit at or near rated speed until the oil temperature is at least 21°C (70°F). At temperatures below 10°C (50°F), the unit should be run 15 minutes at "IDLE" before speeding up.

2-94. OPERATING LIMITS OF AUXILIARY POWER PLANT. The normal operating limits are as follows:

| ENGINE SPEED | |
|---|---|
| Idle | 1800 rpm |
| Normal—No Load | 3500 rpm |
| Normal—Full Load | 3300 rpm |
| 150% Load | 3200 rpm |

| OIL PRESSURE | |
|---|---|
| Desired | 60 psi |
| Minimum | 35 psi |
| Maximum | 75 psi |

| OIL TEMPERATURE | |
|---|---|
| Minimum | 30°C (86°F) |
| Maximum | 146°C (295°F) |

| CYLINDER HEAD TEMPERATURES | |
|---|---|
| Normal (Full Load) | 210°C (410°F) |
| Maximum Allowable | 275°C (527°F) |

| OIL CONSUMPTION | |
|---|---|
| Rated Load | .015 lb.hp-hr |

| FUEL CONSUMPTION | |
|---|---|
| Rated Load | .70 lb/hp-hr |

2-95. OPERATION AT ALTITUDE. When operating at altitude, it will be necessary to change the mixture by adjusting the altitude valve on the carburetor. Set the pointer opposite the figure nearest the altitude at which the engine is operating.

2-96. STOPPING AUXILIARY POWER PLANT.

a. Turn the auxiliary power plant generator switch on the flight engineer's switch panel to the "OFF" position.

b. Allow the engine to run at no load or idle for 5 minutes or until head temperatures are below 121°C (250°F).

c. Turn both ignition switches to "OFF."

d. Turn the auxiliary power plant fuel valve to "OFF."

## 2-97. OPERATION OF SURFACE CONTROL LOCKS.

2-98. LOCKING SURFACE CONTROLS.

a. Check that automatic pilot switch and engaging levers are in their "OFF" positions.

b. Set aileron, elevator, and rudder controls in neutral.

c. Place the lock bar in position between the pilot's and copilot's control columns by placing the end of the bar in the fitting on the copilot's column and bringing the opposite end into position with the locating and lock pins on the pilot's column.

d. Press the lock bar against the pins and give the key in the lock a partial turn to hold the bar against the column.

e. Place the lock yoke around the spoke of the aileron control wheel and press the prongs into the holes in the bar.

f. Turn the locking key completely and withdraw it from the lock.

g. Take the key from the lock with the key chained to it into the tail and lock the rudder and elevator controls.

2-99. UNLOCKING SURFACE CONTROLS.

a. Unlock the rudder and elevator controls with the locking keys in the tail. Carry the keys forward to the pilot's station.

**CAUTION**

Use extreme care in unlocking rudder and elevator controls in high winds or gust conditions to prevent injury to the hands. Assign personnel to hold controls in neutral until the unlocking procedure has been completed.

b. Insert locking key into lock bar and unlock, releasing prongs from the holes in the lock bar and freeing the lock yoke.

c. Unlock pins in the lock bar.

d. Release lock bar from pilot's and copilot's control columns and return to stowed position.

## 2-100. OPERATION OF AUTOMATIC PILOT TYPE S-3.

2-101. BEFORE TAKE-OFF. The following check should be carried out in a few minutes during the warm-up period.

a. After the engines have been started, check vacuum, should be 3.75 to 5 inches of mercury.

b. Turn pump switch for the No. 1 pump to "ON" Check oil pressure gage for proper pressure.

c. See that bank-and-climb gyro control unit is uncaged. Turn caging knob counterclockwise as far as it will go.

d. Set and uncage directional gyro control unit (push directional gyro caging knob in and turn to set lower card to desired heading; then pull knob straight out).

e. Turn rudder knob on directional gyro control unit to align upper card with lower card.

f. Turn aileron knob until its follow-up index matches the zero point on the banking scale at the top of the bank-and-climb gyro dial.

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

**CAUTION**

Do not align follow-up index with the Horizon Bar.

h. Being sure that surface controls are unlocked, engage gyropilot by moving engaging lever (master control lever) slowly, all the way "ON."

i. Check operation of gyropilot by rotating rudder knob, aileron knob, and elevator knob each way. The servo speed control valve settings will determine the speed of control.

j. Leaving gyropilot engaged, turn both pump switches off and check for air in gyropilot hydraulic system; controls should not be resilient (springy) when a moderate pressure is applied to them, but should feel as though locked. If air is present, remove it.

**Note**

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

k. Disengage gyropilot by moving engaging lever "OFF."

2-102. AFTER TAKE-OFF.

a. Trim airplane "HANDS OFF."

b. See that all three servo speed control valves are turned counterclockwise at least as far as "3" on the dial. Turning the knobs clockwise, toward slow, retards the speed of control. Turning the knobs all the way clockwise locks the controls and must be avoided.

**Note**

The numbers on the speed control valve dials represent turns of the valves and may be used as a reference for returning them to desired settings. Experience will show which settings are the most effective for normal air conditions, and thereafter, the valves may be left in these positions, except when removing air from the hydraulic system.

c. See that bank-and-climb gyro control unit is uncaged. (Turn caging knob counterclockwise as far as it will go.)

d. Set and uncage directional gyro control unit. Push directional gyro caging knob in and turn to set lower card to desired heading; then pull knob straight out.

e. Turn rudder knob on directional gyro control unit to align upper and lower cards.

f. Turn aileron knob until its follow-up index matches the zero point on the banking scale at the top of the bank-and-climb gyro dial.

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

**CAUTION**

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

h. Be sure that directional gyro and bank-and-climb gyro are uncaged and that airplane is in straight, level flight. Engage gyropilot by slowly moving engaging lever to the "ON" position. By holding the manual controls, you can feel when the gyropilot takes over.

i. After engaging gyropilot, it may be necessary to rotate rudder knob, aileron knob, and elevator knob slightly to obtain exact course and attitude.

j. Set servo speed control valves for best flying. Turn them only sufficiently toward "SLOW" (retarding speed of control) to stop oscillation. Do not turn them all the way toward "SLOW," as this will lock the controls.

k. If the angle of attack of the airplane is (a) increased (nose-up), or (b) decreased (nose-down) from normal to compensate for a changed load condition, then, for convenience, adjust the bank-and-climb gyro miniature airplane (a) downward, or (b) upward.

2-103. TURNS.

a. To change course, turn rudder knob slowly and smoothly.

b. If turning a large amount, set in bank by turning aileron knob.

c. Cage the directional gyro control unit by pushing directional gyro caging knob straight in. Turn rudder knob to offset the upper card a few degrees in the desired direction. (As the knob is turned, the upper card will move off a few degrees, and then return as rudder is applied.) Immediately set in bank with aileron knob to bring inclinometer ball in central.

d. Uncage the directional gyro control unit by pulling caging knob straight out. Immediately remove bank by turning aileron knob until inclinometer ball is central. Due to offset position of rudder, course will continue to change a few degrees after uncaging directional gyro control unit (until control is centered).

2-104. SPIRALS. Longitudinal control is obtained by turning the elevator knob a small amount in the proper direction for ascent or descent. This operation, combined with a caged turn, comprises the procedure for spiral maneuvers.

2-105. GYRO DRIFT. Remember that the directional gyro control unit of the gyropilot has no directive force like that of a magnetic compass. The airplane will therefore, in time, drift away from the original compass heading, in one direction or the other. Periodically, correct for small amounts of drift by adjusting the rudder knob to keep the airplane on the desired course, as indicated by the magnetic compass. When there is an appreciable difference in reading between the magnetic compass and the directional gyro lower card, disengage the gyropilot and realign the cards with the magnetic compass.

2-106. OPERATING LIMITS—CLIMBING OR GLIDING. When operating automatically, do not exceed ± 20 degrees. When operating manually (using gyros as flight instruments only), do not exceed ± 55 degrees with the directional control unit and do not exceed ± 50 degrees with the bank-and-climb control unit.

2-107. OPERATING LIMITS—BANKING. When operating automatically, do not exceed ± 30 degrees. When operating manually (using gyros as flight instruments only), do not exceed ± 55 degrees with the directional control unit and do not exceed ± 50 degrees with the bank-and-climb control unit.

## 2-108. OPERATION OF REVERSE PITCH PROPELLERS.

2-109. The inboard reversible propellers may be reversed immediately upon landing. This operation supplies a substantial backward thrust which, by application of the throttle, makes it possible to stop the plane within a short distance. It also greatly facilitates the maneuverability of the plane on the water. Operation of airplane engines with propellers in reverse pitch may be conducted up to and including full take-off power. Care must be taken, however, not to exceed allowable engine temperatures.

2-110. TO REVERSE PITCH:

a. Place throttles to "IDLING" and mixture control to "AUTO RICH."

b. Set reverse safety switch to "ON."

c. Set reverse-normal switch to "REVERSE."

d. When the tel-lite indicates that the reverse blade angle is reached, return the reverse safety switch to the "OFF" position.

**Note**

The tel-lite will light when the reverse pitch angle is reached.

e. When the reverse blade angle is reached, operate the engines as required for braking or maneuvering.

2-111. TO RETURN FROM REVERSE:

a. Throttle engines to idling rpm.

**CAUTION**


Never return from reverse at engine speeds above idling rpm.

b. Set reverse-normal switch to "NORMAL."

c. When the low blade angle is reached, the propellers may be operated in "AUTOMATIC" or "SELECTIVE FIXED PITCH."

# SECTION III

# FLIGHT OPERATING DATA

## 3-1. AIR-SPEED CORRECTION TABLE.

3-2. Since the air-speed installation is not completely free from interference, air-speed indicated on the air-speed indicators contains a small error. Add the error shown in the second or third column to the indicator reading to obtain the corrected indicated air-speed.

MODEL JRM-1
AIR-SPEED ERROR TABULATION

| I.A.S. KNOTS | CORRECTION ADD KNOTS | |
|---|---|---|
| | FLAPS UP | FLAPS DOWN |
| 180 | —7.8 | |
| 170 | —6.9 | |
| 160 | —6.1 | |
| 150 | —5.2 | |
| 140 | —4.8 | |
| 130 | —4.3 | |
| 120 | —3.5 | |
| 110 | —3.0 | —3.5 |
| 100 | —2.6 | —1.7 |
| 90 | —2.6 | — .9 |
| 80 | | — .9 |
| 70 | | — .9 |

## 3-3. POWER PLANT CHART. *(See figure 3-1.)*

3-4. The Power Plant Chart gives, in tabular form, recommended engine operation for several conditions of flight. Any deviation from the charted values is dangerous and should be resorted to only in extreme emergency and then for as short a time as possible. For additional engine data, refer to the Engine Calibration Curve, figure A-5.

# POWER PLANT CHART

| AIRCRAFT MODEL | PROPELLER(S) | ENGINE MODEL(S) |
|---|---|---|
| JRM-1 | CURTISS ELECTRIC FULL FEATHERING | W.A.C. R-3350-8 TWO-SPEED |

| GAUGE READING | FUEL PRESS. | OIL PRESS. F. | OIL PRESS. R. | OIL TEMP. | COOLANT TEMP. | |
|---|---|---|---|---|---|---|
| DESIRED | 17 | 35 | 75 | 70-85 | | |
| MAXIMUM | 18 | 40 | 85 | 100 | | |
| MINIMUM | 16 | 30 | 60 | 60 (3) | | |
| IDLING | 11 | 25 | 45 | | | |

MAXIMUM PERMISSABLE DIVING RPM: 3000 (5)
MINIMUM RECOMMENDED CRUISE RPM: 1400
MAXIMUM RECOMMENDED TURBO RPM:

OIL GRADE: 1120 SPEC. AN-O-8
FUEL GRADE: 100/130 SPEC. AN-F-48

| WAR EMERGENCY (COMBAT EMERGENCY) | | | MILITARY POWER (NON-COMBAT EMERGENCY) | | | OPERATING CONDITION | | | NORMAL RATED (MAXIMUM CONTINUOUS) | | | MAXIMUM CRUISE (NORMAL OPERATION) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MINUTES | | | 5 MINUTES | | | TIME LIMIT | | | UNLIMITED | | | UNLIMITED | | |
| | | | 260°C | | | MAX. CYL. HD. TEMP. | | | 248°C (4) | | | 232°C | | |
| | | | RICH | | | MIXTURE | | | RICH | | | NORMAL | | |
| | | | 2600 | | | R. P. M. | | | 2400 | | | 2130 | | |
| MANIF. PRESS. | SUPER-CHARGER | FUEL (1) Gal/Min | MANIF. PRESS. | SUPER-CHARGER | FUEL (1) Gal/Min | STD. TEMP. °C | PRESSURE ALTITUDE | STD. TEMP. °F | MANIF. PRESS. | SUPER-CHARGER | FUEL GPH (2) | MANIF. PRESS. | SUPER-CHARGER | FUEL GPH (2) |
| | | | | | | -55.0 | 40,000 FT. | -67.0 | | | | | | |
| | | | | | | -55.0 | 38,000 FT. | -67.0 | | | | | | |
| | | | | | | -55.0 | 36,000 FT. | -67.0 | | | | | | |
| | | | | | | -52.4 | 34,000 FT. | -62.3 | | | | | | |
| | | | | | | -48.4 | 32,000 FT. | -55.1 | | | | | | |
| | | | | | | -44.4 | 30,000 FT. | -48.0 | | | | | | |
| | | | | | | -40.5 | 28,000 FT. | -40.9 | | | | | | |
| | | | | | | -36.5 | 26,000 FT. | -33.7 | | | | | | |
| | | | | | | -32.5 | 24,000 FT. | -26.5 | | | | | | |
| | | | | | | -28.6 | 22,000 FT. | -19.4 | | | | | | |
| | | | FT. | HIGH | 4.4 | -24.6 | 20,000 FT. | -12.3 | FT. | HIGH | 225 | | | |
| | | | FT. | | 5.0 | -20.7 | 18,000 FT. | - 5.2 | FT. | | 245 | | | |
| | | | FT. | | 5.5 | -16.7 | 16,000 FT. | 2.0 | 41.0 | | 258 | | LOW | 118 |
| | | | 44.5 | | 5.6 | -12.7 | 14,000 FT. | 9.1 | 42.0 | | 258 | FT. | | 118 |
| | | | 45.0 | | 5.6 | - 8.8 | 12,000 FT. | 16.2 | 42.5 | | 258 | FT. | | 121 |
| | | | FT. | LOW | 4.6 | - 4.8 | 10,000 FT. | 23.4 | 43.5 | LOW | 258 | 32.5 | | 131 |
| | | | FT. | | 4.9 | - 0.8 | 8,000 FT. | 30.5 | FT. | | 243 | 33.0 | | 131 |
| | | | FT. | | 5.3 | 3.1 | 6,000 FT. | 37.6 | FT. | | 262 | 33.5 | | 131 |
| | | | 46.0 | | 5.5 | 7.1 | 4,000 FT. | 44.7 | 44.0 | | 282 | 34 | | 131 |
| | | | 47.0 | | 5.5 | 11.0 | 2,000 FT. | 51.8 | 45.0 | | 282 | 34.5 | | 131 |
| | | | 47.5 | | 5.5 | 15.0 | SEA LEVEL | 59.0 | 45.5 | | 282 | 35.5 | | 131 |

**GENERAL NOTES**

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

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

**TAKE-OFF CONDITIONS:**

RPM: 2600; MP: 50"; TEM. 260°C: 5 MIN.

**CONDITIONS TO AVOID:**

**SPECIAL NOTES**

(3) 30°C (86°F) MINIMUM OIL TEMPERATURE FOR NORMAL TAKE-OFF 20°C (68°F) FOR EMERGENCY TAKE-OFF.

(4) NORMAL RATED POWER TO 70% NRP-248°C (480°F) UNLIMITED 70 % NORMAL RATED POWER AND BELOW -232°C (450°F) UNLIMITED.

(5) 30 SECONDS MAXIMUM.

DATA AS OF 6-30-47 BASED ON BUAER CURVE — 6-24-47

AAFMC-526 8-1-44

Figure 3-1—Power Plant Chart

# POWER PLANT CHART

| AIRCRAFT MODEL(S) | PROPELLER(S) | ENGINE MODEL(S) |
|---|---|---|
| JRM-1 | CURTISS ELECTRIC FULL FEATHERING | W.A.C. R-3350-8 TWO-SPEED (MODIFIED) |

| GAUGE READING | FUEL PRESS. | OIL PRESS. | OIL TEMP. | COOLANT TEMP. | |
|---|---|---|---|---|---|
| DESIRED | 17 | F. R. 35 75 | 70-85 | | |
| MAXIMUM | 18 | 40 85 | 100 | | |
| MINIMUM | 16 | 30 60 | 60 (3) | | |
| IDLING | 11 | 25 45 | | | |

MAXIMUM PERMISSABLE DIVING RPM: 3000 (5)
MINIMUM RECOMMENDED CRUISE RPM: 1400
MAXIMUM RECOMMENDED TURBO RPM:

OIL GRADE: 1120 SPEC. AN-O-8
FUEL GRADE: 100/130 SPEC. AN-F-28

| WAR EMERGENCY (COMBAT EMERGENCY) | | | MILITARY POWER (NON-COMBAT EMERGENCY) | | | OPERATING CONDITION | | | NORMAL RATED (MAXIMUM CONTINUOUS) | | | MAXIMUM CRUISE (NORMAL OPERATION) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MINUTES | | | 5 MINUTES 260°C | | | TIME LIMIT | MAX. CYL. HD. TEMP. | | UNLIMITED 248°C (4) | | | UNLIMITED 232°C | | |
| | | | A. R. 2600 | | | MIXTURE | R. P. M. | | A. R. 2400 | | | A. L. 2025 | | |
| MANIF. PRESS. | SUPER-CHARGER | FUEL (2) Gal/Min | MANIF. PRESS. | SUPER-CHARGER | FUEL (2) Gal/Min | STD. TEMP. °C | PRESSURE ALTITUDE | STD. TEMP. °F | MANIF. PRESS. | SUPER-CHARGER | FUEL GPH (3) | MANIF. PRESS. | SUPER-CHARGER | FUEL GPH (3) |
| | | | | | | -55.0 | 40,000 FT. | -67.0 | | | | | | |
| | | | | | | -55.0 | 38,000 FT. | -67.0 | | | | | | |
| | | | | | | -55.0 | 36,000 FT. | -67.0 | | | | | | |
| | | | | | | -52.4 | 34,000 FT. | -62.3 | | | | | | |
| | | | | | | -48.4 | 32,000 FT. | -55.1 | | | | | | |
| | | | | | | -44.4 | 30,000 FT. | -48.0 | | | | | | |
| | | | | | | -40.5 | 28,000 FT. | -40.9 | | | | | | |
| | | | | | | -36.5 | 26,000 FT. | -33.7 | | | | | | |
| | | | | | | -32.5 | 24,000 FT. | -26.5 | | | | | | |
| | | | FT. | HIGH | | -28.6 | 22,000 FT. | -19.4 | FT. | HIGH | | | | |
| | | | FT | ↓ | | -24.6 | 20,000 FT. | -12.3 | FT. | ↓ | | | | |
| | | | | ↓ | | -20.7 | 18,000 FT. | - 5.2 | | ↓ | | | | |
| | | | FT. | ↓ | | -16.7 | 16,000 FT. | 2.0 | FT. | ↓ | | FT. | LOW | |
| | | | 44.5 | ↓ | | -12.7 | 14,000 FT. | 9.1 | 41.0 | ↓ | | FT. | ↓ | |
| | | | 45.0 | ↓ | | - 8.8 | 12,000 FT. | 16.2 | 41.0 | ↓ | | 28.5 | ↓ | |
| | | | FT. | LOW | | - 4.8 | 10,000 FT. | 23.4 | FT. | LOW | | 29.5 | ↓ | |
| | | | FT | ↓ | | - 0.8 | 8,000 FT. | 30.5 | FT. | ↓ | | 30.0 | ↓ | |
| | | | FT. | ↓ | | 3.1 | 6,000 FT. | 37.6 | FT. | ↓ | | 30.5 | ↓ | |
| | | | 46.0 | ↓ | | 7.1 | 4,000 FT. | 44.7 | 44.0 | ↓ | | 31.2 | ↓ | |
| | | | 47.0 | ↓ | | 11.0 | 2,000 FT. | 51.8 | 44.7 | ↓ | | 31.8 | ↓ | |
| | | | 47.5 | ↓ | | 15.0 | SEA LEVEL | 59.0 | 45.5 | ↓ | | 32.5 | ↓ | |

GENERAL NOTES

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

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

**TAKE-OFF CONDITIONS:**

RPM: 2600: MP: 50": TEM. 260°C: 5 MIN.

**CONDITIONS TO AVOID:**

SPECIAL NOTES

(3) 30°C (86°F) MINIMUM OIL TEMPERATURE FOR NORMAL TAKE-OFF. 20°C (68°F) FOR EMERGENCY TAKE-OFF.

(4) NORMAL RATED POWER TO 70% NRP-248°C (480°F) UNLIMITED 70% NORMAL RATED POWER AND BELOW -232°C (450°F) UNLIMITED.

(5) 30 SECONDS MAXIMUM.

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT TEST.

DATA AS OF 5-1-46 BASED ON BUAER CURVE- 16 APRIL 1946

AAF MC-526 4-1-44

FIG. NO. 3-1A POWER PLANT CHART

# SECTION IV

# EMERGENCY OPERATING INSTRUCTIONS

## 4-1. FIRE EXTINGUISHERS AND FIRE EXTINGUISHER SYSTEMS.

4-2. PORTABLE FIRE EXTINGUISHERS. *(See figure 4-1.)* Five portable $CO_2$ pistol grip fire extinguishers are stowed in the following positions:

One 7 pound in the auxiliary power plant compartment.

One 5 pound in the galley compartment.

One 2 pound at the flight engineer's station.

One 2 pound in the aft cargo compartment.

One 2 pound in the forward cargo compartment.

4-3. ENGINE FIRE DETECTOR AND EXTINGUISHER SYSTEM. The engine fire extinguisher system consists of two bottles each charged with 11.25 pound of methyl bromide, located in the wing aft of the front spar, and connected to the accessory section of each nacelle. Nineteen detectors in each nacelle provide fire warning to the flight engineer. Red lights located on the flight engineer's switch panel will indicate the starting of a fire in one of the nacelles. When the red light appears, the flight engineer will proceed as follows for the engine involved:

a. Feather the propeller (this automatically shuts off the fuel and oil.)

b. Open the cowl flaps.

c. Move mixture control to "IDLE CUT-OFF."

d. Turn on the methyl bromide.

e. Turn the ignition off.

f. Turn the electrical switches off.

g. Do not restart the engine (unless reason for fire has been eliminated).

4-3A. For engine fire on the water with no engine running, the flight engineer proceeds as follows:

a. Put override switch to "OVERRIDE" position.

b. Turn on methyl bromide.

4-4. AUXILIARY POWER PLANT FIRE EXTINGUISHER SYSTEM. Provisions are made for two 5-pound $CO_2$ bottles located forward of the rear spar in the wing. Four detectors, suspended above each auxiliary power plant located in the left and right side of the auxiliary power plant compartment, provide fire warning to the flight engineer. Red lights located on the flight engineer's switch panel indicate the starting of a fire in either the left or right auxiliary power plant. When the red light appears, the flight engineer will throw either the left or right auxiliary power plant fire extinguisher switch for the plant affected thus releasing the $CO_2$ from both bottles. Throwing both switches will direct the $CO_2$ to both auxiliary power plants. A duplicate set of fire extinguisher controls is located in the crew's quarters to the left of the doorway to the auxiliary power plant compartment. Only one fire may be put out with the two bottles. If a second fire starts, use the portable fire extinguishers.

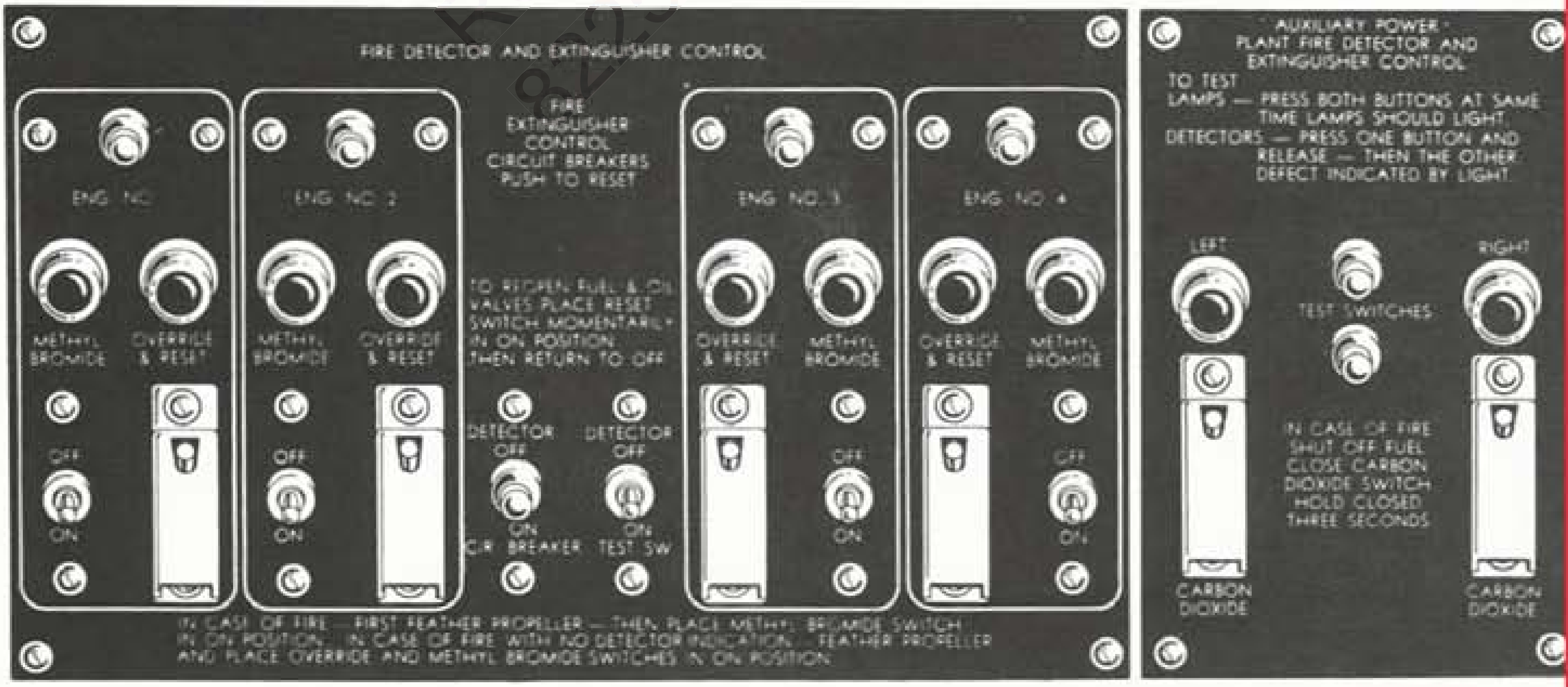



*Figure 4-0. Fire Extinguisher Control Panels*

## 4-5. EMERGENCY EQUIPMENT.

4-6. PARACHUTE STOWAGE. *(See figure 4-1.)* There are provisions for the stowage of 11 parachutes, 8 on the crown of the flight deck compartment and 3 on the ceiling of the forward entrance compartment.

4-7. LIFE RAFT. *(See figure 4-1.)* One Mark VII life raft is provided in the trailing edge of the center wing on the left and right side outboard from the hull. Access is provided through the life raft hatch on the top side of the wing. Turn the hatch handle to open the hatch, unfasten the stowage straps, and lift raft clear.

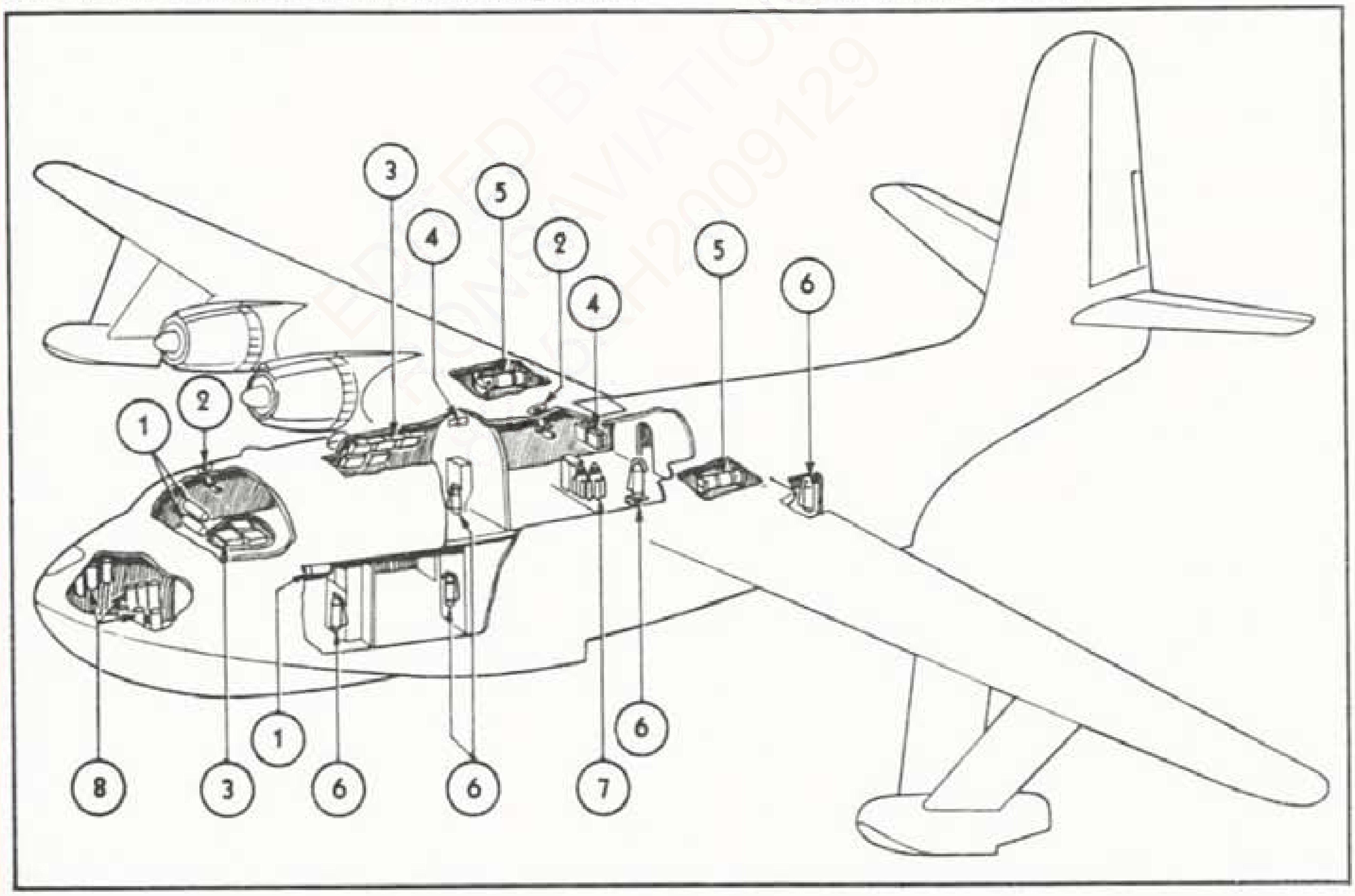
4-8. FIRST AID KIT. *(See figure 4-1.)* Two first aid kits are provided. One on the forward side of the aft bulkhead on the flight deck and one on the aft side of the forward bulkhead in the aft crew quarters compartment.

4-9. WATER STILL. *(See figure 4-1.)* Two water distilling units are provided in the auxiliary power plant compartment for the distillation of sea water. Instructions are provided on the units.

4-10. PYROTECHNICS. *(See figure 4-1.)* Two type M-8 signal pistols; blast tubes; and cartridge stowage case with 12 rounds of ammunition each are provided. One is located on the crown of the copilot's station, and the other on the crown of the auxiliary power plant compartment. Provisions for 12 parachute flares with stowage racks and flare holders are made on the left and right side of the bow compartment. To release parachute flares, load the flare in the flare holder and lift either the left, right, or both parachute flare release levers located between the pilot and co-pilot.

**WARNING**

Flares are not to be carried in place while the airplane is on the water.



1 Water Breakers
2 Signal Pistol
3 Parachute Stowage
4 First Aid Kit
5 Life Raft
6 Fire Extinguisher
7 Water Still
8 Parachute Flare Stowage

***Figure 4-1—Emergency Equipment***

4-11. SEA ANCHOR STOWAGE. One sea anchor is stowed on each side of the emergency hatch in the upper deck. Each anchor is held by two straps which cross in the middle through the sea anchor bridle ring.

## 4-12. CARBON MONOXIDE SIGNAL.

4-13. A carbon monoxide signal, type K-1, is provided forward of the flight engineer's panel. To start the unit, turn the CO power switch on the flight engineer's switch panel to "ON." A warm-up period of 15 minutes is required to bring the detector cell to operating temperature and condition. After 8 to 12 minutes of the period has elapsed, the red indicator light on the flight engineer's switch panel may come on. This is characteristic of the signal assembly during the warm-up period. At the end of the 15-minute period, push the reset switch on the flight engineer's switch panel. The light will then go off and remain off unless carbon monoxide in concentrations greater than .01 to .015 percent is present. Ventilate the area as required. If personnel have been exposed to concentrations of carbon monoxide, don oxygen mask and breathe pure oxygen until symptoms disappear.

## 4-14. EMERGENCY ESCAPE FROM AIRPLANE.

4-15. Should it become necessary to abandon ship, crew members will secure parachutes if in flight and exit through any of the recommended hatches. (See figure 4-2.)

## 4-16. EMERGENCY TAKE-OFF IN THE OPEN SEA.

4-17. While each situation confronted by a pilot in planning an open sea take-off presents different aspects of wind, sea conditions, and load, successful take-offs can be made in heavy swell regardless of the direction of the wind, including directly down wind. The following are guiding principles:

a. Lighten the airplane by jettisoning as much removable weight as safety and balance permit.

b. Start take-off with the swell at the stern; i. e. headed down swell.

c. Apply power immediately before the crest of a swell has reached the airplane. This results in very rapid acceleration of the airplane due both to the application of power and the surfing effect of the swell.

d. The airplane should be on the step prior to climbing on top of the swell which was next ahead at the start of the take-off.

e. The airplane should be air borne when on top of the first swell next ahead. If not, make a small arc in the take-off in order to ride the crest of the swell for a longer period.

f. Do not attempt take-off except into the wind when swells are small and irregular or crossing; i.e. come from more than one direction.

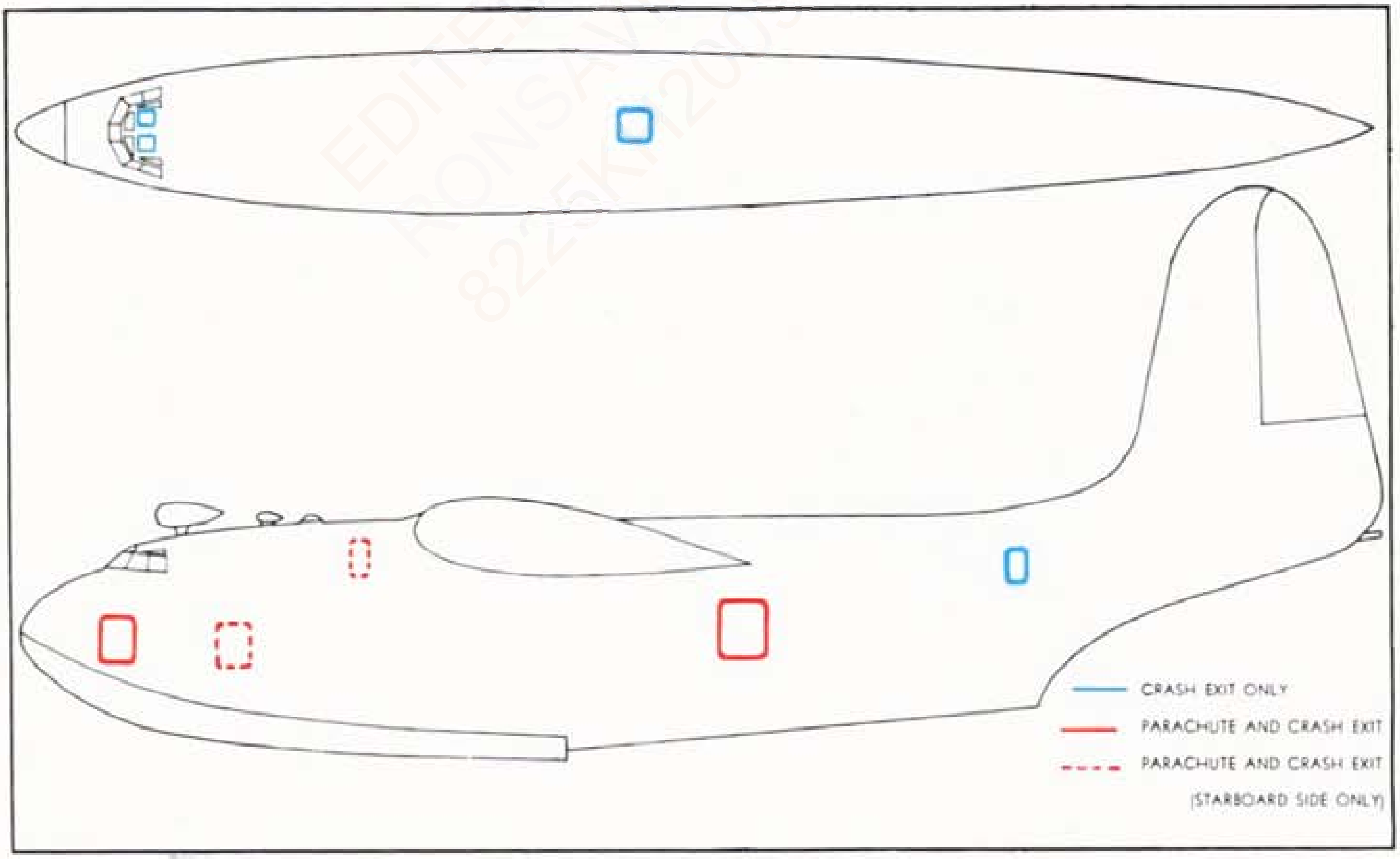



*Figure 4-2—Emergency Exits*

## 4-18. EMERGENCY OPERATION OF SURFACE CONTROLS.

4-19. EMERGENCY OPERATION OF RUDDER AND ELEVATOR BOOST CONTROLS. When a loss of pressure and increased control forces indicate a failure of the surface control booster pump, throw the switch for the standby pump to its "ON" position, and throw the switch for the inoperative pump to the "OFF" position.

4-20. When operating the surface controls with the booster system inoperative, the pressure may be relieved by opening the manually operated bypass valves. The bypass valve for the elevator control is on the left-hand side of the airplane at frame 66. The bypass valve for the rudder control is on the lower corrigation of the stabilizer.

**CAUTION**

Check that the bypass valves are closed before returning to booster operation.

4-20A. If either the elevator or the rudder boost become inoperative isolate the inoperative portion of the system by using the emergency booster by-pass kit which is stowed on the left side of the airplane below the servo valves.

4-20B. To by-pass the elevator servo valve proceed as follows: (See figure 4-2A.)

a. Disconnect the tube (2) from the rudder servo valve return port (3).

b. Connect one end of the flexible hose (1) from the emergency kit to the rudder servo valve return port (3).

c. Disconnect the tube (4) from the tee (5) in the return line.

d. Connect the other end of the flexible hose (1) to the tee (5) in the return line.

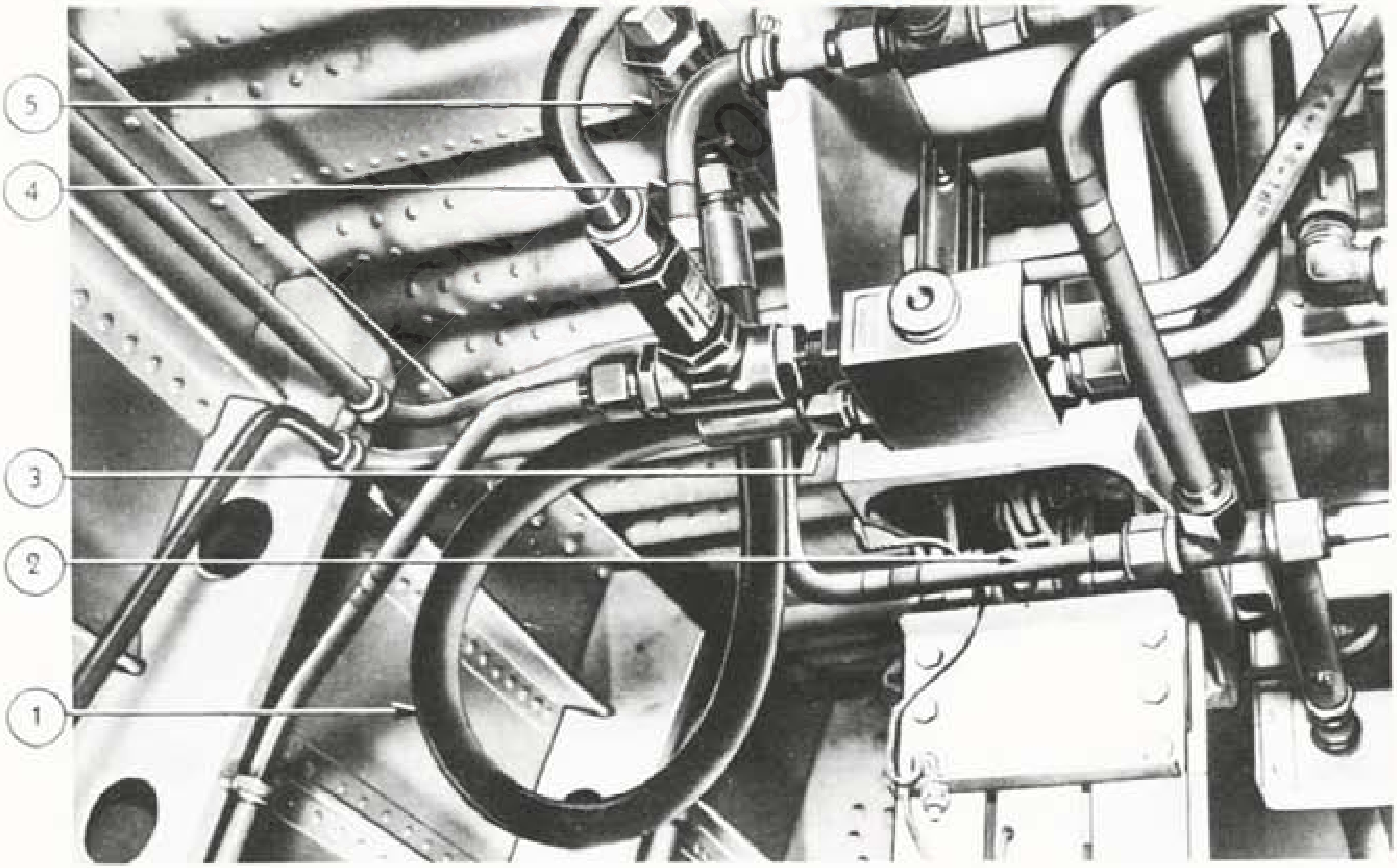
4-20C. To by-pass the rudder servo valve, proceed as follows: (See figure 4-2B.)

a. Disconnect the tube (2) from the elbow (3) in the tee assembly which enters the pressure port of the elevator servo valve (4).

b. Connect one end of the flexible hose (1) from the emergency kit to the elbow (3) in the tee assembly at the elevator servo valve pressure port (4).

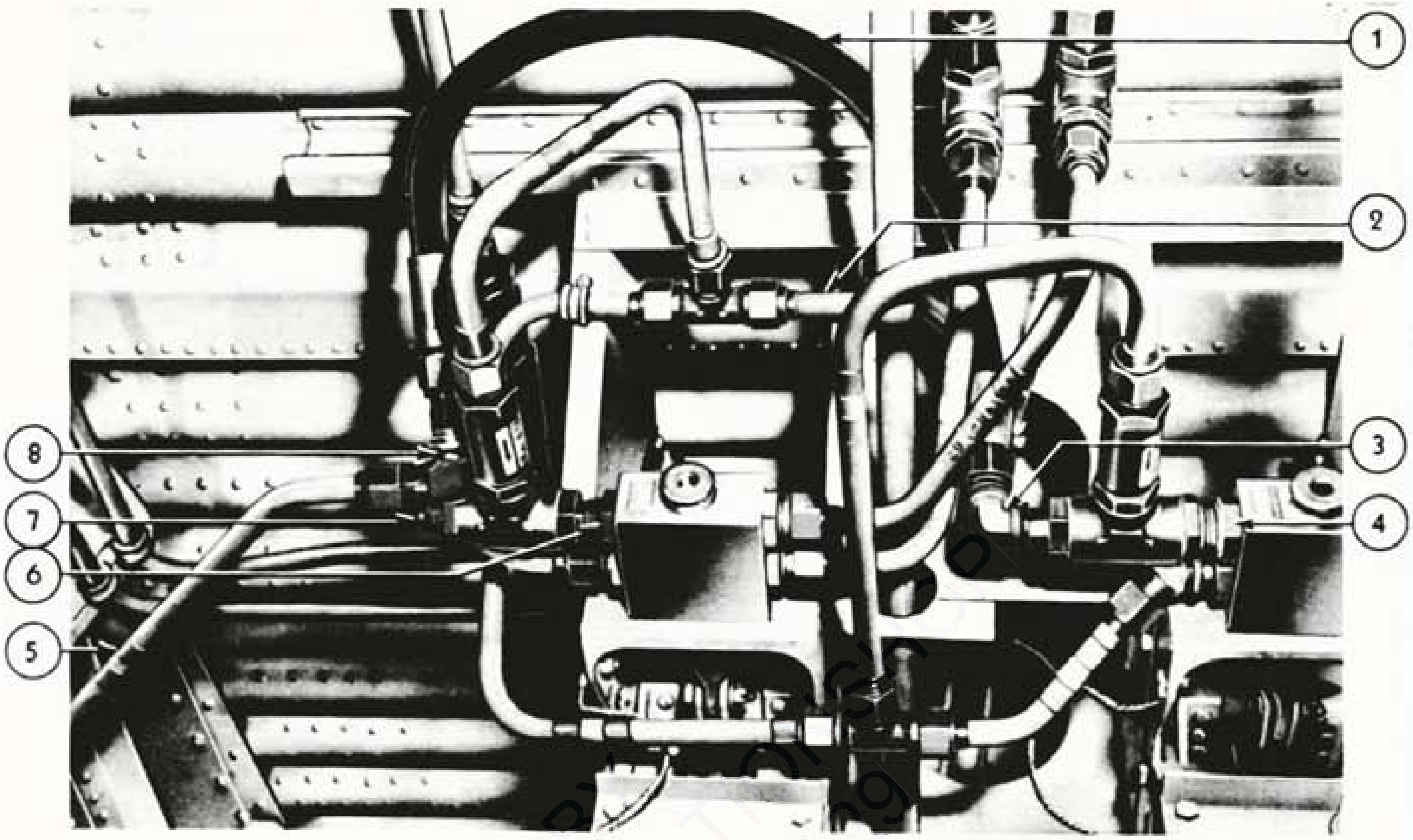
**NOTE**

Rotate the elbow (3) 180 degrees if necessary.




1 Flexible Hose
2 Tube A-448036-138
3 Rudder Servo Valve Return Port
4 Tube A-448036-143
5 Return Line Tee

*Figure 4-2A. Elevator Servo By-Pass*




| | | | |
|---|---|---|---|
| 1 | Flexible Hose | 5 | Tube A-448036-164 |
| 2 | Tube A-448036-140 | 6 | Rudder Servo Valve Pressure Port |
| 3 | Elbow | 7 | Tee Assembly |
| 4 | Elevator Servo Valve Pressure Port | 8 | Elbow AN821-8D |

*Figure 4-2B. Rudder Servo By-Pass*

c. Disconnect the tube (5) from the tee assembly (7) at the rudder servo valve pressure port (6). Add the elbow (8) from the emergency kit to the free end of the tube (5).

d. Connect the other end of the flexible hose (1) to the elbow (8).

4-21. EMERGENCY OPERATION OF ELEVATOR BALANCE TAB. In the event of electrical failure, the elevator tab balance adjustment may be operated by use of the handcrank located on the aft side of frame 1284 in the hull tail section. To operate, be sure the elevator tab balance switch on the pilot's pedestal is in the "OFF" position. Turn the crank clockwise for lead balance and counterclockwise for lag balance.

**CAUTION**

Care should be exercised in operating the handcrank so that the indicator does not go past 75 percent balance or damage to the limit switch in the motor will result.

4-22. EMERGENCY OPERATION OF WING FLAP. In event of failure of the hydraulic system operating the wing flaps, hand pumps located in the center wing walkways between the flight deck and the auxiliary power plant compartment are to be used. It is first necessary to set the solenoid valve indicator located on the rear spar at the centerline of the airplane to either "FLAPS UP" or "FLAPS DOWN;" then operate hand pumps.

## 4-23. EMERGENCY OPERATION OF FUEL SYSTEM.

(See paragraphs 2-17 to 2-25.)

4-24. FUEL JETTISON. *(See figure 4-3.)* To jettison fuel, proceed as follows:

a. Consult the Handbook of Weight and Balance Data AN01-1B-40 before jettisoning fuel to determine the effect on the center of gravity.

b. Warn all crew members that fuel is to be jettisoned.

c. Turn off all radio power.

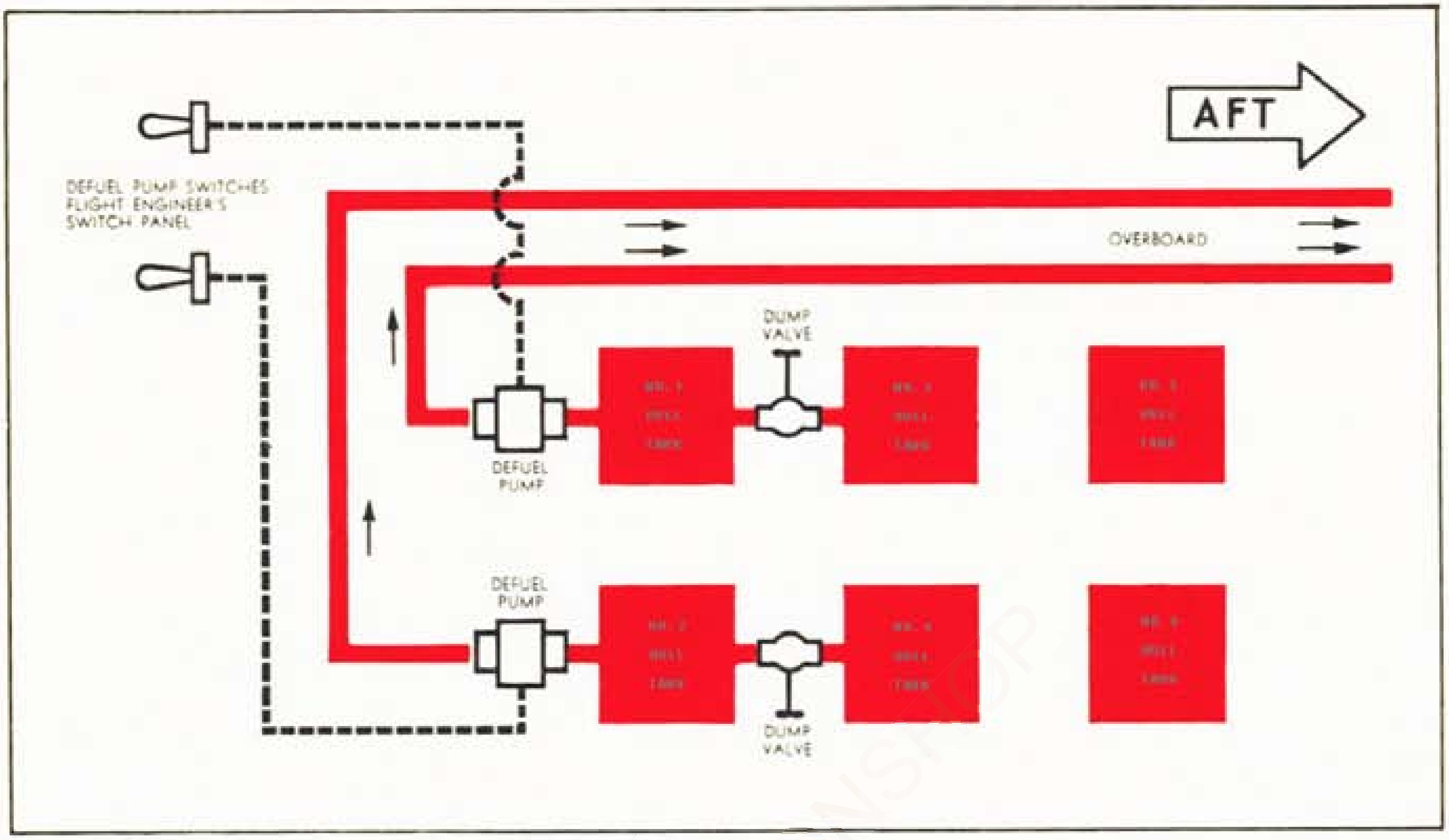



*Figure 4-3—Fuel Jettison System*

**WARNING**


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

d. Throw the two defuel pump switches on the flight engineer's switch panel to "ON." The red indicator light will go on, indicating the pumps are operating. Fuel is pumped from hull tank numbers 1 and 2 through a pump for each tank. Fuel from hull tank numbers 3 and 4 may be run into tank numbers 1 and 2 by opening the dump valves in the re-fueling compartment. Fuel from hull tank numbers 5 and 6 may be transferred to numbers 1 and 2 for dumping. See paragraph 2-19 for transferring fuel.

e. Note drop in fuel tank quantity gages as a check on performance of pumps; 100 US (83 Imperial) gallons per minute each.

f. When jettisoning is completed, throw the defuel pump switches to "OFF."

g. Calculate reduction in gross weight of airplane and compensate accordingly.

4-24A. EMERGENCY MANUAL FUEL TRANSFER. If the hull tank selector valve becomes inoperative, fuel can be transferred from any hull tank containing fuel to the tank to which the hull tank selector valve is set by use of the fuel bilging system. (See figure 4-3A.) Operate the controls located in the refueling compartment as follows:

a. Set the bilge selector valve to the tank from which fuel is to be drawn.

b. Set the selector valve to "MANIFOLD."

c. Open the shut-off cock on the refueling manifold for the tank to which the hull tank selector valve is set. Check that the other cocks are closed.

d. Pump the bilge pump. At 120 strokes a minute, the pump has a capacity of approximately 800 US (666 Imperial) gallons per minute.

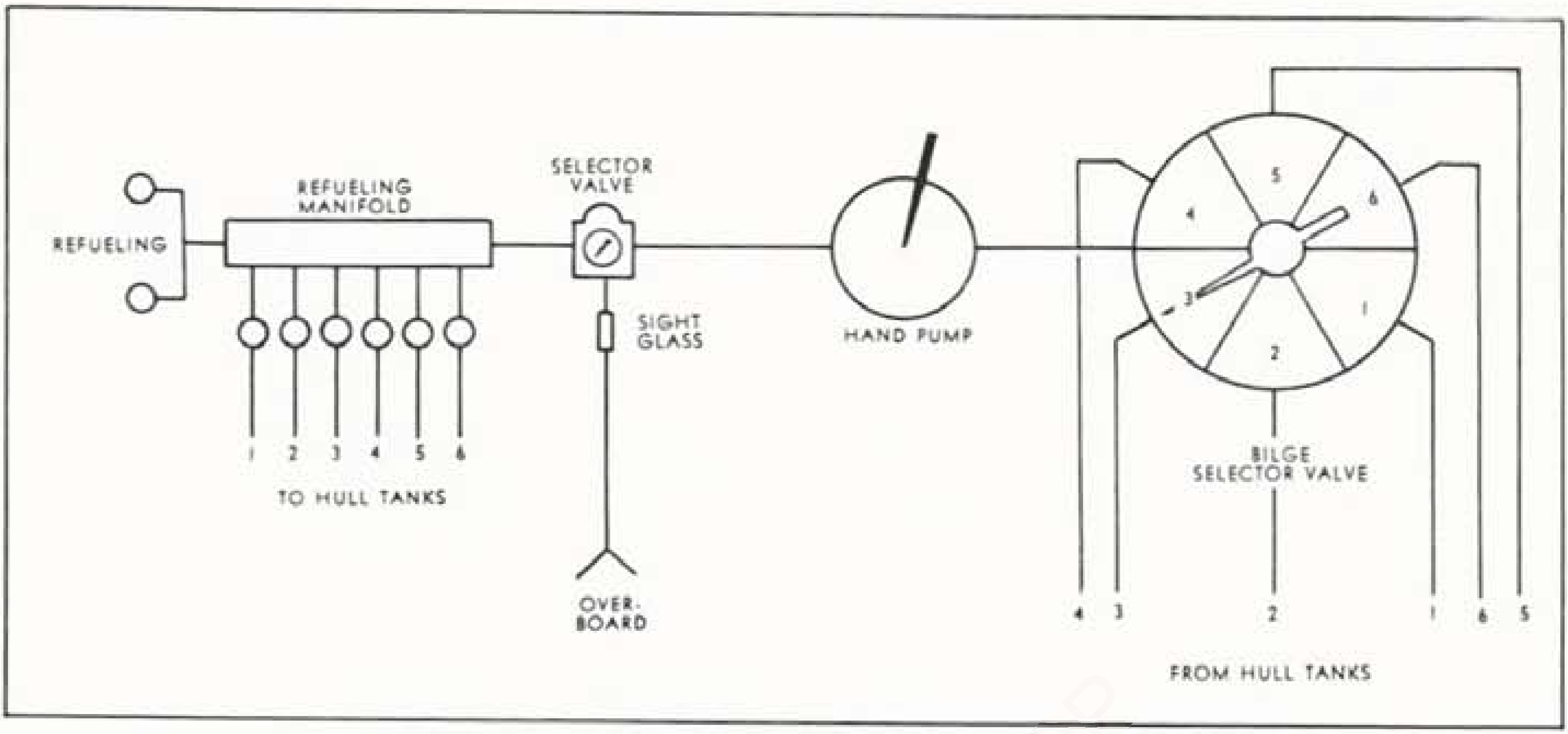



*Figure 4-3A. Fuel Bilging System*

## 4-25. ANNUNCIATOR SYSTEM.

4-26. An annunciator system with six loud speakers conveniently located throughout the airplane is provided. For operation by pilot or copilot, proceed as follows:

a. Master radio switch on pilot's pedestal must be "ON."

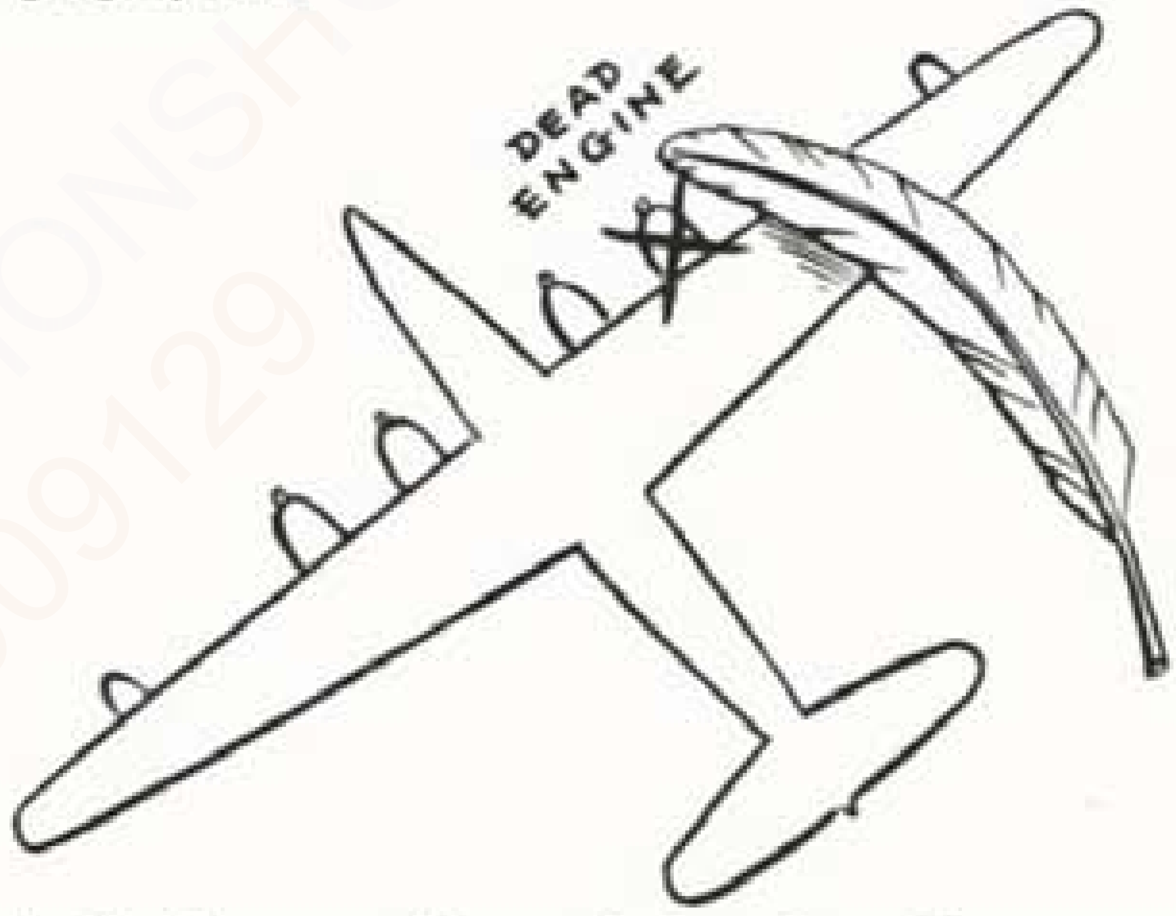
b. Remove microphone from the clip above the pilot's head.

c. Press microphone button, and speak.

## 4-27. ENGINE FAILURE DURING FLIGHT.

4-28. For engine failure during flight, proceed as follows:

a. Disengage automatic pilot.




b. Feather propeller on dead engine. (See paragraph 4-29.)

c. Apply rated power to all engines.

d. Place wing flaps in full up position.

e. Close cowl flaps on dead engine.

f. Open cowl flaps on good engines only enough to maintain cylinder head temperatures below limits.

g. Entrance 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 Charts on cruising data for partial engine operation.

**Note**

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

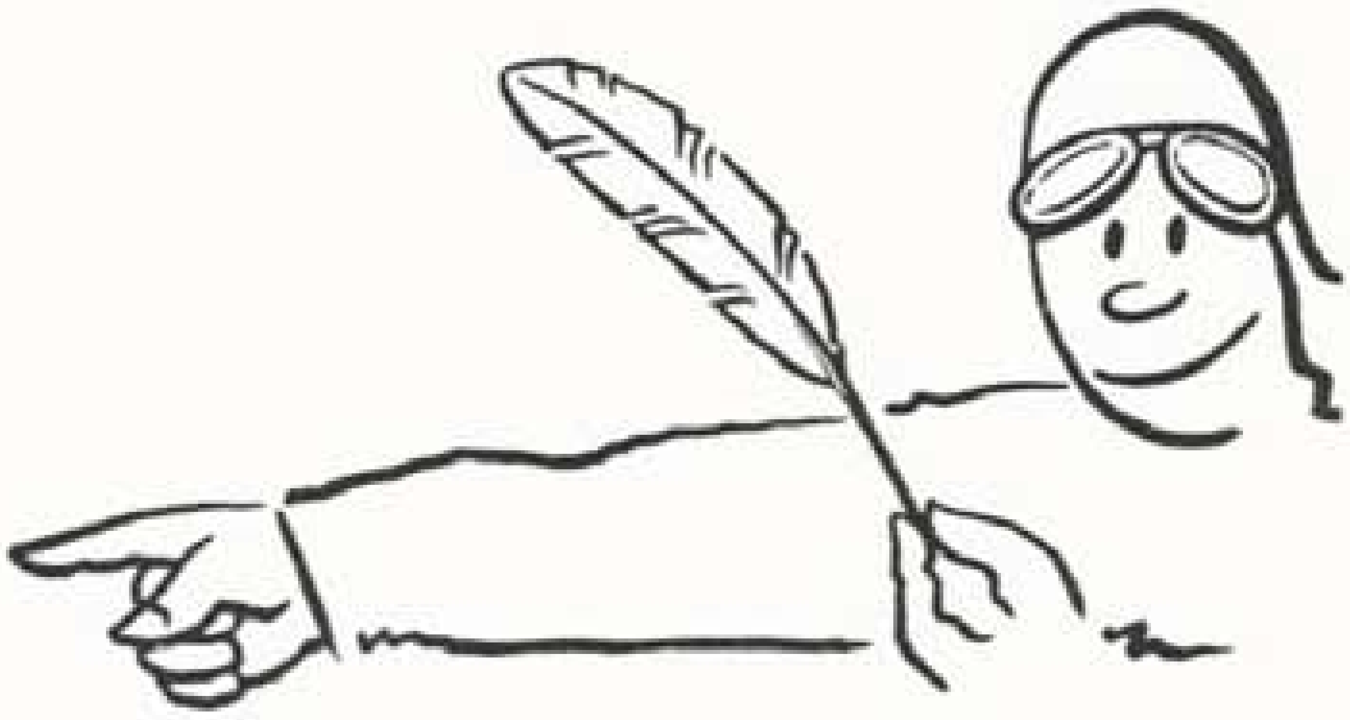
j. Instruct members of crew to jettison cargo, gasoline, etc., to reduce weight if necessary to maintain a constant altitude.

## 4-29. PROPELLER FEATHERING AND UNFEATHERING.

4-30. FEATHERING PROPELLER. Before feathering a propeller, use any available power.

**Note**

This action should be deliberate as it would naturally be disastrous to make a mistake and feather the propeller on one of the running engines. Also, there is always a bare possibility that the failing engine may pick up and start running again.



| PILOT | FLIGHT ENGINEER |
|---|---|

**PILOT**

a. Close the throttle. This eliminates the tendency to backfire.

**FLIGHT ENGINEER**

b. Throw the feathering switch to the "FEATHER" position.

**PILOT**

**Note**

The pilot can also feather by holding the selector switch in the "DEC. RPM" position until the blades reach the feather angle. This can be done only when the flight engineer has the feather switch in the "NORMAL" position. The feather rate is slower with this method than when the engineer's feather switch is used.

**FLIGHT ENGINEER**

c. Move the mixture control to the "IDLE CUT-OFF" position.

d. Turn off the fuel supply to the affected engine.

**WARNING**

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

**PILOT**

e. Leave ignition switch on until propeller stops, then turn switch off.

f. If, after the above feathering procedure has been followed, the propeller fails to respond, then attempt to feather by holding the propeller selector switch in "DEC. RPM" position. In the event that the propeller still fails to feather and remains in locked pitch, an attempt will then be made to windmill the propeller at the lowest possible rpm. The propeller will windmill at a speed proportional to the air speed, making it desirable to fly the airplane at an air speed of not more than 15 to 25 knots above the stalling speed.

**Note**

If the selector switch is used in the "DEC. RPM" position, the flight engineer's feather switch must be in the "NORMAL" position.

g. If severe vibration exists, the tendency to vibrate can be reduced by flying at the absolute minimum air speed. Frequently the engine will seize and stop the windmilling. At other times when the engine seizes, the reduction gear housing will fail allowing the propeller, propeller shaft, and reduction gearing to be carried away. In other cases of engine seizure, only the reduction gearing will be wrecked which relieves the windmilling propeller of the engine drag and permits it to windmill faster.

4-31. UNFEATHERING PROPELLER. The mixture control should still be in "IDLE CUT-OFF" position and the throttle closed.

| PILOT | FLIGHT ENGINEER |
| --- | --- |
| | a. Return feather switch to "NORMAL." |
| b. Turn the ignition switch to "BOTH." | |
| c. Open the throttle to give a maximum engine speed of 1200 rpm. | |
| d. Hold the propeller selector switch in the "INC. RPM" position. | |
| | e. Turn on the fuel supply to the engine as soon as the propeller has turned approximately three revolutions. This prevents flooding of the lower cylinders. |
| f. When the engine speed reaches 800 rpm, release the propeller selector switch. | |
| | g. Place the mixture control in the "AUTO-RICH" position. |
| | h. Operate the engine at as near 1000 rpm as possible until satisfactory cylinder head and oil temperatures are obtained. Be sure to obtain the proper fuel and oil pressures. Refer to Power Plant Chart. (See figure 3-1.) |
| i. Set the propeller synchronizer control at the proper rpm, and place the propeller selector switch in "AUTO" after the engine has been warmed up. | |
| j. Adjust the throttle for the desired manifold pressure. | |

IN ANY EMERGENCY

BE PREPARED

KEEP COOL

ACT QUICKLY

# SECTION V
# OPERATIONAL EQUIPMENT

## 5-1. RADIO NAVIGATION, COMMUNICATION, AND OTHER ELECTRONIC EQUIPMENT.

**Note**

Do not operate the radio equipment unless either the auxiliary generators 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.

5-2. GENERAL. The radio navigation, communication, and other electronic equipment installed in the JRM-1 airplanes consists of the following equipment:

| *EQUIPMENT* | *PURPOSE* |
|---|---|
| AN/ART-13 (ATC) (Pilot, Co-Pilot and Radioman Controlled). | Provides: Pretuned LF-MHF-HF high power liaison transmission. |
| BC-348 (Radioman Controlled). | Radio Receiver. |
| AN/ARC-1 (Pilot and Co-Pilot Controlled). | VHF Receiver and Transmitter. |
| AN/AIA-2A (Pilot, Co-Pilot and Radioman Controlled). | Provides: Intercommunication plus audio distribution and control of receiver outputs and transmitter side tone. |
| SCR-269F (Pilot and Co-Pilot Controlled) (Pilot, Co-Pilot, and Navigator Controlled). | Automatic Radio Compass provides aural and visual indications. |
| AN/ARN-8 (Pilot and Co-Pilot Controlled). | Marker Beacon Receiver provides aural and visual indications. |
| AN/APN-1 (Pilot and Co-Pilot Controlled). | Provides: Direct indication of altitude. |
| LM Series (Radioman Controlled). | Frequency meter provides means of checking frequency of radio signals. |
| AN/APN-4 (Navigator Controlled). | Airplane Navigation system of position finding by reception of signals from transmitting stations of known position. |
| AN/APX-2 (Pilot, Co-Pilot, and Radioman Controlled). | Airborne Interrogator — Responder — Transponder Equipment. |
| AN/ARC-5 (Pilot Controlled). | Reception on tunable LF range and MHF receivers. |

**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.

5-3. POWER TO EQUIPMENT. Power to the equipment is obtained by turning the generator control switches and circuit breaker power switches located on the flight engineer's switch panel to "ON." The pilot controlled equipment is then turned on with the master radio switch located on the pilot's pedestal. The radioman controlled equipment is turned on with the master radio switch located at the radio operator's station.

5-4. OPERATION OF AN/ART-13 (ATC).

5-5. VOICE OPERATION—PANEL CONTROL. AN/ART-13 (ATC).

**Note**

The antenna loading coil is used to tune the transmitter's antenna system for operation in the low frequency band between 0.2 and 0.6 MC. Throw the antenna knife switch below the load coil to the "LOAD COIL" position and use the key on the radio operator's table.

a. Place local-remote switch in the "LOCAL" position.

b. Insert the microphone cord plug into the microphone jack.

c. Check microphone switch beneath tuning chart to make sure that the circuit selected is correct for the type of microphone to be used (carbon or dynamic).

d. Place the emission selector switch in the "VOICE" position.

e. Select the autotune channel, corresponding to the frequency upon which output is desired, with the channel selector switch.

f. Place the power level switch in the "OPERATE" position.

g. Check battery voltage by rotating the metered circuit selector switch to the "BATTERY VOLTAGE" position.

h. Normal battery voltage is indicated when the needle deflects and comes to rest within the solid yellow portion of the scale under "BATTERY."

i. Rotate the metered circuit selector switch to the "P.A. PLATE" position.

j. Close the push-to-talk switch on the microphone.

k. Check the P.A. plate current.

l. When selector switch is in the "P.A. PLATE" position, the meter reading is the sum of the power amplifier plate and modulator static plate currents. Therefore the zero signal P.A. plate current reading will be slightly higher than when operating with "CW" emission.

m. If operating on one of the ten high-frequency channels, check the antenna current.

n. If the above readings appear to be normal, the transmitter may be operated with voice emission; the carrier being controlled by the push-to-talk button on the microphone.

5-6. CW OPERATION—PANEL CONTROL. AN/ART-13 (ATC). (Range 2000-18,100 KC).

a. Place the local-remote switch in the "LOCAL" position.

b. Place the emission selector switch in the "CW" position.

c. Select the autotone channel corresponding to the frequency upon which transmission is desired, using the channel selector switch.

d. Check the battery voltage by placing the metered circuit selector switch in the "BATTERY VOLTAGE" position.

e. Normal battery voltage is indicated if the meter needle comes to rest within the solid yellow portion of the meter scale under "BATTERY."

f. Rotate selector switch to the "P.A. PLATE" position.

g. Close the telegraph key and check the P.A. plate current. The meter should indicate power amplifier plate current within the range of the yellow shaded portion of the scale designated as "CW."

h. Check the antenna current as indicated by the meter on the transmitter panel.

i. If the meters indicate normal operating conditions, operation with "CW" emission may be continued, using the telegraph key to control the r-f output.

5-6A. CW OPERATION—PANEL CONTROL AN/ART-13 (ATC) (RANGE 266-600 KC).

a. Place the antenna knife switch in the "LOAD COIL" position.

b. Place the local-remote switch in the "LOCAL" position.

c. Place the emission selector switch in the "VOICE" position.

d. Place the channel switch in the "L. FREQ." position.

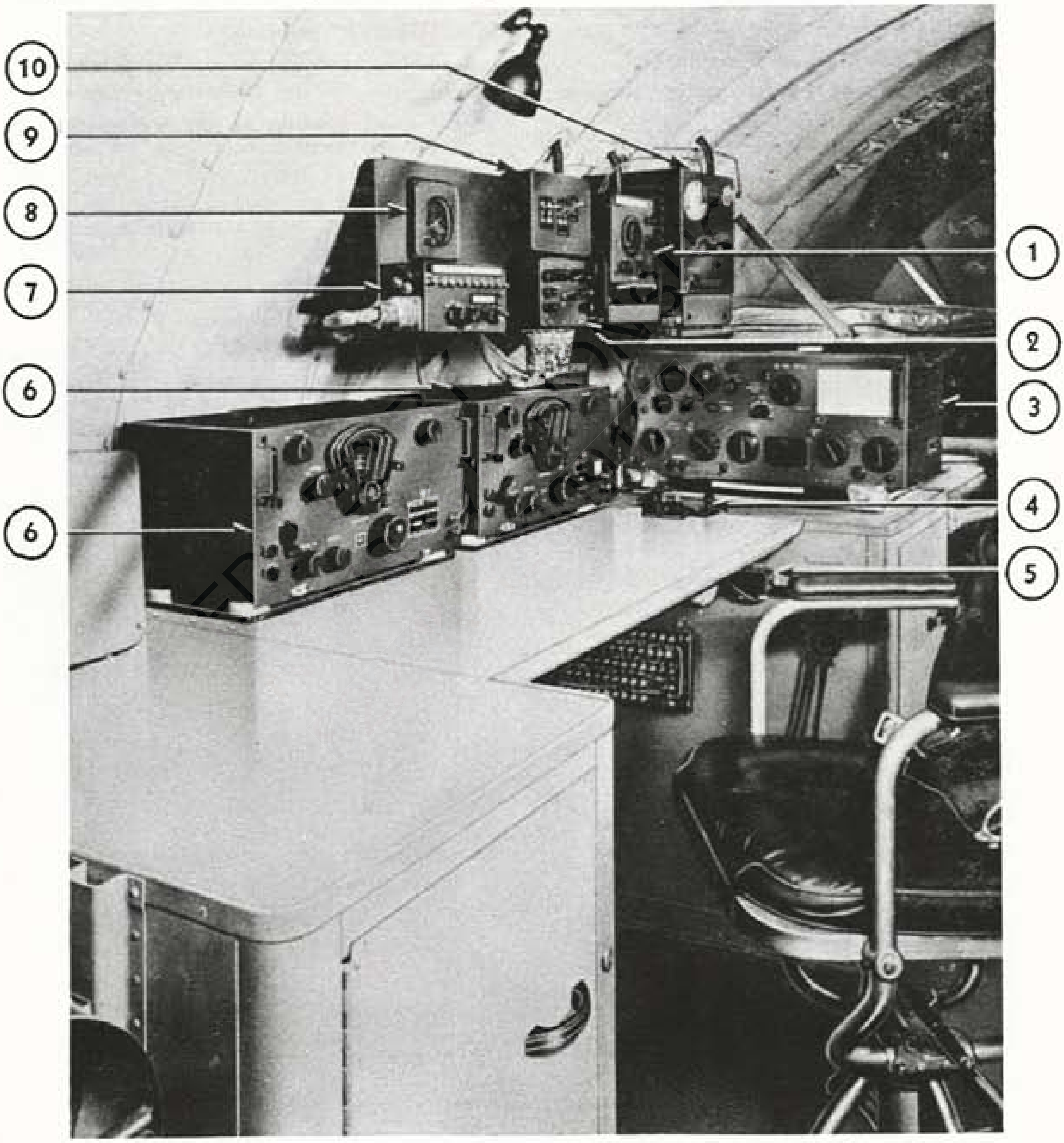
e. Unlock Controls A and C, place Control A on Position "13" and Control C on Position "1." Lock them in these positions. (If manual operation is being used, place Control A on Position "13" and Control C on Position "1" without unlocking them.)

f. Set the movable indicating mark in line with the stationary indicating mark above Control G by means of the corrector knob located below and to the right of Control G.

g. Find the desired frequency in the "CALIBRATION BOOK" and note the nearest crystal check point marked in heavy black type.

h. Set Control F to the position corresponding to the number in column F at the crystal check point.

i. Unlock Control G by turning the lock knob counterclockwise until loose. Then set Control G to




| | | | | | |
|---|---|---|---|---|---|
| 1 | L/M Series Frequency Meter | 5 | Radio Operator's Interphone Jack Box | 8 | Clock |
| 2 | IFF Control Panel | 6 | BC-348 Liaison Receivers | 9 | Power Control Panel ATC-ARC |
| 3 | AN/ART-13 Liaison Transmitter | 7 | Radio Operator's Interphone Control Box | 10 | CU-25/ART-13 Antenna Loading Coil |
| 4 | Transmitting Key | | | | |

*Figure 5-1. Radio Operator's Station*

the position corresponding to the number in column G at the crystal check point.

j. Set the power level switch to the "CALIBRATE" position and listen in the sidetone circuit for a beat note while rotating Control G back and forth about its position. Set Control G on the position that gives zero beat and turn the power level switch to the "TUNE" position.

k. Set the movable indicating mark by means of the corrector knob near Control G to the reading on Control G found in column G at the crystal check point.

l. Rotate Control G to the figure in column G at the desired frequency, setting the reading to the movable indicating mark. Lock the dial.

m. Place load coil Control K on Position "1."

n. Turn the load coil lock knob counterclockwise until loose on Control "L."

o. Place the emission selector switch on "CW" position.

p. Hold the test switch closed and rotate Control L throughout its range, seeking a plate current dip indicating resonance of the circuit. Be sure metered circuit selector switch is in "P.A. PLATE" position.

q. If no resonance was found, place Control K on the next higher position, hold the test switch closed and rotate Control L again, seeking the dip in plate current.

r. Repeat (q) above until resonance is found.

s. Adjust Control L to the position giving minimum plate current.

t. Place the calibrate-tune-operate switch in the "CALIBRATE" position.

u. This completes the tuning procedure as there is no provision in the frequency range of 200 to 1500 kc for exact loading of the transmitter to the light

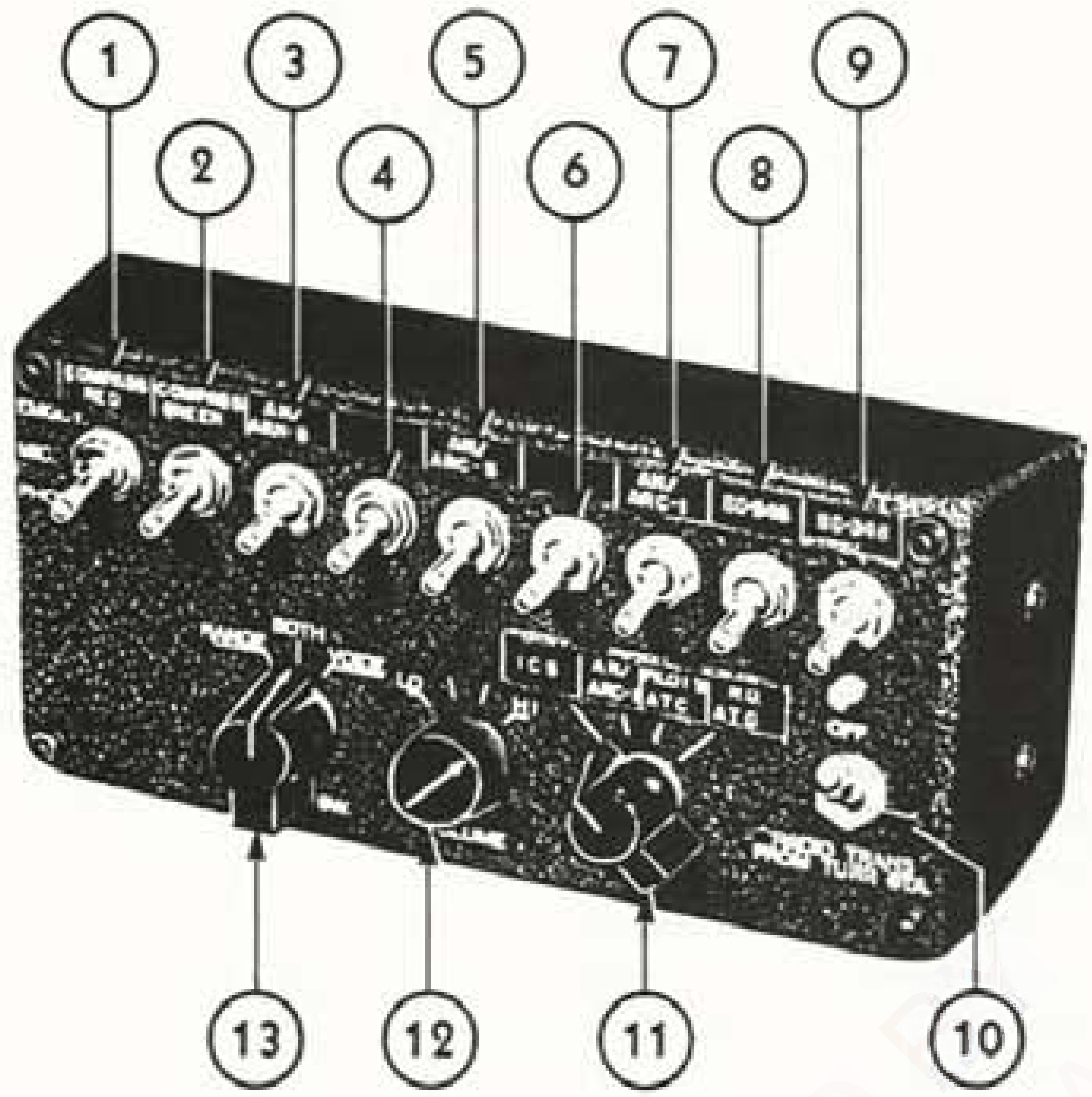

1 ARC-5 Spare Receiver
2 Loran Indicator
3 ARC-5 Pilot's Receiver
4 ART-13 Pilot's Transmitter
5 Loran Receiver
6 Navigator's Interphone Station Box
7 Fatigue Seats (2)
8 Radio Compass (Red)
9 ARC-1 Pilot's Command Transmitter-Receiver
10 Gyro Fluxgate Amplifier
11 Annunciator System Amplifier
12 CO indicator
13 Navigator's Table
14 Navigator's Switch Panel
15 Free Air Temperature Indicator
16 Gyro Fluxgate Compass Master Indicator
17 Airspeed Indicator
18 Clock
19 Altimeter
20 Radio Compass Indicator
21 Radio Compass Control Panel

*Figure 5-1A. Navigator's Station*

shaded area marked "CW" on the plate meter. The plate current may read anywhere from 10 to 110.

**Note**

If the low frequency Autotune mechanism should fail it is necessary only to switch to "MANUAL" and set Control A to position "13" and Control C to position "1."




1 Compass Red Switch
2 Compass Green Switch
3 AN/ARN-8 Switch
4 Switch Not Used
5 AN/ARC-5 Switch
6 Switch Not Used.
7 AN/ARC-1 Switch
8 BC-348 Switch (Aft Set)
9 BC-348 Switch (Fwd. Set)
10 Radio Trans. from Turret Station Switch
11 Microphone Selector Switch
12 Volume Control
13 Range Filter Switch

*Figure 5-1B. Radio Control Box C-69/AIA-2*

5-7. MCW OPERATION—PANEL CONTROL. AN/ART-13 (ATC).

a. Place the local-remote switch in the "LOCAL" position.

b. Place the emission selector switch in the "MCW" position.

c. Using the channel selector switch, select the autotune channel corresponding to the frequency upon which transmission is desired.

d. Check the battery voltage by rotating the metered circuit selector switch to the "BATTERY VOLTAGE" position.

e. Normal battery voltage is indicated when the needle of meter comes to rest within the solid yellow portion of the meter scale under "BATTERY."

f. Rotate selector switch to the "P.A. PLATE" position.

g. Close the telegraph key and check the P.A. plate current.

h. When operating with "MCW" emission, the meter indicates both power amplifier and modulator plate current. Therefore the meter reading will be considerably greater than for "CW" emission. Normal current is indicated when the meter needle comes to rest within the solid yellow portion of the meter scale designated as "MCW."

i. Check the antenna current as indicated by the meter if operating in one of the ten high-frequency channels.

j. If meter readings appear to be normal, operation may be continued with the modulated carrier controlled by the telegraph key.

5-8. OPERATION—REMOTE CONTROL. AN/ART-13 (ATC).

a. Place the local-remote switch on the transmitter front panel in the "REMOTE" position.

b. If voice operation is contemplated, insert the microphone cord plug into the microphone jack of the pilot's control box and turn the microphone selector switch to the "PILOT'S ATC" position.

c. Select the autotone channel corresponding to the frequency upon which transmission is desired, using the channel selector switch on the pilot's pedestal.

d. Operate the push-to-talk button on the microphone to transmit.


*Figure 5-1C. Interphone Station Box*

5-9. OPERATION OF BC-348 RECEIVERS. Two identical BC-348 receivers are mounted on the radio operator's table. Either receiver may be selected by the radio operator, pilot, or co-pilot by using the correct switch on the radio control box. Switch No. 8 (figure 5-1B-8) controls the aft set and switch No. 9 (figure 5-1B-9) controls the forward set on the radio operator's table. Both sets are tuned by the radio operator.

5-10. OPERATING TEST—BC-348. When the power has been turned on, an operating test should be made as follows:

a. Plug a headset into one of the jacks marked "TEL." Set receiver switch to "MVC." Start the dynamotor. After the tubes have warmed up (approximately 30 seconds), advance volume control knob until a slight background noise is heard. Set band switch to the frequency band in which test signals are available.

b. Using the tuning knob with reference to the calibrated scale on the dial, tune in the desired signal.

**Note**

All tuning should be done on "MVC" switch with the volume control advanced only enough to give the desired signal strength. In the absence of a signal, the setting of the volume control can be judged by the loudness of the background noise. On "MVC" with the volume control set at maximum, very strong carrier waves will block the receiver and intelligible signals cannot be received.

c. Turn "ON" the BC-348 switch (figure 5-1B-8 or -9) on the radio operator's interphone control box.

d. Set the receiver switch to "AVC." The desired signal should still be heard.

e. With the beat frequency adjustment at zero beat position (arrow on knob pointing up), turn the c-w oscillator switch to the "ON" position. An audible beat note should be heard which should vary in pitch when the beat frequency adjustment is changed.

f. With the c-w oscillator still on, throw the crystal filter switch to "IN." Noise should be greatly reduced, and the signal can be tuned out by a much smaller movement of the tuning control knob than when the crystal filter switch is in the "OUT" position.

g. Turn the dial light rheostat and observe if control of illumination is secured with both dial lights functioning.

h. A check should be made before flight with the airplane engines running. An increase of background noise, when the engine starts, indicates imperfect shielding, imperfect bonding, faulty generator regulator, faulty generator, open filter capacitors, or a combination of these faults.

i. Always turn the receiver switch to the "OFF" position when the receiver is not being used.

5-11. RECEPTION—BC-348.

a. MODULATED SIGNAL RECEPTION. For the reception of modulated signals in the frequency bands covered by this receiver, turn the receiver switch to "MVC," the c-w oscillator control to "OFF," and the crystal control to the "OUT" position.

**Note**

Tuning should be done in the "MVC" position with the volume control advanced only as far as required for a comfortable output level. While waiting for the tubes to warm up, adjust the dial light control for the desired dial illumination and turn the band switch to the frequency band in which the signals to be received are transmitted.

After the tubes have warmed up (approximately 30 seconds), adjust the volume control until the background noise can be heard. Turn the tuning control until the frequency of the desired signal is reached and the signal is heard in the headphones. Turn the tuning control slowly back and forth until the position at which the signal is received the strongest is found. After the signal is tuned in, if automatic volume control is desired, it may be used by switching the receiver switch control to the "AVC" position and readjusting the volume control for the desired output. In the event interference is encountered, the crystal filter may be switched into the circuit, increasing selectivity and permitting reception that would be exceedingly difficult otherwise.

b. C-W RECEPTION. For the reception of c-w signals, turn the c-w oscillator control to "ON" and the beat frequency control to the zero beat position (arrow on knob pointing up). Proceed as instructed for the reception of modulated signals and, when the signal is tuned in, adjust the beat frequency control to the position producing the most satisfactory tone. Automatic volume control may be used, when desired, by switching to the "AVC" position and readjusting the volume control. The crystal filter should be used to increase the selectivity of the receiver if objectionable interference is encountered. A slight readjustment of the tuning, beat frequency, and volume controls may be required to secure the desired beat note frequency and volume level after the crystal filter is switched in. The sensitivity may sometimes be slightly improved by readjusting the positions of the beat frequency knob and the tuning control.

**Note**

The crystal band pass filter is intended primarily for use in c-w reception. However, the added selectivity may at times prove helpful in receiving modulated signals through heavy interference.

5-12. OPERATION OF AN/ARC-1. The model AN/ARC-1 aircraft radio equipment provides two-way voice communication between aircraft or between aircraft and ground stations on any of nine pre-arranged main-channel communication frequencies or a guard-channel frequency. Incoming signals are received with the equipment, except for those intervals when transmission is desired. The change from the receiving to the transmitting condition is accomplished simply by operating a microphone push button or a throttle switch. Under normal conditions, reliable communication may be expected over line-of-sight distances provided there are no intervening obstructions. While VHF communication is ordinarily restricted to line-of-sight range, under certain atmospheric conditions VHF signals may be heard at a considerable distance beyond; some VHF signals have been received at distances of 500 miles. Therefore, there is no positive assurance that security is strictly limited to line-of-sight. Under other conditions, communication may even be restricted to ranges less than line-of-sight.

5-13. CONTROLS—AN/ARC-1. The equipment is arranged for complete remote control by means of the master radio switch, three operator's radio output boxes, and a control unit C-115/ARC-1. Each audio output box forms a part of the aircraft and includes jacks for the headset and microphone plugs. In addition, each audio output box includes a control which allows the operator to adjust the headset signal for comfortable operation. The control unit C-115/ARC-1 provides a chan sel switch for selecting one of the nine main channels and a guard-main switch. The guard-main switch provides a choice of operation on the selected main channel or the guard-channel, or operation on the selected main channel and monitoring on the guard channel. Windows are provided to show the guard- and main-channel operating conditions. The guard-channel window shows "OFF," "R," or "T/R," indicating that the guard channel is turned off, is set for reception only, is set for transmission and reception. The main-channel window shows the number (1 to 9) of the selected main channel when the main channel is in an operating condition, or "OFF" when the equipment is set for operation on the guard channel only.

**Note**

The "ON-OFF" switch at the radio operator's station is safetied in the "ON" position.

5-14. OPERATING PROCEDURE—AN/ARC-1.

**Note**

Each time the equipment is turned on, allow at least 20 seconds for the vacuum tubes to reach operating temperature before operating the microphone button.

a. For reception, turn the pilot's master radio switch on the pilot's pedestal to the "ON" position, the guard-main switch to the "BOTH" position, and rotate the channel selector switch as required for operation on the desired main channel. The equipment will be signal for the reception of incoming signals on the guard channel and the selected main channel after the vacuum tubes reach operating temperature.

b. Turn "ON" the AN/ARC-1 switch (figure 5-1B-7) on the pilot's interphone control box.

c. Do not be surprised if the headset noise sometimes heard with other receivers is absent; this equipment suppresses such noise during the intervals between incoming messages. While operating on the main channel and monitoring on the guard channel (guard-main switch in the "BOTH" position), reception on either channel may be prevented by interfering signals or noise passed by the other channel. This interference may be suppressed by operating the guard-main switch to the "MAIN T/R" or "GUARD" position as required. If the desired signal is recognized to be on the main channel, operate the switch to the "MAIN T/R" position. If the desired signal is recognized to be on the guard channel, operate the switch to the "GUARD" position. The use of the equipment is blocked for approximately five seconds when the switch is moved to the "GUARD" position. This delay is required by the channel selector motor in order to change the main channel r-f circuits for operation on the guard-channel frequency. When the operator wishes to talk, it is necessary only to press the microphone button or throttle switch. Microphones such as the NAF213264-6 (Navy type RS-38) should be held with the lips just touching the face. Keep the microphone face substantially vertical while transmitting and talk in a loud, clear voice, but do not shout. Regardless of the type of microphone used, finish each word completely before starting the next one. Emphasize all terminal consonants such as "T" and "G," and emphasize with a distinct hiss all sibilants such as "S," "C" and "Z." The microphone button must be released after each transmission in order for the equipment to operate for the reception of signals.

5-15. OPERATION OF AN/AIA-2A EQUIPMENT. The purpose of this equipment is to provide the crew with simplified control of the radio and interphone equipment. The pilot, co-pilot, and radio operator may monitor any combination of seven receivers. A suitable volume control governs the audio out-put level. They may also select interphone or any of three transmitters. Two separate volume controls are provided on the crew station boxes, one for interphone and one for radio. The station boxes in the wing have no volume control and the pilots, co-pilot's and radio operator's control boxes have only one volume control, which controls both ICS and radio volume.

5-16. CONTROL BOX C-69A/AIA-2A. The control boxes are provided for pilot, co-pilot, and radio operator. Their functions are as follows:

a. RECEIVER OUTPUT SELECTIONS. Nine toggle switches are provided and wired to permit selection of any one or any combination of seven receiver outputs without appreciable interference between receiver out-put circuits. To monitor any receiver, it is only necessary to operate the associated switch to the "UP" position. When the switches connecting to navigation receiver outputs which pass through the range filters are operated, the range-filter switch must be operated to "RANGE," "VOICE" or "BOTH," as desired. While any number of receiver outputs may be connected in parallel, the power output from the isolation amplifier is reduced as the number of receiver outputs operating in parallel is increased. For this reason, only those receiver outputs actually in use should be connected to the isolation amplifier by means of the toggle switches provided at any one time.

b. MICROPHONE AND CONTROL CIRCUIT SELECTION. The "MIC. SEL." switch permits switching the microphone and associated control circuit to the interphone or any one of three transmitter in-put circuits. Operation of the various relay control circuits is automatic after the proper selection is made. Sidetone from a transmitter is received through the receiver associated with that transmitter; however, the switch for the receiver must be turned on before the sidetone can be heard.

**Note**

The position of the "OFF/RADIO TRANS. FROM TURR. STA." switch does not interfere with the use of the vhf transmitter by the pilot, co-pilot, or radio operator.

c. VOLUME CONTROL. The volume control affects the output from the isolation amplifier for the outputs of the radio receivers associated with switches S-205 through S-209 only. The range of this control is limited to approximately 9 db.

d. EMERGENCY JACKS. The microphone jack on the control box may be used interchangeably with the microphone jack on the jack box. The headphone jack without the cap may likewise be used interchangeably with headphone jack on the jack box. However, on the pilot's and co-pilot's control boxes, the headphone jacks with the cap are cross-connected so that, if one of these control boxes becomes defective, the individual affected may transfer to the jack with the cap and listen to the output from the control box which is still operative.

5-17. STATION BOX C-70A/AIA-2A. Numerous station boxes are provided for members of the crew. Their functions are as follows:

a. SELECTOR SWITCH. The three position switch is marked "RADIO," "ICS CREW," and "ICS ALL." This switch transfers both the microphone and control circuits to the unit selected. The "RADIO" position is not used in this installation. In the "ICS CREW" position, the crew member may communicate only with other members of the crew also equipped with station boxes. However, in the "ICS ALL" position, all crew members are connected to the interphone circuit.

b. VOLUME CONTROL. Two volume controls are provided: one for the interphone, the other for the vhf radio. The radio volume control is not used in this installation.

5-18. OPERATION OF SCR-269F RADIO COMPASS. Two complete SCR-269F sets are installed in this airplane. The dual radio compass indicators at the pilot's and navigator's stations have a separate arrow for each set, one red and one green. The operation of the two sets is identical.

5-19. GENERAL PROCEDURE—SCR-269F.

a. Turn "ON" either or both the compass red and the compass green switches (figure 5-1B-1 and -2) on the radio operator's interphone station box.

b. Set the radio control box switch to "COMP." or "ANT." position.

c. Push the control switch to operate green light. The green light identifies the radio control box in control.

d. Rotate the bandswitch to the frequency band in which operation is desired.

e. Turn tuning crank to the desired frequency in kilocycles and rotate back and forth through resonance to determine the exact setting of the dial for maximum clockwise deflection of the tuning meter. Listen for station identification to be sure the correct station is being received.

f. Radio compass SCR-269-F provides for aural identification of keyed "CW" stations by means of internal modulation controlled by the "cw-voice" switch. Switch to "CW" when this type of operation is desired.

5-20. HOMING COMPASS PROCEDURE — SCR-269-F. For homing operation, perform the operations of paragraph 5-19 preceding and proceed as follows:

a. Turn the "VAR" knob on the navigator's and pilot's indicator until the azimuth zero is at the index.

b. Switch to "COMP."

c. Apply rudder in the direction shown by the indicator pointer. When the indicator pointer is at zero, the aircraft is headed toward the radio station. The indicator pointer always points toward the radio station. If the pointer is to the right of zero, the station is to the right of the aircraft's heading.

d. Adjust "AUDIO" of interphone control for satisfactory headset level.

e. Since in "COMP." operation, the equipment has an excellent automatic volume control action, it is not practical to home on a radio range course and fly it aurally at the same time.

f. Radio compass homing operation is such that aircraft will ultimately arrive over the radio station antenna regardless of probable drift due to cross wind. However, the flight path will be a curved line, and coordination with ground fixes or landing fields along the route will be either difficult or impossible. Consequently, it is often expedient to fly a straight-line course by off-setting the aircraft's heading to compensate for wind drift. To do this, determine the wind drift either with the drift sight or by noting the change in magnetic compass reading over a period of time while homing with the radio compass. A decreasing magnetic bearing indicates a wind from the left, while an increasing magnetic bearing indicates a wind from the right. By trial and error, find the correct up-wind radio compass angle as shown by the indicator pointer providing the minimum rate of change of magnetic compass reading. The scale on the indicator shows the deviation of the aircraft's heading from the direction of the radio station, directly, in degrees.

5-21. DIRECTION FINDING PROCEDURE, VISUAL METHOD—SCR-269F. For operation as an automatic visual indicating direction finder, perform the operations of paragraph 5-19 and proceed as follows, using the navigator's indicator:

a. Switch to "COMP."

b. Prior to making fix determinations, the stations to be used should be located on the map, tuned in, identified, and the dial reading logged. This avoids delay and error at the time of obtaining the fix.

c. For best accuracy, several bearings should be taken in rapid succession thereby eliminating error caused by the distance traveled between bearing observations. Bearings cannot be accurate unless the aircraft is held on a steady heading.

d. Adjust "AUDIO" or interphone control for desired headset level.

e. With the "VAR" knob on the navigator's indicator set the azimuth scale so that the numerical value of the aircraft's magnetic heading is at the index.

f. Determine the magnetic variation for the locality over which the aircraft is passing and rotate the "VAR" knob for the required correction in the direction indicated by the arrows. The knob is marked with arrows to show the proper direction of rotation to compensate for east or west variation.

g. Record the bearing by the tail end of the bearing indicator pointer. This will be station-to-aircraft bearing from north.

h. To obtain a fix, take bearings on three or more stations, 30 degrees or more from the line of direction of any one station, and plot them on a map. The intersection of the plotted lines is the position of the aircraft at the time of observation.

i. In this equipment if the instructions have been followed, the radio compass deviation is compensated for automatically and need not be considered when taking bearings.

5-22. DIRECTION FINDING PROCEDURE, AURAL-NULL METHOD—SCR-269F.

a. Switch to "LOOP," push control switch to obtain green light, and tune in desired station. When listening for station identification, it may be necessary to rotate the loop to a maximum signal position to obtain a good intelligible signal. The aural width of the loop null may be decreased somewhat by using "CW" operation. "CW" operation is also necessary to identify keyed "CW" stations.

b. Adjust "AUDIO" or interphone control for desired headset level.

c. Using the "VAR" knob on the navigator's indicator, set the bearing scale so that the numerical value of the aircraft's magnetic heading is at the index mark.

d. Determine the magnetic variation for the locality and rotate the "VAR" knob for the required correction in the direction indicated by the arrows. The knob is marked with arrows to show the proper direction of rotation to compensate for east or west variation.

e. Using the "LOOP L-R" switch, rotate the loop for minimum headset volume and read the bearing indicator. If the signal null exists over too wide an angle, greater accuracy may be obtained by placing the "AUDIO" knob fully clockwise and locating the null by either listening for the disappearance of the audio signal or noting the dip in tuning meter deflection.

f. Record the bearing shown by the tail end of the bearing indicator pointer. Bearings are subject to 180-degree ambiguity.

g. Fixes may be obtained as by the visual method, except that the 180-degree ambiguity must be resolved by a different method. Roughly draw lines from the positions of the radio stations at the approximate angles indicated by the bearings obtained in preceding paragraph 5-22, step f, using arrows to show the directions the lines are drawn from the stations. Extend the lines until they meet. If all arrows point to the intersection, the position is correct, and bearings may be plotted accurately as in paragraph 5-21, step h; if not, the entire fix should be retaken with the bearing pointer rotated approximately 180 degrees for all those bearings whose arrows point away from the intersection.

5-23. ANTENNA AND LOOP RECEIVER PROCEDURE—SCR-269F. Perform the operation described in paragraph 5-19 and proceed as follows:

a. For antenna reception set the function switch to "ANT." and adjust the interphone knob or the "AUDIO" knob of the radio control box for satisfactory headset volume. For the best definition of radio range signals (between 200 and 420 kc), set the interphone control fully clockwise and adjust the "AUDIO" knob for the lowest usable headset volume.

b. For loop reception, if reception on the antenna is noisy because of precipitation static, commonly known as rain or snow static, possibly loop reception may be employed for better results. Turn function switch to "LOOP" position. Depress "LOOP L-R" knob and turn to "L" or "R" holding until maximum signal strength is obtained. Adjust the "AUDIO" knob for desired headset volume. To rotate loop at slow speed, do not depress "LOOP L-R" knob when turning it to "L" or "R." For the best definition of radio range signals on "LOOP," it is necessary to maintain the loop near the 90 or 270 degree position, set the interphone control fully clockwise, and adjust the "AUDIO" knob for the lowest usable headset volume.

**Note**

Cone of silence indications with "LOOP" receiver operation depend on the particular type of range transmitting antenna and the mounting of the loop on the aircraft and therefore are not always reliable. In some cases, an increase instead of decrease in signal strength will be noted.

## 5-24. PRECAUTIONS DURING OPERATION—SCR-269F.

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

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

c. During periods of precipitation static, operate on "LOOP" and, for best reception, rotate the loop until a maximum signal is obtained.

d. For aural reception of A-N signals on interphone, the interphone volume control must be set fully clockwise, and the "AUDIO" control on the compass control box used to reduce headset volume. This is essential to obtain proper course definition.

e. When determining direction on "LOOP" by aural-null method, there is an 180-degree ambiguity, and the direction of the station may be 180 degrees from the null obtained. The broadness of the null with aural-null direction finding depends on the strength of the signal. Strong fields produce very sharp nulls, sometimes as small as 1/10 degree. Vary "AUDIO" control until null is of satisfactory width. The tuning meter may be used as a visual null indicator.

f. For loop operation if the loop should be in the null position when flying on a radio range course, the signal may fade in and out and possibly be mistaken for a cone of silence. Cone of silence indications are not reliable on loop type radio range stations when the radio compass is operating on "LOOP." The signal may increase in volume to a strong surge when directly over the station instead of indicating a silent zone.

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

h. Check dial calibrations against actual station frequencies. If the calibration is wrong, report the defect. When homing, fly the airplane with the indicator pointer at zero or fluctuating equally slightly left and right. Do not depend on tuning meter as a distance meter. Do not disturb any internal adjustments.

i. Night effect or reflection of the radio wave from the sky is always present. It may be recognized by a fluctuation in bearings. The remedy is: (1) increase altitude thereby increasing the strength of the direct wave; (2) take an average of the fluctuations; or (3) select a lower frequency station. Night effect is worse at sunrise and sunset. Night effect may be present on stations at 1750 kc at distances greater than 20 miles; as the frequency decreases, the distance increases until at 200 kc the distance will be about 200 miles. Satisfactory bearings, however, will often be obtained at much greater distances than stated, and unsatisfactory bearings may be obtained at shorter distances.

j. To obtain accurate station bearing when close to a station, accurate bearings cannot be taken with the airplane in a steep bank. This is especially applicable to reception of signals from instrument landing trucks. Only head-on bearings are entirely dependable. If side bearings are taken, keep the wings horizontal. Do not depend on two stations for a fix of location; at least three station bearings should be used. In general, a set of stations with bearings spaced approximately at equal intervals throughout 360 degrees will give best accuracy.

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

l. For "CW-VOICE" and "COMP." operations when receiving modulated signals, intelligibility is greatly reduced as the "CW-VOICE" switch is set to "CW." Operation of the equipment when the function switch is set to "COMP." is not affected by the position of the "CW-VOICE" switch.

m. Erroneous or fluctuating bearings, in some instances, are produced by reflection of radio waves from the mountains. This phenomenon is called mountain effect and is known to exist under certain conditions in the vicinity of Pittsburgh and Salt Lake City. Because of this effect, bearings taken when flying over mountainous terrain, should not be relied upon explicitly. An additional effect, not unlike that discussed in preceding paragraphs, has been observed to a limited extent when the radio wave travels through a cold front.

n. Check the loop control switch located above the pilot's head. Select "LP-21" loop for normal operation of equipment. Select "MN-24" loop for use of receiver as communicating receiver under adverse noise conditions or for aural-null homing under adverse noise conditions.

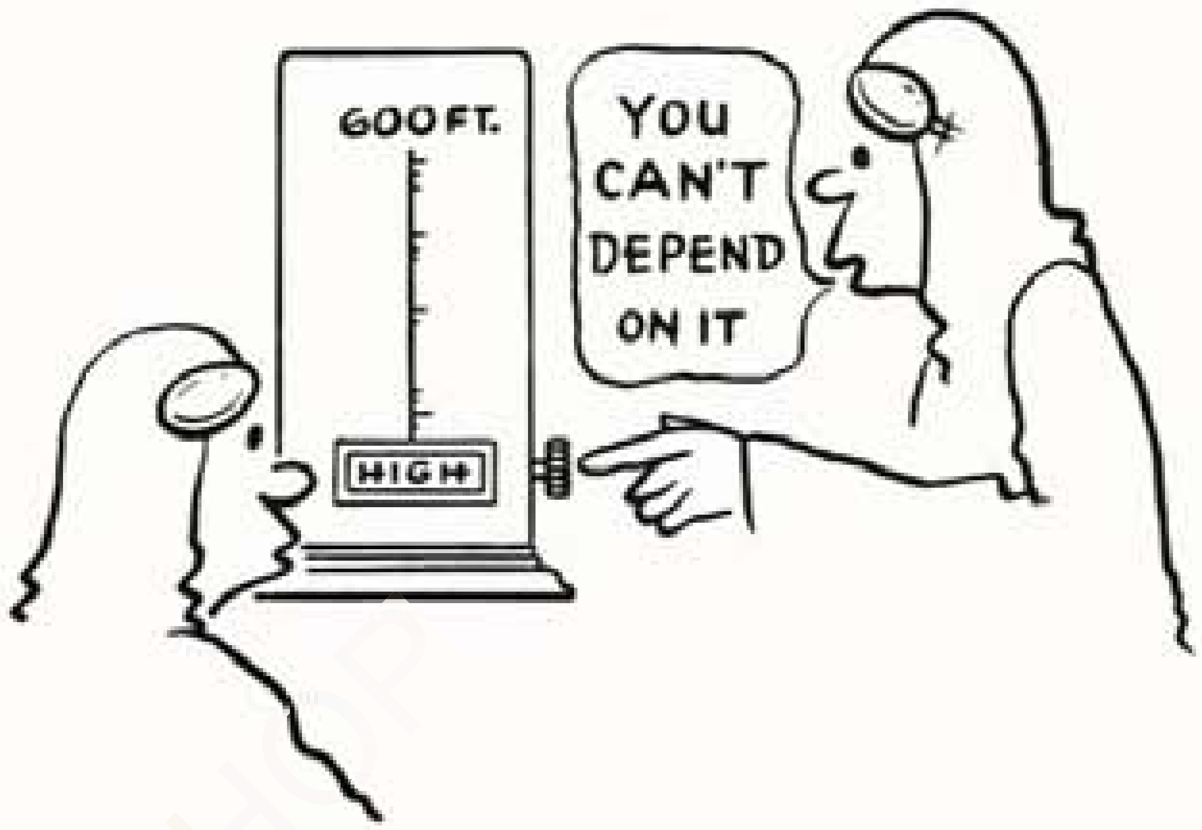
5-25. OPERATION OF ARN-8. The R-8/ARN-8 receiver requires no adjustment or attention of any kind after mounting. Alignment has already been made, and the receiver power switch locked "ON." When mounted and connected to antenna, power supply, and instrument panel, the receiver is in operation. The audio output of the receiver, in two channels, is fed into the audio circuits of the plane at the interphone control box. Turn "ON" the AN/ARN-8 switch (figure 5-1B-3), and the signals will be heard by anyone listening on the circuit involved. The tone varies with the type of marker beacon being passed, since it represents the modulation of the transmitter. The presence of the signal tone in the phones indicates that the plane is over a marker beacon, and the nature of the tone will give an indication of the type of marker beacon.

5-26. OPERATION OF RADIO ALTMETER—AN/APN-1. The radio altimeter supplies actual altitude above terrain measured on a two-scale indicator with 0-400-foot and 400-4000-foot scales; and altitude limit indicator composed of red, white, and green lights which indicates altitude with relation to a preset altitude. The preset altitude can be selected by the altitude limit switch in one of the 11 different altitudes between 50 and 300 feet on the low range and between 500 to 3000 feet on the high range. Operation is normally as follows:

a. POWER. With main battery switch "ON," turn on the "ON-OFF" switch on the altitude limit indicator.

b. RANGE SWITCH. No ground check is necessary, but flickering of the needle on the indicator should be checked. First set range switch to 0-400-foot scale. After sufficient altitude is obtained, switch to high range.

**WARNING**




The altimeter may read high below 600 feet on the high range and should not be relied on below this altitude, unless the particular installation is known to be operating correctly.

c. ALTITUDE LIMIT SWITCH. An altitude limit indicator composed of red, white, and green lights is mounted in the instrument panel. This indicator operates in conjunction with an altitude limit switch. One of 11 different altitudes may be preselected by this switch. When altitude is preselected, only the white light will be on if the airplane is flying at the preselected altitude; only the green light will be on if above the preselected altitude; only the red light will be on if below the preselected altitude.

5-27. OPERATION OF LM SERIES

**Note**

The frequency meter draws its plate current from the aft BC-348 receiver, and therefore the aft BC-348 receiver must be on before the frequency meter will operate.

5-28. CORRECTING TO CALIBRATION — LM SERIES. Before attempting to make any frequency adjustments, the heterodyne oscillator should always be corrected to agreement with the calibration through comparison with the crystal oscillator at the crystal check point nearest to the frequency desired. Comparison between the crystal and heterodyne oscillators may be made at many points over the calibrated range through the employment of the fundamental or harmonic frequencies of either or both oscillators. Comparison between the two oscillators is affected by rotating the heterodyne tuning control through a portion of the scale range corresponding to the crystal check point desired and noting the beat tones as heard in a pair of 600-ohm headphones plugged into the phones jack, the modulation switch must be set to the "OFF" position. To correct the heterodyne oscillator preparatory to setting on any desired frequency within the calibrated range, proceed as follows:

5-29. From the high or low frequency indices on the front and rear covers of the calibration book, determine in which band the desired frequency is located and set the frequency band switch to correspond.

5-30. Also, from the frequency indices, ascertain on which page the desired frequency is listed. The crystal check point nearest the desired frequency, together with the dial setting, will be found noted in red at the bottom of this page.

5-31. Set the heterodyne oscillator scales to agree with this crystal check point dial setting: crystal and both power switches "ON;" modulation switch "OFF." A beat note will most probably be heard in the phones, as a complete absence of beat tone can result only from four possible conditions, as follows: when the heterodyne oscillator is exactly on calibration, when it is so far off calibration that the beat frequency is above audibility; when the modulation switch is set to "ON," and when the equipment is defective. However, should no beats be heard, which of the first two of these conditions may exist can be determined by rotating the corrector dial to where the beats become audible and noting the direction of change. If the third or fourth condition is the cause, no beats should be heard at any point in the complete heterodyne oscillator range.

5-32. With the heterodyne oscillator dials on the desired crystal check point setting, the heterodyne oscillator frequency should be adjusted as close to the crystal oscillator frequency as possible, by rotation of the corrector dial only. Adjust the corrector to produce zero beat at the strongest beat point within its range. After the operator has become familiar with the equipment, it will be found that this adjustment can be precisely made to practically zero beat. This is possible because the design is such that all locking-in tendencies have been minimized, and characteristic rushes due to the rise and fall of the beat frequency peaks are aurally recognizable well below the lower limit of audible tone.

**Note**

> In making the first correction to calibration immediately after any installation or physical modification, the dial hundreds scale should be read from a position directly in line.

When so corrected, the heterodyne oscillator frequency will agree with the calibration to within the reset accuracies previously quoted throughout the range of frequencies included in all the pages to which this particular crystal check point applies, provided: that the ambient temperature remains constant, and the filament and/or plate supply voltages do not vary by more than 10 percent.

5-33. READJUSTMENT OF TRIMMER CAPACITORS—LM SERIES 14. It may be found that the heterodyne oscillator cannot be corrected to agree with calibration, particularly if the frequency meter is installed in a locality where either extreme condition of humidity prevails. Under such conditions, and then only, it becomes necessary to reset the heterodyne trimmer capacitors. Access to the trimmer adjusting screws may be had through the holes in the upper right-hand corner of the frequency meter panel after swinging aside the L and H cover plates. An ordinary screwdriver will be required to make these adjustments, the necessary procedure being as follows:

a. Place the unit in operation with the frequency band switch set to low and modulation switch to "OFF." Allow the unit to warm for a period of at least 10 minutes before proceeding.

b. Set the dial units and dial hundreds scales to agree with the reading given for 250 kcs. Set the corrector dial at midscale (5.5 divisions).

c. After determining that the dials are set correctly as in step b, insert the screwdriver through the L hole in the panel and rotate the trimmer capacitor toward the right, while listening in the phones, until the heterodyne oscillator is set to zero beat with the crystal calibrator.

d. Check the ability of the corrector to reset the heterodyne oscillator to zero beat at all crystal check points listed on the back cover of the calibration book.

e. If the frequency meter cannot be corrected at all crystal check points in the low band with the trimmer adjustment that was made with the corrector set at 5.5 for 250 kcs, the processes outlined in steps c and d should be repeated with the corrector set to 6 divisions for 250 kcs.

f. By thus progressing, a setting of the L trimmer will be found where it will be possible with the corrector to reset the unit to zero beat at all crystal check point readings given for the low band in the calibration book.

g. Cover the L trimmer and repeat the preceding processes with the frequency band switch set to "HIGH" and the dial units and dial hundreds scales set to agree with the reading given for 4000 kcs on page 34 of the calibration book. Adjust the trimmer capacitor through the H hole to the position where it is possible with the corrector to reset the heterodyne oscillator to zero beat at all crystal check points listed for the high band.

5-34. TRANSMITTER ADJUSTMENTS—LM SERIES 14. Briefly, the method of adjusting a transmitter to a desired frequency consists of zero beating the transmitter frequency with the proper heterodyne oscillator frequency, effecting the comparison by means of a pair of headphones plugged into the phones jack located on the front panel of the frequency meter. The crystal and modulation switches should be in the "OFF" position during the process. Specifically the procedure is as follows:

a. Correct the heterodyne oscillator to calibration at the crystal check point nearest to the desired frequency.

b. Turn the crystal switch to "OFF."

c. Turn the frequency meter tuning control to the dial setting of the desired frequency as given in the calibration book. Do not disturb the corrector adjustment.

d. With the frequency meter pick-up lead loosely coupled to the transmitter output, tune the transmitter to give an audible beat in the phones.

e. Adjust the RF coupling control to obtain a comfortable signal level in the headphones.

f. Tune the transmitter to zero beat with the frequency meter.

**Note**

Steps b thru f should be accomplished in the shortest possible interval following step a, otherwise voltage and/or temperature changes may cause the frequency meter to drift.

5-35. RECEIVER ADJUSTMENTS CW—LM SERIES 14. The method of adjusting a receiver to a desired frequency consists of tuning the receiver to the proper heterodyne oscillator out-put frequency, effecting the comparison by means of a pair of headphones connected to the receiver out-put circuit. The method varies with the character of signal reception involved. To tune a CW receiver to a desired frequency, proceed as follows:

a. Correct the heterodyne oscillator to calibration at the crystal check point nearest the desired frequency. The modulation switch must be set to "OFF."

b. Turn the crystal switch to "OFF" and transfer the phones from the frequency meter to the receiver out-put jack.

c. Turn the frequency meter tuning control to the dial setting of the desired frequency as given in the calibration book. Do not disturb the corrector adjustment as made in step a preceding.

d. With the frequency meter pick-up lead loosely coupled to the receiver antenna lead, tune the receiver to give an audible signal in the phones.

e. Adjust the RF coupling control to obtain a comfortable signal.

f. Adjust the receiver tuning to that side of zero beat which results in best reception conditions for the particular operator concerned.

**Note**

Steps b thru f should be accomplished in the shortest possible interval following step a, otherwise voltage and/or temperature changes may cause the frequency meter to drift.

5-36. RECEIVER ADJUSTMENT MCW—LM SERIES 14. To tune an MCW receiver to a desired frequency, the following procedure applies:

a. Correct the heterodyne oscillator to calibration at the crystal check point nearest to the desired frequency, the modulation switch must be set to "OFF."

b. Turn the crystal switch to "OFF" and transfer the phones from the frequency meter to the receiver out-put jack.

c. Turn the frequency meter tuning control to the dial setting of the desired frequency as given in the calibration book. Do not disturb the corrector adjustment as made in step a preceding.

d. Turn the modulation switch to "ON."

e. With the frequency meter pick-up lead loosely coupled to the receiver antenna lead, tune the receiver to give an audible signal in the phones.

f. Adjust the RF coupling control to obtain a comfortable signal.

g. Adjust the receiver tuning for maximum response.

5-37. FREQUENCY MEASUREMENTS—LM SERIES 14. The model LM-10 crystal calibrated frequency indicating equipment may also be employed for accurately measuring a frequency emitted from an external source, whether it be of local or remote origin, provided that such frequency lies within the calibrated range. If it is desired to measure accurately the emitted frequency of an adjacent transmitter or oscillator, the order of which is approximately known, the heterodyne oscillator is first corrected to the crystal check point nearest to the approximately known frequency. The modulation switch must be set to "OFF." The actual frequency is then determined, after loosely coupling the frequency meter pick-up wire to the source and turning the crystal switch to "OFF," by turning the frequency meter tuning control to the zero beat point found nearest the setting given for the approximate frequency and reading from the appropriate frequency column, opposite the resultant dial setting, in the calibration book. If the order of the frequency to be measured is absolutely unknown, it may first be determined to an approximation most readily with the aid of an absorption type wavemeter, following which the actual frequency is determined as explained in the preceding sentences. When it is desired to measure accurately a frequency of remote origin, the signal is first tuned in on a radio receiver and the approximate frequency noted from the receiver calibration. The heterodyne oscillator of the frequency meter is next corrected to calibration at the nearest crystal check point. The crystal switch is then turned to "OFF." The phones are transferred back to the receiver out-put jack; the frequency meter pick-up wire is loosely coupled to the receiver antenna lead; and the frequency meter tuning control is turned until its signal is heard in the phones. If the signal in question is CW in character, the receiver is tuned to zero beat, and the frequency meter is tuned to zero beat with the receiver modulation switch "OFF." If the signal is modulated, both the receiver and frequency meter are adjusted for maximum response, and the frequency meter modulation switch is turned to "ON." In both cases, the frequency read from the appropriate column in the calibration book for the resultant frequency meter dial setting is the frequency of the signal in question.

5-38. OPERATION OF AN/APN-4 LORAN EQUIPMENT. Operation of the Loran equipment involves many basic adjustments prior to its use in flight. Complete details for accomplishing these adjustments are found in the Equipment Operating Manual. The following preflight tests must be made by the operator.

5-39. PRELIMINARY CHECK AN/APN-4. Before proceeding, turn the "LORAN APX POWER" switch located at the flight engineer panel to "ON." Check the first counter in the following sequence: (1) trace separation, (2) number of counts, (3) coincidence of markers, and (4) horizontal amplitude of trace. Check the second counter in the following sequence: (1) trace separation, (2) number of counts, and (3) horizontal amplitude of trace. Check the third counter as follows: (1) trace separation, (2) trace centering, (3) horizontal amplitude of trace, and (4) number of counts. Check the fourth counter by determining the number of counts. Check station selector alignment in all positions. Check "COARSE" and "FINE" delay circuit adjustments. Check sensitivity of the receiver by disconnecting the antenna cable from the receiver and turning the "GAIN" control to minimum clockwise position and "AMP. BALANCE" control to center index. The heavy grass on both indicator traces should be 1/2 inch high or more. Rotating the "AMP. BALANCE" control clockwise and counterclockwise should cause the grass to disappear on the bottom and top traces respectively.

5-40. OPERATING PROCEDURE AN/APN-4. After preceding checks are made, the equipment is ready for use. The following operations are performed during flight:

a. Turn "ON-OFF" switch to "ON" position (on the receiver). Set "SWEEP SPEED" control in position "1." Center "AMP. BALANCE" knob. Set station selector switch to the correct station number.

b. Turn "GAIN" knob slowly to right until pulses are visible on the trace lines. Use "CRYSTAL PHASING" control to correct drifting of pulses.

c. By means of "LEFT-RIGHT" switch, place left-hand pulse on "A" pedestal.

d. Turn "COARSE" control until "B" pedestal is centered under "B" pulse.

e. Adjust "AMP. BALANCE" control so that amplitude of both pulses are approximately equal. Adjust "GAIN" control so that the height of these pulses is satisfactory. Correct drift by adjusting "CRYSTAL PHASING" control.

f. Turn "SWEEP SPEED" to position "2." Correct any drift by adjusting "CRYSTAL PHASING" control. Turn "FINE" control until "B" pulse is directly below "A" pulse.

g. Turn "SWEEP SPEED" to position "3." Adjust "LEFT-RIGHT" switch until pulses are in center of the trace line. Adjust "FINE" control until both pulses are directly centered.

h. Turn "SWEEP SPEED" switch to position "4." Adjust "FINE" control and "AMP. BALANCE" control until leading edges are superimposed.

i. Calculate time between reception of pulses by setting the "SWEEP SPEED" to position "5" and counting 10 microsecond spaces between it and first 50 microsecond index on lower trace. Record the count. Repeat operation by turning to position "6," counting 50 microsecond spaces. Repeat for position "7," each space representing 500 microseconds. Total the readings for the final value. If sky waves instead of ground waves were used to obtain this reading, a sky wave correction must be applied to the reading to obtain a correct line of position.

5-41. OPERATION OF AN/APX-2 EQUIPMENT. Operators must be thoroughly familiar with the equipment controls. Hence for complete and comprehensive description of all controls, including preset maintenance adjustments, the operator should be acquainted with the Equipment Operating Manual. The following is an abbreviated operating procedure:

a. PREPARATION. Before actual operation is begun, check that a complete destructor-firing circuit test has been performed in accordance with instructions of Equipment Operating Manual; check that the guard latch marked "PUSH" effectively prevents the accidental rotation of the master control switch to its "EMERGENCY" position; and the red guard cover is closed and wired down over the "DESTRUCT" switch.

b. TO START THE EQUIPMENT. Before proceeding, check that "LORAN APX POWER" switch on the flight engineer panel is turned on. On the pilot control unit, rotate the master control switch S403 clockwise away from the "OFF" position and set in the desired operating position.

c. TO CHANGE SELECTOR SWITCH POSITIONS. On the operator control unit, rotate the selector switch S302 to the position designated by the commanding officer. Unless otherwise designated, S302 is set and left in position "1."

d. FOR INT OPERATION. On the pilot control unit, throw the "INT" switch S401 to the "ON" position; or, on the operator control unit, hold the "INT" switch S301 momentarily in the "PRESS" position.

e. FOR G-BAND OPERATION. On the pilot control unit, throw the "G-BAND" switch S402 to the "ON" position or flip it to the "TIME" position.

f. FOR ROO OPERATION. On the pilot control unit, rotate the master control switch S403 to the "ROO" position. only by specific direction of the commanding officer and only if a specified "ROO" adjustment has been made inside the receiver-transmitter unit by the maintenance crew.

g. FOR DISTRESS OPERATION. On the pilot control unit, push the guard latch H 410 to the right, tilting it up, and rotate the master control switch to the "EMERGENCY" extreme clockwise position.

h. TO DESTROY THE RECEIVER TRANSMITTER UNIT. If possible, warn operating personnel to stand clear of the receiver transmitter unit. On the pilot control unit, raise the red guard cover, breaking the safety wire, and throw the "DESTRUCT" switch to the "ON" position.

i. FURTHER OPERATING PROCEDURES. Information on further operating procedures must be obtained from the commanding officer and the Equipment Maintenance Manual.

j. TO STOP THE EQUIPMENT. On the pilot control unit, rotate the master control switch to the extreme counterclockwise position marked "OFF."

5-42. OPERATION OF THE AN/ARC-5. Any of the LF-MF-HF receivers may be operated by remote control on voice, or CW by use of the type C-26/ARC-5 control unit, as follows: (a) turn the CW-voice switch to "CW" for reception of continuous-wave keyed signals or to "V" for reception of voice or tone-modulated signals, (b) tune to the desired frequency as indicated on the direct-reading tuning dial, (c) increase the manual sensitivity control to maximum tolerable signal output or noise level, and (d) adjust the receiver tuning to determine whether desired signal is on the air. If it is not, leave the dial set to the desired frequency; (e) when using the navigation receivers for reception of radio range, homing, or direction finder signals, keep the manual sensitivity control at a setting corresponding to the weakest usable signal. If the sensitivity is not reduced manually to a low value when receiving radio range, homing, or direction finder signals, the course indications will be broad due to the AVC action. When using the communication receivers, keep the manual sensitivity control at a setting corresponding to the maximum tolerable noise level.

**Note**

The built-in AVC will automatically adjust the sensitivity of the receiver to weak or strong signals over a wide range producing about the same audio output in the headset.

## 5-43. NAVIGATOR'S STATION. (*See figure 5-1A.*)

5-44. Provision is made for the installation and stowage of the following equipment at the navigator's station:

a. One Mark 5-A plotting board and base.

b. One navigator's case.

c. One E-6B computor.

d. One vector plotting machine.

e. One parallel ruler (15 inches).

f. One astro compass.

g. One Mark 5 sextant and case with arm.

h. Two navigational watches and boxes.

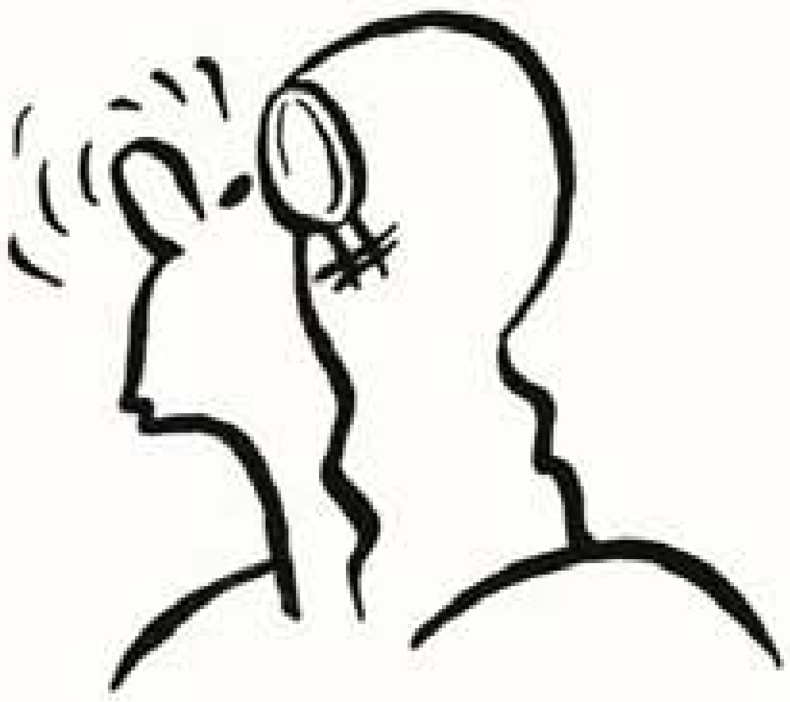
i. Two-part 7 x 50 power binoculars.

5-45. ASTRO COMPASS MOUNTING BRACKET. An astro compass mounting bracket for the astro compass is stowed at the navigator's station. Two adapter sockets on the navigator's hatch are provided for the mounting of the bracket. They are arranged so as to provide four positions of the compass.

## 5-46. OXYGEN SYSTEM.

5-47. There are provisions for the installation of 15 individual 295-cubic inch diluter demand oxygen units. (See figure 5-2.) By pulling the lockpin at the base of the bracket, the cylinder may be lifted clear and slung over the shoulder for portable use. Face masks are stowed under the bunks on the flight deck.

**WARNING**



All personnel using oxygen equipment should familiarize themselves thoroughly with the symptoms of anoxia (for further information refer to Technical Note 30-41) so that they will at all times be on the alert to detect oxygen deficiencies before serious physical effects have been encountered.

5-48. OXYGEN PREFLIGHT CHECK LIST. The following items shall be checked while the plane is on the ground prior to flight in which oxygen is to be used, or is likely to be used, to assure proper functioning of the oxygen system.

a. Emergency valve closed.

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

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

**Note**

If leakage was found by c. preceding, test further. Open cylinder valve, carefully noting pressure gage reading, then close cylinder valve. If gage pointer drops more than 100 pounds in 5 minutes, there is excessive leakage, and such an oxygen system must be repaired prior to use.

d. Check mask fit by placing thumb over end of mask tube and inhale lightly. If there is no leakage, mask will adhere tightly to face due to suction created. If mask leaks, tighten mask suspension straps and/or adjust nose wire. Do not use mask that leaks.

e. Couple mask securely to breathing tube by means of quick-disconnect coupling. Mating parts of coupling must not be cocked, but be fully engaged.

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

**Note**

Since the amount of added oxygen is very small at sea level, the oxygen flow meter may not operate while the plane is on the ground. In this case turn air valve to "OFF" or "100% OXYGEN" and test again. If oxygen flow indicator operation is now satisfactory, reset air valve to "ON" or "NORMAL OXYGEN" in which setting adequate oxygen flow and blinker operation will be assured at oxygen use altitudes.

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

5-49. OPERATION OF OXYGEN SYSTEM. To operate oxygen system, proceed as follows:

a. Open oxygen cylinder valve. Pressure gage should read 1800 ± 50 pounds per square inch if cylinder is fully charged.

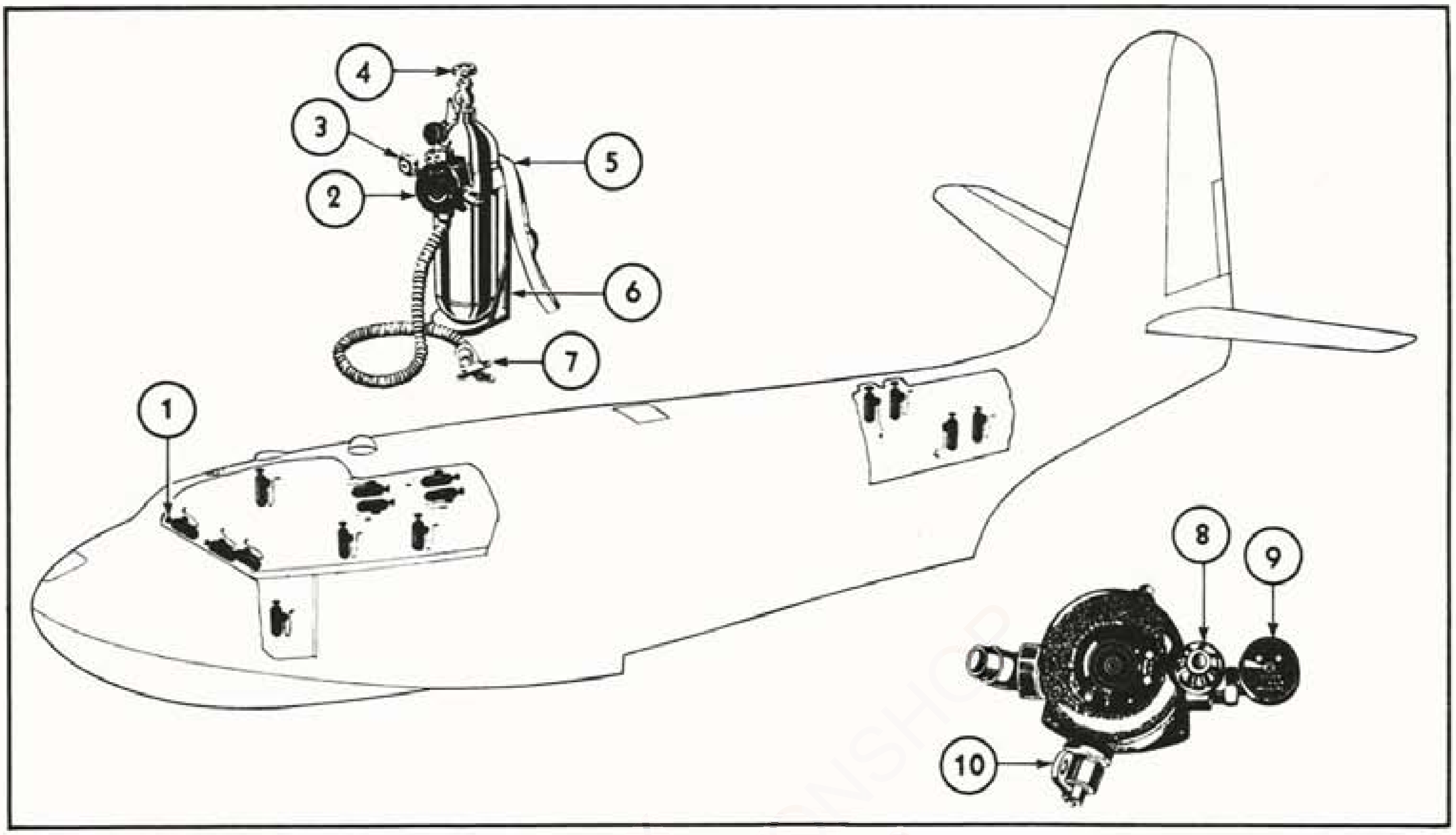
b. Set air valve to "ON" or "NORMAL OXYGEN" position, except when the presence of excessive carbon monoxide is suspected, then set to "OFF" or "100% OXYGEN" position.

c. Put on the oxygen mask. Be sure that quick-disconnect coupling is fully engaged.

d. Check mask fit by squeezing mask tube and inhaling lightly. Mask will adhere tightly to face due to suction if there is no leakage. If mask leaks, tighten suspension straps.

**CAUTION**


Never check mask fit by squeezing mask tube while emergency valve is "ON."




| | | | |
|---|---|---|---|
| 1 | Diluter demand oxygen unit | 6 | Installation bracket |
| 2 | Diluter demand regulator | 7 | Quick disconnect coupling (to face mask) |
| 3 | Flow indicator | 8 | Emergency by-pass valve |
| 4 | Cylinder valve | 9 | Cylinder pressure gage |
| 5 | Shoulder sling for portable use | 10 | Air dilution valve |

***Figure 5-2—Oxygen System***

e. Breathe normally and observe oxygen flow indicator to verify positive flow of oxygen.

f. Frequently check cylinder pressure gage for state of available oxygen supply and oxygen flow indicator for flow of oxygen to mask.

g. Upon completion of oxygen flight, close oxygen cylinder valve.

5-50. ENDURANCE OF OXYGEN SYSTEM. The oxygen endurance table gives in tabular form the endurance hours of oxygen available, with the diluter on and off, from one 295-cubic inch capacity cylinder based on 1800 to 300 pounds per square inch.

| OXYGEN ENDURANCE HOURS | | |
|---|---|---|
| *Altitude In Feet* | *Diluter—Demand Regulator With Diluter "OFF"* | *Diluter—Demand Regulator With Diluter "ON"* |
| 5,000 | 1.06 | 4.1 |
| 10,000 | 1.21 | 4.9 |
| 15,000 | 1.49 | 5.8 |
| 20,000 | 1.90 | 5.2 |
| 25,000 | 2.38 | 3.5 |

**Note**

During normal operations the air dilution valve should be turned to the "ON" position, thus obtaining the maximum economy and endurance from the oxygen supply aboard.

## 5-51. HEATING AND VENTILATING SYSTEM.

5-52. The heating and ventilating system consists of four combustion heaters. The two forward heaters are located on the left and right of the flight deck. Heat and ventilation is supplied to the flight deck, galley, baggage compartment and lower forward deck. The left heater is arranged for heating and ventilating the airplane on the ground as well as in the air. The switch over from ground operation to flight operation is automatic. There is a foot warmer controlled by a manually operated damper for the pilot and co-pilot and a manually operated main shut-off damper next to the pilot's seat, which stops the flow of air to the cockpit. The galley is provided with an adjustable exhaust to assure sufficient ventilation when the hatch to the flight deck and the door are closed. The flight deck heater control panel is located on the flight engineer's switch panel.

5-53. The aft two heaters are located on the right and left side of the aft stair well and they supply the aft upper and lower passenger compartments with heat and ventilation. The aft heater control panel is located on the forward left side of the stair well.

5-53A. OPERATION OF THE HEATER SYSTEMS. To operate the heaters proceed as follows:

a. See that the fuel valves between the bubble chamber and service tank in the fuel compartment as well as all valves to each heater, are fully open.


*Figure 5-3. Flight Deck Heater Control Panel*

b. See that the intake damper between the scoop and the heater is fully open.

c. Close the cabin heater circuit breaker switches located on the flight engineer's switch panel for forward heaters and the aft side of the aft cargo compartment bulkhead for aft heaters.

d. Throw fuel pump switch to the "START" position for the forward heaters until the indicator lights come on. (See figure 5-3). For the aft heaters, throw fuel pump switch to "ON" then throw the starter switch to "START" until the indicator lights come on. (See figure 5-3A.)

e. Throw the fuel pump switch to the "RUN" position. The indicator lights should go out and the fuel pressure gage located at the heater should read 14 to 16 pounds per square inch.

f. Turn the selector switch to "VENTILATION" and leave on one minute. This step is omitted for forward right heater.

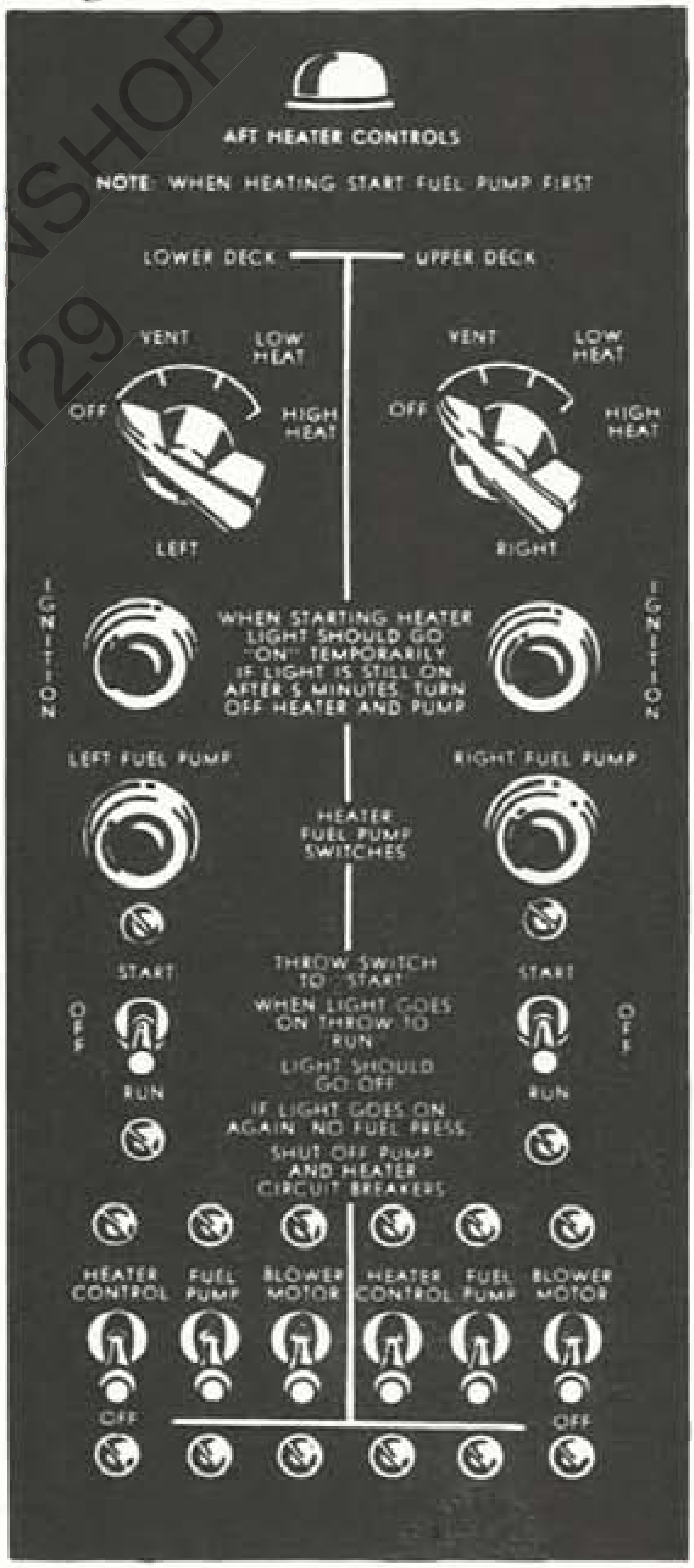


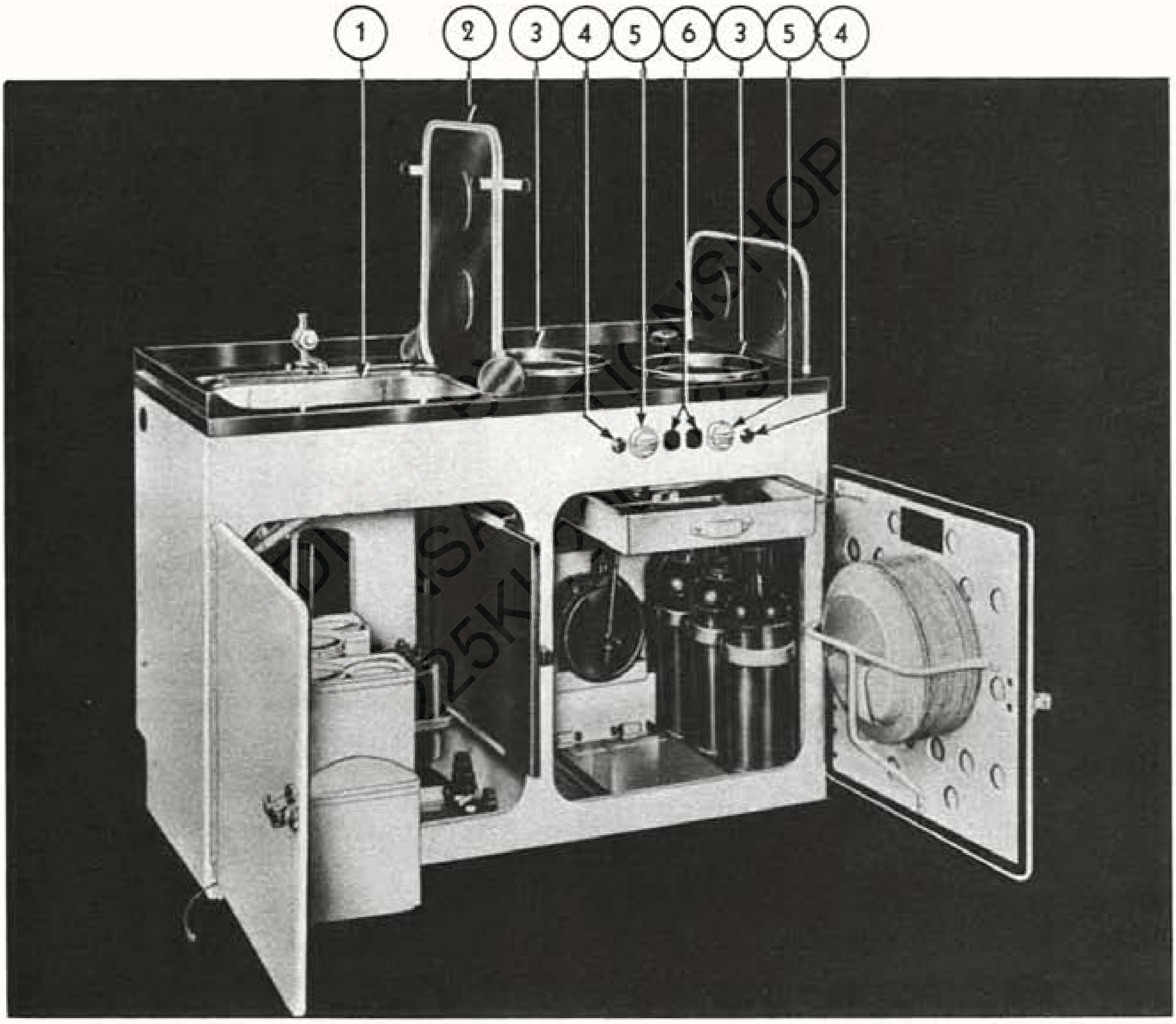

*Figure 5-3A. Aft Heater Control Panel*

**5-54. GALLEY.** ***(See figure 5-4.)***

5-55. A galley, series 1100, is installed in the galley compartment. The galley has two 1000-watt heating elements set in recessed bowls and a sink with adjustable splash board on the top. The elements are controlled by heat switches so that they may be regulated at either "LOW," "MED," or "HIGH." Red indicator lights glow when the heating elements are on. Check to see that the galley grill power switch located on the flight engineer's switch panel is in the "ON" position before operating the galley. Provision is made for the stowage of service for 15 crew members with necessary utensils. The adjustable splash board, when folded left, serves as table top, and, when folded right, serves as dish drain board.

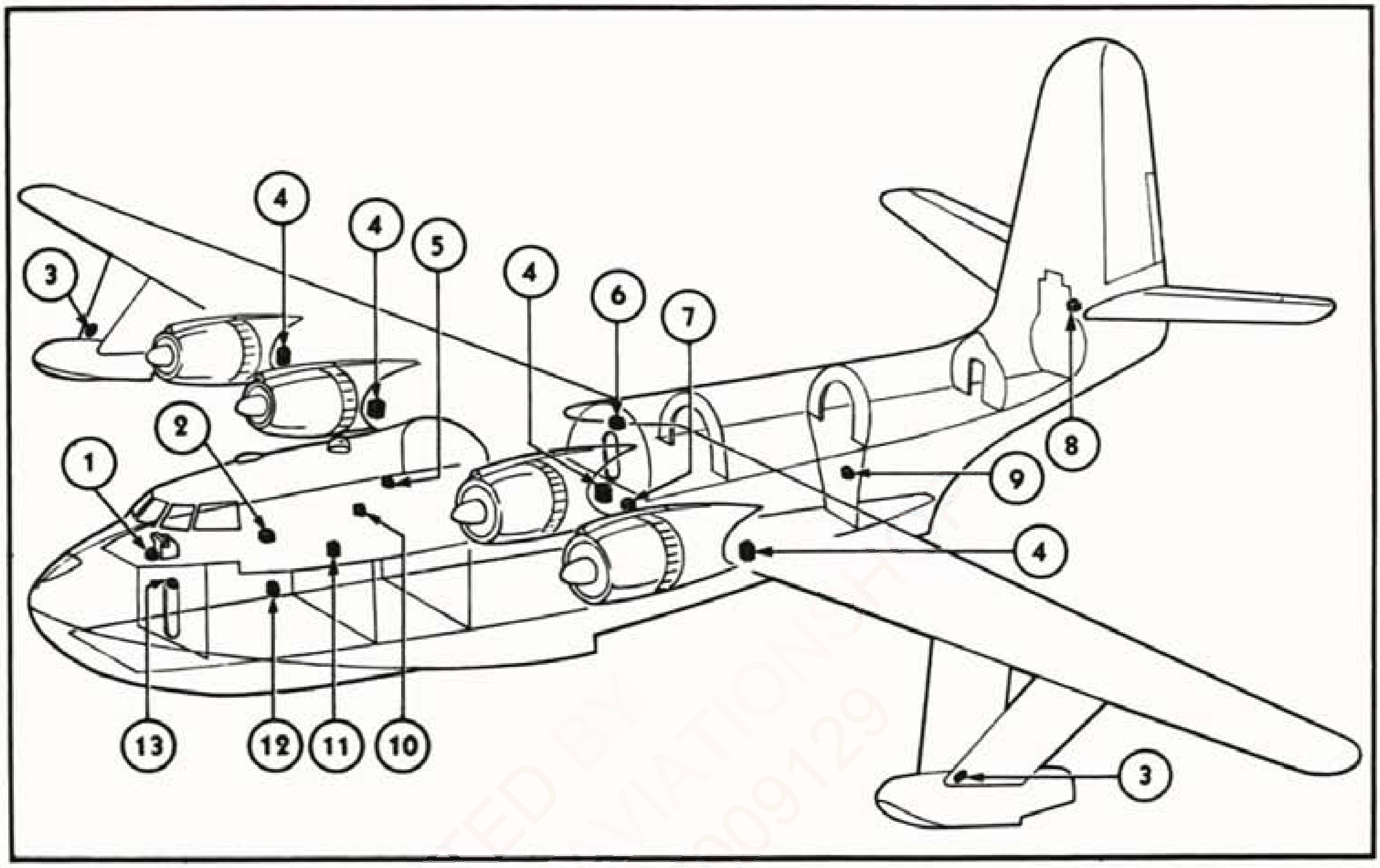
**5-56. REFRIGERATORS.**

5-57. Two electric refrigerators, AR-4 Chrysler, and a cabinet are installed in the galley compartment.




| | | | |
|---|---|---|---|
| 1 | Sink | 4 | Power-On Light |
| 2 | Splash Board | 5 | Heater Switch |
| 3 | Heating Element | 6 | Receptacles |

*Figure 5-4—Galley*




1 Pilot's Pedestal
2 Board and Anchor Light Switch Box
3 Float Strut
4 Nacelle Junction Box
5 Lower Panel
6 Auxiliary Power Plant Compartment Dome Light Switch Box
7 Middle Cargo Compartment Dome Light Switch Box
8 Tail Section D.C. Junction Box
9 Stairway Dome Light Switch Box
10 Forward Cargo Compartment Dome Light Switch Box
11 Navigator's Switch Panel
12 Baggage Compartment Dome Light Switch Box
13 Anchor Mooring Compartment Switch Box

*Figure 5-5—Utility Receptacles*

**5-58. WATER BREAKERS.** *(See figure 4-1.)*

5-59. Three water breakers of 4-1/2 gallon capacity each are installed. Two are located in the flight deck compartment, and one in the galley compartment.

**5-60. UTILITY RECEPTACLES.** *(See figure 5-5.)*

5-61. There are seventeen utility receptacles located throughout the airplane.

**5-62. PORTABLE FOG HORN.**

5-63. A portable fog horn is stowed in the cabinet in the auxiliary power plant compartment. For operation, the horn is mounted on a bracket at the base of the auxiliary power plant hatch sill. The lead is plugged into a convenient receptacle.

**5-64. PORTABLE SIGNAL LIGHT.**

5-65. A portable signal light is stowed in the cabinet in the auxiliary power plant compartment. For operation, the light is mounted on a bracket at the base of the auxiliary power plant hatch sill. The lead is plugged into a convenient receptacle.

**5-66. TOILET FACILITIES.**

5-67. Four toilets and one urinal are located in the aft hull section of the upper deck.

**5-68. HYDROBAL.**

5-69. DESCRIPTION. The Hydrobal is an instrument for determining the gross weight and center of gravity of a flying boat when at rest on the water.

**Note**

> It is not intended that the Hydrobal should supplant the Weight and Balance Handbook, AN-01-1B-40, or the load Adjuster. The standard methods of calculating Form "F" of the handbook should be used. The Hydrobal accuracy and ease of operation make it an important aid to the standard loading procedure. It can be depended on for a positive indication of weight and balance which is accurate to ± 1000 pounds and ± .7 MAC.

5-70. USES OF THE HYDROBAL. The Hydrobal may be used in any of the following loading situations.

a. Verification of the accuracy of the loading calculations.

b. Verification of the actual loading.

c. Last minute changes in the loading.

d. Emergency and rescue operations.

e. Indication of damage.

5-71. PREPARATIONS FOR USE OF THE HYDROBAL.

5-72. MOORING INSTRUCTIONS. Special mooring procedures or locations are not required for taking a Hydrobal reading. Lines should be taunt enough for a safe mooring, but excessive tension should be avoided. Head the airplane into the wind, since errors may result from readings taken in a cross wind.

**Note**

> Do not attempt a reading when the engines are running. It is impossible to obtain a stabilized reading.

5-73. WEATHER AND WATER CONDITIONS. Maximum accuracy will be obtained with calm water and wind velocities less than 10 mph. However, it is not necessary to wait for mill pond condition. Tests at 25 mph indicate no serious inaccuracies, when the ship is headed into the wind.

5-74. CONDITION OF THE AIRPLANE. Hydrobal readings may be taken either in the basic weight or the fully loaded conditions. It is important that the crew and passengers be located at the positions used in the flight loading calculations. A check on the center of gravity is impossible if the crew members are walking around.

5-75. INSTRUCTIONS FOR USE OF THE HYDROBAL.

5-76. METHOD OF READING. *(See figure 5-6.)* The Hydrobal control panel is located at the aft bulkhead of the fueling compartment. To take readings it is only necessary to start the pumps, close the atmosphere vent valves on the indicator panel and read the desired information when the pointers have reached a stable position. The gross weight gage should be read first, then the center of gravity corresponding to that Gross Weight is read on the balance indicator.

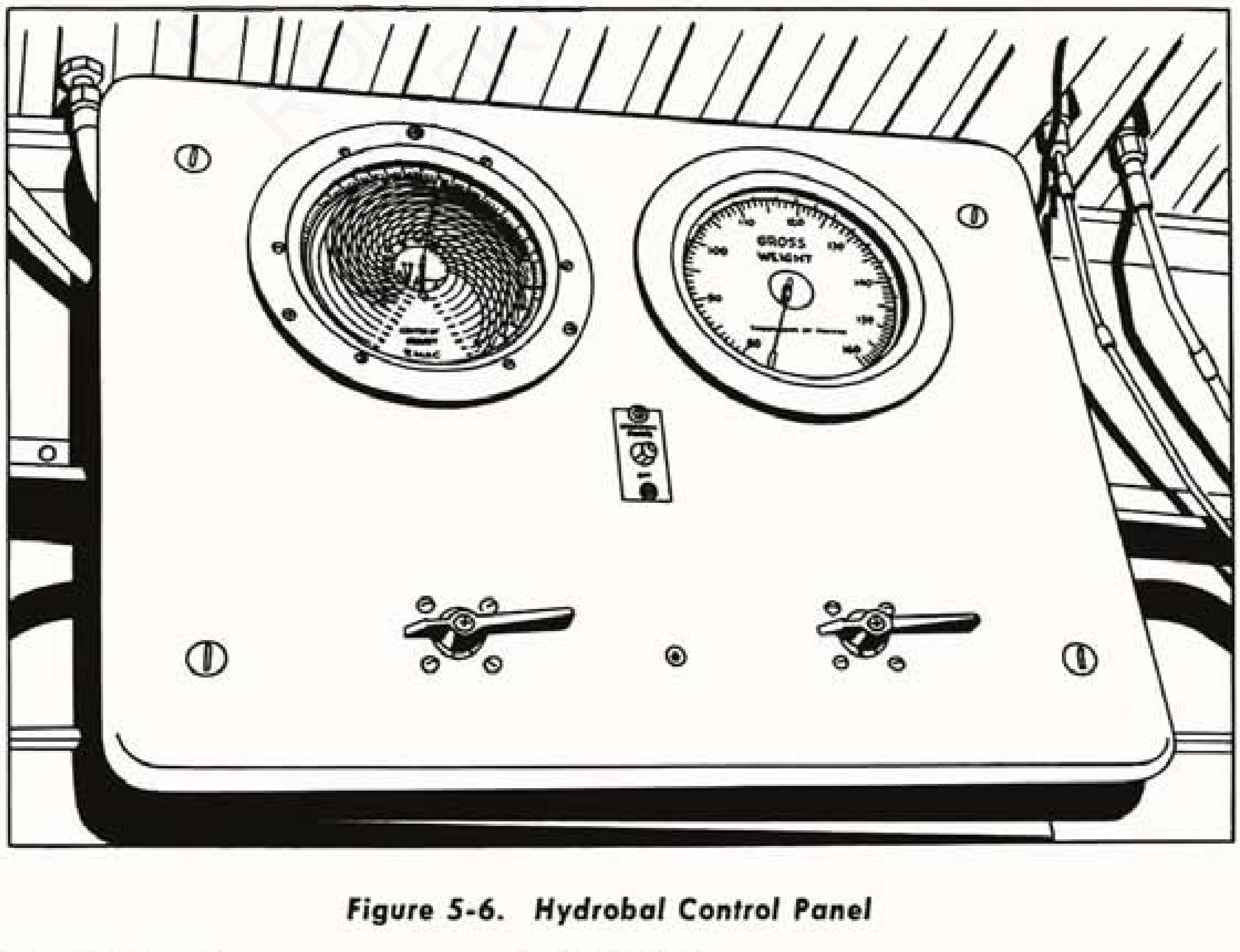



***Figure 5-6. Hydrobal Control Panel***

# SECTION VI

# EXTREME WEATHER OPERATIONS

## 6-1. SURFACE DE-ICING SYSTEM.

6-2. WING AND TAIL DE-ICING SYSTEM. The de-icing system is used to remove ice formation from the leading edges of the wing, stabilizer, and fin. The ice formation is broken up to be blown away by the slip stream. The system is controlled by an electronic de-icer timer. The timer is designed for use in conjunction with the manifold type de-icer system to open the boot inflating valves automatically in the proper sequence and for the proper time intervals. Since ice does not form at the same rate or to the same degree on all occasions, a certain flexibility of control has been incorporated to permit the flight engineer to vary certain components of the automatic cycle to suit the conditions existing at the time. The de-icing system may be shut down by turning two vacuum shut-off valves found in the right-hand center wing at rib 20 if there is a failure of the vacuum supply to the automatic pilot and instruments and vacuum is preferred for these instruments over the de-icing system.

6-3. OPERATION OF THE DE-ICER SYSTEM. Turn on the de-icing circuit breaker switch on the flight engineer's switch panel. Depress the starter button on the electronic timer on the flight engineer's switch panel. After engines are operating, check pressure gage on flight engineer's fuel panel. Pressure should be between 7 and 7.5 pounds per square inch. Operate the selector dial on the electronic timer as follows:

a. Position "1" (single cycle) in which the unit inflates each boot in turn once, after the starting button is depressed, and then waits until the starting button is again depressed before proceeding with another inflation cycle. This position is useful under low rate icing conditions.

b. Position "2" (60-second dwell) in which the unit inflates each boot in turn, waits 60 seconds, then inflates the boots again, waits 60 seconds, etc., until the unit is turned off or switched to another position. Position "2" therefore is preferable under medium rate icing.

c. Position "3" (0 seconds dwell) in which the unit keeps repeating the inflating cycle just as in position "2," but does not delay between successive inflation cycles. Position "3" obviously provides for high rate icing.

d. Position "4" (50 percent increase) in which the cycling is repetitive without delay between cycles, but the inflation period for each boot is increased by 50 percent. This position provides for higher altitudes and sub-normal air flow from the engine air pump.

## 6-4. OIL DILUTION SYSTEM.

6-5. OPERATION OF OIL DILUTION SYSTEM. If temperatures below 2°C (36°F) are forecast for the period before the next start, the lubrication oil should be diluted immediately before stopping in accordance with the following procedure:

a. Open the oil dilution shut-off cocks located on the left side of each nacelle on the aft side of the fire wall.

b. Place fire watch on top of center wing.

c. Set the oil dilution circuit breaker to "ON."

d. Hold engine speed constant at 1000 rpm.

e. Hold oil dilution switch "ON" 4 minutes.

f. Stop engine by moving mixture control to "IDLE CUT OFF" position, then cut ignition.

6-6. 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 2°C (36°F).

d. Keep oil system free of sludge and water.

e. Close 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 the 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.

## 6-7. PROPELLER ANTI-ICER.

6-8. All four propellers are supplied with anti-icer fluid by one 30 US (24.6 Imperial) gallon per hour pump drawing from a reservoir of 37.2 US (30.9 Imperial) gallons capacity. The pump is controlled by a switch on the flight engineer's switch panel which opens a solenoid valve on the line to the propellers and a switch on the pilot's pedestal which opens a solenoid valve on the line to the windshields. The system will deliver 2 US (1.7 Imperial) gallons of fluid per hour to each propeller. When icing conditions are encountered, throw the propeller anti-icer switch on the flight engineer's switch panel to the "ON" position.

## 6-9. WINDSHIELD ANTI-ICER AND DEFROSTER.

6-10. WINDSHIELD ANTI-ICER. The windshield anti-icing fluid pump is controlled as outlined in paragraph 6-8. To operate windshield anti-icer, turn on switch located on pilot's pedestal. The amount of fluid sprayed on the windshield is controlled by a valve located to the left of the pilot. Use the anti-icer to remove ice, and the de-icer to keep ice from forming on the windshield.

6-11. WINDSHIELD DEFROSTER PANELS. Removable windshield panels are provided for the pilot's and copilot's windshield. Hot air from the heater is blown into the space between the panel and the windshield, preventing fog forming on the inner surface and ice on the outer surface of the windshield. The heater must be on to use defroster panels. (See paragraph 5-51.) To shut down, close the heater duct main damper on the left side, aft of the pilot, thus cutting off hot air to the windshields and footwarmers. The panels may be stowed under the bunks on the flight deck when not in use.

## 6-12. CARBURETOR AIR CONTROL.

6-13. DESCRIPTION OF CARBURETOR AIR CONTROL. The carburetor air intake duct contains a damper valve so that the air coming in from the carburetor air scoop is closed off and the carburetor air is taken from inside the nacelle. The loss of ram and the higher temperature of the air cause a reduction of power that can be compensated by advancing the throttle under all conditions except full throttle. The increase in temperature is enough to prevent ice from forming, but not great enough to melt ice that has already formed.

**Note**

When engine operation indicates that ice has formed in the induction system, remove the ice with the anti-icing system and prevent more icing by operating on alternate air.

6-14. OPERATION OF CARBURETOR AIR CONTROL. Whenever atmospheric conditions indicate the possibility of icing conditions existing, proceed as follows:

a. Place the carburetor air controls in their "ALTERNATE" positions.

**WARNING**

Do not take off with the controls in the "ALTERNATE" position. If icing conditions exist, place the controls in the alternate position immediately before take-off to clear the induction system, then place the controls in the "DIRECT" position for take-off.

b. Advance throttles to adjust for loss of power.

c. Avoid low power or closed throttle glides to insure adequate heat.

d. Seek ice-free altitudes when possible.

## 6-15. CARBURETOR ANTI-ICING SYSTEM.

6-16. DESCRIPTION OF CARBURETOR ANTI-ICING SYSTEM. One pump is provided for each carburetor, and each pump has a switch on the flight engineer's switch panel. Each outboard pump draws from a reservoir of 18.6 US (15.4 Imperial) gallons. The inboard pumps draw from a common reservoir of 37.2 US (30.9 Imperial) gallons. The fluid is metered to the carburetors at a rate of 17.8 US (14.6 Imperial) gallons per hour.

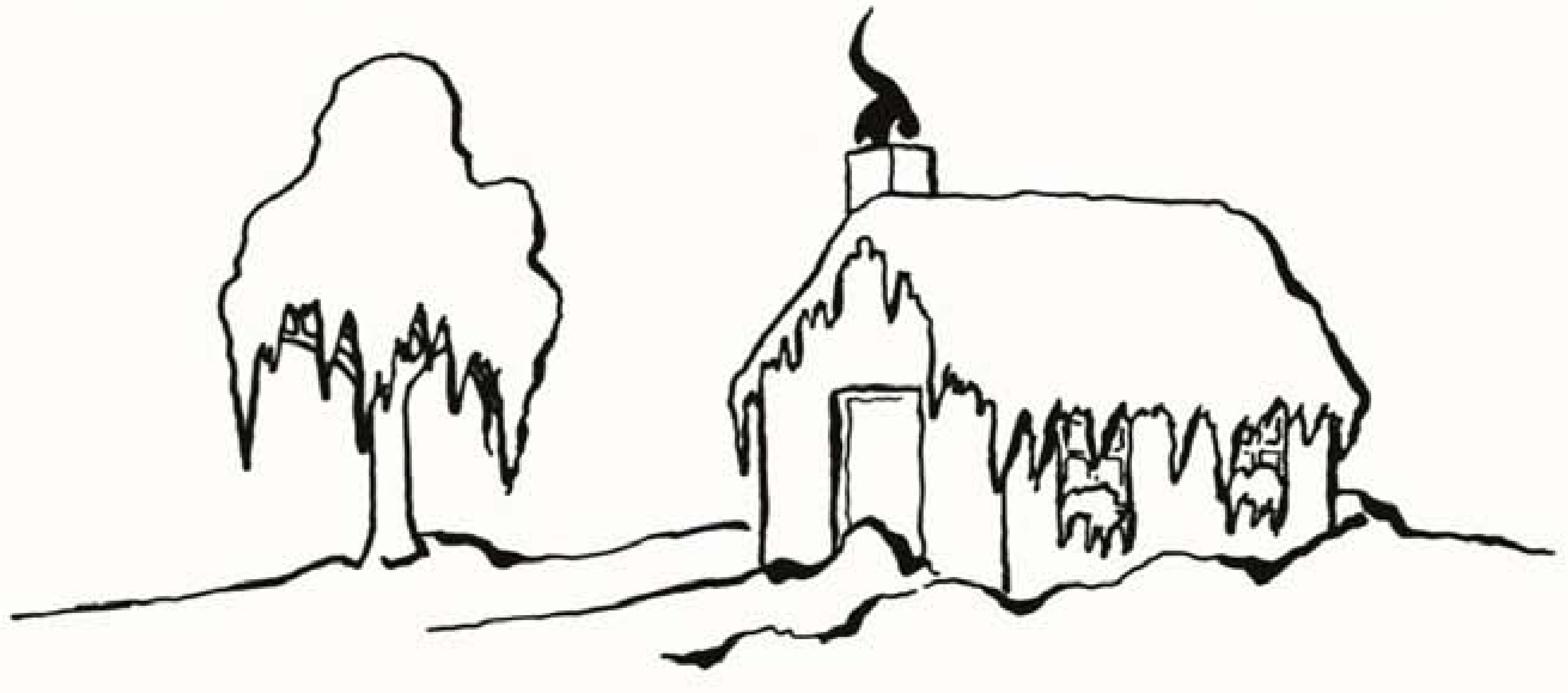
6-17. OPERATION OF CARBURETOR ANTI-ICING SYSTEM. When uneven engine operation with a loss of power is noted when atmospheric conditions are conducive to icing, proceed as follows:

a. Throw the carburetor anti-icing switch to "ON" until the engine is up to speed and running smoothly.

b. Put the carburetor air controls in their "ALTERNATE" positions.

c. Adjust the throttle to compensate for power loss.

d. Seek ice-free altitude when possible.



# APPENDIX I

# OPERATING CHARTS, TABLES, CURVES, AND DIAGRAMS

## A-1. INTRODUCTION.

A-2. GENERAL. The following flight operation data is presented to acquaint the pilot with the estimated operation and performance of the airplane. Adherence to the operating instructions given on the charts will result in the attainment of best possible performance under each required condition.

## A-3. TAKE-OFF, CLIMB, AND LANDING CHART. *(See figure A-1.)*

A-4. The take-off time and distance table lists the take-off time, water run and distance required to clear a 50-foot obstacle for various gross weights and wind speeds The take-off times and distances are for average service conditions. With precision flying, take-off times and distances of 80 percent of values shown may be obtained.

A-5. The climb data table gives the best climb speed, rate of climb, time to climb, and the fuel used for climb to various altitudes with normal rated power. The rates of climb listed are estimated values. It is imperative that the cowl flaps and oil cooler shutters be kept as near closed as possible without exceeding engine temperature limits. An allowance of 190 gallons of fuel is shown in the sea-level column for warm-up and take-off, and the same allowance is contained in the fuel values shown on this chart to climb to other altitudes.

A-6. The landing distance table lists the water run distance as well as the total distance required to land over a 50-foot obstacle for various gross weights and altitudes. The best indicated approach speed gives safe air speeds for approaching the landing area with flaps deflected full down. The landing distances given are for average service conditions. With precision flying landing distances of 80 percent of values shown can be obtained.

## A-7. FLIGHT OPERATION INSTRUCTION CHARTS. *(See figures A-2 to A-4.)*

A-8. In making up a flight plan, the available fuel for the mission is obtained by subtracting the allowances for warm-up, taxiing, take-off, and climb from the total fuel load. The remaining fuel is available for cruising and reserve. From gross weight range required, altitude desired, and available fuel figures, the engine operation and cruising speed can be chosen to meet the requirement. The fuel required and flying time for a given mission depend largely upon the speed desired. With all other factors remaining equal in the airplane, speed is obtained with a sacrifice in range, and conversely, range is obtained with a sacrifice in speed. The speed is usually determined after considering the urgency of the flight and the range obtainable at various speeds. The time of take-off is adjusted to have the flight arrive at its destination at the predetermined time.

A-9. The charted ranges make no allowance for warm-up, take-off, and climb. Fuel consumed during these operations should be obtained from the take-off, climb, and landing chart (see figure A-1). Similarly no account is taken of the improved miles per gallon realized during descent. Neglect of this factor is recommended to balance the fuel required for landing operations.

A-10. The operating data included on any one chart should be used only when the gross weight is within the limits specified in the title block. When diminishing fuel load causes the gross weight to decrease to a value included in the weight limits of the next chart, the operating data included in the corresponding column of the chart should be used. This is essential, as ranges have been computed on this basis.

A-11. All data is based on the maximum weight for which the chart is applicable. When gross weight is within the chart weight limits and less then the maximum due to lighter initial weight or diminished fuel load the air speed should be slightly greater than that listed on the chart In order to maintain the chart in simplified form, no account has been taken of this factor.

A-12. Experience has shown that calculated fuel consumption should be increased 15 percent to take account of variation in service airplanes and operating techniques. These allowances have been made on the flight operation instruction chart. No allowance has been made for wind navigational error, combat, formation flight or other contingencies. Appropriate allowances for these items should be dictated by local doctrine. The fuel quantity used in entering the chart, therefore, should be the fuel available after reaching flight altitude less allowance appropriate for the mission.

A-13. For planning a flight proceed as follows:

a. Select the flight operating instruction chart for the initial gross weight.

b. Locate the largest figure entered under G.P.H. (gallons per hour) in the column applicable to the flight plan on the lower half of the chart.

c. Multiply this figure by the number of hours desired for reserve fuel.

d. Add the resulting figure to the number of gallons required for starting, warm-up, and take-off (normally 190 gallons unless additional allowance is required for delays in take-off or climbing).

e. Subtract this figure from the number of gallons of fuel in the airplane before the engines were started. The result represents the amount of fuel available for cruising.

f. Select the figure in the fuel column equal to, or just below the amount of fuel determined in the preceding paragraphs.

g. Read horizontally to the right or left and select the range in air-miles figure equal to, or just above, the number of air-miles, with no wind, to be flown.

h. Reading horizontally downward in the column in which this figure appears will give the highest cruising speed (TAS, true air speed) possible for the range desired together with the optimum engine setting. The airplane may be flown using values contained in any column of a higher range with the flight plan being completed at a sacrifice of air speed but an increase in fuel economy. The airplane and engine operating values listed in any single column are calculated to give approximately constant miles per gallon at all altitudes listed. Therefore, the airplane may be operated at any altitude with the corresponding conditions given, as long as they are in the same column listing the range desired.

i. For operating and planning during flight proceed as follows:

j. When the gross weight becomes less than the minimum limit specified on the flight operation instruction chart used for take-off, read the operating data from the same column on the chart of the next lowest gross weight.

k. The time in hours during flight, when this transition occurs, can be found by dividing the difference between the take-off gross weight and the minimum weight on the chart by six times the gallon per hour fuel consumption.

l. If the flight is of long duration, make the change in operating data several times, i.e., as soon as the airplane gross weight falls in the next weight range.

m. The flight plan may be changed readily at any time enroute, and the chart will show the balance of range at various cruising powers by following the instructions printed on each chart. If the flight indicates a mission requiring change in engine power, air speed, gross weight, or if one engine fails in flight; break down the total flight into a series of short flights compute each individually, then add them together to determine the total flight and its requirements.

n. The highest operating efficiency of an airplane is obtained under conditions which give the maximum miles per gallon of fuel. Since the airplane is composed of the airframe and the power plant, peak efficiency results from the best operating combination of both. The Flight Operation Instruction Charts are computed to give optimum engine settings for each airplane condition shown, with maximum range being obtained in column V.

**Note**

In addition to following the chart precisely the operating efficiency can be increased by reducing unnecessary drag items and by choosing the optimum altitude.

### A-14. ENGINE CALIBRATION CURVE. *(See figure A-5.)*

A-15. This curve can be used to determine correct power settings for any power at any altitude within the operating range of the airplane. The heavy dot-dash line marks the transition from normal to rich mixture; use rich mixture for all powers *above* this line, normal for all powers *below* the line provided operating temperatures remain below limits. The heavy dashed line marks the critical altitudes (with zero ram at standard conditions) for the various powers; all power settings to the left of this line are at part throttle, all power settings to the right are at full throttle. Because actual operating conditions may not conform to standard conditions, and a varying degree of ram may be available, critical altitudes should be expected to vary somewhat from the charted values.

A-16. For part throttle operation with rich mixture, lines sloping upward to the right show combinations of manifold pressure and rpm that are safe at any altitude at which the manifold pressure is attainable. Intermediate settings may be determined by interpolation; for example, 36.5 in Hg is the correct manifold pressure to use with 2250 rpm. Settings obtained in this manner are simple and sufficiently economical to be used for short periods of high power operation. When operated according to this schedule, an engine does not approach propeller load conditions except near critical altitude; at lower altitudes, the power falls off at constant rpm, as indicated by the sloping lines. Improved economy is obtainable by maintaining propeller load conditions at all altitudes up to full throttle. In order to do this, manifold pressure must be selected according to altitude; for example, to obtain constant power at 2300 rpm, 41.0 in Hg manifold pressure would be required at sea-level, 38.5 in Hg at 6700 feet (the approximate critical altitude), and 40.0 in Hg at 2000 feet (rounding off manifold pressure to the nearest half-inch). For extended operation, this method is recommended because friction horsepower loss is reduced, especially at low altitudes, and fuel consumption is reduced accordingly. Do not increase manifold pressure to compensate for above-standard carburetor air temperature; use the charted manifold pressure-rpm combinations without modification.

A-17. Below 1150 BHP, operation at 140 BMEP is authorized. It should be noted that within this power range, manifold pressure required to obtain 140 BMEP varies with respect to both engine speed and altitude.

A-18. Head temperature limits must be observed. The limits for maximum head temperatures follow:

TAKE-OFF and MILITARY POWER 260°C (500°F)
(Not over five minutes continuously)

NORMAL RATED POWER TO 70% NRP 248°C (480°F)
(No time limit)

70% NORMAL RATED POWER and BELOW 232°C (450°F)
(No time limit)

A-19. Seventy percent normal rated power is obtained at 1470 BHP, 2130 rpm, 163 BMEP. The required manifold pressure varies with altitude, and should be read from the chart (Examples: 34.8 in Hg at sea-level, 32.5 in Hg at 8500 feet).

AIRCRAFT MODEL
JRM-1

# TAKE-OFF, CLIMB & LANDING CHART (WATER)

TAKE-OFF TIME—SECONDS
TAKE-OFF DISTANCE—FEET

ENGINE MODEL S
R-3350-8
4 ENGINES OPERATING:

| GROSS WEIGHT LB. | HEAD WIND | | NORMAL TAKE-OFF | | | | | | JATO CONDITION I | | | | | | JATO CONDITION II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | AT SEA LEVEL | | | AT 3000 FEET | | | AT SEA LEVEL | | | AT 3000 FEET | | | AT SEA LEVEL | | | AT 3000 FEET | | |
| | MPH | KTS | TIME ON WATER | RUN ON WATER | DIST TO CLEAR 50' OBJ | TIME ON WATER | RUN ON WATER | DIST TO CLEAR 50' OBJ | TIME ON WATER | RUN ON WATER | DIST TO CLEAR 50' OBJ | TIME ON WATER | RUN ON WATER | DIST TO CLEAR 50' OBJ | TIME ON WATER | RUN ON WATER | DIST TO CLEAR 50' OBJ | TIME ON WATER | RUN ON WATER | DIST TO CLEAR 50' OBJ |
| 145,000 | 0 | 0 | 67 | 5200 | 6205 | 74 | 5900 | 6965 | | | | | | | | | | | | |
| | 12 | 10 | 55 | 3600 | 4475 | 62 | 4300 | 5234 | | | | | | | | | | | | |
| | 23 | 20 | 43 | 2500 | 3256 | 50 | 3000 | 3817 | | | | | | | | | | | | |
| | 35 | 30 | 31 | 1400 | 2026 | 35 | 1700 | 2382 | | | | | | | | | | | | |
| 115,000 | 0 | 0 | 28 | 2100 | 2772 | 32 | 2500 | 3206 | | | | | | | | | | | | |
| | 12 | 10 | 24 | 1500 | 2075 | 26 | 1800 | 2408 | | | | | | | | | | | | |
| | 23 | 20 | 20 | 1100 | 1586 | 22 | 1300 | 1818 | | | | | | | | | | | | |
| | 35 | 30 | 16 | 700 | 1088 | 18 | 900 | 1321 | | | | | | | | | | | | |
| 85,000 | 0 | 0 | 16 | 1000 | 1463 | 18 | 1100 | 1588 | | | | | | | | | | | | |
| | 12 | 10 | 14 | 700 | 1085 | 15 | 800 | 1209 | | | | | | | | | | | | |
| | 23 | 20 | 11 | 400 | 713 | 12 | 500 | 837 | | | | | | | | | | | | |
| | 35 | 30 | 8 | 300 | 535 | 10 | 300 | 558 | | | | | | | | | | | | |

NOTE: INCREASE CHART DISTANCES AS FOLLOWS: 75°F + 10%, 100°F + 20%, 125°F + 30%, 150°F + 40%
DATA AS OF 1-21-47 BASED ON: CALCULATIONS
OPTIMUM TAKE-OFF WITH 2600 RPM 58.0 IN. HG. & 25 DEG. FLAP IS 80% OF CHART VALUES
OPTIMUM TAKE-OFF WITH JATO CONDITION I WITH RPM IN. HG. & DEG. FLAP IS 80% OF CHART VALUES
OPTIMUM TAKE-OFF WITH JATO CONDITION II WITH RPM IN. HG. & DEG. FLAP IS 80% OF CHART VALUES

## CLIMB DATA

| GROSS WEIGHT LB. | AT SEA LEVEL | | | | AT 5000 FEET | | | | | AT 10,000 FEET | | | | | AT 15,000 FEET | | | | | AT FEET | | | | | AT FEET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BEST IAS | | RATE OF CLIMB FPM WITHOUT JATO | GAL. OF FUEL USED | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | |
| | MPH | KTS | | | MPH | KTS | | TIME MIN | FUEL USED | MPH | KTS | | TIME MIN | FUEL USED | MPH | KTS | | TIME MIN | FUEL USED | MPH | KTS | | TIME MIN | FUEL USED | MPH | KTS | | TIME MIN | FUEL USED |
| 145,000 | 130 | 114 | 650 | 190 | 130 | 114 | 578 | 8.1 | 341 | 130 | 114 | 382 | 18.8 | 539 | 130 | 114 | 330 | 33.0 | 784 | | | | | | | | | | |
| 115,000 | 126 | 109 | 1027 | 190 | 126 | 109 | 948 | 5.0 | 284 | 126 | 109 | 730 | 11.2 | 399 | 126 | 109 | 684 | 18.1 | 527 | | | | | | | | | | |
| 85,000 | 115 | 101 | 1605 | 190 | 116 | 101 | 1530 | 3.1 | 248 | 116 | 101 | 1263 | 6.8 | 317 | 116 | 101 | 1226 | 10.8 | 392 | | | | | | | | | | |

POWER PLANT SETTINGS: (DETAILS ON FIG. 3-1 SECTION III)
DATA AS OF 1-21-47 BASED ON: CALCULATIONS
TIME MIN. DOES NOT INCLUDE TIME REQ'D FOR TAKE-OFF
FUEL USED (U.S. GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE
SUBTRACT GAL. IF JATO CONDITION I WAS USED
SUBTRACT GAL. IF JATO CONDITION II WAS USED

## LANDING DISTANCE FEET

| GROSS WEIGHT LB. | BEST IAS APPROACH | | | | CALM WATER | | | | 10 KNOTS HEADWIND (12 MPH) | | | | 20 KNOTS HEADWIND (23 MPH) | | | | 30 KNOTS HEADWIND (35 MPH) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | POWER OFF | | POWER ON | | AT SEA LEVEL | | AT 3000 FEET | | AT SEA LEVEL | | AT 3000 FEET | | AT SEA LEVEL | | AT 3000 FEET | | AT SEA LEVEL | | AT 3000 FEET | |
| | MPH | KTS | MPH | KTS | RUN ON WATER | TO CLEAR 50' OBJ | RUN ON WATER | TO CLEAR 50' OBJ | RUN ON WATER | TO CLEAR 50' OBJ | RUN ON WATER | TO CLEAR 50' OBJ | RUN ON WATER | TO CLEAR 50' OBJ | RUN ON WATER | TO CLEAR 50' OBJ | RUN ON WATER | TO CLEAR 50' OBJ | RUN ON WATER | TO CLEAR 50' OBJ |
| 145,000 | 118 | 102 | 112 | 97 | 2300 | 5258 | 2500 | 5658 | 1800 | 4392 | 2000 | 4793 | 1400 | 3659 | 1600 | 4049 | 1000 | 2892 | 1200 | 3276 |
| 115,000 | 105 | 91 | 100 | 87 | 1900 | 4403 | 2100 | 4773 | 1400 | 3558 | 1600 | 3921 | 1100 | 2940 | 1300 | 3297 | 700 | 2195 | 800 | 2444 |
| 80,000 | 88 | 76 | 83 | 72 | 1400 | 3353 | 1600 | 3673 | 1000 | 2634 | 1100 | 2848 | 700 | 2041 | 800 | 2249 | 400 | 1420 | 500 | 1624 |

DATA AS OF 1-21-47 BASED ON: CALCULATIONS
OPTIMUM LANDING IS 80% OF CHART VALUES

REMARKS:
NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS, MULTIPLY BY 10 THEN DIVIDE BY 12

LEGEND
IAS: INDICATED AIRSPEED
MPH: MILES PER HOUR
KTS: KNOTS
FPM: FEET PER MINUTE

RED FIGURES ARE PRELIMINARY DATA SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure A-1 (Sheet 1 of 2 Sheets). Take-Off, Climb, and Landing Chart

Appendix I of 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.

Appendix I of 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.

AIRCRAFT MODEL
JRM-1

# TAKE-OFF, CLIMB & LANDING CHART (WATER)

TAKE-OFF TIME—SECONDS
TAKE-OFF DISTANCE—FEET

ENGINE MODEL S
R-3350-8
3 ENGINES OPERATING:

| GROSS WEIGHT LB. | HEAD WIND | | NORMAL TAKE-OFF | | | | | | JATO CONDITION I | | | | | | JATO CONDITION II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | AT SEA LEVEL | | | AT 3000 FEET | | | AT SEA LEVEL | | | AT 3000 FEET | | | AT SEA LEVEL | | | AT 3000 FEET | | |
| | MPH | KTS | TIME ON WATER | RUN ON WATER | DIST. TO CLEAR 50 OBJ. | TIME ON WATER | RUN ON WATER | DIST. TO CLEAR 50 OBJ. | TIME ON WATER | RUN ON WATER | DIST. TO CLEAR 50 OBJ. | TIME ON WATER | RUN ON WATER | DIST. TO CLEAR 50 OBJ. | TIME ON WATER | RUN ON WATER | DIST. TO CLEAR 50 OBJ. | TIME ON WATER | RUN ON WATER | DIST. TO CLEAR 50 OBJ. |
| 115,000 | 0 | 0 | — | — | — | | | | | | | | | | | | | | | |
| | 12 | 10 | — | — | — | | | | | | | | | | | | | | | |
| | 23 | 20 | 95 | 5000 | 5726 | | | | | | | | | | | | | | | |
| | 35 | 30 | 75 | 3200 | 3780 | | | | | | | | | | | | | | | |
| 100,000 | 0 | 0 | 96 | 6600 | 7355 | | | | | | | | | | | | | | | |
| | 12 | 10 | 75 | 4300 | 4938 | | | | | | | | | | | | | | | |
| | 23 | 20 | 63 | 2000 | 3530 | | | | | | | | | | | | | | | |
| | 35 | 30 | 50 | 1900 | 2313 | | | | | | | | | | | | | | | |
| 85,000 | 0 | 0 | 60 | 3800 | 4379 | | | | | | | | | | | | | | | |
| | 12 | 10 | 47 | 2500 | 2981 | | | | | | | | | | | | | | | |
| | 23 | 20 | 39 | 1600 | 1992 | | | | | | | | | | | | | | | |
| | 35 | 30 | 30 | 1000 | 1294 | | | | | | | | | | | | | | | |

NOTE: INCREASE CHART DISTANCES AS FOLLOWS 75°F + 10%, 100°F + 20%, 125°F + 30%, 150°F + 40%.
DATA AS OF 1-27-47 BASED ON CALCULATIONS

OPTIMUM TAKE OFF WITH 2600 RPM 50.0 IN. HG. & 15 DEG. FLAP IS 80% OF CHART VALUES
OPTIMUM TAKE OFF WITH JATO CONDITION I WITH RPM IN. HG. & DEG. FLAP IS 80% OF CHART VALUES
OPTIMUM TAKE OFF WITH JATO CONDITION II WITH RPM IN. HG. & DEG. FLAP IS 80% OF CHART VALUES

## CLIMB DATA

| GROSS WEIGHT LB. | AT SEA LEVEL | | | | AT 5000 FEET | | | | | AT 10,000 FEET | | | | | AT 15,000 FEET | | | | | AT FEET | | | | | AT FEET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BEST IAS | | RATE OF CLIMB FPM WITHOUT JATO | GAL. OF FUEL USED | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | | BEST IAS | | RATE OF CLIMB FPM | FROM SEA LEVEL | |
| | MPH | KTS | | | MPH | KTS | | TIME MIN. | FUEL USED | MPH | KTS | | TIME MIN. | FUEL USED | MPH | KTS | | TIME MIN. | FUEL USED | MPH | KTS | | TIME MIN. | FUEL USED | MPH | KTS | | TIME MIN. | FUEL USED |
| 145,000 | 122 | 106 | 290 | 142 | 122 | 106 | 224 | 18.8 | 405 | 122 | 106 | 65 | 60.0 | 976 | | | | | | | | | | | | | | | |
| 115,000 | 117 | 102 | 581 | 142 | 117 | 102 | 514 | 9.0 | 268 | 117 | 102 | 335 | 21.1 | 450 | 117 | 102 | 286 | 37.3 | 677 | | | | | | | | | | |
| 85,000 | 109 | 95 | 1025 | 142 | 109 | 95 | 953 | 5.0 | 212 | 109 | 95 | 745 | 11.0 | 295 | 109 | 95 | 704 | 17.9 | 391 | | | | | | | | | | |

POWER PLANT SETTINGS: (DETAILS ON FIG. 3-1 SECTION III)
DATA AS OF 1-27-47 BASED ON CALCULATIONS

TIME MIN. DOES NOT INCLUDE TIME REQ'D. FOR TAKE-OFF
FUEL USED (U.S. GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE
SUBTRACT GAL. IF JATO CONDITION I WAS USED
SUBTRACT GAL. IF JATO CONDITION II WAS USED

## LANDING DISTANCE FEET

| GROSS WEIGHT LB. | BEST IAS APPROACH | | | | CALM WATER | | | | 10 KNOTS HEADWIND (12 MPH) | | | | 20 KNOTS HEADWIND (23 MPH) | | | | 30 KNOTS HEADWIND (35 MPH) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | POWER OFF | | POWER ON | | AT SEA LEVEL | | AT 3000 FEET | | AT SEA LEVEL | | AT 3000 FEET | | AT SEA LEVEL | | AT 3000 FEET | | AT SEA LEVEL | | AT 3000 FEET | | |
| | MPH | KTS | MPH | KTS | RUN ON WATER | TO CLEAR 50 OBJ. | RUN ON WATER | TO CLEAR 50 OBJ. | RUN ON WATER | TO CLEAR 50 OBJ. | RUN ON WATER | TO CLEAR 50 OBJ. | RUN ON WATER | TO CLEAR 50 OBJ. | RUN ON WATER | TO CLEAR 50 OBJ. | RUN ON WATER | TO CLEAR 50 OBJ. | RUN ON WATER | TO CLEAR 50 OBJ. | |
| | | | | | | | | | | | | | | | | | | | | | |

DATA AS OF 1-27-47 BASED ON CALCULATIONS OPTIMUM LANDING IS 80% OF CHART VALUES

REMARKS:
NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS MULTIPLY BY 10 THEN DIVIDE BY 12

LEGEND
IAS: INDICATED AIRSPEED
MPH: MILES PER HOUR
KTS: KNOTS
FPM: FEET PER MINUTE

RED FIGURES ARE PRELIMINARY DATA SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure A-1 (Sheet 2 of 2 Sheets). Take-Off, Climb, and Landing Chart

AIRCRAFT MODEL
JRM-1

ENGINE S : R-3350-8

# FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 145,000 TO 130,000 POUNDS

EXTERNAL LOAD ITEMS
NONE

NUMBER OF ENGINES OPERATING: 4

| LIMITS | R.P.M. | M.P. IN. HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 1320 |

FOR DETAILS SEE POWER PLANT CHART (FIG. 3, (SECT. III))

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

| COLUMN I | | FUEL | COLUMN II | | COLUMN III | | COLUMN IV | | FUEL | COLUMN V | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | | RANGE IN AIRMILES | | RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | |
| STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL | STATUTE | NAUTICAL | STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL |
| | | | SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1] | | | | | | | | |
| 2080 | 1806 | 10833 | 2720 | 2360 | 3792 | 3290 | 4526 | 4002 | 10833 | 5283 | 4585 |
| 1918 | 1664 | 10000 | 2510 | 2180 | 3482 | 3022 | 4136 | 3585 | 10000 | 4825 | 4190 |
| 1723 | 1497 | 9000 | 2258 | 1978 | 3110 | 2700 | 3674 | 3182 | 9000 | 4276 | 3713 |
| 1528 | 1327 | 8000 | 2006 | 1742 | 2738 | 2376 | 3209 | 2782 | 8000 | 3727 | 3235 |
| 1334 | 1158 | 7000 | 1750 | 1519 | 2369 | 2057 | 2758 | 2390 | 7000 | 3195 | 2775 |
| 1141 | 990 | 6000 | 1489 | 1293 | 2003 | 1741 | 2323 | 2020 | 6000 | 2679 | 2325 |
| 948 | 823 | 5000 | 1228 | 1066 | 1637 | 1419 | 1888 | 1638 | 5000 | 2163 | 1878 |
| 757 | 657 | 4000 | 979 | 849 | 1281 | 1112 | 1476 | 1270 | 4000 | 1697 | 1472 |
| 566 | 491 | 3000 | 730 | 634 | 924 | 802 | 1071 | 930 | 3000 | 1231 | 1070 |
| 376 | 326 | 2000 | 484 | 420 | 526 | 457 | 696 | 604 | 2000 | 798 | 692 |
| 188 | 163 | 1000 | 242 | 210 | 298 | 258 | 348 | 302 | 1000 | 399 | 346 |

| MAXIMUM CONTINUOUS | | | | | | PRESS | (.242 STAT. (.210 NAUT.) MI./GAL.) | | | | | | (.298 STAT. (.259 NAUT.) MI./GAL.) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R.P.M. | M.P. INCHES | MIX-TURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | ALT. FEET | R.P.M. | M.P. INCHES | MIX-TURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | R.P.M. | M.P. INCHES | MIX-TURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
| | | | | | | 40000 | | | | | | | | | | | | |
| | | | | | | 35000 | | | | | | | | | | | | |
| | | | | | | 30000 | | | | | | | | | | | | |
| | | | | | | 25000 | | | | | | | | | | | | |
| | | | | | | 20000 | | | | | | | | | | | | |
| 2400 | 41.5 | RICH | 1120 | 228 | 198 | 15000 | 2350 | 38 | RICH | 872 | 211 | 183 | | | | | | |
| 2400 | 43.5 | RICH | 1120 | 218 | 189 | 10000 | 2300 | 34 | RICH | 893 | 216 | 188 | 2300 | 34 | RICH | 703 | 210 | 182 |
| 2400 | 42.5 | RICH | 1098 | 222 | 193 | 5000 | 2300 | 38 | RICH | 860 | 208 | 181 | 2200 | 35 | RICH | 647 | 198 | 172 |
| 2400 | 45.5 | RICH | 1139 | 214 | 186 | S.L. | 2250 | 38 | RICH | 798 | 193 | 168 | 2200 | 36 | RICH | 627 | 187 | 162 |

| (.348 STAT. (.302 NAUT.) MI./GAL.) | | | | | | PRESS | MAXIMUM AIR RANGE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R.P.M. | M.P. INCHES | MIX-TURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | ALT. FEET | R.P.M. | M.P. INCHES | MIX-TURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
| | | | | | | 40000 | | | | | | |
| | | | | | | 35000 | | | | | | |
| | | | | | | 30000 | | | | | | |
| | | | | | | 25000 | | | | | | |
| | | | | | | 20000 | | | | | | |
| | | | | | | 15000 | | | | | | |
| 2130 | 32 | NOR. | 566 | 197 | 171 | 10000 | 1950 | 28 | NOR. | 401 | 160 | 139 |
| 2130 | 33.5 | NOR. | 546 | 190 | 165 | 5000 | 1950 | 29.5 | NOR. | 401 | 160 | 139 |
| 2130 | 35 | NOR. | 520 | 181 | 157 | S.L. | 1850 | 31 | NOR. | 381 | 152 | 132 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-1) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 145,000 LB. GROSS WEIGHT WITH 8000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 341 GAL.) TO FLY 3727 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 1950 RPM AND 29.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: NORMAL

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

*Figure A-2 (Sheet 1 of 4 Sheets). Flight Operation Instruction Chart—4 Engine*

Appendix I of 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.

| AIRCRAFT MODEL | FLIGHT OPERATION INSTRUCTION CHART | EXTERNAL LOAD ITEMS |
|---|---|---|
| JRM-1 | | NONE |
| ENGINE S : R-3350-8 | CHART WEIGHT LIMITS: 130,000 TO 115,000 POUNDS | NUMBER OF ENGINES OPERATING: 4 |

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 1320 |

FOR DETAILS SEE POWER PLANT CHART (FIG. 3. [illegible])

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

| COLUMN I RANGE IN AIRMILES STATUTE | COLUMN I NAUTICAL | FUEL U.S. GAL. | COLUMN II RANGE IN AIRMILES STATUTE | COLUMN II NAUTICAL | COLUMN III RANGE IN AIRMILES STATUTE | COLUMN III NAUTICAL | COLUMN IV RANGE IN AIRMILES STATUTE | COLUMN IV NAUTICAL | FUEL U.S. GAL. | COLUMN V RANGE IN AIRMILES STATUTE | COLUMN V NAUTICAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1] | | | | | | | | |
| 1610 | 1398 | 8333 | 2115 | 1835 | 3047 | 2655 | 3658 | 3180 | 8333 | 4285 | 3721 |
| 1350 | 1172 | 7000 | 1779 | 1545 | 2551 | 2220 | 3038 | 2640 | 7000 | 3553 | 3083 |
| 1155 | 1002 | 6000 | 1527 | 1325 | 2179 | 1892 | 2573 | 2237 | 6000 | 3004 | 2610 |
| 960 | 833 | 5000 | 1275 | 1108 | 1807 | 1573 | 2108 | 1832 | 5000 | 2455 | 2133 |
| 767 | 666 | 4000 | 1014 | 881 | 1441 | 1252 | 1673 | 1457 | 4000 | 1939 | 1683 |
| 574 | 498 | 3000 | 753 | 654 | 1075 | 936 | 1238 | 1078 | 3000 | 1423 | 1237 |
| 382 | 332 | 2000 | 498 | 432 | 714 | 620 | 810 | 705 | 2000 | 932 | 810 |
| 191 | 166 | 1000 | 249 | 216 | 357 | 310 | 405 | 352 | 1000 | 466 | 405 |

**MAXIMUM CONTINUOUS (Column I)**

| R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | PRESS ALT. FEET |
|---|---|---|---|---|---|---|
| | | | | | | 40000 35000 30000 |
| 2400 | 41.5 | RICH | 1120 | 234 | 203 | 25000 20000 15000 |
| 2400 | 43.5 | RICH | 1120 | 223 | 194 | 10000 |
| 2400 | 42.5 | RICH | 1098 | 226 | 196 | 5000 |
| 2400 | 45.5 | RICH | 1139 | 217 | 188 | S.L. |

**Column II: (.242 STAT.) (.210 NAUT.) MI./GAL.**

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 35000 30000 | | | | | | |
| 25000 20000 15000 | 2300 | 36.5 | RICH | 888 | 221 | 192 |
| 10000 | 2350 | 35.5 | RICH | 888 | 221 | 192 |
| 5000 | 2300 | 38 | RICH | 847 | 211 | 183 |
| S.L. | 2200 | 38 | RICH | 787 | 196 | 170 |

**Column III: (.357 STAT.) (.310 NAUT.) MI./GAL.**

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 35000 30000 | | | | | | |
| 25000 20000 15000 | | | | | | |
| 10000 | 2130 | 32 | NOR. | 574 | 205 | 178 |
| 5000 | 2130 | 33.5 | NOR. | 546 | 195 | 170 |
| S.L. | 2130 | 35 | NOR. | 521 | 186 | 162 |

**Column IV: (.405 STAT.) (.352 NAUT.) MI./GAL.**

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 35000 30000 | | | | | | |
| 25000 20000 15000 | 2130 | 27 | NOR. | 474 | 192 | 167 |
| 10000 | 2100 | 30.5 | NOR. | 483 | 196 | 171 |
| 5000 | 2000 | 31 | NOR. | 442 | 179 | 156 |
| S.L. | 2000 | 32 | NOR. | 415 | 168 | 146 |

**MAXIMUM AIR RANGE (Column V)**

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 35000 30000 | | | | | | |
| 25000 20000 15000 | | | | | | |
| 10000 | 1700 | 27 | NOR. | 339 | 158 | 137 |
| 5000 | 1600 | 29 | NOR. | 332 | 155 | 135 |
| S.L. | 1600 | 30.5 | NOR. | 318 | 148 | 128 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-1) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 120,000 LB. GROSS WEIGHT WITH 5000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 190 GAL.) TO FLY 1807 STAT. AIRMILES AT S.L. FT. ALTITUDE MAINTAIN 2130 RPM AND 35 IN. MANIFOLD PRESSURE WITH MIXTURE SET: NORMAL

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure A-2 (Sheet 2 of 4 Sheets). Flight Operation Instruction Chart—4 Engine

| AIRCRAFT MODEL JRM-1<br>ENGINES: R-3350-8 | FLIGHT OPERATION INSTRUCTION CHART<br>CHART WEIGHT LIMITS: 115,000 TO 100,000 POUNDS | EXTERNAL LOAD ITEMS NONE<br>NUMBER OF ENGINES OPERATING: 4 |
|---|---|---|

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 1320 |

FOR DETAILS SEE POWER PLANT CHART (FIG.-), (SECT.III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

| COLUMN I | | FUEL | COLUMN II | | COLUMN III | | COLUMN IV | | FUEL | COLUMN V | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | | RANGE IN AIRMILES | | RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | |
| STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL | STATUTE | NAUTICAL | STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL |
| | | | SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1] | | | | | | | | |
| 1133 | 984 | 5833 | 1493 | 1298 | 2155 | 1870 | 2638 | 2290 | 5833 | 3120 | 2710 |
| 970 | 842 | 5000 | 1283 | 1114 | 1845 | 1600 | 2248 | 1950 | 5000 | 2662 | 2315 |
| 775 | 673 | 4000 | 1031 | 895 | 1473 | 1280 | 1786 | 1550 | 4000 | 2113 | 1832 |
| 580 | 504 | 3000 | 779 | 676 | 1101 | 960 | 1321 | 1150 | 3000 | 1564 | 1359 |
| 386 | 335 | 2000 | 522 | 453 | 732 | 636 | 870 | 756 | 2000 | 1032 | 896 |
| 193 | 167 | 1000 | 261 | 226 | 366 | 310 | 435 | 378 | 1000 | 516 | 498 |

| PRESS ALT. FEET | MAXIMUM CONTINUOUS R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | (.261 STAT.) (.226 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40000 35000 30000 | | | | | | | | | | | | |
| 25000 20000 15000 | 2400 | 41.5 | RICH | 1120 | 240 | 208 | 2300 | 36 | RICH | 866 | 226 | 196 |
| 10000 | 2400 | 43.5 | RICH | 1120 | 228 | 198 | 2350 | 35.5 | RICH | 862 | 225 | 195 |
| 5000 | 2400 | 42.5 | RICH | 1098 | 229 | 199 | 2250 | 38 | RICH | 816 | 213 | 185 |
| S.L. | 2400 | 45.5 | RICH | 1139 | 220 | 191 | 2200 | 38 | RICH | 766 | 200 | 174 |

| PRESS ALT. FEET | (.366 STAT.) (.318 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | (.435 STAT.) (.378 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40000 35000 30000 | | | | | | | | | | | | |
| 25000 20000 15000 | 2200 | 27 | RICH | 560 | 205 | 178 | 2130 | 27 | NOR. | 466 | 203 | 176 |
| 10000 | 2130 | 32 | NOR. | 573 | 210 | 182 | 2050 | 29.5 | NOR. | 451 | 196 | 170 |
| 5000 | 2130 | 33.5 | NOR. | 546 | 200 | 174 | 1950 | 30 | NOR. | 418 | 182 | 158 |
| S.L. | 2130 | 35 | NOR. | 522 | 191 | 166 | 1900 | 31.5 | NOR. | 391 | 170 | 148 |

| PRESS ALT. FEET | MAXIMUM AIR RANGE R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 35000 30000 | | | | | | |
| 25000 20000 15000 | 1850 | 24.5 | NOR. | 327 | 168 | 146 |
| 10000 | 1600 | 27 | NOR. | 335 | 173 | 150 |
| 5000 | 1600 | 28 | NOR. | 318 | 174 | 151 |
| S.L. | 1600 | 30 | NOR. | 286 | 148 | 128 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG.A-3) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 110,000 LB. GROSS WEIGHT WITH 3000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 385 GAL.) TO FLY 779 STAT. AIRMILES AT 10,000 FT. ALTITUDE MAINTAIN 2350 RPM AND 35.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: RICH

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

*Figure A-2 (Sheet 3 of 4 Sheets). Flight Operation Instruction Chart—4 Engine*

Appendix I of 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.

| AIRCRAFT MODEL JRM-1<br>ENGINE S : R-3350-8 | FLIGHT OPERATION INSTRUCTION CHART<br>CHART WEIGHT LIMITS: 100,000 TO DOWN POUNDS | EXTERNAL LOAD ITEMS NONE<br>NUMBER OF ENGINES OPERATING: 4 |
|---|---|---|

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 1320 |

FOR DETAILS SEE POWER PLANT CHART (FIG. 3, (SECT. III))

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[(1)] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[(a)] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

| COLUMN I RANGE IN AIRMILES STATUTE | COLUMN I NAUTICAL | FUEL U.S. GAL. | COLUMN II RANGE IN AIRMILES STATUTE | COLUMN II NAUTICAL | COLUMN III RANGE IN AIRMILES STATUTE | COLUMN III NAUTICAL | COLUMN IV RANGE IN AIRMILES STATUTE | COLUMN IV NAUTICAL | FUEL U.S. GAL. | COLUMN V RANGE IN AIRMILES STATUTE | COLUMN V NAUTICAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[(a)] | | | | | | | | |
| 650 | 565 | 3333 | 840 | 739 | 1240 | 1075 | 1550 | 1345 | 3333 | 1830 | 1589 |
| 390 | 338 | 2000 | 504 | 437 | 744 | 646 | 930 | 808 | 2000 | 1098 | 954 |
| 195 | 169 | 1000 | 252 | 218.5 | 372 | 323 | 465 | 404 | 1000 | 549 | 476 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

| MAXIMUM CONTINUOUS R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | PRESS ALT. FEET | (.252 STAT.) (.219 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | (.372 STAT.) (.323 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 40000<br>35000<br>30000 | | | | | | | | | | | | |
| 2400 | 41.5 | RICH | 1120 | 244 | 212 | 25000<br>20000<br>15000 | 2350 | 38 | RICH | 932 | 235 | 204 | 2200 | 27 | RICH | 572 | 213 | 185 |
| 2400 | 43.5 | RICH | 1120 | 231 | 201 | 10000 | 2350 | 35 | RICH | 912 | 230 | 200 | 2130 | 32 | NOR. | 578 | 215 | 187 |
| 2400 | 42.5 | RICH | 1098 | 231 | 201 | 5000 | 2300 | 38 | RICH | 872 | 220 | 191 | 2130 | 33.5 | NOR. | 548 | 204 | 177 |
| 2400 | 45.5 | RICH | 1139 | 222 | 193 | S.L. | 2250 | 38 | RICH | 809 | 204 | 177 | 2130 | 35 | NOR. | 535 | 199 | 173 |

| (.465 STAT.) (.404 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | PRESS ALT. FEET | MAXIMUM AIR RANGE R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 40000<br>35000<br>30000 | | | | | | |
| 2130 | 27 | NOR. | 562 | 209 | 181 | 25000<br>20000<br>15000 | 1850 | 24.5 | NOR. | 339 | 186 | 161 |
| 1850 | 28 | NOR. | 421 | 196 | 170 | 10000 | 1650 | 27 | NOR. | 328 | 180 | 156 |
| 1900 | 29.5 | NOR. | 396 | 184 | 160 | 5000 | 1600 | 27 | NOR. | 308 | 169 | 147 |
| 1800 | 31 | NOR. | 370 | 172 | 149 | S.L. | 1600 | 26.5 | NOR. | 257 | 141 | 122 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-1) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 90,000 LB. GROSS WEIGHT WITH 2000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 284 GAL.) TO FLY 1098 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 1600 RPM AND 27 IN. MANIFOLD PRESSURE WITH MIXTURE SET: NORMAL

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure A-2 (Sheet 4 of 4 Sheets). Flight Operation Instruction Chart—4 Engine

Appendix I of 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.

| AIRCRAFT MODEL JRM-1 | FLIGHT OPERATION INSTRUCTION CHART | EXTERNAL LOAD ITEMS NONE |
|---|---|---|
| ENGINE S : R-3350-8 | CHART WEIGHT LIMITS: 145,000 TO 130,000 POUNDS | NUMBER OF ENGINES OPERATING: 3 |

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 990 |

FOR DETAILS SEE POWER PLANT CHART (FIG. 3, SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)

| COLUMN I STATUTE | COLUMN I NAUTICAL | FUEL U.S. GAL. | COLUMN II STATUTE | COLUMN II NAUTICAL | COLUMN III STATUTE | COLUMN III NAUTICAL | COLUMN IV STATUTE | COLUMN IV NAUTICAL | FUEL U.S. GAL. | COLUMN V STATUTE | COLUMN V NAUTICAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2377 | 2063 | 10833 | 2929 | 2543 | 3543 | 3080 | 4265 | 3700 | 10833 | 4824 | 4190 |
| 2190 | 1901 | 10000 | 2670 | 2318 | 3231 | 2810 | 3848 | 3340 | 10000 | 4346 | 3770 |
| 1965 | 1706 | 9000 | 2359 | 2045 | 2805 | 2437 | 3348 | 2905 | 9000 | 3774 | 3275 |
| 1740 | 1510 | 8000 | 2048 | 1778 | 2379 | 2061 | 2848 | 2476 | 8000 | 3200 | 2780 |
| 1516 | 1316 | 7000 | 1762 | 1530 | 2012 | 1745 | 2371 | 2058 | 7000 | 2682 | 2330 |
| 1294 | 1123 | 6000 | 1501 | 1303 | 1703 | 1480 | 1948 | 1690 | 6000 | 2217 | 1922 |
| 1072 | 931 | 5000 | 1240 | 1076 | 1394 | 1210 | 1543 | 1340 | 5000 | 1752 | 1522 |
| 855 | 742 | 4000 | 972 | 844 | 1085 | 943 | 1203 | 1045 | 4000 | 1347 | 1168 |
| 638 | 552 | 3000 | 704 | 611 | 776 | 673 | 864 | 743 | 3000 | 942 | 818 |
| 424 | 368 | 2000 | 456 | 396 | 498 | 432 | 556 | 483 | 2000 | 592 | 514 |
| 212 | 184 | 1000 | 228 | 198 | 249 | 216 | 278 | 250 | 1000 | 296 | 257 |

COLUMN I: MAXIMUM CONTINUOUS

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | APPROX. T.A.S. MPH | APPROX. T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 | | | | | | |
| 35000 | | | | | | |
| 30000 | | | | | | |
| 25000 | | | | | | |
| 20000 | | | | | | |
| 15000 | 2400 | 41.5 | RICH | 840 | 171 | 148 |
| 10000 | 2400 | 43.5 | RICH | 840 | 174 | 151 |
| 5000 | 2400 | 42.5 | RICH | 825 | 184 | 161 |
| S.L. | 2400 | 45.5 | RICH | 855 | 181 | 157 |

COLUMN II: (228 STAT. (198 NAUT.) MI./GAL.)

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | APPROX. T.A.S. MPH | APPROX. T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 | | | | | | |
| 35000 | | | | | | |
| 30000 | | | | | | |
| 25000 | | | | | | |
| 20000 | | | | | | |
| 15000 | | | | | | |
| 10000 | | | | | | |
| 5000 | 2350 | 42 | RICH | 807 | 184 | 160 |
| S.L. | 2350 | 42.5 | RICH | 758 | 173 | 150 |

COLUMN III: (249 STAT. (215 NAUT.) MI./GAL.)

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | APPROX. T.A.S. MPH | APPROX. T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 | | | | | | |
| 35000 | | | | | | |
| 30000 | | | | | | |
| 25000 | | | | | | |
| 20000 | | | | | | |
| 15000 | | | | | | |
| 10000 | 2400 | 35.5 | RICH | 683 | 170 | 148 |
| 5000 | 2300 | 39 | RICH | 699 | 174 | 151 |
| S.L. | 2300 | 40 | RICH | 662 | 165 | 143 |

COLUMN IV: (278 STAT. (241 NAUT.) MI./GAL.)

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | APPROX. T.A.S. MPH | APPROX. T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 | | | | | | |
| 35000 | | | | | | |
| 30000 | | | | | | |
| 25000 | | | | | | |
| 20000 | | | | | | |
| 15000 | | | | | | |
| 10000 | | | | | | |
| 5000 | 2200 | 36 | NOR. | 572 | 159 | 138 |
| S.L. | 2200 | 37 | NOR. | 561 | 156 | 135 |

COLUMN V: MAXIMUM AIR RANGE

| PRESS ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | APPROX. T.A.S. MPH | APPROX. T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000 | | | | | | |
| 35000 | | | | | | |
| 30000 | | | | | | |
| 25000 | | | | | | |
| 20000 | | | | | | |
| 15000 | | | | | | |
| 10000 | | | | | | |
| 5000 | 2150 | 34.5 | NOR. | 500 | 147 | 128 |
| S.L. | 2150 | 36 | NOR. | 500 | 147 | 128 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-1) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 145,000 LB. GROSS WEIGHT WITH 9000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 976 GAL.) TO FLY 3774 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 2150 RPM AND 34.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: NORMAL

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure A-3 (Sheet 1 of 4 Sheets). Flight Operation Instruction Chart—3 Engine



Appendix I of 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.

| AIRCRAFT MODEL JRM-1<br>ENGINES: R-3350-8 | FLIGHT OPERATION INSTRUCTION CHART<br>CHART WEIGHT LIMITS: 130,000 TO 115,000 POUNDS | EXTERNAL LOAD ITEMS NONE<br>NUMBER OF ENGINES OPERATING: 3 |
|---|---|---|

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 990 |

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

| COLUMN I | | FUEL | COLUMN II | | COLUMN III | | COLUMN IV | | FUEL | COLUMN V | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | | RANGE IN AIRMILES | | RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | |
| STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL | STATUTE | NAUTICAL | STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL |
| | | | SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1] | | | | | | | | |
| 1847 | 1603 | 8333 | 2358 | 2047 | 2921 | 2538 | 3570 | 3100 | 8333 | 4036 | 3500 |
| 1547 | 1343 | 7000 | 1944 | 1687 | 2396 | 2080 | 2903 | 2520 | 7000 | 3320 | 2980 |
| 1322 | 1148 | 6000 | 1633 | 1418 | 1970 | 1710 | 2403 | 2085 | 6000 | 2747 | 2395 |
| 1097 | 952 | 5000 | 1322 | 1148 | 1544 | 1340 | 1903 | 1676 | 5000 | 2174 | 1885 |
| 875 | 760 | 4000 | 1061 | 921 | 1186 | 1028 | 1482 | 1288 | 4000 | 1709 | 1481 |
| 653 | 567 | 3000 | 800 | 695 | 877 | 761 | 1059 | 920 | 3000 | 1244 | 1080 |
| 434 | 377 | 2000 | 536 | 465 | 618 | 536 | 678 | 588 | 2000 | 810 | 703 |
| 217 | 188 | 1000 | 268 | 233 | 309 | 268 | 339 | 294 | 1000 | 405 | 352 |

| MAXIMUM CONTINUOUS | | | | | | PRESS ALT. FEET | (268 STAT. (233 NAUT.) MI./GAL.) | | | | | | (308 STAT. (268 NAUT.) MI./GAL.) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
| | | | | | | 40000 | | | | | | | | | | | | |
| | | | | | | 35000 | | | | | | | | | | | | |
| | | | | | | 30000 | | | | | | | | | | | | |
| | | | | | | 25000 | | | | | | | | | | | | |
| | | | | | | 20000 | | | | | | | | | | | | |
| 2400 | 41.5 | RICH | 840 | 191 | 166 | 15000 | 2300 | 35.5 | RICH | 612 | 164 | 142 | | | | | | |
| 2400 | 43.5 | RICH | 840 | 186 | 161 | 10000 | 2400 | 35 | RICH | 683 | 183 | 159 | 2250 | 34 | RICH | 567 | 175 | 152 |
| 2400 | 42.5 | RICH | 825 | 192 | 167 | 5000 | 2300 | 38 | RICH | 668 | 179 | 155 | 2200 | 35 | RICH | 548 | 169 | 147 |
| 2400 | 45.5 | RICH | 855 | 186 | 161 | S.L. | 2250 | 39 | RICH | 630 | 169 | 147 | 2200 | 36.5 | RICH | 522 | 161 | 140 |

| (339 STAT. (294 NAUT.) MI./GAL.) | | | | | | PRESS ALT. FEET | MAXIMUM AIR RANGE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
| | | | | | | 40000 | | | | | | |
| | | | | | | 35000 | | | | | | |
| | | | | | | 30000 | | | | | | |
| | | | | | | 25000 | | | | | | |
| | | | | | | 20000 | | | | | | |
| | | | | | | 15000 | | | | | | |
| 2130 | 32 | NOR. | 472 | 160 | 139 | 10000 | | | | | | |
| 2130 | 33.5 | NOR. | 463 | 157 | 136 | 5000 | 2100 | 33 | NOR. | 380 | 154 | 134 |
| 2130 | 35 | NOR. | 451 | 153 | 133 | S.L. | 2050 | 33 | NOR. | 343 | 139 | 121 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-1) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 120,000 LB. GROSS WEIGHT WITH 4000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 405 GAL.) TO FLY 1061 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 2300 RPM AND 38 IN. MANIFOLD PRESSURE WITH MIXTURE SET: RICH

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S.GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

*Figure A-3 (Sheet 2 of 4 Sheets). Flight Operation Instruction Chart—3 Engine*

Appendix I of 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.

AIRCRAFT MODEL
JRM-1

ENGINES: R-3350-8

# FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 115,000 TO 100,000 POUNDS

EXTERNAL LOAD ITEMS
NONE

NUMBER OF ENGINES OPERATING: 3

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 990 |

FOR DETAILS SEE POWER PLANT CHART (FIG. 3, (SECT. III))

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S.GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]

| COLUMN I RANGE IN AIRMILES STATUTE | COLUMN I NAUTICAL | FUEL U.S. GAL. | COLUMN II RANGE IN AIRMILES STATUTE | COLUMN II NAUTICAL | COLUMN III RANGE IN AIRMILES STATUTE | COLUMN III NAUTICAL | COLUMN IV RANGE IN AIRMILES STATUTE | COLUMN IV NAUTICAL | FUEL U.S. GAL. | COLUMN V RANGE IN AIRMILES STATUTE | COLUMN V NAUTICAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1305 | 1133 | 5833 | 1689 | 1465 | 2149 | 1865 | 2732 | 2365 | 5833 | 3073 | 2666 |
| 1117 | 970 | 5000 | 1430 | 1241 | 1837 | 1591 | 2315 | 2005 | 5000 | 2595 | 2253 |
| 892 | 774 | 4000 | 1119 | 971 | 1211 | 1050 | 1815 | 1575 | 4000 | 2022 | 1755 |
| 667 | 579 | 3000 | 808 | 701 | 985 | 855 | 1315 | 1140 | 3000 | 1449 | 1257 |
| 444 | 385 | 2000 | 522 | 453 | 618 | 536 | 846 | 734 | 2000 | 930 | 807 |
| 222 | 193 | 1000 | 261 | 227 | 309 | 268 | 423 | 367 | 1000 | 465 | 403 |

| MAXIMUM CONTINUOUS R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | PRESS ALT. FEET | COL. II (.261 STAT.) (.227 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | COL. III (.309 STAT.) (.268 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 40000 | | | | | | | | | | | | |
| | | | | | | 35000 | | | | | | | | | | | | |
| | | | | | | 30000 | | | | | | | | | | | | |
| | | | | | | 25000 | | | | | | | | | | | | |
| | | | | | | 20000 | | | | | | | | | | | | |
| 2400 | 41.5 | RICH | 840 | 201 | 174 | 15000 | 2300 | 36 | RICH | 740 | 193 | 168 | 2300 | 35.5 | RICH | 576 | 178 | 154 |
| 2400 | 43.5 | RICH | 840 | 193 | 168 | 10000 | | | | | | | 2200 | 34 | RICH | 602 | 186 | 161 |
| 2400 | 42.5 | RICH | 825 | 197 | 171 | 5000 | 2300 | 39.5 | RICH | 725 | 189 | 164 | 2200 | 35 | RICH | 572 | 177 | 153 |
| 2400 | 45.5 | RICH | 855 | 190 | 165 | S.L. | 2300 | 40.5 | RICH | 682 | 178 | 155 | 2200 | 37 | RICH | 547 | 169 | 147 |

| COL. IV (.423 STAT.) (.367 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | PRESS ALT. FEET | MAXIMUM AIR RANGE R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 40000 | | | | | | |
| | | | | | | 35000 | | | | | | |
| | | | | | | 30000 | | | | | | |
| | | | | | | 25000 | | | | | | |
| | | | | | | 20000 | | | | | | |
| | | | | | | 15000 | | | | | | |
| 2130 | 32 | NOR. | 411 | 174 | 151 | 10000 | 1900 | 28 | NOR. | 301 | 140 | 121 |
| 2130 | 33.5 | NOR. | 397 | 168 | 146 | 5000 | 2000 | 30 | NOR. | 318 | 148 | 128 |
| 2130 | 35 | NOR. | 380 | 161 | 140 | S.L. | 1900 | 31.5 | NOR. | 296 | 138 | 120 |

**SPECIAL NOTES**

[1] MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-1) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 150,000 LB. GROSS WEIGHT WITH 2000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 450 GAL.) TO FLY 930 STAT. AIRMILES AT 10,000 FT. ALTITUDE MAINTAIN 1900 RPM AND 28 IN. MANIFOLD PRESSURE WITH MIXTURE SET: NORMAL

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

*Figure A-3 (Sheet 3 of 4 Sheets). Flight Operation Instruction Chart—3 Engine*

Appendix I of 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.

Appendix I of 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.

| AIRCRAFT MODEL JRM-1 ENGINE S: R-3350-8 | FLIGHT OPERATION INSTRUCTION CHART | EXTERNAL LOAD ITEMS NONE |
|---|---|---|
| | CHART WEIGHT LIMITS: 100,000 TO DOWN POUNDS | NUMBER OF ENGINES OPERATING: 3 |

| LIMITS | R.P.M. | M.P. (IN.HG.) | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 990 |

FOR DETAILS SEE POWER PLANT CHART (FIG. 3, SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

| COLUMN I RANGE IN AIRMILES STATUTE | COLUMN I NAUTICAL | FUEL U.S. GAL. | COLUMN II RANGE IN AIRMILES STATUTE | COLUMN II NAUTICAL | COLUMN III RANGE IN AIRMILES STATUTE | COLUMN III NAUTICAL | COLUMN IV RANGE IN AIRMILES STATUTE | COLUMN IV NAUTICAL | FUEL U.S. GAL. | COLUMN V RANGE IN AIRMILES STATUTE | COLUMN V NAUTICAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING(1) | | | | | | | | |
| 750 | 651 | 3333 | 1036 | 899 | 1377 | 1195 | 1677 | 1455 | 3333 | 1910 | 1658 |
| 450 | 391 | 2000 | 622 | 540 | 852 | 740 | 1000 | 868 | 2000 | 1146 | 995 |
| 225 | 195 | 1000 | 311 | 270 | 426 | 370 | 500 | 434 | 1000 | 573 | 497 |

| MAXIMUM CONTINUOUS R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH. | T.A.S. MPH. | T.A.S. KTS. | PRESS ALT. FEET | (.311 STAT. (.270 NAUT.) MI./GAL.) R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH. | T.A.S. MPH. | T.A.S. KTS. | (.426 STAT. (.369 NAUT.) MI./GAL.) R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH. | T.A.S. MPH. | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 40000 | | | | | | | | | | | | |
| | | | | | | 35000 | | | | | | | | | | | | |
| | | | | | | 30000 | | | | | | | | | | | | |
| | | | | | | 25000 | | | | | | | | | | | | |
| | | | | | | 20000 | | | | | | | | | | | | |
| 2400 | 41.5 | RICH | 840 | 208 | 181 | 15000 | 2300 | 36 | RICH | 620 | 193 | 168 | | | | | | |
| 2400 | 43.5 | RICH | 840 | 199 | 173 | 10000 | 2300 | 34.5 | RICH | 624 | 194 | 168 | 2130 | 32 | NOR. | 427 | 182 | 158 |
| 2400 | 42.5 | RICH | 825 | 201 | 174 | 5000 | 2200 | 36.5 | RICH | 595 | 185 | 161 | 2130 | 33.5 | NOR. | 411 | 175 | 152 |
| 2400 | 45.5 | RICH | 855 | 193 | 168 | S.L. | 2200 | 37.5 | RICH | 560 | 174 | 151 | 2130 | 35 | NOR. | 390 | 166 | 144 |

| (.500 STAT. (.434 NAUT.) MI./GAL.) R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH. | T.A.S. MPH. | T.A.S. KTS. | PRESS ALT. FEET | MAXIMUM AIR RANGE R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH. | T.A.S. MPH. | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 40000 | | | | | | |
| | | | | | | 35000 | | | | | | |
| | | | | | | 30000 | | | | | | |
| | | | | | | 25000 | | | | | | |
| | | | | | | 20000 | | | | | | |
| | | | | | | 15000 | | | | | | |
| 2150 | 29.5 | NOR. | 334 | 167 | 145 | 10000 | 1600 | 27 | NOR. | 239 | 137 | 119 |
| 2000 | 31.5 | NOR. | 318 | 159 | 138 | 5000 | 1650 | 28.5 | NOR. | 242 | 139 | 121 |
| 1900 | 31.5 | NOR. | 294 | 147 | 127 | S.L. | 1600 | 29.5 | NOR. | 225 | 129 | 112 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-3) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 90,000 LB. GROSS WEIGHT WITH 1000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 142 GAL.) TO FLY 225 STAT. AIRMILES AT SL FT. ALTITUDE MAINTAIN 2400 RPM AND 45.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: RICH

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

*Figure A-3 (Sheet 4 of 4 Sheets). Flight Operation Instruction Chart—3 Engine*

# FLIGHT OPERATION INSTRUCTION CHART

| AIRCRAFT MODEL JRM-1 | EXTERNAL LOAD ITEMS NONE |
|---|---|
| ENGINE S: R-3350-8 | NUMBER OF ENGINES OPERATING: 2 |

CHART WEIGHT LIMITS: 130,000 TO 115,000 POUNDS

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 660 |

FOR DETAILS SEE POWER PLANT CHART (FIG. ) (SECT. III)

**INSTRUCTIONS FOR USING CHART:** SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

**NOTES:** COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)[1]. TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]

| COLUMN I RANGE IN AIRMILES STATUTE | COLUMN I NAUTICAL | FUEL U.S. GAL. | COLUMN II STATUTE | COLUMN II NAUTICAL | COLUMN III STATUTE | COLUMN III NAUTICAL | COLUMN IV STATUTE | COLUMN IV NAUTICAL | FUEL U.S. GAL. | COLUMN V STATUTE | COLUMN V NAUTICAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2197 | 1907 | 8333 | | | | | | | 8333 | 3100 | 2695 |
| 1826 | 1585 | 7000 | | | | | | | 7000 | 2448 | 2125 |
| 1548 | 1343 | 6000 | | | | | | | 6000 | 1960 | 1702 |
| 1270 | 1102 | 5000 | | | | | | | 5000 | 1472 | 1280 |
| 1001 | 869 | 4000 | | | | | | | 4000 | 1136 | 988 |
| 732 | 636 | 3000 | | | | | | | 3000 | 800 | 695 |
| 478 | 415 | 2000 | | | | | | | 2000 | 506 | 439 |
| 239 | 207 | 1000 | | | | | | | 1000 | 253 | 220 |

| MAXIMUM CONTINUOUS R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | PRESS ALT. FEET | COL. II ( STAT. ( NAUT.) MI./GAL.) R.P.M. | M.P. INCHES | MIXTURE | TOT. GPH | MPH | KTS. | COL. III ( STAT. ( NAUT.) MI./GAL.) R.P.M. | M.P. INCHES | MIXTURE | TOT. GPH | MPH | KTS. | COL. IV ( STAT. ( NAUT.) MI./GAL.) R.P.M. | M.P. INCHES | MIXTURE | TOT. GPH | MPH | KTS. | PRESS ALT. FEET | MAXIMUM AIR RANGE R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 40000 | | | | | | | | | | | | | | | | | | | 40000 | | | | | | |
| | | | | | | 35000 | | | | | | | | | | | | | | | | | | | 35000 | | | | | | |
| | | | | | | 30000 | | | | | | | | | | | | | | | | | | | 30000 | | | | | | |
| | | | | | | 25000 | | | | | | | | | | | | | | | | | | | 25000 | | | | | | |
| | | | | | | 20000 | | | | | | | | | | | | | | | | | | | 20000 | | | | | | |
| | | | | | | 15000 | | | | | | | | | | | | | | | | | | | 15000 | | | | | | |
| | | | | | | 10000 | | | | | | | | | | | | | | | | | | | 10000 | | | | | | |
| 2400 | 42.5 | RICH | 550 | 131.5 | 114 | 5000 | | | | | | | | | | | | | | | | | | | 5000 | | | | | | |
| 2400 | 45.5 | RICH | 569 | 141.5 | 123 | S.L. | | | | | | | | | | | | | | | | | | | S.L. | 2350 | 43 | RICH | 514 | 130 | 113 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-8) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 130,000 LB. GROSS WEIGHT WITH 7000 GAL. OF FUEL TO FLY 1826 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 2400 RPM AND 42.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: RICH

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure A-4 (Sheet 1 of 3 Sheets). Flight Operation Instruction Chart—2 Engine

Appendix I of 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.

Appendix 1 of 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.

AIRCRAFT MODEL JRM-1

ENGINE S : R-3350-8

# FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 115,000 TO 100,000 POUNDS

EXTERNAL LOAD ITEMS NONE

NUMBER OF ENGINES OPERATING: 2

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 660 |

FOR DETAILS SEE POWER PLANT CHART (FIG.) (SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[(1)] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[(1)] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

| COLUMN I | | FUEL | COLUMN II | | COLUMN III | | COLUMN IV | | FUEL | COLUMN V | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | | RANGE IN AIRMILES | | RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | |
| STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL | STATUTE | NAUTICAL | STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL |
| | | | SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[(1)] | | | | | | | | |
| 1600 | 1390 | 5833 | 1780 | 1545 | 1958 | 1700 | 2157 | 1870 | 5833 | 2468 | 2142 |
| 1367 | 1187 | 5000 | 1515 | 1315 | 1660 | 1440 | 1820 | 1570 | 5000 | 2060 | 1790 |
| 1089 | 945 | 4000 | 1198 | 1040 | 1303 | 1132 | 1420 | 1232 | 4000 | 1572 | 1367 |
| 811 | 704 | 3000 | 881 | 765 | 946 | 821 | 1018 | 883 | 3000 | 1084 | 942 |
| 538 | 457 | 2000 | 578 | 502 | 614 | 532 | 654 | 567 | 2000 | 672 | 584 |
| 269 | 234 | 1000 | 289 | 251 | 307 | 266 | 327 | 284 | 1000 | 336 | 292 |

| PRESS ALT. FEET | MAXIMUM CONTINUOUS R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | (289 STAT.) (251 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40000<br>35000<br>30000 | | | | | | | | | | | | |
| 25000<br>20000<br>15000 | | | | | | | | | | | | |
| 10000 | | | | | | | | | | | | |
| 5000 | 2400 | 42.5 | RICH | 550 | 154 | 133 | 2350 | 41 | RICH | 515 | 149 | 129 |
| S.L. | 2400 | 45.5 | RICH | 569 | 153 | 133 | 2350 | 42.5 | RICH | 498 | 144 | 125 |

| PRESS ALT. FEET | (307 STAT.) (266 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | (327 STAT.) (284 NAUT.) MI./GAL. R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40000<br>35000<br>30000 | | | | | | | | | | | | |
| 25000<br>20000<br>15000 | | | | | | | | | | | | |
| 10000 | | | | | | | | | | | | |
| 5000 | 2250 | 37.5 | RICH | 426 | 131 | 114 | | | | | | |
| S.L. | 2300 | 40 | RICH | 443 | 136 | 118 | 2200 | 37.5 | RICH | 382 | 125 | 108 |

| PRESS ALT. FEET | MAXIMUM AIR RANGE R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
|---|---|---|---|---|---|---|
| 40000<br>35000<br>30000 | | | | | | |
| 25000<br>20000<br>15000 | | | | | | |
| 10000 | | | | | | |
| 5000 | | | | | | |
| S.L. | 2050 | 33 | RICH | 348 | 117 | 101 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-4) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 110,000 LB. GROSS WEIGHT WITH 3000 GAL. OF FUEL TO FLY 1018 STAT. AIRMILES AT SL FT. ALTITUDE MAINTAIN 2200 RPM AND 37.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: RICH

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

Figure A-4 (Sheet 2 of 3 Sheets). Flight Operation Instruction Chart—2 Engine

| AIRCRAFT MODEL | FLIGHT OPERATION INSTRUCTION CHART | EXTERNAL LOAD ITEMS |
|---|---|---|
| JRM-1 | | NONE |
| ENGINE S : R-3350-8 | CHART WEIGHT LIMITS: 100,000 TO DOWN POUNDS | NUMBER OF ENGINES OPERATING: 2 |

| LIMITS | RPM | M.P. IN.HG. | BLOWER POSITION | MIXTURE POSITION | TIME LIMIT | CYL. TEMP. | TOTAL G.P.H. |
|---|---|---|---|---|---|---|---|
| WAR EMERG. | | | | | | | |
| MILITARY POWER | 2600 | 47.5 | LOW | RICH | 5 MIN | 260 °C | 660 |

FOR DETAILS SEE POWER PLANT CHART (FIG. 3, [SECT. III])

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

| COLUMN I | | FUEL | COLUMN II | | COLUMN III | | COLUMN IV | | FUEL | COLUMN V | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | | RANGE IN AIRMILES | | RANGE IN AIRMILES | | U.S. | RANGE IN AIRMILES | |
| STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL | STATUTE | NAUTICAL | STATUTE | NAUTICAL | GAL. | STATUTE | NAUTICAL |
| | | | SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[(1)] | | | | | | | | |
| 927 | 805 | 3333 | 1057 | 917 | 1190 | 1033 | 1340 | 1163 | 3333 | 1628 | 1412 |
| 556 | 483 | 2000 | 634 | 550 | 714 | 620 | 804 | 698 | 2000 | 976 | 847 |
| 278 | 741 | 1000 | 317 | 275 | 357 | 310 | 402 | 349 | 1000 | 488 | 423 |

| MAXIMUM CONTINUOUS | | | | | | PRESS | (317 STAT.) (275 NAUT.) MI./GAL. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
| | | | | | | 40000<br>35000<br>30000 | | | | | | |
| 2400 | 41.5 | RICH | 560 | 158 | 137 | 25000<br>20000<br>15000 | | | | | | |
| 2400 | 43.5 | RICH | 560 | 156 | 135 | 10000 | | | | | | |
| 2400 | 42.5 | RICH | 550 | 163 | 142 | 5000 | 2300 | 40 | RICH | 498 | 158 | 137 |
| 2400 | 45.5 | RICH | 569 | 160 | 139 | S.L. | 2300 | 41.5 | RICH | 473 | 150 | 130 |

| PRESS | (357 STAT.) (310 NAUT.) MI./GAL. | | | | | | (402 STAT.) (349 NAUT.) MI./GAL. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
| 40000<br>35000<br>30000 | | | | | | | | | | | | |
| 25000<br>20000<br>15000 | | | | | | | | | | | | |
| 10000 | 2350 | 34.5 | RICH | 417 | 149 | 129 | 2300 | 34 | RICH | 358 | 144 | 125 |
| 5000 | 2250 | 36.5 | RICH | 412 | 147 | 127 | 2200 | 35 | RICH | 353 | 142 | 123 |
| S.L. | 2200 | 38 | RICH | 406 | 141 | 122 | 2200 | 36.5 | RICH | 338 | 136 | 118 |

| PRESS | MAXIMUM AIR RANGE | | | | | |
|---|---|---|---|---|---|---|
| ALT. FEET | R.P.M. | M.P. INCHES | MIXTURE | APPROX. TOT. GPH | T.A.S. MPH | T.A.S. KTS. |
| 40000<br>35000<br>30000 | | | | | | |
| 25000<br>20000<br>15000 | | | | | | |
| 10000 | | | | | | |
| 5000 | 2130 | 33.5 | NOR. | 264 | 129 | 112 |
| S.L. | 2130 | 35 | NOR. | 262 | 128 | 111 |

**SPECIAL NOTES**

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. A-1) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

**EXAMPLE**

AT 95,000 LB. GROSS WEIGHT WITH 2000 GAL. OF FUEL TO FLY 804 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 2200 RPM AND 35 IN. MANIFOLD PRESSURE WITH MIXTURE SET: RICH

**LEGEND**

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.T. : FULL THROTTLE

DATA AS OF 7-30-47 BASED ON: WAC SP475A, 476A, 473A, 474B

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

*Figure A-4 (Sheet 3 of 3 Sheets). Flight Operation Instruction Chart—2 Engine*

Appendix I of 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.

Appendix I of 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.

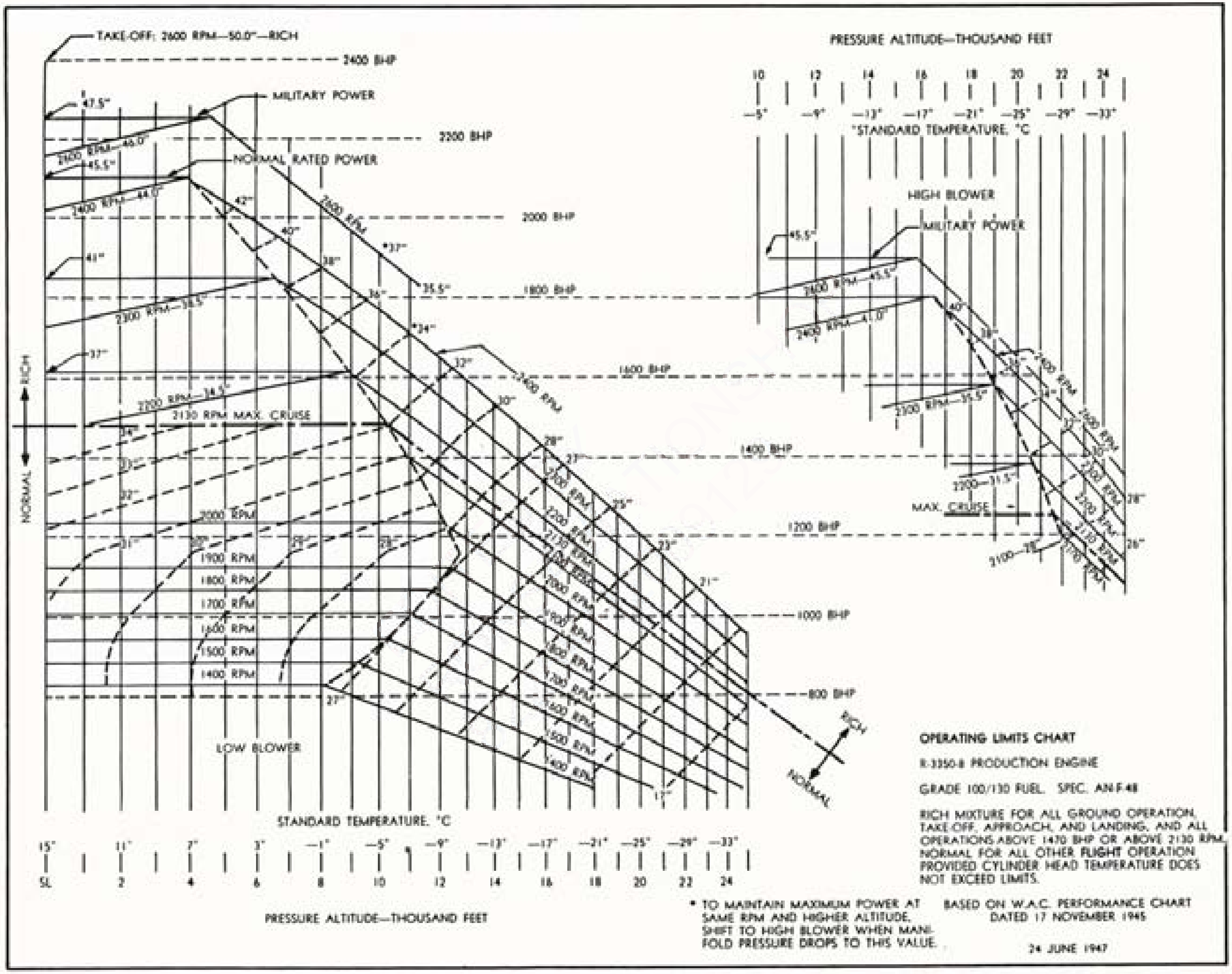



*Figure A-5. Engine Calibration Curve*