PILOT'S FLIGHT OPERATING INSTRUCTIONS

FOR

ARMY MODEL B-32 AIRPLANES

This publication contains specific instructions for pilots and should be available for Transition Flying Training as contemplated in AAF Reg. 50-16.

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.

Published under joint authority of the Commanding General, Army Air Forces, the Chief of the Bureau of Aeronautics, and the Air Council of the United Kingdom.

NOTICE: This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, 50 U. S. C., 31 and 32, as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

WF-4-17-45-7900

5 MARCH 1945
REVISED 10 MAY 1945

POLICY GOVERNING DISTRIBUTION AND USE OF THIS PUBLICATION

Instructions Applicable to Army Personnel:

1. This publication is intended for technical aid and education of military and civilian personnel engaged in promoting the war effort. Its maximum distribution and use is therefore encouraged. However, since the publication is "restricted" within the meaning of AR 380-5, the following security regulations will be observed:

a. *Members of Armed Forces and civilian employees of War Department* will be given access to this publication whenever required to assist in the performance of their official duties (including expansion of their knowledge of AAF equipment, procedures, etc.).

b. *Personnel of War Department contractors and subcontractors* may be given possession of this publication, on a loan basis, or knowledge of its contents, only when required to assist in the performance of War Department contracts. Releases will be made in accordance with the requirements of T. O. No. 00-5-2.

c. *Representatives of other governments* will be given possession of this publication, or knowledge of its contents, only in accordance with AAF Letter No. 45-6.

2. This publication is restricted because the information contained in it is restricted. It does not follow that the physical article to which it relates is also restricted. Classification of the materiel or component must be ascertained independently of the classification of this document.

3. Neither this publication nor information contained herein will be communicated to press or public except through Public Relations channels.

Instructions Applicable to Navy Personnel:

Navy Regulations, Article 76, contains the following statements relating to the handling of restricted matter:

"Par. (9) *(a)*. Restricted matter may be disclosed to persons of the Military or Naval Establishments in accordance with special instructions issued by the originator or other competent authority, or in the absence of special instructions, as determined by the local administrative head charged with custody of the subject matter."

"*(b)* Restricted matter may be disclosed to persons of discretion in the Government service when it appears to be in the public interest."

"*(c)* Restricted matter may be disclosed, under special circumstances, to persons not in the Government service when it appears to be in the public interest."

The Bureau of Aeronautics Aviation Circular Letter No. 90-44 contains the following paragraph relative to the use of aeronautical technical publications:

"Par. 8. *Distribution to All Interested Personnel.* In connection with the distribution of aeronautical publications within any activity, it should be borne in mind by the offices responsible for such distribution that technical publications, whether confidential or restricted, are issued for use not only by officer personnel, but also by responsible civilian and enlisted personnel working with or servicing equipment to which the information applies."

Disclosure of technical information in this publication may be made to representatives of foreign governments in instances where those foreign governments have been cleared to receive information concerning all equipment covered by this publication.

Instructions Applicable to British Personnel:

FOR OFFICIAL USE ONLY.—Not to be communicated to anyone outside of His Majesty's Service. Not to be published. The information given in this document is not to be communicated, either directly or indirectly, to the press or to any person not holding an official position in His Majesty's Service.

LIST OF REVISED PAGES ISSUED

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

Page No.	*Latest Revision Date*
40	10 May 1945

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

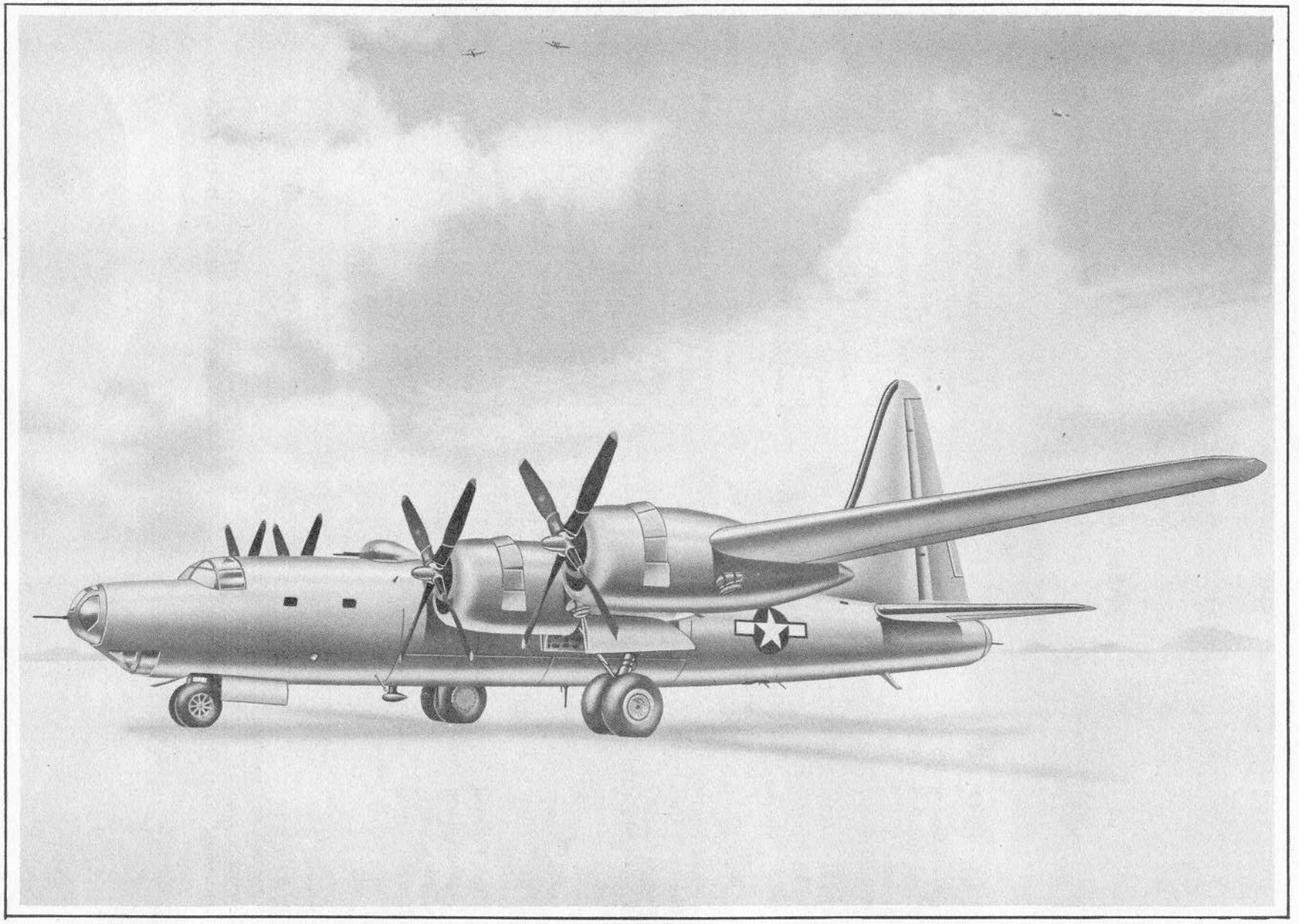
AAF ACTIVITIES.—In accordance with T. O. No. 00-5-2, base Air Inspectors, Technical will submit requisitions (AAF Form 104B) to:

Commanding General
Fairfield Air Technical Service Command
Patterson Field
Fairfield, Ohio
Attn: Publications Distribution Branch

NAVY ACTIVITIES.—Submit requests to Chief, BuAer, Navy Department, Washington, D. C., Attention: Publications Branch on order form NAVAER-140. For complete listing of available material and details of distribution see Naval Aeronautic Publications Index, NavAer 00-500.

BRITISH ACTIVITIES.—Submit requirements on Form 294A, in duplicate, to the Air Publications and Forms Store, New College, Leadhall Lane, Harrogate, Yorkshire, England.

TABLE OF CONTENTS



The B-32 Heavy Bombardment Airplane

SECTION I

Description

1. GENERAL DESCRIPTION.

The B-32, manufactured by Consolidated Vultee Aircraft Corporation, is an all-metal, high-wing, long-range, very heavy bombardment airplane. Its four Wright R-3350-23 air-cooled engines each deliver 2200 take-off horsepower at 2800 rpm. The airplane has a wing spread of 135 feet and a length of 83 feet. The fuselage is circular in section and is divided into a forward and aft cabin, between which are two bomb bays. The design gross weight of the airplane is 123,000 pounds, giving a wing loading of 70 pounds per square foot. It can be flown with gross weights up to 120,000 pounds with a maneuvering limit load factor of 2.0.

Flak blankets will be used for protection against gun fire. They may be hung where desired. Sections of the nacelle vulnerable to flak are built of heavy Alclad. Armor protection for turret gunners is illustrated in appendix I.

2. FLIGHT AND POWER PLANT CONTROLS.

a. THROTTLE CONTROL.—The throttle controls are dual and are on two control pedestals, one convenient to pilot and one to the copilot. These controls are conventional in operation.

b. SUPERCHARGER CONTROL. — The type B electronic turbosupercharger control installed in this airplane maintains desired carburetor inlet pressure and prevents the turbosuperchargers from exceeding their safe speed limits. This system also permits the pilot to control engine power with the throttles only. The turbosupercharger boost selector (T.B.S.) is mounted on the pilot's control pedestal just aft of the rudder trim tab knob. The T.B.S. is the control unit for the turbosuperchargers. Its dial is marked from "1" to "10" with the area from 8 to 10 banded red. Each mark is a relative position only and does not indicate absolute pressure values.

A latch stops the dial at "8" but it may be released to permit the control to be turned to "10."

Although the system is calibrated for take-off power at position "8," it may be necessary to operate in the red-lined area for normal rated power. This condition should not be viewed with alarm, as it is an inherent characteristic of the control system. Remember, the markings on the T.B.S. are only reference points, and the dial should be regulated as required to maintain desired manifold pressure.

c. MIXTURE CONTROLS.—The mixture controls are located on top of the copilot's control pedestal. They are conventional in operation. No mixture controls are provided for the pilot.

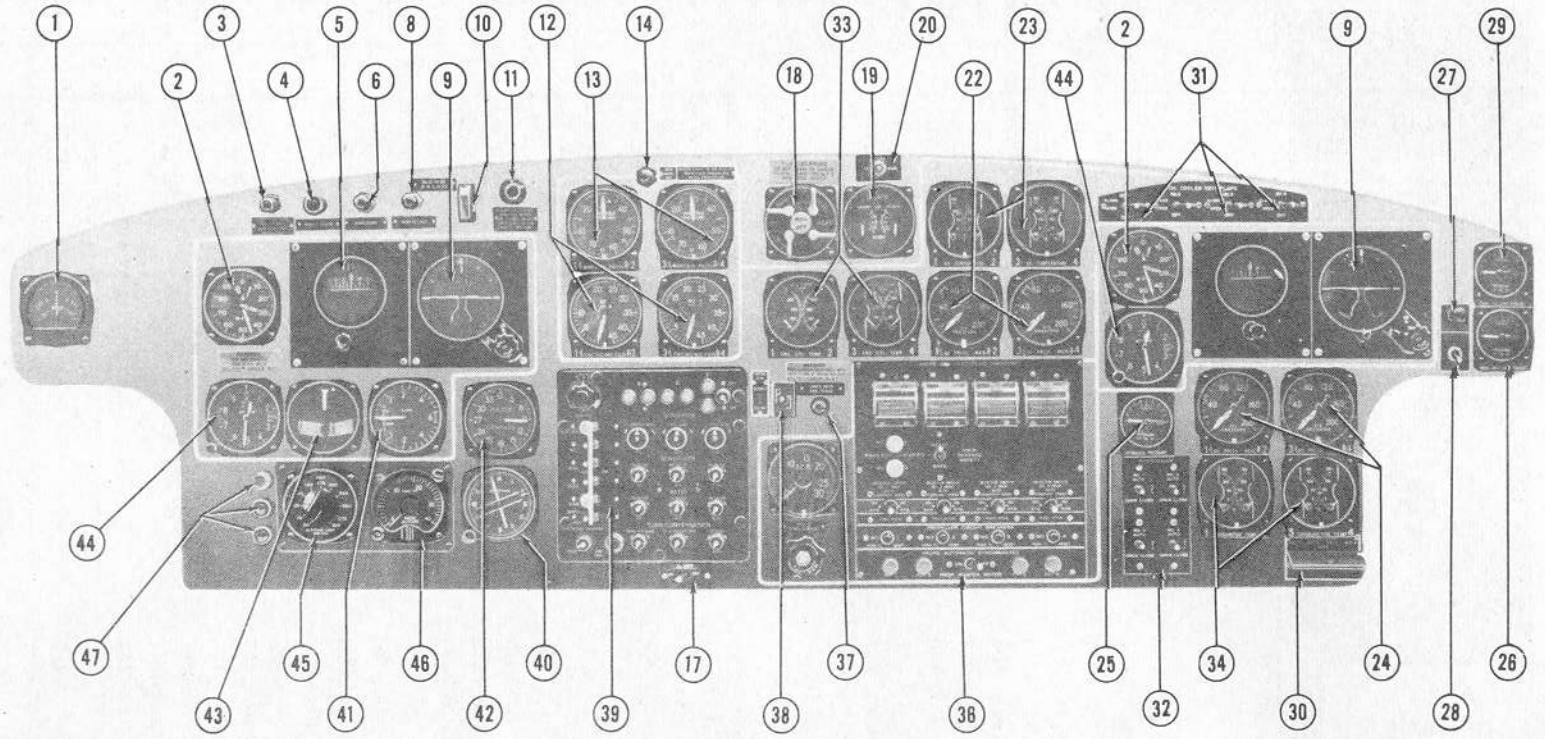
d. PROPELLER CONTROLS.—The propeller controls are located on the center of the instrument panel. Blade settings are limited to the following angles: high pitch 57 degrees, low pitch 17 degrees, reverse pitch −15.7 degrees. For complete operating instructions, see paragraph 3.*c.* of this section.

e. INTERCOOLER FLAP CONTROLS.—Four switches on the instrument panel to the left of the copilot's control column are provided for carburetor air temperature control. Each switch has three positions: "AUTO," "OPEN," and "CLOSE." When the switches are in the "AUTO" position, the intercooler flaps are automatically adjusted to maintain carburetor air temperature at a predetermined value. The switches can be held in the "OPEN" or "CLOSE" position to override the automatic control of the intercooler flaps.

f. COWL FLAP CONTROL.—The cowl flaps are controlled by four switches on the instrument panel to the left of the copilot's control column.

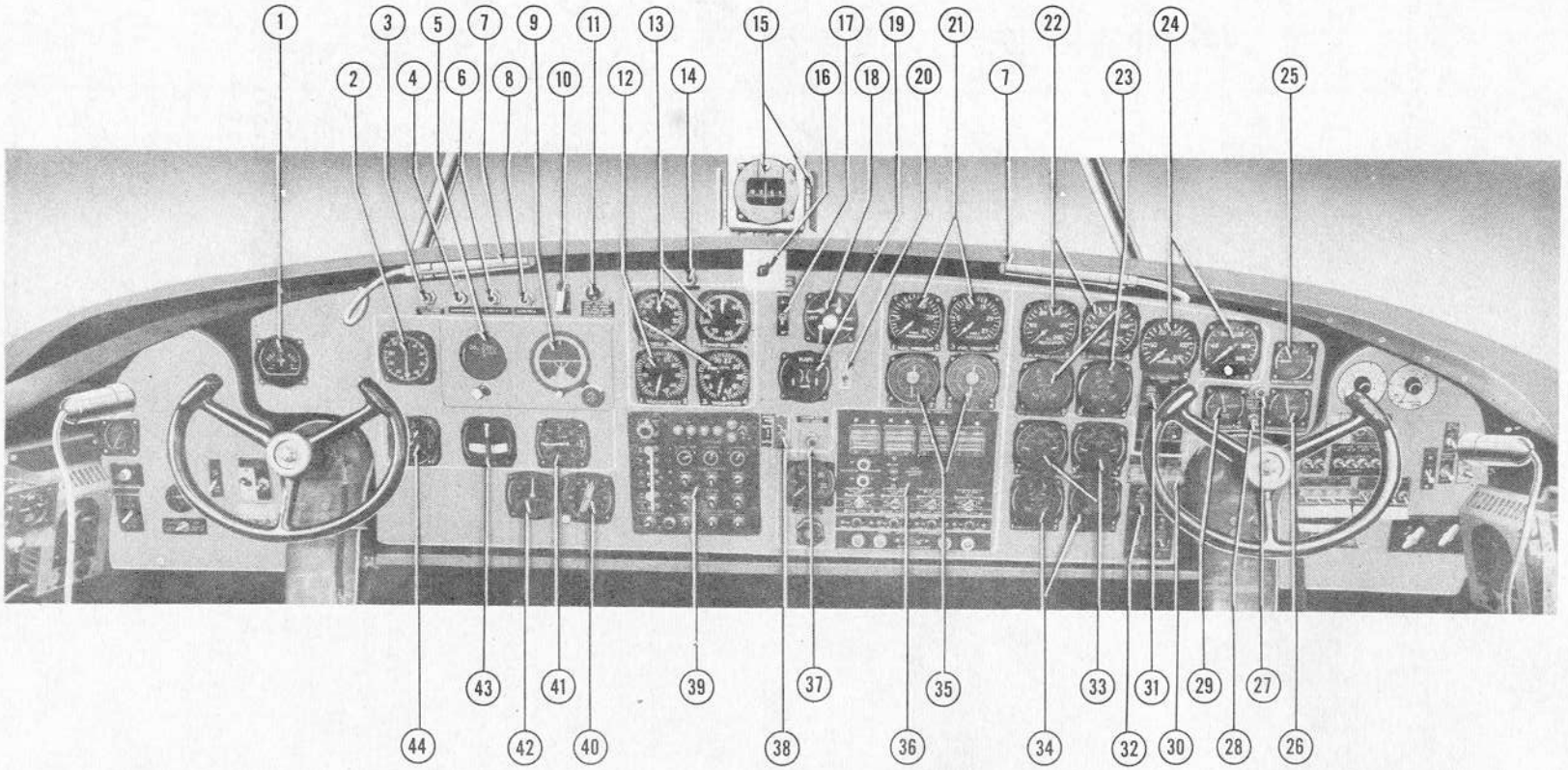
g. FUEL SYSTEM.—The controls for the fuel system are on top of the flight compartment directly over the copilot's station. For operation of the fuel system, see "Fuel System Management Chart" in section II of these instructions.

h. OIL COOLER CONTROLS.—Four switches on the instrument panel to the left of the copilot's con-



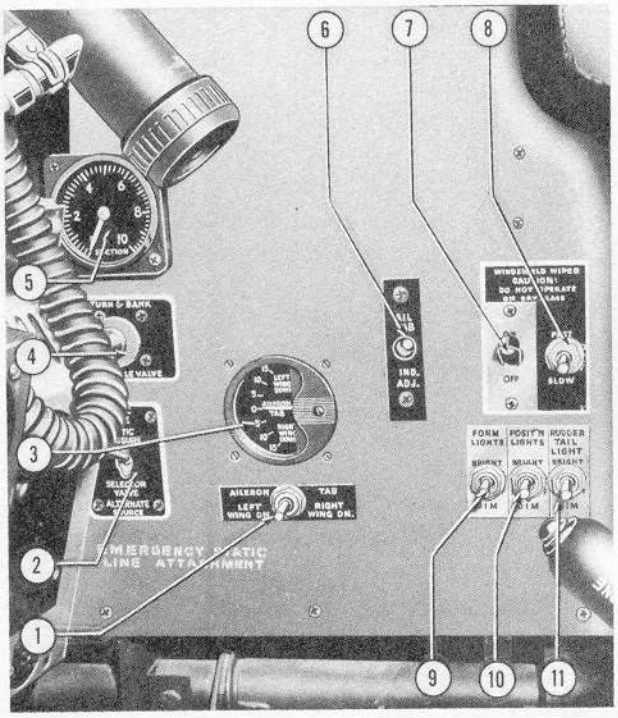
1. Pilot's Directional Indicator
2. Airspeed Indicator
3. Ball Turret Indicator Light
4. Marker Beacon
5. Turn Indicator
6. Bomb Door Indicator Light
7. AC Fluorescent Panel Lights (2) Not Shown
8. Bomb Release Indicator Light
9. Artificial Horizon
10. Bomb Salvo Switch
11. Salvo Indicating Light
12. Engine Tachometers
13. Manifold Pressure Gages
14. AC Power Failure Light
15. Magnetic Compass and Card Not Shown
16. Compass Light Rheostat Switch Not Shown
17. Alarm Bell Switch
18. Ignition Switch
19. Flap Position Indicator
20. Flap Switch
21. Fuel Pressure Gages Located on Sub-Panel
22. Main Oil Pressure Gages
23. Oil Temperature Gages
24. Nose Oil Pressure Gages
25. Hydraulic Pressure Gage
26. Outboard Brake Hyd. Pressure Gage
27. Brake Pressure Warning Light
28. Hydraulic Pump Override Switch
29. Inboard Brake Hyd. Pressure Gage
30. Cowl Flap Switches
31. Oil Cooler Flap Switches
32. Intercooler Flap Switches
33. Cylinder Head Temp. Gages
34. Carburetor Air Temp. Gages
35. Fuel Level Ind. Atop Copilot's Pedestal
36. Propeller Control Panel
37. Landing Gear Indicator Light
38. Landing Gear Switch
39. Automatic Pilot Control Panel
40. Fluxgate Repeater Ind. Compass
41. Rate-of-Climb Indicator
42. Radio Compass
43. Bank and Turn Indicator
44. Altimeter
45. Altitude Limit Switch (Radar)
46. Altitude Indicator (Radar)
47. Radar Indicator Lights (3)

Figure 1 — Pilot's and Copilot's Instrument Panel (Sheet 1 of 2 Sheets) (Prior to AAF No. 42-108525)



1. Pilot's Directional Indicator
2. Airspeed Indicator
3. Ball Turret Indicator Light
4. Marker Beacon
5. Turn Indicator
6. Bomb Door Indicator Light
7. AC Fluorescent Panel Lights (2)
8. Bomb Release Indicator Light
9. Artificial Horizon
10. Bomb Salvo Switch
11. Salvo Indicating Light
12. Engine Tachometers
13. Manifold Pressure Gages
14. AC Power Failure Light
15. Magnetic Compass and Card
16. Compass Light Rheostat Switch
17. Alarm Bell Switch
18. Ignition Switch
19. Flap Position Indicator
20. Flap Switch
21. Fuel Pressure Gages
22. Main Oil Pressure Gages
23. Oil Temperature Gages
24. Nose Oil Pressure Gages
25. Hydraulic Pressure Gage
26. Outboard Brake Hyd. Pressure Gage
27. Brake Pressure Warning Light
28. Hydraulic Pump Override Switch
29. Inboard Brake Hyd. Pressure Gage
30. Cowl Flap Switches
31. Oil Cooler Flap Switches
32. Intercooler Flap Switches
33. Cylinder Head Temp. Gages
34. Carburetor Air Temp. Gages
35. Fuel Level Indicators
36. Propeller Control Panel
37. Landing Gear Indicator Light
38. Landing Gear Switch
39. Automatic Pilot Control Panel
40. Fluxgate Repeater Ind. Compass
41. Rate-of-Climb Indicator
42. Radio Compass
43. Bank and Turn Indicator
44. Altimeter

Figure 1 — Pilot's and Copilot's Instrument Panel (Sheet 2 of 2 Sheets) (AAF No. 42-108525 and on)



1. Aileron Tab Switch
2. Static Pressure Selector Valve
3. Aileron Tab Position Indicator
4. Turn and Bank Needle Valve
5. Suction Gage
6. Aileron Tab Indicator Adjustment
7. Windshield Wiper Circuit Breaker
8. Windshield Wiper Switch
9. Formation Lights Switch
10. Position Lights Switch
11. Rudder Tail Light Switch

Figure 2 — Pilot's Auxiliary Panel

trol column provide for operation of the oil cooler flaps. Each switch has three positions, "AUTO," "CLOSE," and "OPEN."

When the switches are in the "AUTO" position the oil temperature is maintained at a predetermined value; when in the "OPEN" or "CLOSE" position the automatic control is over-ridden.

i. LANDING GEAR CONTROL. — The landing gear is controlled by a switch in the center of the instrument panel. It has three positions, "OFF," "EXTEND," and "RETRACT."

j. FLAP CONTROL.—The wing flaps are controlled by a switch on the instrument panel above the landing gear control switch. A position indicator is mounted to the left of the switch.

k. TRIM TAB CONTROLS.

(1) ELEVATOR TRIM TABS.—The elevator tabs are operated by two wheels, one on the outboard side of each control pedestal. They are conventional in operation.

(2) RUDDER TRIM TABS.—The rudder trim tab is controlled by knobs on top of the pilot's and copilot's control pedestals. Their operation is conventional.

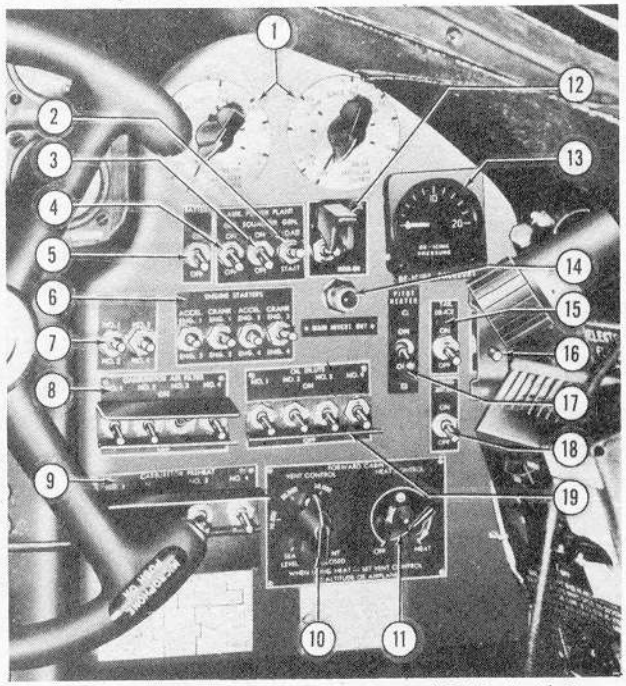
(3) AILERON TRIM TABS.—The aileron trim tabs are actuated by electric motors. The operating switch is on the instrument panel to the left of the pilot.

l. DE-ICING AND ANTI-ICING CONTROLS.

(1) WING ANTI-ICING. — Wing anti-icing is effected by heated air which is ducted along the interior of the wing leading edge. This air receives heat from the engine exhaust gas through heat exchangers located in the outboard nacelles. The wing anti-icing control switch is located on the right of the copilot's instrument panel.

WARNING

Engine No. 1 deices the left wing; engine No. 4 deices the right. Should either engine be inoperative, while icing conditions prevail, it may be necessary to shut off the system to



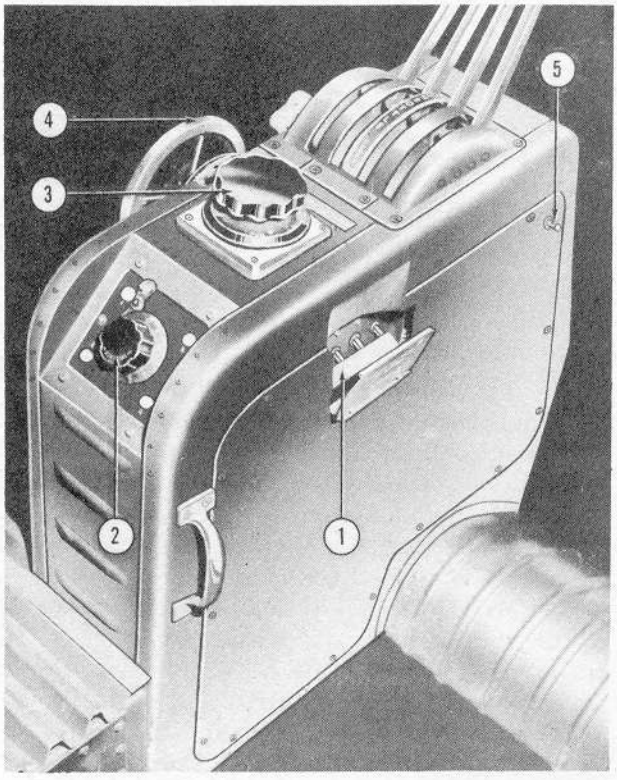
1. Anti-Icer Flow Controls
2. Auxiliary Power Plant Generator Switch
3. Auxiliary Power Plant Equalizer Switch
4. Auxiliary Power Plant Ignition Switch
5. Battery Switch
6. Engine Starters
7. Primers
8. Carburetor Air Filter Switches
9. Carburetor Pre-heat Switches
10. Forward Cabin Ventilating Control
11. Forward Cabin Heat Control
12. Inverter Switch
13. De-Icing Gage
14. Main Inverter Out Warning Light
15. Tail De-Icer Switch
16. Tail Anti-Icer Switch
17. Pitot Heater Switch
18. Wing Anti-Icer Switch
19. Oil Dilution Switches

Figure 3 — Copilot's Auxiliary Panel

avoid the dangerous condition that would be caused by ice accumulation on one wing and not on the other.

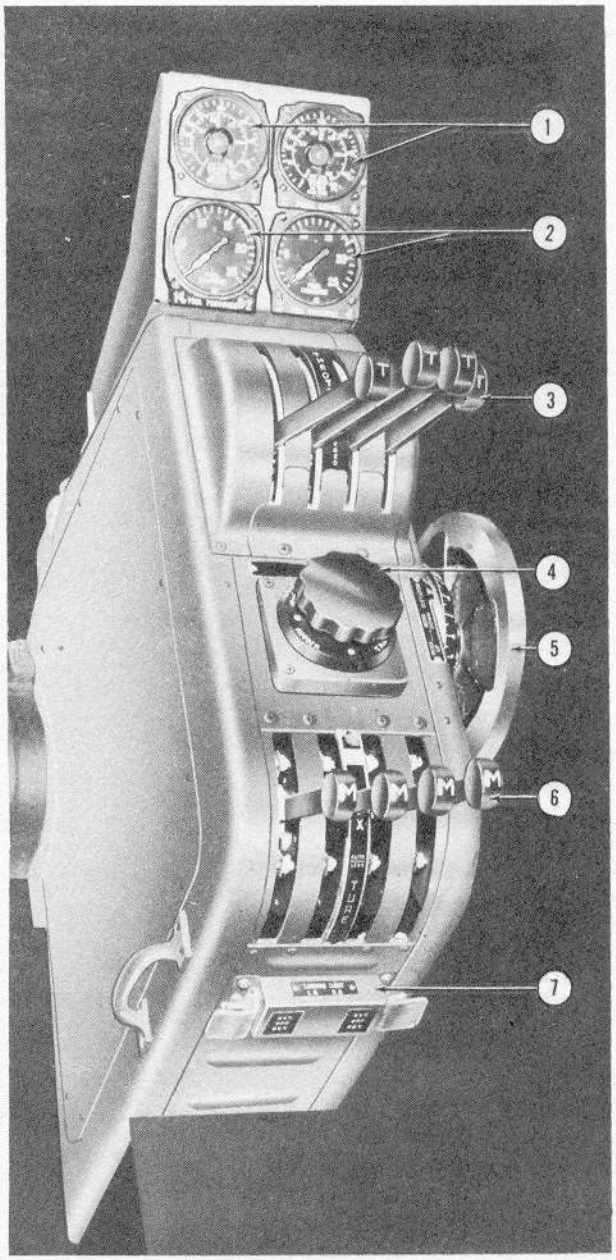
(2) EMPENNAGE DE-ICER.—De-Icer boots are installed on the empennage leading edges. A De-Icer pump is located in the aft cabin, forward of the stabilizer, and provides for the distribution of the air through tubing connected to the De-Icers. A toggle switch on the copilot's instrument panel or an auxiliary switch on the forward side of the pump will activate the De-Icer system.

(3) PROPELLER ANTI-ICER. — The propeller anti-icer system prevents ice accumulation on the propellers by pumping isopropyl alcohol through a distributing line from a tank located on the forward side of bulkhead 6.0 in the aft bomb bay to slinger rings and collectors which are integral parts of the propeller. At this point the fluid is spread along the surface of the propeller blades by centrifugal force. Two rheostats mounted on the copilot's instrument panel control the output of the pumps to obtain the desired amount of fuel flow.



1. Propeller Reverse Switches
2. Turbo Boost Selector
3. Rudder Tab Control
4. Elevator Tab Control
5. Throttle Warning Horn Switch

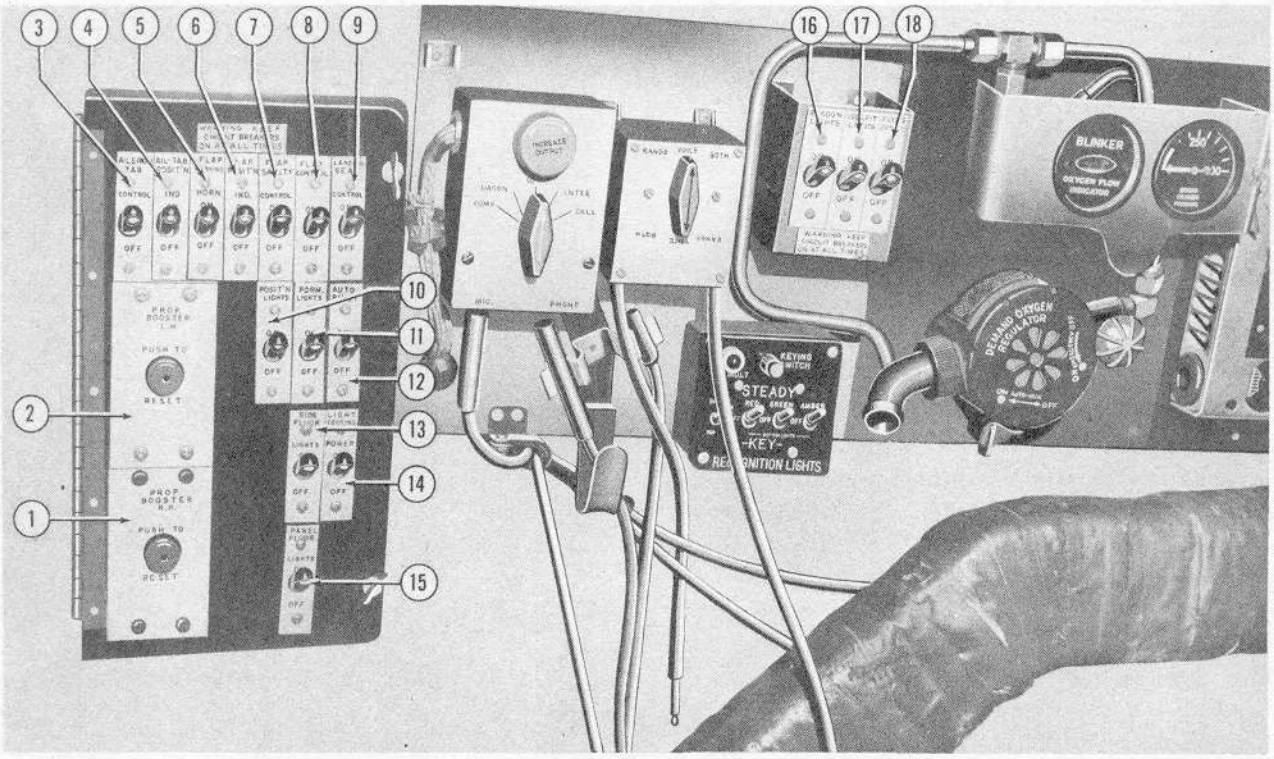
Figure 4 — Pilot's Control Pedestal



1. Dual Fuel Quantity Gages
2. Dual Fuel Pressure Gages
3. Throttles
4. Rudder Tab Control
5. Elevator Tab Control
6. Mixture Controls
7. Landing Lights Switches

Figure 5 — Copilot's Control Pedestal

(4) WINDSHIELD DE-ICING AND DEFROSTING.—The pilot's and copilot's windshield is of double-pane construction and is deiced and defrosted by heated air passing between the panes. All of the forward cabin heating air can be directed to the windshield by closing all other forward cabin heating outlets. Heated air blast tubes are provided for the bombardier's panel and the navigator's astro panel.



1. R. H. Prop Booster
2. L. H. Prop Booster
3. Aileron Tab Control
4. Aileron Tab Position Indicator
5. Flap Warning Horn
6. Flap Position Indicator
7. Flap Safety Control
8. Flap Control
9. Landing Gear Control
10. Position Lights
11. Formation Lights
12. Auto Pilot
13. Side Fluorescent Lights
14. Light Testing Power
15. Panel Fluorescent Lights
16. Recognition Lights
17. Cockpit Lights
18. Flying Suit Heater

Figure 6 — Pilot's Circuit Breaker Panel

m. AUTOMATIC PILOT—TYPE C-1.

(1) CONTROLS.—A panel in the center of the instrument panel holds the controls for the automatic pilot.

3. SYSTEMS.

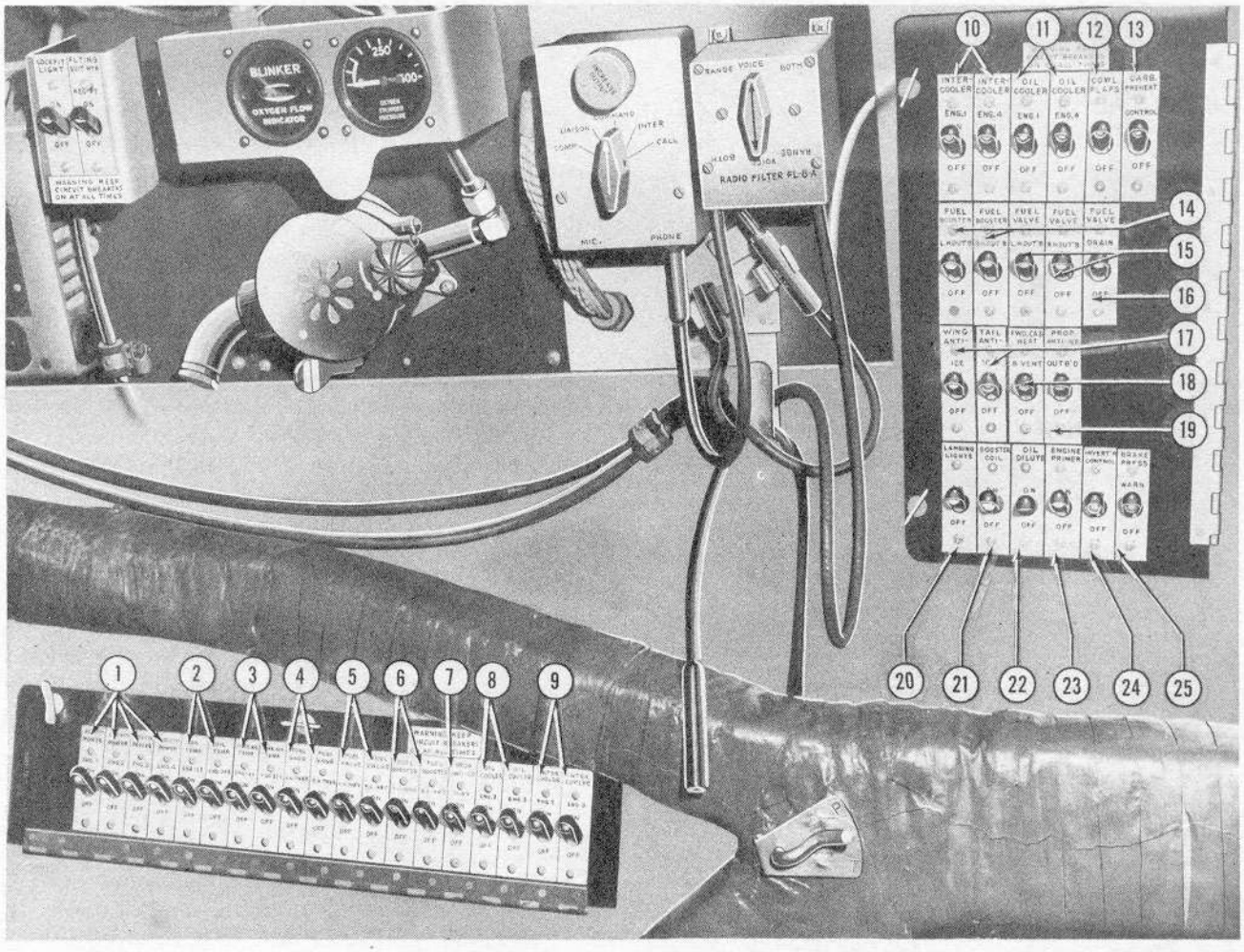
a. POWER PLANT.—The airplane is powered by four Wright R-3350-23, radial air-cooled, double-row, 18 cylinder engines. Each engine is equipped with a single-stage, single-speed, engine-driven integral supercharger with a gear ratio of 6.08:1. The propeller reduction ratio is 20:7 (.350). Each engine is equipped with the Chandler Evans carburetor, type 58-CPB-4, solenoid type priming valve, and a Scintilla magneto type DF-18LN-1. The engine is designed to use oil Specification No. AN-VV-O-446, grade 1120 and fuel Specification No. AN-F-28, grade 100/130.

b. COWL FLAPS.—The cowl flaps are actuated by an electric motor and a set of flexible shafts. The settings of the cowl flaps are from full-closed to 20 degrees open (30 degrees on later airplanes).

c. PROPELLERS.—The Curtiss electric propellers, type C-644S-A24, have four hollow steel blades with a diameter of 16 feet 8 inches.

The automatic propeller control system is used to synchronize the four engines at the desired speed by means of a proportional synchronizer and alternator.

The propellers are controlled by switches located on the main instrument panel. To operate the propeller automatically, place the propeller master motor switch in the "ON" position, turn the control knob until the desired rpm reading is indicated by the master motor tachometer. Place the selector switch for each propeller in the "AUTOMATIC" position. Four circuit breakers, for the automatic and manual propeller circuits, are located below the selector switches in place of fuses; they may be reset by pushing in on the buttons. Four feathering switches placed under Plexiglas guards are installed near the upper part of the propeller panel for feathering the propellers. The two circuit breakers, located to the left of the pilot's seat, are in the feathering, reverse, and return from reverse circuits, thus being independent from the automatic and manual propeller circuit. These circuit breakers



1. Autosyn Power
2. Oil Temperature Gages
3. Carburetor Air Temperature
4. Fuel Gages
5. Fuel Valves (Inboard)
6. Fuel Booster
7. Prop Anti-Icer Pump (Inboard)
8. Oil Cooler (Engines 2 and 3)
9. Intercooler (Engines 2 and 3)
10. Intercooler (Engines 1 and 4)
11. Oil Cooler (Engines 1 and 4)
12. Cowl Flaps
13. Carburetor Preheat Control
14. Fuel Booster (Outboards)
15. Fuel Valves (Outboards)
16. Fuel Valve (Drain)
17. Wing and Tail Anti-Icer
18. Forward Cabin Heat
19. Prop Anti-Icer (Outboard)
20. Landing Lights
21. Booster Coil
22. Oil Dilute
23. Engine Primer
24. Inverter Control
25. Brake Pressure Warning Signal

Figure 7 — Copilot's Circuit Breaker Panel

will be in operation only when the voltage booster is operating.

The reverse pitch will be used as a brake during landing; it reverses the two inboard propellers. To reverse the two inboard propellers place the throttles at idling (800 rpm), and mixture control in "AUTOMATIC RICH;" set the reverse pitch safety switch to "READY;" place the reverse normal switch, located behind a spring-loaded door on the inboard side of the pilot's pedestal, in "REVERSE" position. During the reversing operation, the throttle must be maintained so that the engine tachometer will not indicate less than 800 rpm at any time. When the reverse blade angle is reached, the reverse pitch amber tel-light will light; set the reverse safety switch to "SAFE" and operate the engines for braking. To return from reverse, operate the engines at idling (800 rpm) and set the reverse-normal switch to "NORMAL." When the green automatic light comes on, the blades will have reached the low blade angle and then only may normal operation be resumed.

d. SUPERCHARGER SYSTEM. — Each engine is equipped with two B-31 exhaust-driven turbosuperchargers. Minneapolis-Honeywell electronic regulators are provided to control the carburetor air inlet pressure.

Figure 8 — Automatic Pilot Controls Panel

e. FUEL SYSTEM.—The fuel valve control system is completely electrical with the exception of the manual drain valve in the forward bomb bay. Any set of tanks may be drained, or used to supply all engines if necessary. Fuel may be transferred from any set of tanks by operating the booster pump of the tanks to be drained and opening the ports of the fuel selector tanks to be filled. The control switch panel is mounted above and to the left of the copilot. The control switch knob is rotated clockwise or counterclockwise for selection of any desired position of the valve ports. All five switches must be operated to get the desired operating conditions unless the switch knob indicates that the ports are already in the desired position. All switches should be in the "OFF" position when the airplane is not in use. Each switch is composed of cam-operated switches mounted beside each other, with a ratchet device installed at the end of the cam to stop the knob at the intervals shown on the switch name plate. The valve ports are identified with numbers 1, 2, and 3. These ports are all wired the same with relation to the disconnect receptacle pin identification letters; that is, pins A, C, and E close ports 1, 2, and 3, respectively, while B, D, and F open ports 1, 2, and 3, respectively. For operating instructions see section II. A fuel system diagram may be found at the end of this section. (See figure 11 for fuel capacity.)

f. AUXILIARY POWER PLANT.—The auxiliary power plant, type D-2, located under the flight deck, consists of a four cycle, two cylinder engine, type V-32, which drives a 28.5 volt, 200 ampere generator, type P-2. The engine will deliver approximately 10 horsepower at sea level but this power output decreases with altitude. A manual altitude compensator located on the upper part of the power plant has a sea level, 5000 feet and 10,000 feet adjustment. The power plant's voltage regulator and reverse current relay are mounted to the right of the power plant. There are three switches installed on the copilot's auxiliary instrument panel for operation of the auxiliary power plant: the ignition, the equalizer, and generator switches. An additional ignition switch is mounted on the power plant itself. The throttle may be controlled on the power plant or remotely by a handle on the floor near the copilot's seat. The unit may be started electrically by the copilot or manually by the crew. Energy for electrical starting is provided by a 17 ampere battery located adjacent to the unit. A solenoid valve, located below the right inboard fuel cell, permits fuel to flow to the auxiliary power plant when its generator switch is in the "START" or "LOAD" position.

The function of the auxiliary power plant is to provide electric power for the airplane while it is on the ground and as a stand-by electric power source in flight and landing. It can be connected to the main direct current power system and operated in parallel with the four engine-driven generators by moving the "EQUALIZER" switch on the copilot's panel to the "ON" position.

g. ELECTRICAL SYSTEM.

NOTE

The switches and wiring for the control and indicating circuits of this airplane are located in a different manner than on other airplanes of the conventional type. They are so arranged by isolation, that damage to the right hand side of fuselage can affect only outboard engines and damage to left hand side of fuselage can affect only the inboard engines. Switches for engines 1 and 4 are generally on the right hand side of the pilot's compartment while switches for engines 2 and 3 are on the left hand side. This is accomplished by routing wiring for the outboard engines along right side of fuselage to front wing spar, where wiring for engine No. 1 crosses over to the left wing. Wiring for the inboard engines is routed along left side of fuselage to front wing spar and wiring for engine No. 3 crosses over to the right wing.

(1) The airplane is equipped with a direct current power system, utilizing the structure of the airplane for the negative return and insulated cables for the positive conductors. There is a complete ring of three conductors in parallel around the fuselage; also, this ring is interconnected adjacent to front spar in the fuselage with three parallel cables, forming a forward

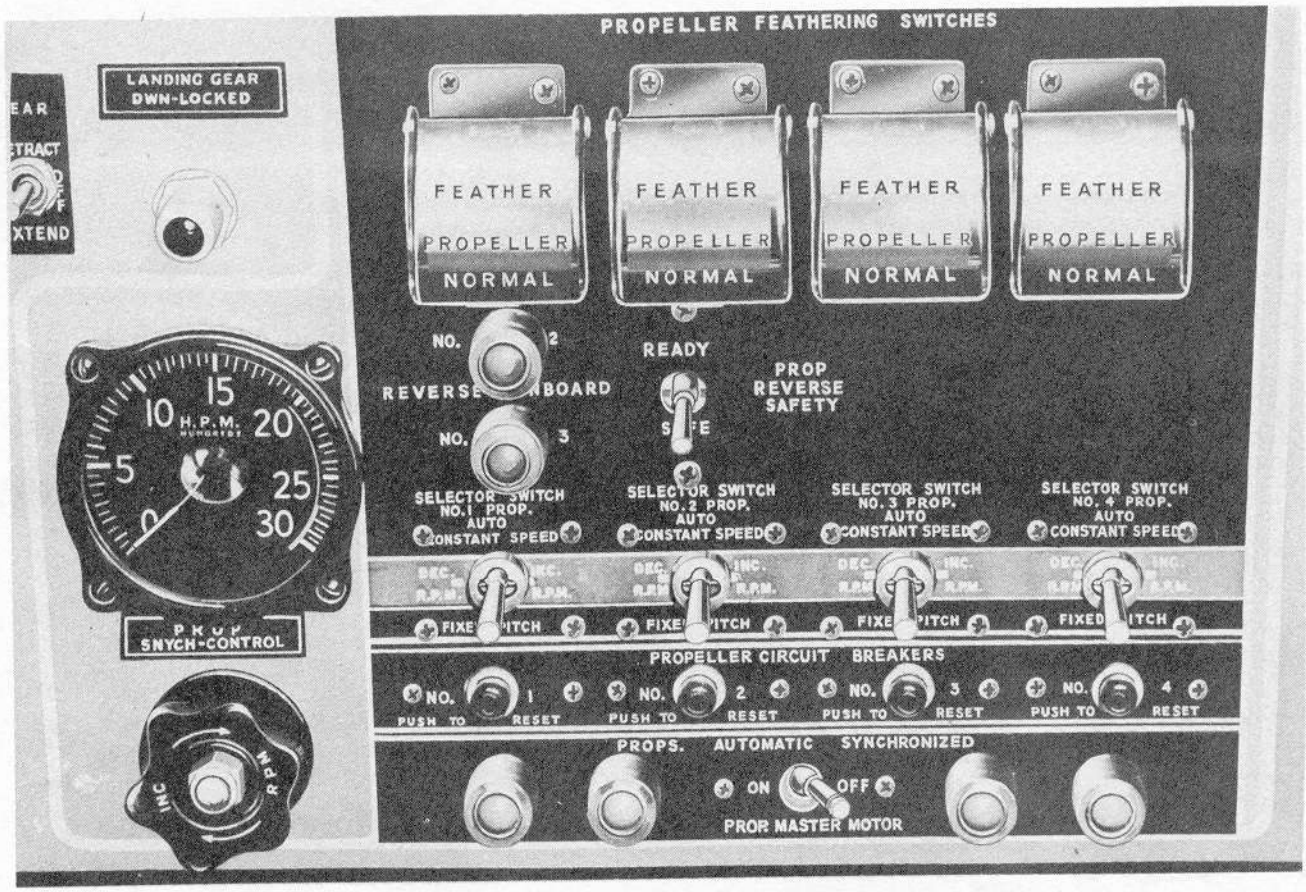


Figure 9 — Propeller Controls Panel

ring and an aft ring inside of the fuselage power loop. Any one of the three cables is capable of carrying the power load in case of an emergency.

Direct current is supplied by one 200-ampere generator on each outboard engine. These generators are equipped with a two-speed adapter drive which cuts in when engine speed drops to 1475 rpm and will furnish up to 200 amperes down to 800 rpm speed of the engine. The two-speed adapter drive disengages when engine rpm exceeds 1625. The inboard engines are each equipped with one 300-ampere generator. The total generator capacity at 28.5 volts is 28.5 KW. Generators have an overload capacity of 50 percent but this period should not exceed four minutes, otherwise serious damage may result to the generators. The direct-current power system is protected with current limiters instead of fuses. Current limiters operate by means of a thermal element carrying the current. Limiters time-current characteristic is therefore affected by the amount of current in the circuit when the overload or fault occurs.

EXAMPLE

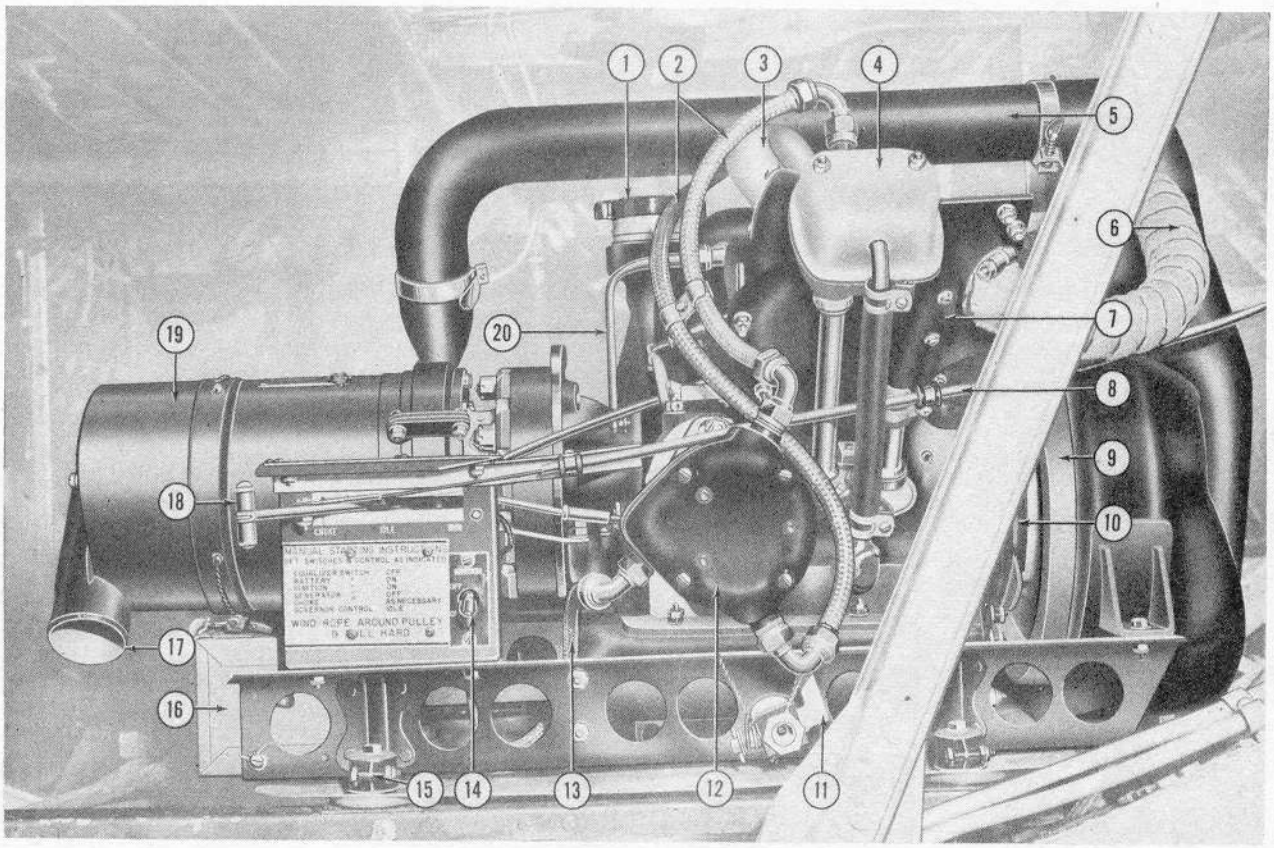
A 100-ampere current limiter will carry 300 amperes for two seconds, 200 amperes for 40 seconds, and 160 amperes continuously.

CAUTION

The auxiliary power unit must be running during all ground operation of the airplane or its equipment, and should be started at least ten minutes preceding take-off or landing so that it will have the necessary warm-up cycle before picking up the load required. It is also mandatory that the A.P.U. be running when the airplane is being taxied, because the brake accumulators are charged only by an electric-driven pump. The battery alone cannot be depended upon to supply sufficient power to keep the accumulators charged for more than five minutes of braking as required during taxiing.

IMPORTANT

The airplane has only one battery rated at 24 volts 17 ampere-hours. This capacity is so small that relatively little operation of any electrical equipment will completely dis-



1. Oil Filler Cap
2. Ignition Harness
3. Fuel Intake Pipe
4. Rocker Box Cover
5. Generator Cooling Tube
6. Exhaust Pipe
7. Cylinder Air Deflector
8. Choke and Throttle Control to Copilots Seat
9. Fly Wheel
10. Starting Rope Pulley
11. Oil Drain Valve
12. Magneto
13. Ignition Switch Harness
14. Ignition Switch
15. Engine Mount Bolts
16. Spare Parts Box
17. Cooling Air Exit
18. Throttle and Choke Control
19. Generator (Type R-1)
20. Fuel Line to Carburetor

Figure 10 — Auxiliary Power Plant

charge the battery. It is therefore necessary that if any electrical equipment is operated when the airplane is on the ground that the A.P.U. should be running or power should be supplied from an outside source.

(2) EXTERNAL POWER RECEPTACLE.—This receptacle is located in the nose wheel well, aft section, and is connected to fuselage power network through a solenoid switch.

(3) INVERTERS.—Two 400 cycle, 750-volt ampere inverters with a 26 and 115-volt a.c. output, and an input of 28.5 volts d.c. are installed just aft of the nose wheel well. The inverters are referred to as the MAIN and the SPARE unit. A double-throw switch with one momentary contact and one fixed contact is mounted on the copilot's auxiliary panel. The fixed contact side of the switch controls the operation of starting and stopping the MAIN inverter; the momentary contact is for testing the SPARE inverter. The a.c. voltage output from the inverters can be checked at the a.c. and d.c. power system panel, located at the right rear of the forward cabin on the bulkhead. A double-throw switch with one side for 26 volts a.c. and the other side 115 volts a.c. is located just to the left of the voltmeter with a single scale to indicate either of the two voltages.

An automatic change-over relay is incorporated in the system to change over to the SPARE inverter in case of a failure in the MAIN inverter. Two red failure signal lights have been installed with the automatic change-over relay. One light is mounted on the copilot's auxiliary panel near the inverter switch, and when a red signal is given, it indicates the failure of the MAIN inverter. The other red light is mounted on the pilot's instrument panel, adjacent to the manifold pressure gages and when it gives out a signal, it indicates that all a.c. power has failed.

b. LIGHTING SYSTEM.

(1) INTERIOR.

(a) BOMB BAY LIGHTING.—The bomb bay is equipped with ten dome lights, type A-9, and four spare bulbs. These lights can be switched on or off at the radio operator's equipment panel in the forward cabin or at the aft cabin's switch and circuit breaker panel.

(b) COCKPIT EXTENSION LIGHTS. — The cockpit is equipped with six extension lights located at the following stations:

Bombardier's
Copilot's
Forward Cabin Settee
Pilot's
Navigator's
Radio Operator's.

These lights are each protected with a circuit breaker mounted adjacent to the lights. Two spare bulbs are supplied and are stowed in a box at the radio operator's station.

(c) CABIN DOME LIGHTS. — The forward cabin is equipped with one dome light; the circuit is protected with a circuit breaker located in the circuit breaker and switch box at station 3.0. This light may be turned on or off from two switches; one located in the nose wheel well, and the other located in the forward cabin adjacent to the light. The auxiliary compartment, under the flight deck, between station 3.0 and 4.0 is equipped with a dome light. This circuit is protected with a circuit breaker located near the circuit breaker and switch box at station 3.0. This light may be turned on and off from two switches; one located in the nose wheel well, and the other at station 4.0 right hand switch panel, just forward of the bomb bay. The aft cabin is equipped with one dome light and is protected with a circuit breaker located at the aft cabin switch and circuit breaker panel. This light is controlled by two switches; one at the entrance to the aft cabin, and one at the aft cabin camera panel.

(d) NAVIGATOR'S TABLE LIGHT. — The navigator's table is equipped with one lamp assembly, type A-11. This lamp has a variable rheostat for dimming purposes, the current being supplied from the navigator's instrument panel and protected by a circuit breaker.

(e) D. C. FLUORESCENT LIGHTS.—The pilot's and copilot's stations are equipped with fluorescent lights fed from the pilot's circuit breaker panel; the bombardier's station is also equipped with a fluorescent light equipped with a head band, and fed from the bombardier's instrument panel. Circuit breakers protect the circuits.

(f) PILOT'S A. C. FLUORESCENT LIGHTS.—The pilot's instrument panel is equipped with two a.c. fluorescent lights. This circuit is fed from the 115-volt pilot's circuit breaker panel and is operated with a circuit breaker.

(g) PILOT'S COMPASS LIGHT.—The pilot's magnetic compass light is energized from the pilot's circuit breaker panel and is protected by a circuit breaker and controlled by a rheostat. A resistor is used to cut down the voltage.

i. FLIGHT CONTROLS. — Conventional, cable-operated, dual controls are provided for both pilot and copilot.

(1) RUDDER PEDAL ADJUSTMENT. — The pedal stirrups are adjustable for pilot leg length.

(2) AILERON TABS.—These surfaces alone are electrically controlled and operated. Both trim and balance deflections are incorporated.

The trim tab mechanism consists of an electric motor and position transmitter assembly housed in the aileron. The motor produces trim deflection through a screw mechanism and push-pull tube attached to the tab. Motor operation is controlled by a toggle switch with reference to a tab position indicator, both located on the pilot's left instrument panel.

Balance tab deflection automatically accompanies aileron deflection by nature of the tab linkage hookup. It is equal to and opposite to the aileron deflection.

(3) RUDDER TAB. — Tab control wheels are mounted on top of both the pilot's and copilot's control pedestals (figure 5), and are interconnected.

The tab linkage incorporates automatic balance deflection of the rudder tab.

Rudder trim is capable of reducing the control force to zero with any one engine inoperative at any speed above 125 percent of stalling speed, with remaining engines delivering normal rated power.

(4) ELEVATOR TAB. — Both control pedestals house interconnected elevator tab control wheels on their outboard faces.

The elevator tab provides no balance deflection.

(5) CONTROLS LOCK.—A controls lock lever, located forward and to the left of the pilot, locks the rudder, elevator, and aileron in this sequence at about one-third intervals of the lever arc. The aileron and rudder lock in neutral position; the elevator locks in "full-down" position.

To lock the surfaces, pull out the spring-loaded handle sleeve and swing it upward. At one-third inter-

vals manipulate the rudder in neutral until the lock pin engages, then the elevator in "down" position, and finally the ailerons in neutral position. Release the handle in "full-up" position after the lock clip has been inserted below the handle sleeve.

In locked position, the lever lies across the rudder pedals restricting the use of the pedals, making it apparent to the pilot that the controls lock is engaged.

(6) PARKING BRAKES.—The brake pedals are installed just above the rudder pedals, and pivot from the same torque tube. The brake lock lever projects aft at the bottom of the pilot's instrument panel at his right and left pedal linkage.

To set parking brakes, depress the pedals fully, pull out on the lock levers and release the brakes. The pedals should remain in the depressed position when the parking brakes are "ON."

CAUTION

Check the brake pressure gages for at least 850 pounds pressure reading.

j. HYDRAULIC SYSTEM. — Hydraulic power is used on this airplane for operation of the landing gear, bomb bay doors, inboard and outboard wing flaps, and brakes. A separate manual system is provided for retraction of the belly turret. This airplane is provided with a main (open-center) system for normal operation, an emergency system for use in the event of main system failure, a brake system, and a turret system. The main system supplies pressure fluid for a landing gear, a bomb bay door, and a flap system. Operation of any of these systems is controlled by a solenoid-operated multiple selector valve which directs flow of fluid from the open-center system to the actuating mechanism. Control switches are mounted on the pilot's and bombardier's instrument panels. (See figure 1.)

A switch located near the center of the main instrument panel electrically controls the landing gear hydraulic main selector valve. A limit switch located on the torsion link assembly of the left landing gear prevents the retraction of the gear by use of the selector control switch while the airplane is resting on the gear.

A switch located near the center of the main instrument panel electrically controls the flap unit of the hydraulic main selector valve.

Relief valves incorporated in the flaps-up hydraulic system are provided to prevent damage to the flap structure in the event that the hydraulic selector valve fails to return to neutral at the end of flap retraction.

In order to prevent a take-off without sufficient flap extension, a warning horn is provided. This horn will sound if the engine throttles are advanced more than two-thirds of their full travel and the flap extension is less than 18 degrees.

CAUTION

Flaps should not be lowered at air speeds in excess of 190 miles per hour indicated air speed.

A switch, located on the bombardier's control panel, electrically controls the bomb door unit of the hydraulic main selector valve.

The brake system consists of two separate accumulator systems, so that failure of one system will not result in total brake failure. The accumulators supply fluid under pressure to two brake control valves. The left accumulator supplies fluid to the forward brake valve which controls the inboard brakes of all main landing gear wheels. (Inboard and outboard brake designation is with reference to the main landing gear strut.)

Similarly, the right accumulator supplies pressure fluid to the aft brake valve controlling the outboard brakes on all main landing gear wheels. Each wheel contains two expander-tube brake assemblies, or a total of eight brake assemblies for the four main wheels.

Each brake valve consists of two independent control units, each unit operating two brake expander tube assemblies.

The brake valves are mechanically interconnected so that pressure on the right hand brake pedal of either pilot's or copilot's station will actuate all brake assemblies of the right landing gear.

The accumulators are kept charged by an electric motor-driven hydraulic pump, which is automatically turned on by a pressure control switch when the accumulators pressure falls below 850 pounds per square inch. Warning light will glow when pressures fall below 650 pounds per square inch.

Two brake pressure gages on the copilot's instrument panel indicate the available accumulator pressure for the brake operation. The "INBOARD BRAKE PRESSURE" gage indicates pressure in the left accumulator. The "OUTBOARD BRAKE PRESSURE" gage indicates pressure in the right accumulator.

In the event of pressure control switch or switch-over valve switchette failure, an over-ride switch is provided. This unit is located beneath the accumulator warning light on the copilot's panel and when actuated, it over-rides all switches in the electric-driven pump circuit except the circuit breaker, thereby causing the electric-driven pump to operate continuously to provide pressure in the event of pressure control failure.

k. CABIN HEATING AND VENTILATING SYSTEM.—Cabin heat is derived from rammed air, heated in primary heat exchangers in each inboard nacelle, and led to secondary heat exchangers in the cabin. The heated air is then distributed throughout the cabin by a system of ducts for cabin heating and defrosting of windshields and turrets.

Vents located over the forward heat exchanger and aft at the stabilizer control the ventilating air flow through the cabin.

Rheostats designated with "OFF," "HEAT," and "OFF," "VENT" are located on the copilot's auxiliary instrument panel for controlling heating and ventilating in the forward cabin and on the aft left hand settee equipment panel for controlling the ventilating and heating in the aft cabin.

The "VENT" rheostats read in altitude and should be set to the prevailing altitude of flight.

Manual controls regulate the heat output at the individual outlets installed in the ducting.

WARNING

During combat if both primary and secondary exchangers are damaged, shut off the system to prevent the distribution of exhaust gases in the cabin.

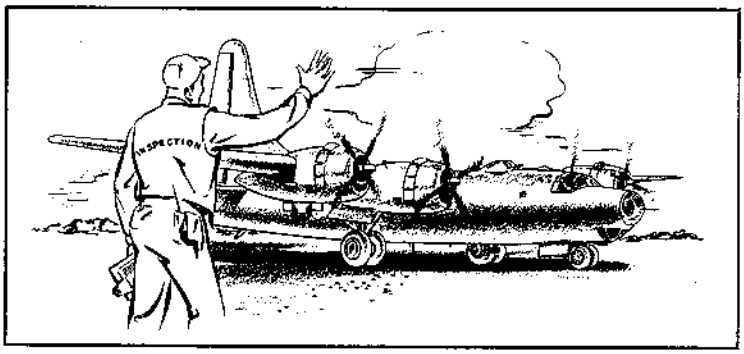
l. WINDSHIELD WIPER CONTROL.—Windshield wipers are mounted on the bombardier's, pilot's, and copilot's windshields. Operation of the pilot's and copilot's windshield wiper is controlled by a switch on the pilot's auxiliary panel. The bombardier's switch is located on the bombardier's panel.

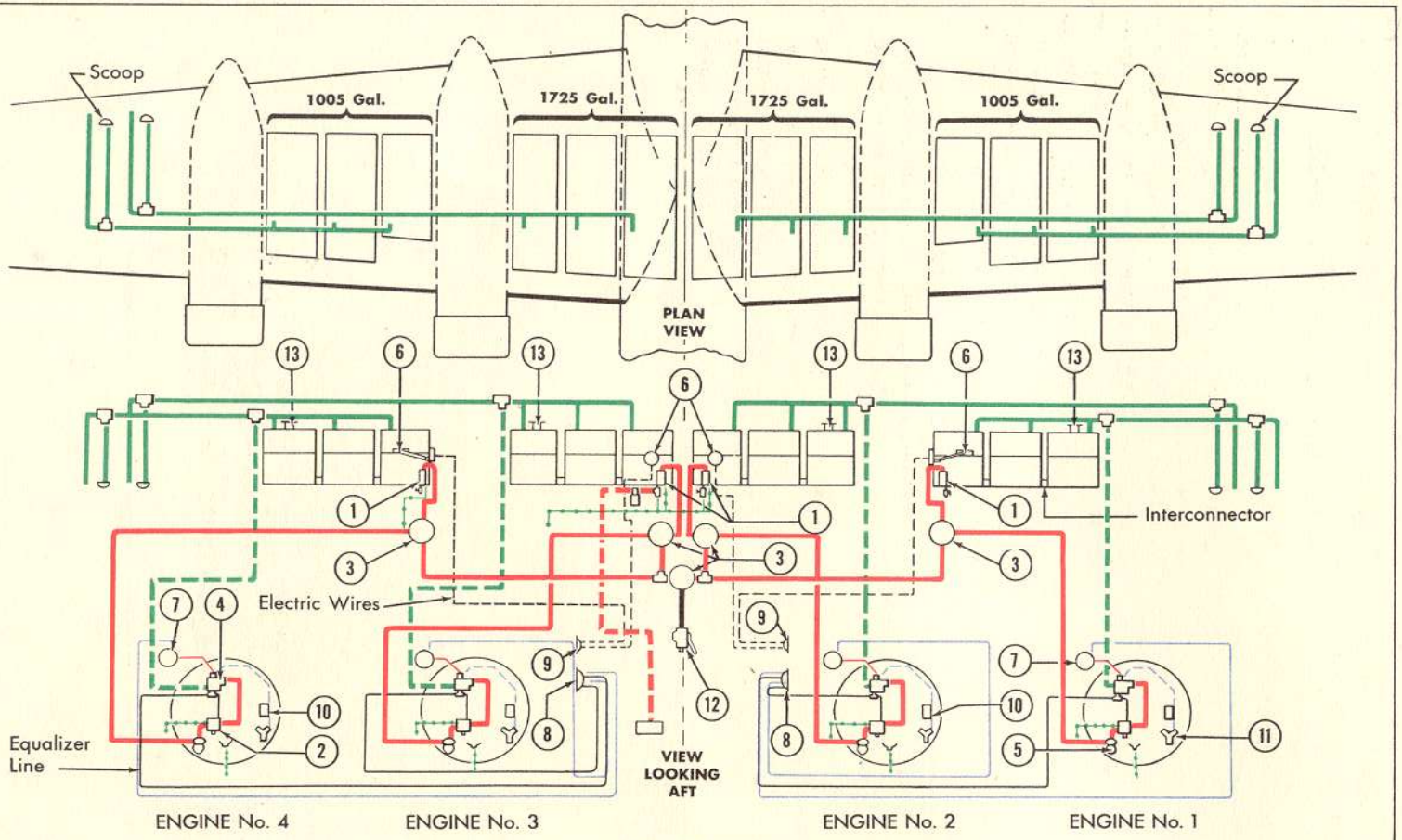
4. MOVEMENT OF FLIGHT PERSONNEL.

The fuselage is divided into eight compartments: the nose compartment, nose wheel well compartment, forward accessory compartment, flight deck, bomb bays, aft accessory compartment, aft cabin compartment, and tail compartment. Passages permit movement of crew members to and from the nose compartment, nose wheel well compartment, forward accessory compartment, flight deck, bomb bays, aft cabin compartment, and tail compartment. The catwalk extending through the bomb bays provides passage between the forward and aft compartments.

NOTE

Certain airplanes will be delivered without armament and radar equipment. In order to compensate for the effect of this deletion upon the airplanes center of gravity, ballast is installed as follows: 700 pounds in the fuselage just aft of the tail. This ballast shall not be removed as long as these airplanes are operated without armament and radar equipment.





LEGEND

1. Electric Booster Pumps (4)
2. Engine Driven Fuel Pumps (4)
3. Fuel Selector Valves (5)
4. Carburetors
5. Strainers (4)
6. Liquidometers (4)
7. Fuel Pressure Transmitters (4)

LEGEND

8. Fuel Pressure Gages (Dual) (2)
9. Fuel Quantity Gages (Dual) (2)
10. Oil Dilution Solenoid Valves (4)
11. Oil Drain Valves (4)
12. Manual Fuel Drain Valve
13. Filler Necks (4)

Figure 11 — Fuel System Diagram

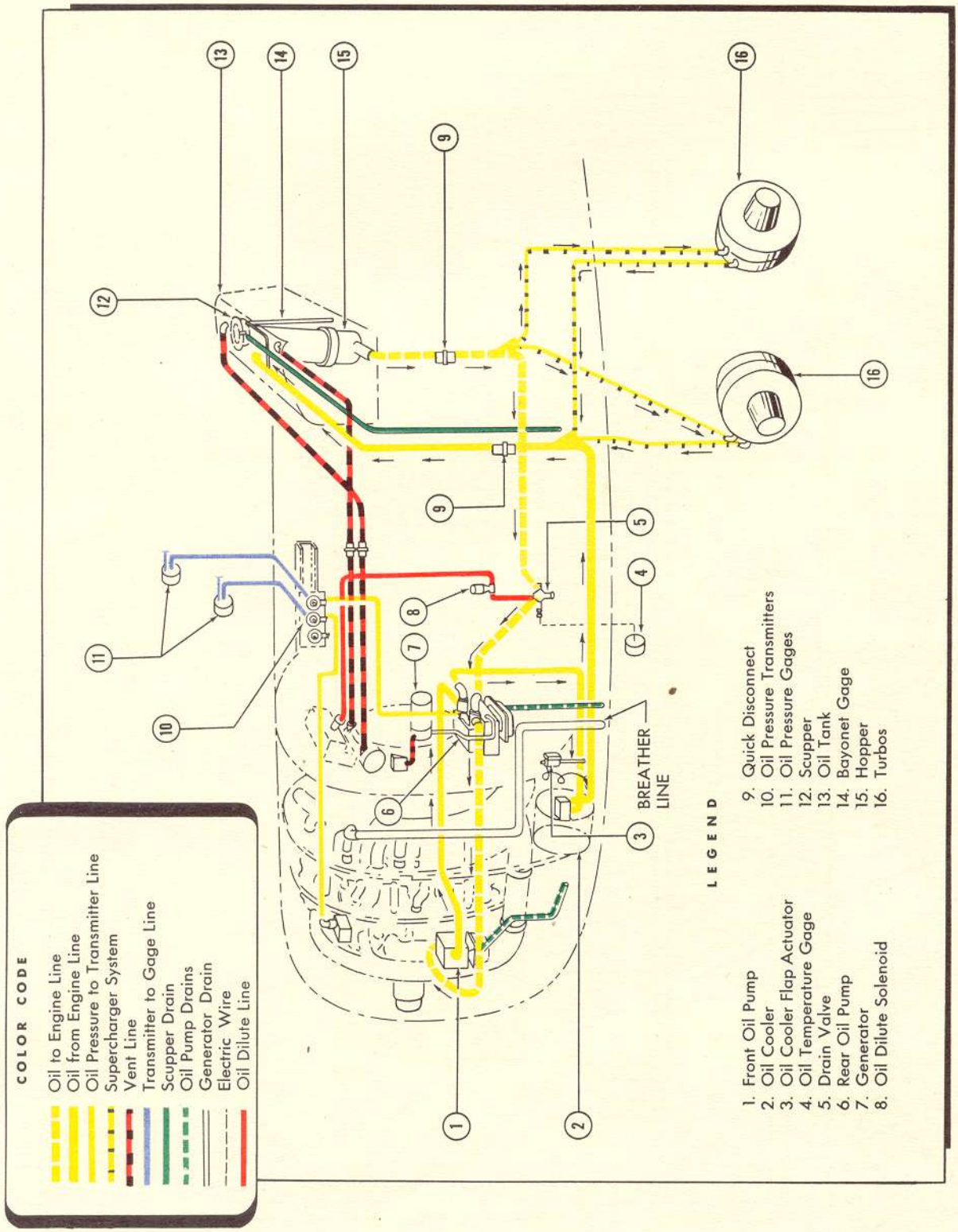


Figure 12 — Oil System Diagram

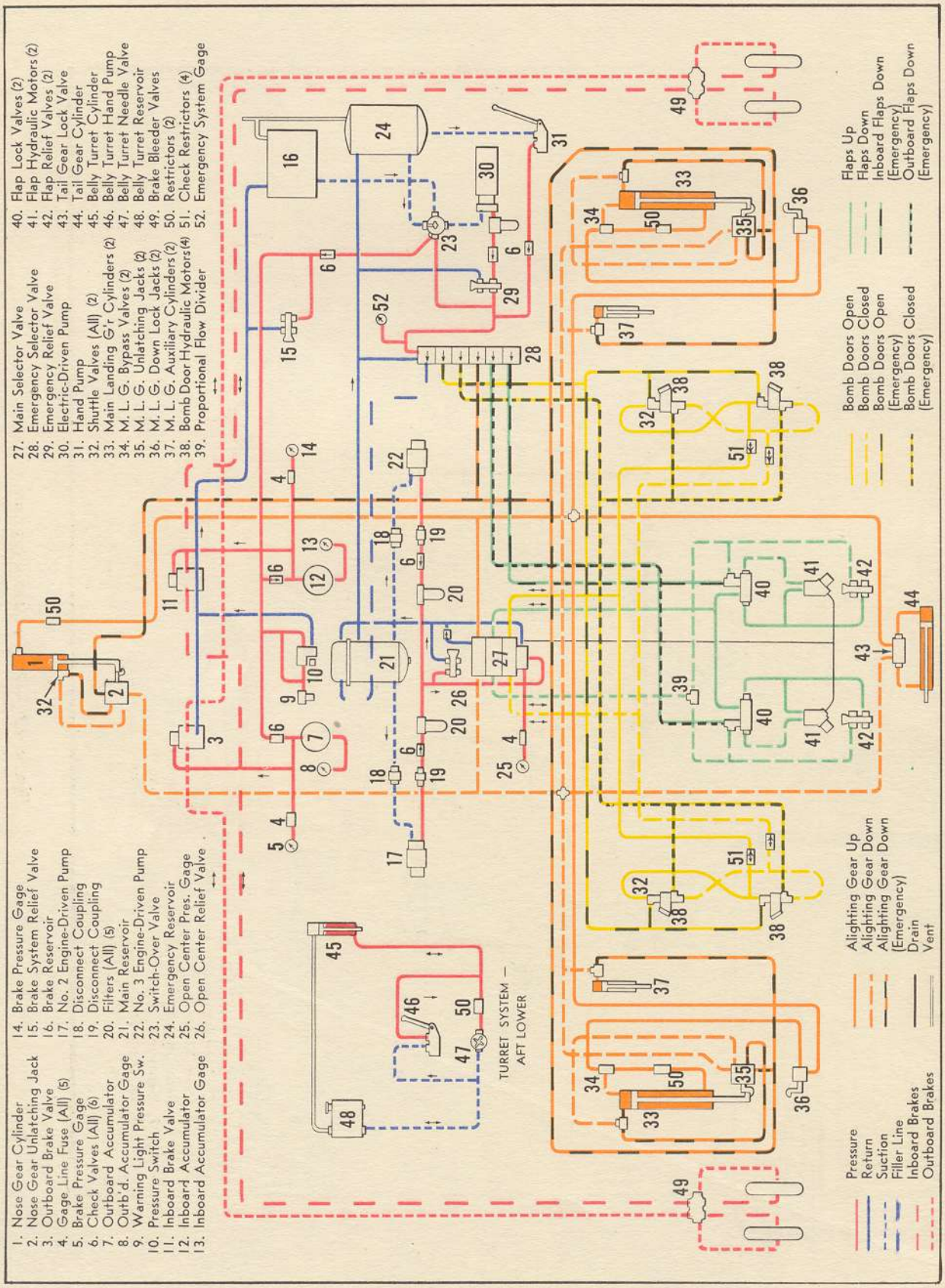


Figure 13 — Hydraulic Schematic Diagram

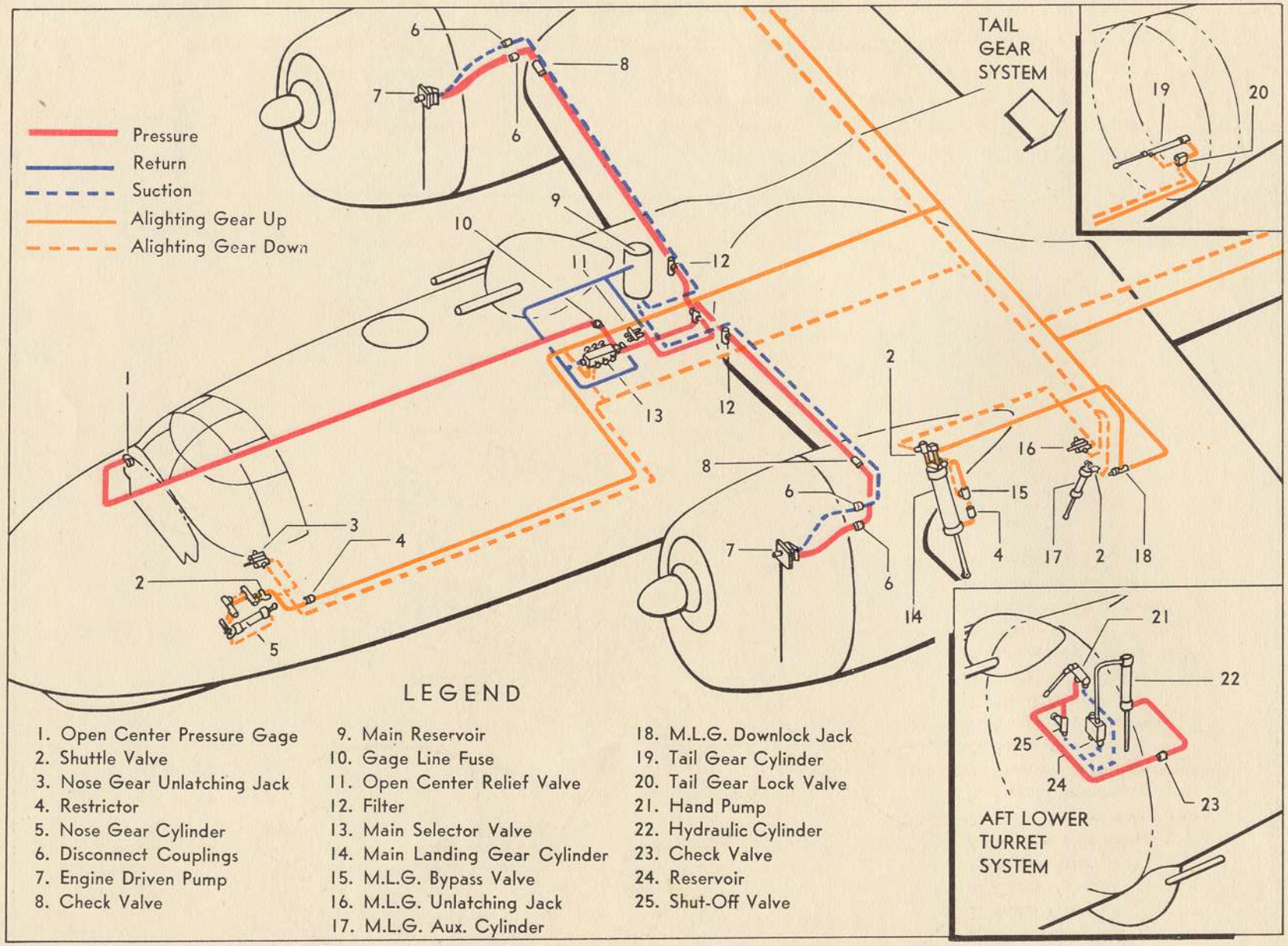


Figure 14 — Hydraulic Landing Gear System

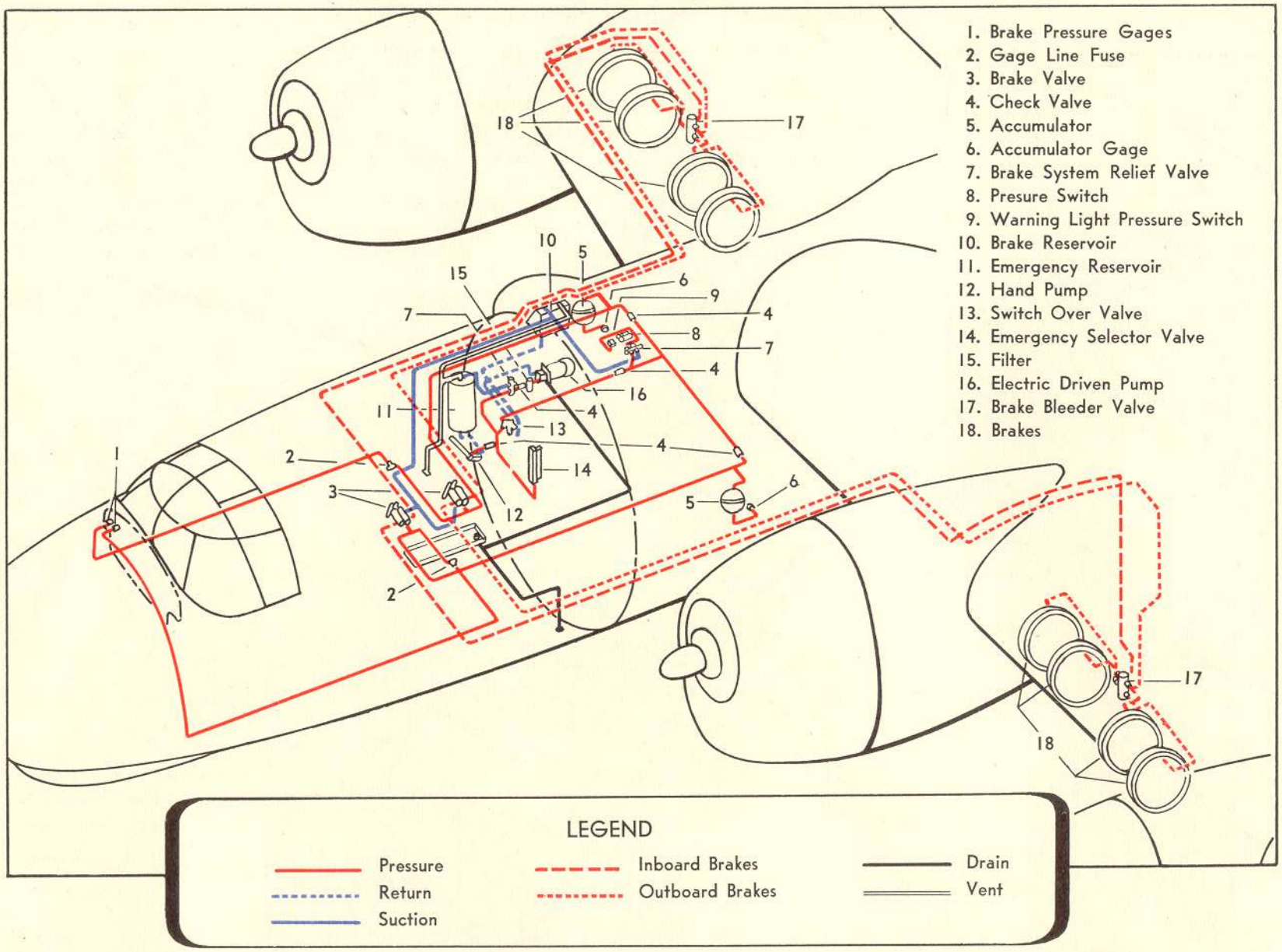


Figure 15 — Hydraulic Brake System

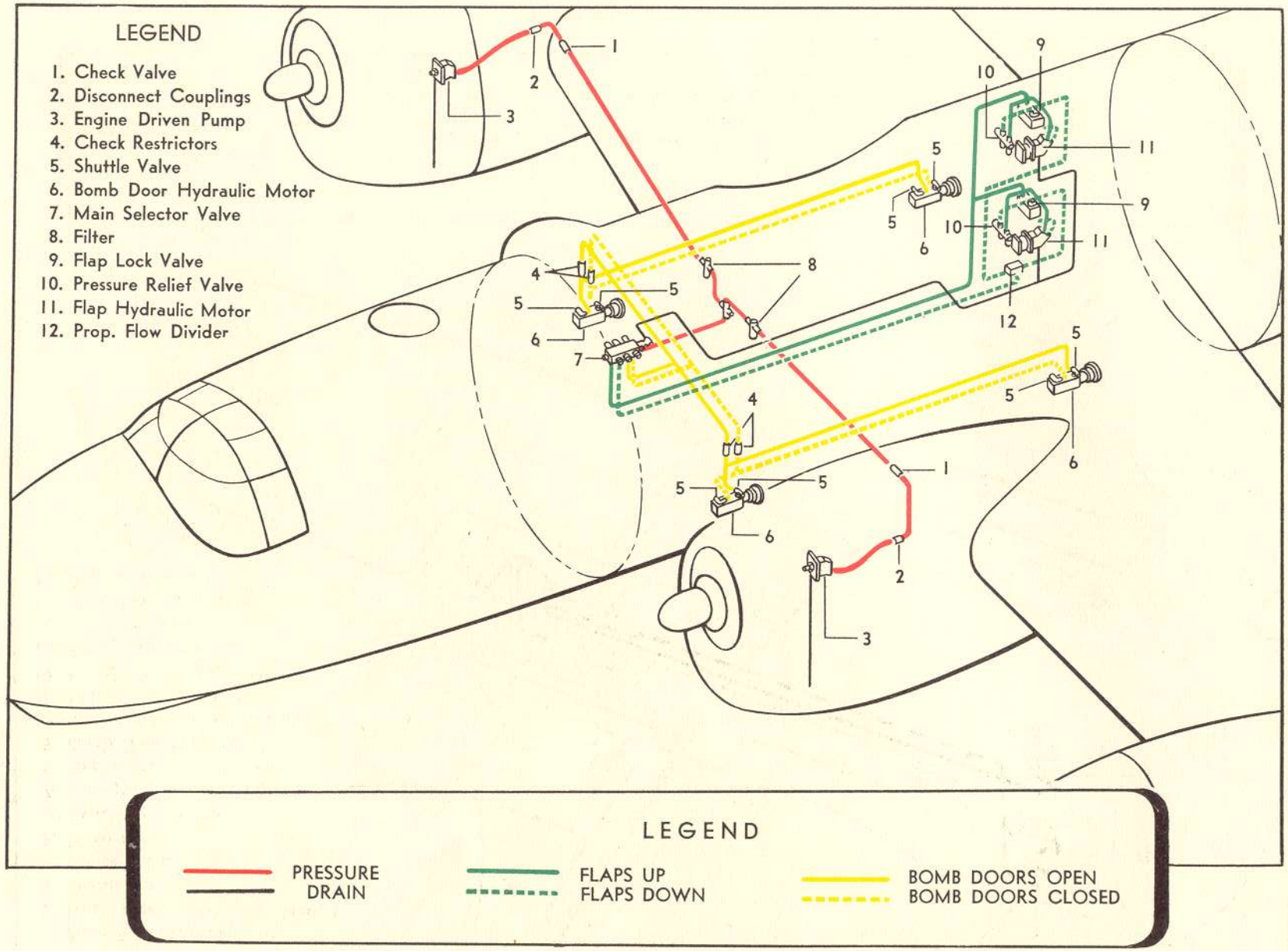


Figure 16 — Hydraulic Bomb Door and Flaps System

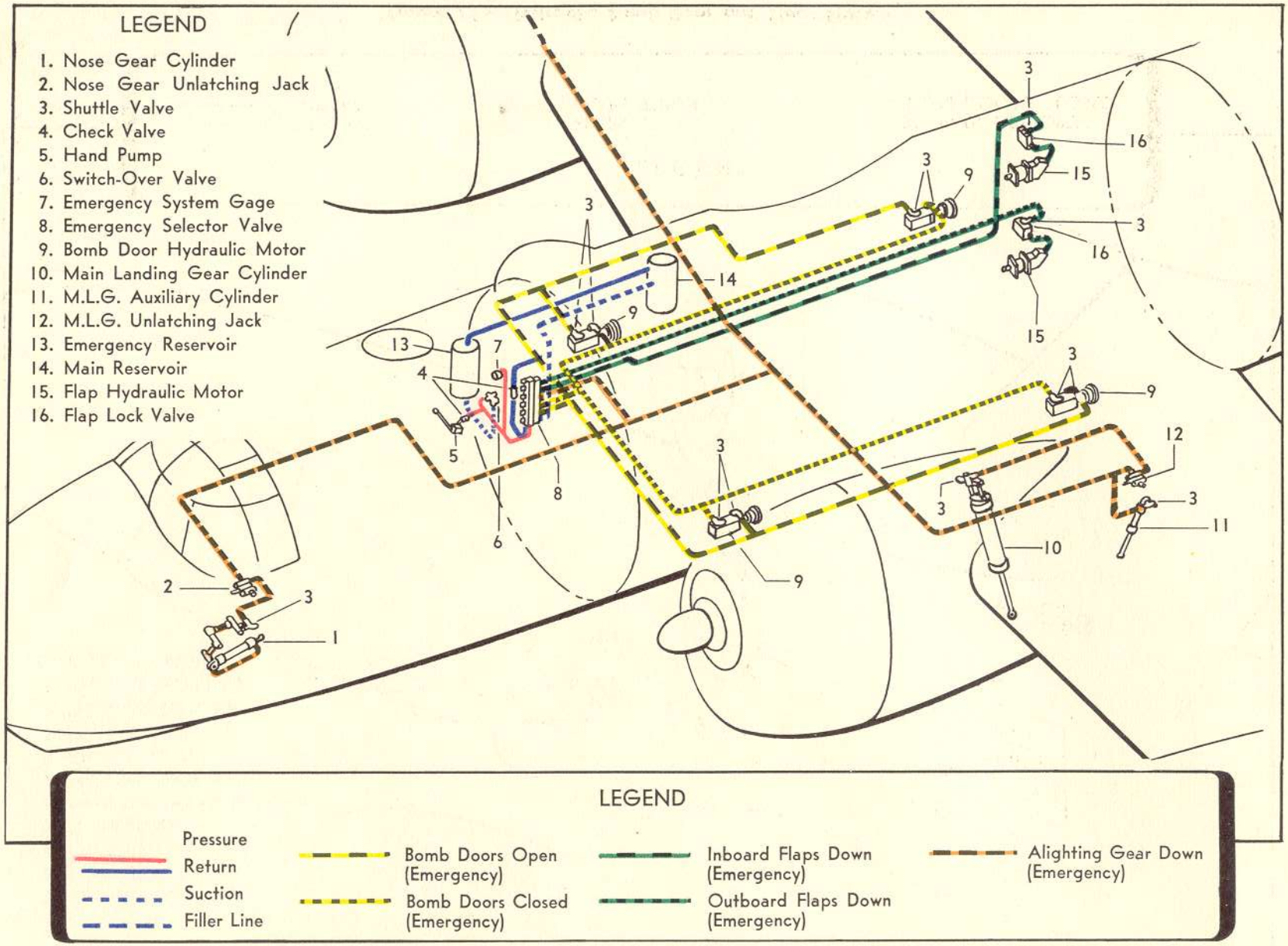


Figure 17 — Hydraulic Emergency System

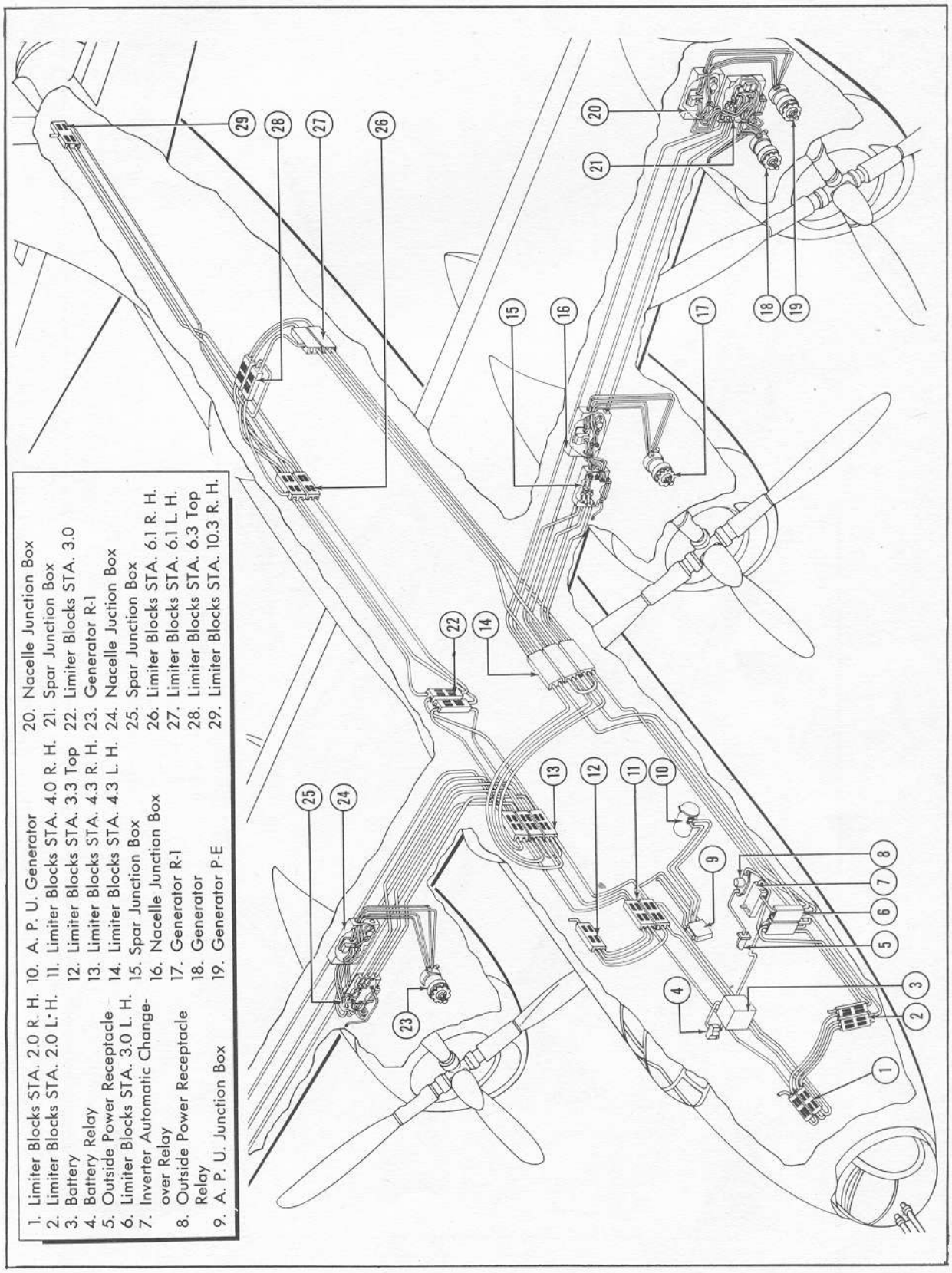


Figure 18 — Electric Power Source Diagram

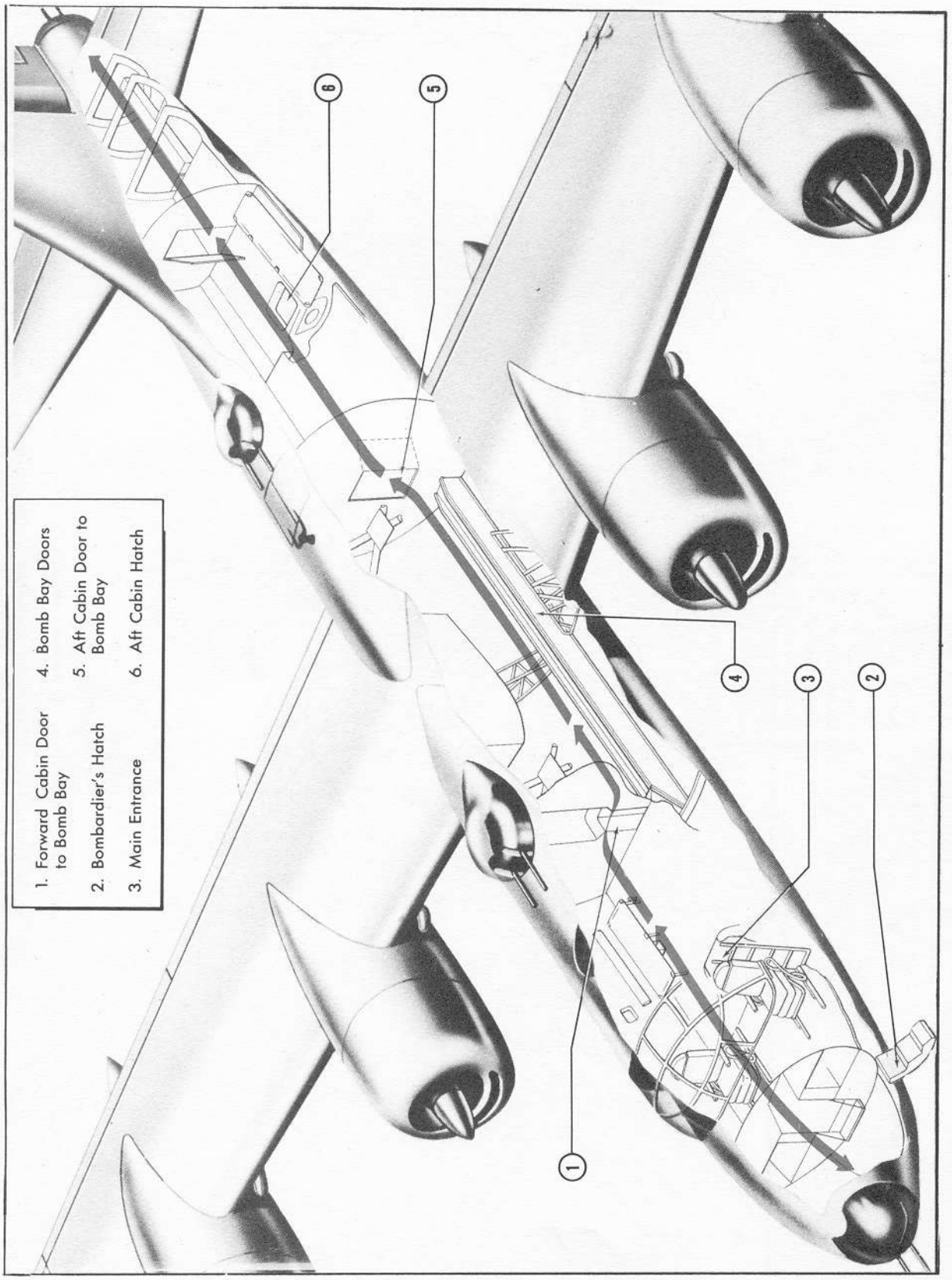


Figure 19 — Provisions for Movement of Personnel

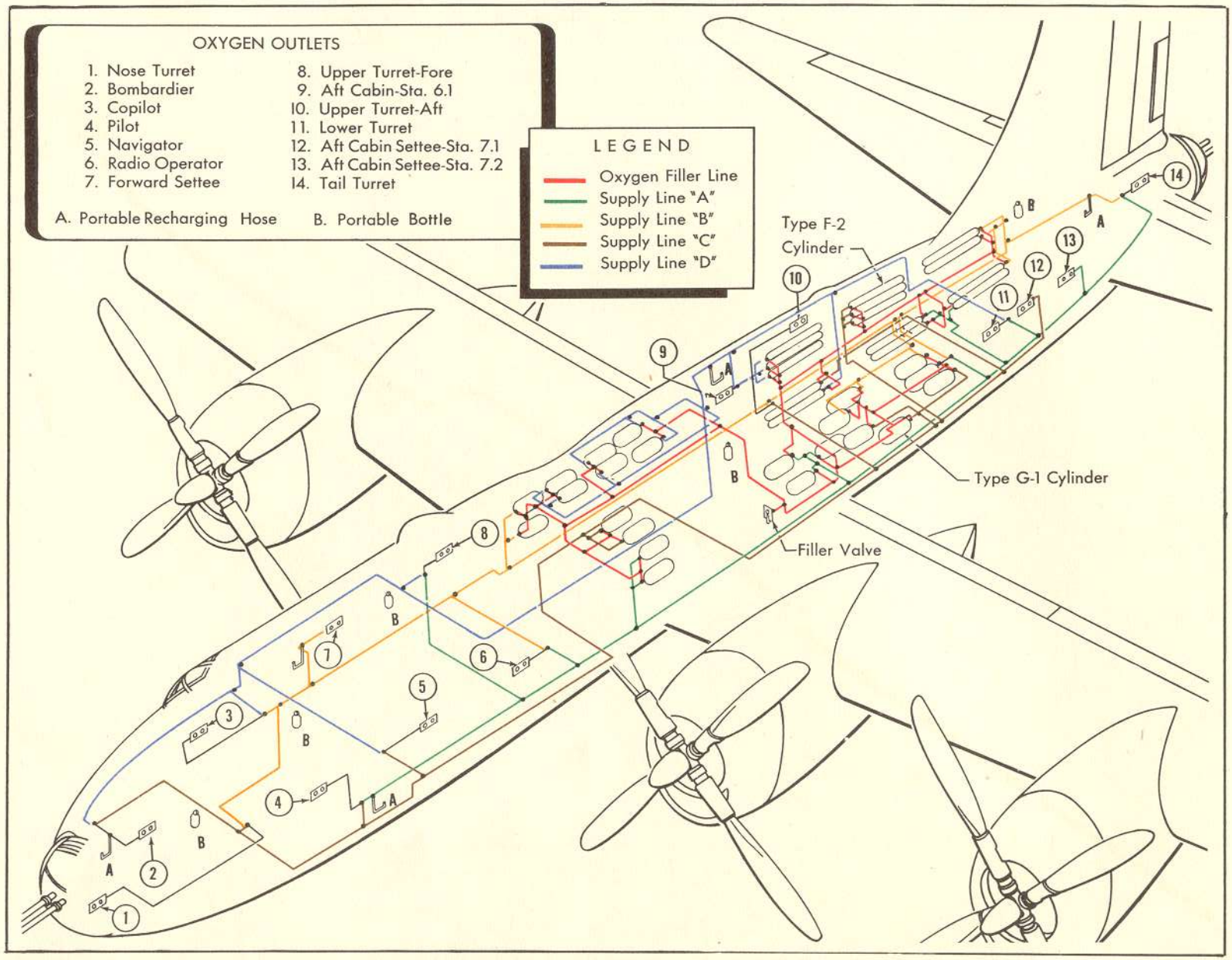


Figure 20 — Oxygen System (Sheet 1 of 2 Sheets)

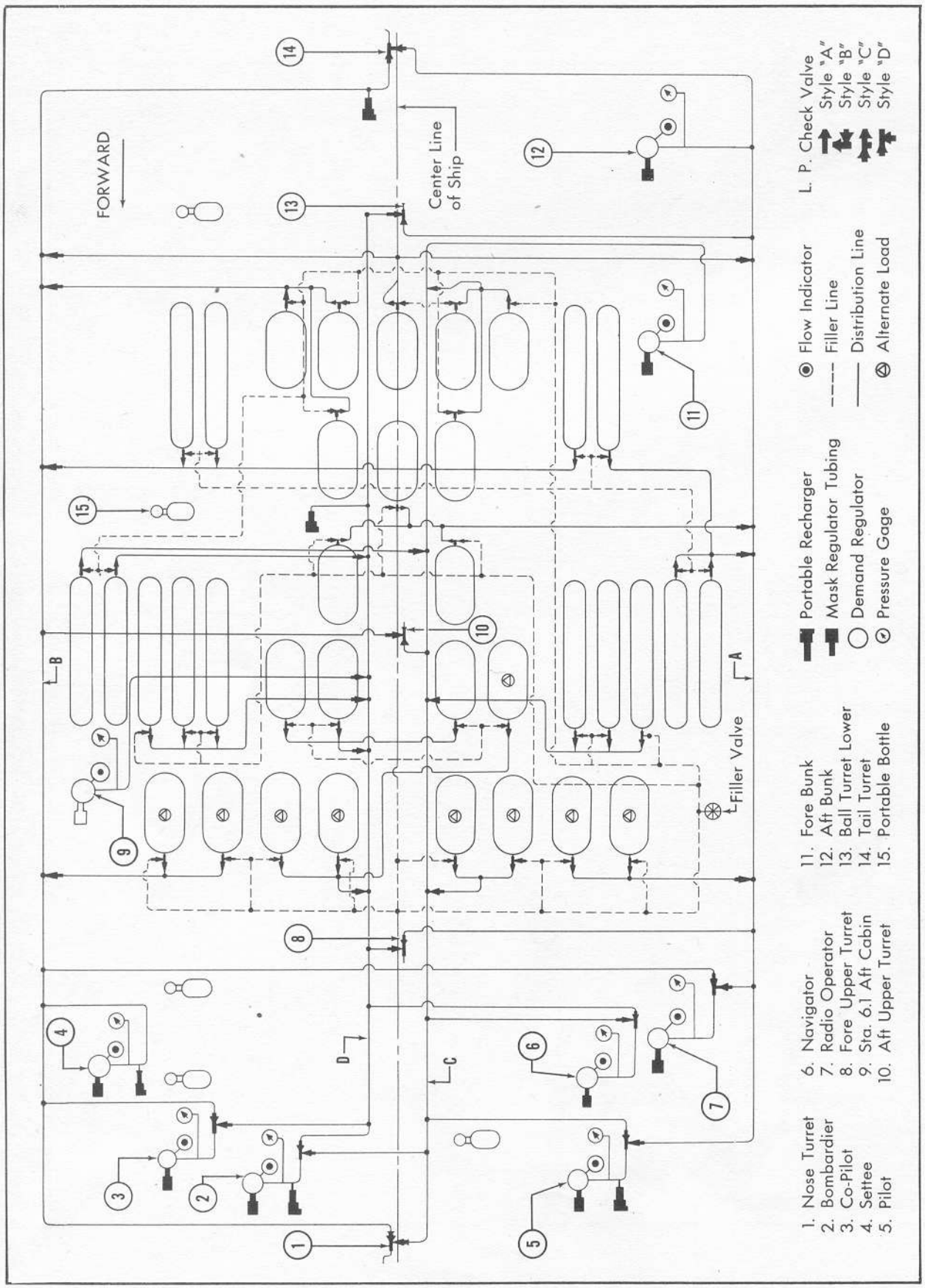


Figure 20 — Oxygen System Schematic (Sheet 2 of 2 Sheets)

SECTION II

Pilot OPERATING INSTRUCTIONS

NOTE

All power settings given in this section are for use with grade 100/130 fuel only, Specification No. AN-F-28.

1. BEFORE ENTERING THE PILOT'S COMPARTMENT.

a. GROSS WEIGHT AND LOADING. — Comply with the instructions contained in "Weight and Balance Data," AN 01-1B-40 and check form F.

b. ENTRANCE.—The interior of the airplane may be gained through the bomb bays, the forward hatch in the bombardier's compartment, through the hatch in the aft compartment, and through the main entrance door in the nose wheel well.

c. See that pitot tube cover is removed.

d. Inspect landing gear and nose wheel tires and oleos for correct inflation.

e. Check fire extinguisher disc to be sure there has been no accidental discharge.

f. Inspect propellers for nicks and anti-icer fluid leakage.

g. Check nacelles for loose fasteners, cowl flaps and entire nacelle for oil leaks.

h. Check wing center section area and wheel wells for fuel leaks.

i. See that oil and fuel caps have been properly installed and tightened.

j. Check trim tabs for condition and position (recheck trim tab control settings in cockpit).

k. Check condition of De-Icer boots on empennage.

l. Have antennas checked. See that trailing antenna is retracted.

m. Check landing lights for retraction and flush fit.

n. Make certain that parachutes and oxygen masks are available for crew members.

WARNING

Make sure that safety locks have been removed from main landing gear and nose gear.

2. ON ENTERING THE PILOT'S COMPARTMENT.

a. STANDARD CHECK FOR ALL FLIGHTS.

(1) Check main, brake, and emergency hydraulic supply reservoirs for correct fluid levels. Check anti-icing fluid level and reserve supplies of both anti-icing and hydraulic fluids.

(2) See that control cables and pulleys are free from interference from cargo or stored equipment and that cargo is properly secured.

(3) Ascertain that oxygen system has been fully serviced.

(4) Check "Instrument Approach Procedures," "Radio Facility Charts" and other like data to determine that all are current issues and in good condition.

(5) Check forms 1 and 1-A.

(6) Sign exceptional release if necessary.

(7) Check fuel and oil quantity.

(8) Landing gear switch "OFF."

(9) DETERMINE THAT ALL ELECTRICAL UNIT SWITCHES (EXCEPT GENERATORS) ARE OFF. This will prevent placing an undesirable heavy load on the battery when the switch is turned on.

(10) Turn battery switch "ON."

NOTE

The master ignition switch is not connected in the airplane electrical circuits.

CAUTION

The battery switch should remain off as long as an external power supply is connected. This will prevent damage to battery relays and wiring which might occur if the battery has a higher voltage than the outside supply.

NOTE

Check pitot heater before turning on APU, first by noting the amperage drop when the switch is turned on; secondly, by feeling the pitot tube ten seconds after the switch is turned on.

CAUTION

Do not leave pitot heater switch on for extended periods while the airplane is on the ground, as damage to heating element might result.

(11) Start auxiliary power unit.

(12) Place A.P.U. generator switch in "LOAD" position after engine is running.

(13) Leave equalizer switch "OFF" until engine generators are charging.

CAUTION

AUXILIARY POWER UNIT MUST BE KEPT RUNNING UNTIL AFTER TAKE-OFF.

(14) Turn inverter switch to "MAIN."

(15) Check A.C. voltage (100 to 125 volts).

NOTE

Always allow TWO MINUTES for turbo control amplifiers to warm up before starting engines, or operating turbo-boost selector.

CAUTION

NEVER TURN OFF INVERTERS WHILE ENGINES ARE RUNNING.

(16) LEAVE GENERATORS "ON" AT ALL TIMES EXCEPT WHEN NOT FUNCTIONING OR WHEN REQUIRED TO BE "OFF" FOR ELECTRICAL SYSTEM REPAIR.

(17) Check to determine that all circuit breaker switches are "ON."

(18) Check propeller master motor "ON."

(19) Check propeller selector switches "AUTOMATIC." Green tel-lights should be on to indicate proper switch setting.

(20) Check propeller reverse safety switch for "SAFE."

(21) Check propeller reverse control switch for "NORMAL."

(22) Turn hydraulic pump motor switch "ON." This switch is located on the forward side of the flight deck aft wall, above the emergency hydraulic selector switch group.

(23) Check accumulator pressure, minimum 850 pounds per square inch. Operate brakes until accumulator pressure drops below 850 and note cut-in and cut-out pressures. Cut-in pressure is 850 (plus 50 minus 0), cut-out pressure is 1030 (plus 50 minus 0) pounds per square inch. Check copilot's electric hydraulic override switch "OFF."

(24) Set parking brakes.

(25) Determine that chocks are properly located at each main landing gear tire.

(26) Unlock controls.

(27) Move control wheel to all extremities and check control surface movement. Have crew member visually check movement of all control surfaces.

(28) Move rudder full right and left.

(29) Set altimeter—check barometric setting and altitude indication.

(30) Set and wind the airplane clock.

(31) Check automatic pilot in "OFF" position.

(32) Move engine controls through operating range to check free action.

(33) Set intercooler controls in "AUTOMATIC" position.

(34) Open cowl flaps. Pilot and copilot visually check flaps for full open position. Burning of cylinder fins and ignition leads may result if cowl flaps are not full open.

(35) Set oil cooler flap controls in "AUTOMATIC" position in warm weather. Place in "MANUAL CLOSED" position if starting engines in cold weather until the oil temperature reaches normal, then place in "AUTOMATIC."

(36) Carburetor air filters should be used whenever engines are operated in areas where dust is prevalent; otherwise, air filters should not be used.

(37) Check wing anti-icers in "OFF" position.

(38) Check tail De-Icer switch in "OFF" position.

(39) Check carburetor preheat controls in "COLD" position.

(40) Place heat exchanger exit flap in "OPEN" position.

(41) Propeller anti-icer system "OFF."

(42) Check MASTER and INDIVIDUAL ignition switches in the "OFF" position.

(43) Check turbo boost selector at "0" position.

(44) Signal service crew to pull each propeller through six blades. This is important to determine that liquid locks do not exist in bottom cylinders. Should liquid locks occur it will be necessary to remove one plug from each bottom cylinder to drain out liquid. After liquid has drained out and before replac-

ing plugs, pull propeller through four blades in order to open the intake valves and release any fluid which may be trapped in the intake manifolds. Do not permit more than two men to pull on a blade.

b. SPECIAL CHECK FOR NIGHT FLIGHTS.

(1) Make sure all interior and exterior lights are operating properly.

(2) Check the condition of the glare curtains.

(3) If rapid climb to above 10,000 feet is planned, instruct all personnel to use oxygen from ground up.

3. FUEL SYSTEM MANAGEMENT.

For specific instructions for the management of the fuel system, refer to "Fuel System Management Chart" and its accompanying illustration, figure 21.

4. STARTING ENGINES.

a. Before starting engines, head airplane into wind to assist in equal cooling of all cylinders.

b. Check mixture controls in "IDLE CUT-OFF."

c. Place all four fuel selector valves in "TANK TO ENGINE" position.

d. Set fuel booster pump control switches in "LOW" position.

NOTE

Fuel pressure will not be indicated by fuel pressure gages with mixture controls in "IDLE CUT-OFF." Do not move mixture controls from "IDLE CUT-OFF" until engine is turning over. This is important, since moving the mixture controls from "IDLE CUT-OFF" will permit a continuous flow of fuel to be discharged directly into the blower section through the induction manifold with possibility of fuel being permitted to drain into the lower cylinders, causing a liquid lock.

e. Place throttles in approximately the 1000 rpm position.

f. Engine starting sequence will be determined by operating activities.

g. Have fire guard stationed by engine to be started and be sure propellers are CLEAR during entire starting procedure.

h. Place master ignition switch in "ON" position.

i. Keep ALL individual ignition switches in the "OFF" position before starting engines.

j. After propeller has turned over one revolution, place individual ignition switch in the "BOTH ON" position.

NOTE

Once a starter has been meshed it must be permitted to cool for at least one minute before it is energized again. Never mesh a starter for more than one minute.

CAUTION

Never turn on individual ignition switches until propeller has turned over one revolution.

k. After individual ignition switch has been turned on and while engine is turning over, operate the primer and ignition booster simultaneously by holding them in the "ON" position until engine is running.

NOTE

Engine primers discharge fuel directly into the induction manifold between the carburetor and engine blower section in a quantity sufficient for engine to operate at 1000 to 1200 rpm.

CAUTION

Do not operate engine primer at any time when engines are not turning over as the system requires that the engine impeller be revolving to provide proper fuel distribution. This prevents possible liquid lock in lower cylinders.

l. After engine is running on primer, move mixture control from "IDLE CUT-OFF" to "AUTO-RICH," releasing booster and primer. If engine stops, move mixture control to "IDLE CUT-OFF" immediately.

m. After engine is running, readjust throttles to obtain 1000 to 1200 rpm.

CAUTION

Quick movements of the throttle may lead to backfires and induction system fires.

n. If main oil pressure does not register 40 pounds per square inch within 10 seconds or nose oil pressure does not register 45 pounds per square inch within 30 seconds, STOP ENGINE IMMEDIATELY.

o. Normal oil pressures are: Nose 45 to 50 pounds per square inch, main 60 to 70 pounds per square inch.

p. Turn booster pump "OFF" when engine is operating normally.

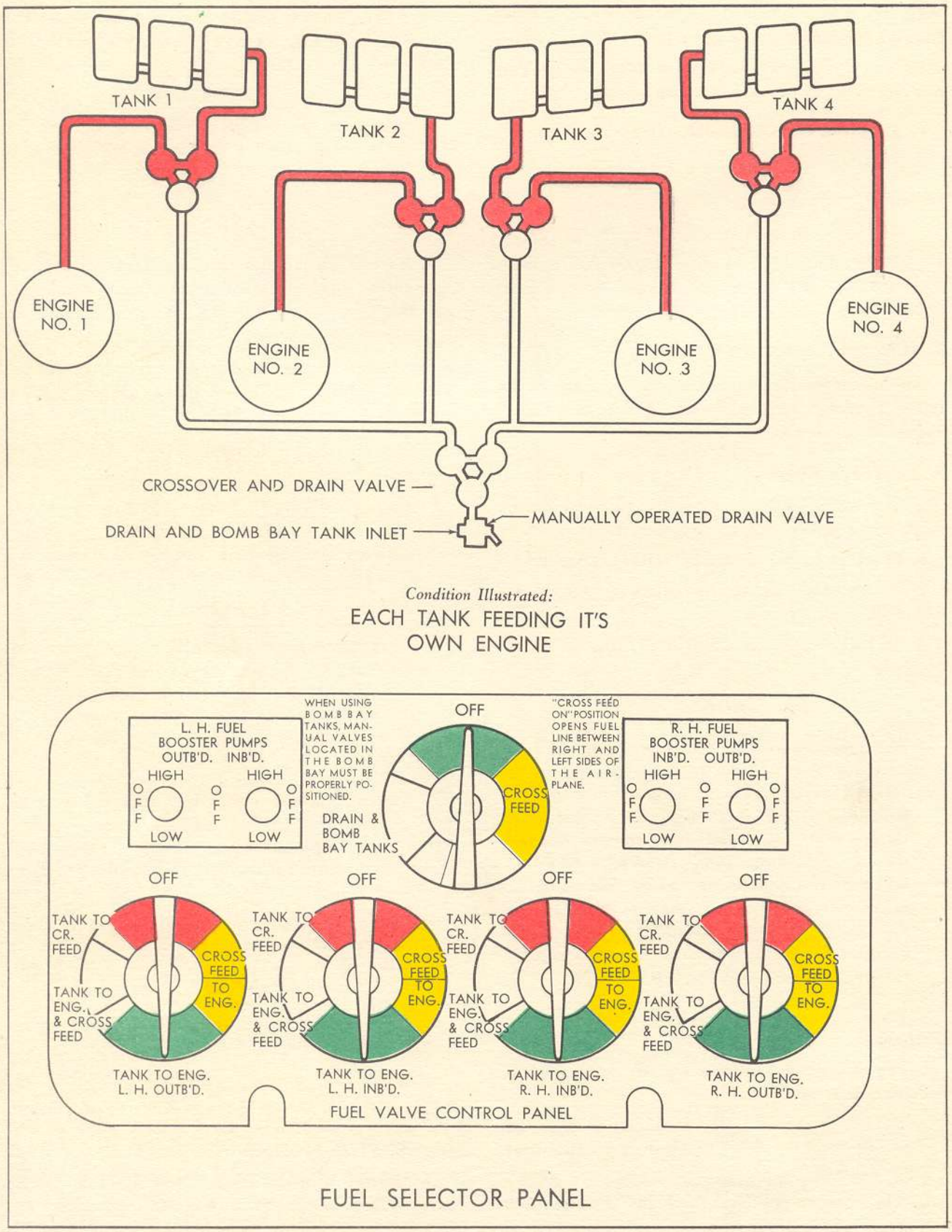


Figure 21 — Fuel Selector Panel

CONDITION	SELECTOR VALVE NO. 1	SELECTOR VALVE NO. 2	SELECTOR DRAIN VALVE	SELECTOR VALVE NO. 3	SELECTOR VALVE NO. 4
1. All Four Tanks Feeding All Four Engines, Take-Off Condition	Tank to Engine	Tank to Engine	Off	Tank to Engine	Tank to Engine
2. Inboard Tanks Feeding All Four Engines	Cross-feed to Engine	Tank to Engine and Cross-feed	Cross-feed	Tank to Engine and Cross-feed	Cross-feed to Engine
3. Outboard Tanks Feeding All Four Engines	Tank to Engine and Cross feed	Cross-feed to Engine	Cross-feed	Cross-feed to Engine	Tank to Engine and Cross-feed
4. L. H. Inboard and Outboard Tanks Feeding All Four Engines	Tank to Engine and Cross feed	Tank to Engine and Cross-feed	Cross-feed	Cross-feed to Engine	Cross-feed to Engine
5. R. H. Inboard and Outboard Tanks Feeding all Four Engines	Cross-feed to Engine	Cross-feed to Engine	Cross-feed	Tank to Engine and Cross-feed	Tank to Engine and Cross-feed
6. Tanks No. 1, 2, and 3 Feeding all Four Engines	Tank to Engine and Cross-feed	Tank to Engine and Cross-feed	Cross-feed	Tank to Engine and Cross-feed	Cross-feed to Engine
7. Tanks No. 2, 3, and 4 Feeding all Four Engines	Cross-feed to Engine	Tank to Engine and Cross-feed	Cross-feed	Tank to Engine and Cross-feed	Tank to Engine and Cross-feed
8. Tanks No. 1, 2, and 4 Feeding all Four Engines	Tank to Engine and Cross-feed	Tank to Engine and Cross-feed	Cross-feed	Cross-feed to Engine	Tank to Engine and Cross-feed
9. Tanks No. 1, 3, and 4 Feeding all Four Engines	Tank to Engine and Cross-feed	Cross-feed to Engine	Cross-feed	Tank to Engine and Cross-feed	Tank to Engine and Cross-feed
DRAINING					
10. Drain all Four Tanks	Tank to Cross-feed	Tank to Cross-feed	Drain (Also open manual drain valve)	Tank to Cross-feed	Tank to Cross-feed

FUEL TRANSFER

Fuel may be transferred from one tank to another if the proper selector valves are placed so that the ports leading to the tanks are open, and if the booster pump is on. For example, if it is desired to transfer fuel from the left hand inboard tank to the left hand outboard tank the valves and switches should be set as follows: left hand inboard selector switch—"TANK TO ENGINE AND CROSS-FEED;" left hand outboard selector valve switch—"TANK TO ENGINE AND CROSS-FEED;" left hand inboard booster pump—"LOW;" left hand outboard booster pump—"OFF."

Fuel system management, while one or more engines are dead, will vary with conditions. If a long flight is to be made, fuel should be used from the tanks on the dead engine side.

q. Operate engines at 1000 to 1200 rpm until oil temperature reaches 55 degrees C. or in an emergency, at least until a 10 degree C. rise in temperature is indicated.

5. ENGINE WARM-UP AND ACCESSORIES CHECK.

NOTE

Never operate propeller controls when engines are not running, because pitting of slip rings might result. Be sure that A.P.U. IS IN OPERATION before making propeller control check.

a. FOR PROPELLER AUTOMATIC CONTROL CHECK.—Set throttle to obtain 1800 rpm (BE SURE MIXTURE CONTROLS ARE IN "AUTO-RICH"). Check propeller control selector switch in the "AUTOMATIC CONSTANT SPEED" position. Rotate rpm control knob in an anticlockwise direction until a 200 rpm drop is indicated on the engine tachometers. Green tel-lights will indicate when master motor has reached its set speed if the corresponding selector switches are in the "AUTOMATIC" position. Be sure that engine speeds remain CONSTANT without HUNTING or SURGING at the REDUCED SPEED. Rotate the rpm control knob clockwise to "FULL HIGH" rpm and note that master synchronizer tachometer indicates take-off rpm (2800) and be sure that the original engine rpm is obtained on engine tachometers. Close throttles to idle rpm.

b. Ground check A.F.C.E.

6. ENGINE RUN-UP.

NOTE

Whenever practical, the airplane should be headed into the wind during engine warm-up to provide uniform cooling of all cylinders. Ground operations will always be conducted in AUTO-RICH, NEVER IN AUTO-LEAN. The carburetor jets which supply fuel during idling give the same mixture strength regardless of whether the mixture control lever is in "AUTO-RICH" or "AUTO-LEAN."

a. Turn A.P.U. equalizer switch "ON."

b. Check generator "ON" for the engine to be run-up. At 2000 rpm the generator voltmeter should indicate 28 to 28.5 volts for each generator.

NOTE

Generators should normally remain "ON" at all times. However, if they should be turned "OFF" the engine rpm must first be reduced to 1200 or below to prevent arcing and pitting of relay points.

c. Run engine at 2000 rpm, 28 to 30 inches Hg, with propeller selector "AUTO CONSTANT SPEED" and master motor set at 2800 rpm.

CAUTION

Ground running will be limited to 2000 rpm and 30 inches Hg manifold pressure except for turbo boost run-up. This speed and power range will be sufficient to provide an adequate check of magnetos, spark plugs, and propeller controls.

d. Oil pressures, rear section 60 to 70 pounds per square inch; nose section 45 to 50 pounds per square inch; fuel pressure 16 to 18 pounds per square inch.

e. With propeller selector switch in "AUTO" position, turn individual magneto switch to "LEFT MAGNETO" and observe drop in rpm. Return switch to "BOTH" and allow sufficient time for engine to pick up rpm. Then move switch quickly to "RIGHT MAGNETO" and again observe drop in engine rpm.

NOTE

Permissible drop in rpm between "BOTH" and "RIGHT" or "LEFT" is 100, provided the drop in rpm is not accompanied by any abnormal roughness while engine is operating on a single magneto. Engine roughness may be best determined by a visual check of the engine nose cowling during single magneto operation. Do not operate engine on one magneto for more than 5 seconds at any one period.

f. ZERO TURBO-BOOST RUN-UP.—With turbo-boost selector at position "0," push throttles full open one at a time and observe the rpm and manifold pressures. Manifold pressures should not vary more than 2 inches Hg between engines.

g. Check vacuum pumps on No. 2 and No. 3 engines by the following procedure:

(1) Observe vacuum with No. 2 and No. 3 engines idling.

(2) Observe vacuum with either engine being run-up at 2000 rpm; the other idling. If the vacuum indication is higher for condition (2) than for both engines idling, the pump is functioning on the engine which was run-up. A very low idling speed may be required to make possible any vacuum change.

h. Idle engine at 800 to 1000 rpm.

7. SCRAMBLE TAKE-OFF.

As soon as oil pressure steadies down and oil temperature shows a rise of 10 degrees C. it is safe to "SCRAMBLE." Oil dilution may be used to speed the process of steadying the oil pressure.

8. ENGINE IDLING.

a. After engines are run up they may be idled at any rpm from 800 to 1000.

CAUTION

Never use AUTO-LEAN at any time for ground operations.

b. Change inverter switch from "MAIN" to "SPARE" to check voltage (100 to 125) then back to "MAIN." "MAIN INVERTER OUT" light should glow when "MAIN" inverter is not operating.

c. Set oil cooler controls to the "AUTOMATIC" position when oil temperatures reach normal (60° C. plus or minus 5).

d. Operate wing flaps full-down and full-up.

e. Turn on command radio to contact control tower. Set transmitter and receiver to proper frequency. Turn volume control on jack boxes to desired output. Set selector switch on filter box to "VOICE" or "BOTH," and selector switch on jack box to "COMMAND." Contact control tower for taxi and take-off instructions.

9. BEFORE TAXIING.

a. Oil pressure rear, 60 to 70 pounds; nose, 45 to 50 pounds.

b. Oil temperature, 55 to 85 degrees Centigrade.

c. Cylinder head temperature, maximum 260 degrees Centigrade.

d. Fuel pressures, 16 to 18 pounds per square inch.

e. Check tachometers.

f. Hydraulic pressures (brakes) minimum 850.

g. Check clock.

h. Check compass.

i. Check free air temperature indicators.

j. Landing gear "DOWN-LOCK" light (green for down position).

k. Recheck vacuum, 3.75 to 4.25 inches Hg at 1000 rpm.

l. Check ball turret indicator lights to be sure the turret is retracted.

m. Remove wheel chocks.

10. TAXIING INSTRUCTIONS.

a. This airplane should be taxied like any other large, tricycle-gear airplane. Because of the nose wheel installation, it is imperative that the airplane is moving before any turn is attempted. Turns should be made with the largest possible radius to minimize nose wheel tire wear and to make the turns easier be accomplish. The airplane should be stopped with the nose wheels in line with the center line of the airplane so as to minimize nose gear side loads during engine run-up and at restart of taxiing.

b. The two nose wheels are fixed to an axle so that they necessarily rotate together, co-rotating. This design eliminates nose wheel shimmy without the incorporation of a shimmy-damper unit, but causes some nose wheel tire slippage when turns are made.

c. Use of brakes for long periods will cause excessive overheating with possible brake expander tube failure, resulting in loss of brakes.

d. When taxiing long distances or down wind, it may be impossible to use sufficient engine rpm to prevent fouling of the plugs and still maintain a reasonable taxiing speed. Under such conditions it is advisable to cut the inboard engines.

NOTE

The brake hydraulic system is electrically operated and is independent of the engine-driven hydraulic pumps.

e. The A.P.U. should always be operating when the airplane is taxied.

f. Crew members should be at take-off stations during taxiing.

11. AFTER TAXIING TO RUNWAY.

a. Stop the airplane and set parking brakes.

b. Close bomb bay doors.

c. Close and secure all hatches.

d. Uncage directional gyro and artificial horizon.

e. Pilot will set directional gyro to correspond with magnetic compass.

f. Check all generator switches "ON."

g. Check main inverter switch " No. 1 ON."

h. Set booster pump control switches in "HIGH" position.

i. Fuel tank selectors set "TANK TO ENGINE."

j. Check master tachometer for 2800 rpm and the prop selector switches for "AUTOMATIC."

k. Check mixture controls for "AUTO-RICH."

l. Check cowl flaps "FULL OPEN."

m. Set oil cooler shutters "AUTOMATIC."

n. Intercooler shutters on "AUTOMATIC."

o. Carburetor preheat on "COLD."

p. Extend wing flaps to 30 degrees.

q. Return flap switch to "NEUTRAL."

r. Trim tabs; aileron 0°, elevator 0°, rudder 3° right.

s. Operate rudder control full-right and left.

t. Move elevator control full-forward and full-rear.

u. Rotate aileron control wheel full-right and full-left.

v. Prior to turning onto runway for take-off, each engine should be run up to check the turbo boost selector setting.

(1) Set turbo boost selector to "0" position.

(2) Advance one throttle to the full open position, then turn turbo selector control to "8" or until a manifold pressure of 49 inches is reached.

(3) Retard the throttle leaving turbo boost selector at "8" or at the required position to obtain 48 inches Hg.

(4) Advance throttle of each remaining engine individually and note that 49 inches manifold pressure is developed. Close each throttle leaving the turbo selector at "8" or at the 49 inches position.

CAUTION

This check must be made as quickly as possible to prevent excessive head temperatures during take-off. Approximately 2800 rpm should be developed at 49 inches manifold pressure.

12. TAKE-OFF.

a. Release brakes, allowing airplane to roll onto runway, using outboard engine to turn and align the airplane with the runway.

b. Walk throttles slowly and smoothly forward until rudder directional control is effective; then move throttles smoothly full open. Use of brakes during take-off slows airplane, overheats the brakes and lengthens take-off run.

c. Take-off M.A.P. — 49 inches Hg, 2800 rpm.

NOTE

When the throttles are first opened the engine tachometers may indicate a slight overspeed with the electric synchronizer type propeller control; however, the control should immediately reduce the engine rpm to normal. Overspeed should never be allowed to exceed 2880 rpm.

d. During take-off, copilot will maintain check of M.A.P. and engine rpm to make certain maximum is not exceeded.

e. Should it be necessary to reduce manifold pressure during take-off, reduction will be accomplished by pulling the desired throttle back.

f. Maximum allowable head temperatures during take-off — 260° C. FOR 5 MINUTES ONLY.

NOTE

The following are excerpts from the "Pilot's Check List":

BEFORE TAKE-OFF
Generators — ON
Inverter — CHECK
Trim Tabs — SET
Turbo — 8
Props. — Auto — 2800
Flaps — 30 Degrees
Mixture — AUTO-RICH
Fuel Valves — TANK TO ENGINE
Fuel Boost Pumps — HIGH
Cowl Flaps — FULL OPEN
Gyros — SET
AFTER TAKE-OFF
Wheels — APPLY BRAKES then RETRACT
Flaps — RETRACT after attaining 160 I.A.S.
Turbo — Boost — 43 inches Hg
Props. — AUTO, 2400
Cowl Flaps — 260° C. — maximum
A.P.U. and Equalizer — OFF

13. AFTER TAKE-OFF.

CAUTION

Pilot will apply brakes to stop rotation of wheels BEFORE signaling for gear up.

a. As soon as the airplane is definitely airborne, copilot will retract landing gear upon signal from pilot.

b. Return landing gear switch to "OFF" when gear is up.

c. Decrease engine rpm to 2400 for climb.

d. Set turbo boost selector to 43 inches Hg.

e. Retract wing flaps after 160 I.A.S. has been attained.

f. Do not start extended climb until I.A.S. is 180 mph, and maintain this airspeed or better during climb to effect proper engine cooling, using power settings as shown below.

g. Stop auxiliary power plant and turn equalizer switch "OFF."

h. Set fuel booster pumps to "LOW."

14. ENGINE OR PROPELLER FAILURE DURING TAKE-OFF.

For proper operation and action in these emergencies, see section IV of this publication.

15. CLIMB.

NOTE

Maximum allowable head temperature for operation at 90 percent normal rated power to full normal rated power is 248 degrees C.

a. POWER SETTINGS FOR CLIMB.

(1) 2400 rpm — 43 inches (maximum).

(2) 2300 rpm — 39 inches.

(3) 2200 rpm — 35 inches.

b. CRUISING. — Cruising altitude should be approached from above. This is accomplished by climbing to above desired altitude; then leveling off, maintaining climb power until airplane is at or above desired cruising speed before reducing the power. Cruise conditions should be established and a shallow dive then made to desired cruising altitude. Should the power be reduced before the airplane is allowed to gain full cruising speed, cowl flaps will probably have to remain open to effect necessary cooling. This creates a high drag which causes loss of speed for delivered engine power. Controls will be sluggish due to the high angle of attack.

ALWAYS APPROACH CRUISING LEVEL FROM THE TOP, BOTH SPEED AND ALTITUDE, NEVER FROM BELOW.

c. CRUISING POWER SETTINGS.

(1) Maximum for continuous operation in "AUTO-LEAN" should not exceed 2200 rpm or 35 inches M.A.P.

(2) Maximum head temperature, 232 degrees C. for continuous operation.

d. REQUIREMENTS FOR AUTO-LEAN OPERATION.

(1) Mixture controls, "AUTO-LEAN."

(2) Oil pressure REAR section, 60 to 70 pounds.

(3) Oil pressure NOSE section, 45 to 50 pounds.

(4) Cylinder head temperatures, 232 degrees Centigrade maximum for continuous operation.

(5) Fuel pressure, 16 to 18 pounds per square inch. (Use booster pumps whenever necessary.)

(6) Cowl flaps closed, if possible, or as required to maintain head temperatures below 232 degrees Centigrade.

e. SETTINGS FOR NORMAL TRAINING OPERATION.

(1) 2000 rpm — 28 inches Hg.

(2) Mixture control, "AUTO-RICH" unless on extended flights.

(3) Turbo control, turbo selector should be set at "0" except when required manifold pressure is higher than obtainable with full throttle.

f. MIXTURE CONTROLS.

(1) Should power settings be within the "AUTO-LEAN" power limits, mixture controls may be moved to the "AUTO-LEAN" positions.

NOTE

Always move mixture controls to the "AUTO-LEAN" positions individually.

g. A.C. OR INVERTER POWER.—Inverter operation should be checked frequently during flight since turbo control is dependent on power supplied by the inverters. Voltmeter on power switch panel should read between 100 minimum and 125 maximum.

CAUTION

INVERTERS SHOULD NEVER BE TURNED OFF DURING FLIGHT OR DURING ENGINE OPERATION.

16. GENERAL FLYING CHARACTERISTICS.

a. See "Specific Engine Flight Chart" in section III of this publication.

b. Power settings for various conditions of flight may be found in the "Flight Operating Instruction Charts" in Appendix I of this manual.

17. MANEUVERS PROHIBITED.

The following maneuvers are prohibited: Loop, roll, spin, inverted flight, Immelman and vertical bank.

18. STALLS.

Stalling characteristics are clean and indicated by severe tail shake 3 to 5 miles per hour before stall. A slight rolling movement prior to the actual stall may

develop as a result of an intermediate stall in or around the aileron. During the final phase of the stall a tendency for aileron snatch may be noticed. It is therefore recommended that if the stall is allowed to progress after first observing tail shake, the wheel should be held firmly in order to prevent any whip which might be transmitted to it from the aileron. The complete stall is followed by the airplane falling straight forward without any tendency to spin.

STALLING SPEEDS

Indicated Air Speed, in Miles Per Hour
Power Off, Landing Gear Down

Gross Weight Pounds	Full Flaps Extended 40°	3/4 Flaps Extended 30°	1/2 Flaps Extended 20°	Flaps Up 0°
80,000	106	113	117	131
90,000	111	118	122	137
100,000	116	123	128	144
110,000	120	128	133	151
120,000	125	133	139	156

19. SPINS.

Spins shall not be attempted with this airplane but in the event it does go into a spin, use the conventional methods for recovery.

20. DIVING.

Do not exceed 330 I.A.S. at 100,000 pounds gross weight or 240 I.A.S. at 118,000 pounds gross weight (full fuel and bomb load).

21. NIGHT FLYING.

No special instructions other than those covered elsewhere in this manual.

22. APPROACH AND LANDING.

NOTE

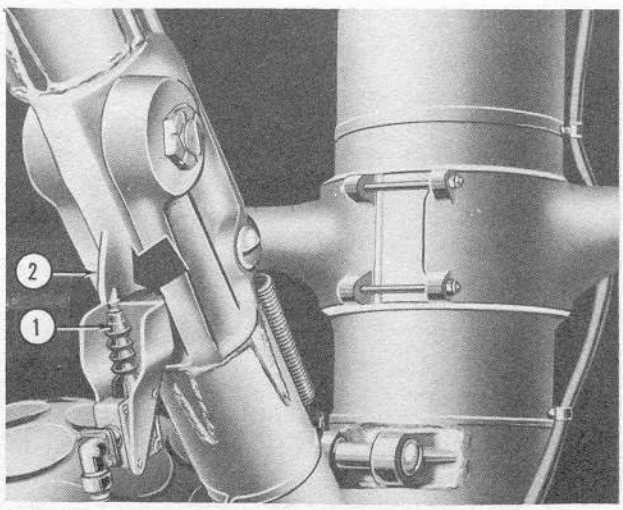
The following are excerpts from the "Pilot's Check List":

BEFORE LANDING

Crew Warning
A.P.U. Start, Equalizer and Load Switch — ON
Turret Retracted
Fuel Selectors — TANK TO ENGINE
Fuel Boost Pumps — LOW
Hydraulic (Electric) Pump — ON
Brakes — CHECK PRESSURE
Trailing Antenna "IN"
Mixture — AUTO-RICH
Turbo — "8"
Generators — ON
Inverter — CHECK
Props. — AUTO 2400 RPM
Landing Gear — EXTEND
Flaps — 30°, 190 I.A.S. Maximum
Cowl Flaps — As Needed

FINAL APPROACH

Flaps — FULL DOWN
Props. — AUTO, 2400
Prop. Reverse Safety — Ready
Props. REVERSE WHEN GROUND CONTACT IS MADE.



1. Drag Strut Down Lock Limit Switch
2. Engage Tip

Figure 22 — Main Landing Gear Down and Locked

a. BEFORE LANDING.

(1) Start auxiliary power unit. Turn equalizer switch "ON." Place A.P.U. generator switch in load position after engine is running.

NOTE

Always start A.P.U. approximately 10 minutes before landing to insure its continued operation under load.

(2) Check auto-pilot "OFF."

(3) Intercoolers — "AUTOMATIC."

(4) Set fuel tank selectors "TANK TO ENGINE."

(5) Set mixture controls in "AUTO-RICH."

(6) Turn booster pumps on "LOW" position.

(7) Increase propeller rpm to 2400, "AUTOMATIC CONSTANT SPEED."

(8) Extend landing gear — green light will indicate gear is down and locked.

NOTE

AIR SPEED MUST NOT EXCEED 200 MPH WHEN GEAR IS LOWERED. Return landing gear switch to "NEUTRAL" after gear is down and locked.

(9) Lower wing flaps 30 degrees before final approach.

WARNING

Dispatch crew member to bombardier's compartment to check for down and locked position of nose gear. Instruct crew member in forward cabin to check for down and locked position of main landing gear.

NOTE

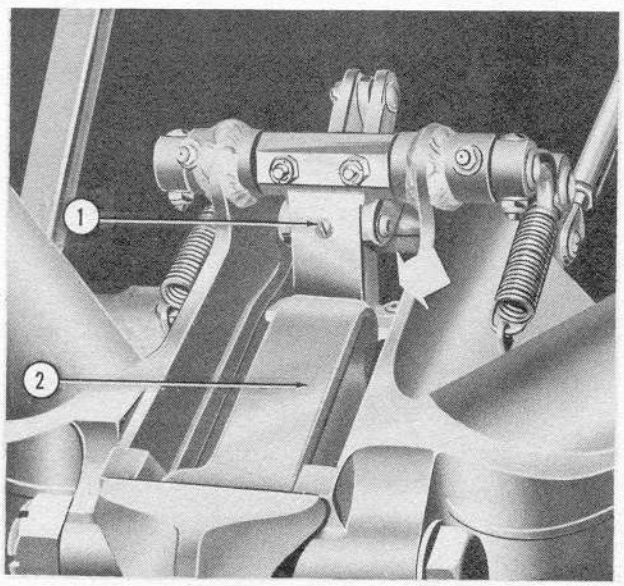
AIR SPEED MUST NOT EXCEED 190 MPH WHEN WING FLAPS ARE LOWERED.

(10) Set cowl flaps as needed.

(11) Check brake accumulator pressure; minimum 850 pounds per square inch.

NOTE

The brake pressure warning light (amber) will glow when the brake pressure is below 650 pounds per square inch.



1. Latch Release Lever 2. Latch Lever

Figure 23 — Nose Landing Gear Down and Locked

(12) Check to insure that brake system hydraulic pump motor switch is "ON."

b. FINAL APPROACH.

(1) Set turbo selector to "8."

(2) Extend flaps to full landing position—40 degrees.

(3) Return flap switch to "NEUTRAL" when flaps are down.

(4) Move propeller reverse safety switch from "SAFE" to "READY" position.

(5) Pilot will move propeller reverse switch from "NORMAL" to "REVERSE."

CAUTION

PROPELLERS SHOULD NEVER BE REVERSED UNTIL GROUND CONTACT IS MADE. As the propeller pitch is reversing, it will be necessary for copilot to closely control the inboard throttles to prevent engines from stopping due to reversed air force on blades.

c. AFTER LANDING.

(1) Cowl flaps full open.

(2) Retract wing flaps.

(3) Return wing flap switch to "NEUTRAL" after flaps are up.

(4) Pilot will move propeller reverse pitch from "REVERSE" to "NORMAL."

(5) Move reverse pitch safety switch from "READY" to "SAFE" position.

(6) Place propeller controls in 2800 rpm, "AUTOMATIC."

(7) Return turbo selector to "0" position.

(8) Turn booster pumps "OFF."

(9) Return elevator trim tabs to neutral.

23. STOPPING ENGINES.

a. Engines will be idled at 1000 rpm until head temperatures are reduced to 205 degrees C.

b. Increase rpm to 1200 for 30 seconds to properly scavenge oil; then stop engines by moving mixture controls to "IDLE CUT-OFF."

c. AFTER engines have stopped, turn master and individual ignition switches "OFF."

d. Stop auxiliary power unit, turn equalizer switch "OFF" and turn A.P.U. generator switch "OFF."

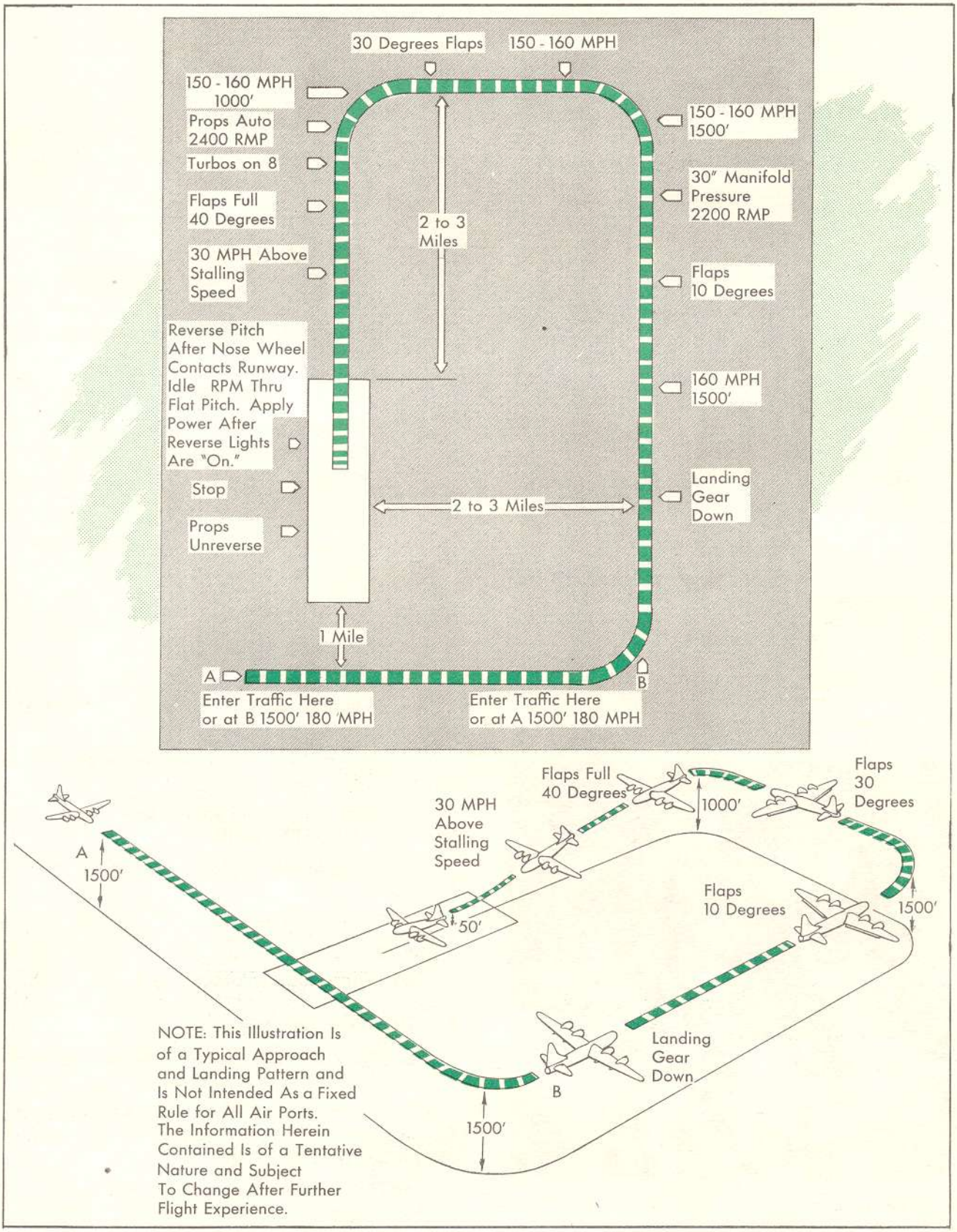


Figure 24 — Traffic Pattern

e. Turn off ALL electrical units except circuit breakers and generators.

f. After all electrical units have been turned off, battery switches shall be turned off.

WARNING

ALL ELECTRICAL UNITS MUST BE TURNED OFF BEFORE THE BATTERY SWITCHES. THIS PROCEDURE IS NECESSARY TO PREVENT ARCING AND BURNING OF BATTERY RELAY CONTACTS, ALSO TO PREVENT AN UNNECESSARILY HEAVY LOAD BEING PLACED ON BATTERY WHEN SWITCHES ARE AGAIN TURNED ON.

g. Pilot will align controls and engage locks. Be sure all controls are not movable in any direction.

h. Leave cowl flaps full open until engines are cold. Do not close until head temperatures have dropped to below 100 degrees Centigrade.

WARNING

COOLING IS IMPORTANT TO PREVENT RESIDUAL HEAT FROM DAMAGING IGNITION HARNESS AND CYLINDER FINS.

24. OPERATION OF C-1 AUTOPILOT.

a. AUTOPILOT ENGAGING PROCEDURE.

(1) SET CONTROL PANEL KNOBS.—Unless it is known that the autopilot control panel is already in correct adjustment, it is well to turn all knobs to their midpositions (pointers at 12 o'clock) before engaging.

Exceptions: The control transfer should be left at "PILOT" and the tell-tale light shutter should be left "ON."

(2) TURN ON SERVO-PDI SWITCH.

(3) MANUALLY TRIM AIRPLANE FOR STRAIGHT-AND-LEVEL FLIGHT. CHECK WITH INSTRUMENTS.

(4) DISENGAGE AUTOPILOT CLUTCH AND CENTER PDI.

Alternate Method: If crew does not include a bombardier, leave the autopilot clutch engaged, and center PDI by turning the airplane in the direction of the PDI needle; then hold zero PDI course while engaging the autopilot.

(5) Move clutch arm to center PDI.

(6) Press down on directional arm lock to keep PDI centered.

(7) Put out both aileron tell-tale lights by adjusting aileron centering knob.

(8) Snap on aileron switch.

(9) Check gyro horizon and readjust aileron centering knob to level wings.

(10) Put out rudder tell-tale lights with rudder centering knobs.

(11) Snap on rudder switch.

(12) Re-engage autopilot clutch.

(13) Release directional arm lock.

(14) READJUST RUDDER CENTERING KNOB TO CENTER PDI.

(15) Put out elevator tell-tale lights with elevator centering knob.

(16) Snap on elevator switch.

(17) Check altimeter and readjust elevator centering.

CAUTION

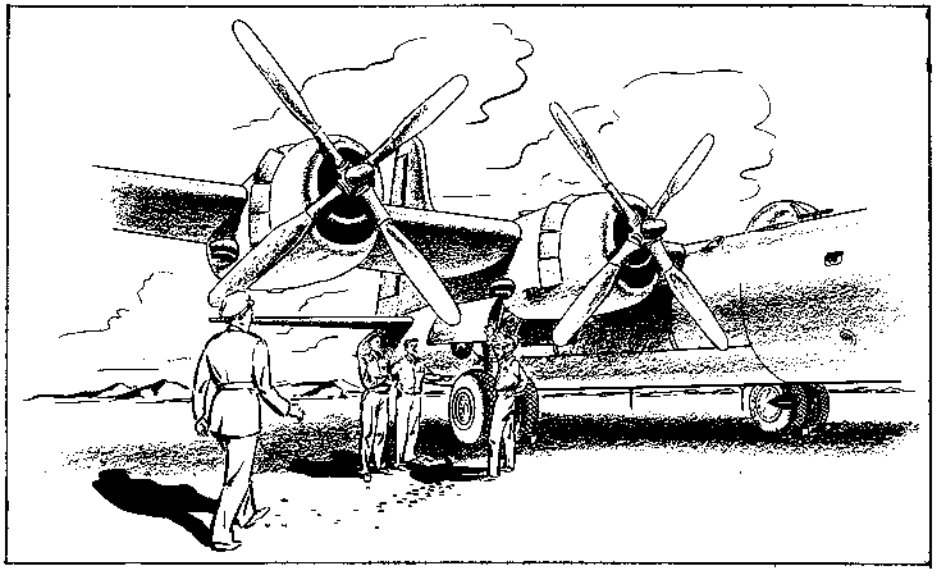
Never adjust the mechanical trim tabs when the autopilot is fully engaged.

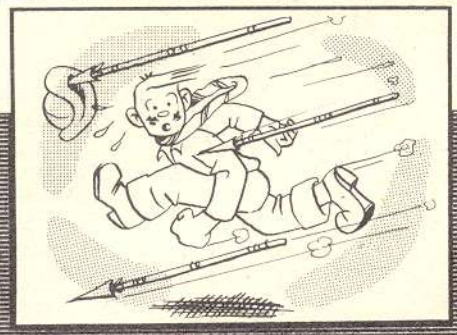
Note

The autopilot may be disengaged by one flip of the master bar. It can also be overpowered by the pilot if enough force is applied.

(18) CENTERING.—After the autopilot is engaged, centering knobs should not be moved except to correct for slight changes in attitude resulting from changes in air speed or loading. On long flights, considerable change of loading occurs as gasoline is consumed. Every few hours, therefore, the autopilot should be disengaged and the airplane *retrimmed manually* before re-engaging.

(19) SENSITIVITY.—The sensitivity knobs are used to regulate the amount of airplane deviation the autopilot will allow before it applies correction.





SECTION III

Flight OPERATING INSTRUCTIONS

1. SPECIFIC ENGINE FLIGHT CHART.

The data presented in this chart was furnished by the engine manufacturer. Engines R3350-21 and R3350-23 are identical except that the -21 engine is equipped with a torque meter. The R3350-23 engine is installed on production airplanes after the first four. Operating conditions listed in the chart are conventional. No "War Emergency" operating condition is provided by the engine manufacturer. It should be noted that while "Military Power" condition is generally considered to be for 30 minutes, in this chart operation at 2600 rpm with 47 inches Hg is limited to 5 minutes.

2. AIRSPEED CORRECTION TABLE.

When this airplane is flight tested, information for an airspeed correction table will be secured and published.

3. AIRSPEED LIMITATIONS.

a. FLAPS.—Do not extend the wing flaps at air speeds above 190 mph. A protective device is incorporated in the wing flap system that automatically retracts the flaps when air speed exceeds 210 mph but this is a safety provision only.

b. LANDING GEAR.—The landing gear shall not be extended in air speeds greater than 200 mph.

c. ENGINE OVERSPEED. — Do not operate the R3350-23 engines above 2880 rpm.

d. HIGH SPEED.—When loaded to 100,000 pounds the diving speed must be kept below 330 mph, I.A.S.; when loaded to 118,000 pounds the diving speed must be kept below 240 mph, I.A.S.

POWER PLANT CHART

AIRCRAFT MODEL(S)	PROPELLER(S)	ENGINE MODEL(S)
B-32	CURTISS ELECTRIC	-41 -57 -59 -19 R-3350-13,21,23,23A

GAUGE READING	FUEL PRESS.	OIL PRESS.	OIL TEMP.	COOLANT TEMP.	CARB. AIR		NOSE OIL
DESIRED MAXIMUM	16-18 19	60-80 80	50-85 95	AIR COOLED	15-40 40		30-50 50
MINIMUM IDLING	15 15	60 20	40 -		-40		20

MAXIMUM PERMISSABLE DIVING RPM: 3100
MINIMUM RECOMMENDED CRUISE RPM: 1400
MAXIMUM RECOMMENDED TURBO RPM: 26400

OIL GRADE: (S) 1120 (W) 1120
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)		
5 MINUTES			5 MINUTES			TIME LIMIT			UNLIMITED			UNLIMITED		
260°C			260°C			MAX. CYL. HD. TEMP.			248°C			232°C		
AUTO RICH			AUTO RICH			MIXTURE			AUTO RICH			AUTO LEAN		
2800			2600			R. P. M.			2400			2200		
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						
						-56.0	36,000 FT.	-67.0						
			47.5		5	-52.4	34,000 FT.	-62.3	43.5		250	35		145
			"		5	-48.4	32,000 FT.	-55.1	"		250	"		145
50.5		5.5	"		5	-44.4	30,000 FT.	-48.0	"		250	"		145
"		5.5	"		5	-40.5	28,000 FT.	-40.9	"		250	"		145
"		5.5	"		5	-36.5	26,000 FT.	-33.7	"		255	"		150
"		5.5	"		5	-32.5	24,000 FT.	-26.5	"		255	"		150
"		5.5	"		5	-28.6	22,000 FT.	-19.4	"		255	"		150
"		5.5	"		5	-24.6	20,000 FT.	-12.8	"		255	"		150
"		5.5	"		5	-20.7	18,000 FT.	- 5.2	"		255	"		145
"		5.5	"		5	-16.7	16,000 FT.	2.0	"		255	"		145
"		5.5	"		5	-12.7	14,000 FT.	9.1	"		255	"		145
"		5.5	"		5	- 8.8	12,000 FT.	16.2	"		250	"		145
"		5.5	"		5	- 4.8	10,000 FT.	23.4	"		250	"		145
"		5.5	"		5	- 0.8	8,000 FT.	30.5	"		250	"		140
"		5.5	"		5	3.1	6,000 FT.	37.6	"		250	"		140
"		5.5	"		5	7.1	4,000 FT.	44.7	"		245	"		135
"		5.5	"		5	11.0	2,000 FT.	51.8	"		245	"		135
"		5.5	"		5	15.0	SEA LEVEL	59.0	"		240	"		130

GENERAL NOTES

(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:
2800 RPM 49" MP AUTO-RICH MAX. 260°C

CONDITIONS TO AVOID;

SPECIAL NOTES

AAFMC-526
8-1-44

DATA AS OF 2-20-45 BASED ON Flight Test

SECTION IV

Emergency OPERATING INSTRUCTIONS

1. GENERAL.

All emergency instructions have been assembled in this section. Members of the crew should obtain a practical background from the instructions contained herein before their initial flight. All emergency procedures that so lend themselves should be practiced on the ground. There is no known substitute for experience.

2. BAIL OUT ALARM BELL.

An alarm bell, located on the face of bulkhead 7.1 just forward of the stabilizer in the aft cabin, is controlled by a switch on the pilot's instrument panel.

3. EMERGENCY EXITS.

Passage openings in the fuselage are shown in figure 25, together with conditions which dictate their use. Unless prearranged, personnel should exit through the most convenient opening. On this airplane the bomb doors may be opened and landing gear extended simultaneously. Bomb doors may be opened and bombs salvoed conventionally by the bombardier, or by operating either of the salvo switches accessible to those on the flight deck. One salvo switch is located on the pilot's panel, the other on the forward face, left hand side of the aft wall of the flight deck. The bomb doors may also be opened by manual operation of the main hydraulic selector valve or by use of the emergency hydraulic system. First, make certain the nose wheel is down and locked before attempting to use nose wheel well as an exit during flight. It may be advisable for personnel using the bombardier's hatch as an exit during flight to do so before gear is extended to escape possible collision with the nose wheel door.

4. BAIL-OUT PROCEDURE.

a. GENERAL.—Immediate action should follow the decision to abandon the airplane. Guess-work and confusion must be minimized. Alarm and interphone signals, and desired routine of exit should have been prearranged. If the airplane is still under control, the pilot will reduce the air speed as much as is practical. Members of the crew are to assist each other, mutually inspecting chutes and harnesses. The aircraft should be abandoned through the openings recommended for use during flight as shown on figure 25. Parachute stowage locations for each crew member are shown on the same diagram.

5. ENGINE FAILURE.

WARNING

When flying the airplane with one or more engines inoperative, all maneuvers should be made cautiously and with forethought to prevent placing the airplane in an attitude from which recovery would be impossible.

a. ENGINE FAILURE ON TAKE-OFF.

(1) When engine failure occurs on take-off, immediately apply rudder and aileron to counteract the yaw created by the unbalanced power condition.

(2) Do not allow wing carrying the dead engine to drop.

(3) Use power as required to improve directional stability (49 inches manifold pressure maximum).

(4) MAINTAIN AIR SPEED. — Nose down if necessary and possible until sufficient velocity has been acquired.

(5) Retract the landing gear.

(6) Feather the propeller of the faulty engine.

(7) Raise wing flaps GRADUALLY in stages as flying speed increases.

Note

All the foregoing should be done as quickly as possible; pilot and copilot cooperating. Keep the dead engine high enough to insure directional control.

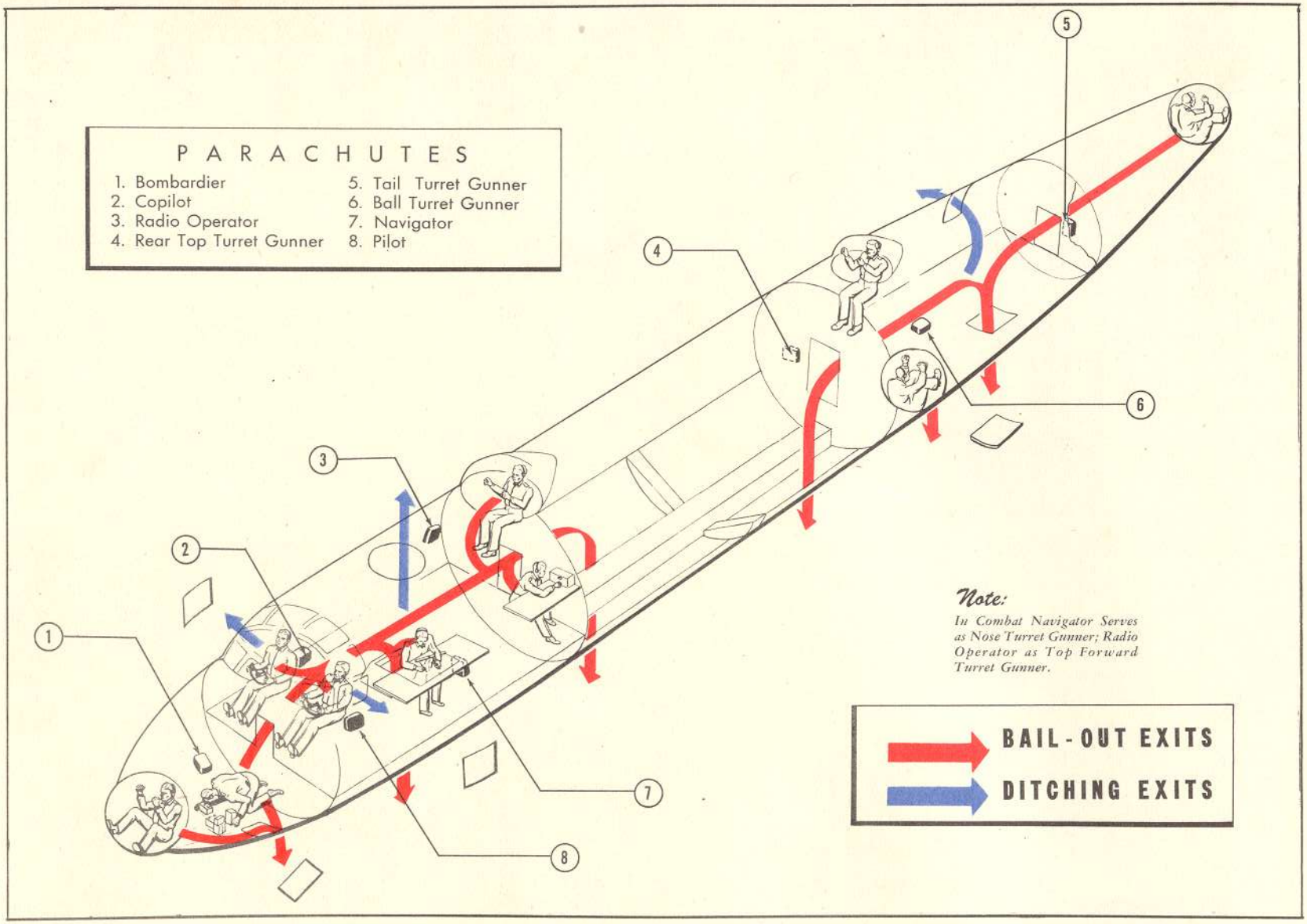


Figure 25 — Emergency Exits and Parachute Stowages

(8) After initial instabilities have been overcome, operate trim tabs to reduce forces on the controls.

(9) As soon as conditions warrant, engines should be relieved of excessive power output.

b. ENGINE FAILURE IN FLIGHT.

(1) Use surface controls to counteract yaw.

(2) Keep the wing carrying the dead engine(s) high.

(3) Feather propeller(s) of engine(s) that are inoperative.

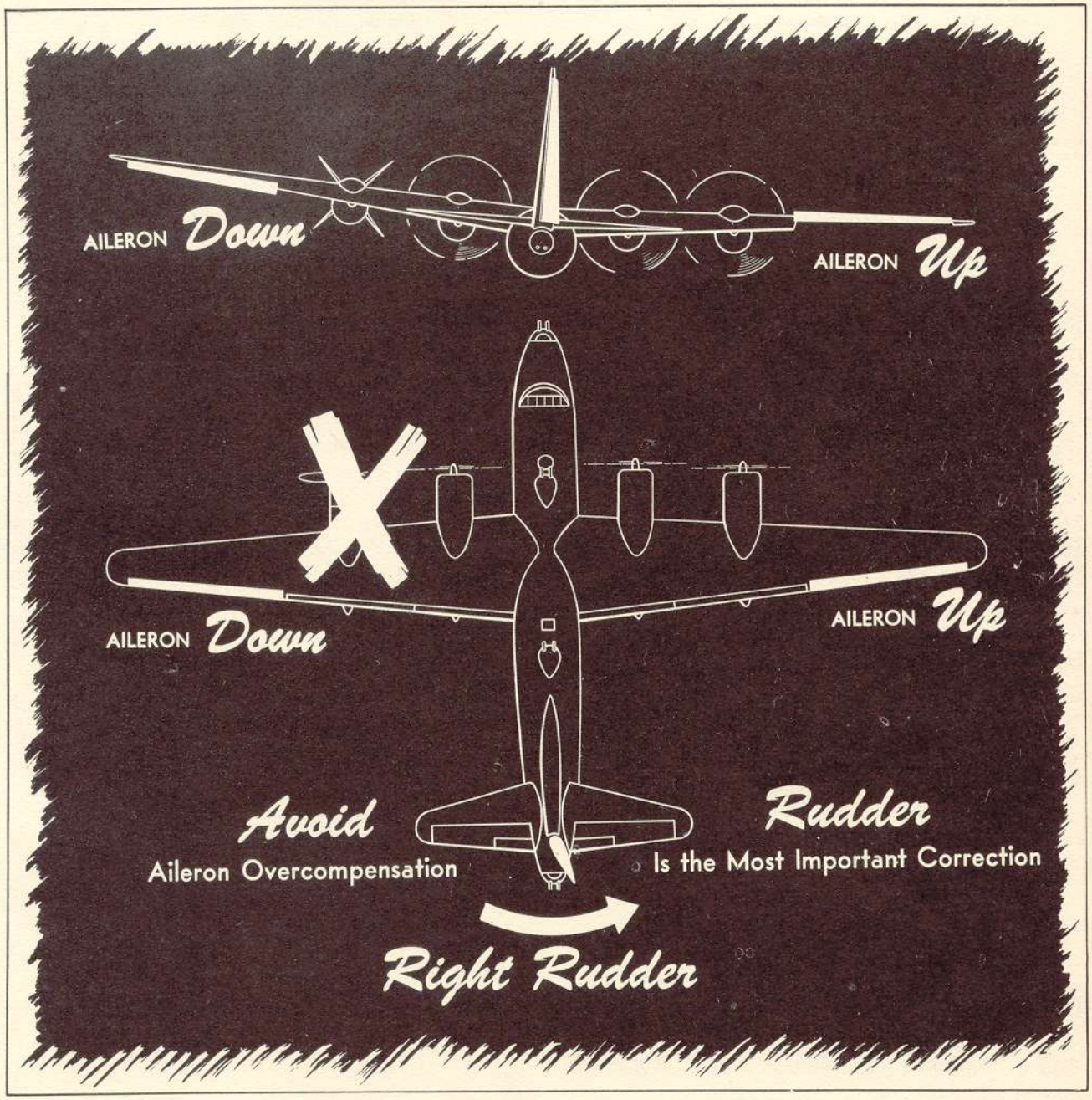
(4) Close cowl flaps of engine(s) not operating.

(5) Use power to improve directional control if tab effect proves insufficient.

(6) If at low speeds, make all turns with operating engines down and toward the center of the turn.

(7) When engine failure occurs at high altitude do not use excessive power to maintain original height. Allow the airplane to descend into denser air where it will hold its altitude with less power.

c. FEATHERING AND UNFEATHERING PROPELLERS.



(1) FEATHERING.

(a) Close the throttle.

(b) Place the feathering switch in the "FEATHERED" position.

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

(d) Shut off fuel booster pump.

(e) Place fuel selector valve in "OFF" position.

(f) When the propeller stops windmilling, turn "OFF" the ignition switch.

(g) Turn off the generator.

(2) UNFEATHERING.

(a) Make certain throttle is closed and mixture is in "IDLE CUT-OFF."

(b) Place fuel selector in position desired.

(c) Turn on booster pump.

(d) Return feather switch to "NORMAL."

(e) Hold propeller selector switch in "INC. RPM" until engine tachometer indicates about 800 rpm. Release to "FIXED PITCH" position.

(f) Turn on ignition.

(g) Move mixture control to "AUTOMATIC RICH."

(h) Open throttles until engine idles from 1000 to 1200 rpm and maintain this throttle setting until oil temperature and pressures are normal.

(i) When engine is warm move propeller selector switch to "AUTOMATIC."

(j) Readjust throttle and mixture controls to the desired normal flight positions.

(k) Turn on the generator.

d. LANDING — ONE OR TWO ENGINES NOT OPERATING.

(1) Approach from an altitude of at least 1000 feet. Play approach leg close to field.

(2) Lower the landing gear.

(3) Lower flaps approximately 20 degrees.

(4) Trim airplane for a lower power condition.

If two engines on one side are not operating place power emphasis on the good inboard engine.

(5) When a successful landing is assured, lower flaps to "full down," and with power set, land in the normal manner.

CAUTION

While flying the airplane with less than four engines operating, obtain or hold a safe air speed. Do not fail to use sufficient rudder when correcting yaw; insufficient rudder and too much aileron will cause the airplane to be flown in a forward slip, making it impossible to attain safe air speed. First, introduce rudder, then aileron; hold, then relieve strain with tabs. When trying to increase air speed or maintain altitude, retract all retractable items. Avoid sudden full operation of the flaps in either direction. When long flights are made with any of the engines not operating, fuel should be transferred or used from the tanks of the dead power plants.

Note

Vacuum pumps (power for gyro instruments) are installed on No. 2 and No. 3 engines. Hydraulic pumps are located on No. 2 and No. 3 engines. If No. 2 and No. 3 engines fail, use the emergency hydraulic system.

6. EMERGENCY LANDING — GEAR UP.

Pilot will notify crew of his intention to make a belly landing. All seated crew members on the flight deck should fasten their safety belts. Remainder of the crew is to assume crash landing positions. The bombardier's compartment will be vacated. Crew, in the crash landing positions, should look directly aft of their station to make certain that this area is free from poorly stowed or loosely installed equipment, since such articles may assume the role of battering rams during a quick stop.

a. Make certain all doors on the bottom of the fuselage are closed.

b. Open top hatches, remove the navigator's optical flat—chop off at the hinges with the fire ax if necessary.

c. Be sure bottom turret is retracted.

d. Extend wing flaps full down.

e. If both outboard engines are operating satisfactorily, feather both inboard propellers when possibility of "undershooting" has been eliminated.

f. Just before or at ground contact:

(1) Close all fuel shut-off valves.

(2) Place mixture controls in "IDLE CUT-OFF."

(3) Cut battery switch.

(4) Cut ignition switches.

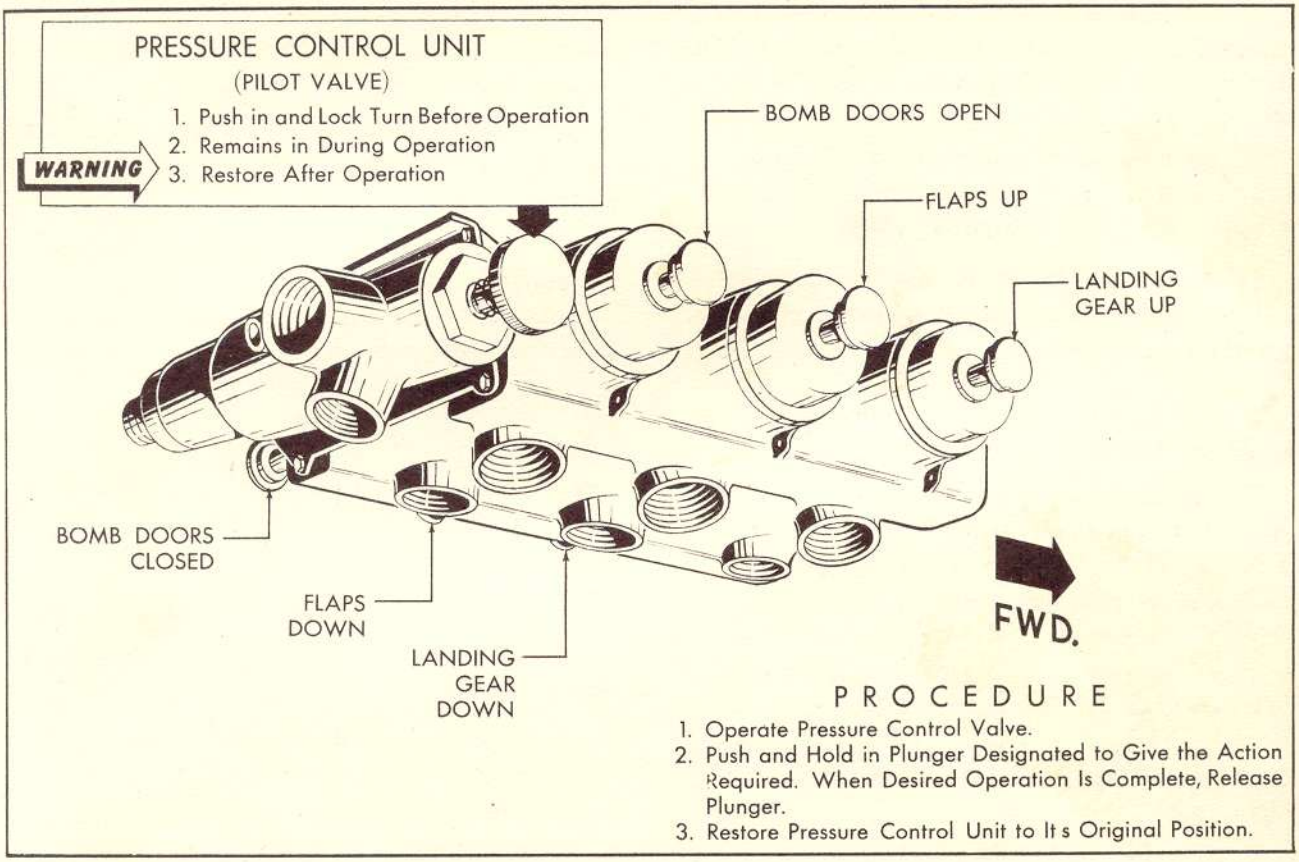


Figure 26 — Main Hydraulic Selector Valve

(5) Cut generator switches.

(6) Stop auxiliary power plant.

(7) Land with as many legs down as possible to minimize damage. Do not land with only nose gear down because fuselage may be broken.

CAUTION

Guard against a stall while airplane is high off the ground. It is better to have too much speed than not enough. Landing attitude should be approximately level—tail SLIGHTLY low. On airplanes with a long fuselage, destructive rotational momentum may result if the airplane strikes the ground with the tail too low.

7. FAILURE OF SYSTEMS.

The airplane is equipped with a dual independent hydraulic system: to lower the landing gear, open and close the bomb doors, and lower the wing flaps. Landing gear, bomb bay doors and flaps may be moved in EITHER direction by manually operating the main selector valve, in the event of electrical failure, but the airplane contains no emergency means to raise the landing gear or flaps if hydraulic failure should occur. A single hydraulic system is installed to raise the landing gear and a single system is used to retract the flaps. The brake system is the pressure type equipped with dual accumulators.

a. LANDING GEAR.—In the event the gear fails to respond when prevailed upon in normal manner, the following alternate procedures are available:

(1) FAILURE IN THE ELECTRIC SYSTEM. *(See figure 26.)*

(a) Isolate the main hydraulic selector valve installed above the catwalk just aft of the front top turret in the forward bomb bay.

(b) Locate the pressure control button of the selector valve. This button may be identified by its position at the rear of the left row of buttons on the hydraulic selector valve (looking toward the rear of the airplane), and by a coil spring installed around the stem of the plunger.

(c) Push in the pressure control button and rotate it until it locks in.

(d) Push in the button on the selector valve corresponding to the landing gear action required. Hold this button in until the operation is completed, then release.

(e) Pull out the pressure control button.

CAUTION

Always restore the pressure button to its original position after manual operation of the main selector valve.

(2) FAILURE OF THE LANDING GEAR HYDRAULIC SYSTEM.

(a) Manually operate the main selector valve as described in paragraph (1) above.

(b) IF THE GEAR FAILS TO RETRACT pilot must continue with his wheels down or return to the field.

(c) IF THE GEAR FAILS TO EXTEND resort to the emergency hydraulic system. (See figure 27.)

1. Locate the emergency hydraulic selector valve and the switch-over valve on the aft wall of the flight deck.

2. Turn and HOLD the switch-over valve to the "EMERGENCY ON" position.

3. Turn the emergency landing gear control on the emergency valve to the "LANDING GEAR DOWN" position.

NOTE

WORK HAND PUMP AT THIS POINT IF ELECTRIC HYDRAULIC PUMP FAILS TO OPERATE.

4. When the landing gear is down and locked, turn the emergency valve to the neutral position.

5. Release the spring-loaded switch-over valve and allow it to return to its original position.

Note

When operating the emergency valves correct sequence of operation is mandatory. Before releasing the switch-over valve control, return the emergency selector valve unit to the neutral position.

(d) IF THE TAIL BUMPER FAILS TO EXTEND.

1. Disconnect the aft tube from the hydraulic lock valve located on the left face of the left tail bumper beam.

2. Remove the plug from the emergency extension port at the forward end of the tail bumper installation.

3. Insert a rod through this hole and extend the gear by pushing the jack piston rod to the rear. (The lower turret hydraulic jack handle may be used to perform this operation.)

b. FLAPS.

(1) IF THE FLAPS FAIL TO RETRACT, manually operate the main hydraulic selector valve. (See figure 26.) Should flaps remain extended, pilot must return to the field.

(2) IF THE FLAPS FAIL TO EXTEND.

(a) Manually operate the main hydraulic selector valve.

(b) If flaps remain up, operate the emergency hydraulic system. (See figure 27.)

1. Turn and HOLD the switch-over valve to the "EMERGENCY ON" position.

2. Turn the flap extension valves on the emergency hydraulic valve to the "ON" positions until the flaps assume the desired settings.

NOTE

WORK HAND PUMP AT THIS POINT IF ELECTRIC HYDRAULIC PUMP FAILS TO OPERATE.

3. Turn the emergency "FLAPS DOWN" valves back to neutral.

4. Release the switch-over valve.

c. BOMB DOOR FAILURE.

(1) Manually operate the main hydraulic selector valve.

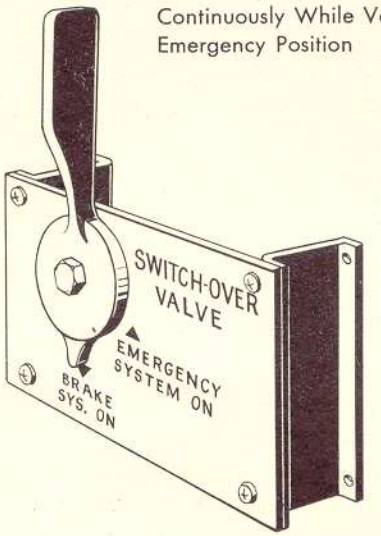
(2) If doors still fail to operate, use the emergency hydraulic system. (See figure 27.)

(a) Turn and HOLD the switch-over valve to the "EMERGENCY ON" position.

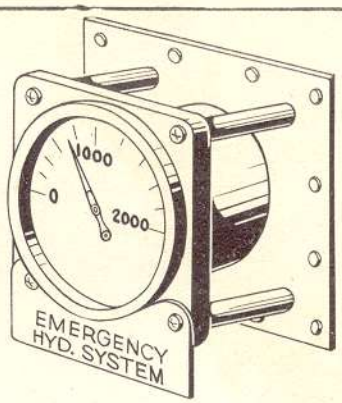
(b) Operate the bomb door switch on the emergency hydraulic selector valve that corresponds to the bomb door action desired.

SWITCH-OVER VALVE

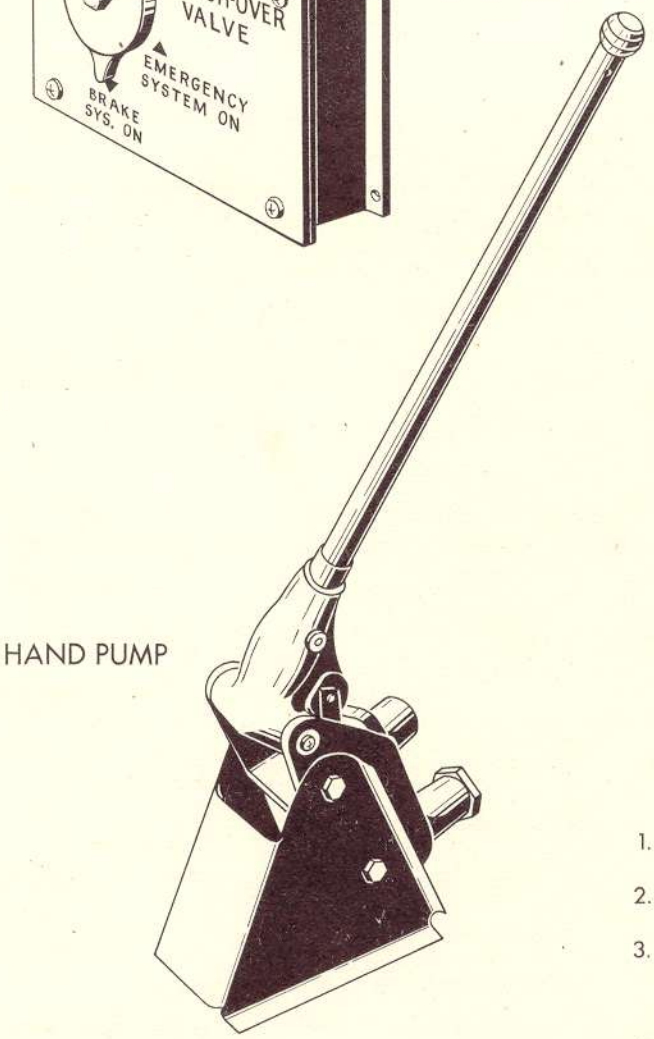
Electric Hydraulic Pump Operates Continuously While Valve Is in Emergency Position

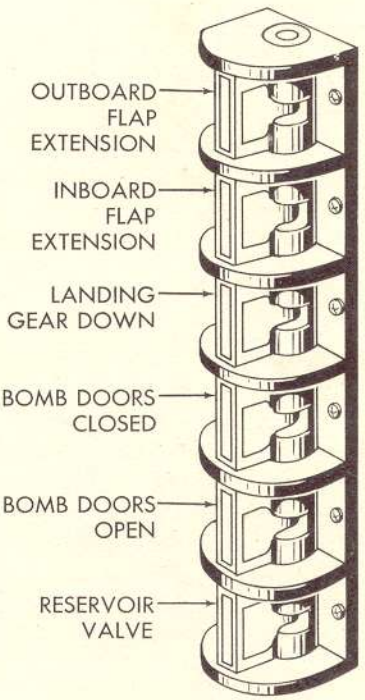


EMERGENCY HYDRAULIC PRESSURE GAGE



Do Not Operate Continuously at 1500 Pounds for Over Two Minutes Out of Any Eight Minute Period





EMERGENCY HYDRAULIC SELECTOR VALVE

EMERGENCY HYDRAULIC SYSTEM

1. Turn and HOLD Switch-Over Valve to the EMERGENCY SYSTEM on Position.
2. Operate the Switch on the Emergency Hydraulic Valve Correlated With the Action Desired.
3. After the Operation Is Complete, Return the Emergency Hydraulic Valve to Neutral.

Before You

4. Allow the Switch-Over Valve to Return to the BRAKE SYSTEM ON Position

Figure 27 — Emergency and Switch-Over Hydraulic Valves

NOTE

WORK HAND PUMP AT THIS POINT IF ELECTRIC HYDRAULIC PUMP FAILS TO OPERATE.

(c) After the door operation is complete restore the selector valve switch to neutral.

(d) Allow the switch-over valve to return to its original position.

d. BRAKE FAILURE. — Normal brake pressure range is from 850 to 1080 pounds. With an initial brake pressure of 1080 pounds, four full brake applications may be realized by the use of the accumulators alone. A pressure of 850 pounds will give two full actuations. At no time should a landing be attempted with less than 850 pounds pressure until all efforts to attain this pressure have proven futile. A brake pressure warning light and override switch are located on the copilot's panel. This switch will operate the electric hydraulic motor, overriding all units except the circuit breaker. If the electric-hydraulic pump fails to respond, operate the hand pump until satisfactory pressure is obtained.

NOTE

To obtain emergency brake pressure do not operate any valves—just work the hand pump.

e. HYDRAULIC SYSTEM.

(1) GENERAL.—The open-center and emergency systems are independent systems when the switch-over valve is in the normal position. The engine-driven pumps supply power to the open-center system which operates all hydraulically activated equipment except the brakes. The brake system derives its power from the electrically driven pump. The switch-over valve in the emergency position diverts fluid from the emergency reservoir into the emergency system lines. A micro-switch on the back of the switch-over valve turns on the electric hydraulic pump which supplies power for the emergency system. The electric-hydraulic pump will be in continuous operation during the period the switch-over valve is in the "EMERGENCY ON" position. If pilot's hydraulic pressure gage indicates excessive pressure when units are not in operation, check the positions of the flap, bomb door, and landing gear operating switches. Return all of these switches not so positioned to neutral.

CAUTION

While operating emergency hydraulic units, observe the pressure gage located on the right hand rear wall of the flight deck—do not operate continuously at 1500 pounds for over two minutes out of any eight-minute period.

The main hydraulic reservoir will overflow DOWNHILL into the emergency hydraulic tank. In FLIGHT, as on the ground, the main hydraulic reservoir may be filled from the emergency reservoir by using the emergency hydraulic selector valve in conjunction with the switch-over valve. If an accessible leak in the main hydraulic system empties the main reservoir and the emergency hydraulic system is inoperative (such an occurrence would be rare outside of the combat zone):

(a) Locate the leak in the main system and seal by crimping or plugging the tubing.

(b) Fill the main hydraulic reservoir from the emergency reservoir as described above.

(c) Effect normal operation of the hydraulically controlled units.

f. EMERGENCY BOMB RELEASE.—Bomb doors can be opened and bombs released by bombardier in the normal manner or bombs can be salvoed, using either the salvo switch on the pilot's panel or the salvo switch in the box on the rear flight deck wall. If bomb doors open and bombs fail to salvo, bombs can be released manually by tripping the release or by using a tool to force the release lever of each bomb shackle past the hinge ear of the bomb rack release unit.

8. EMERGENCY — ELECTRIC PROPELLER.

a. RUN-AWAY PROPELLERS.—In case of a "runaway" propeller, that is, one which allows the engine to overspeed:

(1) Immediately reduce rpm by throttle control.

(2) Check circuit breakers.

(3) Check switch settings.

(4) Hold selector switch in the "DECREASE RPM" position.

If this fails to reduce the rpm, "blip" (turn on, then quickly off again) the feathering switch to reduce rpm to the correct setting. Be careful not to reduce the rpm too much when using this method.

b. PROPELLER CIRCUIT BREAKERS.

(1) On automatic or manual operation circuits:

(a) If a push button propeller circuit breaker on the pilot's panel opens due to an overload, reset by holding the button closed for several seconds.

(b) In an emergency and at the discretion of the pilot, this button may be held closed at the risk of

burning out wiring to achieve a desired propeller setting even though the overload remains in the circuit.

(2) On feather and reverse circuits.

Circuit breakers that may be held closed in emergency against overload during feathering or reversing are located on the fuselage wall to the left of the pilot.

c. SELECTIVE FIXED PITCH OPERATION.—Should selective fixed pitch be desired or should constant speed control become inoperative, move the selector switch lever to "FIXED PITCH." The desired RPM setting can then be obtained by momentarily holding the switch lever to "DECREASE RPM," as required.

9. ELECTRIC SUPERCHARGER REGULATOR.

a. If manifold pressure gages give evidence of supercharger control failure:

(1) CHECK THE INVERTER WARNING LIGHTS.—The red warning light on the pilot's panel indicates failure of BOTH inverters. If both inverters fail, waste gates will remain in the positions they occupied when the auxiliary inverter went out. Should changes in pressure and temperature build up excessive manifold pressure when the waste gates are inoperative, this pressure may be relieved by throttling down the engines until a safe pressure is registered.

NOTE

Failure of the main inverter is indicated by a light on the copilot's auxiliary panel. This calls for no emergency action as an automatic change-over switch will throw in the standby inverter.

(2) CHECK THE FUSES.—Fuses are below the navigator's seat on the aft face of the nose wheel well —replace blown fuses.

(3) USE THE SPARE AMPLIFIER.—If manifold pressure on one engine fails to respond when the control is operated, replace the amplifier for this engine. Amplifiers are located as shown in figure 28. Amplifiers may be correlated with the engine whose turbo they control by remembering the amplifier position and its engine number read in sequence in a counterclockwise direction, with the amplifier for No. 1 engine on the forward right side. To replace a faulty amplifier: (See figure 28.)

(a) Unfasten Dzus fastener at base of amplifier.

(b) Pull amplifier case forward and remove from mount.

(c) Remove Cannon plug connection at the rear of the amplifier.

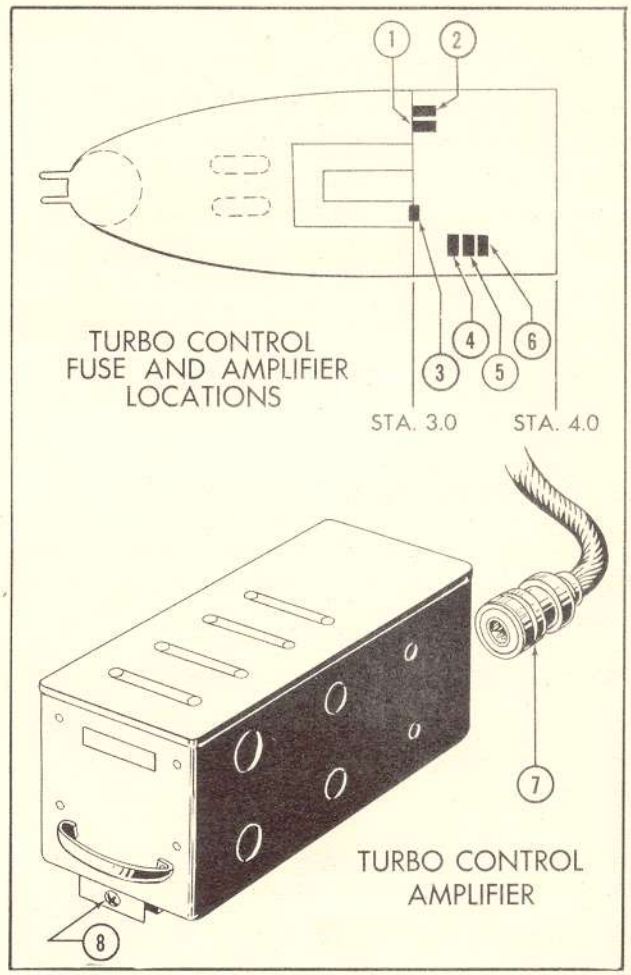


Figure 28 — Turbo Control System Details

1. Engine No. 1
2. Engine No. 4
3. Turbo Control Fuse Box
4. Engine No. 2
5. Spare Amplifier
6. Engine No. 3
7. Cannon Plug
8. Dzus Nut

(d) Replace amplifier with spare—set defective amplifier in spare mount.

Note

Remove defective amplifier upon landing and repair, or install a new spare unit.

b. EMERGENCY POWER.—Power, in excess of 48 inches M.A.P., is not recommended by the engine manufacturer; however, the turbo regulator is set to deliver 48 inches M.A.P. at a dial setting of(8.) Releasing the dial stop permits turning the selector to (10) with a subsequent increase of manifold pressure. Operation above 49 inches is not recommended and should only be resorted to in extreme emergencies since failure of the engines may result.

10. AUTOMATIC PILOT.

To disengage the automatic pilot in the event of an emergency, close the master and stabilizer switches which in turn will close the remaining auto-pilot switches through the connecting bar. No violent evasive action should be attempted for at least 10 minutes after cutting the switches unless the circumstances require immediate action to maintain safety of aircraft and crew. This precaution must be taken to permit the auto-pilot gyros to lose their speed in order that they shall not be damaged through sudden changes in position.

11. EMERGENCY IGNITION CONTROL.

To open immediately all ignition circuits, pull the release plunger located in the center of the four individual ignition switches.

12. EMERGENCY USE OF CIRCUIT BREAKERS.

Any of the electrical circuit's pull breakers may be held in the "ON" position to effect emergency operation of the units. If apparatus fails to respond after its circuit breaker has been held in for thirty seconds, successful operation is improbable. Avoid indiscriminate use of the circuit breakers.

13. AUXILIARY POWER UNIT.

a. Should an engine fail or one of the engine-driven generators burn out in flight, the auxiliary power unit may be put into operation. When it is properly turning over, the A.P.U. should be thrown into the main circuit by moving the "equalizer" switch on the co-pilot's panel to the "ON" position. This connects the A.P.U. to the main electrical system in parallel with the generators and it will operate as an auxiliary power source.

NOTE

The A.P.U. power output drops radically above 6000 feet since the engine unit is not supercharged; therefore, the A.P.U. is of little advantage at higher altitudes.

b. If the A.P.U. will not start in the conventional manner, that is, if the engine will not fire after all preliminary starting operations have been correctly accomplished and the generator switch on the copilot's panel has been turned to "START," wind the starting rope furnished with the unit around the pulley and pull the rope sharply.

14. FIRE.

a. ENGINE INDUCTION SYSTEM FIRES.—Induction system fires can be caused by a series of backfires. These backfires can be controlled by closing the throttle sharply, if the engine does not immediately pick up when the throttle is opened. The possibility of engine induction fires occurs in the following order:

(1) During ground operation and initial take-off. This is ordinarily caused by rapid changes in throttle opening.

(2) When manual leaning is attempted during cruising powers.

CAUTION

Manual leaning between auto-lean and idle cut-off is strictly forbidden.

b. CONDITIONS INDICATING INDUCTION SYSTEM FIRES.

(1) A sudden drop in manifold pressure and rpm.

(2) Regain or partial pick-up of initial loss of manifold pressure and rpm due to windmilling.

(3) Heavy black smoke from the engine exhaust.

(4) The final phase is heavy white smoke billowing from the exhaust.

Figure 29 — Engine Fire Extinguisher Controls

1. Fire Detector No. 1
2. Fire Detector No. 2
3. Fire Detector No. 3
4. Fire Detector No. 4
5. Push-to-Test Buttons
6. Tee Discharge Handles

c. PROCEDURES TO BE FOLLOWED IN CASE OF INDUCTION SYSTEM FIRES.

(1) Any crew member spotting an engine fire immediately announces "FIRE in (applicable engine) ENGINE," using "CALL" position on radio box and repeating engine location.

(2) Pilot immediately closes throttle of engine on fire and takes or directs the following action as required.

(a) Copilot moves mixture control to "IDLE CUT-OFF," turns booster pump to "OFF," turns fuel selector valve to "OFF."

(b) If smoke stops immediately, engine power may be applied normally. This should be done smoothly and engine operation and exhaust must be carefully observed.

(c) If smoke does not stop in approximately 10 seconds, pilot will feather the propeller on the affected engine.

(d) Copilot will close cowl flaps to decrease drag on the airplane.

d. NACELLE FIRES.—In the event of an engine fire, proceed as follows:

(1) Place mixture control in "IDLE CUT-OFF."

(2) Shut off fuel supply at fuel selector panel.

(3) Open cowl flaps.

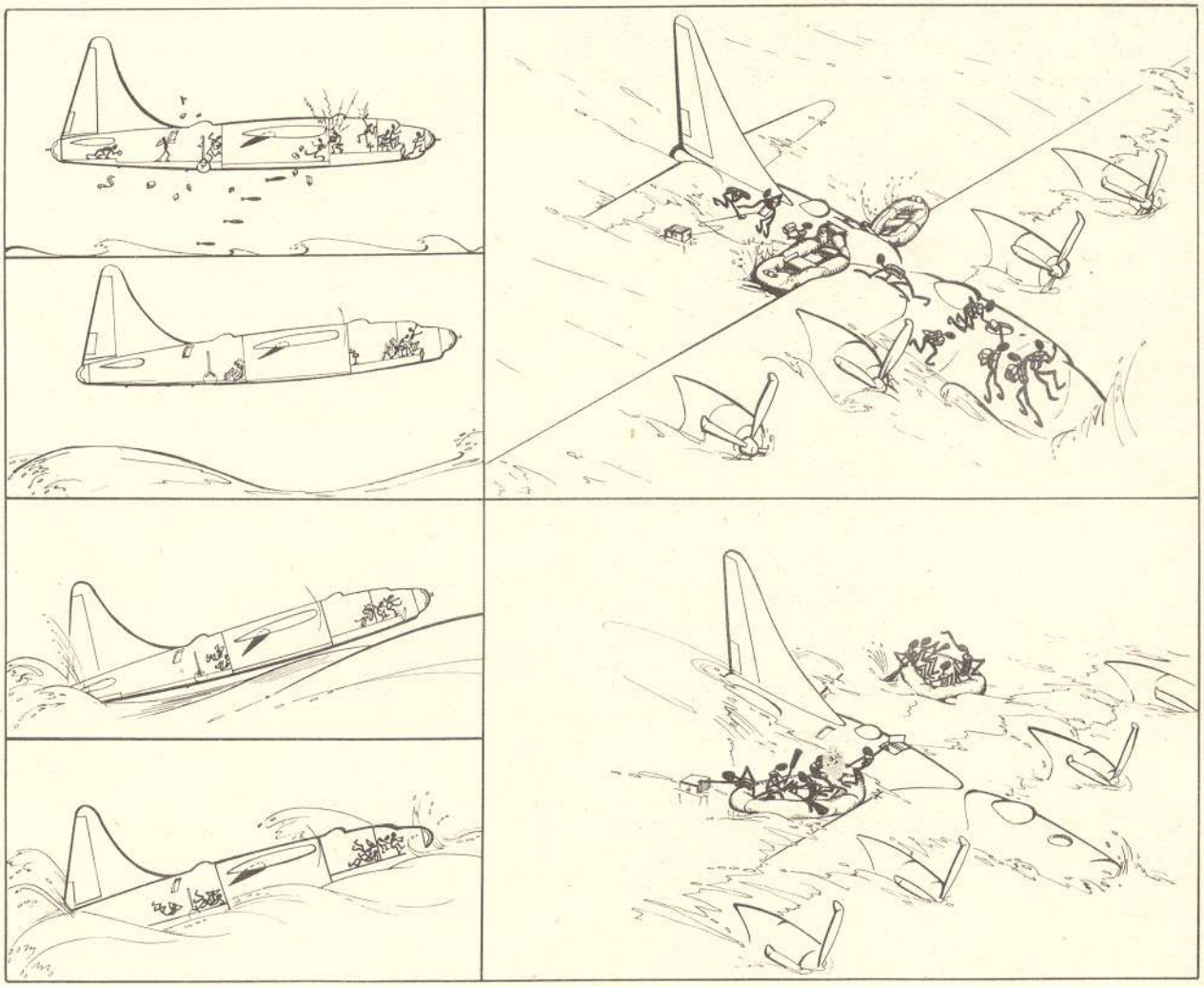
(4) Close throttle.

(5) Feather propeller.

(6) When the engine stops turning, shut off the ignition switch immediately.

(7) Turn off generator.

(8) Copilot pull up on T handle on the fire extinguisher control panel, for the affected nacelle.



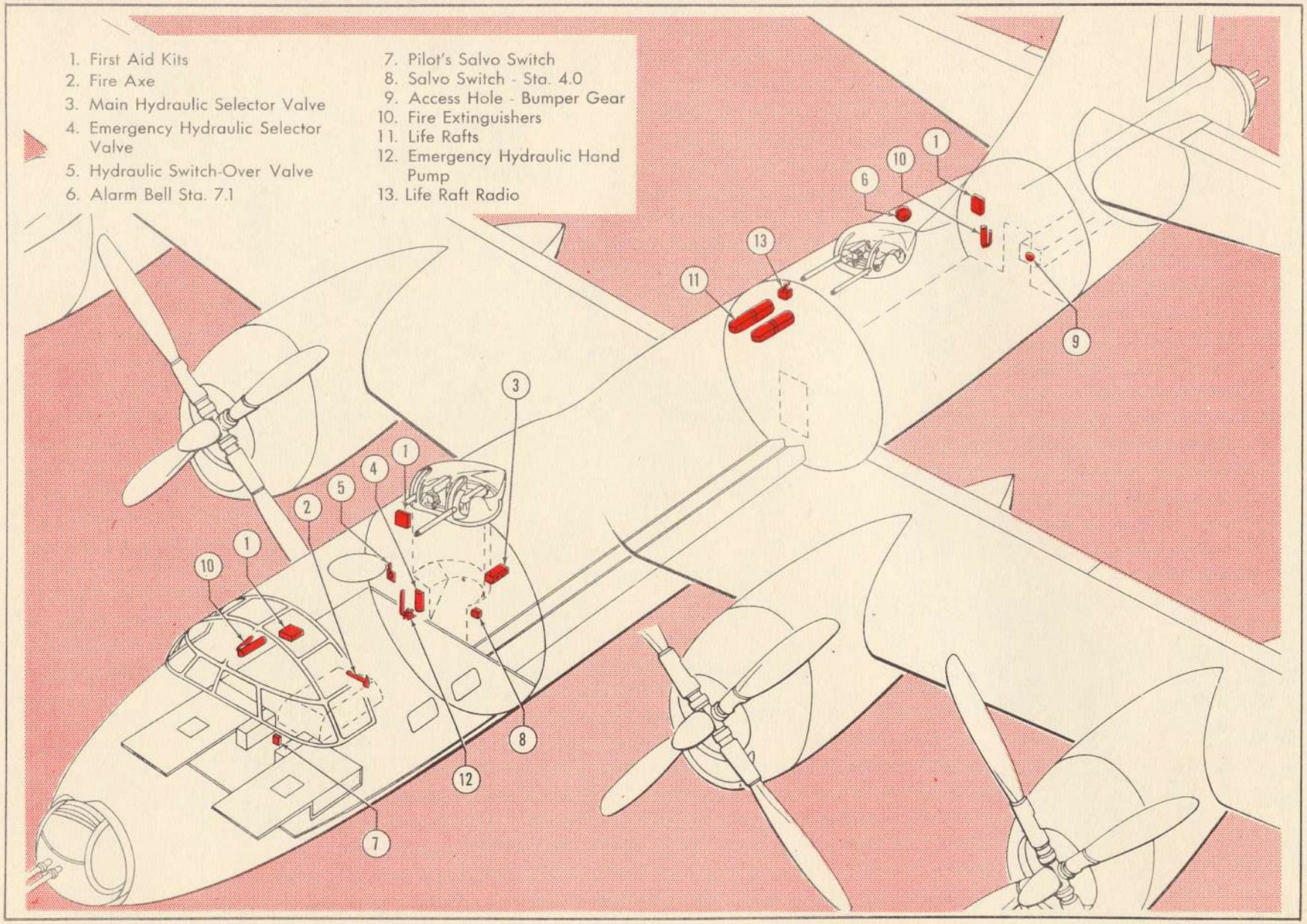


Figure 30 — Emergency Equipment Location

NOTE

Determine the cause of the fire as soon as possible. If the airplane is able to continue in flight, land at the earliest opportunity.

CAUTION

On airplanes prior to AAF No. 42-103506, CO_2 supply is sufficient to quench a fire in all four engines. On airplanes AAF No. 42-103506 and on, a "one-shot" fixed type system is used which discharges the total supply of CO_2 to extinguish a fire in any one selected engine.

e. CABIN FIRES.—Fire extinguishers are located in the front cabin on the cable guard behind the copilot's seat and in the aft cabin on the rear bulkhead to the left of the door. A fire ax is strapped on the rear side of the nose wheel well in the front cabin. When a cabin fire occurs, close all windows and vents, including the cabin doors to the bomb bay. Current limiters protect the plane against fire due to failure of electrical equipment.

15. LANDING ON WATER (DITCHING).

a. GENERAL. — The circumstances governing the actual procedure in a ditching (the part played by each man of the crew, the choice of emergency exits, etc.) differ measurably in each ditching. They will be dependent on the physical condition of the aircraft and the crew, the loading of the airplane, the point of the ditching (radio silence in enemy waters), and the weather; these circumstances cannot all be anticipated far in advance and the eventual success of the ditching depends upon the skill and judgment of the pilot and the crew.

b. JETTISON BOMBS AND EXCESS EQUIPMENT.—All disposable load should be jettisoned to reduce weight and landing speed. Bombs should be salvoed. Loose equipment should be thrown out through the bomb bay, including any equipment which might break away from its mounting and become a potential missile during the ditching. In the aft cabin, loose equipment, including the camera, should be thrown out the lower hatch or out the bomb bay. Make certain that lower hatch is closed and secured before ditching.

WARNING

Be sure bomb bay doors are completely closed. Shut fuselage doors to bomb bays. The nose turret door and the fuselage door behind it should be shut to safeguard against collapse of the nose turret Plexiglas window. Landing gear and belly turret must be completely retracted.

c. ESCAPE HATCHES.—In preparation for ditching, the top escape hatches should be opened to prevent jamming on impact. The navigator's optical flat should be removed by chopping off at the hinges if necessary. In the aft compartment, the emergency hatch on the right side of the fuselage should be opened. If the sea is calm the side windows of the pilot's enclosure may be jettisoned.

d. CRASH STATIONS.—Crash stations should be selected with regard to the number of persons involved and the particular equipment in the cabin. Personnel must brace themselves with the crash—not against it. Place the back against some solid structure; never attempt to absorb the shock by extending arms or legs forward against the structure.

WARNING

Bombardier's compartment must be vacated.

e. LIFE RAFTS.—After the plane has made contact with the water and its forward motion has ceased, release the life rafts. Release handles are located in the flight deck on the rear bulkhead and in the rear cabin on the front bulkhead, both on the right side of the airplane. Life rafts are in a compartment forward of the rear turret and may be released from the outside of the airplane by operating the handles on the hatch covers and opening the CO_2 release valve. Each raft is secured by a mooring line that will break if the airplane sinks. A crew member in the aft cabin should be responsible for recovering the rafts.

f. ESCAPE PROCEDURE.—Throw the emergency radio transmitter out the rear top hatch—it is waterproof and will float. Exit through the top hatches to the top of the fuselage. Bring as many emergency items as time will permit. Rafts are brought along side by means of the mooring line and boarded. Wait patiently on top of the fuselage—do not jump into the raft. Stay near the airplane if it floats; it is a better mark on the water than two rafts.

Now... read it again!

(It May Add Years To Your Life!)

1. REMOTE COMPARTMENTS AND FUSELAGE EQUIPMENT.

a. ENTRANCES AND EXITS. — Entrance from ground to nose section is through a drop-type door which, when open, forms a small stair. Panels separate the nose turret compartment from the nose section and when closed form a wind bulkhead for the nose gunner.

Entrance from the ground to the flight compartment is made by means of a removable five-rung steel ladder which hangs in the nose wheel well. The ladder is stowed on the flight deck behind the navigator's table. On ships AAF No. 42-108481 and on, a hatch in the flight deck floor opens to the forward accessory section.

The door between the forward cabin and bomb bay section is of the drop-type and when open forms a small stair from flight deck to catwalk.

The aft cabin has two entrance doors; one through the forward wall leading to the bomb bay, the second at the bottom center line of the fuselage to the rear of the belly turret; its door swings downward forming an entrance ladder.

b. BOMBARDIER'S COMPARTMENT.

(1) BOMBSIGHT GLASS.—The bombsight glass of the bombardier's enclosure is laminated plate glass and is equipped with a windshield wiper. The remainder of the transparent portion of enclosure is of laminated Plexiglas.

(2) SEAT.—When the airplane is not on a bomb run, the bombardier's station is at the settee in the forward cabin. The bombardier's compartment is furnished with a kneeling pad.

c. PILOT'S COMPARTMENT.

(1) WINDSHIELD.—Pilot's and copilot's windshield is the double plate glass panel type, designed so heated air for defrosting can be routed between the panels. Remainder of transparent portion of pilot's compartment is formed of Plexiglas.

(2) CLEAR-VIEW PANEL.—Two panels, one at the pilot's station and one at the copilot's station, slide open to give emergency clear view when necessary for landing and take-off.

(3) SEATS.—Pilot's and copilot's seats are adjustable fore and aft as well as vertically.

d. SOUNDPROOFING.—Forward and aft cabins, bombardier's compartment and top forward gun turret are sound-proofed. The floors of the two cabins are also insulated against sound and cold.

e. RADIO OPERATOR'S AND NAVIGATOR'S FIXED EQUIPMENT.

(1) SEATS. — Navigator's and radio operator's chairs are swivel type. Spring catches, hand manipulated, lock the chairs in four different positions. Both chairs are equipped with safety belts.

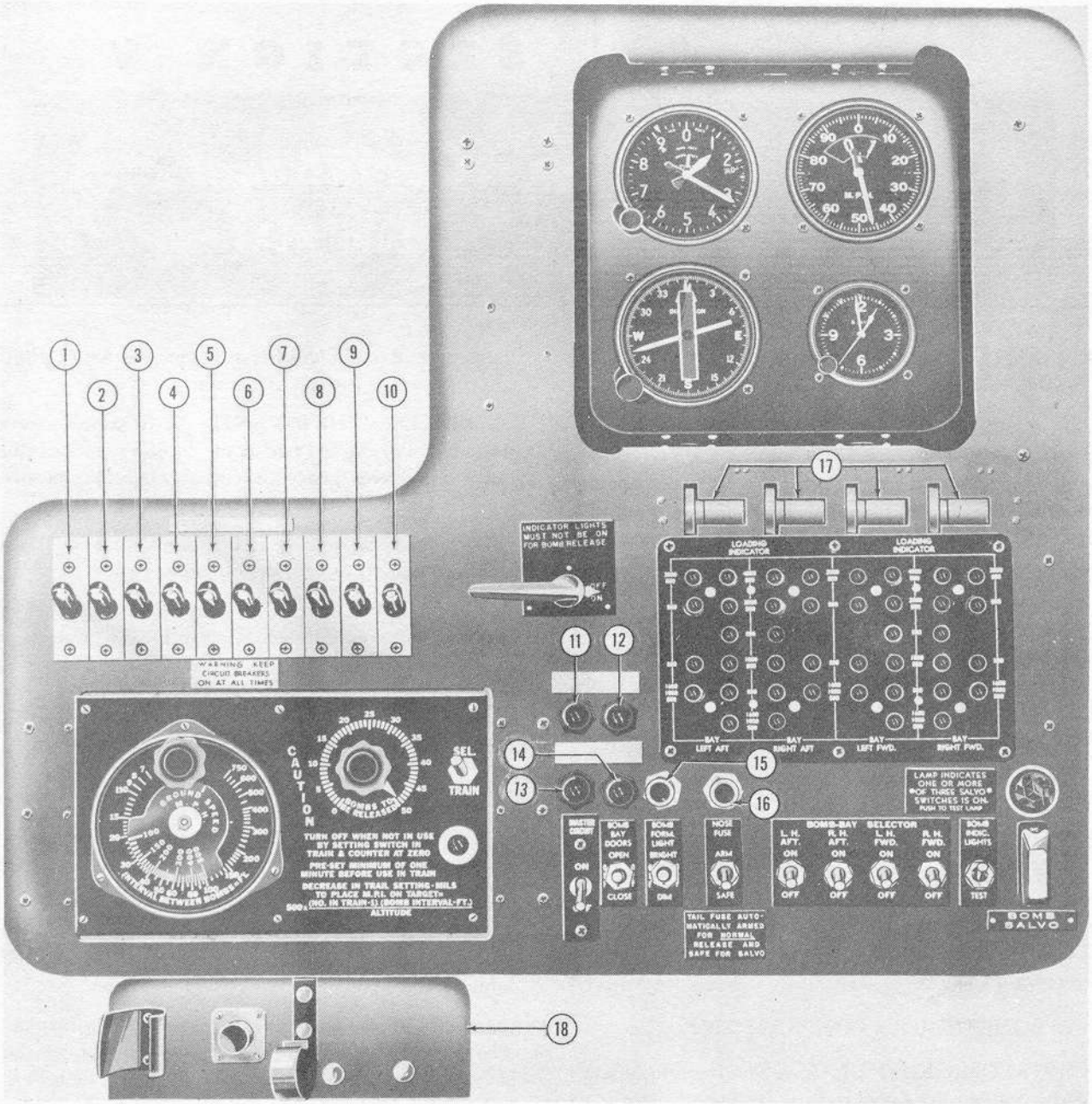
(2) TABLES.—Both navigator's and radio operator's table tops are of 1/2-inch plywood. Navigator's table is equipped with a drafting machine.

f. SETTEES.—There are two settees on the airplane. The one in the forward cabin seats two people and the one in the aft cabin seats four people. The forward settee has a back rest and the aft settee is of the bunk type which may be raised and fastened in the up position when not in use. The forward settee has two safety belts, the aft settee has four.

g. DATA CASES.

(1) NAVIGATOR'S DATA CASE. — The navigator's map case is located on the forward edge of the navigator's table. His insert case hangs above the table to his left.

(2) FLIGHT REPORT AND MAP CASES.—The flight report and map cases are installed together near the floor line to the pilot's left.

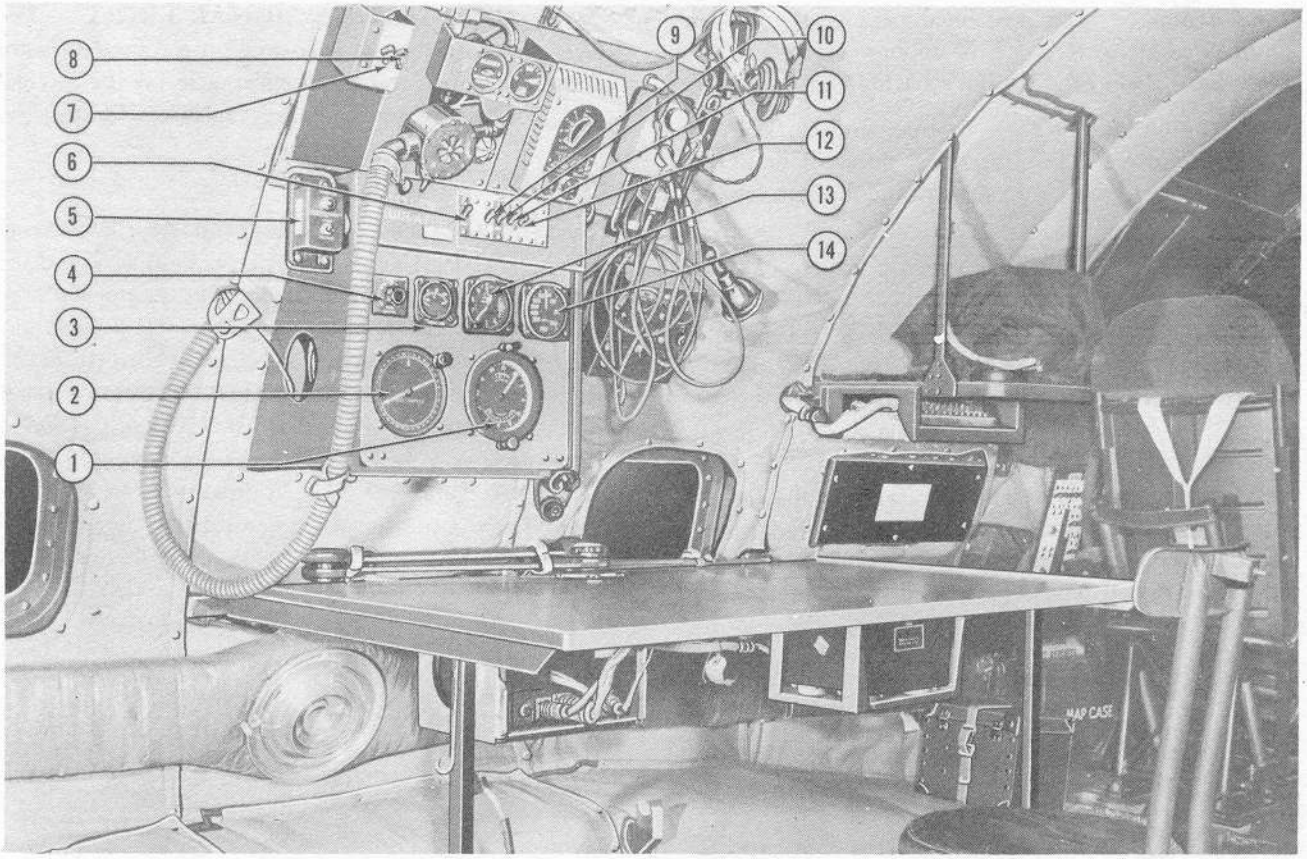


1. Fluorescent Light Circuit Breaker
2. Nose Fusing Circuit Breaker
3. Bomb Release Circuit Breaker
4. Bomb Door Circuit Breaker
5. Light Testing Circuit Breaker
6. Bomb Formation Circuit Breaker
7. Intervalometer Control Circuit Breaker
8. Bomb Salvo Circuit Breaker
9. Glide Bombing Circuit Breaker
10. Rack Selector Circuit Breaker
11. Left Hand Aft Bomb Bay Door Warning Light
12. Right Hand Aft Bomb Bay Door Warning Light
13. Left Hand Forward Bomb Bay Door Warning Light
14. Right Hand Forward Bomb Bay Door Warning Light
15. Bomb Formation Light
16. Nose Fusing Light
17. Bomb Load Indicators
18. Bomb Release Switch Panel

Figure 31 — Bombardier's Panel

(3) COPILOT'S DATA CASE.—The data case for the copilot is installed at about head level to the right and behind the copilot's seat.

b. TOILET FACILITIES.—There are two relief tubes, one in the forward and one in the aft cabin. Both tubes are on the left hand side of the airplane, one at the aft end of each cabin. There is also a disposal bag for each cabin. In the forward cabin, the bag is on a cable guard forward of the settee. In the aft cabin the bag is on the aft face of the bulkhead forming the rear wall of the cabin.



1. Master Flux Gate Indicator
2. Radio Compass Indicator
3. Free Air Thermometer
4. Auto Pilot Turn Control
5. Flux Gate Gyro Caging Switch
6. Flux Gate Compass (A.C.) Circuit Breaker
7. Flying Suit Heater Circuit Breaker
8. Cockpit Light Circuit Breaker
9. Radio Compass Circuit Breaker
10. Flux Gate Compass (D.C.) Circuit Breaker
11. Table Light Circuit Breaker
12. Outside Air Temperature Thermometer Circuit Breaker
13. Altimeter
14. Airspeed Indicator

Figure 32 — Navigator's Station

i. DRINKING WATER. — The airplane carries four one-gallon canteens and two cup dispensers. Two canteens and a cup dispenser are in the forward cabin on the left hand side of the airplane.The others are in the aft cabin on the bulkhead forming its rear wall.

j. CURTAINS AND COVERS.—Black-out curtains for all windows, also a night flying curtain for the pilot's and copilot's compartment are provided with each airplane. Curtains for the three forward scanning windows and the pilot's night flying curtain are stowed in a container attached to the left hand side of the nose wheel well housing. The navigator's astro glass curtain is secured to the ceiling just left of the astro glass.

Engine covers, turret and gun covers, covers for the pilot's enclosure and the bombardier's station are stowed in the tail compartment.

Roll-away curtains and sun visors are provided at the pilot and copilot's stations.

Anti-glare coamings are installed over the instrument panels to aid in preventing glare on the instruments.

k. TOOL KITS. — Propeller tool kit, two radio operator's kits, armorer's kit and tool roll, and the crew chief's kit are stowed in the tail section of the airplane.

l. FIRST AID KITS.—Three first aid kits are supplied with each ship. Two are installed in the forward cabin, one on the right hand cable guard forward of the settee, the second is located aft of the settee on the cabin ceiling. The third one is located in the rear cabin above and at the aft end of the settee.

m. AIR MESSAGE BAGS.—Five drop message bags are stowed in the forward cabin above the settee.

n. PYROTECHNIC AND SIGNAL EQUIPMENT.

(1) VERY PISTOL EQUIPMENT.

(a) DESCRIPTION. — A Pyrotechnic pistol (type AN-M8) in holder (type A-2) is stowed with a

signal container (type A-8) on the cable guard at the copilot's station. The pistol mount is installed at about head line at the copilot's station.

(b) OPERATION.—To open breech, pull out unlocking lever. After inserting signal flare, relock breech. Insert pistol into mount and lock in vertical position.

CAUTION

Do not shoot pistol without locking it in the mount, since the pistol has about 216 pounds recoil.

(2) DRIFT SIGNAL EQUIPMENT.—Drift signal chute is located in the floor forward of the forward settee. A chute with a spring-loaded cover extends through the floor and bottom of the fuselage. Day and night signal flares are stowed under the forward settee.

(3) NAVIGATOR'S SIGNAL LIGHT. — The navigator's signal light is stowed on the floor forward of the navigator's table. A receptacle on the navigator's panel can be used for plugging in the light.

2. OXYGEN EQUIPMENT.

a. DESCRIPTION.—The oxygen system is made up of 13 type G-1 cylinders, 14 type F-2 cylinders, and the necessary plumbing and panels. The system is a low-pressure type and when charged to 400 pounds per square inch will provide eight men with sufficient oxygen at 25,000 feet for ten hours. Provision is made for the installation of nine additional type G-1 cylinders which will increase the capacity from 570 cubic feet to 830 cubic feet. The following table gives the approximate duration of oxygen supply under normal conditions. Five type A-4 "walk-around" bottles are provided. A larger number may be carried if necessary.

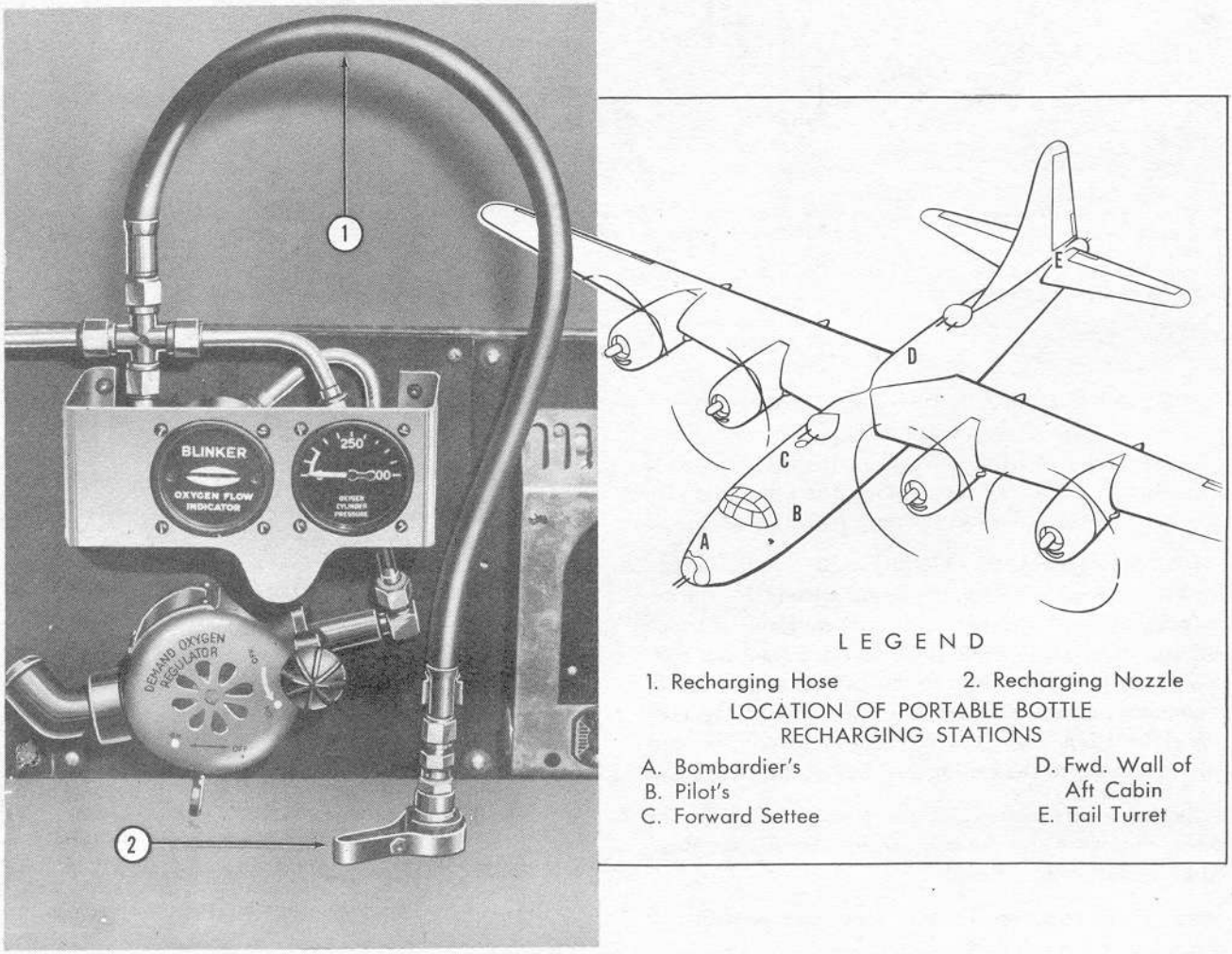


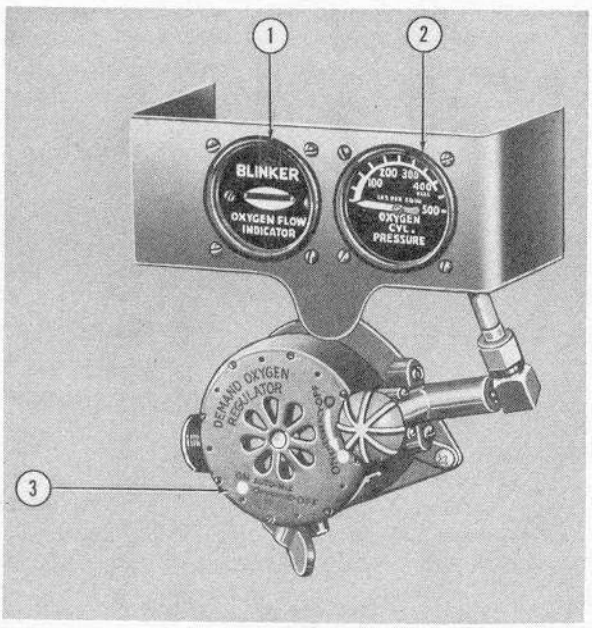
Figure 33 — Walkaround Bottles Recharging Provisions

APPROXIMATE DURATION OF OXYGEN SUPPLY FOR NORMAL, AND FOR NORMAL PLUS ALTERNATE INSTALLATIONS. ALL CYLINDERS CHARGED TO 400 POUNDS PER SQUARE INCH.

	For Normal Installation 13 G-1 Cylinders Plus 14 F-2 Cylinders					*For Normal Plus Alternate Installation 22 G-1 Cylinders Plus 14 F-2 Cylinders*				
Altitude	*No. of Men in Crew*					*No. of Men in Crew*				
	4	*6*	*8*	*10*	*12*	*4*	*6*	*8*	*10*	*12*
10,000	37	25	19	15	12	54	36	27	22	18
12,500	32	21	16	13	11	47	31	23	19	16
15,000	28	19	14	11	9	41	27	20	16	14
17,500	25	17	13	10	8	37	25	19	15	12
20,000	23	15	12	9	8	34	22	17	14	11
22,500	22	15	11	9	7	32	21	16	13	11
25,000	20	14	10	8	7	30	20	15	12	10
27,500	21	14	11	8	7	31	20	15	12	10
30,000	22	14	11	9	7	32	21	16	13	11
32,500	25	17	12	10	8	36	24	18	15	12
35,000	29	20	15	12	10	43	28	21	17	14
37,500	34	23	17	13	11	49	32	24	20	16
40,000	39	26	20	16	13	57	38	29	23	19

NOTE

The above tabulation shows TO THE NEAREST WHOLE HOUR the length of time the respective installations may be expected to supply flight crews of various sizes, engaged in their usual occupations, at the altitudes shown.



1. Flow Indicator
2. Pressure Gage
3. Regulator

Figure 34 — Oxygen Panel

b. PANELS. *(See figure 30.)*.—An oxygen panel is located at each of the following locations: pilot's station, copilot's station, nose turret, bombardier's station, settee in the forward cabin, navigator's station, radio operator, forward upper turret, aft upper turret, three at the aft settee, and one each in the lower ball gun turret and the aft gun turret.

c. CHARGING PROVISIONS.—The entire system may be charged through a valve located on the forward wall of the aft cabin, a British adapter is included in this assembly. The walk-around units may be charged at any one of the following five stations: the pilot's, bombardier's, the settee in the forward cabin, at the forward wall of the aft cabin, and at the tail gun turret.

d. REGULATORS.—A type A-12 regulator is provided at each oxygen panel. It will provide the proper mixture of oxygen and air required by the user at any altitude. Turning the "AUTO MIX" - "OFF" permits the user to take pure oxygen when necessary. A pressure gage is installed at each panel to indicate the amount of pressure in the system. A flow indicator blinks as the user inhales.

e. OPERATING INSTRUCTIONS.

(1) OXYGEN USE.—Oxygen must be used at all times above 10,000 feet. During night flights it is desirable to use oxygen from the ground up, particularly if rapid ascent is made and on flights over 8000 ft. for more than 4 hours.

(2) PRECAUTIONS.—The following precautions are necessary if oxygen is to be used effectively.

(a) Each man must have a mask that fits him and it must be properly adjusted.

(b) Masks must be kept clean by frequent washing with soap and water.

(c) All crew members must know where the walk-around units are located so that they may be found in the dark if necessary.

(d) A pressure drop may be expected as the temperature drops.

(e) Anoxia (oxygen starvation) is very insidious and must be avoided. Use oxygen at all times above 10,000 feet and at lower altitudes if strenuous work is being done.

(f) In order to conserve oxygen avoid all unnecessary activity. Use the "AUTO MIX" of the regulators except in an emergency.

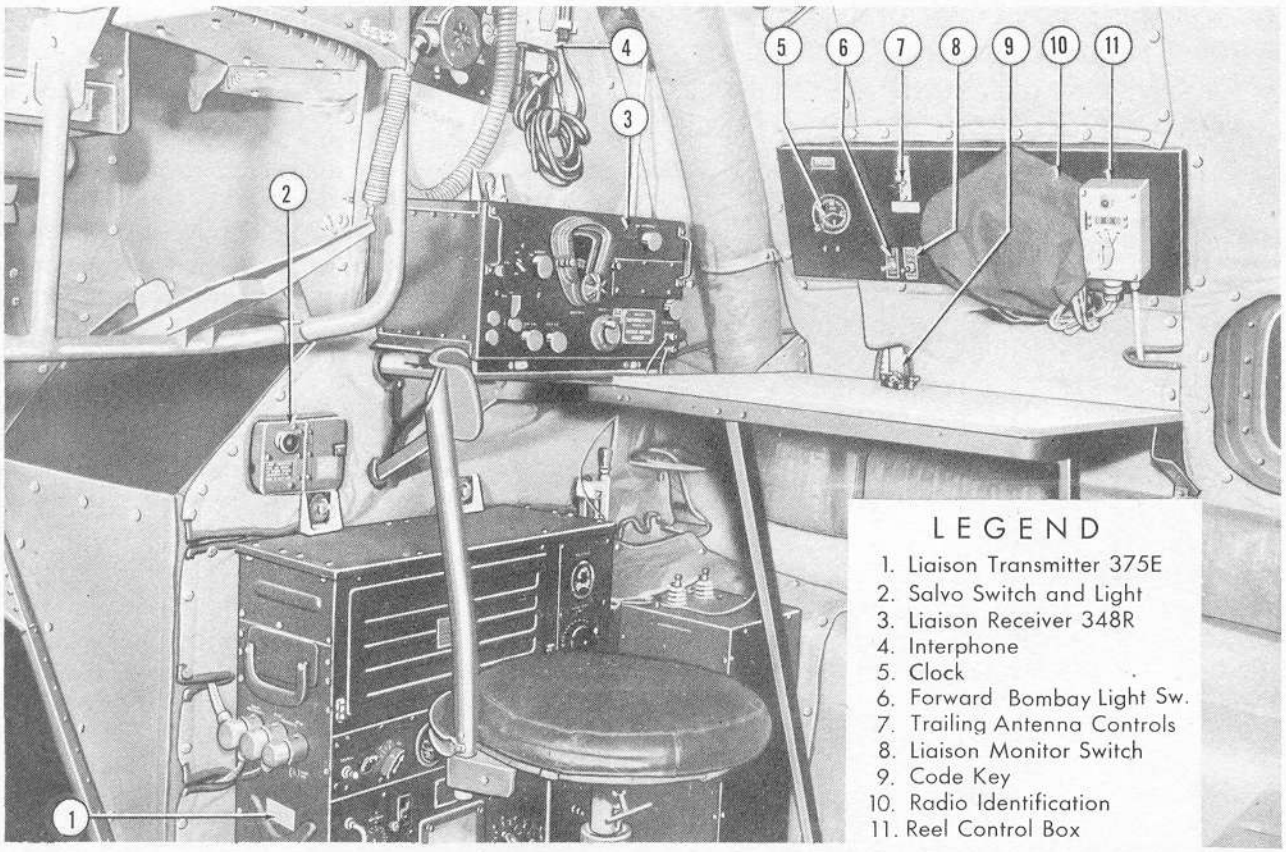


Figure 35 — Radio Operator's Station

(g) Do not permit grease or oil to come in contact with oxygen under pressure; an explosion is sure to result.

(h) When bailing out above 10,000 feet, always take a walk-around unit with you.

(i) When using oxygen breathe normally. Nothing is gained by breathing deeply or rapidly.

(j) Make sure to report any malfunctioning of the oxygen system immediately on landing.

3. COMMUNICATIONS EQUIPMENT.

Communications equipment on this airplane consists of the following:

Interphone System	RC-36
Command Radio Set	SCR-274
Radio Compass Set	SCR-269-G
Liaison Radio Set	SCR-287
Radio Identification Set	SCR-695
Radio Altimeter	SCR-718
Blind Approach	RC-103
Marker Beacon Set	RC-193

a. INTERPHONE SYSTEM. — Conventional type interphone jack boxes are installed at 14 locations in the airplane. The interphone system becomes operative when the battery switch is "ON" and remains in operation as long as there is power on the power system network. The power circuit is protected by a circuit breaker located above the settee in the forward cabin.

b. COMMAND RADIO SET.—The command radio set is a multi-channel aircraft receiving and transmitting set which provides plane-to-plane or short range plane-to-ground communication. In case of failure of the interphone amplifier, the command set can be used for intraplane communication by switching the command transmitter control box switch to positions "3" or "4" and switching the interphone jackboxes to "COMMAND."

(1) When operating on voice, do not expect to obtain distance ranges in excess of 25 miles. In the absence of atmospheric and local disturbances, plane-to-plane ranges as high as 100 miles may be obtained. Communication over a greater distance can be obtained by operating with a key on "TONE" or "CW" than by operating on voice.

(2) Signal fading will increase with distance of transmission. Sometimes fading will be so rapid as to

produce severe distortion of voice modulated signals. If signals suddenly become unintelligible, it does not necessarily indicate a fault in the apparatus. A test should be made with the transmitting and receiving stations in sight of each other before looking for trouble in the radio equipment.

c. RADIO COMPASS SET.—To use the radio compass indicator, set the switch on the control box on "COMP" position. In this position the indicator will point toward the station to which the receiver is tuned.

In cases where communication receivers on the airplane are being interferred with by rain, snow or dust static, it may be possible to improve the reception by placing the control in the "LOOP" position and rotating the loop until the compass indicator points to 90 or 270 degrees (maximum volume position).

If the radio compass indicator is inoperative but signals still can be heard on the receiver, bearings toward the station may be taken by rotating the loop in the manner outlined above and obtaining an aural null. When using broadcast stations for taking bearings for homing purposes at night, dawn, or dusk, it is very important that these stations be identified before their use. At such times transmitted signals on these frequencies are apt to skip across the earth's surface and a station which is a great distance away may be tuned in unintentionally.

d. LIAISON RADIO SET.—The liaison radio set provides long range code or voice communication with ground stations or between airplanes. This set is locally controlled by the radio operator. All crew stations may receive the station's signal reception through their respective interphones, but only the pilot, copilot, and radio operator may modulate the transmitter.

(1) RADIO RECEIVER BC-348.

(a) Turn "AVC-OFF-MCV" switch on the liaison receiver to "MCV."

(b) Turn "CW-OSC" "ON-OFF" switch to "ON."

(c) Turn "BEAT FREQ" control so arrow on the knob is pointing up.

(d) Turn "CRYSTAL" "OUT-IN" switch to "OUT."

(e) Turn "DIAL LIGHTS" control clockwise.

(f) Turn "INCREASE VOL" control clockwise until a sufficiently strong background is heard.

(g) Turn "BANDSWITCH" to band covering 500 kilocycles, indicated on frequency dial above switch.

(h) Tune receiver to signal nearest to 500 kilocycles by means of "TUNING" crank.

(i) Tune "ANT ALIGN" control maximum signal, indicated by hand-set volume.

(j) To receive a modulated signal, turn "CW-OSC" "ON-OFF" switch to "OFF." Tune in desired signal by means of band change switch, tuning crank, and volume control.

(k) If a "CW" signal is being received, signal pitch may be adjusted by "BEAT FREQ" control.

(l) Automatic volume control may be employed, after signal is tuned in, by turning "AVC-OFF-MVC" switch to "AVC."

(m) To reduce noise and inter-firing signals, turn "CRYSTAL" "OUT-IN" to "IN" and make any necessary tuning adjustment.

(n) Auxiliary head-set jacks, marked "TEL" are provided on the receiver.

(o) To turn off receiver, turn "AVC-OFF-MVC" switch to "OFF."

(2) TRANSMITTING COMPONENTS.

NOTE

The transmitter will give satisfactory service on "CW" at all altitudes up to 27,000 feet on "TONE" and "VOICE." Insulation breakdown may be experienced about 25,000 feet with tuning unit TU-8-B (6200-7700 kilocycles) and above 19,000 feet with tuning unit TU-9-B (7700-10,000 kilocycles). These limitations may be exceeded slightly by care in tuning and by guarding against an accumulation of dust and other foreign matter in the equipment. Effective operation of "CW" alone is assured between 6200 and 10,000 kilocycles at altitudes between 19,000 and 27,000 feet; transmitter tuning unit TU-26 will give satisfactory service at all altitudes up to 15,000 feet.

(a) For "CW" operation select the transmitter tuning unit for desired frequency. "CW" operation may then be obtained as follows:

1. Place signal switch on "CW."

2. From calibration chart on the front of the transmitter tuning unit, set the "BAND CHANGE SWITCH A," the "M.O. TUNING" control and the "P.A. TUNING" control for the desired frequency, and set the "ANT. COUPLING SWITCH D" on point 1. (It should be remembered that the band change switch does not appear on transmitter tuning units TU-7-A to TU-10-A inclusive.)

3. Place the "OFF-ON" switch in the "ON" position. The dynamotor should now start and the M.O. and the P.A. filaments will light.

4. Press the "TEST KEY" or the transmitting key. The vacuum will now draw plate current as indicated by the "TOTAL PLATE CURRENT" meter. The P-9 tuning should be checked immediately for resonance by varying the control slightly until a minimum total plate current is indicated. When the P-9 circuit is properly resonated, the total plate current will be from 80 to 100 milliamperes.

5. The antenna should next be tuned to resonance.

6. Antenna resonance is indicated by a reading of current on the "ANT. CURRENT" meter and by an increase in total plate current.

7. The equipment is now delivering rated power output, and the transmission may be carried on by operating the transmitting key. In order to shut down the equipment it is necessary only to place the "OFF-ON" switch in the "OFF" position.

(b) VOICE OPERATION.—Assuming that the equipment has been placed in operation on the "CW," the following procedure is recommended for obtaining "VOICE" operation. Note the value of total plate current for the "CW" operation. Then place the signal switch in the "VOICE" position, and by means of the "MOD. BIAS" adjustments in the tube compartment, adjust until total plate current with the microphone switch depressed is approximately 20 to 35 milliamperes higher than for "CW." The modulator tubes are now biased nearly to cut-off for proper class B operation and radiophone communication may be carried on by speaking into the microphone. It will be noted that the total plate current increases when the microphone is spoken into. This increase is due to current drawn by the modulator tubes. With sustained normal level of speech impressed on the microphone, the plate current should rise to an average of 300 milliamperes. If this value is not obtained, the "INPUT LEVEL" control in the tube compartment can be adjusted until the proper amount of modulation, as indicated by the correct plate current, is obtained.

(c) TONE OPERATION. — After the equipment has been adjusted for "VOICE" operation, it is necessary only to place the signal switch on "TONE" for proper tone telegraph operation. The total plate current on "TONE" will be between 300 and 350 milliamperes.

(d) SPEECH-AMPLIFIER BIAS.—The correct speech-amplifier bias will usually be found between 6.0 and 7.5 on the "S.A. BIAS" adjustment dial.

(e) SIDETONE IN AIRCRAFT SET. — The "SIDETONE" level control, located in the tube compartment, is used to adjust side tone to a suitable value for any particular installation.

e. RADIO IDENTIFICATION SET SCR-695. — This radio identification set, operating in conjunction with an antenna installed on lower fuselage surface, provides a means of identifying friendly aircraft. To start this equipment, use following procedure:

(1) Move the "ON-OFF" switch on the pilot's radio control panel to the "ON" position.

(2) Set the six position switches on selector control box BC-965 to position specified by the communications officer-in-charge. In the absence of specific information, set selector switch to position "1."

(3) Direction will also be given as to the employment of the "G" band switches.

(4) Details concerning the use of the "EMERGENCY" switch can also be obtained from the communications officer-in-charge.

(5) When the airplane is ready to take off, or preferably in the air, insert the destructor plug PL-177 in the destructor unit.

STOPPING PROCEDURE.

(1) Move all switches into "OFF" position.

(2) Remove destructor plug PL-177 from destructor unit as soon as the airplane lands.

f. BLIND APPROACH EQUIPMENT RC-103. — Blind approach equipment RC-103 is designed to give lateral guidance to the pilot during blind landing operation. This set, in conjunction with other airborne and ground equipment, composes what is known as the instrument landing system.

(1) OPERATION PROCEDURE.

(a) Approximately 20 minutes before the runway or landing area is approached, turn the "ON-OFF" switch on the radio control box BC-732-A to the "ON" position. This will give the receiver a chance to warm up.

(b) Turn the "FREQUENCY SELECTOR" switch to the desired position. The frequency of the localizer transmitter must be known, either by communication with the ground or by consulting the radio facilities charts.

(c) Turn the control switch on the interphone box to "COMMAND" position.

(d) Adjust the volume to a comfortable hearing level by means of the "INCREASE VOLUME" knob on the radio control box.

(e) Observe the vertical pointer on the indicator. When the aircraft is coming into the transmitter on the front course, the vertical needle will point in the direction toward which the heading of the airplane should be corrected. When the aircraft is directly in line with the runway, the vertical needle will be centered. A deviation of 1/4 scale deflection to right or left of center is not too great for a successful landing. When the vertical pointer is more than 1/4 inch scale off center, corrections in the airplane direction of travel should be made very slowly so that the aircraft will not overshoot the localizer path.

(f) After landing, turn the "ON-OFF" switch to the "OFF" position.

g. MARKER BEACON SET RC-193.—The marker beacon receiving equipment is an ultra-high frequency receiver used in aircraft as an aid to navigation and instrument landing. The radio receiver's response to a 75-megacycle marker transmitter signal will be indicated by the lighting of the amber indicator lamp on the pilot's panel. The indicator lamp may be steady or flash regularly, corresponding to the key to transmitter. The duration of indication in flying over a marker transmitter may vary from a few seconds to several minutes, depending upon the type of marker.

(1) Be certain that the circuit is energized. Current is supplied from the bomb salvo and fusing relay box located in the middle of the bomb bay, adjacent to the beacon receiver, through a circuit breaker. No adjustment or manipulation is required for service operation. This receiver is in operation as long as the battery switch on the copilot's panel is "ON," there is no connection with other radio sets or controls.

(2) Be careful to avoid misinterpretation of indication or results. Flickering or irregularities not characteristic of the keying of marker transmitters must be recognized. Such irregularities may be caused by a defect in the antenna, microphonic tubes or ignition interference.

(3) An irregularity which may occur is that the receiver may not follow the keying of strong marker transmitters with keyed modulation when flying through the strongest part of the beam at low altitudes. In this case the signal may be so strong that a slight ripple of the transmitter power supply causes sufficient modulation to operate the receiver.

4. OPERATION OF THE K-24 CAMERA.

a. Operation of the camera is controlled from the bombardier's compartment as follows:

(1) Set camera intervalometer.

(2) Turn on master camera switch.

(3) Place camera control switch in "AUTOMATIC" position.

(4) Check circuit breaker visually for the "ON" position.

(5) When indicator light is "ON" (green) camera is operating.

(6) Push-to-test lamp for check of condition of lamp bulb.

NOTE

When a prolonged shot is required, place camera control switch in "MANUAL" position to override the intervalometer setting.

5. GUNNERY EQUIPMENT.

There are five turrets on this airplane. Each contains two .50 caliber M-2 machine guns. All are locally operated and afford a considerable field of fire. Nose, tail, and lower are ball turrets.

TURRET DATA.

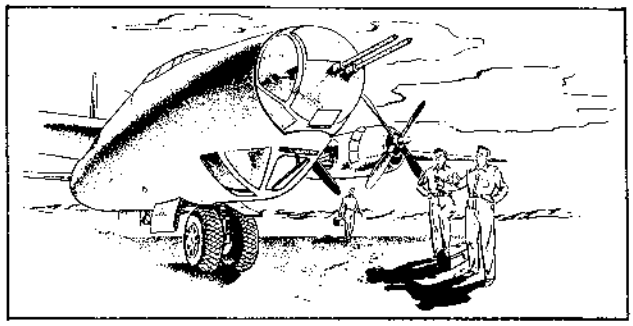
Location	*Type*	*Sight*	*Ammunition Rounds Per Gun*	*Boxes*
Nose	A-17	K-11	600	Bombardier's Compartment
Tail	A-17	K-10	1,000	Fuselage
Upper Fwd.	A-3-D	K-8	400	In Turret
Upper Aft	A-3-D	K-8	400	In Turret
Lower Ball	A-13-A	K-4	500	On Hanger

FIELD OF FIRE

Azimuth Movement Degrees		*Maximum Elevation Degrees*	*Interrupters*
Nose	134	at 60 Up	
Tail	150	0 Horizontal	Limit stops only
	122	60 Down	
Both Continuous		79 Up	
Upper Continuous		6.5 Down	Yes
Lower Continuous		10 Up 90 Down	Yes

WEIGHT AND BALANCE DATA

The attention of personnel operating this airplane is called to AN 01-1B-40 "Weight and Balance Handbook" to be found in the "G" file. A thorough understanding of the contents of this technical order and strict compliance with its instructions is absolutely necessary if this or any other airplane is to be operated safely and efficiently.



SECTION VI

Cold Weather OPERATING INSTRUCTIONS

1. GENERAL.

These instructions describe general procedure to be followed in low temperatures 0° to -54° C. (32° to -65° F.). They are in addition to operating instructions given in other sections of this manual.

NOTE

Aircraft Checker's Report, Winterization Check List, AAF Form 263B, in the data case, lists winterization items and special cold weather equipment installed on the airplane.

2. PROCEDURE PRIOR TO STARTING ENGINES.

a. Before starts in temperatures of 0° C. (32° F.) and below, preheating of each engine is recommended. However, experience may show that pre-heating is not always necessary in temperatures below freezing, since the airplane is completely winterized. The two sleeves of the engine cover fit onto ducts of ground heater and direct heat blast on propeller hub and rear engine sections. Access door at rear engine section is marked "ATTACH GROUND HEATER DUCT" and must be removed.

b. Apply external heat to bombardier's and pilot's compartments. Heat may be admitted through bombardier's access door and bomb bay doors. Warm the instrument panel with radiant heater of bath-room type. Do not allow strong heat blasts to play on instrument panel.

c. If starting on a bombing mission, see that all parts of the bomb sight are warmed up. If conditions permit, period of warm-up should be two hours. In any case, instruments should be run at least one-half hour with cover heat "ON" prior to take-off. If temperature of bomb sight and stabilizer does not fall below —21° C. (—5° F.) pre-heating is not necessary.

d. If the battery has been allowed to get cold, it must be heated before take-off. (See paragraph 9.*c.* of this section.)

e. Check wing surfaces (both inside and out), flap tracks, landing gear, brakes, exposed hinges, all openings between fixed and movable surfaces for collection of ice, frost or snow.

Wing surfaces should always be protected from possible collection of snow and ice. (See paragraph 8.*b.* of this section.) Snow can be removed by gentle brushing with brooms or evergreen boughs, but ice removal is a tedious job. Strict care must be taken not to scratch or mar wing surfaces in any way. Iced wings may be cleaned by two men vibrating a rope across the surfaces. Moisture condensation may cause ice accumulation inside the wings. It must be removed with heat before take-off. Stubborn ice formations on any part of the airplane can be removed by use of a portable hand-operated heater or by applying hot water on a small area and flushing with denatured alcohol.

WARNING

Even a light layer of snow on the wing is a hazard and all snow, ice, or frost on the wing must be removed before take-off. Do not remove wing covers until absolutely necessary.

f. Special check must be made of shock strut pistons. After they are cleaned, wipe them with a rag soaked in hydraulic fluid.

g. Operate ailerons, elevators, rudders, and all trim tabs through their complete travel three or four times to check ease of operation and for further check against collections of frozen matter.

h. Check fuel and oil tank sumps and Y-drains for possible frozen condensation.

i. Check fuel tank vents, located on the lower wing surface outboard of No. 1 and No. 4 nacelles, for freedom from ice.

j. Check engine breather line outlet, located near cowl flaps on the lower side of nacelles, for frozen condensation.

k. Check functioning of instruments that can be checked without engines in operation. Some instruments may require further heating.

l. Inspect hand microphone as moisture may collect and freeze in small holes of the microphone cap.

m. Remove engine covers just before starting the engines.

3. STARTING ENGINES.

Use normal starting procedure with the following precautions:

a. Turn a cold engine four or five revolutions by hand before engaging starter. Be sure that battery and ignition switches are "OFF." NEVER have more than two crew members pull prop through. If more than two are required, engine is not warm enough to start or a liquid lock may be present.

b. As a general practice, external power source should be used for starting engines. External power cart receptacle is located in the aft section, left hand side, of nose wheel well. If an external power source is not available, the airplane auxiliary power plant should be started and warmed up for approximately 20 minutes before being used as a power source.

c. Prime the engine carefully. This is particularly important. If the engine has not been sufficiently pre-warmed, unsuccessful attempts to start may cause ice to form on the spark plug points. They must then be removed and cleared of ice before a new start is attempted. Be very careful not to overprime on a second start. Care in this particular situation will minimize dangers of liquid locks in lower cylinders.

NOTE

If engines become flooded, turn off ignition switch and pull engines through by hand with throttles wide open. Repeat starting process. If engines do not start on third or fourth attempt, make thorough recheck before attempting another start. It may be necessary to remove and dry all spark plugs.

4. DURING WARM-UP.

a. Keep cowl flaps open NO MATTER HOW LOW TEMPERATURE MAY BE. Circulation of air is essential to keep all parts of engine at safe temperatures. With flaps closed, safe temperatures in rear sections of engine cannot be maintained.

b. If time does not permit normal engine warm-up, it may be necessary to use oil dilution to reduce viscosity of oil after engine start. Hold oil dilution controls "ON" momentarily several times but use procedure with caution since over oil dilution can cause engine failure and oil pressure gages may, under unusual circumstances, fail to register correctly.

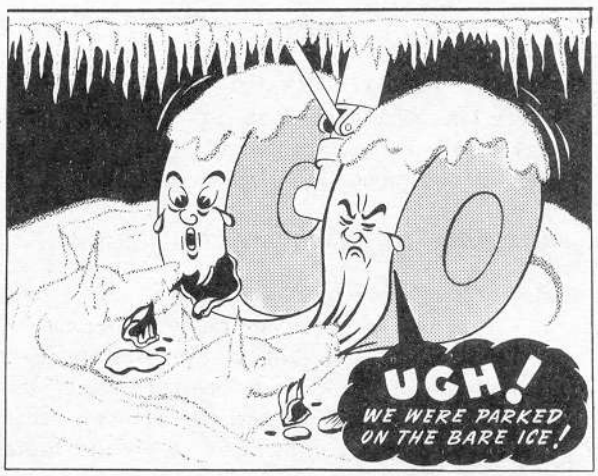
c. Work pedals gently two or three times.

d. Check especially on the operation of nose, tail and belly turrets. These three turrets operate on a combined hydraulic and electric system.

e. Check operation of propeller and windshield anti-icing equipment and windshield wipers.

f. As soon as engines reach normal operating conditions, turn on heating system. Test wing anti-icing system, defrosting ducts, and boot De-Icers of tail surfaces.

g. While carburetor icing conditions are not probable on the ground, if they exist, use carburetor heat immediately *before* (but *not* during) take-off.



5. TAKE-OFF.

a. If oil dilution was used on shut-down, engines should be ground run with oil temperatures above 70° C. for thirty minutes before take-off. However, in an emergency, take-off may be made with diluted oil in the system as soon as oil pressure is normal and oil temperatures show a slight rise.

b. Do not take off on soft snow. Taxi back and forth along runway until snow is packed down.

6. DURING FLIGHT.

a. If there is any suspicion that carburetor icing conditions exist, carburetor pre-heat should be used immediately after take-off. It is easier to prevent ice formation than to remove it.

b. If you are in icing zones immediately after take-off, see that wing anti-icing system, tail de-icing sys-

tem, propeller and windshield anti-icing systems, pitot heater and defrosting systems are in operation.

7. LANDING.

a. Temperature inversions are characteristic in cold weather. To avoid excessive cooling when preparing to land, regulate cowl flaps to keep cylinder head temperatures within safe operating ranges.

b. In order to assure good operation, start auxiliary power plant 20 minutes prior to landing.

c. Carburetor preheat control should be in "HOT" position when in long glide before landing, but should be in "COLD" position immediately prior to landing approach so that full power is always available.

d. Cowl flaps must be closed during landing and opened immediately after landing is made.

e. During landing approaches in cold temperatures sufficient power should be maintained to prevent cooling of the engines and loss of power.

f. Use brakes cautiously when ground temperatures are below freezing. However, at temperatures below -35° C. (-31° F.) ice and snow act almost like gravel and landing conditions are usually good.

8. PROCEDURE AFTER FLIGHT.

a. OIL DILUTION.

(1) When a cold weather start is anticipated, dilute the oil as follows:

(a) If oil temperatures are above 50° C. stop the engines and allow the oil to cool to 40° C. before starting dilution. During oil dilution process maintain oil temperature below 50° C.

(b) Idle engines to between 1000 and 1200 rpm. (Avoid spark plug fouling by a short acceleration period at the end of the dilution run.)

(c) Recommended oil dilution periods for various outside air temperatures are listed below.

NOTE

Winterization requirements specify grade 1100 oil for operation at temperatures below freezing.

Outside Air Temperature	*Dilution Period*
4° to —12° C. (39° to 10° F.)	2 minutes
—12° to —29° C. (10° to —20° F.)	4 minutes
—29° to —46° C. (—20° to —51° F.)	7 minutes
—46° to —51° C. (—51° to —60° F.)	8 minutes
—51° to —56° C. (—60° to —69° F.)	9 minutes

To accomplish satisfactory starting of the engine it is imperative that the engine oil systems be diluted according to the chart above before every shut-down. Thus, if engines are ground run after oil dilution is accomplished, further dilution must ensue. If the engines are operated for thirty minutes with oil temperature above 70° C. fuel added for dilution will have boiled off and oil will have returned to its normal viscosity. Complete redilution is necessary. Fifteen minutes operation at 70° C. and over will remove about one-half of dilution fuel from the oil system and will require a dilution period one-half of that shown in chart above. After other periods of less than thirty minutes running with oil temperature above 70° C., reduce dilution periods shown in chart proportionately. However, never dilute oil for less than one-half minute. Effect on diluted oil of engine runs with oil temperature under 70° C. is negligible.

(d) Under all conditions release dilution switch only after engine stops. This is important because only diluted oil must be circulated through the oil system.

(e) Do not permit engine oil pressure to fall below 15 pounds per square inch. If necessary, stop engine, wait about 5 minutes and continue dilution.

(f) If oil tank servicing is required, divide the dilution period in half, add oil at the end of first period.

(g) If oil temperature rises above 50° C. during oil dilution period, stop dilution procedure until oil temperature drops. It may be necessary to dilute the oil in two or more periods.

(h) Operation of the dilution system is indicated by a substantial fuel pressure drop. If this fuel pressure drop is not obtained, investigate, paying particular attention to dilution solenoid which may be

stuck, dilution line which may be plugged, and restricted fitting which may be reversed.

(2) NOTES ON OIL DILUTION.

(a) A high percentage of oil dilution will not harm engine bearings if oil pressures remain normal.

(b) When take-off is made before engines have been run long enough to evaporate fuel from oil system (paragraphs 5.*a.* and 10.*c.* of this section), it is possible that scavenging difficulties may arise during or shortly after take-off and diluted oil may be discharged through the engine breather lines at a dangerous rate. The difficulties will not normally occur if the dilution procedure outlined above is used with care and judgment by the operating personnel. If scavenging difficulties do arise and oil is discharged through the breather lines, a landing must be made immediately. The reason for this procedure is twofold: it is possible to lose a dangerous amount of oil and the fire hazard is great. Replenish oil supply with warm undiluted oil.

(c) When engines suddenly show a loss of oil pressure or throw oil out of breather lines, after the airplane has been in flight for some time, the oil dilution valve may be stuck open. Operate the oil dilution switch a few times. This will usually correct this condition. Have oil dilution valve checked immediately upon return to field.

b. PROTECTIVE COVERS.—When oil dilution is completed and propellers have been cleaned: gun, engine, wing and propeller covers must be installed. Gun and engine covers are stowed in tail compartment forward of tail turret. Wing and prop covers are ground equipment.

c. OIL IMMERSION HEATERS.—If full oil dilution was accomplished, the use of oil immersion heaters should not be necessary unless expected temperatures are below —20° C. and ground heating facilities are not available. Under these circumstances, immersion heaters should be installed immediately after shutdown and should be operated continuously during lay-over. The heater to be used must be 250 W, 115 V.

NOTE

Immersion heaters must not be placed in congealed oil. Congealed oil will carbonize around the heater and render it ineffectual.

d. FUEL TANKS.—If fuel tanks are kept filled, condensation in fuel lines will be minimized.

e. Check all drain points and vent line openings for condensation which, if not drained, will freeze.

9. GROUND HANDLING OF AIRPLANE.

a. PARKING.

(1) Head airplane into the wind and set brakes "ON." Do not set brakes until they have cooled. Otherwise they might freeze in "ON" position.

(2) Put a layer of fabric, grass, straw, green boughs or other insulating material under the wheels to prevent freezing of tires to ground surface. Lack of such precautions frequently results in tearing off large pieces of rubber from tires when the airplane is moved. No special mooring kit is provided with this airplane. In extraordinarily high winds it may be necessary to use type D-1 kits or "deadman" moorings to augment holding strength of brakes and chocks.

b. FROST PREVENTION.—When the airplane is parked, leave a door or window partly open to permit circulation of air inside the airplane to prevent frosting of windows.

c. BATTERY.—At freezing temperatures and below, remove battery and stow in heated room if possible. Battery should be kept warm at all times.

(1) PERFORMANCE IN COLD WEATHER.—Batteries give best performance at 27° C. (80°F.) and the performance of even a new fully charged battery decreases as the temperature decreases. This is not a straight-line relationship, as shown by the table below which is calculated on a 300-ampere discharge.

Temperature	*Percent of Output in Relation to Capacity at 27° C. (80° F.)*
5° C. (+ 40° F.)	93 percent
—18° C. (+ 0° F.)	76 percent
—29° C. (—20° F.)	55 percent
—34° C. (—30° F.)	30 percent
—37° C. (—34° F.)	5 percent

d. BOMB SIGHT.—When temperatures fall below freezing, heating cover of bomb sight should be used continuously. Thermostatic control on cover will prevent excessive heat. Temperature of instruments must never, under any conditions, fall below that of their surrounding air.

10. EMERGENCY COLD WEATHER OPERATION DURING LAY-OVER.

a. ENGINE RUN.—If lay-over is necessary in extreme cold weather, oil dilution outlined in paragraph 8.*a.*(1)*(c)* may be increased to provide additional fluidity and safety in accordance with experience of operating personnel. Under extreme circumstances when adequate cold-weather starting equipment is not avail-

able and adequate fuel supply is available, it is advisable to run engines periodically throughout lay-over period. Oil dilution must be accomplished before each shut down. Keep head temperatures above 0° C. (32° F.) during shut down periods.

b. LUBRICATION SYSTEM.

(1) DRAINING OIL SYSTEM. — Circumstances where it is necessary to drain oil tanks are rare. With proper oil dilution, external heat and immersion heaters available, drainage should not be necessary. If, in an emergency, the oil must be drained, proceed as follows:

(a) Idle engines at approximately 800 rpm until cylinder head temperature is below 190° C.

(b) Move controls to "IDLE CUT-OFF."

(c) Turn ignition "OFF" after props stop.

(d) Install engine covers.

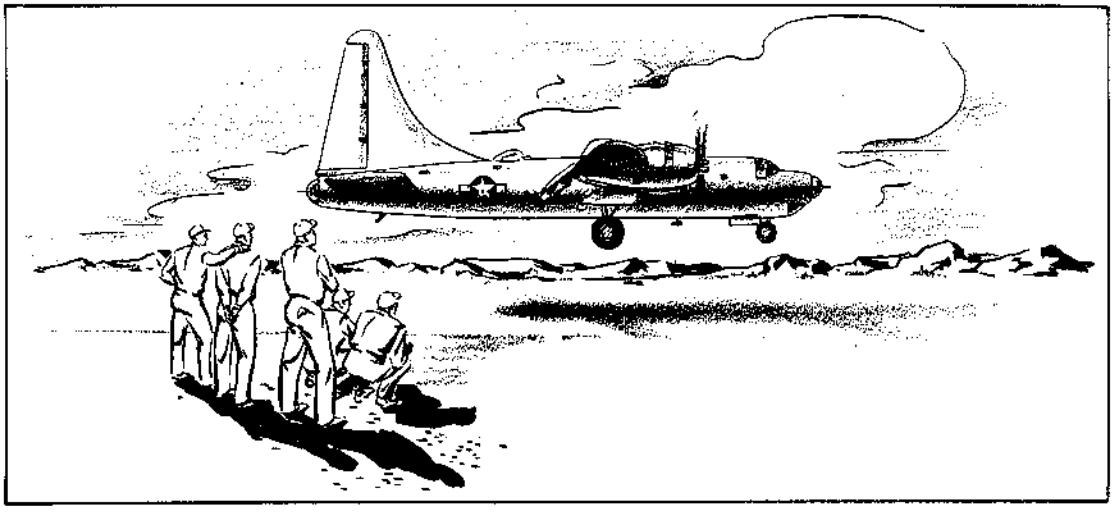
(e) Drain oil into clean containers and if possible store in place where oil can be kept warm.

NOTE

If oil cannot be kept warm it should be heated to approximately 70° to 80° C. (158° to 176° F.) before it is returned to tank just before engine start.

(2) EMERGENCY PROCEDURE. — In temperatures above —30° C. (—22° F.) when containers and heating facilities are not available, proceed thus: use normal dilution procedure; stop engines; drain oil to 2/3 normal level; run engines until oil temperature is 50° to 60° C.; with engines still running fill oil tank with fuel; stop engines again; after 15 minutes give full oil dilution again. *Use this procedure only in emergency.*

c. TAKE-OFF.—After periodic running of engines and dilution of oil system, it is necessary to ground-run engines for thirty minutes with oil temperatures above 70° C. prior to take-off. Purpose of run is to eliminate possibility of excess dilution. Oil levels should be checked before take-off.



APPENDIX I

FLIGHT OPERATING CHARTS, TABLES AND DIAGRAMS

1. GENERAL.

The several charts presented here are essential to flight planning. Figures printed in red indicate that those values are estimated and have not been flight checked. As soon as flight tests are completed these charts will be revised to conform to actual experience.

2. TAKE-OFF, CLIMB, AND LANDING CHARTS.

The take-off distance chart shows the take-off distance for various altitudes, head wind velocities, gross weights, and runway surfaces. Both the ground run and total distance required to clear a 50-foot obstacle are given.

Two types of climb are presented: (1) combat climb using maximum continuous power, and (2) a ferry climb using 70 percent maximum continuous power, which is the operating limit for automatic lean fuel flows. It is recommended that the combat climb be used, because of better cooling and shorter time required to attain operating altitude. The ferry climb would be advantageous only when climbing to medium altitudes at lighter gross weights.

Landing distances required for two gross weights, at various altitudes, wind velocities, and runway surfaces, are given in the landing chart. Both the distance required for ground roll and total distance required to clear a 50-foot obstacle are indicated. Best indicated air speeds for approach for the two gross weights are also shown. These speeds are 25 percent above stalling speed with full flaps.

3. FLIGHT OPERATING INSTRUCTION CHARTS.

These charts are most essential in flight planning. In any flight plan, the fuel available for cruising and reserve is found by subtracting the fuel required for warm-up, take-off, and climb to cruising altitude from the total fuel initially in the airplane. The allowances given in the flight operating instruction charts are for an operating altitude of 5000 feet, and can be used directly if the cruising altitude is 5000 feet.

If the cruising altitude is higher, the climb chart should be consulted, and the amount of fuel corresponding to the initial gross weight, operating altitude, and type of climb are subtracted from the fuel initially in the airplane. This gives fuel available for cruising and reserve at the cruising altitude indicated in the flight plan. Since the fuel allowance in the climb chart includes fuel for warm-up and take-off, it is unnecessary to use the fuel allowance given in the flight operating instruction charts if the climb chart is used to determine fuel used during climb.

When the fuel for cruising and reserve is determined, the amount of fuel required for reserve is subtracted from this amount, and the chart corresponding to the take-off gross weight is entered at the amount of fuel available for cruising, or the next lower amount of fuel. A range is found corresponding to the range required, or greater, by moving to the left or right on the flight chart. The operating conditions can be found by moving to the lower section of the chart and reading off engine operating data and indicated air speed at the altitude at which the flight is to be made. It will be noted that speed is gained at the expense of range.

The operating data in the same column and altitude in the chart covering the next lower gross weight should be used as soon as enough fuel has been consumed or bombs dropped to decrease the gross weight of the airplane below the minimum of the first chart. The decrease in gross weight can be checked by multiplying the gallons of fuel consumption given in the proper "operating data" by 6, and multiplying this quantity by the number of hours the airplane has been cruising at this condition.

SPEC. AN-H-8
Dec. 18, 1942
FORM ASC-510

AIRPLANE MODELS

B-32

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODELS

R-3350-21 or 23

TAKE-OFF DISTANCE (IN FEET)

GROSS WEIGHT (IN LBS.)	HEAD WIND		HARD SURFACE RUNWAY						SOD-TURF RUNWAY						SOFT SURFACE RUNWAY					
	AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.				AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.	
	MPH	KNOTS	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.
80,000	0	0	2550	3200	3000	3650	3550	4300	2700	3300	3250	3900	3800	4550	3150	3750	3900	4550	4750	5500
	17	15	1950	2450	2250	2800	2700	3300	2050	2600	2400	2950	2900	3500	2300	2850	2950	3500	3650	4250
	34	30	1300	1750	1550	2000	1900	2400	1400	1800	1600	2050	2000	2550	1650	2050	2050	2500	2650	3150
	51	45	900	1200	1050	1400	1250	1700	950	1250	1150	1500	1300	1750	1050	1400	1400	1750	1800	2250
100,000	0	0	3600	4700	4300	5500	5150	6450	3900	4950	4800	6000	5650	6950	4900	5950	6100	7300	7650	8950
	17	15	2700	3600	3250	4250	4000	5150	2900	3800	3650	4650	4300	5500	3700	4600	4800	5850	6150	7300
	34	30	1900	2650	2200	3200	2900	3850	2000	2750	2700	3550	3200	4200	2700	3450	3550	4450	4700	5650
	51	45	1250	1900	1550	2250	2000	2800	1300	1950	1900	2550	2200	3000	1900	2500	2500	3200	3500	4300
120,000	0	0	5500	7550	6450	8850	7700	10,600	6200	8200	7200	9600	8600	11,500				DO NOT	ATTEMPT	
	17	15	4250	6050	5000	7150	6250	8850	4800	6050	5750	7900	7000	9600				TAKE-OFF		
	34	30	3050	4600	3700	5550	4750	7000	3550	5100	4450	6300	5650	7900						
	51	45	2200	3500	2700	4300	3500	5500	2500	3800	3300	4900	4350	6300						

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

OPTIMUM TAKE-OFF WITH 30 FLAPS IS 80% OF CHART VALUES

CLIMB DATA

COMBAT MISSIONS USE 2400** RPM & 42 IN. HG

FERRY MISSIONS USE 2130* RPM & 31.5 IN. HG

GROSS WEIGHT IN LBS.	TYPE OF CLIMB	S. L. TO 10,000 FT. ALT.				15,000 FT. ALT.						20,000 FT. ALT.						25,000 FT. ALT.						30,000 FT. ALT.						BLOWER CHANGE
		BEST I.A.S.		FT/MIN	TIME FROM S. L.	BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		
		MPH	KNOTS			MPH	KNOTS			U. S.	IMP.	MPH	KNOTS			U. S.	IMP.	MPH	KNOTS			U. S.	IMP.	MPH	KNOTS			U. S.	IMP.	
80,000	COMBAT	157	137	1948	5.6	157	137	1386	9.9	316	263	157	137	1310	13.6	374	346	157	137	1134	17.6	437	364	157	137	936	22.5	514	428	
	FERRY	150	131	797	11.5	150	131	720	18.1	296	246	150	131	632	25.4	352	299	150	131	538	33.9	415	345	150	131	410	44.4	494	411	
100,000	COMBAT	169	147	1218	8.1	169	147	846	15.4	402	335	169	147	756	21.6	500	416	169	147	616	28.7	612	509	169	147	428	38.3	764	655	
	FERRY	165	143	374	22.3	165	143	295	37.2	440	366	165	143	204	57.1	591	491	165	143	95	91.8	852	709							
120,000	COMBAT	179	155	765	14.2	179	155	446	26.4	576	479	179	155	342	39.4	780	649	179	155	212	56.7	1052	875							
	FERRY	179	155	59	92.1																									

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

LANDING DISTANCE (IN FEET)***

GROSS WEIGHT IN LBS.	BEST I. A. S. APPROACH		HARD DRY SURFACE						FIRM DRY SOD						WET OR SLIPPERY					
			AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.	
	MPH	KNOTS	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL
100,000	134	116	4600	2850	5000	3150	5400	3400	5000	3250	5450	3600	5900	3900						
70,000	111	97	3400	2000	3650	2200	3950	2400	3700	2300	3950	2500	4300	2750						

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

OPTIMUM TAKE-OFF WITH 30 FLAPS IS 80% OF CHART VALUES

REMARKS:
* 2200 RPM @ 35,000 FT.
** 2600 RPM & 47" HG FOR FIRST 5 MIN. FOR COMBAT CLIMB.
OPEN COWL FLAPS FULLY FOR TAKE-OFF AND AS REQUIRED FOR CLIMB.
DEFLECT WING FLAPS 30° FOR TAKE-OFF AND 40° FOR LANDING.
*** DECREASE GROUND RUN 7% FOR REVERSE PITCH ON INBOARD PROPS.
BASED ON ESTIMATES

LEGEND
I.A.S.: Indicated Air Speed
M.P.H.: Miles Per Hour
S.L.: Sea Level
U.S.: U. S. Gallons
IMP.: Imperial Gallons
NOTE: All Distances Are Average
RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

Figure 36 — Take-Off, Climb and Landing Chart

MODEL(S)

B-32

ENGINE(S): (4) R-3350-21 OR -23

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: **120,000** TO **110,000** POUNDS

EXTERNAL LOAD ITEMS

NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
TAKE-OFF	2800	48.0	.....	A.R.	5 Min.	1210
MILITARY POWER	2600	47.0	.....	A.R.	5 Min.	1115
NORMAL RATED	2400	42.0	.....	A.R.	Cont.	945

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

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

(NO WIND) — ALTERNATE CRUISING CONDITIONS — (NO RESERVE FUEL ALLOWANCE)

I				FUEL	II		III		IV		FUEL	V	
RANGE IN AIR MILES				U. S.	RANGE IN AIR MILES		RANGE IN AIR MILES		RANGE IN AIR MILES		IMP.	RANGE IN AIR MILES	
STATUTE		NAUTICAL		GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
AT SEA LEVEL	AT 25,000 FEET	AT SEA LEVEL	AT 25,000 FEET	5460	*270 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT						4550		
1370	1750	1190	1520	5190	2180	1900	2600	2260	3030	2640	4325	3460	3010
1300	1650	1130	1440	4900	2050	1780	2450	2130	2850	2480	4080	3250	2830
1220	1550	1060	1350	4600	1930	1680	2300	2000	2680	2330	3830	3060	2660
1140	1450	990	1260	4300	1800	1570	2150	1870	2500	2180	3580	2850	2480
1060	1350	920	1170	4000	1680	1460	2010	1750	2330	2030	3335	2650	2300
980	1240	850	1080	3700	1550	1350	1860	1620	2160	1880	3080	2460	2140
900	1140	780	990	3400	1420	1230	1700	1480	1980	1720	2835	2260	1970
820	1040	710	900	3100	1300	1130	1550	1350	1800	1570	2580	2050	1780
740	940	640	820	2800	1170	1020	1400	1220	1630	1420	2335	1850	1610
660	840	570	730	2500	1050	910	1260	1100	1460	1270	2080	1660	1440

MAXIMUM CONTINUOUS						ALT.	OPERATING DATA						OPERATING DATA						OPERATING DATA						ALT.	MAXIMUM RANGE					
R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																			40000						
						35000																			35000						
2400	214	A.R.	42.0	945	351	30000	2375	208	A.R.	40.0	875	340	2325	195	A.R.	37.5	785	320	2300	190	A.R.	36.5	735	311	30000	Fly Condition IV					
2400	227	A.R.	42.0	945	340	25000	2350	220	A.R.	39.5	850	329	2325	214	A.R.	38.0	785	320	2275	206	A.R.	36.5	715	308	25000	2200	188	A.R.	33.5	620	281
2400	238	A.R.	42.0	945	327	20000	2350	229	A.R.	38.5	830	313	2300	224	A.R.	36.5	755	306	2275	216	A.R.	35.0	695	296	20000	2200	205	A.R.	33.0	615	280
2400	249	A.R.	42.0	945	314	15000	2325	236	A.R.	37.5	770	298	2275	231	A.R.	36.0	715	291	2250	224	A.R.	35.0	660	282	15000	2200	215	A.R.	33.0	595	271
2400	259	A.R.	42.0	945	301	10000	2300	243	A.R.	37.5	740	282	2250	237	A.R.	36.0	680	276	2200	229	A.R.	34.5	615	266	10000	2150	221	A.R.	32.5	570	257
2400	267	A.R.	42.0	945	288	5000	2275	246	A.R.	36.5	695	265	2225	241	A.R.	35.5	640	260	2175	234	A.R.	34.0	585	252	5000	2125	227	A.L.	32.5	455	244
2400	274	A.R.	43.5	945	274	S. L.	2250	251	A.R.	37.0	655	251	2200	245	A.R.	35.5	600	245	2150	237	A.R.	34.0	550	237	S. L.	2125	236	A.L.	34.0	455	236

NOTES

* ALLOW 270 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB TO 5000 FT. PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQUIRED. FOR CLIMB TO OTHER ALTITUDES SEE "TAKE-OFF, CLIMB AND LANDING CHART."

EXAMPLE

AT 120,000 LB. GROSS WT. WITH 4000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 1050 GAL.) TO FLY 2000 STAT. AIRMILES AT 25,000 FT. ALT, MAINTAIN 2325 RPM AND 214 MPH IND. AIRSPEED WITH MIXTURE SET A.R.

LEGEND

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

RED FIGURES ARE PRELIMINARY
SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 37 — Flight Operation Instruction Charts (Sheet 1 of 8 Sheets)

MODEL(S)

B-32

ENGINE(S): (4) R-3350-21 OR -23

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: **110,000** TO **100,000** POUNDS

EXTERNAL LOAD ITEMS

NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
TAKE-OFF	2800	48.0	.....	A.R.	5 Min.	1210
MILITARY POWER	2600	47.0	.....	A.R.	5 Min.	1115
NORMAL RATED	2400	42.0	.....	A.R.	Cont.	945

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

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

(NO WIND) — ALTERNATE CRUISING CONDITIONS — (NO RESERVE FUEL ALLOWANCE)

I RANGE IN AIR MILES STATUTE AT SEA LEVEL	I STATUTE AT 25,000 FEET	I NAUTICAL AT SEA LEVEL	I NAUTICAL AT 25,000 FEET	FUEL U.S. GAL.	II RANGE IN AIR MILES STATUTE	II NAUTICAL	III RANGE IN AIR MILES STATUTE	III NAUTICAL	IV RANGE IN AIR MILES STATUTE	IV NAUTICAL	FUEL IMP. GAL.	V RANGE IN AIR MILES STATUTE	V NAUTICAL
				5460	*250 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT						4550		
1390	1790	1210	1560	5210	2280	1980	2770	2410	3260	2840	4340	3750	3260
1310	1680	1140	1460	4900	2140	1860	2600	2260	3060	2660	4080	3530	3070
1230	1580	1070	1370	4600	2010	1750	2450	2130	2880	2500	3830	3310	2880
1150	1470	1000	1280	4300	1870	1630	2280	1990	2690	2340	3580	3100	2700
1070	1370	930	1190	4000	1740	1510	2120	1850	2500	2180	3330	2880	2510
990	1270	860	1100	3700	1610	1400	1960	1710	2310	2010	3080	2660	2320
910	1160	790	1010	3400	1480	1290	1800	1570	2120	1850	2830	2440	2120
830	1060	720	920	3100	1350	1180	1640	1430	1930	1680	2580	2220	1930
750	960	650	830	2800	1220	1070	1480	1290	1740	1510	2330	2010	1750
670	860	580	750	2500	1090	950	1320	1150	1550	1350	2080	1800	1570
590	750	510	660	2200	960	840	1170	1020	1380	1200	1830	1590	1380

MAXIMUM CONTINUOUS R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.	ALT. Feet	II OPERATING DATA R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.	III OPERATING DATA R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.	IV OPERATING DATA R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.	ALT. Feet	MAXIMUM RANGE R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																			40000						
						35000																			35000						
2400	220	A.R.	42.0	945	360	30000	2300	204	A.R.	37.0	760	334	2200	182	A.R.	32.0	600	298	Fly Condition III						30000	Fy Condition III					
2400	232	A.R.	42.0	945	348	25000	2300	218	A.R.	37.0	745	326	2175	198	A.R.	32.5	585	296	2125	188	A.L.	31.5	455	282	25000	2100	182	A.L.	31.5	425	272
2400	243	A.R.	42.0	945	333	20000	2275	224	A.R.	35.5	710	306	2125	202	A.L.	32.0	455	276	2125	202	A.L.	32.0	455	276	20000	2075	186	A.L.	30.0	405	254
2400	253	A.R.	42.0	945	318	15000	2250	231	A.R.	35.0	675	291	2125	213	A.L.	32.0	455	268	2125	213	A.L.	32.0	455	268	15000	2050	194	A.L.	29.5	375	244
2400	261	A.R.	42.0	945	303	10000	2225	236	A.R.	35.0	640	274	2125	223	A.L.	32.0	455	260	2125	223	A.L.	32.0	455	260	10000	2000	202	A.L.	29.5	370	235
2400	269	A.R.	42.0	945	290	5000	2175	239	A.R.	34.0	595	258	2125	231	A.L.	32.5	455	248	2100	227	A.L.	31.5	425	244	5000	1950	209	A.L.	29.0	350	225
2400	277	A.R.	43.5	945	277	S. L.	2125	241	A.R.	34.0	550	241	2125	239	A.L.	34.0	455	239	2075	228	A.L.	32.0	405	228	S. L.	1800	208	A.L.	30.0	320	208

NOTES

* ALLOW 250 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB TO 5000 FT. PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQUIRED. FOR CLIMB TO OTHER ALTITUDES SEE "TAKE-OFF, CLIMB AND LANDING CHART."

EXAMPLE

AT 110,000 LB. GROSS WT. WITH 3100 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 500 GAL.) TO FLY 1930 STAT. AIRMILES AT 15,000 FT. ALT. MAINTAIN 2125 RPM AND 213 MPH IND. AIRSPEED WITH MIXTURE SET A.L.

LEGEND

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

RED FIGURES ARE PRELIMINARY
SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 37 — Flight Operation Instruction Chart (Sheet 2 of 8 Sheets)

MODEL(S)

B-32

ENGINE(S): (4) R-3350-21 OR -23

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: **100,000** TO **90,000** POUNDS

EXTERNAL LOAD ITEMS

NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
TAKE-OFF	2800	48.0	.....	A.R.	5 Min.	1210
MILITARY POWER	2600	47.0	.....	A.R.	5 Min.	1115
NORMAL RATED	2400	42.0	.....	A.R.	Cont.	945

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

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

(NO WIND) — ALTERNATE CRUISING CONDITIONS — (NO RESERVE FUEL ALLOWANCE)

I				FUEL	II		III		IV		FUEL	V	
RANGE IN AIR MILES				U. S.	RANGE IN AIR MILES		RANGE IN AIR MILES		RANGE IN AIR MILES		IMP.	RANGE IN AIR MILES	
STATUTE		NAUTICAL		GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
AT SEA LEVEL	AT 25,000 FEET	AT SEA LEVEL	AT 25,000 FEET	5460	*240 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT						4550		
1390	1790	1210	1550	5220	2350	2040	2900	2530	3460	3010	4350	3990	3470
1310	1680	1140	1460	4900	2200	1910	2720	2360	3240	2820	4000	3750	3260
1230	1580	1070	1370	4600	2060	1790	2560	2220	3040	2640	3830	3520	3060
1140	1470	1000	1280	4300	1930	1680	2390	2080	2840	2470	3580	3300	2870
1070	1370	930	1190	4000	1800	1570	2230	1940	2650	2280	3330	3080	2680
990	1270	860	1100	3700	1660	1440	2050	1780	2450	2130	3080	2850	2480
910	1170	790	1010	3400	1530	1330	1890	1640	2250	1960	2830	2610	2270
830	1060	720	930	3100	1400	1220	1730	1500	2060	1790	2580	2390	2080
750	960	650	830	2800	1260	1100	1560	1340	1860	1620	2330	2170	1890
670	860	580	750	2500	1130	980	1400	1220	1670	1450	2080	1940	1690
590	750	510	650	2200	990	880	1230	1070	1470	1280	1830	1700	1480

MAXIMUM CONTINUOUS							OPERATING DATA						OPERATING DATA						OPERATING DATA							MAXIMUM RANGE					
R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	ALT. Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	ALT. Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																			40000						
						35000																			35000						
2400	225	A.R.	42.0	945	369	30000	2300	213	A.R.	37.0	760	348	2150	192	A.R.	31.0	570	314	2125	185	A.L.	31.5	455	302	30000	2100	177	A.L.	29.5	415	290
2400	237	A.R.	42.0	945	354	25000	2275	221	A.R.	36.5	715	330	2125	199	A.L.	32.5	455	298	2125	199	A.L.	32.5	455	298	25000	2000	177	A.L.	30.0	370	265
2400	246	A.R.	42.0	945	338	20000	2250	227	A.R.	35.0	685	310	2125	209	A.L.	32.5	455	286	2125	209	A.L.	32.0	455	286	20000	1950	183	A.L.	29.0	350	250
2400	255	A.R.	42.0	945	320	15000	2225	231	A.R.	34.5	640	291	2125	218	A.L.	32.0	455	275	2100	215	A.L.	31.0	430	271	15000	1850	189	A.L.	28.5	335	238
2400	264	A.R.	42.0	945	307	10000	2200	237	A.R.	34.0	610	276	2125	227	A.L.	32.0	455	264	2075	219	A.L.	30.5	415	255	10000	1750	194	A.L.	28.5	315	226
2400	271	A.R.	42.0	945	292	5000	2150	239	A.R.	33.5	565	258	2125	236	A.L.	32.5	455	254	2050	221	A.L.	30.0	380	238	5000	1650	197	A.L.	28.5	295	212
2400	279	A.R.	43.5	945	279	S. L.	2125	243	A.L.	34.0	455	243	2125	241	A.L.	33.5	445	241	1950	223	A.L.	30.5	355	223	S. L.	1425	186	A.L.	30.0	260	186

NOTES

* ALLOW 240 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB TO 5000 FT. PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQUIRED. FOR CLIMB TO OTHER ALTITUDES SEE "TAKE-OFF, CLIMB AND LANDING CHART."

EXAMPLE

AT 100,000 LB. GROSS WT. WITH 4000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 400 GAL.) TO FLY 2650 STAT. AIRMILES AT 15,000 FT. ALT. MAINTAIN 2100 RPM AND 215 MPH IND. AIRSPEED WITH MIXTURE SET A.L.

LEGEND

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

RED FIGURES ARE PRELIMINARY
SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 37 — Flight Operation Instruction Chart (Sheet 3 of 8 Sheets)

MODEL(S)

B-32

ENGINE(S): (4) R-3350-21 OR -23

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: **100,000** TO **90,000** POUNDS

EXTERNAL LOAD ITEMS

NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
TAKE-OFF	2800	48.0	.....	A.R.	5 Min.	1210
MILITARY POWER	2600	47.0	.....	A.R.	5 Min.	1115
NORMAL RATED	2400	42.0	.....	A.R.	Cont.	945

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

NOTES: Column I is for emergency high speed cruising only. Columns II, II[1], IV and V give progressive increase in range at a sacrifice in speed. Manifold pressure (M. P.), gallons per hour (G. P. H.) and true airspeed (T. A. S.) are approximate values for reference. For efficiency maintain indicated airspeed (I. A. S.) hourly. Adjust RPM slightly if necessary to avoid exceeding manifold pressure more than 3 in Hg.

(NO WIND) — ALTERNATE CRUISING CONDITIONS — (NO RESERVE FUEL ALLOWANCE)

I RANGE IN AIR MILES STATUTE AT SEA LEVEL	I STATUTE AT 25,000 FEET	I NAUTICAL AT SEA LEVEL	I NAUTICAL AT 25,000 FEET	FUEL U.S. GAL.	II RANGE IN AIR MILES STATUTE	II NAUTICAL	III RANGE IN AIR MILES STATUTE	III NAUTICAL	IV RANGE IN AIR MILES STATUTE	IV NAUTICAL	FUEL IMP. GAL.	V RANGE IN AIR MILES STATUTE	V NAUTICAL
					(Continued from Sheet 3)		*240 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT						
510	650	440	570	1900	850	740	1060	920	1260	1100	1580	1460	1270
430	550	370	490	1600	720	620	890	770	1060	920	1330	1230	1070
350	450	300	390	1300	580	500	720	630	860	750	1080	1000	870
270	340	230	300	1000	450	390	560	480	660	570	830	770	670
190	240	160	210	700	320	280	390	340	460	400	580	540	470
110	140	90	120	400	180	160	220	190	270	240	330	310	270
30	30	20	30	100	50	40	60	50	70	60	80	80	70

MAXIMUM CONTINUOUS R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.	ALT. Feet	OPERATING DATA R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.	OPERATING DATA R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.	OPERATING DATA R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.	ALT. Feet	MAXIMUM RANGE R. P. M.	I. A. S. M.P.H.	MIXTURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																		40000						
						35000																		35000						
2400	225	A.R.	42.0	945	369	30000	2300	213	A.R.	37.0	760	348	2150	192	A.R.	31.0	570	314	2125	185	A.L.	31.5	455	302	30000	2100	177	A.L.	29.5	415	290
2400	237	A.R.	42.0	945	354	25000	2275	221	A.R.	36.5	715	330	2125	199	A.L.	32.5	455	298	2125	199	A.L.	32.5	455	298	25000	2000	177	A.L.	30.0	370	265
2400	246	A.R.	42.0	945	338	20000	2250	227	A.R.	35.0	685	310	2125	209	A.L.	32.0	455	286	2125	209	A.L.	32.0	455	286	20000	1950	183	A.L.	29.0	350	250
2400	255	A.R.	42.0	945	320	15000	2225	231	A.R.	34.5	640	291	2125	218	A.L.	32.0	455	275	2100	215	A.L.	31.0	430	271	15000	1850	189	A.L.	28.5	335	238
2400	264	A.R.	42.0	945	307	10000	2200	237	A.R.	34.0	610	276	2125	227	A.L.	32.0	455	264	2075	219	A.L.	30.5	415	255	10000	1750	194	A.L.	28.5	315	226
2400	271	A.R.	42.0	945	292	5000	2150	239	A.R.	33.5	565	258	2125	236	A.L.	32.5	455	254	2050	221	A.L.	30.0	380	238	5000	1650	197	A.L.	28.5	295	212
2400	279	A.R.	43.5	945	279	S. L.	2125	243	A.L.	34.0	455	243	2125	241	A.L.	33.5	445	241	1950	223	A.L.	30.5	355	223	S. L.	1425	186	A.L.	30.0	260	186

NOTES

* ALLOW 240 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB TO 5000 FT. PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQUIRED. FOR CLIMB TO OTHER ALTITUDES SEE "TAKE-OFF, CLIMB AND LANDING CHART."

EXAMPLE

AT 100,000 LB. GROSS WT. WITH 4000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 400 GAL.) TO FLY 2650 STAT. AIRMILES AT 15,000 FT. ALT. MAINTAIN 2100 RPM AND 215 MPH IND. AIRSPEED WITH MIXTURE SET A.L.

LEGEND

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

RED FIGURES ARE PRELIMINARY
SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 37 — Flight Operation Instruction Charts (Sheet 4 of 8 Sheets)

MODEL(S)

B-32

ENGINE(S): (4) R-3350-21 OR -23

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: **90,000** TO **80,000** POUNDS

EXTERNAL LOAD ITEMS

NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
TAKE-OFF	2800	48.0	.....	A.R.	5 Min.	1210
MILITARY POWER	2600	47.0	.....	A.R.	5 Min.	1115
NORMAL RATED	2400	42.0	.....	A.R.	Cont.	945

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

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

(NO WIND) — ALTERNATE CRUISING CONDITIONS — (NO RESERVE FUEL ALLOWANCE)

I				FUEL	II		III		IV		FUEL	V	
RANGE IN AIR MILES				U. S.	RANGE IN AIR MILES		RANGE IN AIR MILES		RANGE IN AIR MILES		IMP.	RANGE IN AIR MILES	
STATUTE		NAUTICAL		GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
AT SEA LEVEL	AT 25,000 FEET	AT SEA LEVEL	AT 25,000 FEET	4720	*220 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT						3933		
1210	1550	1050	1350	4500	2070	1800	2580	2240	3090	2680	3747	3600	3130
1120	1450	980	1260	4200	1930	1680	2410	2100	2880	2500	3500	3360	2920
1040	1340	910	1170	3900	1790	1560	2240	1950	2680	2330	3250	3120	2710
960	1240	840	1080	3600	1650	1440	2060	1790	2470	2150	3000	2890	2510
880	1140	770	990	3300	1520	1330	1900	1650	2270	1970	2750	2650	2300
800	1030	700	900	3000	1370	1190	1710	1490	2050	1780	2500	2400	2080
720	930	630	810	2700	1240	1080	1550	1350	1850	1610	2250	2160	1880
640	830	560	720	2400	1100	960	1370	1190	1640	1430	2000	1910	1660
560	720	490	630	2100	960	840	1200	1040	1440	1250	1750	1670	1450
480	620	420	540	1800	820	710	1020	890	1220	1060	1500	1420	1230
400	520	350	450	1500	680	590	840	730	1000	870	1250	1170	1020

MAXIMUM CONTINUOUS						ALT.	OPERATING DATA						OPERATING DATA						OPERATING DATA						ALT.	MAXIMUM RANGE					
R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																			40000						
						35000																			35000						
2400	229	A.R.	42.0	945	375	30000	2275	214	A.R.	35.5	715	350	2125	195	A.L.	31.5	455	320	2125	195	A.L.	31.5	455	320	30000	2000	170	A.L.	27.0	360	278
2400	239	A.R.	42.0	945	358	25000	2250	222	A.R.	35.5	680	330	2125	205	A.L.	32.5	455	304	2100	200	A.L.	31.0	430	299	25000	1825	170	A.L.	26.5	310	254
2400	248	A.R.	42.0	945	340	20000	2225	225	A.R.	33.5	630	308	2125	214	A.L.	30.5	455	294	2075	204	A.L.	30.0	400	280	20000	1650	170	A.L.	25.0	290	233
2400	257	A.R.	42.0	945	323	15000	2175	229	A.R.	33.0	590	290	2125	222	A.L.	30.5	455	271	1975	206	A.L.	29.0	360	261	15000	1500	170	A.L.	27.5	270	214
2400	265	A.R.	42.0	945	308	10000	2125	231	A.L.	32.0	455	268	2125	231	A.L.	32.0	455	268	1875	209	A.L.	29.0	340	243	10000	1400	172	A.L.	27.5	250	200
2400	273	A.R.	42.0	945	294	5000	2125	238	A.L.	32.5	455	257	2100	232	A.L.	31.0	430	251	1750	210	A.L.	28.5	315	227	5000	1300	174	A.L.	29.0	238	187
2400	280	A.R.	43.5	945	280	S. L.	2125	251	A.L.	34.0	455	251	2050	233	A.L.	31.0	385	233	1675	212	A.L.	30.0	295	212	S. L.	1250	176	A.L.	31.0	225	176

NOTES

* ALLOW 220 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB TO 5000 FT. PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQUIRED. FOR CLIMB TO OTHER ALTITUDES SEE "TAKE-OFF, CLIMB AND LANDING CHART."

EXAMPLE

AT 90,000 LB. GROSS WT. WITH 3000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 500 GAL.) TO FLY 1700 STAT. AIRMILES AT 25,000 FT. ALT. MAINTAIN 2125 RPM AND 205 MPH IND. AIRSPEED WITH MIXTURE SET A.L.

LEGEND

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

RED FIGURES ARE PRELIMINARY
SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 37 — Flight Operation Instruction Charts (Sheet 5 of 8 Sheets)

MODEL(S)

B-32

ENGINE(S): (4) R-3350-21 OR -23

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: **90,000** TO **80,000** POUNDS

EXTERNAL LOAD ITEMS

NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
TAKE-OFF	2800	48.0	.....	A.R.	5 Min.	1210
MILITARY POWER	2600	47.0	.....	A.R.	5 Min.	1115
NORMAL RATED	2400	42.0	.....	A.R.	Cont.	945

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

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

(NO WIND) — ALTERNATE CRUISING CONDITIONS — (NO RESERVE FUEL ALLOWANCE)

I				FUEL	II		III		IV		FUEL	V	
RANGE IN AIR MILES				U. S.	RANGE IN AIR MILES		RANGE IN AIR MILES		RANGE IN AIR MILES		IMP.	RANGE IN AIR MILES	
STATUTE		NAUTICAL		GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
AT SEA LEVEL	AT 25,000 FEET	AT SEA LEVEL	AT 25,000 FEET										
320	410	280	360	1200	540	470	670	580	800	700	1000	940	820
240	310	210	270	900	410	360	510	440	610	530	750	700	610
160	210	140	180	600	270	230	330	290	390	340	500	450	390
80	100	70	90	300	130	110	160	140	200	170	250	230	200

(Continued from Sheet 4) *220 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT

MAXIMUM CONTINUOUS						ALT.	OPERATING DATA						OPERATING DATA						OPERATING DATA						ALT.	MAXIMUM RANGE					
R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																			40000						
						35000																			35000						
2400	229	A.R.	42.0	945	375	30000	2275	214	A.R.	35.5	715	350	2125	195	A.L.	31.5	455	320	2125	195	A.L.	31.5	455	320	30000	2000	170	A.L.	27.0	360	278
2400	239	A.R.	42.0	945	358	25000	2250	222	A.R.	35.5	680	330	2125	205	A.L.	32.5	455	304	2100	200	A.L.	31.0	430	299	25000	1825	170	A.L.	26.5	310	254
2400	248	A.R.	42.0	945	340	20000	2225	225	A.R.	33.5	630	308	2125	214	A.L.	30.5	455	294	2075	204	A.L.	30.0	400	280	20000	1650	170	A.L.	25.0	290	233
2400	257	A.R.	42.0	945	323	15000	2175	229	A.R.	33.0	590	290	2125	222	A.L.	30.5	455	271	1975	206	A.L.	29.0	360	261	15000	1500	170	A.L.	27.5	270	215
2400	265	A.R.	42.0	945	308	10000	2125	231	A.L.	32.0	455	268	2125	231	A.L.	32.0	455	268	1875	209	A.L.	29.0	340	243	10000	1400	172	A.L.	27.5	250	200
2400	273	A.R.	42.0	945	294	5000	2125	238	A.L.	32.5	455	257	2100	232	A.L.	31.0	430	251	1750	210	A.L.	28.5	315	227	5000	1300	174	A.L.	29.0	235	187
2400	280	A.R.	43.5	945	280	S. L.	2125	251	A.L.	34.0	455	251	2050	233	A.L.	31.0	385	233	1675	212	A.L.	30.0	295	212	S. L.	1250	176	A.L.	31.0	225	176

NOTES

* ALLOW 220 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB TO 5000 FT. PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQUIRED. FOR CLIMB TO OTHER ALTITUDES SEE "TAKE-OFF, CLIMB AND LANDING CHART."

EXAMPLE

AT 90,000 LB. GROSS WT. WITH 3000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 500 GAL.) TO FLY 1700 STAT. AIRMILES AT 25,000 FT. ALT. MAINTAIN 2125 RPM AND 205 MPH. IND. AIRSPEED WITH MIXTURE SET A.L.

LEGEND

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

RED FIGURES ARE PRELIMINARY
SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 37 — Flight Operation Instruction Charts (Sheet 6 of 8 Sheets)

MODEL(S)

B-32

ENGINE(S): (4) R-3350-21 OR -23

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: **80,000** TO **70,000** POUNDS

EXTERNAL LOAD ITEMS

NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
TAKE-OFF	2800	48.0	.....	A.R.	5 Min.	1210
MILITARY POWER	2600	47.0	.....	A.R.	5 Min.	1115
NORMAL RATED	2400	42.0	.....	A.R.	Cont.	945

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

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

(NO WIND) — ALTERNATE CRUISING CONDITIONS — (NO RESERVE FUEL ALLOWANCE)

I				FUEL	II		III		IV		FUEL	V	
RANGE IN AIR MILES				U. S.	RANGE IN AIR MILES		RANGE IN AIR MILES		RANGE IN AIR MILES		IMP.	RANGE IN AIR MILES	
STATUTE		NAUTICAL		GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
AT SEA LEVEL	AT 25,000 FEET	AT SEA LEVEL	AT 25,000 FEET	3110	*210 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT						2590		
780	1000	680	870	2900	1370	1190	1740	1510	2110	1840	2420	2480	2150
700	900	600	780	2600	1230	1080	1560	1360	1900	1650	2170	2230	1930
620	800	530	690	2300	1100	960	1390	1210	1680	1460	1920	1980	1720
540	700	470	600	2000	960	840	1220	1060	1470	1280	1670	1720	1490
460	590	400	510	1700	810	700	1030	900	1240	1080	1420	1460	1270
380	490	330	420	1400	670	580	850	740	1020	890	1170	1200	1040
290	380	260	330	1100	520	450	660	570	800	700	920	940	820
210	280	190	240	800	390	340	490	430	590	510	670	690	600
120	160	110	140	500	230	200	300	260	360	310	420	430	370
50	70	45	60	200	90	80	120	100	150	130	170	180	150

MAXIMUM CONTINUOUS						ALT.	OPERATING DATA						OPERATING DATA						OPERATING DATA						ALT.	MAXIMUM RANGE					
R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																			40000						
						35000																			35000						
2400	231	A.R.	42.0	945	378	30000	2275	218	A.R.	35.5	710	357	2125	201	A.L.	31.5	455	328	2100	199	A.L.	30.5	435	326	30000	1925	163	A.L.	24.0	310	267
2400	242	A.R.	42.0	945	362	25000	2250	223	A.R.	34.0	650	331	2125	210	A.L.	32.5	455	312	2050	198	A.L.	29.5	380	297	25000	1725	163	A.L.	23.5	270	243
2400	251	A.R.	42.0	945	344	20000	2200	227	A.R.	33.0	610	311	2125	218	A.L.	30.5	455	299	1950	201	A.L.	29.0	355	276	20000	1550	163	A.L.	22.5	250	223
2400	259	A.R.	42.0	945	327	15000	2175	230	A.R.	32.0	570	291	2125	224	A.L.	31.5	450	283	1850	203	A.L.	28.5	330	257	15000	1275	163	A.L.	26.0	240	206
2400	267	A.R.	42.0	945	310	10000	2125	234	A.L.	32.0	455	272	2075	226	A.L.	32.0	425	265	1750	206	A.L.	28.5	310	239	10000	1225	165	A.L.	28.0	220	192
2400	274	A.R.	42.0	945	295	5000	2125	241	A.L.	32.5	455	260	2050	230	A.L.	30.0	395	248	1650	208	A.L.	28.5	290	224	5000	1200	166	A.L.	28.0	205	179
2400	282	A.R.	43.5	945	282	S. L.	2125	251	A.L.	34.0	455	251	2000	235	A.L.	31.0	365	235	1475	210	A.L.	30.0	260	210	S. L.	1200	167	A.L.	29.5	195	167

NOTES

* ALLOW 210 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB TO 5000 FT. PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQUIRED. FOR CLIMB TO OTHER ALTITUDES SEE "TAKE-OFF, CLIMB AND LANDING CHART."

EXAMPLE

AT 80,000 LB. GROSS WT. WITH 1100 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 420 GAL.) TO FLY 500 STAT. AIRMILES AT 20,000 FT. ALT. MAINTAIN 2200 RPM AND 227 MPH IND. AIRSPEED WITH MIXTURE SET A.R.

LEGEND

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

RED FIGURES ARE PRELIMINARY
SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 37 — Flight Operation Instruction Charts (Sheet 7 of 8 Sheets)

MODEL(S)

B-32

ENGINE(S): (4) R-3350-21 OR -23

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: **70,000** TO **60,000** POUNDS

EXTERNAL LOAD ITEMS

NONE

LIMITS	R. P. M.	M. P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	TOTAL G. P. H.
TAKE-OFF	2800	48.0	.....	A.R.	5 Min.	1210
MILITARY POWER	2600	47.0	.....	A.R.	5 Min.	1115
NORMAL RATED	2400	42.0	.....	A.R.	Cont.	945

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

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

(NO WIND) — ALTERNATE CRUISING CONDITIONS — (NO RESERVE FUEL ALLOWANCE)

I RANGE IN AIR MILES				FUEL U. S.	II RANGE IN AIR MILES		III RANGE IN AIR MILES		IV RANGE IN AIR MILES		FUEL IMP.	V RANGE IN AIR MILES	
STATUTE		NAUTICAL			STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL
AT SEA LEVEL	AT 25,000 FEET	AT SEA LEVEL	AT 25,000 FEET	GAL.							GAL.		
				1550	*200 GAL. ALLOWANCE NOT AVAILABLE IN FLIGHT						1290		
360	470	310	410	1350	670	580	860	750	1060	920	1130	1250	1090
280	360	240	320	1050	510	440	660	570	820	710	880	970	840
200	260	170	230	750	370	320	480	420	580	500	620	690	600
120	150	100	130	450	220	190	290	250	350	300	380	420	360
40	50	35	45	150	80	70	110	100	130	110	130	150	130

MAXIMUM CONTINUOUS						ALT.	OPERATING DATA						OPERATING DATA						OPERATING DATA						ALT.	MAXIMUM RANGE					
R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.	Feet	R. P. M.	I. A. S. M.P.H.	MIX-TURE	M. P. In. Hg.	G. P. H.	T. A. S.
						40000																			40000						
						35000																			35000						
2400	235	A.R.	42.0	945	385	30000	2250	217	A.R.	34.0	660	355	2125	205	A.L.	31.5	455	335	2000	194	A.L.	27.0	380	318	30000	1850	158	A.L.	21.5	270	249
2400	245	A.R.	42.0	945	366	25000	2200	222	A.R.	33.5	610	330	2125	214	A.L.	32.5	455	318	1825	196	A.L.	28.0	345	293	25000	1650	158	A.L.	22.0	240	236
2400	252	A.R.	42.0	945	346	20000	2150	225	A.R.	31.5	570	308	2125	217	A.L.	30.5	455	297	1800	197	A.L.	28.0	320	270	20000	1500	158	A.L.	23.5	220	217
2400	261	A.R.	42.0	945	329	15000	2125	229	A.L.	30.5	455	290	2075	220	A.L.	30.0	405	278	1675	198	A.L.	28.0	300	250	15000	1200	158	A.L.	24.5	208	199
2400	269	A.R.	42.0	945	313	10000	2125	234	A.L.	32.0	455	272	2025	222	A.L.	29.5	370	258	1550	200	A.L.	28.0	275	232	10000	1200	158	A.L.	25.5	198	184
2400	276	A.R.	42.0	945	297	5000	2125	243	A.L.	32.5	455	262	1925	225	A.L.	29.0	350	243	1425	197	A.L.	28.5	250	213	5000	1200	158	A.L.	26.5	185	170
2400	283	A.R.	43.5	945	283	S. L.	2125	251	A.L.	34.0	455	251	1825	229	A.L.	30.0	325	229	1250	196	A.L.	30.0	230	196	S. L.	1200	159	A.L.	27.0	175	159

NOTES

* ALLOW 200 GAL. FOR WARM-UP, TAKE-OFF & INITIAL CLIMB TO 5000 FT. PLUS ALLOWANCE FOR WIND, RESERVE & COMBAT AS REQUIRED. FOR CLIMB TO OTHER ALTITUDES SEE "TAKE-OFF, CLIMB AND LANDING CHART."

EXAMPLE

AT 70,000 LB. GROSS WT. WITH 750 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 350 GAL.) TO FLY 650 STAT. AIRMILES AT 20,000 FT. ALT, MAINTAIN 1500 RPM AND 158 MPH IND. AIRSPEED WITH MIXTURE SET A.L.

LEGEND

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

RED FIGURES ARE PRELIMINARY
SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 37 — Flight Operation Instruction Charts (Sheet 8 of 8 Sheets)

ELEMENTS OF THE B-32 AIRPLANE THAT AFFECT PERFORMANCE AND ARE CONTROLLABLE BY FLIGHT PERSONNEL

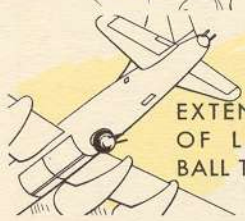
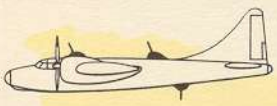
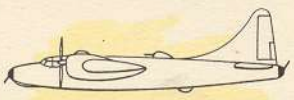
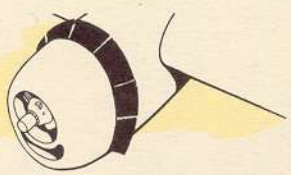
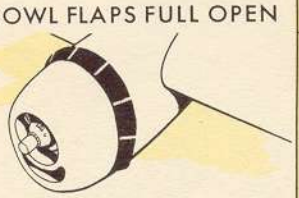
ITEM AFFECTING PERFORMANCE	Change in High Speed @ 25000' with Mil. Pwr. & 100000# G. W. mph	Change in Max. Range @ 25000' with Full Fuel & Full Bombs miles	Change in 4-Eng. Service Ceiling with Full Fuel & Bombs (350 FPM R/C) Feet	Change in 2-Eng. Service Ceiling with 90000# G.W. (100FPM R/C) Feet
 TOP TURRETS TURNED SIDE-WAYS	-17.0	-400	-3600	-4800
 EXTENSION OF LOWER BALL TURRET	-7.5	-170	-1500	-2000
 TOP AND BOTTOM GUNS VERTICAL TURRETS AT 0° AZIMUTH	-6.0	-140	-1200	-1600
 NOSE AND TAIL GUNS UP OR DOWN	-3.5	-80	-700	-1000
 COWL FLAPS FULL OPEN	-21.0	-500	CHANGES IN PERFORMANCE DUE TO COWL FLAP OPENING ARE BASED ON PERFORMANCE WITH COWL FLAPS CLOSED. CLIMB DATA ARE ESTIMATED FOR COWL FLAPS FULL OPEN; HENCE NO CHANGES ARE SHOWN.	
 COWL FLAPS HALF OPEN	-11.0	-260		

Figure 38 — Controllable Flight Elements

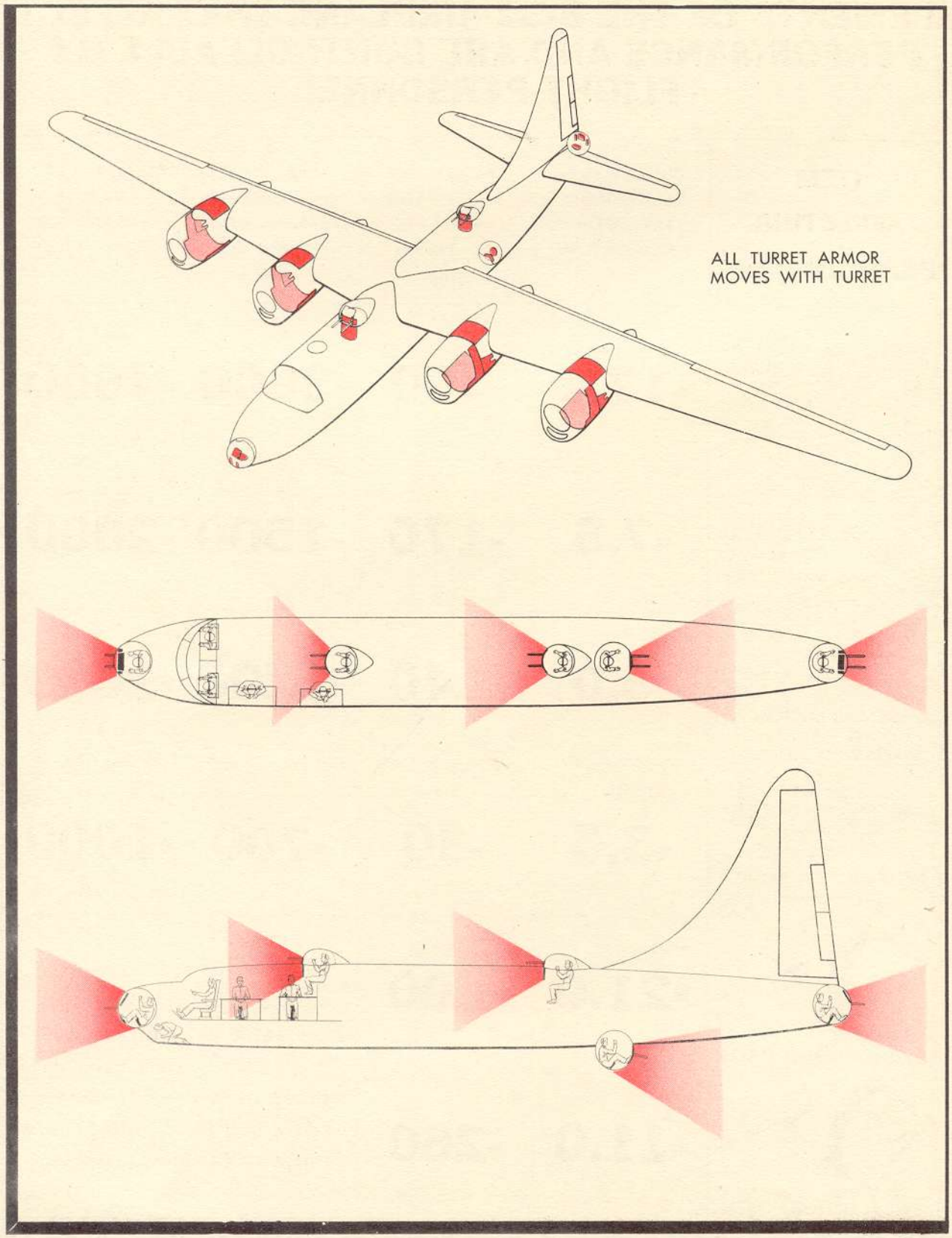


Figure 39 — Angles of Gun Fire Protection

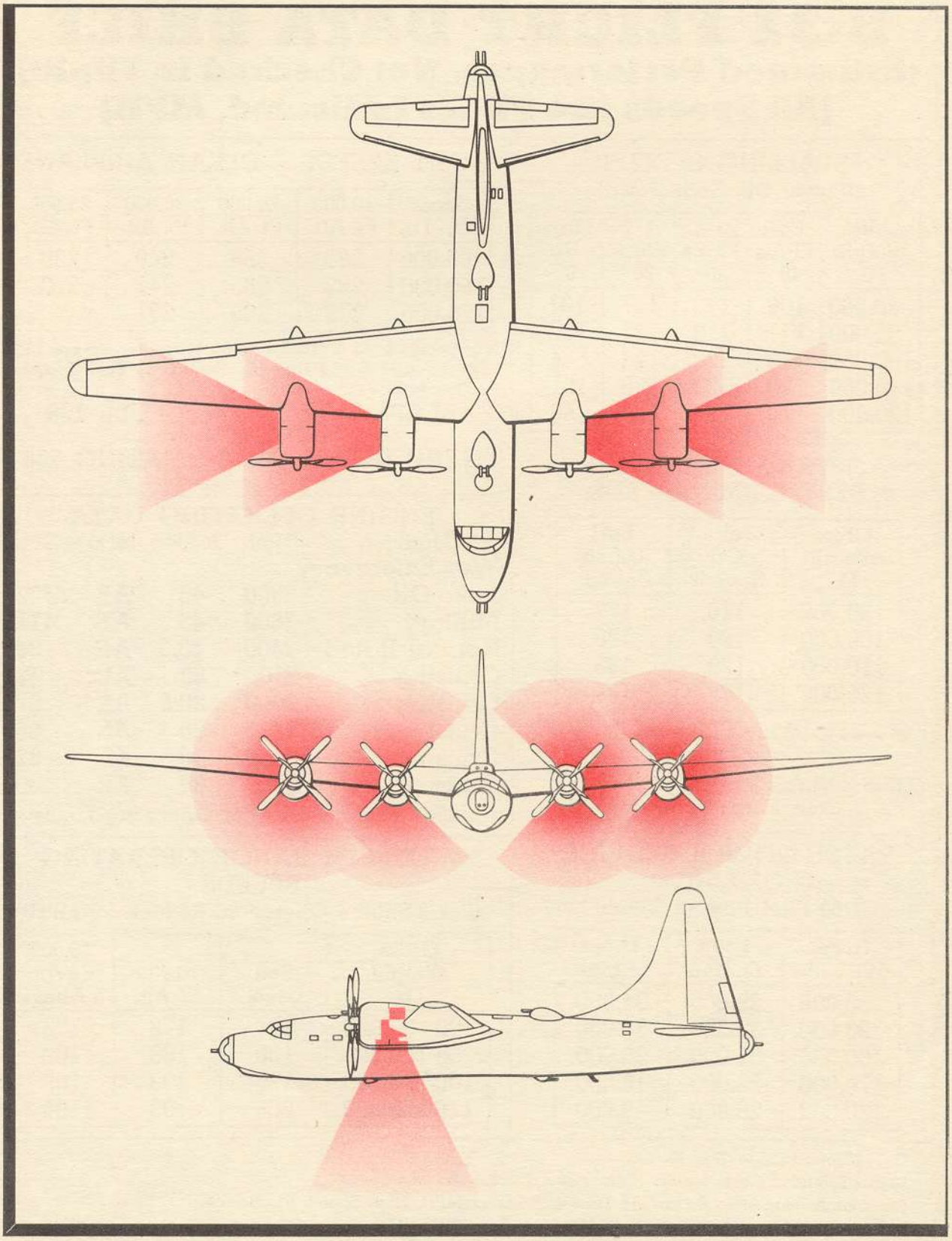


Figure 40 — Portions of Nacelle Protected from Flak

B-32 FLIGHT DATA BRIEF

(Estimated Performance, Not Checked in Flight)

(All Speeds Are Pilot's Indicated, MPH)

STALLING SPEEDS
(Power Off, Gear Down)

Gross Weight Lb.	Full Flaps 40°	3/4 Flaps 30°	1/2 Flaps 20°	Flaps Up 0°
80,000	106	113	117	131
90,000	111	118	122	137
100,000	116	123	128	144
110,000	120	128	133	151
120,000	125	133	139	156

TAKE-OFF AND BEST CLIMB SPEEDS

Gross Weight Lb.	Take-Off Speeds	Best Climb Speeds
90,000	118	172
100,000	123	178
110,000	129	183
120,000	133	188

TAKE-OFF: Wing Flaps 30°,
Cowl Flaps 20°

CLIMB: Wing Flaps Up.
Cowl Flaps 20° or as Req'd

RATED POWER SERVICE CEILING
(100 FPM Rate of Climb)

Gross Wt.—Lb.	Four Engine	Three Engine
80,000	39,000	34,000
90,000	37,500	30,000
100,000	35,000	25,000
110,000	32,000	18,000
120,000	28,000	9,000

LIMIT SPEEDS*—CLEAN AIRPLANE

Gross Wt. - Lb.	10,000 Ft. Alt.	20,000 Ft. Alt.	30,000 Ft. Alt.	35,000 Ft. Alt.
80,000	285	268	249	220
100,000	282	265	241	210
120,000	279	260	231	—

*For Design Load (2 - 1000# Bombs) Increase Speeds 10%.
*For Escape Condition (No Bombs, ½ Fuel) Increase Speeds 25%.

FLAPS DOWN ½ TO FULL 198
(Any Wt. or Altitude)

GEAR DOWN OR OPERATING 208
(Any Wt. or Altitude)

ENGINE OPERATING DATA

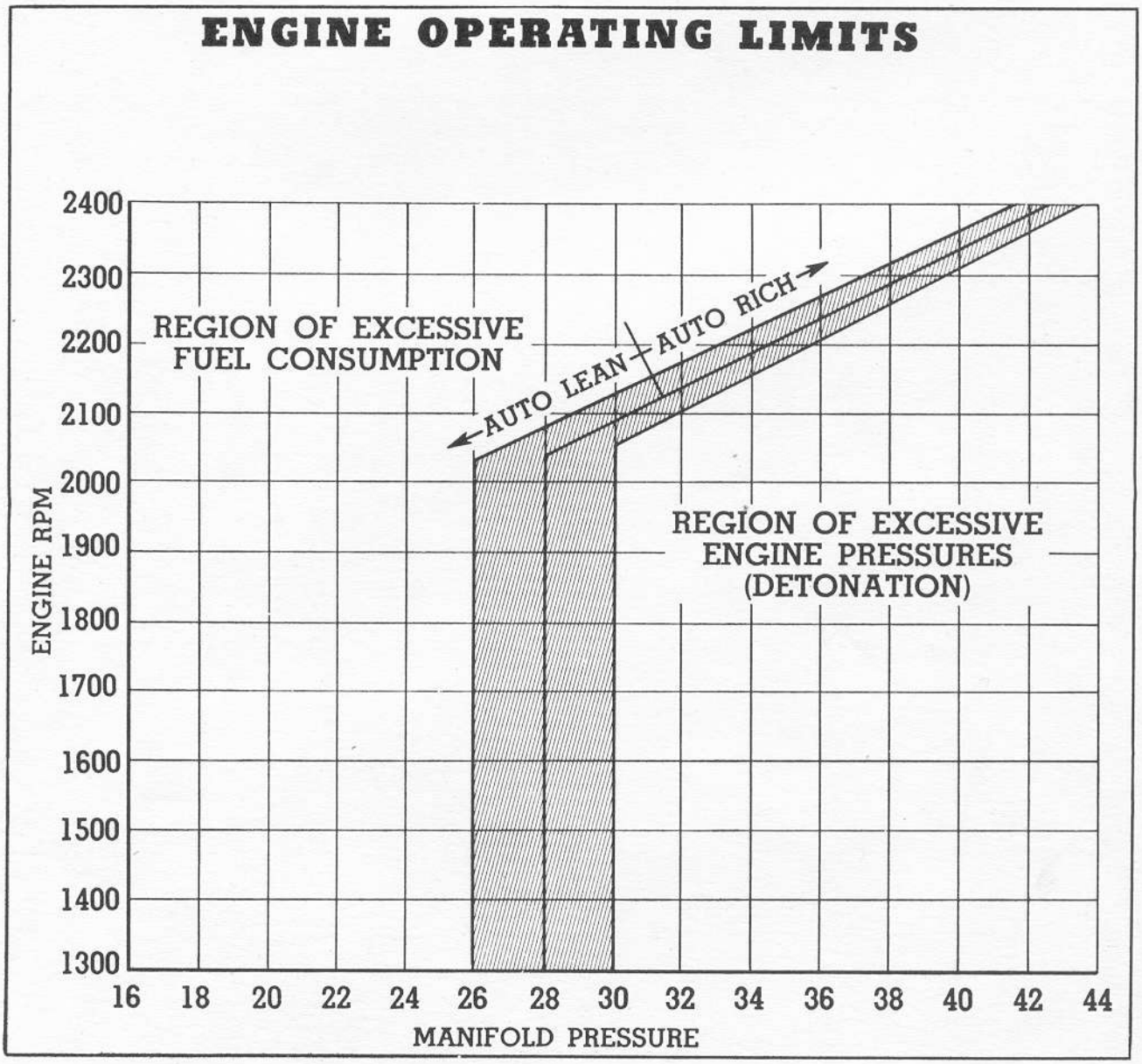
Condition	RPM	MAP	MIX	GPH
War Emergency				
Take-Off	2800	48	AR	1220
Military	2600	48	AR	1115
Normal Rated	2400	43.5	AR	945
Cruising	2100	33	AL	435
Cruising	2000	30.5	AL	370
Cruising	1900	30	AL	345
Cruising	1800	30	AL	325
Cruising	1700	30	AL	300

(See Reverse Side for Operating Limits)

MAXIMUM RANGE OPERATING SPEEDS
(For 3-Engine Operation, Reduce 5-9 MPH)

Gross Weight Lb.	Sea Level	10,000 Ft. Alt.	15,000 Ft. Alt. & Above
80- 90,000	181	178	176
90-100,000	190	186	182
100-110,000	199	193	188
110-120,000	206	198	194

C.G. Limits: 19% to 33% M.A.C.
Radar Extended Costs 5 MPH High Speed, 2% Range.
Stripped Airplane (No Radar, No Turrets) Adds 12 MPH. High Speed, 5% Range.
Minimum Speed With 2 Engines Out On One Side (Flaps Up): Power-Off Stalling Speed + 20 MPH.


ENGINE OPERATING LIMITS
REGION OF EXCESSIVE FUEL CONSUMPTION
AUTO LEAN
AUTO RICH
REGION OF EXCESSIVE ENGINE PRESSURES (DETONATION)
ENGINE RPM
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44
MANIFOLD PRESSURE