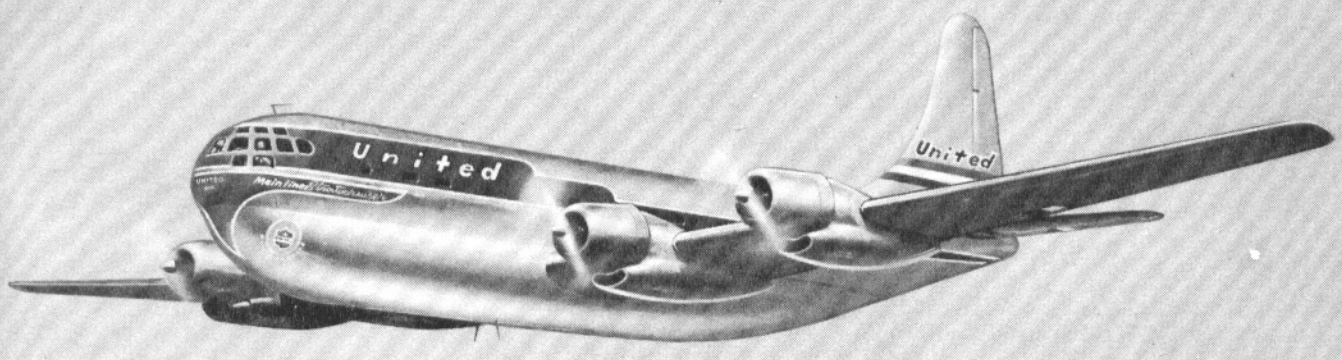
BOEING

# Stratocruiser

# PILOT'S HANDBOOK

# BOEING STRATOCRUISER

## PILOT'S HANDBOOK




BOEING MODEL 377-10-34
MANUFACTURED BY BOEING AIRPLANE COMPANY
SEATTLE DIVISION

**UNITED AIR LINES, INC.**

Boeing Document No. D-8341

**Completely Revised 20 February 1950**



54026 B

# TABLE OF CONTENTS



54027 B

# Chapter 1 DESCRIPTION

GENERAL DESCRIPTION.

The Boeing Stratocruiser is a double-deck, four-engine, medium to long range, high altitude, high speed, commercial transport airplane. The airplane is designed for a normal gross weight of 142,500 pounds, a high speed of approximately 351 MPH, a service ceiling of 34,000 feet, and a maximum range of approximately 4,000 miles.

The wing span is 141 feet, with a total wing area of 1769 square feet. The airplane is 110 feet long, 20.5 feet high at the nose, and 38 feet high at the tail. The rudder and fin fold down to 26.5 feet for hangar storage.

The normal crew consists of a pilot, copilot, auxiliary operator, radio operator, navigator, and attendants for the passenger compartments.

The crew compartment, luxury compartment, forward and aft cabins, stateroom, lounge, and both cargo compartments are pressurized and completely air-conditioned, both in flight and on the ground.

The airplane is equipped with complete facilities for both day and night passenger accommodations. In addition, space is provided in the forward and aft cargo compartments in the lower fuselage for cargo and baggage.

FLIGHT CONTROLS.

SURFACE CONTROLS. The surface controls are conventional except for the left elevator trim tab. The rudder controls have a hydraulic boost.

CONTROL SURFACE LOCK. The control-surface lock handle is on the forward end of the engine control stand. When the lock handle is in the locked position the ailerons and rudder are in a neutral posi-

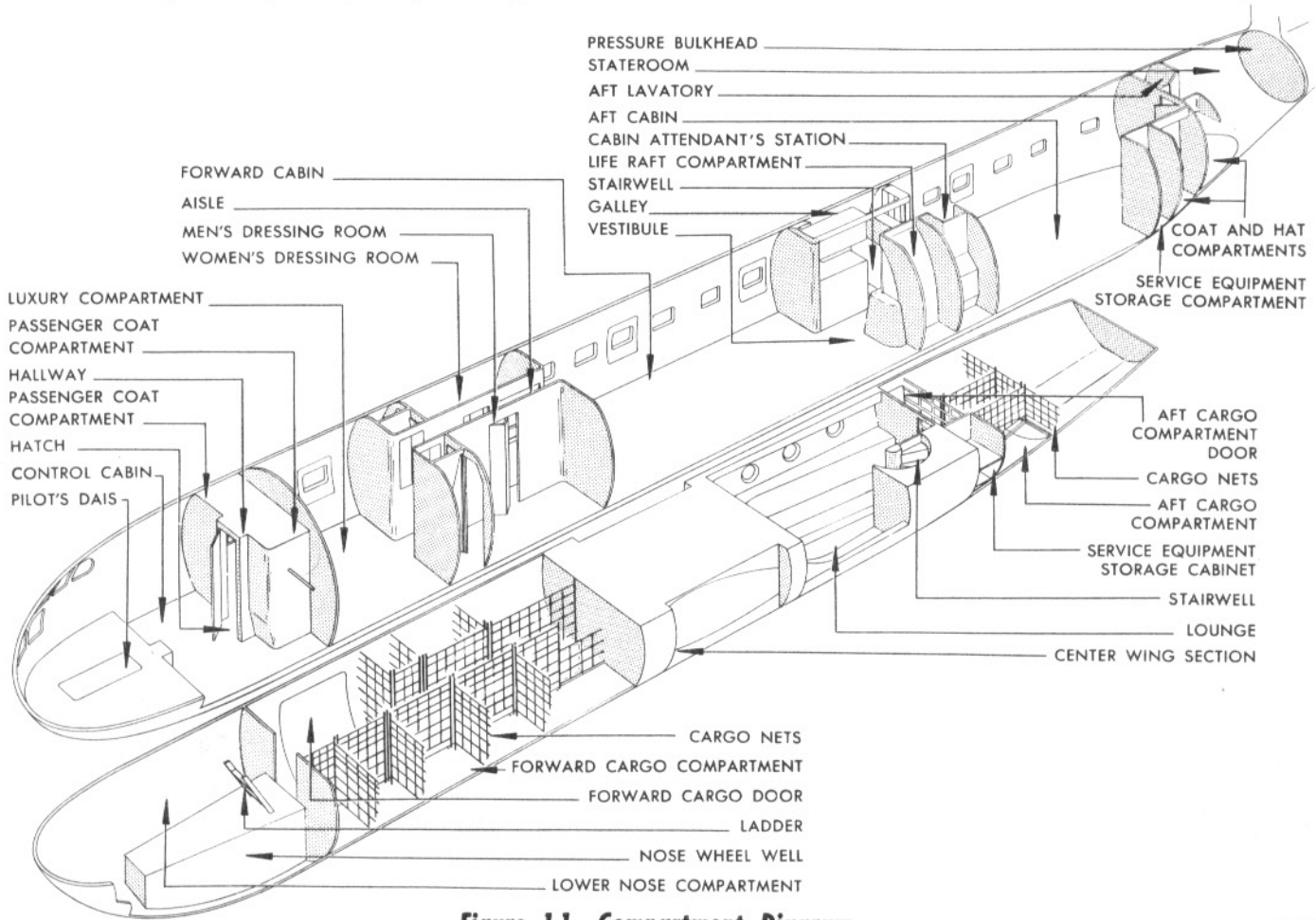



***Figure 1-1. Compartment Diagram***

54028B

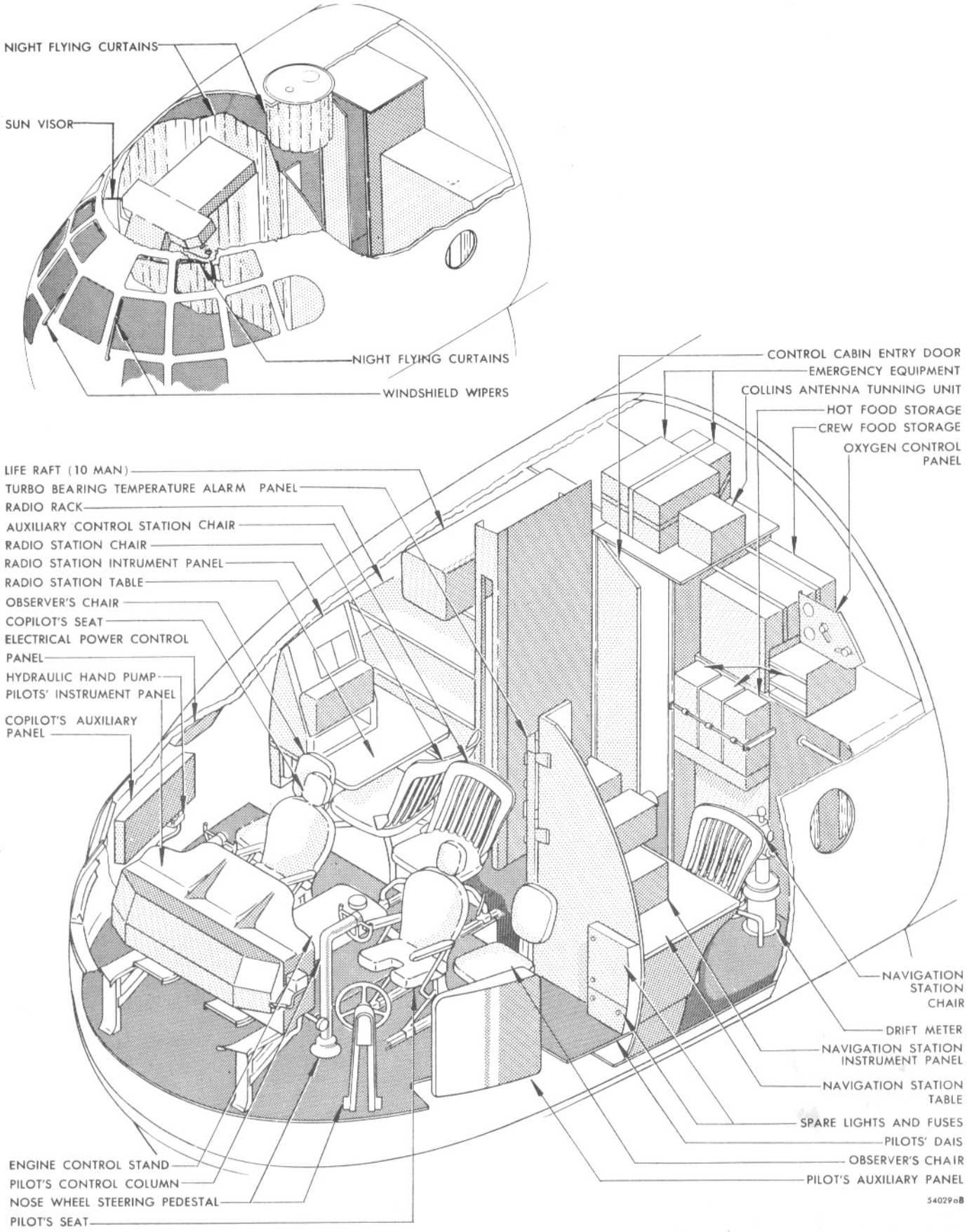
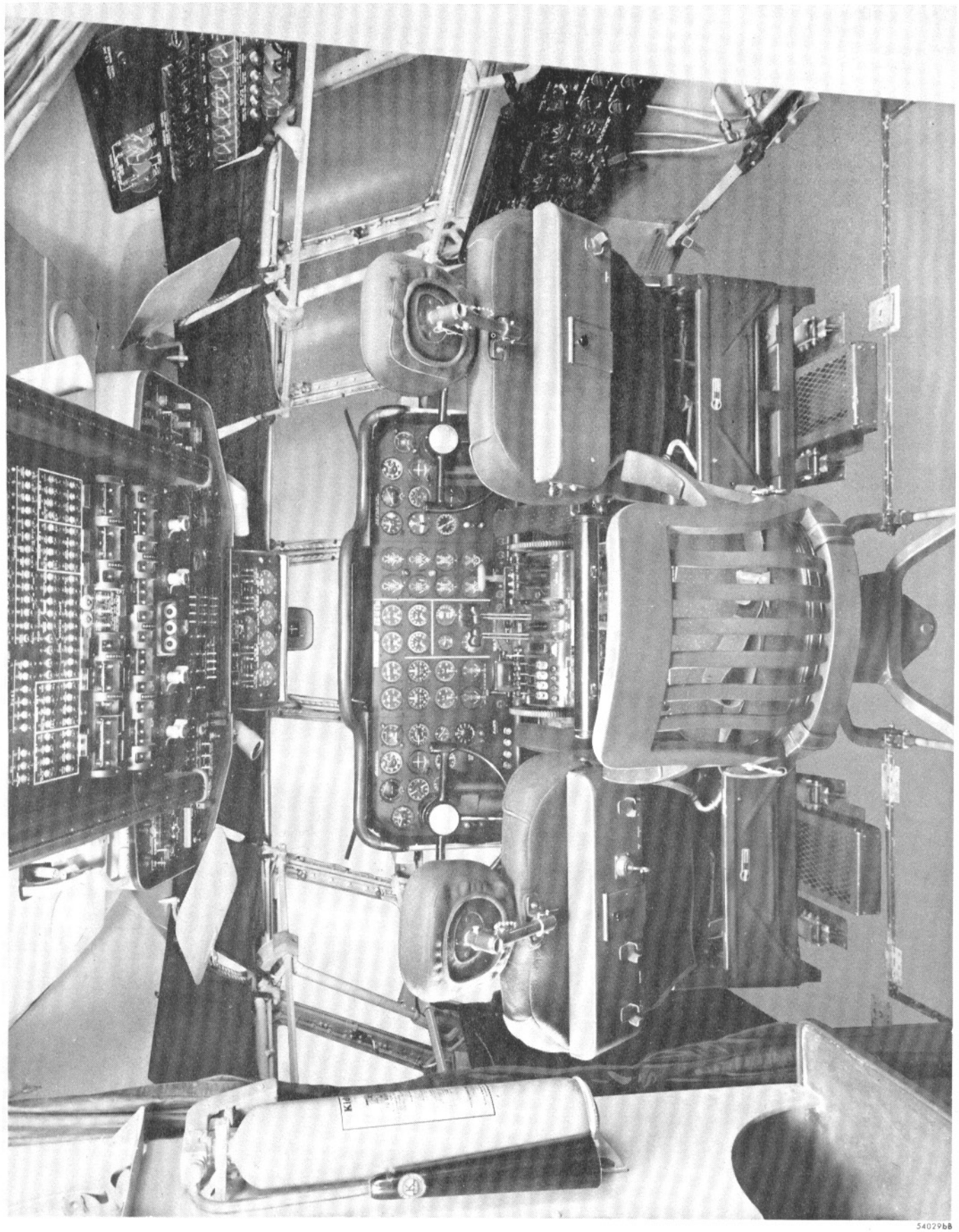



***Figure 1-2 (Sheet 1 of 2 Sheets). Control Cabin***



54029b8

*Figure 1-2 (Sheet 2 of 2 Sheets). Control Cabin*

tion, the elevators are in the down position, the throttles are locked "CLOSED," and the rudder boost is inoperative.

NOTE

At least two throttles, one on each side of the airplane, must be in the "CLOSED" or idle position before locking the control-surface lock.

The throttles are locked so that only two opposite throttles can be fully opened at one time. As an example, throttles 1 and 3 can be fully opened, but not throttles 1 and 2.

The control surface locking pins are spring-loaded to the unlocked position to prevent accidental locking of controls due to cable failure.

TRIM TABS. The aileron trim tabs are of the booster-tab type; movement of the ailerons causes the trim tabs to move in the opposite direction thus decreasing the forces required to actuate the control. The elevator trim control operates the right elevator trim tab only. The left elevator trim tab is actuated by the flaps. As the flaps are lowered, the trim tab is raised, thus giving a tail high moment to maintain stability. The rudder trim control is not connected directly to the control tab. Movement of the rudder trim control moves the rudder quadrant. Maximum trim is available when rudder boost is on. When rudder boost is off, rudder trim is available only when aerodynamic force on the rudder is less than the spring load induced into the rudder system. Trim controls are on the engine control stand.

RUDDER BOOST. The airplane is equipped with a hydraulic rudder-boost system to aid in rudder control. When the control surface lock is unlocked the system is in operation. A guarded "OFF--ON" switch on the engine control stand (figure 1-4) is used to shut off the system in an emergency. A circuit breaker for the rudder boost control is on the overhead electrical panel.

WING FLAP NORMAL CONTROLS. The flaps are electrically operated by an "UP--OFF--DOWN" switch on the engine control stand. The switch is spring-loaded to "OFF" when in the "DOWN" position. A flap position indicator is on the pilots' instrument panel. The warning horn will sound on takeoff if the flaps are not positioned between 20 and 30 degrees when the throttles are three-fourths or more open. Extending the flaps raises the left elevator trim tab proportionally to correct the nose-up pitching condition normally caused by lowering the flaps. When the flaps are fully extended the trim tab is fully raised. The circuit breakers for the wing flap control and for the warning horn are on the overhead electrical panel; fuses for motor power and position indicator are on the main power panel and AC power shield (figure 1-14).

WING FLAP EMERGENCY CONTROLS. A portable auxiliary flap motor (figure 1-19), mounted above the normal flap motor, is used to operate the flaps in event of normal motor failure. A three-position spring-loaded "EMERGENCY" switch, on the overhead instrument panel, controls the auxiliary motor for flap operation. The switch on the auxiliary motor is inoperative when the motor is mounted on the flap bracket. When used as a landing gear emergency motor, the switch will function. A circuit breaker for the control is on the overhead electrical panel, and a fuse for the motor circuit is in the main power panel.

AUTOMATIC PILOT. The Eclipse-Pioneer PB-10 automatic pilot is installed in this Stratocruiser. Controls for the automatic pilot consist of: the controller, clutch switch, caging switch, altitude control switch, gyro beacon light, and the servo clutch disconnect lever, all on the engine control stand; and the electrical release switches on both the pilot's and copilot's control wheels.

Instruments for the automatic pilot consist of a pitch trim indicator on the pilots' instrument panel and a master direction indicator on the navigation station instrument panel. The direction indicator repeater on the pilot's side of the instrument panel and the card on the magnetic and dual ADF indicator on the copilot's side of the instrument panel repeat the magnetic heading indicated by the master direction indicator.

The autopilot has the following features: magnetic directional control of the airplane course, coordinated rudder and aileron turns, climbs and dives, automatic pressure altitude control, positive gentle flight corrections in all weather, and safety interlocks to prevent faulty manual operation of the controls.

CONTROLLER. The autopilot controller is a central control unit which reduces the operation of maneuvering the airplane to the manipulation of two knobs and a turn handle.

TURN HANDLE. The turn handle gives rudder and aileron coordinated turns with enough up elevator to maintain altitude. A detent marks the neutral position of the handle. The amount of handle displacement determines the bank angle and rate of turn. Maximum handle displacement will give a bank of approximately 45 degrees. The rate of turn is dependent upon air speed and rate limits of the autopilot. The trigger switch on the handle cuts out flux gate control when small turns are desired.

PITCH AND BANK KNOBS. The pitch knob controls the elevators for climb or dive. Forward rotation, from the neutral position, results in dive and aft rotation results in climb. The angle of climb or dive is proportional to the knob rotation, but maximum angle is 18 degrees in either direction. The bank knob provides lateral trim correction should the autopilot be engaged when the airplane is not level about the roll axis.

CLUTCH SWITCH. The clutch switch is forward of the controller on the engine control stand. The automatic pilot is engaged by pressing the clutch switch. This operates a clutch in each of the servos and in the master direction indicator. After engaging, the PB-10 will keep the airplane in the attitude and heading which

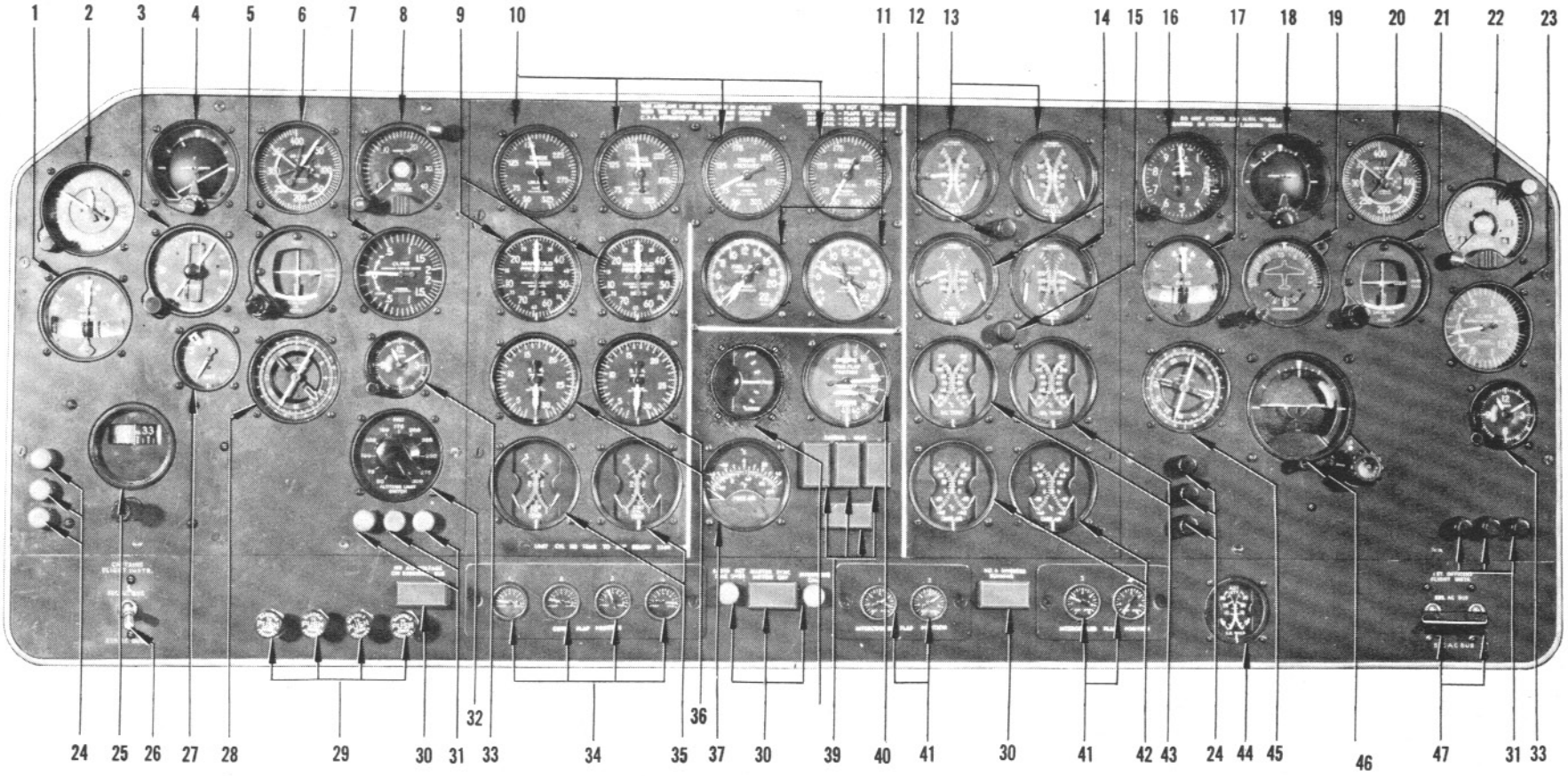



Figure 1-3. Pilots' Instrument Panel

## LEGEND

1. TURN AND BANK
2. ALTIMETER
3. GYROSYN COMPASS REPEATER (AUTOPILOT)
4. GYRO HORIZON
5. INSTRUMENT LANDING INDICATOR
6. MACH AIRSPEED
7. RATE OF CLIMB
8. RADIO ALTIMETER
9. MANIFOLD AIR PRESSURE
10. TORQUEMETERS
11. FUEL FLOW
12. FUEL PRESSURE WARNING LIGHT
13. FUEL PRESSURE
14. OIL PRESSURE
15. OIL PRESSURE WARNING LIGHT
16. ALTIMETER
17. TURN AND BANK
18. GYRO HORIZON
19. GYROSYN COMPASS
20. MACH AIRSPEED
21. INSTRUMENT LANDING INDICATOR
22. RADIO ALTIMETER
23. RATE OF CLIMB
24. MARKER BEACON
25. DIRECTIONAL GYRO (VACUUM)
26. FLIGHT INSTRUMENT POWER SWITCH
27. VACUUM GAGE
28. MAGNETIC AND DUAL ADF INDICATORS
29. M A P PURGE VALVES
30. WARNING LIGHTS
31. RADIO ALTIMETER INDICATOR LIGHTS
32. RADIO ALTIMETER LIMIT SWITCH
33. CLOCK
34. COWL FLAP POSITION
35. CYLINDER HEAD TEMPERATURE
36. TACHOMETERS
37. OUTSIDE AIR TEMPERATURE
38. PITCH TRIM INDICATOR
39. LANDING GEAR POSITON LIGHTS
40. WING FLAP POSITION
41. INTERCOOLER FLAP POSITION
42. CARBURETOR AIR TEMPERATURE
43. OIL TEMPERATURE
44. ADI QUANTITY
45. MAGNETIC AND DUAL ADF INDICATORS
46. GYRO HORIZON (VACUUM)
47. FLIGHT INSTRUMENT POWER SWITCH

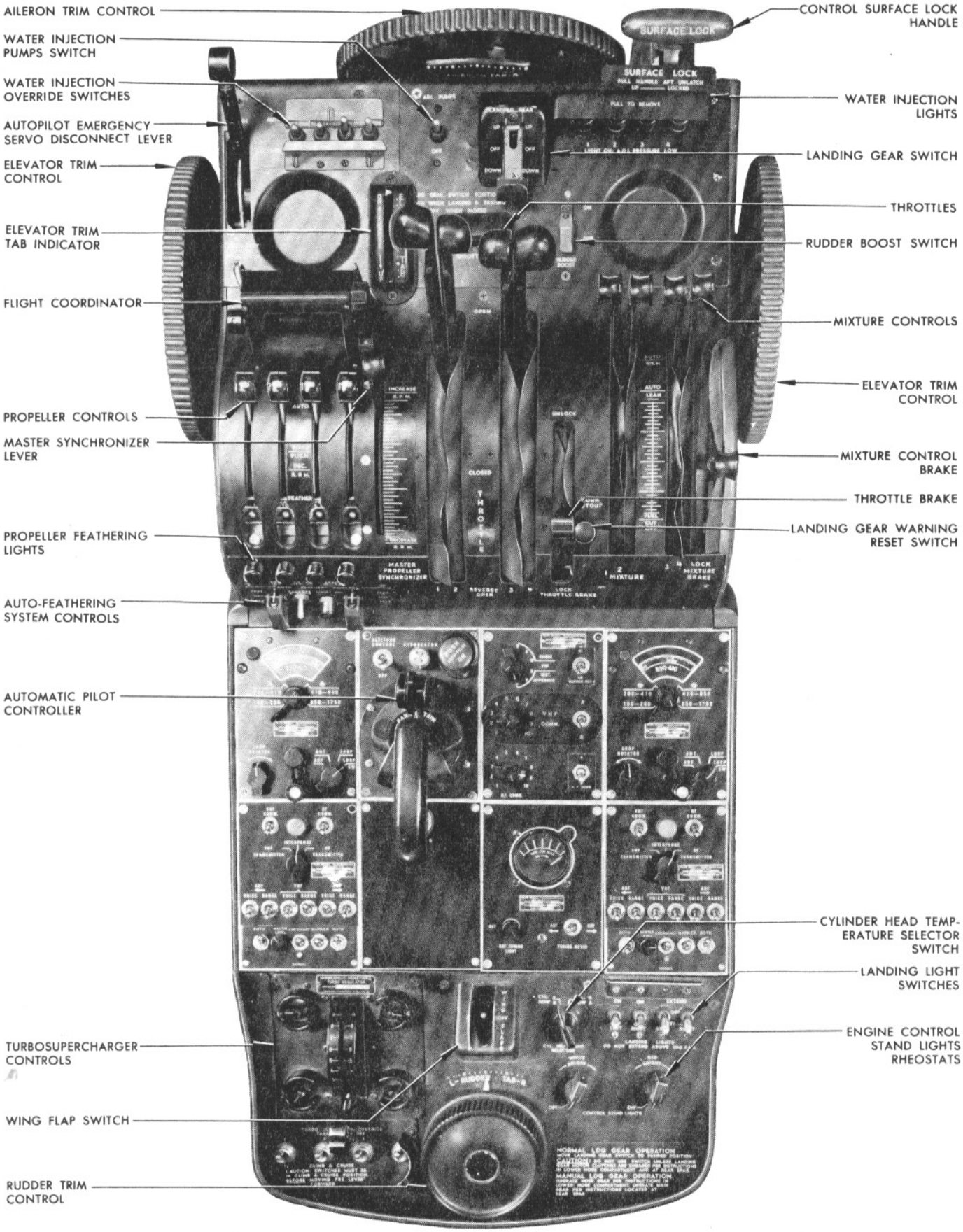



***Figure 1-4. Engine Control Stand***

540318

it had the instant the clutch switch was pressed. As a safety factor, interlocks will prevent the autopilot from being engaged, if the gyros are caged, the power fails, or if any other condition is present that would produce malfunctioning of automatic control.

ALTITUDE CONTROL SWITCH. The altitude control switch controls a barometric unit which automatically controls the elevators to maintain the pressure altitude being flown when the switch is turned "ON." The altitude control switch is always ready for operation; it is not necessary to center the trim knobs or fly straight and level before moving the switch to "ON." The elevator trim should be checked occasionally to prevent excessive servo operation.

GYRO BEACON. This lamp flashes when the autopilot is ready to be engaged. It is controlled by an electric eye in the amplifier, which senses whether the gyros are erect or up to speed. Normally the beacon should flash 30 to 40 times per minute. When the beacon is flashing approximately once every 1 1/2 seconds the autopilot is ready to engage.

CAGING SWITCH. The caging switch operates caging motors which erect the flux gate transmitter gyro and the flight gyro. A momentary closing of the caging switch starts the caging cycle which first erects the gyros then releases them. An interlock will release the clutch switch should the caging switch be closed while the autopilot is engaged.

MASTER DIRECTION INDICATOR. The card of the master direction indicator shows the magnetic heading as well as the reciprocal heading of the airplane. Power is supplied to the indicator and the flux gate system when the airplane AC and DC systems are turned on. Therefore, the indicator shows magnetic heading at all times. When the autopilot is engaged, movement of the card results in generation of signals which apply control to turn the airplane. The pilot's direction indicator repeater and the card of the copilot's magnetic and dual ADF indicator repeat the heading indicated on the master direction indicator.

PITCH TRIM INDICATOR. A constant deflection of the pitch trim indicator needle above or below the horizontal marker denotes an out-of-trim condition. To trim the airplane, rotate the elevator trim tab wheel until the needle indicates "TRIM."

PILOTS' RELEASE SWITCH. The electrical release switch in each of the pilots' control column wheels, permits instantaneous manual control of the airplane by electrically disconnecting the autopilot. The clutch switch is released and the clutches in each of the servos and the master direction indicator are disengaged.

SERVO DISCONNECT LEVER. This lever, on the forward end of the engine control stand, operates the servo disconnects which mechanically disengage the autopilot from the airplane control surfaces. These clutches (servo disconnects) completely disengage the servo pulleys from the servo drive shaft so that the pulleys are free to turn with control cable movement.

POWER PLANT.

The Stratocruiser is powered with four Pratt and Whitney TSB3-G, four row, 28-cylinder, Wasp Major radial engines. Each engine incorporates a single-stage, single-speed, engine-driven supercharger, a pressure injection carburetor, water injection, and an exhaust-driven General Electric BH-4 turbosupercharger. A torquemeter installation is in the nose section of the engine. Maximum continuous horsepower output is 2800 BHP; maximum take-off power dry is 3250 BHP; and maximum take-off power wet is 3500 BHP.

THROTTLES. Four throttle levers are installed on the engine control stand. The throttles control engine power for both forward and reverse thrust.

Three positions are marked on the throttle quadrant: "OPEN," "CLOSED," and "REVERSE OPEN." Movement of the throttles from "CLOSED" to "OPEN" is conventional. Movement of the throttles from "CLOSED" to "REVERSE OPEN," for reverse thrust, is accomplished by raising the throttle levers over the stops and then moving them aft toward "REVERSE OPEN." As the levers are moved over the stops, a friction can be felt as the reverse pitch switches are actuated. Continued aft movement of the throttles toward "REVERSE OPEN" increases reverse thrust power. Forward movement of the throttles past the stops toward the "OPEN" position will return the propellers to normal pitch.

It is not possible to move the throttles to the "REVERSE OPEN" position while in flight, because of a solenoid-operated catch which stops the throttles at the "CLOSED" position. The catch releases when any one of the landing gears contacts the ground; therefore, reverse pitch is possible immediately upon landing. The reverse pitch catch may be released in event of a malfunction by depressing the reverse pitch indicator flag on the engine control stand.

Circuit breakers for the propeller reversing control and the throttle lock are on the overhead electrical panel.

THROTTLE BRAKE. A throttle friction brake is at the right of the throttles. The braking friction is proportionate to the degree of brake applied.

MIXTURE CONTROLS. Four mixture controls are installed on the engine control stand adjacent to the throttles. The mixture quadrant has the following positions: "FUEL CUTOFF," "AUTO LEAN," and "AUTO RICH." The graduated scale between "FUEL CUTOFF" and "AUTO LEAN" is for manual operation of the mixture controls. A mixture control brake is adjacent to the mixture quadrant. The braking friction is proportionate to the degree of brake applied.

IGNITION. Four rotary-type engine ignition switches are on the overhead electrical panel. A main ignition lever selects "RIGHT," "LEFT," "BOTH," and "OFF" positions for all seven magnetos simultaneously. A push-pull bank selector knob allows selection and checking of the left or right bank of each magneto individually. This selection permits relatively close detection of individual spark plug failure.

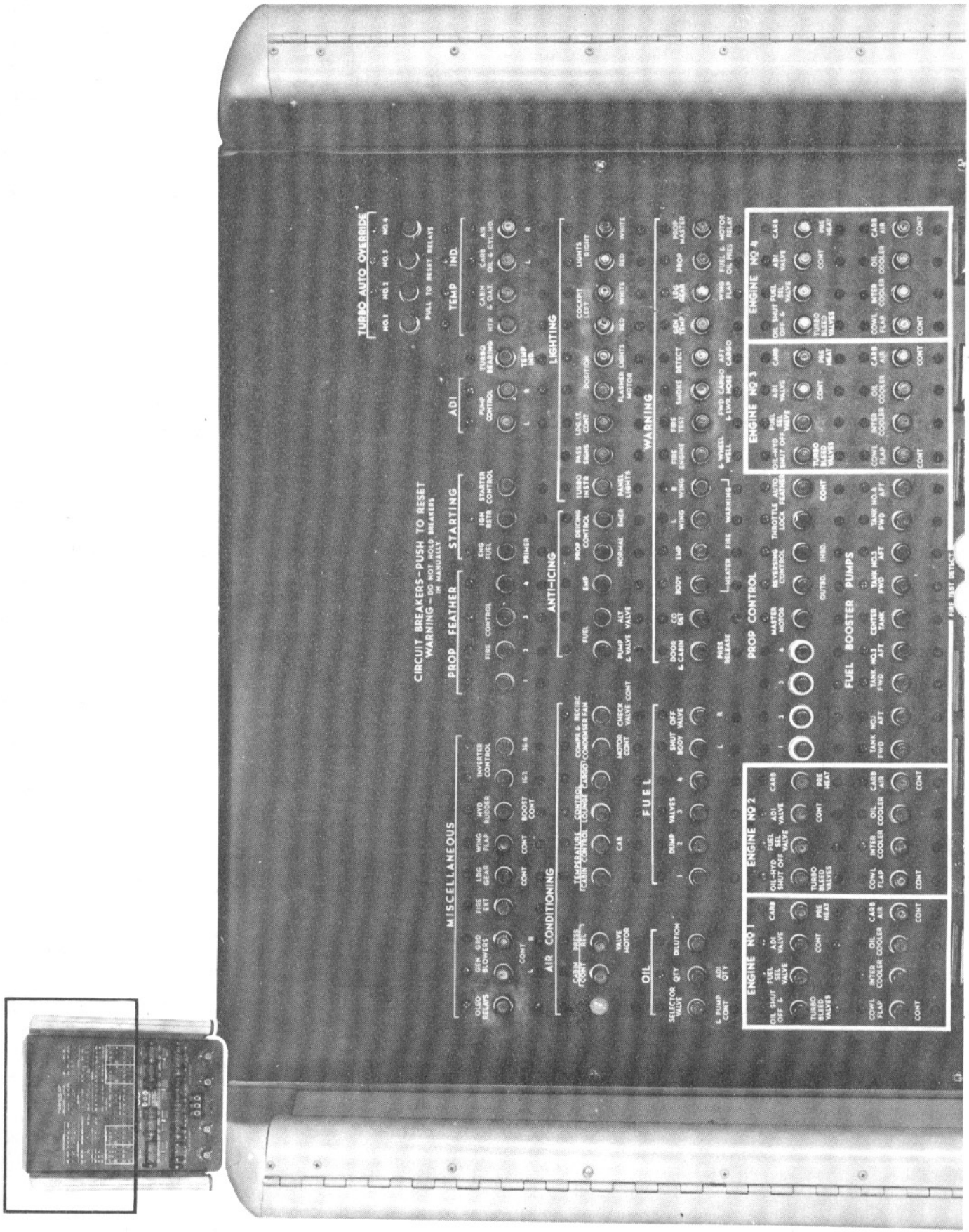



*Figure 1-5 (Sheet 1 of 2 Sheets). Overhead Electrical Panel*

54032aB

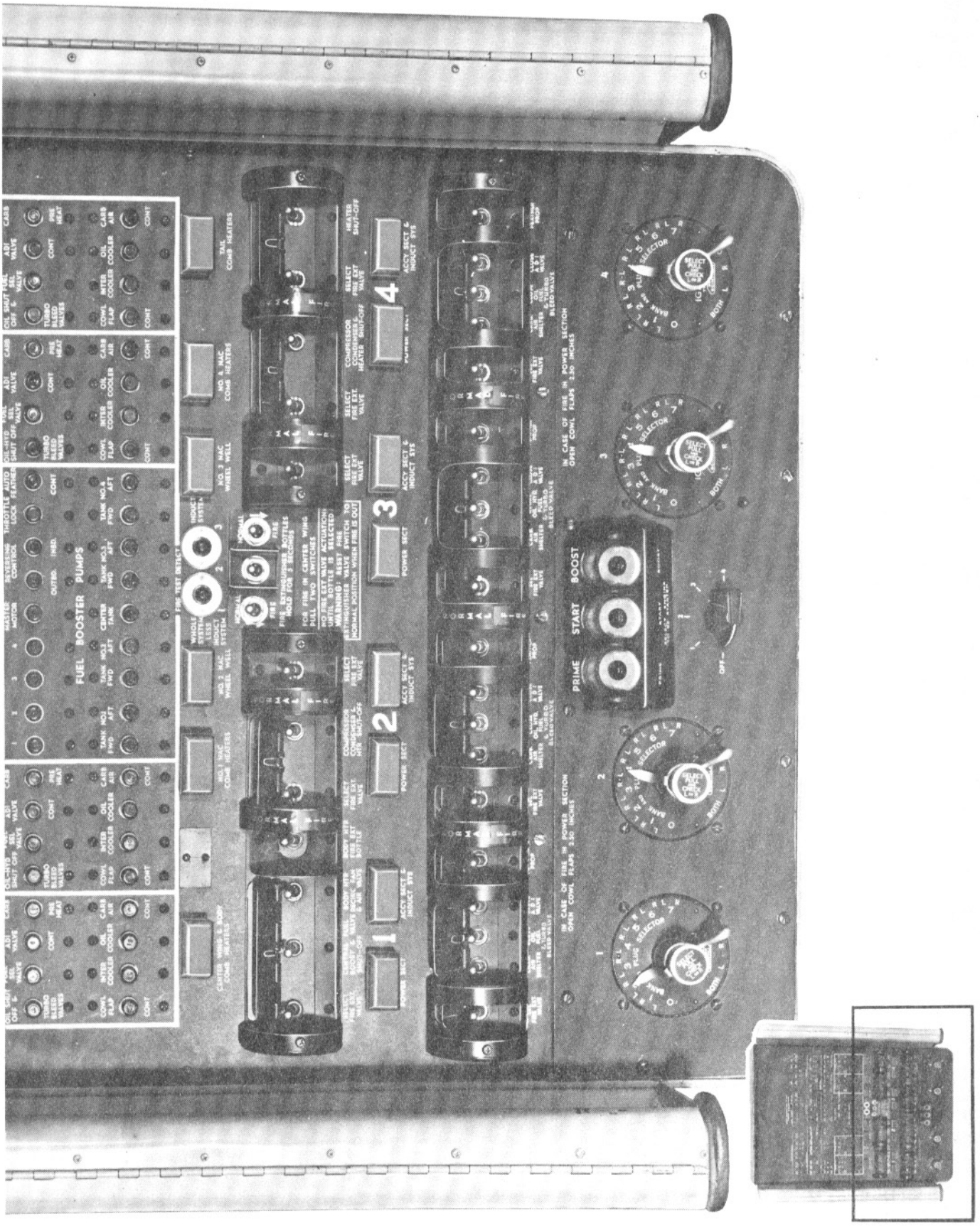



*Figure 1-5 (Sheet 2 of 2 Sheets). Overhead Electrical Panel*

54032b8

ENGINE STARTING CONTROLS. The engine starting controls consist of an engine selector switch and the "PRIME," "START," and "BOOST" push-button switches grouped on a raised and guarded base. The starting controls are on the forward end of the overhead electrical panel. Each push-button switch controls that engine selected by the engine selector switch. The center "START" push-button controls the direct cranking starter. The "PRIME" push button on the left electrically controls engine priming which is accomplished by injecting fuel through the carburetor acceleration pump nozzles. The "BOOST" push button on the right controls the ignition boost.

Circuit breakers for the starting controls are on the aft end of the overhead electrical panel.

COWL FLAPS. Four switches on the aft end of the overhead instrument panel control the cowl flaps. The switches have "OPEN--CLOSE" positions and they are spring-loaded to the neutral or off position. Four cowl flap position indicators are on the pilots' instrument panel. Circuit breakers for the control circuits are in the engine control group on the overhead electrical panel. Circuit breakers for the cowl flap motors are on the main circuit breaker panel. Fuses for the position indicators are on the AC power shield.

CARBURETOR PREHEAT CONTROLS. Four "OPEN--OFF--CLOSE" switches on overhead instrument panel control the carburetor preheat valves. The switches are spring-loaded to "OFF" in the "OPEN" position. Opening the valve allows recirculation of a portion of the pressurized air through the supercharger. The use of the valves must be in conjunction with carburetor air temperature and manifold pressure indicators. The supercharger must be operating before preheat is possible. Circuit breakers for the system are on the overhead electrical panel.

CARBURETOR AIR CONTROLS. The "RAM--SHELTERED" switches, on the overhead instrument panel, control the ram air shutoff door. In the "RAM" position, air enters the air scoop and passes directly into the induction system. In the "SHELTERED" position, the shutoff door closes the air intake scoop and allows air to enter the induction system from the bottom of the air scoop. Moisture is partially eliminated from the carburetor air by this method. Four fire switches on the overhead electrical fire panel close the ram air door when the fire switches are placed in the "FIRE" position. A circuit breaker for the controls is in each engine group on the overhead electrical panel and four circuit breakers for the shutoff door motors are on the main circuit breaker panel.

INTERCOOLER FLAPS. Four "OPEN--OFF--CLOSE" switches, on the overhead instrument panel, control the intercooler flaps. The switches are spring-loaded to the "OFF" position. The intercooler flaps are positioned for carburetor air cooling by moving the switches in the desired direction. The intercooler flaps automatically close when the fire switch is actuated and when the carburetor air switches are placed in the "SHELTERED" position. A circuit breaker for the controls is in each of the engine groups on the overhead electrical panel.

Four flap position indicators, on the pilots' instrument panel, show intercooler flap position in inches of opening. Fuses are on the AC power shield.

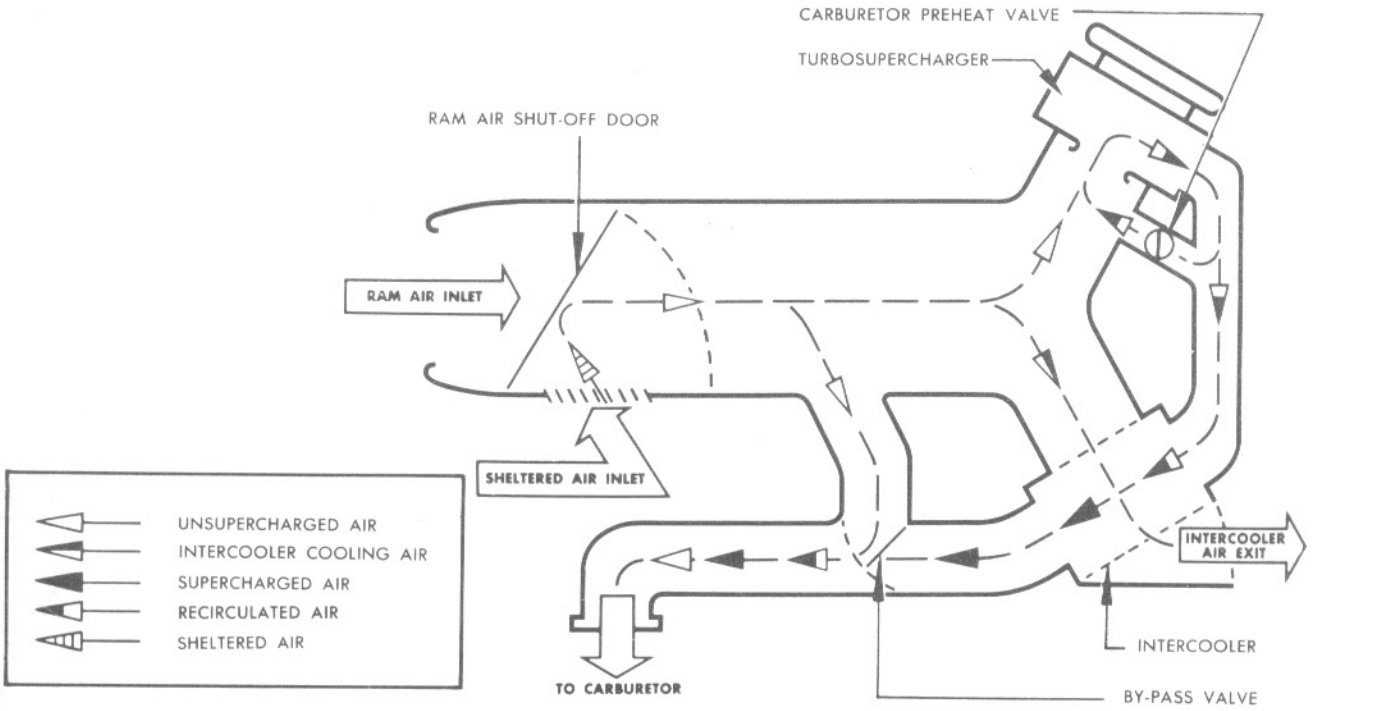



*Figure 1-6. Induction System*

54037B

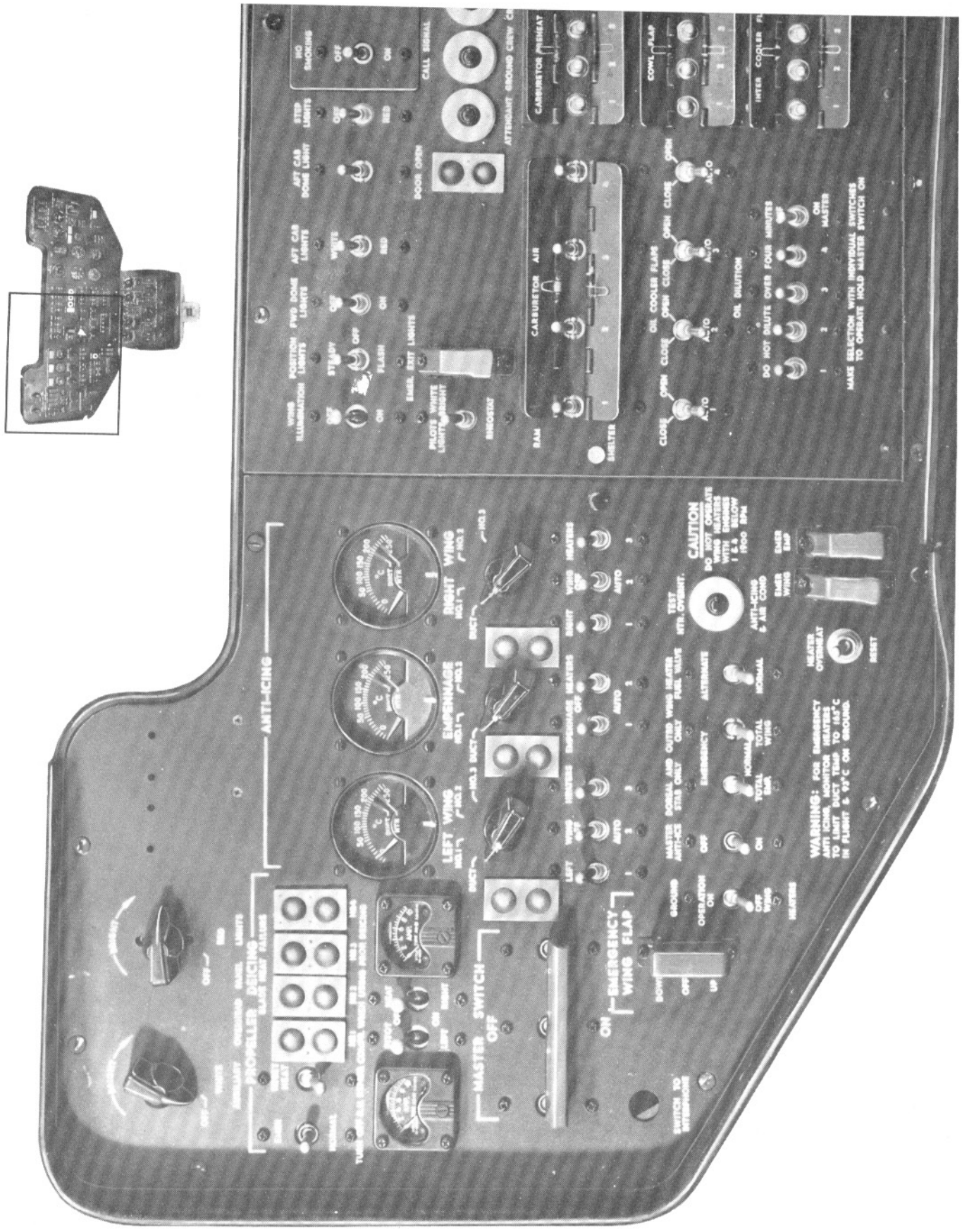



*Figure 1-7 (Sheet 1 of 3 Sheets). Overhead Instrument Panel*

54033 aB

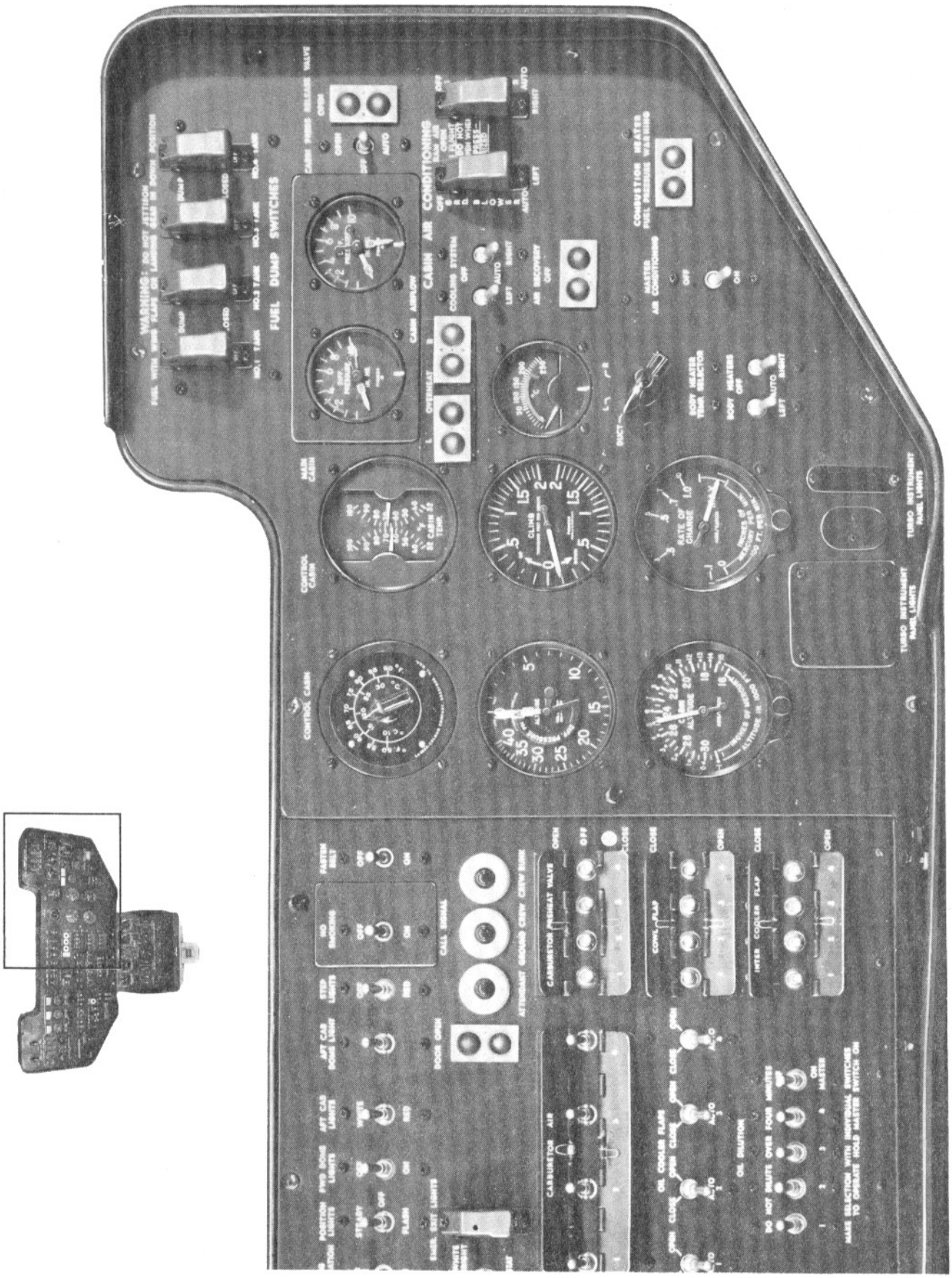



*Figure 1-7 (Sheet 2 of 3 Sheets). Overhead Instrument Panel*

54033b8


*Figure 1-7 (Sheet 3 of 3 Sheets). Overhead Instrument Panel*

54033c8

TURBOSUPERCHARGERS. The engine exhaust-driven turbosuperchargers are used for altitude power and cabin pressurization but are not used for takeoff and landing. The turbo controls consist of a turbo selector lever, four calibrating potentiometers (grouped around the selector lever), and four turbo control override switches all on the engine control stand. (See figure 1-4.)

The turbosupercharger selector lever (TBS) is calibrated from "0" to "10." Movement of the lever from the "0" position applies turbo in proportion to the number selected. The four calibrating potentiometers provide a means of setting a uniform manifold pressure on all engines. The four turbo control override switches have a "TAKE-OFF" position and a "CLIMB AND CRUISE" position. When the switches are in the "TAKE-OFF" position, the normal turbo control system is overridden and the waste gates move open. When the switches are in the "CLIMB AND CRUISE" position, the normal TBS control system functions; however, an automatic pressure switch (actuated by exhaust back-pressure) will override the normal control system and open the waste gate to prevent the exhaust back-pressure from exceeding 49 (+ 1/- 2) inches of mercury. The automatic override system incorporates a transformer which boosts the voltage supplied to the waste gate motor. This provides for faster and more positive action in opening the waste gate. Circuit breakers for the turbo controls are on the AC power shield. Circuit breakers for the turbo control override system are on the overhead electrical panel and fuses are on the AC power shield.

The turbo instruments consist of the manifold pressure gages on the pilot's instrument panel, and two dual indicating exhaust back-pressure indicators and four Edison alarm panels mounted on the forward end of the navigation station bulkhead (see figure 1-8). Each Edison panel has a dual indicating turbine bearing and blower bearing temperature indicator, a warning light, a selector switch, and a master fire warning system cutout switch. When either of the maximum allowable bearing temperatures is exceeded, the warning light will illuminate and the master fire warning bell and light will be energized. The selector switch is provided to check the warning system of both bearings. A circuit breaker for the turbo bearing temperature indicators and warning system is on the overhead electrical panel. Circuit breakers for the exhaust back-pressure indicators are on the AC power shield.

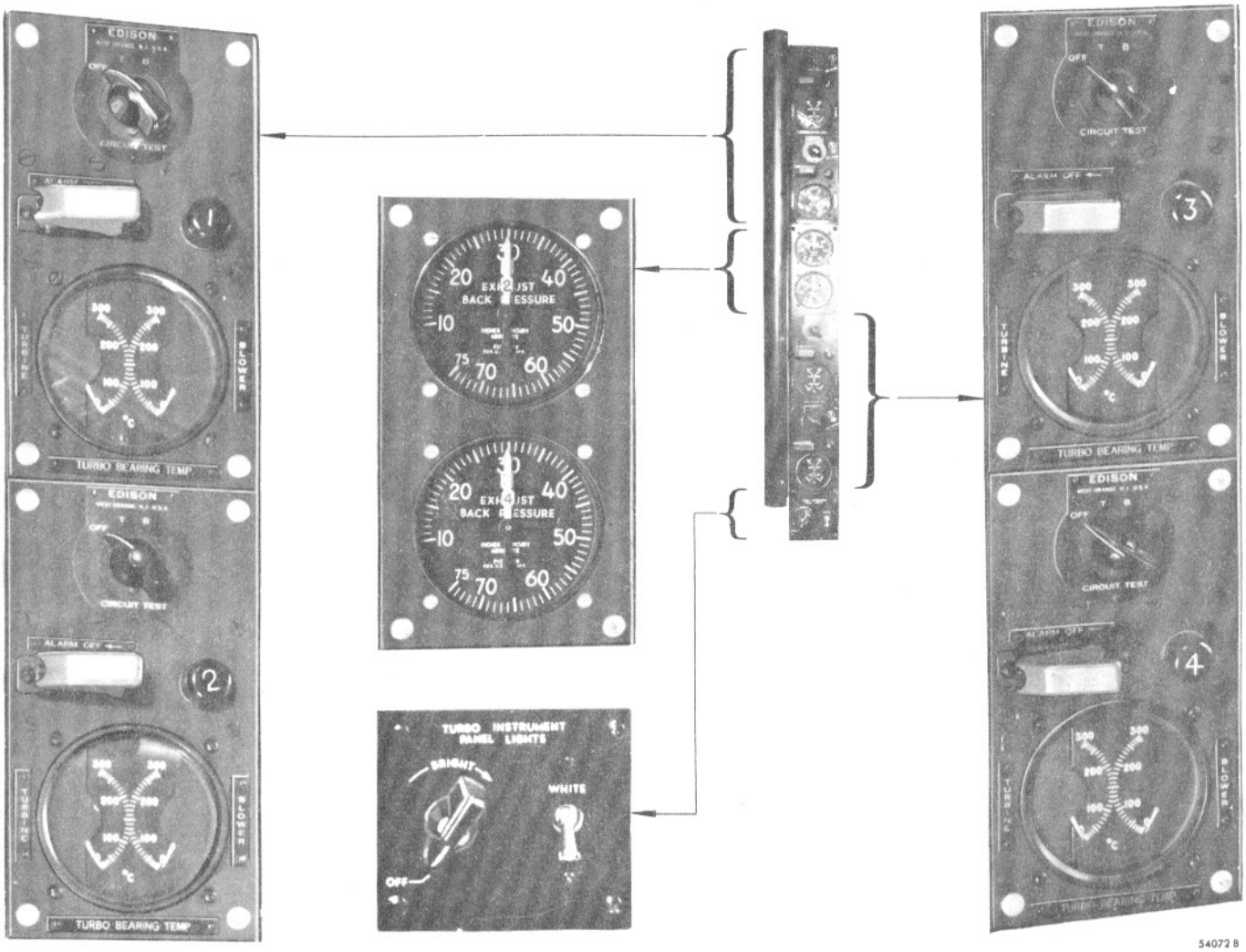



*Figure 1-8. Turbo Bearing Temperature and Alarm Panel*

WATER INJECTION SYSTEM. The water injection (Anti-Detonant Injection) system has two 30-gallon supply tanks; each tank supplies the two engines on its side of the airplane. The supply has a duration of approximately 8 minutes at 3500 BHP. An "ON--OFF" pump switch, four ADI override switches, and four pressure lights are on the forward end of the engine control stand. An ADI quantity indicator is on the lower right side of the pilots' instrument panel. Two pump control circuit breakers are on the overhead electrical panel, and two pump power circuit breakers are on the main circuit breaker panel.

WATER INJECTION SYSTEM CONTROLS. An "ADI PUMP" switch, on the engine control stand (figure 1-4), controls water injection pumps which supply water under pressure to the ADI shutoff valves. When the four "ADI VALVE" switches, on the engine control stand (figure 1-4), are placed in the "AUTO" position, the shutoff valves are automatically controlled by a manifold pressure switch on each engine. The manifold pressure switches automatically open the shutoff valves when the throttles are advanced to 45 inches of MAP or above. Water is then supplied to the water regulators, carburetor derichment valves, water pressure switches (indicator lights), and subsequently into the engines. The manifold pressure switches automatically close the ADI valves when the manifold pressure is reduced to approximately 41 inches of MAP. The "OPEN" position of the "ADI VALVE" switches provides a means of manually opening the shutoff valves in event of manifold pressure switch malfunction. Four water pressure lights on the engine control stand illuminate when the pumps are turned on and will go out when sufficient water pressure is in the line between the regulator and the engine. Four "CLOSE ADI VALVE" switches on the fire control panel shut off the fluid flow when placed in the "FIRE" position. The circuit breakers for the ADI controls are on the overhead electrical panel.

ENGINE INSTRUMENTS. The engine instruments on the pilots' instrument panel consist of: four torquemeters, two dual-indicating tachometers, and two dual-indicating instruments for the manifold pressure, cylinder head temperature, fuel flow, fuel pressure, oil pressure, oil temperature, and carburetor air temperature. Four dual-indicating turbo bearing temperature and two dual-indicating exhaust back-pressure indicators are mounted in the turbo bearing temperature alarm panel on the forward side of the navigation station bulkhead.

The torquemeter, fuel flow, fuel pressure, oil pressure, and exhaust back-pressure instruments are of the alternating-current type and have replaceable fuses on the AC power shield. The cylinder head, oil, carburetor air, and turbo bearing temperature indicators are of the direct-current type and have circuit breakers on the overhead electrical panel. The manifold pressure indicators are direct pressure reading instruments. The cylinder head temperature indicators are connected to one of two resistance bulbs on each engine (cylinder B-2 or A-4) through a selector switch on the engine control stand. This allows selection of the desired resistance bulb for cylinder head temperature indication.

PROPELLERS.

Each engine drives a four-bladed, Curtiss Electric propeller with full feathering and reverse pitch features. The propeller reduction gearing ratio is .375 to 1.

PROPELLER PITCH ANGLES. The propeller blade pitch settings are:

| | |
|---|---|
| Low pitch blade setting | $17.3^{o}$ |
| High pitch blade setting | $57.3^{o}$ |
| Feather blade setting | $84.7^{o}$ |
| Reverse blade setting | $-20.3^{o}$ |

PROPELLER CONTROLS. The propeller controls consist of the master synchronizer lever, four propeller selector levers, the auto-feathering system, and the reverse pitch throttle lock on the engine control stand (figure 1-4). Two dual-indicating tachometers and a master synchronizer motor warning light are on the pilots' instrument panel. Circuit breakers for the propeller controls are in the propeller control group on the overhead electrical panel. Circuit breakers for propeller power are on the inboard side of the forward power panel and on the propeller feather relay panel.

MASTER SYNCHRONIZER LEVER. The master synchronizer lever, when moved from the full "DECREASE RPM" position with the propeller selector levers in the "AUTO" positions, energizes the master synchronizer motor. The master synchronizer motor then provides synchronized constant speed governing of the engines through the complete operating range and simultaneous selection of identical RPM of all propellers. The RPM is determined by the relative position of the master synchronizer lever in the graduated scale between "INCREASE RPM" and "DECREASE RPM" positions (see figure 1-4). The master synchronizer motor warning light on the pilots' instrument panel will illuminate if the master motor fails, or during unsynchronized propeller operation. A rapid movement of the master synchronizer lever toward the "INCREASE RPM" position will cause momentary illumination of the warning light.

PROPELLER SELECTOR CONTROLS. The four individual selector levers provide a means of selecting automatic or manual operation of each propeller. The selector levers have five positions "AUTO," "INC. RPM." "FIXED PITCH," "DEC. RPM," and "FEATHER." The levers are spring-loaded to the "FIXED PITCH" position in the "INC. RPM" and "DEC. RPM" positions. Detents indicate the "AUTO" positions. The "FEATHER" positions lock into place. The push buttons on the base of the lever quadrants release the lock catch permitting the lever to move into or out of the "FEATHER" position.

PROPELLER FEATHERING CONTROLS. The propellers may be feathered by placing the selector levers in the "FEATHER" position, by actuating the "FEATHER PROP" switch in the fire control section of the overhead electrical panel, or by holding the selector levers in the "DEC. RPM" positions. The latter method, however, requires approximately three times longer.

540568

PROPELLER AUTO-FEATHERING. The auto-feathering system consists of an auto-feather arming switch, a green system-armed indicator light, two guarded auto-feather test switches, and four red auto-feather indicator lights on the engine control stand; and an interconnected throttle switch, blocking relay and the normal feathering system. The auto-feathering system is designed to operate on take-off and climb. The system is placed in operation by placing the arming switch in the "TAKE-OFF & CLIMB" position, which will energize the system and illuminate the indicator light. The throttle switch is incorporated in the throttles to allow auto-feathering at only take-off and climb power settings. The blocking relay will allow only one propeller to auto-feather on take-off. Auto-feathering of a propeller is indicated by the green system-armed indicator light going out and the red auto-feather indicator light illuminating for the propeller being feathered.

REVERSE PITCH THROTTLE LOCK. The throttles are prevented from entering the reverse pitch range by oleo-operated solenoid locks. A red flag forward of the throttles on the engine control stand comes into view when the airplane leaves the ground. The flag is marked "LOCKED" and indicates the reverse pitch lock is on and reverse pitch is not possible. The flag disappears when any one of the landing gears contacts the ground, thus indicating the solenoid-operated lock is unlocked and reverse pitch is possible. If the flag does not disappear when ground contact is made, the flag can be pushed down to release the lock.

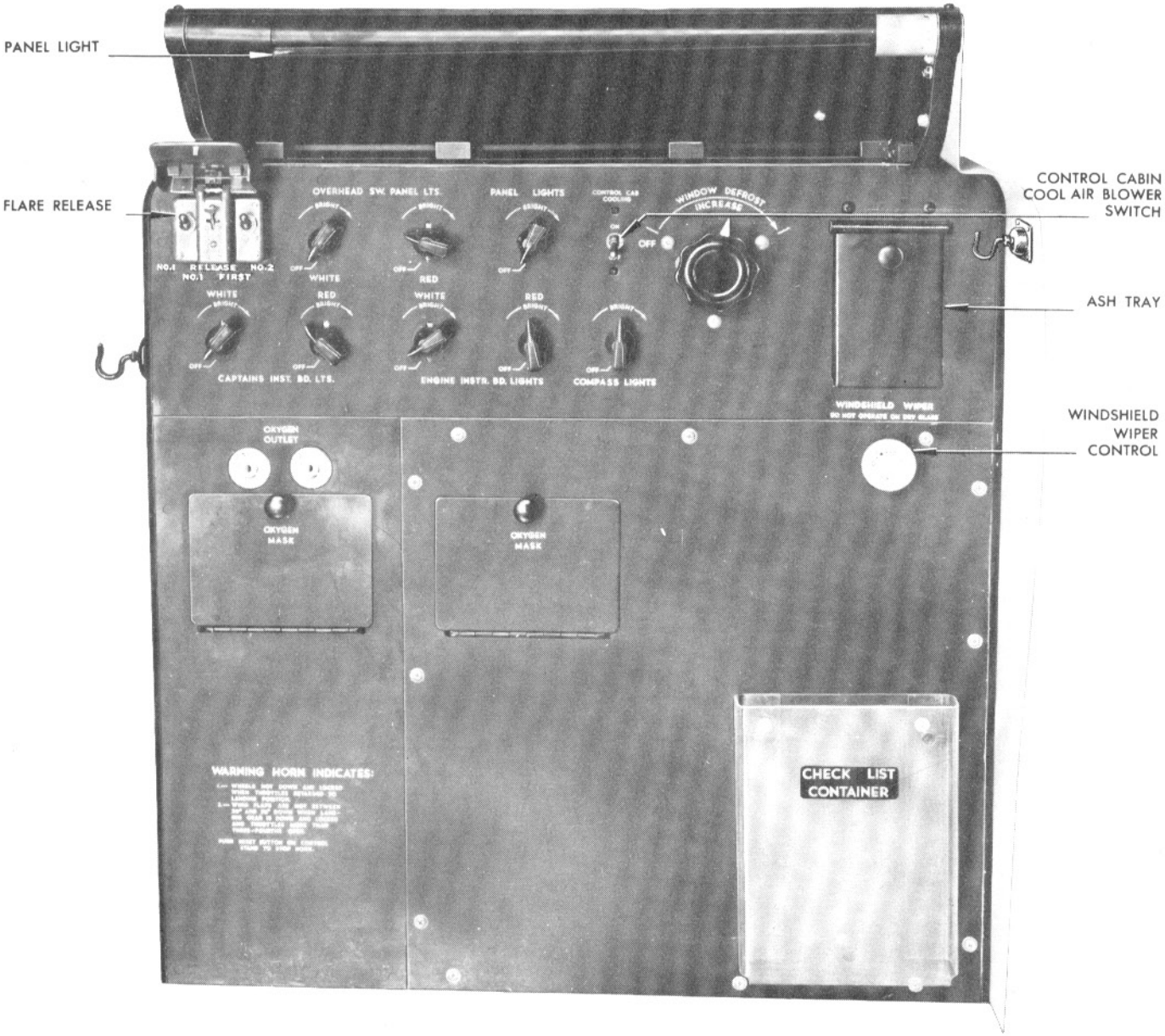



*Figure 1-9. Pilot's Auxiliary Panel*

54035B

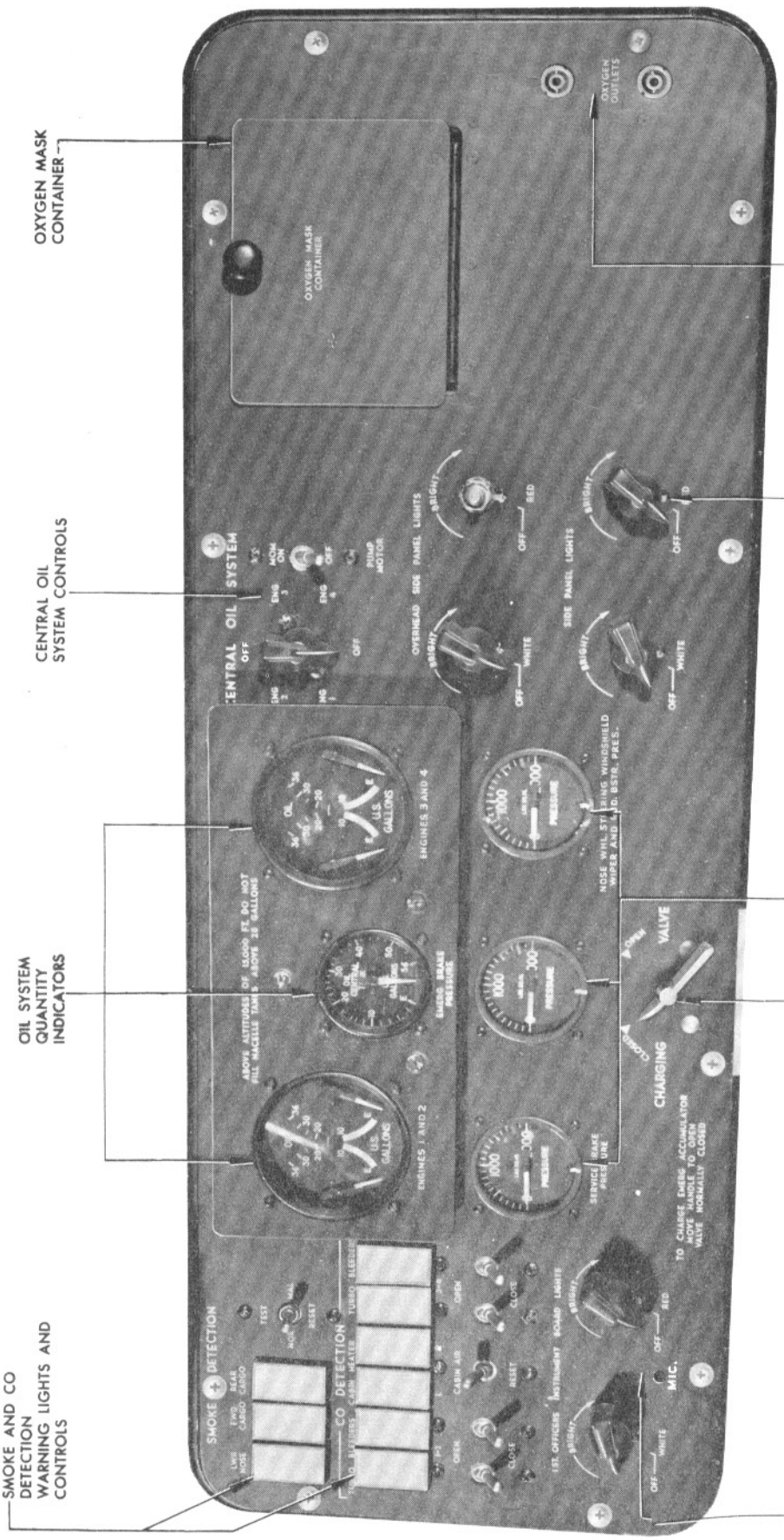



*Figure 1-10. Copilot's Auxiliary Panel*

OIL SYSTEM.

The Stratocruiser oil system combines two separate systems. One is the central oil system and the other is the engine oil system.

CENTRAL OIL SYSTEM. This system, as shown in figure 1-11, has a central tank in the lower nose compartment with a capacity of 56 U.S. gallons. This supply is used to replenish each engine oil tank as needed. The oil is transferred by an electric pump which has a normal pumping capacity of 6 gallons per minute. The oil is directed to the desired engine tank by a five-position selector valve.

CENTRAL OIL SYSTEM CONTROLS. The transfer pump is controlled by a "MOM ON--OFF" switch which is spring-loaded to the "OFF" position. The selector valve is controlled by a rotary switch. Both of these switches are on the copilot's auxiliary panel. Circuit breakers for the central oil system are on the overhead electrical and forward power panels.

ENGINE OIL SYSTEM. Each engine has an individual oil system consisting of a 35-gallon supply tank; distribution lines to the engine; distribution lines to the tank from the engine through two oil coolers; drain cocks; and vent lines.

OIL COOLER FLAP CONTROLS. The oil cooler flaps for each engine are controlled by an "OPEN--AUTO--CLOSE" switch on the overhead instrument panel. The four switches are spring-loaded to the neutral or off position from "OPEN" and "CLOSE." In the "AUTO" position the oil coolers automatically maintain the oil temperature within a range of $77^{\circ}$ to $85^{\circ}$C. If extreme operating conditions exist, or failure of the automatic control causes abnormal oil temperatures, the oil cooler flaps can be operated by the manual "OPEN" and "CLOSE" positions of the switch. Approximately 15 seconds are required to fully open or close the oil cooler flaps when the manual switch positions are used. Circuit breakers for the controls are on the overhead electrical panel.

OIL SYSTEM FIRE SHUTOFF CONTROLS. The oil shutoff valve for each engine is controlled by a two-position switch in the engine gang fire switches on the overhead electrical panel. When the switch is placed in the "FIRE" position, the oil valve closes. Circuit breakers for the controls are on the overhead electrical panel.

OIL DILUTION CONTROLS. Oil dilution is controlled by four oil dilution valve "OPEN--CLOSED" selector switches and a master "ON--OFF" switch on the overhead instrument panel. The master switch is spring-loaded to the "OFF" position.

Oil dilution is accomplished by placing the desired selector valve switches in the "OPEN" position and holding the master switch "ON." A circuit breaker for the system is on the overhead electrical panel.

OIL SYSTEM INSTRUMENTS. Dual oil pressure indicators and dual oil temperature indicators are on the pilots' instrument panel. Two dual engine oil tank quantity indicators and a central oil tank quantity indicator are on the copilot's auxiliary panel. Circuit breakers for the oil pressure indicators are on the AC power shield. Circuit breakers for the oil quantity and oil temperature indicators are on the overhead electrical panel.

NOTE

Oil foaming in flight will cause the nacelle oil tank quantity indicators to read as much as 5 gallons high. The degree of foaming will vary with RPM and altitude, being least at low RPM and low altitude.

OIL PRESSURE WARNING LIGHTS. A warning light between the oil pressure gages on the pilots' instrument panel will illuminate when the oil pressure falls below 60 PSI. A circuit breaker is on the overhead electrical panel.

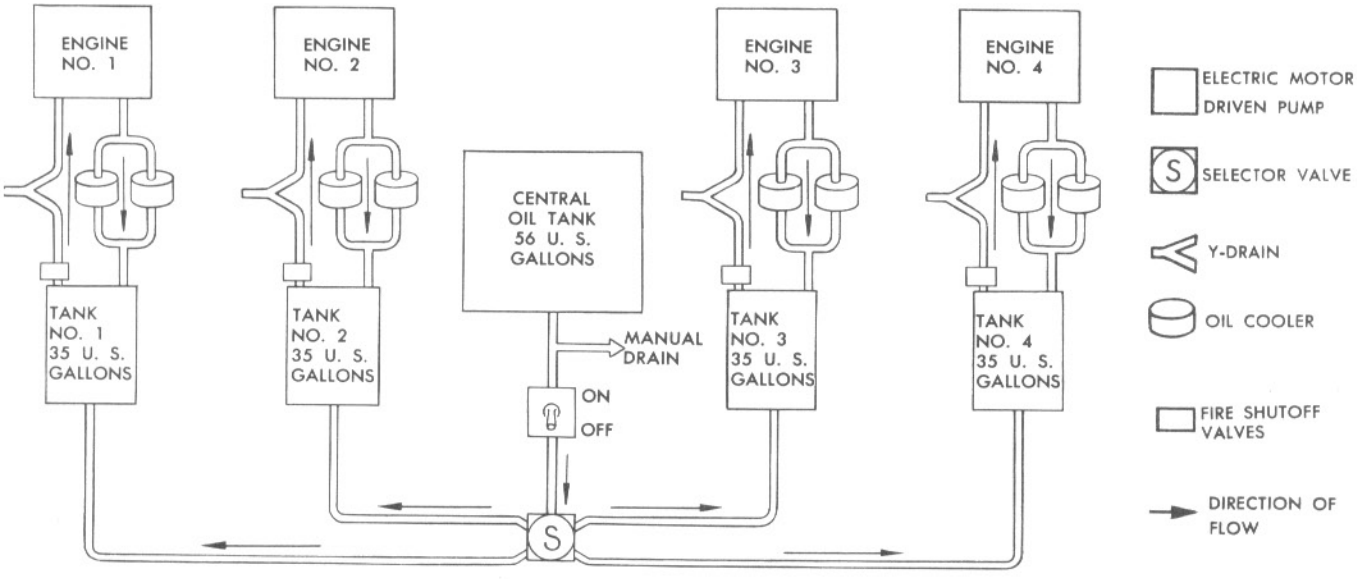



*Figure 1-11. Oil System Diagram*

54039

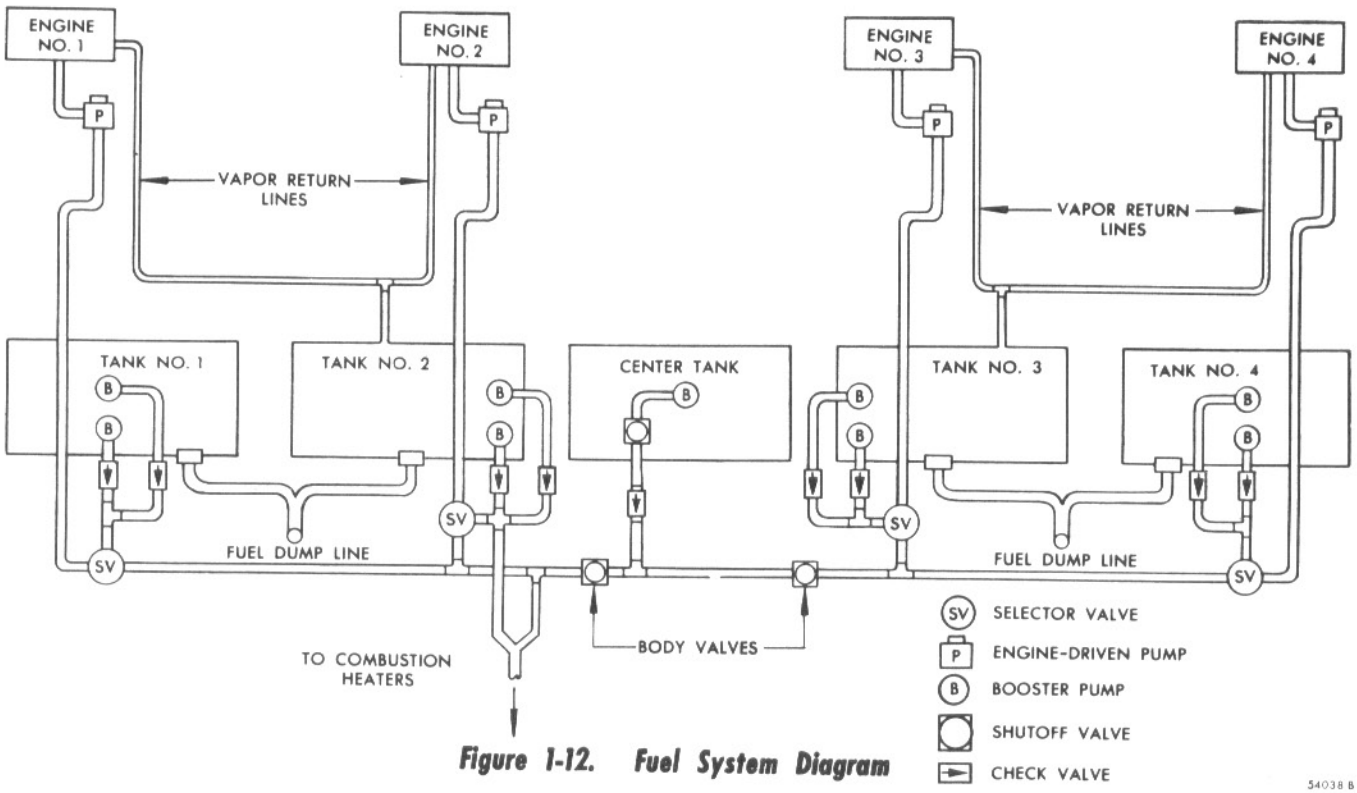



***Figure 1-12. Fuel System Diagram***

FUEL SYSTEM.

The Stratocruiser airplanes have a manifold fuel system, arranged as shown in figure 1-12, allowing fuel to be supplied to any engine from any one or more tank

Each outboard fuel tank consists of twelve interconnected cells with a capacity of 10,620 pounds (1770 gallons) of fuel. Each inboard tank consists of four interconnected cells, with a capacity of 9120 pounds (1520 gallons) of fuel. The center tank, located in the center wing section, has three interconnected cells with a capacity of 7260 pounds (1210 gallons) of fuel. The total fuel capacity is 46,740 pounds (7790 gallons). The total available fuel is shown on the individual fuel tank quantity indicators.

FUEL SELECTOR CONTROLS. The fuel tank selector valves are controlled by system marked switches on the overhead instrument panel. The selector switches for the main fuel tanks have five positions which permit the following combinations:

Fuel from the tank to the engine.
Fuel from the manifold to the engine.
Fuel from the manifold and tank to the engine.
Fuel from the tank to the manifold.
Fuel shutoff.

The manifold line has two body shutoff valves which are controlled by two "OPEN--CLOSE" switches. When both body valves are closed, the center tank is isolated from the engines and fuel is prevented from entering the center wing tank manifold line. When either of the valves are in the "OPEN" position, fuel may be drawn from the center tank to that side of the airplane. When both of the body valves are "OPEN," fuel may be supplied from a wing tank through the manifold line to the opposite side of the airplane or fuel may be simultaneously supplied by the center tank through the manifold line to both sides of the airplane. Center tank operation is controlled by a single "PUMP AND VALVE" switch which opens the center tank shutoff valve and energizes the booster pump. Circuit breakers for the fuel system controls are on the overhead electrical panel.

FUEL BOOSTER PUMP CONTROLS. Each of the two submerged booster pumps in each main tank is controlled by a three-position, "HIGH--OFF--NORMAL" switch below the fuel selector switches. The pumps are located in each main tank in a manner so as to minimize the amount of unavailable fuel in extreme flight attitudes. The single center tank booster pump is turned "ON" or "OFF" by the center tank "PUMP AND VALVE" switch. The speed of the pump is controlled by a two-position "HIGH--NORMAL" switch. With the engines not running, the booster pump pressure will be approximately 15 PSI when the booster pump switches are on "NORMAL" and 28 PSI on "HIGH." Circuit breakers for the booster pumps and booster pump controls are on the main circuit breaker and overhead electrical panels.

FUEL SYSTEM INSTRUMENTS. Individual fuel tank quantity indicators are directly below each fuel selector switch on the fuel control panel. Dual-indicating fuel pressure and fuel flow indicators are on the pilots' instrument panel. Circuit breakers for the fuel system instruments are on the AC power shield.

FUEL SYSTEM WARNING LIGHTS. A red warning light, between the fuel pressure indicators on the pilots' instrument panel, illuminates when the fuel pressure falls below 23 PSI. Four warning lights, one below each fuel selector switch, illuminate to indicate incorrect positioning of the selector valve for switch position.

FUEL SYSTEM FIRE SHUTOFF CONTROLS. A fuel selector valve for each tank is controlled by a switch marked "CLOSE FUEL VALVE," on the overhead electrical panel in the group of emergency fire switches. These switches close each fuel tank selector valve and the center tank booster pump and shutoff valve when the switches are placed in "FIRE." The switches must be in the "NORMAL" position for selector valve operation.

FUEL DUMP CONTROLS. A fuel dump system is controlled by four "DUMP--CLOSE" switches under a safety cover on the overhead instrument panel. The automatic extending dump chute in the lower rear section of each inboard nacelle is connected to both the outboard and inboard tank dump lines. Fuel from one tank will jettison at an approximate rate of 810 pounds (135 gallons) per minute. Fuel from two tanks, using the same chute, will jettison at an approximate rate of 1080 pounds (180 gallons) per minute. Fuel dumping will jettison all but 1320 pounds (220 gallons) in each outboard tank and 1620 pounds (270 gallons) in each inboard tank. Circuit breakers for the fuel dump controls are on the overhead electrical panel.

WARNING

Do not jettison fuel while wing flaps or landing gear are in down position.

FUEL VAPOR RETURN LINES. The fuel vapors from engines No. 1 and No. 2 are vented back to wing tank No. 2 and the vapors from engines No. 3 and No. 4 are vented back to wing tank No. 3.

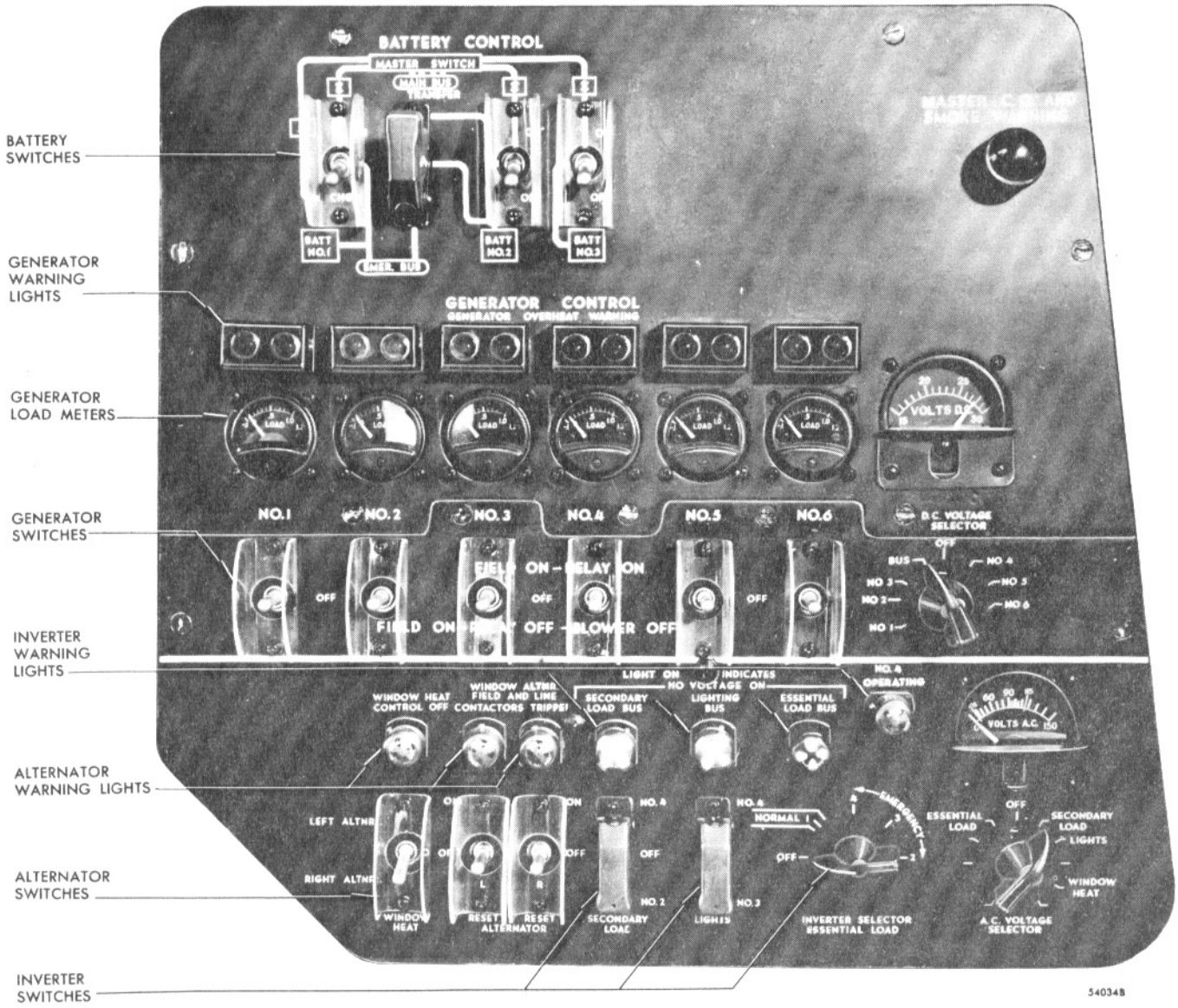



*Figure 1-13. Electrical Power Panel*

ELECTRICAL SYSTEM.

The Stratocruiser has a 28-volt, single-wire, ground-return, direct current electrical system. Power is supplied by six engine-driven generators (one on each outboard engine and two on each inboard engine) and three batteries. Batteries No. 1 and No. 2 are in the lower nose compartment and accessible through the floor of the pilots' dais. Battery No. 3 is under battery No. 2 and is accessible only from the lower nose compartment. The airplane has two alternating current systems: one is a 115-volt, 400-cycle, inverter powered system supplied by four direct current powered inverters; the other is a 120-volt, three-phase, variable frequency system supplied by two engine-driven alternators (one on each outboard engine). All electrical power control switches, instruments, and warning lights are on the electrical power control panel on the right side of the control cabin ceiling above the copilot (see figures 1-13, 1-14, and 1-15).

MASTER SWITCH. The master switch on the overhead instrument panel completes the control circuits for the batteries, generators, inverters, and alternators. The master switch must be "ON" to get power to all buses except the direct current emergency bus.

GENERATOR CONTROLS. Six three-position switches control the generators. When the switches are in the "FIELD ON--RELAY ON" position, the generators deliver power to the direct current system. The "FIELD ON--RELAY OFF, BLOWERS OFF" position provides a generator output no-load voltage check position. The "OFF" position cuts the field current and disconnects the generator from the direct current bus. Six load meters, one above each generator switch, provide generator load indication. Six warning lights above the load meters will illuminate respectively to indicate generator overheat condition. A "DC VOLTAGE SELECTOR" switch and a voltmeter adjacent to the control switches provide a means of checking the generator and the bus voltages.

BATTERY SWITCHES. The batteries are controlled by three battery switches and a transfer switch. Battery No. 1, which is connected to the emergency bus at all times, is controlled by an "ON--CHG" switch. The switch should remain in the "CHG" (off) position at all times except that during starting or during emergency operation the switch should be placed "ON." Battery No. 2 is controlled by both an "ON--OFF" switch and a "MAIN BUS--EMER. BUS" transfer switch that is guarded to the "MAIN BUS" position. The transfer switch should remain in the "MAIN BUS" position except that during emergency operation it should be placed to "EMER. BUS." Battery No. 3 supplies only the main bus when the switch is in the "ON" position. Batteries No. 2 and No. 3 are automatically charged when their switches are in the "ON" position. Battery No. 1 is charged when the switch is in either the "CHG" or "ON" position.

EMERGENCY BUS. The emergency bus, or circuit, provides an emergency source of direct current power for operation of the emergency lights, flares, and some radio equipment, in event of normal power failure. Power is supplied to the bus at all times by battery No. 1 and by battery No. 2 when the guarded transfer switch is in the "EMER. BUS" position. It is not necessary for the master switch to be "ON" when operating on emergency power. Batteries No. 1 and No. 2 are above the normal height of water expected after a ditching; therefore, the power in these batteries may be used to operate a radio transmitter and receiver for emergency calls.

INVERTERS. Four inverters in the lower nose compartment supply the inverter powered alternating current distribution system. Three of the inverters supply the normal alternating current distribution system comprised of three busses: the essential AC bus, the secondary AC bus, and the lighting AC bus. The fourth inverter is a stand-by inverter and can be used to supply power to any of the normal AC busses.

Power for the essential bus is normally provided by the No. 1 inverter. The essential bus supplies alternating current for operation of the following: right and left ADF radios; supercharger controls; the automatic pilot system; the torquemeters; the driftmeters; and the indicators for fuel pressure, oil pressure, cowl flaps, intercooler flaps, wing flaps, exhaust back-pressure, cabin air flow, and fuel flow. The essential bus also normally supplies the pilot's gyro horizon and turn and bank indicators.

Power for the secondary bus is normally provided by inverter No. 2. The secondary bus supplies alternating current for operation of the following: high range radio altimeter, Loran radio, combustion heater ignition, and fuel quantity indicators. The secondary bus also normally supplies the copilot's gyro horizon, turn and bank indicator, and the gyrosyn compass.

Power for the lighting bus is normally supplied by inverter No. 3. The lighting bus load consists of the fluorescent lights.

In the event of inverter failure of inverter No. 1 when supplying the essential bus, an automatic change-over system transfers the load to inverter No. 4, which is a stand-by inverter. If the automatic change-over should fail to function, the essential load can be transferred manually to any one of the inverters. In the event of failure, the load of either No. 2 or No. 3 inverter can be manually transferred to No. 4 inverter. The automatic change-over system for the essential load will override the manual selection should the failure of No. 1 inverter be subsequent to the failure of either No. 2 or No. 3 inverter. A test switch for the automatic change-over system is installed in the side of the AC power shield.

INVERTER CONTROL SWITCHES. A five-position "INVERTER SELECTOR, ESSENTIAL LOAD" switch selects the inverter to supply power to the essential bus. A guarded three-position "SECONDARY LOAD" switch selects either No. 2 or No. 4 inverter to supply power to the secondary bus. A guarded three-position "LIGHTS" selector switch selects either No. 3 or No. 4 inverter to supply power to the lighting bus. The selector switches, four inverter warning lights, an

alternating current voltmeter, and an AC voltage selector are located on the electrical power control panel. Three of the warning lights indicate no voltage on the three buses; the fourth light indicates when inverter No. 4 is operating. A warning light on the pilots' instrument panel indicates when there is no voltage on the essential bus.

FLIGHT INSTRUMENT POWER SELECTOR SWITCHES. Three flight instrument selector switches are on the pilots' instrument panel. The "CAPTAINS FLIGHT INSTR." switch selects either the "SEC. AC BUS" or the "ESS. AC BUS" (normal) for power supply to the pilot's turn and bank indicator and the gyro horizon. The two "1ST OFFICERS FLIGHT INSTR." switches select either the "ESS. AC BUS" or the "SEC. AC BUS" (normal) for power supply to the copilot's turn and bank indicator, gyro horizon, and the gyrosyn compass.

ALTERNATORS. Two engine-driven alternators (one on each outboard engine) supply alternating current power for Nesa windshield deicing. A switch on the electrical power control panel selects one of the alternators to supply the windows. A warning light above the switch will illuminate to indicate when the window heat control is off. Two switches on the electrical power control panel turn the alternators "ON" or "OFF." The "RESET" position of the switch resets the control circuit relay after the field and line contactors have tripped. Two warning lights above the switches indicate that the field and line contactors have tripped due to a short or the failure of an alternator or when the direct current power is turned off.

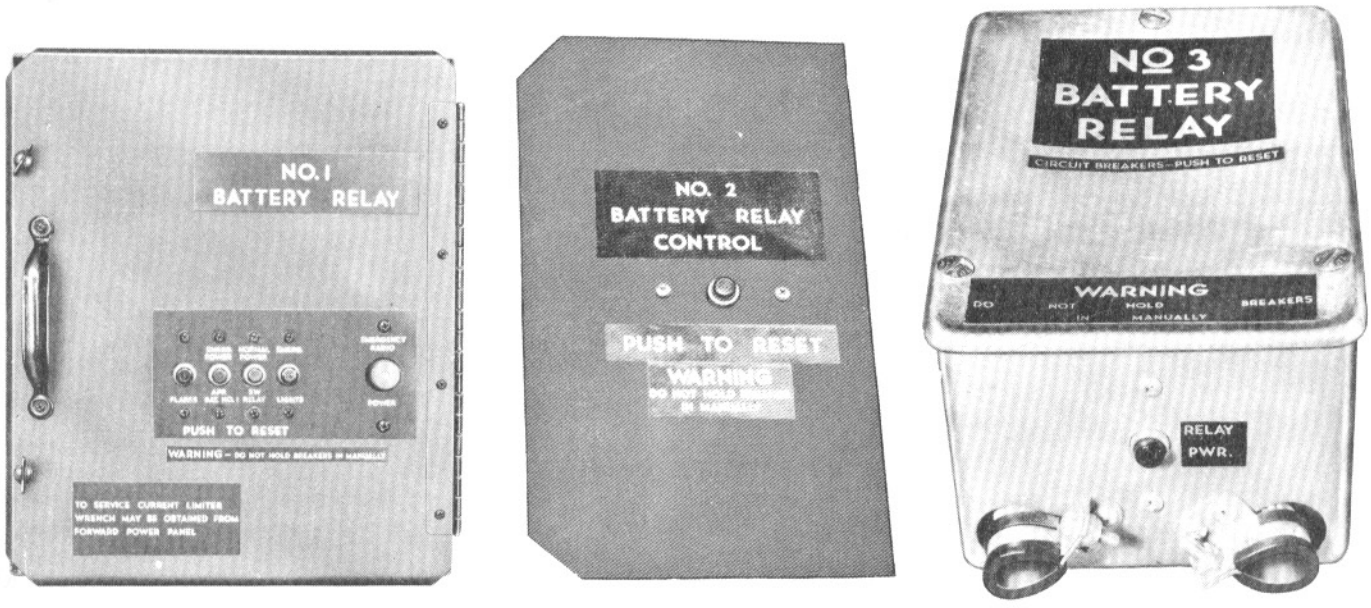
VOLTMETERS AND LOADMETERS. A direct current voltmeter with an eight-position rotary selector switch permits voltage reading for any one of the generators or the bus circuit. An alternating current voltmeter with a ten-position rotary selector switch permits voltage reading for the essential, secondary, and lighting loads and for each phase of the window deicing loads. Six load meters (figure 1-13) are provided to indicate generator load. Load is indicated in per cent of total load, 1.0 being 100% load.

CIRCUIT BREAKERS. Push-to-reset circuit breakers and fuses protect the individual electrical circuits from overloads. The circuit breakers and fuses are located on the overhead electrical panel and various power panels, as shown in figures 1-5, 1-14, and 1-15.

EXTERNAL RECEPTACLES. To provide a means of connecting an external power source for ground operations, receptacles are provided on the left side of the fuselage forward of the wing for direct current and in the nose wheel well for alternating current.

ELECTRIC OUTLETS. Seven AC and seven DC electric shaver outlets, two AC vacuum cleaner outlets, and a DC motion picture projector outlet are provided in the airplane. The electric shaver AC outlets are supplied by an electric shaver converter. The converter receives its power from the direct current bus and is protected by a circuit breaker on the forward power panel. The converter operates only when a shaver is plugged into one of the seven shaver outlets. The two vacuum cleaner outlets, one in the control cabin and the other in passenger cabin at the stairwell, receive power from the AC external power receptacle in the nose wheel well. These outlets may be used during ground operation. The motion picture projector outlet is installed at the cabin attendant's station. A circuit breaker is on the main circuit breaker panel.

DOOR WARNING. A warning light on the overhead instrument panel indicates when any one or all of the entry doors are not closed, latched, and locked. The circuit breaker is on the overhead electrical panel.

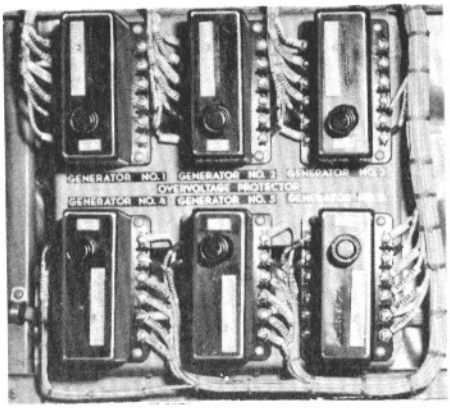



NO. 1 BATTERY RELAY SHIELD NO. 2 BATTERY RELAY SHIELD NO. 3 BATTERY RELAY SHIELD

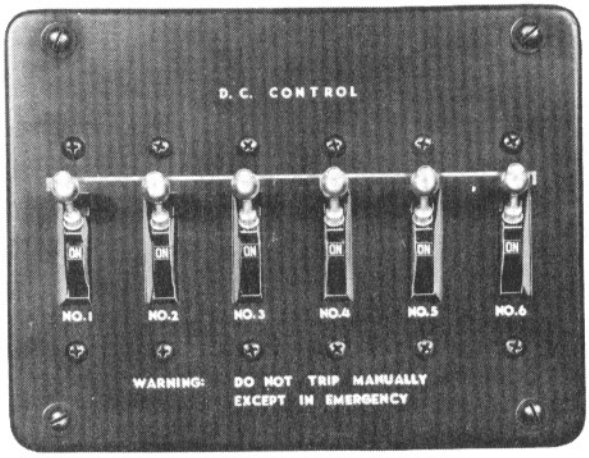
54040a

*Figure 1-14 (Sheet 1 of 4 Sheets). Circuit Breaker Panels*

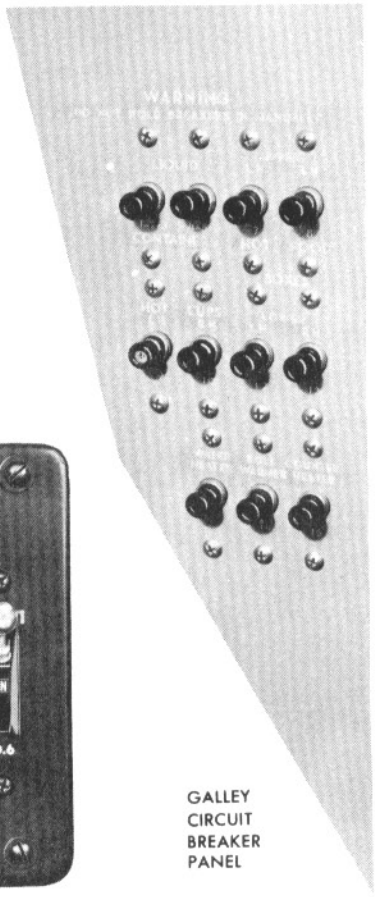

AFT POWER PANEL




OVERVOLTAGE RELAYS

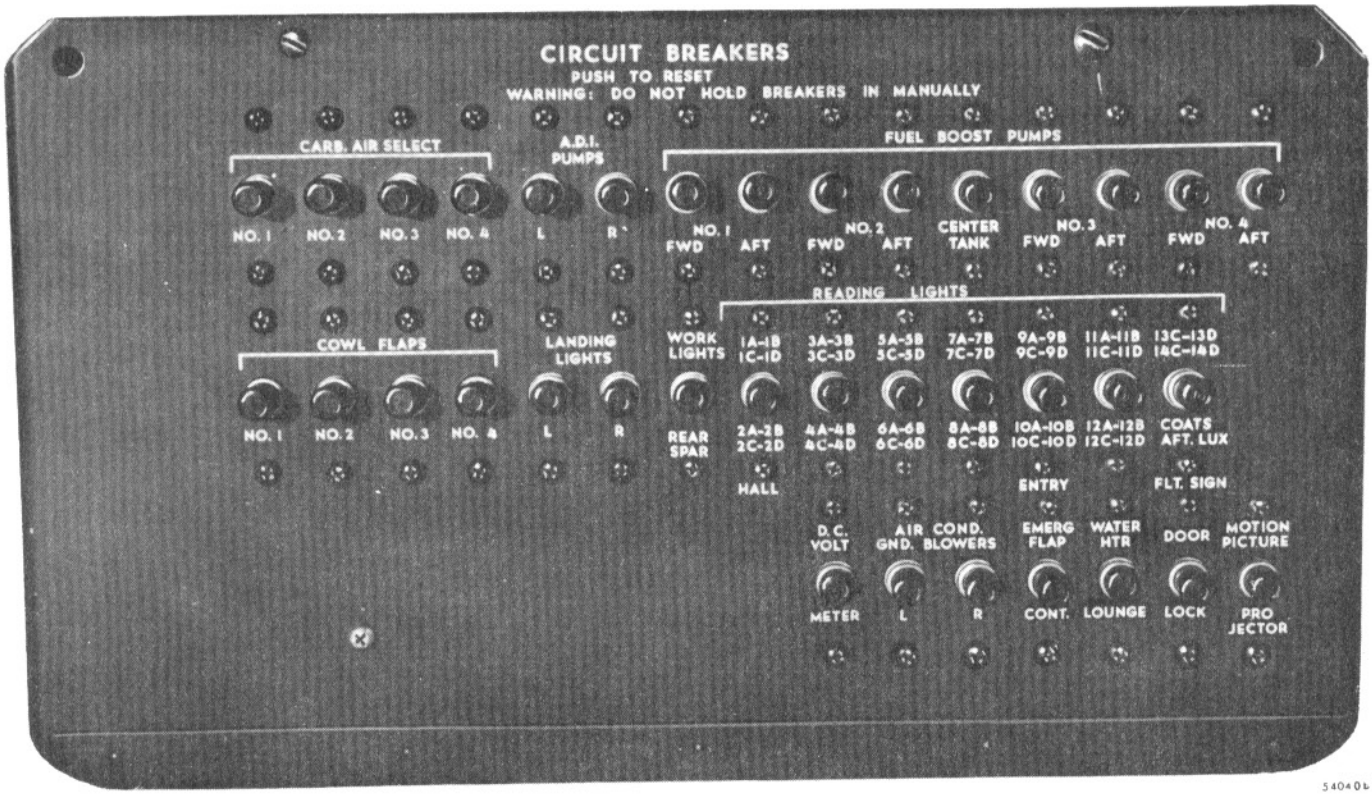



GENERATOR FIELD CIRCUIT BREAKER PANEL



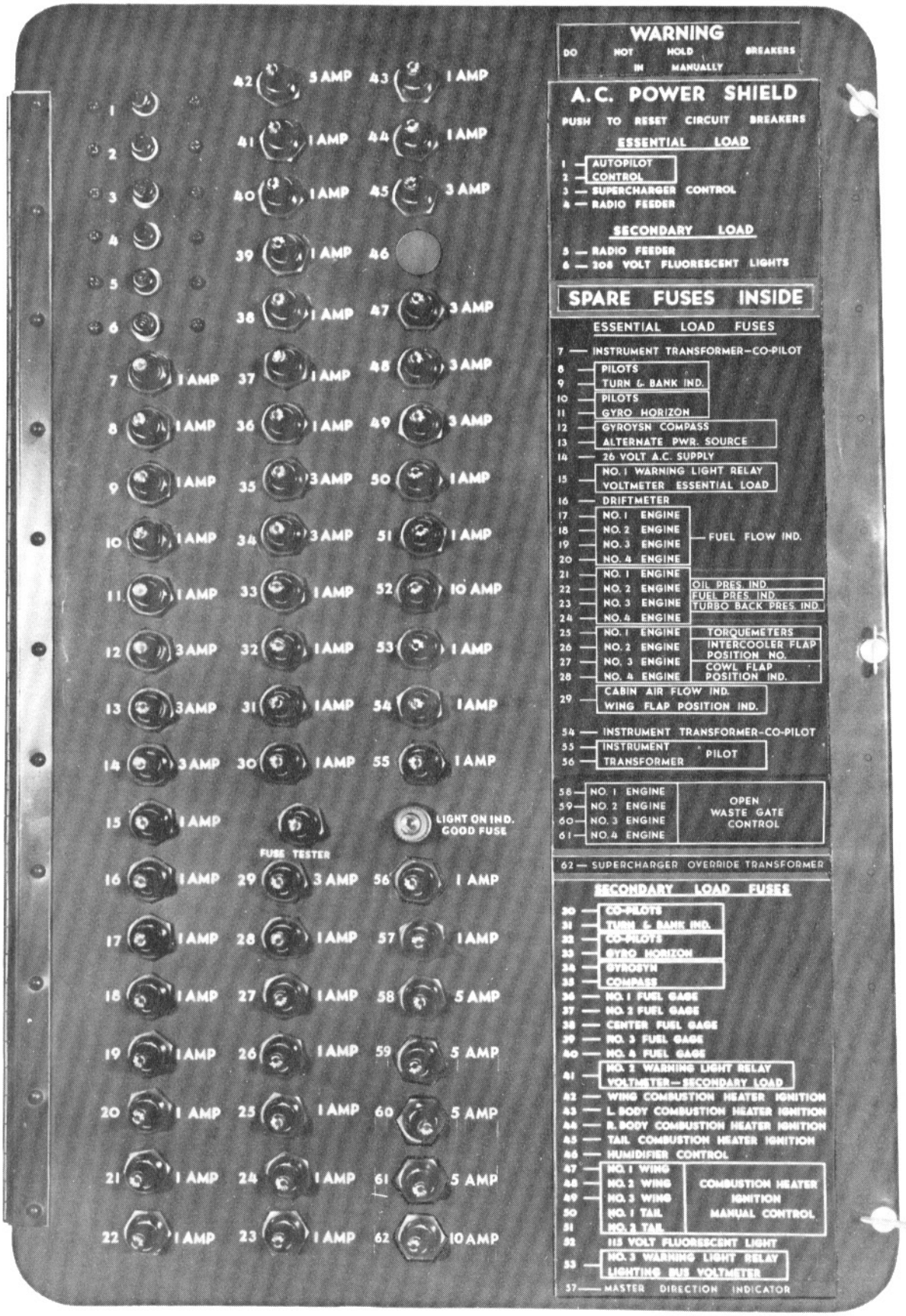
GALLEY CIRCUIT BREAKER PANEL

MAIN CIRCUIT BREAKER PANEL




5404048

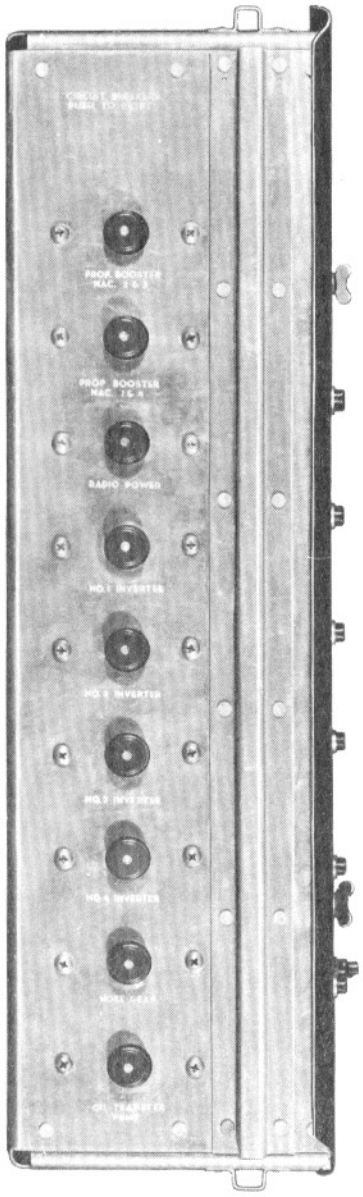
***Figure 1-14 (Sheet 2 of 4 Sheets). Circuit Breaker Panels***



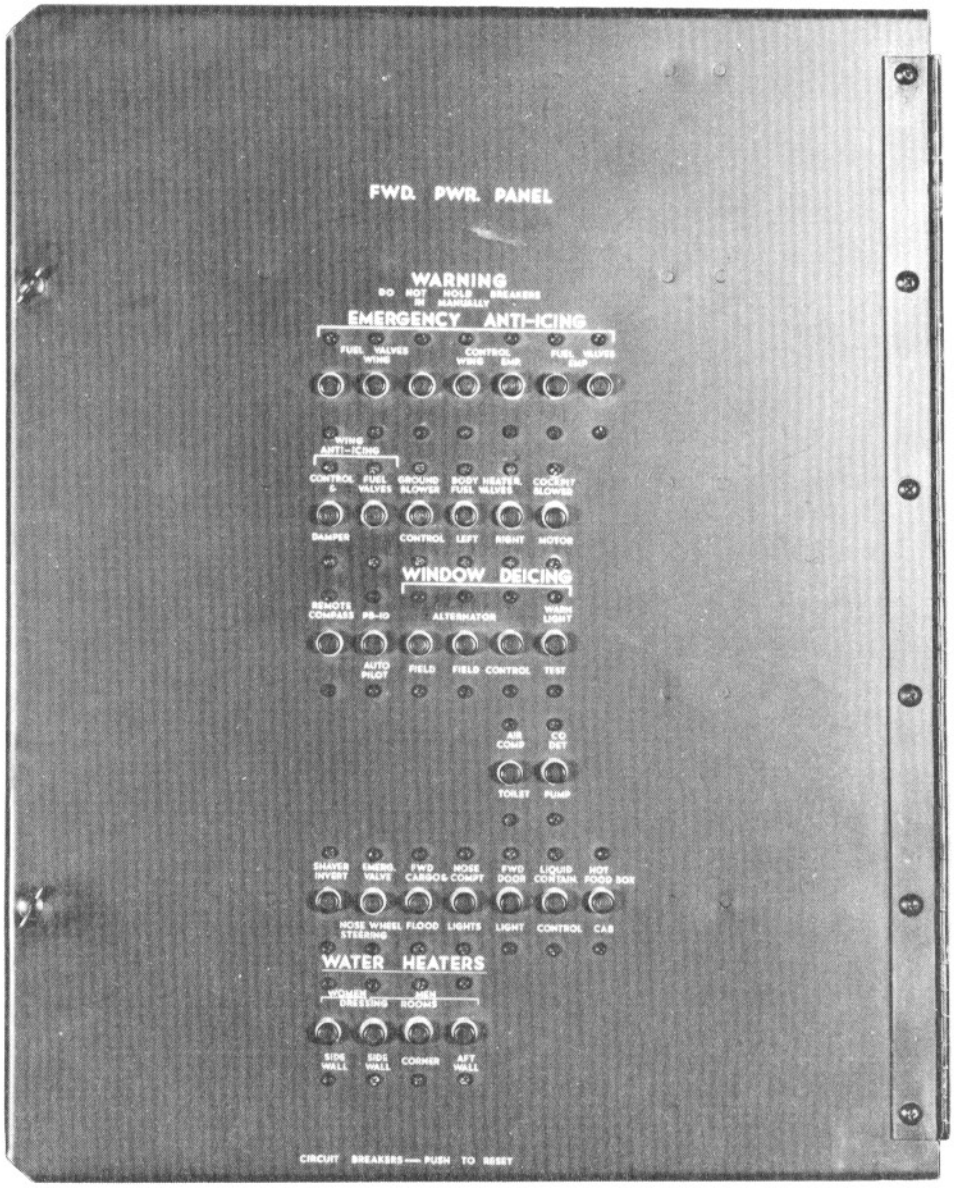

A. C. POWER SHIELD

54040 c B

***Figure 1-14 (Sheet 3 of 4 Sheets). Circuit Breaker Panels***

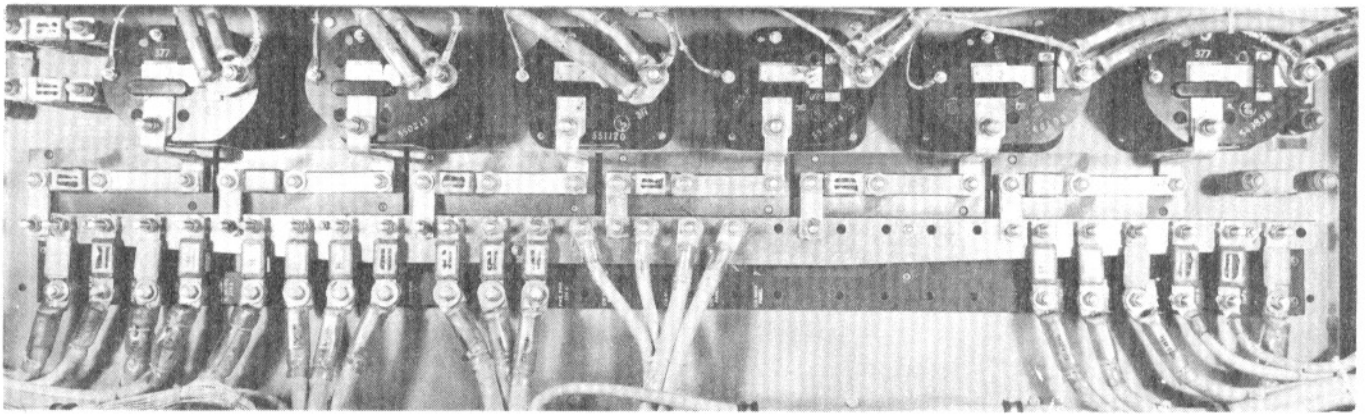


RIGHT SIDE OF
FORWARD POWER PANEL



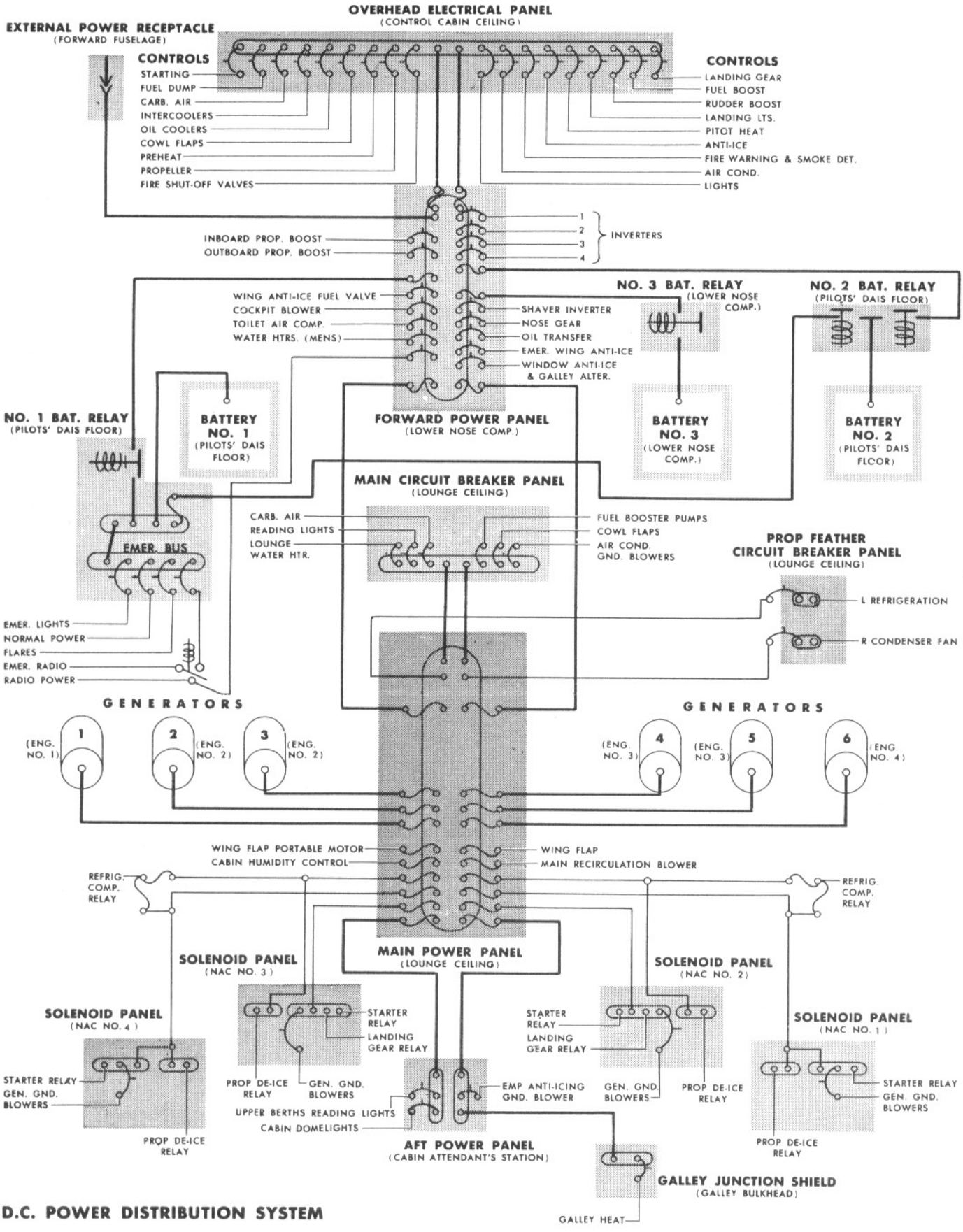

FORWARD POWER PANEL

MAIN POWER PANEL



54040d

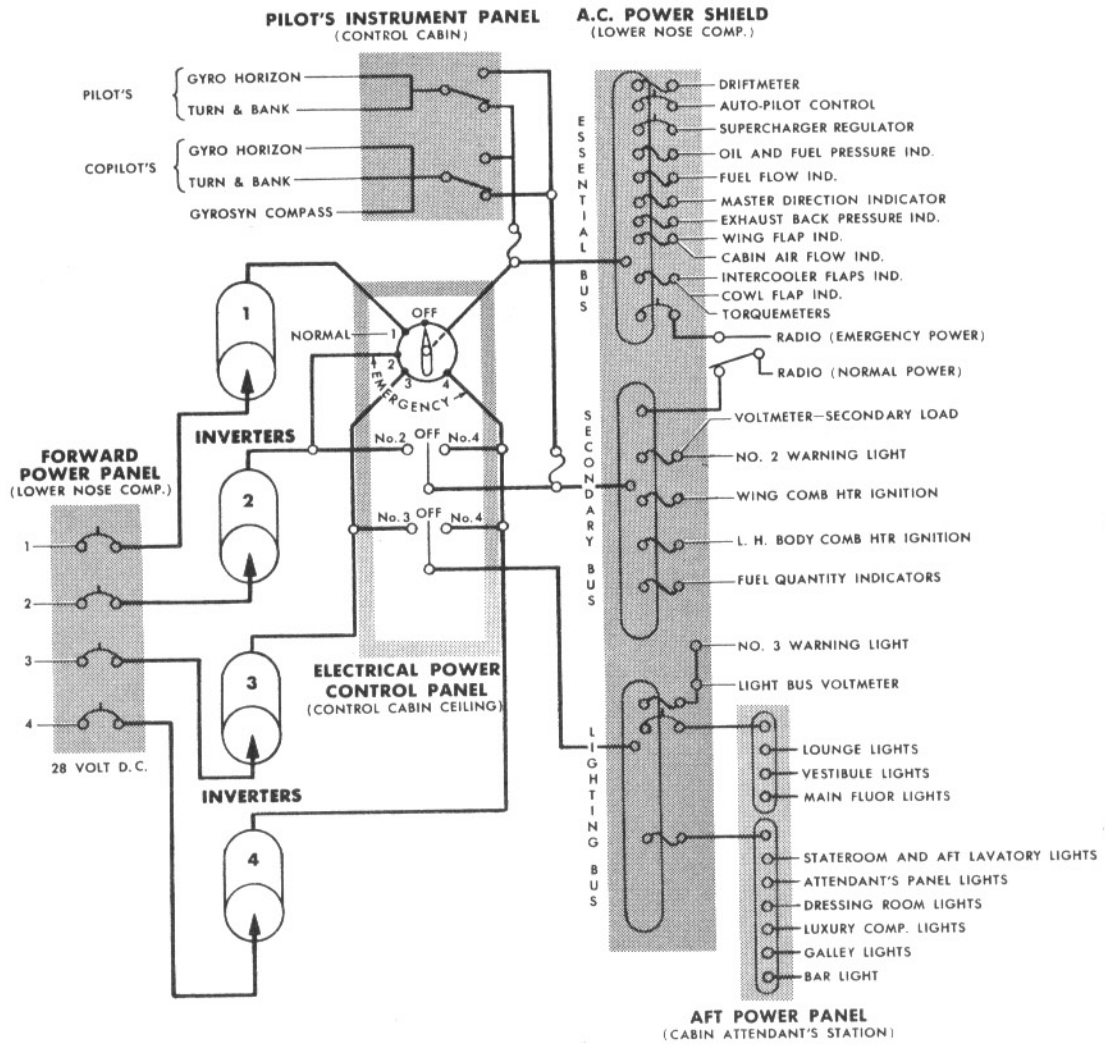
***Figure 1-14 (Sheet 4 of 4 Sheets). Circuit Breaker Panels***



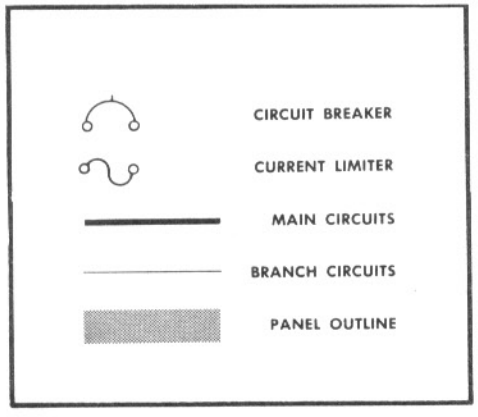

**D.C. POWER DISTRIBUTION SYSTEM**

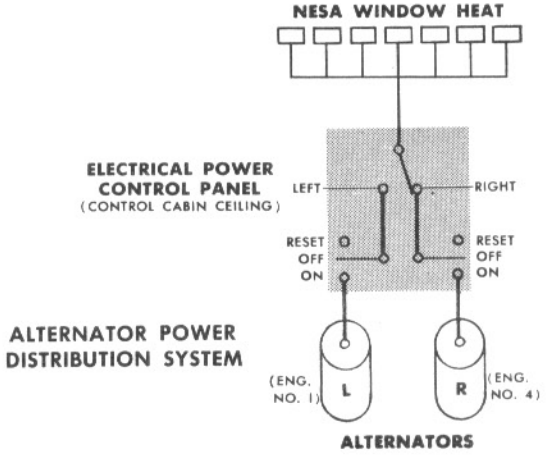
5404108

*Figure 1-15 (Sheet 1 of 2 Sheets). Electrical Distribution Systems*




INVERTER POWER DISTRIBUTION SYSTEM




54041b8

***Figure 1-15 (Sheet 2 of 2 Sheets). Electrical Distribution Systems***

HYDRAULIC SYSTEM.

The Stratocruiser hydraulic system is used to operate the normal and emergency brakes, nose wheel steering, rudder boost, and the windshield wipers, as shown in figure 1-16. An engine-driven pump on each inboard engine provides a hydraulic pressure of 1650 PSI for the entire system. System pressure is available when either No. 2 or No. 3 engine is started. One pump will maintain system pressure under normal system usage. A 3 1/2-gallon reservoir, plus a half-gallon reserve, is on the right side of the control cabin.

HYDRAULIC SYSTEM CONTROLS. A charging valve on the copilot's auxiliary panel permits charging of the emergency brake system with the pressure in the normal system. The charging valve should remain in the "CLOSED" position except when charging the emergency system. The controllable check valve in the lower nose compartment provides a means of charging the entire hydraulic system with the emergency hand pump. This is used only on the ground when the engines are not operating. The controllable check valve should remain in the "NORMAL" position. The emergency hand pump, beneath the copilot's auxiliary panel, provides a means of charging the normal brake system in the event of engine-driven pump failure or of charging the entire hydraulic system for ground testing. In case of loss of hydraulic fluid, a 1/2-gallon reserve is available for hand pump operation of the normal brake system.

HYDRAULIC SYSTEM INDICATORS. Three hydraulic pressure indicators are on the copilot's auxiliary panel: one for the service brakes; one for the emergency brakes; and one for nose wheel steering, rudder boost, and windshield wipers.

HYDRAULIC SYSTEM FIRE SHUTOFF SWITCHES. Two fire switches for engines No. 2 and No. 3 shut off the hydraulic supply to these engines. The fire switches are located in the fire control section of the overhead electrical panel. Circuit breakers are on the overhead electrical panel.

WINDSHIELD WIPER CONTROL. The windshield wiper speed and parking control is on the pilot's auxiliary panel.

SERVICE AND EMERGENCY BRAKES. See "Landing Gear" for the service and emergency brake system and controls.

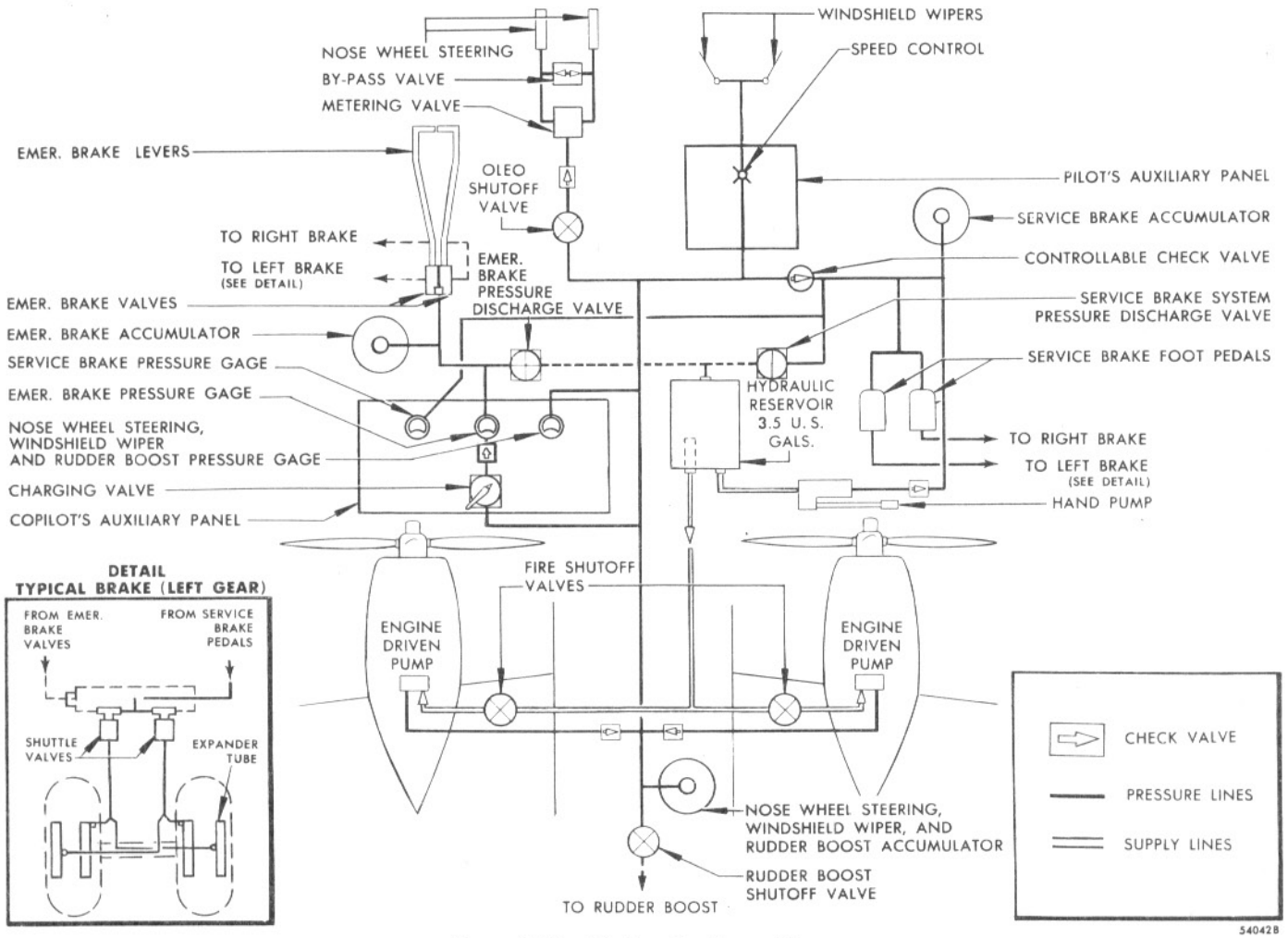



*Figure 1-16. Hydraulic Flow Diagram*

LANDING GEAR.

The exceptionally fast-acting, electrically-operated landing gear consists of dual-wheel main gear and nose gear, with combination oil and air shock struts throughout. The nose gear is hydraulically steered by a control wheel in the control cabin.

LANDING GEAR NORMAL CONTROLS. A three-position "DOWN--OFF--UP" switch on the engine control stand controls the electric motors that operate the landing gear. Three green lights and one red light, grouped on the pilots' instrument panel, indicate when the landing gear is down, up, or at any intermediate position. A warning horn will sound if one or more throttles is retarded to less than one-third open and the landing gear is in any position but fully down and locked. A warning horn reset button, adjacent to the throttles on the engine control stand, will turn the horn off if it is desired to keep a throttle retarded.

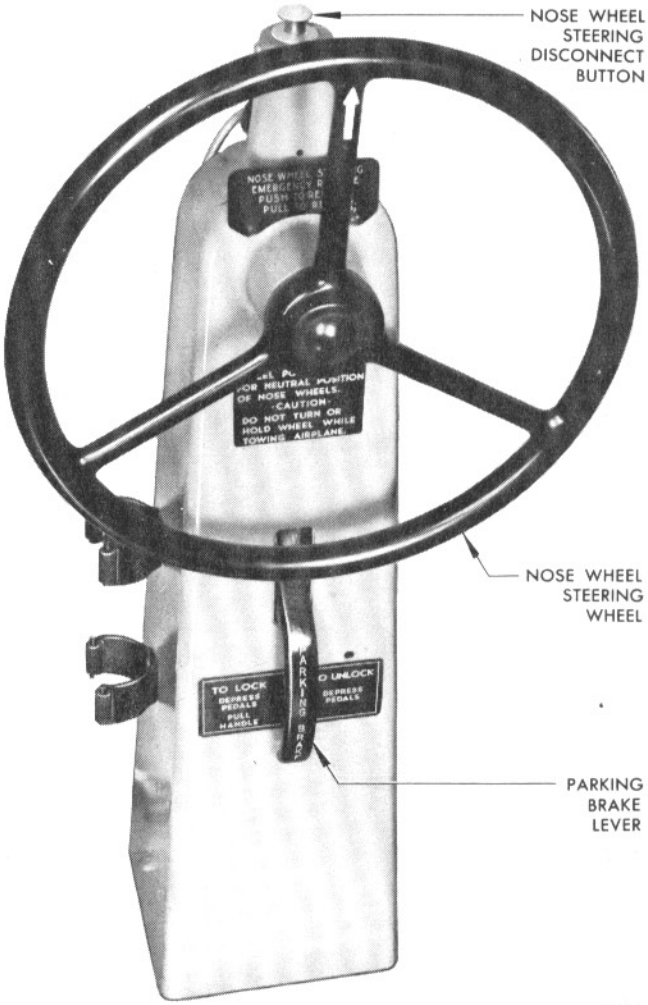
NOSE WHEEL STEERING. The Stratocruiser is equipped with a steerable nose wheel which is hydraulically controlled by a steering wheel on the pedestal (figure 1-17) to the left and forward of the pilot. An arrow on the wheel and a decal on the pedestal indicate when the nose wheel is centered. The nose wheel turns in the direction selected by the steering wheel and remains in that position until the control wheel is returned to center. A cable follow-up system will return the nose wheel to its original course should the wheel momentarily be deflected by some obstacle. When the airplane weight is relieved from the nose gear, the nose wheel automatically centers.

NOSE WHEEL EMERGENCY DISCONNECT. The push button on the steering pedestal by-passes the steering cylinders, allowing the nose wheel to caster. This is used to release the nose wheel in event of steering system malfunction. An indicator light, within the push button, illuminates when the switch is actuated. In the event of hydraulic pressure failure, the nose gear has a conventional caster action.

LANDING GEAR EMERGENCY CONTROLS. In an emergency the landing gear is operated manually by hand cranks. The nose gear crank is located on the nose gear emergency controls access door. When the access door is raised, the clutch lever is visible on the left and the crank receptacle is on the right. Instructions for operation of the nose gear emergency controls are on the bottom side of the access door. Always replace the receptacle plug after emergency operation to prevent the escape of cabin pressure. The main gear cranks are located adjacent to the crank adapters on each side of the airplane, aft of the rear spar. Access to the main gear emergency controls is through the mirror panels at the forward end of the lounge. Pull handles are located near the emergency operation gear boxes to release the normal motor clutches and engage the manual system. The auxiliary flap motor, mounted above the normal wing flap motor, can be removed and used for emergency operation of the main gear, but the hand crank is simpler and quicker for emergency extension of the gear. Rotation of the hand crank will release the uplocks, lower the gear, and engage the down-locks. A three-position switch mounted on the wing flap motor will control its operation when the motor is used for emergency landing gear operation (see figure 1-18).

BRAKES. The Stratocruiser has conventional, toe-operated, hydraulic main-wheel service brakes. Pressure is supplied to the service brake system as shown in figure 1-16. If the hydraulic pumps should fail, pressure for operation of the service brake system can be maintained by the hydraulic hand pump. In case of loss of hydraulic fluid, a half-gallon reserve is available for hand pump operation of the brakes.

EMERGENCY BRAKES. Two hand levers above the pilot's seat provide a means for emergency hydraulic operation of the service brakes in the event of service brake control failure, line failure, or failure of both hydraulic pumps. The emergency levers apply pres-




54043

***Figure 1-17. Nose Wheel Steering Pedestal***

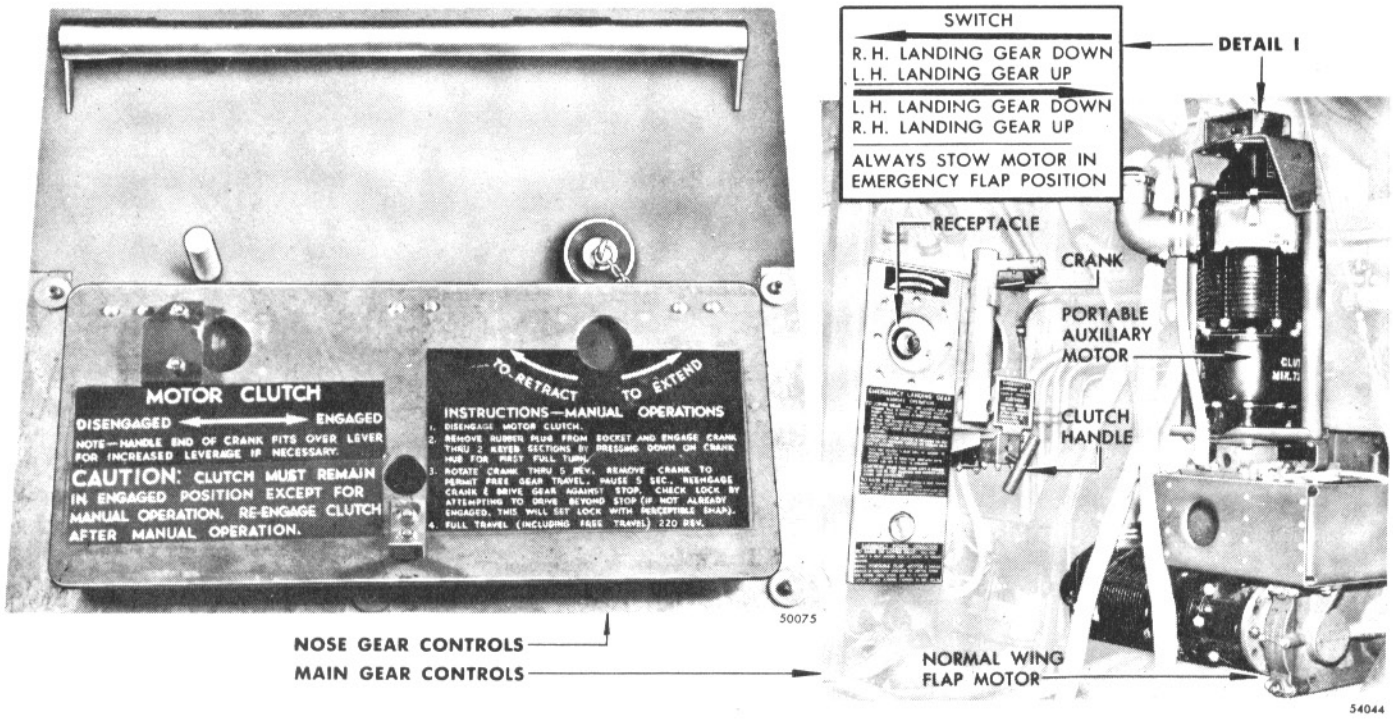



***Figure 1-18. Landing Gear Emergency Controls***

sure from the emergency accumulator through separate lines to the shuttle valves. From the shuttle valves the pressure is supplied through the normal service brakes to the expander tubes. The number of brake applications with the emergency system is limited to the duration of pressure which will apply the brakes. The system is normally charged with the nose wheel steering, rudder boost, and windshield wiper system pressure upon operation of the charging valve on the copilot's auxiliary panel. The valve normally is "CLOSED," but when in the "OPEN" position, the system can be charged.

PARKING BRAKE. The parking brake lever is on the nose wheel steering pedestal (figure 1-17). The parking brake is set by depressing the pilot's brake pedals and pulling the spring-loaded parking brake lever upward. The parking brake is automatically released when the pilot's pedals are again depressed.

LANDING GEAR GROUND SAFETY LOCKS. Three external safety locks, one for each landing gear, as shown in figure 1-19, are provided to prevent accidental retraction of the landing gear while on the ground. The main gear lock pins are installed in the lower end of the main gear actuator beneath a spring-loaded cover. The nose gear lock is installed between the oleo and the drag strut with the yoke end forward and the latch ring down. Red warning streamers are attached to the locks for easy recognition.

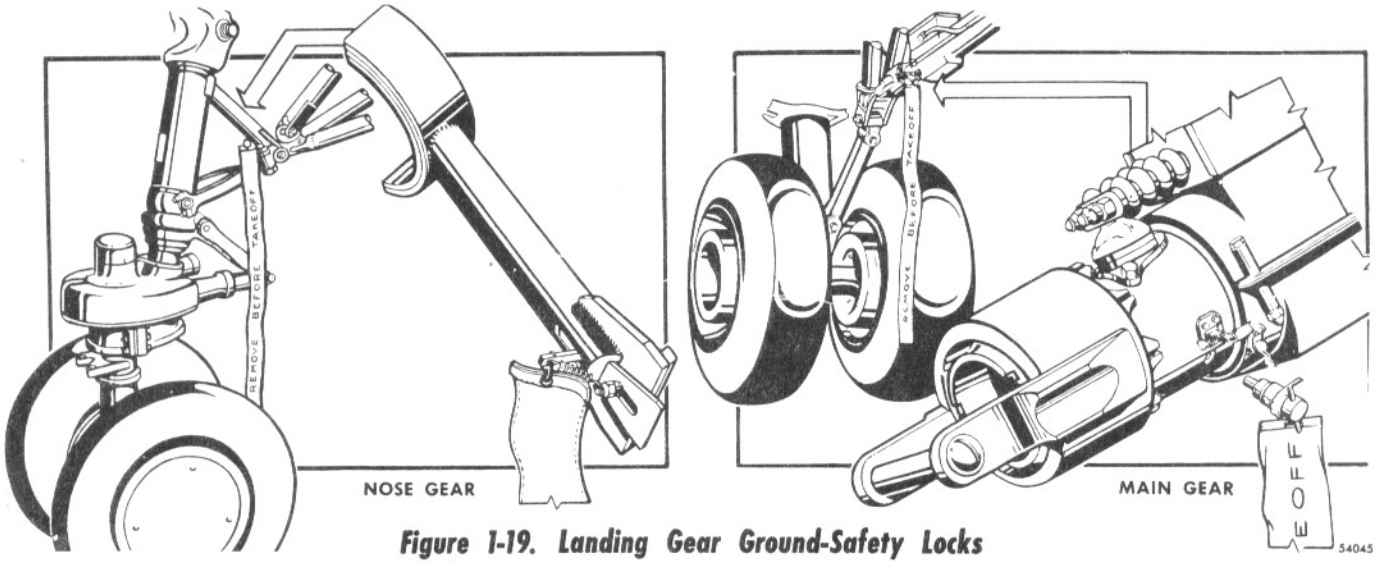



***Figure 1-19. Landing Gear Ground-Safety Locks***

INSTRUMENTS.

The flight and engine instruments for the pilot, copilot, and auxiliary operator are grouped in the following classes.

ALTERNATING CURRENT INSTRUMENTS. The alternating current instruments include: pilot's and copilot's gyro horizon and turn and bank indicators; the indicators for the cabin air flow, cabin humidity, wing flap position, cowl flap position, intercooler flap position, fuel flow, exhaust back-pressure, fuel pressure, fuel quantity, and oil pressure; and the torquemeters.

DIRECT CURRENT INSTRUMENTS. The direct current instruments include the ADI and oil quantity indicators and oil, cylinder head, carburetor air, cabin air, turbo bearing, outside air, and combustion heater temperature indicators.

PITOT STATIC, DIRECT PRESSURE, AND VACUUM INSTRUMENTS. The airspeed indicators, altimeters, and rate-of-climb indicators are connected to the pitot static source. The manifold pressure indicators, hydraulic pressure gages, cabin altitude indicator, and the cabin rate-of-climb indicator are direct-pressure instruments. The vacuum-operated instruments include: the pilot's directional gyro, the copilot's gyro horizon, and the vacuum gage.

RADIO AND AUTOPILOT CONTROLLED INSTRUMENTS. The autopilot, gyrosyn compass, and radio controlled instruments require AC and DC electrical power. These instruments include: the autopilot pitch trim indicator; the automatic master direction indicator; the pilot's master direction indicator repeater; the copilot's gyrosyn compass; and the pilot's, copilot's, and navigation station magnetic and dual ADF indicators. The direction indicating cards on the pilot's and navigation station magnetic and dual ADF indicators are controlled by the copilot's gyrosyn compass. The card on the copilot's magnetic and dual ADF indicator is controlled by the autopilot. The radio controlled instruments include the magnetic and dual ADF indicators, the instrument landing indicators, and the high and low range altimeters.

MISCELLANEOUS INSTRUMENTS. The tachometers are alternator-motor type units and operate independently of the electrical system.

FIRE SYSTEM.

FIRE WARNING. Warning lights on the overhead electrical panel indicate the presence of fire in the power section, accessory section and firewall to spar area, or induction system of each nacelle, each combustion heater, each main gear wheel well, or the center wing area. A master fire warning light, on the fuel control panel, is illuminated whenever any one of the other warning lights is illuminated. A fire warning bell, mounted on the steering wheel pedestal, will sound whenever fire, CO, or smoke is detected by the fire warning or CO and smoke detection systems. The bell will also sound if the turbo bearing temperature exceeds the maximum. The lights will go out and the bell will become silent when the fire is extinguished. Two "FIRE TEST DETECT" buttons on the overhead electrical panel provide a means of determining whether or not all fire warning circuits are operating correctly. When each button is depressed, all the warning lights for that system, plus the master light, will illuminate and the bell will sound. Circuit breakers for the system are on the overhead electrical panel.

FIRE EXTINGUISHER SYSTEM. Three sets of $CO_2$ bottles, one set in the left inboard nacelle and two sets in the right inboard nacelle, supply $CO_2$ to the carburetor and accessory section of each power package; firewall to spar area of each nacelle; each combustion heater; the center wing section; each main gear wheel well; and the ducts of the cabin heaters. A separate $CO_2$ bottle in the fuselage supplies an additional source of $CO_2$ to the cabin combustion heaters. Each section is separated from the remainder of the system by direction valves as shown in figure 1-21. The direction valves are controlled by switches on the overhead electrical panel. After the direction valves have been selected, the $CO_2$ bottles are discharged by means of three "NORMAL--FIRE" switches in the fire control panel of the overhead electrical panel. Each switch controls two $CO_2$ cylinders. The single body cylinder is controlled by a separate switch.

An external $CO_2$ cylinder may be connected to a quick-disconnect fitting at the external power receptacle. Purpose of the external cylinder is to provide a supply for use during engine starting and ground operation. After the fire extinguisher gang switches have been actuated, the external cylinder is discharged by opening the hand valve. It is not necessary to operate the individual bottle switches unless the fire necessitates use of the additional bottles.

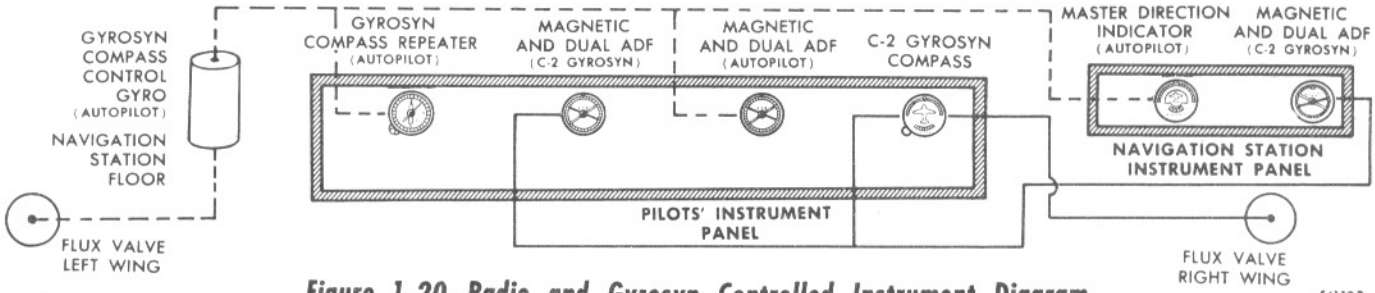



*Figure 1-20. Radio and Gyrosyn Controlled Instrument Diagram*

Red and yellow colored discharge indicators are on the under surfaces of nacelles No. 2 or No. 3 and on the under surface of the fuselage forward of the left wing. The red indicator disks blow out when the $CO_2$ bottles discharge from thermal reaction and the yellow indicator disks blow out when the system is discharged manually.

HAND FIRE FIGHTING EQUIPMENT. Hand fire extinguishers are located as shown in figure 1-22. Fire extinguishers should be directed at the base of the fire while discharging. Do not allow $CO_2$ to be directed at personnel or any part of the body.

A $CO_2$ bottle, oxygen bottle, oxygen mask, and a pair of asbestos gloves, to be used for fire control in the lower nose compartment, are fastened to the bulkhead adjacent to the lower nose compartment entry hatch. Two additional $CO_2$ bottles are in the lower nose compartment, one on the left side of the nose wheel well below the AC power shield and one on the wheel well adjacent to the fuselage oil tank (see figure 1-22).

A smoke mask is mounted in the lounge stairwell wall for use in combating smoke. The smoke mask provides no protection against $CO_2$ or carbon tetrachloride fumes.

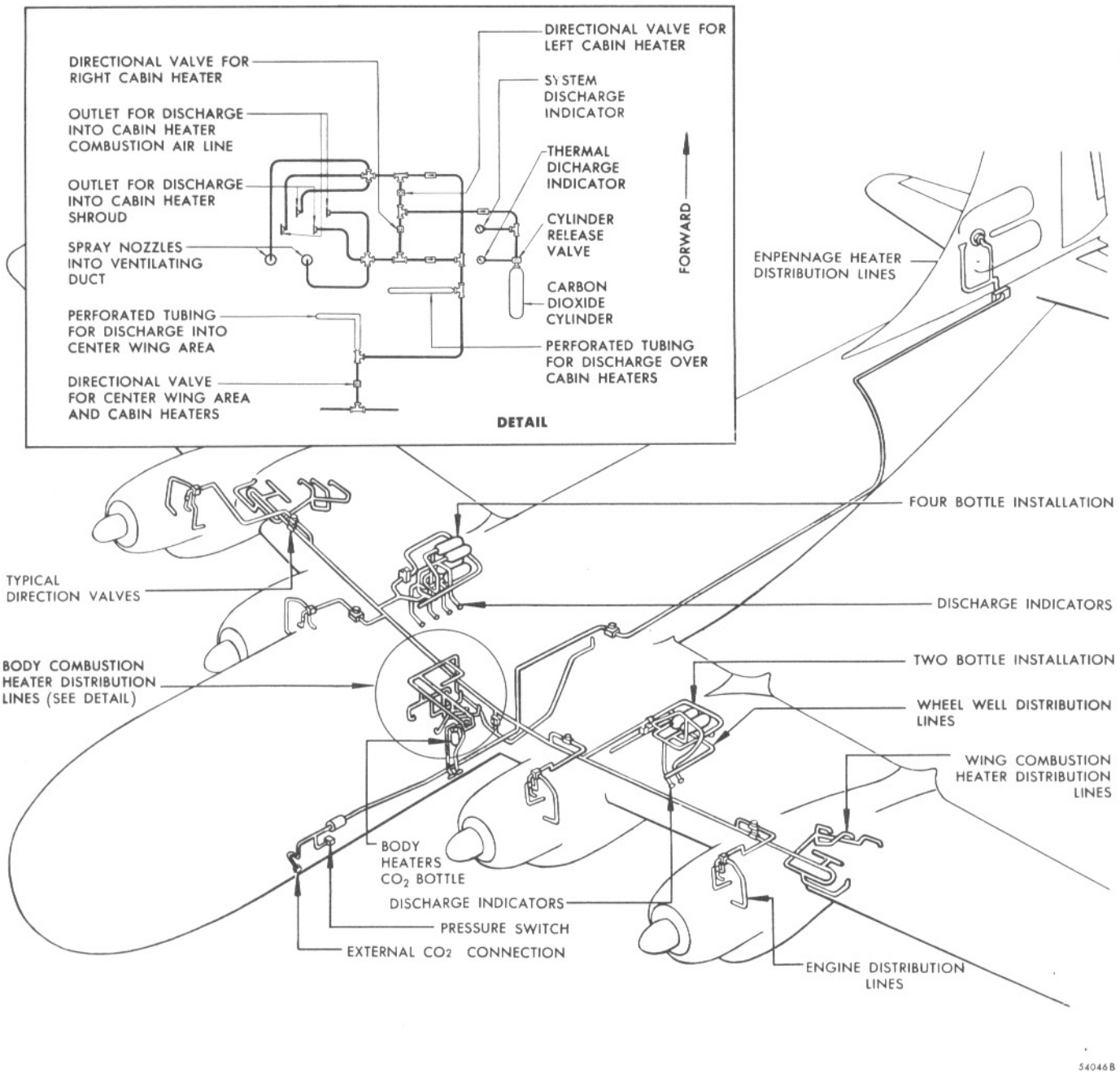
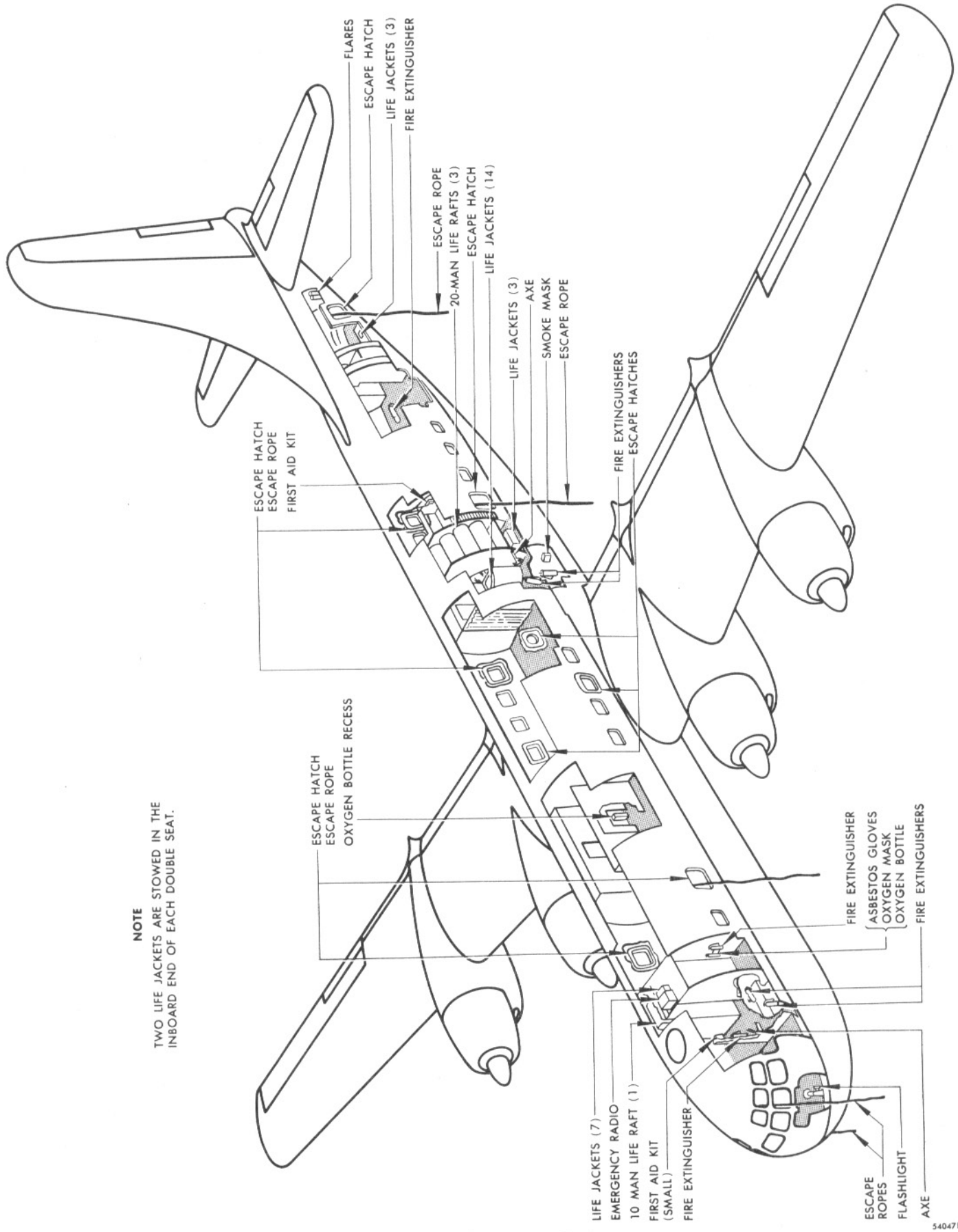



*Figure 1-21. Fire Extinguisher System*




**NOTE**

TWO LIFE JACKETS ARE STOWED IN THE INBOARD END OF EACH DOUBLE SEAT.

***Figure 1-22. Emergency Equipment***

## MISCELLANEOUS EQUIPMENT.

CURTAINS. Night flying curtains are secured against the walls and ceiling at the aft end of the pilots' dais. When the curtains are in use, they extend across the control cabin enclosing the pilot, copilot, and the auxiliary control station. Curtains also cover the upper row of nose windows, the astral window and the navigation station window (see figure 1-2).

Two adjustable visors, above the pilot and copilot, are a protection against glare.

STOWAGE SPACE. Stowage space is provided for the emergency equipment and for crew food storage above the control cabin entry door. A cabinet for stowage of the "Airplane Flight Manual" and small articles is provided in the inboard leg of the navigation station table. Stowage space is also provided in the pilots' dais floor and accessible through hatches in the floor. Check list containers are provided on the pilots' auxiliary panels. A coat rack is mounted in the cabinet behind the navigation station.

Brief case retainers are provided for the pilots on the outboard side of both observers' seats. A navigation station book case and a brief case container are also provided on the outboard wall behind the navigation station seat.

MISCELLANEOUS. Observers' seats are located aft and on the right and left sides of the pilots' dais. The seats are stowed against the sides of the cabin and swing forward for use. Flashlight clips are conveniently located for the crew members. Ash trays are conveniently located for all crew members.

ESSENTIAL TOOLS. Certain small hand tools are necessary for successful operation of the airplane. It is recommended that the following tools be carried in the airplane on each flight: a 6-inch blade screw driver, a 6-inch Phillips style screw driver, a 3-inch Phillips style screw driver, a 6-inch adjustable wrench, a pair of 7-inch diagonal cutting pliers, and a pair of 10-inch water pump pliers.

## EMERGENCY EQUIPMENT.

Emergency equipment is located as shown in figure 1-22.

PYROTECHNICS. Two 3-minute parachute flares are installed in the unpressurized tail compartment. Controls for release of the flares are on the pilot's auxiliary panel.

LIFE RAFTS. Provisions are made for installing a 10-man life raft on the emergency equipment rack above the control cabin entry door. Three 20-man life rafts are installed in the life raft compartment on the left side of the cabin at the main entry door.

LIFE JACKETS. A total of 79 life jackets are available for passenger and crew use. These jackets are stowed at the following locations: 7 jackets are in the emergency equipment rack in the control cabin, 14 jackets in the top of the stairwell coaming, 3 jackets in the life raft compartment at the main entry door, 2 jackets in the inboard leg of each double seat, and 3 jackets in the stateroom.

EMERGENCY RADIO. An emergency radio is stowed on the emergency equipment rack in the control cabin.

ESCAPE ROPES. An 8-foot rope is provided at each emergency hatch, except those over the wing, for use in assisting passengers to the ground or into the life rafts. Two ropes also are provided at the sliding windows in the control cabin. One end of each rope is attached to the hatch frame structure and, when stowed, is looped around the frame.

FIRST AID KITS. A small first aid kit is located on the inboard end of the navigation station bulkhead. A large kit is located inside the upper service cabinet at the cabin attendant's station.

MISCELLANEOUS. Flashlights, smoke mask, axes, and other emergency equipment are provided as shown in figure 1-22.

54059B

# Chapter 2 OPERATING INSTRUCTIONS

NOTE

The operating instructions, procedures, and limitations contained in this handbook are recommended by the manufacturer as information for use in the operation of this airplane. Should there be any discrepancies between information contained in this handbook and information contained in the CAA approved Airplane Flight Manual, the Airplane Flight Manual shall take precedence and govern.

RESTRICTIONS.

a. All acrobatics are strictly prohibited.
b. Do not exceed a maximum air speed of 302 knots (348 MPH) IAS or .58 Mach number, whichever is lower, for normal airplane loading.
c. Do not exceed 200 knots (230 MPH) IAS when extending the landing gear.
d. Do not exceed 188 knots (217 MPH) IAS when extending the wing flaps 25 degrees.
e. Do not exceed 174 knots (200 MPH) IAS when extending the landing lights.
f. Do not exceed 171 knots (197 MPH) IAS when extending the wing flaps 30 degrees.
g. Do not exceed 159 knots (183 MPH) IAS when extending the wing flaps completely (45 degrees).
h. Do not exceed instrument and power plant limitations shown in figure 5-1 of chapter 5, "Operating Charts."
i. Avoid continuous propeller operation between 1500 and 2000 RPM at air speeds above 271 knots (312 MPH).

TAKE-OFF GROSS WEIGHT AND BALANCE.

Check the airplane weight and balance for take-off and anticipated landing.

EXTERIOR INSPECTION.

The following items should be checked before entering the airplane.

GENERAL. Maintenance or inspection report examined and all discrepancies noted.

FORWARD FUSELAGE.
Static Plates, right and left:
a. Check for plugged holes.
b. Check for accumulation of ice.
Radio Antennas: Visually check all antennas for possible damage to masts and insulators during cargo loading.
Access Doors:
a. Visually check or close all access openings which do not have servicing equipment attached.
b. Advise ground maintenance personnel of any open access doors above reach from ground. Recheck as necessary.

Pitot Heads, right and left: Visually check for alignment and evidence of damage.

Nose Gear:
a. Check tires for condition and deflection.
b. Check nose strut for proper extension.
c. Check nose gear lock for position and security.
d. Visually examine nose gear for missing safeties.
e. Visually check all hydraulic lines and fittings for security and leakage.
f. Visually check all swivel glands for leakage.
g. Check steering cylinders for leakage.
h. Check both door control rod disconnects for installation of pin and safety lock.

Ground Power Unit:
a. Check ground power plug for engagement.
b. Visually check ground power unit for operation and correct output.

External $CO_2$ Connection:
a. Check for security of attachment.
b. Check that external bottle valve is closed.
c. Note whether or not external phone line is connected.

Cabin Heater $CO_2$ Discharge Plugs:
a. Check for missing disks.
b. Check for missing snap rings.

Drift Sight Dome: Check glass clean and unobscured.

Cabin Pressure Regulator Discharge Openings: Check for presence of rags or similar foreign materials.

LEFT WING AREA.
Wing Access Doors and Inspection Plates: Visually check entire lower surface of wing for open or unsecured doors or plates. Advise ground maintenance and recheck security after they have been closed.

No. 2 Power Package:
a. Check visually for evidence of gasoline, ADI fluid, hydraulic and engine oil leakage.
b. Check general area for loose or missing parts.
c. Visually check all cowl flaps for relative positioning.
d. Visually check intercooler flaps for security.
e. Visually check oil cooler flaps for security.
f. Note all flap release buttons for positioning.
g. Visually check waste gate open.

54078 B

Propeller, No. 2 engine:
a. Visually check for blade damage.
b. Visually check deice shoe for damage.

Air Intakes:
a. Visually check oil sump servicing doors for being closed and latched.
b. Visually check sheltered air door condition and position.
c. Check all openings for presence of rags or foreign materials.

Main Gear:
a. Visually check all gear links for security and missing bolts or safeties.
b. Check torque links for dirt or ice near or on the micro-switches or actuating mechanisms.
c. Visually check oleo strut for normal extension.
d. Visually check tires for condition and normal deflection.
e. Visually check wheels and gear for condition.
f. Check glands and lines for hydraulic leaks.
g. Check for presence and positioning of wheel.
h. Visually check extension mechanism for presence of gear ground lock pin.
i. Visually check gear down lock indicator pin in lower end of extension strut.
j. Check for condition and security of wheel well doors.
k. Visually check wheel well door operating mechanisms for cable tensions, loose rods, and safeties.

Wheel Well Interior:
a. Visually check electrical wiring for loose wires or disconnected cannon plugs.
b. Visually check all fuel and oil lines for condition, leaks and security.
c. Visually check ADI quantity and check ADI tank and lines for security and leaks.
d. Visually check $CO_2$ bottles and lines for presence, security, and attachment of discharge heads.

$CO_2$ Blowout Plugs:
a. Check for presence of disks.
b. Check for presence of snap rings.

Dump Chutes and Vent Line Openings:
a. Check dump chute seals for presence, condition and security.
b. Check vent line opening in flap for presence of dirt, ice, or rags.

No. 1 Power Package:
a. Check visually for evidence of gasoline, ADI fluid, or engine oil leakage.
b. Check general area for loose or missing parts.
c. Visually check all cowl flaps for relative positioning.
d. Visually check intercooler flaps for security.
e. Visually check oil cooler flaps for security.
f. Note all flaps release buttons for positioning.
g. Visually check waste gate open.
h. Check security of outboard nacelle skate door fasteners.

Propeller, No. 1 engine:
a. Visually check for blade damage.
b. Visually check deice shoe for damage.

Air Intakes:
a. Visually check oil sump servicing door for being closed and latched.
b. Visually check sheltered air door condition and position.
c. Check all openings for presence of rags or foreign materials.

Under Side of Wing and Aileron:
a. Visually check condition.
b. Check anti-icing heater inlet ducts and anti-icing exhaust air vents for condition and presence of foreign materials.

Landing and Position Lights:
a. Check landing lights for condition, cleanliness and position.
b. Check position lights for condition.

Wing Flaps:
a. Visually check for skin damage.
b. Visually check configuration for comparison with cockpit indicator.

All Fuel Tank Sumps, Drains and Strainers: Check for closing, safety, and leakage.

Upper Wing Surface:
a. Check condition of skin and presence of dirt, ice, or snow.
b. Check fuel tank filler caps secured.

AFT FUSELAGE.
Access Doors: Check all doors and inspection plates for being closed and secured. Request ground maintenance help to close any above reach.

Empennage:
a. Visually check control surfaces for condition.
b. Visually check all access doors and inspection plates for security.
c. Visually check for presence of ice, sleet or snow.
d. Check condition of anti-icing exhaust air vents.

Tail Lights: Check for presence and security of lights.

Flare Chutes: Check for presence and condition of seals.

Fuselage Drains: Check drain plugs for presence and proper positioning.

Radio Antennas:
a. Visually check radio altimeter antennas.
b. Check masts for damage.
c. Check for wire and insulator condition.

RIGHT WING AREA.
Wing Access Doors and Inspection Plates: Visually check entire lower surface of wing for open or unsecured doors or plates. Advise ground maintenance and recheck security after they have been closed. 54079

Upper Wing Surface:
a. Check condition of skin and presence of dirt, ice, or snow.
b. Check fuel tank filler caps secured.

No. 3 Power Package:
a. Check visually for evidence of gasoline, ADI fluid, hydraulic and engine oil leakage.
b. Check general area for loose or missing parts.
c. Visually check all cowl flaps for relative positioning.
d. Visually check intercooler flaps for security.
e. Visually check oil cooler flaps for security.
f. Note all flap release buttons for positioning.
g. Visually check waste gate open.

Propeller, No. 3 engine:
a. Visually check for blade damage.
b. Visually check deice shoe for damage.

Air Intakes:
a. Visually check oil sump servicing doors for being closed and latched.
b. Visually check sheltered air door condition and position.
c. Check all openings for presence of rags or foreign materials.

Main Gear:
a. Visually check all gear links for security and missing bolts or safeties.
b. Check torque links for dirt or ice near or on the micro-switches or actuating mechanisms.
c. Visually check oleo strut for normal extension.
d. Visually check tires for condition and normal deflection.
e. Visually check wheels and gear for condition.
f. Check glands and lines for hydraulic leaks.
g. Check for presence and positioning of wheel chocks.
h. Visually check extension mechanism for presence of gear ground lock pin.
i. Visually check gear down-lock indicator pin in lower end of extension strut.
j. Check for condition and security of wheel well doors.
k. Visually check wheel well door operating mechanisms for cable tensions, loose rods and safeties.

Wheel Well Interior:
a. Visually check electrical wiring for loose wires, or disconnected cannon plugs.
b. Visually check all fuel and oil lines for condition, leaks and security.
c. Visually check ADI quantity and check ADI tank and lines for security and leaks.
d. Visually check $CO_2$ bottles and lines for presence, security, and attachment of discharge heads.

$CO_2$ Blowout Plugs:
a. Check for presence of disks.
b. Check for presence of snap rings.

Dump Chutes and Vent Line Openings:
a. Check dump chute seals for presence, condition and security.
b. Check vent line opening in flap for presence of dirt, ice or rags.

No. 4 Power Package:
a. Check visually for evidence of gasoline, ADI fluid, or engine oil leakage.
b. Check general area for loose or missing parts.
c. Visually check all cowl flaps for relative positioning.
d. Visually check intercooler flaps for security.
e. Visually check oil cooler flaps for security.
f. Note all flaps release buttons for positioning.
g. Visually check waste gate open.
h. Check security of outboard nacelle skate door fasteners.

Propeller, No. 4 engine:
a. Visually check for blade damage.
b. Visually check deice shoe for damage.

Air Intakes:
a. Visually check oil sump servicing door for being closed and latched.
b. Visually check sheltered air door condition and position.
c. Check all openings for presence of rags or foreign materials.

Under Side of Wing and Aileron:
a. Visually check condition.
b. Check anti-icing heater inlet ducts and anti-icing exhaust air vents for condition and presence of foreign materials.

Landing and Position Lights:
a. Check landing lights for condition, cleanliness and position.
b. Check position lights for condition.

Wing Flaps:
a. Visually check for skin damage.
b. Visually check configuration for comparison with cockpit indicator.

All Fuel Tank Sumps, Drains and Strainers: Check for closing, safety and leakage.

## ENTERING THE AIRPLANE.

The crew normally will enter the airplane through the forward cargo door on the right side of the airplane. A ladder near the door provides access to the control cabin through a hatch in the upper deck. Another means of entrance is through the rear cargo door on the right side of the airplane which provides access to the lounge from which a spiral staircase ascends into the main cabin. The main entrance door for passengers is on the left side of the upper deck and leads into the main cabin.

54080

INTERIOR INSPECTION.

After entering the airplane and before entering the control cabin, check the following items:

FORWARD CARGO COMPARTMENT.
Entrance Door:
a. Visually check operating mechanism and latches.
b. Visually check door seals for damage.

Cargo Loading:
a. Check security of stowage.
b. Check proper positioning of all cargo to prevent sharp corners from damaging lining and units behind lining.
c. Check cargo nets tightened in place.
d. Check setting of temperature selector.

Crew Bunk: Check security of stowage.

Central Oil Tank Filler: Check filler cap secured.

LOWER NOSE COMPARTMENT.
Forward Power Panel: Check all circuit breakers in (ON).

Voltage Regulator and Over-voltage Relays:
a. Check all voltage regulators for presence and security of mounting.
b. Check over-voltage relays; reset if necessary.

Turbo Amplifiers and Fuses:
a. Check that 4 units are installed.
b. Check presence of 1 spare unit.
c. Check security of mountings.
d. Check all fuses for installation and security.
e. Check presence of spare fuses.

AC Power Panel Circuit Breakers and Fuses:
a. Check all circuit breakers IN (ON).
b. Check fuses for installation and security.
c. Check presence of spare fuses.

Emergency Nose Gear Clutch and Crank:
a. Check clutch engaged.
b. Check crank presence and stowage.

Cabin Pressurization Release Valve:
a. Visually check valve for condition of seals and open position.
b. Check for foreign matter in area.

Hydraulic and Engine Oil System:
a. Check all lines and fittings for evidence of leakage.
b. Check that hydraulic discharge valves are closed.
c. Check controllable check valve handle in "NORMAL" position.

Fire Extinguishers:
a. Check security of mounting.
b. Check seals.
c. Check general condition of nozzle and controls.

MAIN CABIN.
Emergency Exits and Windows:
a. Visually check exits closed and locked and plastic cover in place.
b. Visually check all windows for cracks.

Emergency Evacuation Equipment: Check for installation and security of all emergency gear.

Fire Extinguishers:
a. Check fire extinguishers for security of mounting.
b. Check seals.
c. Check for general condition of nozzle and controls.

Cabin Attendant's Station:
a. Cabin temperature selector set and toggle switch placed to "AUTO."
b. Cabin lighting as required.

Aft Power Panel Circuit Breakers: Check all circuit breakers IN (ON).

Passenger Accommodations: Ready for use.

GALLEY.
Circuit Breaker Panel: All circuit breakers IN (ON).

Electrical Outlet Switches: Place all switches in the "OFF" position to reduce initial electrical load.

STATEROOM.
Emergency Exit and Windows:
a. Visually check exit closed and locked and plastic cover in place.
b. Visually check windows for cracks.

LOUNGE.
Emergency Exit and Windows:
a. Visually check exit closed and locked and plastic cover in place.
b. Visually check windows for cracks.

Fire Extinguisher and Smoke Mask:
a. Check security of mounting.
b. Check seals.
c. Check general condition of nozzle and controls.
d. Check mask for stowage.

Temperature Selector: Set as desired.

Emergency Flap Motor: Check mounting for loose fasteners.

Emergency Gear Controls:
a. Check cranks for stowage.
b. Check clutches for proper positioning.

Main Circuit Breaker Panel: Check all circuit breakers IN (ON).

Main Power Panel:
a. Visually examine all current limiters for blown units.
b. Check stowage of spare limiters.
c. Check stowage of tools.

AFT CARGO COMPARTMENT.
Aft Door:
a. Visually check operating mechanism and latches.
b. Visually check door seals for damage.

Cargo Loading:
a. Check security of stowage.
b. Check proper positioning of all cargo to prevent sharp corners from damaging lining.
c. Check cargo nets tightened in place.

54081

## ENTERING THE CONTROL CABIN (POWER OFF)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Adjust seat, rudder pedals, and safety belt | 1. Check oxygen bottle, oxygen mask, asbestos gloves, and fire extinguisher | 1. Adjust seat, rudder pedals, and safety belt |
| 2. Overhead light switches as desired | 2. Check passenger and crew system oxygen pressure | 2. Battery switches "OFF" |
| 3. Propeller deicing switches "OFF" | 3. Check axe, fire extinguisher and first aid kit | 3. Generator switches "OFF" |
| 4. Pitot heaters "OFF" | 4. Check emergency equipment stowage | 4. Alternator switches "OFF" |
| 5. Master switch "OFF" | 5. Check crew hot food stowage | 5. Inverter switches "OFF" |
| 6. Emergency wing flap switches "OFF," guard down | 6. Set relays and circuit breakers for batteries Nos. 1, 2, and 3 | 6. Circuit breakers set |
| 7. Anti-ice switches "OFF" | 7. Hydraulic fluid quantity checked, cap secured | 7. Fire control switches "NORMAL" |
| 8. Emergency anti-ice switches "OFF," guard down | 8. Observers' seats stowed or ready for use as desired | 8. Ignition switches "OFF" |
| 9. Radios "OFF" | | 9. Light switches as desired |
| 10. Autopilot disengaged and "OFF" | | 10. Engine selector switch "OFF" |
| 11. Landing lights retracted and "OFF" | | 11. Carburetor preheat valves switches "OFF" |
| 12. Cylinder head temperature selector on B-2 | 12. Adjust seat and safety belt | |
| 13. Wing flap switch "OFF" | 13. Check presence of microphone and headset | 13. Intercooler flap switches "CLOSED" |
| 14. Turbo-override switches "TAKE-OFF" | | 14. Oil cooler flap switches "AUTO" |
| 15. Turbo control "0" (zero) | | 15. Oil dilution switches "OFF" |
| 16. Propeller auto-feathering switches "OFF" | | 16. Fuel dump switches "CLOSED," guard down |
| 17. Rudder boost switch "ON" | | 17. Cabin pressure release valve "AUTO" |
| 18. Throttle brake as desired | | 18. Cabin cooling system "OFF" |
| 19. Propeller control lever "AUTO," propeller master synchronizer lever in "DECREASE RPM" | | 19. Ground blower switches "AUTO," guard down |

54082 oB

ENTERING THE CONTROL CABIN (POWER OFF) (CONTINUED)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 20. Propeller reverse pitch indicator "UNLOCKED" | | 20. Master air conditioning switch "OFF" |
| 21. Landing gear switch "DOWN" | | 21. Body heater switches "OFF" |
| 22. ADI pumps switch "OFF" | | 22. Cabin altitude selector set at 1000 feet above field altitude |
| 23. ADI valve override switches "AUTO" | | 23. Rate-of-change selector "MAX." |
| | | 24. Control cabin temperature selector as desired |
| 25. Aileron, elevator, and rudder tabs free and zeroed | | 25. Fuel selector switches "OFF" |
| 26. Flight instrument power selector switch on "ESS AC BUS" | | 26. Booster pumps "OFF" |
| 27. Altimeters and flight instruments checked and set | | 27. Body fuel valves "CLOSED" |
| 28. Parking brakes set | | 28. Altimeter and flight instruments checked and set |
| 29. Nose wheel steering disconnect button, up | | 29. Flight instruments power selector switches on "SEC AC BUS" |
| 30. Flashlight in place | | 30. Smoke detection system "NORMAL" |
| 31. Windshield wiper "OFF" | | 31. Turbo-bleed switches "OPEN" |
| 32. Window defrost "OFF" | | 32. Hydraulic pressures checked, charging valve "CLOSED" |
| 33. Control cabin cooling as desired | | 33. Central oil system selector and pump control "OFF" |
| 34. Panel lights as desired | | 34. Panel light switches as desired |
| 35. Flare release cover, safetied | | 35. Oxygen equipment tested |
| 36. Check presence of headset and microphone | | 36. Hydraulic hand pump lever stowed |
| 37. Oxygen equipment checked | | 37. Unlock controls for pilot's check |
| 38. Check controls for freedom of movement | | 38. If gustiness prevails, lock controls upon completion of pilot's check |

NOTE

To insure locking of the controls, move the aileron and rudder controls to neutral position and the elevator control down. Oscillate the controls to check seating of the locking pins.

54082b8

FUEL SYSTEM MANAGEMENT.

RESTRICTIONS.

a. For takeoff and landing the fuel selector valves must be in the "TANK-TO-ENG" position and booster pumps on "NORMAL."

b. Do not take off with less than 1200 pounds (200 gallons) of fuel in each main tank.

c. Do not operate more than two engines on center tank at one time.

d. Do not use center tank in climb when fuel quantity is below 1800 pounds.

e. Do not operate radio transmitters during dumping.

f. Do not dump fuel with flaps extended or on the side of the airplane having the landing gear extended.

g. When dumping fuel from only one side of the airplane, one of the following procedures should be observed:

When dumping from the outboard and inboard tanks on one side of the airplane, dump 3950 pounds maximum from each tank (7900 pounds total).

When dumping from one inboard tank only, dump 8800 pounds maximum.

When dumping from one outboard tank only, dump 5400 pounds maximum and do not exceed 210 MPH IAS with this loading.

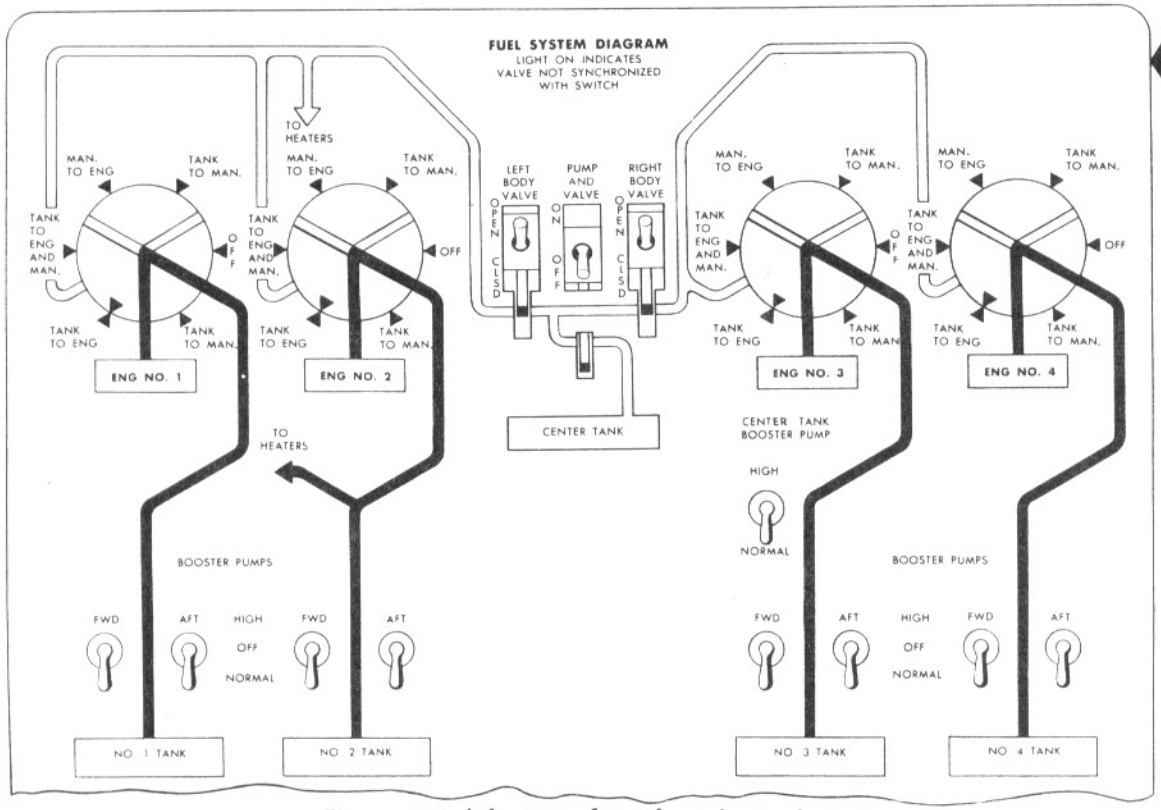
BEFORE STARTING CHECK. With mixture controls in "FUEL CUTOFF," throttles "CLOSED," and the essential load on "NORMAL" (No. 1) inverter, check fuel valves, booster pumps, and warning lights for synchronization and operation.

Rotate all fuel selector valves counterclockwise, pausing at each detent until the synchronization warning light goes out. Then turn the fuel selector valves to the "TANK-TO-ENG.-AND-MAN." position and, with body valves "CLOSED," place one main tank booster pump on "NORMAL" and check that fuel pressure is on that side of the airplane only. Open the body valves and note that fuel pressure is on both sides. Then place the booster pump off and place the center tank "PUMP AND VALVE" switch to the "ON--OPEN" position, note fuel pressure with center tank booster pump on "NORMAL" and on "HIGH," and return center "PUMP AND VALVE" switch to "OFF--CLOSED." Rotate fuel selector valves to "TANK-TO-ENG." position and check each booster pump fuel pressure on "NORMAL," note fuel pressure approximately 15 PSI and warning light on; then check on "HIGH," note fuel pressure approximately 28 PSI and warning light out.

TAKE-OFF AND LANDING OPERATION. Set the fuel selectors to the "TANK-TO-ENG." position and turn both booster pumps for each of the tanks on "NORMAL." Leave the center tank "PUMP AND VALVE" switch "OFF" and the body-valve switches "OPEN." See example 1 of figure 2-1.

CAUTION

It is possible to take off with one booster pump in a main tank inoperative, provided a normal amount of fuel is carried. In extreme cases, on approach descent with a low amount of fuel in a main tank and with a booster pump inoperative, route fuel from an adjacent main tank through the manifold system to assure a continuous fuel supply to the engine.




**EXAMPLE 1.**
TAKE-OFF AND LANDING OPERATION

**NOTE**
BODY VALVES MAY BE OPEN OR CLOSED DURING THIS OPERATION

54050 a B

***Figure 2-1 (Sheet 1 of 3 Sheets). Fuel System Management***

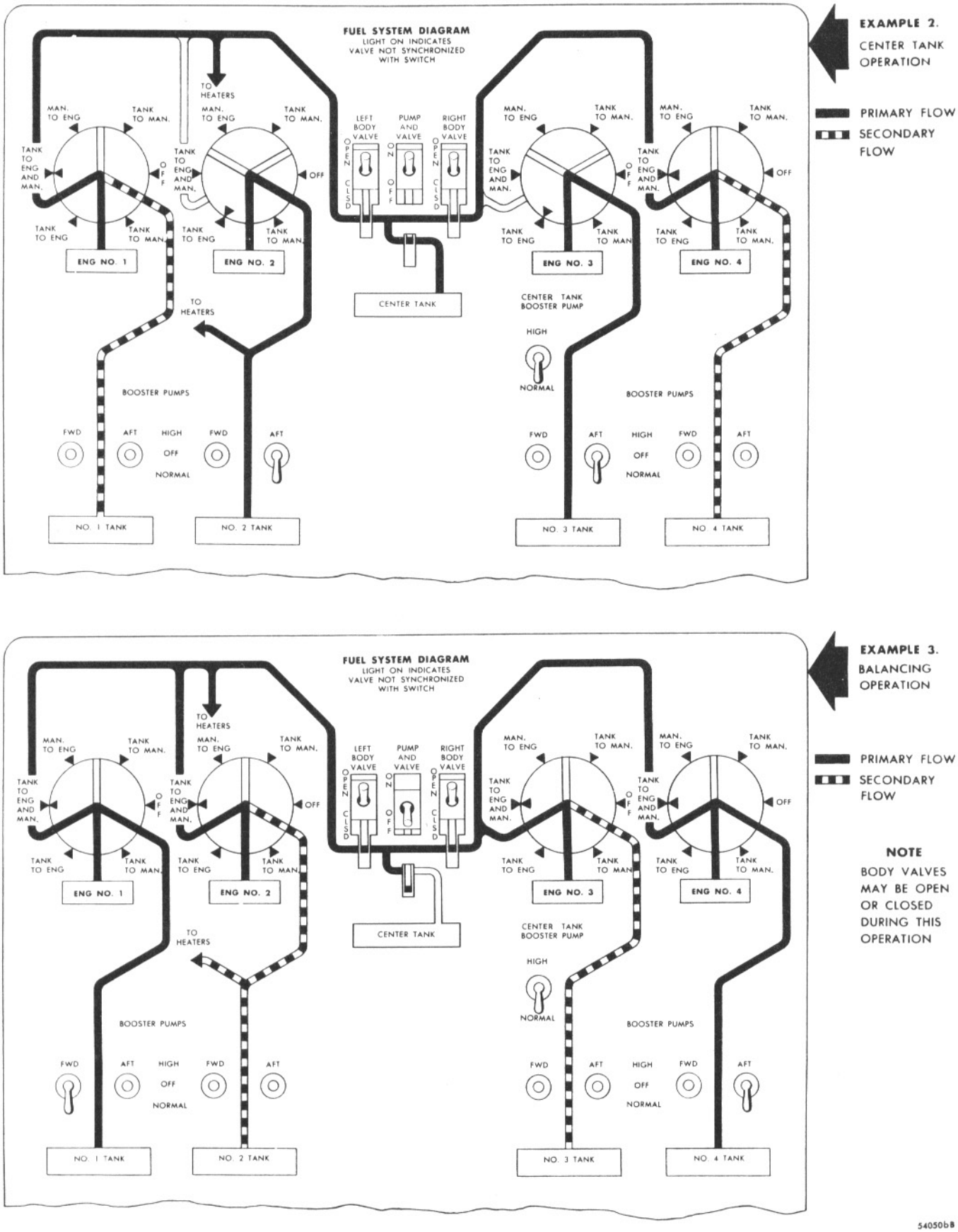
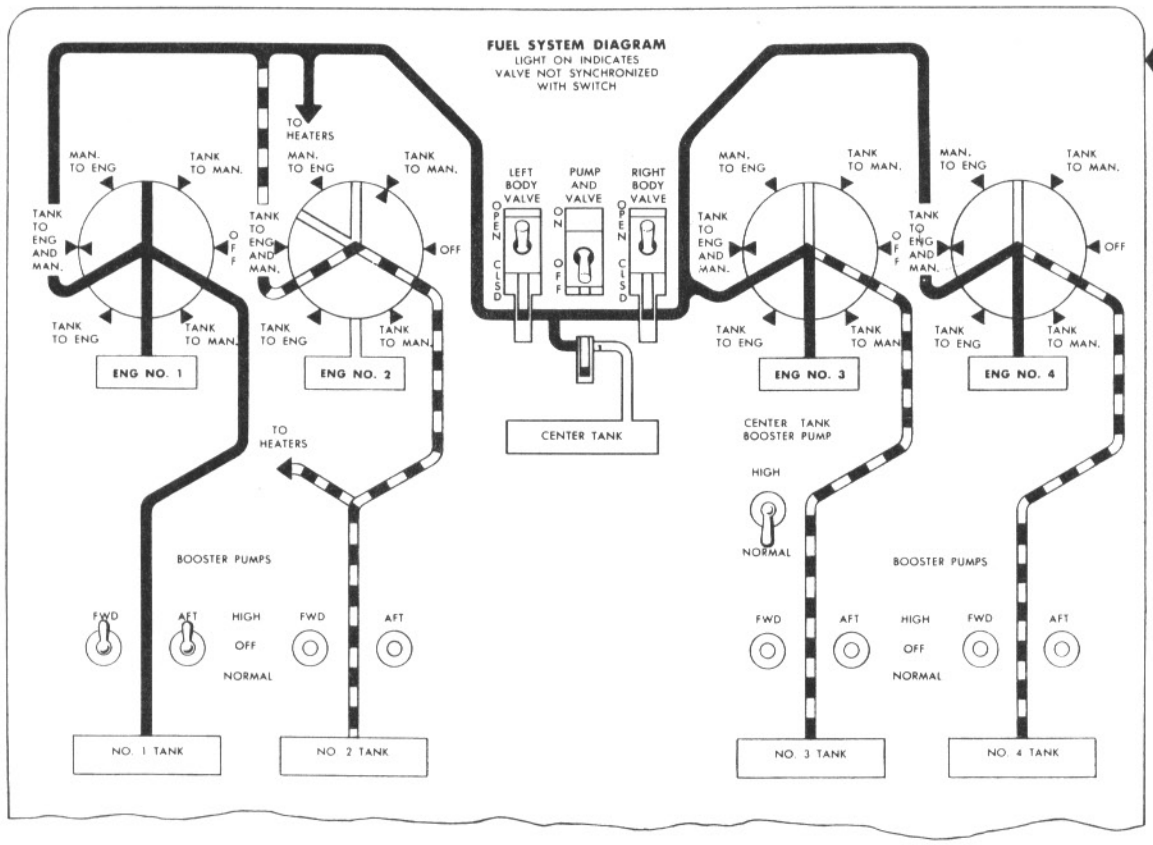



*Figure 2-1 (Sheet 2 of 3 Sheets). Fuel System Management*

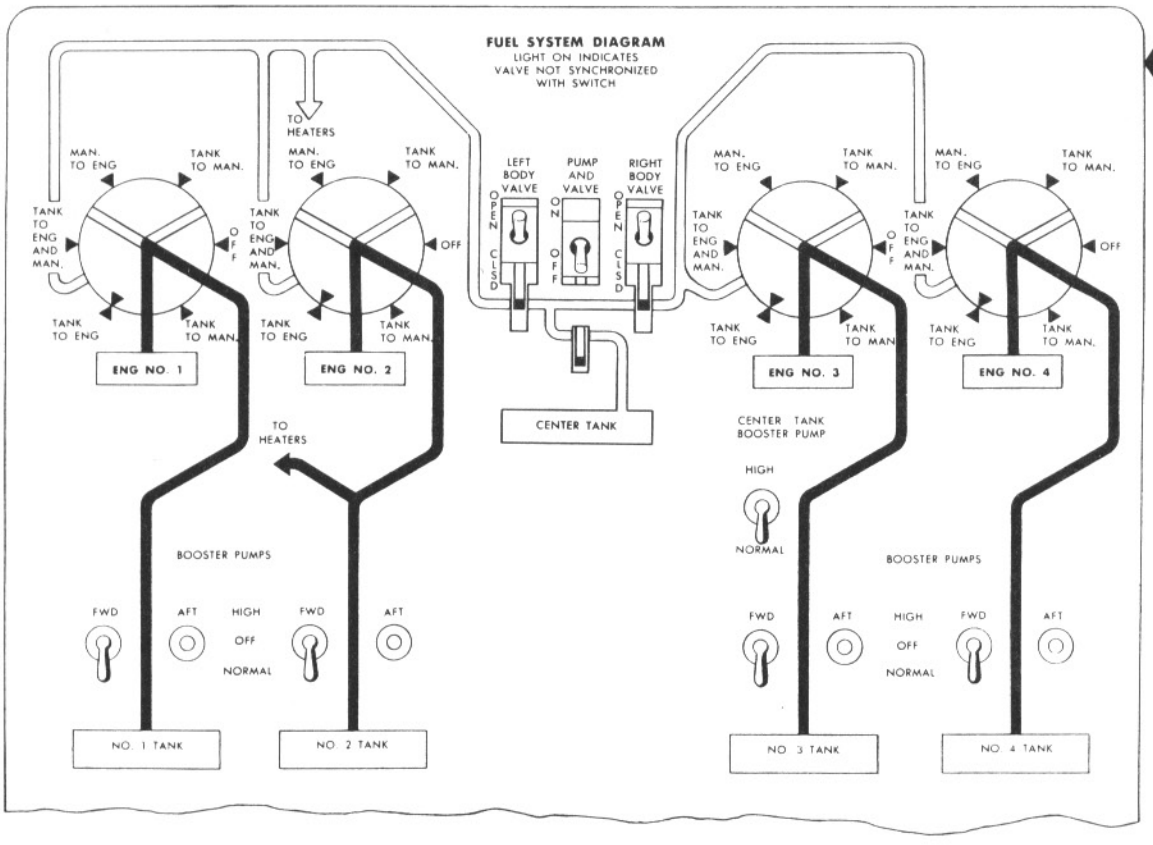



**EXAMPLE 4.**
EMERGENCY OPERATION

TANK NO. 1 LEAKING, ENGINE NO 2 FAILED

PRIMARY FLOW
SECONDARY FLOW

**NOTE**
ABOVE 10,000 FEET 2 ADDITIONAL PUMP SHOULD BE ON "NOR MAL"




**EXAMPLE 5.**
STARTING AND IN-FLIGHT OPERATION

TANKS BALANCED (BOOSTER PUMPS "OFF" BELOW 10,000 FEET)

**NOTE**
BODY VALVES MAY BE OPEN OR CLOSED DURING THIS OPERATION

54058cB

***Figure 2-1 (Sheet 3 of 3 Sheets). Fuel System Management***

STARTING AND IN-FLIGHT OPERATION. Set the engine fuel selectors to the "TANK-TO-ENG." position and turn one booster pump for each of the tanks on "NORMAL." Leave the center tank "PUMP & VALVE" switch "OFF" and the body-valve switches "OPEN." See example 5 of figure 2-1.

CENTER TANK OPERATION. To allow expansion of trapped fuel, bleed holes are provided in the fuel system check valves which are located downstream of each fuel booster pump. If one or more fuel tanks are supplying the manifold, with booster pump on (primary flow), and one or more of the remaining tank selector valves are in the "TANK-TO-ENG.-AND-MAN." position, with booster pump off (secondary flow), these bleeds will allow approximately 50 gallons of fuel per hour (70 gallons per hour if the supplying tank booster pump is on high boost) to enter each of the wing tanks not supplying the primary flow. See example 2 of figure 2-1. Therefore, prior to use of center tank fuel, use sufficient fuel from each of the wing tanks which will be supplying secondary flow (tanks 1 and 4) to prevent their overfilling from this bleed source.

After reaching a safe altitude and setting up climb powers, use the fuel in the center tank first. Set the fuel selectors for engines Nos. 1 and 4 to the "TANK-TO-ENG.-AND-MAN." position, check the body-valve switches "OPEN," turn the center tank "PUMP AND VALVE" switch "ON," and the center tank booster pump on "NORMAL." See example 2 of figure 2-1. Turn both booster pumps for tanks Nos. 1 and 4 and one booster pump for each of tanks Nos. 2 and 3 "OFF." Check the remaining booster pumps for tanks Nos. 2 and 3 on "NORMAL." This will allow the fuel from the center tank to supply engines Nos. 1 and 4. After the center tank is empty, turn one booster pump each for tanks Nos. 1 and 4 "ON" if flying above 10,000 feet altitude, turn the fuel selector valves to the "TANK-TO-ENG." position, and then turn the center tank switch off. In order to avoid inadvertent loss of power, due to depletion of center tank fuel, the center tank booster pump may be turned to "HIGH" and the affected wing tank booster pumps turned to "NORMAL" when approximately 300 pounds of fuel remain in the center tank.

CAUTION

When changing the fuel selector valves or booster pump switches, watch the fuel pressure. A restoration of fuel pressure after a drop may result in engine overspeeding due to power variation. The overspeeding occurs so rapidly that it is necessary to have a hand on the throttles for immediate power reduction whenever making a booster pump or selector valve change. At altitude, set booster pump speeds before accomplishing selector valve change. Always have at least one booster pump on when using the manifold system.

CAUTION

When a fuel selector is changed, watch for proper synchronization of the selector switch and selector valve. This is indicated by the warning light illuminating during the change and going out as synchronization is accomplished.

FUEL BALANCING OPERATION. Balance uneven fuel quantities in the main wing tanks so that tanks Nos. 1 and 4 are either full or their quantities exceed tanks Nos. 2 and 3, respectively. Do not reduce fuel in tanks 1 and 4 below that in tanks 2 and 3 respectively. Select the main tank or tanks with the greatest amount of fuel and turn the booster pumps to "NORMAL," then set the fuel selectors to the "TANK-TO-ENG-AND-MAN." position. See example 3 of figure 2-1. Turn the other main tanks booster pumps "OFF" to create a differential pressure that allows the selected tank to supply fuel in preference to the other tanks. When the fuel quantities are equal, return the selectors to "TANK-TO-ENG" and turn the tank booster pumps "OFF," or if flying above 10,000 feet, turn at least one booster pump in each tank on "NORMAL." Set all selectors to "TANK-TO-ENG" for approach and landing.

NOTE

A lateral fuel unbalance equal to the moment produced by one-half an outboard tank of fuel (5400 pounds) may be handled with only a portion of the aileron and rudder control being required.

FUEL SYSTEM EMERGENCY OPERATION.

SELECTOR VALVE MALFUNCTION. Failure of the fuel selector valve to synchronize with the selector switch, after selector switch actuation, will be indicated by the indicator lights. Rotate the selector switch 360 degrees in the opposite direction in which the switch was originally rotated. If a poor electrical connection is the source of trouble, the above action should give the desired valve position. If foreign material is freezing the valve, the above action may release the valve. Watch fuel pressures closely during the above procedure and be ready to reduce power if necessary. Check to see that circuit breakers are set.

FUEL TANK FAILURE. If a fuel tank is obviously leaking in flight, emptying of the tank may be accelerated in the following manner: Set all fuel selectors to the "TANK-AND-ENG.-TO-MAN." position; check body valve switches "OPEN," turn the leaking tank booster pumps to "HIGH" and turn all other booster pumps "OFF." See example 4 of figure 2-1.

When the leaking tank is nearly empty, turn one of the booster pumps in each main tank to "NORMAL." When the leaking tank is empty, turn the selector to the "MAN.-TO-ENG." position and turn the leaking tank booster pumps "OFF."

NOTE

The service life of the booster pumps when in high boost is limited. Therefore, care should be taken to avoid unnecessary use.

FUEL LINE OR ENGINE FAILURE. If an engine or a fuel line between the engine and the fuel selector valve has failed, shut the fuel off by means of either the fuel selector knob or by the fuel valve switch on the emergency fire panel. If the fuel fire switch is used, rotate the selector knob to the "OFF" position to resynchronize the valve and knob positions.

If subsequent to the emergency it is desired to use the fuel in the tank affected for continued operation of the remaining engines, the following applicable procedure should be employed:

a. If the fuel selector knob was used to shut the fuel off, rotate the fuel selector knob to the "TANK-TO-MAN." position. Fuel from that tank will then supply the manifold.

b. If the fuel fire switch has been used to turn the fuel off and it is desired to retain the oil and hydraulic shutoff valves in the closed positions (to prevent oil or hydraulic fluid from entering the nacelle because of possible fire hazards), pull the "OIL HYD. & TURBO BLEED" circuit breaker on the overhead panel. Then rotate the fuel selector knob to the "TANK-TO-MAN." position and move the fuel fire switch to the "NORMAL" position. Fuel from that tank will then supply the manifold.

FUEL DUMPING. Fuel may be dumped in climb, level flight, or glide. Fuel may be dumped from any one selected tank or all tanks simultaneously. Fuel from one tank will jettison at an approximate rate of 135 gallons (810 pounds) per minute. Fuel from two tanks, using the same chute, will jettison at an approximate rate of 180 gallons (1080 pounds) per minute. All the fuel in the wing tanks can be dumped except that required for approximately 45 minutes of operation at 75% power. If an emergency arises and it is necessary to dump fuel to decrease the airplane gross weight, the following procedure is recommended:

a. An air speed of approximately 190 MPH (165 knots) IAS is recommended.

b. Do not operate radio transmitters.

c. Avoid changing power during fuel dumping.

d. Dump fuel as desired.

WARNING

Do not dump fuel with flaps extended or on the side of the airplane having the landing gear extended.

e. After the desired amount has been dumped, move the switches to "CLOSED" and visually check stoppage of flow.

f. Fuel quantities should be observed during dumping to avoid unfavorable lateral control. When dumping fuel from only one side of the airplane, do not exceed limitations as given under "Fuel System Management, Restrictions."

CRASH LANDINGS. The body fuel valves and the center tank valve must be closed before making a crash or belly landing.

## BEFORE STARTING ENGINES (POWER ON)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Power off check completed | | 1. Turn master switch "ON" |
| 2. Check auxiliary operator's report and ground crew report | | 2. Check battery voltage by turning the DC voltage selector to "BUS" and then turn batteries No. 1, No. 2, and No. 3 "ON" separately and read indicated voltage |
| | | 3. Turn all batteries "ON" if start is to be made on batteries; if external power is connected, leave No. 2 and No. 3 battery switches "OFF" and No. 1 on "CHG" |
| | | 4. Set essential load inverter selector to "NORMAL" (No. 1) inverter and check voltage on "ESSENTIAL LOAD"; place "SECONDARY LOAD" on "NO. 2" inverter, and "LIGHTS" on "NO. 3" inverter and check voltages |
| 5. Lights as desired | 5. Lights as desired | 5. Lights as desired |

54084o8

BEFORE STARTING ENGINES (POWER ON) (CONTINUED)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 6. Test warning and indicator lights | | 6. Rotate fuel selector valves to each position; check fuel pressures at each position and warning lights for synchronization of valves; then return to "TANK-TO-ENG." position |
| 7. Check fuel and oil quantities against dip stick readings | | 7. Test the smoke detection and air conditioning warning systems |
| 8. Radios as required | | 8. Fire detection system checked |
| | 9. Test warning lights | 9. Test warning lights |
| 10. Check instruments | 10. Check turbo bearing temperature alarm panel | 10. Check instruments |
| | 11. Check if external $CO_2$ is connected | 11. Check ADI quantity |
| 12. Hold propeller control levers in "INCREASE RPM" for a few seconds and release to neutral | | 12. "NO SMOKING, FASTEN BELTS" signs "ON" |
| 13. Turbo-boost lever "0" (zero) | | 13. Cowl flaps open |
| 14. Turbo-override switches "TAKE-OFF" | | 14. Oil coolers "AUTO" |
| 15. Move propeller master synchronizer to full "INCREASE RPM" | | 15. Carburetor air "RAM" |
| 16. Passengers aboard and seated | | 16. Preheat closed |
| 17. Doors closed and locked, briefcase aboard | | 17. Intercooler closed |

ENGINE FIRES.

ENGINE FIRES ON THE GROUND. The following procedure should be followed in case of an engine fire on the ground.

a. Discontinue priming.
b. Discontinue cranking.
c. Close the throttle.
d. Move mixture control to fuel cutoff.

If fire continues:

e. Place fire gang switch in the "FIRE" position.
f. Signal ground attendant to release ground $CO_2$ supply.
g. If no external $CO_2$ is available, discharge the airplane supply (hold for five seconds).
h. Turn fuel boost pumps off.
i. Turn fuel selector switch off.
j. If fire continues, order evacuation.
k. Reset fire extinguisher selector to "NORMAL" if fire is out.

NOTE

There is no fire extinguisher valve actuation until the bottle is selected.

WARNING

Reset the fire extinguisher valve switch to "NORMAL" position when fire is out.

54084b8

AUXILIARY OPERATOR

1. Note manifold pressure for power check reference
2. Check ignition "OFF"
3. Have propellers slowly pulled through 8 blades

NOTE

If any resistance is encountered when pulling the propellers through, indicating a hydraulic lock; remove the drain plugs from the lower intake manifolds and, if necessary, also remove one spark plug from each of the lower cylinders; and drain out fuel or oil.

5. Check fireguard for all clear on No. 3 engine

COPILOT

1. Note manifold pressure for power check reference
2. Mixture "FUEL CUTOFF"
3. Turn cooling system compressors "OFF" during engine starting to prevent electrical system overload
4. Set fuel selectors to "TANK-TO-ENG." position and turn one booster pump for each main tank to "NORMAL," leave center tank switch "OFF"
5. Engine starting sequence 3, 4, 2, 1
6. Place fire extinguisher valve selector switch for engine No. 3 to the "FIRE" position
7. Set engine starting selector to "3" (figure 1-5)
8. Push the "START" button and after propeller has turned approximately three blades, turn the ignition switch for No. 3 engine to "BOTH," then push "BOOST," and "PRIME" in accordance with the following cylinder head temperatures

| Cyl. Head Temp. | Prime ON | Prime OFF |
|---|---|---|
| *Below 0°C | 2 seconds | 2 seconds |
| *0 to 100°C | 1 second | 2 seconds |
| 100° to 150°C | Same as above but omit first 1 second prime | |
| 150° to 200°C | No prime for 5 seconds then prime 1/2 second "SHOTS" at 2 or 3 second intervals as required | |

Repeat above ON--OFF prime until the engine starts.

*Estimated

50101

CAUTION

Do not prime engine before engaging starter. To prevent hydraulic lock, avoid every possibility of liquid fuel collecting in the intake pipes or cylinders.

54085oB

STARTING ENGINES (CONTINUED)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 9. Watch for oil pressure rise<br><br>CAUTION<br><br>If oil pressure does not register 50 PSI within 10 seconds, stop engine and investigate. | | 9. When a definite indication of engine starting is observed, slowly adjust the throttle until 800 RPM is obtained; contunue priming until the engine is running steadily and release the "START" and "BOOST" switches; then slowly move the mixture control to "AUTO-RICH" and stop priming<br><br>CAUTION<br><br>Do not attempt to assist start with throttle or mixture control. |
| 10. After oil pressure rises, adjust throttle to 1000 RPM for engine warm-up | | 10. In moderate to warm weather, if engine does not start in 20 to 30 seconds, turn off booster pumps and ignition switch; continue cranking for 5 to 10 seconds with ignition "OFF," mixture controls in "FUEL CUT-OFF," and throttle open; repeat starting procedure omitting the first prime |
| | | 11. If engine fires but does not continue to run, move mixture control to "FUEL CUTOFF" and continue cranking; if engine does not start within 30 seconds from time of engaging, stop cranking and allow starter to cool before repeating starting procedure |
| 12. When engine is running smoothly, turn off booster pump | | 12. When engine is running smoothly, place the generator switch in the "FIELD ON--RELAY ON" position |
| | 13. Alert fire guard for all clear on each engine to be started | 13. Return the fire extinguisher valve switch for the started engine to "NORMAL" and place the switch for the next engine to be started to "FIRE" |
| 14. Repeat starting procedure for the remaining engines (steps 5 to 13) | | 14. Repeat starting procedure for the remaining engines (steps 5 to 13) |
| | | 15. Turn starter selector "OFF" |
| | | 16. Check all fire control switches "NORMAL" |
| | | 17. Return cooling system compressors to "AUTO" |

54085b8

TAXIING INSTRUCTIONS.

NORMAL. After taxiing clearance is received, signal for wheel chock removal, then release the parking brakes. Idle the engines at the lowest possible speed.

NOTE

If the air conditioning system is operating, the engines must be operating at approximately 1000 RPM to provide required electrical output. If it is desired to taxi with only the two inboard engines operating, turn off one of the cooling system switches to reduce the required electrical output.

Use the brakes to control the speed, but do not "ride" the brakes. If the airplane is rolling too fast, apply the brakes firmly until the airplane almost comes to a full stop, then release the brakes entirely. Keep taxiing speed as low as possible. In a strong crosswind, advance the outboard up-wind engine to keep the airplane from tending to weathercock into the wind. The airplane is steered while taxiing by turning the steering wheel in the direction desired.

EMERGENCY. If, while taxiing, the hydraulic system and emergency brakes fail, and the hydraulic pressure cannot be raised with the hand pump, use propeller reverse-thrust action for braking the airplane.

NOTE

Due to irregular and inefficient cooling of the engines while the propellers are reversed, propeller reversing, except for landing, should be limited to only those operations which are necessary, and then held to an absolute minimum of operating time. Do not reverse the propellers if the engines are hot from ground operation. If the airplane rolls backward due to reverse pitch operation, apply brakes cautiously.

Since the steering system will usually be inoperative when the brakes fail, it will be necessary to use the engines for steering the airplane, as the nose wheel will caster freely.

As soon as the airplane is clear and the danger of collision is past, again operate the reverse-thrust throttles to stop the airplane and place the mixture controls in the "FUEL CUTOFF" position. While this is being done, move the inboard engine throttles to the normal open position to return the propellers to normal pitch.

## WARM-UP AND TAXI

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Warm up engines at 1000 RPM | | 1. Check hydraulic pressures within limits; if emergency pressure is low, open the charging valve until the pressure is equal to the main pressure, then return charging valve to "CLOSED" |
| | 2. Have external power source disconnected | 2. Check booster pumps "OFF" |
| 3. Nose wheel steering disconnect button up, light out | 3. Check that external telephone, interphone, and $CO_2$ are disconnected | 3. Turn batteries Nos. 2 and 3 "ON"; if external power is not available and the batteries were used for starting, turn battery No. 1 from "ON" to "CHG" |
| | | 4. Lock mixture controls |
| | | 5. Check air conditioning switches "AUTO" and air conditioning master switch "ON" |
| 6. Check instruments and gyro erection | | 6. Check instruments and gyro erection |
| | | 7. Move alternator control switches to "RESET," then "ON" and check AC voltage by turning the AC voltmeter selector switch to the indicated positions, then return voltmeter selector to "ESSENTIAL BUS" position |
| 8. Obtain cabin report | | 8. Door warning light out |

54087 oR

WARM-UP AND TAXI (CONTINUED)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 9. Weight and balance rechecked | | 9. Check ignition for safety grounding at warm-up RPM by momentarily turning each ignition switch from "BOTH" to "RIGHT" and back to "BOTH," then to "LEFT" and back to "BOTH," then to "OFF" and back to "BOTH"; a slight RPM drop when on each magneto bank and a complete cutting out at "OFF" indicate a safe ignition system and the engine can be operated for a power check |
| 10. Obtain taxi clearance | 10. Have chocks removed | 10. Report to pilot ready to taxi |
| 11. Taxi to run-up area | | 11. Check wing flap operation; lower the flaps to approximately $10^{o}$ and then return them to up |
| | | 12. Set rate-of-change selector to "0" (zero) and cabin altitude selector to the desired value |

54087b8

HYDRAULIC SYSTEM OPERATION.

NORMAL OPERATION. Hydraulic pressure is normally supplied by engine-driven pumps mounted on engines Nos. 2 and 3. With normal usage sufficient hydraulic pressure can be maintained with either pump inoperative.

RUDDER BOOST OPERATIONAL CHECK. Operation of the rudder boost shutoff valve should be accomplished prior to takeoff thereby insuring that the rudder boost system is operative. The following convenient rudder boost check may be accomplished prior to takeoff.

a. Have inboard engines at idling RPM and do not operate any hydraulically-actuated equipment, i.e., the windshield wiper, nose wheel steering, and normal or emergency brake systems.

b. With the rudder boost switch "OFF," note the force required to move the rudder pedals back and forth through their full travel and that the rudder boost hydraulic pressure gage needle does not fluctuate.

c. Return pedals to neutral and then turn rudder boost switch "ON." As the pedals are again moved back and forth through their full travel, the force required should be noticeably less than in step "b" and the pressure gage needle should fluctuate, thus indicating that hydraulic pressure is being utilized for rudder actuation.

NOTE

It is not intended that this procedure be used for checking the system after maintenance work has been performed which necessitated the replacement of units in the rudder control or rudder boost system.

EMERGENCY OPERATION. In the event both hydraulic pumps become inoperative or the main hydraulic system loses pressure due to line or accumulator failure, but leaves the service brake system operative, the hand pump can be used to operate the service brakes by depressing the brake pedals and supplying pressure with the hand pump. If hydraulic fluid is lost due to a ruptured line, a half-gallon reserve is available to the hand pump for service brake operation.

EMERGENCY BRAKE OPERATION. The emergency brake system is charged by placing the charging valve in the "OPEN" position and charging with system or emergency hand pump pressure. (The hand pump is normally not used to charge the system.) When charging is complete, return the selector valve to the "CLOSED" position. The emergency hand brakes will still operate should the service brake system fail provided failure does not include both expander tubes of one landing gear. When applying the emergency hand brakes use steady applications. During cross-wind handling, apply one steady application on both levers, increase leverage on one handle to obtain the desired differential braking. When the leverage is released the pressure is lost. Do not pump the hand levers as this action will rapidly deplete the emergency system pressure. Only three or four applications of the emergency brakes are available, starting with full accumulator pressure (1650 PSI).

EMERGENCY NOSE WHEEL STEERING. If the nose wheel steering mechanism is malfunctioning and the direction of the airplane is uncontrollable, actuation of the nose wheel steering emergency disconnect switch will by-pass the hydraulic pressure used for steering and allow the nose wheel to caster freely. When the switch is actuated a light within the switch is illuminated. The nose wheel will also caster freely if the pressure in the main hydraulic system is lost.

OIL SYSTEM MANAGEMENT.

TRANSFER OPERATION. To replenish the engine oil tanks while in flight, the central oil system selector is set to the desired tank to be refilled and the pump switch is held "ON" until the desired quantity is reached. Turn the selector to the next tank and repeat the procedure. Return the selector to "OFF" when the oil transfer operation is completed.

CAUTION

Do not fill the engine oil tanks to a quantity of more than 28 gallons when flying above 15,000 feet altitude. This is to prevent overfilling, caused by increased scavenging during descent. The tanks should not be overfilled as oil will be discharged overboard through the engine breather.

Both nacelle and central oil tank gages should be observed during oil transfer at low temperatures. If no transfer of oil is indicated by the engine and central oil tank gages after one minute of transfer pump operation, it may be an indication of congealed oil in the lines and further operation should be deferred until the oil is warmed by reducing altitude or use of the wing anti-icing heat.

NOTE

Oil is transferred at the rate of 6 gallons per minute. Do not operate the pump longer than 8 minutes without a cooling period.

GROUND TEST

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Turn airplane into the wind for ground test | | 1. When the engine oil temperatures are above 40° C, notify pilot that engines are ready for ground check |
| 2. Advance all throttles to 1500 RPM | | 2. With all engines at 1500 RPM, check generator load balance |
| 3. Turn autopilot on | | 3. Hold each propeller control lever in "DECREASE RPM" until 1300 RPM is indicated, then move and hold each lever in "INCREASE RPM" until 1500 RPM is indicated; then place the levers in "AUTO" |
| | | 4. Move the master synchronizer lever toward "DECREASE RPM" until 1200 RPM is indicated; all engines should reduce RPM and remain synchronized<br><br>NOTE<br><br>If the master synchronizer lever is moved to the full "DECREASE RPM" position, the propeller master synchronizer motor will be cut out and the indicator light will illuminate. |
| 5. Return the throttles to idle RPM after the synchronizer lever reaches full "INCREASE RPM" | | 5. Return the master synchronizer lever to the full "INCREASE RPM" position with a rapid movement; the synchronizer indicator light should briefly illuminate and then go out when the synchronizer motor speed matches the control lever position; the engines should return to 1500 RPM<br><br>NOTE<br><br>Should the synchronizer indicator light fail to illuminate, the protective relay circuit is malfunctioning. |

GROUND TEST (CONTINUED)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 6. With engines idling, check propeller reverse-pitch by lifting up on the throttles and moving toward "REVERSE OPEN"; RPM increase followed by a decrease denotes propeller reversal; return throttles to normal open position, propellers will automatically return to normal pitch | | 6. Check that all propellers reverse and unreverse by observing the synchronous movement of all tachometers |
| NOTE<br>The cylinder head temperature is not a reliable indication of true engine temperatures while the propellers are reversed, therefore keep the length of time the propellers are reversed to a minimum. | | |
| 7. With all engines operating at 1000 RPM, place the automatic feathering arming switch in the "TAKE-OFF & CLIMB" position; hold the auto-feather test switch to the "TEST" position for the propeller being checked; the red indicator light should illuminate and the green system-armed indicator light go out; as soon as a 300 RPM drop has occurred, release the test switch and turn the arming switch "OFF" | | 7. During auto-feathering check, move the generator switch for the engine being run up to "FIELD ON--RELAY OFF--BLOWER OFF" position; turn the DC voltmeter selector to the respective position and read the generator voltage; then return generator switch to "FIELD ON--RELAY ON" position |
| 8. Repeat the auto-feathering check (step 7) for the remaining engines | | 8. Repeat generator check (step 7) for remaining generators |
| 9. With turbo-override switches in "TAKE-OFF," advance one throttle at a time to a manifold pressure equal to the field barometric pressure (noted on manifold pressure indicator before starting engines), engine RPM should be approximately 2050 RPM | 9. When pilot adjusts the throttle, note EBP (exhaust back-pressure) for turbo check reference | 9. Check magnetos and superchargers when pilot sets power condition; switch ignition from "BOTH" to "RIGHT" and back to "BOTH," note RPM drop; switch ignition to "LEFT" and back to "BOTH," again note RPM drop; normal drop on either "LEFT" or "RIGHT" is 60 to 80 RPM; maximum drop should not exceed 100 RPM; if abnormal magneto drop or engine roughness is observed, do not attempt a take-off<br>WARNING<br>Do not turn ignition switch "OFF"; if accidentally turned off, move mixture to "FUEL CUTOFF" to prevent turbo or exhaust system damage.<br>CAUTION<br>Do not exceed 232° C cylinder-head temperature during ground operation. |

54088b8

GROUND TEST (CONTINUED)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| | 10. When the copilot places the turbo control override switch to "TAKE-OFF," note that the exhaust back-pressure returns to the value noted in step 9. | 10. Place the turbo selector lever to "0," the respective turbo control override switch to "CLIMB & CRUISE," and align the calibrating potentiometer with barrier index; then move the turbo boost lever to "7"; check for a manifold pressure increase of 2 inches, plus 1.5 inches for each 1000 feet of field altitude above sea level; place the turbo control override switch to "TAKE-OFF" and note that exhaust back-pressure and manifold pressure return to their original values; then, move the turbo-boost lever to "0"<br>NOTE<br>A slight variation of the manifold pressure increase between engines may be compensated for by adjusting the respective calibrating potentiometer but if the system is badly out of calibration, a malfunction of the control system, turbosupercharger, or engine probably exists. |
| 11. Return the throttle to idle and repeat step 9 for the remaining engines | | 11. Repeat steps 9 and 10 for the remaining engines |
| 12. Check autopilot operation | | 12. Check oil temperature |
| | | 13. Check oil pressure |
| | | 14. Check fuel pressure |
| | | 15. Turn ADI pumps on, check ADI pressure lights on, and then turn pumps off |
| | | 16. Report to pilot engine ground test completed |

54088cB

WATER INJECTION SYSTEM EMERGENCY OPERATION.

Failure of the water injection system to operate on any engine is indicated by:

a. Illuminated indicator light, denoting insufficient pressure.

b. Higher fuel flow to the affected engine.

c. A lower torquemeter indication for affected engine.

Moving the corresponding "ADI VALVE" switch to "OPEN" may correct the difficulty if the manifold pressure switch or its wiring is at fault. If this does not correct the trouble, the malfunctioning system should be turned off by the corresponding "CLOSE ADI VALVE" switch in the fire gang.

If an engine fire occurs during the operation of this system, any one or all the ADI valves can be closed by their respective fire switches.

CAUTION

Do not use water injection when engine is not operating or when it is operating at low idling speed.

TURBOSUPERCHARGER NORMAL OPERATION.

PREFLIGHT ADJUSTMENT. In order to assure consistent power response on this airplane during power changes while in flight, it is desirable to calibrate the turbosupercharger controls prior to take-off. This can be done during magneto checks prior to each flight. The magneto checks will be made at approximately 2050 RPM as obtained by throttling to a manifold pressure equivalent to the field barometric pressure. With the turbo control override switches in the "CLIMB AND CRUISE" position, check the TBS lever at "0" and the index marks of the individual calibrating potentiometers aligned with their respective barrier indices; then set each throttle, one at a time, to the above condition. Move the TBS lever to position "7." The absolute intake manifold pressure for each engine should increase 2 inches of mercury plus an additional 1 1/2 inches of mercury for each thousand feet the field is above sea level. Proper control system calibration is indicated if the above values are obtained.

NOTE

The above settings should give the 32 inches of mercury carburetor deck pressures required for cabin air flow.

After adjusting manifold pressure per the above, note the MAP and EBP (exhaust back-pressure). Then place the turbo control override switches in the "TAKE-OFF" position and note a return of MAP and EBP to the original values. This indicates correct functioning of the manual turbo control override system. Leave the override switches in the "TAKE-OFF" position until after take-off. Return the TBS lever to zero. Slight variations of individual engines can be compensated for by adjusting the respective calibrating potentiometer knob, but if the entire system is revealed to be badly out of calibration, induction system leakage or possible malfunction of the control system, supercharger, or engine probably exists.

CLIMB. When setting up power following first power reduction, place the turbo control override switches in the "CLIMB AND CRUISE" position and then apply turbo and part throttle as required to hold desired MAP and to set cabin differential flow gages within the green operating range. If it becomes evident that all the superchargers are not operating, check that the turbo control circuit breakers are set and fuses are not blown. If only one of the superchargers should fail to function, move the turbo control override switch for that supercharger back to "TAKE-OFF"; pull out the turbo auto override circuit breaker and reset it; wait 15 seconds and then move the turbo control override switch back to "CLIMB AND CRUISE." During climb, slight increases in the TBS control will be required to maintain the desired MAP and differential pressure. For 2800 horsepower climbs, use full throttle, turbos as required, and resultant cabin pressure. When setting up 2800 horsepower, advance the throttles until the stops are reached then advance the TBS lever slowly. Allow sufficient time for power to stabilize after each lever movement. This is to prevent inadvertent overboost and excessive back-pressures which might result in an open waste gate and some loss of power.

CAUTION

To avoid inadvertent power surge in flight, the turbo control override switches must be in the "CLIMB AND CRUISE" position BEFORE moving the TBS lever forward.

HIGH ALTITUDE CLIMB AND CRUISE. The BH-4 turbosupercharger is rated for continuous operation at 20,000 RPM. The maximum allowable RPM, as controlled by the turbo governor, is 22,000 RPM. Operation above 20,000 RPM is restricted to 15-minute periods. Operation at powers exceeding those in the following table should, therefore, be limited to 15-minute periods.

| ALTITUDE | POWER (Based on 20,000 Turbo RPM) |
|---|---|
| 21,500 feet | 2800 BHP |
| 23,500 feet | 2600 BHP |
| 25,500 feet | 2400 BHP |
| 27,500 feet | 2200 BHP |

CRUISE OPERATION. Set up cruise power with maximum throttle and minimum turbo, using no more turbo than required to maintain cabin differential within green range.

DESCENT. Throttle engines as required for descent and advance the TBS control to keep within the green range (cabin air flow gage). If full TBS is inadequate for cabin requirements with symmetrical power, advance power on the inboards and reduce power on the outboards to obtain desired air flow.

APPROACH. Turbo off on or before final approach.

54086B

TURBOSUPERCHARGER EMERGENCY OPERATION.

OVERBOOST. If MAP or EBP becomes abnormally high during take-off or flight, retard throttle to obtain normal MAP. As soon as feasible, reduce power further and attempt to remedy this situation.

NOTE

The exhaust back-pressure gages may give an earlier and more marked indication of overboost than the manifold pressure gages.

EXCESSIVE BACK-PRESSURE. Should the exhaust back-pressure reach 49 (+ 1/- 2) inches of mercury, the waste gate will automatically open. The waste gate will remain in the open position until the automatic override relay is reset. The following procedure should be followed to reset the relay and regain normal control of the supercharger:

a. Move the turbo control override switch to the "TAKE-OFF" position.

b. Rotate the respective calibrating potentiometer full counterclockwise.

c. Pull and reset the appropriate turbo auto override circuit breaker.

d. After the turbo auto override circuit breaker has been reset, wait 15 seconds (to allow sufficient time for the amplifier to warm up) and then move the turbo control override switch back to "CLIMB AND CRUISE."

e. Slowly rotate the calibrating potentiometer back to the barrier index or previous setting. Observe the back-pressure closely. If the back-pressure does not stabilize at a normal value, move the override switch back to "TAKE-OFF." In such a case, check the amplifier fuse and/or replace the amplifier. Allow 15 seconds for warm-up and repeat steps "b," "c," and "d."

If normal back-pressure cannot be obtained by the above procedure, monitor power on the engine and remove the amplifier fuse. This will allow the waste gate to trail in a position which will generally provide adequate turbo for high altitude cruise operation. Necessary power adjustment must be made with the throttle. If reasonable control cannot be maintained with the throttle, place the turbo override switch to "TAKE-OFF" and operate that engine with open waste gate.

TURBOSUPERCHARGER FAILURE. If a turbo failure is suspected, as indicated by a bearing overheat warning or increased EBP at constant power, the turbo waste gate should be opened for the remainder of the flight by placing the turbo control override switch (for the affected engine) in the "TAKE-OFF" position.

MANUAL POSITIONING OF THE WASTE GATE. Turbo waste gate characteristics are such that cruising power can often be maintained at altitude in spite of control system failures. This is accomplished by de-energizing the control system and allowing the waste gate to assume a trailing position. The following paragraphs illustrate means of power control which generally will be effective. The rate and degree of response of individual waste gates to these procedures will vary considerably due to manufacturing tolerances in the gates and perhaps due to differences in exhaust flow over the gates. The greatest response occurs at high powers and low altitudes.

a. Loss of boost: Loss of boost which cannot be regained by adjustment of the turbo control lever and calibrating potentiometer knob, and/or by changing the amplifier may be due to certain types of electrical failures in the turbo control system. This electrical failure may cause the waste gate to open, thus resulting in the loss of boost. In such case, it may be possible to regain substantial power by pulling the turbo amplifier fuse for the affected system, thus allowing exhaust gas loads to force the waste gate towards a closed position. If the movement of the waste gate is insufficient and results in only partial restoration of boost, further movement may be obtained by momentarily advancing throttle and increasing RPM.

b. Increase in boost: Certain electrical failures may cause the waste gate to tend to close and remain closed regardless of amplifier changes. Normal waste gate positions often may be obtained by first pulling the turbo amplifier fuse, thus cancelling the closing signal to the waste gate, and then momentarily move the turbo control override switch to the "TAKE-OFF" position to reposition the waste gate.

c. Power oscillations: If MAP or EBP surging and oscillation occurs, a dirty or defective potentiometer may be the cause. Remove the amplifier fuse to eliminate the oscillation.

54118B

## BEFORE TAKE-OFF

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Before taxiing onto the runway, turn the airplane into the wind and ground test the engines if not done previously | | |
| 2. Set trim tabs as desired for take-off | | 2. Check doors and windows |
| 3. Set altimeter and flight instruments | | 3. Set altimeter |
| 4. Check flight instrument power switch on "ESS. AC BUS" | | 4. Check flight instrument power switches on "SEC. AC BUS" |
| 5. Check gyro erection, align gyrosyn compass with flux valve and check vacuum within limits<br><br>CAUTION<br><br>Do not depress the aligning knob for more than 2 minutes. | | 5. Check gyro erection |
| 6. Autopilot "OFF" | | 6. Radios checked |
| 7. Check rudder boost "ON" | | 7. Move wing flap switch to "DOWN" until 25 degrees is reached, then switch "OFF" |
| 8. Place automatic feathering arming switch in "TAKE-OFF & CLIMB" position (green indicator light illuminated) | | 8. ADI override switches "AUTO," ADI pumps switch "ON" (pressure lights illuminated) |
| 9. Propeller control levers "AUTO" | | 9. Pitot heaters as required |
| 10. Master synchronizer lever full "INCREASE RPM" (synchronizer warning light out) | | 10. Oil cooler flaps switches "AUTO" |
| 11. Mixture "AUTO RICH" | | 11. Carburetor air "RAM" |
| 12. Turbo-boost lever "0" | | 12. Carburetor preheat "CLOSED" |
| 13. Turbo-override switches "TAKE-OFF" | | 13. Intercooler flaps "CLOSED" |
| 14. Throttle brake adjusted | | 14. Check generator switches on "FIELD ON--RELAY ON" position |
| 15. Check engine instruments within limits | | 15. Check inverter selector essential bus switch on "NORMAL," secondary bus switch on "NO. 2" inverter and lighting bus switch on "NO. 3" inverter |
| | | 16. Compressor "OFF"; body and thermal anti-icing combustion heaters "OFF" |

54089 ⌀ B

## BEFORE TAKE-OFF (CONTINUED)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 17. Check cylinder head temperature below 170° C before take-off | | 17. Cowl flaps set for take-off |
| | | To assure optimum take-off, with the hotter cylinder head temperature not exceeding 160°C to 170°C at the start of take-off, the following cowl flap gaps should be used: |
| | | O.A.T.° C — Cowl Flap Gap<br>To 20° — 1.5 inches<br>20° to 32° — 2.0 inches<br>Above 32°C — 2.5 inches on inboards, 2.0 inches on outboards |
| | | CAUTION<br>Cowl flaps should not be opened more than 3 inches since a larger opening will cause objectionable airplane buffeting |
| | | 18. Turn both booster pump switches for each main tank to "NORMAL," check fuel selectors set to "TANK-TO-ENG." position, and center tank switch "OFF" |
| | | 19. Control surface lock "UNLOCKED" if not done previously |
| 20. Controls tested for freedom of movement | | 20. Obtain take-off clearance |
| 21. Release brakes and taxi into take-off position | | |

ENGINE OVERSPEED.

ENGINE OVERSPEED DURING TAKE-OFF. If the engine overspeeds (not to be confused with momentary overspeed caused by power surge), the following action is recommended:

a. Throttle the overspeeding engine until the RPM is reduced below 2700 RPM.

b. Operate the propeller control lever in the "DECREASE" position until the RPM is controlled; then place the lever in the "FIXED PITCH" position.

c. If the above procedure fails and power is necessary, place the propeller control lever in the "FEATHER" position and when the RPM is within limits, return lever to "FIXED PITCH." This action can be repeated until a safe air speed is established. Reduce power and feather the propeller as soon as practical.

ENGINE OVERSPEED DURING FLIGHT. Severe overspeeding will occur if a propeller should go to flat pitch while the airplane is operating at normal speed at high altitude. Should this occur:

a. Reduce RPM by momentary use of the feathering system and simultaneous reduction of throttle and air speed.

b. If control of RPM is not achieved, attempt to feather.

c. If this is unsuccessful, decrease air speed to a minimum safe value and descend to lower altitude.

d. Evacuate passengers from the luxury and toilet compartments.

FAILURE OF THE SYNCHRONIZER MOTOR IN FLIGHT. If the synchronizer motor becomes inoperative in flight as indicated by the warning light, or if the propeller fails to synchronize, propellers may be operated by placing the selector lever in "FIXED PITCH" and adjusting the RPM manually by momentarily holding the lever in either the "INCREASE" or "DECREASE" position.

54089b8

## TAKE-OFF

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Advance throttles to take-off power; do not exceed 58.0 inches of manifold pressure (at 15° C CAT) and 2700 RPM | | 1. Check wing flaps at 25 degrees; when manifold pressure exceeds 45 inches, check water-pressure lights out |
| 2. Control the airplane direction with steering wheel until rudder becomes effective | | 2. Check propeller levers in "AUTO," mixture control "AUTO RICH," booster pumps "NORMAL," turbo-boost lever "0," turbo-override switches "TAKE-OFF," cowl flaps set for take-off, and intercooler flaps closed |
| 3. At 78 knots (90 MPH) IAS ease the control column back to lift the nose wheel off; the airplane will leave the ground between 100 and 113 knots (115 and 130 MPH) IAS depending on the gross weight | | 3. Check engine instruments during take-off |
| 4. When the airplane leaves the ground apply the brakes and signal copilot to raise the gear | | 4. On signal from pilot move landing-gear switch "UP" and when red warning light goes out move switch "OFF" |
| | | 5. Move turbo-bleed switches to "OPEN" |
| 6. Reduce manifold pressure to 47 inches and move synchronizer lever to 2550 RPM | | 6. When power is reduced by pilot turn ADI pump switch "OFF" |
| | | 7. Place turbo-override switches to "CLIMB AND CRUISE" and advance turbo-boost lever to increase and maintain 50 inches manifold pressure for climb<br><br>CAUTION<br><br>The turbo-override switches must be in the "CLIMB AND CRUISE" position BEFORE moving the TBS lever forward. |
| 8. When sufficient altitude and air speed are gained signal copilot to raise flaps | | 8. On signal from pilot, move wing-flap switch "UP"; and then "OFF" when fully retracted |
| | | 9. Apply intercoolers as required to maintain carburetor air temperature within limits |

## ENGINE FAILURE ON TAKE-OFF

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Close throttles and apply brakes if sufficient runway remains and/or if below safe three-engine speed | | |
| 2. Use propeller reverse thrust on all available engines to aid in stopping | 2. Check that propellers reverse by observing the synchronous movement of the tachometers | |
| 3. If a safe three-engine speed is reached and the airplane is off the ground, maintain directional control with rudder and ailerons | | 3. On signal from pilot, move landing-gear switch to "UP" |
| 4. Close throttle on failed engine if propeller has automatically feathered | | 4. Move mixture to "FUEL CUTOFF" on failed engine, if ordered by pilot |
| 5. If it is desired to reject an auto-feather turn the auto-feather arming switch "OFF" | | |
| 6. If automatic feathering fails and it is desired to feather the propeller, move the propeller control lever to the "FEATHER" position | | |
| 7. Climb only as necessary to clear obstructions until the air speed builds up | | 7. On signal from pilot move wing-flap switch to "UP" when a safe air speed and altitude are reached |
| | | 8. Set failed engine fuel selector "OFF" and turn the respective booster pumps "OFF" |
| 9. When engine stops turning move the propeller control lever to "FEATHER" | | 9. Close cowl flaps on failed engine |
| 10. Disarm the auto-feathering system by placing the arming switch "OFF" | | 10. Turn the failed engine ignition "OFF" |
| 11. Adjust power on remaining engines | | 11. Close turbo-bleed valve on failed engine |
| 12. Trim airplane for three-engine operation | | 12. Close intercooler flap on failed engine |
| | | 13. Turn failed engine generator or generator and alternator off and monitor electrical loads |

## CLIMB

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Climb only as necessary to clear obstacles until an air speed of 165 knots (190 MPH) IAS is reached, then continue climb at this air speed; manifold pressure at 50 inches MAP and 2550 RPM | | 1. Adjust cowl flaps to maintain normal cylinder head temperatures |
| 2. Turn auto-feather arming switch "OFF" | | 2. Advance turbo-boost lever as needed to maintain power and cabin air flow |
| NOTE<br><br>A time delay is incorporated in the auto-feathering circuit so that the system is automatically disarmed 3 minutes after the airplane is airborne by virtue of a landing gear oleo strut switch. Under normal operation the system will not rearm during flight. However, the system will rearm for an additional 3-minute period if the arming switch is turned to "OFF" allowing the time delay element to cool, and is then turned back to "TAKE-OFF & CLIMB" | | CAUTION<br><br>The turbo-override switches must be in the "CLIMB AND CRUISE" position BEFORE moving the TBS lever forward. |
| 3. Adjust propeller RPM as desired with master synchronizer lever | | 3. Adjust intercooler flaps to maintain carburetor air temperature below $38^{O}$ C |
| | | 4. Turn off "NO SMOKING, FASTEN BELTS" signs |
| | | 5. Check turbo-bleed switches "OPEN" |
| | | 6. Turn autopilot "ON" for warm-up |
| | | 7. Booster pumps "OFF" (above 10,000 feet turn one booster pump for each main tank on "NORMAL" to prevent vapor locks) |
| | | 8. Rotate rate-of-change selector to desired value |
| 9. After climb power has been established and a safe altitude has been reached, use the fuel in the center tank | | 9. Compressors as required; body and thermal anti-icing heaters as required |

540928

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. At completion of climb, reduce manifold pressure and RPM until desired cruising power is reached | | 1. Adjust throttles and turbo-boost control to establish cabin air flow and desired pressurization |
| 2. Trim airplane for "hands off" flight | | 2. Move mixture to "AUTO LEAN" after engine has cooled to normal temperature |
| 3. Turn rudder boost "OFF" before and during autopilot operation | | 3. Adjust intercooler flaps to maintain 30 to 38° C CAT and use carburetor preheat if required for anti-icing |
| CAUTION<br>Prior to turning rudder boost "ON" or "OFF," zero and hold rudder pedals firmly; then after rudder boost is "ON" or "OFF," retrim airplane as desired. | | |
| 5. Engage autopilot | | 4. Set equal power on all engines with torquemeter reference |
| | | 5. Adjust cowl flaps |
| | | NOTE<br>In flight cowl flaps should be adjusted to result in desired cylinder head temperatures on basis of the hotter of the two cylinder head temperature indications. |
| | | 6. During reduced power condition on descent, use part throttle and turbo-boost as required to maintain cabin air flow; decrease cabin pressurization with cabin altitude and rate-of-change selectors in accordance with the flight plan |
| | | NOTE<br>When making changes in cabin altitude, always place the rate-of-change selector in the "0" position before adjusting the cabin-altitude selector. |

54093 B

INDUCTION SYSTEM ANTI-ICING.

The Model 377 power plant installation is singularly free from carburetor and induction system icing hazard due to the use of the turbosupercharger and of impeller fuel injection. Under the majority of operating conditions the air temperature rise in the turbo compressor will prevent icing. For added safety a sheltered air inlet and a carburetor preheat valve have been provided.

TAKE-OFF. Carburetor air preheat is unnecessary during take-off because of the full throttle condition required and the short time duration. To reduce the moisture intake, the sheltered air inlet may be used. However, at outside air temperatures above 45° F, the use of sheltered air during take-off is not considered necessary. During weather conditions wherein sheltered air may appear desirable, the temperatures normally encountered will be below 45° F, and the use of sheltered air will reduce power a negligible amount. The loss of ram and resultant loss of power, due to the use of sheltered air at full throttle, is compensated for by the temperature effect below 60° F. The power ratings used for performance determinations are fully obtainable when using sheltered air at temperatures below 30° F; therefore, the airplane performance data, based on the power calibration are considered valid.

CLIMB AND CRUISE. When entering regions where icing conditions exist, the following procedure should be used:

a. The intercooler flap should be closed as required to obtain a minimum CAT of 7.2° C (45° F).

b. If the resultant CAT is still below 7.2° C (45° F) with closed intercoolers, position the carburetor air

switch to "SHELTERED AIR"; re-establish power and cabin air flow with turbo and/or throttle.

NOTE

If the sheltered air switch is operated when using turbo, at CAT above 20° C, an excessive CAT rise will result.

c. If further heat is required, open the preheat valve and again re-establish power.

d. Additional heat may be obtained by part throttling and adding boost to maintain desired power. Boost must be limited to prevent carburetor top deck pressure from exceeding 38 inches absolute. This figure can be determined in the airplane by adding the cabin altitude, expressed in inches of mercury, to the reading obtained from the cabin airflow gages.

LET-DOWN AND APPROACH. Let-down and approach powers may be varied as required. If icing conditions exist or are anticipated the following procedure is recommended:

a. Let-down. Turbo on, carburetor air switch in "SHELTERED AIR" position, preheat valve open.

NOTE

Intercooler flap is automatically closed when ram air shutoff door is closed.

b. Initial Approach. Turbo on, carburetor air switch to "SHELTERED AIR," preheat valve open.

c. Final Approach (Contact or from Close Pattern). Turbo off on final approach. Continue use of sheltered air. Close preheat valve.

d. Final Approach (Long Instrument Approach). Set up final approach power at 2300 RPM, turbo on, preheat valve closed, carburetor air switch to "SHELTERED AIR." Cabin altitude as desired. At approximately 200 feet altitude, turn turbo off. Ice protection for remaining seconds of approach or on go-around to the point of first power reduction, is obtained from sheltered air only. This provides 6° to 11° C (10° to 20° F) temperature rise plus moisture separation protection.

GO-AROUND.

a. Low Altitude. Turbo off, apply power as necessary; at first power reduction, apply turbo. Open the preheat valve if closed intercooler flap does not produce desired CAT.

b. High Altitude (Fields above 7200 feet). Turbo off, preheat valve closed. Apply go-around power of 2550 RPM; 56 inches MAP; mixture AUTO-RICH. Reapply turbo to attain desired MAP; then adjust the intercooler flap and if necessary, open the preheat valve to obtain desired CAT.

## ENGINE FAILURE IN FLIGHT

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Close throttle on failed engine | | |
| 2. Move the propeller control lever to the "FEATHER" position | | 2. Move the failed engine mixture control to "FUEL CUTOFF" |
| NOTE<br>The propeller can also be feathered by actuation of the fire gang switch or by holding the propeller control lever in "DECREASE RPM" | | CAUTION<br>If the fire gang switch is actuated and the propeller does not feather, establish oil flow by following the procedure given under item "k" "Engine Fire in Flight." |
| 3. Trim airplane for three-engine operation | | 3. Close the cowl flaps |
| 4. Adjust power and RPM on remaining engines as required | | 4. Close intercooler flap |
| | | 5. Turn engine ignition "OFF" |
| | | 6. Place the turbo control override switch in the "TAKE-OFF" position |
| | | 7. Close turbo-bleed valve |
| | | 8. Turn the booster pumps "OFF" |
| | | 9. Set the engine fuel selector to "TANK-TO-MAN." position and balance fuel quantity |
| | | 10. Turn generators and alternators of the failed engine "OFF" and monitor electrical loads |

54094B

## UNFEATHERING A PROPELLER IN FLIGHT

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Decrease air speed to approximately 160 knots (184 MPH) IAS | | 1. Move fire gang switches to "NORMAL" |
| NOTE<br>Before practice feathering, cool the engine gradually by reducing power and opening the cowl flaps until cylinder head temperature is below 190° C. If propeller is to be feathered for an extended period, dilute engine oil in accordance with outside air temperature. | | |
| 2. Open the throttle for the feathered engine to approximately 800 to 1000 RPM position | | 2. Set the fuel selector to "TANK-TO-ENG." and turn the tank booster pump to "NORMAL" |
| 3. Rotate the turbosupercharger calibrating potentiometer full counterclockwise | | 3. Turn ignition switch to "BOTH" |
| 4. Move and hold the propeller control lever in "INCREASE RPM" until 800 RPM is obtained and then release to "AUTO" | | |
| 5. When the propeller reaches 800 RPM, slowly move mixture control to "AUTO LEAN" | | |
| CAUTION<br>Watch for oil pressure rise. | | |
| 6. When engine is running smoothly, move mixture control to "AUTO RICH" and warm up the engine at 1200 to 1400 RPM; when operating temperatures are reached, hold the propeller control lever in the "INCREASE RPM" position until the desired RPM is obtained, then position to "AUTO" | | 6. Adjust cowl and intercooler flaps as desired |
| 7. When the RPM is increased, advance the throttle slowly to the position of the other throttles | | 7. Turn generators and alternators for that engine "ON" |
| 8. Slowly rotate the turbosupercharger calibrating potentiometer clockwise to the barrier index and/or until the manifold pressure aligns with that of the other engines | | 8. Open turbo-bleed valve |
| 9. Retrim airplane as required | | |

ENGINE FIRE IN FLIGHT.

The procedure to be followed in case of engine fire in flight should include the following steps:

POWER SECTION (ZONE 1) AND/OR ACCESSORY SECTION (ZONE 2) FIRE:

a. Close the throttle.
b. Actuate the engine gang fire switch to "FIRE."
c. Open the cowl flaps to 2.5 inches.
d. Discharge $CO_2$.
e. Move the propeller selector lever to "FEATHER."
f. Place the mixture control in "FUEL CUTOFF."
g. Turn the fuel boost pumps "OFF."
h. Turn the fuel selector "OFF."
i. Monitor the electrical load.
j. Do not restart engine.
k. If the propeller will not feather, return the fuel and oil shutoff switch on the fire panel to the "NORMAL" position to admit oil only to the engine, after the fire is definitely out and the engine cool. To accomplish this, check that the fuel selector is "OFF," then move the fuel and oil shutoff switch to the "NORMAL" position. Reclose the turbo bleed valve by normal means.
l. If the fire restarts or is not completely put out by the first shot of $CO_2$, actuate the two remaining $CO_2$ discharge switches unless it is obvious that one will be sufficient.
m. Return the $CO_2$ selector switch to "NORMAL."

WHEEL WELL OR WING HEATER COMPARTMENT (ZONE 3) FIRE:

a. Close the throttle.
b. Actuate the engine gang fire switch to "FIRE."
c. Return the "SELECT FIRE EXT. VALVE" switch to "NORMAL."
d. Actuate the "NAC. WHEEL WELL" switch or the "NAC. COMB. HEATERS" gang switch to the "FIRE" position.
e. For wheelwell fire, determine that landing gear is retracted.
f. For wing heater compartment fire, place the manual heater switches in the "OFF" position.
g. Discharge $CO_2$.
h. Move the propeller selector lever to "FEATHER."
i. Place the mixture control in "FUEL CUTOFF."
j. Turn the fuel boost pumps "OFF."
k. Turn the fuel selector to "OFF."
l. Monitor the electrical load.
m. If the propeller will not feather, return the fuel and oil shutoff switch to the "NORMAL" position to admit oil only to the engine after the fire is definitely out.
n. Return the fire extinguisher switch to "NORMAL" after the fire is out.
o. If a tire fire occurs which cannot be controlled by $CO_2$ discharge, lower the landing gear to permit the fire to be blown out.

MINIMIZING CIRCULATION OF SMOKE INTO AIRPLANE. A severe fire may cause turbo duct or turbo bleed valve failure with resultant entry of smoke in the airplane. To control:

a. Close the remaining turbo bleed valve in the affected wing. (The turbo bleed valve for the engine on fire is automatically closed by actuation of the gang fire switch.)
b. If smoke enters the airplane after this action, increase power or turbo boost on the opposite engines or decrease same on the one remaining engine on the affected side, thus creating a favorable duct pressure differential.
c. Turn anti-icing system off if icing conditions permit.
d. After the fire is definitely out, return the power on the remaining engines to normal. Open the turbo bleed valve on the remaining engine on the affected side to maintain pressurization.
e. Check cabin altitude. If cabin pressurization cannot be maintained, descend to a safe altitude.
f. Return anti-icing system to operation if required.

FUSELAGE FIRE COMBAT PROCEDURE.

GENERAL INSTRUCTIONS. Upon warning being received of fire, the following steps should be taken immediately:

a. Turn off the recirculation fan by means of the circuit breaker on the overhead electrical panel, close the louvers located above the luxury compartment forward bulkhead entrance way, and turn off the control cabin cooling switch to minimize air flows and the spreading of smoke and odors throughout the airplane.
b. If terrain and weather permit, begin descent immediately to an altitude which will permit non-pressurized flight. This will protect the passengers from anoxia should fire control and smoke evacuation procedures result in complete depressurization.
c. Depressurize the airplane to minimize the effects of a severe fire on the aircraft structure. The following rules should apply:

If descent is not immediately possible, set the cabin altitude control at 12,000 feet and the rate-of-change selector at maximum.

If descent is possible, descend as rapidly as possible. Either a maximum rate descent (flaps 45°, gear down, air speed 183 MPH IAS) or a high speed (clean airplane, $V_{NO}$ air speed) condition may be used. The former condition is recommended if the fire is severe or in a location likely to affect primary structure. If the latter method is used, care must be observed that the flight load acceleration limits are not exceeded in rough air (see figures 5-5 and 5-6).

d. Investigate the fire before taking action. If of electrical nature, turn off the source.
e. Combat the fire, using either hand equipment or the built-in equipment depending upon the nature and location of the fire. Hand fire extinguishers, flashlights, oxygen mask, asbestos gloves, and smoke

mask are located as shown in the emergency equipment diagram (figure 1-22). Fire extinguishers should be directed at the base of the fire while discharging. Use the smoke mask provided as protection against smoke only. Use oxygen mask while combating fire with $CO_2$.

NOTE

Use the full face oxygen mask and oxygen bottle located on the aft bulkhead of the forward coat compartment for all fires where $CO_2$ concentrations exist. Do not use the rebreather-type oxygen masks as they provide little or no $CO_2$ protection.

WARNING

When using the carbon tetrachloride fire extinguisher, apply only the minimum quantity necessary at the base of the fire. Avoid exposure to smoke or fumes. The fluid is poisonous and its fumes, when unheated, are dangerously toxic. After exposure to heat, the fumes are extremely toxic. Ventilate the area as soon as possible.

f. Ventilate and evacuate smoke and/or $CO_2$ at the earliest opportunity, after it is certain the fire is out and will not flare up due to fanning. Under certain circumstances where large amounts of $CO_2$ have been discharged into the lower nose section or the center wing area, entry without adequate protection must be avoided. When entering these compartments at such a time, the use of the full face oxygen mask is necessary.

WARNING

Ventilate after every fire whether smoke is visible or not, to insure adequate oxygen supply for the crew and passengers.

g. Repressurize, if desired, providing no damage has occurred to primary structure or windows.

h. Do not open control cabin windows.

SPECIFIC INSTRUCTIONS. The following instructions complement the general instructions, and apply to specific fire locations and to pressurized and nonpressurized conditions. In the former, it is assumed that descent is possible. If it is not, the instructions are applicable but must be tempered to prevent anoxia; i.e., do not close the turbo-bleed valves, but maintain a minimum cabin pressure as dictated by passenger requirements.

CONTROL CABIN FIRE CONTROL.

a. See "General Instructions."

b. Maintain adequate power on at least two engines to provide air flow and ventilation for the crew. If in a nonpressurized condition, ventilate, using ram air obtained by moving the ground blower switches to "BLOWERS OFF--RAM AIR OPEN IN FLIGHT."

c. Check to see that supply grilles and defroster valves are open.

d. Have crew oxygen equipment available if needed to counteract smoke, $CO_2$ and fumes.

CONTROL CABIN VENTILATION AND SMOKE EVACUATION.

a. Crack pressure release valve.

b. Open the control cabin door and the floor hatch.

PASSENGER CABIN, DRESSING ROOMS, STATEROOM, GALLEY AND LOUNGE FIRE CONTROL. See "General Instructions." Keep doors closed except as required for entry.

PASSENGER CABIN, DRESSING ROOMS, STATEROOM, GALLEY AND LOUNGE VENTILATION AND SMOKE EVACUATION. Smoke will be evacuated through normal outlets. The evacuation of heavy smoke from the passenger cabin can be hastened by turning on the recirculation fan and by setting the cabin altitude control above the airplane altitude. When evacuating smoke from the other compartments, set the cabin altitude control above the airplane altitude, but do not turn the recirculation fan on.

LOWER NOSE COMPARTMENT FIRE CONTROL.

a. See "General Instructions."

b. Set cabin altitude at 12,000 feet and rate-of-change selector to maximum if in a pressurized condition.

c. Maintain adequate power on two engines during descent, to provide air flow and ventilation for crew. If in a nonpressurized condition, ventilate, using ram air.

d. See that control cabin supply grilles and defroster valves are open.

e. Cover the grille in the control cabin floor to prevent smoke from lower nose compartment entering the cabin.

f. Don full-face oxygen mask, oxygen bottle and asbestos gloves. Duration of oxygen supply in the portable bottle is approximately 10 minutes.

g. Use $CO_2$ bottle mounted on aft bulkhead of the forward coat compartment to combat fire. Two extra hand $CO_2$ bottles are available in the lower nose compartment.

LOWER NOSE COMPARTMENT VENTILATION AND SMOKE EVACUATION.

a. Crack pressure release valve.

b. Reset smoke detector.

FORWARD CARGO COMPARTMENT FIRE CONTROL.

a. See "General Instructions."

b. If airplane is pressurized, close the turbo-bleed valves to depressurize.

c. If crew bunks are installed, lower them to the floor to aid in cargo redistribution during fire fighting.

FORWARD CARGO COMPARTMENT VENTILATION AND SMOKE EVACUATION.

a. Crack pressure release valve.

b. Open turbo-bleed valves and establish power to provide air flow.

c. Open the door between the lower nose and forward cargo compartments.

d. Reset smoke detector.

CENTER WING AREA FIRE CONTROL.

a. Open the recirculation fan circuit breaker.

b. Turn off the "CONTROL CAB COOLING" switch and close the defroster valve.

c. Close the louver above the passenger compartment forward bulkhead.

d. Start descent.

e. Depressurize the cabin by setting the cabin altitude selector to 12,000 feet and setting the rate-of-change selector to maximum.

f. If fire is of electrical nature, turn off the power source.

g. Evacuate lounge passengers and crew members from the lower compartments to the upper deck.

h. If in a pressurized condition, close the turbo-bleed valves to stop air flow through cabin pressure regulators (thus retaining $CO_2$) and to depressurize.

i. If using center tank fuel, insure that wing fuel is supplying all engines before actuating the gang fire switch.

j. Operate gang fire switch for center wing area.

k. After allowing 5 to 10 seconds for the recirculation fan to stop and the air recovery check valve to close, actuate two $CO_2$ discharge switches (60 pounds of $CO_2$).

WARNING

The basic flight crew should put on oxygen masks and wear them until ventilation has been accomplished. This is because gravity effects upon $CO_2$ during a nose down attitude may cause a strong concentration of $CO_2$ in the control cabin, especially if more than 60 pounds of $CO_2$ are discharged.

Retain the $CO_2$ only long enough to extinguish the fire. In order to minimize crew and passenger exposure to the $CO_2$, commence $CO_2$ evacuation and airplane ventilation procedure as soon as possible after the discharge has taken effect.

CENTER WING AREA VENTILATION AND SMOKE EVACUATION. Optimum ventilation of the center wing area is accomplished in the following manner:

a. Set the cabin altitude selector to the highest altitude compatible with passenger safety (above airplane altitude, if possible).

b. Set the cabin rate-of-change selector to "MAXIMUM," and open at least two turbo-bleed valves.

c. Adjust the power of the engines which have the turbo-bleed valves "OPEN" to maintain 3 inches of cabin air flow.

d. Crack the cabin pressure release valve to obtain the maximum tolerable cabin rate of change. If unpressurized, open the release valve.

e. Close the cabin pressure release valve when the maximum tolerable cabin altitude is obtained.

f. Continue to ventilate by means of the cabin pressure regulators for a minimum of 10 minutes before returning to normal cabin pressurizing procedures.

This procedure will open the cabin pressure regulators, thus evacuating smoke and $CO_2$ from the center wing area. Operation of the cabin pressure release valve provides ventilation to minimize hazardous $CO_2$ concentrations in the control cabin.

REAR CARGO COMPARTMENT FIRE CONTROL.

a. See "General Instructions."

b. Evacuate lounge passengers.

c. If in a pressurized condition, close turbo-bleed valves to depressurize.

d. Keep lounge door closed except for entry.

REAR CARGO COMPARTMENT VENTILATION AND SMOKE EVACUATION.

a. Keep lounge door closed.

b. Open turbo-bleed valves and establish power to provide air flow.

c. Reset smoke detector.

COMBUSTION HEATER OVERHEAT PROCEDURE.

BODY COMBUSTION HEATERS OVERHEAT WARNING.

a. Check temperature of faulty heater with selector switch and temperature indicator. Automatic closing of the fire valve may cause a brief rise in temperature indication. This should slowly decrease as the residual heat in the heater is dissipated.

b. Place manual heater switch of malfunctioning heater in the "OFF" position. If temperature rise continues, proceed with step "c" and do not turn heater on again.

c. Discharge heater $CO_2$ by operating the "BODY HTR.FIRE EXT.BOTTLE" switch.

d. Observe reaction of temperature indicator. Temperature should immediately decrease, gradually approaching ambient as the heater cools off.

e. If visual inspection indicates that the overheat condition is not corrected, follow the fire procedure for center wing area (covered under "Fuselage Fire Combat Procedure").

f. If the overheat condition is corrected as indicated by temperature gages and visual inspection of fire area, and all appears normal, operate the overheat reset button (or switch) to reopen the two turbo-bleed valves which were closed by the overheat condition. Overheat light will go out at this time.

CAUTION

(For airplanes which have the single "HTR. OVERHT. TEST & RESET" button)

Do not operate the overheat reset button until the faulty heater and heater fire switch cool. Premature operation of the reset button will turn off all thermal anti-ice and body combustion heaters and close the two remaining turbo-bleed valves, with resultant loss of pressurization.

Should this occur, ascertain that the faulty heater switch is off and reset the overheat system by: turning off the master air conditioning and master thermal anti-ice switches; opening, and then closing the "CABIN TEMPERATURE CONTROL" and "FIRE TEST" circuit breakers on the overhead panel; and turning the master air conditioning and master thermal anti-ice switches on again. This action will reset the heater overheat test and reset relay, put the unaffected heaters back in operation, and open the two unaffected turbo-bleed valves.

54099B

WING AND TAIL COMBUSTION HEATERS OVERHEAT WARNING.

a. Determine faulty heater by use of temperature indicator and selector switch.

b. Place manual switch for malfunctioning heater in the "OFF" position.

c. Visually inspect tail heaters through stateroom ceiling window or the wing heaters in outboard nacelle area through the lounge windows.

d. Observe temperature indicator. Automatic closing of the fire valve may cause a brief rise in temperature which should then slowly decrease as the residual heat in the heater is dissipated.

e. Once control is established, operate the overheat reset button (or switch), thus turning operative heaters in the affected group back on and the overheat light off.

f. For airplanes which have the single "HTR. OVERHT. TEST & RESET" button, observe the "Caution" under "Body Combustion Heater Overheat Warning."

g. Interim anti-icing, while waiting for a faulty heater to cool, may be obtained by operating the guarded emergency "EMP" or "WING" switches.

h. If control is not established or if in doubt, follow procedure in "Wing and Tail Combustion Heaters Fire Warning."

WING AND TAIL COMBUSTION HEATERS FIRE WARNING.

a. Operate the proper gang fire switch on the overhead electrical panel.

b. Place manual heater switch in "OFF" position.

c. Discharge one set of $CO_2$ bottles.

d. Return gang $CO_2$ selector switch to "NORMAL."

e. Visually inspect tail heater area and outboard nacelles.

f. Leave all heaters in affected area "OFF."

## CRASH LANDINGS

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Order crew to jettison all cargo and loose gear if time permits | | |
| 2. Unlock window and fasten safety belt | 2. Fasten safety belt | 2. Unlock window; fasten safety belt; have crew open and release emergency exits shown in figure 2-2 |
| 3. Check that passengers are in the main cabin and secured in the best means possible; no persons should be in the lounge in an emergency | | 3. Close body fuel valves and center tank valve |
| 4. Signal copilot to lower wing flaps | | 4. On pilot's signal move wing flap switch "DOWN" and hold until flaps are fully extended |
| 5. Land with as slow a forward speed as possible with a normal nose-high attitude | | 5. Turn off all air conditioning, refrigeration, and anti-icing equipment |
| 6. On impact, move mixture control to "FUEL CUTOFF," move ignition switches off, close throttles, and 5 seconds after $CO_2$ bottles have been discharged, move the master switch to "OFF" | | 6. On impact, shut off all fuel and oil valves and place center wing area gang fire switch in the "FIRE" position; discharge all three sets of $CO_2$ bottles and hold for 5 seconds |

541088

EMERGENCY ELECTRICAL PROCEDURES.

CIRCUIT PRECAUTIONS. To prevent damage to the electrical system, the following precautions should be observed:

a. All circuit breakers are of the overriding type. In an emergency the circuit breakers may be held closed with a possible risk of increased fire hazard and damage to affected equipment. If any circuit breaker is repeatedly reset, an arc may be established that will increase the fire hazard.

b. Current limiters in the main power panel may be replaced in flight ONLY if the safety of the airplane depends upon their continued operation. Caution must be exercised when replacement is necessary.

c. Upon failure of any engine, turn off the left-hand and/or right-hand cooling systems (compressor and condenser motors) to prevent overloading the remaining generators.

MASTER SWITCH. The master switch should be turned off ONLY when an electrical fire of unknown nature cannot be isolated. BEFORE turning the master switch "OFF," the following steps should be taken:

a. Establish cruise power or less.

b. Select best propeller RPM and place the propeller selector levers in the "FIXED PITCH" position.

c. Select most favorable fuel selector position.

d. Adjust cooling flaps.

e. Place the No. 2 battery guarded transfer switch, the guarded emergency light switch, and the emergency radio switch in the "EMERGENCY" position.

WARNING

When the master switch is "OFF," the following important equipment is inoperative:

- Electric flight instruments
- Engine instruments except tachometers and manifold pressure indicators
- Fire control equipment
- Landing gear and wing flap motors
- Propeller controls
- Supercharger controls
- Communication equipment except for the HF transceiver (Collins 18S-2) and interphone system
- Deicing equipment and pitot heat
- All lights except emergency lights
- Fuel and oil controls including booster pumps

NOTE

The operation of flares is not affected by the master switch.

Prior to returning the master switch "ON," accomplish the following:

a. Turbo control "0."

b. Refrigeration compressors "OFF."

c. Propeller selector levers in "FIXED PITCH" position.

DC POWER FAILURE. The emergency bus, or circuit, provides an emergency source of direct current power for operation of the emergency lights, flares, and some radio equipment in event of normal power failure. Power is supplied to the bus at all times by battery No. 1 and by battery No. 2 when the guarded transfer switch is in the "EMER. BUS" position. It is not necessary for the master switch to be "ON" when operating on emergency bus. Batteries No. 1 and No. 2 are above the normal height of water expected after a ditching; therefore, the power in these batteries may be used to operate the radio transceiver (Collins 18S-2) for emergency calls.

EMERGENCY POWER. In the event of complete loss of power on the DC bus, the following procedure should be used:

a. Move the master switch to "OFF."

CAUTION

Observe master switch precautions prior to turning master switch "OFF" and before turning back "ON."

b. Place the propeller selector lever in "FIXED PITCH" position, the turbo control on "0," and the refrigeration compressors "OFF."

c. Check the circuit breaker panels for location of the fault. If possible, correct the fault and replace current limiters or fuses, and reset circuit breakers as necessary. Then turn the master switch "ON."

d. If the fault cannot be corrected, but can be isolated, disconnect the fault from the system and turn the remaining equipment back on.

e. In the event DC power is no longer available, place the No. 2 battery guarded transfer switch to the emergency bus position and the guarded emergency lights switch and the emergency radio switch in the emergency position. Power is then available for operation of emergency radio equipment, flares, and emergency lights. This power is also available after ditching.

GENERATOR FAILURE. In an emergency, two generators can supply sufficient power to operate the minimum flight equipment, provided all radios, lights, and equipment not necessary to maintain flight are turned off.

a. If one or more generators are inoperative and the load meters for the remaining generators are indicating approximately 1.0 (100%), turn off equipment in the order of least necessity. If a generator or generators become inoperative for any reason, it is recommended that it be turned off to avoid system voltage drop.

b. When generator overheat is indicated by one of the warning lights, check the loadmeters, for uniform load distribution and the voltmeter of the affected generator for overvoltage. Turn the affected generator off and monitor the electrical load. If the pertinent voltmeter shows any voltage after turning off the generator, it is indicative of a short from the field to the power lead. Should this occur, the propeller should be feathered. If the use of the affected engine is required for safe flight, remove the current limiter for the affected generator from the reverse current relay in the main power panel, unfeather the propeller and restart the engine. If the voltmeter of the affected generator does not show any voltage after turning off the generator, no further action is required unless the generator is needed to complete the flight, in which case, it should be used with caution and only after checking the voltage regulator, overvoltage relays, and reverse current relays. If overheat warning is repeated, leave generator off. Overheat will occur usually during conditions of overload or poor cooling due to ground blowers not functioning when on the ground. Circuit breakers for the ground blowers are on the nacelle solenoid panels and the overhead electrical panel.

c. If a load meter indicates no load, check the voltage of the generator. If there is no voltage, turn the generator off and check and reset the overvoltage relay in the lower nose compartment. Turn generator on and recheck the voltage. If the voltage is abnormal, the generator must be left off until the trouble is remedied. If there is no voltage indicated, check the field circuit breaker panel in the lounge ceiling. If the generator has normal voltage (28 1/2 volts) but no load, check the current limiter in the main power panel in the lounge ceiling.

INVERTER FAILURE. In the event of a DC power failure or the master switch being "OFF," the four inverters which supply the alternating current distribution system will become inoperative. The alternating current distribution system comprises three busses: the essential AC bus, the secondary AC bus, and the lighting AC bus.

Should the No. 1 inverter fail, when supplying the essential AC bus, an automatic change-over system automatically transfers the essential load to inverter No. 4, which is the stand-by inverter. The automatic change-over for the essential load will override the manual selection of inverter No. 4 should the failure of No. 1 inverter be subsequent to the failure of inverter No. 2 or No. 3. If the automatic change-over should fail to function, manually transfer the essential load to No. 4 inverter. If inverter No. 4 fails to provide power for the essential AC bus, manually select either No. 2 or No. 3 inverter depending upon operating conditions at the time.

Should the No. 2 inverter fail, manually select inverter No. 4 to supply power to the secondary AC bus.

Should the No. 3 inverter fail, manually select inverter No. 4 to supply power to the lighting AC bus.

In the event two or more inverters become inoperative, one of the operating inverters must be placed on the essential AC bus if icing conditions exist and the remaining operating inverter must be placed on the secondary AC bus, if possible. This will provide power for all AC powered equipment except the fluorescent lights.

If the essential or secondary bus becomes inoperative due to grounding of the bus or due to inverter failure, the source of power for the pilot's and copilot's flight instruments may be transferred to the other operating bus by placing the pilot's and/or copilot's flight instruments selector switch to the desired bus positions.

ALTERNATOR FAILURE. Two engine-driven alternators supply three-phase alternating current for operation of Nesa window heat. In flight, a periodic check should be made of the phase voltage of these two alternators, and, if a full scale deflection (150 volts) is obtained on any phase, the alternator should be turned off.

In the event an alternator becomes inoperative, as indicated by the voltage check or by the warning light, connect the Nesa window system to the operating alternator. Move the switch for the inoperative alternator to "RESET" and then back to "ON." Check the phase voltages and the indicator light. If the indicator light remains on or if the alternator phase voltages are not equal, turn the alternator "OFF." If the light goes out and if the phase voltages are equal and within operating limits, the alternator may be used.

AUTOMATIC PILOT OPERATION.

ENGAGING THE AUTOMATIC PILOT. The autopilot is engaged and operated as follows:

a. Check the emergency servo disconnect lever to "ENGAGE."

b. Check power on "ESSENTIAL AC BUS."

c. Trim airplane for "hands-off" flight.

d. Check gyro beacon for a flashing light (30 to 40 cycles per minute). If light is not flashing, erect gyros by momentarily placing the caging switch to the "CAGE" position; leave switch in the "UNCAGED" position.

e. Check the automatic flight selector switch to "NORMAL."

f. Center controller knobs and handle.

g. Engage autopilot by pressing the clutch switch "ON."

h. Check rudder boost switch "OFF."

i. Trim the autopilot with the bank and pitch trim knobs to maintain level flight.

j. Maneuver the aircraft with the controller handle and trim knobs.

k. If altitude control is desired, first establish the altitude and then move the altitude control switch "ON."

NOTE

Be sure the altitude control switch is "OFF" before climbing or descending with the "PITCH KNOB"

DISENGAGING THE AUTOPILOT. The autopilot may be disengaged as follows:

a. Check the autopilot pitch trim. (If necessary, operate the trim wheel to center the pitch trim needle.)

b. Press the release button on the control wheel.

c. In case of emergency, the autopilot servos can be disengaged from the controls by placing the "EMERGENCY SERVO DISCONNECT" in the "DISENGAGE" position.

NIGHT OR INSTRUMENT FLIGHT.

TAKE-OFF. Generally it is important when making an instrument or night take-off, and immediately afterwards, to hold the airplane at the proper attitude and let the air speed build up steadily without any loss in altitude at any time. Take off normally and allow the air speed to increase to 139 knots (160 MPH) IAS in a shallow climb. Hold this speed by increasing the rate of climb until a safe altitude is reached. Level off at a safe altitude to allow air speed to increase to 165 knots (190 MPH) IAS and then continue to climb.

LANDING. When making an instrument approach or night landing set up sufficient RPM for go-around procedure. Use partial flaps while beam-bracketing and full flaps only on final approach.

CAUTION

The use of large amounts of nose-heavy trim tab during let-downs and approaches is DANGEROUS.

When applying trim, move trim-tab control a small amount and jockey the control column until the change is felt. This step is important before more trim is added, to prevent overtrimming and the resulting dangerous condition.

STALLS

The stalling characteristics of this airplane are normal. Warning of the impending stall comes in the form of buffeting of the horizontal stabilizer and elevator and occasional light buffeting or snatch of the ailerons. With flaps up, the warning comes at approximately 15 knots (17 MPH) IAS above the stalling speed. With partial flaps or full flaps down the warning comes approximately 9 knots (10 MPH) IAS above the stalling speed. The stall is comparatively gentle and presents no problems to the average pilot. In a full forward CG condition it is possible that a normal stall cannot be accomplished with a full-up elevator. The extended landing gear has no appreciable effect on the stalling characteristics.

AILERON EFFECTIVENESS. The ailerons are effective right up to the stall and are somewhat effective through the stall. Use of the ailerons into the stall will not aggravate the stall as is experienced in some types of aircraft. No violent rolling action either precedes or accompanies the power-off stall under any flap setting conditions. However, as in the case of all multi-engine airplanes, stalls encountered under any unsymmetrical power condition will probably cause violent rolling moments.

RECOVERY FROM STALL. When the airplane is stalled, recovery should always be made by nosing the airplane down. A reversal of elevator force may take place during the stall, but the force tending to keep the control column back is comparatively light. In general, recovery from stalls at safe altitudes should be made by leaving the power setting unchanged (provided the power is symmetrical) or by closing the throttles if serious difficulty is encountered. Avoid abrupt pull-outs at any time.

SPINS.

Intentional spins are prohibited. In case a spin is entered accidentally, use normal recovery procedure to regain level flight.

ACROBATICS.

Acrobatics of any kind are strictly prohibited.

DIVING.

Diving speed is limited to 302 knots (348 MPH) IAS or to a Mach number of 0.58 whichever is slower. Avoid abrupt pull-outs at any time.

WING FLAP EMERGENCY OPERATION.

In case the wing flap motor used for normal operation fails, move its switch to "OFF" and hold the guarded "EMERGENCY WING FLAP" switch, on the overhead instrument panel, in the desired position. Extend or raise the flaps until the desired amount is indicated on the wing flap indicator.

CAUTION

There are no limit switches on the wing-flap auxiliary motor; therefore the motor must be stopped before the flaps reach either extreme position to prevent damage to the motor.

When raising the flaps, stop the auxiliary motor when 5 degrees is reached. When extending, stop at 40 degrees; then very carefully inch the flaps to the extreme position.

## APPROACH

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Notify crew to prepare for landing | | 1. Start cabin depressurization sufficiently early to allow the cabin to reach field altitude prior to landing |
| 2. Check weight and CG limits | | 2. Apply brakes and check hydraulic pressure drop and return; check fluid quantity |
| 3. Altimeter set, radio altimeter on and set | | 3. Altimeter set |
| 4. Autopilot as required | | 4. Check fuel and ADI quantity |
| 5. Nose wheel steering button up | | 5. Set fuel selectors to "TANK-TO-ENG." and turn both booster pumps for each main tank on "NORMAL"; check center tank switch "OFF" |
| 6. Move master synchronizer to 2300 RPM | | 6. Turn on "NO SMOKING, FASTEN BELTS" signs |
| 7. Mixture "AUTO RICH" | | 7. Check magnetos |
| 8. Thermal anti-ice switches "OFF" | | 8. If preheat is desired on final approach, check the turbo control override switches to "CLIMB & CRUISE," the turbo-boost lever to "0," and place the carburetor-air switch to "SHELTERED"; if more heat is necessary, hold carburetor preheat switch "OPEN" until carburetor-air temperature of approximately 7.2° is obtained |
| 9. Propeller deice equipment "OFF" | | 9. If preheat is not desired on final approach, place the turbo-control override switches to "TAKE-OFF," the turbo-boost lever to "0," and check carburetor-air to "RAM" and preheat "CLOSED" |
| | | 10. Intercooler flaps "CLOSED" |
| | | 11. Cabin heaters "OFF" |
| 12. Signal copilot to extend landing gear when the air speed is reduced below 200 knots (230 MPH) IAS | | 12. On pilot's signal move landing gear switch to "DOWN" and check green position lights on |

541028

## APPROACH (CONTINUED)

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 13. Signal copilot for wing-flap extension and amount when air speed is reduced below 188 knots (217 MPH) IAS | | 13. On pilot's signal move wing-flap switch to "DOWN" and when desired amount is reached release switch to "OFF"<br><br>CAUTION<br><br>When releasing the wing-flap switch from "DOWN," check that the spring-loaded action does not accidentally snap the switch through "OFF" to "UP." |
| 14. After extending full flaps, make approach at 25 knots (30 MPH) above power-off stalling speed | | 14. Cabin depressurizing complete |
| 15. Autopilot "OFF" | | 15. ADI valves "AUTO," ADI pumps "ON," lights on |
| 16. Rudder boost "ON"<br><br>CAUTION<br><br>Prior to turning rudder boost "ON" or "OFF," zero and hold rudder pedals firmly; then after rudder boost is "ON" or "OFF," retrim airplane as desired. | | 16. Ram air and ground blowers "AUTO"<br><br>17. Compressors "OFF"<br><br>18. If preheat is being used, move turbo-boost lever to "0" at approximately 200 feet |

## GO-AROUND

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Advance throttles smoothly, do not exceed 50 inches MAP; signal copilot to raise the landing gear | | 1. On pilot's signal move landing-gear switch to "UP"<br><br>2. Check turbo-boost lever to "0," and turbo control override switches in "TAKE-OFF" |
| 3. Advance master synchronizer to 2700 RPM and advance throttle as required but do not exceed 60 inches MAP | | 3. Check ADI indicator lights out as power is increased<br><br>4. Check temperatures and pressures within limits |
| 5. Signal copilot to raise the flaps to 25 degrees | | 5. On pilot's signal move wing-flap switch to "UP," and when 25 degrees are reached move switch to "OFF" |
| 6. Check rudder boost "ON" | | 6. Check landing-gear red warning light off |
| 7. Reduce power to 50 inches manifold pressure and 2550 RPM when a safe speed is reached, at least 131 knots (150 MPH) | | 7. Adjust cowl flaps as required |
| 8. Signal copilot to raise the wing flap when sufficient air speed and altitude have been gained | | 8. On pilot's signal move wing-flap switch to "UP" and then "OFF" after the flaps are retracted 541038 |

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Contact the ground with main gear first, keep the nose up for a time then ease nose down; if landing is made in a cross-wind lower the upwind wing and crab into the wind with some rudder; just before ground contact, level the wings and correct the airplane direction | | 1. Check hydraulic pressures up and landing gear switch "DOWN" |
| | | 2. ADI pumps "OFF" |
| | | 3. If reverse thrust is to be used, shut off all body and thermal anti-icing combustion heaters |
| 4. Immediately after ground contact, close throttles | | 4. Cowl flaps "OPEN" when ground contact is made |
| 5. If desired, use reverse thrust to slow airplane roll; immediately upon contact with the ground, lift the pilot's throttles, pull them back over the idle stops and then move them forward against the reverse idle stops; listen for reversal cycle (RPM increase followed by a decrease), indicating the propellers are reversed; make a gradual and continual application of power to prevent stalling or overspeeding the engines; apply sufficient power to obtain the desired reverse thrust | | 5. Check that all propellers reverse by observing the synchronous movements of all tachometers |
| CAUTION<br>A minimum engine speed of 1500 RPM must be maintained during reverse pitch landings. If an engine stops during reverse pitch operation, with the booster pumps on, normal precautions against a hydraulic lock must be observed before restarting the engine. | | |
| NOTE<br>Care must be exercised when reversing propellers on runways where water, dust, light snow, or similar substances exist, as pilots' visibility may be impaired. | | |
| 6. Return the propellers to normal pitch by lifting the pilot's throttles over the reverse idle stops and moving forward | | 6. Check that all propellers return to normal pitch by observing the synchronous movement of all tachometers |
| 7. Move master synchronizer to full "INCREASE RPM" | | 7. Body combustion heaters may be turned back on if desired |
| 8. Cockpit blower as required | | 8. Turn booster pumps "OFF" |
| | | 9. When power is applied to the engines for taxiing off the runway, move the wing-flap switch to "UP" |
| 10. Trim tabs zeroed | | 10. Compressors as desired |
| | | 11. If oil is to be diluted on shut-down, manually open the oil cooler flaps for taxiing |

541048

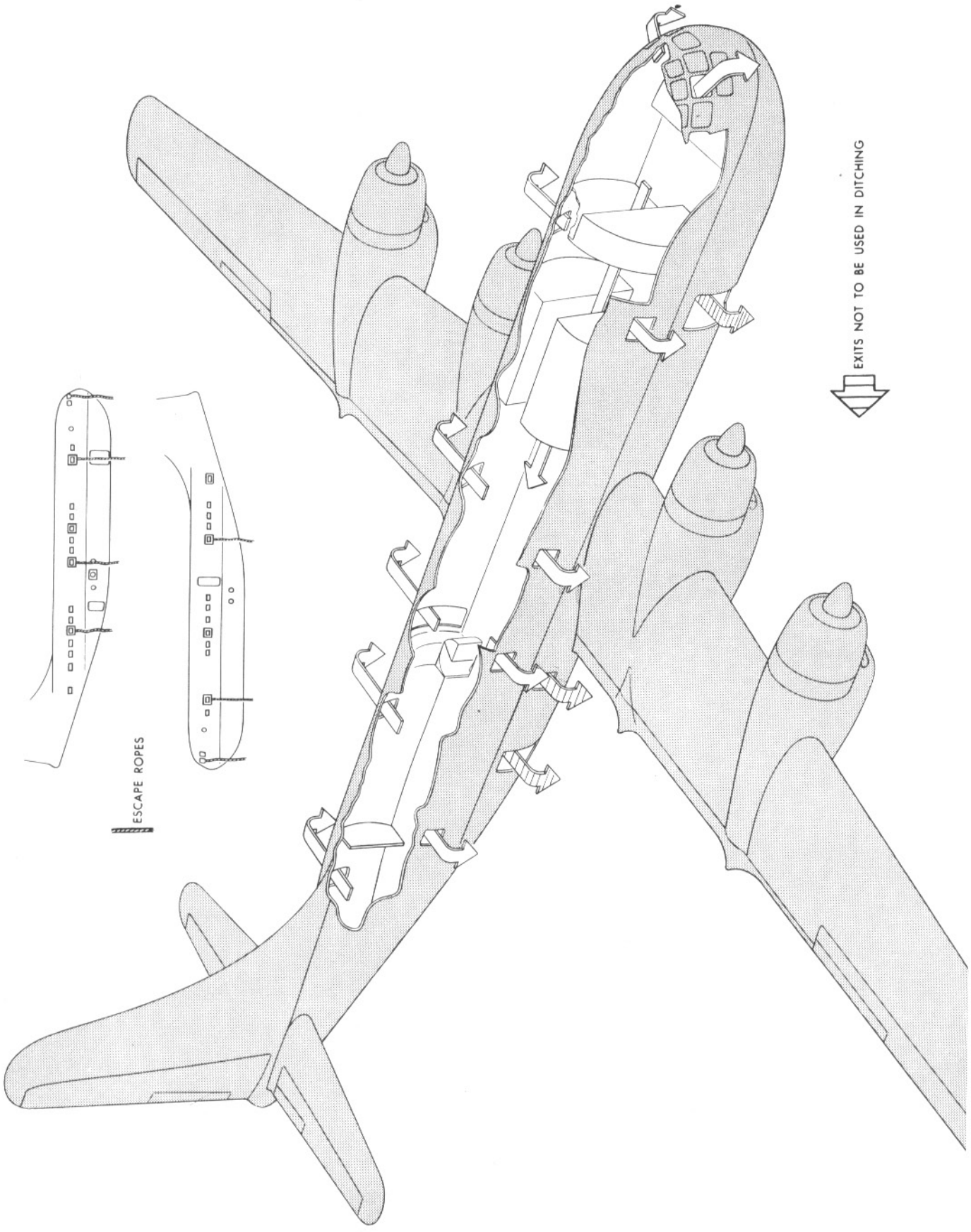



***Figure 2-2. Emergency Exits***

54052B

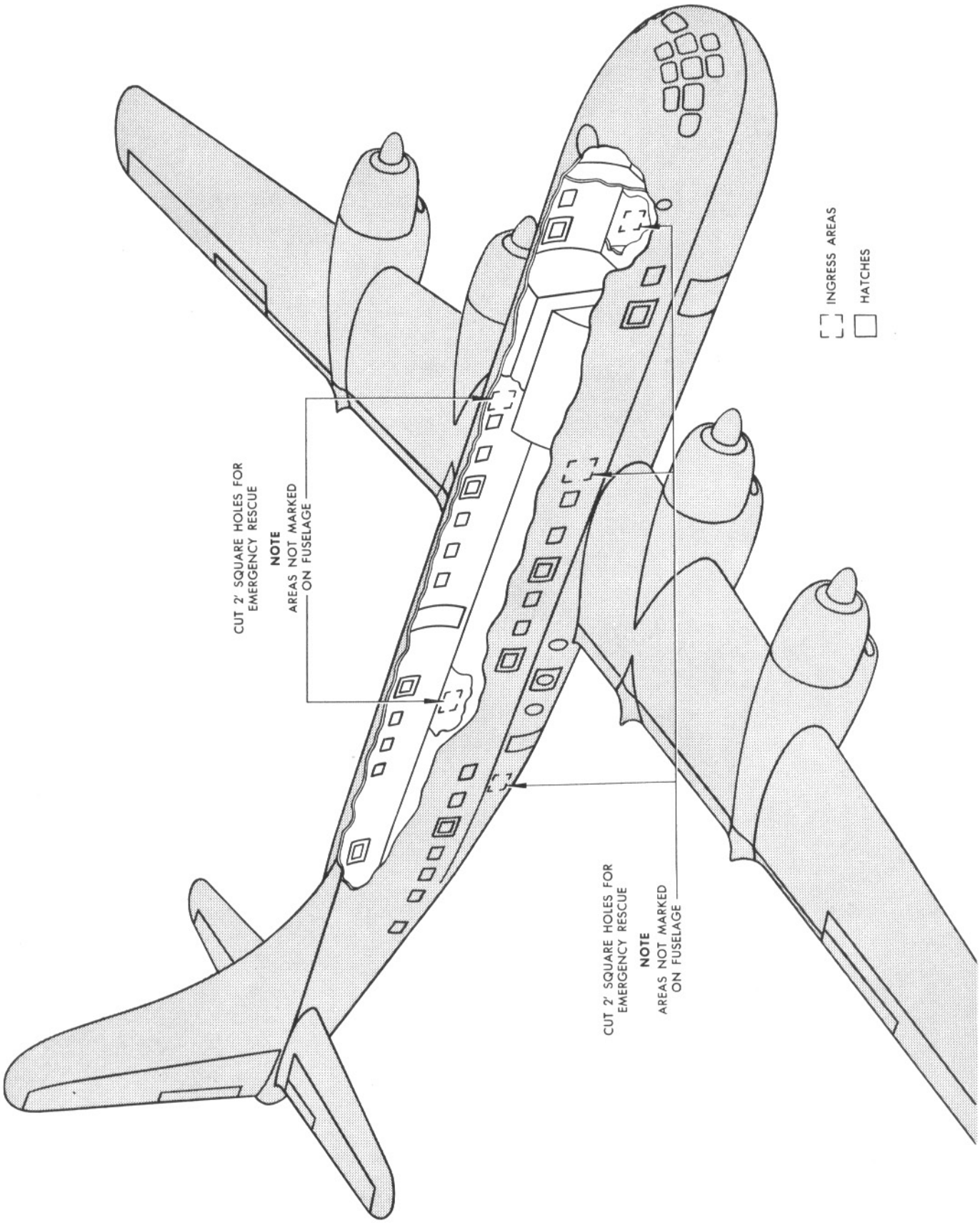



***Figure 2-3. Emergency Entrances***

540538

EMERGENCY EXITS AND ENTRANCES.

The emergency exits, including the control-cabin sliding windows, are used in crash landings and ditching as shown in figure 2-2. Emergency entrance to the airplane may be made by cutting through the fuselage skin as shown in figure 2-3.

DITCHING.

For ditching procedure, see the CAA Approved "Airplane Flight Manual."

LANDING GEAR EMERGENCY OPERATION.

MAIN LANDING GEAR EMERGENCY EXTENSION. If the main landing gear motor should fail, lower the main landing gear as follows:

a. Landing gear switch "OFF."

b. Pull out the red clutch handle, near each landing gear receptacle, and seat the swaged ball in the notch to engage the clutch.

c. Insert the hand crank and rotate 10 turns in the indicated direction.

d. Allow the red clutch handle to return to its seated position.

e. If the gear does not immediately extend, oscillate the hand crank.

CAUTION

After the clutch is released, do not re-engage the clutch or operate the crank for 5 seconds.

f. After the gear has extended by gravity, pull out the red clutch handle and seat the swaged ball in the notch.

g. Rotate the crank in the indicated direction until the stops are hit and the lock is engaged.

CAUTION

Make certain the down lock is engaged. The lock can be felt snapping into place after the stops are contacted.

h. Release the red clutch handle and remove the hand crank.

NOTE

The main landing gear may also be lowered with the portable motor or it may be cranked completely down by hand, but the crank and free-fall method, as explained, is usually quicker.

MAIN LANDING GEAR EMERGENCY RETRACTION.

a. Landing gear switch "OFF."

b. Pull out the red clutch handle and seat the swaged ball in the notch to engage the clutch.

c. Install the portable auxiliary wing flap motor and hold the switch in the direction indicated on the switch cover.

d. Run the motor until the landing gear stops are hit and the motor clutch starts slipping. (Approximately 60 seconds required.)

e. Return the red clutch handle to its seated position and remove the portable motor.

CAUTION

After starting to extend or retract the landing gear, do not reverse direction until the landing gear movement ceases as indicated by the landing gear position lights or visual observation.

The landing gear may be manually retracted as follows:

a. Landing gear switch "OFF."

b. Pull the red clutch handle and seat the swaged ball in the socket to engage the clutch.

c. Insert the crank and rotate it in the direction indicated until the stops are contacted and the lock is engaged. (490 turns are required.)

CAUTION

Always return the red clutch handle to its seated position after emergency operation is completed.

NOSE GEAR EMERGENCY EXTENSION.

a. Landing gear switch "OFF."

b. Move the motor clutch handle to the disengaged position.

c. Remove the rubber plug from the socket and insert the crank through the two keyed sections by pressing down on the crank hub for the first full turn.

d. Rotate the crank five turns. Remove the crank to permit free gear travel, wait at least 5 seconds; then re-engage the crank and turn until the gear hits the stops.

e. Check the gear lock by attempting to turn beyond the stops. If not already engaged, this will set the lock with a perceptible snap.

f. Move the motor clutch handle to the engage position.

g. Replace rubber plug in socket.

CAUTION

Do not crank with the motor engaged.

54106B

NOSE GEAR EMERGENCY RETRACTION. If the nose gear fails to electrically retract the following procedure should be followed:

a. Inspect the nose gear strut through the window in the nose wheel well to ascertain that the oleo strut is fully extended and that the nose wheel is centered. If the oleo strut is not fully extended, the orifice rod may strike and damage the forward bulkhead during gear retraction. If the nose wheel is not centered, damage to the nose gear doors and wheel well may occur during retraction.

NOTE

The ground-safety oleo relay is actuated by the orifice rod and prevents electrical retraction of the nose gear if the oleo strut is not fully extended or the nose wheel is not centered.

b. Should either or both of the above conditions occur, the nose gear should not be retracted.

c. If the oleo strut is fully extended and the nose gear centered, retract the gear manually by following steps "d" through "i."

d. Move landing gear switch "OFF."

e. Move the motor clutch handle to the disengaged position.

CAUTION

Do not crank with the motor engaged.

f. Remove the rubber plug from the socket and insert the crank through the two keyed sections by pressing down on the crank hub for the first full turn.

g. Rotate the crank in the direction indicated until the stops are contacted and the lock is engaged.

h. Move the motor clutch handle to the engage position.

i. Replace rubber plug in socket.

## LANDING WITH LANDING GEAR FAILURE

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Land with as light a gross weight as possible and after every effort has been made to lower the landing gear<br><br>NOTE<br><br>Land with as much of the landing gear down as possible in preference to a gear-up belly landing; do not land with nose gear only; land on a concrete or hard-surface runway rather than dirt or soft-surface. | 1. Turn off all equipment not necessary for flight | 1. Turn off all equipment not necessary for flight |
| 2. Check that all passengers and crew in lower compartments are moved to the main cabin and braced for crash landing | 2. Check emergency exits open; stow hatches in upper berths | 2. Unlock window and fasten safety belt |
| 3. Unlock window and fasten safety belt | 3. Fasten safety belt | 3. Turn booster pumps "OFF" and move body-valve switches to the "CLOSED" position |
| 4. Signal copilot to lower wing flaps | | 4. On pilot's signal, move wing-flap switch "DOWN" and hold until desired amount of flaps is reached |
| 5. Land in a normal nose-high attitude | | |
| 6. On contact with the ground, close throttles, move mixture control to "FUEL CUTOFF"; turn ignition switches "OFF"; and turn master switch "OFF" 5 seconds after $CO_2$ has been discharged | | 6. On contact, shut off all fuel and oil valves and place center wing area gang fire switch in the "FIRE" position; discharge all three sets of $CO_2$ bottles and hold for 5 seconds |

541078

LANDING WITH ENGINE FAILURE.

If it is necessary to land with one or more engines inoperative, trim the airplane as required and increase the power of the other engines to maintain air speed. Lower the landing gear and 30 degrees of flaps while on the base leg just prior to turning on final approach. Keep air speed and altitude slightly higher than normal on the final approach until a safe landing is assured. Lower the remaining flaps. Make a normal landing.

## LANDING WITHOUT BRAKES

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Land with as slow a forward speed as possible | | 1. Check wing flaps fully extended |
| 2. Land as short on the runway as possible | | 2. Check all body and thermal anti-icing combustion heaters off |
| 3. Make contact with the main gear first; then ease the nose down | | 3. Open cowl flaps on contact with ground |
| 4. As soon as the nose gear makes contact, move all four throttles to "REVERSE OPEN" | | |
| CAUTION<br>Observe reverse pitch operation limitations. | | |
| 5. After airplane slows down, reduce reverse thrust and follow emergency taxiing instructions if necessary | | |

54108B

## STOPPING ENGINES

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Check wheels chocked | 1. Check wheels chocked | |
| 2. If oil dilution is desired, and when required temperatures are established (see Oil Dilution Operation), adjust throttles to obtain 1000 RPM | | 2. If oil dilution is desired, service the nacelle oil tanks and then follow the procedure outlined in "Oil Dilution Operation" |
| | | 3. When cylinder head temperatures are below 190° C, move mixture control to "FUEL CUTOFF" while idling between 800 and 1000 RPM |
| 4. Close throttles | | 4. Turn ignition "OFF" when engines stop turning |
| CAUTION<br>DO NOT OPEN THROTTLES | | |
| | | 5. Move turbo-bleed switches to "CLOSE" |
| | 6. Have external power connected if desired | |
| | 7. Leave cowl flaps open for at least 15 minutes after engines are stopped | |

541108

OIL DILUTION OPERATION.

Engine oil should be diluted prior to engine shut-down when outside air temperatures of 40° F or below are anticipated at starting. Oil dilution will ease cold weather starting and minimize starter damage or engine failure caused by a fuel hydraulic lock during starting.

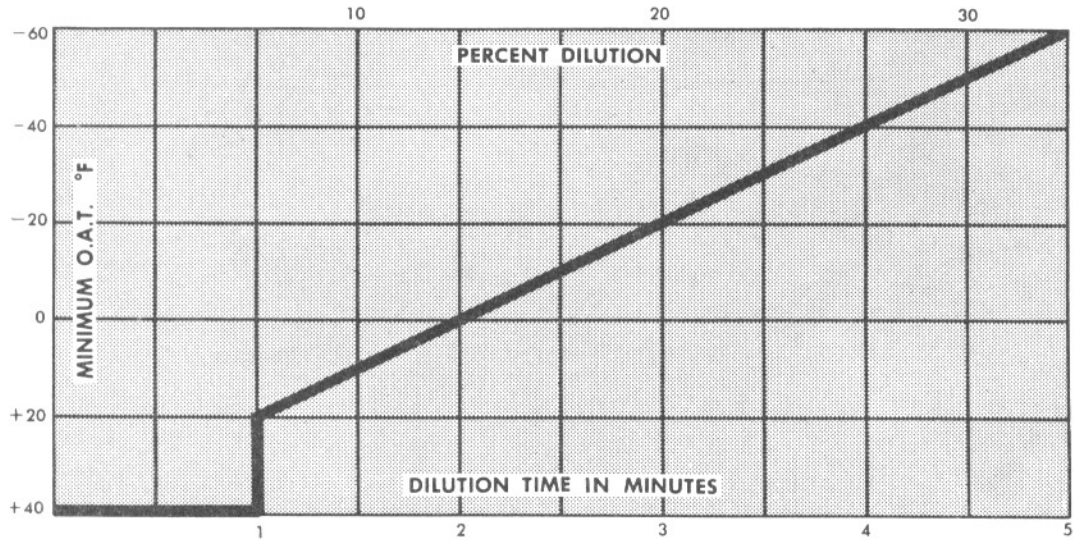
The following procedure is recommended for oil dilution:

a. Service the engine oil tanks. Tanks may be serviced to 35 gallons for normal dilution. For oil dilution time of more than 3 1/2 minutes, service the engine oil tanks to 30 gallons to allow space for the added fuel.

b. Idle the engines at 1000 RPM with the oil cooler flaps and cowl flaps open until the oil temperature has decreased below 50° C or stabilized at a minimum temperature (60° C maximum) and the cylinder head temperature has been reduced below 150° C.

c. Dilute oil at 1000 RPM for the time corresponding to the expected O.A.T. on the "Minimum O.A.T.--Dilution Time" curve.

d. When dilution time has elapsed, shut the engine down.




NOTE

If oil temperature rises above 60° C or oil pressure drops below 15 PSI during dilution, shut the engine down and allow to cool before continuing.

BEFORE LEAVING THE AIRPLANE

| PILOT | AUXILIARY OPERATOR | COPILOT |
|---|---|---|
| 1. Brakes "OFF" if wheels are chocked | | 1. Wing-flap switch "OFF" |
| 2. Cockpit blower "OFF" | | 2. Landing-gear switch "OFF" |
| 3. Master synchronizer lever in full "DECREASE RPM" position and propeller control levers in "FIXED PITCH" | | 3. Control-surface lock "LOCKED"<br>NOTE<br>To insure locking of the controls, move the aileron and rudder controls to the neutral position and the elevator control down. Oscillate the controls to check seating of the locking pins. |
| 4. Radios "OFF" | | 4. Turbo boost "0" |
| 5. Trim tabs zeroed | | 5. Fuel selectors "OFF"<br>6. Cowl flaps "CLOSED"<br>7. Intercooler flaps "CLOSED" |
| 8. All switches "OFF" except rudder-boost switch | 8. All switches "OFF"<br>9. Check that landing-gear ground locks, pitot covers, and air-intake duct plugs are installed | 8. All switches "OFF" |

541098

# Chapter 3 OPERATIONAL EQUIPMENT

COMMUNICATIONS AND RADIO-NAVIGATION EQUIPMENT. 62

The radio and navigation equipment as installed in the Stratocruiser provides communication, navigation, instrument landing facilities, and altitude indication. This equipment consists of the following: 20 22 32

- Interphone System
- Crew Call System
- LF Communication
- HF Communication
- VHF Communication
- Left and Right ADF
- Marker Beacon
- Radio Altimeters
- Localizer and Glide Path
- Loran
- Driftmeter

Most of the radio equipment is shock-mounted on the radio rack in the aft right corner of the control cabin. 41 51

INTERPHONE SYSTEM. This is a two-circuit system for intercommunication between crew members. One circuit provides intercommunication between the control cabin and remote crew stations and the other circuit provides intercommunication among the flight crew. 31 41 11 21 11

In the control cabin circuit, the pilot, copilot, radio station, and navigation station each have audio selection panels, headsets, and microphone extension jackboxes. These audio panels are located on the pilots' radio control panel, for the pilot and copilot, adjacent to the navigation station instrument panel, and on the radio station instrument panel. Extension jacks only, connected through the pilot's and copilot's audio panels, are provided for the auxiliary operator and left side observer. A selector switch on the left auxiliary communication panel gives a selection of reception for the auxiliary operator and left side observer. When the switch is in the "CAPT" position, the auxiliary operator can listen to reception as selected on the pilot's audio panel and the left side observer can listen to reception as selected by the copilot. When the switch is in the "1ST OFF" position, the auxiliary operator can listen to reception as selected on the copilot's audio panel and the left side observer will receive reception as selected on the pilot's audio panel. Both the auxiliary operator and left side observer use the pilots' audio panel for transmissions. A headset extension jack only, connected through the radio station audio panel, is provided for the right side observer. The right side observer can listen to reception as selected on the radio station audio panel and uses the radio station microphone for transmissions. The pilots have special headset and microphone outlets on the right auxiliary communication panel which permit use of the radio station LF communication equipment (BC-348Q receiver and AN/ART-13 transmitter) as an emergency means of communication. Microphone and headset jacks are located as shown in the following chart. 30 20

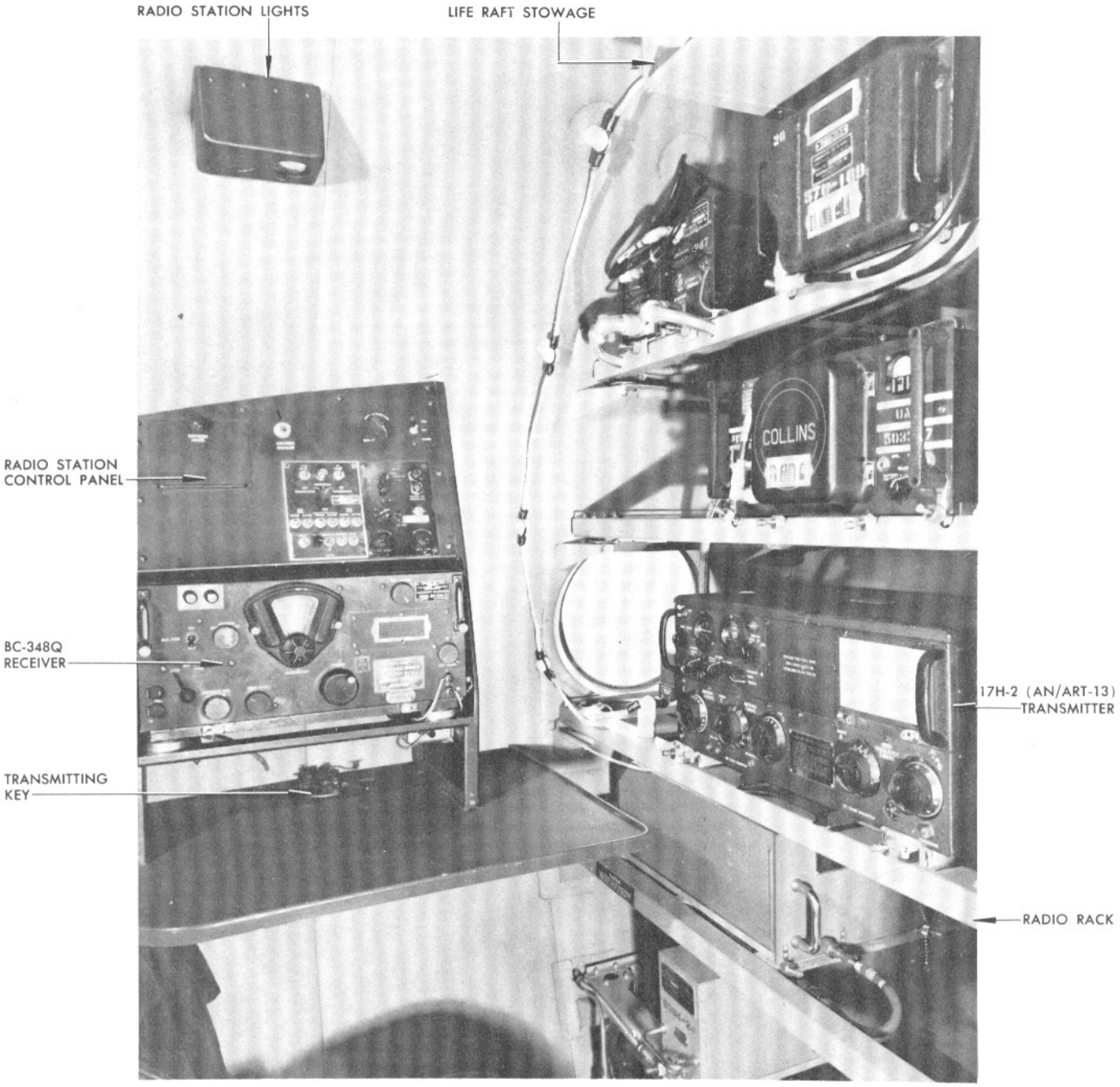
## JACK LOCATIONS

| | MIC JACK | PHONE JACK |
|---|---|---|
| PILOT | PILOT'S AUXILIARY PANEL<br>EMERGENCY<br>LEFT END OF RIGHT AUXILIARY COMMUNICATION PANEL | LEFT AUXILIARY COMMUNICATION PANEL<br>EMERGENCY<br>LEFT END OF RIGHT AUXILIARY COMMUNICATION PANEL |
| COPILOT | COPILOT'S AUXILIARY PANEL | RIGHT AUXILIARY COMMUNICATION PANEL |
| AUX OPERATOR | LEFT AUXILIARY COMMUNICATION PANEL | LEFT AUXILIARY COMMUNICATION PANEL |
| NAVIGATION STATION | NAVIGATION STATION AUXILIARY PANEL | NAVIGATION STATION AUXILIARY PANEL |
| RADIO STATION | EXTENSION JACKBOX ON FORWARD SIDE OF RADIO STATION CABINET | EXTENSION JACKBOX ON FORWARD SIDE OF RADIO STATION CABINET |
| LEFT SIDE OBSERVER | PILOT'S AUXILIARY PANEL | LEFT AUXILIARY COMMUNICATION PANEL |
| RIGHT SIDE OBSERVER | USE RADIO STATION JACK IN EXTENSION JACKBOX ON FORWARD SIDE OF RADIO STATION CABINET | EXTENSION JACKBOX ON FORWARD SIDE OF RADIO STATION CABINET |

540628

The circuit which connects the control cabin to the remote stations has handsets on the right fuselage wall, accessible to the copilot, at the cabin attendant's station and the lounge attendant's station. In addition to the handsets in this circuit, extension jackboxes are located at the rear spar (in the center wing section), in the nose-wheel well, in each main gear wheel well, and on the lower outboard side of each outboard nacelle. This system is in operation when the circuit breaker in the radio junction box is on.

This circuit may also be connected to a ground central telephone exchange while the airplane is at a loading station. A receptacle for this connection is provided on the nose-wheel well interphone box. The handset in the control cabin and at the cabin attendant's station can then be used for conventional telephone communication by employing the transfer switch and dial adjacent to the handsets. One position of each transfer switch permits use of that handset for normal interphone communication while the other position of




540018

***Figure 3-1. Radio Station***

each switch connects that handset and phone dial to central telephone exchange systems.

CREW CALL SYSTEM. A system of interstation signals is available to provide a means of establishing interphone communication between the remote crew stations. The control cabin can signal the cabin attendant's station, the ground crew, and the crew bunk; the cabin attendant's station can signal the control cabin and the lounge attendant's station; the lounge attendant's station can signal the control cabin and the cabin attendant's station; and in addition, the control cabin can be signaled from each ground crew interphone box and from the interphone station behind the lounge mirrors at the rear spar. Call buttons for this purpose are on the overhead instrument panel, the cabin attendant's instrument panel, the lounge bar, in the nose-wheel well interphone box, each nacelle interphone box, and adjacent to the interphone jack box behind the lounge mirrors.

Actuation of a call button will cause a light or lights at the other station to illuminate (except for ground crew and crew bunk signaling). For ground crew and crew bunk signaling, a horn will sound. The blue call light for the control cabin is on the pilots' instrument panel and will be illuminated only while a call button is being depressed. Call lights on the cabin attendant's instrument panel and on the lounge bar will remain illuminated until turned off by an adjacent reset button. An attendant call light on the forward and the aft passenger ceiling call light panels also will illuminate and a chime at the cabin attendant's station will sound (provided the disconnect switch is closed) when the cabin attendant is signaled. A circuit breaker for the crew call system is on the aft power panel. A "SWITCH TO INTERPHONE" light system is used for signaling between the pilot and the radio station. The system includes a light on the LF and HF communication control panel, at the radio station, and another on the overhead instrument panel. When the light at either station is pushed, it will cause the light at both stations to illuminate.

AUDIO SELECTION PANEL. The audio selection panels are conveniently located at each flight crew station. They permit various listening and operating combinations of six receivers, two transmitters, and the interphone system. Any one or all receivers may be heard simultaneously by moving the toggle selection switch for each desired receiver to the up position. A "MASTER LEVEL" knob provides volume adjustments for interphone and receiver output. The "EMERGENCY" switch provides a means of by-passing the audio amplifier tube in each audio panel in event of a normal volume control failure. The microphone selector switch permits voice transmission on either of the transmitters or the interphone system. The transmitter indicator light above the microphone selector switch illuminates on all audio panels when any of the microphone switches are placed to "VHF" or "HF."

RADIO STATION CONTROL PANEL. The radio station control panel is mounted above the BC-348Q receiver at the radio station. (See figure 3-1.) The audio selection panel and an LF and HF communication control panel are mounted on it. The LF and HF communication panel has controls for the AN/ART-13 transmitter and the Collins 18-S-2 (or 18-S-3) transceiver. Primary control of operation of these radios is given the radio station by use of the function selector switch on the panel. This switch selects 18-S-2 or -3 transceiver operation on the left side and AN/ART-13 transmitter operation on the right side. When the switch is in the "18-S" positions, the radio station only has control of the 18-S frequency selection; however, transmissions and reception can be made from the pilots' station on the frequency selected at the radio station. When the switch is in the "ART-13" positions, the pilots have control of the 18-S frequencies and the radio station can operate the AN/ART-13 transmitter. The 18-S positions are (1) "CW," (2) "RECEIVE" (standby), and (3) "VOICE." The ART-13 positions are (4) "VOICE," (5) "MONITOR" (BC-348Q), and (6) "CW." A rotary selector switch with ten positions and an "A-B" toggle selector switch permit selection of the desired 18-S frequency channels. These switches function only while the function selector switch is in the 18-S positions. The beat frequency oscillator control knob and receiver sensitivity control knob are for 18-S functions only and are brought into operation when the function selector switch is set to "18-S." A red light on the panel will be illuminated when the function selector switch is in 18-S "CW" position or while transmitting. A green light, also on the panel, is used to signal the pilot (see "Crew Call System").

A transmitter key on the radio station table is connected through the radio station audio panel and can be used for transmitting on VHF or HF.

PILOTS' RADIO CONTROL PANEL. This radio control panel is in the top of the engine control stand aft of the throttles. See figure 3-3. It is divided into the following sections: left ADF control panel, frequency and volume control panel, right ADF control panel, pilot's audio selection panel, ADF tuning meter panel, and the copilot's audio selection panel. The use of controls on these panels is explained in each paragraph describing the individual receivers.

LF COMMUNICATION. A BC-348Q receiver and a 17H-2 (AN/ART-13) transmitter at the radio station provide LF communication. Controls are self-contained in each unit. The receiver and transmitter are in operation when the switch-type circuit breakers, on the radio circuit breaker panel, are on. This equipment can be used at the pilots' station by switching headset and microphone plugs to the "EMER" outlets on the right auxiliary communication panel.

HF COMMUNICATION. The HF communication radio is either a Collins 18-S-2 (or 18-S-3) transceiver. Frequency selection for transmitter and receiver is controlled from the frequency and volume control panel at the pilots' station or from the LF and HF communication panel at the radio station. Transmissions and reception on the selected frequency is accomplished by having the "HF COMM" headphone switch on and the microphone selector switch to "HF TRANSMIT-

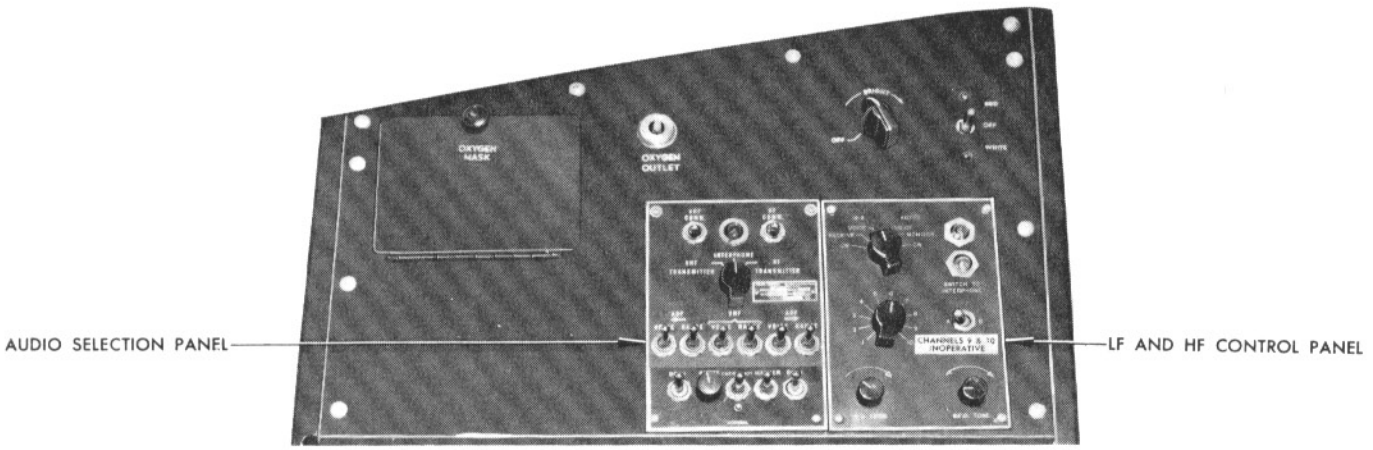


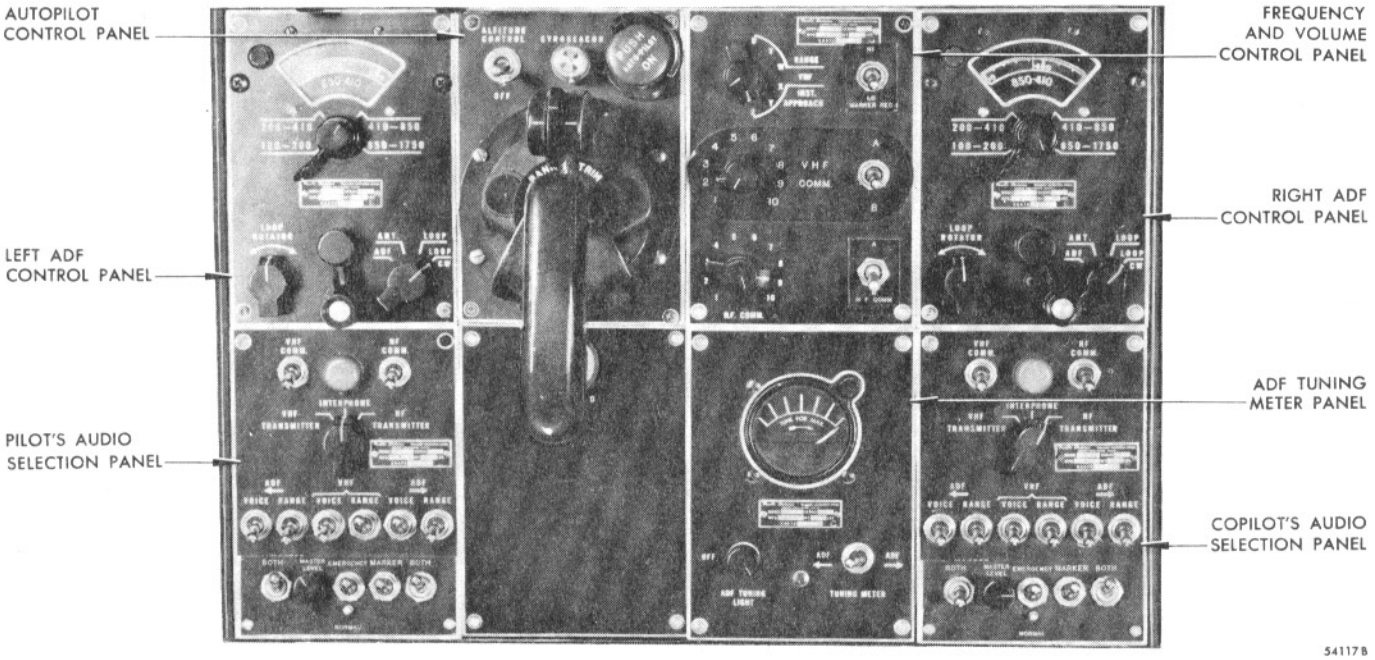

***Figure 3-2. Radio Station Control Panel***

54061B

TER" position. This may be accomplished from any one or all of the audio selection panels. An "A-B" selector switch on the frequency and volume control panel and on the LF and HF communication panel is used in conjunction with the channel selector switch to increase the number of available channels from 10 to 20. A sensitivity control knob is on the LF and HF communication panel and another is incorporated in the channel selector switch on the frequency and volume control panel. These are used in conjunction with the "MASTER LEVEL" knob on the audio selection panel to obtain maximum sensitivity. See also the paragraph "Radio Station Control Panel" for additional HF communication controls. The receiver is in operation when the switch-type circuit breaker, on the radio circuit breaker panel, is on.

VHF COMMUNICATION. The VHF communication radio is an RT-18/ARC-1 transceiver set. Frequency selection for transmitter and receiver is controlled from the frequency and volume control panel at the pilots' station. Transmissions and reception on the selected frequency is accomplished from any one or all of the audio selection panels. An "A-B" selector switch is used in conjunction with the channel selector switch to increase the number of available channels from 10 to 20. The channel selector switch incorporates a sensitivity control knob for adjustment of the sensitivity and audio output of the receiver. The receiver is in operation when the switch-type circuit breaker, on the circuit breaker panel, is on.

LEFT AND RIGHT ADF. The left and right ADF radios incorporate three magnetic and dual ADF indicators, one on each side of the pilots' instrument panel and one on the navigation station instrument panel. Both radios are controlled from the pilots' station. Controls are conventional except that both radios use




54117B

***Figure 3-3. Pilots' Radio Control Panel***

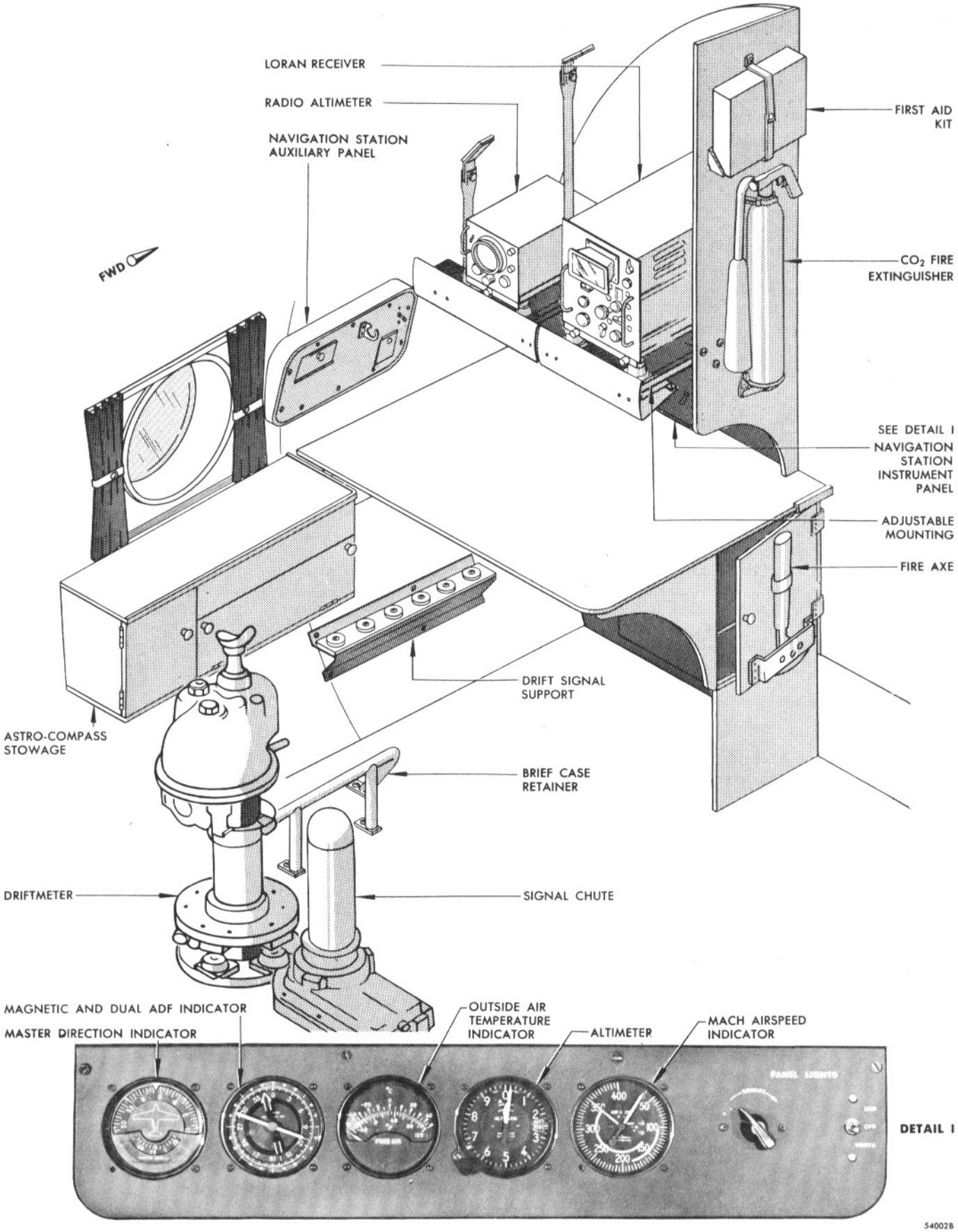
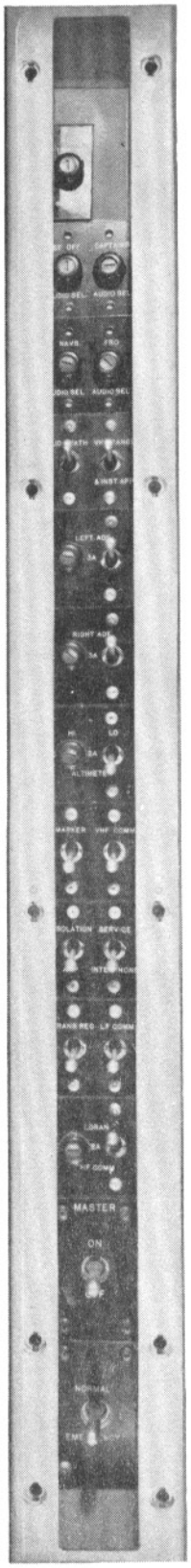



***Figure 3-4. Navigation Station***




54060B

**Figure 3-5. Radio Circuit Breaker and Fuse Panels**

the same tuning meter. A selector switch on the tuning meter panel is positioned for the receiver being tuned. Both receivers are on when the switch-type circuit breakers, on the circuit breaker panel, are on.

MARKER BEACON. An MN-61A marker beacon receiver can be listened to from each of the audio selection panels by placing any one of the "MARKER" switches in the on position. A "HI--LO" sensitivity switch on the frequency and volume control selector panel of the engine control stand is used to broaden or lessen the cone of audibility respectively. The receiver is on when the switch-type circuit breaker, on the circuit breaker panel, is on.

RADIO ALTIMETERS. The pilots' station has provisions for a (AVQ-6) low range radio altimeter system. The transceiver has not been installed, but the following equipment incorporated in the system is installed on the pilots' instrument panel: an indicator, incorporating an altitude range switch and an "ON" switch, on each side of the pilots' instrument panel; red, green, and amber indicator lights on each side of the panel and an altitude limit switch below the indicator lights. The range switch changes the operating range of the altimeter to read either hundreds of feet or thousands of feet. Both altimeters must read in the same range to operate the system correctly. A red light on the pilots' instrument panel is illuminated when the indicators are not set to the same range. The altitude limit switch is graduated in 25-foot increments from a minimum of 50 feet to a maximum of 300 feet or with the high range in operation, 500 to 3000 feet. With the limit switch set to any desired value, the three indicator lights are brought into operation. The red light indicates that the airplane is 25 feet or more below the selected altitude. The green lights indicate that the airplane is 25 feet or more above the selected altitude. The amber lights indicate that the airplane if flying at the selected altitude or within 20 feet above or below that altitude.

The navigation station has an (AVQ-9) high range radio altimeter. The altimeter indicator is mounted on an adjustable mount which permits alignment of the indicator with the operator's line of sight. An "ON--OFF" switch is on the indicator.

LOCALIZER AND GLIDE PATH. A BC733D localizer receiver and an R-89B/ARN-5A glide path receiver are installed for the instrument landing system. A channel selector switch is on the frequency and volume control panel at the pilots' station. Crosspointer indicators on each side of the pilots' instrument panel give visual indication. The localizer will also receive either modulated tone or voice transmissions on the channel selected by selection of the "VHF VOICE" and/or "VHF RANGE" switches on any one of the audio selection panels. Both receivers are in operation when the two switch-type circuit breakers, on the circuit breaker panel, are on.

LORAN RADIO. A Loran receiver indicator is mounted on an adjustable mount above the navigation station table. The adjustable mount permits alignment of the indicator with the operator's line of sight. All controls for operation of the receiver are contained on the receiver. A fuse for the Loran receiver is on the radio circuit breaker panel.

DRIFTMETER AND DRIFT SIGNAL CHUTE. A driftmeter and a drift signal chute are aft of the navigation station. Power is supplied to the driftmeter by a switch on the navigation station auxiliary panel. A fuse for the driftmeter is on the AC power shield.

COMMUNICATIONS ELECTRICAL POWER, CIRCUIT BREAKERS, AND FUSES. Radio equipment using alternating current receives its power from the AC power shield. Radio equipment using direct current receives its normal power from the forward power panel. A master switch on the radio circuit breaker and fuse panel must be "ON" to operate DC radio equipment on normal power. Some DC radio equipment can receive emergency power through the No. 1 battery relay shield. See "Emergency Radio Operation." A circuit breaker for DC radio power is on the forward power panel. Circuit breakers for AC radio power are on the AC power shield. Fuses and switch-type circuit breakers for individual transmitters, receivers, and radio equipment are on the radio circuit breaker and fuse panels at the forward end of the radio junction box (see figure 3-5).

EMERGENCY RADIO OPERATION. In the event of a ditching, crash landing, or DC power failure, some radio-navigation equipment can be operated on the emergency DC bus. A "NORMAL--EMERGENCY" switch in the lower end of the radio circuit breaker and fuse panel is used to select either normal or emergency power. When the switch is in the "NORMAL" position, all radio equipment using DC power is connected to the normal DC bus. When the switch is placed in the "EMERGENCY" position, DC power from the emergency bus (battery power) will be supplied to the following equipment: interphone system, audio selection panels, LF communication radios, HF communication transceiver radio, and the left ADF radio. It is not necessary for the radio master switch to be "ON" when operating on emergency power. A circuit breaker for emergency DC radio power is on the No. 1 battery relay shield. Only the minimum communication equipment should be on when it is necessary to operate on emergency power as the duration of battery current is limited.

CABIN PRESSURIZING SYSTEM.

The airplane is pressurized to provide a maximum amount of comfort to the passengers and crew. The entire airplane, with the exception of the nose wheel well and the tail compartment, is pressurized. This pressurization makes possible the maintaining of a sea level cabin up to an airplane altitude of 15,000 feet. See figure 3-6 for cabin pressurizing system.

CABIN PRESSURIZING SYSTEM CONTROLS. Cabin pressurizing controls consist of four turbo-bleed switches on the copilot's auxiliary panel, a cabin pressure selector, a rate-of-change selector, a cabin rate-of-climb indicator, a cabin altitude indicator, two dual cabin air flow gages, and a cabin pressure release valve switch on the overhead instrument panel. The four turbo-bleed switches control opening and closing of the cabin air venturi valves. The cabin pressure selector permits the selection of any cabin altitude from sea level to 15,000 feet. The rate-of-change selector controls the rate, from 50 to 2,000 feet per minute, at which the cabin altitude may be changed. This rate of change will remain constant at the selected value until the selected pressure altitude is reached. Both selectors control the cabin pressure regulators which regulate and maintain the pressure selected at all airplane altitudes unless the pressure differential between cabin and atmospheric pressure exceeds 6.55 PSI. This differential will then remain constant, making ineffective the cabin pressure selected, until descent to an altitude at which the differ-

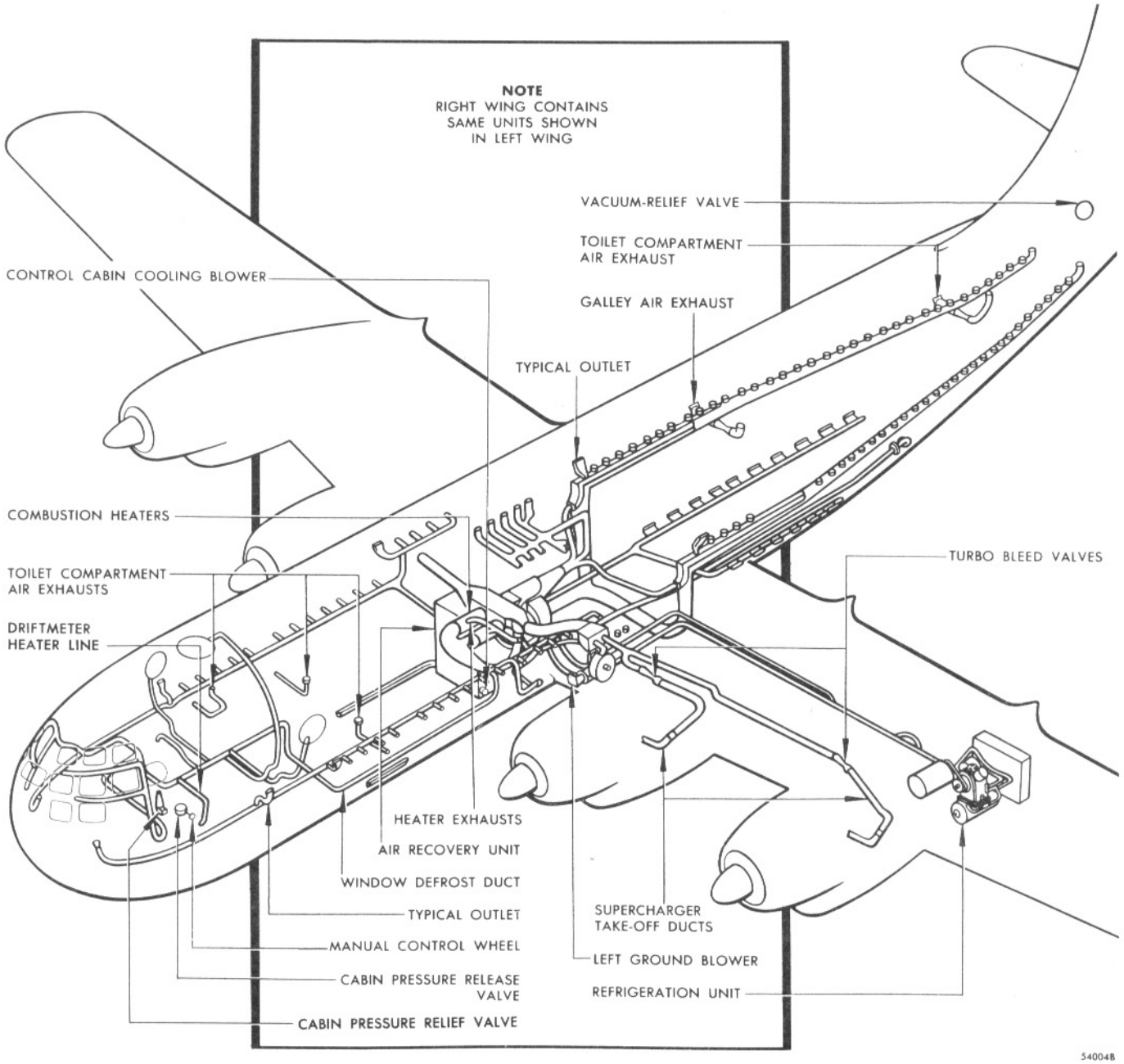



*Figure 3-6. Cabin Pressurizing and Air Conditioning Systems*

ential pressure is again at or below 6.55 PSI. The cabin altitude indicator shows cabin pressure altitude, airplane pressure altitude, and, in addition, the differential pressure, in pounds per square inch, between cabin and ambient. Circuit breakers for this system are on the overhead electrical panel.

CABIN PRESSURE RELIEF VALVE. This valve, in the lower nose compartment, operates automatically to guard against exceeding the structural pressure limit of the airplane by relieving at 6.75 PSI differential pressure.

CABIN PRESSURE RELEASE VALVE. A cabin pressure release valve in the lower nose compartment is controlled by a switch on the overhead instrument panel. When the switch is in the "AUTO" position, the valve will open immediately upon landing, thereby equalizing cabin and atmospheric pressures. In an emergency, the cabin can be depressurized in flight by placing the switch in the "OPEN" position. An amber light adjacent to the switch will illuminate when the release valve is open. The valve may be operated manually by turning the knurled wheel attached to the valve shaft.

WARNING

After operating manual release, return valve to closed position before attempting to operate with motor.

CABIN VACUUM RELIEF VALVE. This automatic-operating valve, which protects the fuselage against negative pressure, is on the aft pressure bulkhead. The valve opens inward whenever atmospheric pressure is greater than cabin pressure.

DIFFERENTIAL PRESSURE GAGES. Two dual differential pressure gages, reading from 0 to 10 inches Hg, are provided as a means of establishing cabin air flow requirements. These gages measure differential pressures between the carburetor top deck (disregarding duct loss between the carburetor and the point of measurement upstream of the flow limiting venturi) and the airplane cabin. A fuse for the indicators is on the AC power shield.

Adequate air flow during cruise operations will be obtained for cabin pressurization if the flow gages are maintained within their green ranges (1 to 3 inches Hg) by applying turbo and part throttling, if required. Care should be taken to use maximum throttle and minimum turbo to provide the lowest cabin air flow gage reading which gives satisfactory cabin altitude.

Under certain conditions, cabin differential flow readings in excess of the green range may occur. This is normal, occurring whenever power requirements dictate a higher carburetor top deck pressure than do cabin pressurizing requirements, or whenever carburetor top deck pressure considerably exceeds cabin pressure as when flying nonpressurized at moderate altitude. (Increased TBS settings and part throttle, as applied for carburetor deicing purposes, also produce high gage readings.)

CABIN PRESSURE NORMAL OPERATION. During flight planning, the cruise-altitude and destination field elevation should be determined. Pressurization should be planned so that the cabin pressure altitude during the flight will be the minimum altitude possible, consistent with engine power and airplane cruise-altitude. The cabin pressure altitude upon arrival at the destination should be equal to the field elevation or above. This is to accomplish complete depressurization prior to landing. Therefore, the flight plan should indicate at what point during the flight it will be necessary to readjust pressurization to the field elevation.

During the warm-up period, select the field elevation plus at least 1000 feet on the cabin-altitude selector; then set the rate-of-change selector to maximum. After 10 minutes, reset the rate-of-change selector to "0" and the cabin-altitude selector to the desired value, as determined in the flight plan. This procedure is to prevent a possible rapid altitude change due to incorrect positioning of the cabin pressure regulator.

WARNING

Check that all doors are closed and locked and that the door warning light on the pilots' instrument panel is out before take-off.

Prior to take-off, place the four turbo-bleed switches in the "OPEN" position and the cabin pressure release valve in the "AUTO" position. When pressurization is started, usually at time of the first power reduction, rotate the rate-of-change selector to the desired value.

If necessary to readjust the cabin pressure-altitude in flight, as required by changes in cruising altitude, first move the rate-of-change selector to "0"; then readjust the cabin altitude selector to the new value and return the rate-of-change selector to the desired value. A rate of 200 feet per minute or less is recommended for passenger comfort. Check the actual rate of change by the cabin rate-of-climb indicator.

NOTE

When making changes in cabin altitude, always place the rate-of-change selector in the "0" position before adjusting the cabin-altitude selector.

The landing altitude should be selected at any convenient point during the flight with allowance for time to accomplish the change.

CABIN PRESSURE EMERGENCY OPERATION. The regulators are designed to limit maximum differential pressure to 6.55 PSI in event of electrical malfunction or improper control. If, due to mechanical failure, a pressure differential of 6.55 PSI is exceeded, the condition will be indicated on the differential pressure gage of the cabin and airplane altitude indicator. The pressure relief valve in the lower nose compartment will relieve if pressure reaches 6.75 PSI. A loud

hissing noise can be heard when the valve opens. This valve will provide protection until the differential pressure is reduced. The correct procedure to alleviate an exceeded pressure limit condition is to reduce cabin pressure to a value below 6.55 PSI by momentary operation of the cabin pressure release switch to the "OPEN" position, and by leaving the switch in the "OFF" position when the desired differential pressure or cabin altitude is obtained. Operation during this condition, while continuing pressurization, will require constant monitoring of the pressure release switch. The cabin pressure release warning light will remain illuminated, indicating that the release valve is partially open. If the electric operation of the pressure release valve fails, it may be manually operated by the control provided at the valve in the lower nose compartment. If it is desired, the airplane altitude may be decreased as the pressure is reduced. When cabin and airplane altitudes are equal, the ground blower switches may be placed in the "OFF, RAM AIR OPEN IN FLIGHT" position and the cabin pressure release valve fully opened. The balance of the flight will then be without cabin pressurization.

OXYGEN SYSTEM.

The airplane is provided with a passenger and a crew high-pressure, continuous-flow oxygen system for use during fire combat procedures, cabin pressurization failure, or for therapeutic treatment of passengers. See figure 3-7. The systems are interconnected through a three-way valve that permits the following arrangements when used with a shutoff valve in the passenger system.

a. Passenger system off; crew system drawing from its own supply.

b. Both systems drawing from their own supply.

c. Both systems drawing from the passenger supply.

d. Passenger system off; crew system drawing from crew and/or passenger supply.

The crew system is normally supplied by a single oxygen cylinder and the passenger system is normally supplied by two cylinders.

OXYGEN SUPPLY CYLINDER AND REGULATOR. The oxygen cylinders are strapped to cradles on the fuselage wall above the control cabin coat compartment. (The two oxygen cylinders which normally supply the passenger system are installed by the customer.) Each cylinder is equipped with a regulator and a pressure gage. They contain 48.3 cubic feet of oxygen when fully charged to 1800 PSI.

The rate of oxygen flow in each system is controlled by the individual cylinder regulators which are adjusted manually to supply the correct rate of flow for various altitudes. The two regulators on the passenger supply cylinders are independent of one another and may be used to supply the system either singly or together. The pressure gages indicate pressure in each cylinder only when the regulator valve is open.

NOTE

The crew oxygen regulator valve is safety-wired in the open position.

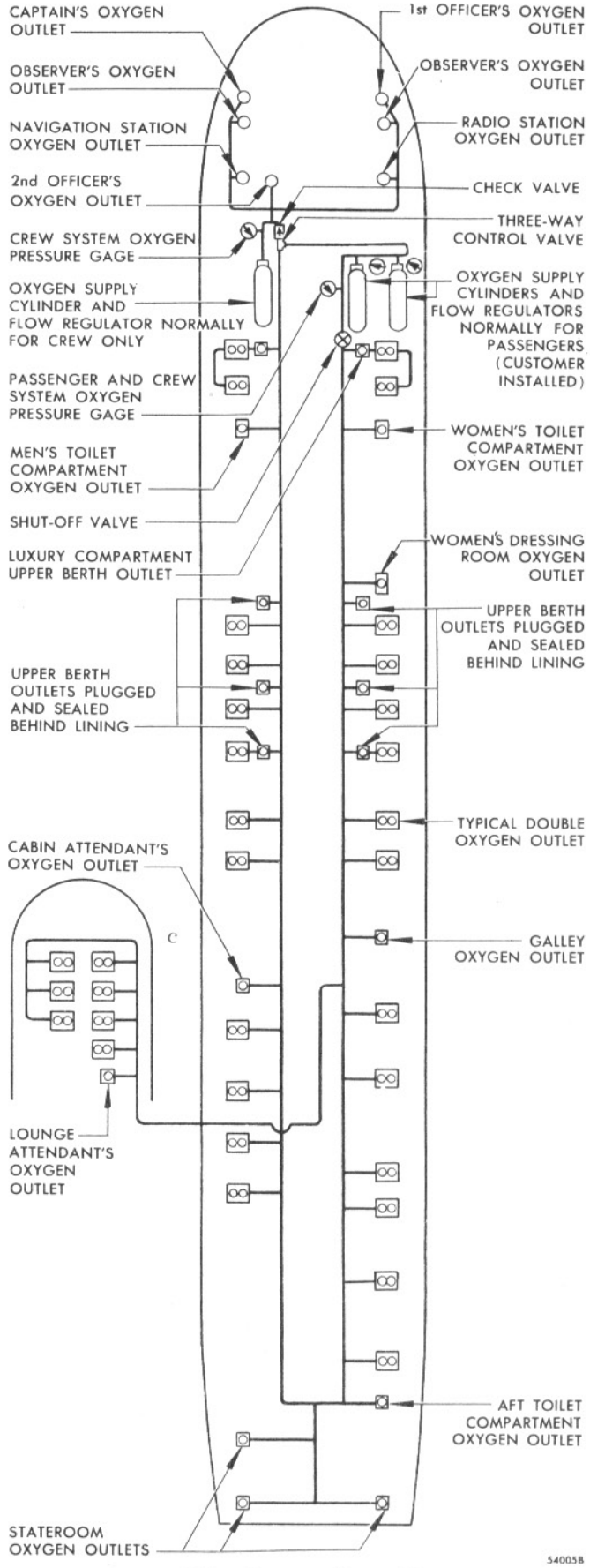



**Figure 3-7. Oxygen Flow Diagram**

OXYGEN CONTROL PANEL. The oxygen control panel, as shown in figure 3-8, is located overhead behind the navigation station. A three-way valve, a passenger system "ON--OFF" valve, a crew oxygen flowmeter, and a passenger oxygen flowmeter are on the panel. The valves permit arrangements as described in the previous paragraph "Oxygen System." If it is desired to use the passenger system for the flight crew only, the shutoff valve should be moved to the "PASSENGER OXYGEN OFF" position. The two flowmeters are calibrated in units of altitude for 10,000, 20,000, 25,000, and 30,000 feet. When the flowmeter is adjusted by means of the regulator knob to indicate cabin altitude, oxygen will flow to all outlets at a rate sufficient for normal body requirements at that altitude. Turning the knob so that the reading exceeds the actual flight altitude will release an additional flow of oxygen.

NOTE

To obtain proper flow of oxygen, the flowmeter reading must correspond with the cabin altitude.

The regulators are capable of supplying the flow indicated in the following table to any or all of the crew or passenger outlets.

OXYGEN RATE OF FLOW
(IN CUBIC INCHES PER MINUTE)

| ALTITUDE IN FEET | CREW | PASSENGER |
|---|---|---|
| 10,000 | 177 to 226 | 58 to 79 |
| 20,000 | 244 to 293 | 122 to 147 |
| 25,000 | 268 to 310 | 134 to 152 |
| 30,000 | 293 to 340 | 145 to 180 |

OXYGEN OUTLET VALVE. Seven single oxygen outlets in the control cabin supply the flight crew members. Seventy-eight outlets in single and double flush-mounted manifolds supply passengers and cabin attendants. The outlets on the upper deck are conveniently located in the fuselage wall adjacent to each seat, but the passenger outlets in the lounge are on the front side of each seat support. Each outlet valve opens when the bayonet fitting on the hose of a continuous-flow mask is inserted and closes when the fitting is removed.

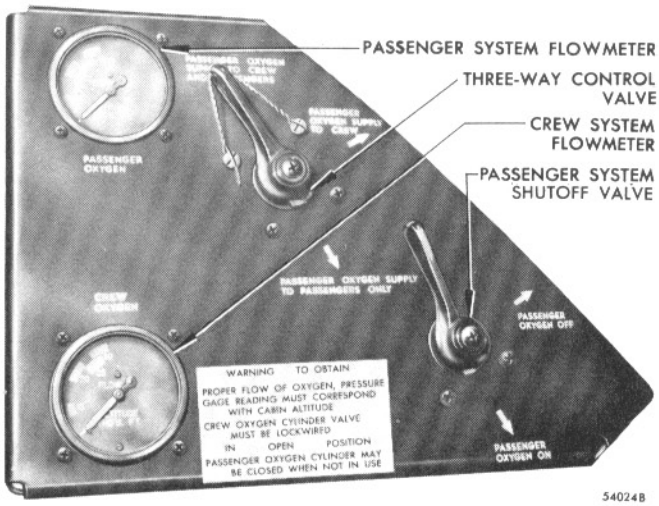



*Figure 3-8. Oxygen Control Panel*

AIR CONDITIONING SYSTEM.

The purpose of the air conditioning system in the airplane is to circulate purified ventilating air at a controlled temperature and pressure.

Outside air is supplied to the cabin by each engine turbosupercharger while the airplane is in flight and by two ground blowers when the airplane is on the ground. The outside air is passed through air filters, two combustion heaters for heating as required, and is then mixed with recirculated air downstream of the heaters and passed into the distribution system. Recirculated air is cabin air which is drawn into an air recovery unit where it is purified and deodorized by passing through filters and then cooled by passing through an evaporator. It is then forced on to be mixed with the heated or unheated outside air.

Cooling of air to temperatures as low as 15° F below ambient is accomplished by two separate refrigeration systems, one in each outboard nacelle. Each refrigeration unit consists of a motor-driven compressor, a condenser and a receiver tank. The evaporator for the system is in the air recovery unit in the fuselage center wing section.

Distribution of heated or cooled air is accomplished by combination radiation and convection ducts throughout the pressurized sections of the fuselage. (See figure 3-6.) Outlets from these ducts pass the heat into the cabin walls where it flows to the ceiling. The air then moves downward through the cabin, passes through grilles in the cabin floor and thence into the unoccupied lower body sections and cargo holds. The air then circulates to the air recovery unit to be repurified and cooled before mixing with heated or unheated outside air. The ventilation rate of all occupied compartments is such as to recirculate the air in approximately 2 minutes. At maximum air flow, sufficient fresh air is added to the system to change the air approximately every 4 minutes. The greater portion of air entering the galley and the toilet compartments is exhausted overboard.

Dry heated air is taken directly from the combustion heaters and routed to the control cabin windows to provide window defogging.

CONTROL CABIN COOL AIR BLOWER. In addition to normal ventilating air, cool air may be supplied to the control cabin by means of a cool air blower. The blower draws air from the air recovery unit and distributes it through the window defrost ducts in the control cabin. The control cabin cooling switch, on the pilot's auxiliary panel, controls a valve in the window defrost duct. When the switch is in the "ON" position the cool air blower is started and the valve closes the heated air supply and opens the cool air supply. When the switch is in the "OFF" position, it shuts off the cool air blower, closes the cool air supply, and opens the heated air supply.

For maximum control cabin cooling, move the temperature selector, on the overhead instrument panel, to the extreme cool position and the control cabin cooling "ON--OFF" switch to "ON."

CABIN AIR CONDITIONING CONTROLS. Controls for operating the air conditioning system are on the cabin attendant's instrument panel (figure 3-10), the overhead instrument panel (figure 1-7), and the co-pilot's auxiliary panel (figure 1-10). The cabin attendant's controls consist of the following: a toggle switch for operating the heating system either automatically or manually, a temperature selector (graduated in degrees centigrade and Fahrenheit) to automatically control the desired temperature in the passenger cabin, a manual temperature control to select temperature if the automatic system should fail, and a temperature indicator to check the correct operation of the system. The controls in the control cabin consist of four turbo-bleed switches, on the copilot's auxiliary panel, a master air conditioning switch, left and right body heater switches, left and right cooling switches, two ground blower switches, a heater fuel valve selector switch, a body combustion heater temperature indicator and selector switch, a control cabin temperature selector, an air recovery warning light, and two heater overheat warning lights on the overhead instrument panel. Airplanes with Boeing serial numbers 15965 and 15966 have a "TEST & RESET HTR. OVERHT." button to check the proper operation of the overheat warning circuit and to release locked-out heaters. Airplanes with Boeing serial numbers 15967 through 15971 have a "TEST HTR. OVERHT." button and a "HEATER OVERHEAT RESET" switch which will allow separate testing of the overheat warning circuit and separate releasing of locked-out heaters. It is important that the warning circuit be checked for proper operation prior to operating the heating system.

The master air conditioning switch supplies power to the air conditioning control system which automatically regulates combustion heater and cooling system operation to satisfy heating or cooling requirements as selected by the temperature selector. The four turbo-bleed switches control turbo-bleed valves which are shutoff valves to the source of pressurized cabin air. The switches have "OPEN" and "CLOSED" positions. The left and right body heater switches control a fuel shutoff valve for each heater. The left and right cooling system switches control a compressor motor, a condenser fan, and a freon valve. Power to the heater switches and the cooling switches is supplied through the master switch. The body combustion heater selector switch is used for checking temperatures of each heater or the manifold duct. These temperatures are indicated on the gage above the switch. Additional indicators, necessary for efficient operation of the system are as follows: free air temperature, cabin air temperature, cabin air flow, and a combustion heater fuel pressure warning light. These are also on the overhead instrument panel except for the free air temperature indicator which is on the pilots' instrument panel.

The air recovery warning light, when illuminated, indicates the recirculation fan is not operating. If this condition should occur, the cooling system is automatically turned off, but heater operation will continue. The ventilation air will flow at a reduced rate and automatic control of the air temperature will become less effective.

Additional temperature selectors in the lounge and each cargo compartment automatically control the temperature in those compartments by actuating valves in the distribution system. The selector for the lounge is located at the lounge attendant's station and the selector for the cargo compartments is on the right side of the forward bulkhead in the forward cargo compartment.

System circuit breakers are on the overhead electrical panel and the forward power panel. A fuse for the recirculation fan motor is on the main power panel. Combustion heater ignition fuses are on the AC power shield.

AIR CONDITIONING NORMAL OPERATION. The airplane should be cooled or heated, whichever is necessary, to obtain the desired temperature prior to loading passengers. All doors possible should be closed during this process to minimize heat loss when heating and prevent heat gain when cooling. When the system is in operation on the ground, either external power must be connected or the engines must be running. The output of four generators is required to operate the air conditioning system.

NOTE

The full operation of both cooling systems requires 1000 amperes of DC load in addition to other loads being used at that time.

All system circuit breakers must first be set. For automatic operation of the system, place the "AUTO-MAN" toggle switch, at the cabin attendant's station, in the "AUTO" position and set the automatic temperature selector to the desired value. Then position the switches on the overhead instrument panel as follows: the left and right ground blower switches, the left and right body heater switches, and the left and right cooling system switches in their "AUTO" position. Turn the body combustion heater selector switch to either "DUCT" position; actuate the test button to check the overheat warning circuit (on the airplanes with the separate test switch and reset button, it is necessary to reset the heater after testing the overheat circuit); check that power is being supplied to the proper AC bus; and then place the master air conditioning switch in the "ON" position. The desired temperature in the control cabin may then be selected with the control cabin temperature selector. Automatic operation of the system will control cooling or heating to maintain the selected temperature in the main cabin.

With the cabin sealed, best heating is accomplished by introducing a maximum amount of outside air into the cabin. The amount of outside air supplied to the system is controlled by the number of turbo-bleed valves open or ground blowers operating. On the ground, best heating is accomplished by using both ground blowers and operating both heaters. Best cooling is accomplished when outside air flow is at a minimum. Should cooling of the airplane on the ground be desired, place the ground blower switches to "OFF" as best cooling is accomplished with recirculated air only. After takeoff and the turbos are

turned on for climb, check the four turbo-bleed switches in "OPEN."

During ground or in-flight operation of the system, actual cabin temperatures may be compared with the selected temperature to check operation of the automatic system. If it is not operating correctly, the manual system may be used. This is accomplished by moving the toggle switch at the cabin attendant's station to "MAN" and then increasing or decreasing heat as desired with the manual selector. Care must be used in operating the system manually as improper operation may result in an overheated cabin in a very short period of time. It will be found that a much longer period of time is required to cool the cabin back to a comfortable temperature than is required to raise the temperature to the overheated condition. To avoid overheating the cabin and to insure maximum passenger comfort during manual temperature control, the following operating procedure is recommended:

NOTE

The manual selector knob normally should be positioned at the third calibration mark from the extreme "COOL" position when the system is not in use.

a. Turn the manual temperature selector knob from its normal position (third calibration mark from the extreme "COOL" position) one calibration toward "COOL" or "HEAT," depending upon temperature requirements.

b. Leave the selector knob in this position for at least 15 minutes to allow the heated or cooled air to circulate throughout the cabin.

c. If, after 15 minutes of operation, the cabin is comfortable, leave the selector positioned and continue to observe the cabin temperature.

d. If, after 15 minutes of operation, the cabin is not comfortable, reposition the selector knob one calibration further in the required direction.

e. Continue to observe the cabin temperature and, if necessary, reposition the selector at 15-minute intervals.

It is also possible to overheat the cabin by improper use of the automatic selector. To avoid this possibility, after a temperature selection has been made, allow at least 15 minutes for the selection to become effective. Then if the cabin is still uncomfortable, turn the selector a few degrees in the desired direction and allow 15 minutes for the air to circulate throughout the cabin.

A periodic check should be made of left and right heater and duct temperatures by means of the selector switch and indicator. This check will determine combined and individual operation of the heaters. If the output of both heaters is approximately the same and does not exceed the red radial mark of 182° C, operation is normal. If one heater is found to be excessively high or extremely low, that body heater switch should be turned off and left off until the trouble has been corrected. If both heaters tend to exceed 182° C or conversely fail to heat the main cabin, the condition may be corrected by using the manual temperature control.

AIR CONDITIONING EMERGENCY OPERATION.

If the left or right "OVERHEAT" warning light illuminates, an overheat condition exists. The affected heater or heaters will be automatically shut off and the heater fire valve and turbo-bleed valves on the side affected will close. Automatic closing of the fire valve may cause a rise in heater temperature of approximately 20° C. With the overheat of one heater, normal pressurization can be restored, but with reduced heating. This is accomplished by manually turning the malfunctioning heater "OFF" and, when the heater and the heater overheat switch cool, actuating the heater overheat reset button (or switch). This will open the heater fire valve and turbo-bleed valves which were closed by the overheat condition. If an overheat condition exists in both combustion heaters, it is not possible to immdeiately supply outside air to the cabin. First, follow the "Combustion Heater Fire Combat Procedure" in chapter II. When the fire is extinguished and the heater and heater overheat switches have cooled, push the heater overheat reset button (or switch). This action will open the heater fire valves and re-establish the outside air flow from the turbo-bleed valves or from ram air if selected.

NOTE

The heater fuel switches for the heater affected must be "OFF" before actuating the reset button (or switch).

With the turbosuperchargers off or inoperative, sufficient outside air to operate the heaters during unpressurized flight is supplied by ram air (ground blower switches "OFF" to obtain ram air), with or without the recirculator fan operating; however, without the recirculator fan operating, it may not be possible to maintain adequate heating or cooling for passenger comfort.

If the combustion heater fuel pressure warning light is illuminated, a fuel pressure below 12 PSI exists. To re-establish fuel pressure, accomplish one or more of the following: turn on the booster pump for tank No. 2, turn on the booster pump for any tank which is set to manifold, and/or change the heater fuel selector switch to "ALTERNATE."

CO DETECTION SYSTEM.

This system operates in conjunction with the air conditioning system. Its purpose is to detect and warn of possible presence of carbon monoxide in cabin air. Samples of air are drawn individually and consecutively from six locations (the four turbo-bleed lines and the two combustion heaters) by a vacuum pump and then delivered to an analyzer which determines the presence of CO. A complete cycle of air samples from all locations takes 3 minutes. Should a sample of air contain in excess of 120 parts of carbon monoxide to 1,000,000 parts of air, the sampling cycle will stop and the "MASTER CO AND SMOKE WARNING" light on the electric power control panel and one of six warning lights on the copilot's auxiliary panel will be illuminated. A toggle switch, between the warning lights, resets the warning relay (turns the warning light off)

54066 B

and starts the sampler on the next cycle. A circuit breaker for the system is on the overhead electrical panel and a circuit breaker for the vacuum pump is on the forward power panel.

CO DETECTION SYSTEM OPERATION. If a warning light illuminates, momentarily actuate the reset switch. If the concentration of carbon monoxide is only momentary, the light will go off and stay off. If the light illuminates again in the next cycle (approximately 3 minutes), carbon monoxide is present in the indicated area. If the signal lights indicate carbon monoxide in a turbo-bleed line, close the indicated turbo valve; if in a cabin heater, shut off the indicated combustion heater. Should it be desired to immediately recheck the sampling point where CO was detected, place the reset switch in the "RESET" position five times in succession and then allow the sampling valve to automatically select the sixth or original detection position. Each time the switch is placed to "RESET," the next sampling point is selected.

SMOKE DETECTING SYSTEM.

This photo-electric detecting system senses smoke and operates in the lower nose compartment and both cargo compartments only. Smoke in any of the three compartments will cause the "MASTER CO AND SMOKE WARNING" light, on the electrical power control panel, and one of the three "SMOKE DETECTION" lights, on the copilot's auxiliary panel, to illuminate. The general fire warning bell on the steering pedestal will also sound. A "TEST--NORMAL--RESET" switch adjacent to the "SMOKE DETECTION" lights, is used to check the system circuit. Should a warning light illuminate, momentarily place the switch to the "RESET" position and then release it to "NORMAL." If the light illuminates again, investigate the area for possible smoke, fog, or fire. If the investigation reveals no cause, the detector for the area is probably out of balance and requires adjustment. Circuit breakers for this system are on the overhead electrical panel.

ANTI-ICING EQUIPMENT.

SURFACE ANTI-ICING SYSTEM. The thermal anti-icing system prevents or eliminates the formation of ice on the leading edges of the wings and tail surfaces. (See figure 3-9.) Outside air is heated by eight combustion heaters, a bank of three for each wing and a bank of two for the tail surfaces. Ram air (for wing anti-icing) is taken in through a scoop in the wing leading edge and directed to the combustion heaters in the lower part of each outboard nacelle. The heated air coming out of the heaters is passed through a restricted space in the leading edge of the wing where it contacts the outer skin surfaces. The heated air then flows into an exhaust duct and is discharged overboard by means of heated air outlets or exhaust vents. Ram air for the empennage system is taken through a scoop in the dorsal leading edge, passed through the two combustion heaters, and then divided into four portions; one portion goes to the dorsal fin, one to the vertical stabilizer, and the remaining two portions to the horizontal stabilizers. The heated air flows through these surfaces in the same manner as in the wing system.

ANTI-ICING SYSTEM CONTROLS. All control switches and indicators for anti-icing system operation are on the overhead instrument panel. These switches and indicators consist of a master anti-ice switch, eight anti-icing heater switches, one heater fuel valve switch, two guarded emergency switches, two partial anti-icing switches, three individual heater temperature selector switches, three temperature indicators, three overheat warning lights, a ground operation switch, and a fuel pressure warning light. Airplanes with Boeing serial numbers 15965 and 15966 have a "TEST & RESET HTR. OVERHT" button to check proper operation of the overheat warning circuit and to release a locked-out bank of heaters. Airplanes with Boeing serial numbers 15967 through 15971 have a "TEST HTR OVERHT" button and a "HEATER OVERHEAT RESET" switch which will allow separate testing of the overheat warning circuit and separate releasing of a locked-out bank of heaters. It is important that the warning circuit be checked for proper operation prior to operating the anti-icing system. The master anti-ice switch supplies power to the anti-icing control system which automatically regulates combustion heater operation. The eight anti-icing heater switches control fuel shutoff valves for each heater. Power to these switches is supplied through the master anti-ice switch. The control system normally regulates heater discharge temperatures (in flight) to 165° C. Should the temperature fail to regulate at 165° C an automatic overheat cycling control will prevent the temperature from exceeding 228° C. Should both the normal regulator system and the overheat cycling control fail to hold the temperature within their limits, an overheat lock-out control will shut off the heaters at 254° C. During ground operation, the 165° C flight limit is reduced to 93° C to prevent overheating of the structure.

With the master anti-ice switch on, the ventilating and combustion air blowers in the dorsal fin automatically turn off when the airplane becomes airborne and combustion air flow is supplied by ram. The heater fuel switch has a "NORMAL" and an "ALTERNATE" position. The switch controls two shutoff valves which receive fuel from the same source of supply (tank No. 2 or the manifold). The "NORMAL" position opens one shutoff valve and the "ALTERNATE" position opens the other shutoff valve. During heavy icing conditions or if heater output is low, the outboard wings, the dorsal fin, and the horizontal stabilizer may be anti-iced independently of the remainder of the system. The two partial anti-icing switches control valves which shut off air to the inboard wings and to the vertical stabilizer thereby directing all of the heated air to the outboard wings, dorsal fin, and horizontal stabilizers. The combustion heater temperature selector switches are used for determining individual heater and duct temperatures for each bank of heaters. The existing temperature for the selected location will be indicated on the gage. Two manual override switches by-pass the automatic control system to permit manual cycling of the heaters. Manual cycling should be used only in event the automatic control system fails. System circuit breakers are on the overhead electrical panel, on the forward

power panel and on the aft power panel. Combustion heater ignition fuses are on the AC power shield.

NORMAL OPERATING PROCEDURE. Place all eight combustion heater switches in "AUTO," the heater fuel valve selector switch in "NORMAL," and move the AC secondary load switch to the "NO. 2" position. If full anti-icing is to be used, the two partial anti-icing switches must be in the "TOTAL EMP" and "TOTAL WING" positions. (For partial anti-icing, these switches are moved to the opposite position.) Move the three combustion heater selector switches to the "DUCT" positions, place the master anti-ice switch in the "ON" position, and then actuate the test button to check proper operation of the overheat warning lights. (On the airplanes with the separate test switch and reset button, it is necessary to reset the heaters after testing the overheat circuit.)

After the heaters are operating, a periodic check should be made of each heater temperature and the duct temperature by means of the three selector switches and indicators. This check will determine the individual and combined operation of the heaters. If the output of each heater in the bank does not exceed the red radial mark of 227° C and the duct temperature does not exceed 190° C, operation is normal. When an individual heater temperature is found to be extremely low with respect to other heaters in that group, that heater switch should be turned off. As a safety measure, if one or more heaters of the bank exceed a temperature of 254° C, the complete bank of heaters is automatically locked out. This condition is indicated

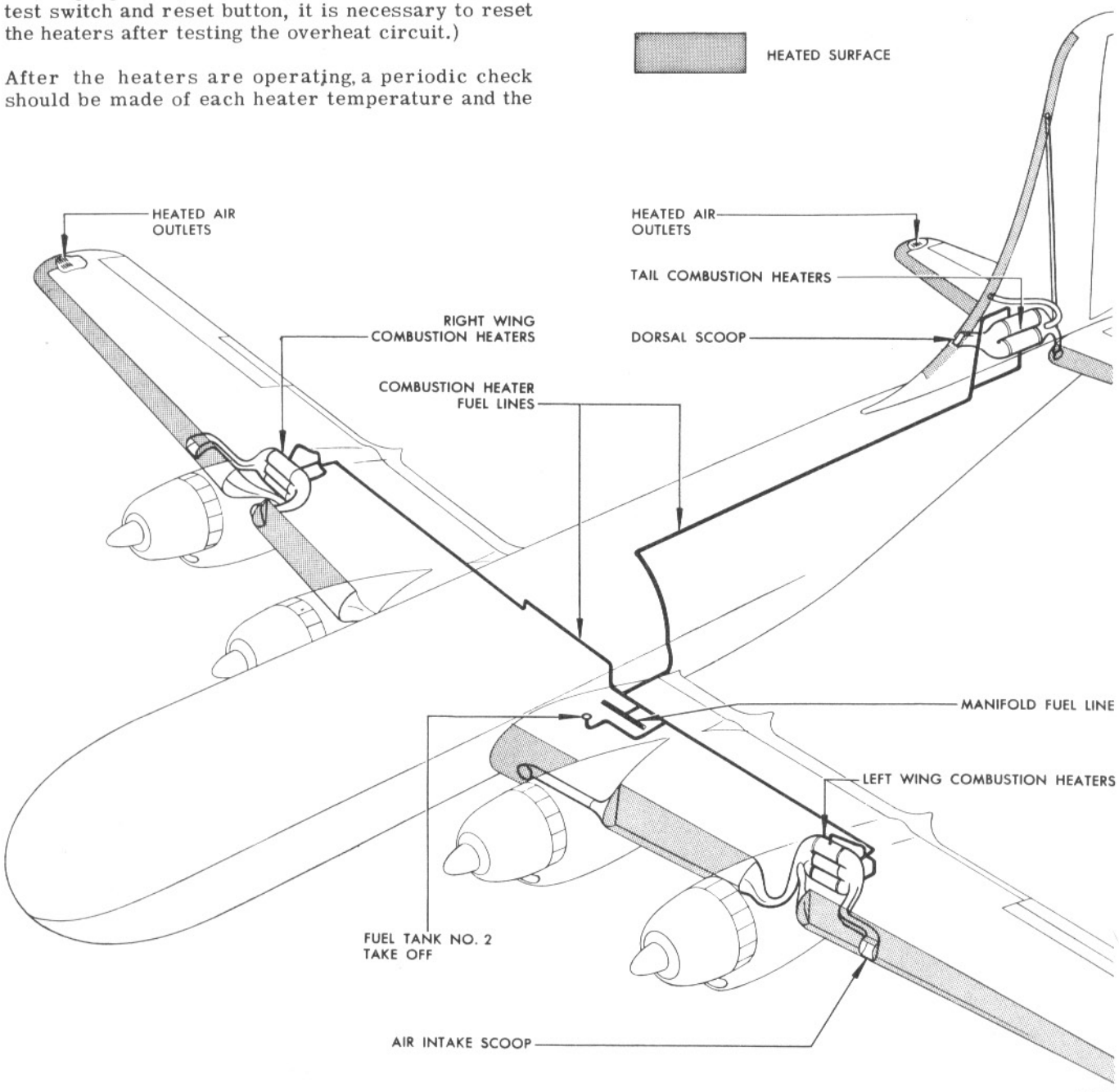



*Figure 3- 9. Thermal Surface Anti-icing System*

by an overheat warning for that bank. Determine which heater is malfunctioning by checking individual heater temperatures. When an overheat condition exists, follow "Combustion Heater Fire Combat Procedure" in chapter 2. If the check of the individual heaters reveals normal temperatures, a malfunction of the warning light has probably occurred. If continued operation of the heaters is necessary with a malfunctioning light, observe the temperatures of that bank of heaters frequently to insure normal operation. To release a locked-out heater, follow the procedure outlined under "Body Combustion Heater Overheat Warning" in chapter 2.

NOTE

If a bank of heaters in either wing is locked out, the opposite wing output temperature will be decreased due to the wing temperature balancing control shutting off the opposite wing heaters.

If the combustion heater fuel pressure warning light is illuminated, a fuel pressure below 12 PSI exists. To re-establish sufficient fuel pressure, accomplish one or more of the following: turn on the booster pump for tank No. 2, turn on the booster pump for any tank which is set to manifold, and/or change the heater fuel selector switch to "ALTERNATE."

CONTROL SYSTEM FLIGHT CHECK. The effects of air speed, altitude, and outside air temperature may cause the combustion heaters to operate continuously. Therefore, if it is desired to make a control system cycling check during flight, it will be necessary to operate the airplane at an air speed at which heater cycling will occur. The following tabulation lists the air speeds below which the airplane must be operated to cause cycling of the heaters (all heaters must be operating). The values of outside air temperatures are approximate minimum values for average flight conditions at each altitude range. The normal system should cycle the heaters at a duct temperature of approximately 164° C and the emergency system should cycle the heaters at a duct temperature of approximately 190° C. It will be necessary to operate the airplane at least 5 minutes at the selected air speed to permit the control unit to establish a stabilized temperature.

GROUND OPERATION. Pressure switches in the wing anti-icing heater inlet ducts prevent operation of the heaters if insufficient combustion air is being supplied. A "WING HEATER GROUND OPERATION" switch on the overhead instrument panel overrides the duct pressure switches to permit ground operation of the heaters.

To operate the wing anti-icing system, operate engines No. 1 and No. 4 at 2000 RPM or more to insure adequate heater air flow; then follow the procedure outlined in the paragraph "Normal Operating Procedure." When this is accomplished, hold the override switch to the "ON" position. Heater operation will be possible only while the switch is being held to the "ON" position.

The tail anti-icing heaters may be operated on the ground simultaneously with the wing heaters or separate from the wing heaters. To operate the tail heaters alone, follow the procedure outlined in the "Normal Operating Procedure" paragraph but do not actuate the wing heater fuel switches.

When the heaters are first turned on, monitor the heater and duct temperatures carefully until duct temperatures stabilize at approximately 93° C (200° F). If the heater discharge temperatures are approximately even when the duct temperatures stabilize at 93° C (200° F) and all heaters are turned on, it is an indication that the ground temperature limit control and the bridge control are functioning satisfactorily.

EMERGENCY OPERATION. Two guarded switches are provided for emergency thermal anti-icing system operation, one for both wing systems and one for the empennage system. These switches may be used independently, thus making it possible to operate either system in the normal manner while the other is on "EMERGENCY," or both wing and empennage may be operated on "EMERGENCY" simultaneously. During emergency operation, individual heater output is automatically limited to 227° C by the cycling switch downstream of each heater. The following normal automatic heater control units are by-passed during emergency operation: the wing temperature balancing control circuit, the duct pressure switches which interrupt ignition and fuel supply to the heaters when

AIRPLANE OPERATING CONDITIONS FOR HEATER CYCLING

| Altitude Range | Minimum Indicated O.A.T. | Indicated Airspeed Normal Operation | Indicated Airspeed Emergency Operation |
|---|---|---|---|
| 0 - 5,000' | 0° C (32° F) | 180 MPH (159 knots) | 170 MPH (148 knots) |
| 5,000 - 10,000' | -10° C (14° F) | 190 MPH (166 knots) | 175 MPH (153 knots) |
| 10,000 - 15,000' | -20° C (-4° F) | 200 MPH (174 knots) | 185 MPH (161 knots) |
| 15,000 - 20,000' | -30° C (-22° F) | 210 MPH (183 knots) | 195 MPH (170 knots) |
| 20,000 - 25,000' | -40° C (-40° F) | 225 MPH (196 knots) | 210 MPH (183 knots) |

NOTE

For O.A.T.'s substantially above those tabulated, the airspeed may be increased approximately 1 MPH per degree centigrade.

541168

there is inadequate air flow through the heat exchanger, the ground limiting controls, the overheat warning circuit, and heater lockout provisions. The overheat warning circuit can be made operative, provided there is no malfunction of the circuit, by leaving the master anti-ice switch "ON" during the emergency operation. If use of the emergency system is necessary because of circuit breaker trip-outs in the normal system, turn the master anti-ice switch "OFF." Do not attempt to reset circuit breakers in order to keep the master anti-ice switch "ON." A close survey of individual heater temperatures must be maintained during these conditions. No ground limiting temperature control is provided in the emergency system.

PITOT HEAD HEATERS. An electrically operated heating element in each of the two pitot heads removes and/or prevents the formation of ice. Two "PITOT HEAT," "ON--OFF" switch type circuit breakers, one for each heater, are on the overhead instrument panel. Ammeters on each side of the switches indicate operation of each system. Always turn the pitot heaters off when the airplane is on the ground to prevent burning out the heater element.

PROPELLER DEICERS. A "NORMAL--EMER" switch and a reset switch, on the overhead instrument panel, control the propeller deicer circuits. When icing conditions are entered, position the propeller deicing control switch to "NORMAL" to actuate the circuit. Propeller deicing will be indicated by the propeller deice indicator lights not being illuminated.

If one or more deicers become inoperative, a protective relay breaks the circuit and energizes the respective warning light on the overhead instrument panel.

NOTE

When the propeller deicing system is being used, turn off the right-hand cooling system or other equipment to maintain electrical loads below 1.0.

In the event of a blade heat failure, hold the reset switch in the "RESET HEAT" position to reset the protective relay. If the warning light is again illuminated, that propeller deicing system has failed and will remain inoperative. Should it become apparent that one or more propellers is not properly deicing and no warning light is illuminated, switch to the "EMER" position and check to see that both circuit breakers on the overhead electrical panel are set.

WINDOW DEICING. The pilots' center row of windows, except the aft window on each side, is electrically deiced. This system is automatically controlled and is energized by a two-position selector switch, and one of two "ON--OFF--RESET" alternator switches on the electric power control panel. The selector switch selects which one of the two available alternators shall supply window deicing equipment with power.

Three warning lights are used in this system. Two of the lights (above the alternator control switches) indicate alternator ground fault and may be illuminated in two different instances. When DC power is on, the lights will illuminate until the respective alternator switches have been momentarily placed in the "RESET" position. If a ground occurs in the alternator output wiring, that alternator will be automatically cut off and the indicator light will illuminate. The third warning light (above the alternator selector switch) indicates a possible malfunction of the automatic temperature control or a window overheat condition.

WINDOW DEICING NORMAL OPERATION. It is recommended that window heat be used when the O.A.T. is less than 80° F and the airplane altitude is less than 12,000 feet in order to improve bird resistant qualities and also to defog, defrost, and deice windshields. At altitudes above 12,000 feet, the probability of bird strikes is greatly reduced and the use of window heat is recommended only as required for keeping windshields defogged, defrosted, and deiced.

To obtain window deicing, place the alternator selector switch in either the "LEFT ALTNR" or "RIGHT ALTNR" position and move the corresponding alternator control switch to "RESET" and then "ON." The system is then in automatic operation. When either of the control cabin side windows is open, the electrical circuit is broken and the system will not function.

WINDOW DEICING EMERGENCY OPERATION. Should the left alternator (or the engine driving that alternator) fail, as indicated by the alternator warning light, move the control switch to the "RESET" position and back to "ON." If the alternator is still inoperative, place the selector switch in the "RIGHT ALTNR" position and move the corresponding alternator control switch to "RESET" and then "ON."

If the automatic temperature control warning light illuminates and the airplane is not in icing conditions at the time, the window heat should be turned off. If a malfunction occurs during icing conditions, the system may be left on for continued window deicing and allowed to cycle on automatic overheat control. When operating on overheat cycling control, the windows should be observed periodically for possible bubbles, in which case the system should be turned off as soon as possible. Check the fuses in the AC fuse box after any malfunction of the system. Control and warning light circuit breakers are on the forward power panel.

WINDOW DEFROSTING. The control cabin windows may be defrosted by heated air taken directly from the body combustion heaters as shown in figure 3-6.

A "WINDOW DEFROST" knob on the pilot's auxiliary panel controls the flow of air to the pilots' windows while the astral window and two side windows will receive a continuous flow of air.

540688

EXTERIOR LIGHTING.

Exterior lighting on the airplane consists of two controllable landing lights, two wing illumination lights, six position lights, two exterior flood lights, and a flight number sign light.

LANDING LIGHTS. The two controllable landing lights, one under each outboard wing, are operated by two "ON--OFF" switches and two "EXTEND--RETRACT" switches on the engine control stand. The lights can be turned on in either the retracted or extended position. Circuit breakers are on the overhead electrical panel and on the main circuit breaker panel. Ground operation of the landing lights should be limited to as short a period as possible, as the lack of a cooling windstream may result in their overheating.

WING ILLUMINATION LIGHTS. Two wing illumination lights, one on each side of the fuselage above and forward of the wing leading edge, are used to illuminate the leading edge of the wings. A single "ON--OFF" switch-type circuit breaker on the overhead instrument panel operates both lights.

POSITION LIGHTS. Six position lights consist of the wing tip lights (left side red and right side green), red and white tail cone lights, and two white body lights (one on the upper side of the fuselage above the wing center section and the other on the bottom of the fuselage below the wing center section). A "FLASH--OFF--STEADY" switch on the overhead instrument panel controls all six lights. When the switch is in either the "FLASH" or "STEADY" position, a warning light dimmer relay causes warning lights of the following systems to be dimmed: propeller, landing gear, oil system, and fuel system. Two circuit breakers for these lights are on the overhead electrical panel.

EXTERIOR FLOOD LIGHTS. Two flood lights on the right side of the airplane illuminate the exterior areas in front of the cargo compartment doors. The lights are turned on by placing the forward and aft cargo dome light switches in the "DOME & FLOOD" position. These switches are adjacent to the dome light in the interior entryway of the cargo compartments. A circuit breaker for the forward lights is on the forward power panel and a circuit breaker for the aft lights is on the aft power panel.

FLIGHT NUMBER SIGN LIGHTS. The flight number sign on the left side of the airplane can be illuminated. A "FLIGHT INDICATOR LIGHT" switch on the cabin attendant's instrument panel controls the lights. A circuit breaker is on the main circuit breaker panel.

INTERIOR LIGHTING.

The interior lighting in the airplane is shown in figure 3-11. The description of all interior lights and their controls is covered by the following compartments: control cabin, luxury compartment, forward cabin, vestibule, galley, aft cabin, stateroom, lounge, and lower nose and cargo compartment.

CONTROL CABIN LIGHTING. The description of lighting in the control cabin is covered by crew stations and a paragraph on miscellaneous lighting in the control cabin. Circuit breakers for all control cabin lights are on the overhead electrical panel.

PILOTS' STATION LIGHTING. The pilot's side of the pilots' instrument panel is illuminated by six red lights and three white lights attached to the hood. These red and white lights are controlled by two "CAPTAINS INST. BD. LTS." rheostat switches on the pilot's auxiliary panel. The center section of the pilots' instrument panel is illuminated by five red lights and four white lights attached to the hood. These lights are controlled by two "ENGINE INSTR. BD. LIGHTS" rheostat switches also on the pilot's auxiliary panel. The red lights may be turned on in an emergency by "EMER EXIT LIGHTS" guarded switch on the overhead instrument panel. The copilot's side of the pilots' instrument panel is illuminated by six red lights and three white lights attached to the hood. These lights are controlled by two "1ST OFFICERS INSTRUMENT BOARD LIGHTS" rheostat switches on the copilot's auxiliary panel.

The pilot's auxiliary panel is illuminated by three red lights on the panel hood. These lights are controlled by a "PANEL LIGHTS" rheostat switch on this panel.

The copilot's auxiliary panel is illuminated by two red lights and one white light on the panel hood. These are controlled by two "SIDE PANEL LIGHTS" rheostat switches on this panel.

The overhead electrical panel is illuminated by 10 red lights and 8 white lights along the sides of the panel. These lights are controlled by two "OVERHEAD SW PANEL LTS." rheostat switches on the pilot's auxiliary panel.

The overhead instrument panel and the fuel control panel is illuminated by 10 red lights and 7 white lights in the forward end of the overhead electrical panel. These lights are controlled by two "AUXILIARY OVERHEAD PANEL LIGHTS" rheostat switches on the overhead instrument panel.

The engine control stand is illuminated by three red lights and two white lights at the aft end of the stand. These are controlled by two "CONTROL STAND LIGHTS" rheostat switches on the engine control stand. A flight coordinator, on the engine control stand, is illuminated by a white light which is controlled by a rheostat on the coordinator.

The turbo bearing temperature alarm panel is illuminated by either five red lights or five white lights along the aft side of the panel. A "TURBO INSTRUMENT PANEL LIGHTS" rheostat switch and a "RED--WHITE" selector switch on the overhead instrument panel control the lights.

The electrical power control panel is illuminated by a red light and a white light above the panel. These lights are controlled by two "OVERHEAD SIDE PANEL LIGHTS" rheostat switches on the copilot's auxiliary panel.

540698

The pilot's and copilot's map lights, each with a removable red shield, are mounted forward of the overhead instrument panel and are each controlled by rheostat switches near the lights.

The pilot's and copilot's dome lights are both controlled by a "FWD DOME LIGHTS" switch on the overhead instrument panel.

A master white light selector switch on the overhead instrument panel, when placed in the "PILOTS WHITE LIGHTS BRIGHT" position, will cause the white lights on the pilots' instrument panel, the overhead electrical panel, the engine control stand, and the pilots' dome lights to illuminate to full intensity regardless of individual rheostat or switch position.

The pilots' compass is illuminated by a light within the compass. This light is controlled by a rheostat switch on the pilot's auxiliary panel.

NAVIGATION STATION LIGHTING. The navigation station instrument panel and table are illuminated by either four red lights or three white lights in the adjustable mounts above the panel. Both the red and the white lights are controlled by a toggle switch and rheostat on the navigation station instrument panel. The "AFT CAB LIGHTS" switch must be in the "WHITE" position before white lights can be operated at this station. Red lights can be used any time.

RADIO STATION LIGHTING. The radio station and instrument panel are lighted by either a red light or a white light. Both the red and the white lights are controlled by a toggle switch and rheostat switch on the radio station control panel. The "AFT CAB LIGHTS" switch must be in the "WHITE" position before white lights can be operated at this station. Red lights can be used any time.

CONTROL CABIN MISCELLANEOUS LIGHTING. There are two red and two white aft cabin dome lights. These are controlled by a "AFT CAB DOME LIGHT, ON--OFF" switch on the overhead instrument panel and a "DOME LIGHT" switch by the control cabin entrance door. These are controlled according to color selection of the "AFT CAB LIGHTS" switch. The lights may be turned on or off by either switch. One of the aft cabin red lights is also controlled by the "EMER EXIT LIGHTS" guarded switch on the overhead instrument panel. Two red lights in the daistep are controlled by a "STEP LIGHTS" switch on the overhead instrument panel.

A single light, controlled by a switch on the left forward side of the hallway, illuminates the hallway and the coat compartments between the control cabin and the luxury compartment. A circuit breaker for this light is on the main circuit breaker panel.

LUXURY COMPARTMENT LIGHTING. Lighting in the luxury compartment consists of one circline fluorescent dome light, two fluorescent strip lights, one incandescent dome light and reading lights for seats and berths. The circline fluorescent dome light provides indirect lighting; it is controlled by the "FWD CABIN DOMES" switch on the cabin attendant's instrument panel. This fixture has a small incandescent lamp in the center which provides a soft diffused light for night lighting.

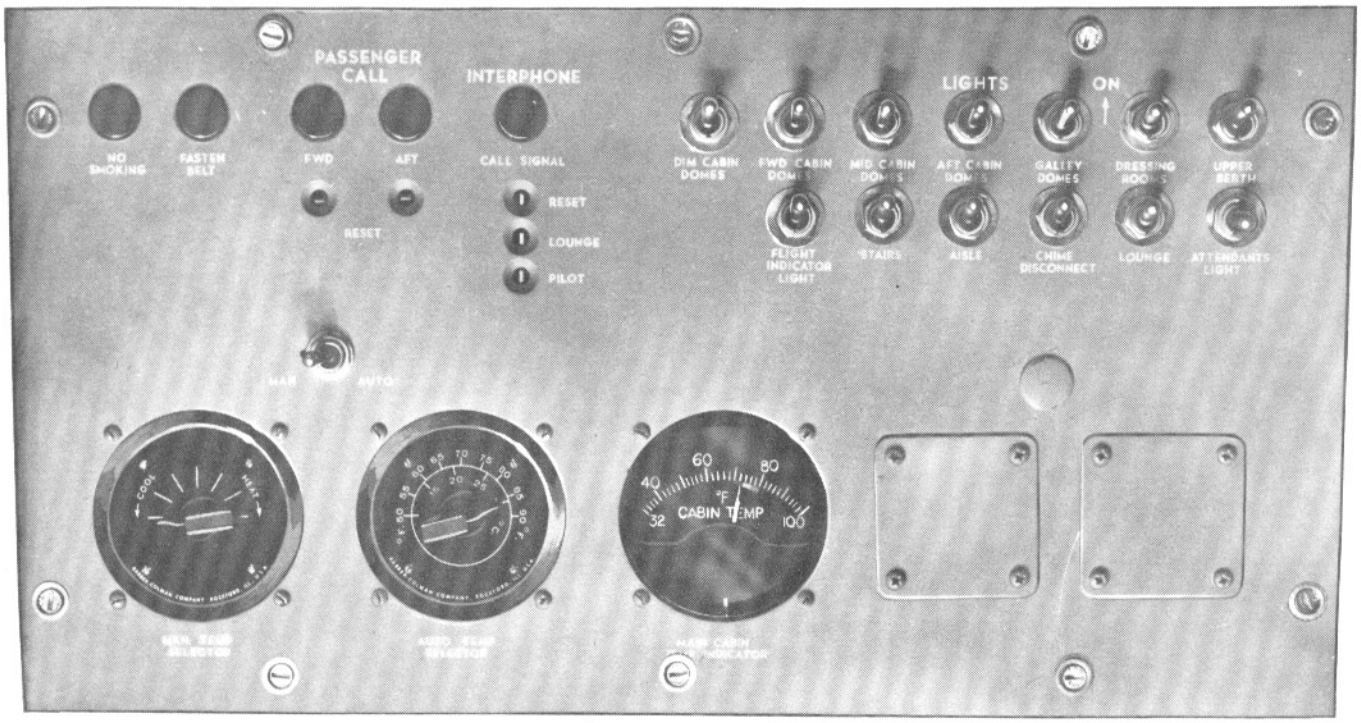



*Figure 3-10. Cabin Attendant's Instrument Panel*

540088

A "DIM CABIN DOMES" switch, also on the cabin attendant's instrument panel, controls all night lights throughout the passenger cabin. The two fluorescent strip lights (on each side of the aisle ceiling) provide compartment light when the berth curtains are drawn. Each of these lights is controlled by push button switches on the dummy berths. The seat and lower berth reading lights are controlled by push button switches on the outside seat arms. Upper berth lights are controlled by push button switches on the fuselage walls. The upper berth master switch, on the cabin attendant's instrument panel, must be on before the upper berth lights can be used. A circuit breaker and a fuse for the fluorescent lights is on the AC power shield. Circuit breakers for incandescent dome lights and upper berth reading lights are on the aft power panel. Circuit breakers for seat reading lights are on the main circuit breaker panel.

MEN'S AND WOMEN'S DRESSING ROOMS LIGHTING. Illumination in both dressing rooms is by fluorescent lights vertically mounted along the edge of each mirror. Each toilet compartment dome light and the "MEN" and "WOMEN" dressing room signs are lighted by incandescent lamps. All of these lights are controlled by a "DRESSING ROOMS" switch on the cabin attendant's instrument panel. This switch also controls the water dispenser light in the main cabin. The aft lavatory is lighted by two fluorescent lights along the mirror edge. These lights are controlled by a switch below the mirror. A fuse for all the dressing room fluorescent lights is on the AC power shield. A circuit breaker for all dressing room incandescent lights is on the aft power panel.

FORWARD CABIN LIGHTING. Lighting in the forward cabin consists of three circline fluorescent dome lights, three incandescent dome lights, a water dispenser light, seat reading lights, and provisions for upper berth reading lights.

The fluorescent dome lights in this section of the cabin are controlled by the "MID CABIN DOMES" switch on the cabin attendant's instrument panel. These fixtures are identical to the circline lamp in the luxury compartment. The water dispenser light is controlled by the "DRESSING ROOMS" switch, on the cabin attendant's instrument panel. The seat reading lights are controlled by push button switches on the outside arms of each seat. There are provisions for installation of six upper berth reading lights and switches. The "UPPER BERTH" master switch on the cabin attendant's instrument panel controls this circuit. A circuit breaker for the fluorescent lights is on the AC power shield. Circuit breakers for the water dispenser light and the upper berth reading light circuit are on the aft power panel. Circuit breakers for seat reading lights are on the main circuit breaker panel.

VESTIBULE LIGHTING. The vestibule is lighted by three circline fluorescent dome lights, four incandescent dome lights and an entryway floor light.

The fluorescent dome lights provide indirect lighting in the vestibule on the aisle side of the galley. These lights are controlled by a "GALLEY DOMES" light switch on the cabin attendant's instrument panel.

The entryway dome light and floor light are controlled by a switch on the stairwell cabinet. A fluorescent light illuminates the cabin attendant's desk and instrument panel. It is controlled by a switch on the panel. A circuit breaker for the fluorescent dome lights and a fuse for the cabin attendant's fluorescent light are on the AC power shield. A circuit breaker for the entryway dome and floor lights is on the main circuit breaker panel.

GALLEY LIGHTING. Three fluorescent lights (one on the fuselage wall and two under the dry storage cabinet) and one dome light illuminate the galley. The two lights under the dry storage cabinet provide illumination of the serving counter. All lights are controlled by three switches on the aft end of the dry storage section. A fuse is on the AC power shield.

AFT CABIN LIGHTING. Lighting in the aft cabin consists of three circline fluorescent dome lights, three incandescent dome lights, seat reading lights, and a coat compartment light.

The fluorescent dome lights are controlled by the "AFT CABIN DOMES" switch on the cabin attendant's instrument panel. The "DIM CABIN DOMES" switch on the cabin attendant's instrument panel controls the night lights. The seat reading lights are controlled by push button switches on the outside arms of each seat. The passenger coat compartment, in the left aft corner of the cabin, is illuminated by one light which is controlled by a slide switch below the light. A circuit breaker for the fluorescent lights is on the AC power shield. A circuit breaker for the incandescent dome lights is on the aft power panel. Circuit breakers for seat reading lights and the coat compartment light are on the main circuit breaker panel.

STATEROOM LIGHTING. The stateroom is lighted by indirect fluorescent lights in the ceiling coves and by a reading light in each corner. The fluorescent lights are controlled by a push-button switch on top of the radio and magazine cabinet. The two shaded pedestal reading lamps in the aft corners of the stateroom and the one on the radio and magazine cabinet are controlled by push-button switches in the base of the lamps. The reading light on the right forward wall is controlled by a push-button switch adjacent to the light. A circuit breaker for the fluorescent lights control circuit is on the aft power panel and a circuit breaker for the fluorescent lights power circuit is on the AC power shield. A circuit breaker for the reading lights is on the main circuit breaker panel.

LOUNGE AND BAR LIGHTING. Illumination of the lounge is by seven fluorescent lights, six behind the seats and one over the bar. All are controlled by a "LOUNGE" switch on the cabin attendant's instrument panel. Two lights behind the mirrors in the lounge illuminate the rear spar area. A slide switch for operating the lights is behind the right mirror. A circuit breaker for the fluorescent lights behind the seats and a fuse for the bar light is on the AC power shield. A circuit breaker for the rear spar lights is on the main circuit breaker panel.

54070 B

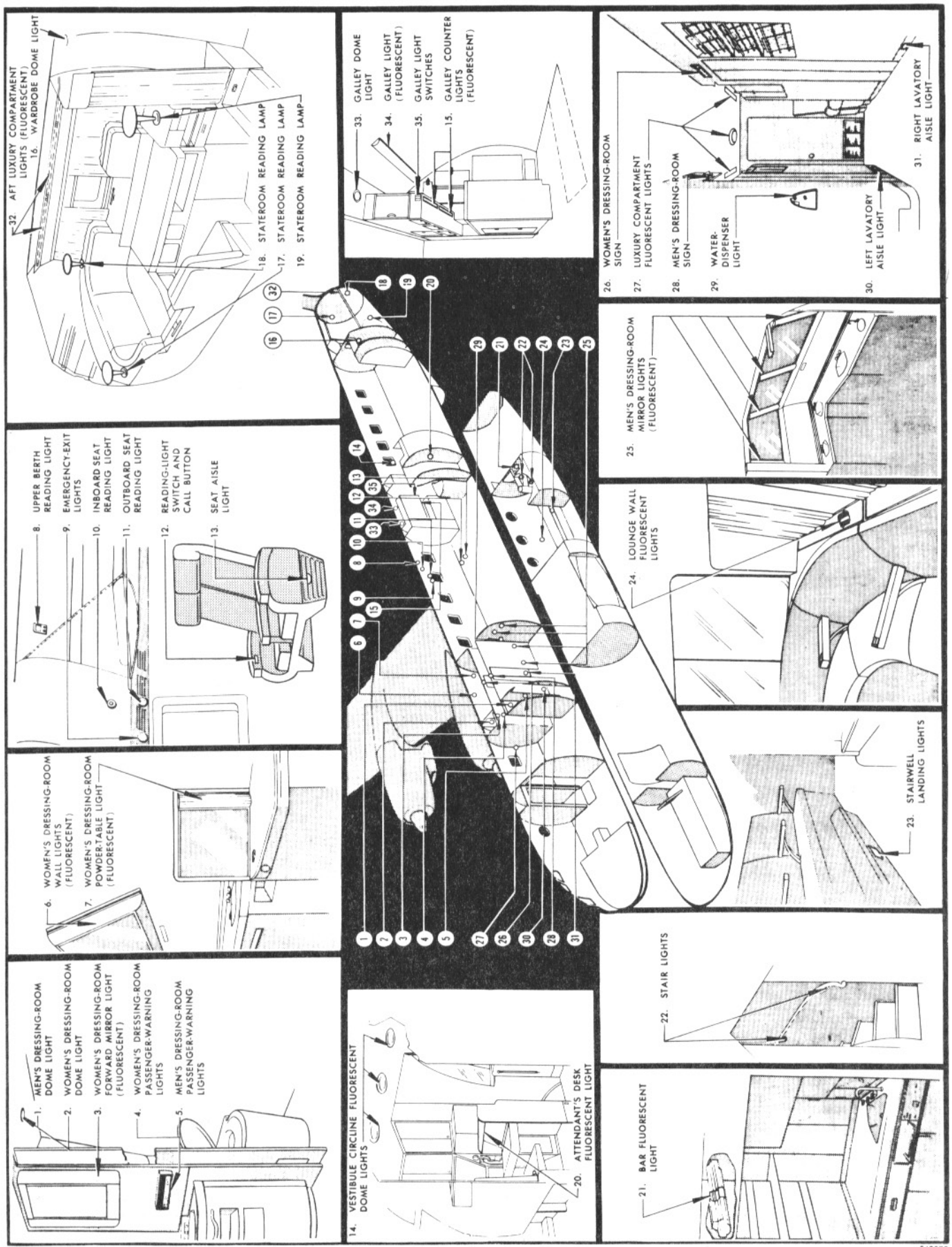



***Figure 3-11. Interior Lighting***

AISLE AND STAIRWELL LIGHTS. The aisle from the control cabin to the stateroom and the stairwell to the lounge can be effectively lighted by 15 small lights. These are normally controlled by two switches on the cabin attendant's instrument panel, but can also be turned on by the overriding "EMER EXIT LIGHTS" switch on the overhead instrument panel. This permits lighting the passenger cabin in event of a ditching, crash landing, or normal power failure. A circuit breaker for the normal circuit is on the aft power panel and a circuit breaker for the emergency circuit is on the battery No. 1 relay shield.

LOWER NOSE AND CARGO COMPARTMENT LIGHTING. There are four dome lights in the lower nose compartment all of which are controlled by a single switch at the forward end of the hatchway. Seven dome lights illuminate the forward cargo compartment. Six of these are controlled by a switch adjacent to the entryway interior dome light. The entryway dome light is controlled by a switch on the ceiling at the forward end of the cargo compartment aisle. Five dome lights illuminate the aft cargo compartment. Four of these are controlled by a switch adjacent to the entryway interior dome light. The entryway dome light is controlled by a switch on the ceiling at the forward end of the cargo aisle. Circuit breakers for the lower nose and forward cargo compartment dome lights are on the forward power panel. Circuit breakers for the aft cargo compartment dome lights are on the aft power panel.

PASSENGER WARNING SIGNS. Four "NO SMOKING" and "FASTEN BELT" signs are conspicuously located in the main cabin at the ceiling and another is on the aft wall of the lounge. The signs are operated by a "NO SMOKING" switch and a "FASTEN BELTS" switch on the overhead instrument panel. The "FASTEN BELTS" switch will also illuminate a "RETURN TO SEATS" sign in each dressing room and in the aft lavatory. Red warning lights for each sign are also illuminated on the cabin attendant's instrument panel. Actuation of either switch will also cause a chime at the cabin attendant's station to sound, provided the "CHIME DISCONNECT" switch is closed. A circuit breaker for these passenger warning signs is on the overhead electrical panel.

EMERGENCY LIGHTS. All emergency exits in the passenger compartment are identified by a green light above each exit. These exit lights are turned on by a guarded "EMER EXIT LIGHTS" switch on the overhead instrument panel. This switch also overrides the two switches on the cabin attendant's panel controlling the aisle and stairway lights in the main cabin, thus giving light in an emergency. Control cabin lights will also be turned on by this switch. A circuit breaker for these lights is on the battery No. 1 relay shield.

PASSENGER CALL SYSTEM. A system of call buttons (push button switches) and lights is provided to enable passengers to signal the cabin attendants for assistance or service. Call buttons at each seat, each berth (in the luxury compartment), each dressing room, each toilet compartment, the stateroom, and the lounge operate call lights which identify the origination of the call. The call lights for all locations forward of the vestibule are in a call light panel in the ceiling offset

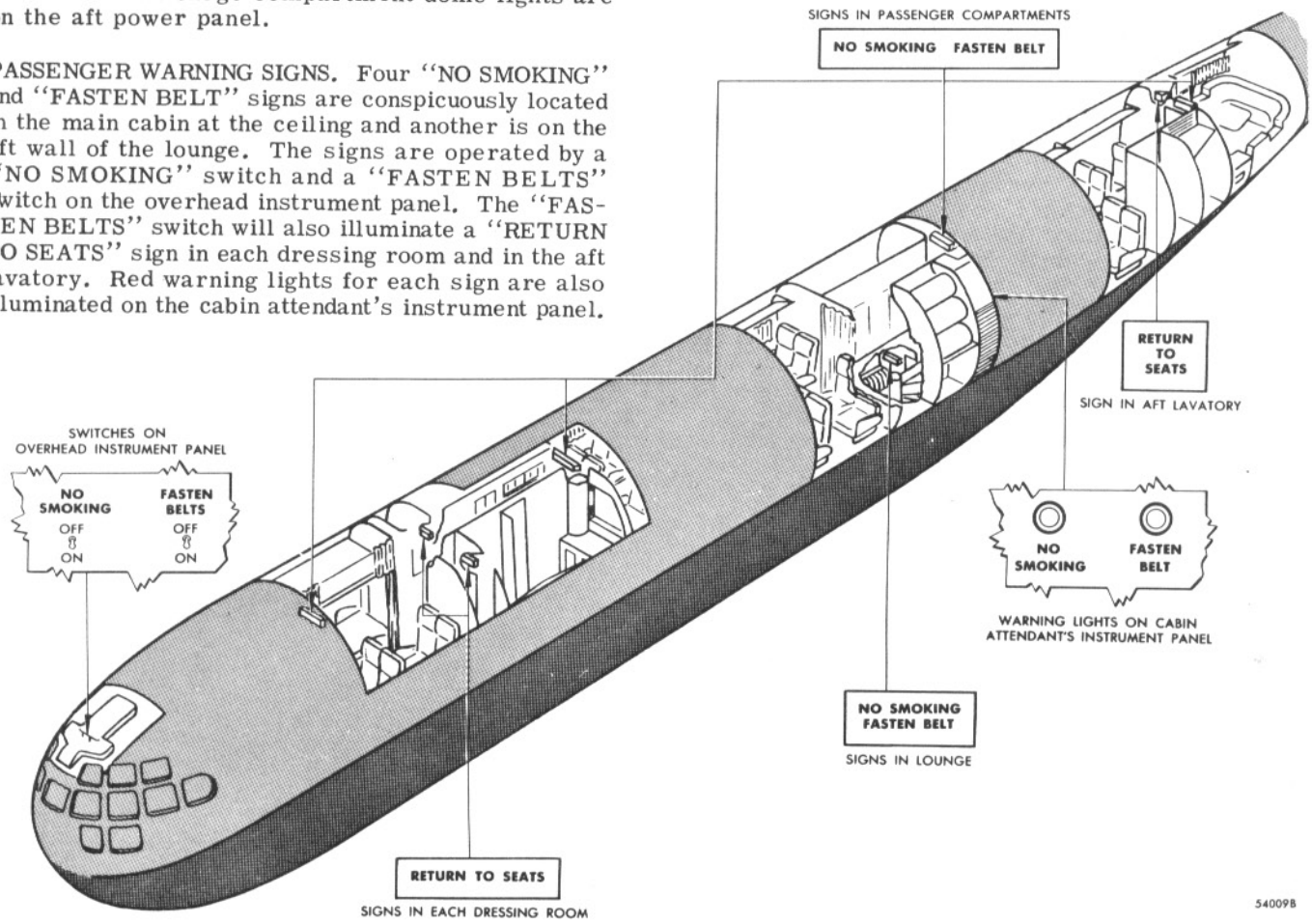



***Figure 3-12. Passenger Warning Signs***

at the forward end of the vestibule. Call lights for all locations aft of the vestibule are in a call light panel in the ceiling offset at the aft end of the vestibule. A lounge call light and a pilot call light are in each call light panel.

A call from any of the forward locations will illuminate a "FWD" master call light on the cabin attendant's instrument panel, another on the aft ceiling call light panel and in addition will indicate on the forward call light panel from which location the call originated. A call from any of the aft locations will illuminate a "AFT" master call light on the cabin attendant's instrument panel, another on the forward ceiling call light panel, and in addition will indicate on the aft call light panel from which location the call originated. A call from the lounge will illuminate only the lounge call lights on each ceiling call light panel. Forward cabin call lights can be reset by either a button on the cabin attendant's instrument panel or by another adjacent to the drinking water dispenser. Aft call lights and lounge call lights can be reset by either a button on the cabin attendant's instrument panel or by another adjacent to the stateroom doorway. A chime, at the cabin attendant's station, will sound simultaneously with a light signal, provided the "CHIME DISCONNECT" switch on the cabin attendant's instrument panel is closed.

A buzzer in the stateroom can be sounded by a call button to advise occupants that entrance is desired. This call button is on the left side of the entrance doorway.

DOOR WARNING SYSTEM. The door warning system indicates when the passenger entry, cargo entry, or galley service doors are not closed and latched. The warning circuit is comprised of nine micro-switches that cause a red warning light on the pilots' instrument panel to illuminate when the doors are not closed and latched. The forward cargo entry, aft cargo entry, and galley service doors each have one "door closed" warning switch and one "door latched" warning switch. The passenger entry door has two "door closed and latched" warning switches and one "door locked" warning switch. The circuit is protected by a circuit breaker on the overhead electrical panel.

Prior to takeoff, check that all entry door handles are in the closed position and that the sliding locks (if installed) for the cargo doors are in the locked position. If a warning light goes on before takeoff, all doors should be unlocked, opened, closed, and locked. If the warning light remains on, check the system as follows:

a. Remove the three main entry door inspection plates and check that the mechanism is in the locked position.

b. On the galley and cargo doors, check that the cams, the cam linkage lock, and the door closed micro-switch actuating cam are in the locked position. If all doors are found to be in the closed and locked position, the illuminated light may be considered a malfunction of the warning system.

If the door warning light illuminates while in flight with the airplane pressurized, depressurize the airplane as rapidly as passenger comfort permits and inspect door mechanism according to steps "a" and "b" in the previous paragraph.

CONTROL CABIN GALLEY EQUIPMENT. A shelf on the control cabin aft wall has storage space for three hot liquid containers. A hot food box is on the shelf above the hot liquid containers. Switches for operation of each hot liquid container and the hot food box are on the front side of the hot liquid container shelf. Circuit breakers for this equipment are on the forward power panel.

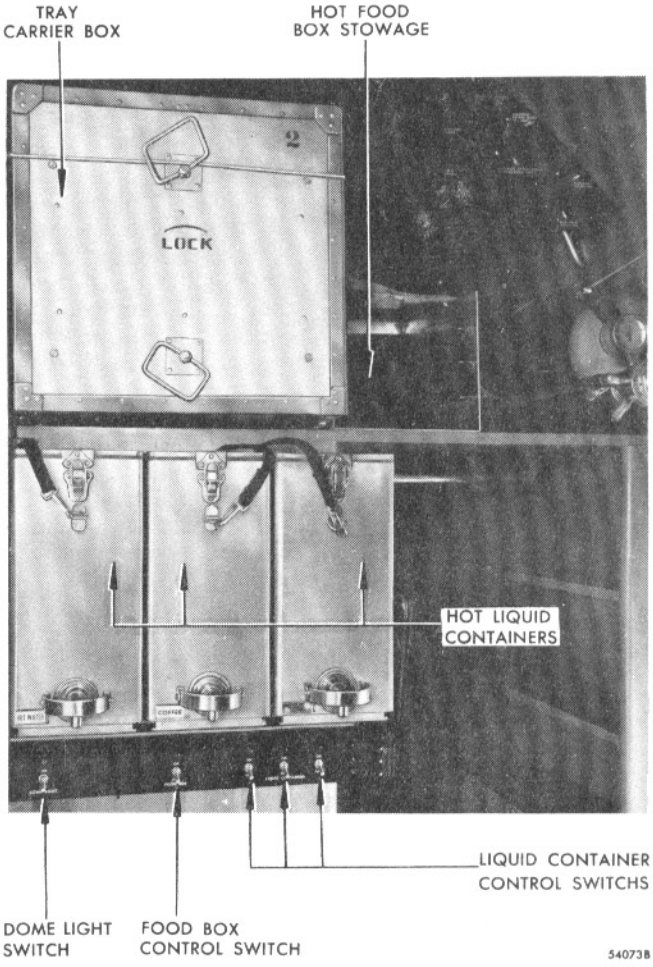



***Figure 3-13. Control Cabin Galley Equipment***

# Chapter 4 PASSENGER AND CARGO EQUIPMENT

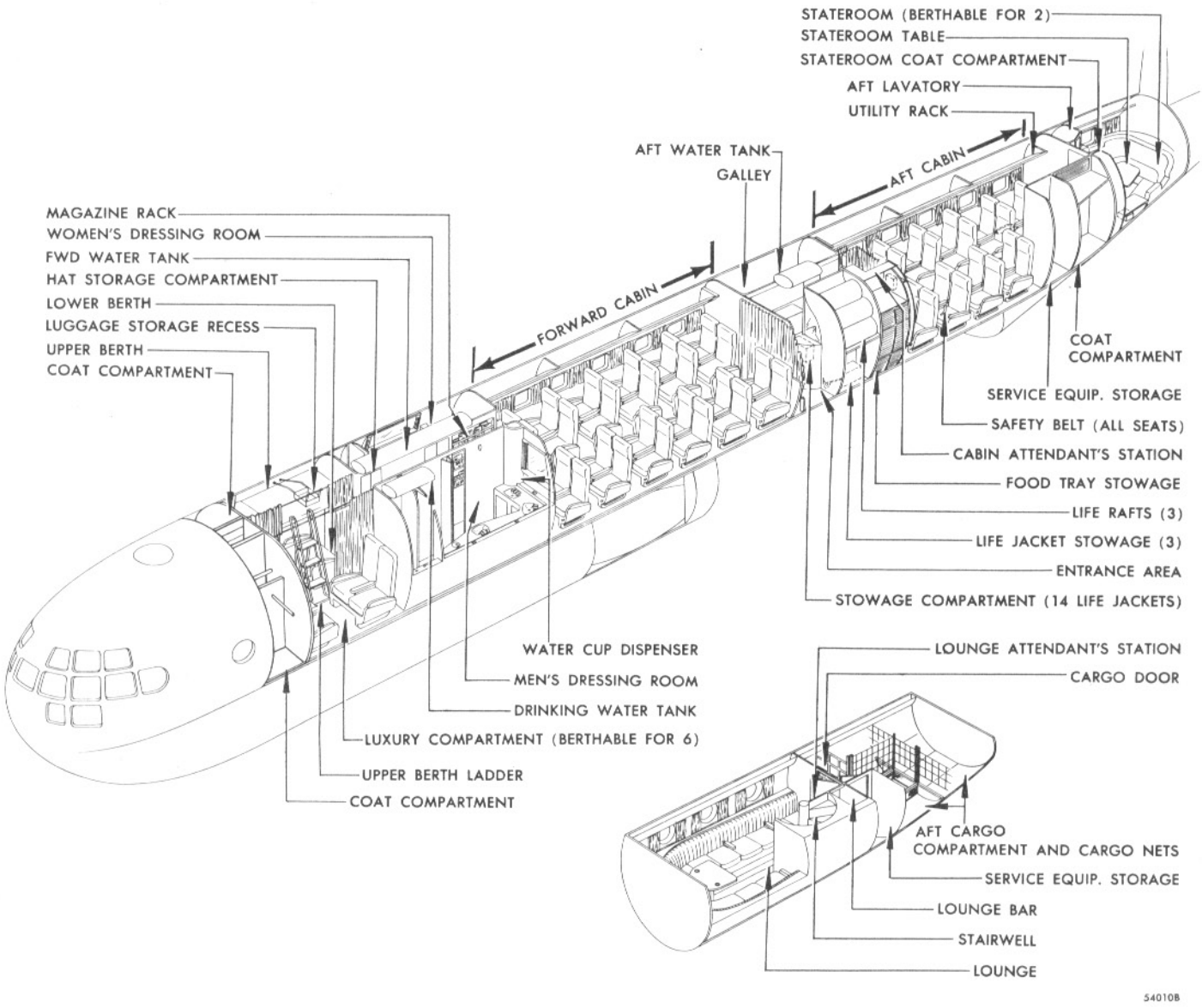



***Figure 4-1. Passenger Accommodations***

PASSENGER EQUIPMENT.

There are complete facilities for the accommodation of a maximum of 69 passengers with 52 in the main forward and aft cabins and luxury compartment, 3 in the stateroom, and 14 in the lounge. Night accommodations reduce the number of passengers to a maximum of 66, with berths available for 8, and the remaining 58 in seats. (See figure 4-1.)

FORWARD COAT COMPARTMENTS. Curtained coat compartments for use of passengers are immediately aft of the control cabin and are accessible from the aisle. Drawers for passenger hat storage are above the right side coat compartment.

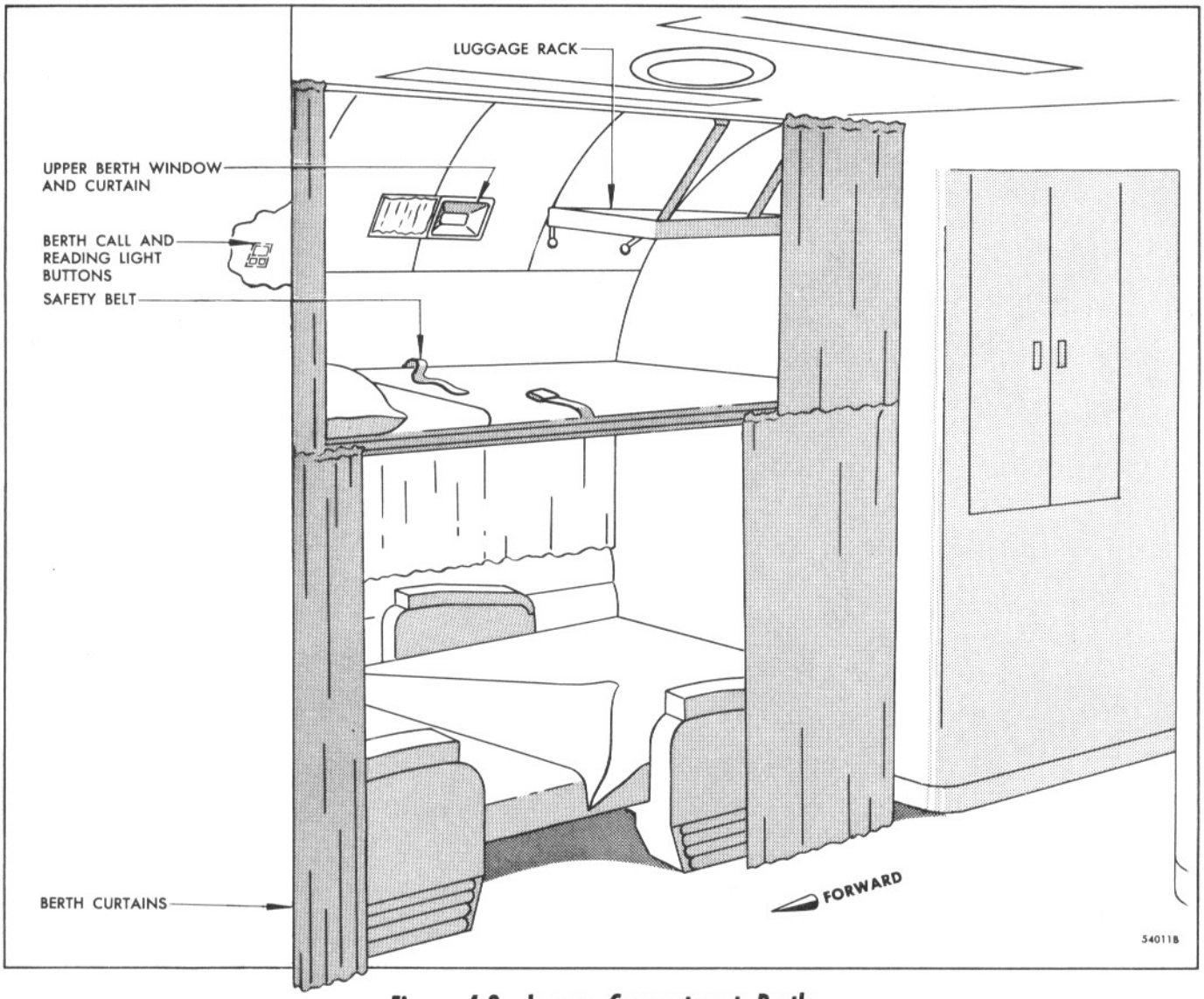



***Figure 4-2. Luxury Compartment Berths***

LUXURY COMPARTMENT. The luxury compartment contains four double seats and can be converted to a sleeping compartment with two lower and upper berths. Each seat has a safety belt, adjustable reclining back, reading light, individual serving tray receptacles, ash tray, and an attendant call button. Airsickness bags and life jackets are stowed in pockets at or near each seat. Four windows are located for maximum passenger visibility. Curtains provide protection from sun glare and also provide privacy when the seats are converted to berths. Each lower berth accommodates two passengers and each upper berth one passenger. The upper berths have a small window, a luggage rack, coat hangers, sickness bags, mirror, reading light, safety belt, and an attendant call button. A berth ladder is stowed in one of these upper berths when not in use. (See figure 4-2.)

DRESSING ROOM AISLE. The aisle between dressing rooms has the following equipment: cabinets at the forward end of each wall for storage or for hanging passengers' hats, a magazine rack on the aft end of the right wall, drinking water dispenser, a paper cup dispenser, and a waste cup disposal container on the aft corner of the left wall.

MEN'S DRESSING ROOM. The men's dressing room is at the forward left side of the passenger cabin, and is divided into a toilet compartment and a lavatory compartment. (See figure 4-3.)

The toilet compartment is equipped as follows:

a. Flushable toilet facilities.

b. A dispenser cabinet which includes an attendant call button, a waste disposal bin, and dispenser recesses for toilet tissue and airsickness bags.

c. An ash tray in the top of the dispenser cabinet.

d. An assist handle on the forward wall and another on top of the dispenser cabinet.

e. Two spring-loaded fold-back coat hooks.

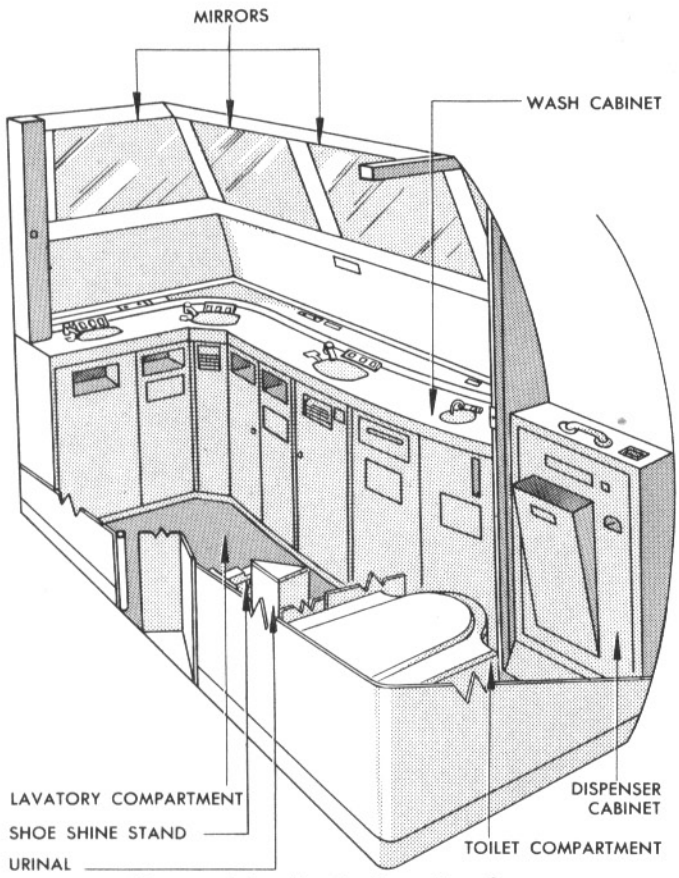



**Figure 4-3. Men's Dressing Room** 54012B

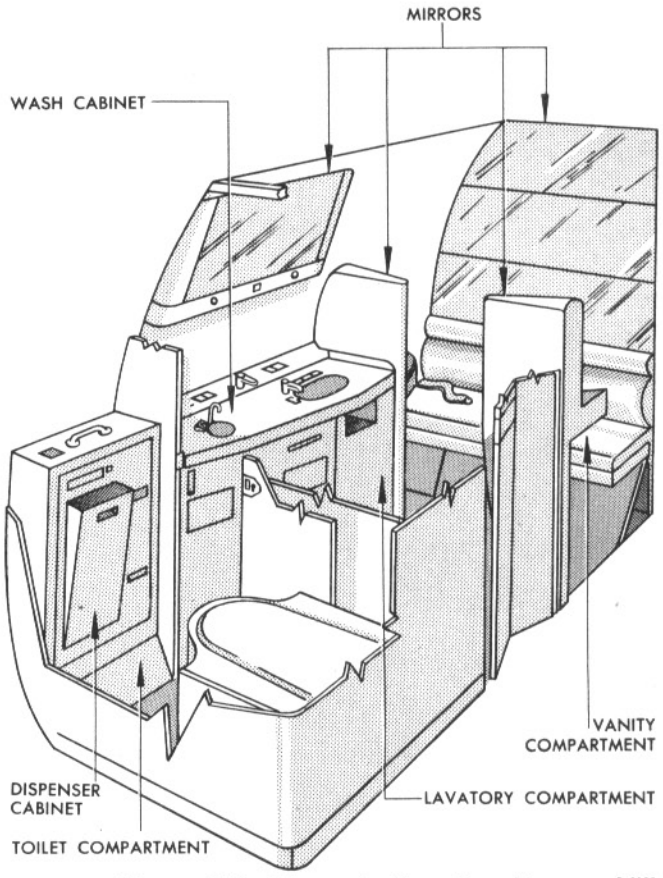



**Figure 4-4. Women's Dressing Room** 54013B

The lavatory compartment is equipped as follows:

a. A urinal that is nonflushable while in flight.

b. A portable shoe shine stand with shoe brush and cloth.

c. An L-shaped wash cabinet which includes three wash basins with hot and cold running water, a dental bowl, a linen towel dispenser recess, two paper towel dispenser recesses, an airsickness bag dispenser recess, two storage recesses for passengers' toilet equipment, three towel disposal bins (one for linen towels and two for paper towels), a razor strop hook, a paper cup dispenser, three liquid soap dispensers, and two storage compartments each with a lock.

d. Four ash trays at the wash cabinet.

e. Mirrors above the wash cabinet tilted to give full length vision.

f. Four AC and four DC electric shaver outlets below the mirrors.

g. Five spring-loaded fold-back coat hooks.

h. Assist handles on each side of the entrance door and one above the urinal.

WOMEN'S DRESSING ROOM. The women's dressing room is at the forward right side of the passenger cabin. It is divided by partitions to form a vanity compartment, a lavatory compartment, and a toilet compartment. (See figure 4-4.)

The vanity compartment accommodates two people and is equipped as follows:

a. Two vanity tables with mirror for each.

b. Mirrors completely covering the back wall above the vanity seat.

c. Rubber cushioned vanity seat and back.

d. An ash tray at each table.

e. A two-passenger safety belt that can be fastened across the seat.

f. A cleansing tissue dispenser and a cleansing tissue disposal drawer in each table.

g. Two spring-loaded fold-back coat hooks.

The lavatory compartment is equipped as follows:

a. A wash cabinet which includes: a wash basin with hot and cold running water, a dental bowl, a liquid soap dispenser, a hand lotion dispenser, a paper cup dispenser, a dispenser recess for linen towels, a disposal bin for towels, a Kleenex dispenser, an airsickness bag dispenser, two ash trays, a waste disposal bin, and a storage compartment with a lock.

b. A mirror on the wall above the wash cabinet, tilted to give full length vision.

c. A vertically mounted mirror on the forward wall.

d. AC and DC electric shaver outlets below each mirror.

e. A spring-loaded fold-back coat hook.

f. An assist handle by the entrance door.

The toilet compartment is equipped as follows:

a. Flushable toilet facilities.

b. Dispenser cabinet with recesses for airsickness bags, toilet tissue, and sanitary napkins.

c. An ash tray, an attendant call button, and a disposal bin for waste in the dispenser cabinet.

d. An assist handle on the cabinet and on the forward wall.

e. Two spring-loaded fold-back coat hooks.

541158

***Figure 4-5. Forward Cabin (Looking Aft)***

FORWARD CABIN. The forward cabin is immediately aft of the luxury compartment and forward of the main entrance door. It contains 12 double luxury seats each adjacent to a window to provide maximum visibility. Sliding curtains provide protection from sun glare. Each seat has an adjustable reclining back, safety belt, ash tray, reading light, individual serving tray receptacles, and an attendant call button. Pockets are provided at or near each seat for stowing life jackets, airsickness bags, and literature. Utility racks for small packages, blankets, and miscellaneous passenger items are above the seats. Sliding curtains at the aft end separate the forward cabin from the vestibule and prevent drafts when the main entry door is open.

VESTIBULE. The vestibule on the left side of the airplane includes the main entrance way, a stairwell leading to the lounge and the cabin attendant's station. (See figures 4-6 and 4-7.) It may be enclosed by curtains at the forward and aft ends.

The cabinets aft of the entrance way form the stairwell and contain life rafts, life jackets, an axe, and storage space. A detachable rope at the head of the stairwell prevents entry to the lounge or an accidental fall into the stairwell.

The cabin attendant's station has a desk with instrument panel, a folding seat with safety belt, interphone facilities, controls for air conditioning, first aid kit, serving tray storage compartments, and service storage compartments.

GALLEY. The galley as shown in figures 4-8 and 4-9 is midship on the right side of the airplane opposite the main entrance door. It is accessible from the vestibule and may be serviced through the main entrance door.

The galley has four main sections, namely: a refrigerated section at the forward end, a salad section facing the aisle, a dry storage section above the salad section, and a heated section at the aft end. A dry ice compartment in the refrigerated section provides cooling. The salad section forms a serving counter adjacent to the cabin aisle. This section also includes disposal bins in the top of the counter for used linen and refuse. The bins can be serviced through a door in cabin aisle side of the section. The interior of the dry storage section is accessible from the galley side for serving and from aisle side for easy servicing. Dry foods, liquid foods, dishes, silverware, etc., can be stored in this cabinet. The heated section includes: a heated counter, a hot food storage compartment under the counter, a sink with hot and cold running water, a fresh-linen storage bin in the compartment under the sink, two roll-warmer ovens above the counter, two shelves for storing six electrically heated thermos jugs, two hot cup outlets above the counter, a switch panel with switches to control all electrical equipment, and two dry storage compartments. Circuit breakers for galley equipment are in the galley junction shield on the outer wall and forward of the heated section.

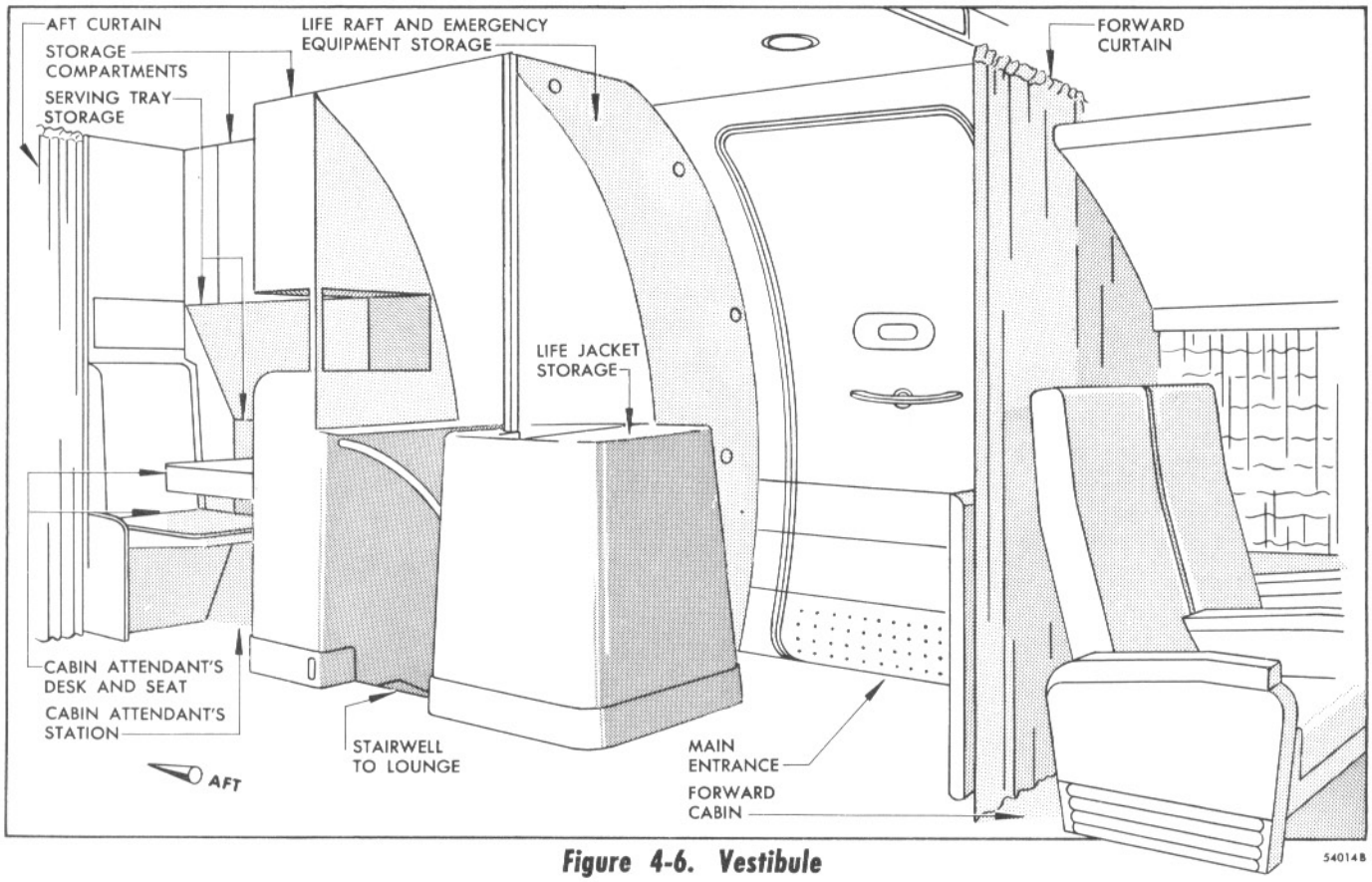



***Figure 4-6. Vestibule***

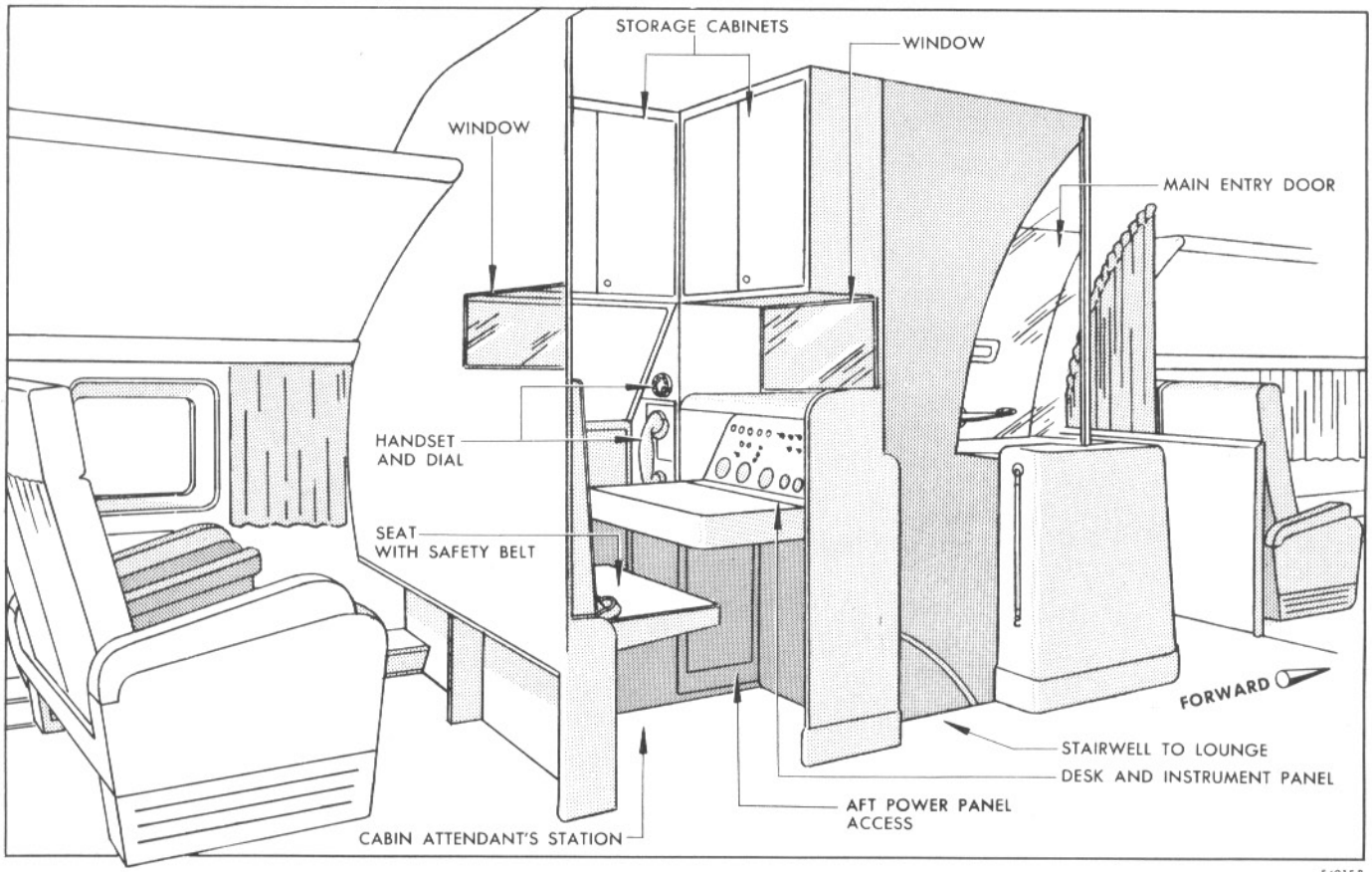



***Figure 4-7. Vestibule***

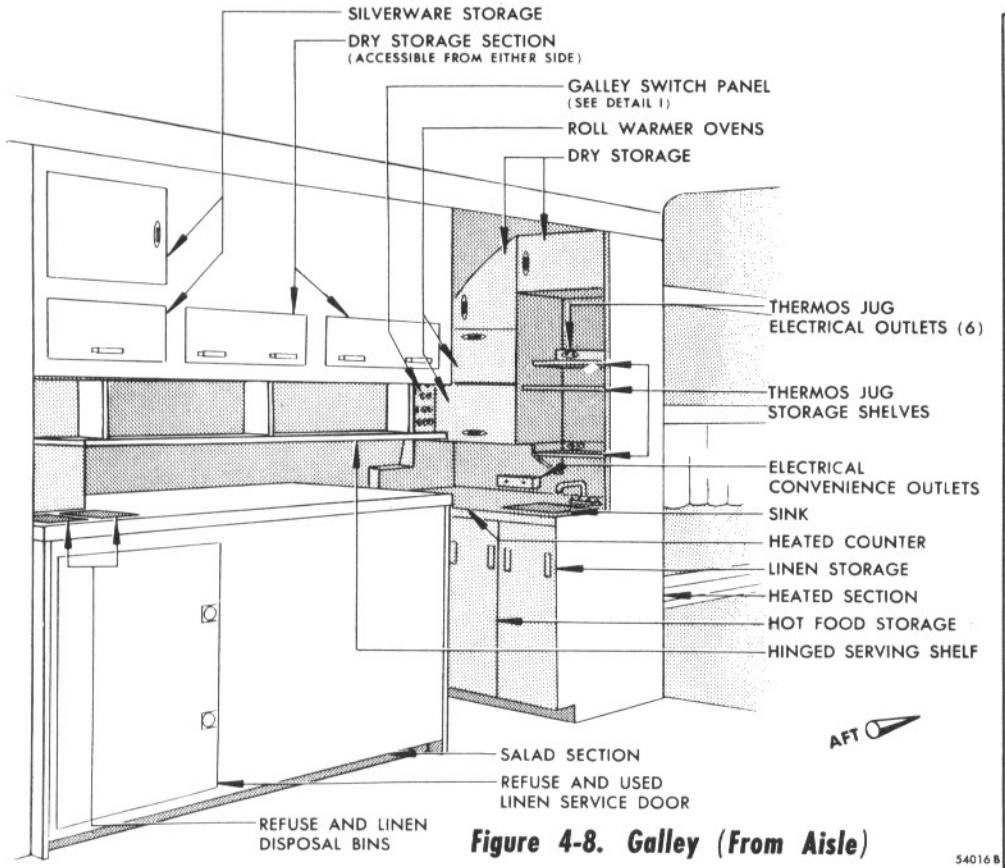
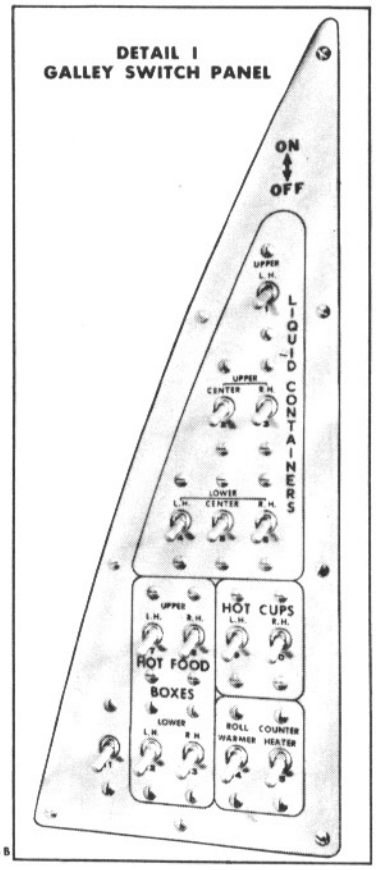



**Figure 4-8. Galley (From Aisle)**



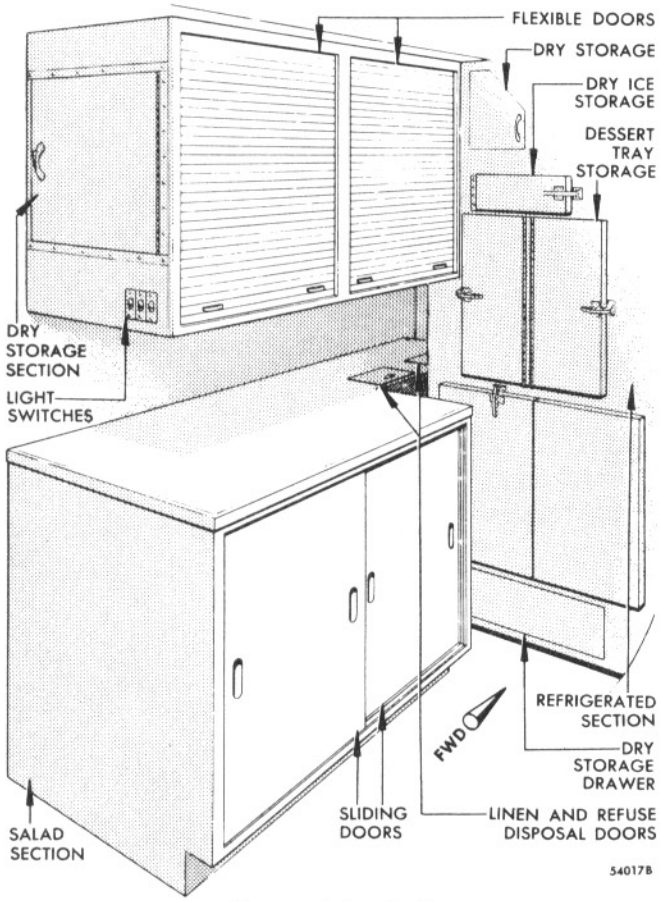
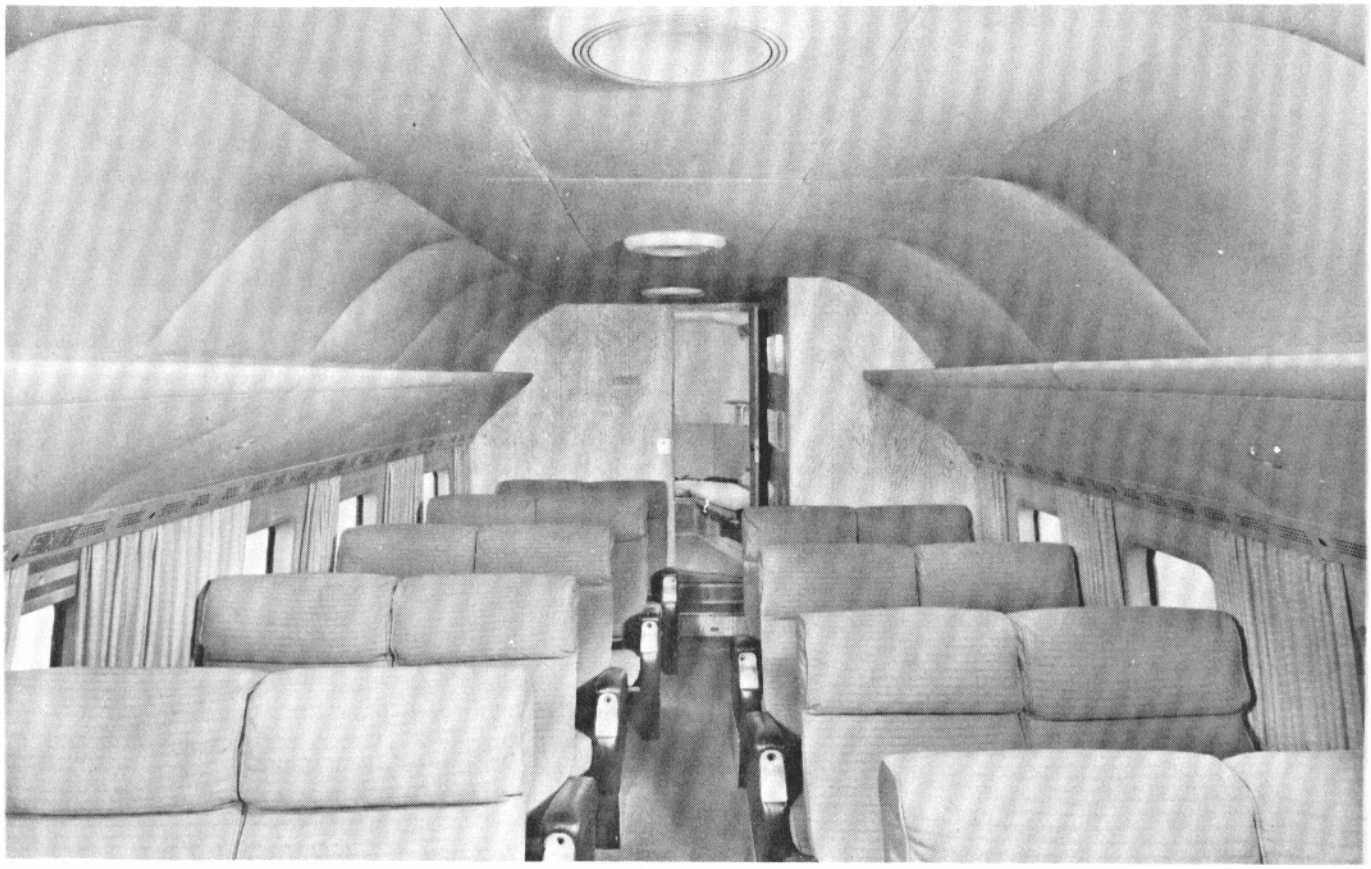




**Figure 4-9. Galley**

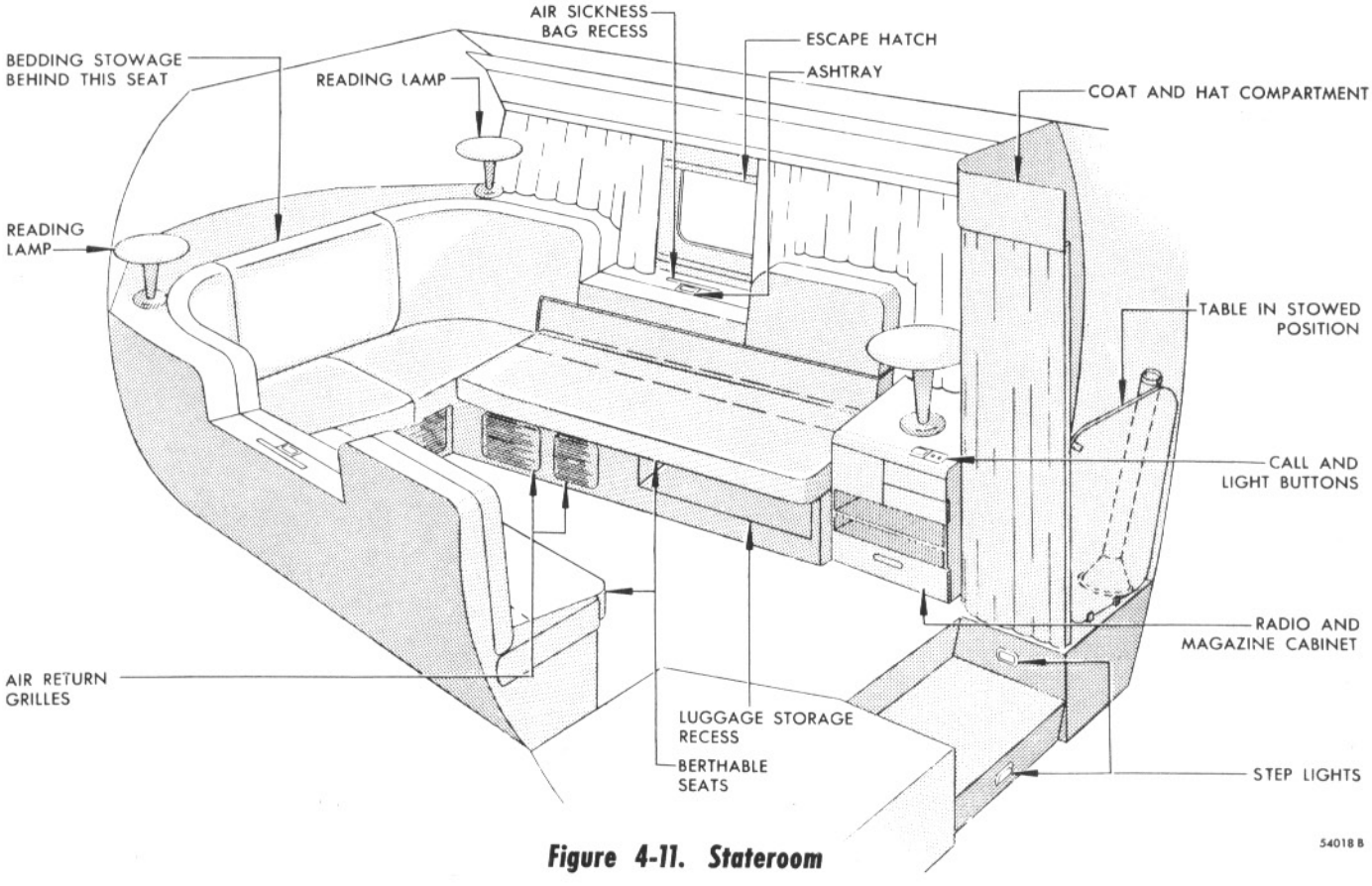
AFT CABIN. The aft cabin, which extends from the vestibule to the stateroom, contains seven double luxury seats and three double day seats. The seats and equipment are the same as those in the forward cabin except that the double day seats are slightly narrower. A service storage compartment with lock and a passenger coat compartment with a curtained front are in the left aft corner of this cabin. A magazine rack is on the outer side of the storage compartment door. Drawers for passenger hat storage are above the coat compartment. The door at the aft end of the cabin leads to the stateroom. Sliding curtains at the forward end separate the aft cabin from the vestibule and prevent drafts when the main entry door is open.

STATEROOM. This luxury compartment as shown in figure 4-11 is at the aft end of the airplane and is accessible through a door from the aft cabin. The seats, equipped with safety belts, are arranged to form a horseshoe-shaped divan. The compartment accommodates three day-passengers and the seats are berthable to accommodate two night-passengers. Bedding material for berthing the seats is stowed behind the aft seat. Luggage recesses are under the side seats. A removable table can be used between the seats and when not in use is stowed in the curtained coat compartment in the left forward corner of the stateroom. Two windows provide maximum passenger visibility. Sliding curtains over the windows provide protection from sun glare. Ash trays and airsickness bags are on the shelves in front of the windows. A cabinet radio with built-in magazine rack, ash tray, light button, and a call button is on the left side adjacent to the seat. Reading lamps are on the radio cabinet and on the shelves above the seats in each aft corner. Life jackets are stowed in the radio cabinet drawer.



54114B

***Figure 4-10. Aft Cabin (Looking Aft)***




54018B

***Figure 4-11. Stateroom***

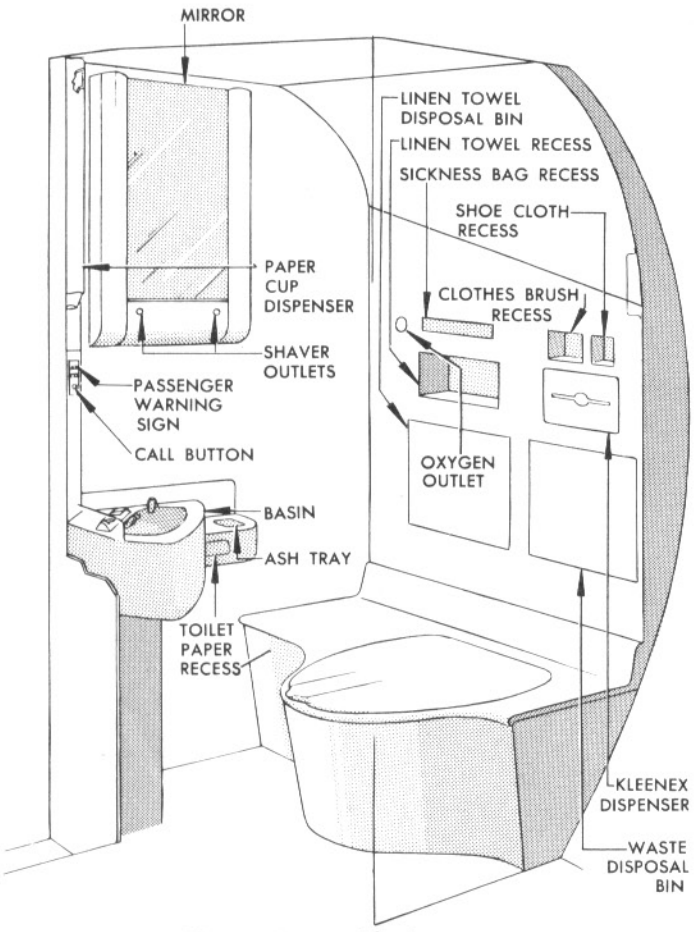



***Figure 4-12. Aft Lavatory***

AFT LAVATORY. The aft lavatory as shown in figure 4-12 is in the right forward end of the stateroom and is accessible through the stateroom. This compartment is equipped as follows:

a. Flushable toilet facilities.

b. Wash cabinet which includes a basin with hot and cold running water, a liquid soap dispenser, ash tray, and a toilet paper dispenser recess.

c. A mirror above the wash cabinet.

d. AC and DC electric shaver outlets below the mirror.

e. A cup dispenser adjacent to the mirror.

f. A spring-loaded fold-back coat hook on the aft wall.

g. A cabinet on the outer wall behind the toilet contains a linen towel disposal bin, a waste disposal bin, a Kleenex dispenser, and recesses for airsickness bags, linen towels, a clothes brush, and a shoe cloth.

h. A call button above the wash cabinet.

LOUNGE. The circular staircase from the vestibule connects the main deck with the lounge. The lounge contains a refreshment bar, a removable table, and seven fixed double seats arranged in the shape of a horseshoe. (See figures 4-13 and 4-14.) Each double seat holds two passengers. Only one safety belt is on each seat. Three removable armrests contain ash trays and provisions to mount two glass holders. Panels under the seats provide access to sickness bag stowage. The door at the aft end of the lounge leads to the aft cargo compartment.

The refreshment bar under the stairwell has a sink with a hot and cold water supply, storage compartments, a storage drawer, a refuse disposal container, and a folding seat for the lounge attendant. Interphone facilities and a temperature control unit are on the front side of the bar.

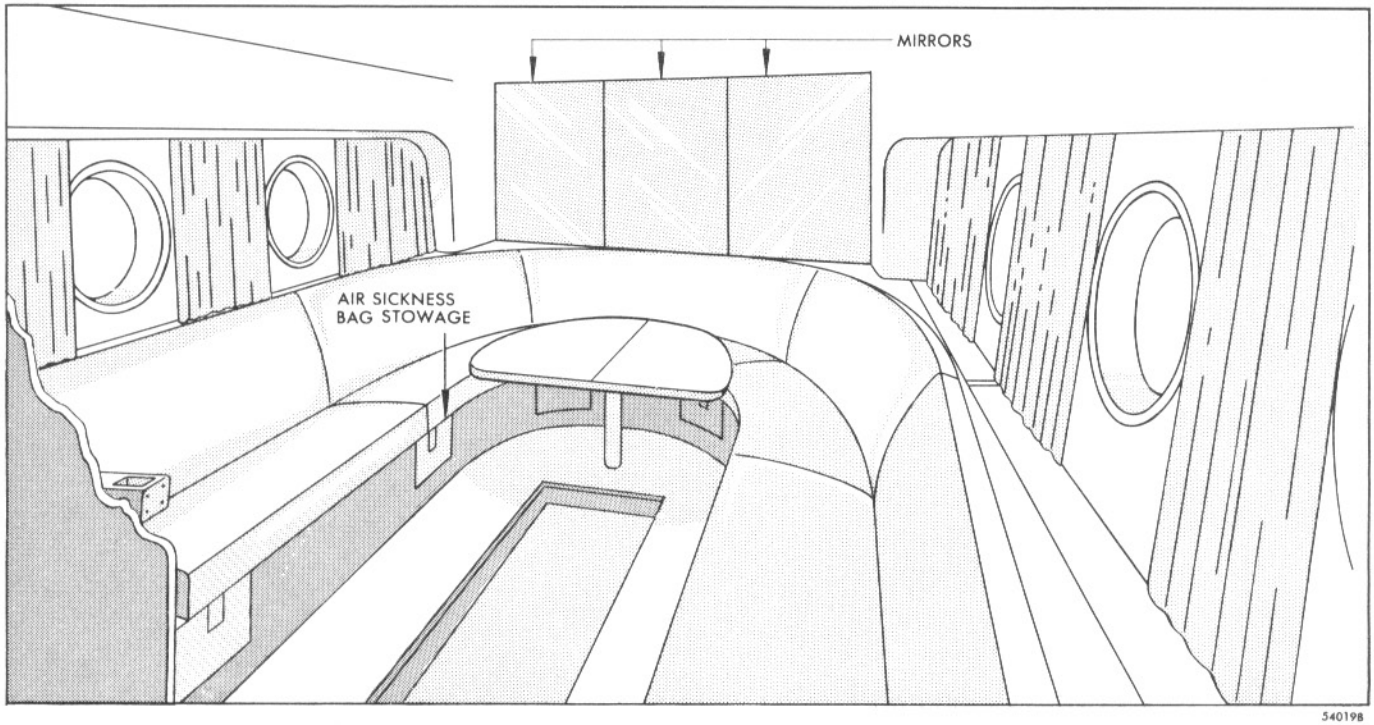



***Figure 4-13. Lounge (Looking Forward)***


54020 B

***Figure 4-14. Lounge (Looking Aft)***

CARGO EQUIPMENT.

FORWARD AND AFT CARGO COMPARTMENTS. Both cargo compartments are accessible during flight. The forward compartment is entered through a hatch in the floor of the control cabin and the aft compartment is entered through a door in the aft end of the lounge. The temperature of the compartments can be controlled as necessary for preservation of the cargo being carried.

Removable partition nets on each side of the aisle form eight cargo or baggage loading stalls in the forward cargo compartment. Tie-down rings facilitate securing cargo. Two safety-belt equipped crew bunks, in one collapsible unit consisting of an upper and lower bunk, may be readily installed in the right forward side of this cargo compartment. (See figure 4-15.) The unit is stowed by lashing to a cradle at the right of the nose-wheel well in the lower nose compartment. The mattresses are stowed by folding and strapping to the forward bulkhead of this cargo compartment.

Partition nets and a cargo restraining net are provided in the aft cargo compartment. The cargo restraining net, to be used at the forward end of the compartment aft of the cargo door, must be tightened in place if cargo is carried in this compartment. Tie-down rings facilitate the securing of cargo. A service equipment locker is opposite the cargo door at the forward end of the compartment.

The cargo doors are hinged at the bottom. A brake on the door hoisting winch allows the door to fall slowly to prevent damage.

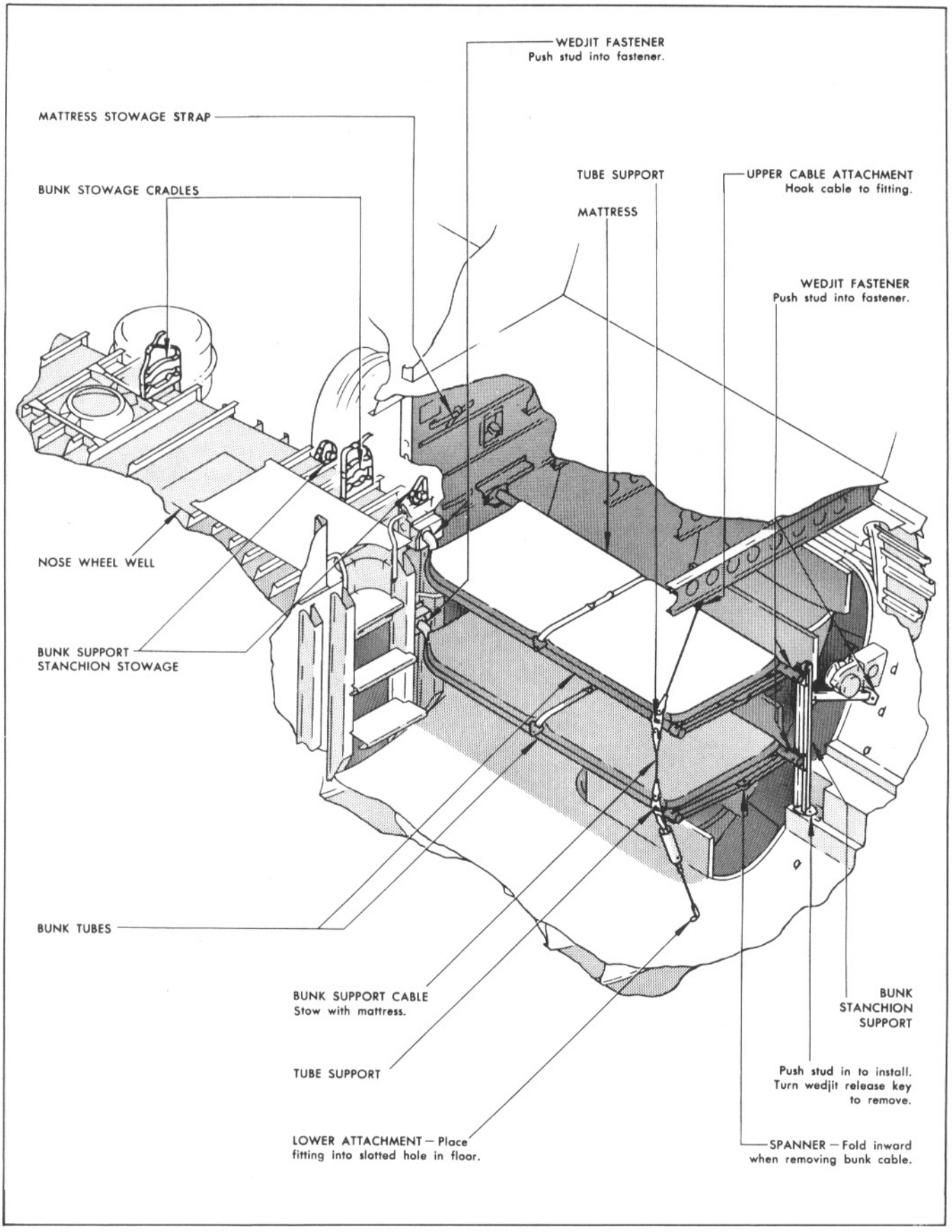



*Figure 4-15. Crew Bunk (Forward Cargo Compartment)*

WEIGHT AND LOADING LIMITATIONS.

CARGO LIMITS. Maximum capacities and distribution of cargo in the forward and aft cargo compartments are shown in figures 4-16 and 4-17.

CARGO FLOOR LOADING LIMITS. Maximum concentration of cargo floor loads is shown in figures 4-16 and 4-17 for the forward and aft cargo compartments.

PASSENGER AND CARGO DISTRIBUTION. The passengers and cargo should be loaded according to the instructions contained in the CAA approved Airplane Flight Manual.

GROSS WEIGHT LIMITS.

a. Maximum take-off weight at sea level is 142,500 pounds with wet power or 138,000 pounds with dry power.

b. Maximum landing weight at sea level is 121,700 pounds.

NOTE

For maximum permissible weights at various altitudes, see the CAA approved Airplane Flight Manual.

c. All weight in excess of maximum permissible landing weight shall consist of disposable fuel.

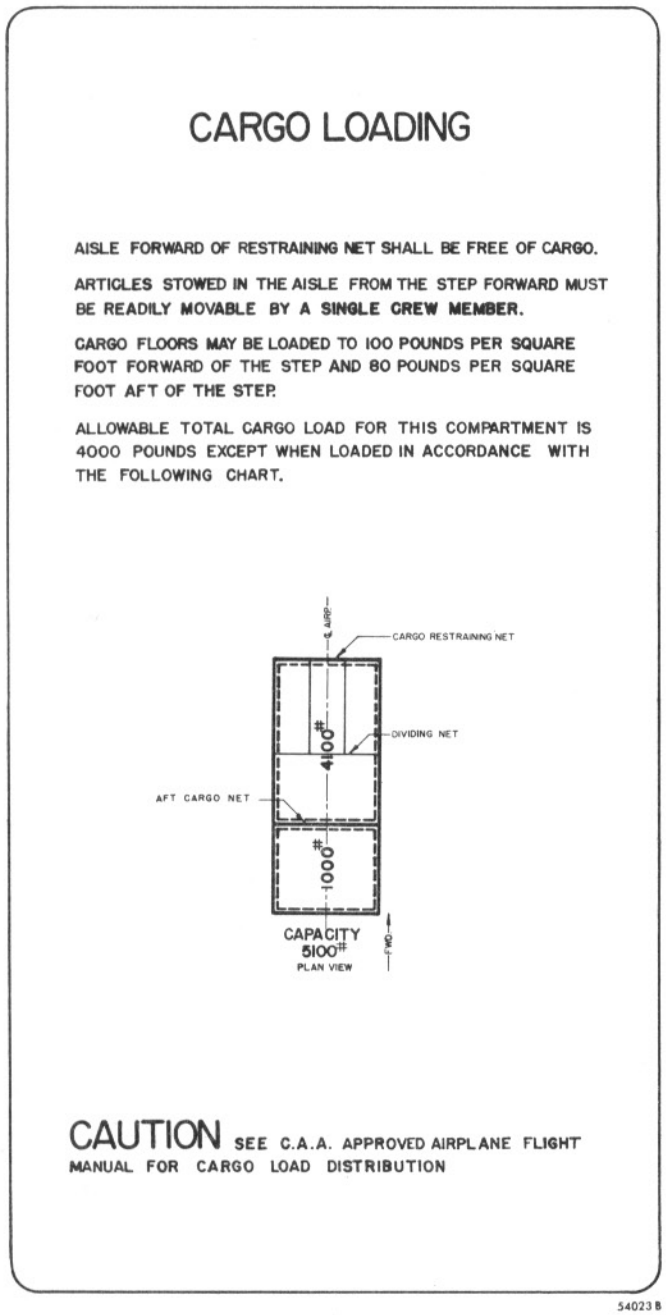



*Figure 4-16. Cargo Loading (Aft Compartment)*

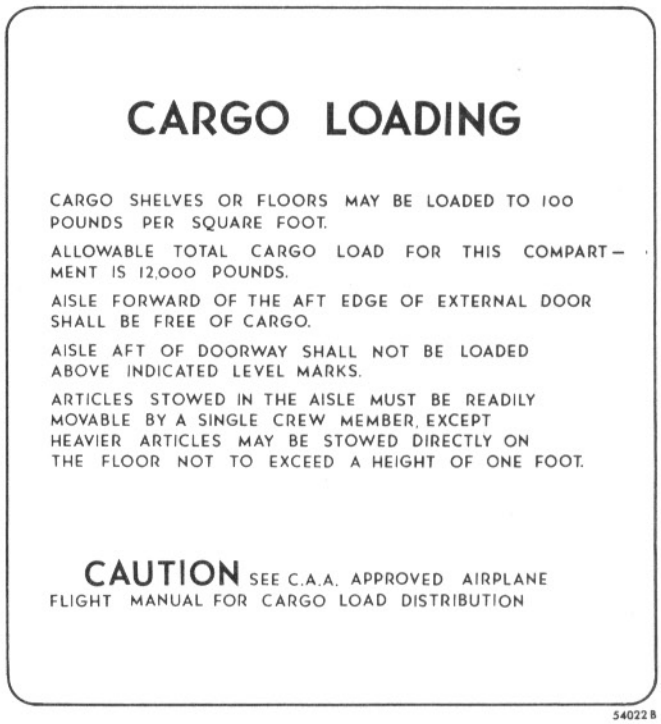



*Figure 4-17. Cargo Loading (Forward Compartment)*

FUEL LOADING AND MANAGEMENT LIMITATIONS.

| Gross weight With Dry Wing (See Note) | Take-off Weight | Structural Limitations on Fuel Loading | Structural Limitations on Fuel Usage in Flight |
|---|---|---|---|
| Up to 109,300 lbs | Up to 142,500 lbs | Fuel in tanks 1 and 4 must equal or exceed fuel in tanks 2 and 3 respectively | Fuel quantities in tanks 1 and 4 must not be reduced to less than those in tanks 2 and 3 respectively |
| From 109,300 lbs to 113,900 lbs | Up to 138,500 lbs | | |
| | From 138,500 lbs to 142,500 lbs | Fuel in tanks 2 and 3 must not exceed 5150 lbs (858 gallons) per tank unless tanks 1 and 4 are full | |

Note - This is the airplane gross weight less nacelle oil, water injection fluid, and all fuel in tanks Nos. 1, 2, 3, and 4. This value must never exceed 113,900 lbs. Values shown in the table for this "Gross Weight with Dry Wing" must include the weight of fuel in the center section tank, if carried.

CENTER OF GRAVITY LIMITS.

a. General. The datum point for all station references is 50 inches ahead of the airplane nose surface. Straight line variations should be used between the forward CG locations in each condition group.

b. Wet Power.

| CONDITION | WEIGHT (POUNDS) | LANDING GEAR | FORWARD LIMIT STATION | FORWARD LIMIT %M.A.C. | AFT LIMIT STATION | AFT LIMIT %M.A.C. |
|---|---|---|---|---|---|---|
| Take-off | 142,500 | Down | 535.7 | 28.6 | 541.8 | 32.6 |
| Take-off | 140,000 | Down | 518.4 | 17.4 | 541.8 | 32.6 |
| Take-off | 130,000 | Down | 515.6 | 15.6 | 541.8 | 32.6 |
| Take-off | 121,700 or less | Down | 514.0 | 14.6 | 541.8 | 32.6 |
| Landing | 121,700 or less | Down | 514.0 | 14.6 | 541.8 | 32.6 |
| Enroute (flaps up) | 142,500 | Down | 535.7 | 28.6 | 544.9 | 34.6 |
| | 139,500 | Down | 513.7 | 14.4 | 544.9 | 34.6 |
| | 114,000 or less | Down | 507.9 | 10.6 | 544.9 | 34.6 |
| Enroute (flaps up) | 142,500 | Up | 534.7 | 28.0 | 544.0 | 34.0 |
| | 139,500 | Up | 512.8 | 13.8 | 544.0 | 34.0 |
| | 114,000 or less | Up | 506.9 | 10.0 | 544.0 | 34.0 |

c. Dry Power.

| CONDITION | WEIGHT (POUNDS) | LANDING GEAR | FORWARD LIMIT STATION | FORWARD LIMIT %M.A.C. | AFT LIMIT STATION | AFT LIMIT %M.A.C. |
|---|---|---|---|---|---|---|
| Take-off | 138,000 | Down | 535.7 | 28.6 | 541.8 | 32.6 |
| Take-off | 135,500 | Down | 517.1 | 16.6 | 541.8 | 32.6 |
| Take-off | 130,000 | Down | 515.6 | 15.6 | 541.8 | 32.6 |
| Take-off | 121,700 or less | Down | 514.0 | 14.6 | 541.8 | 32.6 |
| Landing | 121,700 | Down | 524.6 | 21.4 | 541.8 | 32.6 |
| Landing | 120,500 or less | Down | 514.0 | 14.6 | 541.8 | 32.6 |
| Enroute (flaps up) | 138,000 | Down | 513.4 | 14.2 | 544.9 | 34.6 |
| | 114,000 or less | Down | 507.9 | 10.6 | 544.9 | 34.6 |
| Enroute (flaps up) | 138,000 | Up | 512.5 | 13.6 | 544.0 | 34.0 |
| | 114,000 or less | Up | 506.9 | 10.0 | 544.0 | 34.0 |

540498

# Chapter 5 OPERATING CHARTS

## AIRSPEED INDICATOR

| | | |
|---|---|---|
| MAXIMUM | 302 KNOTS (348 MPH) OR .58 MACH NUMBER, WHICHEVER IS LESS | RED HAND |
| CAUTION | 34 KNOTS (39 MPH) BELOW MAXIMUM | YELLOW RANGE ON HAND |
| NORMAL | 123 TO 268 KNOTS (142 TO 309 MPH) | GREEN ARC |
| FLAP OPERATING RANGE | 89 TO 159 KNOTS (102 TO 183 MPH) | WHITE ARC |

## TACHOMETER

| | | |
|---|---|---|
| NORMAL | 1200 RPM TO 2550 RPM INCLUSIVE | GREEN ARC |
| CAUTION | 2550 RPM TO 2700 RPM | YELLOW ARC |
| MAXIMUM | 2700 RPM | RED RADIAL |

## MANIFOLD PRESSURE

| | | | |
|---|---|---|---|
| NORMAL | - AUTO LEAN OR AUTO RICH | 20" TO 56" HG | GREEN ARC |
| CAUTION | - AUTO RICH | 56" TO 60" HG | YELLOW ARC |
| MAXIMUM (TAKE-OFF POWER) | - AUTO RICH, 2 MINUTE LIMIT | 60" HG | RED RADIAL |

## OIL PRESSURE

| | | |
|---|---|---|
| MINIMUM | 50 PSI | RED RADIAL |
| NORMAL | 80 PSI TO 100 PSI | GREEN ARC |
| MAXIMUM | 100 PSI | RED RADIAL |

## OIL TEMPERATURE

| | | |
|---|---|---|
| MINIMUM | 40° C | RED RADIAL |
| NORMAL | 40° TO 85° C | GREEN ARC |
| CAUTION | 85° TO 100° C | YELLOW ARC |
| MAXIMUM | 100° C | RED RADIAL |

## FUEL PRESSURE

| | | |
|---|---|---|
| MINIMUM - IDLING | 14 PSI | RED RADIAL |
| NORMAL | 24 TO 26 PSI | GREEN ARC |
| MAXIMUM | 30.5 PSI | RED RADIAL |

*Figure 5-1 (Sheet 1 of 2 Sheets). Instrument Markings*

50077aA

### CYLINDER HEAD TEMPERATURE

| | | |
|---|---|---|
| NORMAL | 100° TO 249° C | GREEN ARC |
| MAXIMUM - ALL AUTO LEAN OPERATION<br>- ALL AUTO RICH OPERATION BELOW 2250 HP EXCEPT DURING CLIMB | 232° C | SHORT RED RADIAL |
| MAXIMUM - TAKE-OFF POWER<br>ALL AUTO RICH OPERATION BETWEEN 2250 AND 2800 HP AND AUTO RICH CLIMB BELOW 2250 HP | 249° C | LONG RED RADIAL |

### CARBURETOR AIR TEMPERATURE

| | | |
|---|---|---|
| CAUTION (POSSIBLE ICING) | 0° TO 7° C | YELLOW ARC |
| NORMAL | 7° TO 38° C | GREEN ARC |
| MAXIMUM | 54° C | LONG RED RADIAL |

### A.D.I. QUANTITY

| | | |
|---|---|---|
| INSUFFICIENT FOR 5 MINUTES OPERATION | 0 TO 18 GALLONS | YELLOW ARC |

### HYDRAULIC PRESSURE

| | | |
|---|---|---|
| NORMAL | 1500 PSI TO 1650 PSI | GREEN ARC |
| MAXIMUM | 1825 PSI | RED RADIAL |

### ANTI-ICING HEATER TEMPERATURE

| | | |
|---|---|---|
| MAXIMUM DUCT | 190° C | RED RADIAL |
| MAXIMUM HEATER | 227° C | RED RADIAL |

### CABIN HEATER TEMPERATURE

| | | |
|---|---|---|
| NORMAL | BELOW 182° C | GREEN ARC |
| MAXIMUM | 182° C | RED RADIAL |

### CABIN AIR FLOW

| | | |
|---|---|---|
| NORMAL | 1 TO 3 INCHES HG. | GREEN ARC |

### EXHAUST BACK PRESSURE

| | | |
|---|---|---|
| MAXIMUM | 45 INCHES HG. | RED RADIAL |

### TURBO BEARING TEMPERATURE

| | |
|---|---|
| MAXIMUM, MOMENTARY. (GROUND OPERATION ONLY) | 165° C |
| MAXIMUM, 2 MINUTE LIMIT. | 150° TO 160° C |
| MAXIMUM CONTINUOUS. | 150° C |

54074

***Figure 5-1 (Sheet 2 of 2 Sheets). Instrument Markings***

NOTES

CALIBRATED AIR SPEED (C.A.S.) IS PILOT'S INDICATOR READING CORRECTED FOR INSTRUMENT AND POSITION ERRORS.

AIR SPEED INDICATOR READS 3.0 M.P.H. LOW BECAUSE OF POSITION ERROR.

THE CURVE BELOW IS APPLICABLE:
FOR ALL WTS, ALTITUDES, AIR SPEEDS
FOR ALL FLAP AND GEAR POSITIONS
FOR PILOT'S IAS, COPILOT'S IAS

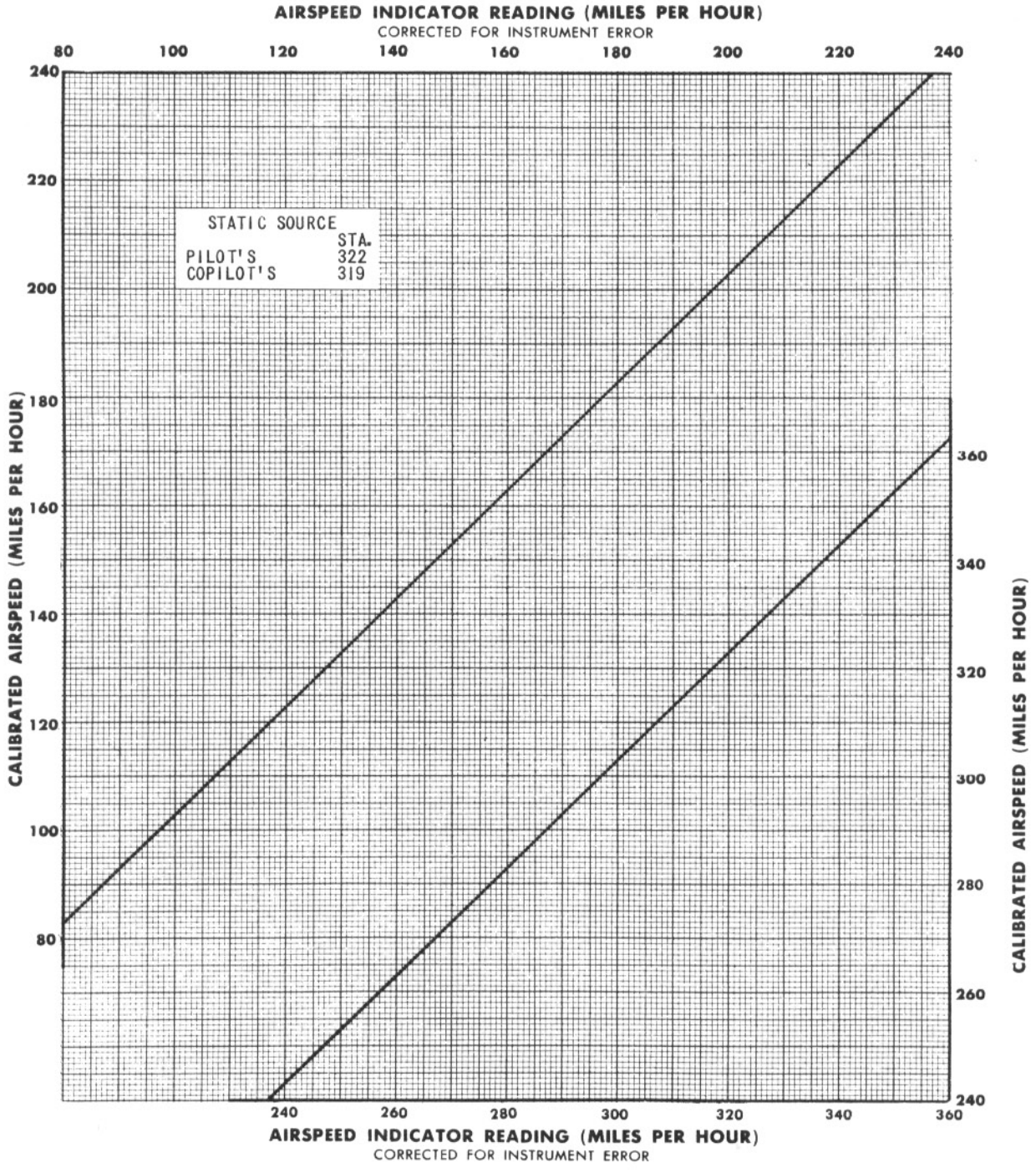



*Figure 5-2. Airspeed Calibration (Pilot's and Copilot's Indicator)*

FOR TRUE INDICATED ALTITUDE, ADD THESE VALUES
TO ALTIMETER READINGS.

FOR ALL WEIGHTS,
FOR ALL FLAP AND LANDING GEAR POSITIONS

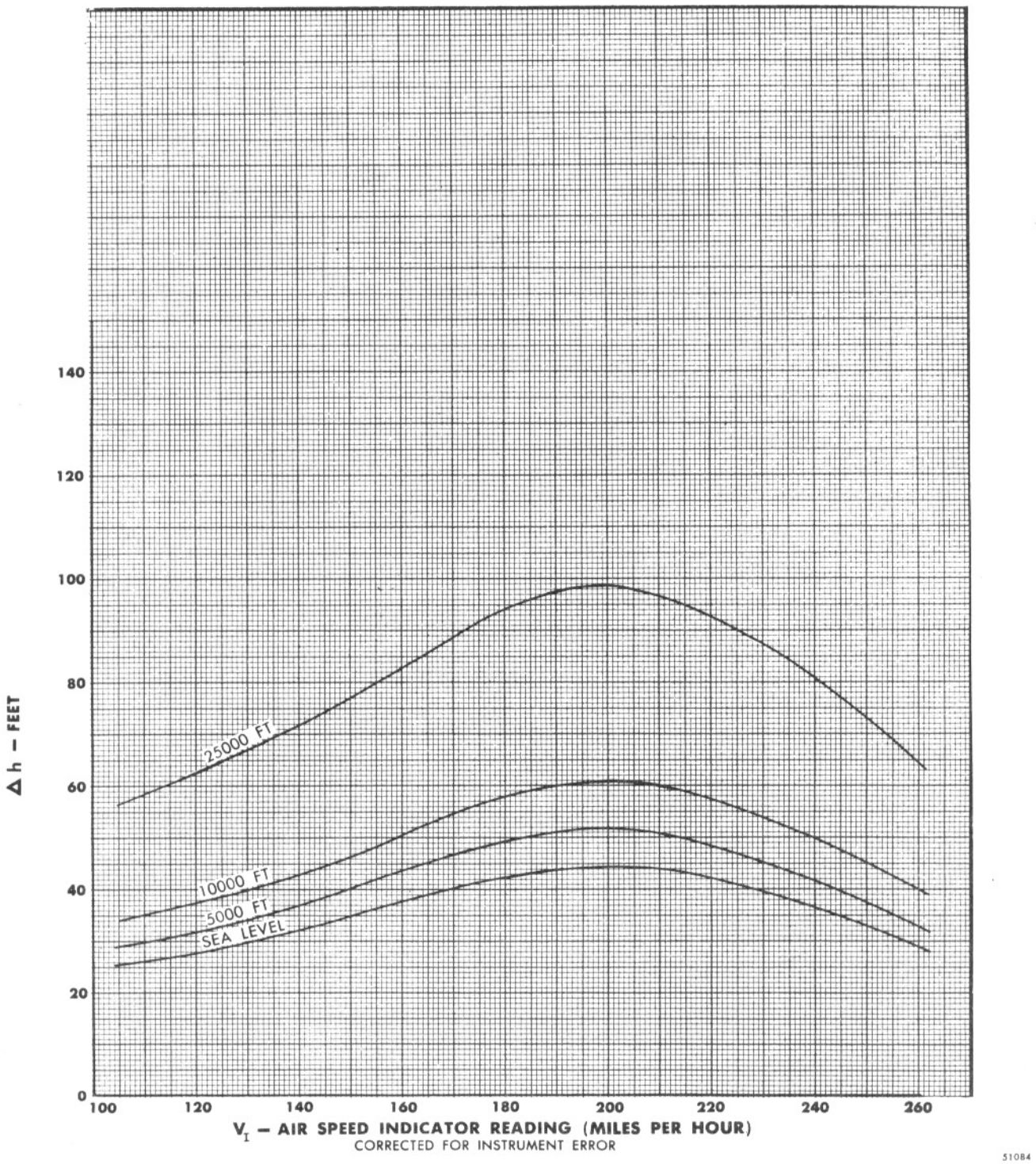



***Figure 5-3. Altimeter Calibration (Pilot's and Copilot's Indicator)***

LANDING GEAR POSITION HAS NO APPRECIABLE EFFECT ON STALLING SPEEDS

EFFECT OF C.G. POSITION IS SHOWN FOR 0° & 45° WING FLAP DEFLECTION ONLY. EFFECT ON 25° & 30° FLAP SETTINGS IS SIMILAR.

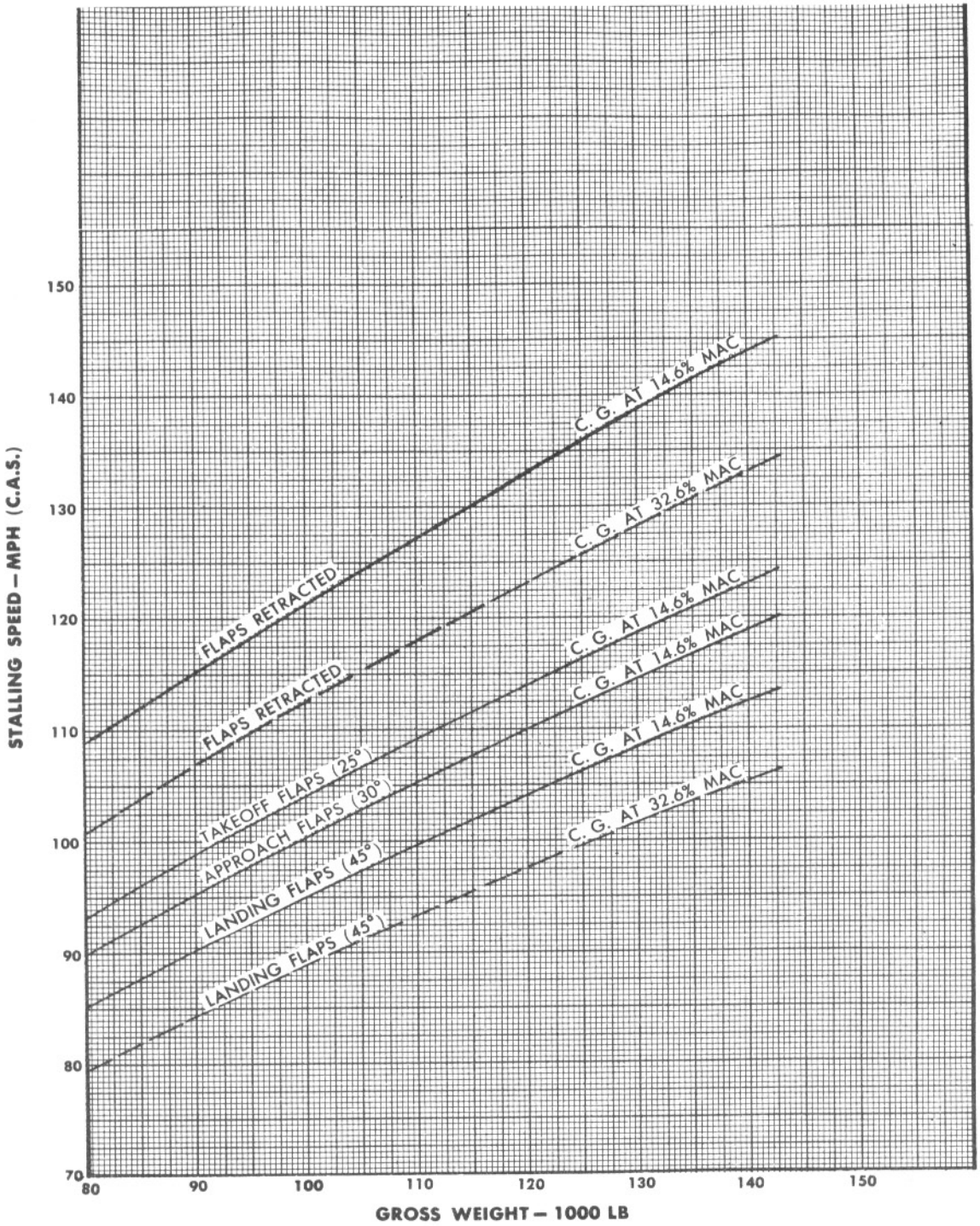
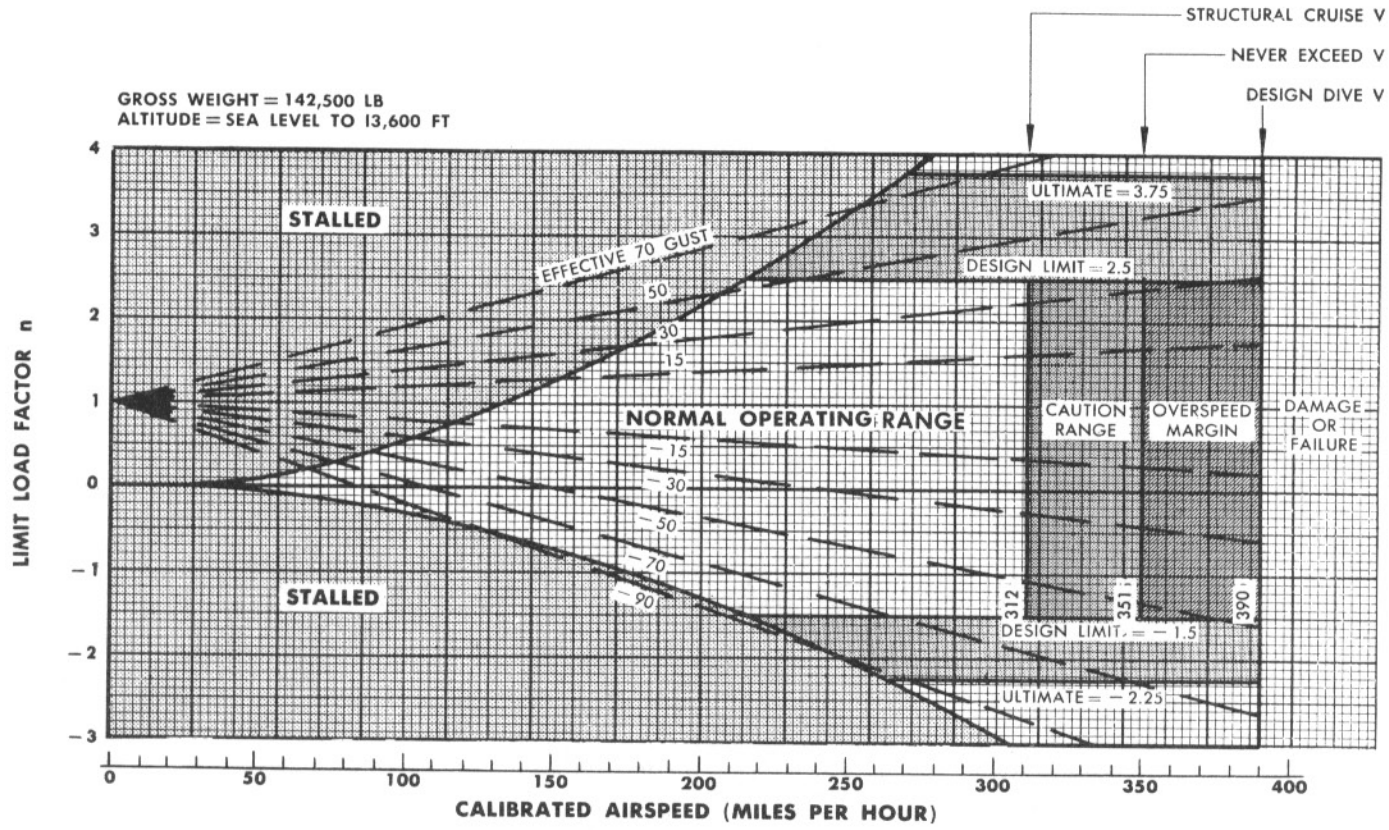



*Figure 5-4. Stalling Speed (C.A.S.) vs Gross Weight, Zero Thrust*



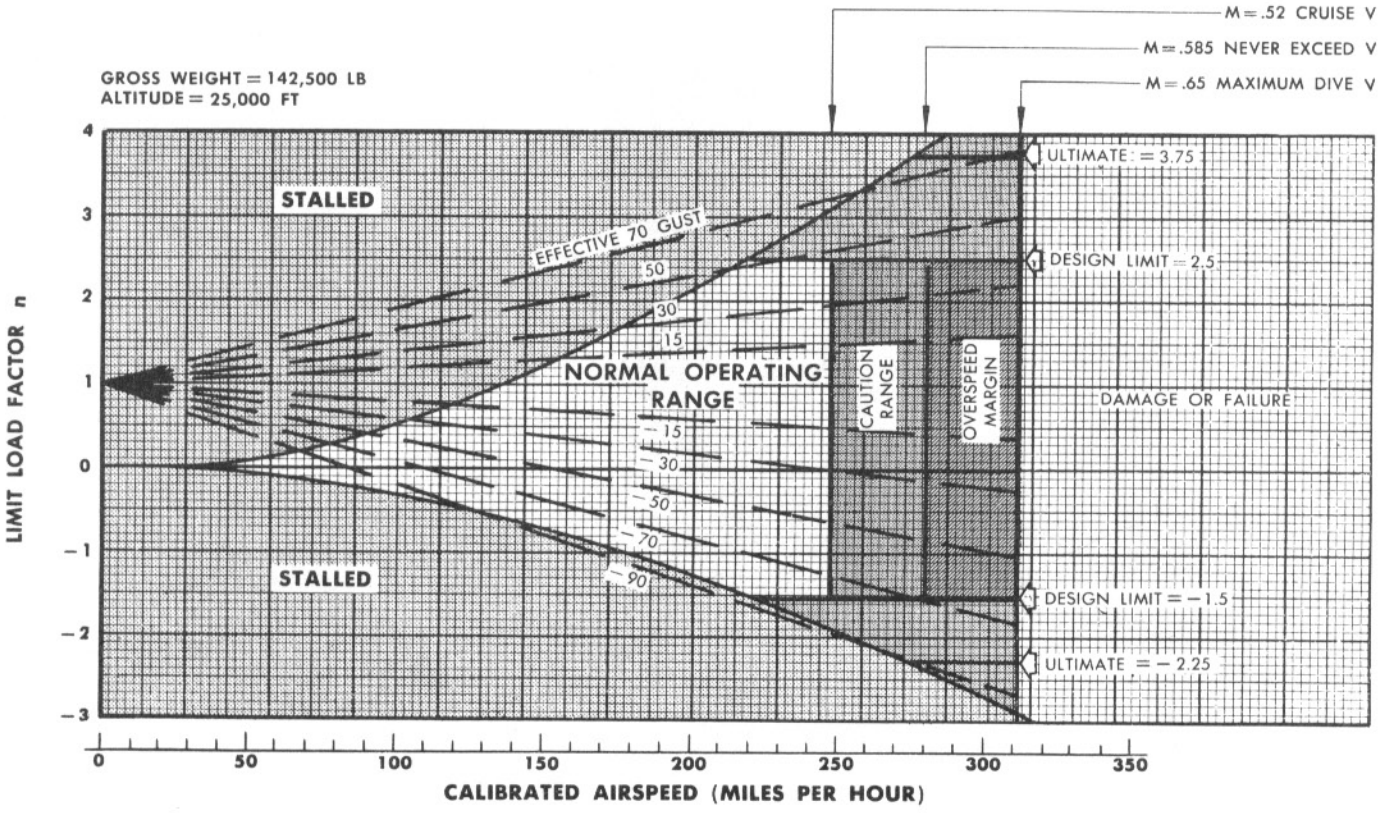




***Figure 5-5. V-n Diagrams, 142,500 Lbs. Gross Weight***

51086A

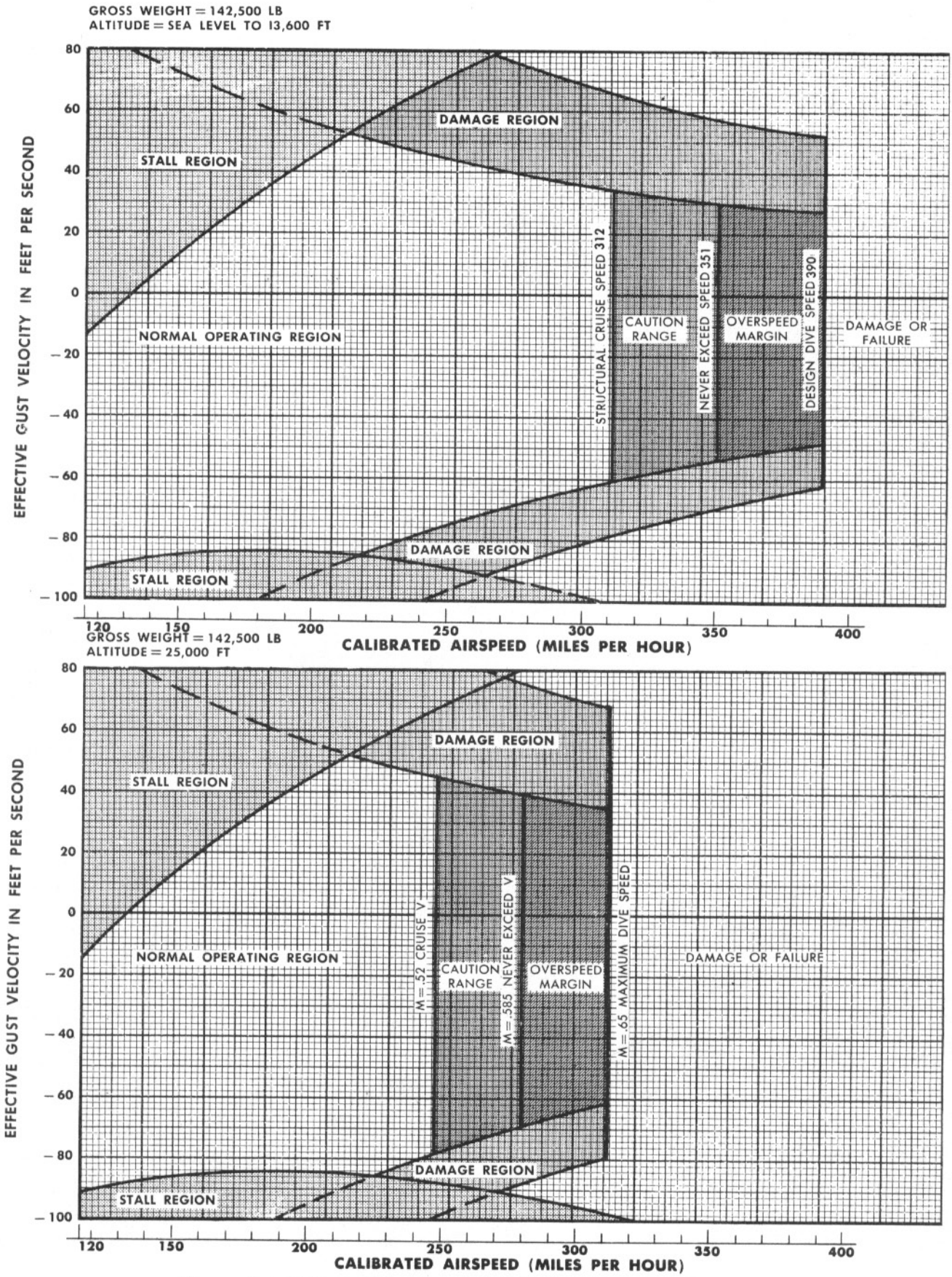



***Figure 5-6. V-Gust Diagrams, 142,500 Lbs. Gross Weight***

51087A