TABLE OF CONTENTS

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

TABLE OF CONTENTS (cont)

SECTION 7 (cont)

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

7.1 THE AIRPLANE

The Chieftain is a twin-engine, retractable landing gear, multi-purpose aircraft. It has a large cabin area that can be converted from a commuter cabin to a cargo or executive interior. The many options and cabin arrangements available allow the aircraft to be suited to the individual needs of the owner.

7.3 AIRFRAME

Aluminum construction is used throughout the primary structure, except for steel engine mounts and miscellaneous parts. Fiberglass and thermoplastic are used extensively for nonstructural parts. The airframe has been designed to meet the applicable Federal Government load factors.

The fuselage is a conventional, semi-monocoque structure. It has an entrance door, emergency exit, baggage doors and miscellaneous access panels.

For ease of entry and exit, a large, two piece cabin entrance door is provided on the left side of the fuselage, just aft of the wing. The door separates in the middle with the upper half, which incorporates the aft rectangular side window, swinging upward and the lower half, which houses the cabin entrance steps, swinging downward. To open the door from the outside, push on the upper portion of the door handle and pull upward on the lower portion of the handle. With the lock mechanism now released, lower the bottom half of the door and pull out the steps. (Later models are equipped with an automatic step extender.) On earlier models, raise the upper half of the door until it locks. The door is closed from the outside by pushing upward on the knurled cylinder on the upper door support and lowering the upper half of the door. On later models, pull the upper half outward a few inches and release it. From this position the gas spring support will push the door fully open and support it in the open position. To close, pull the upper door down and push it into the closed position. Next, raise the lower half of the door, making sure the door support cords do not catch in the door frame, and push in on the door halves and the door handle until the door is securely latched. As a safety feature, a locking bolt is attached to the inside of the upper half of the entrance door. When the door is closed from within the cabin, the bolt is moved to the right across the metal strike plate attachment on the door frame. This feature provides added protection in the event the cabin door should unlatch during flight due to improper latching. To open the door from the inside, pull the bolt to the left, push in and hold the lock button (adjacent to the door handle, Figure 7-1), pull the handle, lower the bottom half of the door and lower the steps. (Later models are equipped with an automatic step extender.) On earlier models, raise the upper half to the locked position. On later models, push the upper half outward a few inches and release it. The gas spring support will push the door fully open. Closing the door from the inside is performed similarly to the outside closing procedure. The door should be checked to insure proper locking by trying to pull the handle to the open position without pushing the lock button and checking that the bolt has been properly attached.

An emergency exit is located in the right forward side of the fuselage. The 23 x 30 inch exit is an integral part of the third window from the front, on the right side. To open, remove the plexiglas window located to the rear of the emergency exit window, pull the handle and push the window out (Figure 7-3).

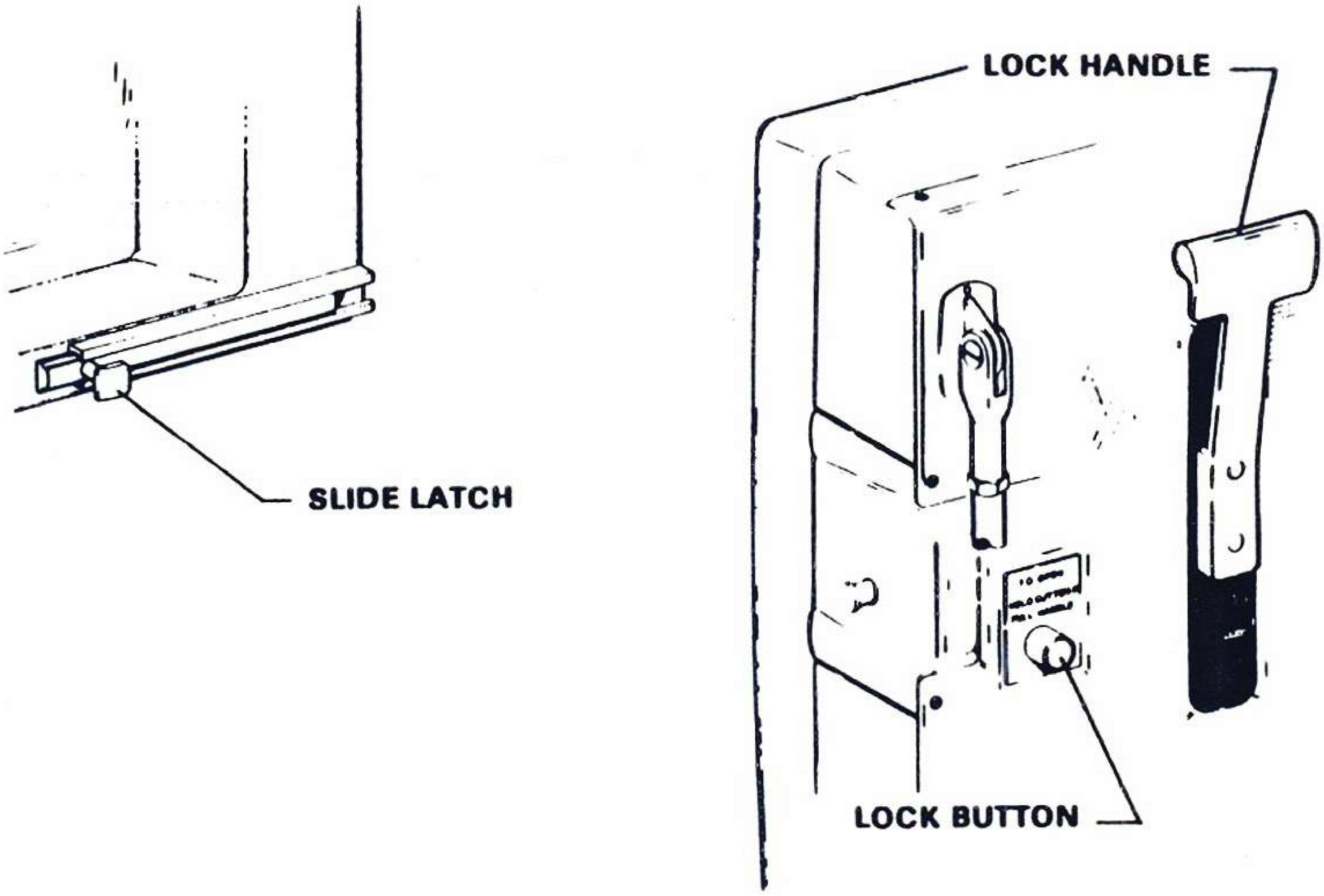
A large two-piece windshield and six windows along each side of the fuselage give excellent visibility to the pilot and passengers. The five forward side windows are of double pane construction to reduce window fogging.

Storm windows are provided for the pilot and copilot in the side windows. To open, turn handle and pull inward.

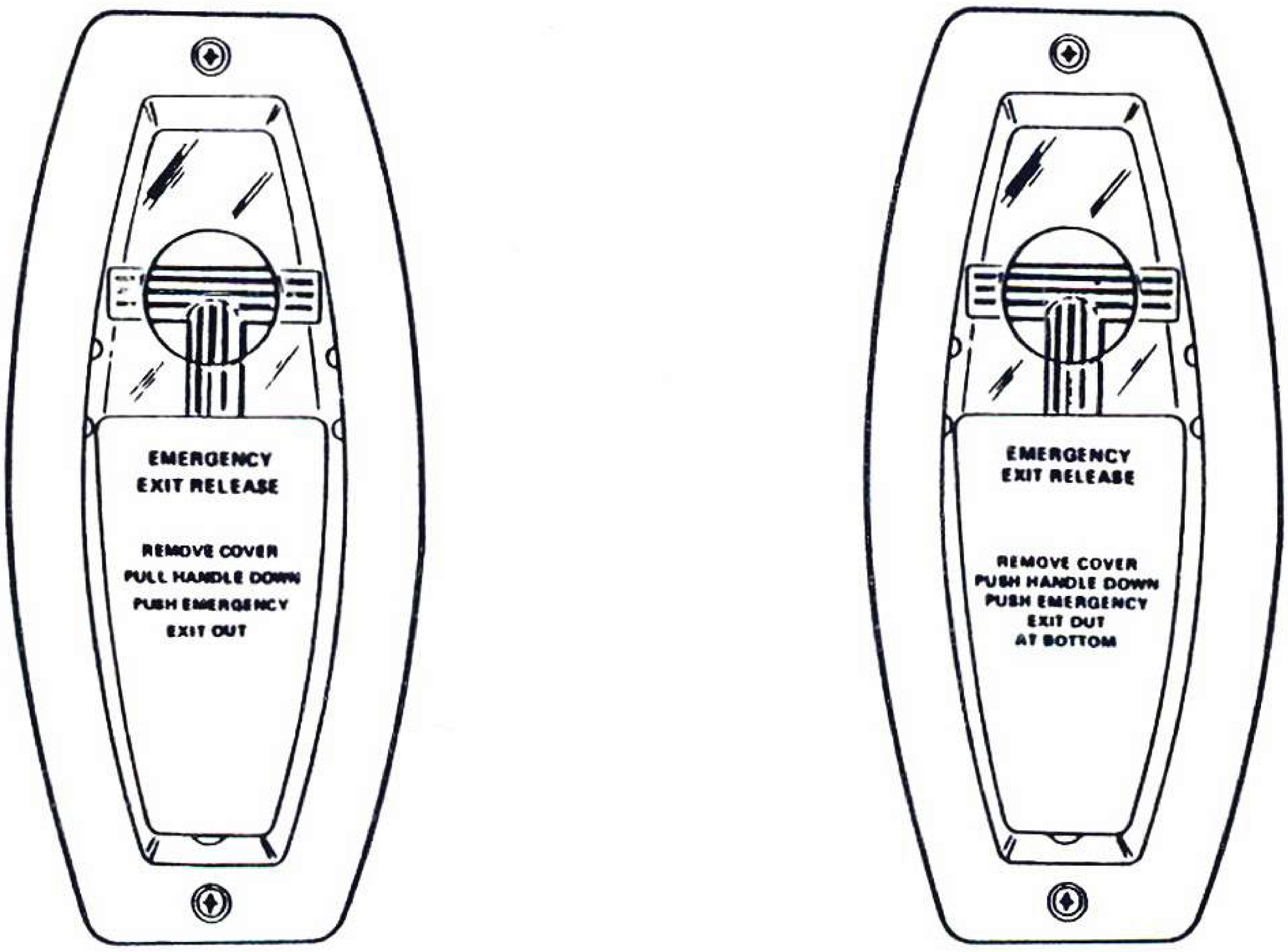
The fuselage also incorporates sufficient access panels and inspection plates to aid inspections and equipment repair.

The wing is an all-metal, cantilever, semi-monocoque structure. Each wing panel incorporates an I-beam main spar that extends into the fuselage. The two spars are bolted together with high strength butt plates giving, in effect, a continuous main spar. There is also a full length rear spar and a short front spar. All of the spars are structurally attached to the side of the fuselage.

The wing tips are made of fiberglass and are removable for repair or replacement. Two bladder fuel cells are mounted in each wing panel. Wheel



CABIN ENTRANCE DOOR LATCH
Figure 7-1



S/N 31-8052001 THRU 31-8352042 S/N 31-8452001 AND UP

EMERGENCY EXIT RELEASE
Figure 7-3

wells in each wing panel store the main gear when retracted. Wheel well doors completely enclose the gear when retracted. Access openings are provided to aid in inspecting and servicing components in the wing. A portion of the leading edge, inboard of the nacelle, is removable for access to and inspection of the wires and lines in the leading edge.

Ailerons are all metal and are fully balanced for smooth control of the aircraft.

Flaps are all metal and are actuated by an electric motor located under the cabin floor. The flap is connected to a screw transmission, which is actuated by a flexible shaft connected to the electric motor.

The engine nacelles are an integral part of the wing. They provide structure for mounting the engines and also added baggage area accessible from the rear of the nacelle.

The empennage consists of a vertical fin, a rudder, a horizontal stabilizer and elevators. They utilize an aluminum cantilever structure with fiberglass tips. The rudder and elevators both have trim tabs. The elevator tab also serves as an anti-servo tab.

7.5 ENGINES AND ACCESSORIES

The Chieftain is powered with turbocharged Avco Lycoming TIO-540-J and LTIO-540-J series engines. The left engine rotates clockwise, and the right engine rotates counterclockwise as viewed from the pilot seat. The six-cylinder engines develop 350 HP each at 2575 RPM. They are equipped with geared starters, single-drive dual magnetos, 28-volt 70-amp alternators, shielded ignition, turbochargers, hydraulic pumps, oil filters, oil coolers, pneumatic pressure pumps and three-bladed propellers. Recommended overhaul is at 1600 hours. This time is based on Avco Lycoming service experience. From time to time Lycoming revises the recommended overhaul period through a Service Instruction. The pilot should check with his dealer for the latest overhaul period on his engines plus any additional Lycoming Service information. Operation beyond the recommended overhaul period is at the discretion of the operator.

The turbocharger is designed to increase the power output and efficiency of the engine by supplying compressed air to the engine intake manifold. This allows the engines to operate at peak power at a much higher altitude than normally aspirated engines. The power to drive the turbocharger is extracted from energy in the exhaust gases. The exhaust gases are ducted through the turbine and then directed overboard at the bottom of the nacelles in the area of the cowl flaps.

The fuel injection system is based on the principle of measuring engine air consumption by use of a venturi tube and using the airflow forces therefrom to control fuel flow to the engines. Fuel distribution to the individual cylinders is obtained by the use of a fuel flow divider and air bleed nozzles. Idle cut-offs are incorporated in the injectors and should always be used to stop the engines. This is accomplished by pulling the mixture control levers to the rearmost position.

An automatic alternate air induction system is provided for each engine. Should the induction air filters become obstructed by ice or other causes, the induction air doors will open automatically to provide air to the engine.

As a backup to the automatic system there are two manual alternate air controls. These are located to the right of the control pedestal and may be used by the pilot to select air, independent of the automatic feature. Since alternate air bypasses the air filter, alternate air should never be used during ground operation.

The cowl flaps, located on the bottom of the engine nacelles, are electrically operated by switches located on the bottom of the engine control quadrant. Cowl flaps should be positioned to maintain temperatures within the normal operating range. Remote indicating gauges located next to the switches give the pilot a visual indication of cowl flap position.

The engines of the airplane are equipped with doors on the induction housings; in the event of a turbocharger compressor failure, the engine will automatically revert to normally aspirated air. Under these conditions approximately 75% of normal rated power or 235 HP will be available at sea level.

The engine mounts are of steel tube construction and incorporate vibration-absorbing dynafocal mounts. The engine cowls are cantilever structures and are attached at the fire wall. The cowlings are made of a combination of fiberglass and metal. The top cowl is quickly removable by means of quick-release fasteners. The cowl flap must be disconnected before removing the lower cowl.

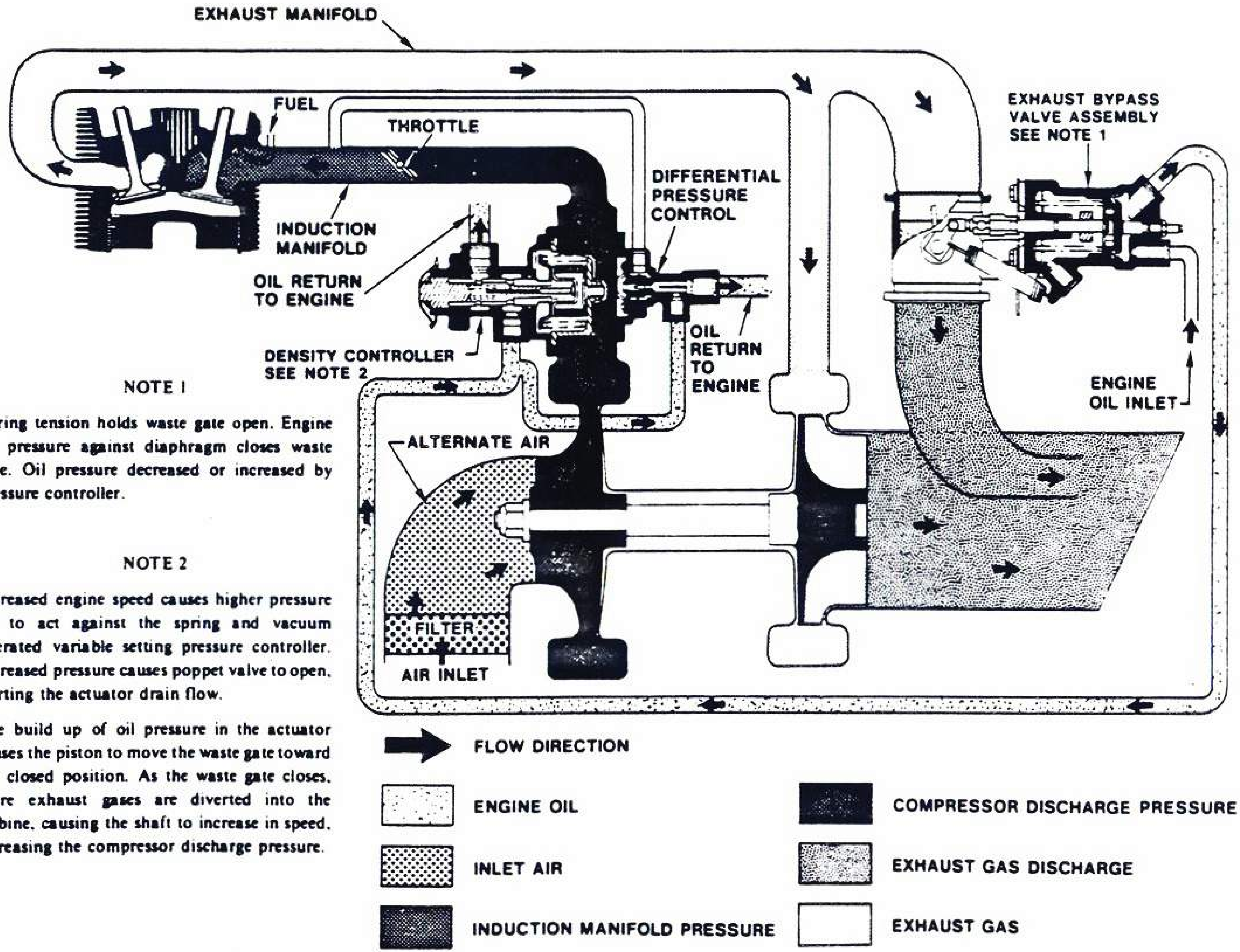
Oil coolers are attached to the engine mounts on the lower left side and below the engine. The engine incorporates a thermostat control bypass that aids in protecting the oil cooler during cool weather engine starts. The valve allows the oil to bypass the cooler when the oil is cold.

In order to obtain maximum engine efficiency and time between overhauls, the pilot should read and follow the procedures recommended by the Avco-Lycoming Operator's Manual for this engine.

7.7 PROPELLERS

The propellers are Hartzell, three-blade, constant speed, controllable pitch and full feathering. They are controlled by a propeller governor mounted on each engine. The governor is controlled by the corresponding propeller control in the pedestal.

A combination of nitrogen or air pressure, a spring, blade counter-weights and governor-regulated oil pressure is utilized to change the pitch of the propeller blades. Nitrogen or air pressure is supplied from the precharged propeller chamber. (Refer to Section 8 - Airplane Handling, Servicing and Maintenance). The nitrogen or air pressure, spring and blade counter-weight force is utilized to move the blades to the high pitch (decreased RPM) and feathered position, and the opposing governor-regulated oil pressure moves the blades to the low pitch (increased RPM) position. As the propeller control lever is moved forward, increasing the propeller RPM, a valve in the propeller governor allows increased oil pressure to enter the propeller hub and move the blades to the low pitch (increased RPM) position. Moving the propeller control lever aft decreases the propeller RPM as the propeller governor decreases the oil pressure to the hub, and the nitrogen or air pressure, spring and blade counter-weights move the propeller blades to the high pitch (decreased RPM) or, if selected, the feathered position.



NOTE 1

Spring tension holds waste gate open. Engine oil pressure against diaphragm closes waste gate. Oil pressure decreased or increased by pressure controller.

NOTE 2

Increased engine speed causes higher pressure air to act against the spring and vacuum operated variable setting pressure controller. Increased pressure causes poppet valve to open, starting the actuator drain flow.

The build up of oil pressure in the actuator causes the piston to move the waste gate toward the closed position. As the waste gate closes, more exhaust gases are diverted into the turbine, causing the shaft to increase in speed, increasing the compressor discharge pressure.

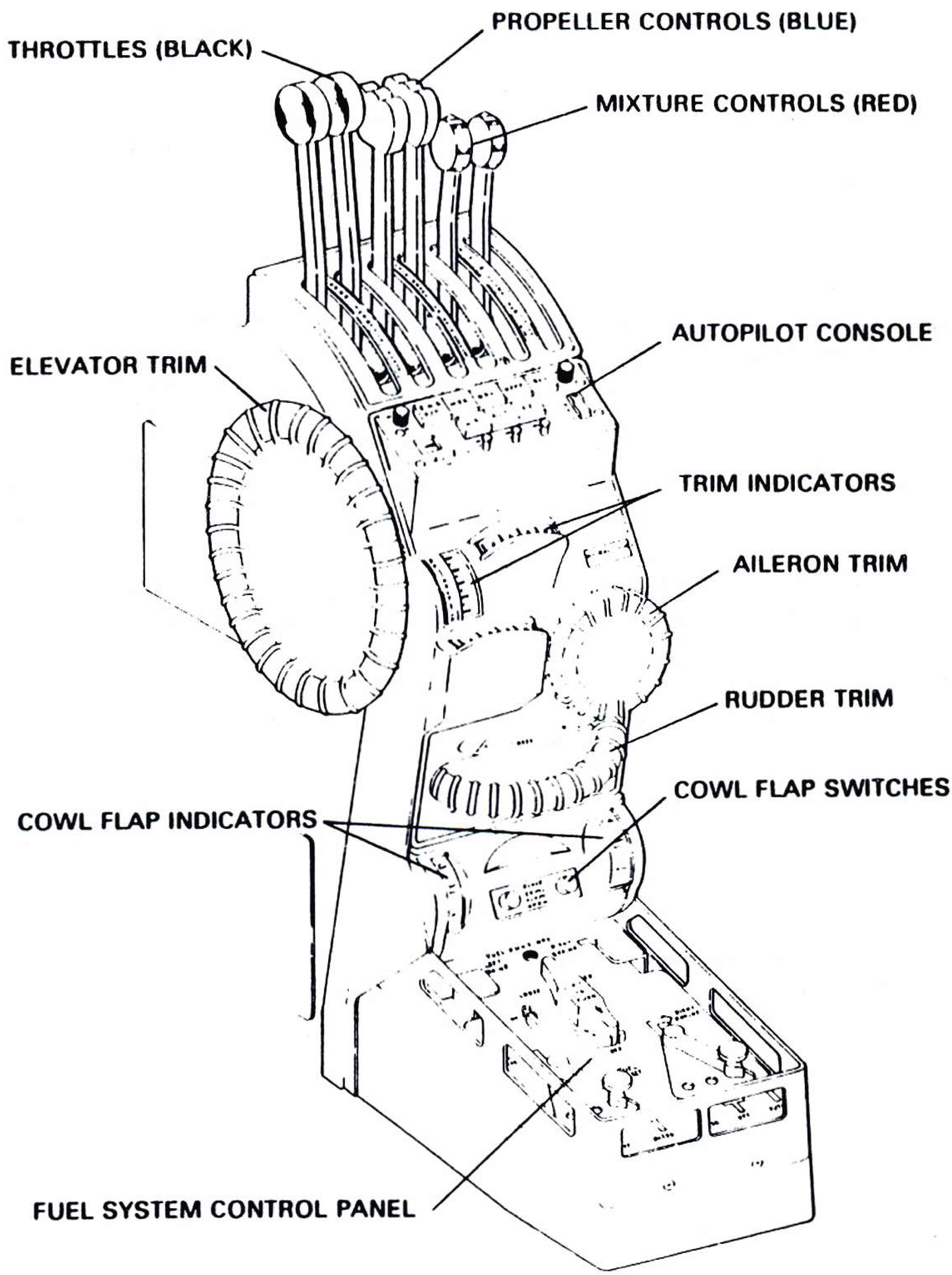
TURBOCHARGER SYSTEM SCHEMATIC
Figure 7-5

7.9 FLIGHT CONTROL SYSTEM

The primary flight controls are conventional and are operated by dual control wheels and rudder pedals. The control wheel operates the ailerons and elevators. The rudder pedals actuate the rudder and nose wheel steering. The toe brakes, which are an integral part of the pedals, operate the wheel brakes. The ailerons and rudder are interconnected, through a spring system, to reduce adverse yaw and the amount of coordination required in normal turns. All flight control systems are operated by closed circuit cable systems.

Secondary control is by aileron, elevator and rudder trim tabs. The controls are located on the pedestal (Figure 7-7). The aileron trim wheel is located below the power controls. Rotate the wheel clockwise for right wing down and counterclockwise for left wing down. The elevator trim control wheel is located on the left side of the pedestal. Rotate the wheel forward for nose down trim and aft for nose up trim. The rudder trim wheel is located below the aileron trim control. Rotate the wheel to the right (counterclockwise) for nose right and left (clockwise) for nose left. Trim indicators for the individual systems are located on the pedestal below the power controls. The trim indicators are operated electrically by a rheostat on the respective control surface.

Wing flap position is controlled by a selector switch mounted on the instrument panel immediately to the right of the control pedestal. The flap position indicator is located to the right of the selector switch. An OFF position on the flap position indicator is also provided to indicate zero (0) voltage to the system. The selector switch provides for variable wing flap positioning in as little as 2° increments from 0° to 40°. Detent positions are provided at the most commonly used positions of 0°, 15°, and 40°. A wing flap position change is made by moving the selector handle to any desired position (marked on the switch selector guard). The flaps will automatically move to the selected position and indicator will display the actual flap position. The flaps may be extended to 25° at airspeeds below 162 KIAS. 40° flap extension is limited to airspeeds below 132 KIAS. The entire system is electronically monitored for system component failures and will prevent an asymmetric flap position greater than 5° differential.



CONTROL PEDESTAL
Figure 7-7

The basic electronic control system consists of an amplifier, three rheostats, two power solenoids, and one motor. The motor is of a D.C. permanent magnet type and extends or retracts the flaps through a pair of flexible shafts attached to jackscrew, transmission assemblies located on each wing flap.

The amplifier is the heart of the control system. It provides a regulated voltage supply for the three external rheostats, circuit logic to analyze the system condition and position; provides commands to the power solenoids to actuate the motor for extensions and retractions and contains its own monitoring system to ascertain the condition of critical components.

The three rheostats feed back to the amplifier the signals necessary to operate the system. One rheostat is located in the flap position selector and one each is located so as to sense the positions of the right and left flaps independently. The selector rheostat signals the amplifier, activating the motor, which positions the flaps. The left flap rheostat controls flap position in relation to the selector rheostat position and provides information to the amplifier to drive the position indicator. The right flap rheostat must agree with the left flap rheostat within 5° at all times or the system will shut down and cannot be reactivated until the imbalance and/or the cause has been corrected.

The system also incorporates an annunciator light that will illuminate when an imbalance exists between the right and left wing flap rheostats or a critical component of the amplifier has failed.

The operation of the flaps may be checked with a test switch before takeoff. This switch is located above the position indicator.

7.11 LANDING GEAR

The Chieftain is equipped with a hydraulically actuated, retractable tricycle landing gear. The gear incorporates air-oil oleo struts. Gear doors completely cover the gear when retracted. The nose gear doors and the outboard doors on the main gear remain in the open position when the gear is extended. The inboard main gear door, operated hydraulically, closes when the main gear is fully extended or fully retracted.

The nose gear is steerable by use of the rudder pedals. The total nose gear turning arc when steered with the rudder pedals is normally 40°. However, a feature is incorporated which allows the nose gear to temporarily disengage from the rudder pedal steering linkage, permitting the gear to be turned an additional 20° in each direction during towing operations, thus extending the turning arc to a full 80°. A spring-loaded cam device will return the nose gear to within the center 40° arc, where it automatically re-engages with the steering linkage. Although this device is intended for use during towing, while taxiing through tight turns with differential engine power and braking, the nose gear can disengage itself, permitting a shorter turning radius. Should this occur, the rudder pedal force change and accompanying noise in the nose gear is normal and should not be interpreted as a malfunction.

NOTE

Avoid unnecessary sharp turns, as excessive tire wear will result.

The nose gear incorporates a shimmy dampening device at the bottom of the outer housing. As the gear retracts, the steering linkage separates to reduce the in-flight rudder forces.

To guard against inadvertent gear retraction on the ground, a solenoid latch is incorporated in the landing gear selector. This prevents the gear selector's being moved to the UP position, while on the ground. The gear selector knob is in the shape of a wheel to differentiate it from the flap control, which has an airfoil shape. To raise or lower the gear in flight, the selector handle must first be pulled aft.

Located on the instrument panel, to the right of the gear selector control are one red and three green lights. The red light indicates when the gear is in transit between the up-locked and down-locked position. Also the light will remain on if the inboard gear doors remain open when the gear is retracted. The green lights indicate when each gear is down and locked. There is no indication when the gear is up and locked. Each light includes a press-to-test feature to check the condition of the bulb. The gear indicator lights can be dimmed individually by turning each light. A gear unsafe horn will sound if the power in one or both engines is reduced below 12 inches of manifold pressure with the landing gear retracted or not down and locked. Also, if the gear selector is in the up or up neutral position with the aircraft on the ground, the gear horn will sound when the master switch is on.

The main wheels are 6.50 x 10 Cleveland Aircraft Products units with disc type brakes and 6.50 x 10 tires with eight-ply rating. The nose wheel is a Cleveland 6.00 x 6 model fitted with a 6.00 x 6 tire with a six-ply rating. All tires have tubes.

7.13 BRAKE SYSTEM

The brakes are hydraulically actuated by individual master cylinders mounted on the left (optional on the right) set of rudder pedals. A hydraulic reservoir, separate from the main hydraulic system, supplies fluid to each master cylinder. From these cylinders, hydraulic fluid is routed through lines and hoses to a parking brake valve, located on the left aft side of the forward cabin bulkhead, through the cabin and wings to the brake assemblies on each main landing gear. The standard brakes are self-adjusting, single-disc, single-housing, four-piston assemblies.

The parking brake handle is located on the lower left face of the instrument panel. To set the parking brake, first depress and hold the toe brake pedals and then pull out the parking brake handle. To release the parking brake, first depress and hold the toe brake pedals and then push in on the parking brake handle.

WARNING

Braking may not occur if parking brake handle is pulled and held prior to brake pedal application.

7.15 HYDRAULIC SYSTEM

The hydraulic system consists of two hydraulic pumps, a power pack, emergency hand pump, actuating cylinders and filters (Figure 7-9).

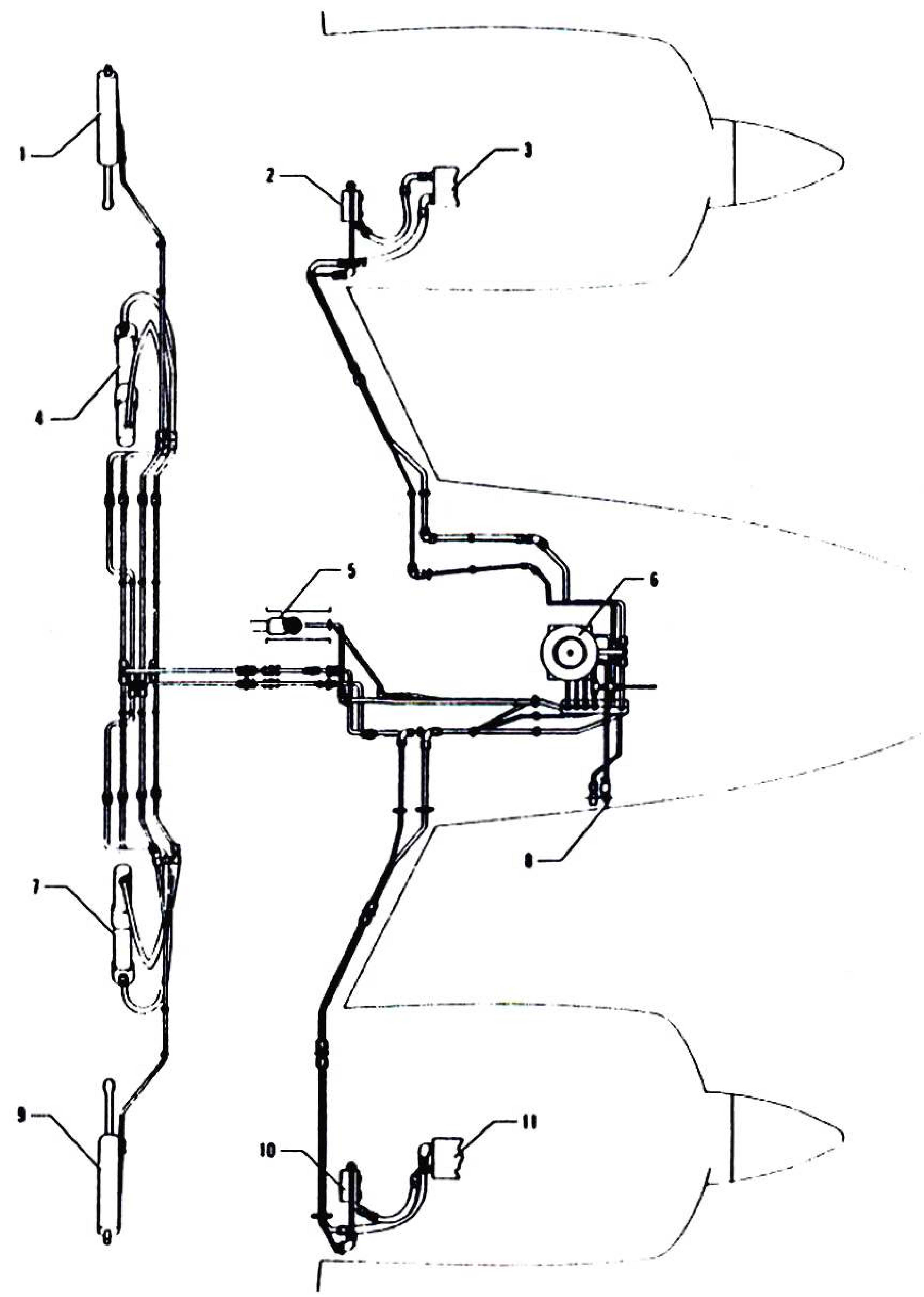
The hydraulic pumps are engine-driven and are mounted on the rear of each engine. The pumps supply the pressure required for gear operation.

The power pack is the central control unit for the hydraulic system. It contains the valves, manifold, fluid reservoir and necessary controls for operation of the landing gear.

Fluid is taken from the reservoir by the pumps and is passed through a filter mounted on each fire wall, then to the power pack, which then directs the fluid to the appropriate actuator, depending on the sequence and gear selector position.

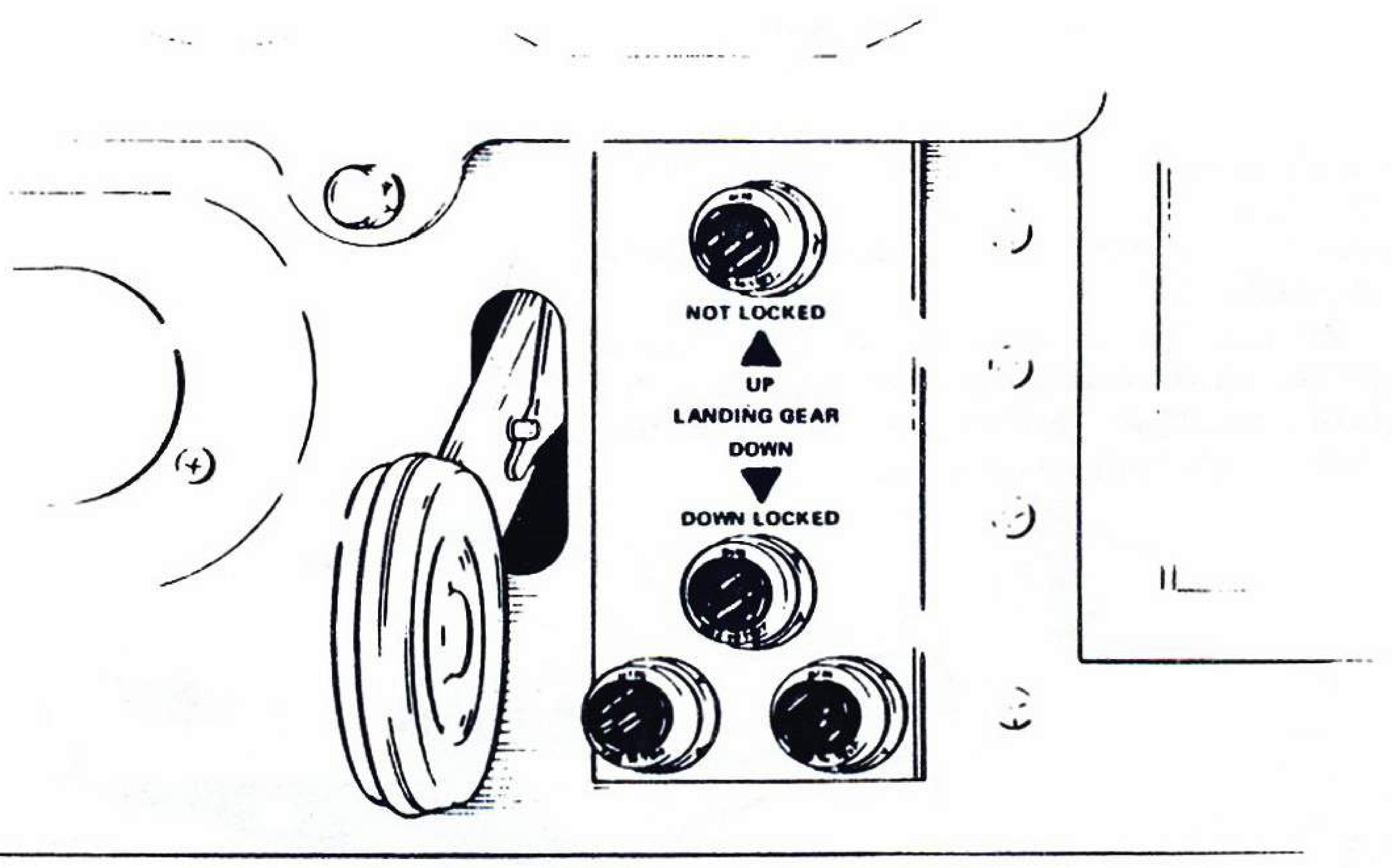
The reservoir contains a standpipe which retains sufficient fluid to operate the emergency hand pump in case of a loss of fluid. The engine-driven pumps are supplied through the standpipe, so if the fluid level is below the standpipe the only way to operate the gear is by using the hand pump.

The door solenoid valve mounted in the power pack is electrically operated and is spring loaded to the door open position. So if an electrical failure occurs, the solenoid valve will move to the door open position so that the gear can be lowered normally or with the hand pump. For a more detailed description refer to the appropriate service manual.



1. LEFT MAIN GEAR ACTUATING CYLINDER
2. LEFT HYDRAULIC PUMP FILTER
3. LEFT HYDRAULIC PUMP
4. LEFT GEAR DOOR ACTUATING CYLINDER
5. EMERGENCY HAND PUMP
6. POWER PACK ASSEMBLY
7. RIGHT GEAR DOOR ACTUATING CYLINDER
8. CHECK VALVES
9. RIGHT MAIN GEAR ACTUATING CYLINDER
10. RIGHT HYDRAULIC PUMP FILTER
11. RIGHT HYDRAULIC PUMP

HYDRAULIC SYSTEM SCHEMATIC
Figure 7-9



LANDING GEAR SELECTOR
Figure 7-11

To operate the gear pull out the gear selector, mounted on the left instrument panel (Figure 7-11), move it from the neutral position to the UP landing gear or DOWN landing gear position. When the desired position of the gear is obtained, the handle is forced back to the center off position by hydraulic pressure in the selector valve, allowing the hydraulic fluid to circulate freely between the pump and control unit. Gear retraction or extension will occur normally in approximately 6 seconds.

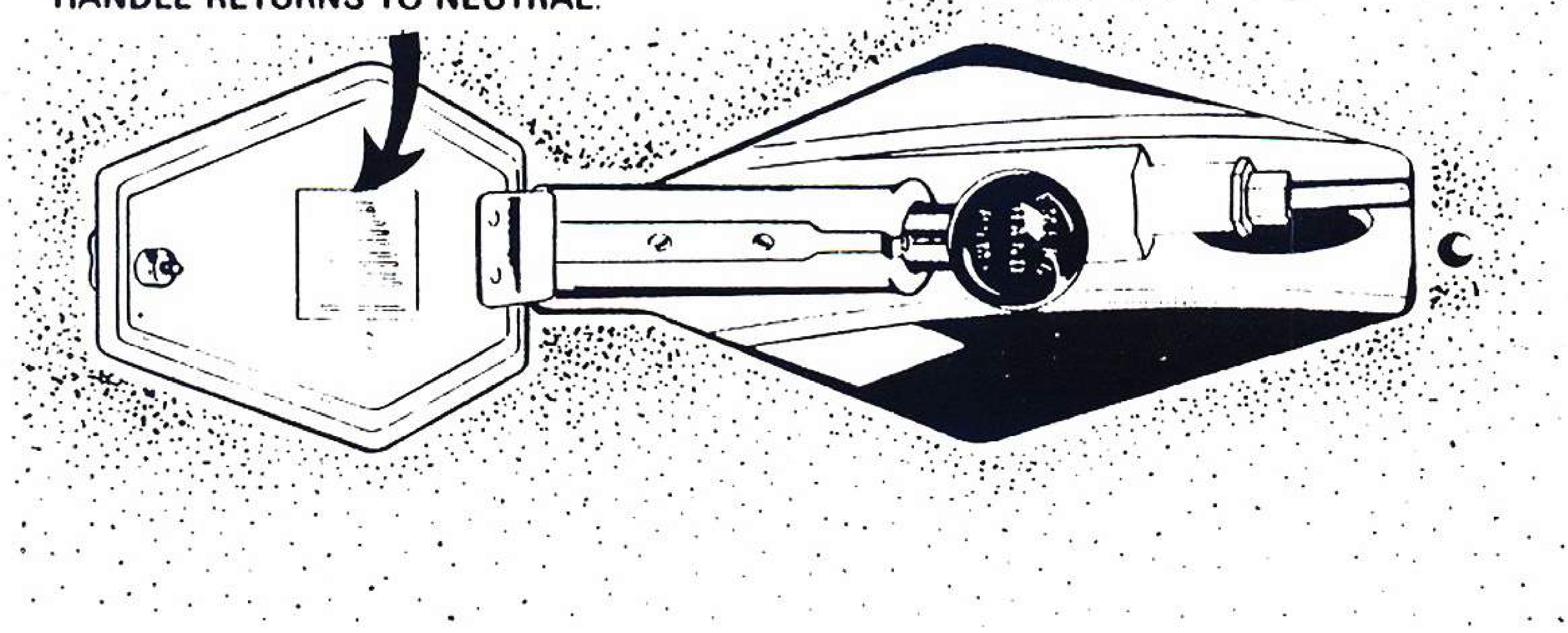
NOTE

In the event of electrical failure or when the master switch is OFF, the selector handle will not return to neutral and the gear doors will not close.

When the selector handle returns to neutral it relieves all pressure in the system. The gear is held in position by mechanical locks. The return of the control handle to the neutral position is an indication that the components have reached full extension or retraction. However, the landing gear position lights should be used as primary indications.

EMERGENCY GEAR EXTENSION

1. PLACE GEAR SELECTOR HANDLE IN THE DOWN POSITION.
2. PULL EMERGENCY PUMP HANDLE OUT AS FAR AS POSSIBLE.
3. PUMP HANDLE UP AND DOWN UNTIL ALL 3 GREEN LIGHTS COME ON. CONTINUE PUMPING UNTIL PRESSURE BUILDS UP AND SELECTOR HANDLE RETURNS TO NEUTRAL.



EMERGENCY LANDING GEAR HAND PUMP
Figure 7-13

CAUTION

When retracting the landing gear be sure that the gear unsafe light is out before exceeding the maximum gear operating speed.

The emergency hydraulic hand pump (Figure 7-13) is used to obtain hydraulic pressure in the event of failure of the engine-driven hydraulic pumps. This hand pump is located between the pilot's and copilot's seats. An access cover marked Emergency Gear Extension must be lifted to gain access to the pump handle. Follow instructions on the underside of the access plate to lower the gear. The hand pump should not be used to retract the gear in flight or to perform gear retractions while aircraft is on jacks.

NOTE

To perform an emergency gear extension, approximately 50 full strokes will be required.

7.17 FUEL SYSTEM

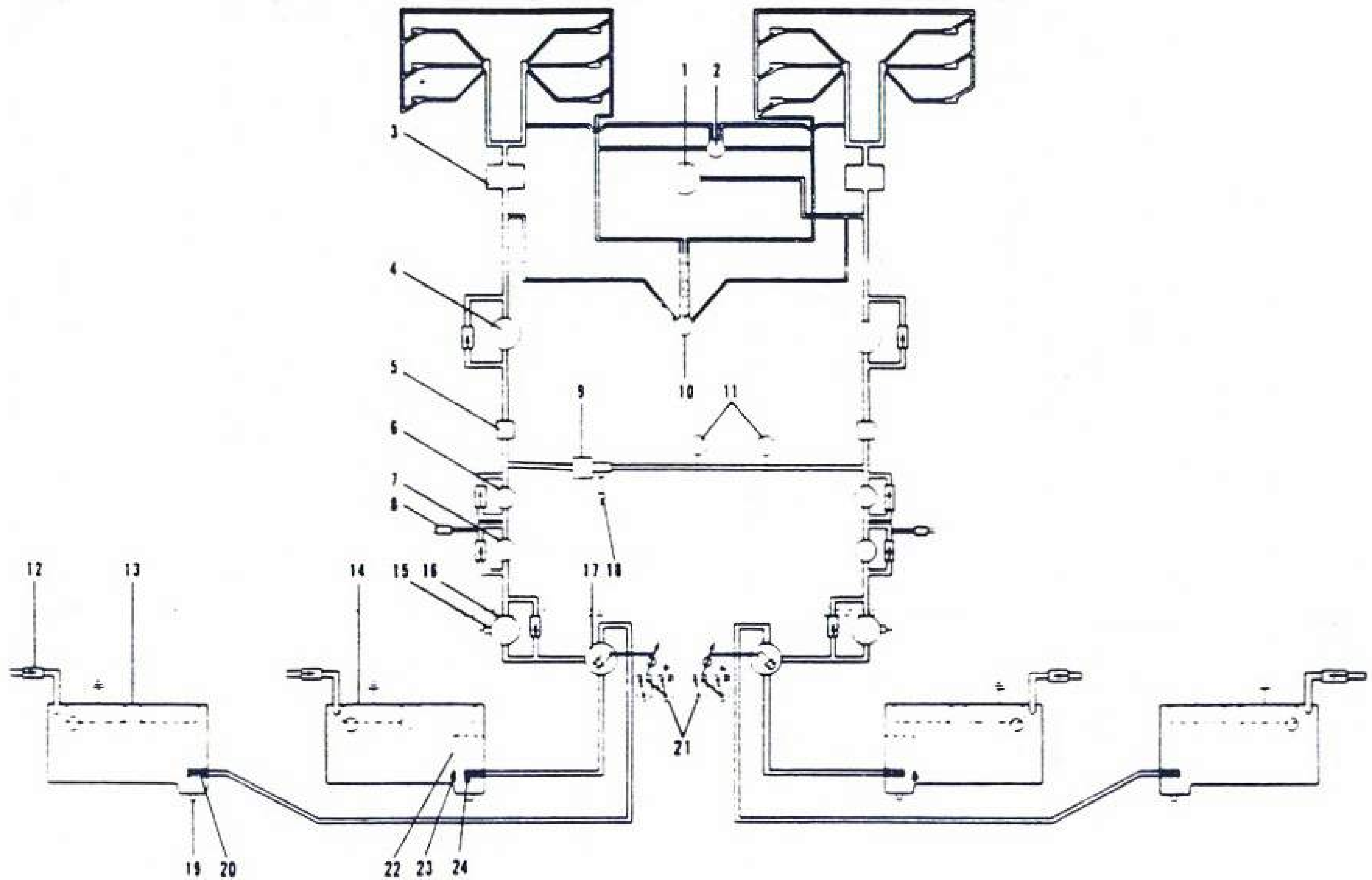
The fuel system consists of fuel cells, engine-driven and emergency fuel pumps, fuel boost pumps, control valves, fuel filters, fuel pressure and fuel flow gauges, fuel drains and non-icing NACA fuel tank vents (Figure 7-15). Lockable filler caps are optional equipment.

Fuel is stored in four flexible fuel cells, two in each wing panel. The outboard cells hold 40 U.S. gallons each, and the inboard cells hold 56 U.S. gallons each, giving a total of 192 gallons, of which 182 gallons are usable. Fuel is routed from the fuel cells to the selector valve, the fuel filter, the fuel boost pump, the emergency fuel pump, the firewall shutoff, the engine-driven fuel pump, to the injector, then to the cylinders. The fuel selector, filter, fuel boost pump, emergency fuel pump and firewall shutoff are located on the butt-rib of each wing panel.

The emergency fuel pumps are installed for emergency use in case of an engine-driven fuel pump failure. They are also used for takeoff and landing and, when necessary, to prime the engines. Control switches for the emergency fuel pumps are located in the overhead switch panel to the right of the fuel gauges.

Two electric fuel-quantity gauges are mounted in the overhead switch panel. The right fuel-quantity gauge indicates the quantity of fuel in the selected right fuel system tank (right inboard or right outboard), and the left fuel-quantity gauge indicates the quantity of fuel in the selected left fuel system tank (left inboard or left outboard). The fuel gauges are connected electrically to micro switches mounted in the fuel selector console. The fuel senders are also connected electrically to the micro switches. When a fuel tank is selected, its corresponding micro switch is actuated, which completes the circuit between the fuel senders and its fuel quantity gauge, providing a visual reading of the fuel quantity in the selected tank. The gauges are illuminated, and the lights are controlled by a rheostat switch on the left side of the overhead switch panel.

The fuel boost pumps are operated continuously and are provided to maintain fuel under pressure to the other fuel pumps, improving the altitude performance of the fuel system. There are no fuel boost pump control switches or pressure gauges provided. Each fuel boost pump is controlled by a separate circuit breaker, located in the circuit breaker control panel. The fuel boost pumps are activated when the master switch is turned on and



1. COMBUSTION HEATER
2. FUEL FLOW GAUGE
3. FUEL INJECTOR
4. ENGINE DRIVEN FUEL PUMP
5. FUEL SHUTOFF VALVE
6. EMERGENCY FUEL PUMP
7. FUEL BOOST PUMP
8. PRESSURE SWITCH
9. EMERGENCY CROSSFEED VALVE
10. FUEL PRESSURE GAUGE
11. FUEL QUANTITY GAUGE
12. FUEL TANK VENT CHECK VALVE
13. OUTBOARD FUEL TANK
14. INBOARD FUEL TANK
15. FUEL FILTER QUICK DRAIN
16. FUEL FILTER
17. FUEL TANK SELECTOR VALVE
18. CROSSFEED QUICK DRAIN VALVE
19. FUEL TANK QUICK DRAIN
20. FUEL TANK STRAINER
21. FUEL SENDER SELECTOR SWITCHES
22. SURGE TANK
23. FLAPPER VALVE
24. LOW FUEL WARNING PROBE

FUEL SYSTEM SCHEMATIC
Figure 7-15

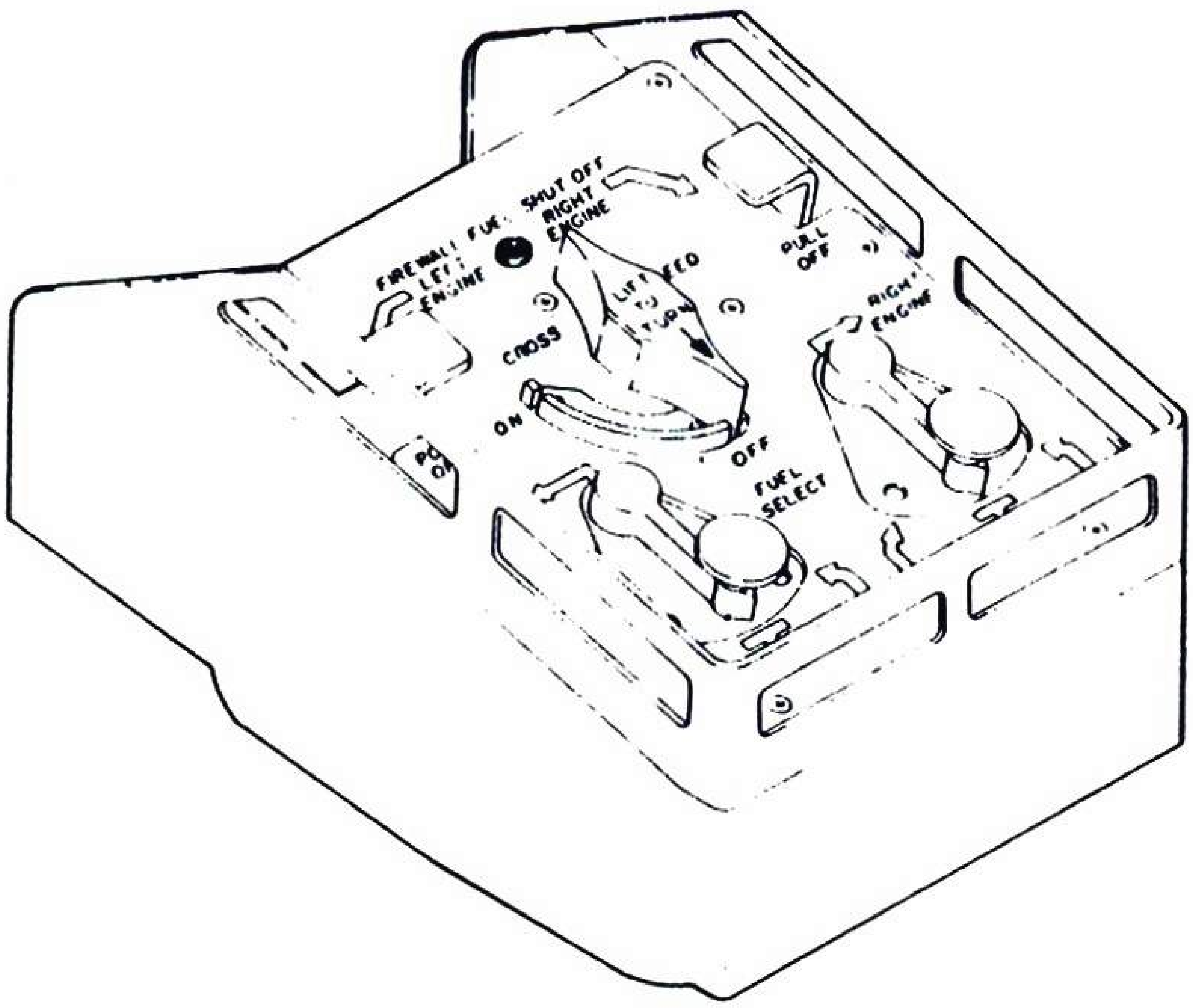
continue to operate until the master switch is turned off or the fuel boost pump circuit breakers are pulled (off). Fuel boost pump warning lights, mounted on the annunciator panel, illuminate when the fuel boost pressure is less than 3 PSI. In a full power continuous climb from takeoff to high altitude under conditions of high ambient temperature, high climb rate, and extremely volatile fuel, the boost pump may not maintain a sufficient pressure head to the engine-driven fuel pump. This condition would be indicated by engine fuel pressure fluctuations of 2-5 PSI and/or illumination of the boost pump warning light. The pilot may continue the climb by using the emergency fuel pump to provide steady fuel pressure for the high power operation; the emergency pump can be turned OFF after level-out if reduction to cruise power extinguishes the boost pump warning light. Cruise can be continued with the emergency fuel pump OFF if fuel pressure remains steady and above 34 PSI, as indicated on the engine fuel pressure gauge.

The fuel management controls (Figure 7-17) are located in the fuel control panel at the base of the pedestal. Located here are the fuel tank selectors, fuel shut offs and crossfeed controls. During normal operation each engine is supplied with fuel from its own respective fuel system. The fuel controls on the right control the fuel from the right cells to the right engine and the controls on the left control the fuel from the left fuel cells to the left engine.

For emergencies, fuel from one system can supply the opposite engine through a crossfeed system. The crossfeed valve is located in the left wing butt area and is intended only for emergencies. The crossfeed control is located in the center of the fuel control panel. A warning light, located on the fuel control panel is incorporated in the firewall shut off system to indicate that one or both of the shut off valves are not fully open.

NOTE

The crossfeed system is not to be used for normal operation. When the crossfeed valve is on, be certain fuel selector valve on tank not in use is off. Do not use crossfeed to compensate for an inoperative emergency fuel pump.



FUEL SYSTEM CONTROL CONSOLE
Figure 7-17

Fuel drains for checking fuel contamination are located at the rear inboard corner of the fuel cells, on the fuel filters and the lowest point of the crossfeed system. The quick drain for the crossfeed is located on the left wing fillet just forward of the main spar. The drains on the filters are at the base of the filter and are accessible through access doors in the lower wing fillets aft of the wing leading edge.

Right and left fuel flow warning lights illuminate to warn the pilot of an impending fuel flow interruption. The lights are activated by a sensing probe mounted near each inboard fuel tank outlet. In the event the fuel level near the tank outlet drops to a point where a fuel flow interruption and power loss could occur, the sensing probe will illuminate its corresponding warning light. The warning light will be on for a minimum of 10 seconds and will remain on if the cause is not corrected.

The warning lights are incorporated in the annunciator panel. For press-to-test procedures, refer to Paragraph 7.23.

NOTE

Heater operation will cause the right fuel pressure gauge to fluctuate during heater cycling.

7.19 ELECTRICAL SYSTEM

The electrical system is a 28-volt system (Figure 7-19). Control switches are located in the overhead switch panels and in the circuit breaker panel. The circuit breaker panel (Figure 7-21), located on the side wall of the cockpit, has provisions to handle a full complement of equipment. Switches and circuit breakers are clearly marked as to their function. Switches are of the toggle and rocker type and the circuit breakers are the push to reset type. If a breaker pops it is recommended to allow the breaker to cool for a couple of minutes before resetting. When a white band can be seen around the shank of the circuit breaker button, the breaker is open. The breakers can be manually tripped by pulling on the reset button.

The standard electrical equipment includes alternators, starters, ammeter, battery, voltage regulators and external power source receptacle.

The starters are energized by a rocker style switch located in the overhead switch panel (Figure 7-23 or 7-24) between the magneto switches. To operate, push on the side of the switch that corresponds to the engine to be started and hold until the selected engine has started. Release the switch and it will return to neutral.

NOTE

Starters should not be energized for more than 30 seconds of continuous cranking. Allow to cool between starting attempts.

The primary electrical source is two 28-volt 70-ampere alternators (Figure 7-19). The alternators are controlled independently by two voltage regulators which are interconnected electrically to provide parallel outputs at normal engine operating speeds. Alternator inoperative lights illuminate when the respective alternator fails to provide voltage. The lights can be checked by turning on the master switch with the engines shut down. If a light fails to illuminate, it should be replaced. Whenever the engines are operating at a high differential RPM, the alternator inoperative light for the slower engine may come on.

A single ammeter in the overhead panel indicates both battery charging current and alternator output. When the ammeter needle indicates to the left of center, the battery is being discharged; when the needle indicates to the right of center, the battery is being charged. During single-engine operation, this feature can be used to determine how much the electrical load should be reduced. To check the output of each alternator individually, use the press-to-test buttons located on either side of the ammeter. The left button, when depressed, will cause the ammeter to indicate left alternator output, and the right button, when depressed, will indicate right alternator output. These buttons are the momentary type, and indicate alternator output only while depressed.

NOTE

When flying in heavy rain, the electrical load on the right alternator must be reduced to 40-amperes or less to insure against alternator belt slippage.

The master switch on the left side panel is a split rocker type and gives the pilot control over the field of the respective alternator.

NOTE

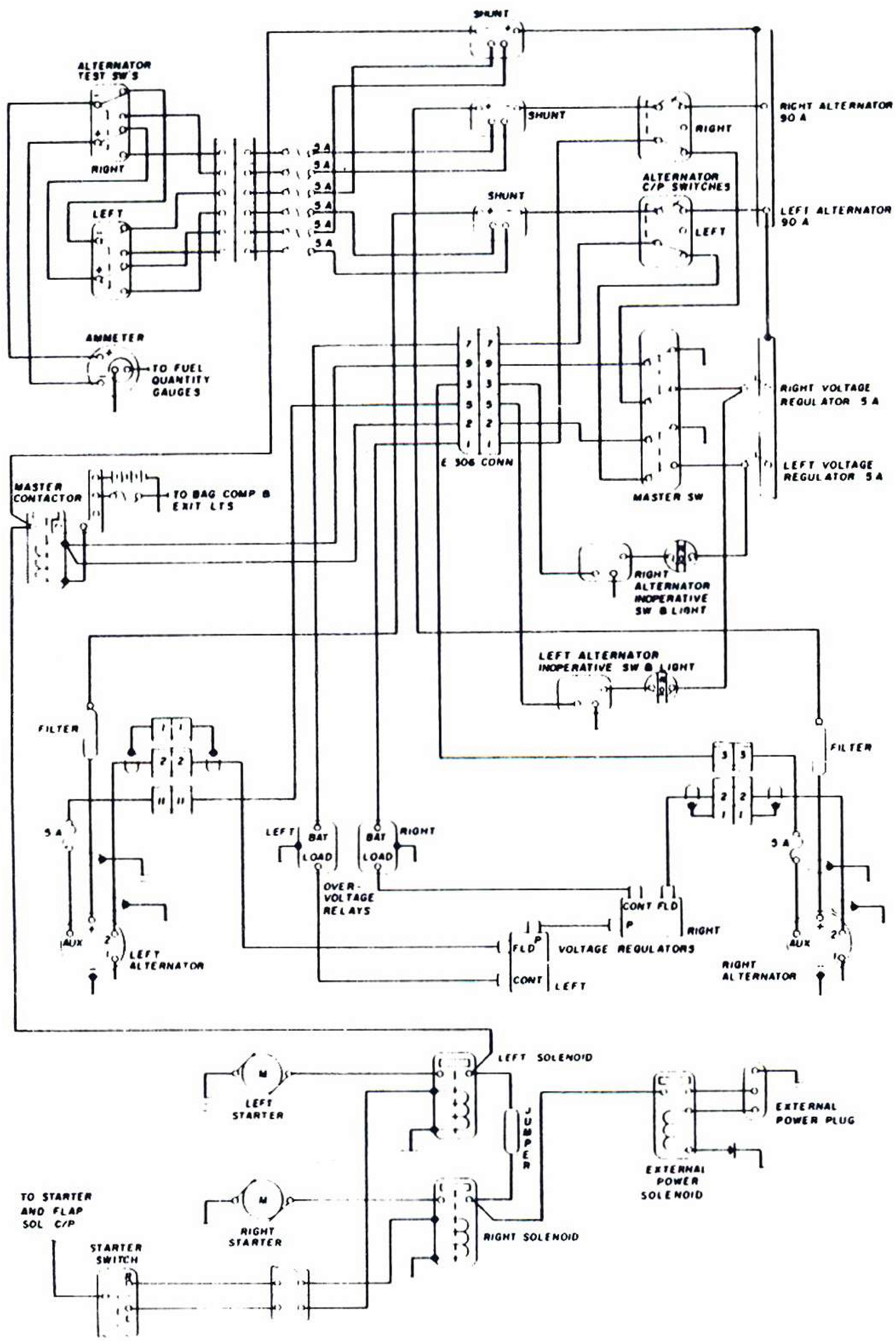
For alternator failure emergency procedure, see Section 3 - Emergency Procedures.

Secondary electrical power is provided by a 24-volt 17-ampere hour battery as standard equipment. A 24-volt 25-ampere hour battery is offered as optional equipment.

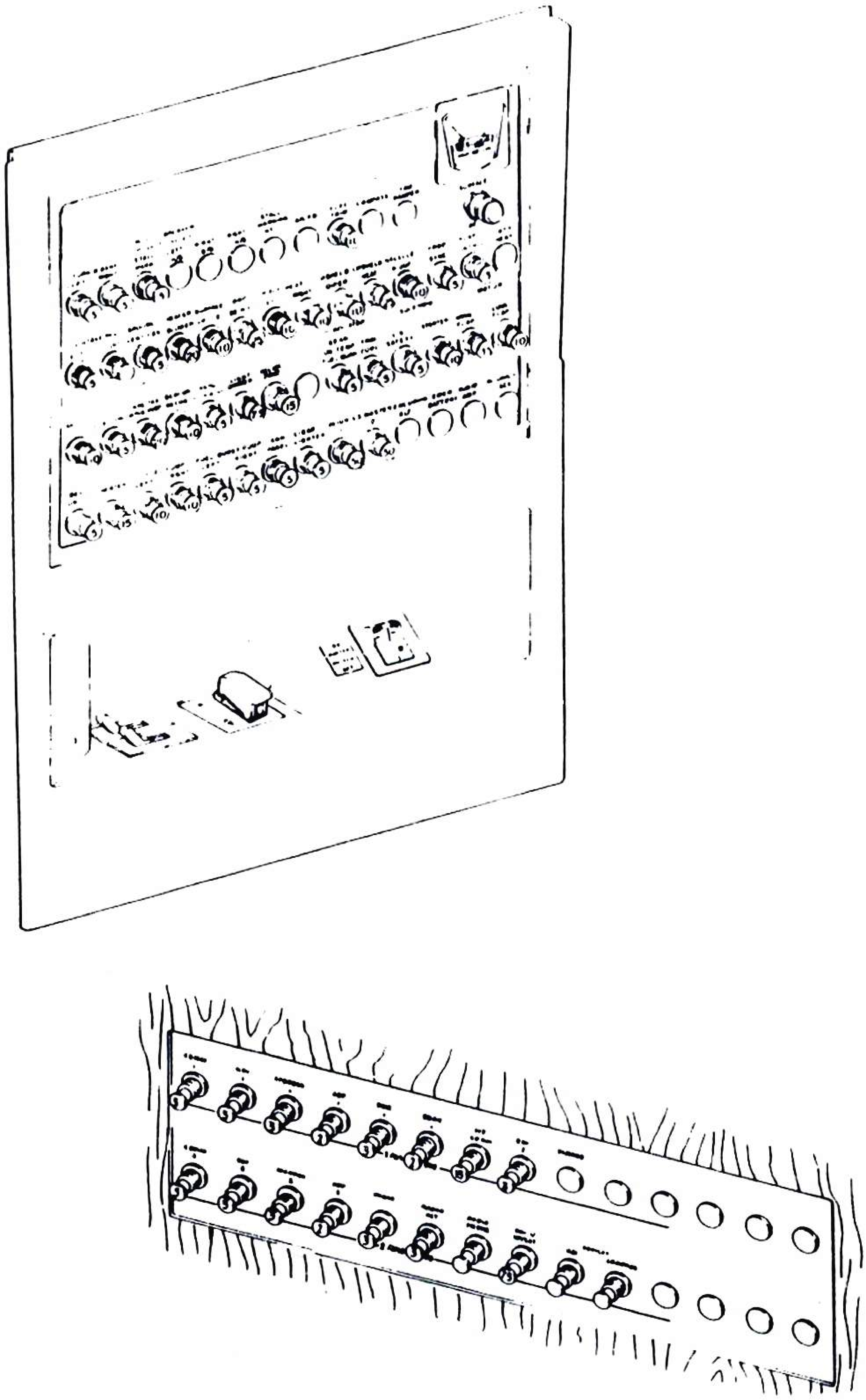
An external power source receptacle is installed in the lower left side of the nose of the aircraft. It is provided to utilize a 24-volt D.C. external power source when the aircraft battery is low or during cold weather to prevent a dead battery because of extended starting procedures. It can be used also to save the battery when ground checking the aircraft systems. Turn the master switch off before inserting the external power plug into the receptacle. The master switch should be off when using an external supply source.

NOTE

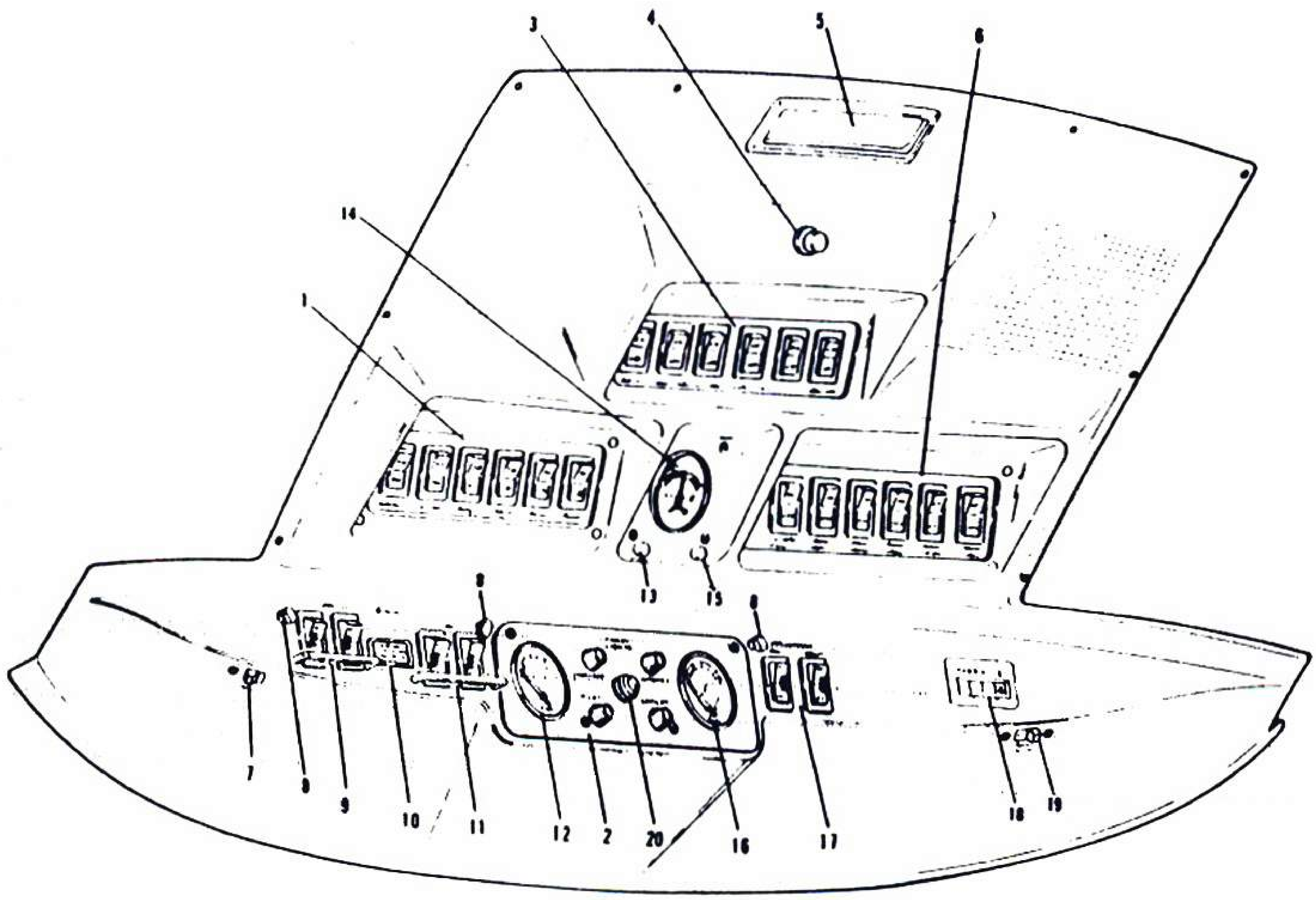
The aircraft battery must be removed before recharging.



ELECTRICAL SYSTEM SCHEMATIC
Figure 7-19

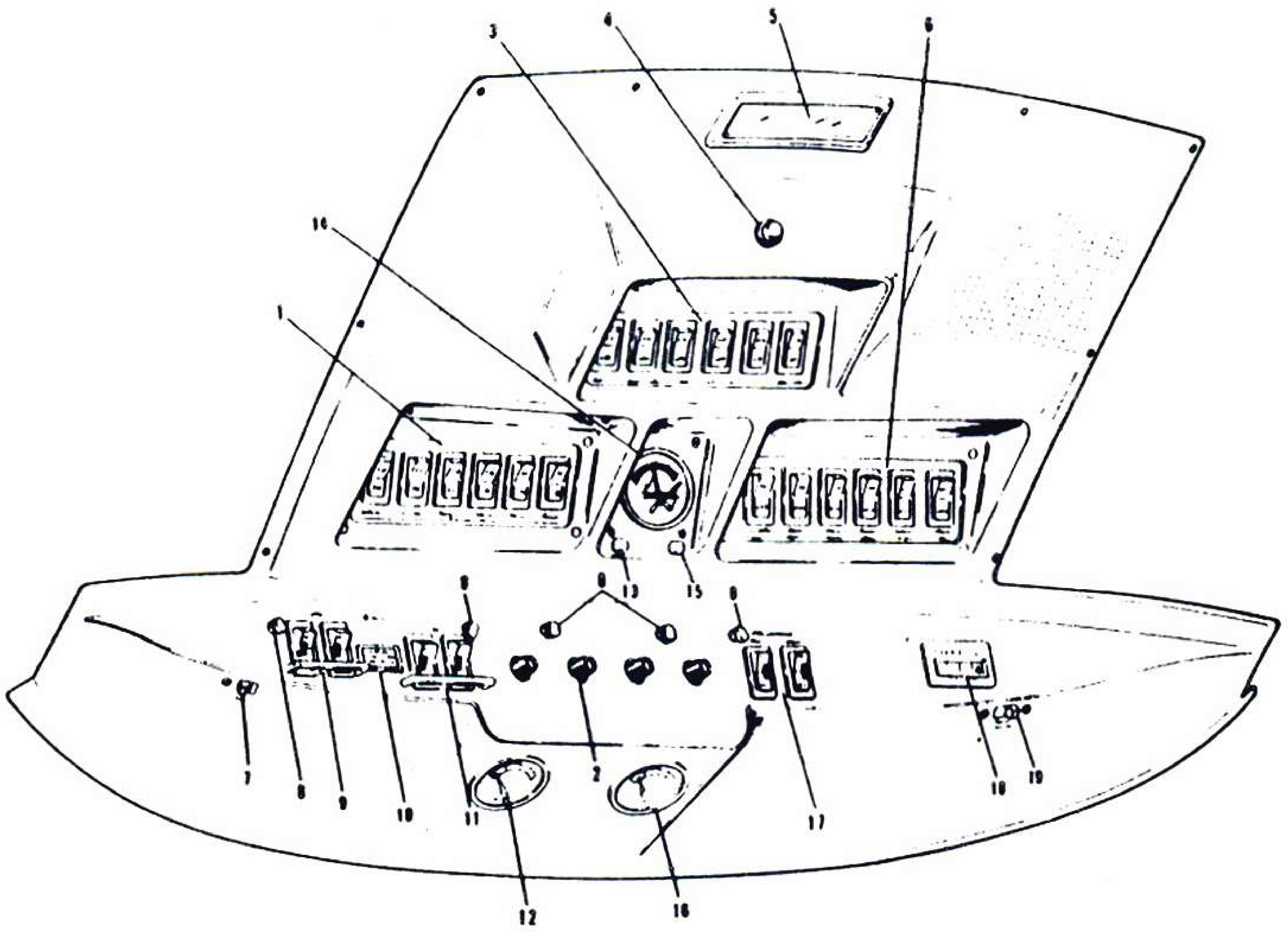


TYPICAL CIRCUIT BREAKER PANEL
Figure 7-21



1. LIGHT SWITCH PANEL
2. RHEOSTAT SWITCHES
3. ELECTRICAL SWITCHES
4. DOME LIGHT SWITCH
5. DOME LIGHT
6. VARIOUS DEICING SYSTEM SWITCHES
7. LEFT MAP LIGHT SWITCH
8. POST LIGHTS
9. LEFT ENGINE MAGNETO SWITCHES
10. STARTER SWITCH
11. RIGHT ENGINE MAGNETO SWITCHES
12. LEFT FUEL GAUGE
13. LEFT ALTERNATOR PRESS-TO-TEST SWITCH
14. AMMETER
15. RIGHT ALTERNATOR PRESS-TO-TEST SWITCH
16. RIGHT FUEL GAUGE
17. FUEL PUMP SWITCHES
18. ENGINE HOUR METER
19. RIGHT MAP LIGHT SWITCH
20. DIAL LIGHT

OVERHEAD PANEL
(AIRCRAFT WITH S/N 31-8052001 THRU 31-8252075)
Figure 7-23



1. LIGHT SWITCH PANEL
2. RHEOSTAT SWITCHES
3. ELECTRICAL SWITCHES
4. DOME LIGHT SWITCH
5. DOME LIGHT
6. VARIOUS DEICING SYSTEM SWITCHES
7. LEFT MAP LIGHT SWITCH
8. POST LIGHTS
9. LEFT ENGINE MAGNETO SWITCHES
10. STARTER SWITCH
11. RIGHT ENGINE MAGNETO SWITCHES
12. LEFT FUEL GAUGE
13. LEFT ALTERNATOR PRESS-TO-TEST SWITCH
14. AMMETER
15. RIGHT ALTERNATOR PRESS-TO-TEST SWITCH
16. RIGHT FUEL GAUGE
17. FUEL PUMP SWITCHES
18. ENGINE HOUR METER
19. RIGHT MAP LIGHT SWITCH

OVERHEAD PANEL
(AIRCRAFT WITH S/N 31-8252076 AND UP)
Figure 7-24

A pilot/copilot dome light is located in the overhead panel. The push button switch is located just forward of the lens. The light will operate with the master switch off.

A reading light is available for each passenger seat. The switch is incorporated in the light assembly.

A rear dome light and a rear exit flood light are controlled by a switch mounted in the overhead switch panel marked EXIT and a switch located just inside the cabin door. The lights operate with the master switch off to aid night loading. In addition, an optional timer is available to operate the lights for 30 seconds upon opening the main cabin door.

Position/strobe light assemblies are installed in each wing tip. The right wing tip incorporates a green position light and a white strobe light and the left wing tip, a red position light and a white strobe light. A white position and a white strobe light are also installed on the tail cone of the airplane. The position lights and the strobe lights are controlled by switches on the overhead switch panel.

WARNING

Anti-collision lights should not be operating when flying through cloud, fog or haze, since the reflected light can produce spatial disorientation. Strobe lights should not be used in close proximity to the ground such as during taxiing, takeoff or landing.

The landing and taxi lights are mounted to the upper nose gear strut. The rocker style switches are located in the overhead switch panel. During retraction, if the lights have not been turned off manually, they will be turned off automatically because they are wired through the gear down micro switch. If the switch is left on, when the gear is extended the lights will again illuminate.

7.21 INSTRUMENT PANEL

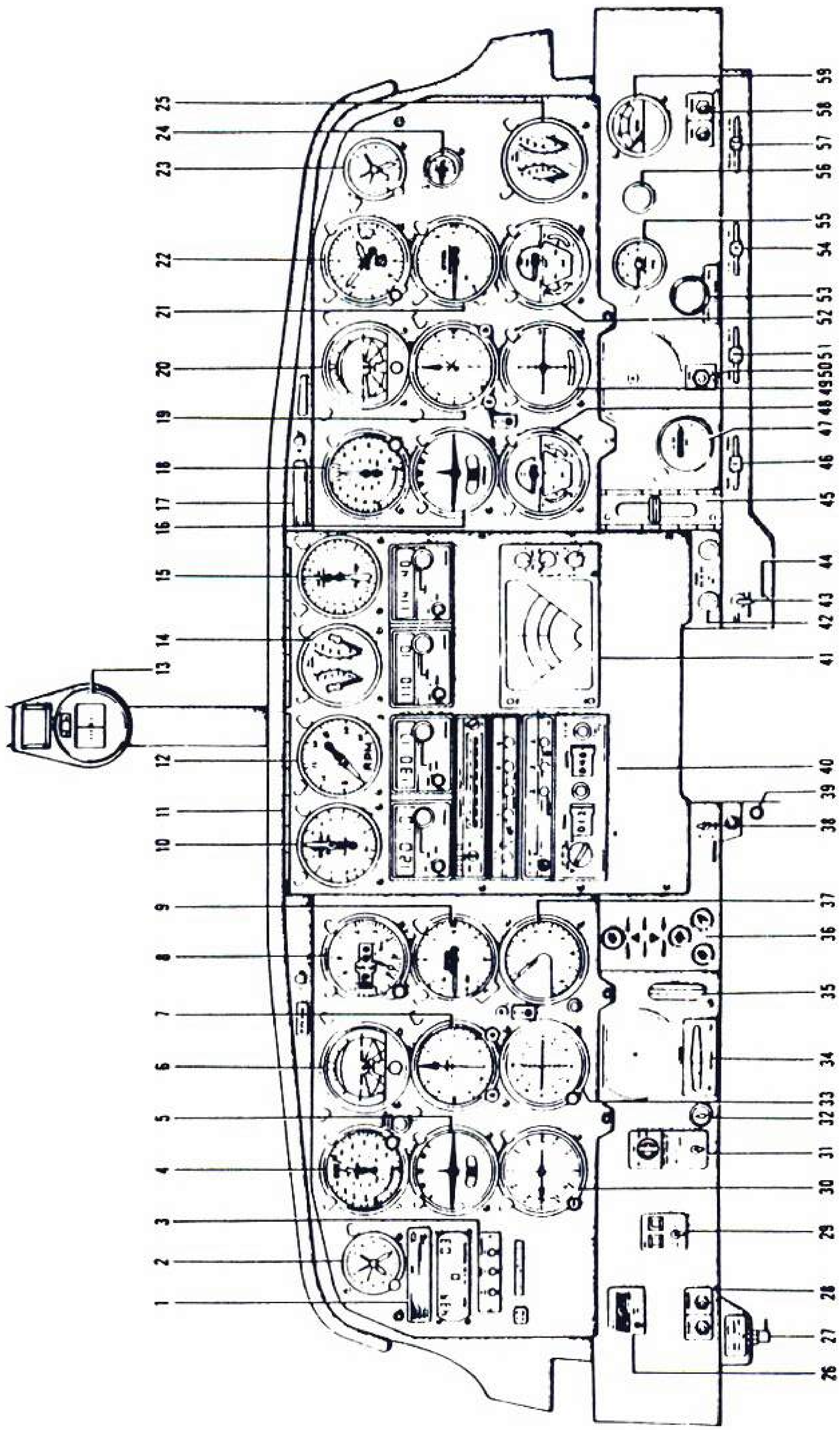
The instrument panel (Figure 7-25) is designed to accommodate complete instruments and avionics for VFR or IFR flights.

Flight instruments are directly in front of the pilot and are grouped in a standard "T" configuration. The radios are located in the middle panel and the engine instruments are mounted horizontally across the top of the center panel or stacked vertically at the right side of the center panel. Additional engine gauges are located in the right instrument panel. Optional dual flight instruments, when installed, are located in the right instrument panel. The tachometer and manifold pressure gauges are located in the center panel.

The standard attitude indicator and standard heading indicator are operated by air under pressure, whereas the turn and slip indicator is operated electrically to serve as a standby instrument in case the pneumatic system becomes inoperative.

Instrument lighting is provided by individual post lamps mounted adjacent to each instrument. These lights are controlled by a rheostat switch located on the overhead panel. The lights are turned on by the first movement of the knob and light intensity is increased by further rotation of the knob.

Pilot and copilot map lights are located in the overhead switch panel. The switch is located on the bottom of the horizontal surface of the panel assembly.



TYPICAL INSTRUMENT PANEL
Figure 7-25

1. AIRSPEED PLACARD
2. CLOCK
3. DME
4. AIRSPEED INDICATOR
5. TURN AND BANK INDICATOR
6. ATTITUDE GYRO
7. DIRECTIONAL GYRO
8. ALTIMETER
9. RATE OF CLIMB INDICATOR
10. DUAL MANIFOLD PRESSURE GAUGE
11. ANNUNCIATOR PANEL
12. DUAL TACHOMETER
13. COMPASS
14. DUAL EGT GAUGE
15. DUAL FUEL FLOW GAUGE
16. TURN AND BANK INDICATOR - COPILOT
17. CATEGORY PLACARD
18. AIRSPEED INDICATOR - COPILOT
19. DIRECTIONAL GYRO - COPILOT
20. ATTITUDE GYRO - COPILOT
21. RATE OF CLIMB INDICATOR - COPILOT
22. ALTIMETER - COPILOT
23. CLOCK
24. GYRO PRESSURE GAUGE
25. DUAL FUEL PRESSURE GAUGE
26. EMERGENCY LOCATOR TRANSMITTER
27. ALTERNATE STATIC SOURCE VALVE
28. MIKE AND EARPHONE JACKS - PILOT
29. AUTOPILOT CONTROLS
30. ADF
31. WINDSHIELD WIPER CONTROL/ EMERGENCY BATTERY PACK
32. CIGAR LIGHTER
33. NAV 2
34. PARKING BRAKE
35. GEAR SELECTOR
36. GEAR INDICATOR LIGHTS
37. RADAR ALTIMETER
38. AVIONICS MASTER SWITCH
39. PA VOLUME CONTROL/ON-OFF KNOB (1980 MODELS ONLY)
40. AVIONICS
41. RADAR
42. MANUAL ALTERNATE AIR CONTROLS
43. HEATER CONTROL SWITCH
44. HEATER START/RESET SWITCH
45. WING FLAP SELECTOR SWITCH
46. CABIN TEMP CONTROL
47. WING FLAP POSITION INDICATOR
48. OIL PRESS CYL HEAD TEMP., AND OIL TEMP - LEFT ENGINE
49. NAV 2 - COPILOT
50. FLAP TEST SWITCH
51. DEFROSTER CONTROL
52. OIL PRESS - CYL HEAD TEMP., AND OIL TEMP - RIGHT ENGINE
53. CABIN EXHAUST CONTROL KNOB
54. CABIN AIR CONTROL LEVER
55. OXYGEN SUPPLY PRESSURE GAUGE
56. OXYGEN CONTROL KNOB
57. COCKPIT AIR CONTROL LEVER
58. MIKE AND EARPHONE JACKS COPILOT
59. VOLTMETER

TYPICAL INSTRUMENT PANEL
Figure 7-25 (cont)

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7. 23 ANNUNCIATOR PANEL

The warning lights are grouped together in an annunciator panel which extends across the upper center of the instrument panel. Monitored functions include the pneumatic system, fuel boost pumps, low fuel flow, flap condition, alternator operation, combustion heater temperature, and cabin and baggage door security. There are also provisions in the annunciator panel for the addition of warning lights for various optional systems.

To the left of the annunciator display is a press-to-test switch. When this switch is depressed while the master switch is ON, all lights on the annunciator panel should illuminate. Failure of a light to illuminate is an indication of a burnt out bulb or other annunciator system abnormality. The switch should be held for at least 3 seconds, as the low fuel flow warning light will take a few seconds longer than the others to illuminate and will remain lit for as long as 10 seconds after the others have extinguished. To the right of the annunciator display is a dimmer switch which raises or lowers the intensity of the lights in the display. During the press-to-test procedure, the lights will test either bright or dim, depending upon the position of the dimmer switch. During daylight operations, the annunciator lights should be in the bright mode.

7.25 RADIO OPERATION

Electrical power for avionics equipment is controlled by a master switch located in the center of the instrument panel below the radios. The audio control panel allows the pilot to select radio audio individually. This allows pre-setting of frequencies or volume and also provides the option of listening with either the speaker or the headphones.

An Emergency Avionics Bus Power circuit breaker switch is located below the left circuit breaker panel. The switch is protected from inadvertent activation by a red switch guard.

In normal operating conditions, the switch is in the OFF position and the guard is closed. The ON position is for emergency use only and causes power from the primary bus to go directly to the number 1 avionics bus. In this configuration, number 1 avionics bus power is independent of the avionics master circuit breaker number 1.

NOTE

To avoid chatter in the speaker with the Emergency Avionics Bus Power ON, pull the avionics master number 1 circuit breaker before turning the Emergency Avionics Bus Power ON.

A public address (PA) volume control knob is mounted on the left side of the pedestal, below and forward of the propeller synchrophaser switch. The control is a rheostat type switch providing variable volume control through the rear speaker system. If operation with oxygen masks is required and the airplane is equipped with Collins radios and Scott Duo-Seal oxygen masks, communications between the pilot and copilot are possible through the headphones by selecting the PA mode and turning down the rear speaker volume. This will allow the pilot and copilot to communicate and still receive incoming communications. Starting with the 1981 models the PA system operates at a fixed volume level with passengers able to monitor the crew conversations mentioned above.

A ground clearance energy saver system is available to provide direct power to '1 Comm without turning on the master switch. An internally lit pushbutton switch, located on the instrument panel, provides annunciation for engagement of the system. When the button is engaged direct aircraft battery power is applied to '1 Comm, the pilot's mike and audio amplifier (speaker). The system is reset to the OFF position by activating the aircraft master switch.

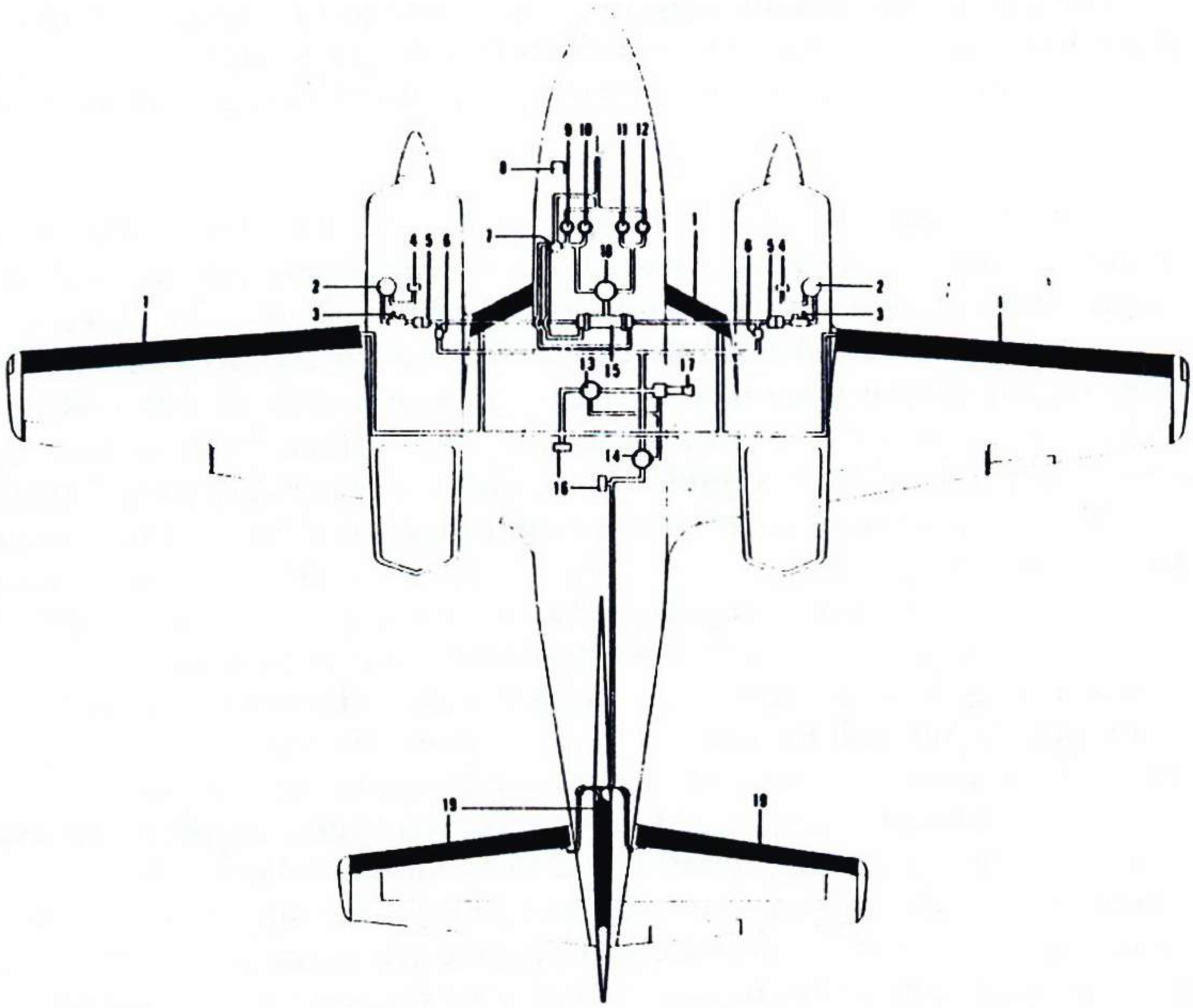
7.27 PNEUMATIC SYSTEM

The pneumatic system supplies air pressure to run the air driven gyros. When the surface deicing system is installed the pneumatic system supplies air to operate the deicing boots on the wings and empennage surfaces (Figure 7-27).

Basically, the pneumatic system is divided into two independently operated pressure supply systems: the left engine supply and the right engine supply. Both systems utilize a common manifold check valve and pressure gauge. Each side of the pneumatic system incorporates its own inlet, inlet filter, engine driven pneumatic pump, regulator and inline filter. Recessed inlets, just aft of the fire wall on the bottom-outboard side of the engine nacelle, extract constant supplies of outside air, which are passed through inlet filters and directed to the left and right engine driven pneumatic pumps. Air pressure from each pump is then routed to its respective pressure regulator. Each pressure regulator has its own adjustment to provide a means of setting the pump outlet pressure. Any airflow supplied by the pumps in excess of the adjusted setting is expelled from the system at the regulators. Regulated air pressure is then passed through a .3 micron inline filter for further protection against contaminated air reaching the instruments. Once filtered, pressure from the left engine supply and pressure from the right engine supply are united in a manifold check valve, common to both sides of the system. The manifold check valve supplies a single outlet line to the gyros In the event one of the engine driven pneumatic pumps fail, the other side of the system can maintain air pressure to the gyros and/or deicers. Air pressure supplied by the system is utilized to operate the attitude gyro and the directional gyro and exhausted through a bulkhead forward of the instrument panel.

Each pressure pump is capable of operating the air driven gyros and the pneumatic deicers up to single engine service ceiling and with both pumps operating normally, up to the maximum approved altitude of the airplane.

A gyro pressure gauge, mounted in the right segment of the instrument panel, indicates system pressure in inches of mercury. A graduated green arc on the face of the gauge indicates pressure readings within normal operating limits. Two annunciator lights, mounted in the annunciator panel, provide a visual warning to the pilot that either the right or left pneumatic source is inoperative. The lights are placarded, R. PNEU. INOP. and L. PNEU. INOP.



1. WING DEICER BOOT
2. PNEUMATIC PUMP
3. DUAL REGULATOR - SOLENOID VALVE
4. INLET AIR FILTER
5. INLINE FILTER
6. CHECK VALVE
7. PRESSURE GAUGE
8. DEICER CYCLE TIMER
9. DIRECTIONAL GYRO - PILOT
10. ATTITUDE GYRO - PILOT
11. DIRECTIONAL GYRO - COPILOT
12. ATTITUDE GYRO - COPILOT
13. "A" SYSTEM (WING) SOLENOID VALVE
14. "B" SYSTEM (TAIL) SOLENOID VALVE
15. MANIFOLD CHECK VALVE
16. PRESSURE SWITCH
17. EJECTOR
18. PNEUMATIC PRESSURE REGUALTOR (RELAY VALVE)
19. EMPENNAGE DEICING BOOT

PNEUMATIC/WING AND EMPENNAGE DEICING
Figure 7-27

7.29 WING AND EMPENNAGE DEICING*

Pneumatic wing and empennage boots are installed on the leading edges of the wings, the vertical stabilizer (fin) and the horizontal stabilizer. A constant suction is applied to all of the surface deicer boots by an ejector to provide smooth streamlined leading edges during normal operation with the deicing system off. The ejector assembly utilizes air pressure supplied by the pneumatic system to obtain a vacuum to hold the boots in the flat, deflated condition.

The deicing system is controlled by a "momentary on" type control switch. When this WING DEICE switch is actuated, the boots perform one complete inflation cycle. The switch must be actuated for each additional inflation cycle. This allows the pilot to manually select boot inflation in any desired time interval that icing conditions require. After each inflation cycle, the timer automatically resets to allow the inflation cycle to begin when the switch is actuated.

Actuation of the momentary switch triggers a system cycle timer, which in turn shifts the two stage regulators to high pressure (18 psi), opens the 'A' system solenoid valve to send air to the wing boots, and cuts off air to the copilot's gyros (when installed). After six seconds, the 'A' system solenoid is closed and the 'B' system solenoid is opened to send air to the tail boots for six seconds. At the completion of the tail cycle, the 'B' system solenoid closes, the two stage regulators return to low pressure (gyro pres.) and the copilot's air supply resumes.

When the inflation cycle is complete, the deicer solenoid valves permit overboard exhaustion of the pressurized boots. Suction is then reapplied to the deicer boots to hold them close to the airfoil surface.

Two blue indicator lights with press-to-test and dimming features, illuminate when each surface deicer boot system inflates to a predetermined pressure. Illumination of the indicator light is controlled by a pressure sensitive switch connected to the deicer pressure lines (one in the 'A' system, and one in the 'B' system).

To insure good ice shedding, the boots should be clean and free of any oils or dirt and in good condition. No special coating is required; but ice

*Optional equipment

shedding may be slightly improved by the application of B.F. Goodrich 'Icex'. It is authorized for use and has been tested in natural icing. The manufacturer's instructions (B.F. Goodrich) must be followed explicitly.

7.31 PITOT STATIC SYSTEM

The pitot static system (Figure 7-29) supplies dynamic and static air pressure for the operation of the airspeed indicator. Static air is also supplied to the vertical velocity indicator and altimeter.

A heated pitot head is located under the nose of the aircraft just forward of the nose gear doors. A second heated pitot system is installed when dual flight instruments are installed.

Static source pickups (about the size of a half dollar) are located on both sides of the rear fuselage forward of the horizontal tail. They connect to a single line leading to the instruments. The dual pickups are provided to reduce side slip effects on the airspeed indicator.

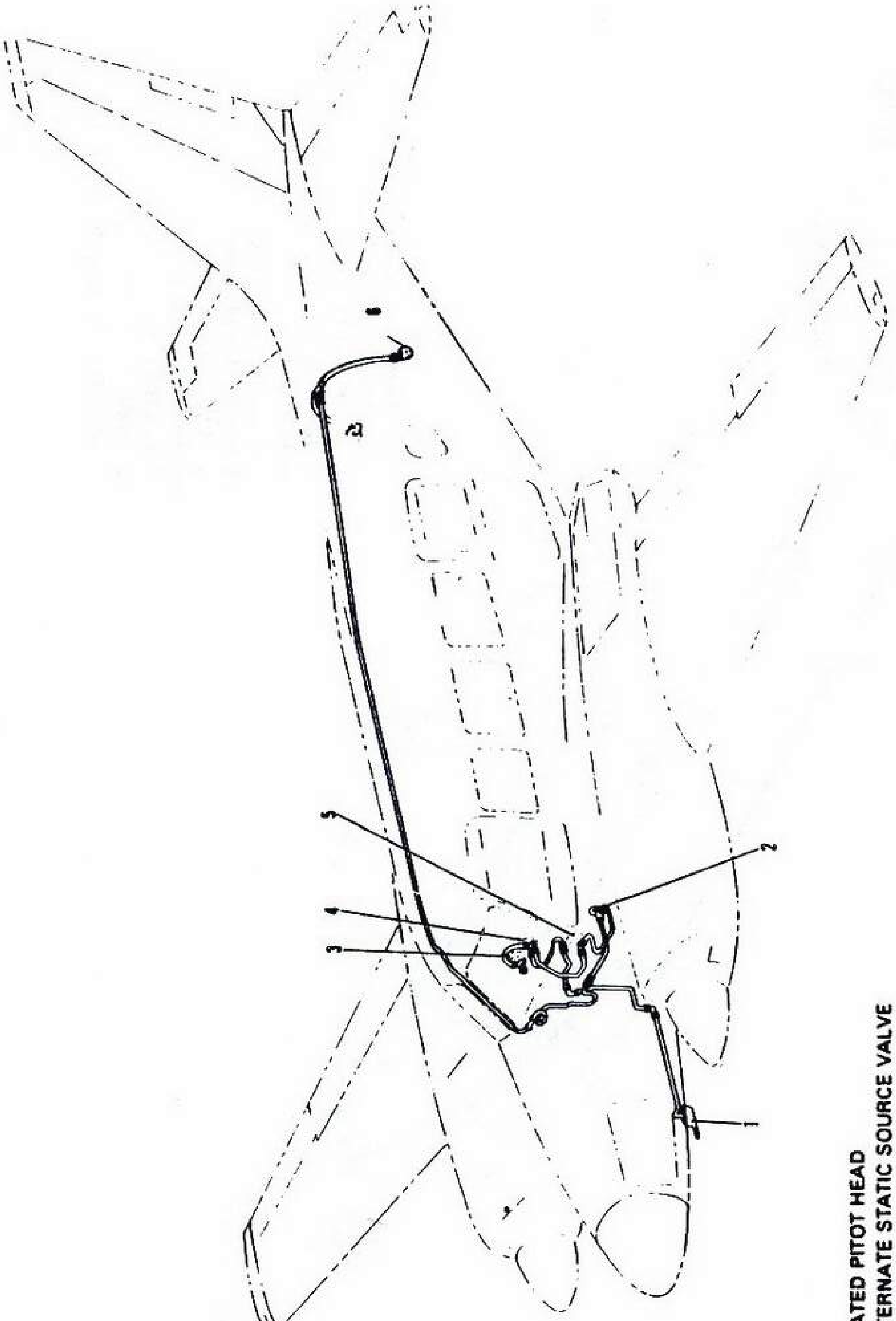
An alternate static source valve is located under the instrument panel near the pilot's left knee. To actuate, push the lever up and to the left to lock the valve in the open position. This valve can also be used to drain condensed water from the static system. To drain, move lever up. If water appears leave open till water stops flowing; then close valve.

When the alternate static source is selected, the pilot's instruments are vented to cabin pressure. This means that the altimeter and airspeed indicator will indicate higher readings than normal. (See correction chart in Section 5 - Performance.) The vertical velocity indicator will show a momentary climb.

The switches for the pitot heat are located in the right overhead switch panel. Pitot covers are provided with each pitot head and should be installed when the aircraft is parked to prevent bugs and rain from entering the pitot head. A partially or completely blocked pitot system will give erratic or zero reading on the airspeed indicator.

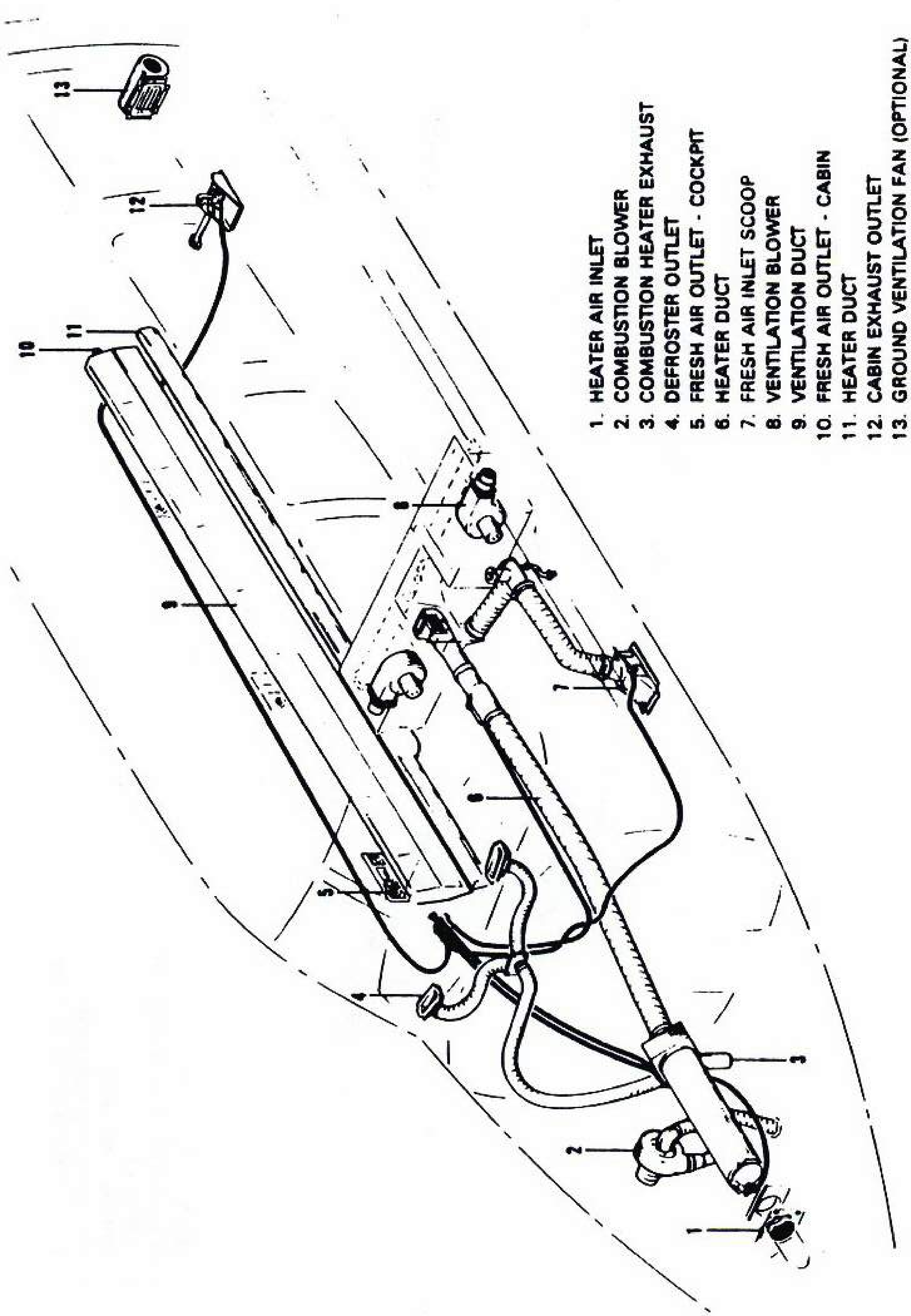
NOTE

Before every flight, check to make sure the pitot cover has been removed.



1. HEATED PITOT HEAD
2. ALTERNATE STATIC SOURCE VALVE
3. ALTIMETER
4. AIRSPEED INDICATOR
5. RATE OF CLIMB INDICATOR
6. STATIC SOURCE PADS (PICKUPS)

PITOT STATIC SYSTEM
Figure 7-29



HEATING, VENTILATING AND DEFROSTING SYSTEM
Figure 7-31

7.33 HEAT, VENTILATING AND DEFROSTING SYSTEM

The heating, ventilating, and defrosting system (Figure 7-31) includes a heater, fuel regulator, heat and defroster ducts, heat and defroster outlets, and corresponding controls.

A 50,000 B.T.U. Janitrol heater, installed in the right nose section, furnishes hot air for cabin heating and windshield defrosting. Fuel is supplied from the right wing fuel cells only. The air inlet for the heater is located on the lower right side of the nose section. The air passes through the heater, into the distribution box and then to the heater outlets and/or the defroster outlets. Heat outlets are provided in the cockpit and cabin areas. The cockpit outlets are located below and at the end of the armrests. The cabin outlets are located below the full length air ducts along the floor, giving good heat distribution. The defroster outlets are located in the instrument panel cover giving good airflow distribution to each windshield.

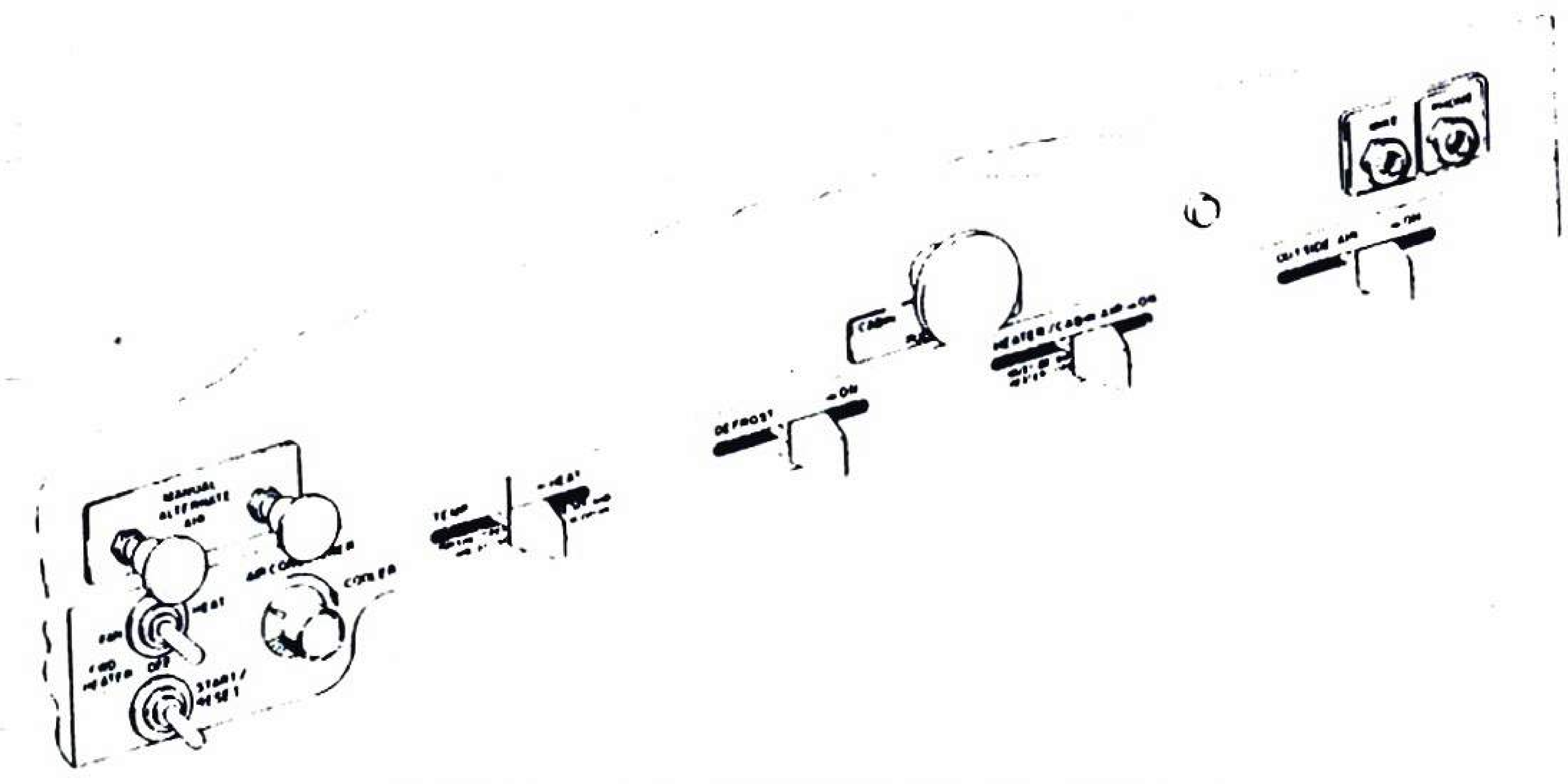
Heater operation is controlled by two switches mounted one below the other and located in the lower right panel just to the right of the pedestal. The upper switch has three positions: FAN, OFF and HEAT. The lower switch is a momentary on type and is marked START/RESET.

When FAN is selected, the vent blower is turned on and air is circulated through the heat ducts while on the ground or used to defog the windshield when heat is not desired. This position is also used to cool the heater, so as not to trip the heat limit switch, after use on the ground. When HEAT is selected and the START/RESET switch is momentarily depressed, the heater fuel pump turns on and ignition occurs simultaneously, providing heated air within a few seconds.

The heater and defroster controls (Figure 7-33) are located on the lower right instrument panel. The temperature control is below the flap switch. Outboard of the temperature control are the defroster and cockpit controls. The temperature control regulates the cabin temperature. To increase temperature move the control to the right.

NOTE

For ground operation, takeoff and climb, do not exceed midpoint.



CABIN AIR CONTROL PANEL
Figure 7-33

The defroster control turns the defrosters on when the control is moved to the right. The air is picked up at the heat distribution box and then ducted directly to the defroster outlets. Because of this, it is suggested that the defroster be turned on full until the windshield is defrosted. Then move the control back toward the off position until just enough heated air is flowing to keep the windshield defrosted.

A heater air inlet valve is located just aft of the heater air inlet scoop. It is used to shut off the air to the heater if the heater becomes inoperative or when the incoming air is cool, but doesn't necessitate turning the heater on.

CAUTION

> The heater air inlet valve must be full open prior to and during heater operation. If this valve is not full open during heater operation the heater will become inoperative from overheating.

The heater has a circulating fan that is controlled by a landing gear safety switch and operates only when the aircraft is on the ground.

To turn the heater off, move the heater switch to OFF. If the heater is turned off after operation on the ground, the switch should first be turned to the FAN position for a few minutes to cool the heater, then turned off. If the heater is turned off while in the air, it is not necessary to select the FAN position.