Attachment 17

to Operational Factors / Human Performance Group Chairman's Factual Report

DCA00MA005

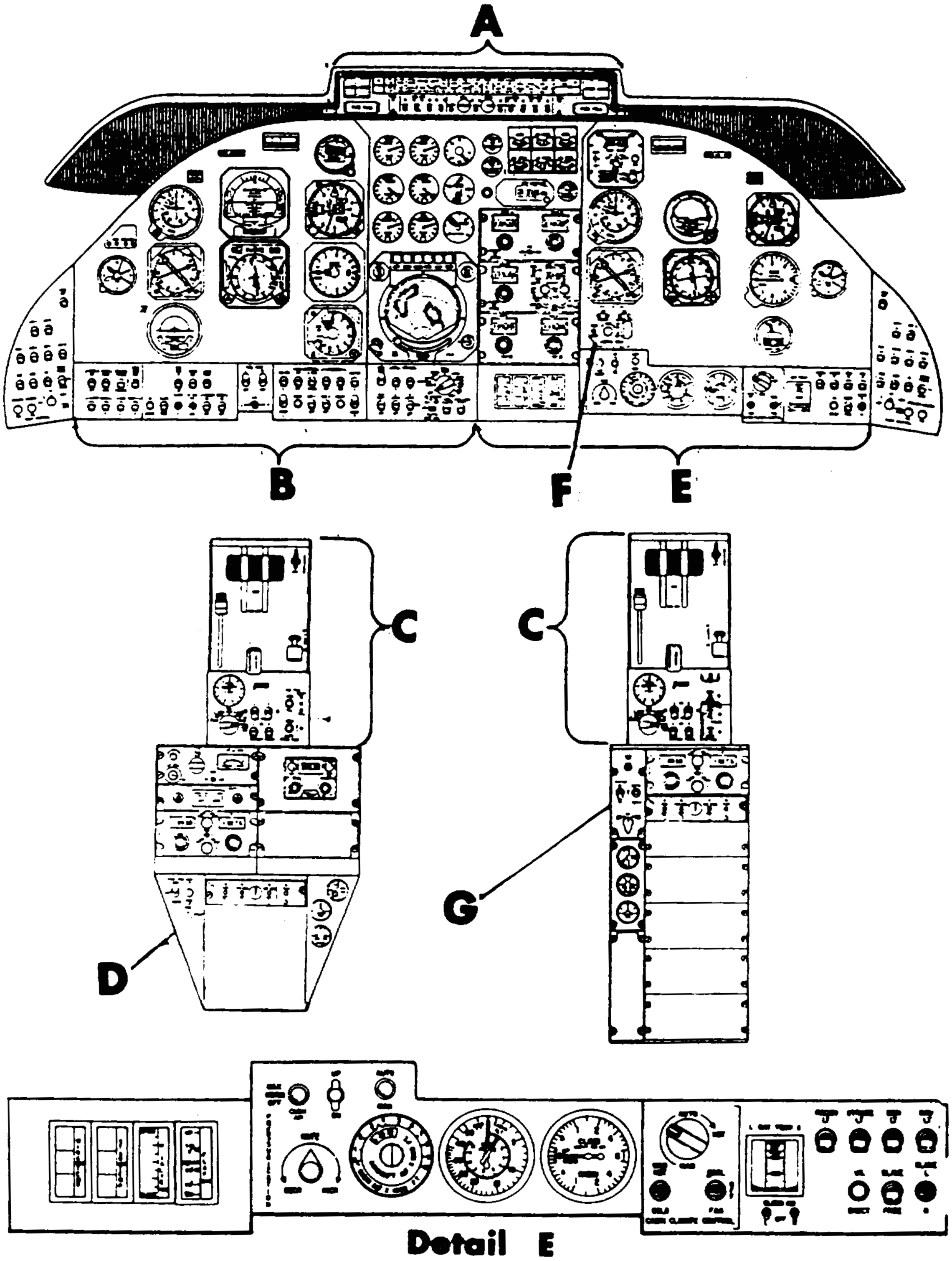

Figure 1-7 Readout Panel and Switch Panel (Sheet 1 of 2)

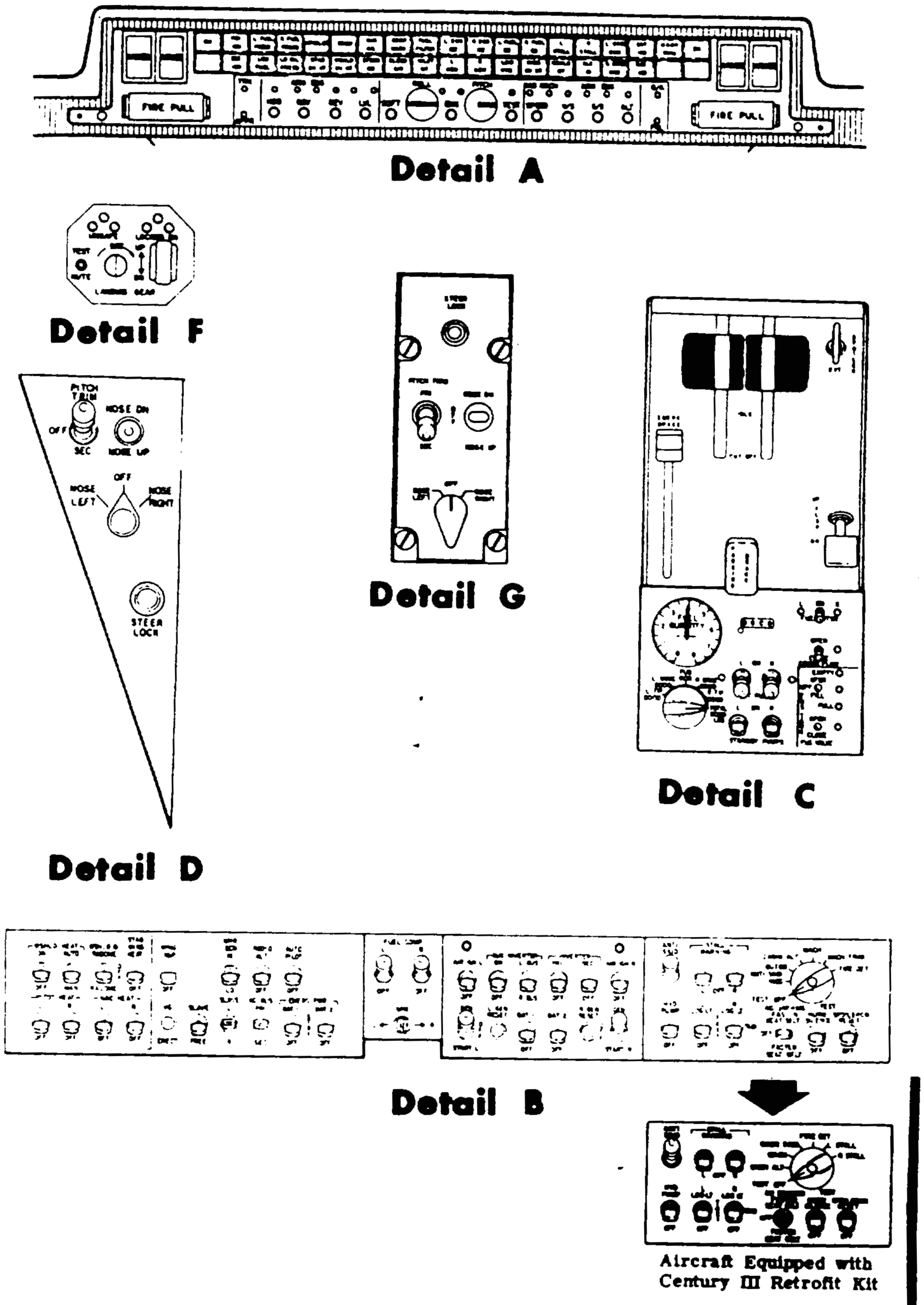

Figure 1-7 Readout Panel and Switch Panel (Sheet 2 of 2)

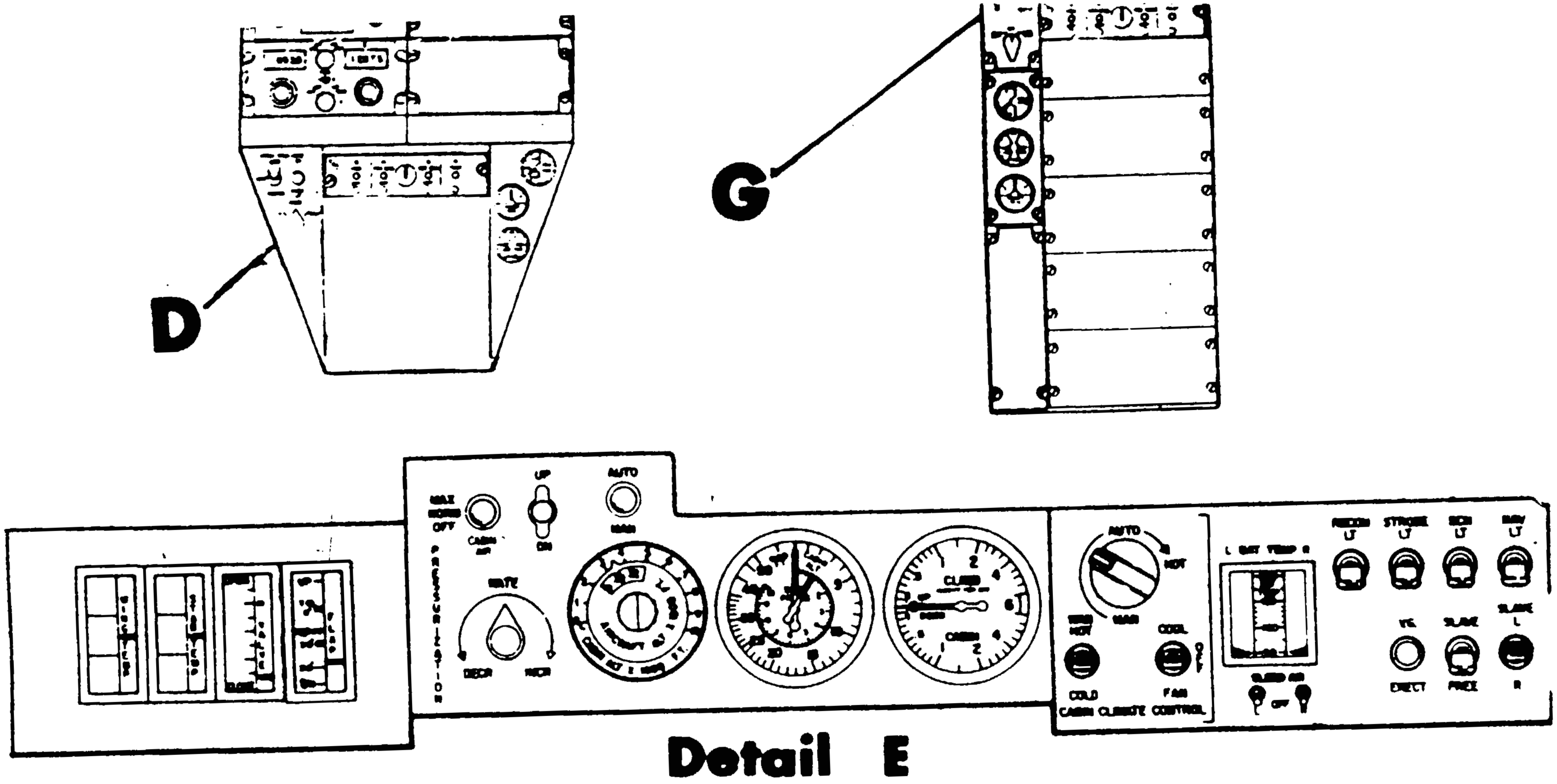

Figure 1-7 Readout Panel and Switch Panel (Sheet 1 of 2)

AUXILIARY AND EMERGENCY SYSTEMS

AIR CONDITIONING AND HEATING

Cabin temperature is regulated by controlling the temperature of pressurization bleed air that enters the cabin. With the BLEED AIR switches ON and the CABIN AIR switch in the NORM position, engine bleed air is admitted through the flow control valve to the heat exchanger. Engine bleed air is precooled in the heat exchanger by ram air entering the dorsal inlet and passing through the heat exchanger. The amount of bleed air passing through the heat exchanger is controlled by the MAN-HOT-COLD switch or MAN-AUTO-HOT rheostat switch which regulates the position of the hot air bypass valve. The position of the hot air bypass valve is indicated on the TEMP CONT INDICATOR. With the rheostat switch in the HOT position or the MAN-HOT-COLD switch in the HOT position the indicator needle should be at the OPEN position. The precooled bleed air is ducted through the air distribution lines into the cabin area. If maximum airflow is desired to remove smoke or fumes from the cabin, set the CABIN AIR switch to MAX. This energizes a solenoid on the flow control valve which overrides the venturi and fully opens the flow control valve.

CABIN CLIMATE CONTROL SWITCHES

With the MAN-AUTO-HOT rheostat type switch in the AUTO position, cabin temperature is controlled by regulating the position of the hot air bypass valve with a temperature resistance bridge circuit and temperature control unit. Cabin temperature is increased by rotating the switch toward the hot position. With the rheostat in the MAN position (the detent in the full counterclockwise direction), the hot air bypass valve position is regulated by the MAN-HOT-COLD switch.

With the hot air bypass valve in the full HOT position, bleed air is ducted directly to the cabin, bypassing the heat exchanger. The TEMP CONT indicator is used to monitor the hot air bypass valve position. The COOL-FAN-OFF switch controls the refrigeration system. When set to COOL, 28 vdc is applied to the compressor motor and to the evaporator blower. The refrigerant system will operate continuously while the switch is set to COOL unless refrigerant pressure exceeds a preset level at which time a high pressure switch will de-energize the compressor motor until pressure drops to within allowable limits. Do not operate the refrigeration system above 18,000 feet due to the possibility of arcing in the compressor motor. If recirculation only is desired, set the switch to FAN and only the blower will operate. An additional cockpit cooling fan provides air circulation to the cockpit and is controlled by the COCKPIT AIR switch.

COOLING SYSTEM

The refrigeration type cooling system is used for ground cooling, in-flight cooling below 18,000 feet and cabin dehumidification. With the Cabin Climate Control COOL-OFF-FAN switch set to COOL, 28 vdc is applied to the evaporator blower and to the compressor motor. The refrigerant is being compressed and circulated throughout the system and the evaporator blower is circulating cabin air through the evaporator for cooling. System overpressure protection is provided by a pressure switch. If only circulation is required, the COOL-FAN switch should be set to FAN. An additional cockpit cooling fan provides air circulation to the cockpit and is controlled by the COCKPIT AIR rheostat switch. For ground operation the refrigeration system must be powered by operating one engine generator or by an auxiliary power unit. The refrigeration system will disengage during engine start.

HEATING SYSTEM

Precooled engine bleed air is used for cabin heating. With the Cabin Air switch set to NORM and the Bleed Air switches set to ON, engine bleed air is admitted through the flow control valve to the heat exchanger. Engine bleed air is precooled in the heat exchanger by ram air entering the dorsal inlet, passing through the heat exchanger and then dumped into the tailcone. The amount of cooling by the heat exchanger is dependent upon the setting of the hot air bypass valve. The hot air bypass valve is controlled by the MAN-AUTO-HOT rheostat switch or MAN-HOT-COLD switch on the Cabin Climate Control panel.

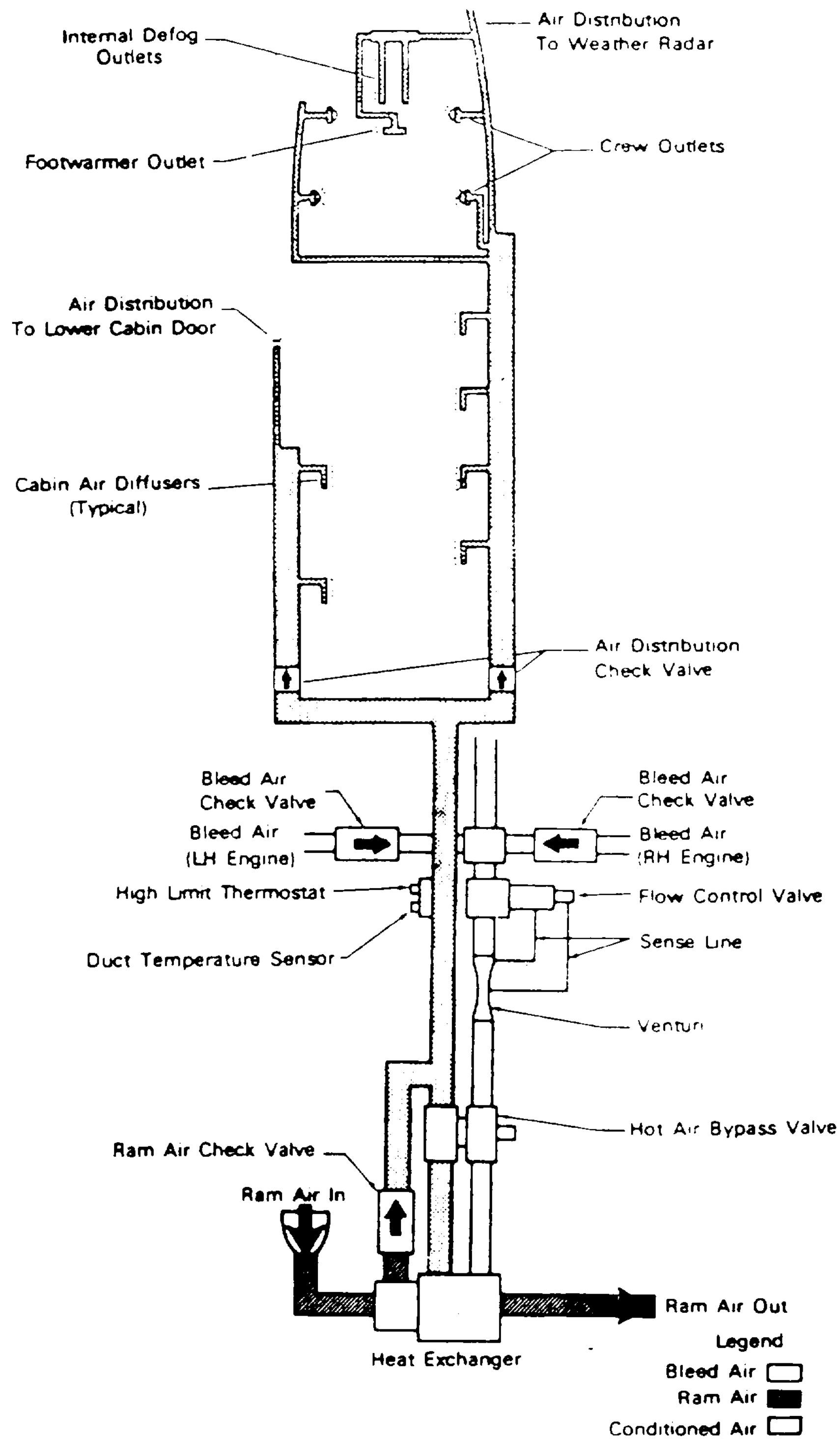

Figure 3-1 Air Conditioning System Schematic

In the AUTO position, selected temperature is maintained by the temperature control system. The system is based on a temperature sensitive resistance bridge circuit using a comparator signal as the bridge unbalance detector. The system consists of a temperature selector switch, temperature control unit, cabin temperature sensor, duct temperature sensor, cabin skin temperature sensor and a hot air bypass valve potentiometer. The relative resistance of the temperature sensors determines the strength and polarity of the unbalance signal applied to the comparator circuit. The comparator circuit senses the strength and polarity of the unbalance signal and automatically moves the hot air bypass valve in the proper direction. When the bridge circuit is rebalanced the hot air bypass valve will stop in its new position. In case of temperature control malfunction, a high limit thermostat removes power from the bridge circuit and completes a power circuit to the closed side of the hot air bypass valve. The MAN-HOT-COLD switch is used to manually control the bypass valve in the event of automatic malfunction.

CABIN TEMPERATURE INDICATOR (OPTIONAL)

Cabin temperature is monitored by the copilot using the Cabin Temperature Indicator. The indicator is graduated from 60 to 90 degrees in blue, green and orange bands. A variable-resistance type sensor in the L.H. service cabinet transmits signals to the indicator. The system operates on 28 vdc through a 2-amp CAB TEMP circuit breaker.

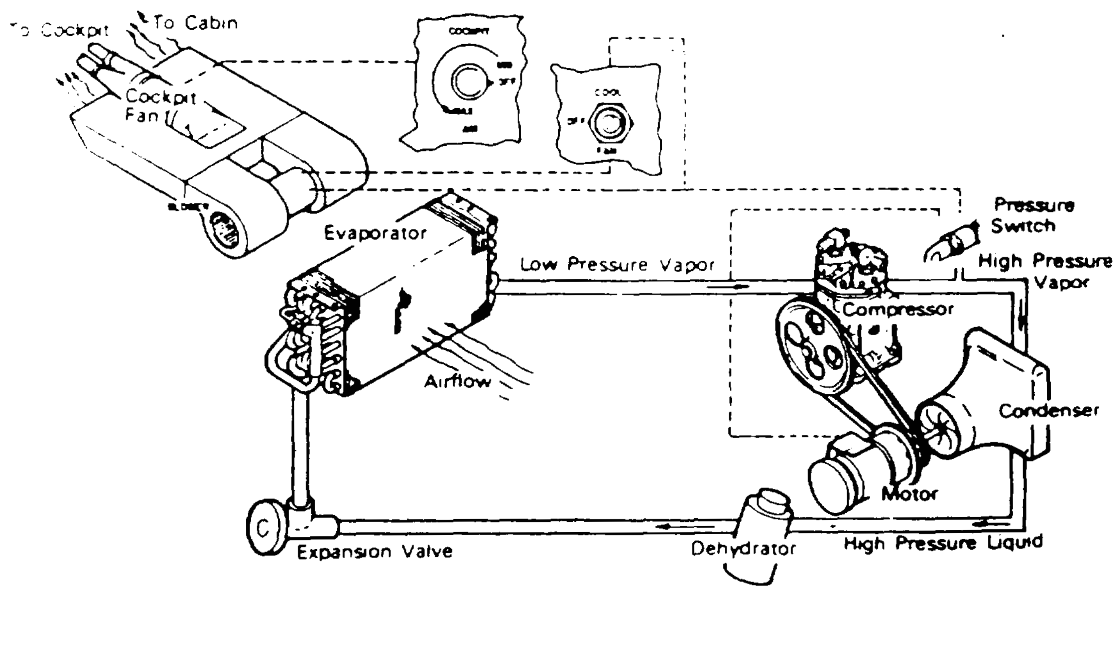

Figure 3-2 Refrigeration System Schematic

AUXILIARY CABIN HEATER SWITCH

Auxiliary heating elements, located in the cooling system ducts, are powered by an auxiliary power unit or engine driven generator. The system consists basically of two heating elements in each duct, a control switch, a thermal switch and a thermal fuse. A safety switch is installed on the diverter doors to prevent heater operation with the doors open. With the diverter doors closed and the AUX HT switch set to HI, both heating elements are energized. The cooling system blower is energized after the elements are hot. With the switch set to LO, only one heater element in each duct is energized. Each heating unit has a thermal switch which cycles its element within a range of 125 to 150°F. The system controls operate on 28 vdc from the 7.5 amp AUX CAB HT circuit breaker.

PRESSURIZATION SYSTEM

Cabin pressurization (Figure 3-3) is provided by conditioned air entering the cabin through the air distribution ducts and controlled by modulating the amount of air exhausted from the cabin. Components of the pressurization system are a cabin air exhaust valve, cabin safety valve, differential pressure relief valve, pressurization jet pump and pressurization module. All pressurization controls and indicators are on a panel in front of the copilot. During ground operation, electrically controlled solenoids control the cabin air exhaust valve to maintain a maximum of 0.25 psi differential. During flight, power is removed from the electrically operated solenoids which makes the pressurization completely independent of the electrical system. With the AUTO-MAN switch in the AUTO position, controlling vacuum from the pressurization jet pump opens and closes the cabin air exhaust valve. As the exhaust valve closes the increase in cabin pressure is sensed by the altitude controller which meters more vacuum to the rate controller. As more vacuum is metered to the rate controller, the ratio of pressure to vacuum decreases. The reduced pressure in the up rate chamber of the rate controller is sensed by the exhaust control valve. With the changing control chamber pressure, an unbalanced condition will exist and move the valve open until the proper amount of air is exhausted to maintain the altitude controller selection. The reduced pressure is also sensed by the rate chamber of the rate controller and as pressure decreases, the down rate needle valve opens, metering more cabin pressure to the vacuum source. An aneroid switch will limit cabin altitude to 10,000 feet when in the AUTO mode. With the AUTO-MAN switch in the MAN position, the cabin altitude is controlled by manually positioning the outflow valve with the red UP-DN switch.

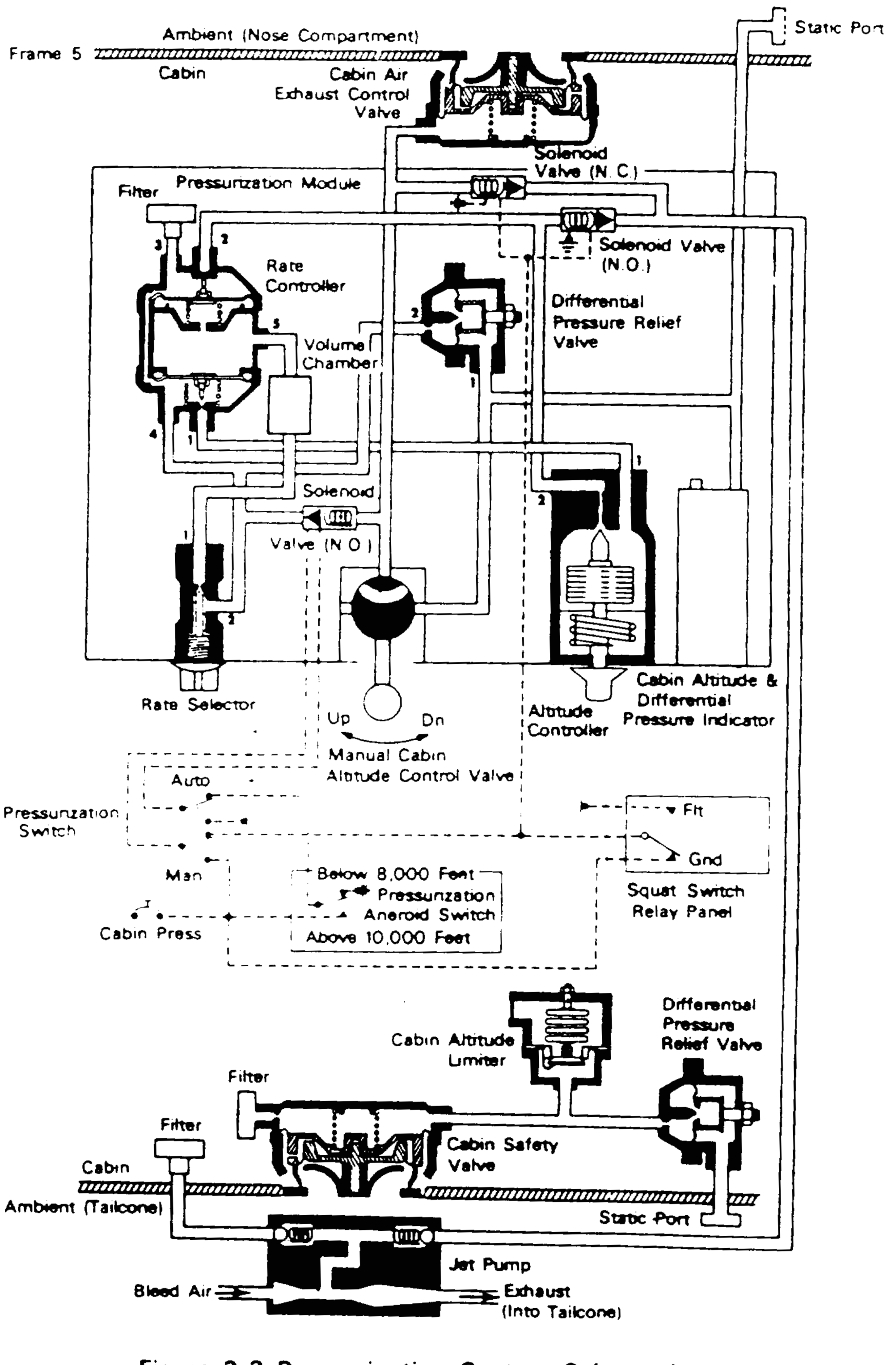

Figure 3-3 Pressurization System Schematic

PRESSURIZATION CONTROLS

Normal pressurization is controlled with the Altitude Controller and the RATE Selector. Prior to takeoff, the AUTO-MAN switch is set to AUTO, the Cabin Air Switch to NORM, the Airplane Altitude Selector knob set to cruise altitude and the IN NORMAL/OUT DEFOG knob pushed in. After takeoff the rate knob may be turned toward INCR or DECR to obtain a recommended rate of cabin pressurization of 600 (±50) fpm. The rate is monitored by the Cabin Rate-of-Climb Indicator and may be varied with the RATE Selector knob. Cabin altitude is monitored with the Cabin Altimeter. This altimeter also includes an aircraft cabin altitude and pressure differential scale.

CABIN ALTITUDE WARNING

If cabin altitude reaches 10,000 feet, the cabin pressurization aural warning will sound. The aural warning may be silenced for approximately 60 seconds by moving the HORN SILENCE-OFF switch to the HORN SILENCE position. The warning circuit may be tested by turning the test switch to CABIN ALT and depressing the center button.

EMERGENCY CABIN PRESSURIZATION

The windshield defog air can be routed into the cabin as an emergency source of pressurization. This is accomplished by pushing the IN NORMAL/OUT DEFOG knob (full in), setting the Windshield Heat Switch to AUTO and the CABIN AIR Switch OFF. Pressurization will then be maintained automatically. If however, pressurization is not maintained in the AUTO position, cabin altitude can be maintained by controlling the outflow valve using the manual UP/DN switch.

ANTI-ICING SYSTEMS

Three methods are used to prevent the formation of ice on various portions of the aircraft. Engine bleed air is used to prevent ice formation on the wing leading edges, horizontal stabilizer leading edges, nacelle inlet and windshield. Electrical heaters are used for the pitot heads, static ports and angle of attack transducer vanes. Methyl alcohol is used for the radome and as a backup for the pilot's windshield bleed air system.

ICE DETECTION

Identification of ice on the aircraft can be made visually by ice formation on the lower corners of the windshield or the nose of the tip tanks. During night flight, a red ice detect light located on each side of the glareshield provides evidence of ice formation. The lights will cause red circles, approximately 1-1/2 inches in diameter to appear on the windshield if particles of moisture or ice form on the windshield. The light on the pilot's side is located in an area cleared by defog airflow and the light on the copilot's side is located outside the defog area. Therefore, if the defog system is operating, the copilot's ice detect light should be monitored for evidence of ice formation. The ice detect lights are on all the time the battery switches are on and will indicate moisture encounter when OAT is above freezing and indicate ice accumulation when OAT is below freezing.

NACELLE INLET AND ENGINE ANTI-ICE SYSTEM

Each engine nacelle inlet and hub spinner is protected from ice formation by engine bleed air. The nacelle anti-ice valve and engine anti-ice valve are controlled by NAC HEAT switches on the pilot's switch panel. When the switches are set to ON, bleed air is routed around the perimeter of the nacelle lip and to the hub spinner. Under no ice conditions (NAC HEAT switches OFF), the nacelle anti-ice valve is energized closed, but the hub spinner anti-ice valve is energized open. Therefore, with a loss of electrical power, anti-ice capabilities are available to nacelle only. A pressure switch in the nacelle and engine anti-ice system senses bleed air pressure and opens a ground to the warning lights. This provides an indication that the anti-icing systems are functioning properly. If air pressure drops below 2 psi at the nacelle or 6 psi at the hub spinner a ground circuit is completed to the warning lights. The warning lights are amber and labeled R ENG ICE and L ENG ICE. Do not operate nacelle anti-icing system for more than 10 seconds when OAT is 40°F or above.

WING AND HORIZONTAL STABILIZER LEADING EDGE ANTI-ICE

Engine bleed air is routed to the wing and horizontal stabilizer leading edges (figures 3-4 & 3-5) to prevent ice accumulation. System components consist of diffuser tubes in each leading edge, a pressure regulator, surface temperature sensors, thermoswitches, warning lights, a wing temperature indicator, a stabilizer temperature indicator and a STAB WING HEAT control switch. The indicators are divided into three color ranges: red range - skin temperature below 35°F and indicates that moisture will freeze on the leading edges, green range - skin temperature above 35°F and moisture will not freeze on leading edges and yellow range - over-heating indicates a possible system malfunction. Setting the STAB WING HEAT switch to ON applies 28 vdc to the wing and stabilizer pressure regulator and anti-ice solenoid on each bleed air modulating valve. The pressure regulator opens and allows bleed air to flow through the ducting to the wing and stabilizer leading edges.

Bleed air is regulated to approximately 16 psig by the regulator. A thermoswitch, installed in the right wing and left horizontal stabilizer to monitor temperature of the structure, will light the applicable WING OV HT or STAB OV HT warning light if temperature reaches 215°F.

WINDSHIELD ANTI-ICE

The windshield anti-ice system consists of two low limit thermoswitches (215°F), two high limit thermoswitches (250°F), a WSHLD HT indicator light, a pressure regulator, a shutoff valve and two WSHLD HT control switches. One control switch is labeled ON-OFF and the other AUTO-MAN. Interior defogging is accomplished by directing conditioned air over the interior surface of the windshield. This occurs anytime pressurization air is flowing into the cabin. Placing the system in the automatic mode is accomplished by pulling the IN NORMAL/OUT DEFOG knob out and placing the AUTO-MAN switch in the AUTO position which opens the defog shutoff valve. The green WSHLD HT light on the readout panel will light. During ground operation bleed air temperature is controlled in the defog outlets by the low limit thermoswitches. Should the temperature in the outlets reach 215°F the defog valve closes until temperature drops to an allowable level. During ground operation the low limit thermoswitches will light the WSHLD OV HT warning light by applying ground through the squat switches. During flight the low limit thermoswitches are isolated by the squat switches and the high limit thermoswitches operate the overheat warning system. To turn off the system during automatic operation, set the AUTO-MAN switch to MAN and hold the other switch to OFF.

Manual operation is accomplished by setting the AUTO-MAN switch to to MAN and then using the ON-OFF switch to control the defog shutoff valve. During manual operation the defog valve is closed and the WSHLD OV HT light is lighted, in flight, by the high limit thermoswitch or , on the ground, by the low limit thermoswitch.

DEFOG CONTROL SYSTEM

The IN NORMAL/OUT DEFOG control knob is used to route bleed air flow over the external surface of the windshield or internally out of the footwarmers. In the IN position all air is routed through the footwarmers; in the OUT position all bleed air is routed externally. A check valve prevents back flow of air through the footwarmers.

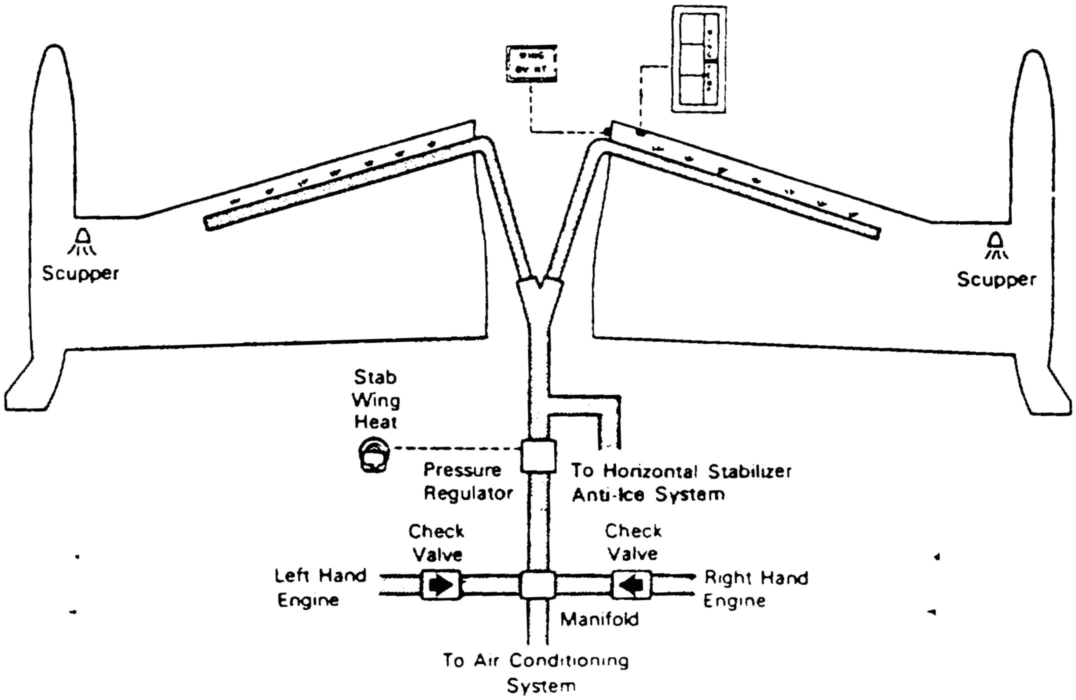

Figure 3-4 Wing Leading Edge Anti-Ice Schematic

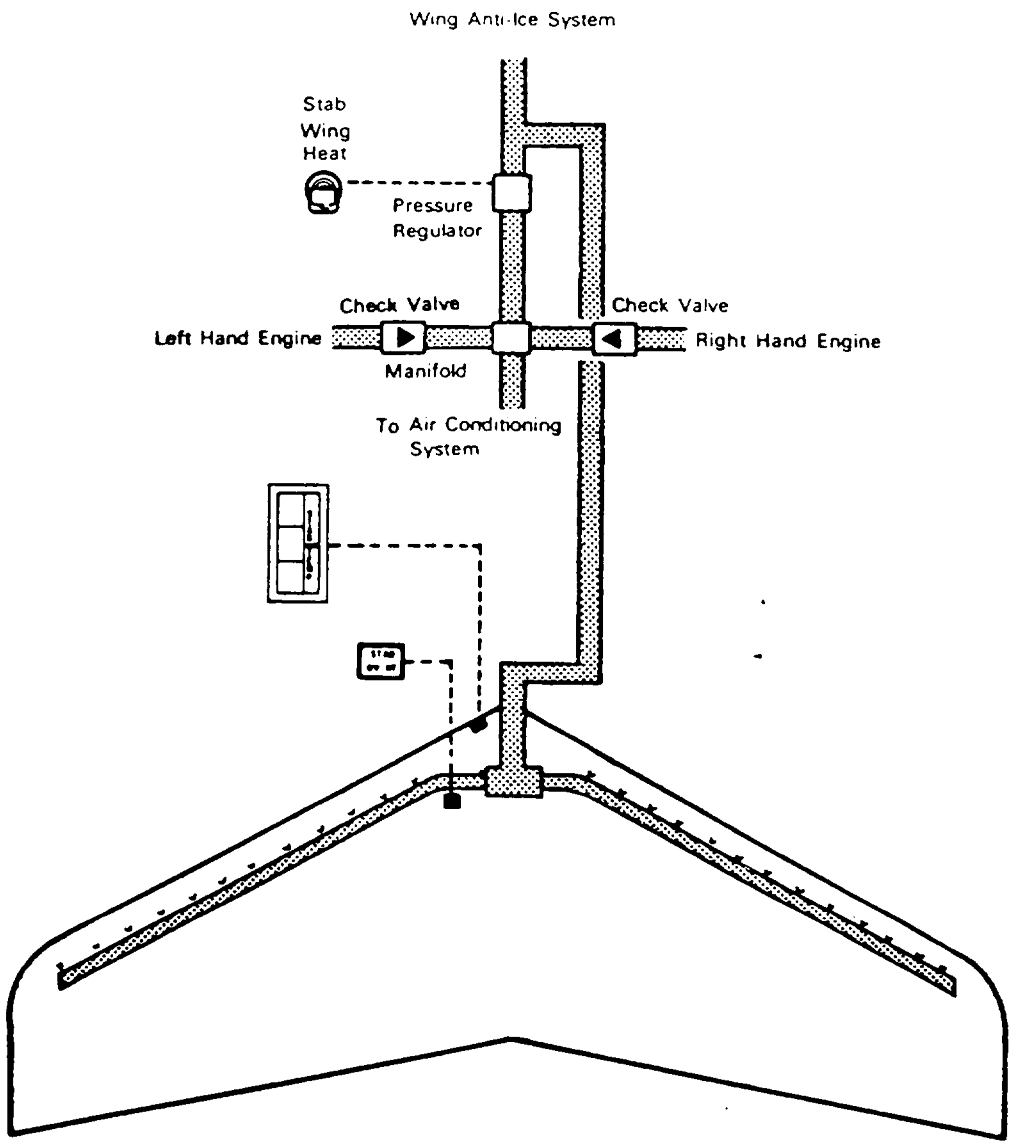

Figure 3-5 Horizontal Stabilizer Anti-Ice System Schematic

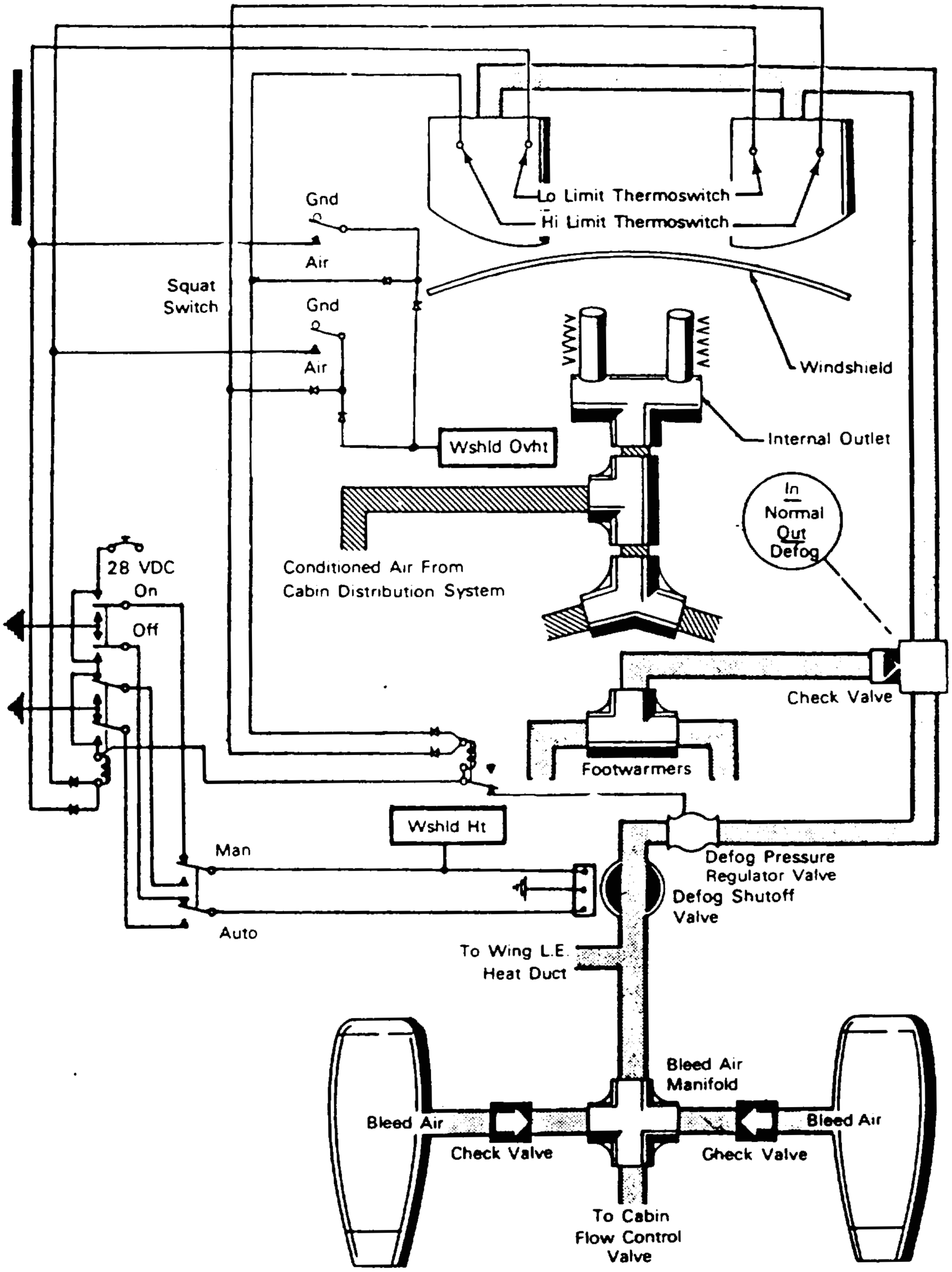

Figure 3-6 Windshield Defog System Schematic

ALCOHOL ANTI-ICE SYSTEM

Methyl alcohol (figure 3-7) is used for radome anti-icing and as a back-up for bleed air windshield anti-icing. The system is controlled by a WSHLD & RADOME OFF-RADOME switch. In the WSHLD & RADOME position, alcohol is routed to the radome and the pilot's windshield. In the RADOME position all alcohol is routed to the radome. Basic components of the system are a 2.2 gallon tank and a pump in the nose compartment and and ALC AI light on the readout panel. This is sufficient fluid to last approximately 43 minutes when used on WSHLD & RADOME or 90 minutes when used on RADOME only. Illumination of the ALC AI light indicates the alcohol supply is depleted.

ELECTRIC HEATERS

Anti-icing heaters are integral parts of the pitot heads, static ports and stall warning vanes. Static port heaters are energized anytime the battery switches are on. The PITOT HEAT switches energize the pitot head heaters and stall warning vane heaters.

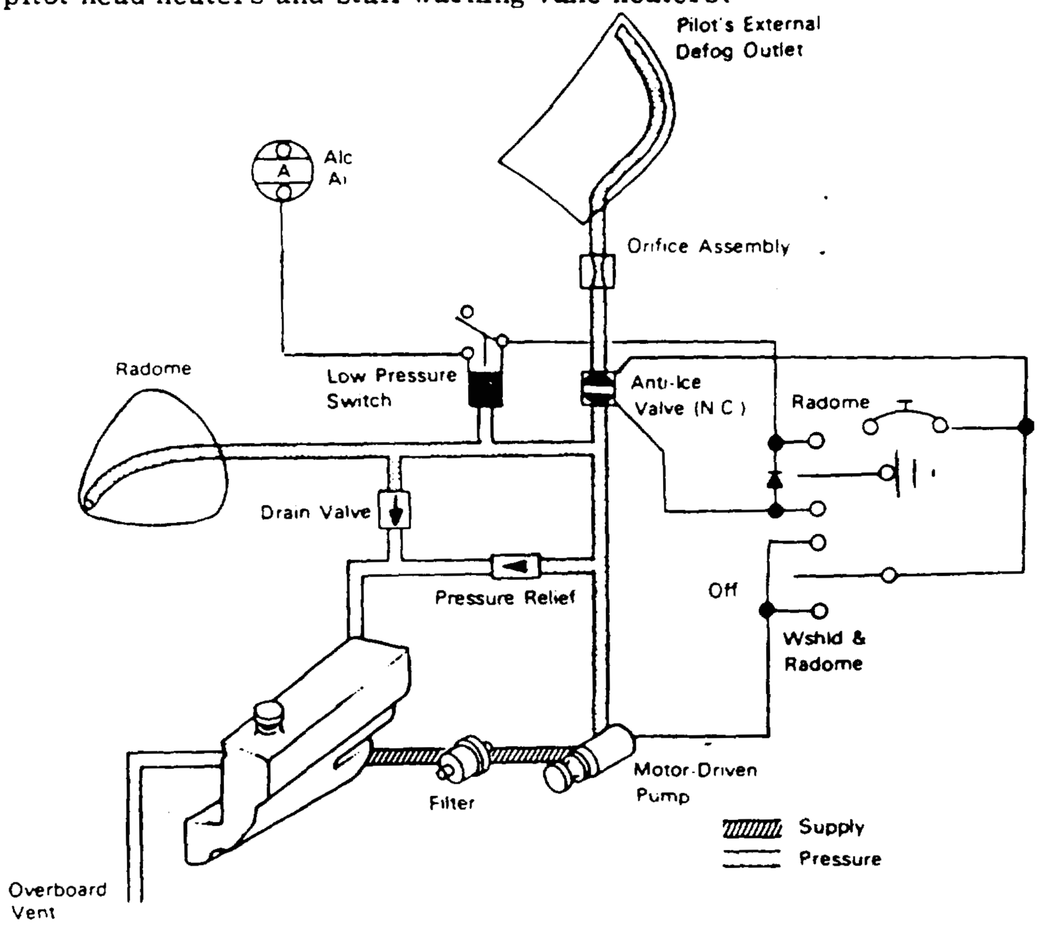

Figure 3-7 Alcohol Anti-Ice System Schematic

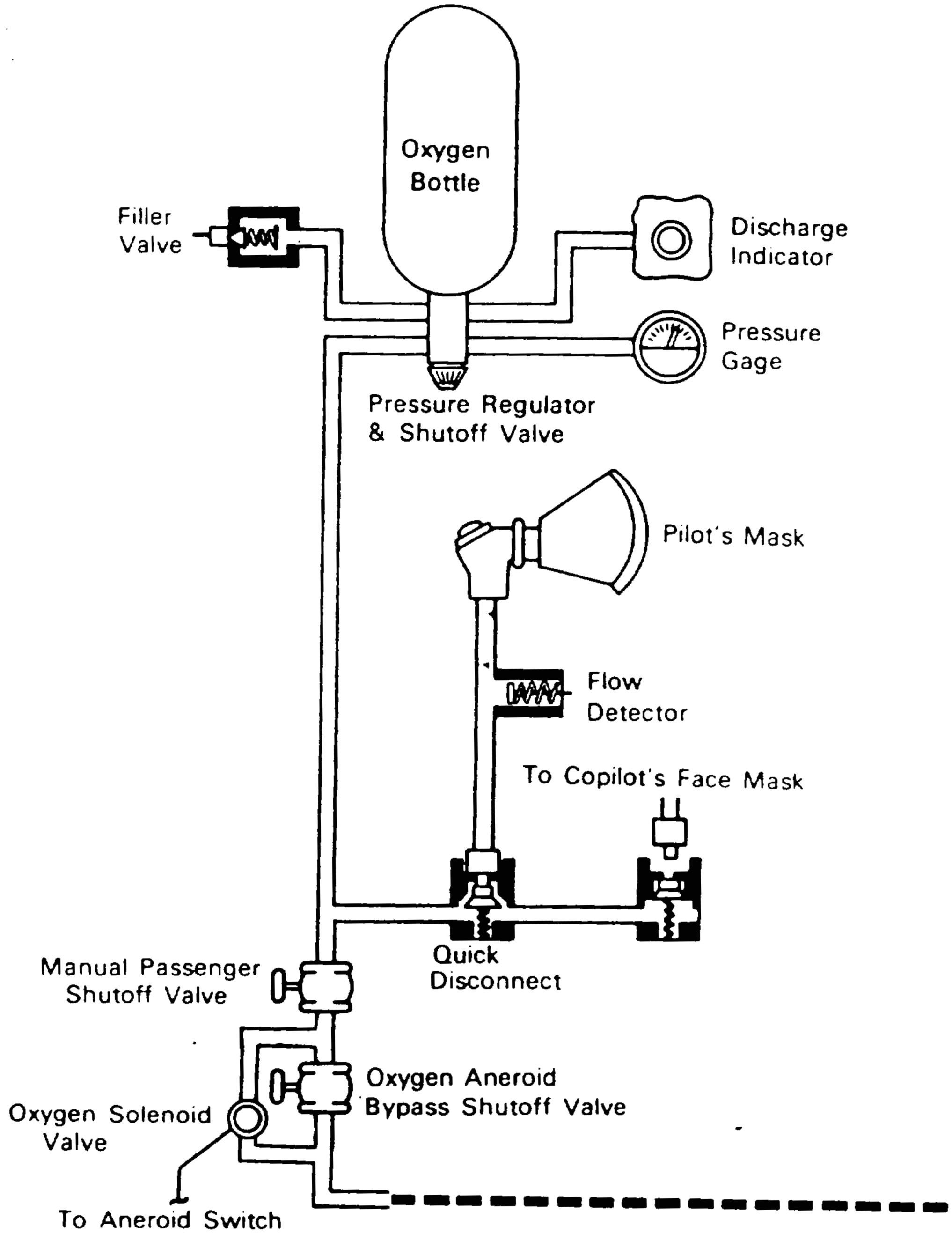

Figure 3-8 Oxygen System Schematic (Sheet 1 of 2)

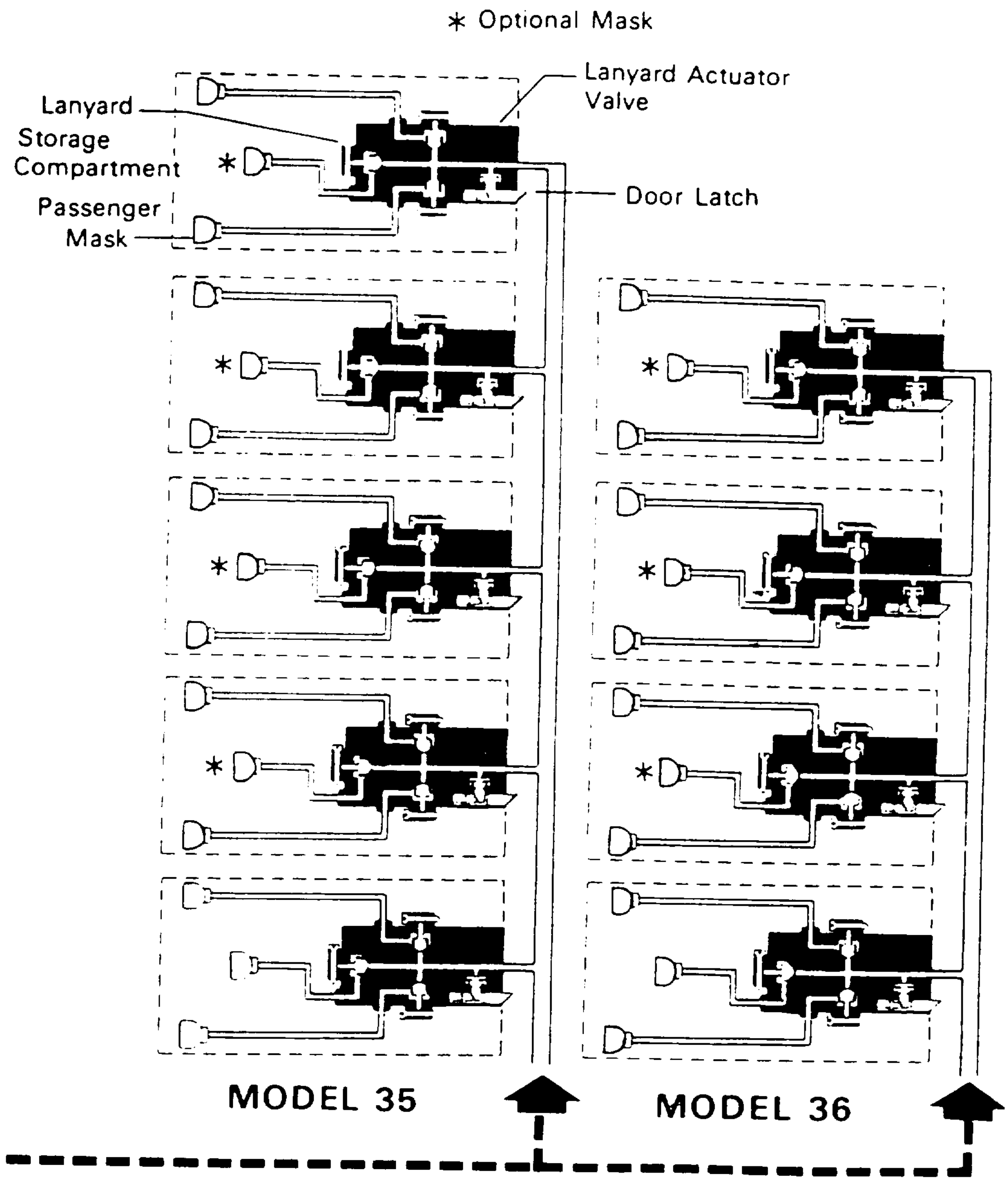

Figure 3-8 Oxygen System Schematic (Sheet 2 of 2)

OXYGEN SYSTEM

The aircraft oxygen system provides oxygen service for the flight crew and passengers. The system consists of the crew and passenger distribution systems, a high-pressure oxygen storage cylinder, a shut-off valve and pressure regulator assembly, an oxygen pressure gage, overboard discharge relief valves and indicator, an oxygen aneroid switch, an oxygen solenoid valve, a manual (PASS MASK MAN↔AUTO) aneroid bypass valve, a manual (PASS OXY NORM↔OFF) oxygen shutoff valve, and lanyard actuated passenger mask oxygen valves. Electrical power to operate the oxygen solenoid valve is supplied through the 7.5-amp OXY VAL circuit breaker on the pilot's circuit breaker panel. Oxygen is available to the crew at all times when the oxygen cylinder shutoff valve is open and can be made available to the passengers either automatically above 14,000 (±750) feet cabin altitude, or manually at all altutudes through use of cockpit controls on the pilot's sidewall. Smoking is prohibited when oxygen is in use.

OXYGEN STORAGE AND PRESSURE REGULATION

The oxygen storage cylinder has a storage capacity of 38 cubic feet at 1800 psi. The cylinder may be located in the nose compartment or in the dorsal fin (Model 36 only). The shutoff valve and pressure regulator assembly provides for pressure regulation, pressure indication, and servicing. Oxygen pressure is available to the passenger and crew distribution systems and is regulated to a pressure of 60 to 80 psi when the shutoff valve is open. There is also a burst disc pressure relief valve incorporated to discharge the oxygen cylinder contents overboard in the event that cylinder pressure reaches 2700 to 3000 psi. Should the cylinder contents be discharged overboard, the green overboard discharge indicator on the outside surface of the aircraft near the storage cylinder will be ruptured or missing.

OXYGEN PRESSURE GAGE

The oxygen pressure gage is located on the center instrument panel or pilot's sidewall. The gage is calibrated from 0 to 2000 in psi. The gage is a direct-reading type that is plumbed to the high-pressure side of the regulator and indicates oxygen cylinder pressure-only.

OXYGEN SYSTEM COCKPIT CONTROLS

The oxygen system cockpit controls consist of two control valves, labeled PASS OXY NORM↔OFF and PASS MASK MAN↔AUTO, located on the pilot's sidewall above the armrest. The PASS OXY control valve controls oxygen availability to the passenger oxygen distribution system. The PASS MASK control valve provides automatic or manual mode selection for the passenger oxygen distribution system. Oxygen is available to the crew oxygen distribution system at all times when the oxygen cylinder shutoff valve is open. Control positions and system function is as follows:

1. With the PASS OXY valve in the NORM position and the PASS MASK valve in the AUTO position, oxygen is available to the passenger distribution system and the aneroid-controlled solenoid valve will deploy the passenger masks automatically. Should the cabin altitude reach 14,000 (±750) feet the aneroid switch will open the solenoid valve, the passenger oxygen masks will deploy, and the upper center panel lights will illuminate. Normally, the controls should be in this position.

2. With the PASS OXY valve in the NORM position and the PASS MASK valve set to MAN, oxygen is available to the passenger distribution system and the passenger masks will deploy. Setting the PASS MASK valve to MAN will bypass the solenoid valve and allow oxygen system pressure to deploy the passenger masks. This position can be used to deploy the passenger masks at any cabin altitude.

3. With the PASS OXY valve in the OFF position, oxygen is <u>not</u> available to the passenger distribution system regardless of the position of the PASS MASK valve. This position can be used when oxygen is required for the crew only.

PASSENGER MASKS

Passenger oxygen masks are stowed in compartments in the cabin ceiling upper-center panel. Whenever the compartment doors open automatically (PASS OXY-NORM, PASS MASK-AUTO) or manually (PASS OXY-NORM, PASS MASK-MAN), oxygen is available for passenger use. Passengers should don masks and pull lanyard. An orifice is incorporated in the mask to provide a constant flow of 4.1 liters per minute. Should the compartment doors be inadvertently opened from the cockpit, pressure must be bled from the system by pulling one of the

PASSENGER MASKS (Cont)

lanyards before the masks can be restowed. The compartment doors can be opened manually for mask cleaning and servicing by releasing the latch labeled OXYGEN adjacent to each door. When the doors are opened using this method, no oxygen flow is available to the masks.

CREW MASKS

The flight crew masks are stowed on straps or brackets behind the pilot's and copilot's seats. The regulator on each mask incorporates a lever for selecting NORM (diluted oxygen) or 100% oxygen (refer to the FAA Approved Flight Manual for detailed operation procedures). Each mask incorporates a microphone controlled by the OXY-MIC-ON-OFF switch on the jack panel (pilot's and copilot's aft armrest. An electrical cord extends from each mask and is plugged into the OXY-MIC jack on the jack panel. With the OXY-MIC-ON-OFF switch in the ON position, the microphone is keyed through the microphone switches on the forward side of the outboard horn of each control wheel. A pressure detector is installed in each mask oxygen supply line to show visible verification of oxygen pressure to the mask. A quick disconnect is provided for each crew member. When the mask bayonet is inserted into the quick-disconnect, a spring loaded poppet moves off its seat and allows oxygen flow into the mask supply line.

EXTERIOR LIGHTS

LANDING-TAXI LIGHTS

A landing-taxi light is installed on each main landing gear. Each light is controlled by a switch labeled LDG LT - TAXI - OFF. The landing lights are wired through the main gear down-and-locked switches. Therefore, the landing lights are inoperative when the gear is retracted. The control relays operate on 28 vdc supplied through 7.5-amp circuit breakers labeled L LDG & TAXI LT on the pilot's circuit breaker panel and 7.5-amp circuit breaker labeled R LDG & TAXI LT on the copilot's circuit breaker panel. The lamps operate on 28 vdc through 20-amp current limiters. In order to extend the service life of landing/taxi lights, it is recommended the lights be used as sparingly as feasible in the LDT-LT mode. In the LDG-LT mode, full 28 vdc is applied to the lights which considerably shortens the service life.

When the LDG LTS/TAXI lights are in the TAXI position, the circuit is shunted through paralleling resistors which dim the lights for taxiing. In the TAXI position, 21 vdc is applied to the lights.

ANTI-COLLISION LIGHTS

Anti-collision lights are installed on top of the vertical stabilizer and bottom of the fuselage. The lights are controlled by a BCN LT switch on the lighting switch panel. Each light is a dual-bulb light and each bulb oscillates 180 degrees at 45 cycles per minute. The beam is concentrated by an integral lens and produces an illusion of 90 "flashes" per minute due to the oscillation. The lights operate on 28 vdc through a 7.5 BCN LT circuit breaker on the copilot's circuit breaker panel.

NAVIGATION LIGHTS

The navigation lights are located on the outboard side of each tip tank and in the aft end of the vertical stabilizer fairing. The lights are controlled by the NAV LT switch on the Lighting Switch panel and operate on 28 vdc through the 7.5-amp NAV LT circuit breaker on the pilot's circuit breaker panel.

STROBE LIGHTS

The strobe light system consists of three power supply modules, a timing circuit, three strobe lights and a STROBE LT switch on the lighting switch panel. The strobe lights are mounted adjacent to each navigation light and may be operated independently of the navigation lights. The timing circuit provides a pulse of approximately 50 times per minute to the power supply module which furnishes 450 vdc for each light. The strobe lights are controlled by the STROBE LT switch which supplies 28 vdc through the STROBE LT circuit breaker on the pilot's circuit breaker panel.

RECOGNITION LIGHT

A recognition light is installed in the nose of the right hand tip tank. The light is controlled by the RECOG LT switch on the Lighting switch panel. When in the ON position 28 vdc is applied through the 7.5-amp RECOG LT circuit breaker to a control relay. With the control relay energized 28 vdc is applied through 30 amp current limiters to the light.