# SECTION XIII

# HEATING AND VENTILATING


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# SECTION XIII

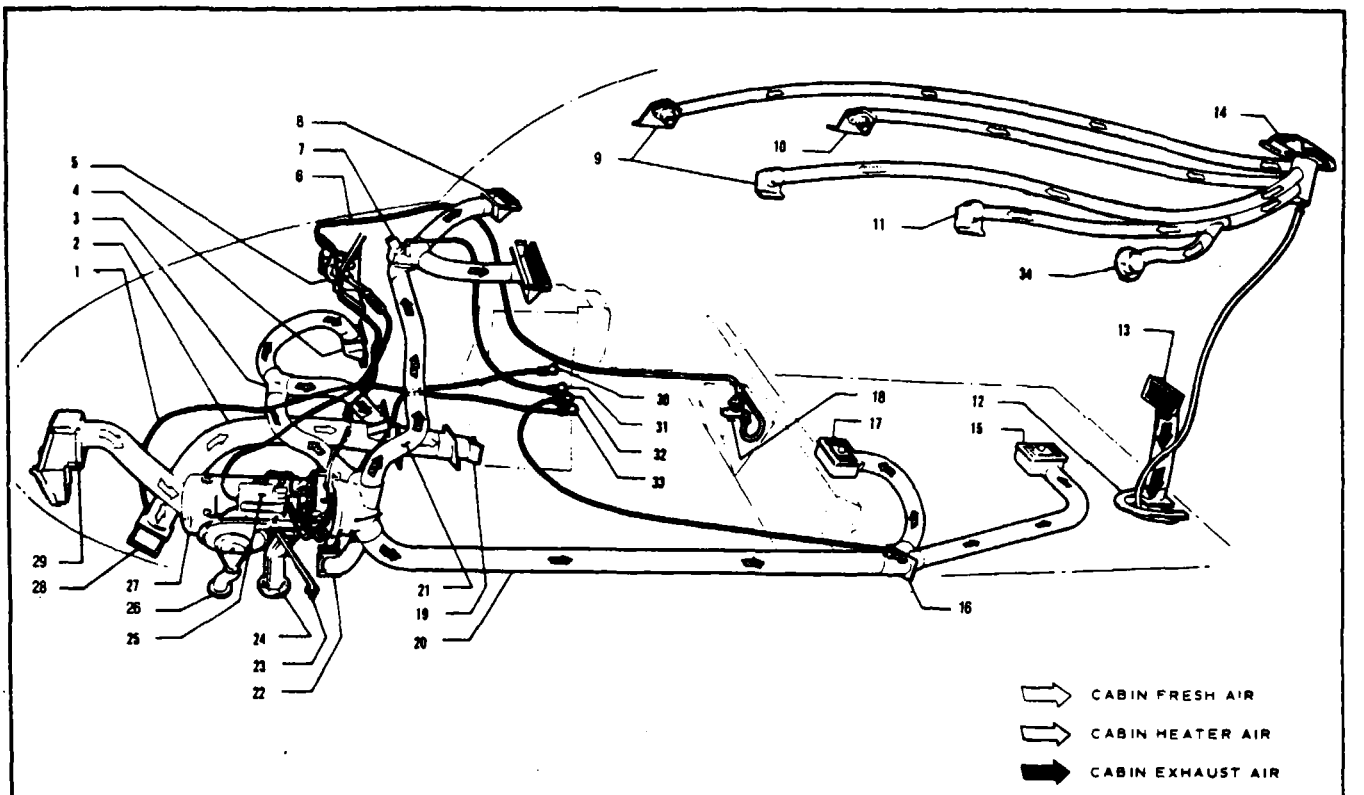
# HEATING AND VENTILATING SYSTEM

13-1. INTRODUCTION. This section contains instructions for the operation, maintenance and overhaul of the different heating and ventilating systems found in the PA-23 Series airplanes. In addition, instructions for the inspection and servicing of the components that contribute to the operation of the heating and ventilating system may be found in this section. Inspection time intervals for these systems may be found in Section III of this manual.

13-2. DESCRIPTION. The flow of air for heating and defrosting is taken through an inlet in the airplane nose section and directed to a South Wind or Janitrol heater located in the left side of the nose section. From the heater, air for defrosting is directed through outlets located on the instrument panel cover, while air for cabin heat is delivered through outlets on the forward cabin bulkhead and grills located in the floor. Fresh air is also taken through the same inlet in the nose and delivered to the forward cabin area through an outlet on the forward bulkhead of the cabin. These functions are controlled by a heater switch on the right side of the instrument panel and push-pull knobs, on the cabin air control panel, located at the bottom of the control pedestal.

An additional scoop mounted on top of the airplane or in the dorsal fin draws fresh air into the cabin through individual vents over each seat. Each vent is adjustable for the desired air flow. Located in the aft section of the cabin interior is an exhaust vent to improve the circulation of air in the cabin interior.

A pictorial description of these systems may be found in Figures 13-1 thru 13-5 with a detailed description and operation of the heaters found in paragraphs 13-8 and 13-92.




1. CABLE - COLD AIR INLET CONTROL, FRONT SEAT
2. DUCT - FRESH AIR, FRONT SEAT
3. DUCT - HEATER SYSTEM AIR, FRONT SEAT
4. INLET - HEATER SYSTEM AIR, FRONT SEAT
5. CONTROL VALVE - HEATER FUEL
6. LINE - HEATER FUEL
7. CONTROL VALVE - DEFROSTER
8. INLET - HEATER SYSTEM AIR, DEFROSTER
9. VENTS - FRESH AIR, FRONT SEAT
10. VENT - FRESH AIR, RIGHT REAR
11. VENT- FRESH AIR, LEFT REAR
12. OUTLET - AIR EXHAUST, CABIN
13. BOX - AIR EXHAUST, CABIN
14. SCOOP - FRESH AIR, CABIN
15. INLET - HEATER SYSTEM AIR, REAR CABIN
16. CONTROL VALVE - HEATER SYSTEM, REAR SEATS
17. INLET - HEATER SYSTEM AIR, CENTER CABIN
18. SHUT-OFF VALVE - HEATER FUEL
19. INLET - FRESH AIR, FRONT SEAT
20. DUCT - HEATER SYSTEM AIR, REAR SEATS
21. DUCT - HEATER SYSTEM AIR,
22. DUCT - HEATER SYSTEM AIR, OVERBOARD DUMP
23. VENT LINE - HEATER FUEL
24. TUBE - HEATER EXHAUST
25. CONTROL VALVE - "HI-LO", HEATER FUEL
26. TUBE - COMBUSTION AIR INTAKE
27. HEATER
28. SCOOP, FRESH AIR, FRONT SEAT
29. SCOOP - OUTSIDE AIR TO HEATER SYSTEM
30. CONTROL - FRESH AIR, FRONT SEAT
31. CONTROL - HEATER SYSTEM AIR, DEFROSTER
32. CONTROL - HEATER SYSTEM AIR, REAR SEATS
33. CONTROL - HEATER SYSTEM AIR, FRONT SEATS
34. VENT - FRESH AIR, FIFTH SEAT

Figure 13-1. Heating and Ventilating System
PA-23-235 and PA-23-250 Serial Nos. 27-1 to 27-504 incl.

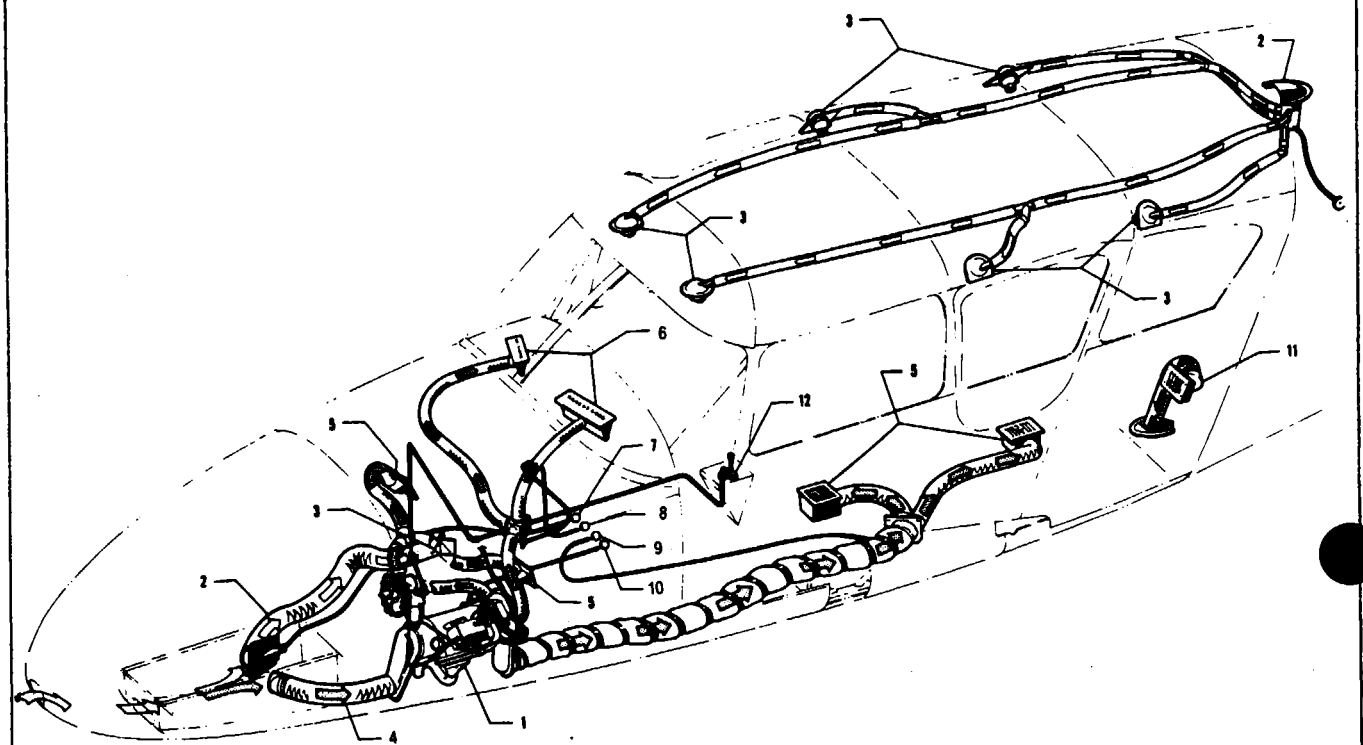



Figure 13-2. Heating and Ventilating System
PA-23-250 (six place) Serial Nos. 27-2000 to 27-2504 incl.

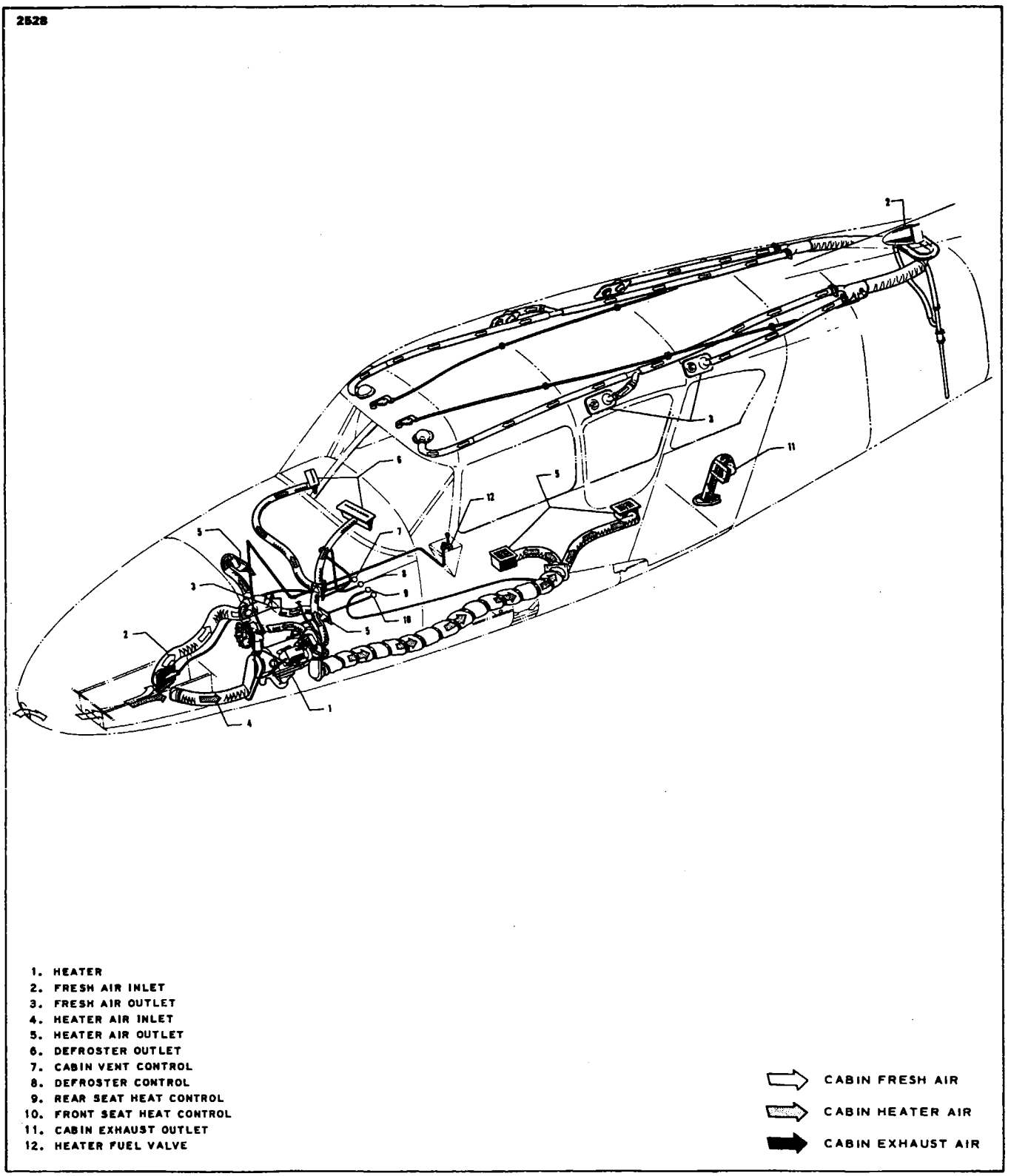



Figure 13-3. Heating and Ventilating System - PA-23-250 (six place)
Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.

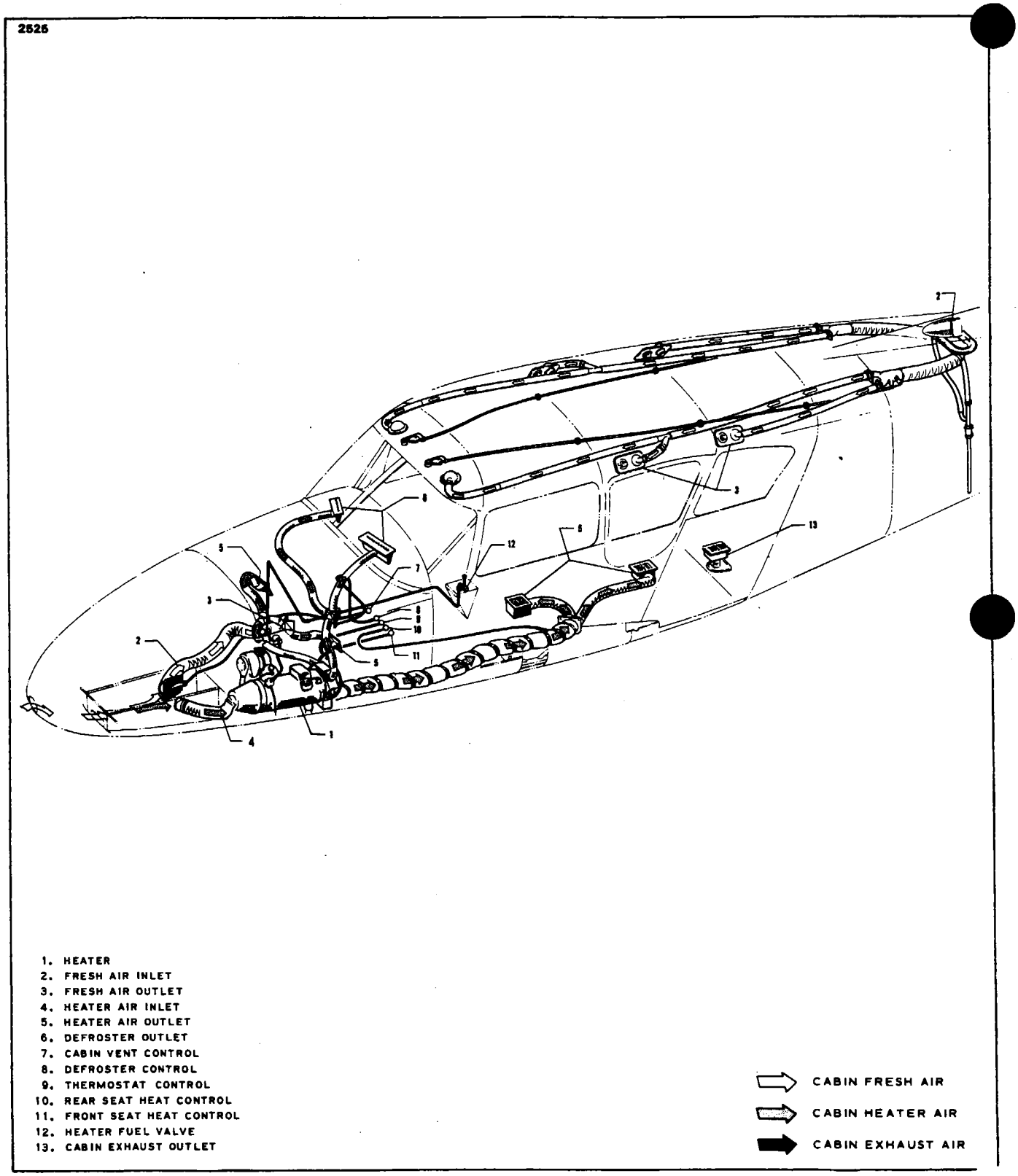



Figure 13-4. Heating and Ventilating system - PA-23-250 (six place)
Serial Nos. 27-3050, 27-3154 to 27-3836, 27-3838 to 27-3943 incl.

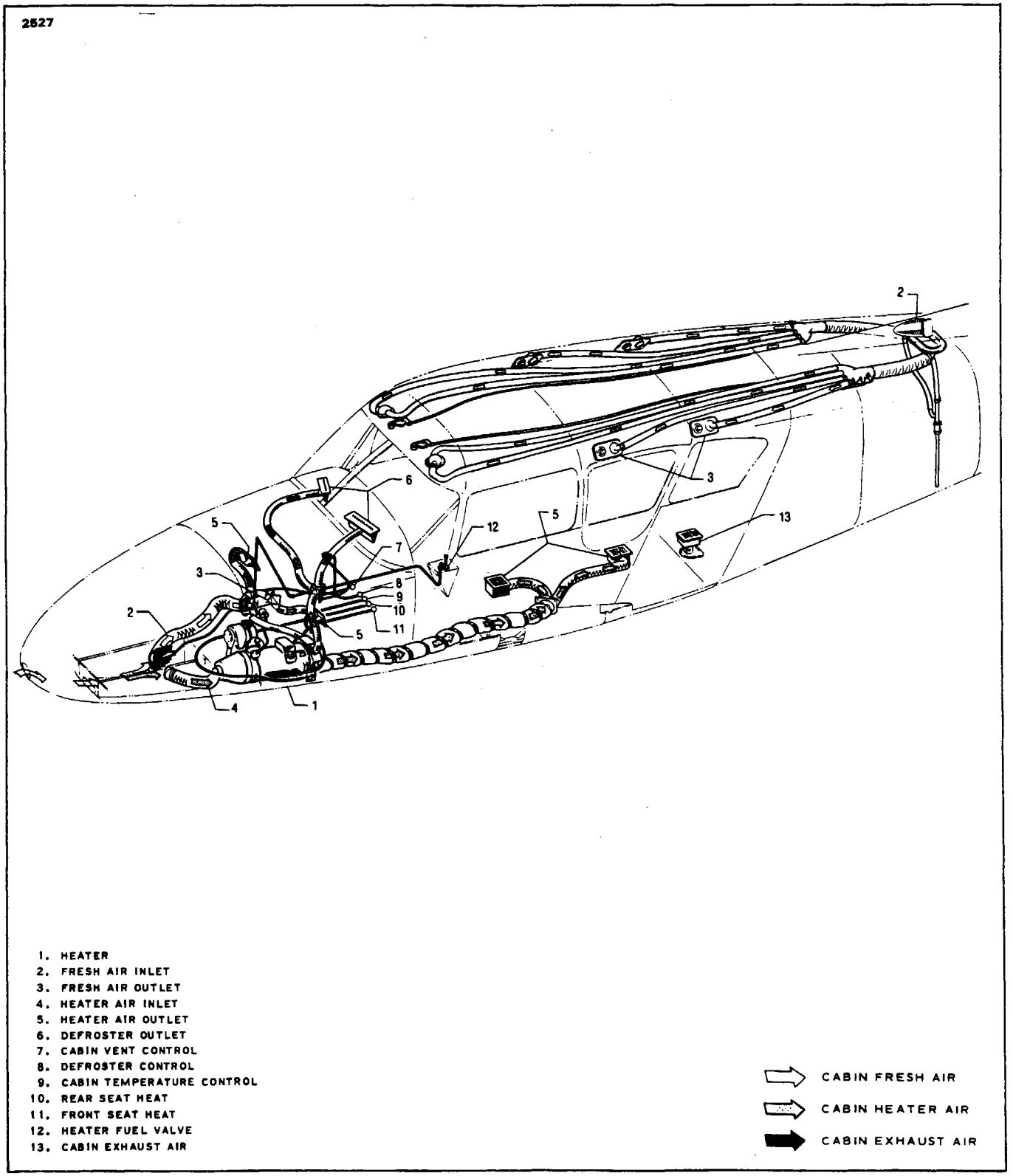



Figure 13-5. Heating and Ventilating System
PA-23-250 (six place) Serial Nos. 27-3837, 27-3944 to 27-4425 incl. and 27-4427 to 27-4573 incl.

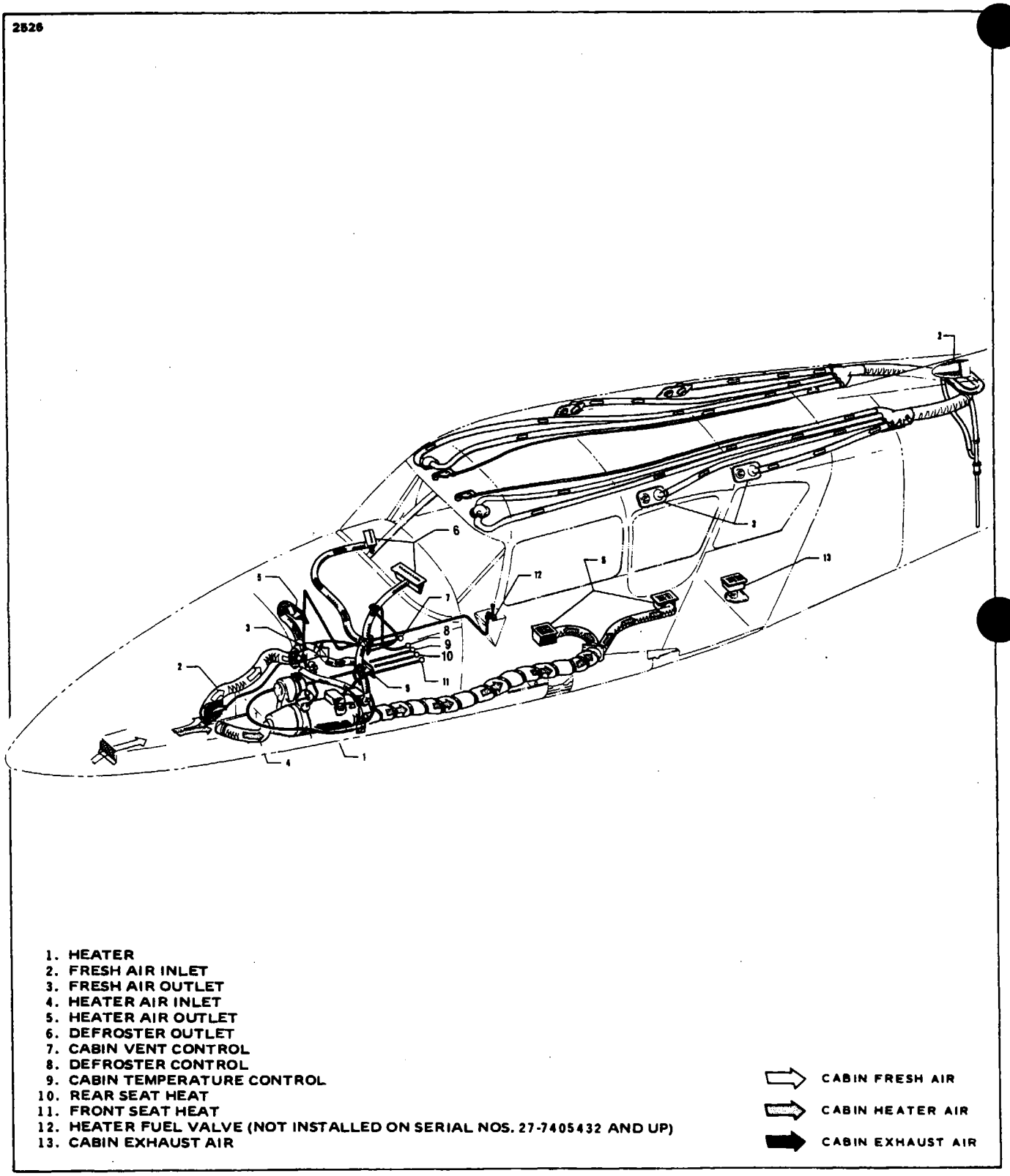



Figure 13-6. Heating and Ventilating System
PA-23-250 (six place), Serial Nos. 27-4426 and 27-4574 and up

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13-3. HEATER SAFETY LIMIT SWITCH. Located in the South Wind and Janitrol heaters is a heat limit switch, which acts as a safety device to render the heater system inoperative if a malfunction should occur causing excessively high temperatures. This control is located in the downstream end of the vent jacket, with the reset button on the heater shroud. It is reached only through the access panel in the left side of the nose section to insure that the malfunction causing the overheat condition is corrected prior to future heater operation.

13-4. INSPECTION OF HEATER AND HEATER COMPONENTS.

a. Inspect all fuel lines and fittings for fuel stains indicating leakage. Replace lines or tighten fittings as necessary.

b. Check heater for cracks and loose bolts, screws and wiring.

c. Inspect all electrical connections for corrosion; if corrosion is evident, clean affected components and wipe clean with a lightly oiled cloth.

13-5. TROUBLESHOOTING. Troubles peculiar to the heating and ventilating systems are found throughout this section in table form. Heaters are grouped according to heater manufacturer. Further assistance to the electrical function of the heaters may be found in the Electrical System Schematics found in Section XI.

13-6. HEATER (South Wind, Model 940 Series). PA-23-250; PA-23-235; PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.; and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.

13-7. HEATER OPERATIONAL INSTRUCTIONS. The South Wind heater installed in the Aztec is a 27, 500 B. T. U. 12 or 24-volt unit. The 12-volt heaters are Models 940-D12, 940-DA12, 940-DB12 and 940-K12 and the 24-volt units are Models 940-D24, 940-DA24 and 940-DB24. The heater is controlled by a switch located on the right side of the instrument panel labeled OFF, PRIME, LOW and HIGH. To operate the heater, first turn on the fuel control valve located on the fuel selector panel. Move the switch to HIGH or LOW heat. If the heater does not start promptly, return the heater switch to PRIME position for 15 seconds to prime the heater; then upon moving the switch to HIGH heat, the heater should start and continue to operate after one to one and a half minutes of warm-up. When operating the heater for any length of time on the ground, it is recommended to operate the heater in LOW heat position.

The heater uses gasoline from either left fuel cell when the fuel crossfeed is off, and from all cells when the crossfeed is on.

The push-pull knobs at the bottom of the control pedestal control air flow and temperature. The left control regulates air flowing to the front seat through the heater system and the second knob from the left controls air flowing to the rear seat, the second knob from the right is the defroster control and the right knob controls the supply of cool air through the vent on the forward bulkhead.

In airplanes equipped with a Model 940-K12 heater, a fifth knob is installed and this is located in the center of the air control panel between the other knobs. The knob is connected to an adjustable thermostat which makes it possible to select a desired temperature of heated air.

After the heater is turned to the OFF position, combustion in the heater stops, but the combustion fan and the circulating air fan continues to operate for about two minutes, while the heater cools and purges itself of hot air and fumes. To obtain best service life from the heater components, it is recommended that the heater switch be turned off about two minutes before turning off the master switch.

During ground operation or when the landing gear is extended, the ventilating fan motor operates and provides hot air flow through the heater system. In flight, when the gear is retracted, a micro switch on the nose gear cuts off the heater fan, and heater air is supplied by ram pressure through the nose inlet beside the landing light. This arrangement assures an adequate flow of air through the heater at all times. There is a dump valve arrangement in the heater bonnet to exhaust excessive heat thereby making it possible to operate the heater with all controls in the closed position.

For the overhaul and complete disassembly of the South Wind heater and its components, refer to paragraph 13-49 of this manual. A wiring diagram of the heater Electrical System Installation will be found in Section XI of this manual.

13-8. DESCRIPTION AND PRINCIPLES OF OPERATION. Principles of operation are basically the same for all models of the 940 Series heaters since the differences between heaters are confined to safety devices which do not function during normal burning of the heater. Operation of the safety devices follows this description.

The heater produces heat by burning a mixture of gasoline and air in a sealed, all-welded, stainless steel heat exchanger. (Refer to Figure 13-7.) Air for combustion is obtained from a blower on the side of the heater housing and is introduced into the heat exchanger through two metal elbows. Gasoline is obtained from the airplane's fuel system and is supplied to the heater through a safety valve and filter which is mounted in the nose section near the heater.

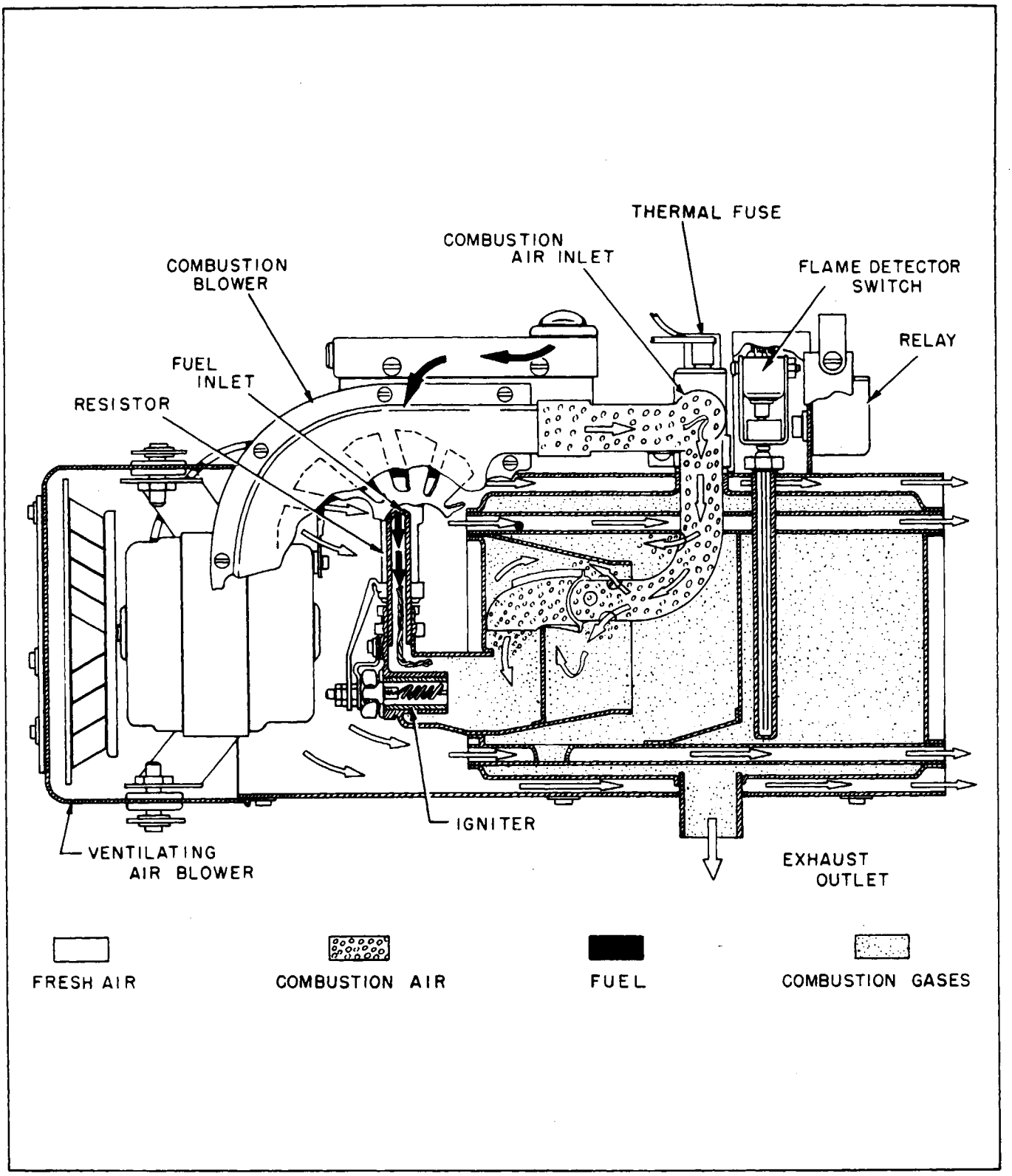



Figure 13-7. Flow System (South Wind Heater)

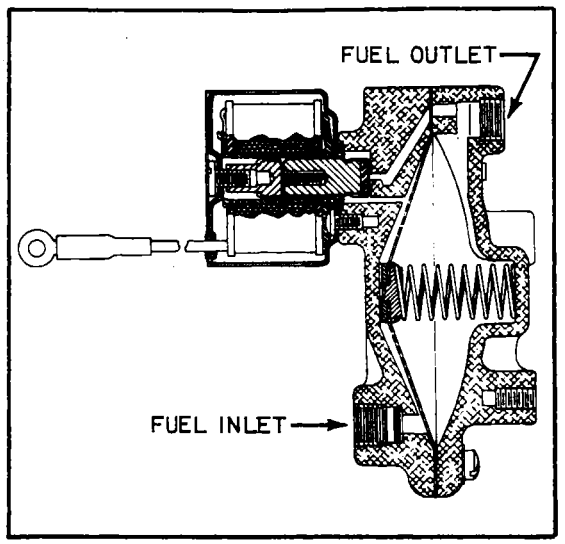



Figure 13-8. Fuel Safety Valve (Cutaway View)

Fuel is metered at the heater by the fuel control valve, (Refer to Figure 13-9.) which is enclosed in a metal case on top of the heater. The metal case is equipped with fittings for a drain tube at the bottom, and a vent tube at the top. These tubes prevent the possibility of a fire hazard, or release of fumes, in the event that a fuel leak should develop in the valve or fuel line connection.

After being metered by the fuel control valve, the fuel passes through a short steel tube and enters a vertical standpipe. (Refer to Figure 13-7.) The fuel drips down the standpipe and saturates the stainless steel wick in the combustion chamber. The standpipe is surrounded by an electric heating element which is energized during the starting period and serves to preheat the fuel, thus insuring quick starts even at the lowest temperatures.

The fuel is ignited within the heat exchanger by a glow-plug igniter, and the resulting hot gases pass through the wraps of the heat exchanger and out the exhaust tube.

After combustion starts, the igniter and fuel preheater are turned off by the flame detector switch (Refer to Figure 13-10 or 13-11.) which also turns on the ventilating air blower at this time. Since the standpipe is now heated by combustion in the heat exchanger, preheating is no longer required and the preheater is also turned off.

13-9. SAFETY VALVE. (Refer to Figure 13-8.) The safety valve which is supplied with all models of the 940 heater consists of a shutoff solenoid and a casting which houses a large diaphragm and spring. The safety valve provides the initial flow of fuel for ignition. Additional fuel to sustain combustion is permitted to flow only after the shutoff solenoid of the safety valve is energized during a starting cycle. Fuel flows from the fuel source through the filter to the inlet side of the safety diaphragm. Pressure of fuel against the diaphragm forces gasoline, contained in the opposite side of the chamber through the outlet port into the heater.

When the flame detector switch transfers after combustion starts, the shutoff solenoid is energized and opens a by-pass through which fuel then flows to the heater. Gasoline will continue to flow through this system until the heater is turned off. The chamber behind the diaphragm will refill during heater operation as

the spring returns the diaphragm to its normal position. This prepares the safety valve for another start. The safety valve may be manually recharged at any time by turning the heater switch to FAN or PRIME position for about 30 seconds.

The safety valve also acts as a second safety fuel shutoff valve, since it is energized through the heater relay. In the event of an overheat condition, which causes the thermal fuse or lockout overheat switch to open, the relay will be de-energized and the safety valve solenoid will close at the same time the heater fuel control valve shutoff solenoid closes. This double shutoff is required by Federal Regulations on airplane heater installations.

13-10. OVERHEAT SWITCH (Models 940-D and 940-DA). Two types of overheat switches are used in the 940 Series heaters. The 940-D Series heaters are equipped with a bimetal blade cycling-type switch which opens at a temperature of 250° F and shuts off fuel flow by de-energizing the fuel control valve shutoff solenoid. This switch is designed to protect the heater and airplane by limiting the heater outlet temperature. The cycling-type switch shuts off fuel only; when the heater cools, the switch will close and permit the heater to restart.

13-11. LOCKOUT OVERHEAT SWITCH (Model 940-K). This model is equipped with a snap-action type overheat switch with a manual reset button. This switch is connected in series with the thermal fuse so that functioning of either device will cause a complete shutdown of the heater. In this event, the fuel control valve solenoid and the safety valve solenoid will both close at the same time. Both of these devices also shut off the igniter.

13-12. THERMAL FUSE (Models 940-D, 940-DA, 940-DB and 940-K). The thermal fuse used on the models listed above consists of a special combustion air inlet elbow which contains a fusible metal link with electric terminals. The fusible link is connected in series with the hot lead from the heater switch.

An additional requirement of Federal Regulations is that airplane heaters be equipped with a device which will prevent operation at any time that combustion air flow is insufficient for safe operation. When applied to the 940 Series heaters, this means that the heater must shut down if combustion air flow is reversed, since the heater will operate safely under any other combustion air flow condition.

The special purposes of the thermal fuse is to shut off the heater if the direction of combustion air flow should be reversed. In such a condition, combustion air would enter through the heater exhaust and flow out through the combustion air inlet. It has been demonstrated that this flow can sustain combustion at a temperature below the overheat switch setting. For this reason, the thermal

fuse has been provided at the combustion air inlet. In the event of reverse burning, the hot gases will quickly melt the fusible link and the heater will be completely shut down. The heater cannot be restarted until the fusible link has been replaced after such an occurrence.

NOTE

The reverse burning described above can only occur under unusual conditions caused by improper installation, or by multiple failure of heater components. The thermal fuse has no effect on the heater during normal operation.

13-13. CYCLING SWITCH (Models 940-DB and 940-K). The cycling temperature limit switch, used on the models listed above, is similar to the cycling overheat switch on the other models but is set at a lower temperature. Its purpose is to prevent unnecessary operation of the lockout overheat switch by limiting heater outlet temperature.

13-14. SYSTEMS. The Model 940 Series heater consists of four systems: The Fuel System, The Combustion Air System, The Ventilating Air System, and The Electrical System. These systems are more fully described below.

13-15. FUEL SYSTEM. The fuel system consists of the safety valve (which was described under Safety Features), the heater fuel control valve and the standpipe. Most heaters are designed to operate with a fuel pressure between 1 and 15 psi. Less than one pound may not be sufficient to operate the safety valve diaphragm, and more than 15 pounds may damage the pressure regulator in the heater fuel control valve. The 940-DB and 940-K heaters are specially designed to operate at a fuel pressure of 20 to 35 psi and must be used only within this pressure range.

13-16. FUEL CONTROL VALVE. (Refer to Figure 13-9. ) The fuel control valve provides the proper amount of fuel for high or low heat operation, depending upon position of the thermostat contacts. The complete valve consists of two solenoid valves and a pressure regulator which maintains constant fuel pressure for heater operation, regardless of fluctuations of pressure in the fuel supply. The flow of fuel is regulated by an orifice plate which contains holes of the proper size to meter fuel flow for high and low heat.

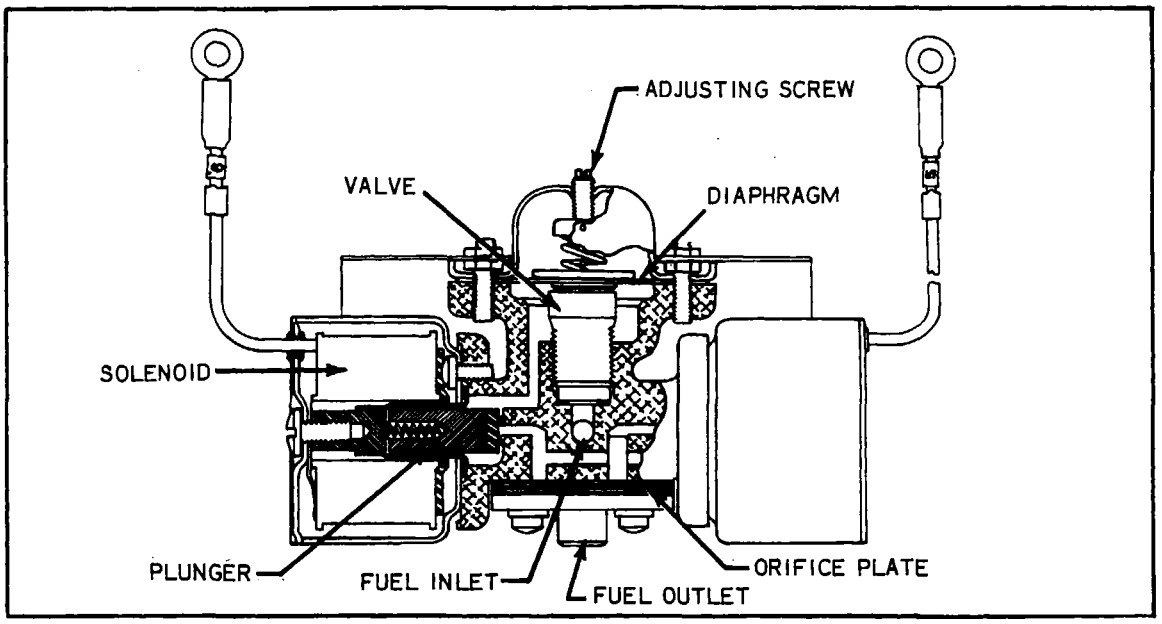



Figure 13-9. Fuel Control Valve (Cutaway View)

When the shutoff solenoid is closed or de-energized, no fuel can enter the standpipe, and the heater is completely shut off. When the shutoff solenoid is energized, fuel flows through the low heat metering orifice and the heater burns on low heat. When both the restriction and shutoff solenoids are energized, fuel flows through both the low heat orifice and the restriction orifice, thereby providing sufficient fuel for high heat operation. After leaving the fuel control valve,, the fuel drips down the standpipe where it saturates the stainless steel wick extending into the combustion chamber. (Refer to Figure 13-7.)

13-17. COMBUSTION AIR SYSTEM. The combustion air blower blows air through the metal elbows into the heat exchanger. Inside the heat exchanger the air passes through another duct (Refer to Figure 13-7. ) and is blown into the burner cone, where it mixes with the gasoline vapor and the mixture is ignited by the igniter. The burning gases then swirl around the heat exchanger and exhaust through the outlet tube.

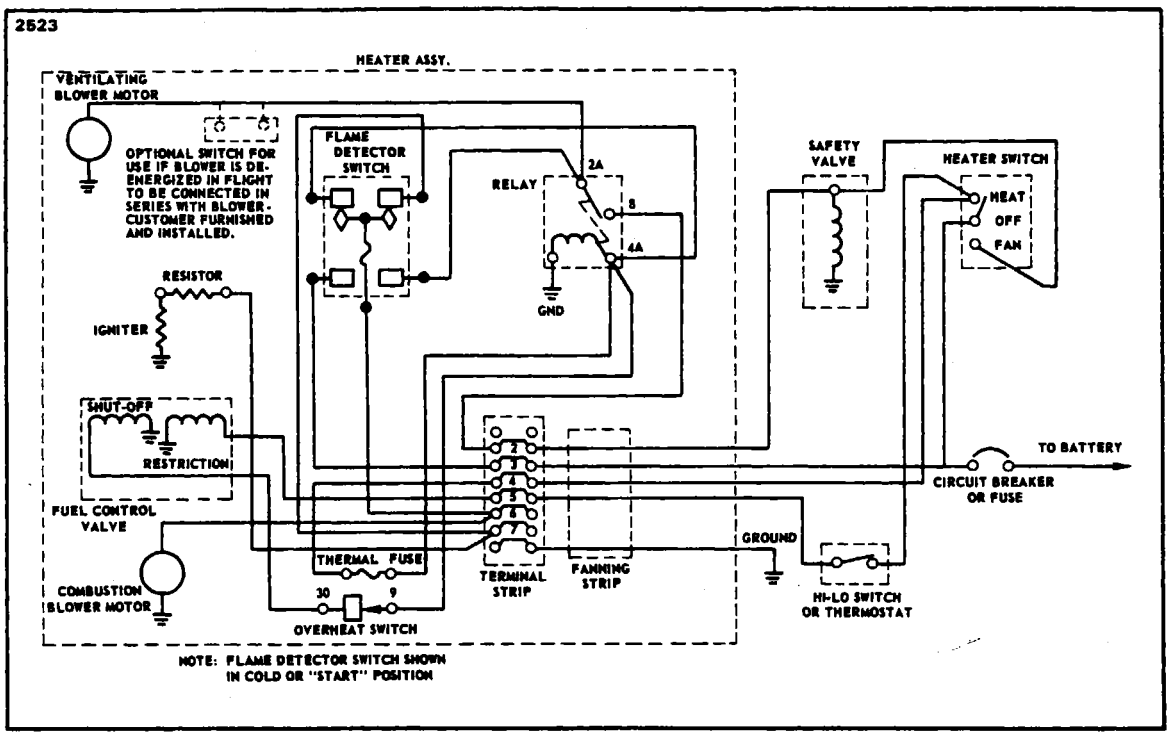



Figure 13-10. Wiring, Models 940-D and 940-DA

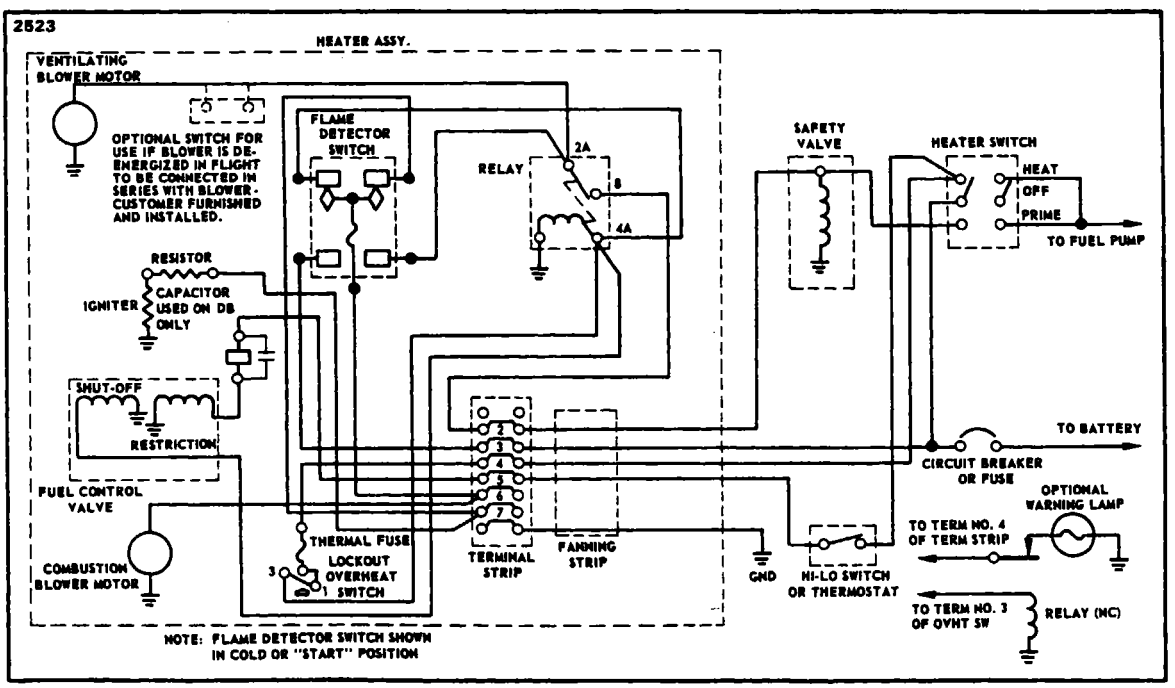



Figure 13-11. Wiring, Models 940-DB and 940-K

13-18. VENTILATING AIR SYSTEM. The ventilating air blower is mounted on the end of the heater by means of bayonet slots. The blower is a mixed-flow type which discharges axially, due to the design of the housing. It picks up clean air from outside the heater housing and blows it through the slots of the heat exchanger and around the sides, where it absorbs heat which is transmitted through the walls of the heat exchanger by the hot products of combustion. The heated air is then conducted to the space which is being heated.

13-19. ELECTRICAL SYSTEM. The heater electrical system consists of the combustion and ventilating air blower motors, the flame detector switch, the fuel valve solenoids, the fuel preheater, and the electric safety devices.

13-20. FLAME DETECTOR SWITCH. The purpose of the flame detector switch is to shut off the igniter and fuel preheater as soon as combustion has been established within the heater, and to provide a "purge" cycle after the heater is shut off. This switch consists of a hollow probe upon which is mounted a bracket and micro switch mechanism. The hollow probe contains a quartz rod which has a low rate of expansion when heated. (Refer to Figure 13-14.) The end of the quartz rod actuates the plunger of the micro switch. A leaf spring between the rod and plunger is provided to maintain a pressure through the rod against the end of the tube.

When installed on the heater, the hollow probe extends into the interior of the heat exchanger where it is subject to the heat of combustion. After combustion starts, the heating effect of the flame causes the metal tube to expand. Since the quartz rod does not expand, the lengthening tube relieves the pressure on the micro switch plunger, and the switch contacts transfer. The switch will then remain in this position as long as the tube remains hot, but will automatically return to the starting position when the heat exchanger cools. This purge cycle, after the heater switch is shut off, holds the blowers on until the residual fuel in the burner has been consumed, and the heater is cooled off.

13-21. IGNITER. The igniter is an electric "glow plug" type of heating element which glows red hot when energized. (Refer to Figure 13-7.) To prolong the life of the igniter, it is shut off by the flame detector switch as soon as combustion starts.

13-22. CYCLE OF OPERATION. When the heater switch is turned on, several things occur simultaneously. (Refer to Figure 13-10 or 13-11 according to heater model.)

a. The shutoff solenoid is energized through terminal No. 4 of the terminal strip, the overheat switch, and through the thermal fuse on models so equipped. This permits fuel to drip into the standpipe and saturate the stainless steel wick.

b. The igniter is energized through the flame detector switch which obtains its energy from terminal No. 4 of the terminal strip (or terminal No. 4A of the relay).

c. The fuel preheater heats up, since it is connected in series in the igniter circuit.

d. The combustion air motor is energized through the center connection of the flame detector switch and the blower starts.

With heated fuel dripping down the standpipe, the igniter glowing red hot, and the combustion air blower in operation, all requirements for combustion are present and burning soon starts in the heater. The heat of combustion causes the tube of the flame detector switch assembly to expand and permits the switch contacts to transfer, as previously described.

13-23. RUNNING CYCLE. When the flame detector switch transfers, the following events take place:

a. The ventilating air blower motor is energized through terminal No. 2 of the terminal strip (or 2A of the relay) and the flame detector switch and the blower start. The combustion air blower continues to run, since it obtains its energy, from the center terminal of the flame detector switch. Electric energy for both blowers is now being supplied from the No. 3 terminal which is connected directly to the battery, and the blowers will continue to run until the flame detector switch cools and returns to its starting position.

b. The igniter and fuel preheater are shut off when the flame detector switch transfers. Since combustion is self-sustaining, they are no longer required.

The heater is now in full operation and will continue to burn as long as fuel, air, and electric current are supplied. The temperature of the air may be regulated by opening and closing the restriction solenoid of the fuel control valve by means of a thermostat or HI-LO switch mounted on the right side of the instrument panel.

13-24. PURGING CYCLE. When the heater switch is turned OFF, the following sequence of events takes place:

a. The shutoff solenoid of the fuel control valve is de-energized, and fuel flow stops immediately. Burning soon stops due to lack of fuel.

b. The combustion air and ventilating air blowers continue to run since the flame detector switch is still hot and is in its running position. The flow of ventilating and combustion air cools the heat exchanger and purges it of all unburned gas fumes which might remain after burning stops.

c. When the heat exchanger cools, the tube of the flame detector switch contracts and forces the quartz rod up against the micro switch plunger. The switch then transfers to its cold position and the blowers stop. The fuel safety valve solenoid is also de-energized and will not open again until the flame detector switch becomes heated on another starting cycle.

13-25. OVERHEAT SWITCH. The heater is equipped with a cycling type overheat switch to limit duct temperature to a safe maximum level. This switch is connected in series between terminal No. 4 of the terminal strip and the shutoff solenoid of the fuel control valve. When the ventilating air stream exceeds a temperature of approximately 250° F., the bimetal blade of the overheat switch will open the switch contacts and break the solenoid circuit, shutting off fuel to the heater. Burning then stops, but the blowers continue to run. As soon as the heater cools, the overheat switch contacts will close and energize the fuel shutoff solenoid. At this point, fuel flow is re-established in the heater, but the igniter is off and ignition will not occur until the flame detector switch cools and transfers to its starting position. The igniter is then energized and combustion again starts.

If the heater switch remains on, and the cause of overheating is not corrected, this process which is known as "re-cycling", will continue indefinitely. Air temperature, however, will not exceed the temperature of the overheat switch setting.

13-26. ELECTRICAL SYSTEM (Model 940-D and 940-DA Series). The electrical system of the Model 940-D and 940-DA heaters has all the components provided for in the preceding paragraphs, plus a thermal fuse in the combustion air inlet elbow and the safety valve relay. (Refer to Figure 13-10.)

The starting cycle for these heaters has a safety valve solenoid that is energized through the normally open terminal No. 8 of the relay. The relay is energized through the circuit from the heater switch, terminal No. 4, and the thermal fuse. The relay is energized at the moment the heater switch is turned on and completes the circuit from terminal No. 2A to terminal No. 8, but the safety valve solenoid remains closed because of the flame detector switch, in its cold position, does not energize terminal No. 2A of the relay.

After ignition occurs and the flame detector switch transfers, the safety valve solenoid is energized and burning proceeds. The Model 940-D Series will

shut off and re-cycle if an overheat condition, due to restriction of ventilating air, should occur since this condition will not normally affect the thermal fuse.

If an unsafe operating condition should occur, due to a lack of combustion air through the heater while it is burning, the hot gases at the combustion air inlet will quickly melt the fusible link of the thermal fuse assembly. This breaks the circuit from the heater switch through terminal No. 4 of the terminal strip, and is equivalent to turning off the heater switch. The heater will then shut down in the normal manner described in the preceding paragraphs, and cannot be restarted until the thermal fuse has been replaced, since the starting circuit will remain open regardless of heater switch position. In the event of such a shut down, the relay will be de-energized at the moment the overheat condition occurs, and the safety valve and fuel solenoid shutoff valve will both close at the same time without regard to flame detector switch position. The combustion air blower and ventilating air blower will continue to run until the flame detector switch cools and transfers.

13-27. ELECTRICAL SYSTEM (Model 940-DB and 940-K Series). The Models listed above have electrical systems similar to the system of the Model 940-D, except that an additional safety device, the lockout overheat switch, is connected in series with the thermal fuse in the starting circuit, and a cycling temperature limit switch is connected into the restriction solenoid circuit. (Refer to Figure 13-11.) The purpose of the lockout overheat switch is to prevent re-cycling the heater after an overheat condition, and the purpose of the cycling limit switch is to prevent needless operation of the lockout overheat switch.

These heaters start in the same manner described for the 940-D Series heaters. Heater outlet temperature will then be controlled by action of the thermostat which opens and closes the restriction solenoid in the normal manner. If the thermostat should fail in the closed position, or should fail to sense duct temperature for any reason, the cycling switch will automatically limit heat output, since it is connected into the thermostat circuit, and serves the same purpose. This feature prevents heater shut down by the lockout overheat switch and consequent loss of heat, due to a defective thermostat or duct system.

The lockout overheat switch protects the heater and the airplane from an overheat condition caused by excessive fuel flow, or by a combined failure of ventilating air and the cycling limit switch. The lockout overheat switch is set at a higher temperature than the cycling limit switch, and like the thermal fuse, will operate only under extreme conditions. In the event of such an overheat condition, the heater will shut down the same as if the heater switch were turned off and cannot be restarted until the overheat switch plunger has been reset.

## TECHNICAL DATA

Electrical Requirements
- 940-D12, 940-DA12, 940-DB12, 940-K12 . . . . . 14-volts DC
- 940-C24, 940-D24. . . . . 28-volts DC

Current Consumption
- 940-D12, 940-DA12, 940-DB12, 940-K12
  - Starting . . . . . 12-amp.
  - Running . . . . . 7-amp.
- 940-D24, 940-DB24
  - Starting . . . . . 11.5-amp.
  - Running . . . . . 3.5-amp.

Fuel Pressure
- All Models except 940-DB and 940-K . . . . . 1 to 15 psi
- Models 940-DB and 940-K. . . . . 20 to 35 psi

Fuel Consumption
- 940-D
  - High Heat. . . . . 0.37 gph (0.037 lb/min)
  - Low Heat . . . . . 0.12 gph (0.012 lb/min)
- 940-DA
  - High Heat. . . . . 0.37 gph (0.037 lb/min)
  - Low Heat . . . . . 0.18 gph (0.018 lb/min)
- 940-K
  - High Heat. . . . . 0.37 gph (0.037 lb/min)
  - Low Heat . . . . . 0.08 gph (0.008 lb/min)

Heat Output
- 940-D
  - High Heat. . . . . 27,500 BTU/HR
  - Low Heat . . . . . 10,000 BTU/HR
- 940-DA, 940-DB
  - High Heat. . . . . 27,500 BTU/HR
  - Low Heat . . . . . 15,000 BTU/HR

TECHNICAL DATA (cont. )

Heat Output (cont. )

940-K

| | |
|---|---|
| High Heat | 27, 500 BTU/HR |
| Low Heat | 5, 500 BTU/HR |

Overheat Switch Operating Temperature

| | |
|---|---|
| 940-D, 940-DA | 250° F |
| 940-K | 140° to 160°F |
| 940-DB | 205° to 245°F |

Cycling Switch Operating Temperature

| | |
|---|---|
| 940-DB, 940-K | 220°F |

Dimensions

All Models . . . . . 16-7/8 in. long; 7-3/4 in. wide; 9-1/8 in. high
Weight: 20 lbs. (Approx. )

| | |
|---|---|
| Diameter of Housing | 6-3/16 in. O.D. |
| Combustion Air Inlet | 1-1/2 in. O.D. |
| Heater Exhaust | 1-1/2 in. O.D. |
| Exhaust Shroud Flange | 2-1/2 in. O.D. |

13-28. REMOVAL OF HEATER. (PA-23-250 and PA-23-235.) (Refer to Figure 13-12.)

a. Turn the heater control switches OFF.

b. Remove the access panel from the left side of the nose section.

c. Disconnect the four hoses from the rear of the heater air distributor box. (Refer to Figure 13-1.)

d. Loosen, but do not remove, the four self-locking nuts securing the ventilating air blower assembly to the heater. Twist the blower clockwise and pull it straight off.

e. Disconnect the black blower motor wire from the heater terminal strip. The wire designation is No. 2.

f. Loosen the four screws at the side of the fuel control valve housing and lift off cover.

g. Disconnect electrical leads at rear of the heater terminal strip. Remove harness clamp and starter lead clamp from flame detector switch guard.

h. Disconnect dump valve push-pull control cable.

i. Remove four cap screws located at the bottom left of the fuselage nose and remove the ring from around the exhaust pipe.

j. Pull the heater fuel drain up and out of the grommet in the bottom of fuselage.

k. Remove nut and lockwasher from the heater support bank clamp, releasing clamp tension.

l. Remove cap screws from upper and lower tubular structure brackets which support the heater. Reach into the front of the heater case and remove washer and self-locking nut of each screw as they are freed.

m. With an assistant inside the fuselage, using a screw driver to prevent the screws from turning, remove four self-locking nuts from the left front seat heater system air inlet. Slide the inlet off the screws and push it away from the heater.

NOTE

The inlet is removed to permit heater removal without the heater air box striking nearby components.

n. If only one mechanic is available, an alternate method for step "m", above, is necessary. Remove the five cap screws from the periphery of the heater air distributor box. Slide the box from the rear of the heater case. This procedure eliminates the need to disconnect the hoses and dump box control cable as described in steps "c" and "h".

o. Carefully remove the heater.

13-29. INSTALLATION OF HEATER. (PA-23-250 and PA-23-235.) (Refer to Figure 13-12.) Install the heater in reverse order of the removal instruction of paragraph 13-28, with the qualifications which follow below.

a. Position heater between the two tubular structure brackets and secure it with two cap screws, plain washers and self-locking nuts.

b. Install the ventilating air fan on the front of the heater case with a counter-clockwise twist and secure it with four self-locking nuts.

c. Apply the heater support bank clamp loosely. Adjust the heater position so that the heater distributor air box does not chafe against the tubular structure and the defroster hose does not rub against the left front seat heater system air inlet. Tighten the clamp.

d. Connect the wires to the aft side of the heater terminal strip as indicated.

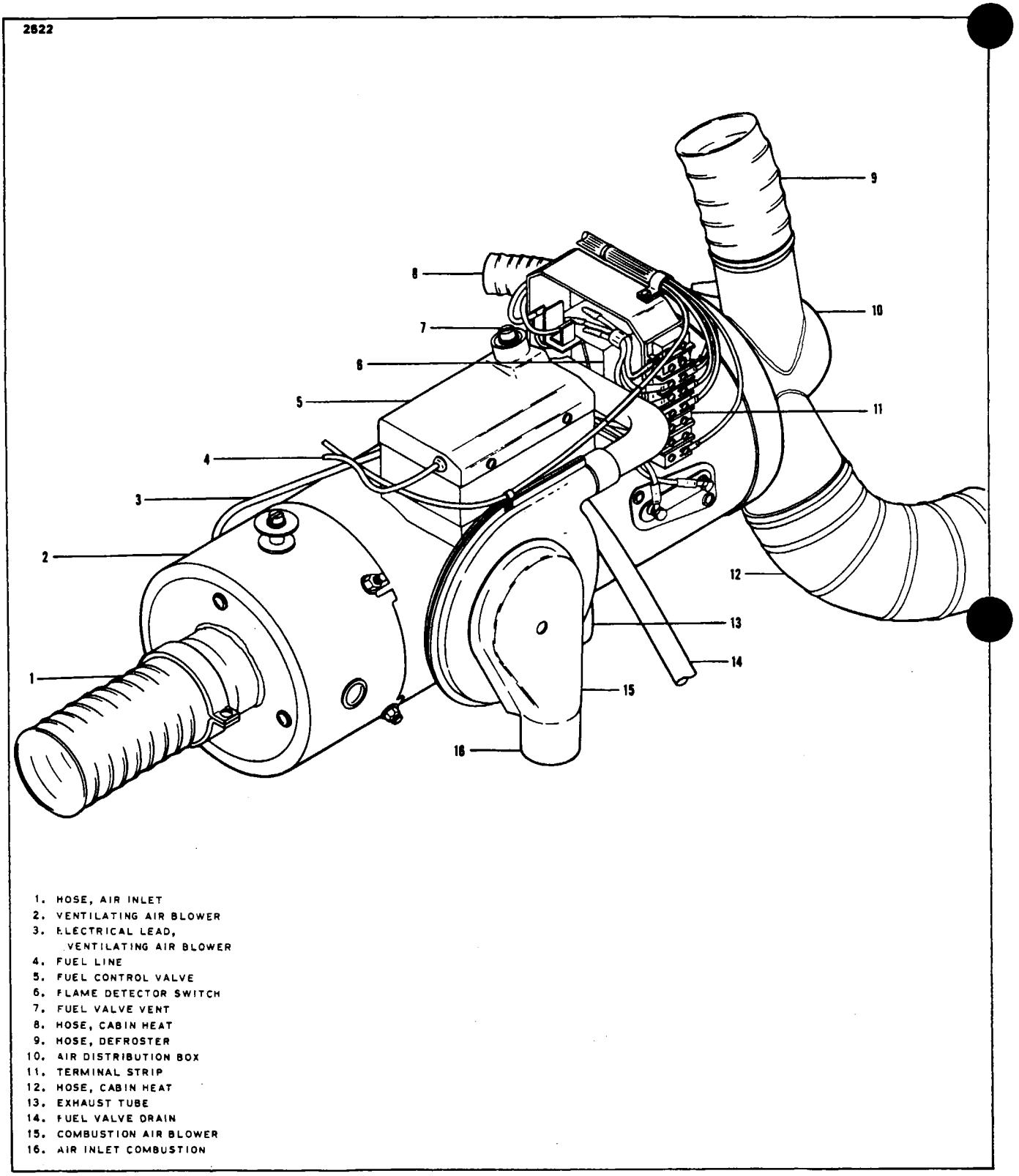
HEATER TERMINAL BLOCK WIRING

| Terminal No. | Wire Designation |
|---|---|
| 2 | H2A |
| 2 | H2B |
| 3 | H3B |
| 4 | H4A |
| 5 | H5A |
| Ground (lowest terminal) | H8A |

HEATER TERMINAL BLOCK WIRING TEST

| Terminal No. | Switch Position at Which Lamp Lights |
|---|---|
| 2 | PRIME |
| 3 | OFF, PRIME, LOW HEAT, HIGH HEAT |
| 4 | LOW HEAT, HIGH HEAT |
| 5 | HIGH HEAT |
| 6 | LOW HEAT, HIGH HEAT |
| 7 | LOW HEAT, HIGH HEAT |

*With fuel applied and burning, the lamps will light in the PRIME, LOW HEAT, HIGH HEAT positions at Terminal No. 2.




1. HOSE, AIR INLET
2. VENTILATING AIR BLOWER
3. ELECTRICAL LEAD, VENTILATING AIR BLOWER
4. FUEL LINE
5. FUEL CONTROL VALVE
6. FLAME DETECTOR SWITCH
7. FUEL VALVE VENT
8. HOSE, CABIN HEAT
9. HOSE, DEFROSTER
10. AIR DISTRIBUTION BOX
11. TERMINAL STRIP
12. HOSE, CABIN HEAT
13. EXHAUST TUBE
14. FUEL VALVE DRAIN
15. COMBUSTION AIR BLOWER
16. AIR INLET COMBUSTION

Figure 13-12. Heater Installation (PA-23-235 and PA-23-250)

e. Connect the black fan motor wire No. 2 to terminal No. 2 at the leading side of the terminal strip.

f. When a new heater is installed (PA-23-250 only), it will be necessary to remove its name plate. Then move the name plate aft until its two leading attaching holes coincide with the two rear mounting holes in the heater housing. Install two of the original attaching screws in the front of the name plate. Using the two holes in the rear of the name plate as guides, drill two holes into the heater housing and install the two remaining self-tapping attaching screws. It will also be necessary to drill two holes in the heater housing to accommodate the screws from the upper and lower tubular structure brackets.

13-30. REMOVAL OF HEATER. (PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl., and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.) (Refer to Figure 13-13.)

a. Turn the heater control switches OFF.

b. Remove the aft panel in the forward baggage compartment and the heater forward access panel on the left side of the fuselage nose section.

c. From inside the forward baggage compartment remove the fresh air duct from the ventilating fan assembly.

d. Disconnect the black wire to ventilating fan. Loosen, but do not remove, the four self-locking nuts securing the ventilating fan assembly to the heater. Twist the fan clockwise and pull straight off.

e. Loosen the four screws at the side of the fuel control valve housing and lift off the cover. Disconnect the fuel line at the fuel control valve.

f. Disconnect all electrical leads at the rear of the heater terminal strip. Remove the harness clamp and the starter lead clamp from the flame detector switch guard.

g. Remove the four cap screws located at bottom left of fuselage nose and remove ring from around exhaust pipe assembly.

h. Pull the heater fuel drain tube up and out of the grommet in bottom of fuselage.

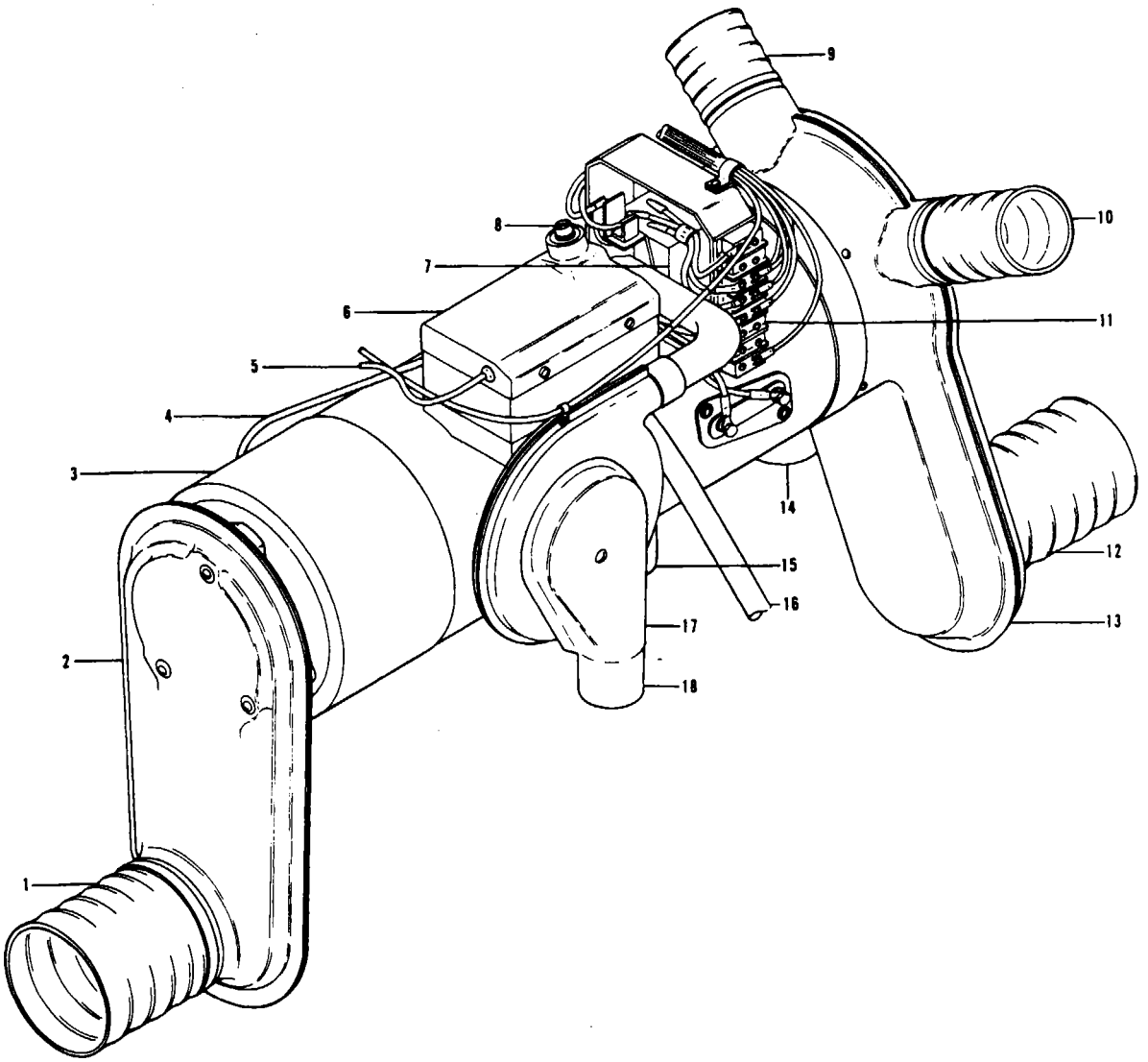
i. Disconnect the air duct to the heater combustion fan.

j. Remove the nut and lockwasher from heater support band clamp, releasing clamp tension.

k. Remove the cap screw from the lower tubular structure bracket which supports front of heater assembly.

l. Remove the heater distributor assembly located at the aft end of the heater by removing the four securing screws.

m. Carefully remove the heater assembly.




1. HOSE, AIR INLET
2. INTAKE, HEATER AIR
3. VENTILATING AIR BLOWER
4. ELECTRICAL LEAD, VENTILATING AIR BLOWER
5. FUEL LINE
6. FUEL CONTROL VALVE
7. FLAME DETECTOR SWITCH
8. FUEL VALVE VENT
9. HOSE, CABIN HEAT
10. HOSE, DEFROSTER
11. TERMINAL STRIP
12. HOSE, CABIN HEAT
13. AIR DISTRIBUTION BOX
14. HOSE, HOT AIR DUMP
15. EXHAUST TUBE
16. FUEL VALVE DRAIN
17. COMBUSTION AIR BLOWER
18. AIR INLET COMBUSTION

Figure 13-13. Heater Installation
PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.; and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.

13-31. INSTALLATION OF HEATER. (PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl., and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.) (Refer to Figure 13-13.) Install the heater in reverse order of the removal instructions of Paragraph 13-30 with the qualifications which follow below.

a. Position heater between the two tubular structure brackets and secure it with two cap screws, plain washers and self-locking nuts.

b. Install the ventilating air fan on the front of the heater case with a counter-clockwise twist and secure it with four self-locking nuts.

c. Apply the heater support bank clamp loosely. Adjust the heater position so that the heater distributor air box does not chafe against the tubular structure and the defroster hose does not rub against the left front seat heater system air inlet. Tighten the clamp.

d. Connect the wires to the aft side of the heater terminal strip as indicated.

| HEATER TERMINAL BLOCK WIRING | |
|---|---|
| Terminal No. | Wire Designation |
| 2 | H2A |
| 2 | H2B |
| 3 | H3B |
| 4 | H4A |
| 5 | H5A |
| Ground (lowest terminal) | H8A |

| HEATER TERMINAL BLOCK WIRING TEST | |
|---|---|
| Terminal No. | Switch Position at Which Lamp Lights |
| 2 | PRIME |
| 3 | OFF, PRIME, LOW HEAT, HIGH HEAT |
| 4 | LOW HEAT, HIGH HEAT |
| 5 | HIGH HEAT |
| 6 | LOW HEAT, HIGH HEAT |
| 7 | LOW HEAT, HIGH HEAT |
| *With fuel applied and burning, the lamps will light in the PRIME, LOW HEAT, HIGH HEAT positions at Terminal No. 2. | |

e. Connect the black fan motor wire No. 2 to terminal No. 2 at the leading side of the terminal strip.

f. When a new heater is installed, it will be necessary to remove its name plate. Then move the name plate aft until its two leading attaching holes coincide with the two rear mounting holes in the heater housing. Install two of the original attaching screws in the front of the name plate. Using the two holes in the rear of the name plate as guides, drill two holes into the heater housing and install the two remaining self-tapping attaching screws. It will also be necessary to drill two holes in the heater housing to accommodate the screws from the upper and lower tubular structure brackets.

13-32. SERVICE.

13-33. GENERAL. The Model 940 heater is specifically designed to simplify servicing procedures. All controls are easily accessible and the ventilating air blower is attached by means of bayonet slots to facilitate removal and replacement.

All repairs in the field should be confined to replacement of major subassemblies of the heater. It is not recommended that any attempt be made to repair these assemblies without shop facilities. Attempts to repair the ventilating air blower, fuel control valve, safety valve, or overheat switches, without complete tools and test equipment, are likely to result in equipment failure or inadequate operation. The following major subassemblies are specially designed to permit unit replacement, and this type of maintenance is recommended for field service personnel:

a. Ventilating air blower.
b. Flame detector switch.
c. Fuel control valve.
d. Igniter.
e. Preheater resistor.
f. Overheat switch.
g. Cycling switch.
h. Combustion air blower motor.

Instructions for disassembly, repair and reassembly, appear with paragraph 13-49 of this manual. The assemblies need not be removed in the order shown since each unit is designed for separate replacement.

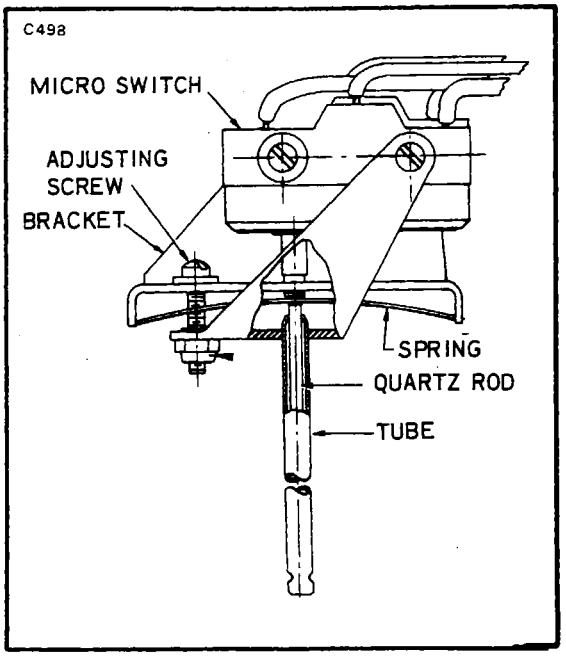



Figure 13-14. Flame Detector Switch (Cutaway View)

13-34. PERIODIC SERVICE.

a. A complete overhaul of the heater is recommended at 1000 hours of heater operating time and thereafter at 500 hour intervals.

b. The fuel filter must be cleaned at regular intervals to prevent the condensation of moisture and formation of ice during cold weather.

c. When the fuel filter is cleaned, all fuel connections should be checked for firmness of connections and condition of insulations.

13-35. ADJUSTING FLAME DETECTOR SWITCH. To adjust the flame detector switch, proceed as follows:

a. Loosen the two locking nuts so that the switch is held firmly but is not locked in position.

b. Back off the adjusting screw until the switch clicks. (Refer to Figure 13-14.)

c. Turn the adjusting screw in slowly until the switch just clicks again.

d. Turn the screw an additional three-quarter turn past the click point.

e. Hold the screws and tighten the switch mounting nuts. Check to make sure the adjusting bracket has not pulled away from the adjusting screw head.

13-36. TROUBLESHOOTING. The Series 940 heaters require a supply of fuel, electric current at the proper voltage, and an unrestricted supply of ventilating and combustion air, for proper operation. External failure of any requirement will cause failure or malfunction, even if the heater itself is in perfect condition. For this reason the external causes should always be checked first and repaired, if necessary, before an inoperative heater is removed from the airplane, or disassembled for repair.

13-37. EXTERNAL CAUSES OF TROUBLE.

13-38. ELECTRIC CHECK.

a. Check voltage at the fuse or circuit breaker, through the heater switch and at terminal No. 3 of the heater terminal strip. Terminal No. 3 should be "hot" at any time the airplane's master switch is on. A minimum of 21-volts at these points is required for proper heater operation. Terminal No. 4 should be "hot" when the heater switch and the master switch are on.

b. Turn the heater switch to FAN or PRIME position and check voltage through the switch to the hot terminal of the heater safety valve. It is possible for the safety valve to lose its charge of gasoline, in which case the heater will not start until the valve is recharged. A defective heater switch or wiring can, therefore, result in failure to start even if the heater and valve are in good condition.

c. Check wiring through the heater thermostat to terminal No. 5 of the heater. This terminal should be hot at any time the heater switch is turned on and the thermostat is calling for heat. A defective thermostat or wiring can cause the heater to burn on low heat continuously and the output will be insufficient for cold weather service.

13-39. FUEL SUPPLY. The Model 940 heaters (except Models 940-DB and 940-K) require a supply of fuel under pressure of at least one pound to operate the safety valve and to properly meter fuel to the heater. Check fuel pressure with a pressure gauge and tee fitting at the inlet to the safety valve while the engine fuel pump, auxiliary fuel pump, or other source of fuel pressure is operating. The heater fuel control valve contains a pressure regulator which will reduce fuel pressure to one psi for proper metering of fuel through the orifice plate. If fuel pressure at the control valve inlet is less than one pound, the pressure regulator ceases to function and the heater will burn at reduced level of heat output, or may fail to ignite. Any pressure between one and fifteen pounds will provide satisfactory operation. The fuel control valve used with the Model 940-DB, 940-K heaters is adjusted for use at a higher pressure and must not be used in a low-pressure system. Conversely, the low-pressure valve must not be used in a high-pressure system.

13-40. COMBUSTION AIR SUPPLY. A reduced or restricted combustion air supply will usually be easy to identify since the heater will produce black smoke at the exhaust outlet and the tube will contain a deposit of soft black carbon. This condition can be caused by an obstruction of any sort in the combustion air inlet, pinching off the combustion air tube, or an installation defect which prevents the combustion air blower from obtaining a sufficient amount of air. Always check these external causes before changing the combustion air motor. (These same symptoms can be caused by a high fuel rate.)

NOTE

The Models 940-D and 940-K heaters require ram air at the combustion air inlet, and the symptoms noted above will always appear if this heater is substituted for one of the other models without making ram air provision. These symptoms will also appear if these heaters, even when properly installed, are operated for any extended period on the ground.

13-41. VENTILATING AIR SUPPLY.

a. The need for ventilating air is apparently less critical than other requirements, since the heater will usually operate at a reduced heat output without any symptoms of malfunctioning when ventilating air flow is impeded. This condition may give the appearance of inadequate heater capacity when the fault is actually an obstruction in the ventilating air stream or a duct system which unduly restricts air flow.

b. Symptoms of inadequate air flow are constant cycling on the cycling switch (or overheat switch) and a relatively high air temperature at the heater outlet. Test for cycling by connecting a test lamp to terminal No. 9 of the overheat switch (or terminal No. 30 of the cycling switch). If the heater cycles constantly, insert a thermometer into the duct about 18 inches from the heater outlet. If the temperature at this point is near 200° F., it can be assumed that ventilating air flow is inadequate and the load on the ventilating air blower must be reduced by removing an obstruction. or reducing the length of the duct system.

c. In extreme cases where air flow is drastically reduced, or completely shut off, the lockout overheat switch on the Models 940-DB or 940-K may operate, shutting the heater completely off. Under the same conditions the Model 940-D will cycle on the overheat switch.

13-42. CHECK-OUT PROCEDURE FOR AN INOPERATIVE HEATER. If a heater fails to ignite, first check external causes previously noted, then proceed as directed in the check-out procedure below. This procedure should be followed through in the order presented, since it is designed to isolate the trouble with a minimum of disassembly.

a. On models so equipped, press the reset button of the lockout overheat switch.

b. Turn the heater control switch to FAN or PRIME position and wait approximately 30 seconds (for the safety valve to charge), then turn heater switch to ON position.

c. The requirements for heater ignition are (1) fuel, (2) a flow of combustion air, and (3) ignition. If the combustion air blower starts when the heater is turned on, the combustion air requirement is satisfied and the thermal fuse and lockout overheat switch are also eliminated as possible sources of trouble, since these components are necessary for blower operation. This leaves only fuel and ignition as causes of failure.

d. If the combustion air blower fails to start, it will be probable that the trouble is in the thermal fuse, lockout overheat switch, flame detector switch, or the combustion air blower itself.

e. Since there is more than one possible cause of either condition described above, the heater starting circuit must be checked out in a methodical way to progressively eliminate the different components. The Starting Circuit Check assumes that the blower is inoperative. If the blower operates, the check-out procedure may be started with paragraph (b) below, since the blower circuit will not be in question.

13-43. STARTING CIRCUIT CHECK.

a. On the 940-D, 940-DB and 940-K heaters, check voltage at terminal No. 4 of the terminal strip, with a test light or voltmeter, then check progressively at both sides of the thermal fuse, at terminal 4A of the relay, and at terminal No. 6 of the terminal strip. Loss of voltage at the thermal fuse indicates a defective fuse; at terminal No. 4A a defective lockout overheat switch (or wiring on 940-D); at terminal No. 6, a defective flame detector switch.

b. If there is voltage at terminal No. 6 and the combustion air blower runs, the trouble is caused by ignition failure or lack of fuel. To differentiate between these possibilities, check voltage at terminal No. 7 of the terminal strip. Loss of voltage at this point will indicate a defective flame detector switch on any model heater.

c. If there is voltage at terminal No. 7, turn off the heater switch and disconnect the igniter wire from terminal No. 7. Connect an ammeter in series between terminal No. 7 and the igniter wire, then turn on the heater switch. The igniter should draw approximately 10 amperes. If there is no current draw, either

the igniter or preheat resistor is defective (any model heater). If current draw is normal and there is voltage at terminal 4A of the relay, it can be assumed that the fuel control valve shutoff solenoid is defective (on Models 940-D, 940-DB or 940-K) and the valve must be replaced.

13-44. RUNNING CIRCUIT CHECK. If the heater starts properly, burns for a short time and then goes out, or develops some other type of malfunction, it can be asuumed that the starting circuit is operating properly and the difficulty is in the heater control system. The elements which affect heater operation, after starting, are as follows:

a. Starting safety devices.
b. Fuel control components.
c. The combustion air supply.

13-45. STARTING SAFETY DEVICES. Failure of the flame detector switch to transfer will be indicated by failure of the ventilating air blower to start after the heater has burned for a short time. The fuel safety valve will shut off fuel after about two minutes, but the igniter will continue to be energized and may burn out before the condition is detected, since it is not designed for continuous operation.

In all cases where the heater ignites normally and then goes out, it will be necessary to differentiate between the flame detector switch and the safety valve. First, reset the flame detector switch as directed in this section, prime the safety valve, and make another trial start. If the heater goes out again, check wiring from the heater terminal strip to the safety valve and then replace the flame detector switch if no defect is found in the wire. If the valve primes when the heater switch is in PRIME position but fails to prime automatically when the heater is burning, the defect will be found in the wiring between the safety valve and terminal strip, or between the terminal strip and relay on heaters so equipped. If the heater burns for less than one minute and then goes out, the safety valve is not holding an adequate charge of fuel and must be replaced.

13-46. FUEL CONTROL COMPONENTS. If the heater ignites and the ventilating air blower starts but heat output is unsatisfactory (too low, too high, or constant cycling), the trouble will be found in the thermostat, the cycling switch, or the fuel control valve. Failure of the restriction solenoid to open will cause low heat output and constant burning, regardless of thermostat setting. Failure of the solenoid to close will cause high heat output and constant cycling. Low heat and constant cycling are caused by a cycling switch or a thermostat out of adjustment. Check these causes and replace the defective component, as required.

13-47. COMBUSTION AIR SUPPLY. Since an excess of combustion air (within limitations of the blower design) does not adversely affect heater operation, the only trouble likely to be encountered with combustion air is an inadequate supply. The symptoms of combustion air restriction are easy to recognize, and have been described under External Causes of Failure in this Section. If the air supply is inadequate and the trouble is not caused by restriction, replace the combustion air motor.

NOTE

The combustion air blower must not be subjected to excessive ram air pressures. The blower needs about 1 to 2 inches of water ram air pressure above the pressure in the heater exhaust, especially Models 940-D and 940-K; but ram air pressures above 3 inches of water are quite liable to cause blower wheel failure.

13-48. TROUBLESHOOTING CHART. The Troubleshooting Chart is a brief summary of the defects and remedies discussed in this Section. The chart may be used as a guide when servicing a heater which fails to perform properly when installed.

TABLE XIII-I. TROUBLESHOOTING CHART (SOUTH WIND HEATER)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater will not start, combustion air blower does not run. | Heater fuel valve not ON. | Check valve position. |
| | Defective wiring. | Check wiring and connections. |
| | Defective combustion air blower. | Replace blower. |
| | Defective thermal fuse. | Replace fuse. |
| | Defective lockout overheat switch. | Replace switch. |
| | Defective overheat switch. | Replace switch. |
| Blower runs when switch is in HEAT position but heater will not ignite. | No fuel pressure. | Check fuel supply. |
| | Defective igniter. | Replace igniter. |
| | Defective fuel control valve. | Replace valve. |
| | Defective cycling overheat switch. | Replace switch. |
| | Defective preheat resistor. | Replace resistor. |
| | Broken quartz rod. | Replace quartz rod. |
| Heater ignites but ventilating air blower will not start. | Defective or improperly adjusted flame detector switch. | Replace or reset switch. |

TABLE XIII-I. TROUBLESHOOTING CHART (SOUTH WIND HEATER) (cont. )

| Trouble | Cause | Remedy |
|---|---|---|
| Heater ignites but ventilating air blower will not start (cont. ). | Defective safety valve. | Replace valve. |
| Heater starts and runs, but goes out later. | Restricted ventilating air flow. | Remove restriction |
| | Defective cycling overheat switch. | Replace switch. |
| | Defective safety valve. | Replace valve. |
| | Defective relay. | Replace relay. |
| Heater overheats. | Defective fuel control valve. | Replace valve. |
| | Restricted ventilating air flow. | Remove restriction. |
| | Defective cycling overheat switch. | Replace switch. |
| | Defective cycling switch. | Replace switch. |
| Heat output low. | Defective fuel control valve. | Replace valve. |
| | HI-LO switch on LO. | Turn to HI. |
| | Thermostat out of calibration. | Replace thermostat. |

TABLE XIII-I. TROUBLESHOOTING CHART (SOUTH WIND HEATER) (cont. )

| Trouble | Cause | Remedy |
|---|---|---|
| Heat output low (cont. ). | Cycling switch out of calibration. | Replace switch. |
| Heater smokes excessively. | Leaking fuel control valve. | Replace valve. |
| | Slow combustion air motor. | Replace motor. |
| | Defective installation. | Correct combustion air supply. |
| Blower will not stop when heater is turned off. | Defective flame detector switch. | Replace or reset switch. |
| Heater "pops" or "bangs" when starting. | Leaking fuel control valve. | Replace valve. |

13-49. DISASSEMBLY, REPAIR, AND REASSEMBLY. An overhaul of the 940 heater consists of a complete disassembly, cleaning, repair, reassembly and test, as described in the following pages. The information is presented in overhaul sequence, but it should be noted that parts are not necessarily removed in the order shown. When making repair or replacements, it is possible to remove most subassemblies without disturbing other parts.

The instructions in the following paragraphs cover all models of the 940 Series heaters. Figure 13-15 is a composite exploded parts view, showing all parts used on all heaters. Not all of these parts are used on any one heater, but the differences and usage of parts are noted in the text. The procedures outlined below are applicable to all models, unless otherwise noted.

The following special service tools are recommended for service and overhaul of the 940 heater:

a. Fuel valve screen tool.
b. Igniter housing scraper.

13-50. DISASSEMBLY. (Refer to Figure 13-15.)

a. Remove the combustion air inlet adapter (1) by removing the sheet metal screw (2) in its center.

b. Remove the shroud adapter (3) by removing the six screws (4) from the weld nuts in the heater housing.

NOTE

The combustion air inlet adapter and shroud adapter may remain in the airplane when the heater is removed. If attached to the heater they may have other installation parts welded or clamped to them. If such is the case, note positions of such parts before they are removed.

c. Remove the exhaust extension (5), washers (6), "O" ring (7), and gasket (8) from the heater exhaust outlet.

13-51. VENTILATING AIR BLOWER.

a. To remove the ventilating air blower (9), disconnect the blower lead from the heater terminal No. 2, or the relay terminal No. 2A, and free the wire.

b. Loosen, but do not remove the four nuts (10) which secure the blower to the heater housing.

c. Turn the blower counterclockwise and pull it straight off of the heater housing.

d. Remove the air inlet louver (11) from the blower assembly by removing the three screws (12).

13-52. FUEL CONTROL VALVE.

a. Remove the cover (13) from the fuel control valve housing by loosening the four screws (16). Disconnect valve solenoid leads.

b. Disconnect the short fuel line (17) from the standpipe by loosening the compression nut (18). The ferrule (19) will remain on the fuel line.

c. Lift the fuel control valve (20) out of the housing and remove the fuel line (17) from the valve by removing the compression nut. Do not attempt to remove the ferrules from the fuel line.

13-53. FLAME DETECTOR SWITCH.

a. Disconnect leads of the flame detector switch (40) from the terminal strip, or from terminal strip and relay, according to heater model.

b. On Models 940-D and 940-K, disconnect wires from relay (25) by removing terminal screws (28). Reinstall screws in terminals.

c. Remove the four screws (24) which secure the flame detector switch guard (23) to the heater housing. Remove the guard and relay as an assembly, on heaters so equipped.

d. On heaters equipped with the relay (25), remove the nut (26) and lockwasher (27) to free the relay ground wire and relay assembly.

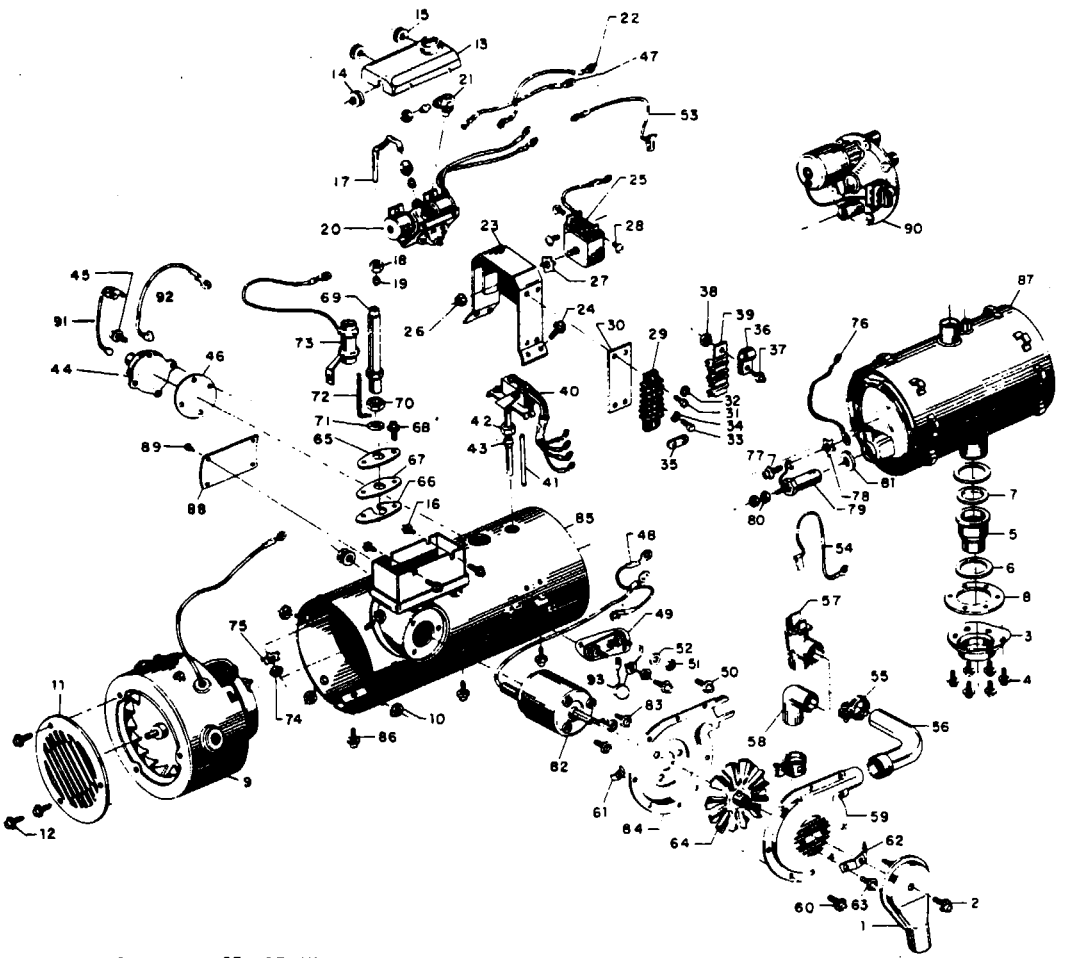
e. Loosen the compression nut (42) underneath the flame detector switch (40) and back it off until it clears the threads of the heat exchanger bushing.

f. Pull the flame detector switch straight out of the heat exchanger, being careful not to bend the tube since it contains a quartz rod (41) which may be broken by rough handling.

13-54. LOCKOUT OVERHEAT SWITCH.

a. On models so equipped, disconnect push-on lead of the lockout overheat switch (44) from the thermal fuse (57). Remove the overheat switch by removing the four screws (45). On older model heaters the leads (91 and 92) are attached to the switch. On current production, leads are separate.

b. On the 940-D heater, the lockout overheat switch is not used, but provision for its installation has been made and the heater housing will have a circular cover plate (46) in its place. This cover need not be removed for overhaul.



| | | | |
|---|---|---|---|
| 1. AIR INLET ADAPTER | 25. RELAY | 49. CYCLING OVERHEAT SWITCH OR LIMIT SWITCH | 72. KNIT CABLE |
| 2. SCREW | 26. NUT | | 73. PREHEAT RESISTOR |
| 3. SHROUD ADAPTER | 27. LOCKWASHER | 50. SCREW | 74. NUT |
| 4. SCREW (6 REQ) | 28. SCREW (3 REQ) | 51. NUT | 75. LOCKWASHER |
| 5. EXHAUST EXTENSION | 29. TERMINAL STRIP | 52. WASHER | 76. GROUND STRAP |
| 6. WASHER (2 REQ) | 30. INSULATOR | 53. WIRE ASSEMBLY | 77. SCREW |
| 7. "O" RING | 31. SCREW (4 REQ) | 54. WIRE ASSEMBLY | 78. LOCKWASHER |
| 8. GASKET | 32. WASHER | 55. CLAMP (2 REQ) | 79. IGNITER |
| 9. VENTILATING AIR BLOWER | 33. SCREW (10 REQ) | 56. ELBOW | 80. NUT |
| 10. NUT (4 REQ) | 34. WASHER (4 REQ) | 57. THERMAL FUSE | 81. GASKET |
| 11. AIR INLET LOUVER | 35. JUMPER | 58. ELBOW | 82. COMBUSTION AIR MOTOR |
| 12. SCREW (4 REQ) | 36. CLAMP | 59. BLOWER COVER | 83. SCREW (3 REQ) |
| 13. COVER | 37. SCREW | 60. SCREW (9 REQ) | 84. BLOWER HOUSING |
| 14. GROMMET (2 REQ) | 38. NUT | 61. NUT (9 REQ) | 85. HEATER HOUSING |
| 15. GROMMET | 39. FANNING STRIP | 62. BRACKET | 86. SCREW (3 REQ) |
| 16. SCREW (4 REQ) | 40. FLAME DETECTOR STRIP | 63. SCREW (2 REQ) | 87. HEAT EXCHANGER ASSEMBLY |
| 17. FUEL LINE | 41. QUARTZ ROD | 64. BLOWER WHEEL | 88. NAMEPLATE |
| 18. NUT (3 REQ) | 42. NUT | 65. FLANGE | 89. SCREW (4 REQ) |
| 19. FERRULE (3 REQ) | 43. FERRULE | 66. TAPPING PLATE | 90. SAFETY VALVE |
| 20. FUEL CONTROL VALVE | 44. LOCKOUT OVERHEAT SWITCH | 67. GASKET | 91. CABLE ASSEMBLY |
| 21. ELBOW | 45. SCREW (4 REQ) | 68. SCREW (2 REQ) | 92. CABLE ASSEMBLY |
| 22. WIRE ASSEMBLY | 46. COVER | 69. STANDPIPE | 93. CAPACITOR ASSEMBLY |
| 23. GUARD | 47. WIRE ASSEMBLY | 70. NUT | |
| 24. SCREW (4 REQ) | 48. WIRE ASSEMBLY | 71. "O" RING | |

Figure 13-15. Exploded Parts View, Heater Assembly

13-55. CYCLING OVERHEAT SWITCH. On all models, remove the cycling overheat switch, or cycling temperature control switch (49) by removing the two attaching screws (50). Also remove the capacitor (93) on the 940-DB models only. These switches appear identical on all heaters, but are set at a lower temperature on models which have the lockout overheat switch and have a different part number.

13-56. COMBUSTION AIR BLOWER.

a. Loosen the two clamps (55) which attach the combustion air elbows (56 and 58), or elbow (56) and thermal fuse (57). Only two of the parts illustrated are used on any one heater. The thermal fuse (57) is used on all models. On all models, disassembly is the same. Disconnect wires from the thermal fuse (if used) and then work the two parts off the blower outlet and heat exchanger inlet. Separate parts after removal.

b. Remove the cover (59) of the combustion air blower, by removing the nine screws (60) and speed nuts (61). It is not necessary to remove the bracket (62), or screws (63) unless replacement is required.

c. Loosen the set screw in the hub of the blower wheel (64) and slide the wheel off the motor shaft.

13-57. STANDPIPE AND PREHEATER RESISTOR.

a. Remove the two screws (68) from the fuel line flange (65) and tapping plate (66). Remove the two plates and the gasket (67).

b. Disconnect preheater connector strip from the igniter (69) and loosen the large hex nut (70) on the bottom of the standpipe (69), one or two turns. Remove the standpipe by backing off the smaller hex, which is welded to the pipe. When the threads are clear, the standpipe (69) and preheat resistor (73) can be lifted out through the opening in the heater housing.

c. Remove the preheat resistor (73) from the standpipe and pull out the knit cable (72). Discard the cable and the "O" ring (71). These parts must be replaced at each overhaul.

13-58. IGNITER.

a. Remove the nut (74) and lockwasher (75) from the ground stud inside the heater housing, to free the igniter ground strap (76), then remove the screw (77) and lockwasher (78) to free the igniter ground wire.

b. Remove the igniter (79), using a 13/15 inch deep socket, and remove and discard the igniter gasket (81).

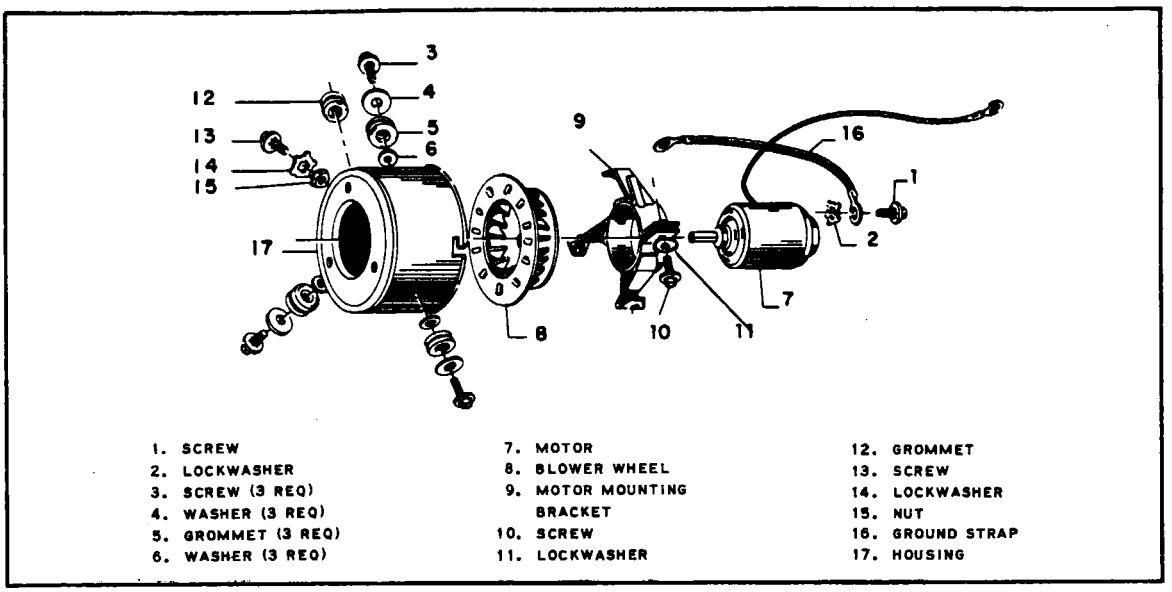



Figure 13-16. Exploded Parts View, Ventilating Air Blower Assembly

13-59. COMBUSTION AIR MOTOR.

a. To remove the combustion air motor, it is necessary to first remove the combustion air elbows, the blower housing cover, the blower wheel, the standpipe and the preheat resistor.

b. After removing the parts noted above, remove the three mounting screws (83) and remove the motor (82) from inside the housing. This will also free the blower housing (84).

13-60. HEAT EXCHANGER. Remove the three screws (86) from the seam of the heat exchanger housing (85) and spread the housing sufficiently to permit the heat exchanger (87) to drop out through the end of the housing.

13-61. VENTILATING AIR BLOWER - ALL MODELS. (Refer to Figure 13-16.)

a. Remove the screw (1) and lockwasher (2) from the end of the motor (7) to free the motor from the ground strap.

b. Remove the three screws (3), washers (4), grommets (5), and small washers (6) to free the motor mounting bracket (9), then withdraw the motor (7), bracket (9), and blower wheel (8) as an assembly.

c. Loosen the set screw in the hub of the blower wheel (8) and remove the wheel from the motor shaft.

d. Mark the position of the mounting bracket (9) on the motor (7) and remove the bracket by loosening the screw (10).

e. Remove the screw, lockwasher, and nut (12, 13 and 14) from the blower housing to free the ground strap (15), then remove the grommet (11) from the housing.

13-62. INSPECTION, CLEANING AND REPAIR.

13-63. HEAT EXCHANGER.

a. Inspect the heat exchanger for possible damage or leaks. Small cracks in the header plate or seams may be repaired by welding, provided the work is done by a welder who is thoroughly experienced in the welding of stainless steel. If the heat exchanger has large cracks, is excessively warped, or has burned through at any point, it must be replaced. When welding cracks, Type 347 weld rod is preferred, although 321 or 310 may be used.

NOTE

Before welding, it is very important to clean all combustion deposits away from the area to be welded, since the lead compounds in the heat exchanger can contaminate the weld to such an extent that a tight weld is almost impossible. Keep all weld beads as small as possible, preferably not over one-eight of an inch.

b. Clean combustion residue from inside walls of igniter housing with igniter housing scraper tool.

c. Remove combustion residue from inside heat exchanger by soaking this assembly in a 20% by weight solution of ammonium acetate at a temperature of 180° F., for a period of 5 to 10 hours. Flush out exchanger with water after cleaning, and dry as well as possible with compressed air. This is the preferred method of cleaning. An alternate is to tap the heat exchanger lightly with a rawhide mallet to loosen carbon from the walls. This will loosen most of the residue, which may then be blown out with compressed air.

d. Pressure test heat exchanger by plugging openings and applying 10 psi air pressure to the flame detector switch or standpipe bushing while the unit is submerged in water. Leakage will be indicated by bubbles. No leakage is permitted.

13-64. FUEL CONTROL VALVE. Replace valve if found defective.

13-65. BLOWER ASSEMBLIES.

a. Clean both blower wheels, housings, and the ventilating air blower motor mounting bracket with dry cleaning solvent, and blow dry. Wipe off outside of motors with a cloth dampened in solvent, but do not immerse motors.

b. Inspect blower wheels for bent blades and cracks. Pay special attention to the combustion air blower wheel. The slightest evidence of small cracks in, or around, the strain relief cutouts near the hub is reason to replace this wheel.

13-66. VENTILATING AIR BLOWER MOTOR OVERHAUL. An overhaul kit, PAC part No. 754 306, is available for all ventilating air blower motors of the 940 Series. This kit contains new bearings, brushes, and other parts required for installation. To overhaul the motor, proceed as follows: (Refer to Figure 13-17.)

a. Remove the two nuts (1) from the end of the motor and pull the end bell (3) off far enough to permit unsoldering of the capacitor lead from the eyelet on the brush holder insulator. Remove the end bell (3).

b. Remove the two nuts (12) from the other end of the motor and pull the two long studs (11) out of the stator (16) without disturbing the two nuts (4) which are threaded part way down to center the studs in the stator.

c. Pull the brush holder (6) out far enough to unsolder stator leads from the eyelets, then remove the brush holder assembly and brushes. If the stator does not have flexible leads to the solder eyelets, cut leads off close to the windings and solder in new leads of flexible stranded wire. This will prevent possible future failure due to vibration.

d. Pull the rotor (13) out of the stator (16). The bearings will remain on the rotor shaft.

e. Remove the load springs (14) from inside the stator (16).

f. Clean the shaft and pull the bearings off the shaft of the rotor (13) with a bearing puller, using anti-seize compound as a lubricant.

g. Clean all parts with a soft bristle brush and blow off with compressed air. Sand commutator of rotor (13) if necessary, or turn down slightly. Do not attempt to repair a badly worn motor. Replace the entire assembly if major repairs are required.

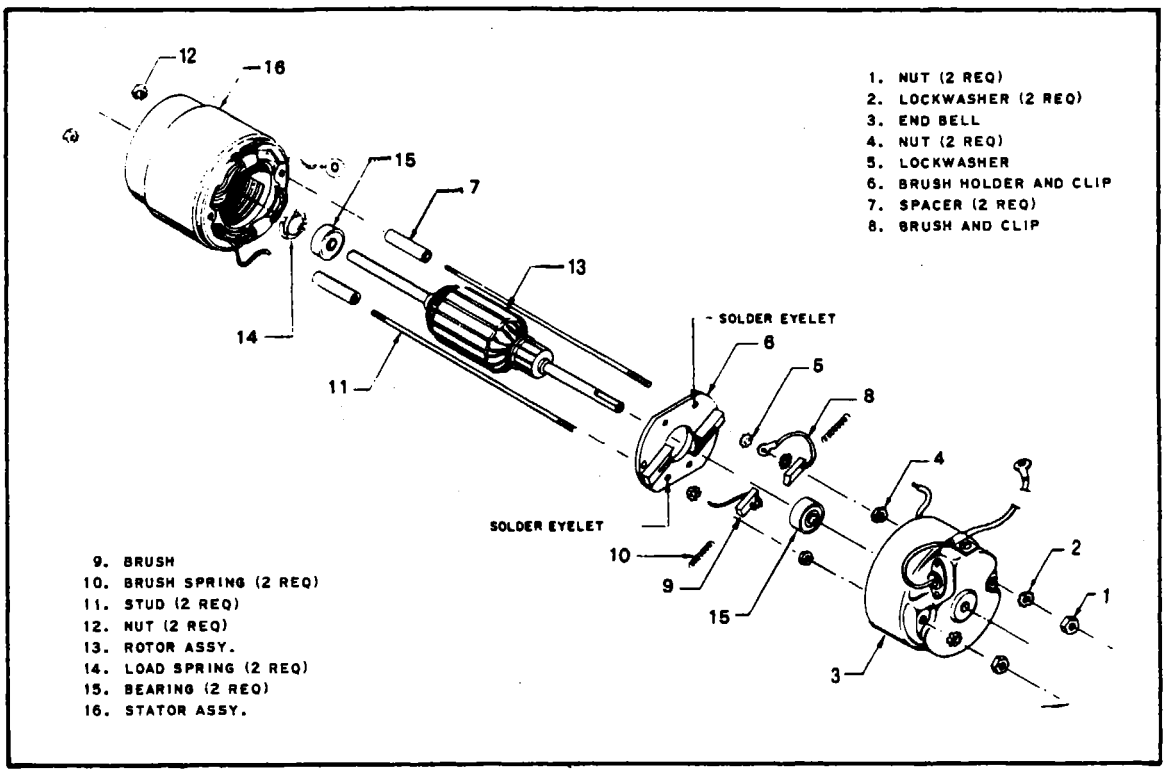



Figure 13-17. Ventilating Air Blower Motor

NOTE

If the commutator is turned, the lathe tool must be ground for copper and must be extremely sharp. Commutator slots must be cleaned after turning to avoid shorts between bars. Sand lightly after turning.

h. Press new bearings on the rotor shaft until they bottom against shoulders on the shaft, using a lubricant.

i. Reassemble the motor parts, using new brushes, brush springs and load springs from the kit. Note that two sets of brushes are provided. Use the new brushes which fit the motor brush holders. The 718855 springs must be used with 1/4 x 3/8 brushes and the 717472 springs with 1/4 x 1/4 brushes. Make sure that stator leads and capacitor lead are securely soldered.

j. No specific test of the motor is required after this repair procedure provided the rotor turns freely and the motor performs satisfactorily after reassembly into the blower assembly. Extensive repairs, that would require performance testing after completion, are not recommended.

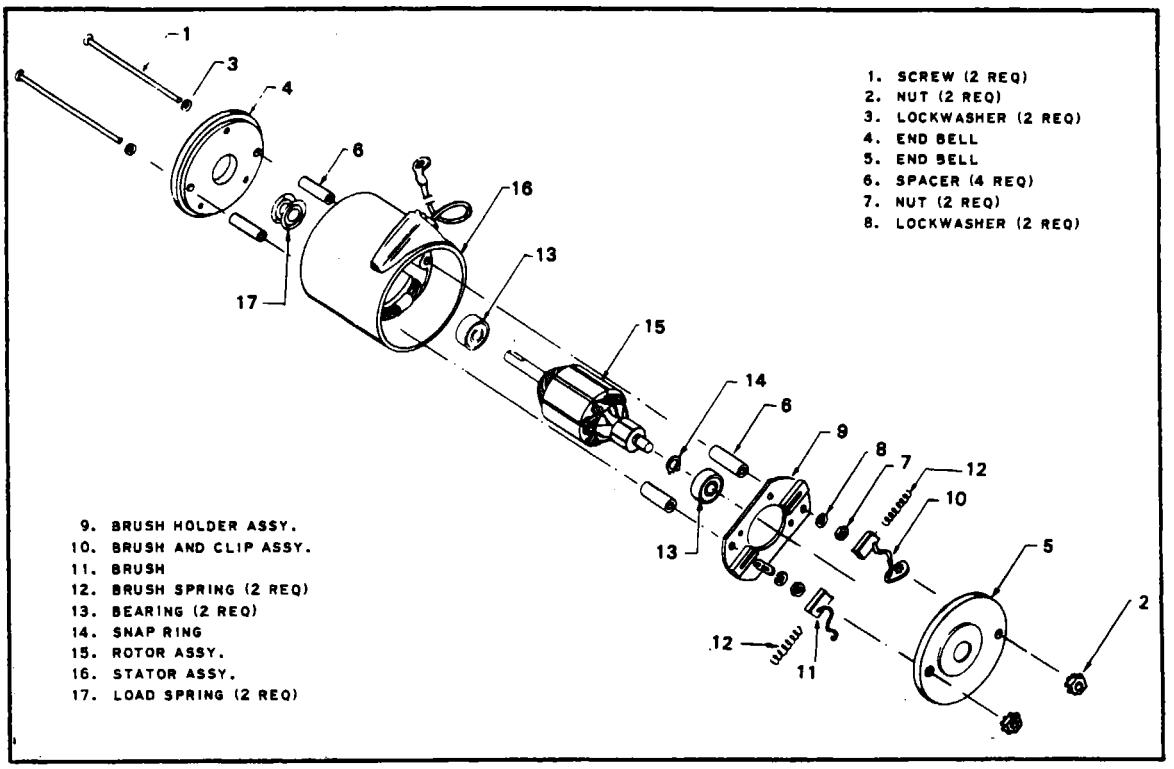



Figure 13-18. Combustion Air Blower Motor

13-67. COMBUSTION AIR BLOWER MOTOR OVERHAUL. An overhaul kit, PAC Part No. 754 307, is available for overhaul of the combustion air blower motor on all models of the 940 Series heaters. To overhaul motor, proceed as follows: (Refer to Figure 13-18.) 7.)

a. Remove the two nuts (2) from the end of the motor and remove the end bell (5).

b. Loosen the two small nuts (7) slightly with a 1/4 inch end wrench (or deep socket), then remove long screws (1) with a screw driver while holding nuts (7). This will free the other end bell (4) and spacers (6).

c. Pull the brush holder assembly (9) out far enough to unsolder the stator lead and remove this entire assembly.

d. Pull the rotor (15) out of the stator (16) with bearings on the shaft. Clean the shaft and remove the bearings with a bearing puller, using a lubricant on the shaft.

e. Clean all parts with a soft bristle brush and blow off with compressed air. Sandpaper commutator of rotor (15) or turn down slightly if required.

NOTE

If the commutator is turned, the lathe tool must be ground for copper and must be extremely sharp. Commutator slots must be cleaned after turning to avoid shorts between bars. Sand lightly after turning.

f. Rebuild motor using new bearings (13), brushes (10 and 11), and brush springs (12). When soldering brush pigtails, use long nosed pliers next to the solder joint to prevent solder from "wicking" into the pigtail.

g. No specific test of the motor is required after the above repair procedure provided the shaft turns freely and the motor performs satisfactorily when reinstalled in the heater. More extensive repairs than those described should not be attempted.

13-68. HEATER HOUSING.

a. Clean inside and out with dry cleaning solvent, and inspect housing for roundness and dents. Straighten, or re-shape, as necessary.

b. Replace all rubber grommets in the housing.

13-69. FLAME DETECTOR SWITCH. Check bow spring to see if pressure of quartz rod is causing it to bow up toward the top of the switch. If the spring is not bowed, but is in a straight position, the quartz rod is broken and must be replaced.

If such is the case, proceed as follows:

a. Loosen the two switch mounting screws.

b. Remove the adjusting screw.

c. Turn micro switch back on the bracket and remove the bow spring. Inspect condition of the quartz rod.

d. If the quartz rod is broken or chipped on either end, it must be replaced. If it is in good condition, replace it in the tube, turn the switch back into position and reinstall the adjusting screw.

e. Back off the adjusting screw until the switch clicks, indicating that the micro switch has transferred.

f. Turn the adjusting screw slowly in, until the switch just clicks again, to determine point of transfer, then turn the screw exactly three-quarter turn past the transfer point.

g. Hold the screws and tighten micro switch mounting nuts to lock switch securely in place.

13-70. OVERHEAT SWITCH AND CYCLING SWITCH. Visually inspect the overheat switch, or cycling switch, for damage and clean contacts by sliding a strip of clean bond paper between the contacts. Do not use a file or sandpaper, and do not attempt to bend the contact arm. These switches are adjusted at the factory and the adjustment cannot be changed in the field. Replace switch if found defective.

13-71. LOCKOUT OVERHEAT SWITCH.

a. Connect wires to the two connector wires of the lockout overheat switch, and suspend this assembly in an oven with an accurate thermometer. Provide a test light, or meter, to indicate opening of the switch contacts. Press the reset button of the switch.

b. Slowly raise the oven temperature until the switch contacts open. Note temperature in the oven at the moment of switch operation. The switch must open at the temperature noted below, according to model. If not within limits, install a new switch. This unit is not adjustable.

| Model Used On | Opening Temperature |
|---|---|
| 940-DB | 205 to 245°F. |
| 940-K | 140 to 160°F. |

13-72. THERMAL FUSE AND COMBUSTION AIR ELBOWS.

a. Inspect for dents and fit between parts.

b. Clean elbows with dry cleaning solvent and blow out with compressed air.

c. Inspect fusible link of thermal fuse assembly for tightness of attaching screws and condition of link. The attaching screws may be tightened, if loose, but the entire assembly must be replaced if the link has been damaged or fused. Do not use compressed air to clean the thermal fuse assembly.

13-73. SAFETY VALVE AND FILTER.

a. To clean filter, remove bowl by loosening bail nut and clean inside of bowl. Wash filter element in dry cleaning solvent and blow dry by directing compressed air jet inside the filter. When replacing the bowl, make sure the gasket is in place.

b. Replace the fuel screen in the safety valve and wipe off the outside with a cloth dampened in cleaning solvent. Do not disassemble, or attempt to repair this unit.

c. Replace safety valve if found defective.

13-74. WIRING.

a. Inspect all heater wiring for condition of insulation, and condition of solder connection of the terminals. Repair, or replace, as required.

b. Inspect the terminal strip for damage and the terminal screws for condition of threads.

13-75. RELAY. Apply a variable voltage between terminal 4A of the relay and the ground wire. Increase and decrease the voltage to determine relay pull-in voltage. The 28-volt relay must pull in at not more than 18-volts and the 14-volt relay at not more than 9-volts. Replace relay if not within limits.

13-76. REASSEMBLY.

13-77. VENTILATING AIR BLOWER - ALL MODELS. (Refer to Figure 13-16.)

a. Replace the bracket (9) on the motor (7) in its original position and tighten the screw (10). Slip the wheel (8) on the motor shaft but do not tighten set screw.

b. Install large flat washers (4), new grommets (5), and small washers (6) on each of the three motor mounting bracket screws (3), in order illustrated.

c. Fit the motor and bracket assembly into the housing and start ends of the mounting bracket screws (3) into the weld nuts on the bracket with the washers and grommets on the screws. After screws are started, drop the small washers (6) through the holes in the housing and stuff grommets (5) into the holes. Tighten the screws alternately and evenly to apply a firm pressure to the grommets, and center the motor in the housing. Do not overtighten screws (3), since this will defeat the purpose of the shock-mounting grommets.

d. Reconnect the ground wire (15) to the end of the motor by reinstalling the screw (1) and lockwasher (2).

13-78. HEATER ASSEMBLY. (Refer to Figure 13-15.) Reassembly of the heater is essentially the reverse of disassembly. If the heater is completely disassembled, reassembly will be simplified by following the procedure below, instead of a strict reversal of disassembly.

a. Reinstall the combustion air motor (82) from inside the heater housing (85), place the blower housing (84) on the outside and reinstall the three screws (83). Replace blower wheel (64) on the motor shaft. Adjust wheel for one-sixteenth inch clearance from housing, and tighten set screw.

b. Replace the blower housing (59) by reinstalling nine screws (60) and speed nuts (61).

c. Reinstall the igniter (79) in the heat exchanger (87), using a new gasket (81), and tighten with a 13/16 inch deep socket. Reinstall the screw (77) to connect the igniter ground wire, attaching one end of the bonding strap (76) with the same screw and lockwasher (78).

d. Adjust the vaporizer cable (72) in the standpipe (69), so that it extends about one-half inch from the threaded end. Smooth the end of the cable and twist strands so that loose particles will not break off on threads inside the heat exchanger. Run the nut (70) up on the threads of the standpipe as far as it will go. Place a new "O" ring (71) on the threads at the bottom. Reinstall the standpipe in the heat exchanger by first turning the welded hexagon down tightly into the threads, then turning down the nut (70) against the "O" ring, to obtain a tight seal.

e. Place the preheat resistor (73) around the standpipe, and install the nut (80) to attach the preheat conductor to the igniter terminal.

f. Spread the housing and combustion air blower assembly, and fit it over the heat exchanger, with the end of the standpipe projecting through the opening provided. Reinstall the three screws (86) in the seam of the housing. Attach the free end of the igniter ground wire bonding strap (76) to the stud inside the housing, using the nut (74) and lockwasher (75).

g. Fit the tapping plate (66) around the standpipe inside the housing, and place a new gasket (67) and the old flange (65) on the outside. Reinstall the two screws (68) to secure and seal the standpipe.

h. Fit the large combustion air elbow (56) and small elbow (58), or thermal fuse (57) loosely together, using one of the clamps (55). Fit these parts on the combustion air blower outlet and heat exchanger inlet, using the remaining clamp (55). Adjust parts to fit, then tighten both clamps securely.

i. Reinstall the overheat switch, or cycling switch (49), by reinstalling the two screws (50). Do not overtighten screws, since this may distort the switch and affect its calibration. Also, reinstall the lockout overheat switch (44), on models so equipped, by reinstalling the four screws (45).

j. Reinstall the flame detector switch (40) by tightening the nut (42) on the ferrule (43). Tighten nut firmly, but avoid excessive crushing of the flame detector switch tube. If a new flame detector switch is being installed, use a new ferrule (43) and nut (42). These parts should remain on the tube after the first installation, since the ferrule will be firmly pressed onto the tube. This does not affect operation of the switch which may be removed and replaced, as required, so long as it continues to function properly.

k. Reinstall the terminal strip (9) and insulator (30) on the flame detector switch guard (23) by reinstalling the four screws (31). Also, reinstall the relay (25), on models so equipped, by installing the lockwasher on the relay stud inside the guard, then the relay ground wire and the lockwasher nut (26). Tighten nut securely to obtain good electrical contact, then reinstall guard (23) over flame detector switch, using the four screws (24).

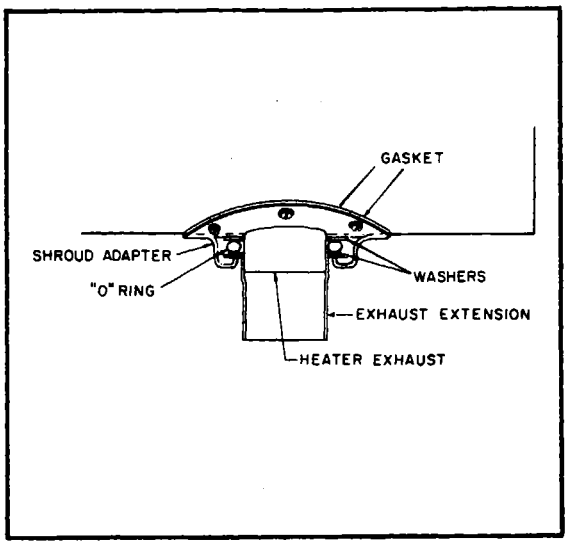



Figure 13-19. Detail of Exhaust Extensions Installation

l. Connect the short fuel line (17) to the outlet of the fuel control valve (20) and tighten compression nut finger tight. Start the screws (16) into the nuts on the fuel control valve mounting bracket. Fit the fuel control valve into the housing and the fuel line into the standpipe, then tighten the two compression nuts (18) very carefully. Fit new grommets (14 and 15) into the slots in the valve housing, then fit the cover (13) on the housing and tighten the four screws (16) into the fuel control valve mounting bracket.

m. Reinstall the air inlet louver plate (11) on the ventilating air blower (9) using screws (12), and reinstall the blower on the heater housing.

n. Install the loose wires (54, 53, 48 and 47), according to the wiring diagram for the heater model, and connect leads of all electric components, using the wiring diagram as a guide. All leads are numbered, with the exception of the two push-on terminals which connect to the thermal fuse. Connect these wires to the nearest terminal. The thermal fuse has no polarity.

o. Place flat washers (6), new "O" ring (7), exhaust extension (5), and flat washer (6) on heater exhaust. Fit new gasket (8) around exhaust and install shroud adapter (3) to hold entire assembly by reinstalling six screws (4).

p. Reinstall the air inlet adapter (1) when the heater is reinstalled in the airplane.

13-79. TESTING.

13-80. GENERAL. Any heater that has been overhauled, or subjected to major repair, should be tested before being returned to service. The test should include a "leak test" and "flow test" of the fuel control valve, a "burn test" of the assembled heater, and a test of the overheat switch.

NOTE

The heat exchanger should have been leak tested as directed in paragraph 13-63 prior to reassembly.

13-81. TEST SET UP. The test set up should include the following components:

a. A suitable cradle or bracket for mounting the heater with provision to dispose of the exhaust gases.

b. A source of 14 or 28-volts dc, depending on the heater model being tested. This should be a variable source from a transformer and rectifier, so that the voltage can be regulated, and must include a voltmeter and ammeter.

c. A source of fuel at a pressure of 1 to 15 psi for all models except 940-DB and 940-K. A filter should be included in the fuel supply line. Fuel pressure may be supplied by a gravity system with a head of at least four feet, or by an electric fuel pump. The 940-DB and 940-K heaters require a source of fuel at 20 to 35 psi from a fuel pump which operates at this pressure.

d. A glass graduate of the type shown in Figure 13-20 is required for testing the fuel control valve, unless a flow meter is available in the fuel supply line.

e. A strobo-type tachometer, although not necessary is desirable to time blower speed.

f. An oven and thermometer, for testing the lockout overheat switch.

13-82. TEST PROCEDURE. The heater test should be conducted in the following order, if possible, since the heater must be cold at the start of the overheat switch test.

13-83. FUEL CONTROL VALVE LEAK TEST. Remove the fuel control valve from the heater, or test the valve separately before reassembly, during the overhaul. Proceed with test as follows:

a. Connect the control valve to the fuel source.

b. Install the short heater fuel line (Refer to Figure 13-15, Ref. 17.) in the fuel control valve outlet, in its normal position. Support the valve in its normal mounting position (Refer to Figure 13-20) so that fuel from the fuel line will drip into a glass graduate.

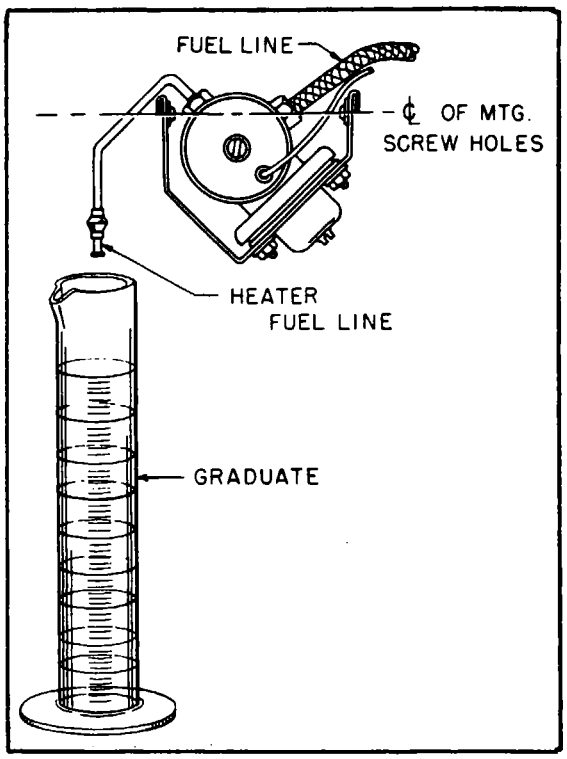



Figure 13-20. Fuel Flow Test Set Up

NOTE

The valve must be supported in a normal position so a line through the mounting screw holes of the bracket will be level. Failure to test the valve in its proper position will affect the fuel rate and may cause rejection of good equipment.

c. Ground the body of the fuel control valve and apply a test voltage to each of the solenoid leads. A distinct click should be heard when the solenoids are energized.

d. Turn on the fuel pressure and energize both solenoids at once. Allow fuel to flow through the valve for a few seconds, then de-energize both solenoids. One or two drops of fuel may fall from the outlet within 15 seconds after the solenoids are closed. After 15 seconds, a drop of fuel may form, but it should not fall. If the valve does not shut off completely, it must be replaced.

13-84. FUEL CONTROL VALVE FLOW TEST. Check fuel flow through the valve, as follows, using the test set up illustrated in Figure 13-20:

a. Energize both solenoids and permit fuel to flow through the valve for a few seconds.

b. Place a glass graduate under the valve outlet and permit fuel to flow for exactly 60 seconds, then shut off both solenoids.

c. Read the graduate at eye level - it should contain the amount of fuel shown in the chart for high heat fuel flow.

d. Repeat the above test with the restriction solenoid de-energized (low heat fuel flow). The graduate should then contain the amount of fuel shown in the table for low heat fuel flow.

e. If fuel flow is not within limits, turn adjusting screw clockwise to increase, or counterclockwise to decrease, fuel flow and retest. Both low and high heat fuel flow must be within limits for proper operation of the heater. Replace or repair the valve if it cannot be brought within limits by adjustment. Reseal the adjusting

FUEL FLOW CHART

| Heater Model | Fuel Pressure | High Heat | Low Heat |
|---|---|---|---|
| 940-D | 1 to 15 psi | 22 ± 2 cc (0. 034 to 0. 041 lb/min on flowmeter) | 7. 0 to 9. 0 cc (0. 010 to 0. 014 lb/min on flowmeter) |
| 940-DA | 1 to 15 psi | 22 ± 2 cc (0. 034 to 0. 041 lb/min on flowmeter) | 12 ± 2 cc (0. 016 to 0. 020 lb/min on flowmeter) |
| 940-DB | 20 to 35 psi | 22 ± 2 cc (0. 034 to 0. 041 lb/min on flowmeter) | 12 ± 2 cc (0. 016 to 0. 020 lb/min on flowmeter) |
| 940-K | 20 to 35 psi | 22 ± 2 cc (0. 034 to 0. 041 lb/min on flowmeter) | 3. 5 to 6 cc (0. 006 to 0. 014 lb/min on flowmeter) |

screw with glyptal cement after test.

13-85. LOCKOUT OVERHEAT SWITCH. The test for the lockout overheat switch is described in paragraph 13-71. This test is normally performed during overhaul, before the switch is installed, but the switch may be removed and tested at any time its operation is in doubt.

13-86. OVERHEAT SWITCH TEST (Models 940-D and 940-DA only). Install the fuel control valve on the heater and install the heater on the test fixture. Make fuel and electrical connections. Proceed with overheat switch test as follows: (Heater should be at room temperature when test is started. )

a. Set the HIGH-LOW switch to HIGH. Preset the voltage control so that voltage, with full starting load, will be 22-volts for the 28-volt heater and 11-volts for the 14-volt heater.

b. Cover the inlet of the ventilating air blower with cardboard or sheet metal, to stop off all flow of ventilating air.

c. Turn on the control switch. Start timing the operation as soon as ignition occurs. When the flame detector switch transfers, reset voltage to 22-volts, or

11-volts, according to heater model.

d. Continue timing until the overheat switch opens and shuts off fuel flow (combustion will stop in the heater). This time must be more than 50 seconds, but less than 80 seconds from the moment of ignition. Replace the overheat switch, if not within limits.

13-87. BURN TEST. Shut the heater off and remove the cover from the ventilating air blower inlet. Allow time for the heater to cool. Proceed with "burn test" as follows:

a. Turn on the heater switch and adjust voltage to 14 or 28-volts, according to heater model. Start timing heater action from the moment the switch is turned on.

b. The current draw should not exceed 13-amperes for either 14 or 28-volt heaters.

c. Ignition should occur within 20 seconds from the moment the switch is turned on.

d. The flame detector switch should close more than 8 seconds, but less than 25 seconds, from the instant the heater ignites.

e. Readjust voltage immediately after the flame detector switch transfers, and allow the heater to run on high heat for at least one minute. If a tachometer is available, the speed of the combustion air motor should be determined with the combustion air adapter removed, and with no restriction on the heater exhaust. The speed should be at least 5000 RPM. In the absence of a suitable light to time the blower, it can be presumed to be operating properly if the heater burns normally and did not have an excessive deposit of carbon in the exhaust tube, or combustion chamber, when cleaned during overhaul. Speed of the ventilating air blower is not critical, since it has no direct effect on combustion.

f. After the heater has burned on high heat for one minute, turn the HIGH-LOW switch to LOW. Burning should decrease in intensity and the heat output should be reduced.

g. Turn off the control switch. Burning must stop within 45 seconds, and both blowers should continue to run for more than one minute but less than two minutes twenty seconds (time from instant the switch is turned off).

13-88. CYCLING SWITCH TEST (Model 940-K).

a. Attach a duct to the heater outlet and insert an accurate thermometer into the airstream, about 18 inches from the heater.

b. Start the heater and permit it to burn until it begins to cycle on the cycling switch.

c. Read the duct temperature, as indicated by the thermometer. It must be within the limits of 200° F to 225° F. If the temperature is not within limits, the cycling switch is defective and must be replaced.

If the heater should fail any test, refer to the Troubleshooting Chart and make repairs or replacements as required.

13-89. JANITROL HEATER. This section contains information for operation, service and overhaul of the combustion heater, Part No. 751 978 and combustion air blower, Part No. 753 443 (14-volt), 758 120 (28-volt) (used with the heater). (Refer to Figure 13-21.)

13-90. TROUBLESHOOTING. The service troubles and suggested remedies listed in Table XIII-II or XIII-III are provided to assist in locating and correcting malfunctions in the heating system. The following procedure is based upon the use of optional components.

13-91. HEATER OPERATION. (PA-23-250 [six place], Serial Nos. 27-3050, 27-3154 to 27-7554040.) The 35,000 B.T.U. Janitrol heater is controlled by a three position switch located on the right side of the instrument panel, labeled FAN, OFF and HEAT. The FAN position will operate the vent blower only and may be used for cabin ventilation on the ground or windshield defogging when heat is not desired. For heat the manual heater fuel valve located on the fuel selector panel must be on and the three position switch turned to HEAT. This will start fuel flow and ignite the burner simultaneously. On Serial Nos. 27-7405432 and up, the manual fuel valve is not installed.

The heater uses gasoline from either left fuel tank when the fuel crossfeed is off and from all tanks when the crossfeed is on.

The push-pull knobs at the bottom of the control pedestal control airflow and temperature. The control regulates air flowing to the front seat through the heater system and the second knob from the left control air flowing to the rear seat. The middle knob is connected to an adjustable thermostat which makes it possible to select a desired temperature of heat air. The second knob from the right is the defroster control and the right knob controls the supply of cold air through the vent on the forward bulkhead. There is also a heater overtemp. reset switch on the lower right hand instrument panel above the heater switch, for inflight reset if and overtemp. of the heater occurs.

For the overhaul and complete disassembly of the janitrol heater and its components, refer to Paragraph 13-103 of this manual. A wiring diagram of the heater Electrical System by appropriate serial number will be found in Section XI of this manual.

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fails to light. | Heater switch or circuit breaker off. | Turn on heater switch or close circuit breaker. |
| | Low voltage supply. | Apply external power supply. Attempt to start heater. (Refer to paragraph 13-99.) |
| | Fuel cut off from fuel cell. | Turn on manual shutoff valve or master solenoid. |
| | Regulator not operating properly | Check for low pressure or replace regulator. (Refer to paragraph 13-117.) |
| | Restriction in fuel nozzle orifice. | Remove the nozzle and clean or replace it. (Refer to paragraph 13-120, m and n; 13-124, i; and 13-127, k and l.) |
| | Fuel heater solenoid not operating. | Remove and check solenoid. Replace if faulty. (Refer to paragraph 13-120; 13-124, k and 13-127, a.) |
| | Fuel lines clogged or broken. | Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located. |

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fails to light (cont.). | Ignition vibrator inoperative. | Replace vibrator. Check for defective radio noise filter. (Refer to paragraph 13-113.) |
| | Manual reset limit (overheat) switch open. | Press reset button firmly and recheck to determine reason for switch opening. |
| | Combustion air pressure switch open. (Defective switch or low combustion air blower output.) | Check for low blower output due to low voltage and correct it. If switch is defective, replace it. (Refer to paragraph 13-116.) |
| | Cycling switch open. | Replace if defective. (Refer to paragraph 13-115.) |
| | Duct switch open. | Operate control to see if switch will come on. Replace switch if defective. (Refer to paragraph 13-118.) |
| Ventilating air blower fails to run. | HEATER switch OFF. Broken or loose wiring to motor. | Energize the HEATER switch. Check and repair wiring. |
| | Circuit breaker open. | Close circuit breaker. |
| | Worn motor brushes. | Replace motor brushes. (Refer to paragraph 13-111.) |

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Ventilating air blower fails to run (cont.). | Blower wheel jammed. | Remove and check the ventilating air blower wheel and realign if necessary. (Refer to paragraph 13-127, g.) |
| | Motor burned out. | Remove blower assembly and replace motor. (Refer to paragraph 13-120, l and r thru u; 13-127, b thru g.) |
| | Defective radio-noise filter. | Replace filter. |
| Combustion air blower fails to run. | Faulty wiring to motor. | Inspect and replace faulty wiring. |
| | Poor ground connection. | Tighten ground screw. |
| | Worn motor brushes. | Replace motor brushes. (Refer to paragraph 13-111, b.) |
| | Blower wheel jammed. (Usually indicated by hot motor housing. | Overhaul the combustion air blower. (Refer to paragraphs 13-121 and 13-128.) |
| | Faulty or burned-out motor. | Remove combustion air motor for overhaul or replacement of motor. (Refer to paragraphs 13-110, 13-120 and 13-128.) |

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

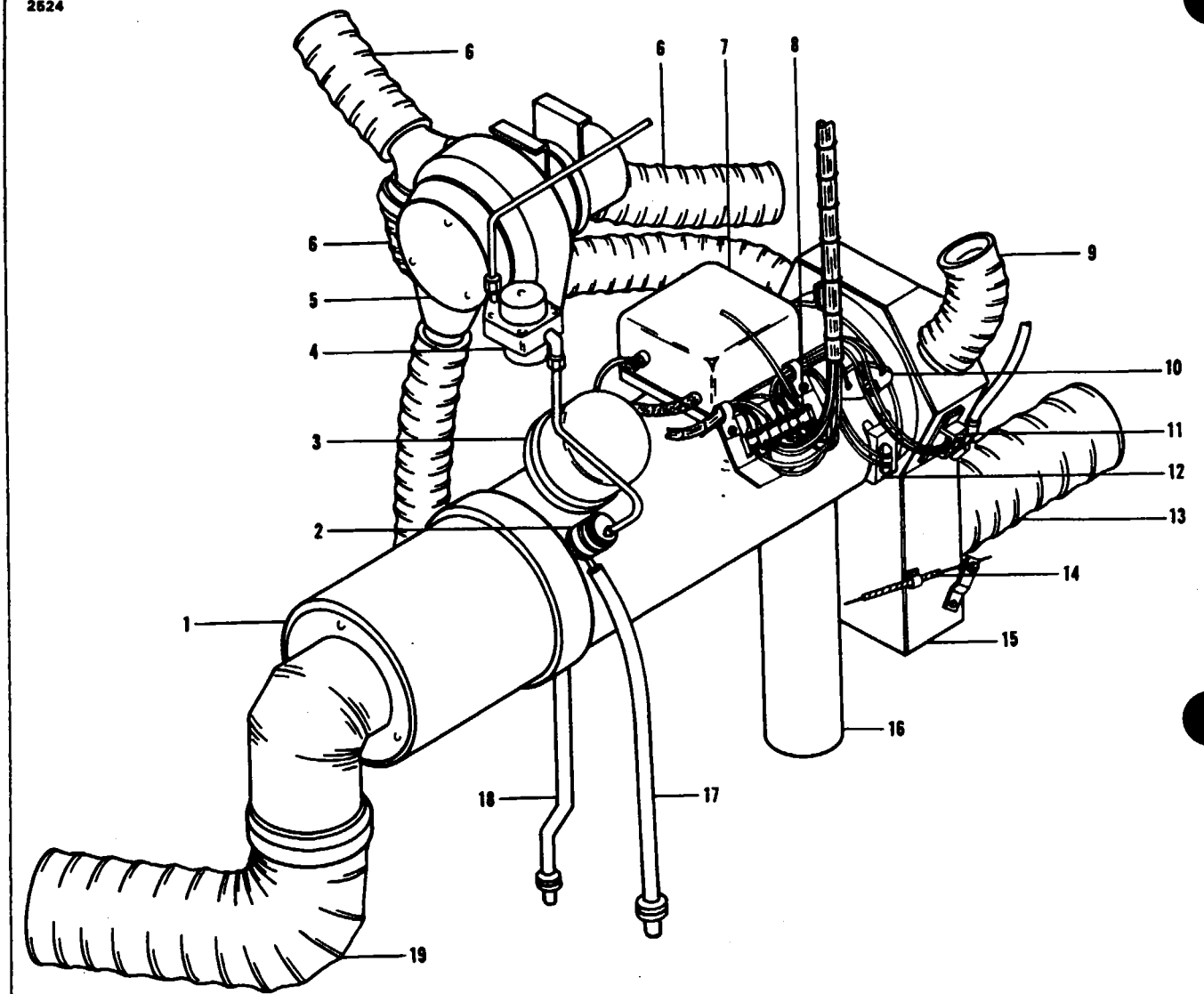
| Trouble | Cause | Remedy |
|---|---|---|
| Heater fires but burns unsteadily. | Insufficient fuel supply. | Inspect fuel supply to heater including shut-off valve, solenoid valve and fuel lines. Make necessary repairs. |
| | Spark plug partially fouled. | Replace spark plug. (Refer to paragraph 13-112.) |
| | Loose primary connection at ignition assembly. | Tighten the connection. |
| | Faulty vibrator. | Replace the vibrator. (Refer to paragraph 13-113.) |
| | Combustion air blower speed fluctuates. (Can be caused by low voltage, loose blower wheel, worn brushes or motor. | Remove and overhaul the combustion air blower assembly as required or correct low voltage condition. (Refer to paragraphs 13-111, 13-121, 13-125 and 13-128.) |
| | High-voltage leak in lead between ignition assembly and spark plug. | Replace ignition assembly. (Refer to paragraph 13-114.) |
| | Inoperative ignition assembly. | If vibrator is in good condition, replace ignition assembly only. (Refer to paragraph 13-114.) |

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fires but burns unsteadily (cont. ). | Restriction in fuel nozzle orifice. | Remove nozzle for cleaning or replacement. (Refer to paragraphs 13-120, m and n; 13-124, i; and 13-125, k and l. ) |
| | Nozzle loose in retainer or improper spray angle. | Tighten or replace the nozzle as required. (Refer to paragraphs 13-123, e; 13-125, k. ) |
| Heater starts then goes out. | Lack of fuel at heater. | Check fuel supply through all components from the cell to the heater. Make necessary corrections. |
| | Inoperative or chattering combustion air pressure switch. | Check, adjust, or replace switch. (Refer to paragraph 13-116. ) |
| | Inoperative overheat switch. | Check or replace switch. (Refer to paragraphs 13-115 and 13-132. ) |
| | Inoperative cycling switch. | Adjust or replace the switch. (Refer to paragraphs 13-115 and 13-132. ) |
| | Low voltage. | Attach external power. |

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fails to shut off. | Fuel solenoid valve in heater stuck open. | Remove and replace solenoid assembly. (Refer to paragraphs 13-120, q; 13-122, k; and 13-125, a.) |
| | Inoperative duct and cycling switch. | Check and repair. (Refer to paragraphs 13-115 and 13-118.) |
| | Defective HEATER switch. | Replace the HEATER switch. |




1. VENTILATING AIR BLOWER
2. FUEL INLET
3. PRESSURE SWITCH
4. FUEL REGULATOR
5. COMBUSTION AIR BLOWER
6. HOSE, CABIN HEAT
7. IGNITION ASSEMBLY
8. TERMINAL STRIP
9. HOSE, DEFROSTER
10. LIMIT SWITCH
11. HEAT REGULATOR
12. CYCLING SWITCH
13. HOSE, CABIN HEAT, REAR
14. CONTROL CABLE, CABIN HEAT, REAR
15. AIR DISTRIBUTION BOX
16. EXHAUST TUBE
17. DRAIN, FUEL LINE
18. DRAIN, HEATER
19. HOSE, HEATER AIR INTAKE

Figure 13-21. Heater Assembly and Combustion Air Blower

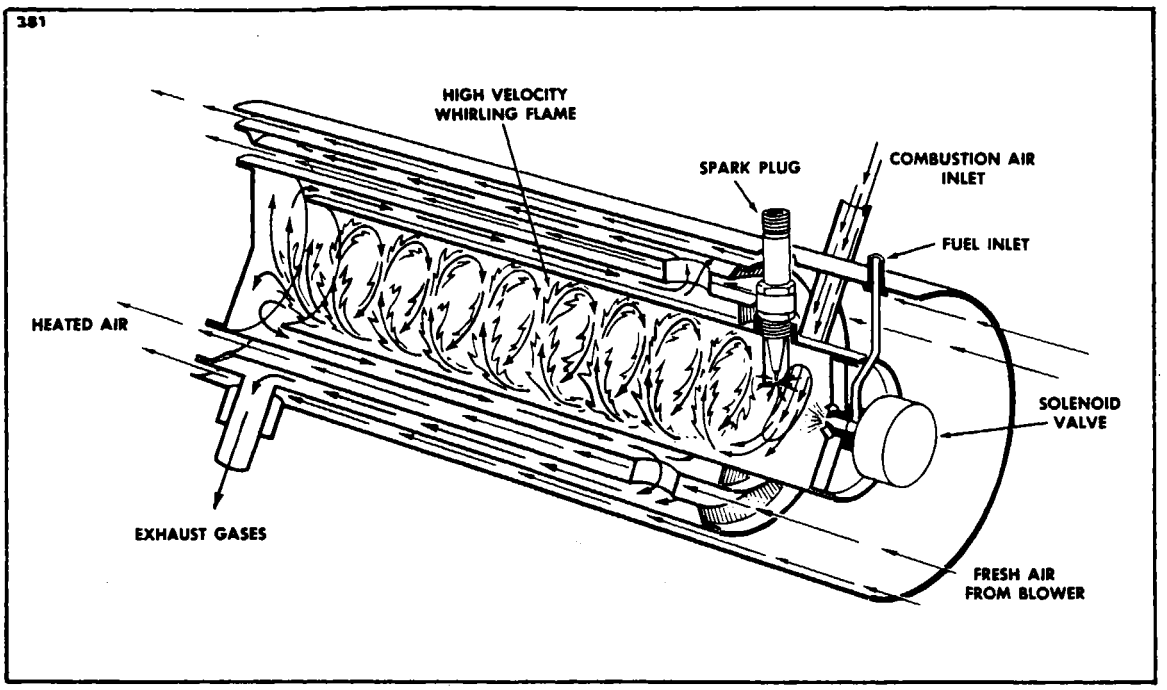



Figure 13-22. Diagramatic Cutaway of Heater to Show Whirling Flame Action

## 13-92. DESCRIPTION OF HEATER AND BASIC COMPONENTS.

13-93. SPARK-SPRAY IGNITION. (Refer to Figure 13-22.) The controlled atomized spray from a specially designed spray nozzle, coupled with high-voltage spark plug ignition, insures instant firing and continuous burning under all flight conditions.

Heat is produced by burning a fuel-air mixture in the combustion chamber of the heater. Aviation gasoline is injected into the combustion chamber through the spray nozzle. The resulting cone-shaped fuel spray mixes with combustion air and is ignited by a spark from the spark plug. Voltage for ignition is supplied by an ignition unit which steps up the 14 or 28-volts to a high, oscillating voltage to provide a continuous spark across the spark plug gap. A shielded, high voltage lead connects the ignition assembly to the spark plug. Combustion air enters the combustion chamber tangent to its surface and imparts a whirling or spinning action to the air. This produces a whirling flame that is stable and sustains combustion under the most adverse conditions because it is whirled around itself many times. Therefore, ignition is continuous and the combustion process is self-piloting. The burning gases travel the length of the combustion tube, flow around the outside of the inner tube, pass through cross-over passages into an outer radiating area, then travel the length of this surface and out the exhaust.

Ventilating air passes through the heater between the jacket and combustion tube assembly outer surface and through an inner passage in the assembly. Consequently, ventilating air comes into contact with two or more heated, cylindrical surfaces.

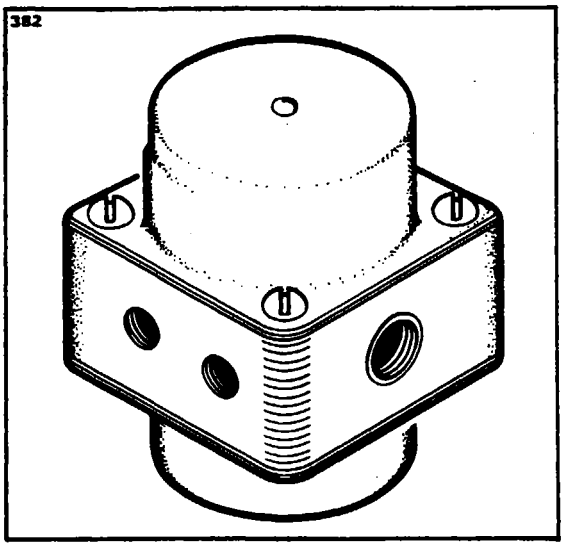



Figure 13-23. Fuel Regulator and Shutoff Valve

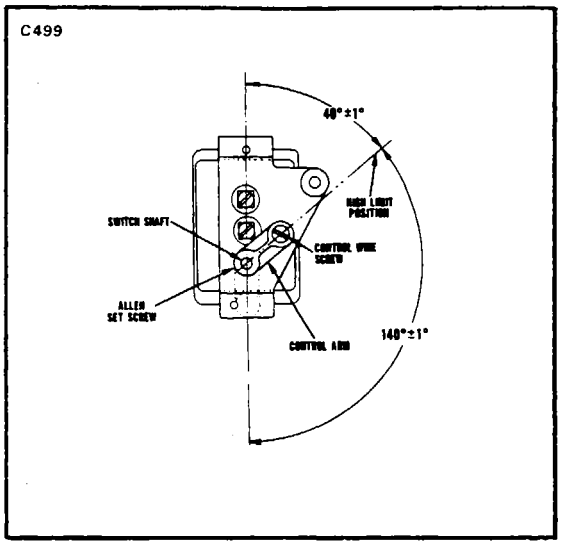



Figure 13-24. Top View - Duct Switch (Typical Control Lever Positions)

13-94. FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 13-23.) This unit provides preset, regulated fuel pressure as well as remote shutoff to the heater, regardless of fuel inlet pressure variations. It is adjustable to 7 psi, with inlet pressures up to 50 psi. The shutoff valve is operated by a solenoid.

13-95. DUCT SWITCH. (Refer to Figure 13-24.) This switch is installed in the ventilating air duct downstream from the heater to sense the ventilating air outlet temperature. To select the desired cabin temperature, the switch may be adjusted manually from a high of 250°F ± 10° downward through a range of 146°F ± 6°. The switch has a differential of 10°F ± 5° at any given setting.

13-96. COMBUSTION AIR BLOWER. This centrifugal-type blower supplies combustion air to the combustion chamber of the heater. Performance of the combustion air blower is assisted by the use of ram air during flight.

13-97. VENTILATING AIR BLOWER. This blower is attached to the inlet end of the heater assembly and provides a source of ventilating air through the heater. Ram air from the ventilating air intake scoop is used during flight.

13-98. OPERATING CONTROLS. (Refer to Figure 13-25.)

NOTE

The schematic diagram (Refer to Figure 13-25.) shows the heater circuit, including the electrical wiring in the airplane.

a. The HEATER SWITCH is connected in the line that supplies electrical power to all heater equipment and controls. When this switch is in the OFF position, the entire heater system is inoperative. This switch has a FAN position which permits use of the ventilating air blower to circulate cool air through the system for summer ground operation. With the switch in FAN position, the heater is inoperative and only the ventilating air blower is energized.

b. The HEATER SWITCH is a normally open switch that supplies power to (lock-in) the safety relay through which power is supplied to the ignition and fuel circuits of the heater.

13-99. OPERATING PROCEDURE. (Refer to Figure 13-25.)

a. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air and combustion air blowers should operate.

b. The heater will ignite and continue to operate.

c. The DUCT SWITCH can be set to regulate the cabin temperature for desired comfort level. If this switch is set for ground operating comfort, it may be necessary to reposition it after being airborne, since ram air will increase the ventilating air flow and the heater output.

d. To stop heater operation, turn off the HEATER SWITCH.

e. It is desirable to operate the fan several minutes to cool the heater after operation. To stop fan operation, turn OFF the HEATER SWITCH.

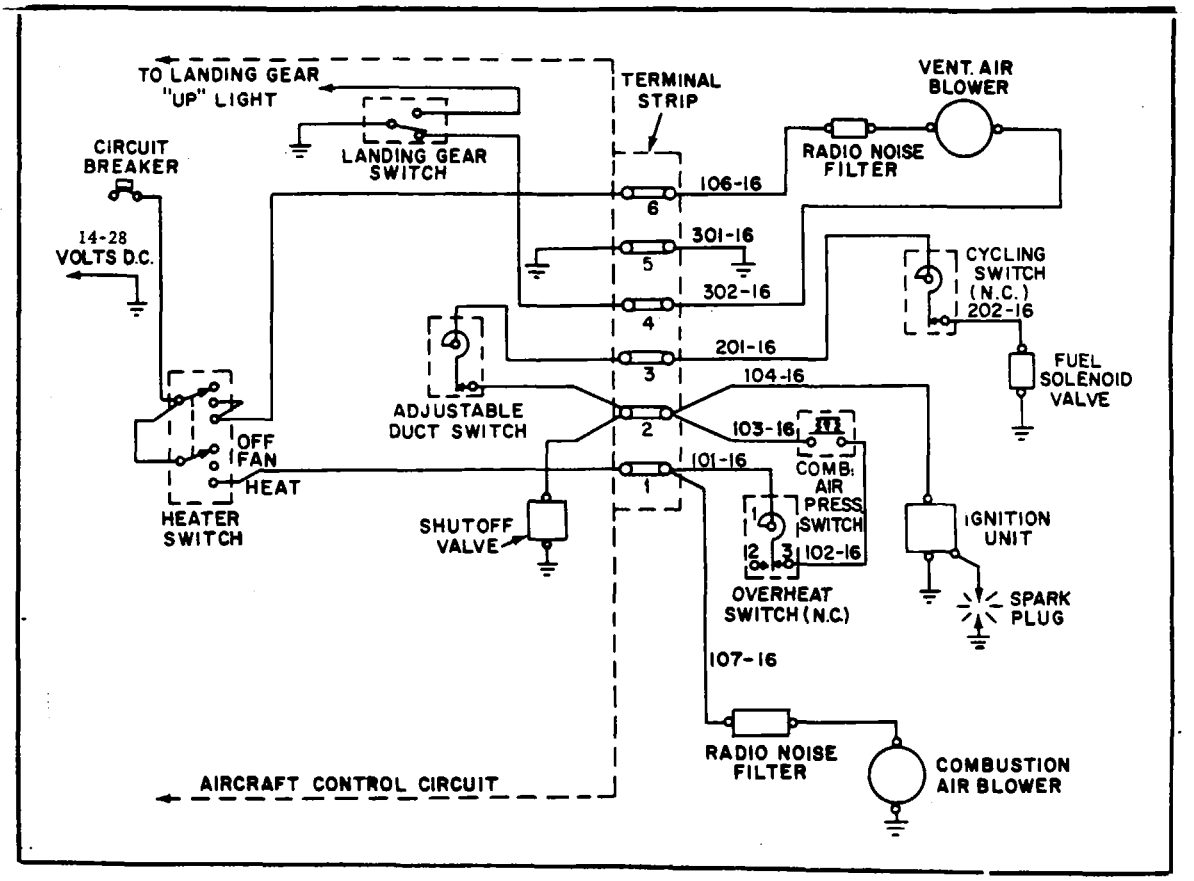



Figure 13-25. Wiring Diagram

## 13-100. INSPECTION OF HEATER AND HEATER COMPONENTS.

13-101. PREFLIGHT AND OR DAILY INSPECTION.

a. Inspect the ventilating air inlet scoop, combustion air inlet scoop, exhaust outlet and fuel drain for possible obstructions. Make sure that all of these openings are clear of any restrictions and that no damage has occurred to air scoop protrusions.

b. Perform an operational check as follows:

1. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air blower and combustion air blower should operate.

NOTE

To proceed with the operational check, follow paragraph 13-99 entitled Operating Procedure, steps a through e. The above procedure should be repeated one or more times.

13-102. 100-HOUR INSPECTION. The mandatory 100-Hour Inspection shall be conducted on new heaters or overhauled heaters with a new combustion tube assembly upon accumulation of 500-heater operating hours or twenty-four months, which-ever occurs first, and thereafter at intervals not to exceed 100-heater operating hours or twenty-four months, whichever occurs first. If an hour-meter is used on the heater assembly, it should be connected across terminals number 2 and 5 on the heater terminal strip. If an hourmeter is not used, count one heater operating hour for each two flight hours for normal aircraft operation. Consideration should be given for any excessive ground operation of the heating system.

NOTE

The 100 Hour Inspection consists of the functional checks and inspection listed below and the Pressure Decay Test.

a. Inspect ventilating air and combustion air inlets and exhaust outlet for restrictions and security at the airplane skin line.

b. Inspect the drain line to make sure it is free of obstructions. Run a wire through it if necessary to clear an obstruction.

c. Check all fuel lines for security at joints and shrouds, making sure that no evidence of leaks exists. Also check for security of attachment of fuel lines at the various attaching points in the airplane. Check fuel pressure to ensure 7 psi.

d. Inspect electrical wiring at the heater terminal block and components for loose connections, possible chafing of insulation, and security of attachment points.

e. Inspect the high-voltage cable connection at the spark plug to make sure it is tight. Also, examine the cable sheath for any possible indications of arcing, which would be evidenced by burning or discoloration of the sheath.

f. Inspect the combustion air blower assembly for security of mounting and security of connecting tubing and wiring. Tigthen any loose electrical terminals and air tube connections.

g. Operate both the combustion and ventilating air blowers and check for unusual noise or vibrations.

h. It is recommended that the condition of the spark plug be check for operation as described in paragraph titled "Spark Plugs".

i. Evaulate the condition of the combustion chamber by performing a "Pressure Decay Test" as described in Janitrol Maintenance and Overhaul Manual P/N 24E25-1 dated October 1981.

j. Following the 100 hour inspection, perform the "Preflight and/or Daily Inspection".

13-103. MAINTENANCE SERVICE. Instructions contained in this section consists of periodic inspection, adjustments, and minor corrections required at normal designated intervals for the purpose of maintaining the heating system in peak operating condition. These inspections assume that a heating system includes accessory components mentioned in preceding paragraphs.

13-104. REMOVAL OF JANITROL HEATER.

a. Turn the heater control switches off.

b. Remove the forward access panel, located on the left side of the fuselage nose section.

c. Open the forward baggage door and remove the heater cover box located on the left rear side of the baggage compartment floor.

d. Remove the screws that attach the air intake elbow to the front of the heater.

e. Note the hook-up of the electrical wires to facilitate reinstallation and disconnect wires from heater.

f. Disconnect the heater exhaust shroud from the heater jacket at the aft bottom side of the heater and slide it down enough to allow the exhaust tube to be disconnected. Remove both the shroud and tube.

g. Disconnect the drain from the forward bottom side of the heater.

h. Loosen the shroud covering the fuel inlet line fitting located at the forward top side of the heater.

i. Disconnect the combustion air blower inlet tube and outlet adapter leading to the heater. Loosen the clamp that secures the air blower motor and roll the unit out of the way or remove it, as desired.

j. Loosen the two clamps that secure the heater to its mounting brackets.

k. Located under the aft clamp are four screws that attach the air distribution box to the heater. Remove these screws.

l. Separate the heater from the air distribution box and remove the heater from the airplane.

m. To remove the air distribution box, disconnect the air hoses located on each upper side of the box.

n. Disconnect the duct switch and cabin heat control cables.

o. Remove the two screws that attach the cabin heat hose to the lower aft end of the distribution box and remove box.

13-105. INSTALLATION OF JANITROL HEATER.

a. Position the air distribution box and attach the cabin heat hose to the lower aft end of the distribution box.

b. Place the heater in position on its mounting brackets and attach the air distribution box to the heater with four screws.

c. Connect and secure the exhaust tube to the exhaust of the heater.

d. Position and secure the exhaust tube shroud to the jacket of the heater.

e. Connect the drain tube to the bottom of the heater.

f. Tighten the two clamps that secure the heater to its mounting brackets.

g. Connect the heat control cable to the control arm located on the right side of the air distribution box. Adjust the cable so that when the door is completely closed, approximately one-sixteenth of an inch exists between the control knob and knob stop.

h. Connect the duct switch control cable to the switch on the left side of the air distribution box. Adjust the cable so that when the control knob is full in against its stop, the control arm aligns with the vertical line of the switch. (Do not loosen the allen set screw that secures the arm to the switch shaft.) Pull the control knob out to ascertain that the control arm will have a 140° ± 1° travel to high heat position. (Refer to Figure 13-24.)

i. Connect the cockpit heat and defroster air hoses to the air distribution box.

j. Place the combustion air blower in position, connect the outlet adapter to the heater and blower inlet tube. Secure blower in position.

k. Connect the fuel inlet line, and secure the fitting shroud in position.

l. Connect the electrical wires to the heater.

| HEATER TERMINAL BLOCK WIRING | |
|---|---|
| Terminal No. | Wire Designation |
| 1 | H4A |
| 2 | H1E H2B |
| 3 | H1D |
| 4 | H9A |
| 5 | H8A H10A |
| 6 | H2A |

m. Within the baggage compartment, attach the air intake elbow to the front of the heater.

n. Operate the heater long enough to determine that the unit is operating properly.

o. Install the access box in the baggage compartment and panel at the side of the fuselage.

13-106. HEATER ELECTRICAL SYSTEM CHECKS.

13-107. ELECTRICAL CONTINUITY CHECK. These tests are listed as an aid in isolating open circuited or inoperative components.

NOTE

The schematic wiring diagram (Figures 13-25, 13-26 and 13-27 shows, in addition to the heater circuitry, a suggested aircraft control circuit. For the purposes of this manual, the circuitry shown in these illustrations will be utilized to describe electrical continuity checks.

It must be assumed that power, which is furnished through the heater circuit breaker, is present at the HEATER SWITCH at all times. Always check the

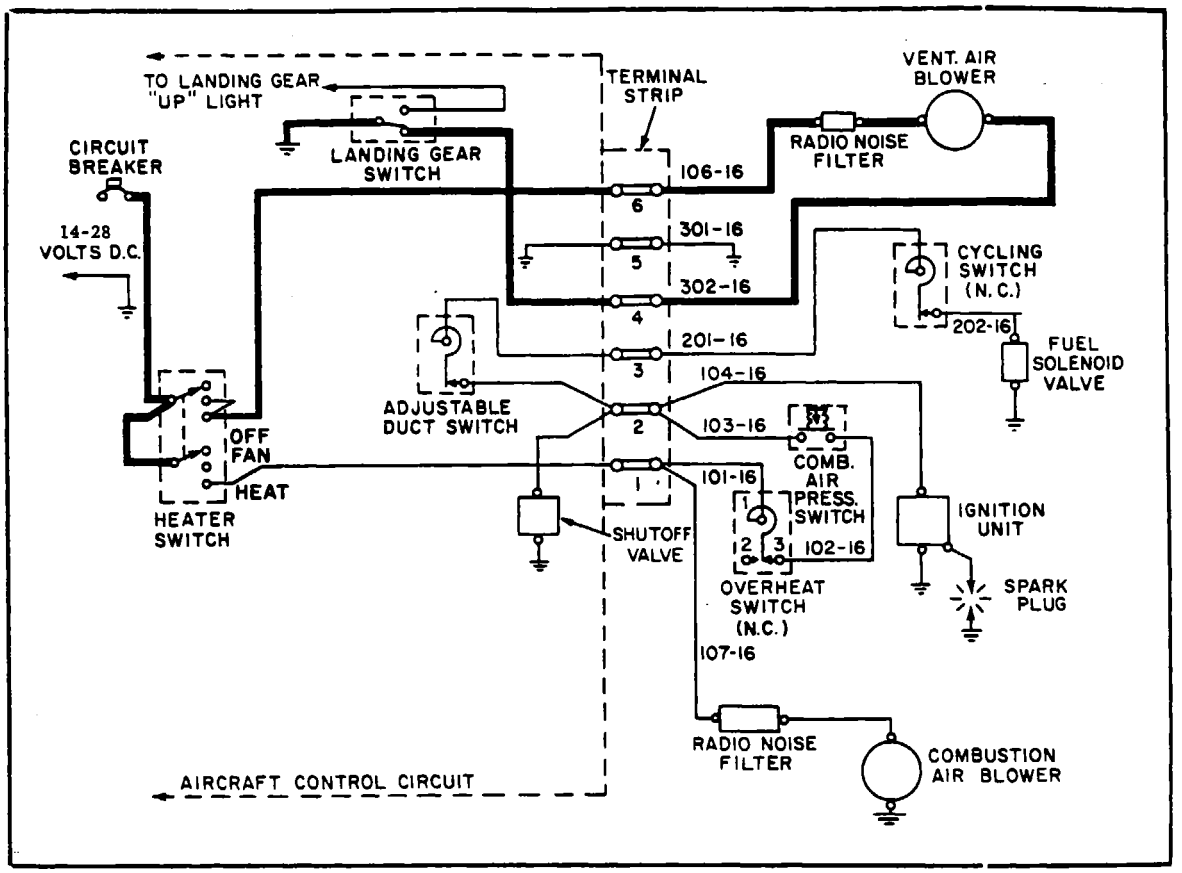



Figure 13-26. Primary Power Circuit

circuit breaker before performing electrical continuity checks.

13-108. VENT BLOWER POWER CIRCUIT CHECK. (Refer to Figure 13-26.) With the HEATER SWITCH in the FAN position, electrical continuity (14-28-volts nominal) should be present at the following locations:

a. Terminal No. 6 on the heater terminal strip.

b. From terminal No. 6 of the heater terminal strip through the radio noise filter to the ventilating air motor.

c. Electrical ground circuit for the ventilating air motor is provided from terminal No. 4 of the heater terminal strip through the LANDING GEAR SWITCH when the landing gear is down. Ventilating air motor is inoperative when the landing gear is up.

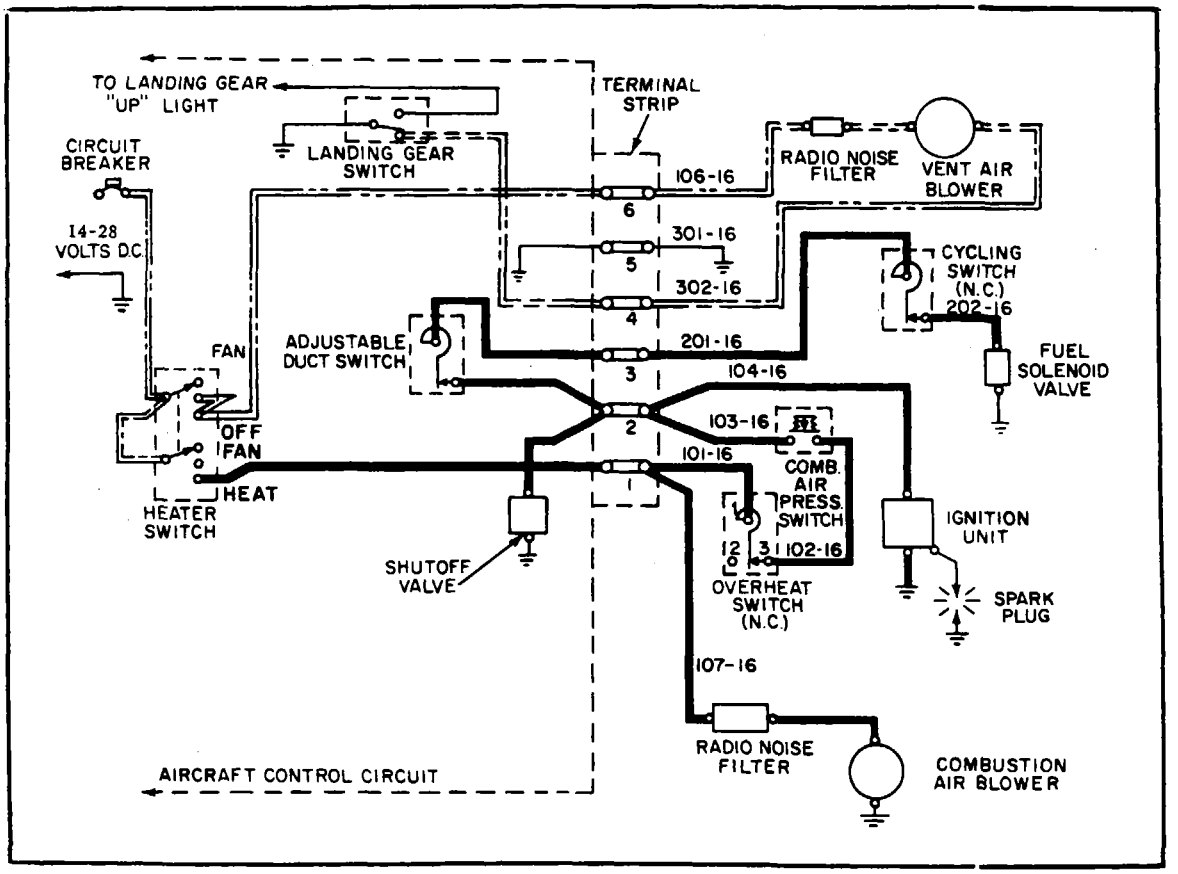



Figure 13-27. Starting Power Circuit

13-109. HEATER POWER CIRCUIT CHECK. (Refer to Figure 13-27.) ) With the HEATER SWITCH in the HEAT position, electrical continuity should be present at the following locations:

NOTE

Power for the ventilating air blower is the same as described above except that power is now supplied through the HEAT side of the HEATER SWITCH.

a. Terminal No. 1 of the heater terminal strip.

b. From terminal No. 1 of the heater terminal strip through the radio noise filter, to the combustion air motor and to terminal No. 1 of the overheat switch.

c. From terminal No. 3 of the overheat switch through the combustion air pressure switch to terminal No. 2 of the heater terminal strip.

d. From terminal No. 2 of the heater terminal strip, through the radio noise filter, to the ignition unit; to the shutoff valve; and through the adjustable duct switch to terminal No. 3 of the heater terminal strip.

e. From terminal No. 3 of the heater terminal strip, through the cycling switch to the fuel solenoid valve.

In the event that electrical continuity is not present at one or more of the above listed points, the wiring must be traced back to the power source. If components are still inoperative after the wiring inspection, check the individual inoperative components for continuity and, if necessary, replace them.

13-110. MAINTENANCE AND REPAIRS. Instructions in this paragraph pertain to maintenance of the basic heater and components while the heater is installed in the airplane. Instructions for removal of components are included provided the installation permits accessibility.

NOTE

No special service tools are required for normal periodic maintenance.

13-111. COMBUSTION AIR BLOWER.

a. Removal:

1. Disconnect wire at quick-disconnect terminal.
2. Disconnect the inlet tubing from the inlet air adapter.
3. Loosen the clamps that hold the combustion air blower assembly in the support bracket and slide the motor out of the bracket.

b. Replacing Motor Brushes: (Refer to Figure 13-32.)

1. Remove the brush cap at one of the brush locations. Note position of brush inside the guide and carefully lift the brush and brush spring out of the guide. Be sure to hold the brush so that it can be reinstalled in precisely the same position if no brush replacement is required.

2. Inspect the brush for wear. A new brush is 17/32 inch long. If brushes are worn to a length of 3/16 inch, they must be replaced.

3. Looking through the brush guide, inspect the commutator, which should be smooth and medium brown to dark brown in color. Remove all dust from commutator with compressed air. If the commutator is grooved in the brush track, gouged, scored or shows signs of having burned spots, replace the complete motor assembly. If the commutator is in good condition, install new motor brushes, and tighten brush caps into place. Make sure each brush is oriented so that the curved end fits the curvature of the commutator.

4. After installing new brushes, it is advisable to run-in the brushes as follows: Connect the motor to a controlled voltage supply (rheostat in a 12-volt line). Operate the motor at approximately one-half its normal speed for the first hour, then gradually increase the speed until it is rotating at approximately normal speed. Continue the run-in operation for at least two hours to properly seat the brushes before installing the blower in the airplane.

c. Installation:

1. Prior to installing the combustion air blower, inspect all parts of the assembly for loose screws, loose nuts and poor ground connection on the blower housing. Make sure the blower wheel is tight on the shaft and properly located in the housing. It should have just enough clearance to rotate at full speed without binding against the spill plate. Blower performance is based upon this close-tolerance clearance. It is recommended that correct voltage be applied for this clearance check.

2. Install the blower inlet adapter in the same orientation as before removal.

3. Place the combustion air blower assembly in position in the attaching clamp so the air tubing can be connected, and slide the tubing into position at the point where it was disconnected during removal. Tighten the motor in the attaching strap.

4. Secure the air tubing by tightening the clamp or installing the sheet metal attaching screws.

5. Connect the wire lead to No. 1 terminal on terminal strip.

6. Check motor operation. By disconnecting the wire at the No. 3 terminal on heater terminal strip, blower can be operated without fuel flow to the heater.

13-112. SPARK PLUG. (Refer to Figure 13-31.)

a. Removal:

1. Remove the necessary access panels to expose the spark plug area of the heater assembly.

NOTE

Insure that heater electrical circuits are de-energized.

2. Unscrew and remove the high-voltage lead connector at the spark plug. Exercise care to avoid fouling or damaging the connector.

3. Remove the grommet (23).

4. Using a 7/8 inch deep hex socket, unscrew and remove the spark plug (22). Make sure the spark plug gasket is removed with the spark plug. It will normally stick on the spark plug threads, but if loose, it might drop into the ven-

tilating air passages of the heater. Should this happen, remove the gasket with a wire hook.

b. Inspection and Servicing:

1. If the spark plug appears to be in good condition, except for a mild coating of oxide on the porcelain and electrodes, it may be cleaned and re-used. Cleaning is accomplished on a conventional airplane type spark plug cleaner, except that it will be necessary to use two or more adapters in order to raise the long extension of the plug far enough out of the cleaner nozzle opening to provide an effective job. Plug the ceramic insert cavity at the terminal-end of the plug with a piece of paper or cloth to keep out any of the cleaning sand. Wipe this cavity out thoroughly with a cloth, wet with carbon tetrachloride. If, after cleaning, the spark plug porcelain is white, and the electrodes are not eroded, re-gap the spark plug by carefully bending the ground electrode until a 0.055 inch feeler gauge can be inserted between the end of the center electrode and the ground electrode.

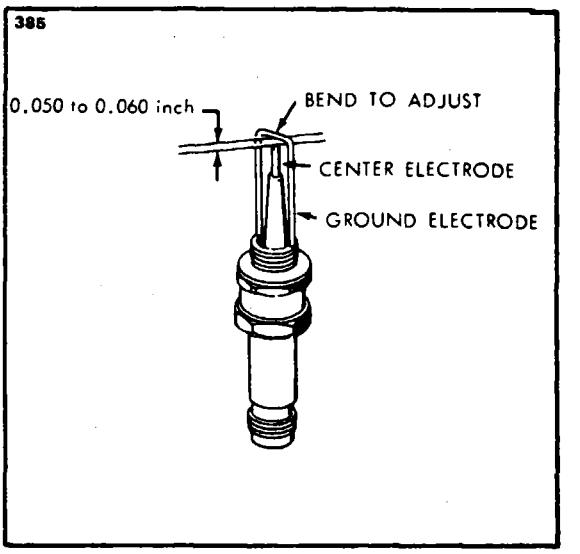



Figure 13-28. Spark Plug Gap Adjustment

NOTE

If the spark plug fails to clean up properly and/or if electrodes are badly eroded, it should be replaced.

c. Installation: (Refer to Figure 13-28.)

1. If a new spark plug is being installed, be sure to measure the gap which should be between 0.051 and 0.060-inches. Do not bend the center electrode.

NOTE

The spark plug can be checked visually for sparking across the gap prior to installing the plug as follows: Disconnect the wire from the No. 3 terminal on the heater wiring side of the terminal strip to de-energize the fuel solenoid valve. Connect the high-voltage lead temporarily and lay the spark plug on the heater jacket.

WARNING

Be sure to plug the spark plug hole in the heater to prevent any possibility of residual fuel blowing out and igniting. Do not touch the spark plug while energized because of dangerously high voltage.

2. Place a new spark plug gasket on the threads. If the gasket does not hold on the threads and would be likely to fall off during installation, place a small drop of Aviation Permatex, or similar material, on the gasket to stick it temporarily to the plug shell.

3. Screw the spark plug into the heater with a deep socket. Tighten to a torque of 28 foot pounds.

4. Install the grommet (Refer to Figure 13-31, 23) in the heater jacket opening.

5. Carefully insert the spring connector on the high-voltage lead into the spark plug shell, press down gently and start the nut on the threads. Tighten the nut to 20 foot pounds.

6. Reconnect the wire to the No. 3 terminal on terminal strip, if disconnected for above tests.

7. Operate the heater to check dependability and close all access openings.

13-113. VIBRATOR ASSEMBLY. (Refer to Figure 13-31.)

a. Measure the distance the vibrator protrudes out of the ignition assembly to determine when the new unit is inserted properly. Grasp the vibrator (19) and with a slight back and forth movement, pull it straight out of the ignition unit. (For a friction grip, it may be necessary to use a piece of masking or friction tape around the exposed portion of vibrator.)

b. Carefully rotate the new vibrator until the index marks are aligned and the connector pins on the vibrator can be felt entering the pin sockets in the vibrator socket, then press the vibrator fully and firmly into position.

c. Check the heater for operation.

13-114. IGNITION ASSEMBLY. (Refer to Figure 13-31.) This unit converts aircraft DC buss voltage t oscillating current capable of producing a continuous spark in the combustion chamber of the heater. This unit remains energized and produces a continuous spark during heater operation. It contains a condenser, resistor, radio noise filter and vibrator socket. It also has an externally mounted vibrator and ignition coil.

a. Removal of ignition assembly:

NOTE

Make sure the heater electrical circuits are de-energized.

1. Disconnect the primary wire (5) from the primary terminal of the ignition assembly (18).
2. Carefully unscrew and disconnect the high voltage ignition cable at the spark plug. Exercise care to avoid fouling or damaging the connector.
3. Remove the four attaching screws (20) and lockwashers (21) and lift the ignition assembly (18) off the mounting brackets on the heater jacket.

b. Installation of ignition assembly:

1. Place the ignition assembly in position on the brackets attached to the heater jacket, with the high voltage cable facing the spark plug end of the heater.
2. Install the four screws (20) and lockwashers (21). Tighten the screws assembly.
3. Carefully connect the high voltage lead to the spark plug. (Refer to paragraph 13-112, c.)
4. Connect the primary lead (5) to the primary terminal on the ignition unit (18) and tighten the nut securely.
5. Check for proper heater operation.

c. Testing ignition unit:

The ignition unit does not require complete overhaul. The following test will indicate whether or not the unit is operational and whether the vibrator should be replace before reinstallation in the aircraft. The following equipment is required to test the components:

1. A battery that will supply power at approximately 14 to 28 volts DC.
2. A voltmeter with a range of 0-30 volts.
3. A lead from the battery to the test fixture in which is included an ammeter with a range of 0-3 amperes and a normally open, momentary-closed switch. The total resistance of the lead including the ammeter and switch must not exceed 0.3 ohms.
4. A spark gap of 0.187 of an inch +/-0. A convenient means of arranging the correct spark gap is to install a spark plug, P/N 39D18, in a test fixture arranged to provide a ground electrode and a .187 of an inch spark gap. (Refer to Figure 13-28a for information on fabricating this fixture.)

NOTE

Any one of the several spark plugs may be used with the new spark plug fixture detailed in Figure 13-28a. However, the "A" dimension in that sketch must be varied with the length of the spark plug electrode to provide a gap of .187 of an inch for all spark plugs.

NOTE

When testing an ignition unit, do not use a screwdriver as a substitute for a spark plug and spark plug fixture.

5. The high tension shielded ignition lead between the ignition unit and the spark plug is a part of the cover assembly.

6. Arrange the test equipment as shown in Figure 13-28b.

d. Operational test of ignition unit:

1. Close the momentary switch and read the voltmeter and ammeter. Release the momentary switch immediately.

2. The amperage reading at 28 volts DC must be 1.25 +/-0.25 amperes.

13-115. CYCLING SWITCH AND LIMIT (OVERHEAT) SWITCH. (Refer to Figure 13-31.)

a. Removal:

1. If the limit switch (27) is damaged or defective, disconnect the two electrical leads from the switch terminals. Be sure to mark the leads for proper reassembly. (The switch terminals are identified by numbers "1", "2" and "3".)

2. Remove the two attaching screws (28), lockwashers (20) and plain washers (30) and lift the limit switch (27) and spacers (gaskets) (31) from the jacket opening.

3. If the cycling switch (32) is damaged or defective, disconnect the electrical leads, being sure to mark them for proper reassembly.

4. Remove the two screws (33), lockwashers (34) and plain washers (35) and lift the cycling switch (32) from the jacket opening.

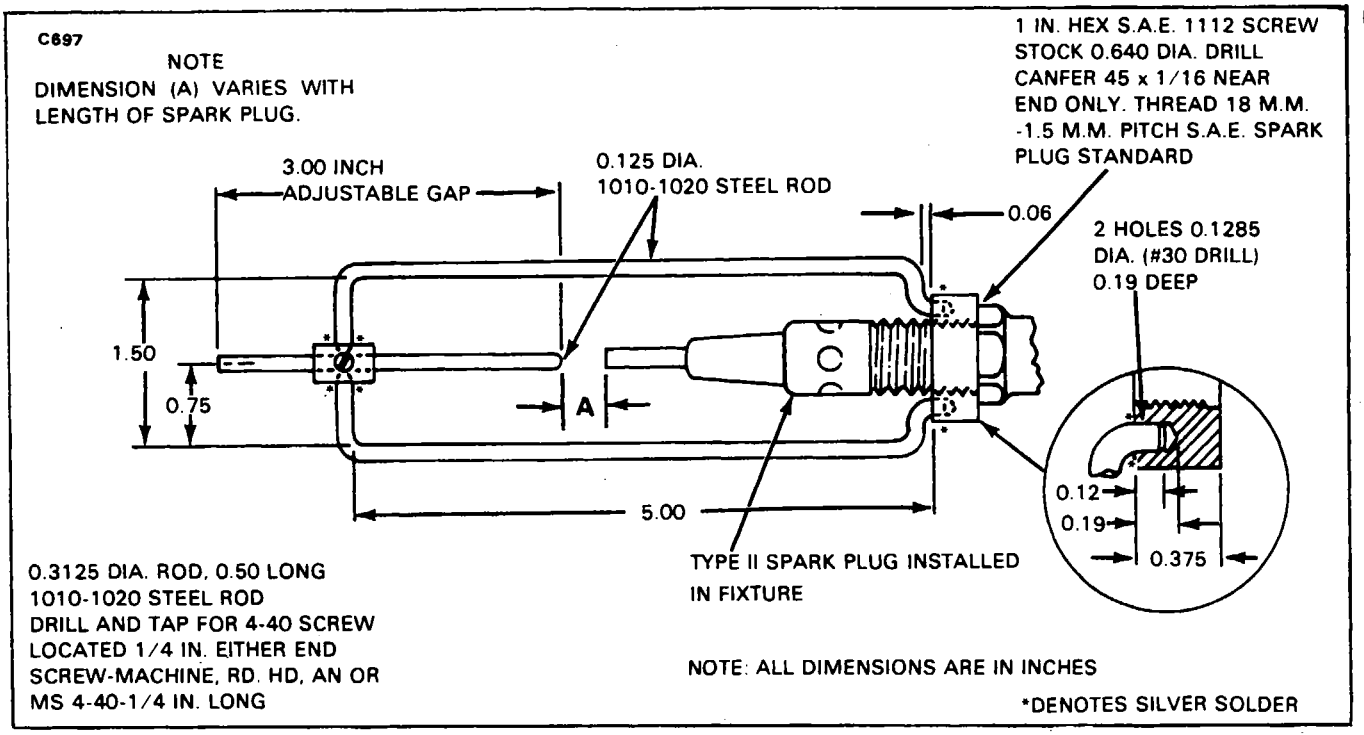



Figure 13-28a. Spark Plug Fixture

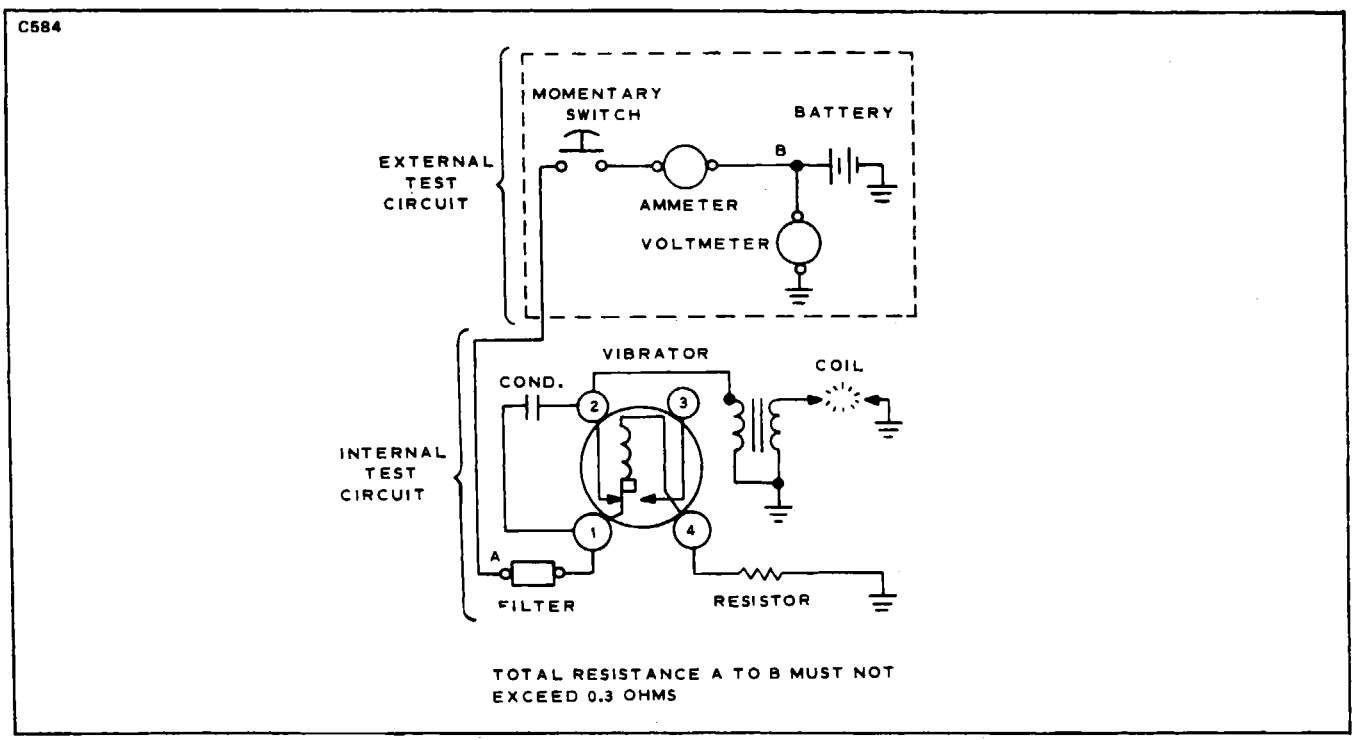



Figure 13-28b. Wiring - Test Setup

NOTE

No attempt should be made to repair either of these switches. If they do not operate properly, they should be replaced. (Refer to paragraph 13-132, m and n for test instructions.)

b. Installation:

1. Install the limit switch (27) and spacer (gasket, 2 required) (31) by placing them in position in the heater jacket opening and installing two screws (28), lockwashers (29) and plain washers (30).

2. Tighten screws securely, then reconnect the electrical leads in accordance with markings made during disassembly. (If electrical connections are uncertain, refer to the wiring diagram, Figure 13-25.)

3. Install the cycling switch (Refer to Figure 13-31, 32) by placing it in position in the heater jacket opening and securing it with the two screws (33), lockwashers (34) and plain washers (35). Tighten screws securely, then reconnect the electrical leads to their respective terminals as marked during disassembly. (If connections are uncertain, refer to wiring diagram, Figure 13-25.)

13-116. COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 13-31.)

a. Removal:

1. Disconnect electrical leads from the terminals of the combustion air pressure switch (41), being sure to mark them for proper reassembly. Disconnect the tube from the switch cap. Exercise caution not to exert excessive bending of the tube. (It is "tacked" to the combustion chamber inside the jacket.)

2. Unscrew and remove the combustion air pressure switch from the fitting on the combustion air inlet tube.

b. Installation:

1. Install the combustion air pressure switch (41) by rotating it on the threaded fitting of the combustion air inlet tube and tighten it securely. Exercise caution not to over-torque the switch as this could change the setting.

2. Connect electrical leads to their respective terminals in accordance with markings made during removal. If in doubt regarding proper connections, refer to the wiring diagram, Figure 13-25. Connect the tube to the switch cap.

3. Check for proper heater operation.

13-117. FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 13-32.)

a. Removal:

1. Remove the cover from the fuel regulator/shutoff valve shroud assembly.
2. Disconnect the electrical lead to the valve.
3. Disconnect the fuel lines from the valve nipples.
4. Remove the two bolts securing the valve and shroud to the bulkhead, and save the standoff bushings and washers for reinstallation of the valve and shroud assembly.

b. Installation:

1. Place the regulator/shutoff valve into the shroud. Insure the correct positioning of inlet and outlets ports to their respective lines, and secure the valve and shroud to the bulkhead using the two standoff bushings, washers and bolts.
2. Connect the fuel lines to the valve and tighten securely.
3. Connect the electrical lead. Be sure an insulating sleeve or tape is placed over the connection to avoid any possiblity of a short circuit. If a sleeve is used, secure it in place.
4. Perform an operational check of the heater to insure that the unit is functioning properly and no fuel leaks exist.
5. Reinstall the shroud cover on the shroud assembly.

13-118. DUCT SWITCH. (Refer to Figure 13-32.)

a. Removal:

1. Place the control lever arm in high position and loosen the Allen-head set screw that secures the arm to the temperature selector shaft. Slide the lever and arm off the shaft.
2. Disconnect the two electrical leads from the terminals on the exposed face of the switch.
3. Remove the two attaching screws and washers from the duct.
4. Carefully lift out the switch and gasket (if gasket is used).

b. Cleaning and Inspection:

1. Brush off any duster lint from the switch operating mechanism (exposed inside the duct) and wipe external surfaces with a clean cloth.

c. Installation:

1. Insert the switch carefully, with gasket (if used), into the ventilating duct opening and install the two attaching screws and washers.
2. Connect the two electrical leads to their respective terminals, as marked during removal.
3. Set the temperature selector shaft at the high stop. Then carefully place the control lever arm on the shaft at the high position and lock the lever by tightening the Allen-head set screw. (Do not overtighten.) Rotate the lever arm to make sure it clears the electrical terminal screws and support bracket when it is moved to the high position.
4. Operate the heater with the duct switch set above ambient temperature to check operation. (Refer to paragraph 13-132, I for additional tests and setting instructions.)

13-119. OVERHAUL INSTRUCTIONS. The heater assembly shall be overhauled after 1000 hours or whenever the pressure decay test requirement cannot be met. The heater should be removed from the aircraft, disassembled, all parts throughly inspected and necessary repairs and/or replacements made prior to reassembly. Detailed step-by-step instructions are included for a complete heater overhaul. In some instances, however, inspections may reveal that it is unnecessary to remove certain parts. If so, those portions of the overhaul procedures may be eliminated.

NOTE

For disassembly and reassembly operations, refer to the exploded view drawings and the parts list.

13-120. DISASSEMBLY. (Refer to Figure 13-31.)

a. Remove the screw (4) and slide the elbow adapter (3) off the combustion air inlet tube.

b. Disconnect and remove electrical wiring and individual wires from the various components on the heater. If wires appear to be in good condition, it may be desirable to remove wire harness assembly intact. First, disconnect wires at terminal strip and components. The ventilating air blower housing must be removed so that the two motor wires and solenoid valve quick-disconnect connections may be released.

NOTE

It is advisable to label all wires, prior to removal to insure correct connections during reassembly. Cable straps and clips must be replaced if removed, as they cannot be reused.

c. Carefully disconnect the high-voltage ignition lead at the spark plug. Handle the spring connector on the end of this lead with care to prevent fouling or damage.

d. Remove the four screws (20), lockwashers (21) and cable straps (17) to free the ignition assembly (18) from the heater jacket and remove the ignition assembly. The vibrator may be removed by exerting a firm pull straight away from the ignition assembly case.

e. Remove the two screws (25) and lockwashers (26) to release the radio-noise filter (24) from the jacket (84).

f. Remove the grommet (23) from the jacket (84) and remove the spark plug (22) with a 7/8 inch deep socket. Make sure the spark plug gasket is removed.

g. Remove the two screws (28), lockwashers (29) and plain washers (30) and lift out the overheat (limit) switch (27) and spacer gaskets (31).

h. Remove the two screws (33), lockwashers (34) and plain washers (35) and lift out the cycling switch (32).

i. Remove the four screws (37) and lockwashers (38) to release the terminal strip (36) and insulator (39) from the jacket (84).

j. Disconnect the tube fitting (40) at the cover of the combustion air pressure switch (41). (Refer to paragraph 13-116, a, (1) for precaution on tube bending.) Unscrew and remove the combustion air pressure switch (41) from the combustion air inlet tube.

k. Loosen the four screws (48) and rotate the blower and motor housing (59) to disengage the notched end from the four screws in the end of the heater jacket. Remove the grommet (47) and separate the two electrical quick-disconnects after sliding back the insulator sleeves on the wire ends.

l. Reach inside the inlet end of the jacket assembly (84) with a 3/4 inch open-end wrench and, while holding the fuel-tube fitting at the jacket, remove the reducing bushing adapter (42). Then, with 3/4 inch deep socket, remove the nut (44), fuel fitting shroud (43) and gasket (46).

m. Remove the two screws (72) and lockwashers (73) and carefully withdraw the nozzle holder and valve assembly from the combustion tube assembly (86). Remove the gasket (82).

n. Remove the screws (88 and 69), lockwashers (71) and remaining cable straps (17), if not previously removed, from the seam of the jacket assembly (84). Note positions of cable straps as they are removed. Spread the jacket (84) at the seam and remove it from the combustion tube assembly (86). This will free the rope gasket (85) which can be removed from the particular part on which it remains attached.

o. Carefully unscrew and remove the spray nozzle (83) from the nozzle holder and solenoid valve assembly.

CAUTION

Handle the nozzle with care to avoid damage to the tip. The material around the orifice is very thin and any sharp blow on the face of the nozzle can distort the spray pattern and cause mal-ignition or improper combustion.

p. Remove the screw (76), lockwasher (77), cover (75) and "O" ring (78). Then carefully slide the solenoid coil (79) off the valve assembly. It is not necessary to remove the base plate (80) unless it is warped.

q. Loosen the nut (55) and remove the screw (53), flat washer (45) and rubber

grommet (58) from the blower housing.

r. Remove the two screws (54), flat washers (45) and rubber grommets (58) at the other two locations around the blower motor housing (59).

s. Slide the ventilating air blower motor out of the blower housing (50) with the motor bracket assembly (52) and blower wheel (60) attached. Loosen the set screw in the blower wheel (60) and slide it off the end of the motor shaft. The flat washers (58) and rubber washers (57) will fall out when the bracket is removed. Then remove the motor bracket assembly (52). If these parts are in good condition, they need not be disassembled further.

t. Remove the screw (62) and lockwasher (63) to free the capacitor assembly (61) with attached leads.

13-121. DISASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 13-32.)

a. Remove the combustion air blower inlet adapter (2) by removing three screws, lockwashers, cover plate and gasket.

b. Remove the outlet adapter (5) by removing the two screws (6) and lockwashers (7).

c. Remove the inlet flange (8) by removing the three screws (9) and lockwashers (10).

d. Remove screws (12 and 16) and lockwashers (13 and 17), then separate the back plate (20), with motor (25) attached, from the blower housing (15) and free the motor leads and capacitor (11) from the back plate (20).

e. Loosen the set screw in the blower wheel (19) and slide it off the motor shaft.

f. Remove the two hex nuts (21), lockwashers (23) and flat washers (22), and slide the back plate (20) off the motor through bolts. The spacer (24) will drop out.

g. Install new motor brushes as described in paragraph 13-111, b. If the motor commutator is badly worn, or if the motor is defective in any respect, it must be replaced.

13-122. CLEANING. (Refer to Figure 13-31.)

a. Clean individual metal parts (except those parts containing switches and electrical wiring) and the combustion tube assembly, by immersing them in dry-cleaning solvent, such as Stoddard solvent (Federal Specification P-D-680). A bristle brush should be used to assist the cleaning process if foreign accumulations are stubborn to remove.

CAUTION

Do not attempt to buff or scrape off any deposits on face of spray nozzle. The face of the nozzle is very susceptible to damage from mishandling. Carefully repeat cleaning process using only a bristle brush and repeated applications of solvent to loosen any stubborn deposits.

b. Use compressed air or lintless cloth to dry the parts, unless sufficient time is available for them to air dry.

c. Wipe electrical components with a clean, dry cloth. If foreign material is difficult to remove, moisten the cloth in carbon tetrachloride or electrical contact cleaner and clean all exterior surfaces thoroughly.

13-123. CLEANING AND INSPECTING THE COMBUSTION TUBE ASSEMBLY. (Refer to Figure 13-31.)

a. Slight scaling and discoloration of the combustion tube assembly (86) is a normal condition for units that have been in service up to 1000 airplane hours. The slight scaling condition will appear to be mottled and a small accumulation of blue-gray powder may be present on the surface in certain areas. This condition does not require replacement of combustion tube assembly, unless severe overheating has produced soft spots in the metal.

NOTE

This assembly should be inspected prior to cleaning in order to prevent the removal of visible evidences of damage.

b. Look inside the exhaust outlet to determine if the combustion tube appears to be heavily scaled or mottled. Deformation is more difficult to detect visually but can usually be observed by looking straight through the combustion tube assembly and sighting along the outer surface of the inner combustion tube. An assembly that has been obviously deformed should be replaced. Slight deformation will not affect heater operation unless it is extensive and localized enough to reduce the flow of ventilating air through the heater more than 10 percent.

c. The combustion tube assembly may be cleaned by either of two methods:

1. One method is to soak the combustion tube assembly overnight in an Oakite M-S Stripper solution, made by mixing one pound of Oakite salts with each gallon of water used. The solution should be maintained at a temperature of be-

tween 190° F and 210° F. After overnight soaking, rinse the combustion tube assembly thoroughly in water to remove all traces of the Oakite solution. In order to reach all areas of the combustion tube assembly, it is advisable to let it stand in the rinsing water for as long as one-half hour, while occasionally agitating it to circulate the water. All openings should be left open during this operation. Be sure to dry the combustion tube assembly thoroughly after cleaning.

2. A second method of cleaning is what is commonly known as hand "tumbling." Insert shot or other metallic particles through the exhaust outlet opening, then close all openings and shake the combustion tube assembly vigorously, while rotating it and changing from end-to-end frequently. Be sure to pour out all of the particles and loosened material, then with all openings uncovered, direct a stream of compressed air into the combustion tube assembly from first one opening, then the other. Make sure all loose material is removed.

13-124. INSPECTION OF REMAINING COMPONENTS. (Refer to Figure 13-31.)

a. Discard all rubber parts such as grommets, gaskets, etc. These items should always be replaced at overhaul. Also discard the rope gasket (85).

b. Inspect all wires and wiring harnesses for damage to insulation, damaged terminals, chafed or cracked insulation and broken plastic bands. Individual wires can be replaced by making up new wires from No. 16 AWG stock and cut to correct length. It is advisable to use an acceptable crimping tool for installing terminals, rather than solder for all heater wiring connections. If wiring harness damage is visible, the entire harness assembly should be replaced. If only one or more wires are damaged, cut the cable ties, make up new wires, install them in the harnesses, and restore all cable ties and clamps. If heater controls were operating properly at the time of removal, reinstall them.

c. Inspect all hard parts, consisting of bolts, screws, nuts, washers and lockwashers. Replace damaged parts.

d. The combustion air pressure switch (41) must respond to delicate pressure changes and should always be checked and/or replaced at overhaul. (Refer to paragraph 13-125, c, and Figure 13-30.)

e. Replace the vibrator in the ignition unit at each overhaul.

f. Inspect the ignition assembly (Figure 13-31, 18) for dented case, loose or damaged primary terminal insulator and broken or obviously damaged high-voltage lead. Give particular attention to the condition of the spring connector at the end of the lead. If the spring is burned off, visibly eroded, or carbon tracked, the ignition assembly should be replaced.

NOTE

Do not attempt a field repair of the ignition unit, as it is a sealed assembly.

g. Inspect the terminal strip (36) for distortion and cracks and replace it if either condition exists.

h. Inspect radio-noise filters for short circuits by checking from either terminal to ground with an ohmmeter. An open-circuit reading should be obtained.

i. Inspect the spray nozzle (83) with a magnifying glass for any obstructions in the nozzle orifice and any sign of damage to the slight conical protrusion at the nozzle tip. Use compressed air to remove obstructions and re-examine it to make sure the orifice is open. Exercise care when handling the nozzle to avoid pressing or rapping on the tip face. Do not burr or scrape off deposits on the tip face. After cleaning, it is advisable to store the nozzle in a polyethylene bag until ready for reassembly.

j. Replace the nozzle at overhaul.

NOTE

The nozzle (83) can be spray tested by installing it in the holder and connecting the fuel tube to a 7 psi fuel pressure source. Connect the solenoid leads to a 14-28-volt source (battery) to open the solenoid valve. The conical angle spray pattern should be even and dispersed the same in all directions. Exercise caution to keep atomized fuel away from fire.

k. Inspect the nozzle holder and solenoid valve assembly for damaged threads at the fuel-tube fitting, crimped or cracked fuel line or distorted housing. The only part in this assembly that can be replaced is the solenoid winding. Check the solenoid for continuity by connecting across each wire lead with an ohmmeter. A reading of between 18 and 22-ohms should be obtained at room temperature. If not within these limits, or if the solenoid winding shows any form of physical damage or overheating, it should be replaced.

l. Remove the brushes, one at a time, from the ventilating air blower motor (65) by removing the brush cap and carefully withdrawing the brush from its guide. Remove foreign material from the brush guide and commutator with a stream of filtered compressed air. Check for brush wear. (Refer to paragraph 13-111.) Inspect the commutator for grooved brush track, pitting or burning. The commutator surface should be smooth and medium brown in color. Replace the motor if the commutator or other parts show damage.

m. Inspect the combustion air blower motor as described in the preceding step.

n. Inspect the blower wheel for broken or bent vanes and replace it for either condition.

13-125. TESTING. The following tests should be performed as outlined in the succeeding paragraphs.

a. Check ventilating air and combustion air motors for correct RPM and current draw:

1. Connect motor to 14-28-volt DC power supply. Rotation should be counterclockwise when viewed from the shaft end.

2. Both motors should rotate at approximately 7500 RPM at rated voltage. Current draw is approximately five amperes.

3. If current draw is excessive, or if speed is too low, replace the brushes. Recheck both current draw and RPM after brushes are properly run-in. (Refer to paragraph 13-111, b.)

4. If after replacing brushes operation is still unsatisfactory, replace the motor.

NOTE

The motor checks described above should be made without the blower housing attached, for both the ventilating air and combustion air motors.

b. Test the combustion tube assembly (86) for leads as follows:

1. Fashion a sealing plate from approximately .125 inch thick flat stock to seal the nozzle holder opening in the combustion tube assembly. (Refer to Figure 13-29.) Use a rubber gasket under the plate and attach the plate with two screws.

2. Make up seals for all remaining openings, except the one used to connect the air pressure source. (Refer to Figure 13-29.) Use rubber stoppers as shown. The combustion air inlet tube can be sealed best with a drilled stopper and clamp. Other openings should be sealed with expansion plugs. The seal used in the exhaust tube should be formed so that it will not deform the air pressure switch tube which protrudes into the exhaust.

3. Install plugs and caps in all openings except the one to which the combustion air pressure switch is attached. (Any opening can be used to connect the air pressure source, however, the combustion air pressure switch opening is usually the most convenient. The drain opening would normally be considered a second choice.)

4. Connect a regulated air supply to the opening that has not been plugged and apply a pressure of between three and five psi to the combustion tube assembly.

5. Submerge the combustion tube assembly in water for several minutes while watching for bubbles, which would indicate leaks. No air leakage is permitted from the combustion tube assembly. No weld or braze repairs are permitted on a combustion tube assembly.

c. Test the combustion air pressure switch as follows:

1. Connect an adjustable air pressure line that can be controlled in a range of zero to 5.0 (maximum) of water to the switch opening with a water manometer and needle valve in the line ahead of switch. Switch must be tested in 45 degree position as shown in Figure 13-30.

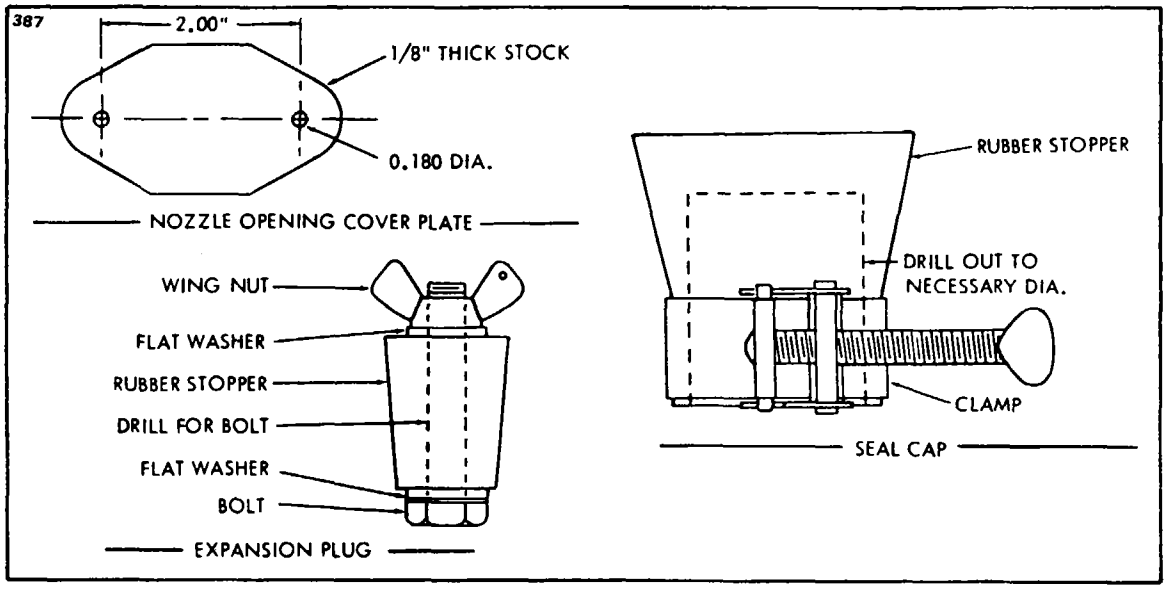



Figure 13-29. Suggested Design for Seal Plate, Plugs and Caps for Combustion Tube Leakage Test

2. Connect an ohmmeter across the switch terminals to determine the exact instant of switch closing.

3. Apply air pressure allowing it to build up very slowly from zero. The switch contacts should close at 0.5 ± 0.1 inches of water which will be indicated on the manometer.

NOTE

The switch cover has a differential pressure tap and this opening must be left open to atmosphere during the test.

4. Make several trials to insure switch reliability. Be sure to increase and decrease the air pressure slowly in order to produce accurate indications.

5. If an adjustment is required, rotate the adjusting screw clockwise to increase settings and counterclockwise to decrease settings.

d. Test the fuel feed and nozzle holder assembly for leaks as follows: This test can be simplified if the following routine is used to test both the fuel line and fuel line shroud tube:

1. Using filtered compressed air, apply 20 psi to the shroud drain port, located on the surface near the threaded nozzle cavity.

2. Immerse the fuel feed and nozzle holder assembly in clean water with the fuel inlet and nozzle cavity left open.

3. Observe for bubbles which would indicate leakage. If bubbles appear at either fuel fitting, there is a leak in the fuel tube. If bubbles appear externally on the shroud tube or at either end of the shroud tube juncture, the shroud tube is leaking.

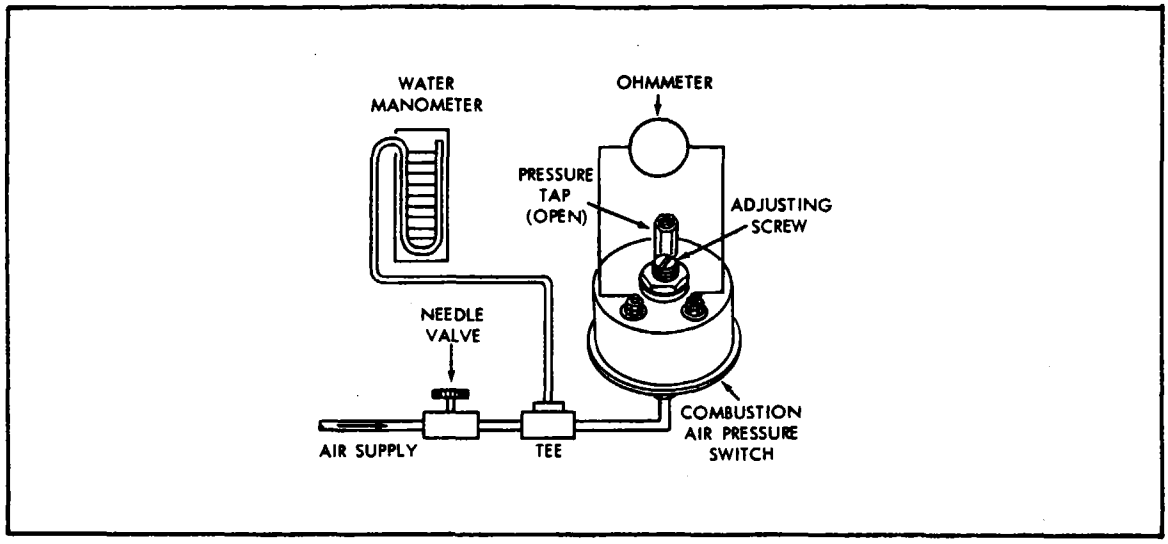



Figure 13-30. Test Setup for Combustion Air Pressure Switch

4. In either of the above cases, the complete fuel feed and nozzle holder assembly must be replaced.

e. Spray test the nozzle (Figure 13-31, 83) as follows:

1. Install the nozzle in the fuel feed and nozzle holder assembly and connect the fuel tube to a 7 psi fuel pressure source.

2. Connect the solenoid leads to a 14-28-volt battery. Connect a switch in the line to open and close the solenoid when desired.

WARNING

Be sure to keep the atomized spray away from fire.

3. With the switch closed (solenoid valve energized) and the fuel line connected, observe the fuel spray pattern. It should be conical in shape with even dispersion in all directions.

4. Energize and de-energize the solenoid several times. The spray should shut off permanently each time the solenoid is de-energized. There should be no sign of dribbling at the nozzle tip in excess of one or two drops.

5. If the spray pattern is distorted, check for an obstruction and clean the nozzle as described in paragraph 13-124, i. If this fails to provide a normal spray pattern, replace the nozzle.

6. If the nozzle continues to dribble, the solenoid valve is not closing properly and the fuel feed and nozzle holder assembly must be replaced.

13-126. REPAIR OF COMBUSTION TUBE ASSEMBLY. No weld or braze repairs of the combustion tube assembly are authorized.

13-127. REASSEMBLY. (Refer to Figure 13-31.)

a. If removed during disassembly, slide the solenoid coil (79) on the stem of the nozzle holder and solenoid valve assembly. Install the "O" ring (78), cover (75), screw (76) and lockwasher (77), then tighten the screw securely. Be careful to avoid pinching the wire leads connected to the solenoid core.

b. Insert the ventilating air motor (65) into the motor bracket assembly (52), slide the blower wheel (60) on the end of the motor shaft and rotate it until the set screw is aligned with the flat side of the motor shaft. Tighten the set screw just tight enough to hold it at this time.

c. Attach the capacitor and leads assembly (61) to the motor bracket (52) with

Legend for Figure 13-31. ⟶

1. HEATER ASSEMBLY
2. PLATE - IDENTIFICATION
3. ADAPTER
4. SCREW - AN530-6R6
5. WIRE ASSEMBLY - IGNITION TO FILTER
6. WIRE ASSEMBLY - BLOWER GROUND
7. WIRE ASSEMBLY - HEATER GROUND
8. WIRE ASSEMBLY - TERMINAL 1 TO OVERHEAT SWITCH
9. WIRE ASSEMBLY - TERMINAL 2 TO IGNITION FILTER
10. WIRE ASSEMBLY - TERMINAL 6 TO BLOWER FILTER
11. WIRE ASSEMBLY - TERMINAL 2 TO PRESSURE SWITCH
12. WIRE ASSEMBLY - TERMINAL 3 TO CYCLE SWITCH
13. WIRE ASSEMBLY - PRESSURE SWITCH TO OVERHEAT SWITCH
14. WIRE ASSEMBLY - CYCLE SWITCH TO FUEL VALVE
15. WIRE ASSEMBLY - TERMINAL 1 TO COMBUSTION AIR BLOWER
16. TIE - CABLE
17. STRAP - CABLE
18. IGNITION ASSEMBLY
19. VIBRATOR - IGNITION
20. SCREW - AN515-8R7
21. WASHER - AN936A8
22. PLUG - SPARK
23. GROMMET - AN931-10-20, MS35489-18
24. FILTER - RADIO NOISE
25. SCREW - AN515-8R5
26. WASHER - AN936A8
27. SWITCH - LIMIT
28. SCREW - AN515-8R8
29. WASHER - AN936A8
30. WASHER - AN960-8
31. GASKET - LIMIT SWITCH
32. SWITCH - CYCLING
33. SCREW - AN515-8R8
34. WASHER - AN936A8
35. WASHER - AN960-8
36. STRIP - TERMINAL
37. SCREW - AN515-8R10
38. WASHER - AN936A8
39. INSULATOR - TERMINAL STRIP
40. ELBOW - PRESSURE SWITCH
41. SWITCH - PRESSURE
42. BUSHING - AN894-4-2
43. SHROUD - FUEL FITTING
44. NUT - AN924-4
45. WASHER - FLAT
46. GASKET - AN900-8
47. GROMMET - MS35489-35
48. SCREW
49. BLOWER ASSEMBLY - VENT AIR
50. SLEEVE - HIGH TEMPERATURE
51. SLEEVE - HIGH TEMPERATURE
52. BRACKET ASSEMBLY - MOTOR
53. SCREW - MACHINE
54. SCREW - MACHINE
55. NUT - AN335-4
56. WASHER - FLAT
57. WASHER - RUBBER
58. GROMMET - MS35489-8
59. HOUSING - BLOWER
60. FAN - VENT AIR BLOWER
61. CAPACITOR ASSEMBLY
62. SCREW - AN515-8R6
63. WASHER . AN936A8
64. WIRE ASSEMBLY - BLOWER GROUND
65. MOTOR ASSEMBLY - VENT AIR BLOWER
66. CAP - BRUSH ASSEMBLY
67. BRUSH ASSEMBLY - MOTOR
68. TERMINAL
69. SCREW - AN515-8R5
70. WASHER - AN960-8
71. WASHER - AN936A8
72. SCREW - AN515-8R8
73. WASHER - AN935-8
74. FUEL FEED, NOZZLE HOLDER AND VALVE ASSEMBLY
75. COVER - SOLENOID
76. SCREW - AN515-8R6
77. WASHER - AN935-8
78. PACKING - "O" RING
79. COIL ASSEMBLY - SOLENOID
80. PLATE - SOLENOID BASE
81. VALVE ASSEMBLY - FUEL
82. GASKET - VALVE ASSEMBLY
83. NOZZLE - FUEL SPRAY
84. JACKET ASSEMBLY
85. GASKET - ASBESTOS
86. TUBE - COMBUSTION
87. TUBE - COMBUSTION AIR SWITCH
88. SCREW - AN515-8R4

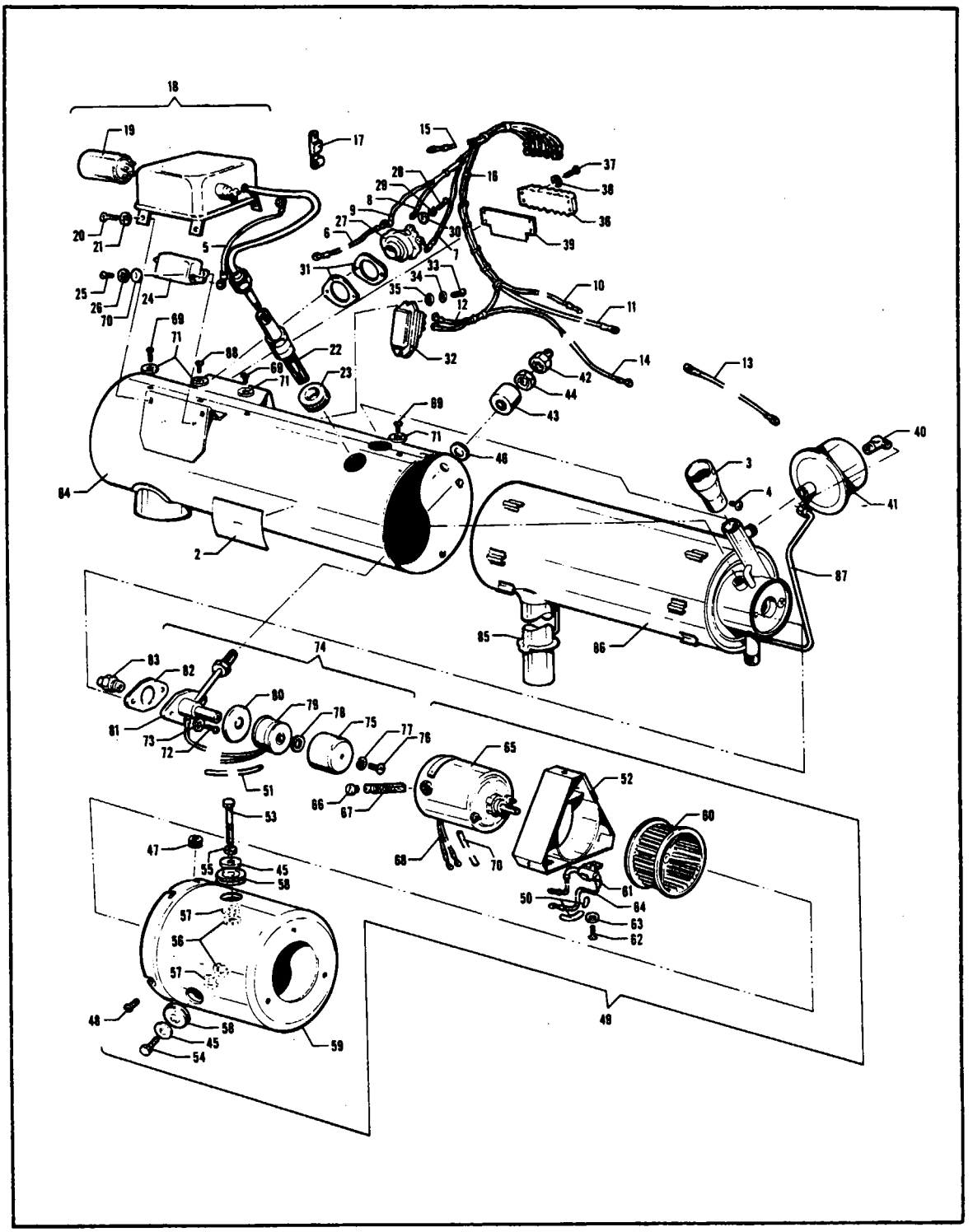


Figure 13-31. Exploded View of Heater Assembly No. 751 978 (14-volt) and 751 999 (28-volt)

the screw (62) and lockwasher (63). Make sure a good electrical ground connection is made at this point.

d. Insert this assembly into the blower housing (59) and position it so the long screw (53) is in alignment with the gap on the inner ring of the motor bracket assembly (52). This is the screw used to secure and align the motor in the bracket.

e. Slide the flat washer (58) and rubber washer (57) into position between the legs of the motor bracket (52) and blower housing (59).

f. Make sure all wires are routed and grommeted as they were prior to disassembly and install the two screws (54), flat washers (45) and new grommets (58) at the two lower edges securing the motor bracket assembly (52). Then install the grommet (58), flat washer (45), nut (55) and screw (53) in the remaining (upper) corner of the motor bracket assembly.

g. Center the motor bracket (52) in the housing and tighten the screw (53) to secure it. The motor (65) should be positioned in the bracket (52) to locate the blower wheel (60) properly in the blower housing (59). The blower wheel should be positioned so it will rotate freely and just clear the contoured spill plate in the blower housing. Tighten the Allen-head set screws and spin the blower wheel by hand for a clearance check. Then apply appropriate voltage to run the motor as a final clearance check.

h. Place a new asbestos gasket (85) in position on the exhaust outlet, spring the jacket assembly (84) open at the seam and insert the combustion tube assembly (86) carefully into the jacket. Exercise care to clear the pressure switch tube in the exhaust outlet and see that the asbestos gasket (85) is properly located. Close the gap on the jacket assembly and install screws (88 and 69) and lockwashers (71) to secure it at the seam. (Two leads ground under these screws. See notations made during disassembly.) Make sure the tongue and channel at the seam are in good condition and a tight fit is effected.

i. Install cable straps at locations noted during disassembly.

j. Remove the spray nozzle (83) from the polyethylene bag. Screw the nozzle into the nozzle holder and tighten to 75-100 inch pounds. It is very important to torque the nozzle to this valve as incorrect tightening could cause improper heater operation and "drool."

CAUTION

The spray nozzle has a slight protrusion on the nozzle face. If this area has been struck by any object which would make a dent or destroy the original contour, the nozzle must be replaced. It cannot be disassembled for cleaning.

k. Insert the fitting on end of nozzle fuel tube through the opening in the jacket (84) and attach the nozzle holder to the combustion tube assembly (86) with the two screws (72) and lockwashers (73). It may be necessary to place a slight bend in the shrouded fuel tube to permit alignment of screw holes. Be sure to use a new gasket (82) and connect the solenoid ground wire under one of these screws. Make sure a good electrical ground connection exists at this point.

l. Using a new spark plug gasket, install the spark plug (22) and tighten to a torque of 28 foot pounds. Install the grommet (23) in the jacket around the spark plug.

m. Install the ignition assembly (18) on the jacket assembly (84) with the four screws (20) and lockwashers (21). Connect the high-voltage lead to the spark plug and tighten it to 20 foot pounds.

n. Attach the radio-noise filter (24) to the jacket assembly (84) with the two screws (25) and lockwashers (26).

o. Attach the overheat limit switch (27) and spacer gaskets (31) to the jacket assembly (84) with two screws (28), lockwashers (29) and flat washers (30). Tighten the screws securely.

p. Attach the cycling switch (32) to the jacket assembly (84) with the two screws (33), lockwashers (34) and flat washers (35).

q. Place the terminal strip insulation (39) in position on the jacket (84), followed by the terminal strip (36). Secure both parts by installing the two screws (37) and lockwashers (38). The two screws are located at two diagonal corners of the terminal strip.

r. Center the fuel fitting in jacket opening. Place the fuel fitting shroud gasket (46) and shroud (43) on the fuel fitting and install the nut (44) finger tight. Insert a 3/4 inch open-end wrench inside the jacket and hold the fuel-tube fitting while tightening the nut (44) with a 3/4 inch deep socket. Install the reducer fitting (42).

s. Rotate the combustion air switch (41) onto the threaded fitting on the combustion air tube and tighten it firmly.

t. Slide the grommet (47) over the combustion air tube and connect the tube to the elbow fitting (40) on the combustion air pressure switch (41).

u. Install the wiring harness and connect all wire leads to their respective terminals. (Refer to the wiring diagram, Figure 13-25.) Place the grommet (47, Figure 13-31) in position in the jacket (84), locate the ventilating air blower (49) at the end of the jacket. Thread the quick-disconnect on the wiring harness through the grommet (47) and connect it to the mating connector on the motor lead.

v. Place the blower housing in position on the jacket assembly (84) and secure it by installing the four screws (48), if removed at disassembly. This operation is easier if the screws (48) are started into their threads and the blower housing rotated into place, allowing the screws to enter the notched openings in edge of blower housing. Tighten all screws securely.

w. Install the elbow adapter (3) with the screw (4).

13-128. REASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 13-32.)

a. Place the spacer (24) over the end of the motor shaft and attach the motor assembly (25) to the back plate (20) with the two self-locking nuts (21), flat washers (22) and lockwashers (23).

b. Slide the blower wheel (19) on the motor shaft and tighten the set screw lightly against the flat portion of the motor shaft.

c. Place the blower housing (15) in position on the back plate (20) and install screws (16) and lockwashers (17).

d. Attach the capacitor (11) at the point shown with the screw (12) and lockwasher (13). The motor ground lead terminal (28) can be grounded to the motor support bracket (3).

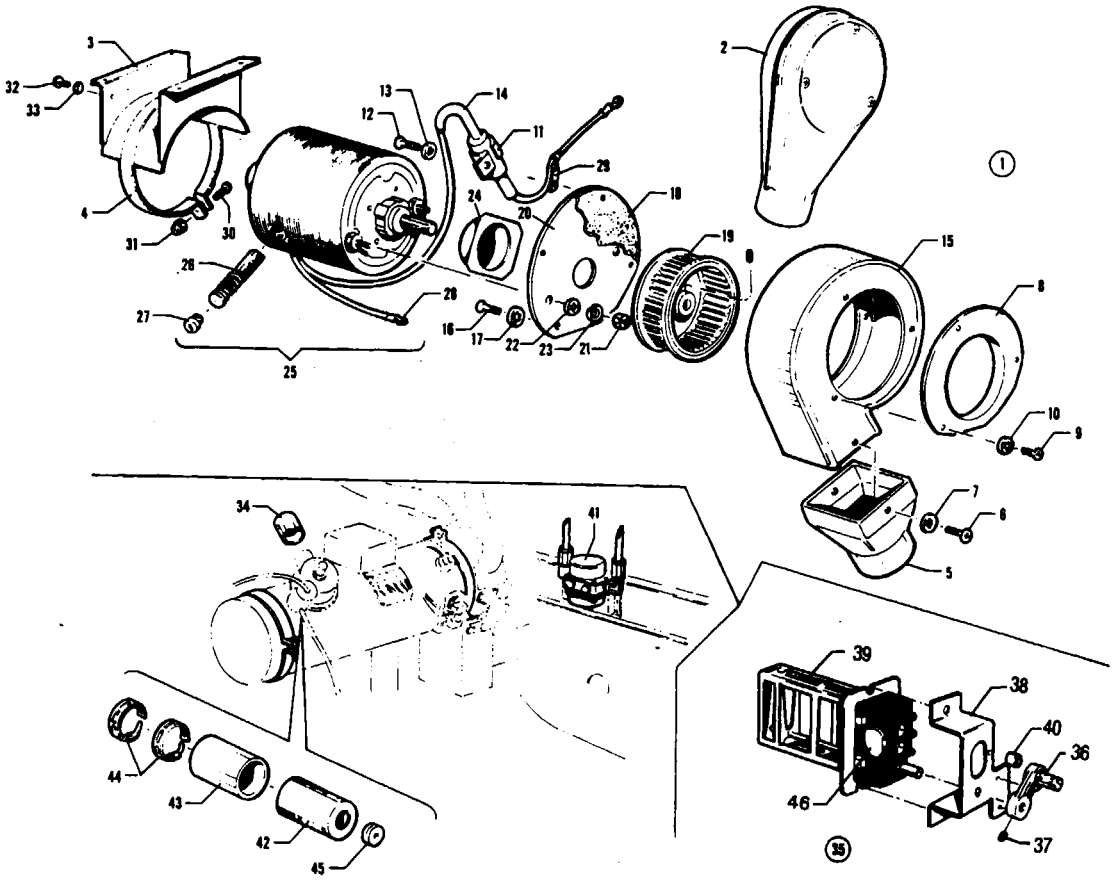
e. Attach the inlet flange (8) and blower inlet adapter (2) to blower housing (15) with three screws (9) and lockwashers (10).

f. Loosen the Allen set screw in the blower fan (19) and shift the fan on the motor shaft until it is near the inlet in the blower housing. Tighten the set screw securely. The blower fan should just clear the inlet flange when rotated at full RPM. Spin the blower fan by hand for clearance check; then apply proper voltage to run motor and recheck for proper clearance.

g. Slide the blower outlet adapter (5) on the blower housing outlet (15) and install the two screws (6) and lockwashers (7).

13-129. TEST PROCEDURE.

13-130. GENERAL INFORMATION. A test of all components should have been made after overhaul to insure proper operation. Some shops may not have complete testing facilities for measuring air flows, pressure drops and other factors which would be accomplished in a laboratory-type test. If such a test cannot be made, install the heater and check operation on the ground and in the air to determine if operation is normal. In shops where complete test equipment is available and a complete functional test can be performed, the test routine described in subsequent paragraphs should be made.



1. COMBUSTION AIR BLOWER AND MOTOR ASSEMBLY
2. ADAPTER ASSEMBLY - BLOWER INLET
3. BRACKET - MOTOR SUPPORT
4. CLAMP - MOTOR MOUNTING
5. ADAPTER - OUTLET
6. SCREW
7. WASHER - AN936A6
8. PLATE - BLOWER HOUSING
9. SCREW
10. WASHER - AN936A6
11. CAPACITOR
12. SCREW
13. WASHER - AN936A6
14. SLEEVE - HIGH TEMPERATURE
15. HOUSING - BLOWER
16. SCREW
17. WASHER - AN936A6
18. GASKET - BACK PLATE
19. FAN - COMBUSTION AIR BLOWER
20. PLATE - BACK
21. NUT - AN345-10
22. WASHER - AN960-10L
23. WASHER - AN936-B10
24. SPACER
25. MOTOR ASSEMBLY - COMBUSTION AIR BLOWER
26. BRUSH ASSEMBLY
27. CAP - BRUSH ASSEMBLY
28. TERMINAL - PREINSULATED
29. STRAP - CABLE
30. SCREW - AN520-10R10
31. NUT - MS20364-1032A
32. SCREW
33. WASHER - AN936-A8
34. TUBE - HOUSING OUTLET
35. SWITCH ASSEMBLY - ADJUSTABLE DUCT
36. LEVER ASSEMBLY - SWITCH
37. SCREW - AN565D8H3
38. COVER - SWITCH
39. SWITCH - ADJUSTABLE DUCT
40. SPACER
41. FUEL REGULATOR AND SHUTOFF VALVE
42. SHROUD - FUEL FITTING
43. HOSE - FUEL FITTING SHROUD
44. CLAMP - HOSE
45. GROMMET - AN931-2-9
46. CAPACITOR - .02M - 1KV

Figure 13-32. Exploded View - Combustion Air Blower and Motor Assembly No. 753 443 (14-volt), 758 120 (28-volt)

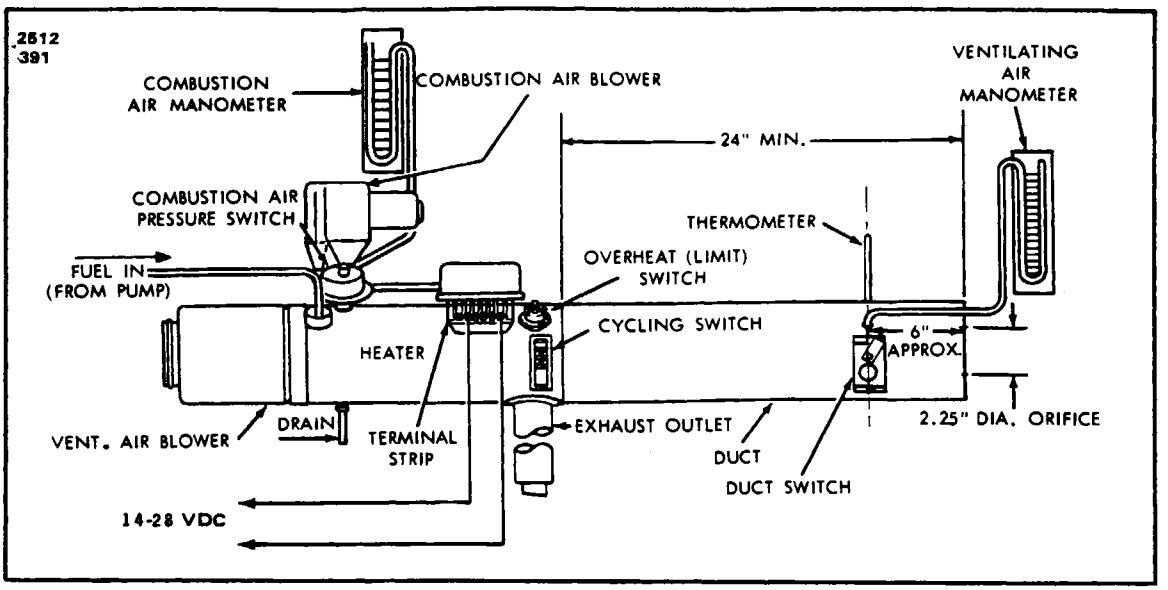



Figure 13-33. Suggested Set-Up for Heater Operation Test

13-131. EQUIPMENT REQUIRED. (Refer to Figure 13-33.)

a. An improvised stand to hold the heater during test. The heater should be located far enough away from any combustible material or atmosphere to avoid hazard. A location should be chosen where exhaust can be dispelled. Do not add an excessive extension to the heater exhaust.

b. A source of fuel capable of being regulated at seven psi.

c. The combustion air blower to be used with the heater should be used for the test.

d. A 14-28-volt DC power supply. A rheostat connected in series with the supply to adjust the voltage and current. An ammeter connected in series with the supply to monitor the current. A voltmeter connected in parallel with the supply to monitor the voltage.

e. Two water manometers (zero to 5.0-inch water column) for measuring the pressure in the ventilating air duct and in the combustion air stream.

f. A piece of duct to be attached to the downstream end of the heater. It should have a minimum length of 24-inches and the same diameter as the heater being tested. A 2.25-inch diameter orifice should be centrally located at the outlet end. An aperature should be provided for the thermometer and duct switch and a static tap should be attached as shown in Figure 13-33.

g. A thermometer with 500° F scale.

h. A fuel-pressure gauge.

i. A controlled source of compressed air for final leakage test.

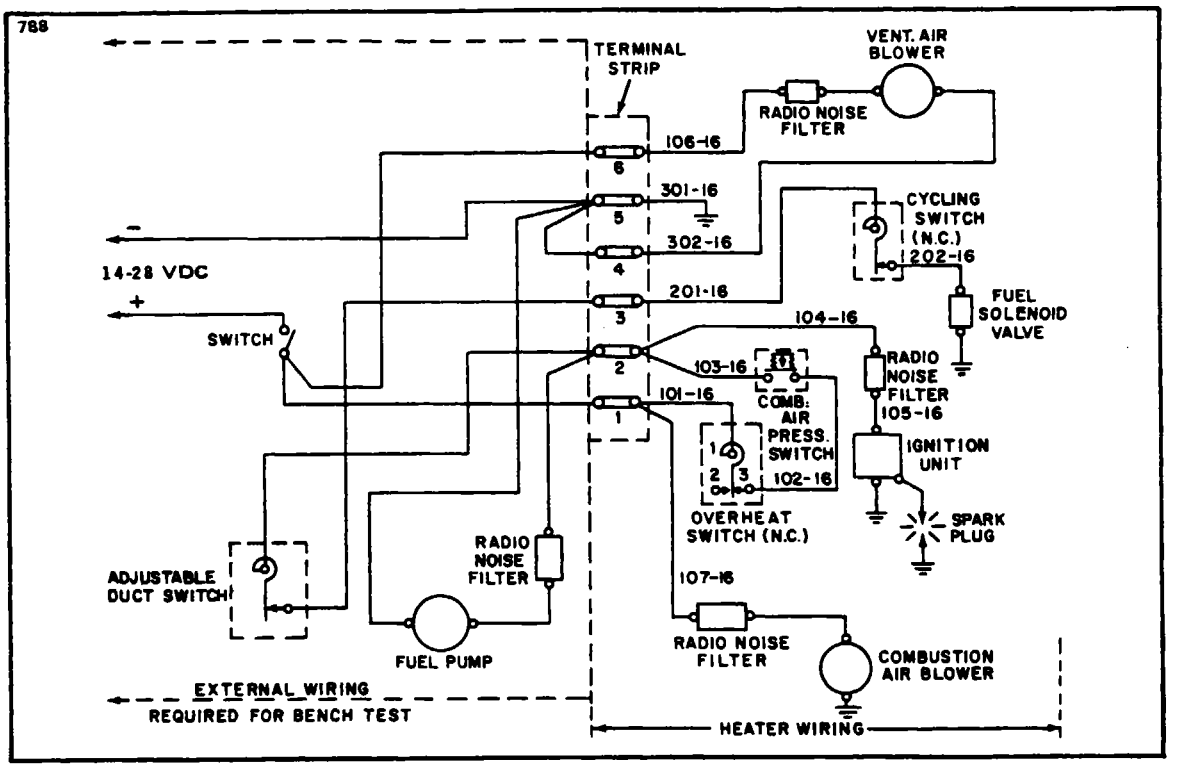



Figure 13-34. Wiring Connections for Heater Operation Test

13-132. OPERATIONAL TEST. (Refer to Figures 13-33 and 13-34.)

a. Connect the heater to the test set-up as shown in Figure 13-33. Make sure the combustion air blower is mounted securely and that the heater is clamped to its supporting stand.

b. Insert the duct switch in the sheet metal extension tube at the location shown in Figure 13-33.

c. Connect components and heater as outlined in the wiring connection diagram, Figure 13-34. The power supply switch should be open.

d. Connect the power source to the heater.

e. Disconnect wire lead from terminal "3" on the heater side of the heater terminal strip to prevent the heater from lighting and close the power source switch to check operation of blowers. The combustion air blower and ventilating air blower should operate at full speed with no blower wheel interference. If either blower fails to run, locate and correct the trouble before proceeding with the test.

f. Connect a voltmeter from open side of combustion air pressure switch terminal to ground to determine if the switch is closed, which would be indicated by a full voltage reading on the meter. If a full voltage reading is not obtained, the

combustion air supply is either inadequate or the switch is defective or improperly adjusted. Make necessary corrections.

g. Observe the manometer connected to the ventilating air pressure tap, which should show a reading of 1. 1 inches of water (minimum) at rated voltage.

h. Observe the manometer connected to the combustion air tube tap, which should show a reading of 1. 5 inches of water (minimum) at rated voltage.

i. Open the power supply switch and reconnect the terminal lead disconnected in preceding step e.

j. Close the power supply switch and turn on the fuel supply. The heater should light within five seconds (may require slightly longer for air to be purged from fuel lines on the first trial).

k. Observe operation of duct switch which should control heater operation according to the switch setting.

l. If the duct switch fails to control the temperature according to the setting, place the control lever in high "H" position and notice the control variation. A high reading of 250° F ± 10° should be obtained (reading will vary in different applications).

m. Connect a jumper across the terminals of the duct switch to make it inoperative and observe action of the cycling switch. The cycling switch should cycle to control the outlet air temperature at approximately 250° F (nominal). This is a function of ambient temperature and air flow conditions. If operation is within a range of 190° F to 290° F, the switch is operating normally. If the switch is out of range it can be reset in the same manner as described for the duct switch, except that no control lever or indicator stop are used. If adjustment fails to restore proper temperature range, replace the switch.

n. With duct switch still jumped, place a jumper across the cycling switch terminals to check operation of the overheat switch. Block the ventilating air outlet and notice if the overheat switch shuts off the heater. It should open at between 300° F and 400° F. (This is also a function of ambient temperature and air flow.) After the switch shuts off, remove ventilating air restriction; remove jumpers from cycling and duct switches and press firmly on the overheat switch reset button until it "clicks. " The heater should light and operate.

o. Shut down the heater and check all components visually to make sure no damage has occurred to any of them.

p. Remove heater and other components from the test set-up and install it in the airplane.

13-133. REPLACEMENT OF FUEL FILTER ELEMENT. The fuel filter element located on the aft bulkhead in the fuselage nose section may be replaced by the following procedures:

a. Remove the access panel from the right side of the nose section.
b. Cut the safety wire on the bottom of the filter.
c. Remove the bowl and filter by unscrewing the round nut at the bottom of the bowl.
d. Clean the bowl and filter with a dry cleaning solvent. Replace the filter element and gasket as necessary.
e. Position the bowl and filter; tighten the round nut and safety with MS20995C32 safety wire.
f. Operate the system and check for fuel leaks.

13-134. REMOVAL OF HEATER FUEL VALVE. (Serial Nos. 27-1 to 27-7405431 inclusive.) The fuel control valve for the heater operation is located in the fuel control box between the two front seats, and may be removed by the following procedure:

a. Remove the two front seats from the airplane.
b. Remove the attaching screws from around the top and sides of the fuel control box.

NOTE

If the valve assembly is being removed due to leakage around the valve stem, refer to paragraph 13-135 for corrective action.

c. Lean the box forward and disconnect the outlet fuel line from the valve in the right side of the box.
d. Disconnect the knob and rod from the top of the valve by removing the self-locking nuts and machine screws.
e. Remove the valve by unscrewing it from the attaching fitting.

13-135. INSPECTION OF HEATER FUEL VALVE. (Serial Nos. 27-1 to 27-7405431 inclusive.) (Refer to Figure 13-36.)

a. Remove the elbow fitting from the valve assembly.
b. The stem assembly (2) may be removed by cutting the safety wire (1) and unscrewing the cap nut (6) with stem handle (3).
c. Inspect the stem, seat body and threads for possible damage.
d. If any part of the stem assembly is damaged or if the cap nut (6) is not drilled for safetying purposes, replace the complete valve assembly.
e. Reassemble the unit and tighten the cap nut (6) tight enough to prevent leakage but not to hamper turning the stem handle (3).
f. Safety the cap nut (6) with safety wire (1) MS20995C32. (Refer to Figure 13-36.)

NOTE

If leakage is still evident around the valve stem, replace the complete valve assembly. (Refer to Parts Catalog for Part No.)

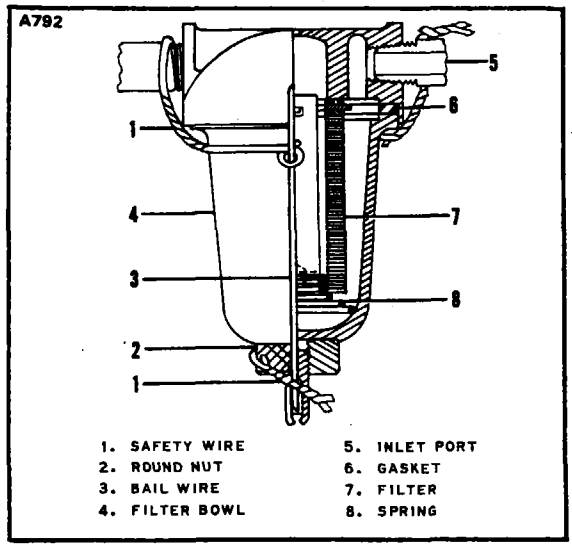



Figure 13-35. Heater Fuel Filter

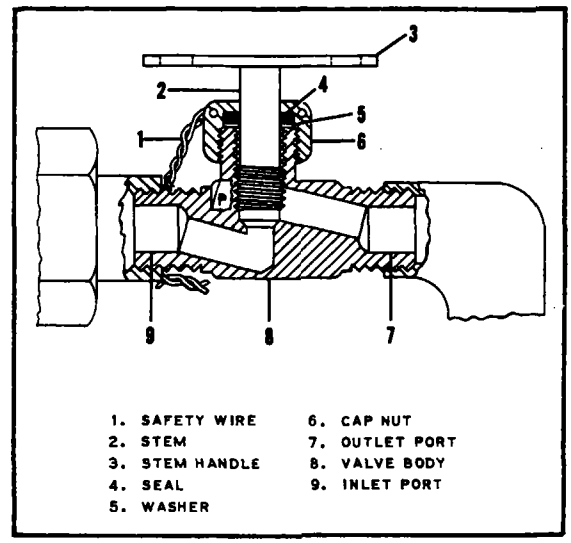



Figure 13-36. Heater Fuel Valve, Serial Nos. 27-1 to 27-7405431 incl.

13-136. INSTALLATION OF HEATER FUEL VALVE. (Serial Nos. 27-1 to 27-7405431 inclusive.)

a. Install the pressure side of the valve to the crossfeed drain line. The pressure side is marked with a "P" stamped on the valve body. On early valves that are not stamped the pressure side can be determined by looking into the body ends, with the valve closed; the end where no part of the stem or seat is visible is the pressure side.

b. Connect the knob and rod to the stem handle of the valve with machine screws and self-locking nuts.

c. Connect the fuel line fitting on the right side of the box to the valve.

d. Operate the left electric fuel pump and check for leakage around the valve stem and connections of the valve body. To determine that the valve seat does not leak when the valve is closed, remove the fuel filter bowl, turn on the electric fuel pump and note if fuel flows from the filter housing inlet port.

e. Position the fuel control box and secure to the spar covering with attaching screws.

f. Install the front seats.

13-137. JANITROL HEATER. PA-23-250E, Serial Nos. 27-7554041 and up. This section contains information for operation, service and overhaul of the combustion heater, Part No. 755 257 and combustion air blower, Part No. 758 304 (used with the heater).

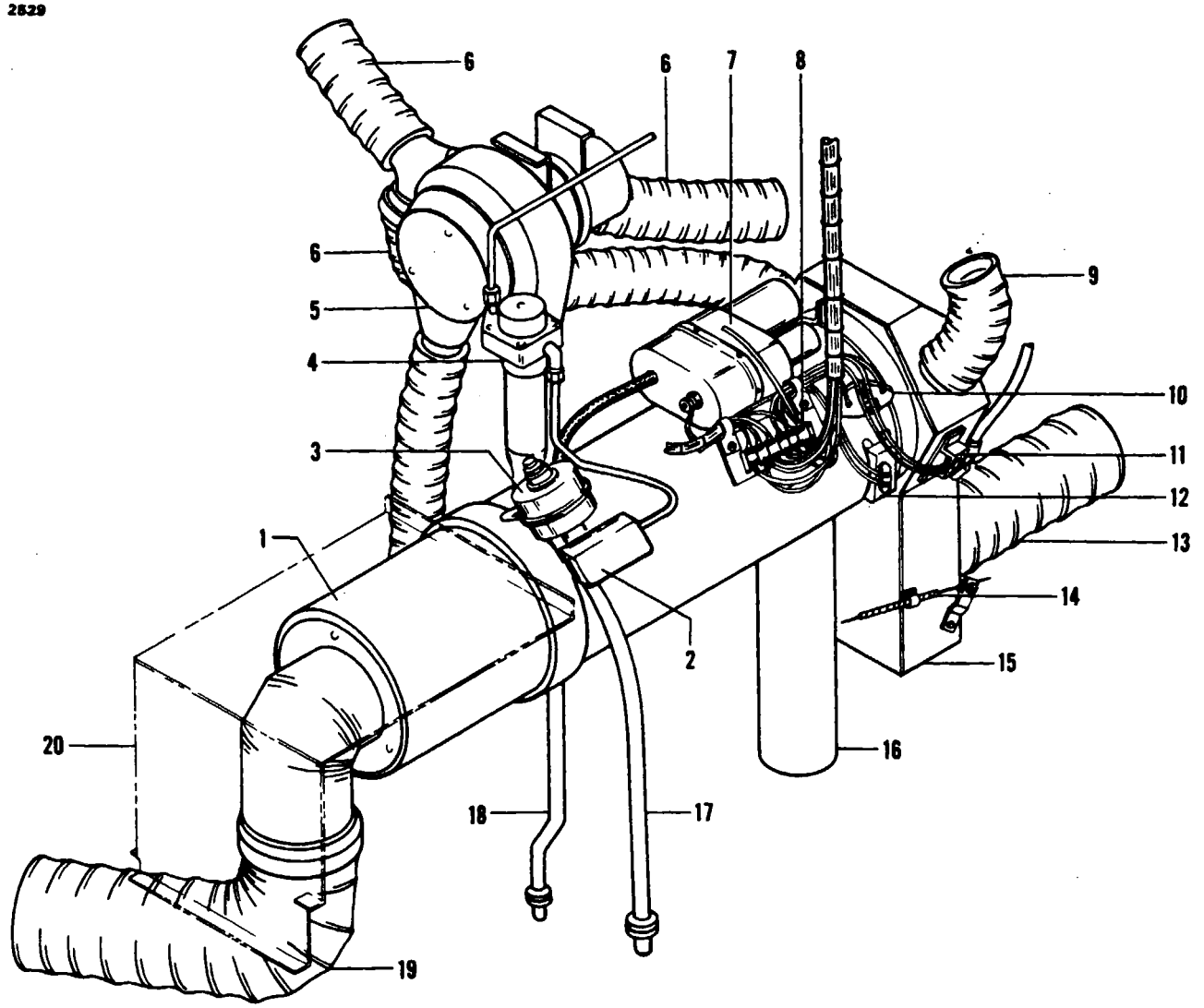
13-138. TROUBLESHOOTING. The service troubles and suggested remedies listed in Table XIII-II are provided to assist in locating and correcting malfunctions in the heating system. The following procedure is based upon the use of optional components.

13-139. HEATER OPERATION. The 35,000 BTU Janitrol heater is controlled by a three position switch located on the right side of the instrument panel, labeled FAN, OFF and HEAT. The FAN position will operate the vent blower only and may be used for cabin ventilation on the ground or windshield defogging when heat is not desired. For heat, the three position switch must be turned to HEAT. This will start fuel flow and ignite the burner simultaneously.

The heater uses gasoline from either left fuel tank when the fuel crossfeed is off and from all tanks when the crossfeed is on.

The push-pull knobs at the bottom of the control pedestal control airflow and temperature. The left control regulates air flowing to the front seat through the heater system and the second knob from the left controls air flowing to the rear seat. The middle knob is connected to an adjustable thermostat which makes it possible to select a desired temperature of heated air. The second knob from the right is the defroster control and the right knob controls the supply of cold air through the vent on the forward bulkhead.

For the overhaul and complete disassembly of the Janitrol heater and its components, refer to paragraph 13-167 of this manual. A wiring diagram of the Heater Electrical System Installation will be found in Section XI of this manual.




1. VENTILATING AIR BLOWER
2. FUEL SHROUD
3. PRESSURE SWITCH
4. FUEL REGULATOR
5. COMBUSTION AIR BLOWER
6. HOSE, CABIN HEAT
7. IGNITION ASSEMBLY
8. TERMINAL STRIP
9. HOSE DEFROSTER
10. LIMIT SWITCH
11. HEAT REGULATOR
12. CYCLING SWITCH
13. HOSE, CABIN HEAT, REAR
14. CONTROL CABLE, CABIN HEAT, REAR
15. AIR DISTRIBUTION BOX
16. EXHAUST TUBE
17. FUEL LINE DRAIN
18. DRAIN HEATER
19. HOSE, HEATER AIR INTAKE
20. HEATER COVER BOX ASSEMBLY

Figure 13-37. Heater Assembly and Combustion Air Blower

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fails to light. | Heater switch or circuit breaker off. | Turn on heater switch or close circuit breaker. |
| | Low voltage supply. | Apply external power supply. Attempt to start heater. (Refer to paragraph 13-147.) |
| | Fuel cut off from fuel cell. | Turn on manual shutoff valve or master solenoid. |
| | Regulator not operating properly. | Check for low pressure or replace regulator. (Refer to paragraph 13-165.) |
| | Restriction in fuel nozzle orifice. | Remove the nozzle and clean or replace it. (Refer to paragraphs 13-168, 13-172 and 13-175.) |
| | Fuel heater solenoid not operating. | Remove and check solenoid. Replace if faulty. (Refer to paragraphs 13-168, 13-172, k and 13-175, a.) |
| | Fuel lines clogged or broken. | Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located. |

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fails to light. (cont.) | Ignition vibrator inoperative. | Replace vibrator. Check for defective radio noise filter. (Refer to paragraph 13-161.) |
| | Manual reset limit (overheat) switch open. | Press reset button firmly and recheck to determine reason for switch opening. |
| | Combustion air pressure switch open. (Defective switch or low combustion air blower output.) | Check for low blower output due to low voltage and correct it. If switch is defective, replace it. (Refer to paragraph 13-164.) |
| | Cycling switch open. | Replace if defective. (Refer to paragraph 13-163.) |
| | Duct switch open. | Operate control to see if switch will come on. Replace switch if defective. (Refer to paragraph 13-166.) |
| Ventilating air blower fails to run. | HEATER switch OFF. Broken or loose wiring to motor. | Energize the HEATER switch. Check and repair wiring. |
| | Circuit breaker open. | Close circuit breaker. |
| | Worn motor brushes. | Replace motor brushes. (Refer to paragraph 13-159.) |

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Ventilating air blower fails to run. (cont.) | Blower wheel jammed. | Remove and check the ventilating air blower wheel and realign if necessary. (Refer to paragraph 13-175.) |
| | Motor burned out. | Remove blower assembly and replace motor. (Refer to paragraphs 13-168 and 175.) |
| | Defective radio-noise filter. | Replace filter. |
| Combustion air blower fails to run. | Faulty wiring to motor. | Inspect and replace faulty wiring. |
| | Poor ground connection. | Tighten ground screw. |
| | Worn motor brushes. | Replace motor brushes. (Refer to paragraph 13-159.) |
| | Blower wheel jammed. (Usually indicated by hot motor housing.) | Overhaul the combustion air blower. (Refer to paragraphs 13-169 and 13-176.) |
| | Faulty or burned-out motor. | Remove combustion air motor for overhaul or replacement of motor. (Refer to paragraphs 13-158, 13-168 and 13-176.) |

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fires but burns unsteadily. | Insufficient fuel supply. | Inspect fuel supply to heater including shut-off valve, solenoid valve and fuel lines. Make necessary repairs. |
| | Spark plug partially fouled. | Replace spark plug. (Refer to paragraph 13-160.) |
| | Loose primary connection at ignition assembly. | Tighten the connection. |
| | Faulty vibrator. | Replace the vibrator. (Refer to paragraph 13-161.) |
| | Combustion air blower speed fluctuates. (Can be caused by low voltage, loose blower wheel, worn brushes or motor. | Remove and overhaul the combustion air blower assembly as required or correct low voltage condition. (Refer to paragraphs 13-159, 13-169, 13-173 and 13-176.) |
| | High voltage leak in lead between ignition assembly and spark plug. | Replace ignition assembly. (Refer to paragraph 13-162.) |
| | Inoperative ignition assembly. | If vibrator is in good condition, replace ignition assembly only. (Refer to paragraph 13-162.) |

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fires but burns unsteadily. (cont.) | Restriction in fuel nozzle orifice. | Remove nozzle for cleaning or replacement. (Refer to paragraphs 13-168, 13-172 and 13-173.) |
| | Nozzle loose in retainer or improper spray angle. | Tighten or replace the nozzle as required. (Refer to paragraphs 13-171 and 13-172, k.) |
| Heater starts then goes out. | Lack of fuel at heater. | Check fuel supply through all components from the cell to the heater. Make necessary corrections. |
| | Inoperative or chattering combustion air pressure switch. | Check, adjust, or replace switch. (Refer to paragraph 13-164.) |
| | Inoperative overheat switch. | Check or replace switch. (Refer to paragraphs 13-163 and 13-180.) |
| | Inoperative cycling switch. | Adjust or replace the switch. (Refer to paragraphs 13-163 and 13-180.) |
| | Low voltage. | Attach external power. |

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

| Trouble | Cause | Remedy |
|---|---|---|
| Heater fails to shut off. | Fuel solenoid valve in heater stuck open. | Remove and replace solenoid assembly. (Refer to paragraphs 13-168, 13-170 and 13-173.) |
| | Inoperative duct and cycling switch. | Check and repair. (Refer to paragraphs 13-163 and 13-166.) |
| | Defective HEATER switch. | Replace the HEATER switch. |

## 13-140. DESCRIPTION OF HEATER AND BASIC COMPONENTS.

13-141. SPARK-SPRAY IGNITION. (Refer to Figure 13-37.) The controlled atomized spray from a specially designed spray nozzle, coupled with high voltage spark plug ignition, insures instant firing and continuous burning under all flight conditions.

Heat is produced by burning a fuel-air mixture in the combustion chamber of the heater. Aviation gasoline is injected into the combustion chamber through the spray nozzle. The resulting cone-shaped fuel spray mixes with combustion air and is ignited by a spark from the spark plug. Voltage for ignition is supplied by an ignition unit which steps up the 28-volts to a high, oscillating voltage to provide a continuous spark across the spark plug gap. A shielded, high voltage lead connects the ignition assembly to the spark plug. Combustion air enters the combustion chamber tangent to its surface and imparts a whirling or spinning action to the air. This produces a whirling flame that is stable and sustains combustion under the most adverse conditions because it is whirled around itself many times. Therefore, ignition is continuous and the combustion process is self-piloting. The burning gases travel the length of the combustion tube, flow around the outside of the inner tube, pass through crossover passages into an outer radiating area, then travel the length of this surface and out the exhaust.

Ventilating air passes through the heater between the jacket and combustion tube assembly outer surface and through an inner passage in the assembly. Consequently, ventilating air comes into contact with two or more heated, cylindrical surfaces.

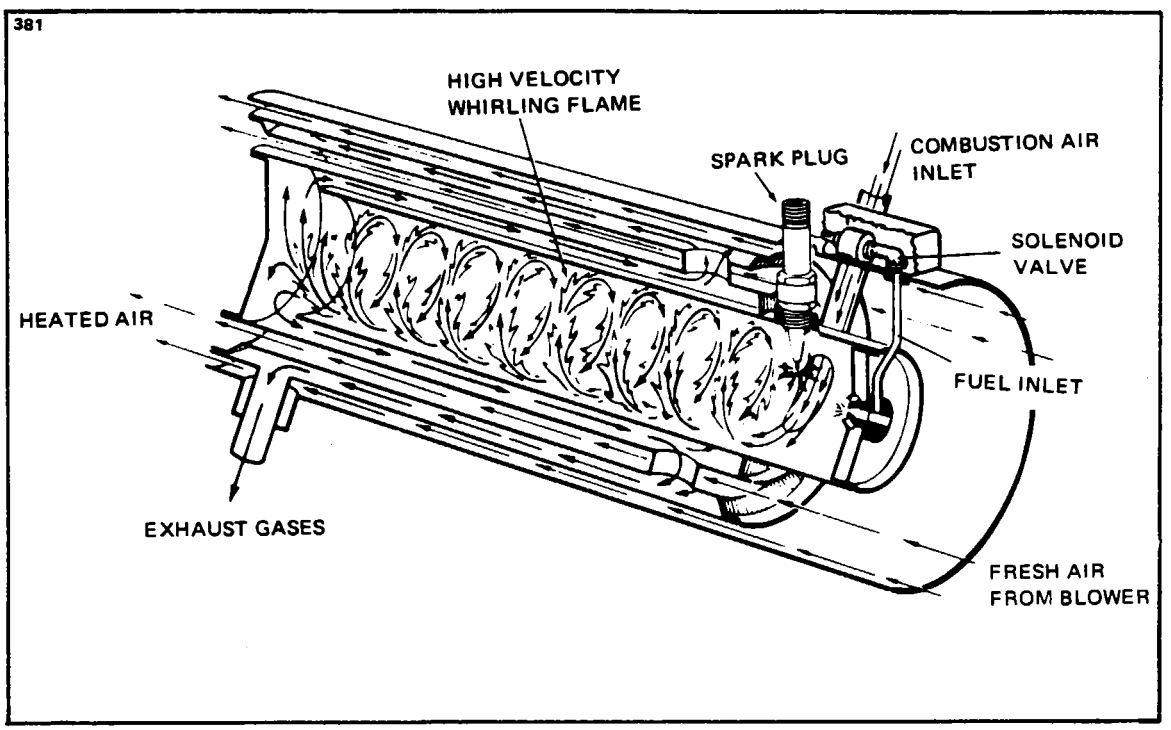



Figure 13-38. Diagramatic Cutaway of Heater to Show Whirling Flame Action

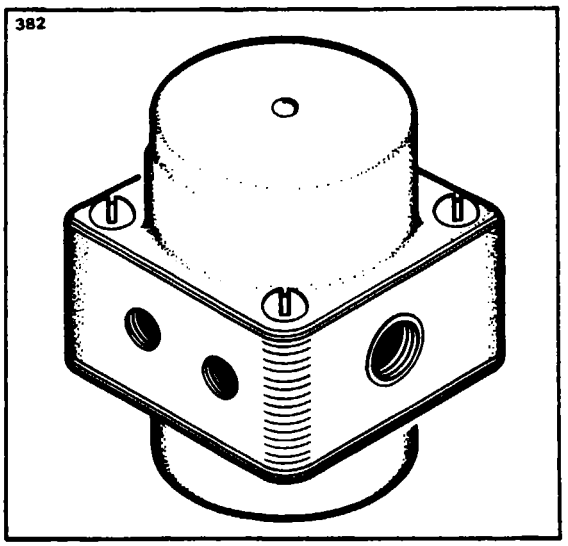



Figure 13-39. Fuel Regulator and Shutoff Valve

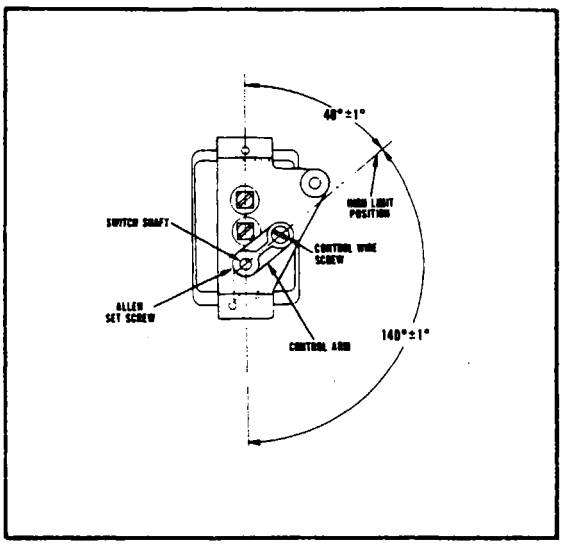



Figure 13-40. Top View - Duct Switch (Typical Control Lever Positions)

13-142. FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 13-39.) This unit provides preset, regulated fuel pressure as well as remote shutoff to the heater, regardless of fuel inlet pressure variations. It is adjustable to 7.5 ± .5 psi with inlet pressures up to 50 psi. The shutoff valve is operated by a solenoid.

13-143. DUCT SWITCH. (Refer to Figure 13-40.) This switch is installed in the ventilating air duct downstream from the heater to sense the ventilating air outlet temperature. To select the desired cabin temperature, the switch may be adjusted manually from a high of 250° F ± 10° downward through a range of 146° F ± 6°. The switch has a differential of 10° F ± 5° at any given setting.

13-144. COMBUSTION AIR BLOWER. This centrifugal-type blower supplies combustion air to the combustion chamber of the heater. Performance of the combustion air blower is assisted by the use of ram air during flight.

13-145. VENTILATING AIR BLOWER. This blower is attached to the inlet end of the heater assembly and provides a source of ventilating air through the heater. Ram air from the ventilating air intake scoop is used during flight.

13-146. OPERATING CONTROLS.

NOTE

The schematic diagram (refer to Figure 13-41) shows the heater circuit, including the electrical wiring in the airplane.

a. The HEATER SWITCH is connected in the line that supplies electrical power to all heater equipment and controls. When this switch is in the OFF position, the entire heater system is inoperative. This switch has a FAN position which permits use of the ventilating air blower to circulate cool air through the system for summer ground operation. With the switch in FAN position, the heater is inoperative and only the ventilating air blower is energized.

b. The HEATER SWITCH is a normally open switch that supplies power to (lock in) the safety relay through which power is supplied to the ignition and fuel circuits of the heater.

13-147. OPERATING PROCEDURE.

a. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air and combustion air blowers should operate.

b. The heater will ignite and continue to operate.

c. The DUCT SWITCH can be set to regulate the cabin temperature for desired comfort level. If this switch is set for ground operating comfort, it may be necessary to reposition it after being airborne, since ram air will increase the ventilating airflow and the heater output.

d. To stop heater operation, turn off the HEATER SWITCH.

e. It is desirable to operate the fan several minutes by placing HEATER SWITCH in FAN position to cool the heater after operation. To stop fan operation, turn OFF the HEATER SWITCH.

13-148. INSPECTION OF HEATER AND HEATER COMPONENTS.

13-149. PREFLIGHT AND/OR DAILY INSPECTION.

a. Inspect the ventilating air inlet scoop, combustion air inlet scoop, exhaust outlet and fuel drain for possible obstructions. Make sure that all of these openings are clear of any restrictions and that no damage has occurred to air scoop protrusions.

b. Perform an operational check as follows:

1. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air blower and combustion air blower should operate.

NOTE

To proceed with the operational check, follow paragraph 13-147 entitled Operating Procedure, steps a through e. The above procedure should be repeated one or more times.

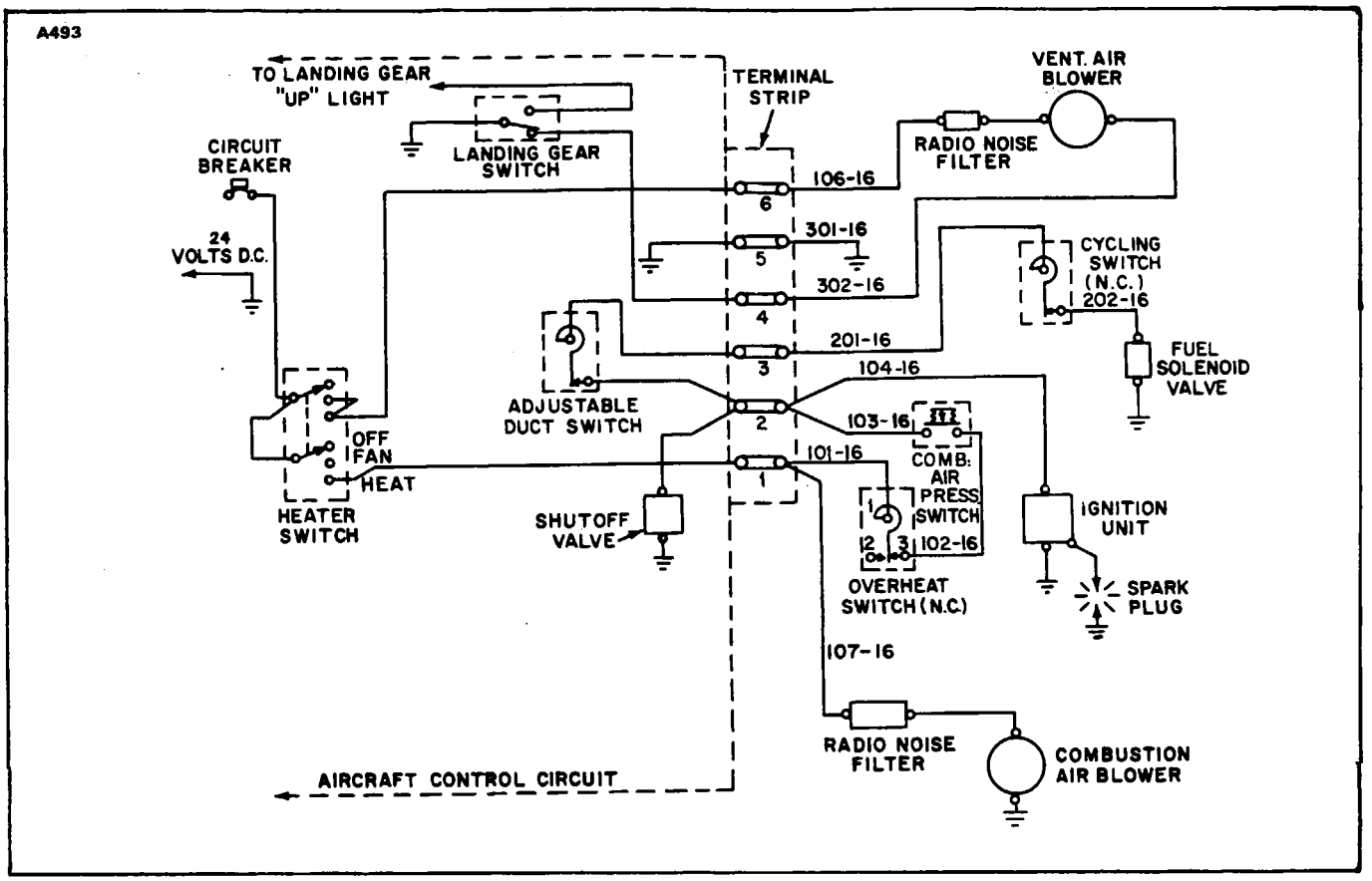



Figure 13-41. Wiring Diagram

13-150. 100-HOUR INSPECTION. The mandatory 100-Hour Inspection shall be conducted on new heaters or overhauled heaters with a new combustion tube assembly upon accumulation of 500-heater operating hours or twenty-four months, which-ever occurs first, and thereafter at intervals not to exceed 100-heater operating hours or twenty-four months, whichever occurs first. If an hour-meter is used on the heater assembly, it should be connected across terminals number 2 and 5 on the heater terminal strip. If an hourmeter is not used, count one heater operating hour for each two flight hours for normal aircraft operation. Consideration should be given for any excessive ground operation of the heating system.

NOTE

The 100 Hour Inspection consists of the functional checks and inspections listed below and the Pressure Decay Test.

a. Inspect ventilating air and combustion air inlets and exhaust outlet for restrictions and security at the airplane skin line.

b. Inspect the drain line to make sure it is free of obstructions. Run a wire through it if necessary to clear an obstruction.

c. Check all fuel lines for security at joints and shrouds, making sure that no evidence of leaks exi
Also check for security of attachment of fuel lines at the various attaching points in the airplane. Check fuel pressure to ensure 7 psi.

d. Inspect electrical wiring at the heater terminal block and components for loose connections, possible chafing of insulation, and security of attachment points.

e. Inspect the high-voltage cable connection at the spark plug to make sure it is tight. Also, examine the cable sheath for any possible indications of arcing, which would be evidenced by burning or discoloration of the sheath.

f. Inspect the combustion air blower assembly for security of mounting and security of connecting tubing and wiring. Tighten any loose electrical terminals and air tube connections.

g. Operate both the combustion and ventilating air blowers and check for unusual noise or vibrations.

h. It is recommended that the condition of the spark plug be checked for operation as described in paragraph titled "Spark Plug".

i. Evaluate the condition of the combustion chamber by performing a "Pressure Decay Test" as described in Janitrol Maintenance and Overhaul Manual P/N 24E25-1 dated October 1981.

j. Following the 100 hour inspection, perform the "Preflight and/or Daily Inspection".

13-151. MAINTENANCE SERVICE. Instructions contained in this section consists of periodic inspection, adjustments, and minor corrections required at normal designated intervals for the purpose of maintaining the heating system in peak operating condition. These inspections assume that a heating system includes accessory components mentioned in preceding paragraphs.

13-152. REMOVAL OF JANITROL HEATER.

a. Turn the heater control switches off.

b. Remove the forward access panel located on the left side of the fuselage nose section.

c. Open the forward baggage door and remove the heater cover box located on the left rear side of t
baggage compartment floor.

d. Remove the screws that attach the air intake elbow to the front of the heater.

e. Note the hookup of the electrical wires to facilitate reinstallation and disconnect wires from heater.

f. Disconnect the heater exhaust shroud from the heater jacket at the aft bottom side of the heater and slide it down enough to allow the exhaust tube to be disconnected. Remove both the shroud and tube.

g. Disconnect the drain from the forward bottom side of the heater.

h. Remove the shroud covering the fuel inlet line fitting located at the forward top side of the heater.

i. Disconnect the combustion air blower inlet tube and outlet adapter leading to the heater. Loosen the clamp that secures the air blower motor and roll the unit out of the way or remove it, as desired.

j. Loosen the two clamps that secure the heater to its mounting brackets.

k. Located under the aft clamp are four screws that attach the air distribution box to the heater. Remove these screws.

l. Separate the heater from the air distribution box and remove the heater from the airplane.

m. To remove the air distribution box, disconnect the air hoses located on each upper side of the box.

n. Disconnect the duct switch and cabin heat control cables.

o. Remove the two screws that attach the cabin heat hose to the lower aft end of the distribution box and remove box.

13-153. INSTALLATION OF JANITROL HEATER.

a. Position the air distribution box and attach the cabin heat hose to the lower aft end of the distribution box.

b. Place the heater in position on its mounting brackets and attach the air distribution box to the heater with four screws.

c. Connect and secure the exhaust tube to the exhaust of the heater.

d. Position and secure the exhaust tube shroud to the jacket of the heater.

e. Connect the drain tube to the bottom of the heater.

f. Tighten the two clamps that secure the heater to its mounting brackets.

g. Connect the heat control cable to the control arm located on the right side of the air distribution box. Adjust the cable so that when the door is completely closed, approximately one-sixteenth of an inch exists between the control knob and knob stop.

h. Connect the duct switch control cable to the switch on the left side of the air distribution box. Adjust the cable so that when the control knob is full in against its stop, the control arm aligns with the vertical line of the switch. (Do not loosen the Allen set screw that secures the arm to the switch shaft.) Pull the control knob out to ascertain that the control arm will have a $140^{\circ} \pm 1$ travel to high heat position. (Refer to Figure 13-40.)

i. Connect the cockpit heat and defroster air hoses to the air distribution box.

j. Place the combustion air blower in position, connect the outlet adapter to the heater and blower inlet tube. Secure blower in position.

k. Connect the fuel inlet line and secure the fitting shroud in position.

l. Connect the electrical wires to the heater.

m. Within the baggage compartment, attach the air intake elbow to the front of the heater.

n. Operate the heater long enough to determine that the unit is operating properly.

o. Install the access box in the baggage compartment and panel at the side of the fuselage.

HEATER TERMINAL BLOCK WIRING

| Terminal No. | Wire Designation |
|---|---|
| 1 | H4A |
| 2 | H1E H2B |
| 3 | H1D |
| 4 | H9A |
| 5 | H8A H10A |
| 6 | H2A |

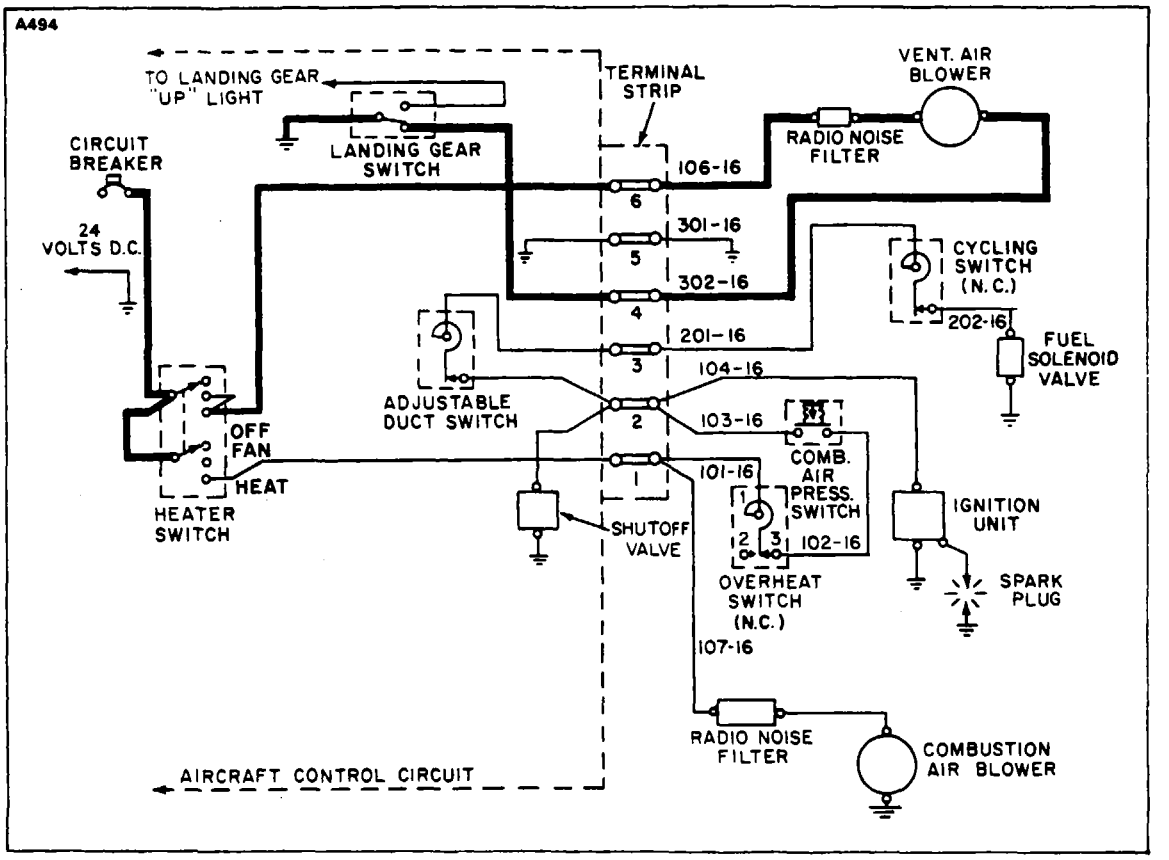



Figure 13-42. Primary Power Circuit

13-154. HEATER ELECTRICAL SYSTEM CHECKS.

13-155. ELECTRICAL CONTINUITY CHECK. These tests are listed as an aid in isolating open circuited or inoperative components.

NOTE

The schematic wiring diagram (Figures 13-41, 13-42 and 13-43 shows, in addition to the heater circuitry, a suggested aircraft control circuit. For the purposes of this manual, the circuitry shown in these illustrations will be utilized to describe electrical continuity checks.

It must be assumed that power, which is furnished through the heater circuit breaker, is present at the HEATER SWITCH at all times. Always check the circuit breaker before performing electrical continuity checks.

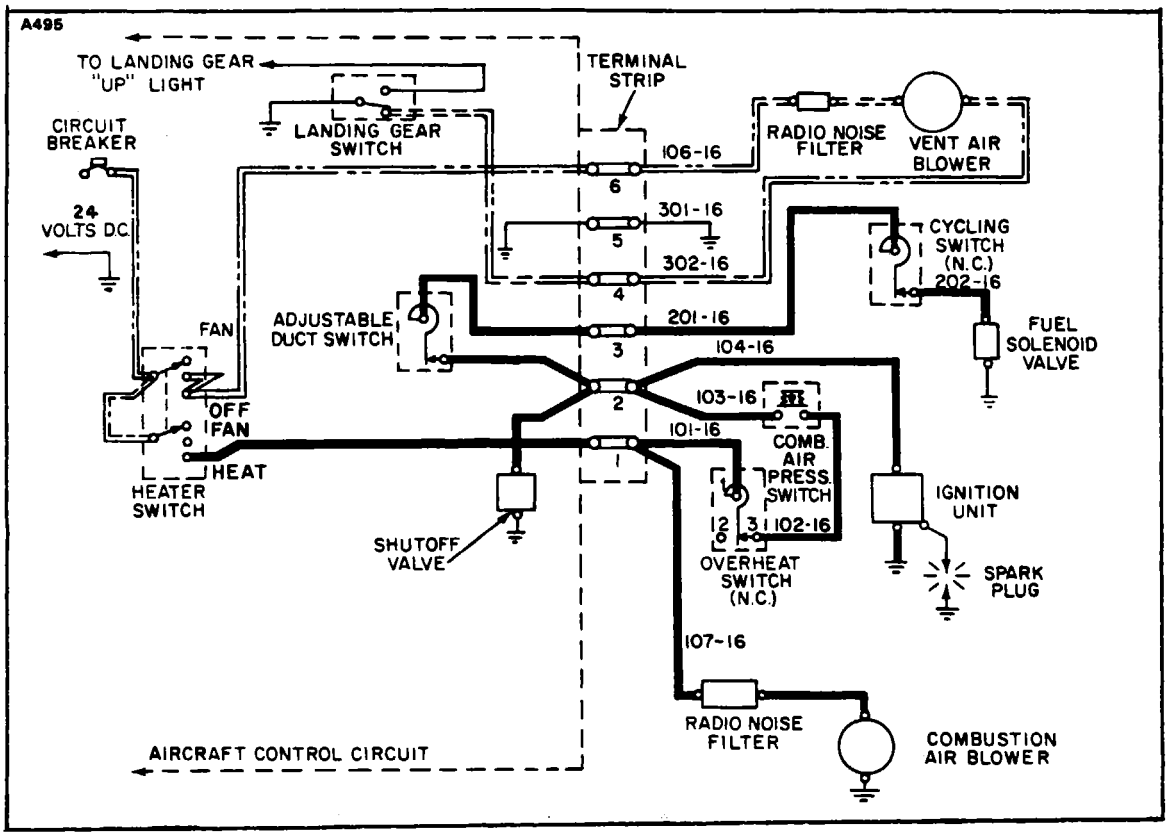



Figure 13-43. Starting Power Circuit

13-156. VENT BLOWER POWER CIRCUIT CHECK. (Refer to Figure 13-41.) With the HEATER SWITCH in the FAN position, electrical continuity (28-volts nominal) should be present at the following locations:

a. Terminal No. 6 on the heater terminal strip.

b. From terminal No. 6 of the heater terminal strip through the radio-noise filter to the ventilating air motor.

c. Electrical ground circuit for the ventilating air motor is provided from terminal No. 4 of the heater terminal strip through the LANDING GEAR SWITCH when the landing gear is down. Ventilating air motor is inoperative when the landing gear is up.

13-157. HEATER POWER CIRCUIT CHECK. (Refer to Figure 13-43.) With the HEATER SWITCH in the HEAT position, electrical continuity should be present at the following locations:

NOTE

Power for the ventilating air blower is the same as described above except that power is now supplied through the HEAT side of the HEATER SWITCH.

a. Terminal No. 1 of the heater terminal strip.
b. From terminal No. 1 of the heater terminal strip through the radio-noise filter to the combustion air motor and to terminal No. 1 of the overheat switch.
c. From terminal No. 3 of the overheat switch through the combustion air pressure switch to terminal No. 2 of the heater terminal strip.
d. From terminal No. 2 of the heater terminal strip to the ignition unit, to the shutoff valve, and through the adjustable duct switch to terminal No. 3 of the heater terminal strip.
e. From terminal No. 3 of the heater terminal strip through the cycling switch to the fuel solenoid valve.

In the event that electrical continuity is not present at one or more of the above listed points, the wiring must be traced back to the power source. If components are still inoperative after the wiring inspection, check the individual inoperative components for continuity and, if necessary, replace them.

13-158. MAINTENANCE AND REPAIRS. Instructions in this paragraph pertain to maintenance of the basic heater and components while the heater is installed in the airplane. Instructions for removal of components are included provided the installation permits accessibility.

NOTE

No special service tools are required for normal periodic maintenance.

13-159. COMBUSTION AIR BLOWER.

a. Removal:
1. Disconnect wire at quick-disconnect terminal.
2. Disconnect the inlet tubing from the inlet air adapter.
3. Loosen the clamps that hold the combustion air blower assembly in the support bracket and slide the motor out of the bracket.

b. Replacing Motor Brushes: (Refer to Figure 13-48.)
1. Remove the brush cap at one of the brush locations. Note position of brush inside the guide and carefully lift the brush and brush spring out of the guide. Be sure to hold the brush so that it can be reinstalled in precisely the same position if no brush replacement is required.
2. Inspect the brush for wear. A new brush is 17/32 inch long. If brushes are worn to a length of 3/16 inch, they must be replaced.
3. Looking through the brush guide, inspect the commutator, which should be smooth and medium brown to dark brown in color. Remove all dust from commutator with compressed air.

NOTE

Installation of new brushes in a motor that has a badly scored or dirty commutator will result in a very short brush life.

If the commutator is grooved in the brush track, gouged, scored or shows signs of having burned spots, replace the complete motor assembly. If the commutator is in good condition, install new motor brushes and tighten brush caps into place. Make sure each brush is oriented so that the curved end fits the curvature of the commutator.

4. After installing new brushes, it is advisable to run in the brushes as follows: Connect the motor to a controlled voltage supply (rheostat in a 28-volt line). Operate the motor at approximately one-half its normal speed for the first hour; then gradually increase the speed until it is rotating at approximately normal speed. Continue the run-in operation for at least two hours to properly seat the brushes before installing the blower in the airplane.

c. Installation:

1. Prior to installing the combustion air blower, inspect all parts of the assembly for loose screws, loose nuts and poor ground connection on the blower housing. Make sure the blower wheel is tight on the shaft and properly located in the housing. It should have just enough clearance to rotate at full speed without binding against the outer housing. Blower performance is based upon this close tolerance clearance. It is recommended that correct voltage be applied for this clearance check.

2. Install the blower inlet adapter in the same orientation as before removal.

3. Place the combustion air blower assembly in position in the attaching clamp so the air tubing can be connected and slide the tubing into position at the point where it was disconnected during removal. Tighten the motor in the attaching strap.

4. Secure the air tubing by tightening the clamp or installing the sheet metal attaching screws.

5. Connect the wire lead to No. 1 terminal on terminal strip.

6. Check motor operation. By disconnecting the wire at the No. 3 terminal on heater terminal strip, blower can be operated without fuel flow to the heater.

13-160. SPARK PLUG. (Refer to Figure 13-47.)

a. Removal:

1. Remove the necessary access panels to expose the spark plug area of the heater assembly.

NOTE

Insure that heater electrical circuits are de-energized.

2. Unscrew and remove the high voltage lead connector at the spark plug. Exercise care to avoid fouling or damaging the connector.

3. Remove the grommet, (39) of Figure 13-47 from the heater jacket opening.

4. Using a 7/8 inch deep hex socket, unscrew and remove the spark plug. Make sure the spark plug gasket is removed with the spark plug. It will normally stick on the spark plug threads, but if loose, it might drop into the ventilating air passages of the heater. Should this happen, remove the gasket with a wire hook.

b. Inspection and Servicing (Spark Plug):

1. If the spark plug appears to be in good condition, except for a mild coating of oxide on the porcelain and electrode, it may be cleaned and reused. Cleaning is accomplished on a conventional airplane type spark plug cleaner, except that it will be necessary to use two or more adapters in order to raise the long extension of the plug far enough out of the cleaner nozzle opening to perform an effective job. Plug the ceramic insert cavity at the terminal end of the plug with a piece of paper or cloth to keep out any of the cleaning sand. Wipe this cavity out thoroughly with a cloth wet with carbon tetrachloride. If after cleaning the spark plug porcelain is white and the electrode is not eroded, proceed to check the ground electrode in the heater and adjust the spark gap in accordance with paragraph 13-160, c and Figure 13-44.

NOTE

If the spark plug fails to clean up properly and/or the electrode is badly eroded, it should be replaced.

c. Spark Gap Check and Adjustment: (See Figure 13-15.)

A spark gap of 0.156 to 0.188 of an inch must be maintained on the P/N 39D18 spark plug. This gap should be checked any time a plug is replaced or at the time of heater overhaul. A spark gap greater than that specified can shorten the life of the ignition assembly. There are several methods in which the spark gap of this heater may be checked. Method I is recommended when the heater is being overhauled and before the installation of the fuel nozzle. Methods II and III are suitable for checking the gap through the spark plug well when the heater is not disassembled.

Method I:

1. Using a 5/32 inch drill (0.156) or a piece of 5/32 rod, reach down through the small opening in the combustion head and find the ground electrode. (It is welded inside the head.)

2. Move the drill along the side of the electrode on the spark plug side. (Movement should be from the outer edge towards the center.) The drill should just pass through the spark plug gap opening. Should the drill fail to pass through this opening, the gap is too narrow. If it passes through too freely, the gap is too wide. In either case, it will be necessary to bend the ground electrode in the direction required. This may be done by removing the spark plug and reaching through the opening.

3. Recheck the gap after repositioning of the ground electrode.

Method II:

1. Measure the distance between the seating surface of the spark plug with a new gasket installed to the end of the plug electrode.

2. Using a depth gauge, measure the distance between the ground electrode in the heater to the spark plug seating surface in the heater jacket and check this measurement against the measurement obtained in Step 1. The difference should be between 0.156 to 0.188 of an inch.

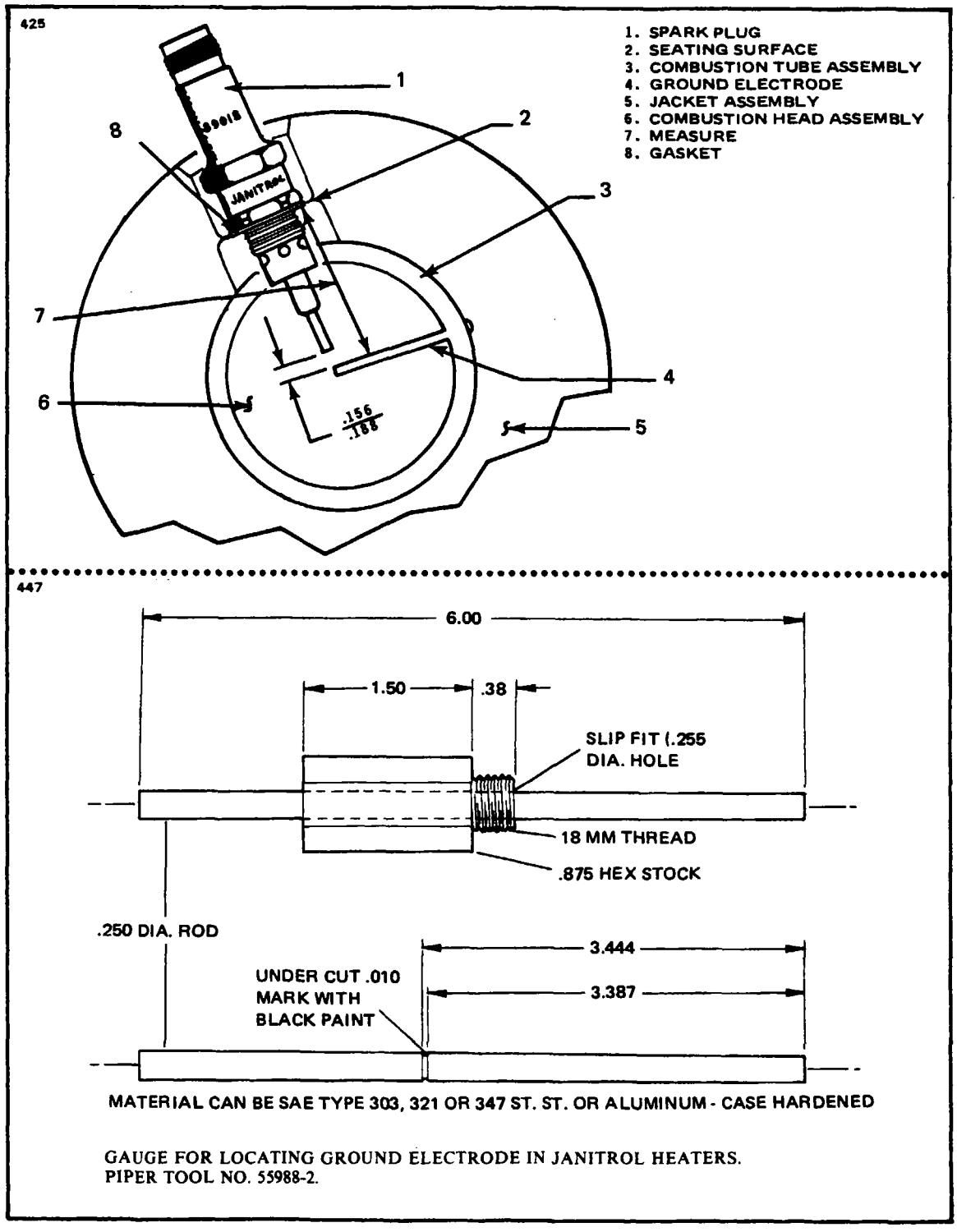



Figure 13-44. Spark Plug Gap Adjustment and Tool

3. The ground electrode can be bent to obtain the required gap.

Method III:

1. Fabricate or purchase from Piper, the special tool from dimensions given in Figure 13-44.

2. Install the threaded end of the tool into the spark plug hole.

3. Slide the rod of the tool into the combustion head until it contacts the ground electrode.

4. Check that the indicator ring on the rod lines up with the end of the tool. The ground electrode may be bent to obtain the required gap.

NOTE

Inspect the ground electrode for erosion. If it is eroded to approximately half of its original 1/8 inch diameter, it should be replaced. This can be done as follows:

(a) Grind off the head of the rivet where it projects through the combustion head and remove the electrode.
(b) Install a new CRES rivet AN125452 which is 1.500 inches in length.
(c) Heliarc tack weld the rivet head to hold it in place.
(d) Check spark gap as noted in Methods I, II or III.

d. Installation:

1. If a new spark plug is being installed, be sure to adjust the spark gap as outlined in step c. Do not bend the electrode on the spark plug.

2. Place a new spark plug gasket on the threads. A small drop of Aviation Permatex, or similar material may be used on the gasket to help hold it to the spark plug shell during installation.

3. Screw the spark plug into the heater with a deep socket wrench. Tighten to a torque of 28 foot-pounds. Install the grommet in heater jacket opening.

4. Carefully insert the spring connector on the high voltage lead into the spark plug shell; press down gently and start the nut on the threads. Tighten the nut to 20 foot-pounds.

5. Operate the heater to check dependability and replace the access panels.

13-161. VIBRATOR ASSEMBLY. (Refer to Figure 13-47.)

a. Measure the distance the vibrator protrudes out of the ignition assembly to determine when a new unit is inserted properly. Loosen the clamp that holds the vibrator in position and with a slight back and forth movement, pull it straight out of the ignition unit. (For a friction grip, it may be necessary to use a piece of masking or friction tape around the exposed portion of the vibrator.)

b. Carefully rotate the new vibrator until the index marks are aligned and the connector pins on the vibrator can be felt entering the pin sockets in the vibrator socket; then press the vibrator fully and firmly into position.

c. Check the heater for operation.

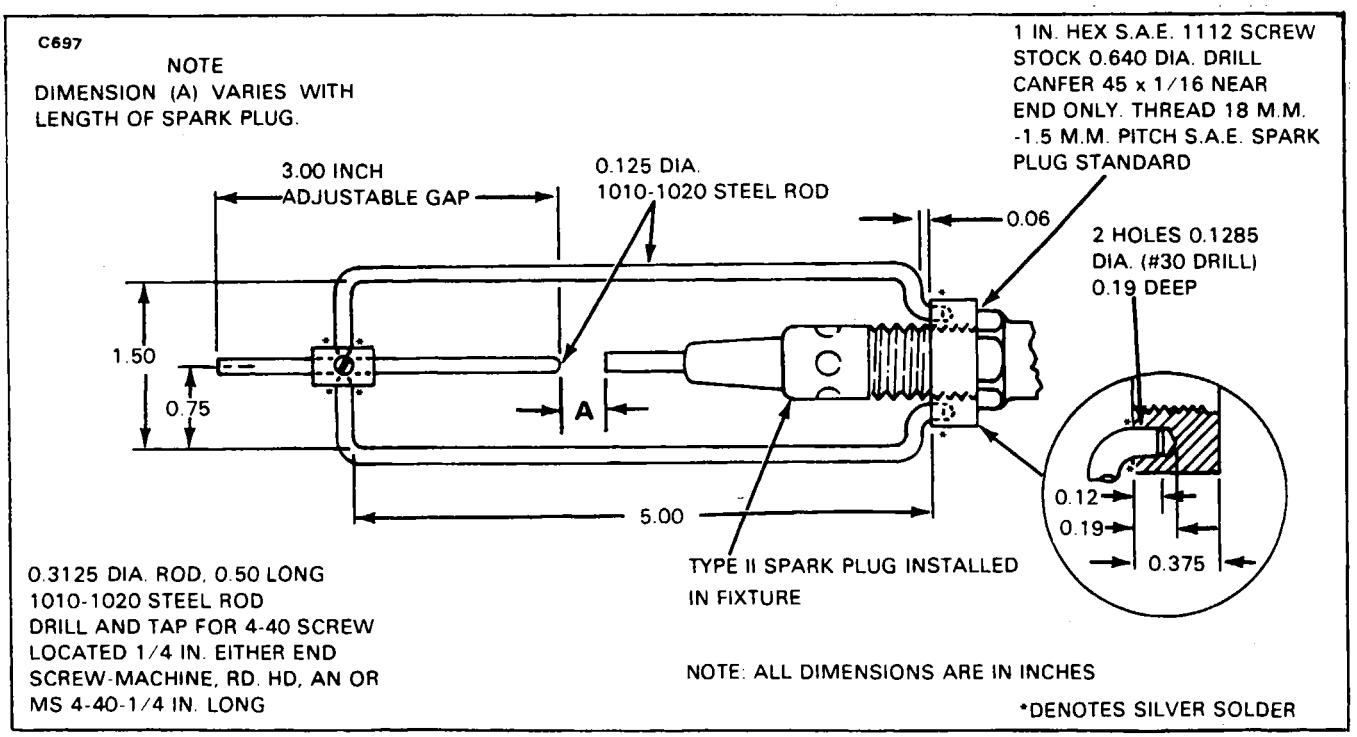



Figure 13-44a. Spark Plug Fixture

13-162. IGNITION ASSEMBLY. (Refer to Figure 13-47.) This unit converts aircraft DC buss voltage to oscillating current capable of producing a continuous spark in the combustion chamber of the heater. This unit remains energized and produces a continuous spark during heater operation. It contains a condenser, resistor, radio noise filter and vibrator socket. It also has an externally mounted vibrator and ignition coil.

a. Removal of ignition assembly:

NOTE

Make sure the heater electrical circuits are de-energized.

1. Disconnect the primary wire from the primary terminal of the ignition assembly (2).
2. Carefully unscrew and disconnect the high voltage ignition cable at the spark plug. Exercise care to avoid fouling or damaging the connector.
3. Remove the four attaching screws and lift the ignition assembly (2) off the heater jacket.

b. Installation of ignition assembly:

1. Place the ignition assembly in position on the brackets attached to the heater jacket, with the high voltage cable facing the spark plug end of the heater.
2. Install the four screws. Tighten the screws securely.
3. Carefully connect the high voltage lead to the spark plug. Torque to 20 foot-pounds.
4. Connect the primary lead to the primary terminal on the ignition unit (2) and tighten the nut securely.
5. Check for proper heater operation.

c. Testing ignition unit:

The ignition unit does not require complete overhaul. The following test will indicate whether or not the unit is operational and whether the vibrator should be replaced before reinstallation in the aircraft. The following equipment is required to test the components:

1. A battery that will supply power at approximately 14 to 28-volts DC.
2. A voltmeter with a range of 0-30 volts.
3. A lead from the battery to the test fixture in which is included an ammeter with a range of 0-3 amperes and a normally open, momentary-closed switch. The total resistance of the lead including the ammeter and switch must not exceed 0.3 ohms.
4. A spark gap of 0.187 of an inch +/-0. A convenient means of arranging the correct spark gap is to install a spark plug, P/N 39D18, in a test fixture arranged to provide a ground electrode and a .187 of an inch spark gap. (Refer to Figure 13-44a for information on fabricating this fixture.)

NOTE

Any one of several spark plugs may be used with the spark plug fixture detailed in Figure 13-44a. However, the "A" dimension in that sketch must be varied with the length of the spark plug electrode to provide a gap of .187 of an inch for all spark plugs.

NOTE

When testing an ignition unit, do not use a screwdriver as a substitute for a spark plug and spark plug fixture.

5. The high tension shielded ignition lead between the igntion unit and the spark plug is a part of the cover assembly.

6. Arrange the test equipment as shown in Figure 13-44b.

d. Operational test of ignition unit:

1. Close the momentary switch and read the voltmeter and ammeter. Release the momentary switch immediately.

2. The amperage reading at 28 volts DC must be 1.25 +/-0.25 amperes.

13-163. CYCLING SWITCH AND LIMIT (OVERHEAT) SWITCH. (Refer to Figure 13-47.)

a. Removal:

1. If the limit switch (25) is damaged or defective, disconnect the two electrical leads from the switch terminals. Be sure to mark the leads for proper reasembly. (The switch terminals are identified by numbers "1", "2" and "3".)

2. Remove the two attaching screws and lift switch (25) and spacers (gaskets, 2 required) (27) from the jacket opening.

3. If the cycling switch (24) is damaged or defective, disconnect the electrical leads, being sure to mark them for proper reassembly.

4. Remove the two screws and lift the cycling switch (24) from the jacket opening.

NOTE

No attempt should be made to repair either of these switches. Switches that do not operate properly must be replaced. (Refer to paragraph 13-138, m and n for test instructions.)

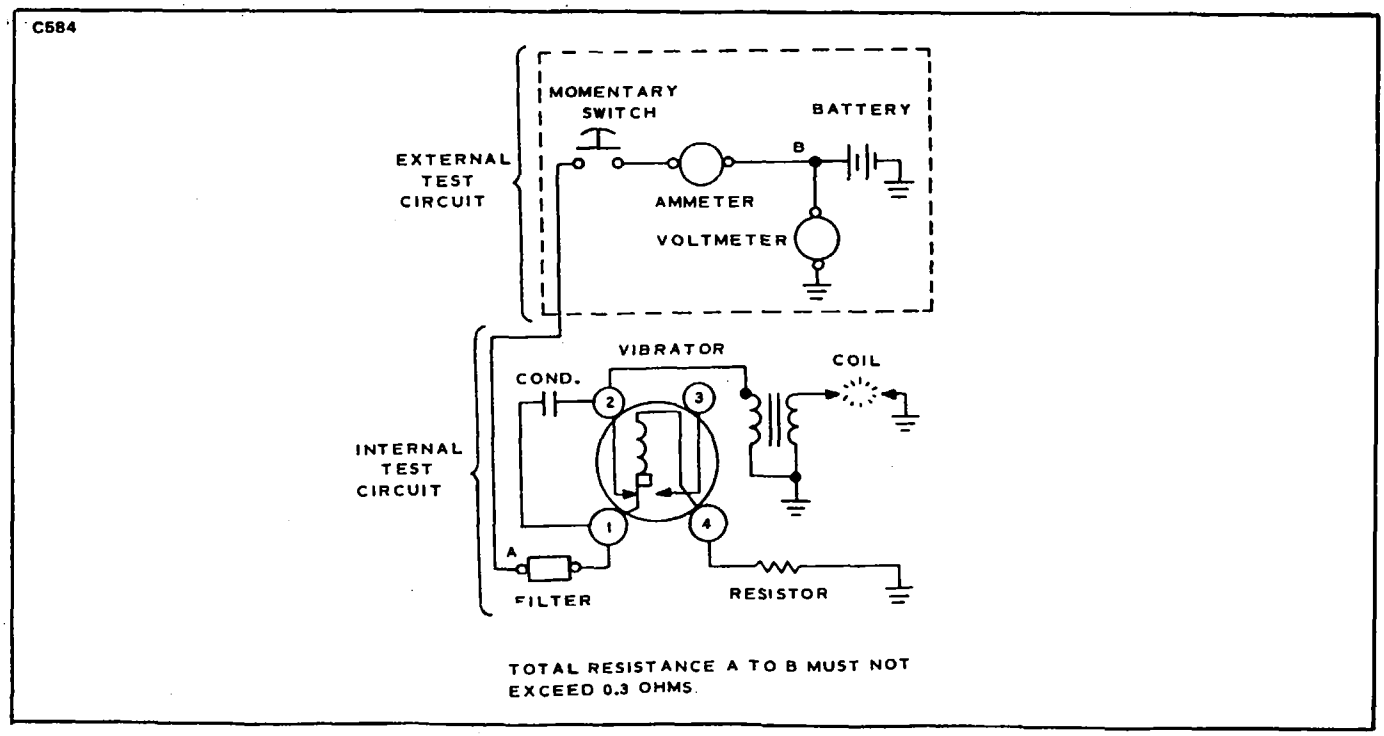



Figure 13-44b. Wiring - Test Setup

b. Installation:

1. Install the limit switch (25) and two spacer gaskets (27) by placing the gaskets in position in the heater jacket opening and installing two screws.

2. Tighten screws securely; then reconnect the electrical leads in accordance with markings made during disassembly. (If electrical connections are uncertain, refer to the wiring diagram, Figure 13-41.)

3. Install the cycling switch by placing it in position in the heater jacket opening and securing it with the two screws. Tighten screws securely; then reconnect the electrical leads to their respective terminals as marked during diasssembly. (If connections are uncertain, refer to wiring diagram, Figure 13-41.)

13-164. COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 13-47.)

a. Removal:

1. Disconnect electrical leads from the terminals of the combustion air pressure switch (26), being sure to mark them for proper reassembly. Disconnect the tube from the switch. Exercise caution not to exert excessive bending of the tube. (It is "tacked" to the combustion chamber inside the jacket.)

2. Unscrew and remove the combustion air pressure switch from the fitting on the combustion air inlet tube.

b. Installation:

1. Install the combustion air pressure switch (26) by rotating it on the threaded fitting of the combustion air inlet tube and tighten it securely. Exercise caution not to over torque the switch as this could change the setting.

2. Connect electrical leads to their respective terminals in accordance with markings made during removal. If in doubt regarding proper connections, refer to the wiring diagram, Figure 13-41. Connect the tube to the switch.

3. Check for proper heater operation.

13-165. FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 13-48.)

a. Removal:

1. Remove the cover from the fuel regulator/shutoff valve shroud assembly.

2. Disconnect the electrical lead to the valve.

3. Disconnect the fuel lines from the valve nipples.

4. Remove the two bolts securing the valve and shroud to the bulkhead, and save the standoff bushings and washers for reinstallation of the valve and shroud assembly.

b. Installation:

1. Place the regulator/shutoff valve into the shroud. Insure the correct positioning of inlet and outlet ports to their respective lines, and secure the valve and shroud to the bulkhead using the two standoff bushings, washers and bolts.

2. Connect the fuel lines to the valve and tighten securely.

3. Connect the electrical lead. Be sure an insulating sleeve or tape is placed over the connection to avoid any possibility of a short circuit. If a sleeve is used, secure it in place.

4. Perform an operational check of the heater to insure that the unit is functioning properly and no fuel leaks exist.

5. Reinstall the shroud cover on the shroud assembly.

13-166. DUCT SWITCH. (Refer to Figure 13-48.)

a. Removal:

1. Place the control lever arm in high position and loosen the Allen head set screw that secures the arm to the temperature selector shaft. Slide the lever and arm off the shaft.

2. Disconnect the two electrical leads from the terminals on the exposed face of the switch.

3. Remove the two attaching screws and washers from the duct.

4. Carefully lift out the switch and gasket (if gasket is used).

b. Cleaning and Inspection:

1. Brush off any dust or lint from the switch operating mechanism (exposed inside the duct) and wipe external surfaces with a clean cloth.

c. Installation:

1. Insert the switch carefully, with gasket (if used), into the ventilating duct opening and install the two attaching screws and washers.

2. Connect the two electrical leads to their respective terminals, as marked during removal.

3. Set the temperature selector shaft at the high stop. Then carefully place the control lever arm on the shaft at the high position and lock the lever by tightening the Allen head set screw. (Do not over-tighten.) Rotate the lever arm to make sure it clears the electrical terminal screws and support bracket when it is moved to the high position.

4. Operate the heater with the duct switch set above ambient temperature to check operation. (Refer to paragraph 13-180, 1 for additional switch tests and setting instructions.)

13-167. OVERHAUL INSTRUCTIONS. The heater assembly shall be overhauled after 1000 hours or whenever the pressure decay test requirement cannot be met. The heater should be removed from the aircraft, disassembled, all parts throughly inspected and necessary repairs and/or replacements made prior to reassembly. Detailed step-by-step instructions are included for a complete heater overhaul. In some instances, however, inspection may reveal that it is unnecessary to remove certain parts. If so, those portions of the overhaul procedures may be eliminated.

NOTE

For disassembly and reassembly operations, refer to the exploded view drawings and the parts list.

13-168. DISASSEMBLY. (Refer to Figure 13-47.)

a. Remove the screw and slide the adapter (23) off the combustion air inlet tube.

b. Disconnect and remove electrical wiring and individual wires from the various components on the heater. If wires appear to be in good condition, it may be desirable to remove wire harness assembly intact. First, disconnect wires at terminal strip and components.

NOTE

It is advisable to label all wires, prior to removal, to insure correct connections during reassembly. Cable straps and clips must be replaced if removed, as they cannot be re-used.

c. Carefully disconnect the high voltage ignition lead at the spark plug. Handle the spring connector on the end of this lead with care to prevent fouling or damage.

d. Remove the four screws and cable straps to free the ignition assembly (2) from the heater jacket and remove the ignition assembly. The vibrator may be removed by loosening the clamp and exerting a firm pull straight away from the ignition assembly case.

e. Remove the grommet (39) from the jacket (5) and remove the spark plug (32) with a 7/8 inch deep socket. Make sure the spark plug gasket is removed.

f. Remove the two screws and lift out the overheat (limit) switch (25) and spacer gaskets (27).

g. Remove the two screws and lift out the cycling switch (24).

h. Remove the four screws to release the terminal strip (35) and insulator (36) from the jacket (5).

i. Disconnect the tube fitting (33) at the cover of the combustion air pressure switch (26). (Refer to paragraph 13-164, a, 1 for precaution on tube bending.) Unscrew and remove the combustion air pressure switch (26) from the combustion air inlet tube.

j. Open baggage door on the right side of the fuselage for access to the heater cover box assembly and remove the screws attaching the cover to the baggage compartment bulkhead and floor. Remove the three screws securing the heater air intake tube assembly to the heater and set aside.

k. Loosen the four screws (20) and rotate the blower and motor housing (11) to disengage the notched end from the four screws in the end of the heater jacket. Remove the grommet (45) and separate the electrical quick-disconnects.

l. Remove the upper fuel shroud (10). Remove grommet from fuel shroud (9) and carefully pull fuel solenoid wires through hole in shroud. With open end wrench, remove fuel solenoid assembly. Reach inside the inlet end of the jacket assembly with a 3/4 inch open end wrench and while holding the fuel-tube fitting at the jacket, remove the elbow fitting (34), nut (38), washer (41), gasket (29) and fuel shroud (9).

m. Remove the two screws and carefully withdraw the nozzle holder from the combustion head assembly (6). Remove the gasket (28). Remove the six screws and withdraw the combustion head assembly from the combustion tube assembly (7). Remove the gasket (30).

n. Remove the screws and remaining cable straps, if not previously removed, from the seam of the jacket assembly (5). Note positions of cable straps as they are removed. Spread the jacket at the seam and remove it from the combustion tube assembly (7). This will free the rope gasket (31) which can be removed from the particular part on which it remains attached.

o. Carefully unscrew and remove the spray nozzle (21) from the nozzle holder (8) and remove gasket (28).

CAUTION

Handle the nozzle with care to avoid damage to the tip. The material around the orifice is very thin and any sharp blow on the face of the nozzle can distort the spray pattern and cause malignition or improper combustion.

p. Remove the three screws and rubber grommet from the blower housing (12).

q. Slide the ventilating air blower motor out of the blower housing with the motor bracket assembly (19) and blower wheel (17) attached. Loosen the set screw in the blower wheel and slide it off the end of the motor shaft. Then remove the motor bracket assembly (19) and fasteners (43).

r. Remove the screw and lock washer to free the capacitor assembly (18) with attached leads.

13-169. DISASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 13-48.)

a. Remove the combustion air blower inlet adapter (2) by removing the screw (18).

b. Remove screws (18); then separate the outer housing (3) from the inner blower housing (8) and free the motor leads and capacitor (10) from the inner housing.

c. Loosen the set screw in the blower wheel (7) and slide it off the motor shaft.

d. Remove the two hex nuts (17), lock washers and flat washers (16) and slide the inner housing (8) off the motor through bolts. The spacer (15) will drop out.

e. Install new motor brushes as described in paragraph 13-159, b. If the motor commutator is badly worn, or if the motor is defective in any respect, it must be replaced.

13-170. CLEANING. (Refer to Figure 13-47.)

a. Clean individual metal parts (except those parts containing switches and electrical wiring) and the combustion tube assembly, by immersing them in dry-cleaning solvent, such as Stoddard solvent (Federal Specification P-D-680). A bristle brush should be used to assist the cleaning process if foreign accumulations are stubborn to remove.

CAUTION

Do not attempt to buff or scrape off any deposits on face of spray nozzle. The face of the nozzle is very susceptible to damage from mishandling. Carefully repeat cleaning process using only a bristle brush and repeated applications of solvent to loosen any stubborn deposits.

b. Use compressed air or lintless cloth to dry the parts, unless sufficient time is available for them to air dry.

c. Wipe electrical components with a clean, dry cloth. If foreign material is difficult to remove, moisten the cloth in carbon tetrachloride or electrical contact cleaner and clean all exterior surfaces thoroughly.

13-171. CLEANING AND INSPECTING THE COMBUSTION TUBE ASSEMBLY. (Refer to Figure 13-47.)

a. Slight scaling and discoloration of the combustion tube assembly (7) is a normal condition for units that have been in service up to 1000 airplane hours. The slight scaling condition will appear to be mottled and a small accumulation of blue-gray powder may be present on the surface in certain areas. This condition does not require replacement of combustion tube assembly, unless severe overheating has produced soft spots in the metal.

NOTE

This assembly should be inspected prior to cleaning in order to prevent the removal of visible evidences of damage.

b. Look inside the exhaust outlet to determine if the combustion tube appears to be heavily scaled or mottled. Deformation is more difficult to detect visually but can usually be observed by looking straight through the combustion tube assembly and sighting along the outer surface of the inner combustion tube. An assembly that has been obviously deformed should be replaced. Slight deformation will not affect heater operation unless it is extensive and localized enough to reduce the flow of ventilating air through the heater more than 10 percent.

c. The combustion tube assembly may be cleaned by either of two methods:

1. One method is to soak the combustion tube assembly overnight in an Oakite M-S Stripper solution, made by mixing one pound of Oakite salts with each gallon of water used. The solution should be maintained at a temperature of between 190° F and 210° F. After overnight soaking, rinse the combustion tube assembly thoroughly in water to remove all traces of the Oakite solution. In order to reach all areas of the combustion tube assembly, it is advisable to let it stand in the rinsing water for as long as one-half hour, while occasionally agitating it to circulate the water. All openings should be left open during this operation. Be sure to dry the combustion tube assembly thoroughly after cleaning.

2. A second method of cleaning is what is commonly known as hand "tumbling." Insert shot or other metallic particles through the exhaust outlet opening; then close all openings and shake the combustion tube assembly vigorously, while rotating it and changing from end-to-end frequently. Be sure to pour out all of the particles and loosened material; then with all openings uncovered, direct a stream of compressed air into the combustion tube assembly from first one opening, then the other. Make sure all loose material is removed.

13-172. INSPECTION OF REMAINING COMPONENTS. (Refer to Figure 13-47.)

a. Discard all rubber parts such as grommets, gaskets, etc. These items should always be replaced at overhaul. Also discard the rope gasket (31).

b. Inspect all wires and wiring harnesses for damage to insulation, damaged terminals, chafed or cracked insulation and broken plastic bands. Individual wires can be replaced by making up new wires from No. 16 AWG stock and cut to correct length. It is advisable to use an acceptable crimping tool for installing terminals, rather than solder for all heater wiring connections. If wiring harness damage is visible, the entire harness assembly should be replaced. If only one or more wires are damaged, cut the cable ties, make up new wires, install them in the harnesses, and restore all cable ties and clamps. If heater controls were operating properly at the time of removal, reinstall them.

c. Inspect all hard parts, consisting of bolts, screws, nuts, washers and lock washers. Replace damaged parts.

d. The combustion air pressure switch (26) must respond to delicate pressure changes and should always be checked and/or replaced at overhaul. (Refer to paragraph 13-173, c, and Figure 13-46.)

e. Replace the vibrator in the ignition unit at each overhaul.

f. Inspect the ignition assembly for dented case, loose or damaged primary terminal insulator and broken or obviously damaged high voltage lead. Give particular attention to the condition of the spring connector at the end of the lead. If the spring is burned off, visibly eroded, or carbon tracked, the ignition assembly should be replaced.

NOTE

Do not attempt a field repair of the ignition unit, as it is a sealed assembly.

g. Inspect the terminal strip (35) for distortion and cracks and replace it if either condition exists.

h. Inspect radio-noise filters for short circuits by checking from either terminal to ground with an ohmmeter. An open-circuit reading should be obtained.

i. Inspect the spray nozzle (21) with a magnifying glass for any obstructions in the nozzle orifice and any sign of damage to the slight conical protrusion at the nozzle tip. Use compressed air to remove obstructions and re-examine it to make sure the orifice is open. Exercise care when handling the nozzle to avoid pressing or rapping on the tip face. Do not burr or scrape off deposits on the tip face. After cleaning, it is advisable to store the nozzle in a polyethylene bag until ready for reassembly.

j. Replace the nozzle at overhaul.

NOTE

The nozzle (21) can be spray tested by installing it in the holder and connecting the fuel tube to a 7 psi fuel pressure source. The conical angle spray pattern should be even and dispersed the same in all directions. Exercise caution to keep atomized fuel away from fire.

k. Inspect the nozzle holder for damaged threads at the fuel tube fitting, crimped or cracked fuel line or distorted housing.

l. Check the solenoid for continuity with an ohmmeter. A reading of between 100 and 125 ohms at room temperature should be obtained. If the reading is not within these limits, the solenoid should be replaced.

m. Remove the brushes, one at a time, from the ventilating air blower motor (13) by removing the brush cap and carefully withdrawing the brush from its guide. Remove foreign material from the brush guide and commutator with a stream of filtered compressed air. Check for brush wear. (Refer to paragraph 13-159.) Inspect the commutator for grooved brush track, pitting or burning. The commutator surface should be smooth and medium brown in color. Replace the motor if the commutator or other parts show damage.

n. Inspect the combustion air blower motor as described in the preceding step.

o. Inspect the blower wheel for broken or bent vanes and replace it for either condition.

13-173. TESTING. The following tests should be performed as outlined in the succeeding paragraphs:

a. Check ventilating air and combustion air motors for correct RPM and current draw:

1. Connect motor to 28-volt DC power supply. Rotation should be counterclockwise when viewed from the shaft end.

2. Both motors should rotate at approximately 7500 RPM at rated voltage. Current draw is approximately three amperes.

3. If current draw is excessive, or if speed is too low, replace the brushes. Recheck both current draw and RPM after brushes are properly run in. (Refer to paragraph 13-159, b.)

4. If after replacing brushes, operation is still unsatisfactory, replace the motor.

NOTE

The motor checks described above should be made without the blower housing attached, for both the ventilating air and combustion air motors.

b. Test the combustion tube assembly for leaks as follows:

1. Fashion a sealing plate from approximately .125 inch thick flat stock to seal the combustion head opening in the combustion tube assembly. (Refer to Figure 13-29.) Use a rubber gasket under the plate and attach the plate with six screws.

2. Make up seals for all remaining openings, except the one used to connect the air pressure source. (Refer to Figure 13-45.) Use rubber stoppers as shown. The combustion air inlet tube can be sealed best with a drilled stopper and clamp. Other openings should be sealed with expansion plugs. The seal used in the exhaust tube should be formed so that it will not deform the air pressure switch tube which protrudes into the exhaust.

3. Install plugs and caps in all openings except the one to which the combustion air pressure switch is attached. (Any opening can be used to connect the air pressure source; however, the combustion air pressure switch opening is usually the most convenient. The drain opening would normally be considered a second choice.)

4. Connect a regulated air supply to the opening that has not been plugged and

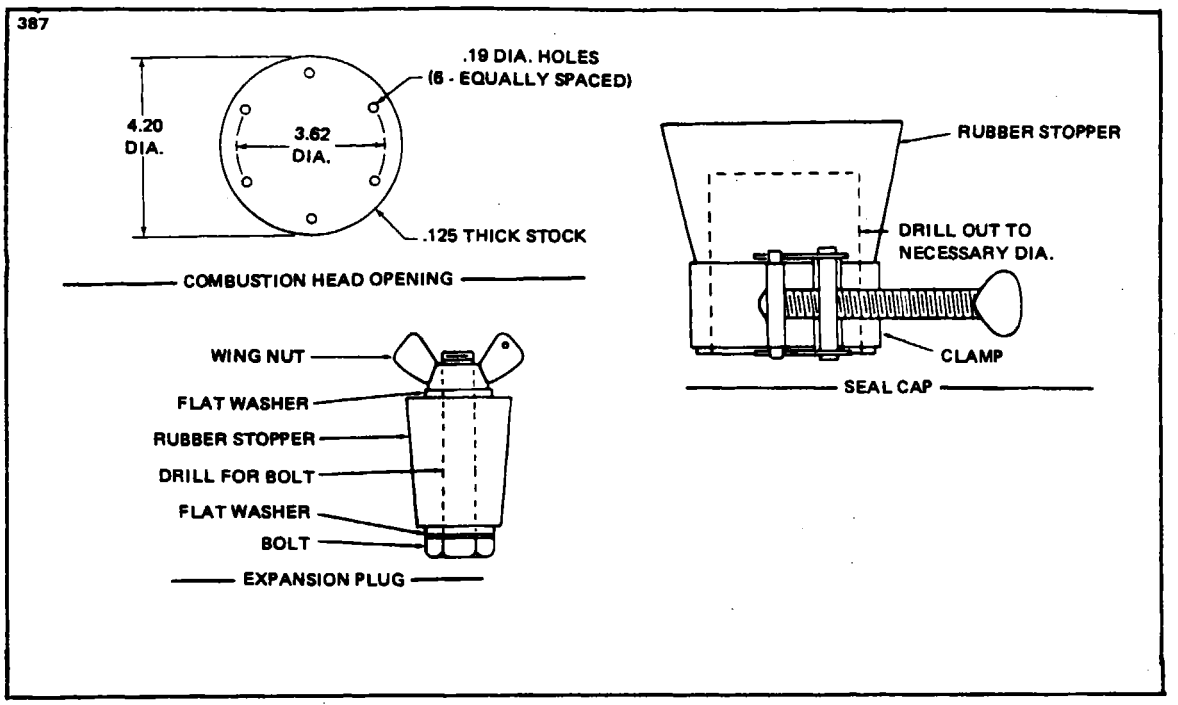



Figure 13-45. Suggested Design for Seal Plate, Plugs and Caps for Combustion Tube Leakage Test

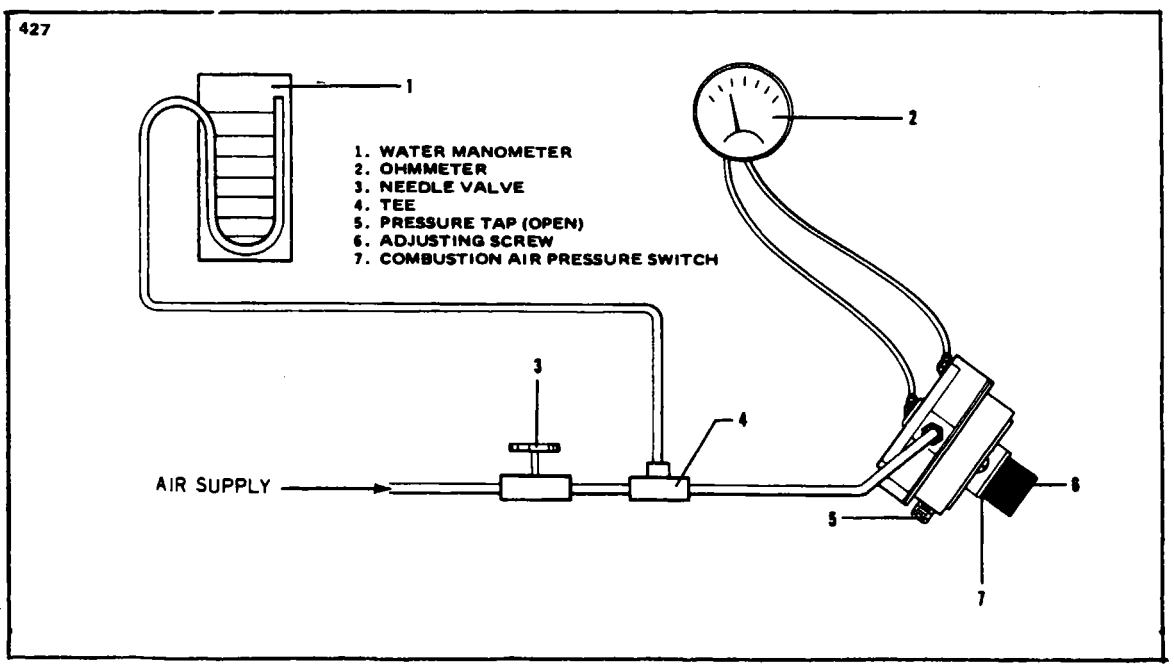



Figure 13-46. Test Setup for Combustion Air Pressure Switch

apply a pressure of between three and five psi to the combustion tube assembly.

5. Submerge the combustion tube assembly in water for several minutes while watching for bubbles, which would indicate leaks. The presence of a small leak, due to a pinhole in the metal or at welded joints, can be repaired successfully, provided it is located in an accessible area and the welder is familiar with stainless steel welds and does not create excessive weld stress concentrations. Be sure to recheck the assembly for leak after welding.

c. Test the combustion air pressure switch as follows:

1. Connect an adjustable air pressure line that can be controlled in a range of zero to 5.0 (maximum) of water to the switch opening with a water manometer and needle valve in the line ahead of switch. Switch must be tested in 45 degree position as shown in Figure 13-46.

2. Connect an ohmmeter across the switch terminals to determine the exact instant of switch closing.

3. Apply air pressure allowing it to build up very slowly from zero. The switch contacts should close at 0.5 $\pm$ 0.1 inches of water which will be indicated on the manometer.

NOTE

The switch cover has a differential pressure tap and this opening must be left open to atmosphere during the test.

4. Make several trials to insure switch reliability. Be sure to increase and decrease the air pressure slowly in order to produce accurate indications.

5. If an adjustment is required, rotate the adjusting screw clockwise to increase settings and counterclockwise to decrease settings.

d. Test the fuel feed and nozzle holder assembly for leaks as follows. This test can be simplified if the following routine is used to test both the fuel line and fuel line shroud tube.

1. Using filtered compressed air, apply 20 psi to the shroud drain port, located on the surface near the threaded nozzle cavity.

2. Immerse the fuel feed and nozzle holder assembly in clean water with the fuel inlet and nozzle cavity left open.

3. Observe for bubbles which would indicate leakage. If bubbles appear at either fuel fitting, there is a leak in the fuel tube. If bubbles appear externally on the shroud tube, or at either end of the shroud tube juncture, the shroud tube is leaking.

4. In either of the above cases, the complete fuel feed and nozzle holder assembly must be replaced.

e. Spray test the nozzle as follows:

1. Install the nozzle in the fuel feed and nozzle holder assembly. Connect the fuel tube to the fuel solenoid. Connect solenoid to a 7 psi fuel pressure source.

2. Connect the solenoid leads to a 14/28-volt battery. Connect a switch in the line to open and close the solenoid when desired.

WARNING

Be sure to keep the atomized spray away from fire.

3. With the switch closed (solenoid valve energized) and the fuel line connected, observe the fuel spray pattern. It should be conical in shape with even dispersion in all directions.

4. Energize and de-energize the solenoid several times. The spray should shut off permanently each time the solenoid is de-energized. There should be no sign of dribbling at the nozzle tip in excess of one or two drops.

5. If the spray pattern is distorted, check for an obstruction and clean the nozzle as described in paragraph 13-172. If this fails to provide a normal spray pattern, replace the nozzle.

6. If the nozzle continues to dribble, the solenoid valve is not closing properly and the solenoid must be replaced.

13-174. REPAIR OF COMBUSTION TUBE ASSEMBLY.

a. If welding is attempted, clean the area thoroughly with a stainless steel brush.

CAUTION

Do not use a brush with ordinary steel bristles, as it would cause subsequent damage to the metal.

b. Wipe the area to be welded with a 30 percent solution of nitric acid; then weld with stainless steel rod (SAE Type 309, using Solar No. 16GH flux) if welding is accomplished with an acetylene torch. If the Heliarc method is used, use either Solar Type I or Type B flux. If a stainless steel rod is not available, a piece of scrap heater combustion chamber may be used as repair material. Make sure severe welding stresses are not present after welding.

NOTE

After welding, test the combustion tube assembly for leaks as outlined in the preceding paragraph.

13-175. REASSEMBLY. (Refer to Figure 13-47.)

a. If removed during disassembly, secure the nipple (37) and elbow (34) to the fuel solenoid (22).

b. Insert the ventilating air motor (13) into the motor bracket assembly (19); slide the blower wheel (17) on the end of the motor shaft and rotate it until the set screw is aligned with the flat side of the motor shaft. Tighten the set screw just tight enough to hold it at this time.

c. Attach the capacitor and leads assembly (18) to the motor bracket (19) with the screw and lock washer. Make sure a good electrical ground connection is made at this point. Install ground bracket (44) and three new fasteners.

d. Insert this assembly into the blower housing (12).

e. Make sure all wires are routed and grommeted in the same manner as before disassembly.

f. The motor (13) should be positioned in the bracket (19) to locate the blower wheel

(17) properly in the blower housing (12). The blower wheel should be positioned so it will rotate freely and just clear the contoured spill plate in the blower housing. Tighten the Allen head set screws and spin the blower wheel by hand for a clearance check. Then apply appropriate voltage to run the motor as a final clearance check.

g. Secure the heater air intake tube assembly to the forward section of the heater. Open the baggage door on the forward right side of the fuselage and install the heater cover box assembly.

h. Place a new asbestos gasket (31) in position on the exhaust outlet; spring the jacket assembly (5) open at the seam and insert the combustion tube assembly (7) carefully into the jacket. Exercise care to clear the pressure switch tube in the exhaust outlet and see that the asbestos gasket is properly located. Close the gap on the jacket assembly and install screws (21) to secure it at the seam. Solenoid lead wire is grounded under one of these screws. Make sure the seam is in good condition and a tight fit is effected.

i. Install cable straps at locations noted during disassembly.

j. Remove the spray nozzle from the polyethylene bag. Screw the nozzle into the nozzle holder and tighten to 75-100 inch-pounds. It is very important to torque the nozzle to this valve as incorrect tightening could cause improper heater operation and "drool."

CAUTION

The spray nozzle has a slight protrusion on the nozzle face. If this area has been struck by any object which would make a dent or destroy the original contour, the nozzle must be replaced.

k. Install a new gasket (30) and combustion head (6) in the combustion tube (7) and secure with the six screws.

l. Insert the fitting on end of nozzle fuel tube through the opening in the jacket (5) and attach the nozzle holder to the combustion head assembly (6) with the two screws. It may be necessary to place a slight bend in the shrouded fuel tube to permit alignment of screw holes. Be sure to use a new gasket (28).

m. Using a new spark plug gasket, install the spark plug (32) and tighten to a torque of 28 foot-pounds. Install the grommet (34) in the jacket around the spark plug.

n. Install the ignition assembly (2) on the jacket assembly (5) with the four screws. Connect the high voltage lead to the spark plug and tighten it to 20 foot-pounds.

o. Attach the overheat limit switch (25) and spacer gaskets (27) to the jacket assembly (5) with two screws. Tighten the screws securely.

p. Attach the cycling switch (24) and bracket to the jacket with the six screws.

q. Place the terminal strip insulation (36) in position on the jacket (5), followed by the terminal strip (36). Secure both parts by installing the two screws.

r. Center the fuel fitting in jacket opening. Position the fuel fitting shroud gasket (29), washer (41) and shroud (9); then install the nut (38) finger tight. Insert a 3/4 inch open-end wrench inside the jacket and hold the fuel-tube fitting while tightening the nut (38) with a 3/4 inch deep socket. Install the fuel solenoid elbow (34) and solenoid (22). Avoid twisting or damaging lead. Install wires through grommet in lower shroud (9).

s. Rotate the combustion air switch (26) onto the threaded fitting on the combustion air tube and tighten it firmly.

t. Slide the grommet (16) over the combustion air tube and connect the tube to the elbow fitting (33) on the combustion air pressure switch (26).

u. Install the wiring harness and connect all wire leads to their respective terminals. (Refer to the wiring diagram. Figure 13-41.) Place the grommet (45, Figure 13-47) in position in the jacket (5); locate the ventilating air blower (11) at the end of the jacket. Thread the quick-disconnect on the motor lead through the grommet and connect it to the mating connector on the wiring harness.

v. Place the blower housing in position on the jacket assembly (5) and secure it by installing the four screws (20), if removed at disassembly. This operation is easier if the screws (20) are started into their threads and the blower housing rotated into place, allowing the screws to enter the notched openings in edge of blower housing. Tighten all screws securely.

w. Install the adapter (23) with the screw.

x. After heater is installed in the aircraft and the fuel line is connected, install the upper fuel shroud box (10) with the screws. Ascertain grommet (40) is installed.

13-176. REASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 13-48.)

a. Place the spacer (15) over the end of the motor shaft and attach the motor assembly (5) to the inner housing (8) with the two self-locking nuts (17), flat washers (16) and lock washers.

b. Slide the blower wheel (7) on the motor shaft and tighten the set screw lightly against the flat portion of the motor shaft.

c. Place the outer blower housing (3) in position on the inner housing (8) and install screws (18).

d. Attach the radio noise filter (10) at the point shown with the screw. The motor ground lead terminal can be grounded to the motor support bracket (13).

e. Loosen the Allen head set screw in the blower fan (7) and shift the fan on the motor shaft until it is near the inlet in the blower housing. Tighten the set screw securely. The blower fan should just clear the inlet flange when rotated at full RPM. Spin the blower fan by hand for clearance check; then apply proper voltage to run motor and recheck for proper clearance.

f. Attach the blower inlet adapter (2) to blower housing (3) with screw (18).

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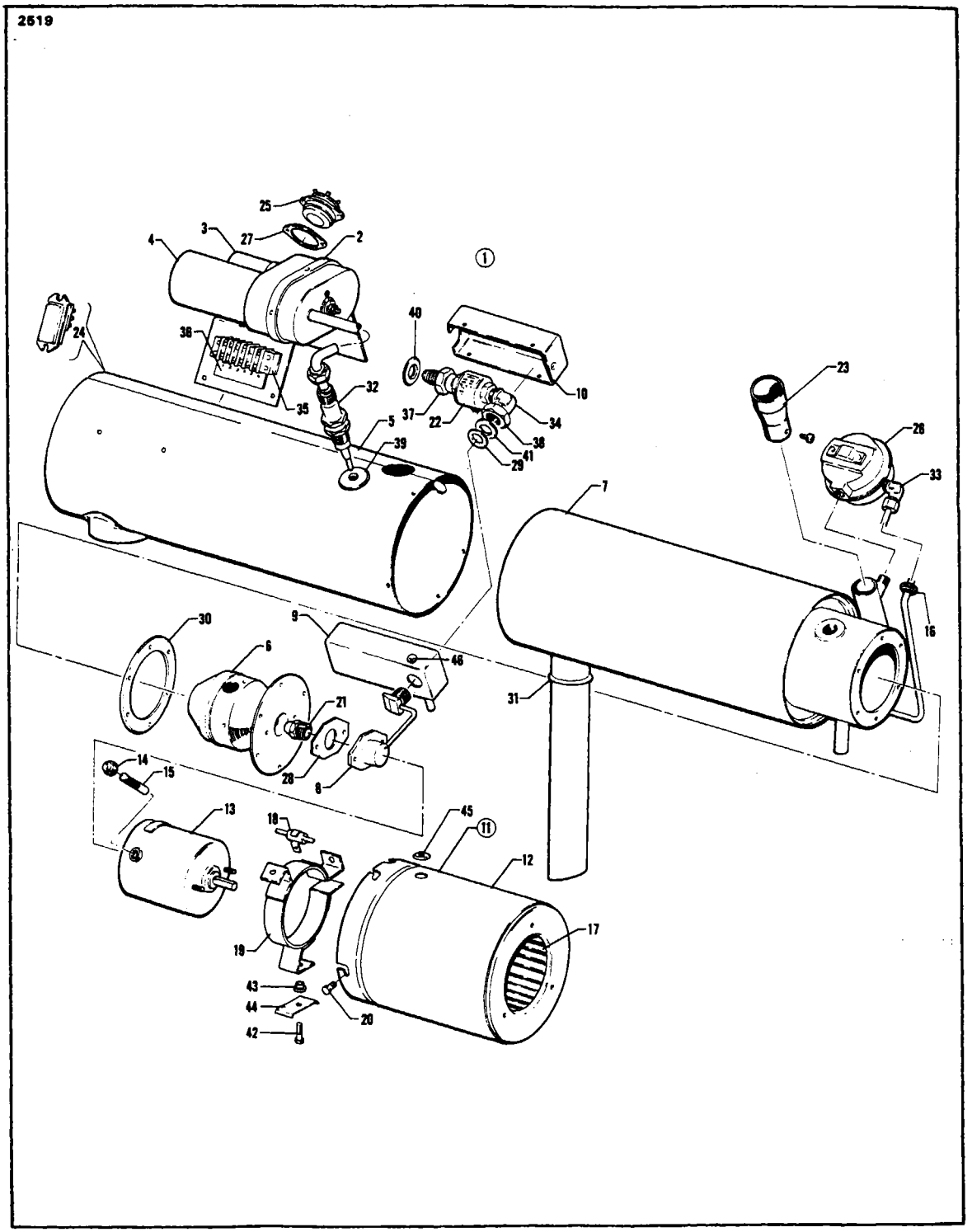
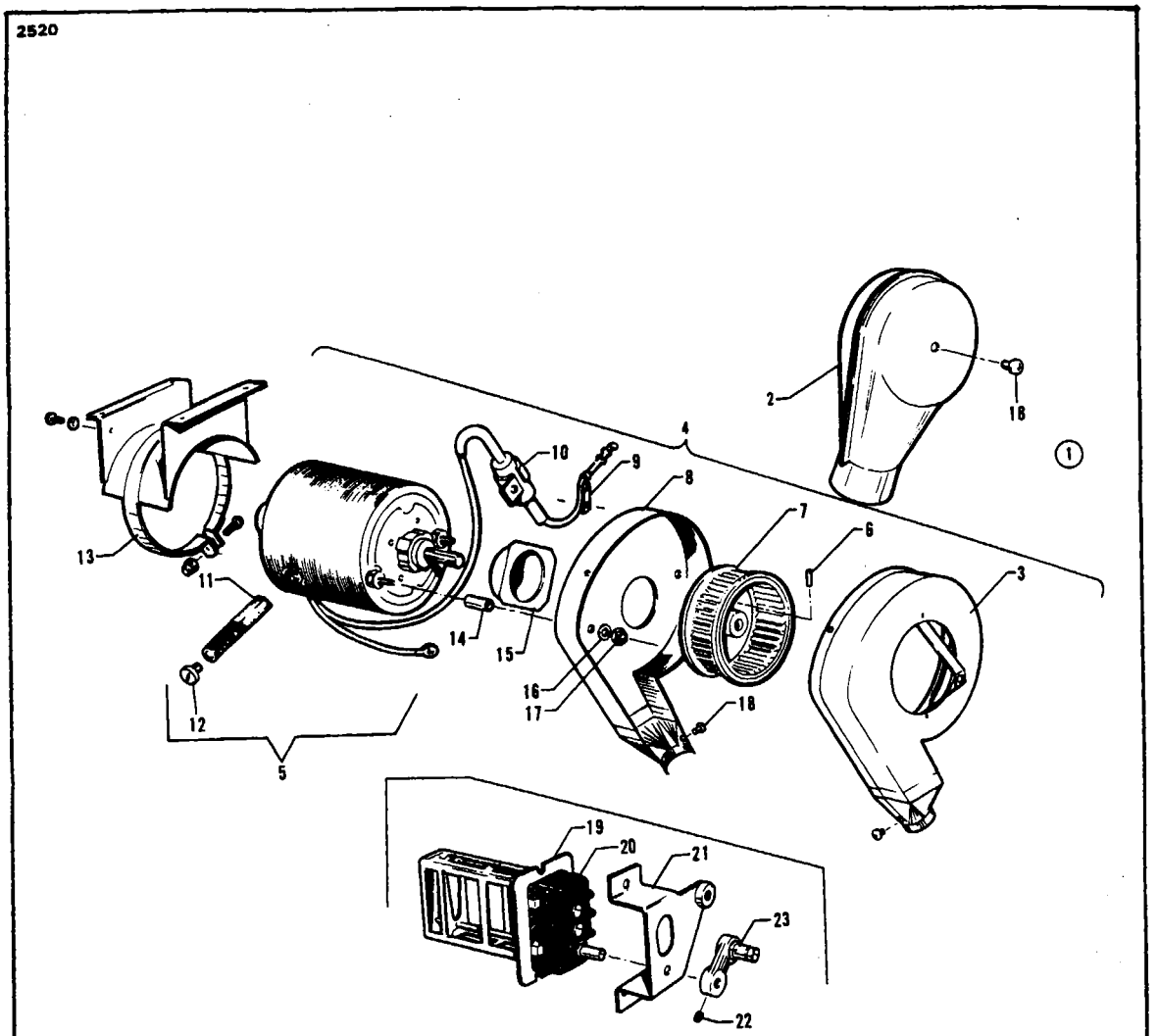



Figure 13-47. Exploded View of Heater Assembly No. 755 257 (28-Volt)

## CALLOUTS FOR FIGURE 13-47

1. HEATER ASSEMBLY
2. IGNITION ASSEMBLY
3. VIBRATOR - IGNITION
4. COIL IGNITION
5. JACKET ASSEMBLY
6. HEAD ASSEMBLY - COMBUSTION
7. TUBE ASSEMBLY - COMBUSTION
8. FUEL FEED AND NOZZLE HOLDER ASSEMBLY
9. BOX ASSEMBLY FUEL SHROUD, LOWER
10. BOX ASSEMBLY FUEL SHROUD, UPPER
11. BLOWER ASSEMBLY - VENT AIR
12. HOUSING - BLOWER
13. MOTOR ASSEMBLY - VENT AIR BLOWER
14. CAP BRUSH ASSEMBLY
15. BRUSH ASSEMBLY - MOTOR
16. GROMMET
17. FAN VENT BLOWER
18. CAPACITOR
19. BRACKET ASSEMBLY - MOTOR
20. FASTENER
21. NOZZLE - FUEL
22. SOLENOID ASSEMBLY - FUEL
23. ADAPTER
24. SWITCH - CYCLING
25. SWITCH - LIMIT
26. SWITCH PRESSURE
27. GASKET LIMIT
28. GASKET
29. GASKET
30. GASKET
31. GASKET ASBESTOS
32. SPARK PLUG
33. ELBOW
34. ELBOW
35. STRIP - TERMINAL
36. INSULATOR - TERMINAL STRIP
37. NIPPLE
38. NUT
39. GROMMET
40. GROMMET
41. WASHER
42. SCREWS
43. FASTENERS
44. BRACKET - GROUND
45. GROMMET
46. GROMMET




1. COMBUSTION AIR BLOWER AND MOTOR ASSY.
2. ADAPTER ASSY. - BLOWER INLET
3. HOUSING BLOWER OUTER HALF
4. COMBUSTION AIR BLOWER AND MOTOR
5. MOTOR ASSY. COMBUSTION AIR BLOWER
6. SET SCREW BLOWER FAN
7. FAN COMBUSTION AIR BLOWER
8. HOUSING - BLOWER INNER HALF
9. STRAP - CABLE
10. CAPACITOR
11. BRUSH ASSEMBLY
12. CAP BRUSH ASSEMBLY
13. MOUNT COMBUSTION AIR BLOWER SUPPORT
14. SPACER
15. SPACER
16. WASHER
17. LOCKNUT - AN345-10
18. SCREWS
19. SPACER
20. SWITCH - ADJUSTABLE DUCT
21. COVER - SWITCH
22. SCREW - AN565-D8-H3
23. LEVER ASSEMBLY SWITCH

Figure 13-48. Exploded View of Combustion Air Blower and Motor Assembly No. 758 304

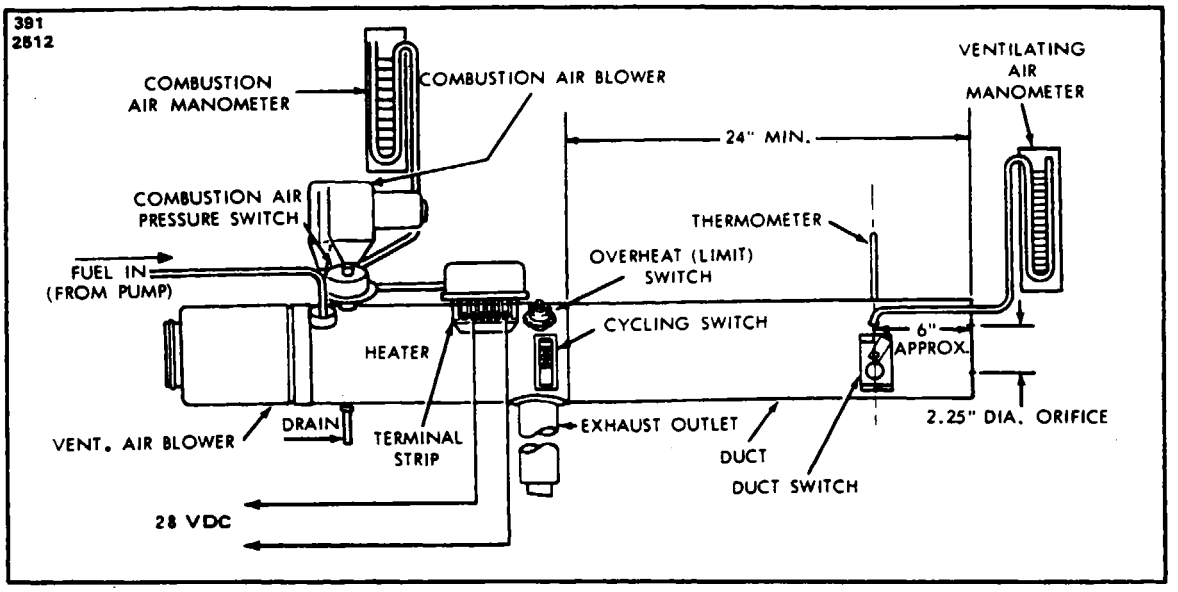



Figure 13-49. Suggested Setup for Heater Operation Test

13-177. TEST PROCEDURE.

13-178. GENERAL INFORMATION. A test of all components should have been made after overhaul to insure proper operation. Some shops may not have complete testing facilities for measuring airflows, pressure drops and other factors which would be accomplished in a laboratory-type test. If such a test cannot be made, install the heater and check operation on the ground and in the air to determine if operation is normal. In shops where complete test equipment is available and a complete functional test can be performed, the test routine described in subsequent paragraphs should be made.

13-179. EQUIPMENT REQUIRED. (Refer to Figure 13-49.)

a. An improvised stand to hold the heater during test. The heater should be located far enough away from any combustible material or atmosphere to avoid hazard. A location should be chosen where exhaust can be dispelled. Do not add an excessive extension to the heater exhaust.

b. A source of fuel capable of being regulated at seven psi.

c. The combustion air blower to be used with the heater should be used for the test.

d. A 28-volt DC power supply. A rheostat connected in series with the supply to adjust the voltage and current. An ammeter connected in series with the supply to monitor the current. A voltmeter connected in parallel with the supply to monitor the voltage.

e. Two water manometers (zero to 5.0 inch water column) for measuring the pressure in the ventilating air duct and in the combustion air stream.

f. A piece of duct to be attached to the downstream end of the heater. It should have a minimum length of 24 inches and the same diameter as the heater being tested. A 2.25 inch diameter orifice should be centrally located at the outlet end. An aperature should be provided for the thermometer and duct switch and a static tap should be attached as shown in Figure 13-49.

g. A thermometer with 500° F scale.

h. A fuel-pressure gauge.

i. A controlled source of compressed air for final leakage test.

13-180. OPERATIONAL TEST. (Refer to Figures 13-49 and 13-50.)

a. Connect the heater to the test setup as shown in Figure 13-49. Make sure the combustion air blower is mounted securely and that the heater is clamped to its supporting stand.

b. Insert the duct switch in the sheet metal extension tube at the location shown in Figure 13-49.

c. Connect components and heater as outlined in the wiring connection diagram, Figure 13-50. The power supply switch should be open.

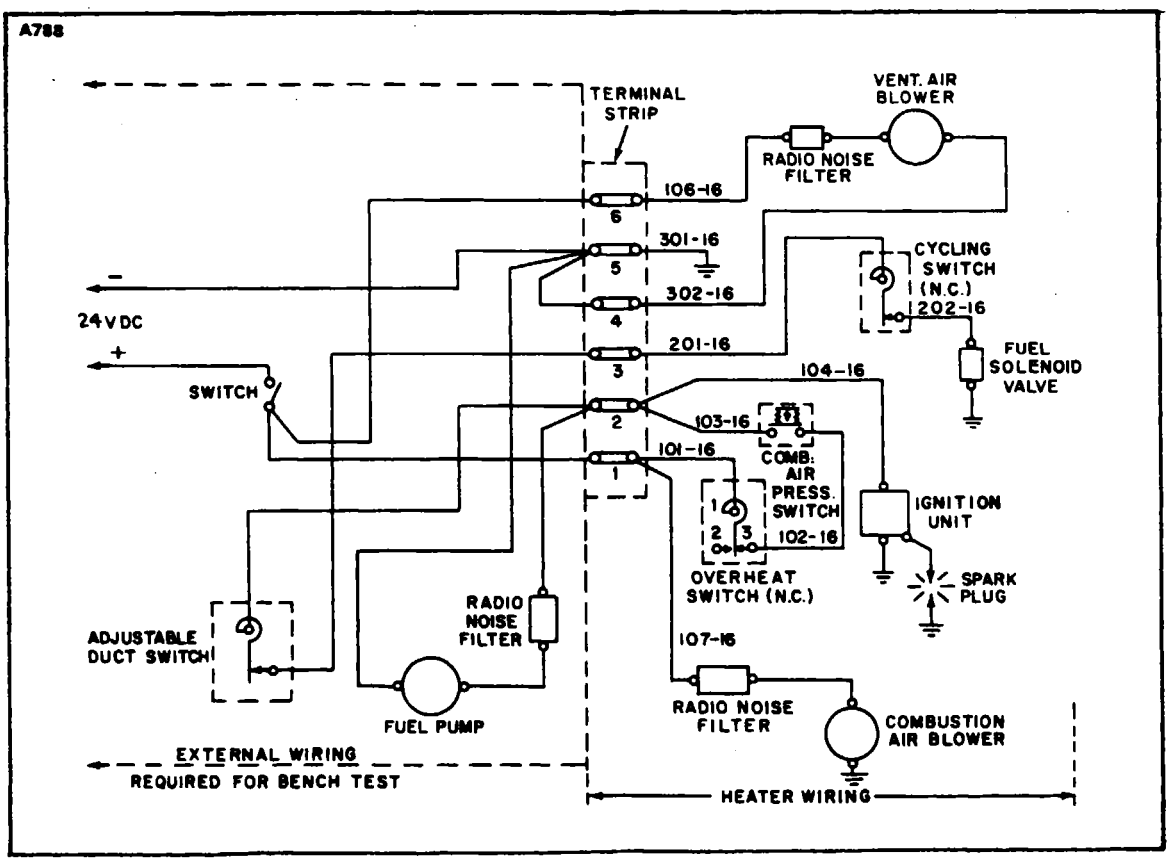



Figure 13-50. Wiring Connections for Heater Operation Test

d. Connect the power source to the heater.

e. Disconnect wire lead from terminal "3" on the heater side of the heater terminal strip to prevent the heater from lighting and close the power source switch to check operation of blowers. The combustion air blower and ventilating air blower should operate at full speed with no blower wheel interference. If either blower fails to run, locate and correct the trouble before proceeding with the test.

f. Connect a voltmeter from open side of combustion air pressure switch terminal to ground to determine if the switch is closed, which would be indicated by a full voltage reading on the meter. If a full voltage reading is not obtained, the combustion air supply is either inadequate or the switch is defective or improperly adjusted. Make necessary corrections.

g. Observe the manometer connected to the ventilating air pressure tap, which should show a reading of 1.1 inches of water (minimum) at rated voltage.

h. Observe the manometer connected to the combustion air tube tap, which should show a reading of 1.5 inches of water (minimum) at rated voltage.

i. Open the power supply switch and reconnect the terminal lead disconnected in preceding step e.

j. Close the power supply switch and turn on the fuel supply. The heater should light within five seconds (may require slightly longer for air to be purged from fuel lines on the first trial).

k. Observe operation of duct switch which should control heater operation according to the switch setting.

l. If the duct switch fails to control the temperature according to the setting, place the control lever in high "H" position and notice the control variation. A high reading of 250° F $\pm$ 10° F should be obtained (reading will vary in different applications).

m. Connect a jumper across the terminals of the duct switch to make it inoperative and observe action of the cycling switch. The cycling switch should cycle to control the outlet air temperature at approximately 250° F (nominal). This is a function of ambient temperature and airflow conditions. If operation is within a range of 190° F to 290° F, the switch is operating normally. If the switch is out of range it can be reset in the same manner as described for the duct switch, except that no control lever or indicator stop are used. If adjustment fails to restore proper temperature range, replace the switch.

n. With duct switch still jumped, place a jumper across the cycling switch terminals to check operation of the overheat switch. Block the ventilating air outlet and notice if the overheat switch shuts off the heater. It should open at between 300° F and 400° F. (This is also a function of ambient temperature and airflow). After the switch shuts off, remove ventilating air restriction; remove jumpers from cycling and duct switches and press firmly on the overheat switch reset button until it "clicks." The heater should light and operate.

o. Shut down the heater and check all components visually to make sure no damage has occurred to any of them.

p. Remove heater and other components from the test setup and install it in the airplane.