SECTION 16
HEATING AND AIR CONDITIONING

MC-9 MAINTENANCE MANUAL

HEATING AND AIR CONDITIONING

HEATING SYSTEM

The coach is provided with a hot water forced-air heating system which uses the engine cooling medium for heating the interior of the vehicle and windshield defrosting. Two heating radiator cores are provided, one for the main interior heating system and one for the driver's heater and defroster.

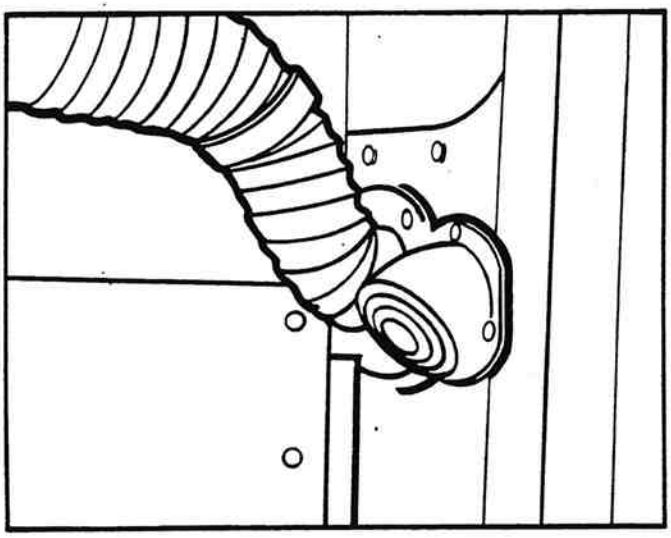
Heating in the stepwell area is provided by the introduction of heated air from the main right hand passenger heating duct into the stepwell. The heat enters the stepwell through louvers at the rear of the stepwell.

A complete air conditioning system is installed as standard equipment. The same duct system is used for both air conditioning and heating.

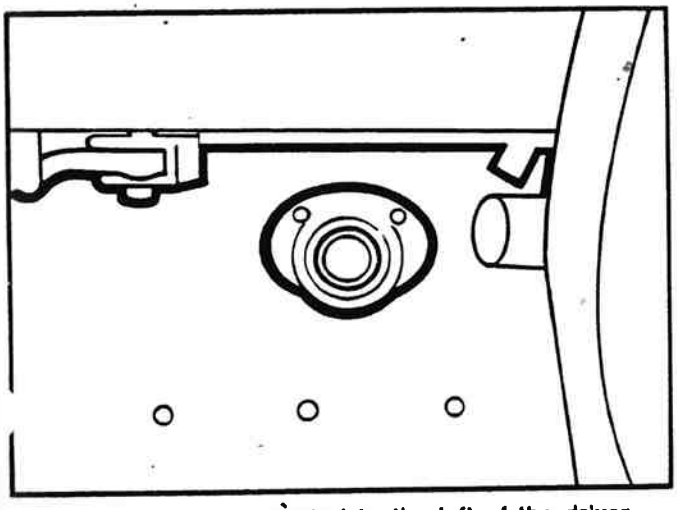
An optional auxiliary air conditioning evaporator and blower unit is mounted at the extreme rear of the left hand side parcel rack. This unit operates in conjunction with the main coach air conditioning system and is controlled by its own coach temperature sensing unit. This auxiliary air conditioner can be used with either Freon 12 or with Freon 500. The purpose of this unit is to provide additional cooling at the rear of the passenger compartment.

Flow of hot water to the main heater core is controlled by an electric water valve. A manually-operated water valve controls the flow to the driver's heater core. In the engine compartment, manually-operated shut-off valves are provided to isolate the heating system in the event of system failure or when the cooling system is to be drained.

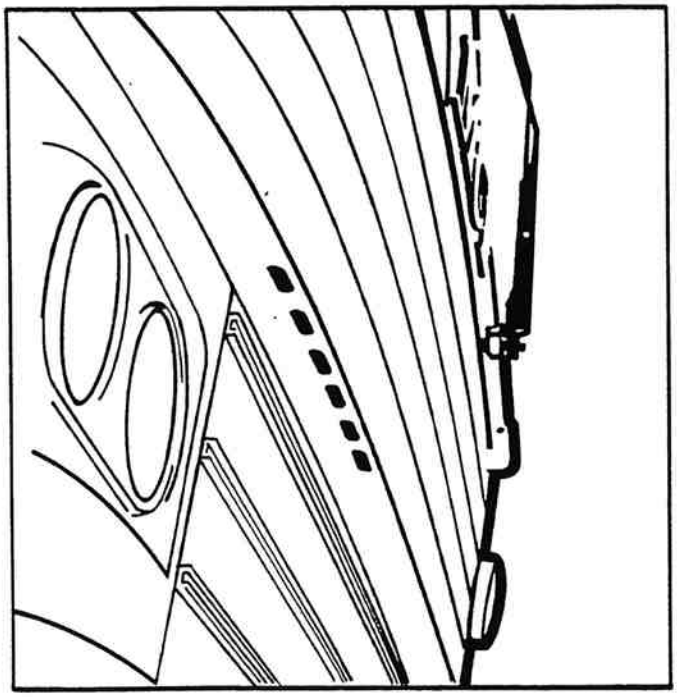
A temperature sensing unit is located in the front L.H. baggage compartment at the center control duct and through relays, controls the main heater water valve within limits selected by means of the heat control dial on the driver's switch panel.



Driver's heater or air conditioning Gasper located to the right of the driver under the dash.

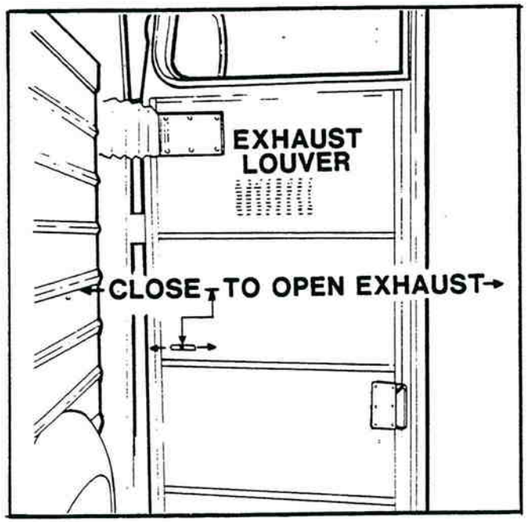


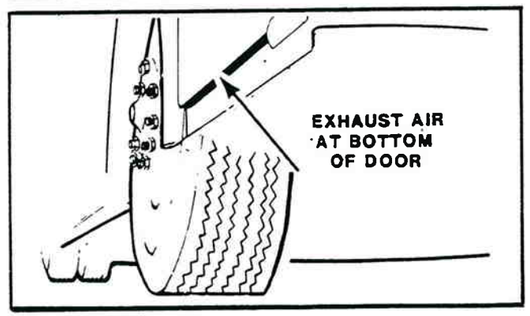
Driver's fresh air located to the left of the driver under the dash.



Fresh air intake above Tire Compartment

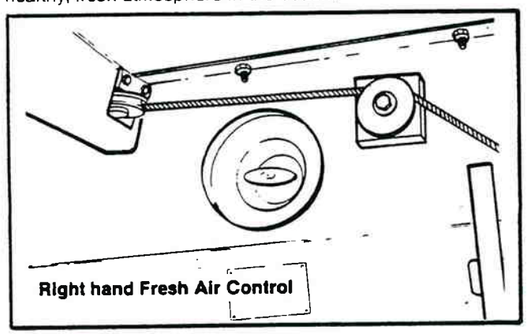
MC-9 MAINTENANCE MANUAL



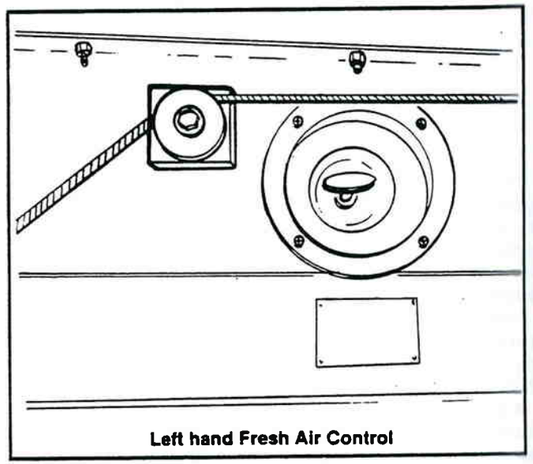


FRESH AIR VENTILATION

Some MC-9 coaches are equipped with controls to regulate the percentage of outside air being drawn into the coach and mixed with recirculated air. The controls should normally be in the closed position. Even in this position approximately 20% of the conditioned air is fresh outside air. This provides a healthy, fresh atmosphere in the coach.



Right hand Fresh Air Control



Left hand Fresh Air Control

At intervals depending entirely on service conditions, the A/C air filter should be removed and washed. To reach the filter, open the battery compartment door, unlatch locks and pull out. The filter is provided with a grab handle for removal.

When the cooling system is drained and flushed (Refer to Section 6, Cooling), the heating water system should be similarly serviced.

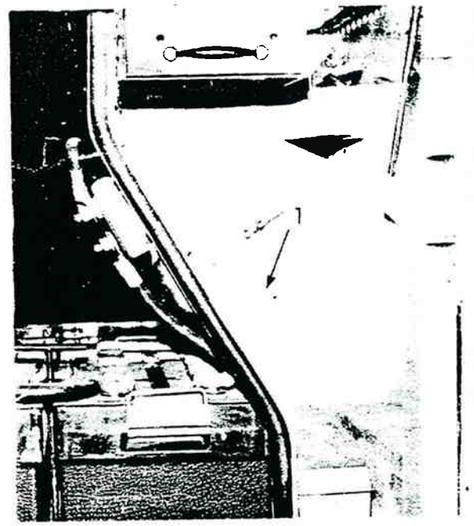


Figure 16-1. A/C Filter

DRAINING AND REFILLING

Refer to Section 6 (Cooling) for instructions on draining and refilling the engine cooling and coach heating system.

MC-9 MAINTENANCE MANUAL

If the heating system is to be drained without draining the engine cooling system, close gate valves in engine compartment and drain radiator cores. A manual vent plug is provided in the top of the main heater core and at the top of the driver's heater core for bleeding air while refilling. The vent plugs allow air to enter during draining.

OPERATION

Controls for coach heating system are located at the driver's switch panel. The temperature control selects the temperature range desired and the system automatically maintains the pre-set limits. Blower motors for coach heating, driver's heater and defroster are controlled by switches on the driver's switch panel.

MAIN HEATER WATER VALVE
(ELECTRICALLY ACTUATED)

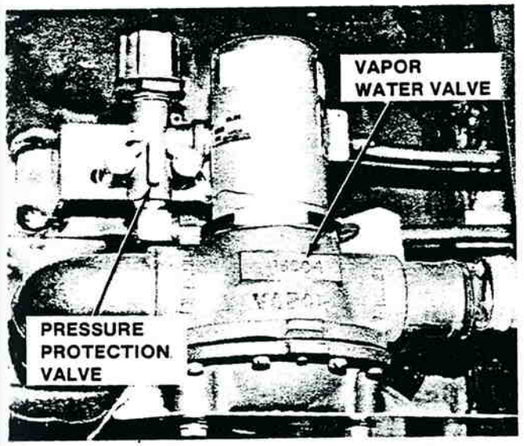


Figure 16-2A. Electrically Actuated Main Heater Water Valve Used Prior To Unit 39263.

Prior to unit 41089, the flow of hot water to the main heater core is controlled by an electric water valve mounted in the right front baggage compartment.

Valves from two different manufacturers are present on the coaches built prior to unit 41089. One make was used prior to unit 39263 and another was used from unit 39263 through unit 41088. These two valves are interchangeable as complete assemblies. Refer to TMC/MCI Service Bulletin No. 2224 for information on replacing the earlier valve with the later vaive.

NOTE: The following information applies specifically to the earlier valve but is generally applicable to the later one.

The valve is designed so that the pilot valve within the assembly opens and closes a port which directs pressure to either the top or bottom of the valve diaphragm, thus opening or closing the valve.

A delay action is built into the water valve through the means of an orifice in the valve body and a modulating cup on the diaphragm assembly. When the coach is operating with no current to the water valve solenoid, inlet water pressure is directed to the upper side of the diaphragm, thus forcing it open.

The pilot valve is normally open, relieving any build-up of pressure under the diaphragm. When the solenoid is energized the pilot valve closes, water pressure builds up through the orifice to the underside of the diaphragm and keeps the valve in closed position.

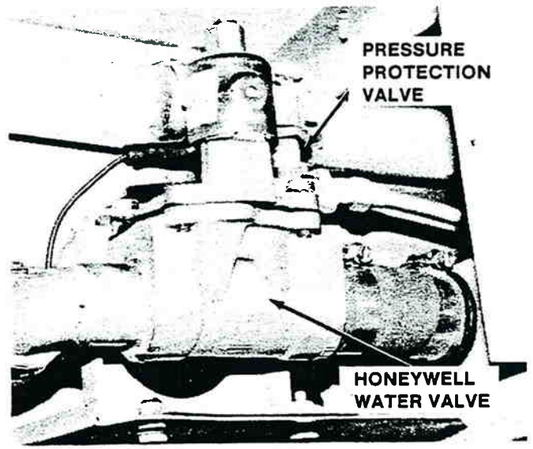


Figure 16-2B. Electrically Actuated Main Heater Water Valve Used On Units 39263 Through 41088.

MAINTENANCE

The main heater water valve requires a minimum amount of maintenance. The valve should be free of any sediment or dirt which might interfere with its operation. The diaphragm (8) (figure 16-2C) should be replaced every year before the heating season begins. No other maintenance is needed unless a malfunction occurs.

OVERHAUL

In the event of a malfunction, remove the water valve from the system.

CAUTION: Do not allow any liquid to reach the solenoid coil. After removing the valve from the system, carefully drain the remaining liquid from the inlet and outlet openings.

DISASSEMBLY

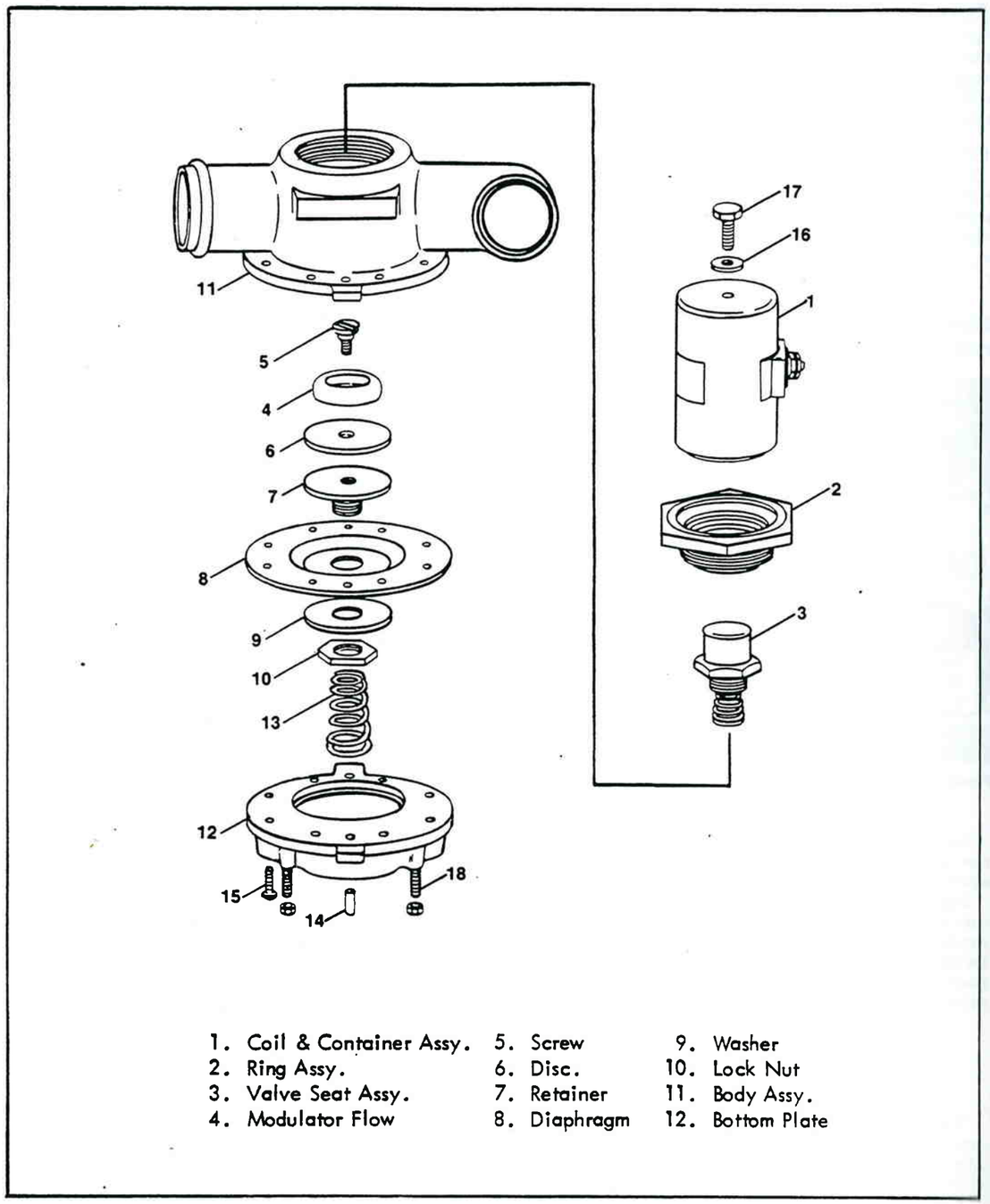
Refer to figure 16-2C.

Remove the terminal nuts, lockwashers, and washers from the valve.

Remove the screw (17) and lockwasher (16) from the coil and container assembly (1).

Remove the valve seat assembly (3) from the coil and container assembly (1) by turning it counterclockwise with a wrench.

MC-9 MAINTENANCE MANUAL



1. Coil & Container Assy.
2. Ring Assy.
3. Valve Seat Assy.
4. Modulator Flow
5. Screw
6. Disc.
7. Retainer
8. Diaphragm
9. Washer
10. Lock Nut
11. Body Assy.
12. Bottom Plate

Figure 16-2C. Main Heater Water Valve Disassembled.

MC-9 MAINTENANCE MANUAL

NOTE: The valve should be held secure in a padded vise for disassembly.

The valve seat assembly (3) must be replaced in its entirety if it is damaged or worn.

Remove the eight No. 10-24 fillister head machine screws (15) used to secure the lower valve body (12) to the upper valve body (11). Carefully separate the two portions by using a screwdriver at the two pry-lugs on either side of the valve. The dowel pin (14) will remain in the upper valve body.

The diaphragm valve disc assembly is now removed and the diaphragm replaced. This is done by removing the locknut (10) and the diaphragm washer (9). If difficulty is experienced in removing the locknut, carefully hold the assembly in a vise between two strips of soft wood.

CAUTION: Do not tighten vise so as to damage or bend the disc assembly.

The locknut (10) should be torqued to 25-30 inch pounds (2.8-3.3 Nm) and the valve disc screw (15) is torqued to 12-15 inch pounds (1.3-1.6 Nm).

CLEANING AND INSPECTION

Before reassembling the valve, make sure that all parts are clean and in good condition. Thoroughly clean the serrations in ıe upper and lower valve bodies.

If the valve seat assembly is defective or leaks more than six drops per minute at 10 psi (69 kPa) when the coil is energized, it should be replaced.

REASSEMBLY

Position the diaphragm disc assembly on the upper valve body (11) so that the holes in the diaphragm align with the dowel pin (14) as well as with the pilot-channel hole and the valve body mounting holes. Set the conical spring (13) on the locknut (10). Carefully place the lower valve body (12) on the diaphragm disc assembly, engaging the dowel pin (14) with the hole opposite. Secure the eight No. 10-24 fillister head machine screws (15). Tighten the screws evenly around the valve body to 15 in. lbs. (1.6 Nm). Insert the valve seat assembly into the upper valve body (11) and tighten.

Screw the flux ring assembly (2) into the valve body.

Seat the cover assembly firmly on the flux ring assembly and tighten.

TESTING VALVE AFTER SERVICING

After servicing, the valve should be tested using water at approximately 170°F ± 10° (77°C ± 6°) and DC voltage at 24 VDC.

Apply water at 25 psi (172 kPa) to valve inlet and outlet; check for external leakage.

Reduce pressure to 10 psi (69 kPa) and open valve outlet. `heck operation of valve by cycling valve several times.

Check internal leakage (through seat and needle valve) with 10 psi (69 kPa) at valve inlet and solenoid energized. Maximum allowable leakage is six drops per minute through the needle valve and zero leakage through the disc seat.

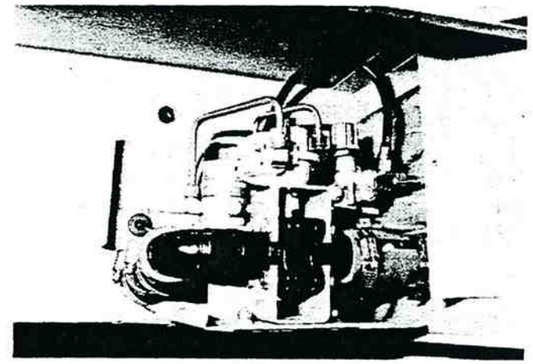


Figure 16-3. Air Operated Water Valve Installed (Effective With Unit 41089).

An air operated type of main heater water valve is used effective with unit 41089 (figure 16-3).

The bonnet of the valve contains a vane which is connected to a ball in the valve body. The valve is double acting; air is applied to both open and close the valve. The side of the vane to which air pressure is applied is controlled by a separate solenoid valve mounted on the same bracket as the water valve. The solenoid is activated by signals from the coach temperature control system which is described later in this section.

The air operated valve does not require any particular servicing; however, if for any reason the valve is disassembled, care must be taken in its reassembly so that the ball is oriented in the correct position in the valve body with respect to the direction of air flow against the vane. If this is not done, any signal to the solenoid valve from the temperature control system will result in the ball in the valve moving in the opposite direction to what is desired, with a consequent effect on the water flow.

DRIVER'S HEATER WATER VALVE

DESCRIPTION

The driver's heater control valve is manually operated. It is located at the left-hand side of driver in heater duct panel at floor.

Note: Before removal of shut-off valve it is necessary to close valve in engine compartment. This prevents extensive water drainage from coolant system.

REMOVAL

1. Remove the valve control handle from the inside of the coach.
2. Open the exterior service door under the driver's window.
3. Disconnect the heater hose clamps at front and rear of valve assembly.

Slide hoses away from valve assembly. Remove the two hex nuts and screws which mount valve assembly Remove complete valve assembly.

MC-9 MAINTENANCE MANUAL

DISASSEMBLY

1. Remove cotter pin from crank pin and slide yoke off.
2. Remove two hex nuts holding valve to mounting bracket.

REASSEMBLY

1. Mount new valve to bracket fastening with same screws and hex nuts removed during disassembly.
2. Install yoke to valve crank pin using new cotter pin. Valve assembly, complete with mounting bracket, is now ready for installation.
3. Mount the valve assembly with two hex nuts and screws.
4. Slide front and rear hoses over inlet and outlet of valve assembly and fasten clamps.
5. Install the valve control handle from the inside of the coach.

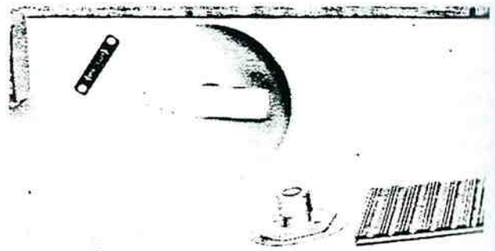
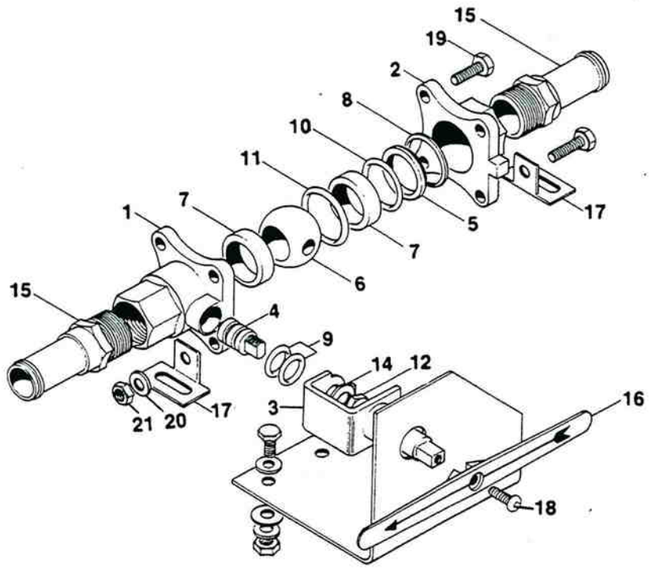


Figure 16-4. Driver's Heater Shut-of Valve.



1. BODY
2. CAP
3. STEM S/A
4. STEM
5. DISC
6. BALL
7. SEAT
8. SPRING
9. 'O' RING-STEM SEAL
10. 'O' RING-SEAT SEAL
11. 'O' RING-JOINT SEAL
12. JAM NUT
13. HEX. MACH. SCREW-¼-20 x ⅝
14. INTERNAL TOOTH LOCKWASHER
15. EXTENSION S/A
16. HANDLE
17. VALVE MTG. ANGLE
18. SCREW-#10-24
19. SCREW-¼-20 x 1
20. LOCKWASHER-¼"
21. HEX. HD. NUT-¼"

Figure 16-4A. Driver's Heater Shut-of Valve Disassembled.

MC-9 MAINTENANCE MANUAL

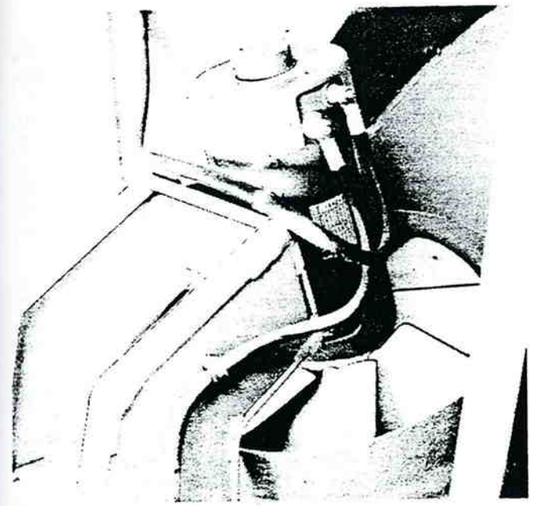


Figure 16-5: Axial Fan and Motor in Condenser Compt.

BLOWER MOTORS

All blower motors are 24 volt units of conventional design. Defective motors may be repaired according to standard procedures.

CAUTION: Do not use emery cloth or sandpaper for seating brushes or cleaning commutators. Motor brushes should be checked at regular intervals. New brushes should be seated using a bedding stone.

The blower motor for the central heat compartment is a 1½ h.p. unit (1.1 KW). The motor for the axial fan is a 2 h.p. unit (1.4 KW).

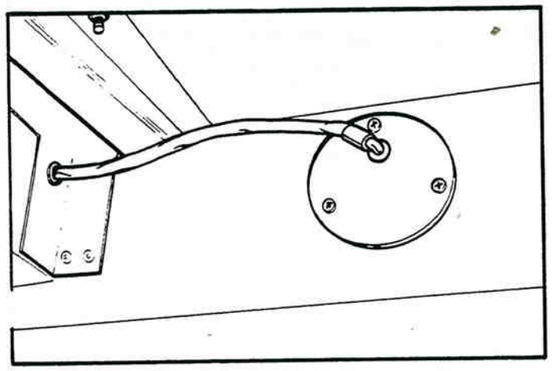


Figure 16-6: Sensing Unit installed at Center Control Duct

TEMPERATURE

The temperature control is a rheostat unit which increases the resistance in the thermostat sensing element, causing cycling at higher or lower temperatures (68°-78°F; 20°-26°C).

This unit is installed at the driver's switch panel and provides a means of selecting a temperature range which is then automatically maintained by the action of the thermostat and water valves.

Wiring connections to the heating system thermostat are shown in the wiring diagram included in Section 7 (Electrical) of this manual.

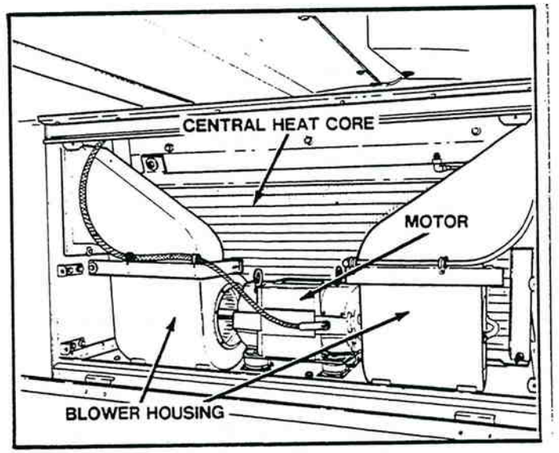


Figure 16-7: C/H Motor and Related Components

A/C & HEATER SWITCH

The A/C-Heating switch is fed from blower cut-in relay when generator is charging.

The selector switch in heat position "A" operates the central heating coach blower at low speed; in A/C position "B", it operates the following:

1) Coach blower operates at high speed.
2) Condenser motor is energized.
3) Compressor unloading solenoid and scavenge solenoid are energized.
4) Condenser blower operates.

AIR CONDITIONING SYSTEM

The air conditioning system is designed to provide a comfortable, healthful atmosphere within the coach. A schematic diagram of the air-conditioning system is illustrated in figure 16-8.

A mixture of cooled, filtered, dehumidified fresh and recirculated air is supplied through wall ducts located below the side windows. The combination of outside and recirculated air is continually filtered, resulting in a clean, fresh atmosphere.

MC-9 MAINTENANCE MANUAL

The air is drawn from the coach interior through center aisle ducts. It is filtered, cooled and dehumidified by an evaporator coil, then passed through a temperature-controlled heat core. Two blower fans send the air conditioned air up into the wall ducts.

The system is designed to provide a nominal 7½ tons main A/C and 1 ton driver's A/C of refrigeration or 90,000 Btu per hour (22,700 kcal/h) heat removal.

AIR CONDITIONING CYCLE

Refrigeration may be defined as "the transfer of heat from a place where it is not wanted to a place where it is unobjectionable." The air conditioning system in the coach is the "closed" type system using Freon 12 refrigerant. The major components required for a closed circuit refrigeration system are the compressor, evaporator, condenser, receiver tank and a liquid metering or expansion valve. The following is an explanation of the air conditioning cycle:

1. The refrigerant (Freon gas) flows to the compressor, is compressed to high pressure, and reaches a temperature higher than the surrounding air. It is passed through the air-cooled fins and tubes of the condenser coil causing the hot, high pressure gas to be condensed into a liquid form.
2. The liquid refrigerant flows to the receiver tank, then through a filter-dryer where all moisture, acids and dirt are removed.
3. By its own pressure, the liquid refrigerant flows through a thermostat controlled expansion valve where reduced pressure causes it to become a low temperature, low pressure liquid.
4. The cold, low pressure refrigerant passes through the evaporator coil, absorbs heat from the air passing over the fins and tubes, and changes into gas. In this form, the refrigerant is drawn into the compressor to repeat the air conditioning cycle.

Proper operation of the air conditioning system depends on retaining the conditioned air within the coach. All windows and intake vents should be closed. An opening approximately eight inches square (203.2 mm) could easily neutralize the total capacity of the system.

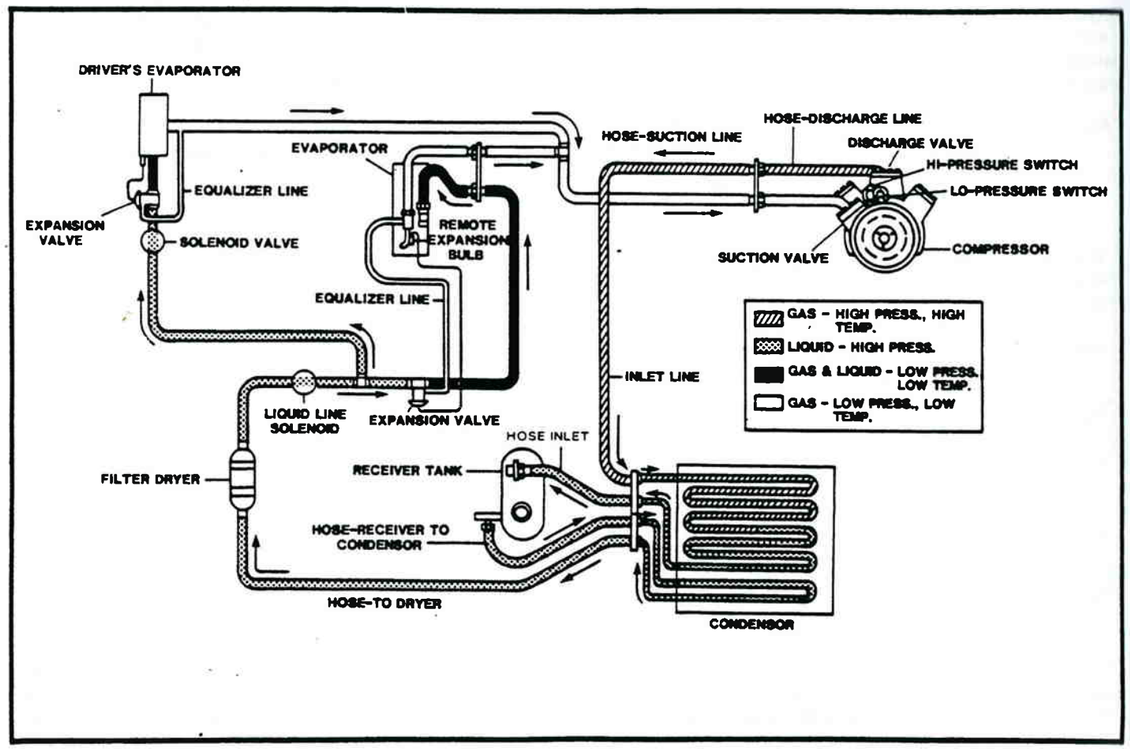


Figure 16-8: Air Conditioning System Diagram

MC-9 MAINTENANCE MANUAL

Another cause of inadequate cooling is a dirt-clogged evaporator coil or filter. Dirt acts as insulation and is also a restriction to air flow.

The refrigeration load is not constant and is affected by outside temperature, relative humidity, passenger load, the number of stops, etc. The compressor will load or unload depending on such operating conditions. The following information on the operating conditions is approximate and will vary:

Oil Level in compressor ..... ½ of sight glass
Freon Level in receiver ..... ½ of lower glass
Speed of engine - fast idle ..... 900 rpm

MANUAL SWITCH CONTROLS

Temperature Rheostat - Located on panel to the left of the driver, it controls the air temperature in the coach during both heating and air conditioning.

Passenger A/C Coach Heat - Located on the switch panel to the left of the driver. In "A/C" position, the air conditioning system is energized and functions as required. In the "Off" position, the condenser and evaporator fans are shut off. In the "heating" position, the evaporator fans are at operating speed and the air conditioning compressor is unloaded.

FAST IDLE

The fast engine idle can only be used to power the air conditioning system when the coach is stationary and the emergency parking brakes are applied. The feature consists of a fast idle switch on the driver's switch panel, an air valve in the engine compartment and an air cylinder mounted on the engine governor.

Placing the Fast Idle switch ON energizes the air valve which lets air pressure to the air cylinder, causing the governor-operating lever to be moved to the fast idle position. To eliminate the possibility of engine damage, the accelerator cannot be operated when the fast idle switch is closed.

DAILY CHECKS

1. Check oil level in compressor.
   CAUTION: It is essential that only the correct lubricant be used, such as Texaco WF 68, WFI 132, or equivalent.
2. Check Freon level in receiver.
3. Check and clean condenser coil. Do not use caustic soap.
4. Check and clean filter.
5. Check compressor and belts.

TEST EQUIPMENT

Specific air conditioning test equipment is recommended for routine servicing of the air conditioning system. It includes the following:

Qty.	Part No.	Description
1	16C-2-92	Air Conditioning Test Equipment Kit
1	16C-2-93	Halide Leak Detector (Bernz-o-Matic Model TX-12)
1	16C-2-94	Freon 12, 35 lb. tank (15.9 kg)
3	16C-2-95	Charging Hoses - (Yellow Jacket Hoses) (HCL-36)
1	16C-2-96	Pressure Gauge 0-400 lbs. with R 12 Temperature Scales
1	16C-2-97	Compound Gauge 0-30" Vac. 0-150 lbs. with R 12 Temperature Scales
1	16C-2-98	Gauge Manifold with handwheels
1	16C-2-99	Thermometer - (Mechanical) to check Superheat 10° to +100°F

The above parts are available from Universal Coach Parts Inc., Northlake, Illinois and in Canada from Motor Coach Industries, Service Parts Division.

A/C SYSTEM MAINTENANCE PROCEDURES

AIR CONDITIONING SYSTEM SOLENOID VALVE

When the Passenger A/C-Heat control is switched on, the system solenoid valve is actuated and allows refrigerant to circulate within the air conditioning system. Turning the switch off will close the valve. This valve is located in the condenser compartment.

The valve can be opened or closed manually in case the solenoid's electric operation of driver's switch operation is suspect. Removal of a seal cap on the valve will expose a 3/16" square stem. To manually open the valve, place a wrench on the stem and turn it 180 degrees (½ turn) counterclockwise.

CAUTION: Turn only 180° counterclockwise. Do not backseat.

To manually close the valve, turn the stem ½ turn clockwise until the stem is tight (seated).

NOTE: The manual stem must be in the closed position before automatic solenoid operation will take place.

PUMPING DOWN

Whenever it is necessary to "open" the refrigeration system for service or repairs, the refrigerant must be removed from that part of the system requiring service. Localizing refrigerant into one part of the system (usually the receiver) is known as "pumping down." The procedure is as follows:

1. Close the outlet valve on the receiver, backseat the suction valve, install a gauge and turn the valve forward ¼ turn, thus enabling visual check of the suction pressure.
2. Connect a jumper wire between horizontal studs 1 and 2 in remote control box

NOTE: This jumper will allow the compressor clutch to remain engaged after pressure drops below 15 psi (103.5 kPa).

3. Start the engine and operate the compressor until pressure reads 1-2 psi (6.9-13.8 kPa), then disconnect the jumper wire.
4. The pressure will probably rise. Install jumper wire again and lower the pressure until it remains at 1 or 2 psi (6.9-13.8 kPa). Close inlet valve to receiver tank. Stop compressor.