# SECTION 4

## AIR SYSTEM AND BRAKES

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AIR SYSTEM AND BRAKES

AIR SYSTEM

The air system of the coach provides a means for braking, suspension, and for operating controls and accessories. This section covers brakes and air operated accessories. Details of the suspension system are covered in Section 12 of this manual. The air operating entrance door mechanism is covered in Section 3. The radiator shutter control system is covered under Section 6.

Included in this section is a schematic drawing of all air system components as well as a schematic drawing of the basic parking brake air system.

The basic air system consists of a compressor (which is belt driven and driven by the engine), air reservoirs, filters, and the necessary fittings and piping.

The brake system consists of brake chambers (one at each axle), brake application valve, quick release valve, relay valve, parking brake (push-pull) valve, reservoir, check valves and necessary fittings and connecting piping. See figure 6.4.

WARNING: To avoid personal injury when working on or around air systems and components, the following precautions should be observed:

1. Always block vehicle wheels. Stop engine when working under a vehicle. Venting vehicle air system pressure may cause vehicle to roll. Keep hands away from chamber push rods and shock adjusters: they may apply as system pressure drops.

2. Vent all air pressure from system.

3. Never connect or disconnect a hose or line containing air pressure. It may whip as air escapes. Never remove a component or pipe plug unless you are certain all system pressure has been vented.

4. Never exceed recommended air pressure and always wear safety glasses when working with air pressure. Never look into air jets or direct them toward anyone.

5. Never attempt to disassemble a component until you have read and understand recommended procedures. Some components contain powerful springs and injury can result if not properly disassembled. Use only proper tools and observe all precautions pertaining to use of those tools.

BRAKE OPERATION

The brakes used on the MC-9 coach incorporated both service and parking air operated brakes. Operation of the air operated parking brake is as follows. (Refer to figure 4-2 for schematic)

NORMAL RUNNING - With the handle of the push-pull valve pushed in, air pressure from the parking and emergency reservoir is delivered to the control port of the inversion valve and then to the lock port of the rear brake actuator. Air pressure acting on piston A moves it forward and contacts rollers B rolling them up ramp A-A. As long as air pressure remains in lock port area, rollers B are not in contact with shaft F and normal service brake applications will permit shaft F to move freely.

PARKING - To park, the handle of the push-pull valve is pulled out. This vents the control port of the inversion valve and the lock port of the rear brake actuator. Spring D then forces rollers B against collar G thereby engaging rollers B with shaft F. When the control port of the inversion valve is vented, piston H moves forward to contact exhaust valve J. This action opens passage between parking and emergency reservoir port L and parking diaphragm port K. The valve then delivers 85 psi (586 kPa) regulated emergency reservoir pressure to the parking diaphragm of the actuator.

LOSS OF AIR PRESSURE WHILE PARKED - If there is a reduction of air pressure while parked, the force output of the diaphragm is reduced. The push rod force, however, is transferred to the mechanical lock mechanism to keep the brake applied. In this position rollers B are now wedged between collar G and shaft F preventing the return of shaft F to a released position. Shaft F is now locked in the applied position.

EMERGENCY OPERATION - If air pressure should be lost from the service reservoirs, the emergency brakes may be applied by pulling out the handle of the push-pull valve. Air from the emergency reservoir which is protected by a single check valve applies the brakes as described under parking.

If air is lost from the emergency reservoir and the wet service reservoir, a normal stop can be made with the service brakes because the dry service reservoir is protected by a single check. If pressure is lost from the emergency reservoir at a relatively slow rate, a partial parking application will be made when the handle of the push-pull valve trips automatically at about 40 psi (276 kPa). The inversion valve will likewise automatically trip at about the same pressure and apply the parking brakes even though the push-pull valve does not trip.

If pressure drops during operation, four parking brake applications can still be made. Parking and emergency brakes will not apply automatically until parking reservoir pressure drops below 40 psi (276 kPa).
WARNING: Air pressure gauge on the dash does not show parking brake reservoir pressure; it shows dry tank pressure. If pressure drops below 70-75 psi (483-517 kPa) during operation, LOW AIR tell-tale will flash and a warning buzzer will sound. The coach should be stopped immediately and the cause of the air loss corrected before proceeding. A sudden automatic parking brake application will result if low air pressure warning signals are ignored during operation.

RELEASE OF PARKING BRAKE

A. WHEN EMERGENCY PRESSURE HAS NOT DROPPED MORE THAN 4 psi (27.6 kPa). After applying the parking brake, push in handgrip of push-pull valve. This applies reservoir pressure to lock port of the actuator thereby releasing the locking mechanism. At the same time, air pressure is also admitted to the control port of the inversion valve which causes air to be exhausted from the parking diaphragm thereby releasing the brakes.

B. WHEN EMERGENCY PRESSURE HAS DROPPED MORE THAN 4 psi (27.6 kPa). After applying the parking brake, push in handgrip of push-pull valve. This applies reservoir pressure to the locking port of the actuator which releases the locking mechanism. Reservoir pressure is simultaneously applied to the control port of the inversion valve which in turn causes air to be exhausted from the parking diaphragm. A heavy service brake application will then produce sufficient forward motion of the actuator piston rod to allow the locking mechanism to disengage. Releasing the service brake application will restore the system to normal running condition.

NOTE: If an inadvertent service brake application is made while the parking brakes are applied, the parking brakes will not release unless the handle of the push-pull valve is pushed in.

PUSH-PULL CONTROL VALVE

The push-pull control valve is used to control the flow of air to the parking ports of the rear brake chambers. It is mounted on the driver's console to the right of the driver's position. See figure 4-3.

In normal operation, the push-pull control valve knob is pushed down. To operate the parking and emergency brake, the plunger is pulled upward to the top position. The system then functions as outlined earlier in this section.

REMOVAL AND INSTALLATION

1. Block or hold vehicle by some means other than air brakes.
2. Vent air brake system. Disconnect the air lines from the control valve.
3. Drive out the spiral pin that holds the button on the control valve plunger. Remove button. (See figure 4-4.)
4. Remove the control valve mounting nut, then the control valve.

Before reinstalling, clean the air lines to the control valve and brake actuators. Installation is the reverse of removal.

Figure 4-3. Push-Pull Control Valve.

Figure 4-4. Push-Pull Control Valve Parts Breakdown.
DISASSEMBLY

WARNING: Pull rod bolt is under spring tension. To avoid possible injury, exercise care when removing pull rod bolt to slowly relieve spring tension.

1. Place the spring "cell" in a vise with pull rod bolt end up and the hex end of the rod held securely in the vise jaws. Slowly and cautiously remove the pull rod bolt. This will release the spring load as the bolt is removed.
2. Remove the springs. Remove the pull rod bolt from the piston.
3. Remove the seal grommet from the pull rod bolt. Remove cover from the pull rod.
4. Take pull rod out of vise.

NOTE: The spiral pin, button, and mounting nut are removed at the time the valve is removed from the valve body. Insert a punch or rod in the spiral pin hole to keep the spiral pin from turning when removing the nut at the bottom of the valve.

5. Remove the plunger and spring. Remove plunger O-ring.
6. Remove the two cover screws and separate the cover from the body. Remove the cover seal O-ring and the inlet and exhaust valve.
7. Remove the piston, the lower large piston O-ring, and the upper piston O-ring.

REPAIR
1. Wash all metal parts in cleaning solvent and dry. Wipe reusable rubber parts clean.
2. Inspect all parts for excessive wear or deterioration.
3. Inspect the plunger and piston bores of the control valve for nicks and burrs. Check spring for cracks, distortion, or corrosion.
4. Inspect the inlet and exhaust valve and grommets for wear or deterioration.
5. Replace all parts not considered serviceable during these inspections, especially rubber parts.

REASSEMBLY
Prior to assembling, lubricate all O-rings and bearing surfaces of the body and cover with recommended lubricant, MOI-TMC Part No. 21-7512-11.
1. Install O-ring on plunger. Place spring on plunger.
2. Insert plunger, with spring and grommet installed, in body.
3. Install inlet and exhaust valve over protruding end of the plunger. The double beaded side of the inlet and exhaust valve should be up against the body seat.
4. Position cover to body seal in body. Attach the cover to the body with two screws.
5. Install the piston O-ring (large diameter O-ring in bottom piston groove). Install the piston with O-ring.
6. Depress the plunger, and with a punch or rod hold it from turning while installing the plunger stem nut. Torque on the stem nut should be between 30-40 inch pounds (3.3-4.5 Nm).
7. The control button should be installed and held in place by the spiral pin after the valve is mounted on the vehicle floor and held by the mounting nut.

INVERSION VALVE
When the control valve is operated, the inversion valve operates permitting air in the isolated reservoir to apply the brakes. The inversion valve also operates automatically when air pressure drops to a predetermined pressure.

With no system air pressure, the inversion valve inlet valve is open and its exhaust is closed. See figure 4-5. On initial build-up, as air enters the isolated reservoir to which the inversion valve supply device is connected, it will pass by the open inlet and out the delivery ports. When the system pressure reaches 50-60 psi (345-414 kPa) the control valve outlet is opened. Air will then pass into the inversion valve from the control valve. The air flows in one control port and exerts a force on the inversion valve piston. At a pressure of 60-70 psi (414-484 kPa), the piston moves against the resistance of the two piston springs. The piston exhaust seal moves away from the inlet and exhaust valve, opening the exhaust passage. The inlet valve spring and supply air at the inlet valve will cause it to seat. Air will then exhaust from the exhaust port.

The inversion valve is mounted on a bracket which is attached to the drive axle at the radius rod mounting bracket.

Figure 4-5, TR-2 Inversion Valve Installed

Field and hold the vehicle by means other than air brakes.
2. Vent the service and isolated reservoir supplies. Disconnect all air lines from the inversion valve.
3. Loosen the valve mounting nut and remove the valve. Prior to installation, check and clean the air lines to the valve.
4. Install the valve valve securely with mounting nut and lockwasher.
5. Reassemble the valve over and position the inlet and exhaust valve in its bore. Place the spring down over the inlet valve.
6. Install the O-ring on the cap nut. Install the capnut with the O-ring and tighten securely.
7. The mounting nut and lockwasher are installed when the valve is mounted on vehicle.

Figure 4-6, TR-2 Inversion Valve.
AIR COMPRESSOR

OPERATION

The air compressor is to provide and maintain air under pressure to operate devices in the air brake and auxiliary air system. It is a two cylinder, single stage, recirculating compressor with a rated displacement of 15.5 cubic feet (439 cu. ft) air per minute at 1500 RPM.

The compressor assembly is made up of three main subassemblies: the cylinder head, the cylinder block and the crankcase. The cylinder head houses the discharge valve and is installed to the cylinder block. The cylinder block houses the cylinder bores and inlet valves and is installed to the crankcase. The crankcase houses the crankshaft and main bearings.

The cylinder head and block coolant is routed to the compressor from the engine cooling system. Lubrication of the internal parts of the compressor is provided by the oil feed line from the engine’s pressurized oil system.

The compressor runs continuously while the engine is operating but actual compression is controlled by the governor which stops or starts the compression of air by loading or unloading the compressor in conjunction with its unloading mechanism. This is done when the air pressure in the system reaches the desired or minimum pressures.

A. INTAKE AND COMPRESSION (LOADED): During the downstroke of the piston, a slight vacuum created above the piston causes the inlet valve to move off its seat. Atmospheric air is drawn in through the compressor intake, past the open inlet valve, and on top of the piston. See figure 4-7. As the piston starts its upward stroke, the air is compressed. Now, air pressure on top of the inlet valve plus the force of its spring, returns the inlet valve to its seat. The piston continues the upward stroke and compresses the air sufficiently to overcome the discharge valve spring and unseat the discharge valve. The compressed air then flows past the open discharge valve into the discharge line and on to the reservoirs. Refer to figure 4-8. Intake and compression cycle is repeated.

As the piston reaches the top of its stroke and starts down, the discharge valve spring returns the discharge valve to its seat. This prevents the compressed air in the discharge line from returning to the cylinder bore as the intake and compression cycle is repeated.

B. NON-COMPRESSION (UNLOADED): When the air pressure in the reservoir reaches the high pressure setting of the governor, the governor opens, allowing air to pass from the reservoir through the governor and into the cavity beneath the unloaded pistons. This lifts the unloaded pistons and plungers. The plungers move up and hold the inlet valves off their seats.

C. INLET VALVES HELD OFF THEIR SEATS: Air is merely pumped back and forth between the two cylinders (figure 4-9). When air is used from the reservoir and the pressure drops to low pressure setting of the governor, the governor closes and doing so exhausts the air beneath the unloaded pistons. The unloaded saddle spring forces the saddle, pistons and plungers down and the inlet valves return to their seats. Compression is then resumed.

MAINTENANCE

Every 6 months, 1,800 operating hours or 50,000 miles (80,500 km), remove the discharge fittings and inspect the compressor discharge port and discharge line for excessive carbon deposits. If excessive build-up is noted in either, the discharge line must be cleaned or replaced and the compressor checked more thoroughly. Carefully inspect the air induction system, oil supply system and if necessary repair or replace compressor. Check for noisy compression operation which would indicate worn drive gear coupling. Check all compressor mounting bolts and tighten evenly if necessary. Check for leakage and tighten unloader operation.

Every 12 months, 3,000 operating hours or 100,000 miles (480 km) perform a thorough inspection; disassemble the compressor to check all parts thoroughly, repair or replace all worn or damaged parts.

CAUTION: Should it be necessary to drain the engine cooling system to prevent damage from freezing, the cylinder head of the compressor must also be drained.

TROUBLESHOOTING

If the compressor fails to maintain adequate air pressure in the air system, it usually denotes loss of efficiency because of worn compression rings, leaking air past the discharge valve, and leaking air past the discharge valve, and leaking air past the compressor. Oil flow is another sign of excessive wear. Leakage past the discharge valve can be detected by removing the discharge line, applying shop air back through the discharge valve and倾听 for escaping air. Also, the discharge valve and unloader piston should be checked for leakage by building up the system until the governor cuts out, then stopping the engine. With the engine stopped, carefully listen for escaping air at the intake. To pinpoint leakage if noted, squirt soapy water on the unloader pistons. If there is no noticeable leakage at the unloader pistons, the discharge valves may be leaking. If the compressor does not function properly or leakage is excessive, it can be repaired as described below.

REMOVAL

1. Block all the wheels to prevent rolling and then vent the air brake system. Drain and refill as outlined in Section 6 and from compressor block.

2. Disconnect all air lines, water and oil lines to and from compressor.

3. Remove compressor mounting bolts and compressor from engine.

4. Use a gear puller to remove the gear from compressor shaft.

ASSEMBLY

1. Clean compressor exterior of dirt and grease using a cleaning solvent.

2. Before the compressor is completely disassembled the following items should be marked to show their relationship when the compressor is assembled: the cylinder block in relation to crankcase and covers in relation to crankcase; position of crankshaft in relation to crankcase; the cylinder head’s relation to the block. Refer to figure 4-10.

3. Remove capscrews and lift off cylinder head. It may have to be tapped with a rawhide hammer to break gasket joint.

4. Remove intake valve springs from head and intake valves from their guides in the block. Scrape off cylinder head gasket from cylinder head and block.

5. Remove discharge valve capsnuts and lift off discharge valve springs and valves.

NOTE: The discharge valve seats can be removed, but it is not necessary unless they are badly worn or nicked.

ROD ASSEMBLY:

6. Straighten prongs of connecting rod bolt lockwashers and remove bolts, lockwashers and bearing caps.

7. Push piston with connecting rods attached out the top of the cylinder block. Replace bearing caps on their respective connecting rods.

8. Remove piston rings from pistons.

9. To remove pistons from connecting rods, remove wristpin lockwire and press wrist pins from pistons and connecting rods.

NOTE: If connecting rods are aluminum, do not re-use. Replace with new die cast aluminum rod assembly. Steel connecting rods can be reused and re-bushed if necessary.

10. Remove capscrews securing end cover at drive end of crankshaft.

CRANKCASE:

11. Remove end cover with oil seal. Remove end cover gasket. Replace oil seal after cleaning and cover.

12. Remove capscrews that hold opposite end cover to crankcase. Remove end cover and its gasket.

13. Press the crankshaft and ball bearings from the crankcase, then press ball bearings from crankshaft.

BLOCK:

14. If compressor is fitted with an air strainer, inlet elbow or governor, remove them.

15. Remove capscrews securing cylinder block to crankcase; separate crankcase and cylinder block and scrape off gasket.

16. Remove unloader spring, spring saddle and spring seat from cylinder block.

17. Remove unloader guides and plunger and with the use of shop air. Blow unloader pistons out of cylinder block unloader piston bores.

18. Remove inlet valve guides.

NOTE: Inlet valve seats can be removed but only if they are worn or damaged and are being replaced. Unloader bore bushings should be inspected but not removed unless they are damaged.
Figure 4-10. Air Compressor.
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21. Install inlet valve seats if they have been previously removed. Position and install inlet valve guides, then drop inlet valves in their guides. There should be a loose fit between guides and valves.

22. If previously removed, the discharge valve seats should be installed. Drop discharge valves into their seats. Install discharge valve springs and caps nuts.

23. Place the inlet valve springs in the cylinder head. Use a small quantity of hese to hold them in place, just enough to keep the springs from falling out.

24. Place cylinder head gasket on cylinder block. Carefully align cylinder head assembly on block and install capscrews with lockwashers.

INSTALLATION

1. Before installation, clean oil supply line. Before connecting this line to the compressor run the engine briefly to be sure oil is flowing freely through the supply line.

2. Clean the oil return line passages through the brackets; these passages must be unobstructed so oil can return to the engine.

3. Coat compressor cylinder walls and bearings with clean engine oil before assembling compressor.

4. Always use a new mounting gasket and be sure oil hole in gasket and compressor is properly aligned with oil return port.

5. Inspect drive coupling and associated parts for wear or damage. They must be tightly fitted on compressor crankshaft. Replace drive coupling if worn or damaged.

6. Install drive coupling on compressor crankshaft making sure it properly contacts the shaft and does not ride on the key. Tighten crankshaft nut securely and install cotter pin.

7. Be sure the air cleaner is clean and properly installed. Compressor intake connections must be tight with no leakage.

8. Clean or replace any damaged, or dirty air or water lines which may be corroded, before connecting them to the compressor. Use a new discharge flange fitting gasket.

9. Tighten mounting bolts securely and evenly. After installation, run compressor and check for air, oil, or water leaks at compressor connections. Also check for noisy operation.

GOVERNOR

The governor, operating in conjunction with the compressor unloading mechanism, automatically controls the air pressure in the air brake or air supply system between the desired, predetermined maximum and minimum pressures. The compressor operates continually while the engine runs, but the actual compression of air is controlled by the governor which stops or starts compression. The governor has a piston upon which air pressure acts to overcome the pressure setting spring and controls the inlet and exhaust valve to either admit or exhaust air to or from the compressor unloading mechanism.

OPERATION

Reservoir air pressure enters the D-2 governor at its reservoir port and acts on the area of the piston and beneath the piston and exhaust valve. As the air pressure builds up, the piston moves against the resistance of the pressure setting spring. The piston and inlet and exhaust valve move up when the reservoir air pressure reaches the cut-out setting of the governor. The exhaust stem seats on the inlet and exhaust valve and then...
LEAKAGE TEST

Leakage checks on the governor are made at its exhaust port in both cut-in and cut-out positions.
1. In the cut-in position, check exhaust port for inlet valve leakage by applying a soap solution at the port. Leakage could also be past the bottom piston O-ring.
2. In the cut-out position check the exhaust port to determine leakage at the exhaust valve seat or stem O-ring. In this position leakage could also be past the upper piston grommet.

REMOVAL AND INSTALLATION

1. Apply parking brake.
2. Drain air brake system and disconnect reservoir air line.
3. Remove governor mounting bolts, then governor.
4. Clean mounting pad on both compressor and governor body. Clean connecting line, or lines. Also be sure compressor unloading port is clean and clear.
5. Install governor using a new governor mounting gasket. Connect air lines to governor. Test governor as outlined in Service Checks.

DISASSEMBLY

1. Clean governor exterior of road dirt and grease using a good cleaning solvent and brush.
2. Unscrew the top cover. With a pair of retainer ring pliers, remove the spring assembly retaining ring.
3. Remove the adjusting screw and spring assembly. Remove the locknut, then the hex-shaped upper spring seat from the adjusting screw.
4. Remove the pressure setting spring, lower spring seat, spring guide and the other lower spring seat from the adjusting screw.
5. Remove the exhaust stem and its spring from the top of the piston.
6. With the body in the inverted position, tap it lightly and the piston should fall out.
7. Remove the inlet and exhaust valve springs and the valve from the piston.
8. Remove the two piston O-rings and with a hooked wire remove the exhaust stem O-ring.
9. Clean or remove the unloader and reservoir port filters.

CLEANING AND INSPECTION

1. Clean all metal parts with cleaning solvent. Wipe rubber parts dry.
2. Inspect body for cracks or other damage. Be particularly careful that all passages in the body, filters, exhaust stem, and the piston are not obstructed.
3. Check springs for cracks, distortion or corrosion. Replace all parts not considered serviceable during these inspections.

REASSEMBLY

Prior to reassembly lubricate the lower body bore, the top of the piston, the piston grooves, piston grommets, piston setting spring guide and the adjustable screw with recommended lubricant, MCI part No. 4A-15-113.

1. Install the exhaust stem O-ring in its groove in the stem bore of the piston. Drop the inlet and exhaust valves into place at the bottom of the piston.
2. Install the inlet valve spring with its narrow end against the valve. Press the spring down until the large coiled end snaps into the groove inside the piston.
3. Position the exhaust stem spring over the exhaust stem, then carefully press the stem into the stem bore of the piston.
4. Install the spring.
5. Install one lower spring seat, spring guide, the other lower spring seat, pressure setting spring, and the hex-shaped upper spring seat on the adjusting screw, in that order. Screw the upper spring seat down until the dimension from the top of the seat to the bottom of the seat head is approximately 1.142" (29.005 mm).
6. Install the locknut. Before placing the adjusting screw and stem assembly in the governor body, check to be sure the exhaust stem and its spring are in place in the piston.
7. Install the adjusting screw and spring assembly retaining ring. At this point, make the adjustment as outlined under Service Checks.
8. After the adjustment is made, the top cover should be screwed in tightly until it seals the body against the entrance of any foreign matter.
9. If necessary, install new filters in the reservoir and unloader ports. These cup-shaped filters can be installed with the head of a pencil.

DUAL BRAKE APPLICATION VALVE

DESCRIPTION

The brake valve is the control unit of the air brake system. See figure 4-14. It provides the driver with an easily operated and graduated means of applying or releasing the vehicle brakes. The brake valve is operated through a lever with a linkage connection to the brake pedal.

The dual brake valve has two separate supply and delivery circuits for service and emergency braking. The service brake portion is that section of the valve between the spring seat which contacts the plunger and the relay piston; the emergency brake portion is that part between the relay piston and the exhaust cavity.

The service brake portion of the valve is similar in operation to a standard single-circuit air brake valve, and under all operating conditions the emergency brake portion of the dual brake valve uses a common exhaust protected by an exhaust diaphragm.

MAINTENANCE

Every 300 operating hours, 20,000 miles (32,000 km) or every three months, check any accumulated dirt, grease or foreign material away from the heel of the treadle, plunger boot and mounting plate. Check the plunger boot for cracks, holes or deterioration and replace if necessary.

With the lever type brake valve, check to be sure that, with brakes fully applied, the pedal contacts the pedal stop. With brakes released, check to be sure that the lever arm contacts the stop button on the brake valve. Adjust pedal linkage to provide for this. After any adjustment, check the brake valve delivery pressure.

Lubricate the plunger using a silicone base lubricant, TMIC/MCI part No. 21-7512-11. Every 3,600 operating hours or 100,000 miles (161,000 km)
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2. Remove the screw securing the exhaust system and make sure the rubber gasket is inside the exhaust cover.
3. Remove the screws that secure the exhaust cover to the lower body.
4. Disassemble the emergency inlet and exhaust valve assembly from the lower body.
5. Disassemble the emergency inlet and exhaust valve assembly by removing the retaining ring. Separate the washer, O-ring retainer, both O-rings, and the spring and valve retainer.
6. Remove the four hex head cap screws securing the lower body to the upper body and separate the two bodies.
7. Remove the rubber seal ring from the lower body.
8. While applying upward pressure to the No. 1 piston, lift out and on the upper three lock tabs of the No. 1 piston retainer.
9. Using a 3/4" wrench, hold the ESNA nut on the thread end of the stem and turn the No. 1 piston. Insert a screwdriver in the exhaust passage through the center of the valve and engage the slotted head of the stem.

WARNING: The combined force of the internal springs is approximately 50 lbs. (22.5 kg). Care must be taken when removing the ESNA nut as the spring forces will be released.

The No. 1 piston and relay piston must be manually or mechanically contained while the nut and stem are being removed.

10. Rotate the screwdriver counterclockwise and remove the stem, stem spring, spring guide, and ESNA nut.
11. Remove the relay piston, relay piston spring from the upper body.
12. Disassemble the No. 1 piston by rotating the spring seat nut counterclockwise. Separate the spring seat nut, spring seat, rubber spring and remove the o-ring on the upper body.
13. Remove the large and small O-rings from the relay piston.
14. Remove the retaining ring securing the service brake inlet and exhaust valve assembly in the upper body and remove the valve assembly.
15. Disassemble the service brake inlet and exhaust assembly by removing the retaining ring and separating the washer, O-ring retainer, both O-rings, valve spring and valve retainer.

CLEANING AND INSPECTION

Wash all metal parts in cleaning solvent and dry them. Inspect all parts for excessive wear or deterioration. Check the springs for cracks, corrosion, or a permanent "set." Replace all rubber parts.

REASSEMBLY

Prior to assembling the brake valve, coat all O-rings, O-ring grooves, piston bore, and metal-to-metal surfaces with silicone base lubricant. TMC/MCI Part No. 517-552-11.
1. Reassemble the service brake inlet exhaust valve assembly by first placing the valve retainer and the valve spring on the inlet and exhaust valve.
2. Place the O-ring retainer with the O-rings grooves away from the spring, over the inlet and exhaust valve and install the
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**MAINTENANCE**

Every year or after 50,000 miles (80,000 km) remove the quick-release valve, disassemble it and clean all parts. The diaphragm should be replaced if worn or deteriorated. See figure 4-18.

**SERVICE CHECK**

1. Apply the parking brake and note the activation of the brake chambers served by the quick-release valve.
2. Release the brake and observe that the air pressure is quickly exhausted through the quick-release valve.
3. Make and hold a brake application and check the exhaust port of the quick-release valve for leakage.

If the quick-release valve does not function properly or leaks excessively, it should be replaced or repaired as outlined below.

**REMOVAL AND INSTALLATION**

1. Block the coach by means other than the brakes.
2. Vent the air brake system.
3. Disconnect the air lines from quick-release valve.
4. Remove mounting bolts and valves.
5. To reinstall, mount quick-release valve with its exhaust port pointing down. Connect the brake valve to the top port and brake chamber lines to side port. Make sure exhaust ports are not restricted.

**QUICK RELEASE VALVES**

The quick-release valves, used for the entrance door and the park brake systems, are found in the fire compartment. These valves speed up the release of air pressure. In the parking brake system, when a brake valve application is released, the exhaust ports of the quick-release valves open and the air pressure accumulated in the brake chambers is exhausted through the quick-release valves, rather than exhausting back through the brake valve.

A line from a delivery port of the brake valve is connected to the top port of each quick-release valve. The two side ports are for brake chamber connections and the bottom ports are for the exhaust.

**OPERATION**

When a brake valve application is made, air pressure enters the top port of the quick-release valve, moves the diaphragm down, closing the exhaust port. At the same time this air pressure forces the edges of the diaphragm down and flows past into the brake chambers. As soon as the brake chamber pressure beneath the diaphragm equals the air pressure being delivered by the brake valve, the diaphragm spring forces the outer edges of the diaphragm against the body seal. The exhaust port is still sealed by the central portion of the diaphragm. When the brake valve is released, air pressure above the diaphragm is exhausted. Now, the pressure under the diaphragm raises it and the exhaust port opens allowing brake chamber pressure to release.

**DISASSEMBLY AND REPAIR**

1. Remove the cover using a wrench on the square portion of the exhaust port. Remove diaphragm and O-ring.
2. Clean all parts in cleaning solvent. Inspect the diaphragm, especially the lower part that contacts the exhaust seat, for wear or deterioration.

**REMOVAL AND DISASSEMBLY**

1. Block the coach by means other than the brakes.
2. Vent the air brake system.
3. Tag the lines to aid in reconnection, then disconnect and remove all air lines.
4. Remove the relay valve from the coach.

**NOTE:** Prior to disassembly, matchmark the location of the mounting bracket to the cover and the cover to the body.

5. Remove the four cap screws and lockwashers securing the cover to the body.
6. Remove the cover, sealing ring, and mounting bracket.
7. Remove the piston and O-ring from the body.
8. While depressing the exhaust cover, remove the retaining ring and slowly release the spring beneath the exhaust cover.
9. Remove the exhaust cover assembly and O-rings.
10. Remove the inlet/exhaust valve return spring from the body.
11. Remove the inlet/exhaust valve from the body.
12. Remove the valve retainer from the inlet/exhaust valve.

**CLEANING AND INSPECTION**

1. Wash all parts in mineral spirits, dry all rubber parts.
2. Inspect all parts for signs of wear and/or deterioration. Inspect springs for cracks, distortion or corrosion.
3. Inspect inlet seat and exhaust seat for nicks and burrs and replace if necessary. All exposed parts and any part showing signs of wear or deterioration should be replaced.

**Figure 4-18. Quick Release Valve.**

**Figure 4-19. Rear Brake Relay Valve R-12.**
REASSEMBLY
1. Install large O-ring on piston.
2. Install inner and outer O-rings in the exhaust cover assembly.
3. Install the sealing ring on the cover.
4. Install piston in body, taking care not to damage the O-ring.
5. Aligning the match marks made during disassembly, install the cover on the valve body and the mounting bracket on the cover.
6. Secure the mounting bracket and cover to the body using the four capscrews and lockwashers. Tighten to 80-120 inch pounds (9-14 Nm) torque.
7. Install the valve retainer on the inlet/exhaust valve and install in the body.
8. Install the inlet/exhaust valve return spring in the body.
9. Install the exhaust cover assembly in the body taking care not to damage the O-ring.
10. While depressing the exhaust cover, install the retaining ring. Make certain the retainer is completely seated in its groove in the body.
11. Test the valve as outlined in the Service Check section before returning the valve to service.

SAFETY VALVE
Normally, the safety valve remains inoperative and only functions if the reservoir pressure rises above its normal limit. The safety valve protects the air system against air pressures above 150 psi (1,035 kPa). The safety valve consists of a spring loaded ball which lifts and permits air to exhaust if the pressure in the reservoir rises above its setting.

Should the reservoir pressure below the ball valve rise to a point above the setting of the safety valve, the force developed will overcome the force of the regulating spring holding the ball on its seat and the ball will lift. This permits air to pass into the spring cage and exhaust through the exhaust port. As soon as this reduces the pressure to the setting of the safety valve, the regulating spring forces the ball back on its seat stopping the exhaust.

TESTING
The safety valve may be tested to be sure it is operative by pulling the exposed end of the valve stem. This removes the spring load from the ball and permits the valve to exhaust. If the safety valve does not "blow off" when this is done, the ball is stuck on its seat. The complete valve should be removed and dismantled for cleaning.

Leakage at the exhaust port in the spring cage should not exceed a three inch soap bubble in three seconds.

DISASSEMBLY AND REPAIR
Every 50,000 miles (80,000 km) the safety valve should be removed and thoroughly cleaned. Refer to figure 4-20.
1. Unscrew the spring cage from the body of the safety valve.
2. Lift ball valve from body and remove spring, spring seat, and release pin from spring cage.
3. Clean all parts in cleaning solvent.
4. Examine the ball valve for signs of pitting or scratches. If the ball valve cannot be reconditioned, it should be replaced.
5. Check the spring and spring cage for cracks. Be sure the exhaust port in the spring cage is not plugged.

REASSEMBLY
1. Place the ball valve in the body of safety valve.
2. Place spring release pin and spring seat in spring cage with the adjusting screw assembly.
3. Position the spring seat over the ball valve and screw the spring cage to the body.

ADJUSTMENT
The pressure setting of the safety valve is stamped on the cover wrench flat (closest to the pipe thread). The correct pressure setting is 150 psi (1,035 kPa).

To adjust, the safety valve must be connected to an air system with air pressure in excess of desired setting. It is important that an accurate gauge be used to check pressure settings while making adjustments.

To release pressure setting, loosen lock nut, turn adjusting nut clockwise to obtain correct pressure setting and tighten lock nut.

To lower pressure setting, loosen locknut, turn adjusting nut counterclockwise to obtain correct pressure setting and tighten lock nut.

LOW AIR PRESSURE SWITCH AND ALTERNATOR CONTROL
The low pressure switch and alternator control gives an automatic warning to the driver when air pressure is below the minimum for safe vehicle operation. It operates an electric buzzer and warning lights.

When reservoir air pressure under the diaphragm is above 70-75 psi (483-517 kPa), the electrical contacts remain open because the force exerted by the air pressure overcomes the force exerted by the spring above the diaphragm. When the reservoir air pressure drops below 70-75 psi (483-517 kPa), the electrical contacts close because the force exerted by the air pressure below the diaphragm. This causes the diaphragm to move down and close the electrical contact. This compels the electrical circuit to the buzzer and warning light informing the driver of the impending loss of air pressure. It also opens the alternator charging circuit.

OPERATION
Operation of the low air pressure switch and alternator control may be checked by reducing the reservoir pressure through application and release of the service brakes numerous times. Observe the air pressure gauge and when the air pressure drops below 70-75 psi (483-517 kPa), the tail-late warning light and buzzer should come on.

The air pressure in the instrument panel reads dry tank pressure in order to ascertain if there is a sufficient supply of air pressure to all accessories prior to driving the vehicle. The buzzer will sound and the tail-late warning light will flash until 100 psi (690 kPa) air pressure is reached in the dry air system.

NOTE: Care should be taken that valve is not lodged between capnut and body when assembling.

AIR LINE CHECK VALVES
The in-line check valves are placed in an air line to allow air flow in one direction and to prevent the flow of air in the opposite direction. An arrow indicating the direction of air flow is cast into the body of the valve.

Air flow in the normal direction moves the disc valve from its seat and the flow is unobstructed. Flow in the reverse direction is prevented by the seating of the disc valve. Refer to figures 4-21 and 4-22.

MAINTENANCE AND TESTING
Every six months, 1,800 operating hours or every 50,000 miles (80,000 km), disassemble, clean and inspect all parts. Replace any parts showing signs of wear or deterioration.

Depending upon installation, it may be necessary to completely remove the check valve so that the following checks may be made. With air pressure present at the outlet side of check valve and the inlet side open, coat the open end of the check valve with soap solution. A "bubbles" leakage is permitted in not less than one second. If the check valve leaks excessively, the valve should be replaced with a new check valve or repaired.

REMOVAL AND DISASSEMBLY
1. Block the coach by means other than the brakes.
2. Apply parking brakes.
3. Vent all reservoirs.
4. Disconnect air lines and plug ends to prevent any foreign particles from entering the system.
5. Check and, if necessary, clean or replace air lines to valve.
6. Unscrew cap nut from body and remove gasket.
7. Remove shims (if present), disc valve, valve seat (if present), spring, and valve stop bushing (if present).

CLEANING AND INSPECTION
1. Wash all metal parts in cleaning solvent.
2. Rubber parts should be wiped clean.
3. Inspect disc valve and seat for signs of wear or deterioration.
4. Check spring for cracks, corrosion or distortion.
5. Inspect body and cap nut for cracks or damage.
6. Replace all parts that are damaged or worn.

To reassemble, position parts in proper order in body, install new grommet on cap nut, screw cap nut into body and tighten securely.

NOTE: Care should be taken that valve is not lodged between capnut and body when assembling.
When installing valve, make certain that it is installed correctly with respect to the desired air flow. An arrow indicating the direction of air flow is cast into the body of the valve.

SERVICE BRAKE STOP LIGHT SWITCH

The stop light switch (figure 4-23) operates in conjunction with the brake valve and stop light by completing the stop light electrical circuit when a brake application is made.

When air pressure from the brake valve enters the cavity on the side of the diaphragm, the diaphragm changes its position, overcoming the force of the spring and moving the contact plunger until the electrical contacts close. This closes the stop light circuit. When the air pressure acting on the diaphragm is exhausted by the brake valve, the spring forces the diaphragm and the contact plunger back to their normal position and the stop light circuit is opened. See figure 4-24. 

TESTING

Apply the brake valve and note that with the first downward movement of the brake valve pedal or treadle, the stop light immediately lights. Release the brake valve and note that the stop light goes-off. With the brake applied, no leakage is permitted at the stop light switch.

REMOVAL AND REPAIR

1. Disconnect electrical connections at the stop light switch.
2. UnscREW switch.
3. Remove the cover from the body and lift out the spring contact plunger, diaphragm ring, and diaphragm.
4. Clean all metal parts in cleaning solvent.
5. If diaphragm is cracked, worn or damaged, replace with new diaphragm.
6. Inspect the contact points for signs of pitting or wear. If pitting is not too severe, the contacts may be reconditioned by filing them with a fine file such as is used for distributor points. If they cannot be reconditioned, they should be replaced.
7. Check the spring for tension. If it has lost its tension, it should be replaced.
8. If the body or cover is cracked or damaged, it should be replaced.

PRESSURE REGULATING VALVES

Pressure regulating valves control the pressure of compressed air. They remain opened until their pressure setting is reached.

Below are the locations where pressure regulating valves are used and the pressures to which they must be set:

1. Blower belt tension: 21 psi (144.8 kPa)
2. A/C compressor belt tension: 35 psi (241.3 kPa)
3. Parking brake: 80-85 psi (552-586 kPa)
4. Trailing axle bellows: 35 psi (241.3 kPa)
5. Trailing wheel brake system: 121 psi (844.8 kPa)
6. Traiding axle uncoupling system: 15 psi (103.3 kPa)
7. Lavatory air flush: 11 psi (75.8 kPa)

The pressure setting is determined in the pressure regulating valve by the tension of an internal spring which is controlled by an adjusting screw at the top of the valve. Turning the adjusting screw clockwise raises the pressure setting; counterclockwise reduces the setting. The locknut must be tightened after final adjustment is accomplished. See figures 4-25, 4-26, and 4-27.

MAINTENANCE

Every 50,000 miles (80,000 km) or yearly:
1. Remove and disassemble the pressure regulating valve and clean all parts. Replace diaphragm.
2. After valve is assembled, check the pressure setting of the valve with a test gauge. Adjust the valve to the specified pressure setting.
3. Install valve and check to see that the mounting bolts and pressure adjusting screw are secure and that there is no air leakage.

REMOVAL AND TESTING

1. Block the coach by means other than the brakes.
2. Vent the air system.
3. Disconnect air lines to pressure regulating valve.
4. Remove pressure regulating valve mounting bolts and remove the valve.
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2. Examine the diaphragm and, if cracked or worn, replace with new diaphragm.
3. Inspect inside of valve for water or damage. If the valve is excessively grooved, or pitted, it should be replaced.
4. Replace any other parts that appear worn or damaged. (Screen and inlet parts should also be removed and cleaned.)

RESEVERVES
Reservoirs store compressed air so that there will be an ample supply for immediate use. Four air reservoirs are used on the coach: two in the service brake system, one in the park brake system, and one in the accessory air suspension system. See figure 4-28.

Air compressors pass a certain amount of oil in order to lubricate the cylinder walls and piston rings. Also, depending on the humidity, the atmosphere entering the compressor contains a certain amount of water. Thus, oil and water normally pass into the reservoir in the form of vapor because of the heat generated during compression. After reaching the reservoir, the vapor cools and condenses in the form of an oil and water emulsion and is drained by a drain cock at the bottom of the reservoir.

In addition to periodic draining, the reservoirs should be checked for mounting integrity, for outer surface corrosion and damaged lines and fittings.

TEST EQUIPMENT REQUIRED
A tee fitting and plug should be installed in the outlet port of the pressure regulating valve. This enables installation of a test gauge for adjusting or checking the pressure regulating valve setting.

The following items of equipment are required to check the pressure regulating valve air pressures:
A. TMC/MCI Part No. 16C-2-95 - Charging Hose - (Yellow Jack Hose) HCL-36.
B. TMC/MCI Part No. 16C-2-96 - Pressure Gauge - 0-400 lbs. with R-12 and R-22 Pressure Scales (No. 172 CA 215)."

NOTE: Any suitable gauge and hose may be used for this procedure. The above gauge and hose can be found in Air Conditioning Test Kit No. 16C-2-92.

Operators who do not already have the test kit in their inventory may purchase the required items. They are available from Universal Coach Parts, Inc., Northlake, Illinois and in Canada from Motor Coach Industries, Service Parts Division.

TEST PROCEDURE
1. Remove the dust cap from the test fitting. Attach pressure gauge No. 16C-2-92 to the test point by means of the pressure hose No. 16C-2-95. If the pressure reading is not correct, perform steps 2 and 3. If correct, disconnect test equipment (step 4).
2. Loosen the locknut, turn the adjusting screw counterclockwise to reduce the pressure approximately 10 psi (69 kPa) below the pressure required.
3. Turn the adjusting screw counterclockwise to increase the pressure slowly until the required pressure setting is reached. Tighten the locknut.
4. Remove the gauge and hose and replace the dust cap on the test fitting.

CLEANING AND INSPECTION
1. Wash all metal parts in cleaning solvent.

FRONT AND TRAILING AXLE BRAKE CHAMBERS
Brake chambers convert compressed air pressure into mechanical force and movement which applies the vehicle brakes. Brake chambers on the front axle and the trailing axle are of the clamp ring type. See figure 4-29. The diaphragm is held between two plates by a clamping ring, two nuts and two bolts.

Air pressure enters the pressure side of the brake chamber against the diaphragm (or the chamber which moves the push rod assembly forward). The push rod is connected to a slack adjuster which is attached to a camshaft that rotates the brake cam and applies the brakes.

When air pressure is released from the brake chamber, the push rod return spring in combination with the brake shoe return spring returns the diaphragm, push rod, slack adjuster and brake cam, releasing the brakes.

Push rod travel should be kept as short as possible without allowing brake drag. Excessive push rod travel shortens diaphragm life, gives slow braking response and wastes air.

TESTING
Check push rod-to-stack adjuster alignment in both the extended and released positions to be sure the push rod moves rod and returns properly and without binding. Also check the angle formed by the slack adjuster arm and push rod. It should be 90° or greater when the chamber is in the applied and released positions.

MAINTENANCE
Every 50,000 miles (80,000 km) or more often, depending on the type of operation, disassemble brake chambers and clean or replace parts. Install a new diaphragm, or any other rubber parts, if they are worn or deteriorated. When the diaphragm or spring is replaced in an inoperative brake chamber, they should be replaced in the corresponding brake chamber on the same axle.

Apply the brakes and check that the brake chamber push rod moves out promptly without binding. Release the brakes and note that the push rod returns to the released position promptly and without binding. Check push rod travel to be sure it is at a minimum without brake drag.

With a full pressure application, check the brake chamber for leakage. No leakage is permissible.

CAUTION: If leakage is detected around the flange, or clamping ring, the bolts should be tightened evenly but only enough to stop the leakage. Otherwise the diaphragm, flange sealing surface or clamping ring could be distorted.

Figure 4-28. Reservoirs in Front Bogie Area.

Figure 4-29. Front and Trailing Axle Brake Chambers.
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If the brake chamber is to be dismantled on the vehicle (for example to change the diaphragm or spring), first back off the slack adjuster to relieve the return spring pressure against the pressure plate, then follow disassembly procedure below.

1. Pull out push rod and clamp it at the non-pressure plate with vice or vise grip pliers. If necessary, use air pressure to move the push rod out.

CAUTION: Jaws of vise or vise grip pliers should be covered or taped to prevent damage to the push rod.

2. Remove clamp ring nuts and bolts. Spread clamp ring slightly, just enough to slip it off the plates. It is sometimes necessary to use a screw driver and gradually pry under the clamp ring to remove it. If the clamp ring is to be reused, caution should be taken against bending it out of shape.

3. Remove pressure plate diaphragm.

4. Remove yoke and lock nut from push rod.

5. Release grip on push rod and remove push rod assembly. Spring and other parts.

6. Clean all metal parts and inspect for damage. Damaged parts should be replaced. If it is necessary to replace the return spring, be sure the correct replacement spring is used.

DRIVE AXLE BRAKE CHAMBERS

The driving axle brake chambers combine the functions of a conventional service brake chamber with a secondary diaphragm and locking mechanism to give service and parking brake operation. Operation of the brake chambers under various conditions has been described earlier in this section.

MAINTENANCE

NOTE: The following procedure is applicable to all brake chambers on the coach.

Depending on experience and type of operation, the drain slot in the actuator non-pressure plate should be checked and cleaned of any restricting road grime, mud, ice, snow, etc. Brakes should be adjusted as is customary with any brake chambers. Push rod travel should be as short as possible without dragging brakes. Excessive travel not only shortens the normal service life of diaphragms but gives slow braking response, wastes air, and could possibly result in decreasing brake torque.

Push rod to slack adjuster alignment should be checked in both the applied and released positions. The rod should move out and return properly without binding. Check the angle formed by the slack adjuster arm and push rod. It should be 90° or greater when the actuator is in the applied or the released position.

Every year or after 50,000 miles (80,000 km) depending on type of operation, disassemble the actuator, clean all parts and lubricate the locking mechanism. Install new diaphragms and other rubber parts if they are worn or deteriorated. A grease nipple is provided in the brake chamber for lubricating the interior with a high quality chassis lubricant.

When diaphragms or return springs or both are replaced, like parts in the corresponding actuator on the same axle should also be replaced.

REMOVAL

1. Block and hold the vehicle by means other than air brakes. With the actuators in the released position, disconnect or completely remove the air lines from parking and service ports of the chamber.

WARNING: Air will be exhausted from the line that is connected to the parking port when the control valve is operated. If this line is not removed, it should be secured in such a way that it will not whip and cause injury or damage as the air exhausts.

2. After disconnecting only the parking and service port lines, operate the parking control valve. The action will exhaust the isolated air supply and air from the locking port.

3. As a safety precaution, the service system should also be vented, if it is separate. Disconnect the air line at the actuator locking port.

4. Remove the yoke pin cotter pin and knock out the yoke pin.

5. Remove the mounting nuts, then the actuator.

DISASSEMBLY

1. Clean the chamber exterior of all road grime then mark it in such a way so it can be assembled in the same manner. Refer to figures 4-31 and 4-32.

2. Remove yoke and yoke lock nuts. Remove boot, speed guard and felt breather.

3. Remove auxiliary and service clamping ring nuts and bolts. Spread clamping rings slightly, just enough to slip them off the plates.

NOTE: It may be necessary to use a soft metal driver to break the clamping rings loose. If the rings are being reused, care should be taken against bending them out of shape.

1. Shaft Assy.

2. Push Rod

3. Retaining Ring

4. Return Spring

5. Non-Pressure Plate Assy.

6. Wiper

7. Retaining Spring

8. Diaphragm

9. Washer

10. Screw

11. Bearing

12. O Ring

13. Bolt

14. Nut

Diaphragm Separator

Auxiliary Diaphragm

Auxiliary Pressure Plate

Auxiliary Clamp Ring

Felt Breather

Gasket

Boot

Splash Guard

Lockwasher

Nut

Figure 4-31. Drive Axle Brake Chamber.

Figure 4-32. Drive Axle Brake Chamber Components.
diaphragm, the replacement part is suitable for use with or without the diaphragm separator.

6. By hand, press down the actuator non-pressure plate and at the same time apply air to the locking port. As the shaft is unlocked, ease the non-pressure plate back and remove the push plate and shaft assembly with push rod and return spring.

7. Hold the lock cap down against roller spring tension and completely remove all four capscrews before releasing and removing the cap.

8. Remove roller spring and spring seat washer. Remove all eight rollers.

9. Next carefully apply air at the locking port to assist in removal of collar and piston, and to remove piston O-ring.

10. Inspect the bearing in shaft bore and remove only if it is showing signs of wear.

NOTE: The push rod should not be removed from the shaft unless it is damaged. If the rod is removed it must be replaced.

11. To remove the rod, place a heavy washer over the rod against the shaft, then position a spacer and a second washer over the rod and beneath the yoke locknut. Turn the locknut down with a long handled wrench, pulling the push rod from the shaft.

12. The knurled T-bolts in the non-pressure plate can be removed and replaced if damaged.

REPAIR

1. Wash all metal parts in a cleaning solvent and dry. Any reusable parts should be wiped clean. Discard felt breast.

2. Inspect all parts for excessive wear or deterioration. Particular attention should be given to the piston and collar cores in the plate.

3. The air passage from the lock port to piston bore should be clean and not restricted. It may be necessary to remove the inspection plug to thoroughly clean this passage.

4. Rollers should all be replaced if one or more need replacing. Check the springs for cracks, distortion or corrosion. Replace all parts not serviceable.

REASSEMBLY

1. Line up parts as they were marked prior to disassembly.

2. Lubricate the piston and collar cores, shaft, piston O-ring and piston cavity with silicone base lubricant TMC/MCI Part No. 21-78-12-11.

3. Position the O-ring in the piston with smooth end down, place the collar in its bore in the plate.

4. Position all eight rollers in the groove formed by the top of the piston and collar rollers.

5. Position the cone shaped roller spring on the washer with the small end to washer.

6. Position the cap on the roller spring. Press the cap and hold while installing capscrews evenly.

7. Turn the non-pressure plate lock mechanism installer and position the return spring in the plate with the large end down.

8. Position the push plate and shaft over the spring and press down so the shaft moves through the lock. The lock should hold the shaft position against return spring. If not, check assembly at this point.

9. Install the service diaphragm, service pressure plate and clamping ring.

NOTE: If the service diaphragm has a bead molded into it (figure 4-34), a diaphragm separator must be used.

10. Install the auxiliary diaphragm, auxiliary pressure plate and clamping ring.

11. Tighten clamping ring bolts, in both clamping rings evenly.

12. Install the new breather felt, then the splash guard over the boost.

INSTALLATION

CAUTION: On installation, actuators must be installed with the drain slot pointing down and towards the center line of the vehicle.

1. Mount chamber on the mounting bracket and tighten securely.

2. Fasten the actuator push rod yoke to the slack adjuster with the yoke pin. Lock the yoke pin with a cotter pin. The angle formed by the push rod and slack adjuster arm should be greater than 90 degrees.

3. Connect the air lines to the chamber. Take care that the correct line is installed in the correct port.

4. Adjust brakes.

SLACK ADJUSTERS (MANUAL)

1. Slack adjusters provide a quick method of adjusting brakes to compensate for brake lining wear (figures 4-34 and 4-35).

2. Slack adjusters utilize worm gear drive to ensure maximum service with a minimum of maintenance.

3. Slack adjusters must be lubricated once every 5,000 miles (8,000 km). The slack adjuster grease fittings may be lubricated with a standard shop grease gun. Only molybdenum disulphide grease should be used on the slack adjusters.

4. Slack adjusters provide a quick method of adjusting brakes to compensate for brake lining wear (figures 4-34 and 4-35).

BRAKE ADJUSTMENT

CAUTION: Prior to adjusting the rear coach brakes, ensure that system air pressure is above 65 psi (449 kPa).
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INSPECTION
Every two months or 25,000 miles (40,000 km), inspect all slack adjusters.

Check brake chamber stroke by making a low pressure (approximately, 20 psi) brake application, and measuring the stroke of the brake chamber push rod. If the stroke does not exceed 1 1/4 (34.45 mm) measured at 6 to 7 (152.4-177.8 mm) from the adjuster, reduce the slack adjuster is operating properly.

Check for looseness in bolts and the anchor bracket and see if it is able to reduce stroke. Readjust the nut by rotating the hex nut on the worm gear by one-half turn in the counterclockwise direction.

A series of full pressure brake applications and observe the rotation of the hex nut during each chamber return stroke. By leaving the wrench on the hex nut during brake applications, rotation will be easier to observe. This check may also be made by measuring the brake chamber stroke before and after the brake application. Rotation of the hex nut or cessation of stroke indicates that the adjuster is functioning as required.

If the slack adjuster fails to reduce the brake chamber stroke, perform the same inspection on all coach adjusters and replace those not operating properly.

LUBRICATION
The coach uses four or six slack adjusters which, although they are internally serviceable, do require regular lubrication. Each adjuster should be cleaned externally, and lubricated every 150 hours or 5,000 miles (8,000 km). Only high carbon molybdenum disulfide grease should be used when lubricating slack adjusters.

ADJUSTMENT ON A PRESS
1. Install the slack adjuster into an accurate press and apply approximately 400 lbs. (181 kg) to the hexagonal end of the screw.

2. Turn the control arm forcibly clockwise as far as possible, from here on, the control arm should not return to its initial position.

3. Slowly increase the pressure on the worm screw. At a fixed level of 794 + 33 lbs. (360 ± 15 kg), the control arm should move back.

4. If the control arm moves back at a lower or higher load, turn the screw clockwise/counterclockwise by means of a spanner wrench.

5. Repeat this procedure until a satisfactory result is achieved.

6. When the adjuster is calibrated correctly, secure the cover, making sure the light punch in the housing just protrudes the notch in the cover.

ADJUSTMENT WITH A SAB TOOL
1. Install the SAB tool in the vice.

2. Install the slack adjuster into the tool with the control arm

The rack and pinion linkage produces rotation of the worm shaft through a clutch, only during the running clearance portion of the adjuster return stroke. During that portion of travel when "lining-drum" contact exists, the transmitted force disengages the shaft from the linkage and stops the shaft from further rotation.

Each time the brake is applied and released, the adjusting mechanism compares the point in the stroke where the space is taken up with the point where the shaft engages the linkage. When lining wear increases the "lining-drum" clearance, the shaft and clutch are engaged for a portion of a stroke and an adjustment is made by a rotation of the shaft and wheel on the return stroke. Adjustment will continue on each brake application until the drum contact space is up to the point at which the mechanism will stop adjusting and maintain a running clearance until lining wear increases the clearance.

The slack adjuster is equipped with a hex nut on the worm shaft for manual adjustment at time of installation or brake servicing.

NOTE: On the Haldex (SAB) slack adjusters, the nut on the earlier models is 12 mm. Later models have 7/16" nut which is identified by notches on the circumference of the nut.

REMOVAL
1. Remove the brake chamber push-poke pin, capscrew, and the washer which holds the slack adjuster on the brake camshaft. (Other methods of affixing the adjuster to the brake camshaft may also be used; however, the capscrew method is the most common.)

2. Slide the slack adjuster off the spline end of the camshaft.

3. If the slack adjuster does not slide off the camshaft easily, a puller tool may be used. Apply the puller to the body or the outer edge of the weaved cover only, using a flat block to protect the slack adjuster.

CAUTION: Do not pry on the control arm assembly or directly on the cover.

The rack and pinion linkage produces rotation of the worm shaft through a clutch, only during the running clearance portion of the adjuster return stroke. During that portion of travel when "lining-drum" contact exists, the transmitted force disengages the shaft from the linkage and stops the shaft from further rotation.

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NOTE: On the Haldex (SAB) slack adjusters, the nut on the earlier models is 12 mm. Later models have 7/16" nut which is identified by notches on the circumference of the nut.

REMOVAL
1. Remove the brake chamber push-poke pin, capscrew, and the washer which holds the slack adjuster on the brake camshaft. (Other methods of affixing the adjuster to the brake camshaft may also be used; however, the capscrew method is the most common.)

2. Slide the slack adjuster off the spline end of the camshaft.

3. If the slack adjuster does not slide off the camshaft easily, a puller tool may be used. Apply the puller to the body or the outer edge of the weaved cover only, using a flat block to protect the slack adjuster.

CAUTION: Do not pry on the control arm assembly or directly on the cover.

Figure 4-36. Optional Automatic Slack Adjuster.
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5.38" (136.55 mm)
2.00" (50.80 mm)

FRONT AXLE

3.00" - 38.5 mm

REAR DRIVE AXLE

3.00" - 76.2 mm

### BRAKES

The brakes used on the coach are heavy duty, double-shoe. Shoes are mounted with individual anchor pins on open-type spindles. The brakes are actuated by "B" type, constant-of-cams which are forged integral with the shaft and mounted in needle bearings. Cam pressure is applied through roller cam followers attached to the brake shoes.

### MAINTENANCE

A schedule for the periodic adjustment, cleaning, inspection, and lubrication of brake equipment should be established by the operator on the basis of parts specifically subject to wear. To compensate for this wear, brakes should be adjusted as frequently as required to maintain satisfactory operation and maximum safety. Adjustments should provide uniform lining clearance, correct travel of levers and proper equalization.

Brakes should be cleaned, inspected, lubricated and adjusted each time the hub is removed.

Machining of brake drums is permitted under the following guidelines:

- **Original Diameter**: 14.50" (368.3 mm)
- **Max. Allowable Wear**: 14.812" (376.2 mm)

Under no circumstances should brake drums be used if they have been machined to a greater dimension than allowed (14.812" - 376.2 mm).

### WARNING

When replaced drums and oversize linings are used, precautions regarding cam travel should be observed to prevent sticking cams or cam "roll-over." This condition may occur when linings become worn beyond allowable limits. Service instructions relative to the use of oversize roller cam followers must be carefully followed. Drums which have been replaced should be installed on coaches operating under the least severe conditions.

Linnings vary considerably in size and content. They should be replaced only with linings available in the Parts Manual.

### DISASSEMBLY

Brake parts are shown in figures 4-38, 39 and 40.

1. Remove the wheels as outlined in Section 15.
2. Remove the brake return spring. Remove lock rings, retainers, and nuts from anchor pins.
3. Cut lock wire and remove anchor pin lock screws.
4. Remove anchor pins and shoe assemblies.
5. Loosen Allen screws and remove roller cam followers and pins. Remove slack adjuster.
6. Remove lock ring or loosen lock screw in spacer and remove camshaft.
7. Wire the spacers to the brake spider.
8. Remove washer and nuts from cam shaft and spider.
9. Remove bushings from shoe of bearings and from spider as required.

### REASSEMBLY

1. Install new bushings in brake shoes if required. New bushings must be line reamed to size before assembling shoes.
2. Install new bearings in brake spider as required.
3. Install roller cam followers and pins. Tighten Allen lock screws securely.

### WARNING

When brake drums have been replaced and oversize linings installed, the following repair parts must be used to prevent sticking cams and/or cam "roll-over" and brake failure:

A. Install large washers, felt and washer on cam end of shaft.
B. Install washers, felt retainers and spacers when inserting camshaft through spider and bracket.
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4. Install lock ring or tighten set screw in spacer. Position shoe over spider and tap anchor pin into position with full in line with lock screw hole. Repeat with opposite shoe assembly.

5. Install lock screws, tighten securely and thread with wrench.

6. Insert bushings, retainers and install lock rings.

7. Install shoe return spring. Install slack adjuster on pinion end of cam shaft and adjust as required.

8. Assemble snap rings using washers to take up end play if necessary.

**ADJUSTMENT**

New limit should be circle ground and adjusted to a few thousandths less than drum diameter. Install slack adjuster on pinion end of cam shaft and adjust as required. See Slack adjustment in section.

**AIR HORNS AND VALVE (OPTIONAL)**

The purpose of the air horns is to provide a warning signal of vehicle volume and carrying qualities than usually found on conventional vehicles. The horns are designed on the principle of creating a diaphragm: they consist of die cast bodies, diaphragms, and two black painted horn bells, with the bells in a differential position.

The horns are operated by pushing down on the button of the horn operated horn valve. This action pushes the diaphragm valve stem in the horn valve and opens the supply valve. When air enters the cavity in each air horn on one side of the diaphragm, pressure builds up on the diaphragm, deflects it, and the air escapes through the horn bell. This action sets up a vibration of the diaphragm in each horn bell. These two different lengths of horn bells give the horn its dual tone. The vibrations are set up in an air column denser than atmosphere, due to escaping compressed air, which produces a double tone carrying qualities.

**MAINTENANCE AND TESTING**

Every 10,000 miles (16,000 km), remove the strainer in the bottom of horn valve and clean thoroughly with cleaning solvent. Remove dirt screens in the horn bells and clean. Refer to figure 4-23.

Every 50,000 miles (80,000 km), disassemble the air horn and clean all parts. Disassemble the air horn valve and clean all parts.

Operating Test: With air pressure in the system, operate the horn valve and the horn should give a loud, clear dual tone horn blast.

Leakage Test: With the horn valve in the released position, leakage at the delivery port or at the valve stem at the top of the horn valve should not exceed a one-inch (25.4 mm) soap bubble in one second. With the horn valve applied, leakage at the stem at the top of the horn valve should not exceed a one-inch (25.4 mm) soap bubble in one second.

**REMOVAL AND DISASSEMBLY**

**AIR HORN**

1. Disconnect the air line to the air horn. Remove air horn mounting nut and remove horn. Refer to Figure 4-41.

2. Remove the eight nuts and bolts holding the two covers to the body.

3. Remove the diaphragms from the body of the air horn.

4. Remove the spring, contact, springs, and the spring assemblies from the covers of the air horn.

5. Remove the horn bells from the body.

**HORN VALVE**

1. Vent the air system. Disconnect air lines to the horn valve. Remove attaching bolts and remove the horn valve. Refer to figure 4-42.

2. Remove the spring seat from the valve body.

3. Remove the valve stem from the valve body.

4. Remove the strainer and spring from the spring seat.
INSTRUCTION
1. Inspect air horn supply valve and seat. If damaged, they should be repaired or replaced.
2. Wash all air horn metal parts in cleaning solvent.
3. Carefully inspect the diaphragms to be sure they are not cracked, deteriorated, or distorted in any way. If ridges or cracks are found, the diaphragms must be replaced.
4. Inspect condition of the body. Be sure diaphragm seat in body is not chipped or damaged in any way. Check for cracks in the body as necessary.
5. Inspect the bows. If they are cracked or broken, they should be replaced.
6. Inspect the spring contacts. Replace if distorted or deteriorated.
7. Check the spring, if broken, replace.

AD-2 AIR DRYER
Prior to Unit 41089

The AD-2 air dryer is installed at the front of the front bogie in the main air line between the compressor and the wet air tank. See figure 4-44. The purpose of the air filter dryer is to remove water and oil vapor from the air system, by means of condensation and desiccant. This provides a longer component life and helps prevent freeze-up. The system is self-purging during the unloading cycle of the air compressor.

The housing assembly consists of two cylindrical steel stampings welded together. A safety valve is mounted in the lower housing assembly protecting against excessive pressure within the housing. Refer to figure 4-44.

The desiccant sealing plate assembly is located midway in the assembly and houses a replaceable bail-type single check valve. Also located in the plate assembly is the purge orifice.

The desiccant cartridge and the pleated paper oil filter are removable and comprise a complete, serviceable unit.

The desiccant, which is referred to as the "drying bed," is a drying substance that has the unique property of exposing a tremendous surface area in proportion to its bulk. One pound of desiccant beads has about two million square feet of adsorptive area made up of a large number of microscopic cavities in each bead. Each desiccant bead absorbs or collects moisture.

The desiccant is held in place by steel perforated plates and filter cloths. The top plate is held in place by a spring and the bottom plate rests on a shoulder approximately 1/4 (3.1 mm) from the bottom of the cartridge housing.

The end cover assembly is retained by a lock ring, castle screws and retainers and houses the purge valve and heater assembly.

The heater and thermostat assembly prevent freeze-up of the purge drain valve when the dryer is used in severe winter conditions.

The 120 volt, 24-volt DC heater and thermostat assembly has an operating range between 50°F - 85°F (10°C - 29°C).
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Every 25,000 miles (40,000 km) or every three months, perform the following maintenance procedure:

1. Check for moisture in the brake air system by draining air reservoirs and checking for presence of water.

NOTE: In areas where more than approximately a 30°F (17°C) range of temperature is common, small amounts of water can accumulate in the air brake system due to condensation. The presence of small amounts of water is normal.

2. Check mounting bolts for tightness. Check all air and electrical connections.

3. Check the operation of the integral single check valve in the air dryer. Build the air system to governor cut-out (115-118 psi/793-814 kPa) and observe the test air gauge installed in the wet air tank reservoir. A rapid loss of pressure could indicate a failed check valve. This can be confirmed by checking at the purge valve exhaust.

NOTE: Purge valve will be open when governor cut-out (115-118 psi/793-814 kPa) pressure is reached. Allow two minutes for purge cycle before testing the check valve.

4. Check for excessive leakage at the purge valve by coating the exhaust with a soap solution while the compressor is loaded (compressing air).

5. Check the operation of the safety valve by pulling the exposed stem while the compressor is loaded (compressing air). There must be an exhaust of air while the stem is held and the valve should reset when the stem is released.

6. Check all air lines and fittings leading to and from the air dryer for leakage and integrity.

7. Check the operation of the heater and thermostat during cold weather operation. This can be done by allowing the end cover assembly to cool below 50°F (10°C) and feeling the end cover when the heater is turned on. The end cover should be warm to the touch within a few minutes. Warming should cease at about 85°F (29°C).

8. The desiccant cartridge interval may vary; however, it is generally recommended that the desiccant be replaced every 12 months. If experience has shown that extended or shortened life has resulted for a particular installation, the interval can be increased or reduced accordingly.

REPLACING OR REBUILDING AIR DRYER

If any of the routine serviceability tests, one or more components of the air dryer requires replacement or maintenance, refer to the following kits for replacement parts.

A. TMC/MD Part No. 4R-19-77: DESCICANT CARTRIDGE REPLACEMENT KIT — This kit contains a factory replacement desiccant cartridge and parts necessary to rebuild the desiccant sealing plate.

B. TMC/MD Part No. 4R-19-78: DESCICANT SEALING PLATE — This kit contains necessary parts to rebuild the air dryer end cover purge valve.

C. TMC/MD Part No. 4R-19-79: CHECK VALVE MAINTENANCE KIT — This kit contains necessary parts to rebuild the check valve.

NOTE: Air dryer parts diagram (figure 4-46) is found at end of section, before Troubleshooting.

1. Make certain the vehicle is safely parked. Block the wheels if necessary.

2. Vent the air system completely, being sure that the lines leading into and out of the air dryer are at atmospheric pressure.

3. Disconnect the air line from the end cover and mark the location of the port on the air dryer.

4. Disconnect the heater wire.

5. Loosen the three capscrews on the end cover and turn the retaining clamps aside (capscrews may be left finger tight).

6. Locate the nut in the air dryer shroud. While pushing the end cover up into the dryer, insert the blade of a screwdriver into the nut and slowly pry out the retaining ring. Remove the end cover assembly and set it aside temporarily.

7. Using a "T" socket wrench, remove the cartridge and desiccant sealing plate assembly.

NOTE: Be certain the desiccant sealing plate assembly comes out with the cartridge.

REMOVING AND REBUILDING DESCICANT SEALING PLATE

Before the desiccant cartridge can be replaced or rebuilt, the desiccant sealing plate must be removed. All non-metallic parts should be replaced when the plate is removed. Removing the single hex lock nut will permit the desiccant plate to be separated from the desiccant cartridge. After removing the desiccant cartridge:

1. Remove the two O-rings from the desiccant plate and desiccant sealing plate.

2. Remove the bail check valve retaining clip and remove and discard the rubber ball valve.

3. Clean the desiccant plate thoroughly using commercial solvent, making sure the purge orifice and check valve seat are clean.

4. Install a new bail check valve and replace the retaining clip and screw. See figure 4-44.

Figure 4-44. Installing Check Valve.

Figure 4-45. Installing Check Valve.

Figure 4-46. Installing O-Rings On End Cover.

Figure 4-47. Desiccant Cartridge.

1. Thoroughly lubricate the two new O-rings and install them in the respective grooves in the purge plate (figure 4-46).

2. Install the desiccant sealing plate aside for reinstallation on the desiccant cartridge.

REPLACING DESCICANT CARTRIDGE

Prior to installing the new replacement cartridge in the air dryer, the following steps must be followed.

1. Carefully remove the lock nut from the cartridge bolt using a 1/4" open end or box wrench.

CAUTION: Care must be taken not to allow the cartridge bolt to slip out the cartridge when the lock nut is removed. Loose desiccant material will occur should this happen.

2. Install the previously rebuilt desiccant sealing plate on the cartridge bolt so that the ball check retaining clip remains in place.

3. While holding the cartridge bolt, reinstall the lock nut on the cartridge bolt.

CAUTION: Before tightening the lock nut make certain that the shoulder (the un-threaded portion) of the cartridge bolt extends slightly above the perforated desiccant plate.

4. By tightening the lock nut, draw the desiccant sealing plate down into the desiccant cartridge until the shoulder of the desiccant sealing plate is against the cartridge shell.

NOTE: Air dryer parts diagram (figure 4-46) is found at end of section, before Troubleshooting.

1. Refer to figure 4-44. Carefully remove the lock nut on top of the desiccant sealing plate. (The plate is spring loaded; however, the spring load is completely relieved when the nut is removed.)
5. Slide oil filter separator over the cartridge bolt with the gasket surface next to the shell, figure 4-49.
6. Install the bolt with the oil separator into the bottom of the shell and through center hole of the perforated plate in the bottom of the shell. See figure 4-50.

7. Pour the entire package of desiccant material into the shell, making sure none is lost. Handle carefully so that the bolt does not fall out. Refer to figure 4-51.
8. Level the desiccant material and install second perforated plate left cloth down. (Make sure the shoulder of the bolt is centered and extends slightly above the top of the perforated plate.) See figure 4-52.

NOTE: If the shoulder of the bolt does not extend above the perforated plate, tap the side of the desiccant container.

Figure 4-49. Oil Filter Separator Installation.

Figure 4-50. Installing Bolt With Separator Into Shell.

Figure 4-51. Pouring Desiccant Into Shell.

Figure 4-52. Perforated Plate In Place.

Figure 4-53. Installing Spring and Spring Retainer.

Figure 4-54. Tapping To Settle Desiccant.

1. Remove the purge valve assembly, the large hex cap nut, and discard both O-rings around the cap nut.
2. Using a 7/16" socket wrench and a large screwdriver, remove the 1/4-20 hex head cap screw which holds the assembly together.
4. Discard the piston O-ring, the purge valve, and the piston return spring. Wash all remaining parts in a commercial solvent, making sure all surfaces, bores, ports and passages are clean and dry before assembly.

REASSEMBLY OF END COVER ASSEMBLY
1. Lubricate the piston O-ring and install it on the piston.
2. Lubricate and install the piston.
3. Install the purge piston return spring and piston.
4. Install the purge valve in the large cap nut so that the rubber portion rests on the metal seat of the capnut.
5. Secure the valve to the piston using the 1/4-20 capscrew and lockwasher and torque to 50 inch lbs. (5.6 Nm).
6. Lubricate and install the two capnut O-rings.
7. Lubricate the capnut threads and the capnut bore of the end cover and install the capnut, tightening to 180-220 inch lbs. (20.3-25.2 Nm) torque.
8. Secure the exhaust diaphragm to the exhaust cover using the No. 5-32 phillips head screw and diaphragm washer.
9. Secure the exhaust cover to the purge valve hex head capnut using No. 6-32 phillips head screws.
10. Lubricate and install the large diameter O-ring around the end cover assembly.

CAUTION: The heater and thermostat assembly in the dryer and cover are non-serviceable. Do not remove the thermostat cover. Should this assembly become defective, the end cover must be replaced.
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REBUILDING OUTLET PORT CHECK VALVE
1. Make certain the vehicle is safely parked. Block the wheels if necessary.
2. Loosen and remove the line connected to the outlet port.
3. Remove the check valve from the outlet port.
4. Remove the rubber sealing ring from the external threaded portion of the body and discard it.
5. Disassemble the check valve by unscrewing the body halves and removing the O-ring from the valve.
6. Discard and replace the check valve, valve spring and metal seal washer.
7. Wash all parts in commercial solvent making sure all surfaces are clean and dry prior to reassembly.
8. Coat all parts with a film of barium base lubricant.
9. Reassemble the check valve and tighten the body halves to 200-225 inch lbs. (22.5-25.4 Nm) torque.
10. Reinstall the check valve in the outlet port and reconnect the line leading to the wet air tank.

REINSTALLING DESICCANT CARTRIDGE
1. Wipe the inside of the dryer clean. If solvent is used, be certain that no residue is left in the shell.

Type AD-2 Discharge Filter Dryer

2. Check to be certain a film of barium grease is present on the O-rings and install the cartridge and purge plate assembly into the body. Engage the bolt and tighten to 375 inch lbs or 43 lbs. (42.3 Nm) torque.
3. Check the end cover O-ring to be certain it is clean, coat with a barium lubricant, install the O-ring on the end cover and install the end cover in the dryer body.
4. Position the end cover as marked during removal and install the retaining ring so that the lip of the ring is within 0.005 inch of the body.
5. Grease the threads on the three capscrews and reinstall them with their retainers in the end cover.
6. Reconnect the air control line to the purge valve port in the end cover.
7. Reconnect the thermostat and heater wire.
8. Test the air dryer as outlined under Maintenance.

Figure 4-35. Air Dryer Exploded View.

AD-4 AIR DRYER
Effective With Unit 41089

The air dryer is mounted on the coach ahead of the front fender on the spare tire compartment bulkhead. The bottom section of the dryer is protected by a sheet metal shroud. Refer to figure 4-35.

The function of the AD-4 Air Dryer is to collect and filter air system contaminants in solid, liquid and vapor form before they enter the brake system. It provides clean, dry air to the components of the brake system which increases the life of the system and reduces maintenance costs. Only manual draining of the reservoirs is eliminated.

The AD-4 consists of a die cast aluminum end cover welded to a cylindrical steel outer shell with eight cap screws and nuts. The end cover contains a purge valve diaphragm, a safety valve and three threaded air connections.

Figure 4-37. Charge Cycle Diagram.

Charge Cycle — Refer to figure 4-37. When the air compressor is loaded (compressing air) compressed air along with oil, oil vapor, water and water vapor flows through the compressor discharge line to the supply port in the air dryer end cover. The flow velocity, or the speed at which the air and its contaminants travel down the discharge line, is reduced substantially as it enters the air dryer and covers battle system behind the supply port. As air travels through the battle system, its direction of flow changes by 180° several times, causing contaminants to condense and drop to the bottom (sump) of the dryer end cover.

After exiting the end cover battle system, the air flows into the desiccant cartridge. Once in the desiccant cartridge the air first flows through an air separator which removes oil, oil vapor and solid contaminants.

Air, still 100% saturated with water vapor, exits the oil separator and enters the desiccant drying bed. Air flowing through the column of desiccant becomes progressively dryer as water vapor adheres to the desiccant material in a process known as "desorption." The desiccant cartridge using the desorption process typically removes 95% of the water vapor from the air.

The majority of dry air exits the desiccant cartridge through its integral single check valve to fill the hollow purge volume between the desiccant cartridge and outer shell. Some air will also exit the desiccant cartridge through the purge orifice adjacent to the check valve.

Dry air flows out of the purge volume through the single check valve and out the delivery port to the first (upper) reservoir of the air system. The air dryer will remain in the charge cycle until air brake system pressure builds to the governor output setting.
Figure 4-58. Purge Cycle Diagram.

Purge Cycle — Refer to figure 4-58. When air brake system pressure reaches the cutout setting of the governor, the governor unload valve (air compression stops) and the purge cycle of the air dryer begins. The line connecting the governor unload port to the AD-4 end cover control port is pressurized when the governor unloads the compressor. Air pressure at the AD-4 end cover control port is also present on the purge valve piston. The purge valve piston moves in response to air pressure causing the purge valve to open to atmosphere.

Contaminants in the end cover sump are expelled immediately when the purge valve opens. Also, air which was flowing through the desiccant cartridge changes direction and begins to flow toward the open purge valve. Oil and solid contaminants collected by the oil separator are removed by air flowing from the desiccant drying bed to the open purge valve.

The initial purge and desiccant cartridge decompression lasts only a few seconds and is evidenced by an audible burst of air at the AD-4 exhaust.

The actual reactivation of the desiccant drying bed begins as dry air flows from the purge volume through the desiccant cartridge purge orifice and into the desiccant drying bed. Pressurized air from the purge volume expands after passing through the purge orifice; its pressure is lowered and its volume increased. The flow of dry air through the drying bed reactivates the desiccant material by removing the water vapor adhering to it. Generally 15 to 30 seconds are required for the entire purge volume of a standard AD-4 to flow through the desiccant drying bed.

The end cover single check valve prevents air pressure in the brake system from returning to the air dryer during the purge cycle. After the 30-second purge cycle is complete, the air dryer is ready for the next charge cycle to begin. The purge valve will remain open after the purge cycle is complete and will not close until air brake system pressure is reduced and the governor signals the compressor to charge.

Figure 4-59. AD-4 End Cover (Bottom View).

b. Turn off the ignition and cool the end cover assembly to below 40°F (4°C). Using an ohmmeter, check the resistance between the electrical terminal (plug boot back) and the metal end cover (see figure 4-59). Resistance should be 4.0-7.0 ohms.

c. Warm the end cover assembly to over 90°F (32°C) and check the resistance as in b. Above the resistance should exceed 1000 ohms.

With the ignition OFF, remove the thermostat cover (see figure 4-60). Using an ohmmeter, check the resistance between the metal end cover and the heater post (figure 4-60). It should be 4.0-5.0 ohms. If the resistance reading is outside the stated limits, a new or remanufactured end cover should be installed, since the heater element cannot be serviced.
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REMOVAL

1. Make sure the coach is safely parked. Block the wheels if necessary.
2. Vent the air system completely, being sure that the lines leading into and out of the air dryer are at atmospheric pressure.

NOTE: Observe basic safety rules so leaking air springs will not present a safety hazard.
3. Remove the metal shroud protecting the air dryer.
4. Identify and disconnect the three air lines from the end cover and note the position of the end cover ports relative to the coach.
5. Pull the boot from the thermostat and heater cover and slide it onto the wire to expose the connection. Remove the nut and disconnect the electrical wire from the thermostat terminal.
6. Refer to figures 4-61 and 4-62. Loosen the two ¼ x 4½" hex bolts securing the mounting straps on the back side of the dryer. Disengage the mounting bracket hook from the end cover.

Figure 4-61. AD-4 Air Dryer Cross Section.

DISASSEMBLY

1. Refer to figure 4-62. Remove the eight ½" crown nuts, spring washers, special washers and capscrews from the flange of the air dryer and separate the end cover from the air dryer shell.
2. Separate the desiccant cartridge and sealing plate from the end cover. Remove and discard the three sealing rings. One sealing ring is located in the groove on the sealing plate and the other two are in grooves in the end cover.
3. Remove the ¼" capscrew and lock washer from the bottom of the purge valve and remove the diaaphragm retainer, exhaust diaaphragm and purge valve. Discard the exhaust diaaphragm and purge valve. Remove the purge valve piston and discard the O-ring.
4. Remove and discard the check valve assembly in the recess at the delivery port on the end cover.
5. Remove the safety valve from the end cover (only if it has been determined during service checks that it needs replacement).
6. To remove the thermostat, see Thermostat Repair, below (only if it has been determined that it needs replacement).
7. Remove the exhaust piston and spring from the top side of the cover.
8. Remove the O-ring from the exhaust piston and discard the O-ring.
9. Remove the four ¼" capscrews and lock washers that secure the sealing plate to the desiccant cartridge. Separate the sealing plate from the desiccant cartridge and discard the sealing ring at the base of the cartridge.

Figure 4-62. AD-4 Parts Breakdown.
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TROUBLESHOOTING

1. Air Pressure Drops Quickly With Engine Stopped and Brakes Released
   - Leaking brake valve tubing or hose line
   - Air compressor discharge valve leaking
   - Compressor governor leaking
   - Brake system leaking

2. Air Pressure Drops Quickly With Engine Stopped and Brakes Fully Applied
   - Leaking brake chamber diaphragm
   - Leaking brake cylinder or brake valve
   - Leaking tubing or hose line

3. Brakes Grab
   - Brake on brake lining — reline brakes
   - Brake drum out of round
   - Brake lining binding

4. Insufficient Brakes
   - Brakes need adjusting, lubricating or realining
   - Low air pressure in brake system — below 80 pounds (352 kPa)
   - Brake valve delivery pressure below normal

5. Brakes Apply Too Slowly
   - Brakes need adjusting or lubricating
   - Low air pressure in the brake system — below 80 kPa (352 kPa)

6. Brakes Release Too Slowly
   - Brake valve delivery pressure below normal
   - Excessive leakage with brakes applied
   - Restricted tubing or hose line

7. Brakes Do Not Apply
   - No air pressure in brake system
   - Restricted or broken tubing or hose line

8. Brakes Do Not Release
   - Brake rigging binding
   - Brake valve not in fully released position
   - Restricted breakage valve

9. Uneven Brakes
   - Brakes need adjusting, lubricating or realining

10. Air Pressure Will Not Rise to Normal
    - Detecting air gauge (registering incorrectly)
    - Excessive leakage
    - Reservoir drain cock open
    - Governor out of adjustment

11. Air Pressure Rises to Normal Too Slowly
    - Excessive leakage
    - Clogged air cleaner
    - No clearance at compressor unloading valves
    - Engine speed too low

12. Air Pressure Rises Above Normal
    - Detecting air gauge (registering incorrectly)
    - Compressor governor out of adjustment
    - Detecting compressor governor

13. Compressor Fails to Maintain Sufficient Pressure in Air System
    - Dirty intake strainer
    - Restriction in compressor intake discharge lines or cavities

14. Noisy Compressor Operation
    - Loose drive gear
    - Excessively worn drive coupling
    - Worn or burnt out bearings
    - Excessive wear
    - Improper lubrication to the compressor
    - Restrictions in the cylinder head or discharge line
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TROUBLESHOOTING

15. Compressor Passes Excessive Oil
   Dirty air strainer
   Oil supply lines to compressor or return lines flooded
   Back pressure from engine crankcase
   High inert vacuum at the compressor
   Excessive engine oil pressure
   Defective oil seal or oil seal ring in end cover
   Piston rings improperly installed
   Excessive ring or cylinder wear

16. Compressor Knocks Continuously or Intermittently
   Loose drive gear
   Worn or burnt out bearings
   Excessive carbon deposits in compressor cylinder head

17. Compressor Fails to Unload
   Detect or worn unloaders pistons or bores
   Inert cavity restrictions
   Defective governor
   Unloader line from governor pistons kinked or the cavity between the unloaders pistons restricted
   Unloader mechanism binding or kinked

18. Safety Valve "Blows Off"
   Safety valve out of adjustment
   Air pressure in the air brake system above normal

19. Dryer is Constantly "Cycling" or Purging
   Excessive system leakage
   Defective check valve between air dryer and first reservoir (check valve to outlet port)
   Defective governor
   Leakage purge valve in air dryer end cover (control side)
   Compresor unloader mechanism leakage excessively

20. Water in Air System Reservoirs
    Desiccant requires replacement
    Air system charged from outside air source (outside air not passing through air dryer)
    Air dryer not purging (see Symptom #23)
    Purge (air exhaust) time insufficient due to excessive system leakage (see causes for Symptom #10)

21. Safety Valve on Air Dryer "Popping Off" or Exhausting Air
    Desiccant cartridge plugged or saturated
    Defective check valve between air dryer outlet port and first reservoir (check valve in outlet port)
    Defective fittings, hose or tubing between air dryer and first reservoir

22. Constant Exhaust of Air at Air Dryer Purge Valve
    Exhaust or Unable to Build System Pressure
    Air dryer purge valve leaking excessively
    Defective governor
    Purge control line connected to reservoir or exhaust port of governor
    Purge valve frozen open — faulty heater and thermostat, wiring, blown fuse
    Inlet and outlet air connections reversed
    Check valve between air dryer and first reservoir defective
    Kinse or blocked (plugged) discharge line
    Excessive bends in discharge line (water collects and freezes)
    Excessive system leakage

23. Air Dryer Does Not Purge or Exhaust Air
    Broken, kinked, frozen, plugged or disconnected purge control line
    Faulty air dryer purge valve
    See causes for Symptom #22

24. Desiccant Material Being Expelled from Air Dryer
    Purge Valve Exhaust (may look like whitish liquid or paste or small beads)
    This symptom is almost always accompanied by one or more of 19 to 23; see related causes for those symptoms above
    Air dryer not securely mounted (excessive vibration)

25. Unable to Remove End Cover, or Unable to Install New Desiccant Cartridge
    Result of reversing the inlet and outlet connections

26. Air Dryer End Cover Separates From Air Dryer Housing During Operation
    Excessive system pressure built up within air dryer
    Caused by either plugged desiccant check valve failure, frozen or obstructed discharge line (between air dryer and first reservoir) or governor failure in conjunction with safety valve failure

Specifications

COMPRESSOR

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Bendix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>T-10 700</td>
</tr>
</tbody>
</table>

MC/MCI Part No.

| Standard (A) Connecting Rods | 4R-7-1 |
| Optional (B) Connecting Rods | 4R-7-2 |

Displacement: 15.5 cu. ft. (439 liters)

Maximum RPM: 3000 (recommended)

INTER BLOCK

| Flywheel Out-Of-Round | .001" max |

INTER HEAD

| Gearscrew Torque | 175-225 in. lbs. (19.7-25.4 Nm) |

FRONCASE

| With Ball Bearing Main Bearings Gap Between Outer Race O.D. and Crankcase Bore Dia | .000"- .0015" (0-0.038 mm) |
| With Sleeve-Type Main Bearings Gap Between Crankshaft Journal O.D. and Main Bearing Dia | .005" (1.27 mm) max |

PISTONS

| Clearance Between Cylinder Bore and Piston | .002" - .004" (0.051 - 0.102 mm) |
| Clearance Between Wrist Pin and Piston | .010" - .024" (0.254 - 0.610 mm) |
| Oversize Pistons Available | .020" - .030" (0.508 - 0.762 mm) |

PISTON RINGS

| Ring Gap (in Cylinder) | .002" - .004" (0.051 - 0.102 mm) |
| Clearance Between Ring and Ring Groove | .002" - .004" (0.051 - 0.102 mm) |

CRANKSHAFT

| Standard Journal O.D. | .01250" - .01242" (2.875 - 2.855 mm) |
| Journals Regrip Specifications | .010" - .024" (0.254 - 0.610 mm) |
| Outside Diameter Journal | .020" - .058" (0.508 - 1.473 mm) |
| Clearance Between Wrist Pin and Main Bearing Journal | .005" (1.27 mm) max |
| Clearance Between Wrist Bearing and Main Bearing Journal | .010" - .024" (0.254 - 0.610 mm) |

CONNECTING RODS

| Clearance Between Wrist Pin O.D. and Connecting Rod Bushing | .002" - .007" (0.005 - 0.177 mm) |
| Wrist Pin / Bushing Clearance Is Worn | |
| Can Be Replaced If Connecting Rods Are Steel, If Rods Are Aluminum, New Rod Assembly Must Be Installed |
| Insurance Connecting Rod Journal and Rod Bearing (After Rebuilding) | .0003" - .010" (0.076 - 0.253 mm) |
| Taper for Bolts on Rod Caps | 125-140 in. lbs. (14.1-15.6 Nm) |

CHARGE VALVE TRAVEL

| .030" - .049" (7.62 - 12.44 mm) |

INLET VALVE

| Distance From Cylinder Block Top to Inlet Valve | 4.8 - 5.4 mm |

GOVERNOR

| Manufacturer | Bendix |
| Model | T-10 |
| MC/MCI Part No. | 4C-6-33 |
## MC-9 MAINTENANCE MANUAL

### SPECIFICATIONS

Cut-in Pressure .......................................................... 95-105 psi (655-724 kPa)
Cut-Out Pressure .......................................................... 115-118 psi max. (793-814 kPa)
Exhaust Valve Travel .................................................... 0.060" - 0.093" (1.524-2.362 mm)
Inlet Valve Travel ....................................................... 0.130" - 0.140" (3.302-3.556 mm)

### BRAKE CHAMBERS

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>FRONT Type</th>
<th>REAR Type</th>
<th>TRAILING Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bendix</td>
<td>24</td>
<td>30</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Max. Stroke</th>
<th>Min. Stroke w/Brake Adj.</th>
<th>Effective Diaphragm Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>7½&quot; (184.1 mm)</td>
<td>8½&quot; (206.3 mm)</td>
<td>3½&quot; (84.2 mm)</td>
<td>24 sq. in (6.1548 sq. cm)</td>
</tr>
<tr>
<td>4½&quot; (88.9 mm)</td>
<td>3½&quot; (84.2 mm)</td>
<td>1½&quot; (38.1 mm)</td>
<td>30 sq. in (76.43 sq. cm)</td>
</tr>
</tbody>
</table>

### AIR LINE CHECK VALVE

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model No.</th>
<th>MC Part No.</th>
<th>Air Pressure Differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bendix</td>
<td>229603</td>
<td>4C-22-17</td>
<td>2 psi (13.8 kPa)</td>
</tr>
</tbody>
</table>

### SLACK ADJUSTERS (MANUAL)

Manufacturer ....................................................... Bendix Westinghouse
Model No. ......................................................... LH Front & RH Rear 288538
......................................................... RH Front & LH Rear 288537

### SLACK ADJUSTERS (AUTOMATIC)

Manufacturer ....................................................... SAB
Model No. ......................................................... LH Front & RH Rear 409-10029
......................................................... RH Front & LH Rear 409-10030

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Service Bulletins will be issued from time to time to acquaint users with the latest service procedures. The number, date and time of bulletins pertaining to this section should be noted below as soon as received. Bulletins should then be filed for future reference.