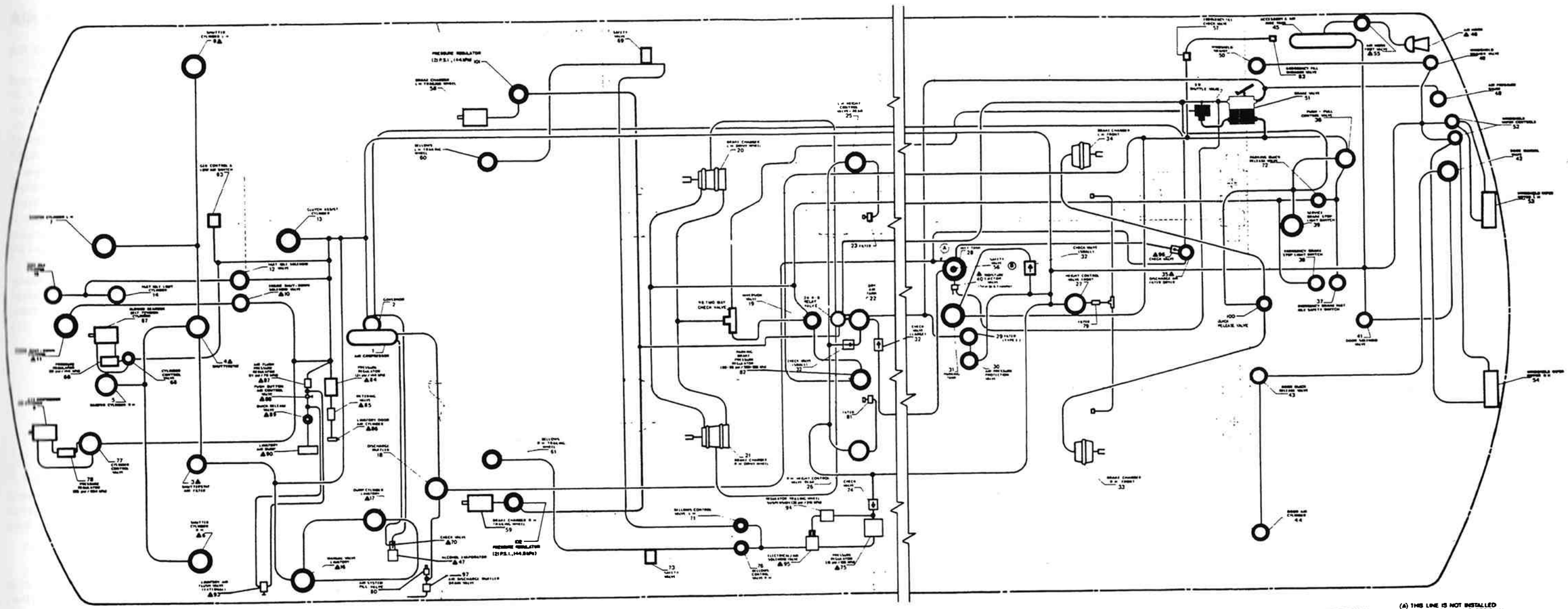
Date 1-1-89

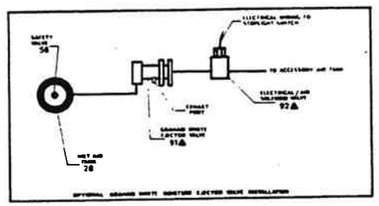
MC-9 MAINTENANCE MANUAL

SECTION 4

AIR SYSTEM AND BRAKES

SUBJECT **PAGE**





ITEM	DESCRIPTION	LOCATION
1	AIR COMPRESSOR	ENGINE COMPT.
2	GOVERNOR	ENGINE COMPT.
3 ▲	SHUTTERSTAT AIR FILTER	ENGINE COMPT.
4 ▲	SHUTTERSTAT	ENGINE COMPT.
5	DAMPER CYLINDER - R. H.	BLOWER COMPT.
6 ▲	SHUTTER CYLINDER - R. H.	ENGINE COMPT.
7	DAMPER CYLINDER - L. H.	BLOWER COMPT.
8 ▲	SHUTTER CYLINDER - L. H.	ENGINE COMPT.
9	A/C AIR CYLINDER	ENGINE COMPT.
10 ▲	ENGINE SHUT-DOWN SOLENOID VALVE	ENGINE COMPT.
11 ▲	ENGINE SHUT-DOWN CYLINDER	ENGINE COMPT.
12	FAST IDLE SOLENOID VALVE	ENGINE COMPT.
13	CLUTCH ASSIST CYLINDER	ENGINE COMPT.
14	FAST IDLE LIMIT CYLINDER	ENGINE COMPT.
15	FAST IDLE CYLINDER	ENGINE COMPT.
16 ▲	MANUAL VALVE - LAVATORY	ENGINE COMPT.
17 ▲	DUMP CYLINDER - LAVATORY	ENGINE COMPT.
18	DISCHARGE MUFFLER	ENGINE COMPT.
19	INVERSION VALVE	REAR WHEEL HSG.
20	BRAKE CHAMBER - L. H. DRIVE WHEEL	REAR WHEEL HSG.
21	BRAKE CHAMBER - R. H. DRIVE WHEEL	REAR WHEEL HSG.
22	DRY AIR TANK	REAR WHEEL HSG.
23	L. H. REAR SUSPENSION AIR FILTER	REAR WHEEL HSG.
24	2-3 RELAY VALVE	REAR WHEEL HSG.
25	HEIGHT CONTROL VALVE - L. H. - REAR	REAR WHEEL HSG.
26	HEIGHT CONTROL VALVE - R. H. - REAR	REAR WHEEL HSG.
27	HEIGHT CONTROL VALVE - FRONT	FRONT WHEEL HSG.
28	WET AIR TANK	FRONT WHEEL HSG.
29	TYPE "E" FILTER	FRONT WHEEL HSG.

ITEM	DESCRIPTION	LOCATION
30	AIR PRESSURE PROTECTION VALVE	FRONT WHEEL HSG.
31	PARKING TANK	FRONT WHEEL HSG.
32	CHECK VALVE (LARGE & SMALL)	WHEEL HSGS.
33	BRAKE CHAMBER - R. H. - FRONT	FRONT WHEEL HSG.
34	BRAKE CHAMBER - L. H. - FRONT	FRONT WHEEL HSG.
35 ▲	DISCHARGE AIR FILTER DRYER	FRONT WHEEL HSG.
36	PUSH - PULL CONTROL VALVE	INTERIOR - FRONT
37	EMERGENCY BRAKE FAST IDLE SAFETY SWITCH	SPARE TIRE COMPT.
38	EMERGENCY BRAKE STOP LIGHT SWITCH	SPARE TIRE COMPT.
39	SERVICE BRAKE STOP LIGHT SWITCH	SPARE TIRE COMPT.
40 ▲	MOIST. EJECTOR VALVE (SEALCO & TAPELLO ONLY)	FRONT WHEEL HSG.
41	DOOR SOLENOID VALVE	SPARE TIRE COMPT.
42	DOOR MANUAL VALVE	DASH
43	DOOR QUICK RELEASE VALVE	SPARE TIRE COMPT.
44	DOOR AIR CYLINDER ENT. DOOR	INTERIOR - FRONT
45	ACCESSORY & AIR RIDE TANK	TOOL COMPT.
46 ▲	AIR HORN	ENGINE COMPT.
47 ▲	ALCOHOL EVAPORATOR	ENGINE COMPT.
48	AIR PRESSURE GAUGE	DASH
49	WINDSHIELD WASHER VALVE	DASH
50	WINDSHIELD WASHER	TOOL COMPT.
51	BRAKE VALVE	SPARE TIRE COMPT.
52	WINDSHIELD WIPER CONTROLS	DASH
53	WINDSHIELD WIPER MOTOR - L. H.	EXTERIOR - FRONT
54	WINDSHIELD WIPER MOTOR - R. H.	EXTERIOR - FRONT
55 ▲	AIR HORN FOOT VALVE	DRIVER'S FOOT REST
56	SAFETY VALVE (130 psi / 9.00 kPa) (SEE NOTE B)	FRONT WHEEL HSG.
57	EMERGENCY TEE CHECK VALVE	TOOL COMPT.
58	BRAKE CHAMBER - L. H. TRAILING WHEEL	REAR WHEEL HSG.

ITEM	DESCRIPTION	LOCATION
59	BRAKE CHAMBER - R. H. TRAILING WHEEL	REAR WHEEL HSG.
60	BELLOWS - L. H. TRAILING WHEEL	REAR WHEEL HSG.
61	BELLOWS - R. H. TRAILING WHEEL	REAR WHEEL HSG.
62		
63	GENERATOR CONTROL & LOW AIR SWITCH	ENGINE COMPT.
64		
65		
66	BLOWER BELT PRESSURE REGULATOR (21 psi / 144 kPa)	ENGINE COMPT.
67	BLOWER GEARBOX BELT TENSION CYLINDER	ENGINE COMPT.
68	A/CYLINDER CONTROL VALVE	ENGINE COMPT.
69	SAFETY VALVE (150-90 psi / 344-379 kPa) L. H. TRAIL. WH.	ENGINE COMPT.
70 ▲	CHECK VALVE - ALCOHOL EVAPORATOR	ENGINE COMPT.
71	L. H. BELLOWS CONTROL VALVE	ENGINE COMPT.
72	PARKING QUICK RELEASE VALVE	SPARE TIRE COMPT.
73	SAFETY VALVE (130-90 psi / 344-379 kPa) R. H. TRAIL. WH.	ENGINE COMPT.
74	CHECK VALVE - BELLOWS SUSPENSION	ENGINE COMPT.
75 ▲	TRAIL. WH. SUSP. PRESS. REG. (10 psi / 103 kPa) (UNLOAD)	ENGINE COMPT.
76	R. H. BELLOWS CONTROL VALVE	ENGINE COMPT.
77	AC BELT TENSION CYLINDER CONTROL VALVE	ENGINE COMPT.
78	AC BELT TENSION PRESSURE REG. (135 psi / 934 kPa)	ENGINE COMPT.
79	FRONT SUSPENSION AIR FILTER	FRONT WHEEL HSG.
80	AIR SYSTEM FILL CHECK VALVE	ENGINE COMPT.
81	R. H. REAR SUSPENSION AIR FILTER	REAR WHEEL HSG.
82	PARKING BRAKE PRESSURE REG. (80-90 psi / 550-580 kPa)	REAR WHEEL HSG.
83	EMERGENCY FILL SC HEADER VALVE	TOOL COMPT.
84 ▲	LAV. DR. PRESSURE REGULATOR (21 psi / 144 kPa)	UNDER LAV. SINK
85 ▲	LAV. DOOR CYLINDER METERING VALVE	UNDER LAV. SINK
86 ▲	LAV. DOOR CYLINDER	LAVATORY COMPT.
87 ▲	AIR FLUSH PRESSURE REGULATOR (11 psi / 76 kPa)	UNDER LAV. SINK

ITEM	DESCRIPTION	LOCATION
88 ▲	LAV. AIR FLUSH PUSH BUTTON AIR CONTROL VALVE	LAVATORY COMPT.
89 ▲	LAV. AIR FLUSH QUICK RELEASE VALVE	UNDER LAV. SINK
90 ▲	LAV. AIR FLUSH PUMP	ENGINE COMPT.
91 ▲	CARLISLE WHITE MOISTURE EJECTOR VALVE	FRONT WHEEL HSG.
92 ▲	ELECTRICAL / AIR SOLENOID VALVE	FRONT WHEEL HSG.
93 ▲	LAVATORY AIR FLUSH VALVE (EXTERNAL)	ENGINE COMPT.
94	REGULATOR TRAILING WH. SUSP. (35 psi / 241 kPa)	ENGINE COMPT.
95 ▲	ELECT / AIR SOLENOID VALVE (TR SUSP UNLOAD)	ENGINE COMPT.
96 ▲	CHECK VALVE AIR DRYER WHEEL HSG.	FRONT WHEEL HSG.
97	DRAIN VALVE - AIR DISCHARGE MUFFLER	ENGINE COMPT.
98	TWO WAY CHECK VALVE	REAR WHEEL HSG.
99	SHUTTLE VALVE	APARK TIRE COMPT.
100	FRT. BRAKE QUICK RELEASE VALVE	ENGINE TIRE COMPT.
101	TRAIL. WH. PRESS. REG. (A. R. (21 P.S.I., 144 kPa)	TRAIL. WH. HSG.
102	TRAIL. WH. PRESS. REG. R.H. (21 P.S.I., 144 kPa)	TRAIL. WH. HSG.
XXX	OPTIONAL EQUIPMENT	

(A) THIS LINE IS NOT INSTALLED ON COACHES HAVING OPTIONAL DISCHARGE AIR DRYER

(B) THIS SAFETY VALVE IS INSTALLED ON DISCHARGE AIR DRYER IN COACHES HAVING OPTIONAL DISCHARGE AIR DRYER

Figure 4-1. MC—9 Air Line Diagram.

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 coach parking brake air system.

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

The brake system consists of brake chambers (one at each wheel), brake application valve, quick release valve, relay valve, parking brake (push-pull) valve, reservoirs, check valves and filters, and necessary fittings and connecting piping. See figure 4-1.

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 slack 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.

PARK'NG - 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).

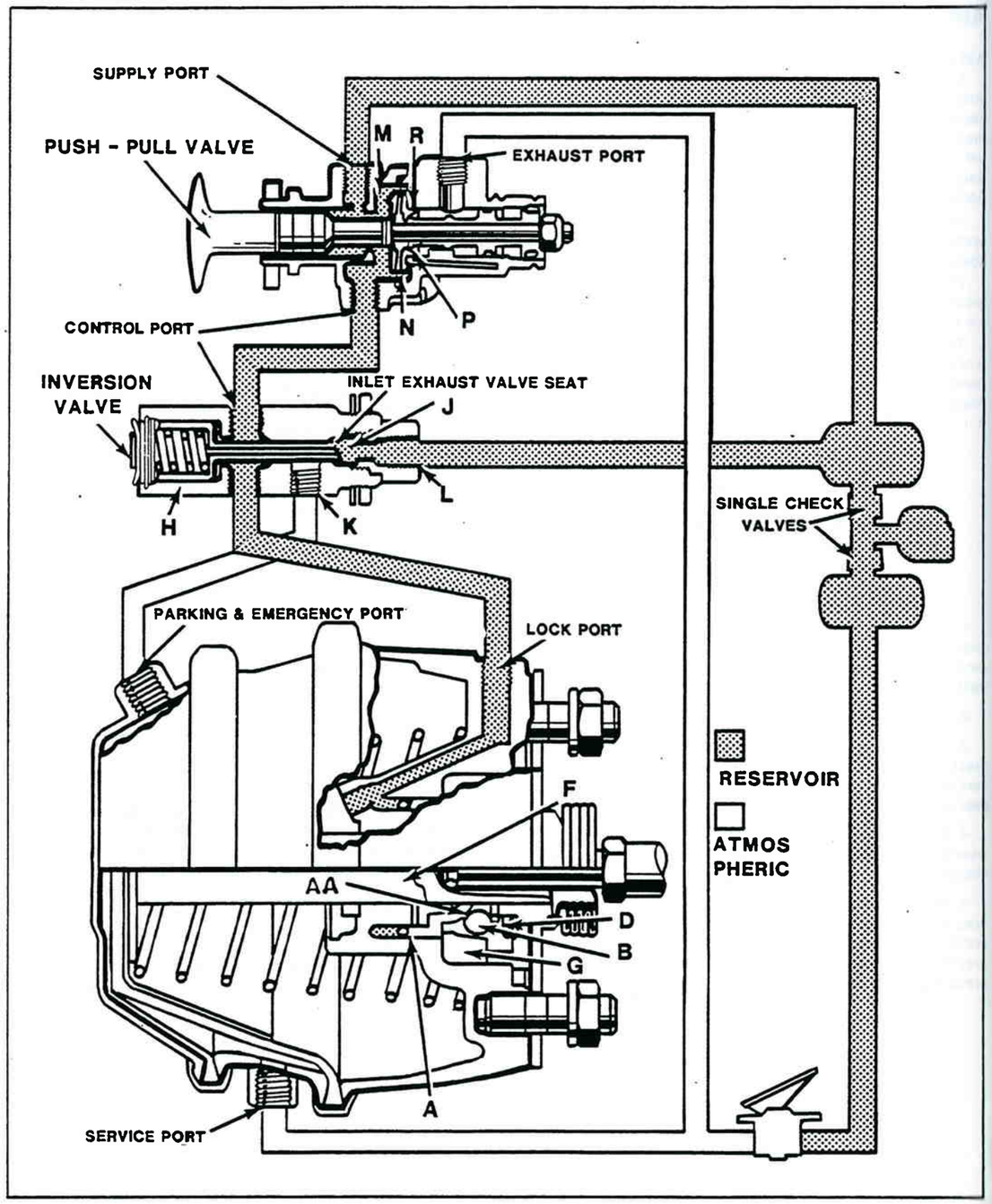


Figure 4-2. Parking Brake Schematic Diagram.

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 handle 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 handle 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.

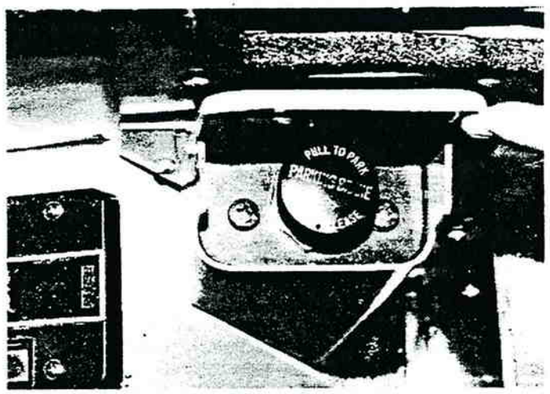


Figure 4-3. Push-Pull Control Valve.

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.

1. Button
2. Spiral Pin
3. Nut
4. O-Ring
5. Body
6. Inlet & Exhaust Valve
7. Lockwasher
8. Machine Screw
9. O-Ring
10. O-Ring
11. Elastic Hex Nut
12. Bottom Cover
13. Piston
14. Sealing Ring
15. Spring
16. Plunger

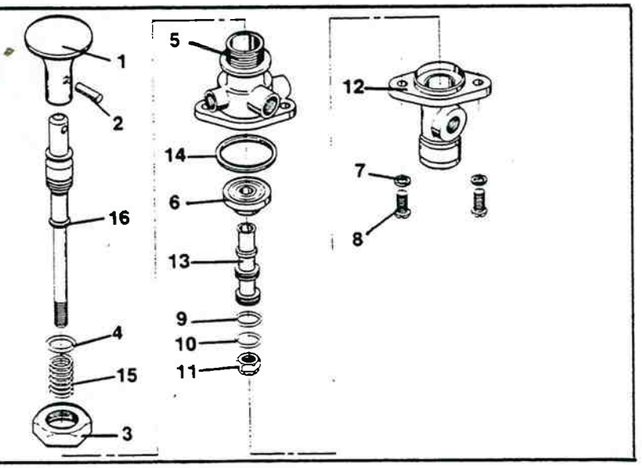


Figure 4-4. Push-Pull Control Valve Parts Breakdown.

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 vehicle dash. Insert a punch or rod in the plunger pin hole to keep the plunger 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, then the lower large piston O-ring, and then 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 assembly, lubricate all O-rings and bearing surfaces of the body and cover with recommended lubricant, MCI/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 port 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) and the control valve is operated, air will pass into the inversion valve from the control valve. This air flows in one control port and exerts a force on the inversion valve piston. At a pressure between 60-70 psi (414-484 kPa), the piston moves against the resistance of the two piston springs. The piston exhaust seat 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.

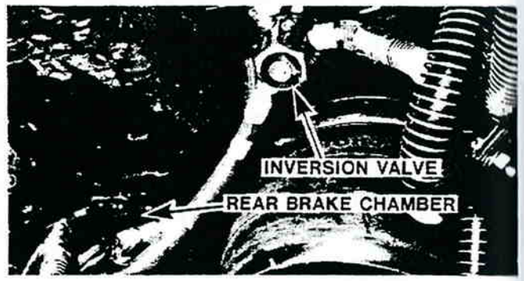


Figure 4-5. TR-2 Inversion Valve Installed

MAINTENANCE

Every year or after 50,000 miles (80,000 km) the inversion valve should be disassembled, cleaned and lubricated. Rubber parts should be replaced and any other parts which show signs of wear or damage should also be replaced.

The air at the inversion valve control ports is exhausted through the control valve exhaust when it is operated. The piston springs will then cause the piston to move and seat on the inlet and exhaust valve closing the exhaust passage. The inlet valve is moved off its seat by the piston exhaust seat so supply air from the isolated reservoir will pass by the open inlet and out the delivery ports.

When the application is released by actuating the control valve, air passes into the inversion valve control port. The piston moves away from the inlet and exhaust valve, opening the exhaust passage through the piston. The inlet valve closes the air in the delivery ports exhausts through the center of the piston stem and out the inversion valve exhaust port.

REMOVAL AND INSTALLATION

1. Block 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. Mount the valve securely with mounting nut and lockwasher.

DISASSEMBLY

1. Refer to figure 4-6. Remove the cap nut with O-ring and remove the O-ring from the cap nut. Remove the inlet valve spring and inlet valve.

2. Turn the valve over and remove the exhaust check valve diaphragm screw, then diaphragm washer and diaphragm.

3. Remove the retaining ring. Remove the cover plate and two piston springs.

4. Remove the piston. Remove the piston O-rings.

REPAIR

1. Wash all metal parts in cleaning solvent and wipe clean. Inspect all parts for excessive wear or deterioration.

2. Check springs for cracks, corrosion, or distortion. Inspect the piston and its exhaust seat, body bores and inlet valve seat for nicks or burrs.

3. Replace all parts not considered serviceable.

REASSEMBLY

Before assembling the valve, lubricate the piston, O-rings and body bores.

1. Install the piston with O-rings in the valve body.

2. Position piston springs, cover plate and retainer ring in the piston in that order.

3. Press the cover and retainer down and snap the ring into the body groove.

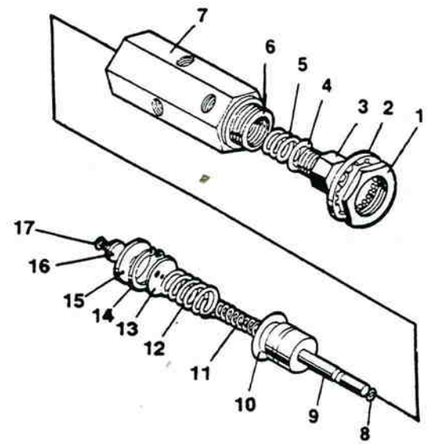
4. Install the diaphragm and diaphragm washer and secure with the cap screw.

5. Turn the inversion 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 capnut. 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.

1. Nut
2. Lock Washer
3. Cap Nut
4. O-Ring
5. Valve Spring
6. Valve
7. Body
8. O-Ring
9. Piston



10. O-Ring
11. Spring
12. Spring
13. Cover Plate
14. Retaining Ring
15. Diaphragm
16. Diaphragm Washer
17. Screw

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, reciprocating compressor with a rated displacement of 15.5 cubic feet (439 Cu Dm) air per minute at 1250 RPM.

The compressor assembly is made up of three cast iron subassemblies; the cylinder head, the cylinder block and the crankcase. The cylinder head houses the discharge valving 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 maximum 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 unloader pistons. This lifts the unloader 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 in doing so exhausts the air from beneath the unloader pistons. The unloader saddle spring forces the saddle, pistons and plungers down and the inlet valves return to their seats. Compression is then resumed.

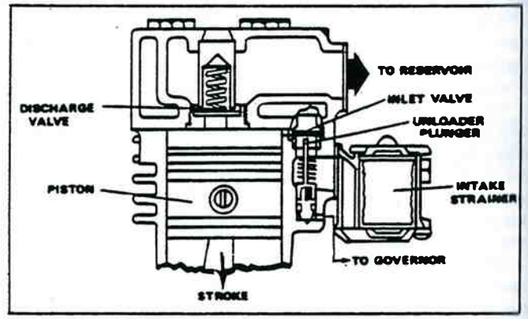


Figure 4-7. Intake Stroke Beginning.

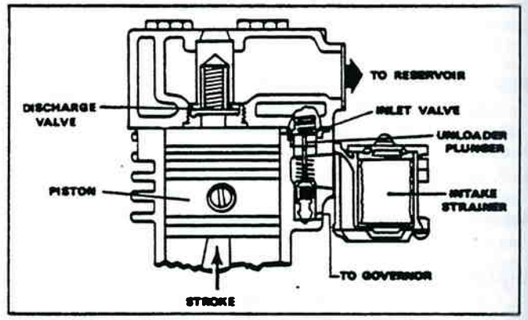


Figure 4-8. Compression Stroke Ending.

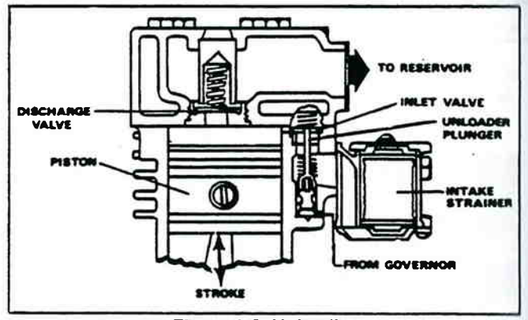


Figure 4-9. Unloading.

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 compressor operation which could indicate a worn drive gear coupling. Check all compressor mounting bolts and retighten evenly if necessary. Check for leakage and proper unloader operation.

Every 12 months, 3,000 operating hours or 100,000 miles (161,000 km) perform a thorough inspection; disassemble the compressor, clean and inspect 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 wear, provided leakage in the air system is not excessive. Oil passing is another sign of excessive wear.

Leakage past the discharge valves can be detected by removing the discharge line, applying shop air back through the discharge port and listening for escaping air. Also the discharge valves and unloader pistons can be checked for leakage by building up the air 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 around 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 engine coolant as described 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 crankshaft.

DISASSEMBLY

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; end 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 inlet valve springs from head and inlet valves from their guides in the block. Scrape off cylinder head gasket from cylinder head and block.
5. Remove discharge valve capnuts and lift out 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 ASSEMBLIES:

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 wrist pin 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 assemblies. Steel connecting rods can be reused and re-bushed if necessary.

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

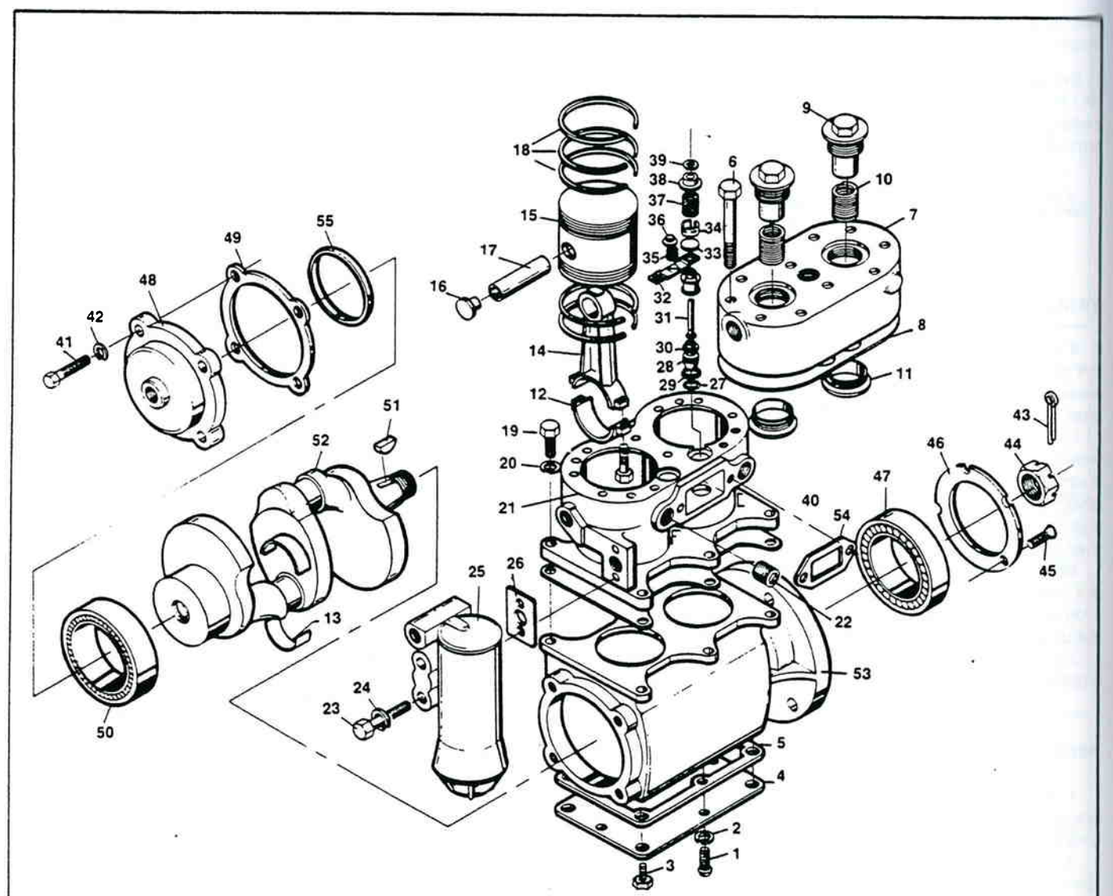
CRANKCASE:

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



1. Machine Screw
2. Lock Washer
3. Capscrew
4. Cover
5. Gasket
6. Capscrew
7. Cylinder Head
8. Gasket
9. Cap Nut
10. Valve Spring
11. Valve Seat
12. Connecting Rod Cap
13. Bearing
14. Connecting Rod
15. Piston
16. Button, Wrist Pin
17. Wrist Pin
18. Piston Ring
19. Capscrew
20. Lock Washer
21. Cylinder Block
22. Pipe Plug
23. Capscrew
24. Lock Washer
25. Governor Assembly
26. Gasket
27. O-ring
28. Piston, Unloader
29. Back-Up Ring
30. Plunger Guide
31. Plunger, Unloader
32. Saddle, Unloader Spring
33. Inlet Valve
34. Guide, Inlet Valve
35. Spring, Unloader
36. Seat, Unloader Spring
37. Spring, Inlet Valve
38. Insert, Spring
39. Seat, Inlet Valve Spring
40. Gasket
41. Capscrew
42. Lock Washer
43. Cotter Pin
44. Nut, Crankshaft
45. Machine Screw
46. Retainer, Bearing
47. Bearing
48. Cover
49. Gasket
50. Bearing
51. Key, Crankshaft
52. Crankshaft
53. Crankcase
54. Gasket
55. Seal

Figure 4-10. Air Compressor.

INSPECTION

1. Check fit of wrist pins on pistons and connecting rod bushings. Wrist pin should be a light press fit in pistons. If wrist pin is a loose fit, the pin, piston, or both should be replaced.

2. Check fit of wrist pin in connecting rod bushing by rocking the piston. This clearance should not exceed .0007" (.0178 mm). Replace wrist pin bushing if excess clearance is found. Wrist pin bushings should be reamed after being pressed into connecting rods. Replace used wrist pin lockwires.

3. Always replace die cast aluminum rods with new ones.

4. Check fit of piston rings in piston ring grooves. Check ring gap with rings installed in cylinder bores. Refer to figure 4-11 for correct gap and groove clearance.

5. Check crankshaft screw threads, keyways, tapered ends and all machined and ground surfaces for wear, scores, or damage. Crankshaft journals which are out of round more than .001" (.0254 mm) must be reground. Bearing inserts are available in .010" (.254 mm), .020" (.508 mm) and .030" (.762 mm) undersizes for reground crankshafts. Main bearing journals must be maintained so bearings are snug fit.

6. The oil seal ring groove or grooves in crankshafts fitted with oil rings must not be worn.

NOTE: The ring groove walls must have a good finish and they must be square. Check to be sure the oil passages are open and clean through the crankshaft.

7. Check connecting rod bearings on crankshaft journals for proper fit. Used bearing inserts should be replaced. Connecting rod caps are not interchangeable. The locking slots of the connecting rod and cap should be positioned adjacent to each other.

8. Check clearance between the connecting rod journal and the connecting rod bearing. It must not be less than .0003" (.0076 mm) or more than .0021" (.0533 mm) after rebuilding.

9. Check for wear or flat spots. If found, bearings should be replaced. If type with sleeve bearing, this bearing should be checked for scores and wear and replaced if necessary.

REPAIRS

DISCHARGE VALVES AND SEATS:

1. If discharge valve seats merely show signs of slight wear, they can be dressed by using a lapping stone, grinding compound and grinding tool. Install new discharge valves, valve springs, and cap nuts. The discharge valve travel should be between .030-.046" (.762-1.168 mm).

2. To test for leakage past the discharge valves, apply about 100 psi (690 kPa) air pressure through the cylinder head discharge port and apply soap suds at the discharge valves and seats. If excessive leakage is found, leave the air pressure applied, and with the use of a fiber or hardwood dowel and hammer, tap the discharge valves off their seats several times. This will help the valves to seat and should reduce any leakage.

3. With air pressure still applied at the discharge port of the cylinder head, check for leakage at the discharge valve capnuts. No leakage is permissible.

INLET VALVES AND SEATS:

4. If inlet valve seats show signs of slight nicks or scratches, they can be redressed with a fine piece of emery cloth or by lapping with a lapping stone, grinding compound and grinding tool. If the seats are damaged to the extent that they cannot be reclaimed, they should be replaced. The dimension from the top of the cylinder block to the inlet valve seat should not exceed .145" (3.683 mm) nor be less than .101" (2.565 mm). Slightly worn or scratched inlet valves can be reclaimed by lapping them on a piece of fine crocus cloth on a flat surface, but it is suggested that new inlet valves be installed.

REASSEMBLY

1. Position block gasket and block on crankcase according to markings made prior to disassembly. Using capscrews with lockwashers, secure cylinder block to crankcase.

2. If the crankshaft is fitted with oil seal rings, install rings. Position ball bearings and crankshaft in crankcase making sure the drive end of the crankshaft is positioned as marked before disassembly.

3. Carefully press crankshaft and bearings into crankcase using arbor press.

4. Position a new rear end cover gasket over the rear end of the crankcase making sure the oil hole in the gasket lines up with the oil hole in the crankcase.

5. Position end cover with oil seal ring installed over crankcase and end cover gasket. The end cover should be positioned correctly in relation to the oil holes in the gasket and crankcase. Secure the end cover to the crankcase with capscrews and lockwashers.

6. If the opposite end cover requires an oil seal (removed on disassembly), a new seal should be pressed into end cover. Position new end cover gasket and carefully install end cover over crankshaft and to crankcase avoiding damage to the seal. Secure end cover with capscrew and lockwashers. If connecting rods are steel, they can be reused and serviced as follows. Do not reuse aluminum die cast connecting rods.

7. If new wrist pin bushings are to be used, they should be pressed into the connecting rods so that the oil hole in the bushing lines up with the one in the rod. The new bushings should then be reamed or honed to provide between .0001" (.0025 mm) and .0006" (.0152 mm) clearance on the wrist pin.

8. Position connecting rod in piston and press in wrist pin so that lockwire hole in the pin aligns with that in the piston.

9. Install new lockwire through piston and wrist pin and lock it by snapping short end into lockwire hole at the bottom of the piston.

10. Install piston rings in correct location with ring pipmarks up. Stagger the position of the ring gaps.

11. Coat piston, piston rings, wrist pin and connecting rod bearings with clean engine oil before installing them in the compressor.

12. Remove connecting rod bolts and bearing cap from one connecting rod.

CAUTION: It is important that caps and rods are not intermixed.

13. Turn crankshaft so one of its connecting rod journals is in the downward, center position. Insert the connecting rod with piston through the top of the cylinder whose journal is down.

14. Position and attach the bearing cap to the connecting rod making sure the bolt and lockwashers are properly positioned on the cap. Tighten connecting rod bolts evenly and bend the two new lockwasher prongs up against the hex head of the bolt.

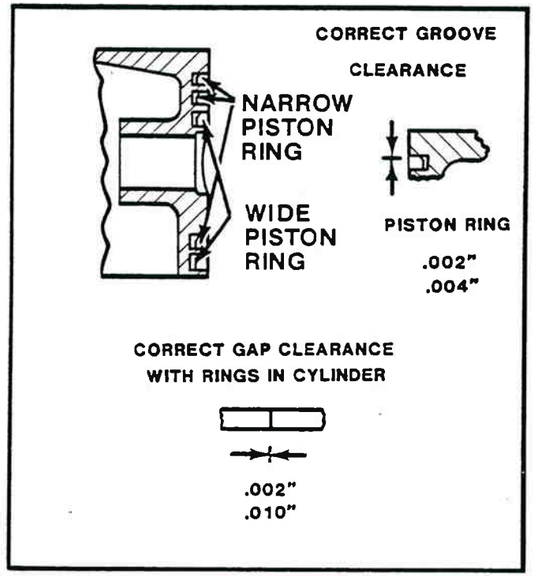


Figure 4-11. Piston Fits and Tolerances.

15. Install the other connecting rod and piston in the same manner.

16. Coat unloader pistons and their bores with special lubricant (dimethyl polysiloxane) prior to installation. If new unloader kits are being installed, the pistons in the kit are already lubricated.

17. Install the unloader pistons in their bores with caution against cutting the O-rings or distorting the back-up rings.

18. Position unloader plungers in their guides and slip them in and over the tops of the pistons.

19. Install the unloader spring seat in the cylinder block; a small hole is drilled in the block for this purpose.

20. Position the saddle between unloader piston guides so its forks are centered on the guides. Install the unloader spring making sure it seats over the spring seats both in the block and on the saddle. (See figure 4-12.)

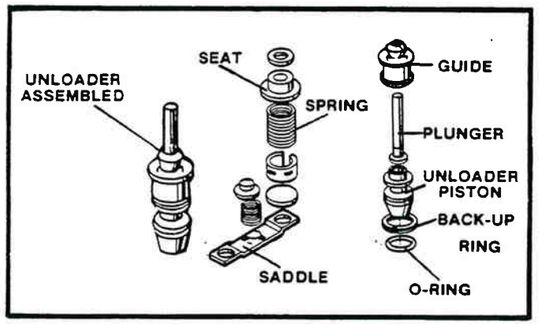


Figure 4-12. Unloader Mechanism.

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 sliding 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 cap nuts.

23. Place the inlet valve springs in the cylinder head. Use a small quantity of grease to hold them in place, just enough grease 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 unrestricted 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 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 inlet 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 the

inlet passage opens. Reservoir air pressure then flows past the open inlet valve, through the passage in the piston and out the unloader port to the compressor unloading mechanism. The air, besides flowing to the compressor unloading mechanism, also flows around the piston and acts on the additional area of the piston, assures a positive action and fully opens the inlet valve.

As the system reservoir air pressure drops to the cut-in setting of the governor, the force exerted by the air pressure on the piston will be reduced so that the pressure setting spring will move the piston down. The inlet valve will close and the exhaust will open. With the exhaust open, the air in the unloader line will escape back through the piston through the exhaust stem and out the exhaust port.

MAINTENANCE

After 15,000 miles (24,000 km), clean or replace governor filters. If cleaning, use a solvent which is known to have no detrimental effect on metal or rubber material. If filters are removed they should be replaced with new filters.

After 100,000 miles (161,000 km), disassemble the governor and clean and inspect all parts. Refer to figure 4-13.

SERVICE CHECKS

1. Start the engine and build up pressure in the air system and check the pressure registered by the dash gauge or test gauge at the time the governor cuts out, stopping the compression of air. The cut-out pressure should be approximately 115-118 psi (793-814 kPa) maximum.

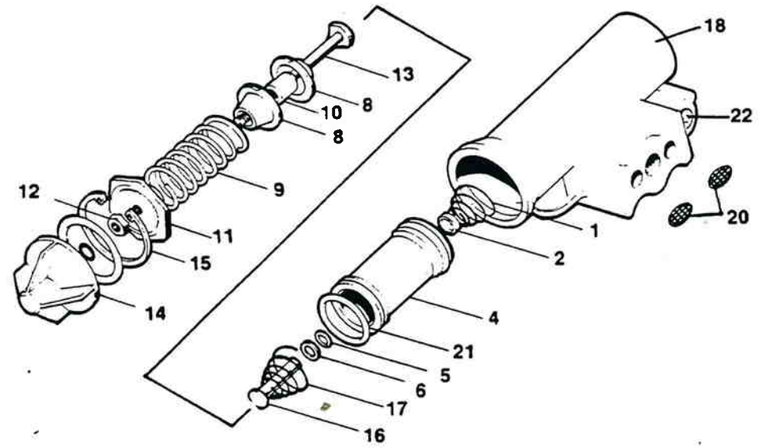
2. With the engine still running, make a series of brake applications to reduce the air pressure and observe at what pressure the governor cuts in the compressor. Cut-in pressure should be 95-105 psi (655-724 kPa).

NOTE: Never doubt or adjust the governor pressure settings unless they are checked with an accurate test gauge or a dash guage that is registering accurately.

3. If the pressure settings of the governor are inaccurate or it is necessary that they be changed, unscrew the cover at the top of the governor and loosen the adjusting screw locknut.

4. With a screwdriver, the adjusting screw is turned counterclockwise to raise the pressure settings, and turned clockwise to lower the pressure setting.

5. After the adjustment is completed, the adjusting screw locknut should be tightened to lock the setting.



1. Valve Spring
2. Valve
4. Piston
5. O-ring
6. Washer
8. Lower Spring Seat
9. Spring
10. Spring Guide
11. Upper Spring Seat
12. Nut
13. Adjusting Screw
14. Cover
15. Retaining Ring
16. Exhaust Stem
17. Exhaust Stem Spring
18. Body
20. Filter
21. O-ring
22. Pipe Plug

Figure 4-13. Governor Parts Breakdown.

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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. Applying 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 block. Clean connecting line, or lines. Also be sure compressor unloading port is clear and clean.
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 retaining 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 piston in the body.
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 stem head is approximately 1.142" (29.006 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 outlies under Service Checks.
8. After the adjustment is made, the top cover should be screwed on 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, clean any accumulated dirt, gravel 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 TMC/MCI Part No. 21-7512-11.

Every 3,600 operating hours or 100,000 miles (161,000 km)

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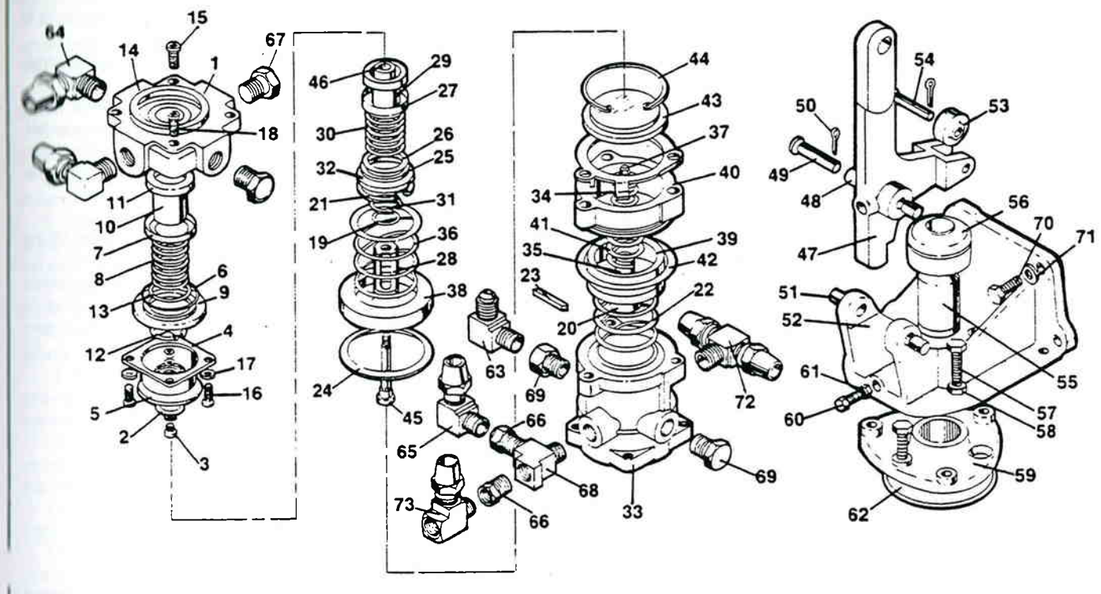


1. O-ring
2. Washer, Diaphragm
3. Screw
4. Cover, Exhaust
5. Diaphragm, Exhaust
6. O-ring
7. Retainer, Valve
8. Spring, Valve
9. Retainer, O-ring
10. Valve, Inlet & Exhaust
11. Body
12. Retaining Ring
13. O-ring
14. Body, Lower
15. Screw, Machine
16. Screw, Machine
17. Lock Washer
18. Capscrew
19. O-ring
20. O-ring
21. Retaining Ring
22. Spring, Piston Return
23. Filter, Vent
24. O-ring
25. O-ring
26. O-ring
27. Retainer, Valve
28. Valve, Inlet & Exhaust
29. Body
30. Spring
31. Retaining Ring
32. Retainer, O-ring
33. Body, Upper
34. Guide, Spring
35. Guide, Spring
36. Spring, Piston
37. Lock Nut
38. Piston, Relay
39. Piston, Primary
40. Adapter
41. Spring, Grod.
42. O-ring
43. Retainer, Spring
44. Retaining Ring
45. Stem
46. Washer
47. Liner
48. Bushing
49. Pin
50. Cotter Pin
51. Bushing
52. Mounting Bracket
53. Roller
54. Pin
55. Plunger
56. Boot
57. Capscrew
58. Lock Washer
59. Adapter Plate
60. Screw, Adjusting
61. Lock Nut
62. Gasket
63. Elbow
64. Elbow
65. Elbow
66. Bushing, Reducer
67. Plug
68. Tee, Street
69. Adapter
70. Capscrew
71. Washer
72. Tee
73. Tee, Street

Figure 4-14. E-10 Brake Valve.

or yearly, the inlet and exhaust valves, exhaust diaphragm, O-rings and rubber graduating spring should be replaced if they show signs of wear or deterioration.

Every 7,200 operating hours or 200,000 miles (320,000 km) or every two years, disassemble the brake valve, clean and inspect all parts. Install new parts where they are found to be worn or damaged.

SERVICE CHECK

Check the service and emergency circuits using test gauges known to be accurate. Depress the pedal to several positions between the fully released and fully applied positions and check the delivered pressure on the test gauge to see that it varies equally and proportionately with the movement of the brake pedal.

After a full application is released, the reading on the test gauge should promptly fall off to zero. Service brake delivery pressure will be about 2 psi (13.8 kPa) greater than the emergency brake delivery pressure with both supply reservoirs at the same pressure. This is a normal condition.

WARNING: A change in vehicle braking characteristics or a low pressure warning may indicate a malfunction in one or the other brake circuit. Although the vehicle air system may continue to function, the vehicle should not be operated until the necessary repairs have been made. Always check the vehicle brakes after performing brake work and before returning the vehicle to service.

LEAKAGE CHECK

1. Coat the exhaust port and body of the brake valve with a soapy solution. See figure 4-15.
2. Make and hold a brake application to 80 psi (552 kPa).
3. Leakage permitted is a one inch (25.44 mm) bubble in three seconds.

If the brake valve has excessive leakage, it can be repaired.

REMOVAL

1. Block the coach wheels and vent the air system reservoirs by opening the drain cocks.
2. Disconnect all supply and delivery structural lines at the brake valve.

NOTE: Tag all air lines and their relation to the brake valve for reconnection.

3. Remove the mounting bolts and the brake valve.

DISASSEMBLY

1. If the entire brake valve and lever assembly was removed from the vehicle, remove the stop light switch and remove the three capscrews securing the treadle assembly to the basic brake valve.
2. Remove the screw securing the exhaust diaphragm and washer to the exhaust cover.
3. Remove the four screws that secure the exhaust cover to the lower body.
4. Remove 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, the spring and the valve retainer.
6. Remove the four hex head capscrews securing the lower body to the upper body and separete the body halves.
7. Remove the rubber seal ring from the lower body.
8. While applying thumb pressure to the No. 1 piston, lift out and up on the three lock tabs of the No. 1 piston retainer.
9. Using a ⅜" wrench, hold the ESNA nut on the threaded end of the stem on top of 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. (22.6 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 piston O-ring.
13. Remove the large and small O-rings from the relay piston.
14. Remdve 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 bores and metal-to-metal surfaces with silicone base lubricant, TMC/MCI Part No. 21-7512-11.

1. Reassemble the service brake inlet exhaust valve assembly by first placing the valve retainer and the valve spring over the inlet and exhaust valve.
2. Place the O-ring retainer with the O-ring grooves away from the spring, over the inlet and exhaust valve and install the O-rings in their proper grooves.
3. Place the washer over the inlet and exhaust valve, against the O-ring retainer and O-rings, and install the retaining ring.
4. Install the service brake inlet and exhaust assembly in the upper body and replace the retaining ring to secure it. Be sure the retaining ring is seated completely in its groove.
5. Install the large and small O-rings on the No. 2 relay piston.
6. Replace the No. 1 piston O-ring in the piston O-ring groove.
7. Install the rubber spring, concave side down, in the No. 1 piston. Place the spring seat, flat side up, over the rubber spring.
8. Install the No. 1 piston spring seat nut, with its hex closest to the spring seat, and rotate clockwise until the top surface of the spring seat is even with the top surface of the piston.
9. Place the No. 1 piston return spring in the upper body piston bore.
10. Install the No. 1 piston, spring seat out, over the return spring and press the piston into the body bore.
11. Place the No. 2 relay piston return spring in the upper body and place the No. 2 relay piston over the spring, so that the concave side of the piston is against the spring.
12. Compress both the No. 1 piston and relay piston into the upper body and hold them compressed, either manually or mechanically.
13. Place the stem through the exhaust passage of the lower body so that the threaded portion is visible at the No. 1 piston.
14. Using a screwdriver to engage and hold the slotted head of the stem, install the stem spring and spring seat. Make certain all three lock taps have engaged and outer lip of the body.
15. Reassemble the emergency brake inlet and exhaust valve assembly as referenced in steps 1, 2 and 3 of this section.
16. Install the emergency brake inlet and exhaust valve assembly in the lower body.
17. Place the exhaust cover on the lower body and install the four machine screws with lockwashers, to secure it to the body.
18. Tighten the four machine screws to 20-30 inch pounds (2.3-3.4 Nm) torque.
19. Install the exhaust diaphragm and diaphragm washer to the exhaust cover using the Phillips head screw and lockwasher.
20. Install the seal ring in the lower body and secure the lower body to the upper body using the four hex head capscrews and lockwashers.
21. Tighten the four capscrews to 70-100 inch pounds (7.9-11 Nm) torque.
22. Install the lever assembly to the basic brake valve using the three capscrews and lockwashers and tighten to 80-100 inch pounds (9-11 Nm) torque.
23. Install stop light switch.

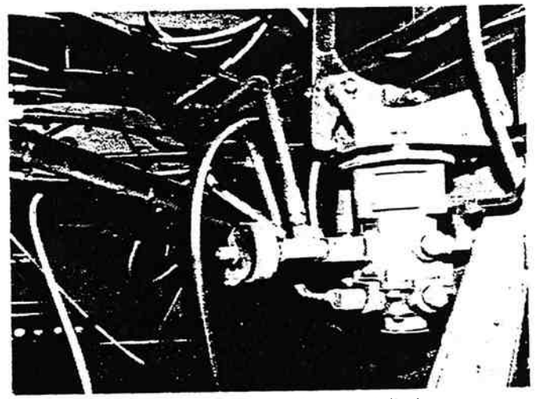


Figure 4-15. Brake Valve Installed.

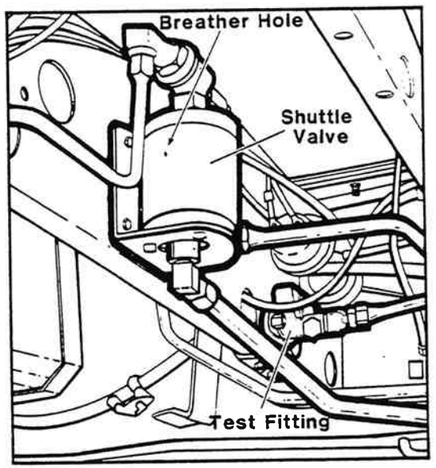


Figure 4-16. Shuttle Valve Installed.

SHUTTLE VALVE

The shuttle valve is located under the entrance floor in the tire compartment (figure 4-16). Under normal conditions the shuttle valve does not play an active role in the braking system. When a loss of air is experienced in the service brake system creating a pressure difference of 30 to 40 psi (207 kPa) between the service and emergency brake systems, the shuttle valve piston is moved upward. This allows air pressure from the parking tank to be modulated by the brake valve to apply the rear brakes.

Virtually no maintenance is required on the shuttle valve. There is a breather hole on the body of the valve and some air may exhaust from it (listen for hissing sound). If the leak continues while the brakes are fully applied, the valve should be removed, disassembled, and the O-rings replaced.

TESTING

The valve can be tested to see if the piston in the valve shuttles (moves) to allow parking brake air pressure into the brake lines, by simulating an emergency loss of air pressure from the service tanks.

1. Place an air pressure gauge in the brake line between the shuttle valve and the check valve.
2. Build up air pressure until the governor cuts out.
3. Turn off the engine and vent the dry and wet tanks by opening the drain cocks.
4. Apply the brakes and check the air pressure gauge. Air pressure from the parking brake tank will apply the rear brakes as if braking in an emergency situation (loss of service brakes). The brake valve has a modulating feature; as more pressure is applied to the brake valve, there is an increase in brake line pressure.

Once the drain cocks are closed and pressure built up to normal in the service tanks, the piston in the shuttle valve will

close the emergency brake air line on the first service brake application.

For shuttle valve disassembly, refer to figure 4-17.

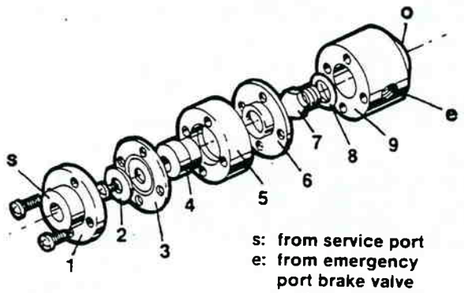


Figure 4-17. Shuttle Valve Parts.

QUICK RELEASE VALVES

The quick-release valves, used for the entrance door and the park brake systems, are found in the tire 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 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 seat. The exhaust port is still sealed by the center 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.

MAINTENANCE

Every year or after 50,000 miles (80,000 km) remove the quick-release valve, dismantle 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.

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 port is not restricted.

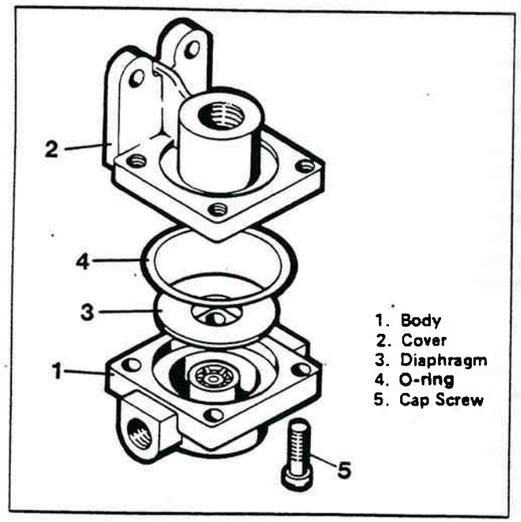


Figure 4-18. Quick Release Valve.

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.

3. Check the exhaust seat for pitting or nicks. This seat should be smooth and sharp. If not, use a fine piece of emery cloth to restore its finish. Clean or replace as necessary.

To reassemble, position diaphragm and O-ring in place. Install cover and tighten securely.

R-12 REAR BRAKE RELAY VALVE

The R-12 brake relay valve is mounted on the center of the rear baggage compartment bulkhead. Application and release of the drive axle (and trailing axle) brakes are made through the relay valve. Lines from the dry air tank are connected directly to the valve providing high pressure air close to the drive axle (and trailing axle) brake chambers at all times. The relay valve is connected to the brake application valve (located in front tire compartment) by an air line which delivers air pressure to the relay valve. The relay valve provides a rapid application of the drive and trailing axle brakes and acts as a quick-release valve permitting rapid release of air pressure from the rear brake chambers.

MAINTENANCE

Every 20,000 miles (32,000 km) check the relay valve for proper operation and leakage. If valve leakage occurs, disassemble the valve, clean and inspect all parts. Refer to figure 4-19. Install new rubber parts and replace any other part found worn or damaged.

SERVICE CHECK

1. Apply the parking brake push-pull control valve by pulling up on plunger.
2. Coat the relay valve exhaust port with a soap solution to check for inlet valve and O-ring leakage.
3. Push to release the parking brake control valve and again check at the exhaust port for leakage of the exhaust valve.
4. Apply soap solution around the valve where the cover joins the body to check for seal ring leakage. With the parking brake in "release" position, apply soap solution to the quick-release exhaust port to check the diaphragm exhaust seat.

If the relay valve does not function properly, or if leakage is excessive, the valve must be disassembled and repaired.

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 capscrews 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 relax 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 as necessary. All rubber parts and any part showing signs of wear or deterioration should be replaced.

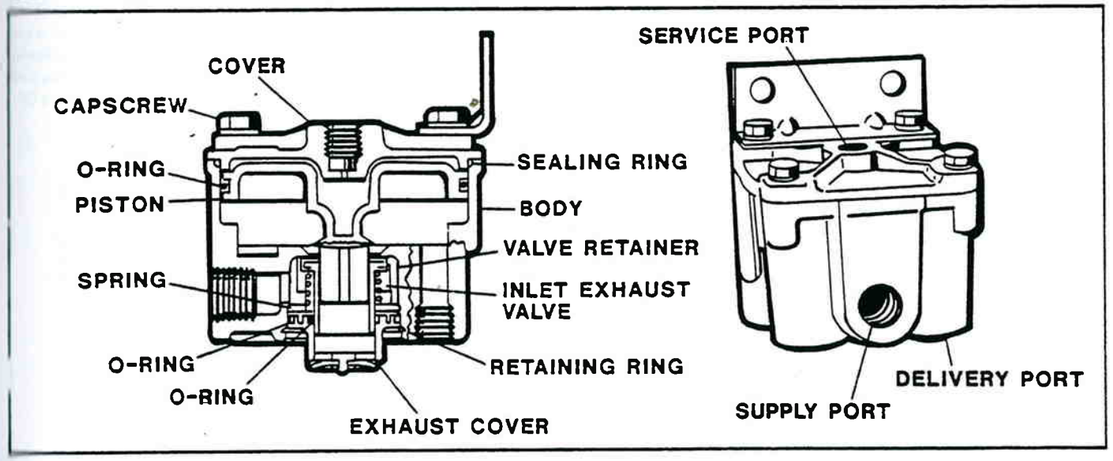


Figure 4-19. Rear Brake Relay Valve R-12.

MC-9 MAINTENANCE MANUAL

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 matchmarks 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 up 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 body 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.

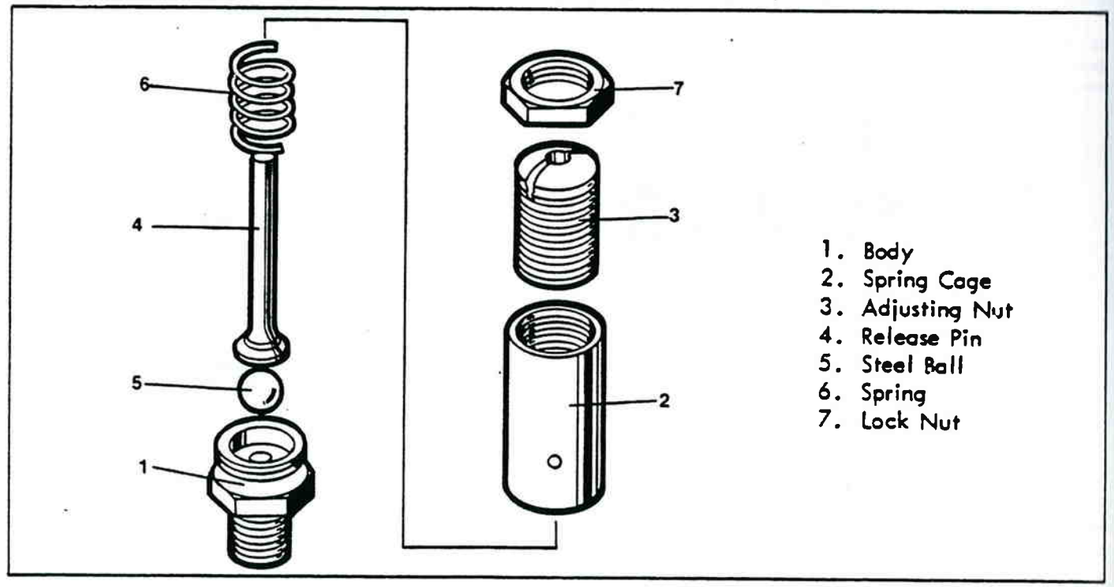


Figure 4-20. Safety Valve.

MC-9 MAINTENANCE MANUAL

ADJUSTMENT

The pressure setting of the safety valve is stamped on the lower 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 raise pressure setting, loosen lock nut, turn adjusting nut clockwise to obtain correct pressure setting and tighten lock nut.

To lower pressure setting, loosen lock nut, 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 diaphragm spring exerts a force greater than the force exerted by the air pressure below the diaphragm. This causes the diaphragm to move down and close the electrical contact. This completes 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 tell-tale warning light and buzzer should come on.

The air gauge 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 tell-tale warning light will flash until 100 psi (690 kPa) air pressure is reached in the dry air system.

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 1" bubble leakage is permitted in not less than five seconds.

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.

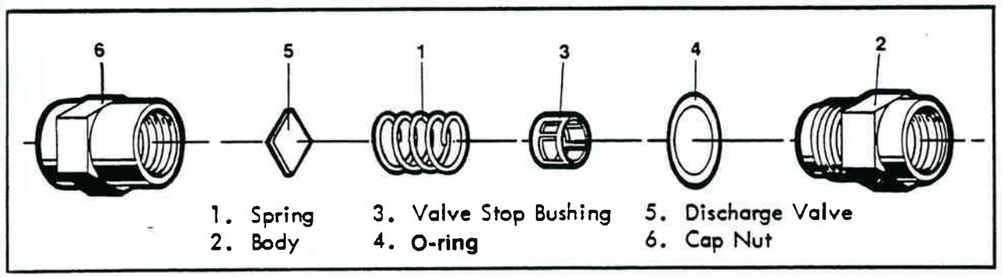
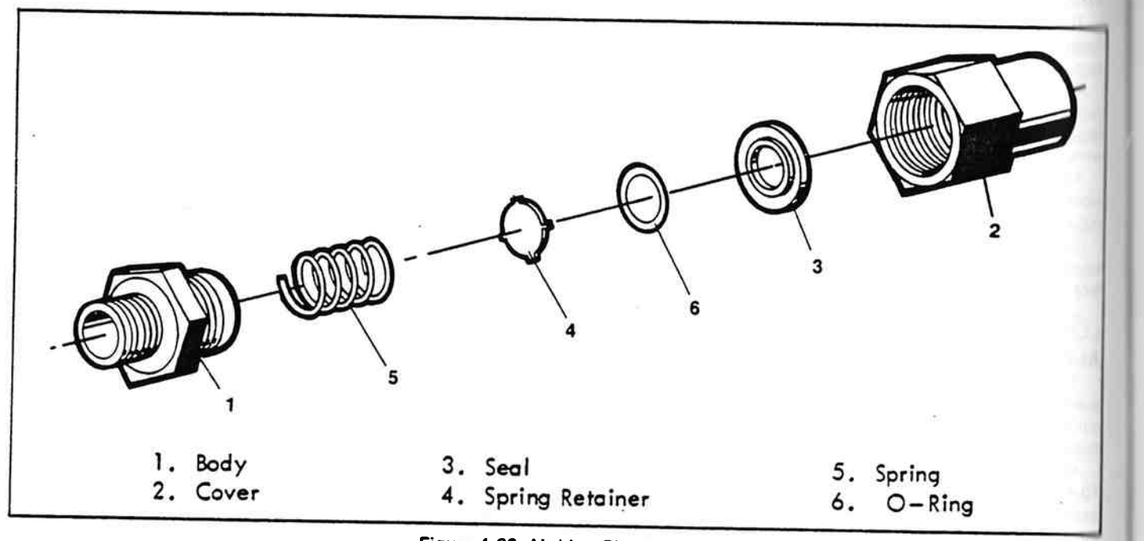


Figure 4-21. Main Air Supply Check Valve.



1. Body
2. Cover
3. Seal
4. Spring Retainer
5. Spring
6. O-Ring

Figure 4-22. Air Line Check Valve.

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.

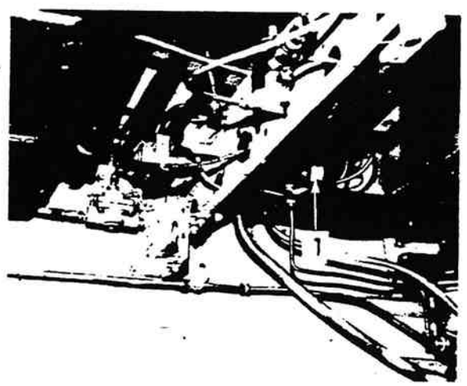


Figure 4-23. Stop Light Switch Location in Front Tire Compartment (1).

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

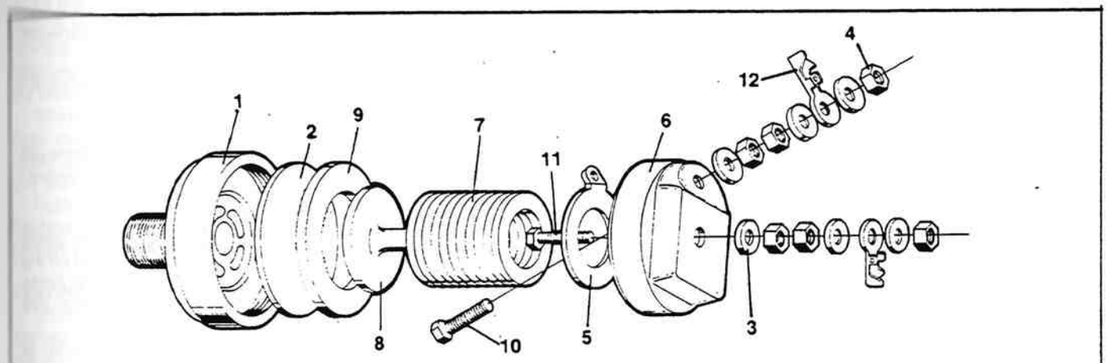
1. Disconnect electrical connections at the stop light switch.
2. Unscrew switch.
3. Remove the cover from the body and lift out the spring contact plunger, diaphragm ring, and diaphragm.
4. Clean all metal parts in cleaning solvent.
5. If diaphragm is cracked, worn or damaged, replace with new diaphragm.
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.

TEST OF REBUILT STOP LIGHT SWITCH

Both operating and leakage tests, as indicated under Testing, must be made after rebuilding or repairing the stop light switch. The switch must meet the following specifications:

A. No leakage is permissible at the stop light switch with the brake applied.

B. The stop light switch contacts should close at not more than 5 psi (34.5 kPa) of air pressure.



1. Body
2. Diaphragm
3. Washer
4. Nut
5. Terminal Connector
6. Cover
7. Spring
8. Contact Plunger Assy.
9. Washer
10. Terminal Screw
11. Terminal Screw
12. Cable Terminal

Figure 4-24. Stop Light Switch Parts Breakdown.

PRESSURE REGULATING VALVES

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

Listed 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 ..... 95 psi (655 kPa)
3. Parking brake ..... 80-85 psi (552-586 kPa)
4. Trailing axle bellows ..... 35 psi (241.3 kPa)
5. Trailing wheel brake system ..... 21 psi (144.8 kPa)
6. Trailing axle unloading system (optional) ..... 15 psi (103.3 kPa)
7. Lavatory door control (optional) ... 21 psi (144.8 kPa)
8. Lavatory air flush (optional) ..... 11 psi (75.8 kPa)

The pressure setting is determined in the pressure regulating valve by the tension of an internal spring which in turn 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.

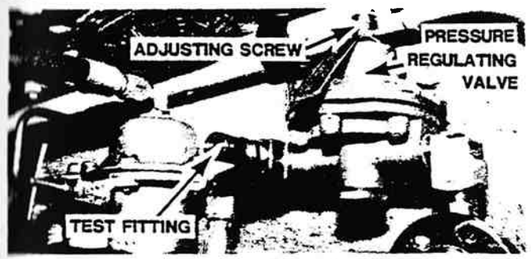


Figure 4-25. Pressure Regulating Valve (typical).

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.

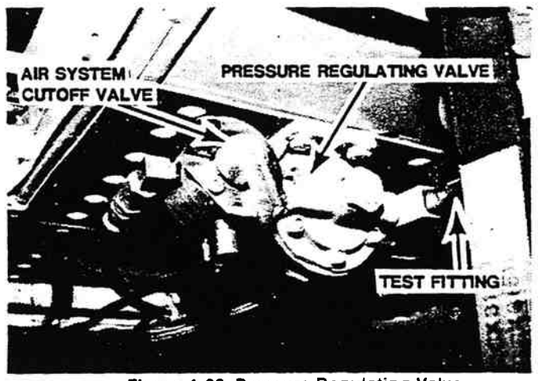


Figure 4-26. Pressure Regulating Valve

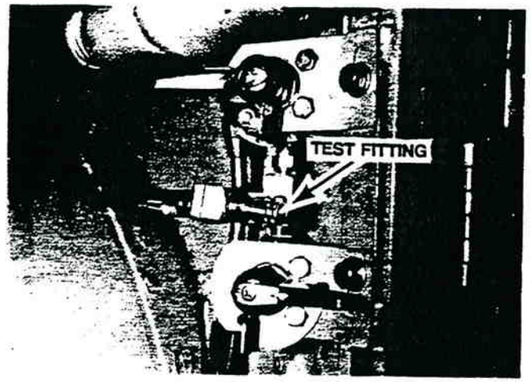


Figure 4-27. Test Fitting Remote From Pressure Regulator Valve.

TEST EQUIPMENT REQUIRED

A tee fitting and plug are 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 2½").

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-2-96 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 clockwise 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.

2. Examine the diaphragm and, if cracked worn or damaged, 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.)

RESERVOIRS

Reservoirs store compressed air so 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.

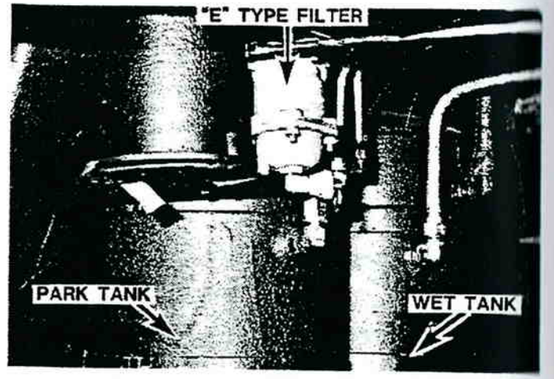


Figure 4-28. Reservoirs in Front Bogie Area.

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 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 causing brake drag. Excessive push rod travel shortens diaphragm life, gives slow braking response and wastes air.

TESTING

Check push rod-to-slack adjuster alignment in both the applied and released positions to be sure the push rod moves out 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 all parts. Install a new diaphragm, or any other rubber parts, if they are worn or deteriorated. When the diaphragm or spring are replaced in one 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 4-30. Brake Chamber Installed at Trailing Axle.

REMOVAL AND INSTALLATION

1. Block the coach by means other than the brakes.
2. Disconnect the air line and push rod yoke. Refer to figure 4-30.
3. Remove brake chamber.
4. For installation, mount brake chamber to mounting bracket.
5. Install yoke and its lock nut on push rod and connect to slack adjuster arm.

Check the angle formed by the push rod and slack adjuster. The angle should never be less than 90° when full air pressure is applied to the brake chamber when the brakes are cold and properly adjusted.

DISASSEMBLY AND REPAIR

After cleaning the exterior of the brake chamber, matchmark the parts in such a way that they can be assembled the same way.

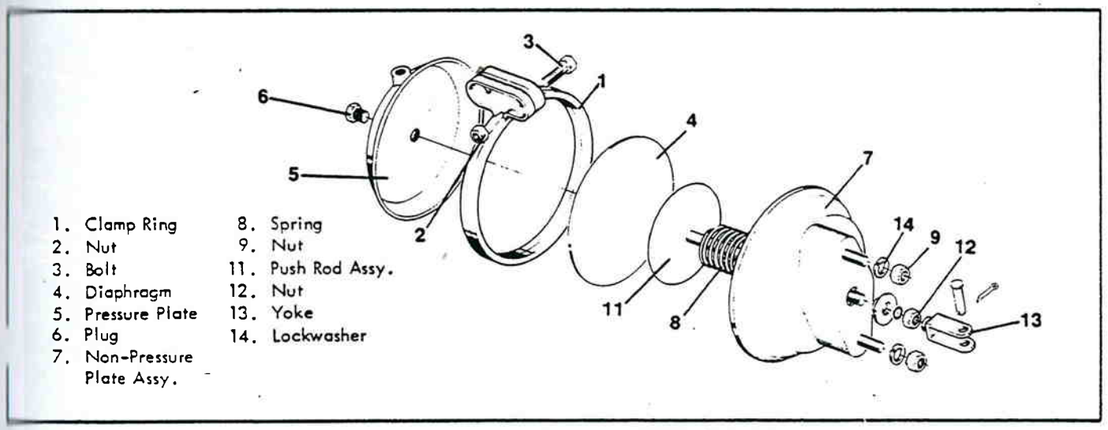


Figure 4-29. Front and Trailing Axle Brake Chambers.

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 vise 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 and 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 spring 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 lock 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, splash 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 mallet driver to break the clamping rings loose. If the rings are being reused, care should be taken against bending them out of shape.

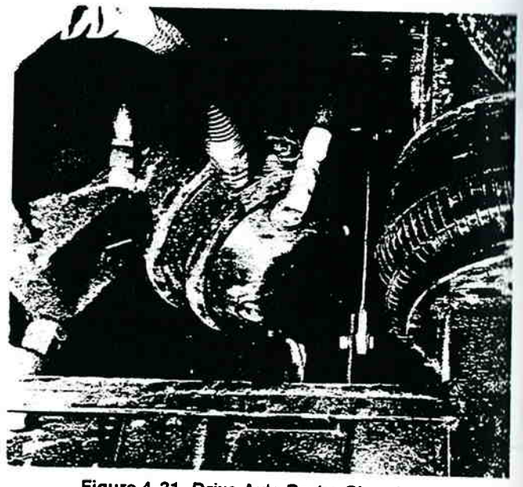
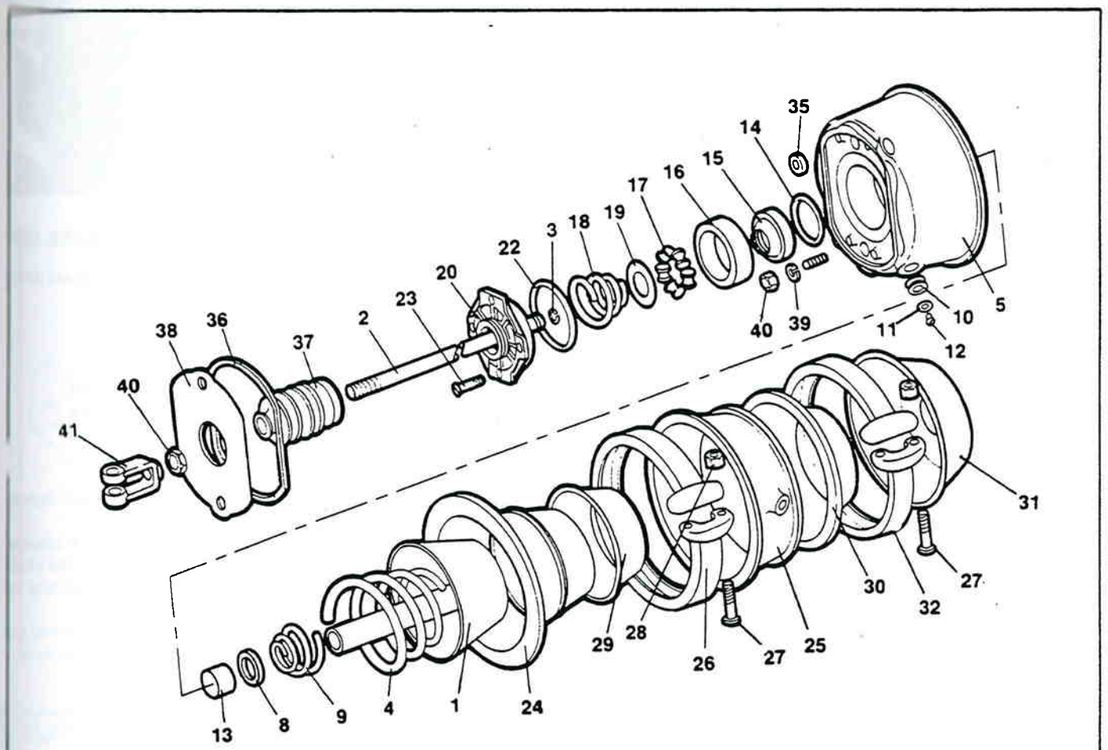


Figure 4-31. Drive Axle Brake Chamber.

4. After the clamping rings are removed, the auxiliary pressure plate, auxiliary diaphragm service pressure plate and service diaphragm are removed in that order.

A diaphragm separator may have been installed between the auxiliary and service diaphragms. When replacing the service diaphragm, check the old diaphragm for the presence of a bead (figure 4-33) molded into it. If the bead is present, a diaphragm separator is required and the new diaphragm must also have a bead.

When replacing both the service and auxiliary diaphragms, kits are available in either 2-piece or 3-piece configuration, and either kit may be installed. When replacing only the auxiliary



1. Shaft Assy.	15. Piston	28. Nut
2. Push Rod	16. Collar	29. Diaphragm Separator
3. Retaining Ring	17. Roller	30. Auxiliary Diaphragm
4. Return Spring	18. Spring	31. Auxiliary Pressure Plate
5. Non-Pressure Plate Assy.	19. Washer	32. Auxiliary Clamp Ring
8. Wiper	20. Cap	35. Felt Breather
9. Retaining Spring	22. O Ring	36. Gasket
10. Diaphragm	23. Screw	37. Boot
11. Washer	24. Service Diaphragm	38. Splash Guard
12. Screw	25. Service Pressure Plate	39. Lockwasher
13. Bearing	26. Service Clamp Ring	40. Nut
14. O Ring	27. Bolt	41. Yoke Assy.

Figure 4-32. Drive Axle Brake Chamber Components.

diaphragm, the replacement part is suitable for use with or without the diaphragm separator.

5. Place the remains of actuator on a smooth surface with the push plate down. Connect an air supply (shop air) line to the locking port.

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 cautiously 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 it 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 breather.

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 bores, shaft, piston O-ring and piston cavity with silicone base lubricant TMC/MCI Part No. 21-7512-11.

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 installed 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 4-30), 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 down over the boot.

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.

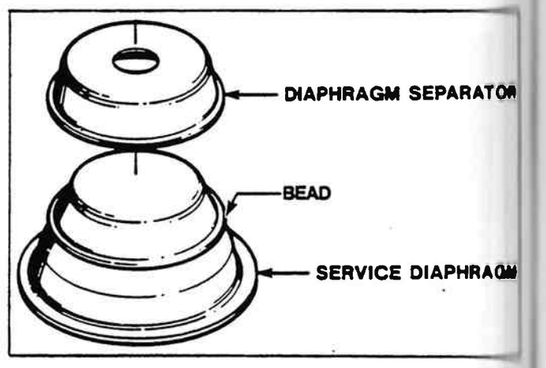


Figure 4-33. Diaphragm Configuration in Drive Axle Brake Chambers.

Figure 4-34. Manual Slack Adjuster Installed.

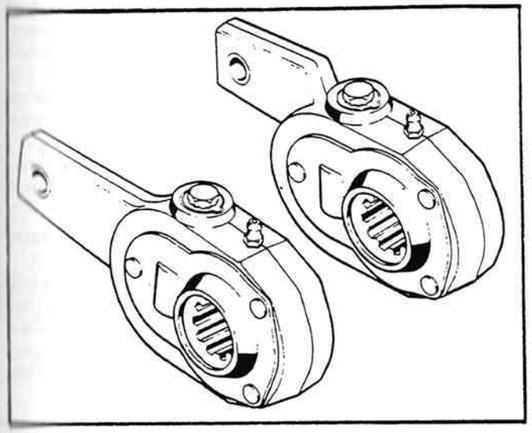


Figure 4-35. Typical Slack Adjusters.

SLACK ADJUSTERS (MANUAL)

Slack adjusters provide a quick method of adjusting brakes to compensate for brake lining wear (figures 4-34 and 4-35). The slack adjusters utilize worm gear drive to ensure maximum road service with a minimum of maintenance.

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.

BRAKE ADJUSTMENT

CAUTION: Prior to adjusting the rear coach brakes, ensure that system air pressure is above 65 psi (449 kPa).

While making brake adjustments, the wheel must be in a jacked-up position.

1. Install the wrench on the adjusting screw and disengage the locking sleeve by depressing it. While the locking sleeve is in the depressed position, calibrations may be made by turning the adjusting screw.

2. Turn the adjusting screw until the brake shoes are tight against the brake drum (brake chamber push rod in the released position).

3. Back off the adjusting screw two notches on the front units and three notches on the rear units.

4. When all adjustments have been completed, ensure that the locking sleeve is returned to a locked position by permitting it to engage the hexagon head of the adjusting screw.

CAUTION: All the slack adjusters on the coach must be at the same angle.

REMOVAL AND INSTALLATION

1. To remove a slack adjuster, remove the brake chamber push rod yoke pin, capscrew, and the snap ring which holds the slack adjuster onto the brake camshaft.

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

3. When installing a slack adjuster, clearance must be allowed to ensure that the slack adjusters can be rotated to the maximum stroke of the brake chamber. Install the grease fitting and locate the slack adjuster on the camshaft in such a manner as to allow both the adjuster screw and grease fitting easy access when servicing.

4. Install the retaining ring onto the end of the slack adjuster in order to hold the slack adjuster in place.

Refer to Operating Test to ensure that proper adjustments are made to provide for these conditions when installing the slack adjuster.

OPERATING TEST

1. Apply the coach brakes and inspect to ensure that the slack adjusters rotate freely and without binding.

2. Release the brakes and check to be sure that slack adjusters return to a released position freely without binding.

AUTOMATIC SLACK ADJUSTERS (OPTIONAL)

Automatic slack adjusters are designed to resist wear and to function for longer periods on coaches under severe service conditions. Because of the slack adjuster's importance, the coach comes from the factory with the cover plates welded in place. This ensures that no tampering is done with the internal components of the adjuster. See figures 4-36.

The automatic slack adjuster consists of a worm shaft and wheel combined with an adjusting mechanism. The worm wheel is attached to the brake camshaft.

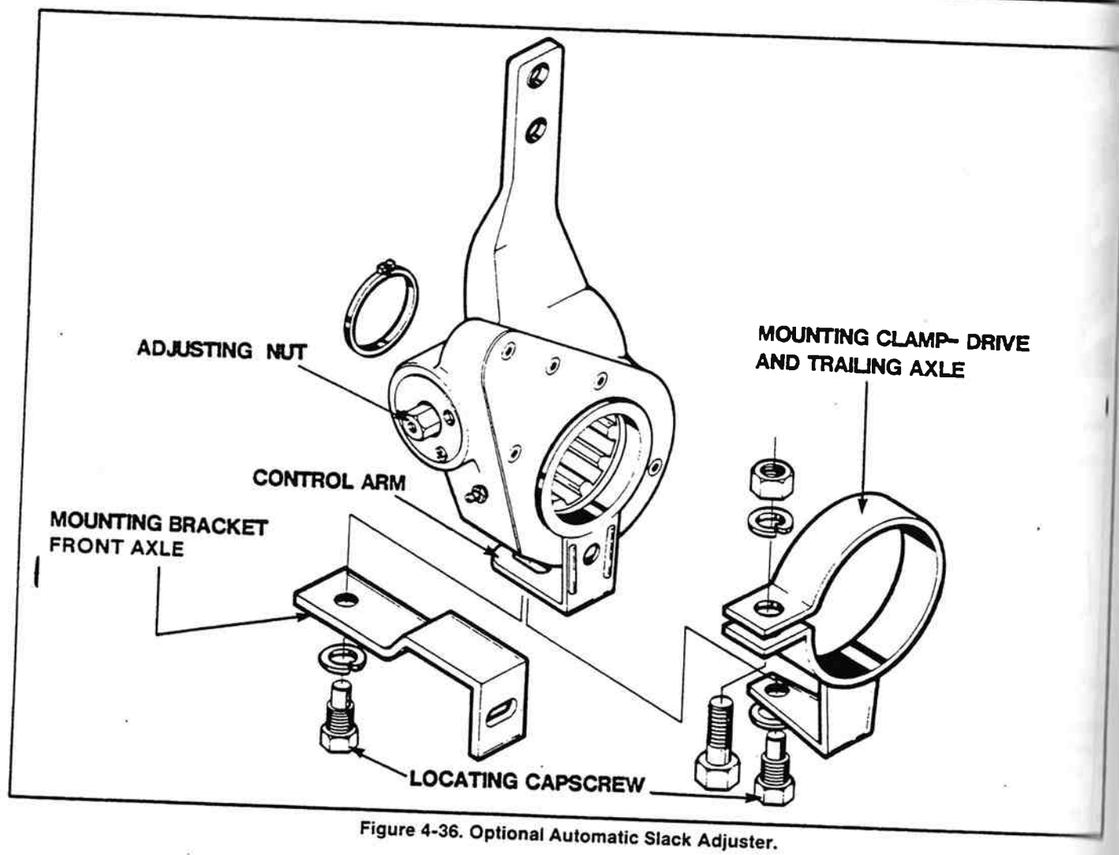


Figure 4-36. Optional Automatic Slack Adjuster.

The rack and pinion linkage produces rotation of the worm shaft through a clutch, only during the running clearance portion of the adjuster travel on the 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 taken up occurs at the same point. At this point, 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-yoke 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 welded 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.

INSPECTION

Every two months or 25,000 miles (40,000 km), inspect all coach 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 1¾" (44.45 mm) measured at 6" to 7" (152.4-177.8 mm) along the adjuster radius, the slack adjuster is operating properly.

Check for looseness in bolts and the anchor bracket and tighten if necessary.

Every 100,000 miles (160,000 km) or once a year, inspect one adjuster to determine if it is able to reduce stroke. Readjust the unit by rotating the hex nut on the worm gear by one-half turn in a counterclockwise direction.

Make 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 reduction 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 correctly.

LUBRICATION

The coach uses four or six slack adjusters which, although they are not internally serviceable, they do require regular lubrication. Each adjuster should be cleaned (externally) and lubricated every 150 hours or 5,000 miles (8,000 km). Only molybdenum disulphide 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 worm screw.
2. Turn the control arm forcibly clockwise as far as possible. From here, the control arm should not return to its initial position.
3. Slowly increase the pressure on worm screw. At a fixed load 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 cover 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 screw cover by means of a light punch in the housing just opposite 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 guided upwards and screw cover pressed against the mechanism of the tool.
3. Turn the cylindrical part of the SAB tool by means of a spanner until the pegs match the holes in the screw cover.
4. Apply a fixed load to the end of worm screw by turning the handle of the tool approximately half a turn. Turn control arm clockwise as far as possible. From here, the control arm should not return to its initial position.
5. If the control arm moves back too early or late, adjust the screw cover by turning the cylindrical part of the tool clockwise/counterclockwise with a spanner wrench.

INSTALLATION

NOTE: The procedure that follows applies to the Haldex (SAB) automatic slack adjusters. The second procedure covers the Rockwell and Bendix-Westinghouse slack adjusters.

1. Check that the brake chamber push rod is in the fully released position.
2. Refer to figure 4-36. As required, install mounting clamp or bracket in position to mount the slack adjuster (tighten the mounting bracket if used but do not tighten the mounting clamp).
3. Fit the slack adjuster on the cam shaft and install the retaining ring.
4. Rotate the adjusting screw clockwise to align the hole in the slack adjuster arm with the hole in the chamber rod clevis.

CAUTION: DO NOT manually push the adjuster into position to align the holes. Use the adjusting nut.

5. Install the clevis pin and retaining pin or clip.
6. Manually rotate the control arm toward the brake chamber until the control arm reaches a positive internal stop.
7. Fix the control arm in this position by installing the locating capscrews, as required, through the mounting clamp or mounting bracket. Tighten the capscrews and tighten the mounting clamp (if used) on the spider boss.

CAUTION: Do not use a hammer or any prying tool to achieve hole alignment. To do so will result in improper adjuster installation or damage.

8. To provide proper initial brake adjustment, rotate the adjusting nut clockwise until brake shoe-to-drum contact occurs. To aid in this determination, spin the wheel.
9. After shoe-to-drum contact, rotate adjusting nut counterclockwise ½ to ¾ turn.
10 Refer to figure 4-37 to confirm the distance measured from the brake chamber to the clevis pin. This measurement must be met by the slack adjusters at both ends of the same axle.

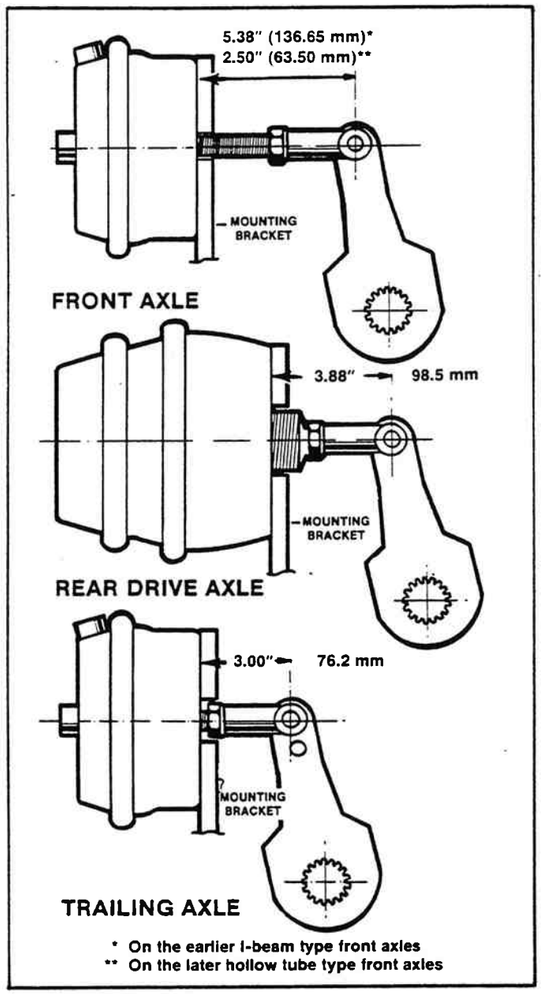


Figure 4-37. Push Rod Adjustment, Automatic and Standard Slack Adjusters.

NOTE: The angle formed by the slack adjuster arm and brake chamber push rod should be 90 to 120 degrees.

11. As a final installation check, remove the clevis pin and manually push the slack adjuster into the clevis pin and release it. Upon return, the adjuster is installed correctly if the adjuster hole and clevis pin hole are in alignment. Secure all fasteners.

NOTE: Step 12 is not necessary if adjuster final check (step 11) was satisfactory.

12. If holes do not align (step 11), place clevis pin through holes. Loosen the control arm fasteners and move the control arm toward the brake chamber until it comes to a definite stop. Tighten the bracket fasteners and repeat step 11.

BRAKES

The brakes used on the coach are heavy duty, double-shoe. Shoes are mounted with individual anchor pins on open-type spiders. The brakes are actuated by "S" type, constant lift 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 particularly 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 hubs are removed.

Machining of brake drums is permitted under the following guideline.

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 refaced 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 refaced should be installed on coaches operating under the least severe conditions.

Linings 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 shoe return spring. Remove lock rings, retainers, and felts 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 felts from cam shaft and spider.
9. Remove bushings from shoe of bearings and from spider as required.

REPAIR

During major overhaul, the following parts should be carefully checked and, if necessary, replaced with genuine replacement parts as required:

1. Backing plates for distortion, and backing plates and fasteners for looseness or sheared rivets.
2. Anchor pins for wear plates or angles faces.
3. Cam shaft and cam shaft bearings or bushings for wear or scoring.
4. Shoe return springs should be replaced at the time of overhaul.
5. Brake linings for grease saturation, wear, and loose rivets or bolts.
6. Drums for cracks, scoring, or other damage.

Prior to reassembling, the following parts should be lightly coated with lubricant:

1. Anchor pins at abutment block or shoe surface.
2. Adjustable anchor pin bearing surface.
3. Cam shaft bearings or bushings.
4. Cam roller followers and wear plates.

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 refaced 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.

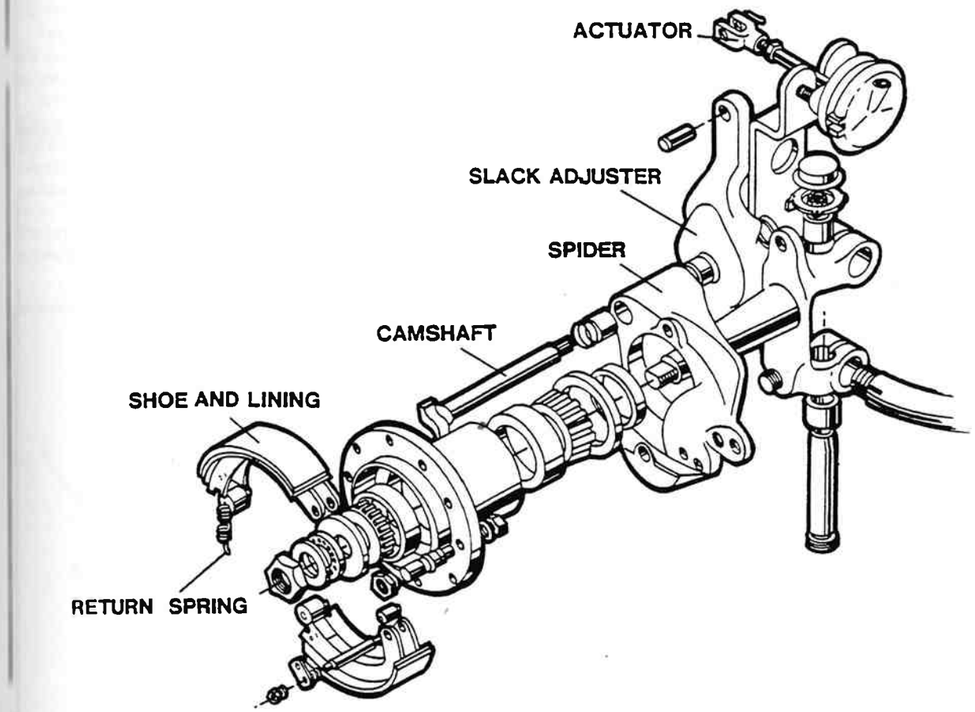


Figure 4-38. Front Brakes.

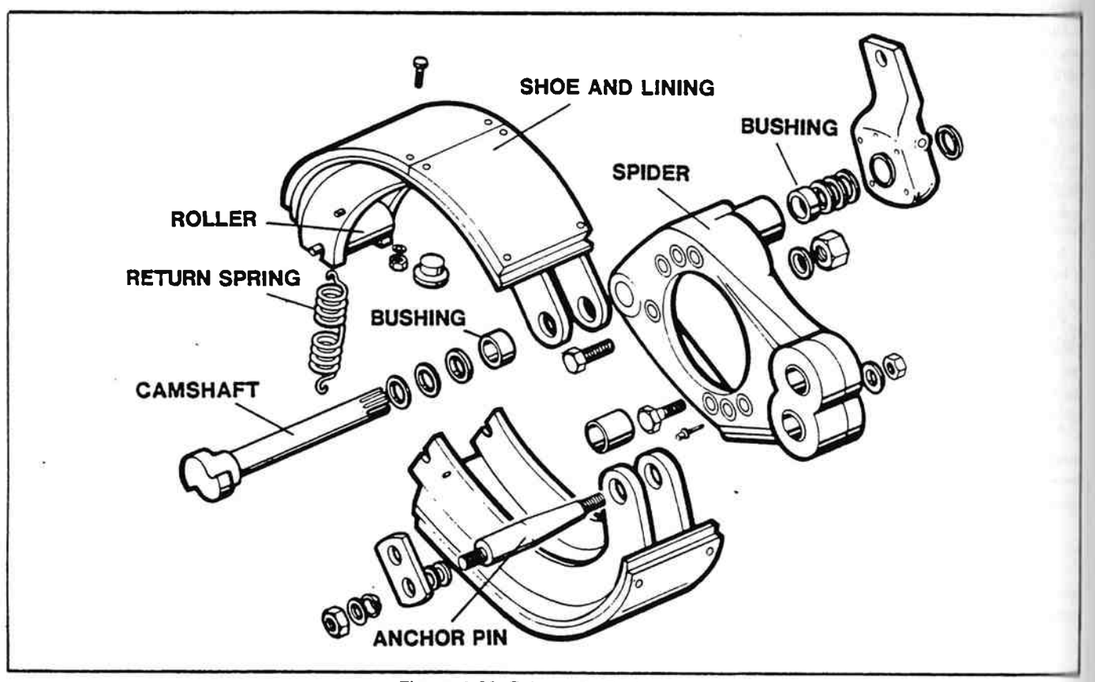


Figure 4-39. Drive Axle Brakes.

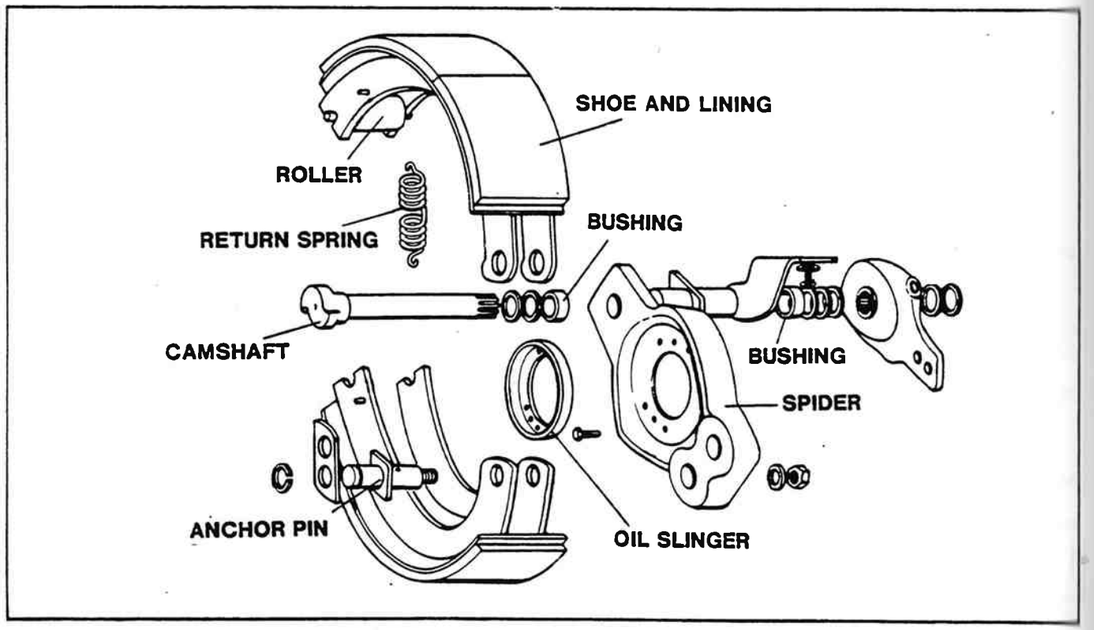


Figure 4-40. Trailing Axle Brake.

4. Install lock ring or tighten set screw in spacer. Position brake shoe over spider and tap anchor pin into position with "dot" in line with lock screw hole. Repeat with opposite shoe assembly.

5. Install lock screws, tighten securely and thread with safety wire.

6. Position felts, retainers and install lock rings.

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

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

ADJUSTMENT

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

AIR HORNS AND VALVE (OPTIONAL)

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

The horns are operated by pushing down on the button of the foot-operated horn valve. This action pushes down on the supply 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 bells. This action sets up a vibration of the diaphragm in each horn bell.

The 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 provides unusual 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 4-43.

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 load, 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 mounting 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.

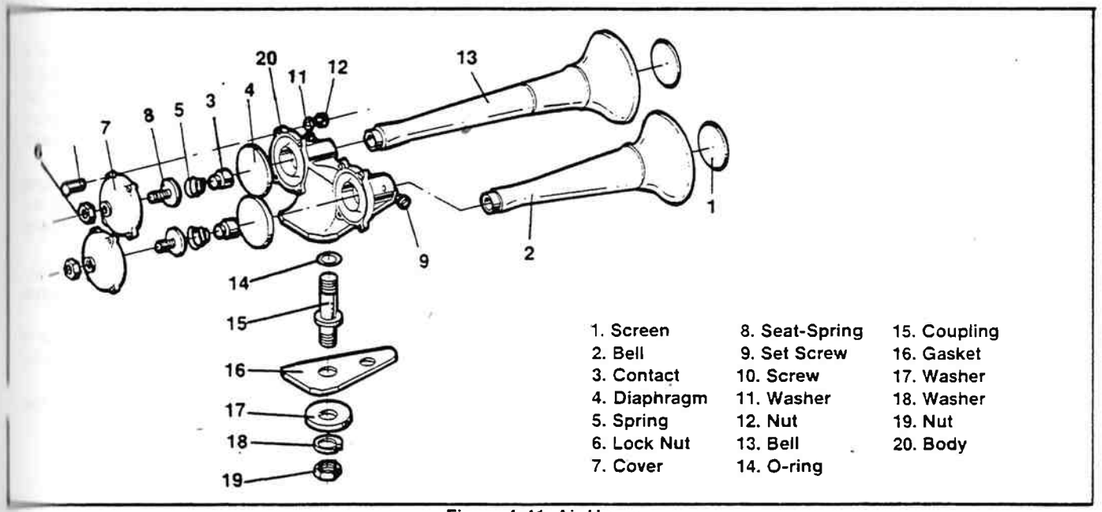


Figure 4-41. Air Horns.

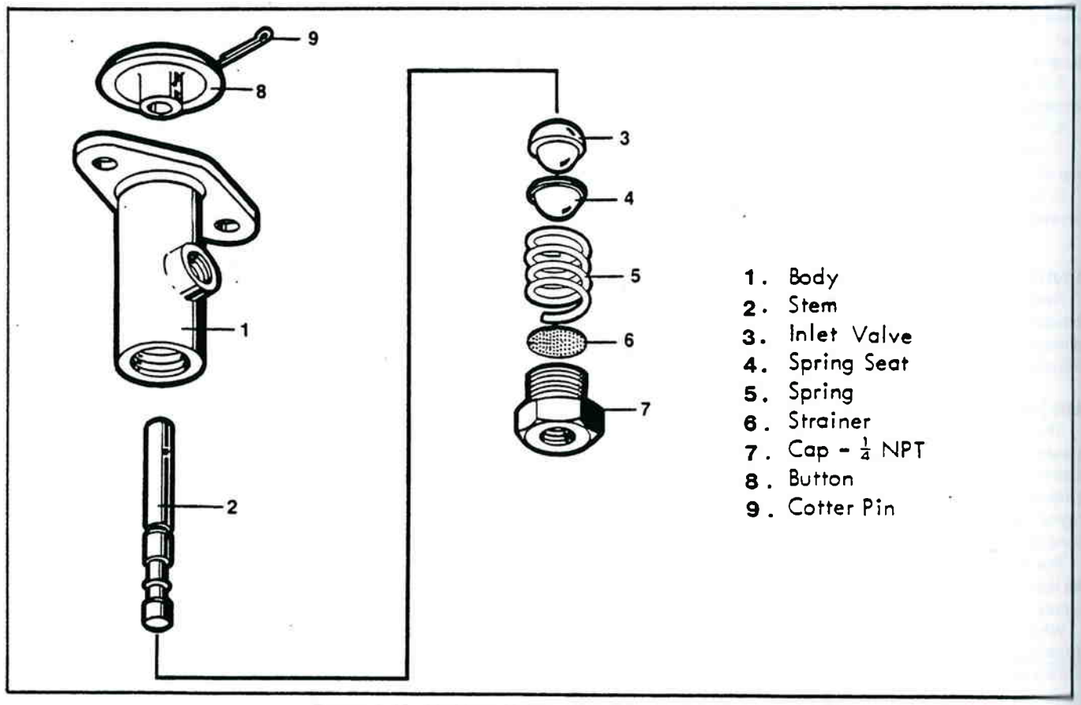


Figure 4-42. Air Horn Valve.

INSPECTION

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 and replace as necessary.
5. Inspect the covers. Be sure diaphragm seat in cover is not chipped or damaged. Inspect the cover for cracks.
6. Inspect the horn bells. If they are cracked or broken, they should be replaced.
7. Inspect the spring contacts. Replace if distorted or deteriorated.
8. 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 4-43. The purpose of the air filter dryer is to remove water and oil vapor from the air system, by means of condensation and a desiccant. This provides 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 ball-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 adsorbs 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 ⅛" (3.1 mm) from the bottom of the cartridge housing.

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

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

The 120 watt, 24 volt DC heater and thermostat assembly has an operating range between 50°F - 85°F (10°C - 29°C).

NOTE: The heater and thermostat assembly provided with the dryer has a 3/16" (4.7 mm) diameter threaded electrical terminal protected by a boot. It is nonserviceable.

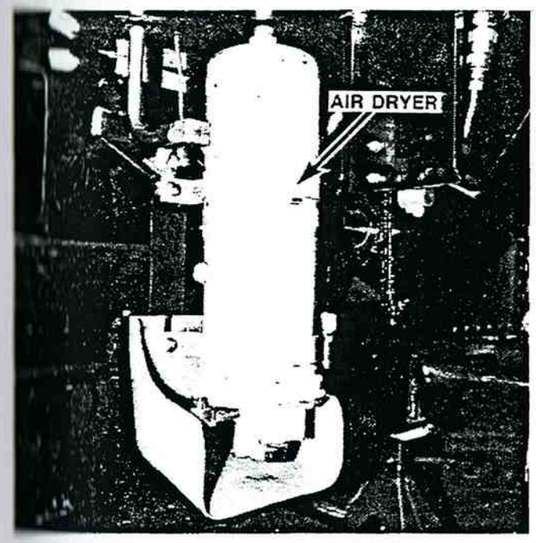


Figure 4-43. Air Dryer Installed.

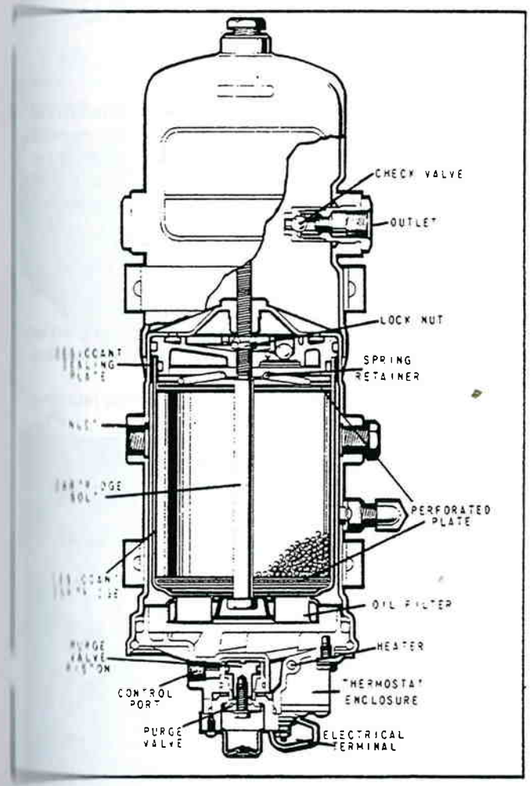


Figure 4-44. Air Dryer Cross-Section.

OPERATION

The operation of the AD-2 dryer can be best described by separating the operation into two cycles: the charge cycle and the purge cycle.

CHARGE CYCLE — With the compressor in its "loaded" or compressing cycle, air from the compressor enters the air dryer through the discharge line. When the air, along with the water and other contaminants, enter the air dryer, the velocity of the air reduces substantially and much of the entrained liquid drops to the bottom of the air dryer. The initial air flow is toward the bottom of the dryer, but air flow direction changes 180° at the bottom of the air dryer, dropping some water and oil.

The air now passes through the oil filter which removes some oil and foreign material but does not remove water vapor. At this point, the air remains saturated with water.

The filtered air and vapors penetrate the desiccant drying bed and the absorption process begins. Water vapor is removed from the air by the desiccant.

The unsaturated "dry air" passes through the ball check valve and purge orifice into the purge volume. From the purge volume air flows through a check valve and into the air reservoir.

PURGE CYCLE — When desired air system pressure is reached, the governor cuts out (115-118 psi/793-814 kPa), pressurizing the unloader cavity of the compressor which unloads the compressor. The line connecting the governor unloader port to the end cover purge valve port (bottom of the air dryer) is also pressurized, opening the exhaust of the purge valve to atmosphere. With the exhaust of the purge valve open, contaminants in the discharge line and dryer sump are purged, or forced past the open exhaust out to atmosphere.

The reverse air flow across the desiccant starts the removal process of moisture from the desiccant surface. Dry air flowing from the purge volume through the purge orifice and across the drying bed further dries the desiccant.

The combination of these reverse flows strips the water vapor from the desiccant (drying bed). This normally takes 12-15 seconds.

The desiccant becomes re-activated from this cycle and is now ready for another charge cycle, which occurs when the compressor returns to the compressing cycle.

MAINTENANCE

The desiccant cartridge should be replaced or rebuilt when the desiccant is contaminated and does not have adequate water adsorption capacity. However, the following checks should be made before replacing the desiccant cartridge to ascertain that the water accumulation is not related to the below listed conditions.

A. An outside air source has been used to charge the system. This air did not pass through the drying bed.

B. Air usage is exceptionally high and not normal for the coach. This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload (compressing and non-compressing cycle) in a normal fashion. Check for high air system leakage.

C. The air dryer has been installed in a system that has been previously used without an air dryer. This sytem will be saturated with moisture and several weeks of operation may be required to dry it out.

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 reseat 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 ignition is turned on. The end cover should be warm to the touch within a few moments. Warming should cease at about 85°F (29°C).

The desiccant change 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, after completing 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/MCI Part No. 4R-19-77: DESICCANT CARTRIDGE REFILL KIT — This kit can be used for the Type AD-2 air dryer. This kit consists of necessary parts to rebuild the cartridge and purge plate.

B. TMC/MCI Part No. 4R-19-76: DESICCANT CARTRIDGE REPLACEMENT KIT — This kit contains a factory replacement desiccant cartridge and the parts necessary to rebuild the desiccant sealing plate.

C. TMC/MCI Part No. 4R-19-78: PURGE VALVE MAINTENANCE KIT — This kit contains the parts necessary to rebuild air dryer end cover purge valve.

D. TMC/MCI Part No. 4R-19-79: CHECK VALVE MAINTENANCE KIT — This kit contains the components necessary to rebuild the integral check valve in the outlet port of the air dryer.

REMOVAL OF DESICCANT CARTRIDGE

NOTE: Air dryer parts diagram (figure 4-55) 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 location of this 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 notch in the air dryer shell. While pushing the end cover up into the dryer, insert the blade of a screwdriver in the notch and slowly pry out the retaining ring. Remove the end cover assembly and set it aside temporarily.
7. Using a ¾" 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 DESICCANT 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 discard them.
2. Remove the ball 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 ball check valve and replace the retaining clip and screw. See figure 4-45.

Figure 4-45. Installing Check Valve.

5. Thoroughly lubricate the two new O-rings and install them in their respective grooves in the purge plate (figure 4-46).
6. Set the desiccant sealing plate aside for reinstallation on the desiccant cartridge.

REPLACING DESICCANT 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 an 11/16" 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. Loss of 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 visible.
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 unthreaded portion) of the cartridge bolt extends slightly above the perforated desiccant plate.

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

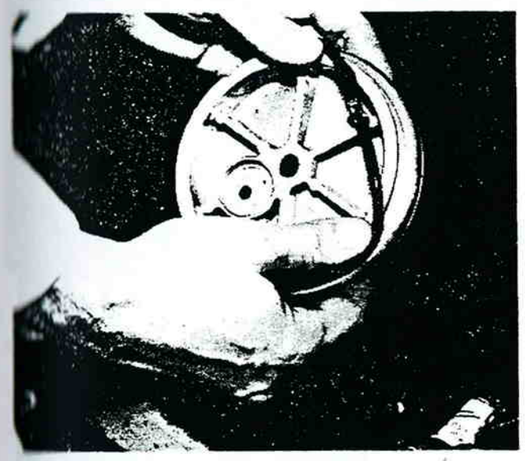


Figure 4-46. Installing O-Rings On End Cover.

REBUILDING THE DESICCANT CARTRIDGE

The desiccant cartridges are identified by the Bendix trademark BW stamped in the hex head of the cartridge bolt, and by the letters and number AD-2 displayed on the bottom face of the oil filter.

1. Refer to figure 4-47. 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.)

Figure 4-47. Desiccant Cartridge.

2. Remove the desiccant sealing plate and rebuild it as outlined under Removing and Rebuilding the Desiccant Sealing Plate.
3. Remove and retain the spring, spring seat, bolt and cartridge shell. Discard the oil separator filter, the two perforated plates and desiccant material.
4. Insert one of the perforated plates into the cartridge, felt cloth up, and tap it firmly to the bottom. (Felt always faces desiccant material.) See figure 4-48.

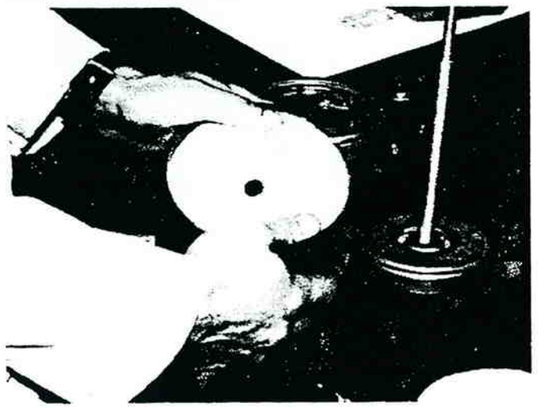


Figure 4-48. Inserting Felt Plate.

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.

Figure 4-49. Oil Filter Separator Installation.

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

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 felt 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 4-51. Pouring Desiccant Into Shell.

Figure 4-52. Perforated Plate in Place.

9. Set the conical spring on top of the perforated plate. (Large diameter down - small diameter up.)

10. Place the spring retainer on top of the spring (figure 4-53).

11. Using the lock nut, draw the assembly together to approximately half of the spring's free height. While slowly turning the cartridge, tap the side of the shell with a plastic mallet (figure 4-54). This allows the desiccant material to settle properly into place. Continue to tighten the nut, making sure all parts are properly aligned. Tighten nut firmly using an 11/16" socket or box wrench.

Figure 4-53. Installing Spring and Spring Retainer.

REMOVING END COVER ASSEMBLY

To remove the end cover assembly from the air dryer, follow steps 1-6 under the section entitled Removal of Desiccant Cartridge. Before rebuilding the end cover, clean the exterior thoroughly using commercial solvent.

DISASSEMBLY OF END COVER ASSEMBLY.

1. Remove and discard the large O-ring around the end cover assembly.
2. Remove the single No. 6-32 screw securing the exhaust diaphragm and separate the diaphragm, washer and screw.
3. Discard the diaphragm.
4. Remove the three No. 6-32 screws securing the exhaust cover and remove the exhaust cover.

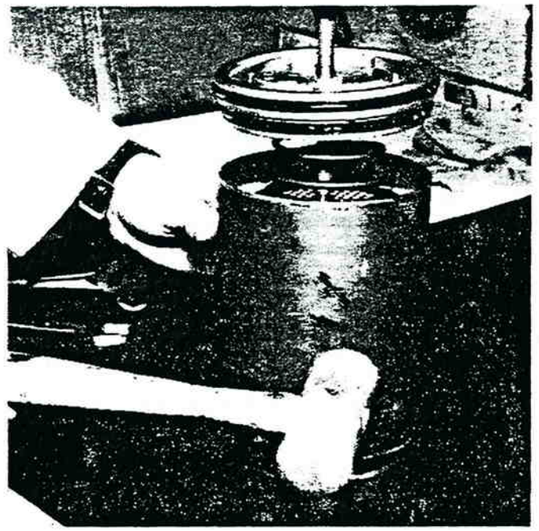


Figure 4-54. Tapping To Settle Desiccant.

4. Remove the purge valve assembly, the large hex cap nut, from the end cover and discard both O-rings around the cap nut.

5. Using a 7/16" socket wrench and a large screwdriver, remove the ¼"-20 hex head capscrew which holds the assembly together.

6. Separate capscrew, purge valve, purge valve piston and the piston return spring.

7. 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 ¼-20 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 it to 180-250 inch lbs. (20.3-28.2 Nm) torque.
8. Secure the exhaust diaphragm to the exhaust cover using the No. 6-32 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.

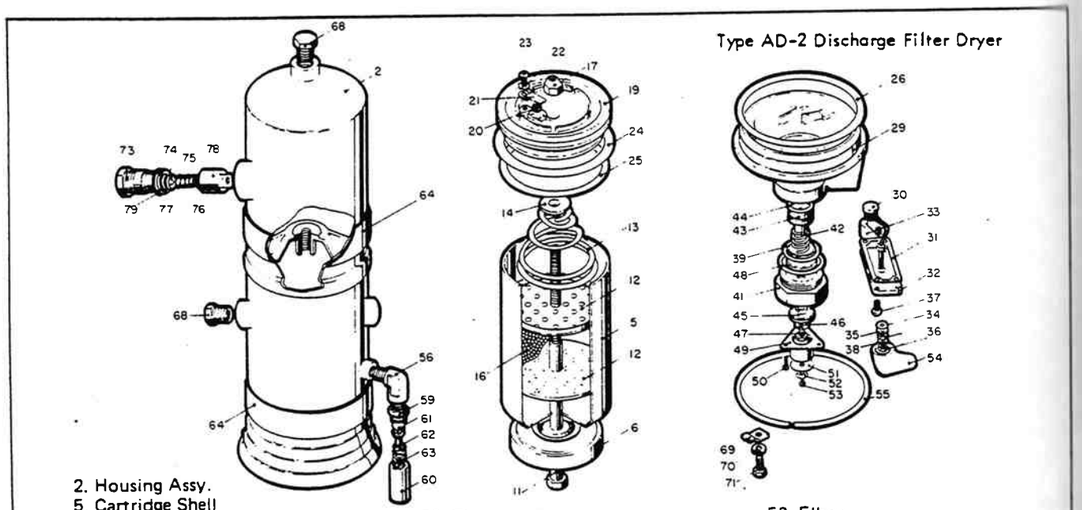
CAUTION: The heater and thermostat assembly in the dryer and cover are non-serviceable. Do not remove the thermostat cover. Should this assembly become defective, the end cover must be replaced.

REBUILDING OUTLET PORT CHECK VALVE

1. Make certain the vehicle is safely parked. Block the wheels if necessary.
2. Locate 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 note the order of the removal of the parts.
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.
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 32 ft 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 retainer ring so that the gap in the ring is within an inch of the notch in 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.



2. Housing Assy.
5. Cartridge Shell
6. Filter Oil Separator
11. Bolt Cartridge
12. Perforated Plate S/A
13. Conical Spring
14. Spring Seat
16. Desiccant
17. Lock Nut - 7/16 - 14 Hex.
19. Plate - Desiccant Sealing
20. Ball Valve
21. Valve Cover
24. O Ring
25. O Ring
26. O Ring End Cover
29. End Cover
30. Thermostat
31. Gasket
32. Cover Thermostat
33. Spacer
34. O Ring
39. O Ring
44. O Ring
48. O Ring
49. Exhaust Cover
50. Screw - 6-32 Thread Forming
51. Diaphragm
52. Washer
53. Screw - 6-32 Thread Forming
55. Retainer Ring
56. Elbow
59. Body
63. Spring
68. Pipe Plug
69. Retaining Clip
70. Lock Washer
71. Cap Screw - 1/4" - 20 Hex. Hd.
73. Body
74. Spring Guide
75. Spring
76. Ball Valve
77. Sealing Washer
78. End Cap
79. O Ring

Figure 4-55. Air Dryer Exploded View.

AD-4 AIR DRYER
Effective With Unit 41089

The air dryer is mounted on the coach ahead of the front axle on the spare tire compartment bulkhead. The bottom portion of the dryer is protected by a sheet metal shroud. Refer to figure 4-56.

The function of the AD-4 Air Dryer is to collect and remove 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. Daily manual draining of the reservoirs is eliminated.

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

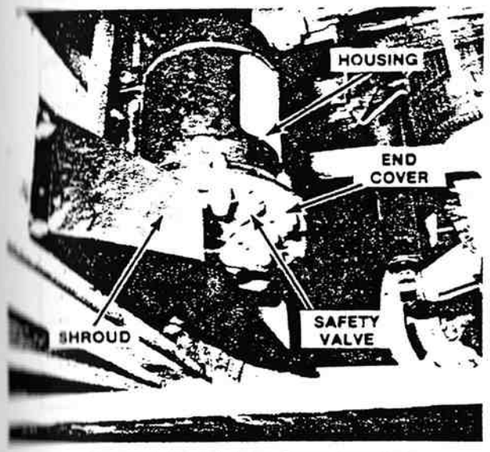


Figure 4-56. AD-4 Air Dryer Installed.

The three air connections on the AD-4 are identified with embossed numbers and lettering. The identification and function of each is as follows:

4 — CON. — Control port (purge valve control)
1 — SUP. — Supply port (air in)
2 — DEL. — Delivery port (air out)

A cast-in heater element and replaceable thermostat with an external electric terminal are provided.

The voltage and wattage requirements of the heater and thermostat are shown with embossed numbers and letters in a recess adjacent to the control port marked CON.

OPERATION

Operation of the air dryer can most easily be understood if it is separated into two cycles — the CHARGE cycle and the PURGE cycle.

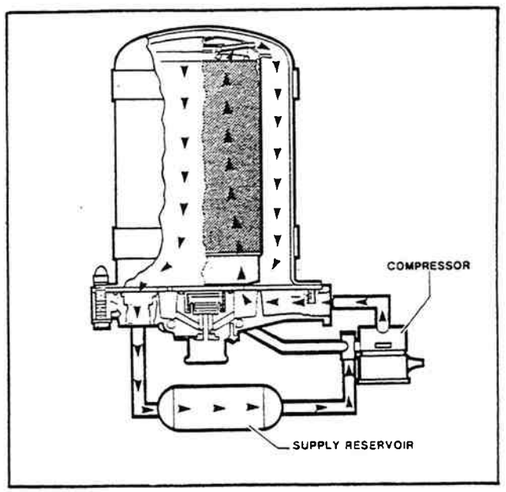


Figure 4-57. Charge Cycle Diagram.

Charge Cycle — Refer to figure 4-57. 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 end cover baffle system behind the supply port. As air travels through the baffle system, its direction of flow changes by 180° several times, causing contaminants to condense and drop to the bottom (sump) of the air dryer end cover.

After exiting the end cover baffle system, the air flows into the desiccant cartridge. Once in the desiccant cartridge the air first flows through an oil 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 "adsorption." The desiccant cartridge using the adsorption 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 (supply) reservoir of the air system.

The air dryer will remain in the charge cycle until air brake system pressure builds to the governor cutout setting

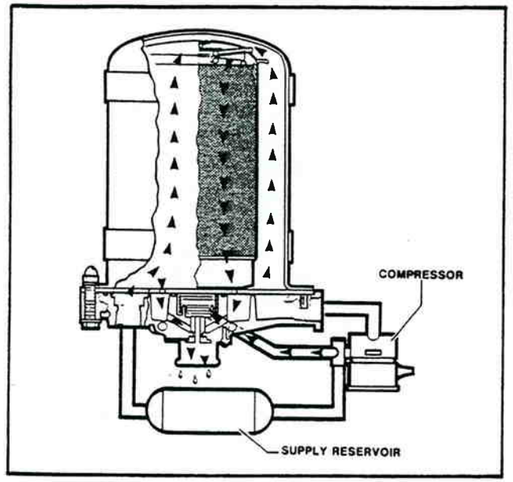


Figure 4-58. Purge Cycle Diagram.

Purge Cycle — Refer to figure 4-58. When air brake system pressure reaches the cutout setting of the governor, the compressor unloads (air compression stops) and the purge cycle of the air dryer begins. The line connecting the governor unloader 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.

MAINTENANCE

The desiccant cartridge should be replaced or rebuilt when the desiccant is contaminated and does not have adequate water adsorbing capacity. However, the following checks should be made before replacing the desiccant cartridge to ascertain that the water accumulation is not related to the below listed conditions.

A. An outside air source has been used to charge the coach air system. This air did not pass through an air dryer.

B. Air usage is exceptionally high and not normal for the coach. This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload (compressing and non-compressing cycles) in a normal fashion. Check for high air system leakage.

C. The air dryer has been installed on a coach that has been previously used with a defective air dryer. This sytem will be saturated with moisture and several weeks of operation may be required to dry it out.

Every 900 operating hours or 25,000 miles, or every three months, perform the following maintenance procedure:

1. Check for moisture in the air brake sytem by opening reservoirs, drain cocks or valves, and checking for the presence of water. If mositure is present, the desiccant may require replacement; however, the conditions above should be considered before the desiccant cartridge is replaced.

NOTE: In areas where more than an approximate 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.

In addition, a small amount of oil in the system may be normal and should not be considered a reason to replace the desiccant. Oil-stained desiccant can function adequately.

2. Check mounting bolts for tightness. Retighten to 300 lb-in (34 Nm) torque.

3. Check the operation of the check valve in the end cover of the AD-4. 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 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 (figure 4-59) 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 reseat when the stem is released.

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

7. The desiccant change interval may vary with different coaches. Although typical desiccant cartridge life is three years, it may perform adequately for a longer period of time. In order to take maximum advantage of desiccant life and assure that replacement occurs only when necessary, it is important that the following checks be made.

8. Check the operation of the end cover heater and thermostat assembly during cold weather operation, as detailed in a, b and c, below. If the resistance values obtained are within the stated limits, the thermostat and heater are operating properly. If the resistance values are outside the stated limits, proceed to step d to determine the cause.

a. With the coach ignition ON, check for power between the dryer's electrical terminal and metal end cover with a voltmeter or test light.

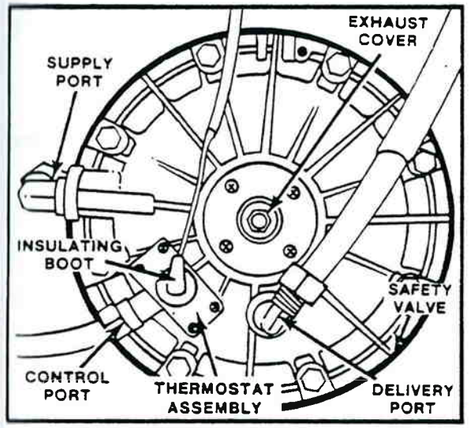
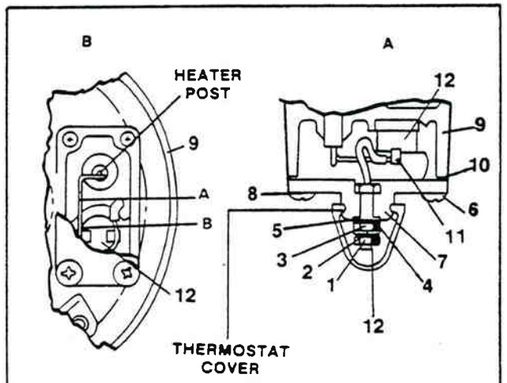


Figure 4-59. AD-4 End Cover (Bottom View).

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 (pull 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.

d. 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 4.0-6.0 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.



1. NUT
2. LOCK WASHER
3. NUT
4. WASHER
5. O-RING
6. SCREW
7. COVER
8. LOCK WASHER
9. END COVER
10. GASKET
11. SPACER
12. THERMOSTAT

Figure 4-60. Thermostat Assembly.

If the heater resistance value obtained is within the stated limits, the thermostat should be replaced or a new or remanufactured end cover installed. (Ordering information is found below.)

Reassembly — Reinstall the thermostat cover as illustrated in figure 4-59. Take care to assure the rubber spacer and the gasket are correctly installed, to assure proper operation.

REPAIR

For ease in servicing the AD-4, it is recommended that it be removed from the coach.

NOTE: When only the purge valve is being serviced there is no need to remove the dryer from the coach.

Maintenance kits are available from Universal Coach Parts, Inc., Northlake, IL.

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 5/16 x 4½" hex bolts securing the mounting straps on the back side of the dryer. Disengage the mounting bracket hook from the end cover.

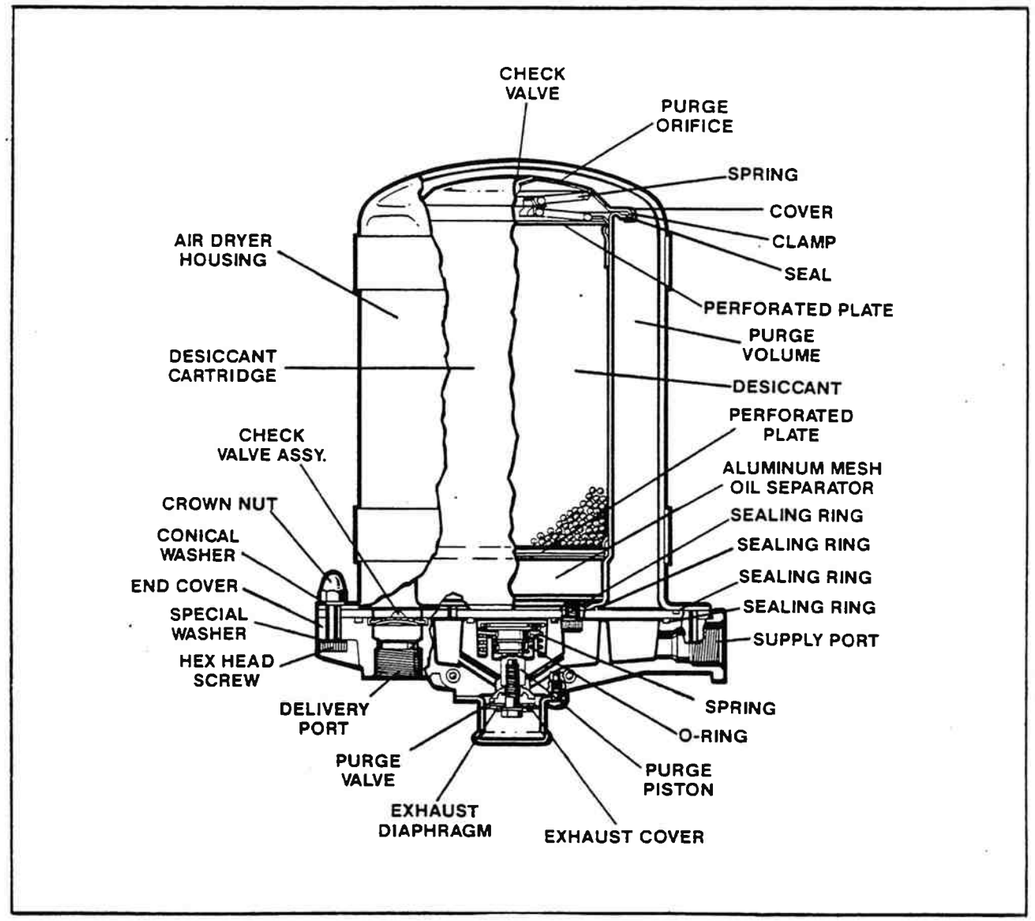


Figure 4-61. AD-4 Air Dryer Cross Section.

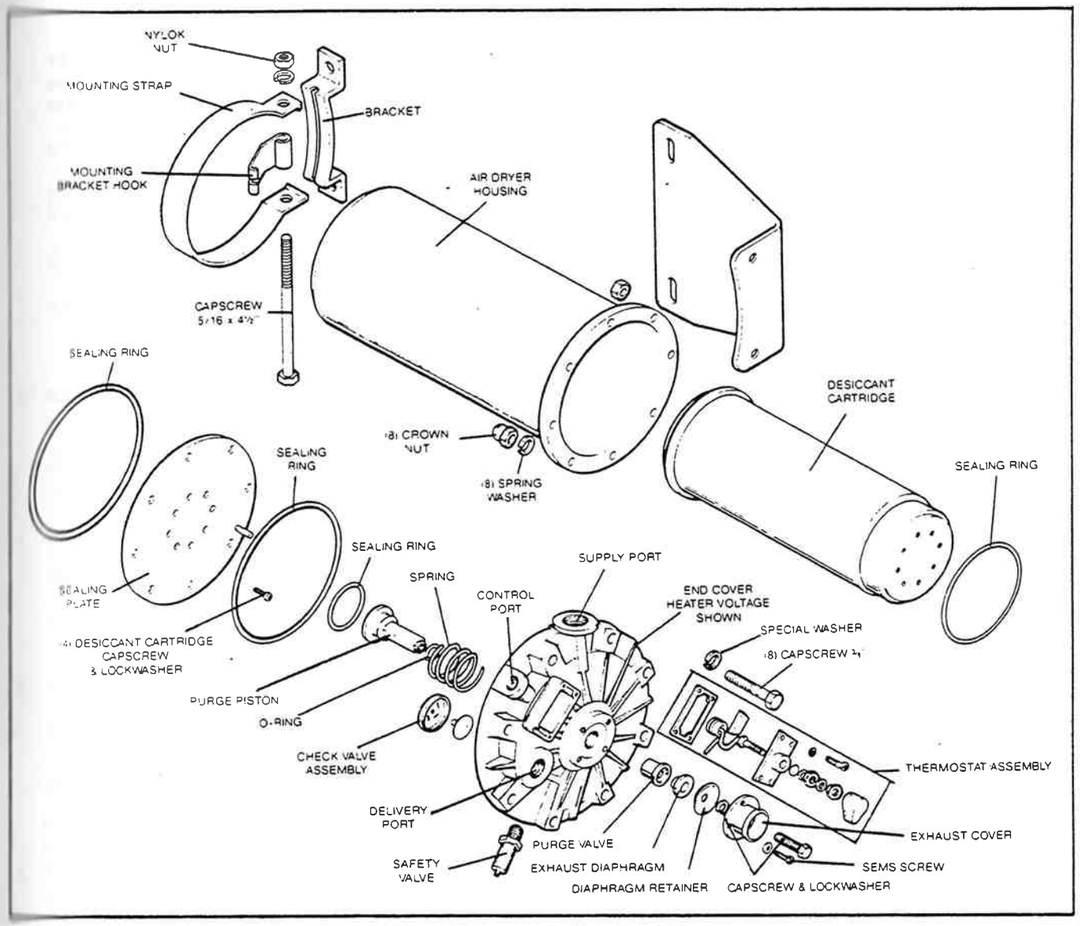


Figure 4-62. AD-4 Parts Breakdown.

DISASSEMBLY

1. Refer to figure 4-62. Remove the eight ⅜" 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 diaphragm retainer, exhaust diaphragm and purge valve. Discard the exhaust diaphragm 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.

ASSEMBLY

Prior to assembly, wash all metal parts thoroughly using a quality commercial solvent (such as mineral spirits). Inspect all parts for wear or damage and replace any parts that fail this visual inspection.

1. Refer to figure 4-62. Place the purge valve spring into the cavity in the center of the top side of the end cover.
2. Lubricate the piston O-ring with a barium base lubricant, and install the O-ring on the purge valve piston and place the piston inside the spring installed in step 1.
3. Turn the cover over on a flat, clean surface (making sure the purge valve piston and spring remain in proper position). Compress the spring by pushing down on the cover and align the square shank of the purge valve piston into the mating hole in the cover.
4. Place the washer, diaphragm retainer, diaphragm and purge valve onto the purge valve capscrew.
5. Install the purge valve capscrew with parts on it into the exhaust cover and tighten to 30-40 lb-in (3.4-4.5 Nm) torque.
6. Install the safety valve (if removed) and tighten to 120-400 lb-in (13.5-45.0 Nm) making sure that the exhaust hole is pointed downward when the dryer is installed.
7. Install the thermostat (if removed). Refer to instructions pertaining to thermostat installation, below.
8. Place the sealing ring on the bottom of the desiccant cartridge. Attach the cartridge to the plate (smooth side of plate opposite cartridge) with four socket head capscrews and lock washers. Tighten to 80-100 lb-in (9.0-11.3 Nm) torque.
9. Lubricate and install the two sealing rings in the recesses of the end cover. Use a barium base lubricant.
10. Install the check valve assembly into the cover making sure the holes in the metal stamping are facing up and the tang on the check valve assembly fits into the mating recess in the cover.
11. Place the desiccant cartridge and sealing plate assembly onto the cover taking care not to displace the sealing rings. The large hole in the sealing plate must line up with the check valve and the spirol pins in the sealing plate must enter the corresponding holes in the end cover.
12. Lubricate the outer sealing ring with barium base lubricant and install on the sealing plate. Place the housing of the air dryer over the desiccant cartridge (lining up the marks on the housing and cover made prior to disassembly) and retain with eight ⅜" hex head bolts, special washers and crown nuts. Tighten to 270-330 lb-in (30.7-37.5 Nm).

NOTE: If the ⅜-24 x 2½" bolts require replacement, insure that the replacement bolts are grade 5 minimum. Use of inferior bolts can compromise the integrity of the air dryer and lead to premature failure.

13. Install the assembled AD-4 air dryer on the coach by sliding it into the mounting brackets until the mounting bracket hook catches under the lip of the cover and tighten the mounting bracket bolts to the 70-85 lb-in (7.9-9.6 Nm).
14. Reconnect the three air lines to the proper port on the cover (identified during disassembly).
15. Reconnect the thermostat and heater wire and place the boot in position to protect the connection by forcing it over the knob on the plastic cover.
16. Install the dryer shroud with the retained mounting hardware.
17. Test the air dryer as outlined under Maintenance, above.

THERMOSTAT REPAIR

1. Refer to figure 4-60. Remove nut (1), then lock washer (2) nut (3), washer (4) and O-rings (5). Discard O-rings and retain other parts.
2. Remove and retain the four Phillips head screws (6) and cover (7).
3. Remove and discard gasket (10).
4. Remove and retain spacer (11).
5. Cut uninsulated thermostat wire at Point B (figure 4-62), remove and discard thermostat and terminal assembly (12).
6. Clean remaining wire attached to heater terminal.
7. Clean thermostat "pocket" in end cover (9).

NOTE: Steps 8 thru 16 are for thermostat assembly.

8. Cut the uninsulated lead of the new thermostat at point A (figure 4-60).
9. Install the thermostat in the end cover pocket and position the uninsulated leads next to each other.
10. Using a soldering heat sink, clamp the uninsulated leads at point B (figure 4-60) and solder the leads with straight rosin core solder. DO NOT USE ACID CORE SOLDER as corrosion can result. Clean excess solder off end cover.
11. Install thermostat terminal (12) in cover (6).
12. Install O-ring (5), washer (4) and nut (3). Tighten nut to 20-30 lb-in (2.3-3.4 Nm) torque. Then install lock washer (2) and nut (1) finger tight to allow for reconnection of electrical wire when reinstalled on coach.
13. Install spacer (11) over thermostat (12).
14. Install gasket (7) and thermostat cover (6) and secure thermostat cover to end cover (9) using screws (7) and lock washers (8).
15. Tighten to 30-40 lb-in (3.4-4.5 Nm) torque.
16. Test the thermostat as follows:

a. At a temperature above 90°F (32°C), check the resistance between the thermostat terminal (2) and end cover (9). Resistance should be 1000 ohms or greater. If not, check for solder short.

b. Chill the end cover assembly to 40°F (4°C) and check resistance again. Resistance should be 4-7 ohms.

TROUBLESHOOTING

1. **Air Pressure Drops Quickly With Engine Stopped and Brakes Released**

   Leaking brake valve tubing or hose line
   Compressor discharge valves leaking
   Compressor governor leaking
   Leaking elsewhere in the air brake system

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**

   Grease on brake lining — reline brakes
   Brake drum out of round
   Defective brake valve
   Brake rigging binding

4. **Insufficient Brakes**

   Brakes need adjusting, lubricating or relining
   Low air pressure in brake system — below 80 pounds (522 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 PSI (522 kPa)
   Brake valve delivery pressure below normal
   Excessive leakage with brakes applied
   Restricted tubing or hose line

6. **Brakes Release Too Slowly**

   Brakes need adjusting or lubricating
   Brake valve not returning to fully released position
   Restricted tubing or hose line
   Exhaust port of brake valve or quick release valve restricted or plugged
   Defective brake valve or quick release valve

7. **Brakes Do Not Apply**

   No air pressure in brake system
   Restricted or broken tubing or hose line
   Defective brake valve

8. **Brakes Do Not Release**

   Brake rigging binding
   Brake valve not in fully released position
   Defective brake valve
   Restriction in tubing or hose line

9. **Uneven Brakes**

   Brakes need adjusting, lubricating or relining
   Grease on brake lining — reline brakes
   Brake shoe release spring or brake chamber release spring broken
   Brake drum out of round
   Brake chamber diaphragm leaking

10. **Air Pressure Will Not Rise to Normal**

    Defective air gauge (registering incorrectly)
    Excessive leakage
    Reservoir drain cock open
    Governor out of adjustment
    No clearance at compressor unloading valves
    Defective compressor

11. **Air Pressure Rises to Normal Too Slowly**

    Excessive leakage
    Clogged air cleaner
    No clearance at compressor unloading valves
    Engine speed too low
    Compressor discharge valve leakage
    Worn compressor
    Excessive carbon in compressor cylinder head or discharge line

12. **Air Pressure Rises Above Normal**

    Defective air gauge (registering incorrectly)
    Compresor governor out of adjustment
    Defective compressor governor
    Restriction in line between governor and compressor unloading mechanism
    Too much clearance at compressor unloader valves
    Unloading valve cavities or unloading passage in compressor cylinder head blocked with carbon
    Compressor unloading valves stuck closed

13. **Compressor Fails to Maintain Sufficient Pressure in Air System**

    Dirty intake strainer
    Restriction in compressor inlet or discharge lines or cavities
    Leaking or broken discharge valves
    Drive coupling slipping
    Ir let valves worn excessively or stuck open
    Excessive air system leakage
    Excessive wear on piston rings and/or cylinders

14. **Noisy Compressor Operation**

    Loose drive gear
    Excessively worn drive coupling
    Worn or burned out bearings
    Excessive wear
    Improper lubrication to the compressor
    Restrictions in the cylinder head or discharge line

TROUBLESHOOTING

15. Compressor Passes Excessive Oil

Dirty air strainer
Oil supply lines to compressor or return lines flooded
Back pressure from engine crankcase
High inlet 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 burned out bearings
Excessive carbon deposits in compressor cylinder head

17. Compressor Fails to Unload

Defective or worn unloader pistons or bores
Inlet cavity restrictions
Defective governor
Unloader line from governor pistons kinked or the cavity beneath the unloader 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)
Compressor unloader mechanism leaking 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 Sympton #19)

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
Kinked 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 these symptoms above
Air dryer not securely mounted (excessive vibration)

Or Unsatisfactory Desiccant Life

Defective cloth covered perforated plate in air dryer desiccant cartridge or improperly rebuilt desiccant cartridge
Compressor passing excessive oil
Faulty heater and thermostat, wiring, fuse not allowing purge (cold weather operation only)

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

AIR COMPRESSOR
- Manufacturer ..... Bendix
- Model ..... Tu Flo 700
- TMC/MCI Part No. Standard (Alum Connecting Rods) 4R-7-1
- TMC/MCI Part No. Optional (Steel Connecting Rods) 4R-7-2
- Displacement ..... 15.5 cu. ft. (439 liters)
- Maximum RPM ..... 3000 (recommended)

CYLINDER BLOCK
- Bores
  - Out-Of-Round ..... .001" max

CYLINDER HEAD
- Capscrew Torque ..... 175-225 in. lbs. (19.7-25.4 Nm)

CRANKCASE
- (With Ball Bearing Main Bearings) Gap Between Outer Race O.D. and Crankcase Bore I.D. ..... .0000"-.0015" (0-.0381 mm)
- (With Sleeve-Type Main Bearings) Gap Between Crankshaft Journal O.D. and Main Bearing I.D. ..... .005" (.127 mm) max

PISTONS
- Clearance Between Cylinder Bore and Piston ..... .002"-.004" (.051-.102 mm)
- Clearance Between Wrist Pin and Piston ..... None - light press fit required
- Oversize Pistons Available ..... .010" (.254 mm)
  .020" (.508 mm)
  .030" (.762 mm)

PISTON RINGS
- Ring Gap (In Cylinder) ..... .002"-.004" (.051-.102 mm)
- Clearance Between Ring and Ring Groove ..... .002"-.004" (.051-.102 mm)

CRANKSHAFT
- Standard Journal O.D. ..... 1.1250"-1.1242" (28.575-28.555 mm)
- Journal Regrind Specifications ..... .010" (.254 mm) Undersize
  .020" (.508 mm) Undersize
  .030" (.762 mm) Undersize
- Clearance Between Sleeve Bearing and Main Bearing Journal ..... .005" (.127 mm) max
- Clearance Between Ball Bearing and Main Bearing Journal ..... None - snug fit required

CONNECTING RODS
- Clearance Between Wrist Pin O.D. and Connecting Rod Bushing ..... .0002"-.0007" (.00508-.01778 mm)

If Wrist Pin/Bushing Clearance Is Worn, It Can Be Replaced If Connecting Rods Are Steel; If Rods Are Aluminum, New Rod Assembly Must Be Installed.

- Clearance Between Connecting Rod Journal and Rod Bearing (After Rebuilding) ..... .0003"-.0022" (.0076-.0533 mm)
- Torque for Bolts on Rod Caps ..... 125-140 in. lbs. (14.1-15.8 Nm)

DISCHARGE VALVE TRAVEL ..... .030"-.046" (.762-11.68 mm)

INLET VALVE
- Distance From Cylinder Block Top to Inlet Valve ..... .101"-.113" (2.56-2.87 mm)

GOVERNOR
- Manufacturer ..... Bendix
- Model D-2
- TMC/MCI Part. No. 4C-8-33

SPECIFICATIONS

Cut-In Pressure .... 95-105 psi (655-724 kPa)
Cut-Out Pressure .... 115-118 psi max. (793-814 kPa)
Exhaust Valve Travel .... .060"-.093" (1.524-2.362 mm)
Inlet Valve Travel .... .030"-.040" (.762-1.016 mm)

BRAKE CHAMBERS

	FRONT	REAR	TRAILING
Manufacturer	Bendix	Bendix	Bendix
Type	24	30	12
Diameter	7¼" (184.1 mm)	8⅛" (206.3 mm)	5-21/32" (143.6 mm)
Max. Stroke	2¼" (57.1 mm)	3" (76.2 mm)	1¾ (44.4 mm)
Min. Stroke (w/Brake Adj.)	1¾" (44.4 mm)	1½" (38.1 mm)	1⅜" (34.9 mm)
Effective Diaphragm Area	24 sq. in. (6.1548 sq. cm)	30 sq. in. (193.5 sq. cm)	12 sq. in. (77.4 sq. cm)

AIR LINE CHECK VALVE
Manufacturer .... Bendix
Model No. 229603
MCI Part No. 4C-22-17
Air Pressure Differential .... 2 psi (13.8 kPa)

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

SERVICE BULLETINS

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

Number	Date	Subject