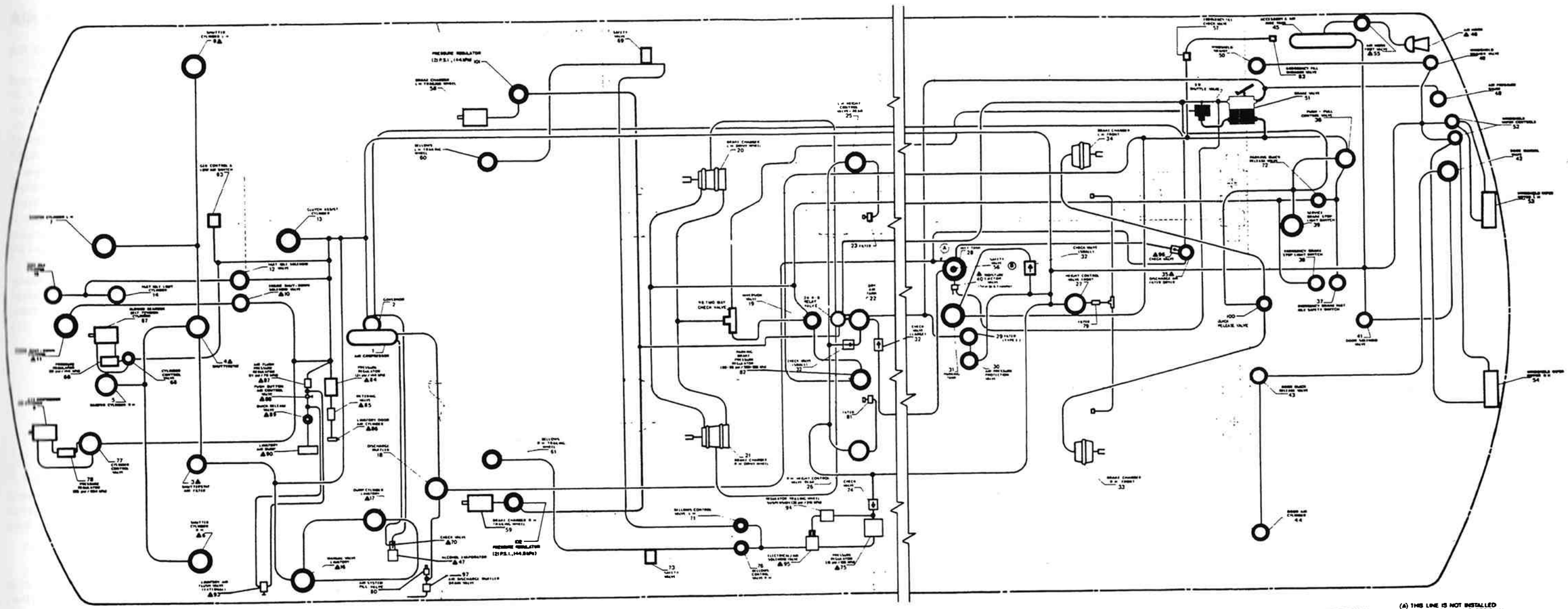
Date 1-1-89

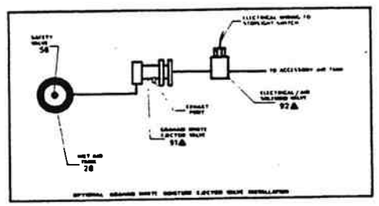
# MC-9 MAINTENANCE MANUAL

# 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).

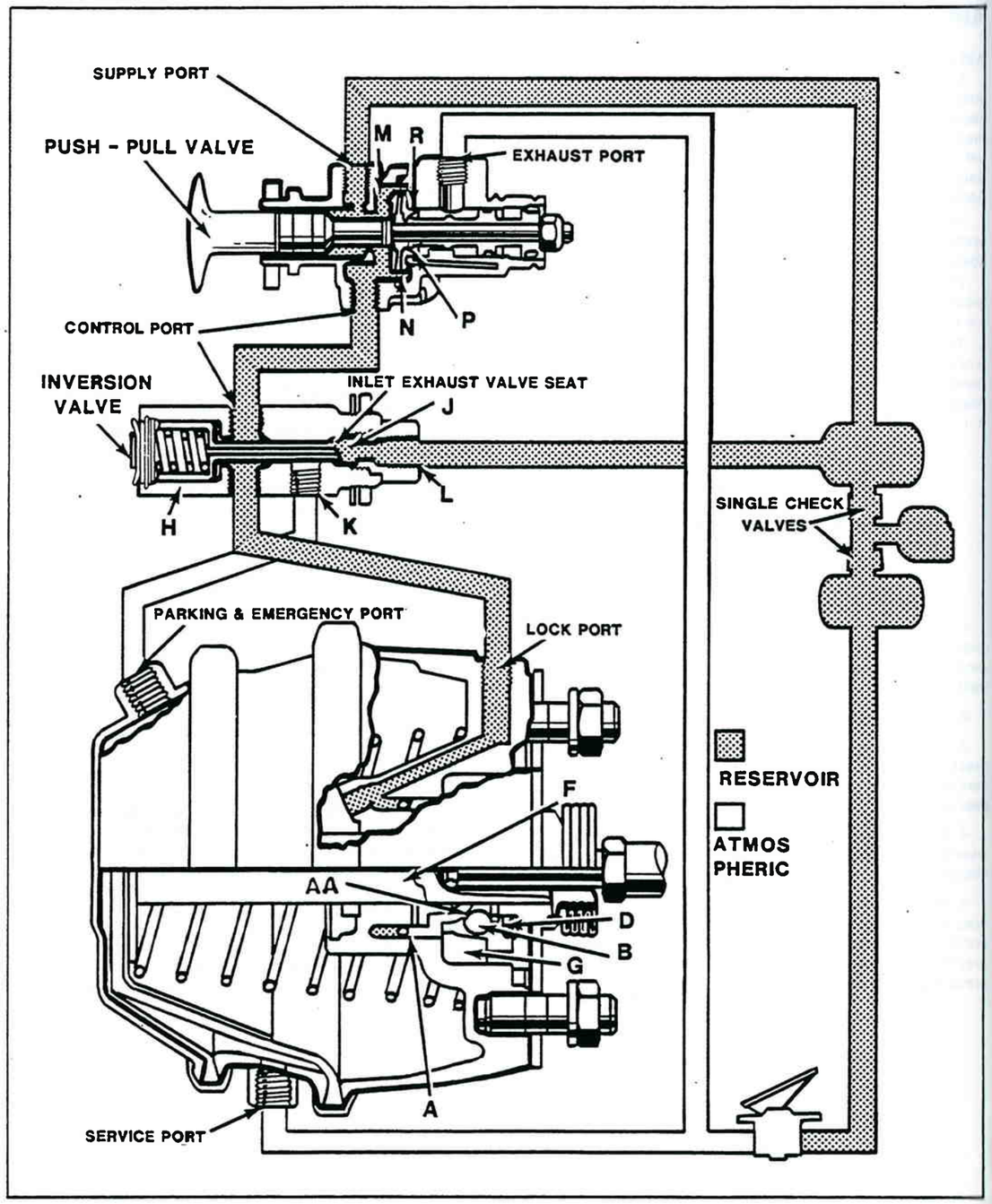



Figure 4-2. Parking Brake Schematic Diagram.



**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.

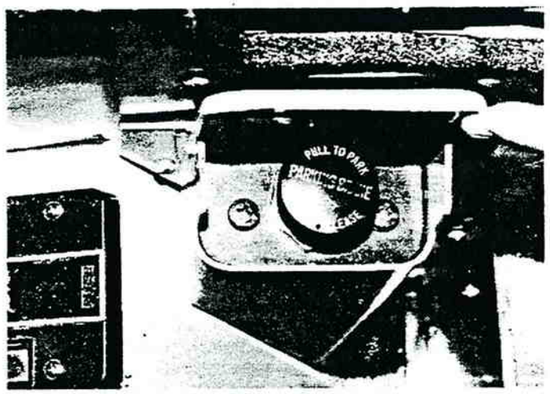



Figure 4-3. Push-Pull Control Valve.

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

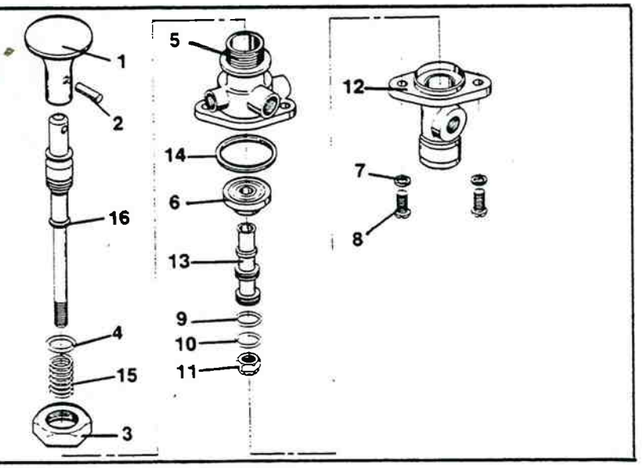



Figure 4-4. Push-Pull Control Valve Parts Breakdown.

**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.

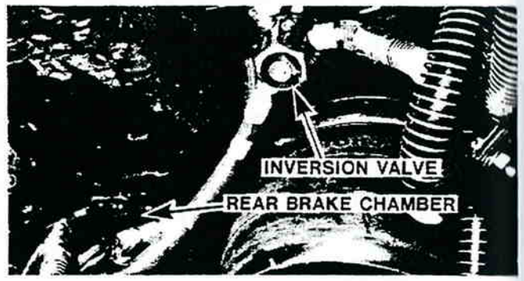



**Figure 4-5. TR-2 Inversion Valve Installed**



**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.

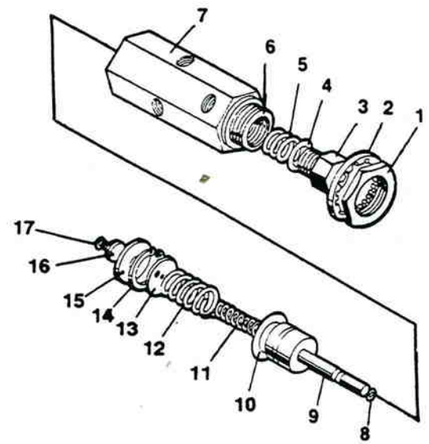
4. Install the diaphragm and diaphragm washer and secure with the cap screw.

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.

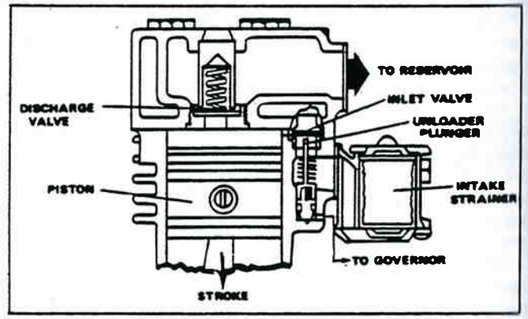



Figure 4-7. Intake Stroke Beginning.

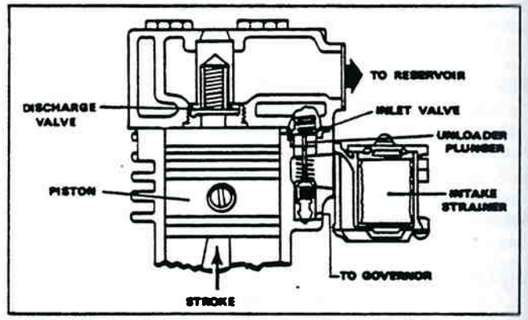



Figure 4-8. Compression Stroke Ending.

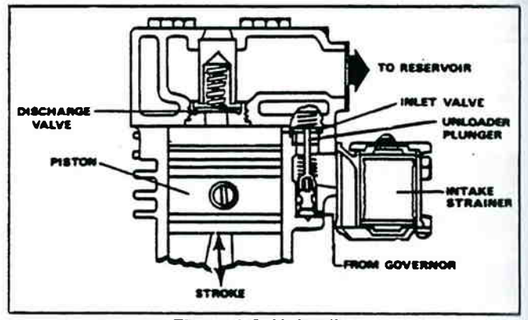



Figure 4-9. Unloading.

### 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.**