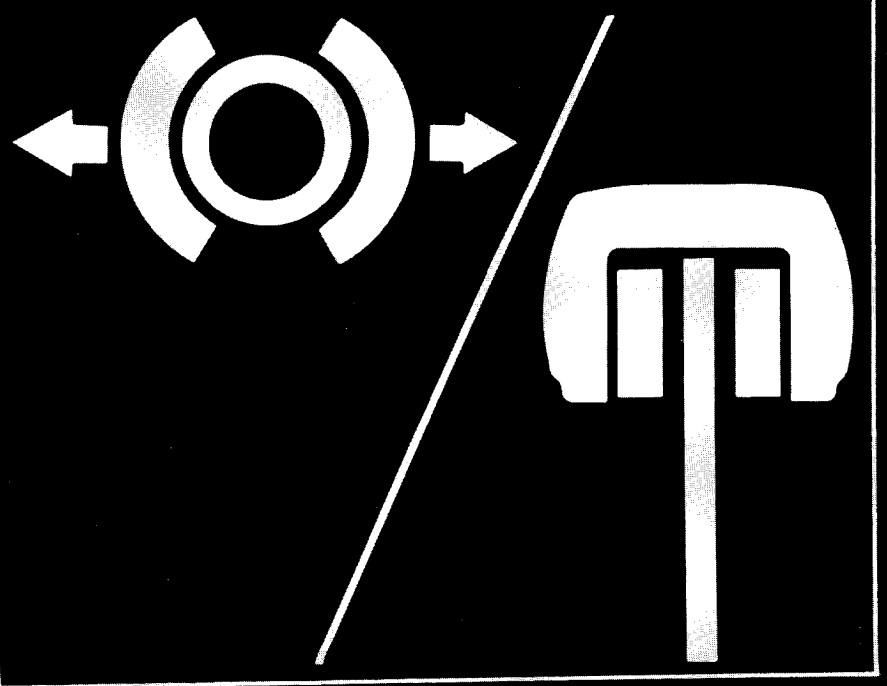
STRAIGHT AIR & AIR OVER HYDRAULIC BRAKE MANUAL

9093



CLARK

Michigan Company

CLARK

STRAIGHT AIR & AIR OVER HYDRAULIC BRAKE MANUAL 9093

PUBLICATION NO. 9093

The Clark Product Support Language is a special technical language designed to improve the readability of Clark manuals.

59-940-9093
2M 8411 CGAC

Printed in U.S.A.

NOTES

FOREWORD

This manual covers the Straight Air and Air Over Hydraulic Brake Systems used on medium and large size Clark Wheel Loaders and Dozers. Both of these systems utilize a similar BASIC SYSTEM to build-up and store an air supply. This air supply is then used either to directly apply or to assist hydraulics to apply the brake assemblies. Both of these systems meet or exceed S.A.E. standards for automatic secondary braking provisions.

Each of these systems consists of an air compressor and governor, relief valve, treadle valves, hand valve, double check valve (shuttle valve), ERQ valves (emergency relay quick release valve), air reservoirs, air chambers and air dryer (optional on some machines).

This manual will explain brake component and system operations; preventive maintenance and adjustments; and troubleshooting of specific problems.

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WORK SAFELY

The Safety Alert Symbol  is used throughout this manual to call attention to warnings where the safety to the serviceman may be involved.

SAFETY

Before you begin your work, make sure your machine is in the service position. Observe these Safety rules. Work safely.

Steering frame lock connected

Bucket on the ground

Parking brake applied

Engine shut down

Ignition key removed

Red Warning flag tied on steering wheel

Wheels blocked

*Let the machine become cool

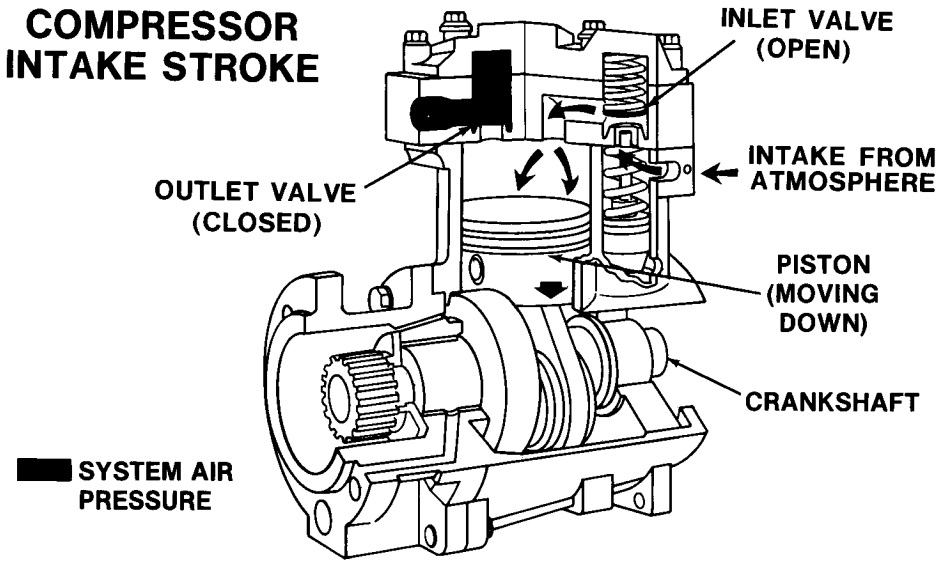
Remove all pressure caps slowly to relieve pressure

***If work must be done on a warm machine, BE CAREFUL OF HOT liquids and components.**

AIR COMPRESSOR AND GOVERNOR

The air compressor compresses air and sends it to the brake system to operate the service and emergency brakes.

Intake Stroke

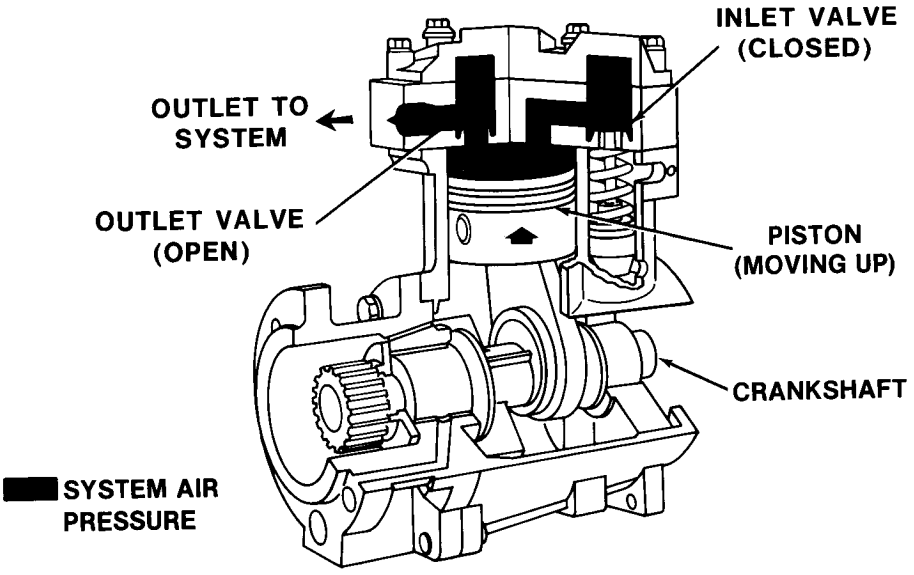


TS 20889

When the compressor is in the intake stroke, the piston is moving down. This causes a vacuum in the cylinder. The air at atmospheric pressure can now push the inlet valve off the seat against the spring tension. Air flows into the cylinder of the air compressor. When the piston reaches the end of the stroke, it stops moving down. When the piston stops moving down, it stops causing vacuum. Air flows into the cylinder until the pressure difference from one side of the inlet valve to the other decreases enough so that the spring can close the valve.

The system air pressure and the spring hold the outlet valve in the closed position.

Compression Stroke



TS 20888

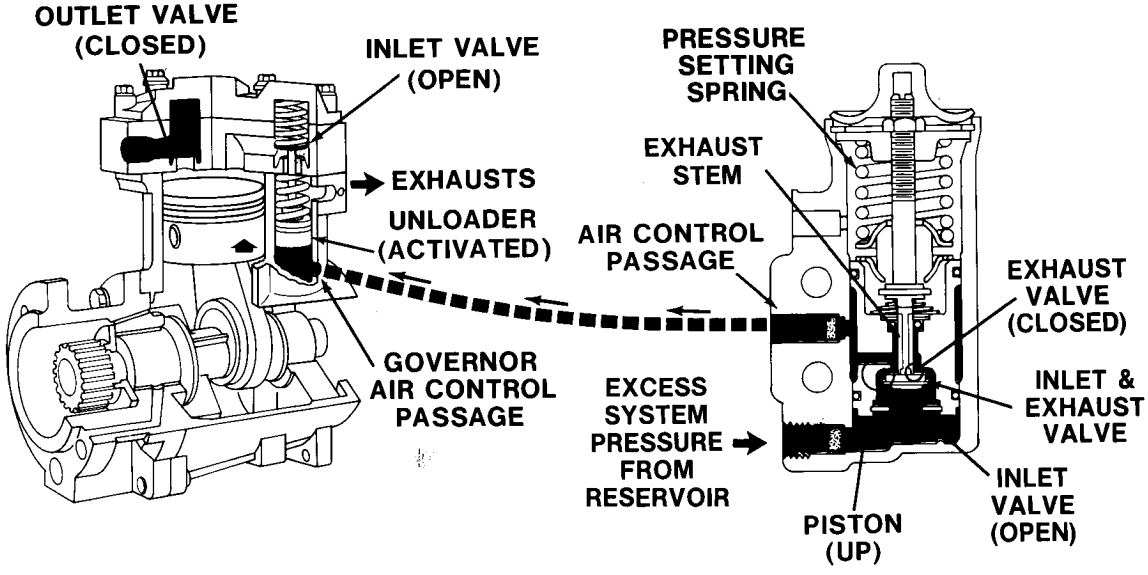
When the air compressor is in the compression stroke, the piston is moving up. As the piston moves up, it compresses the air in the cylinder. This causes the pressure of the air to increase. When the pressure becomes higher than the pressure in the air system, it pushes the outlet valve off the seat. The air is pushed out of the cylinder and into the air system. When the piston reaches the end of the stroke, it stops moving up and also stops compressing the air. The air flows out of the cylinder until the pressure of the air in the cylinder and below the valve decreases. When the pressure decreases enough the spring closes the outlet valve.

The air pressure inside the cylinder and the spring hold the inlet valve in the closed position.

Each time the crankshaft turns one revolution, there is an intake and compression stroke in each cylinder of the compressor.

Governor in compresser cut-off mode, compressor in unload cycle.

The governor controls the operation of the compressor.

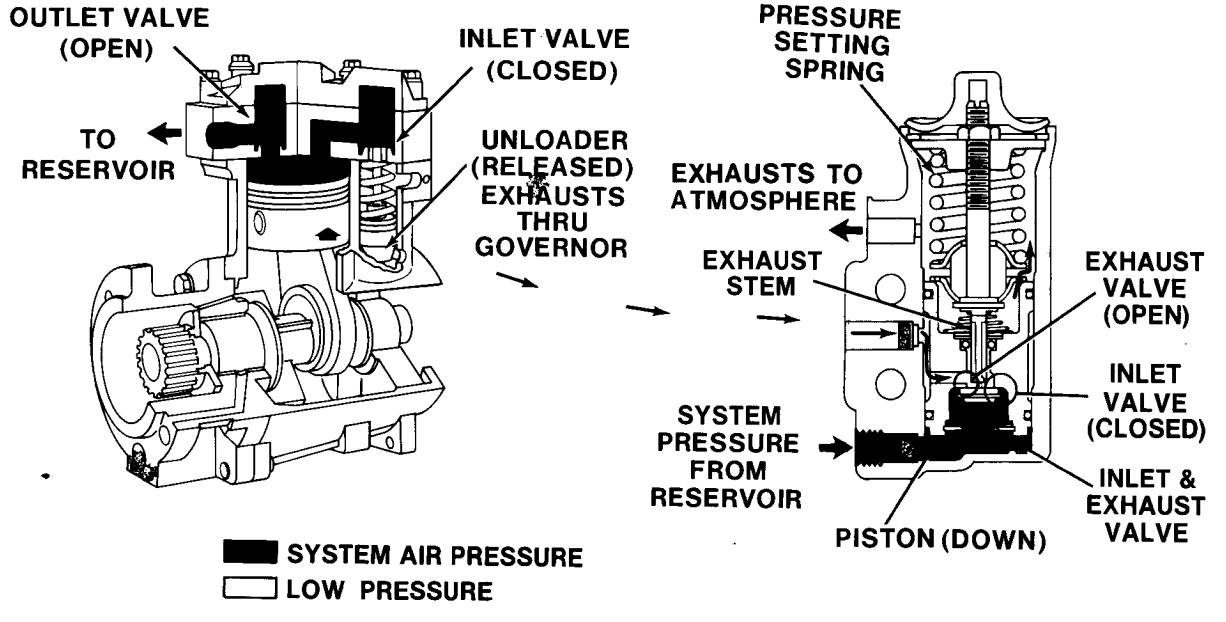


TS 20886

When the air pressure in the system becomes high enough, it pushes the piston in the governor up. As the piston moves up, the inlet and exhaust valve comes in contact with the exhaust stem. The exhaust stem stops the inlet and exhaust valve from moving. As the piston continues to move, the inlet valve starts to open. When the inlet valve starts to open, the air pressure is against more area of the piston. This pushes the piston so that the inlet valve is all of the way open. System air pressure now flows through the inlet valve, through the piston and to the unloader on the compressor. This air activates the unloader which holds the inlet valve in the compressor open. As the piston moves down air flows into the cylinder through the inlet valve. As the piston moves up the air flows backward out of the cylinder through the inlet valve.

The air from the air system holds the outlet valve in the compressor closed. The compressor sends no air into the air system.

Governor in normal mode, Compressor Charging (load cycle)

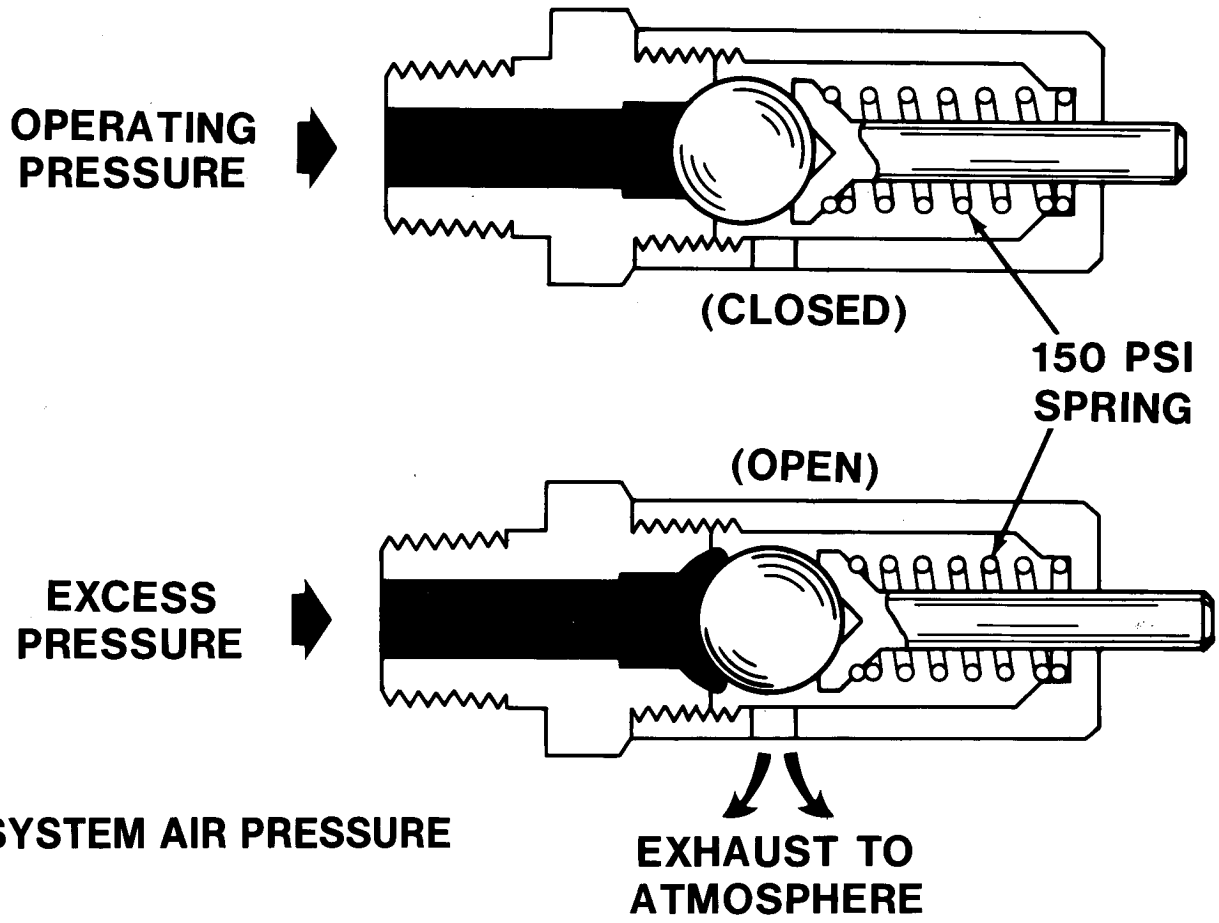


TS 20887

As the pressure in the system decreases, the piston in the governor moves down. When the piston moves down enough, the inlet valve makes contact with the piston and is closed. When the inlet valve closes, the area of the piston with air pushing it up is decreased. This causes the piston to move down farther and take the inlet and exhaust valve with it. The inlet and exhaust valve is no longer against the exhaust system. Air from the unloader in the compressor now flows to the governor. This air flows through the piston, through the exhaust stem and out the exhaust port. The unloader no longer holds the inlet valve in the compressor open.

The unloader is open through the exhaust port in the governor and the compressor sends air to the air system.

RELIEF VALVE



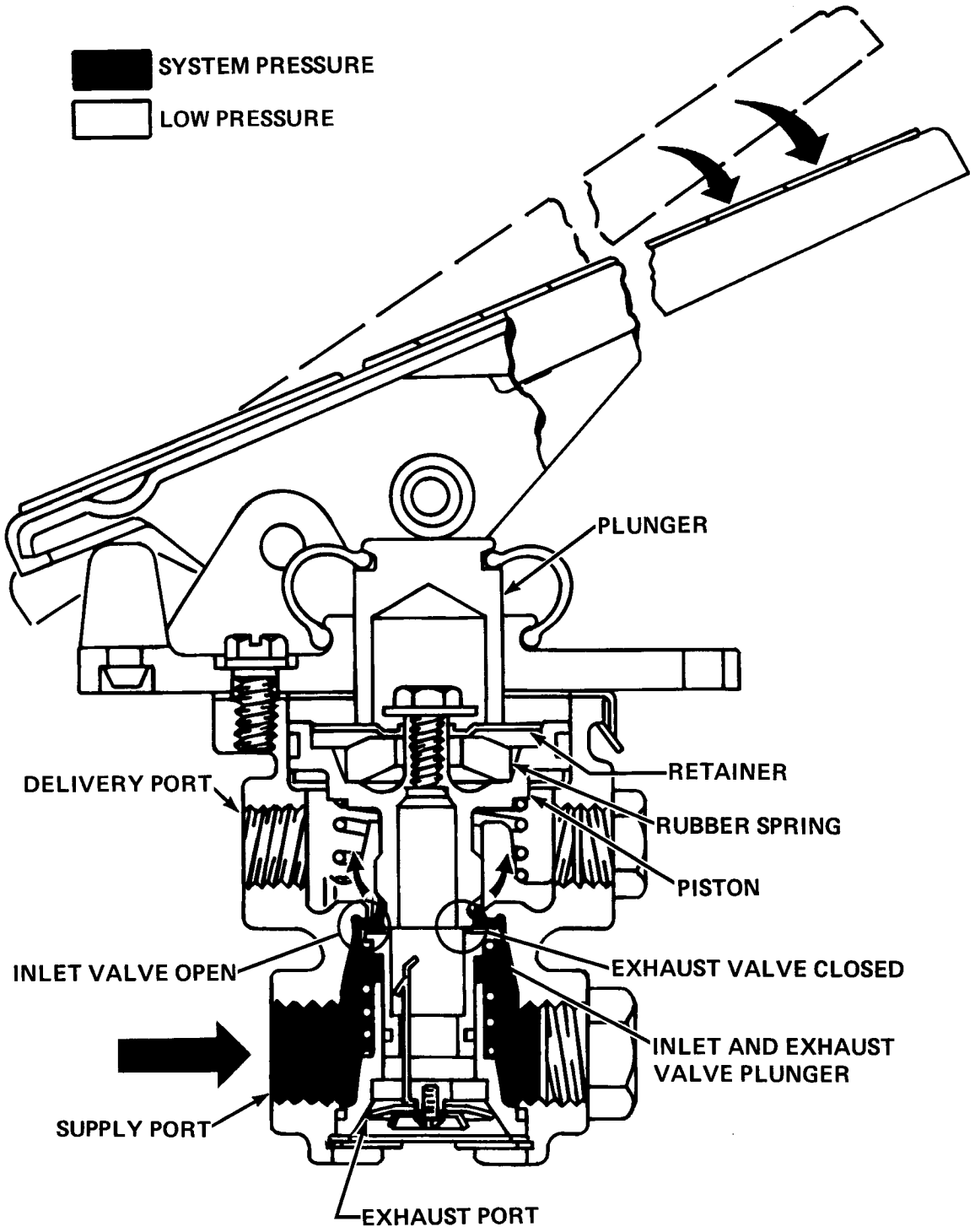
TS 20885

The system air pressure is against the ball in the Relief Valve. The ball is held on the seat by a spring.

If the pressure in the system reaches approximately 150 psi (1034,2 kPa) (10,5 kgf/cm^2), it pushes the ball off the seat. The high pressure air can now flow through the exhaust port and to the atmosphere.

The relief valve protects the system components from damage caused by high pressure.

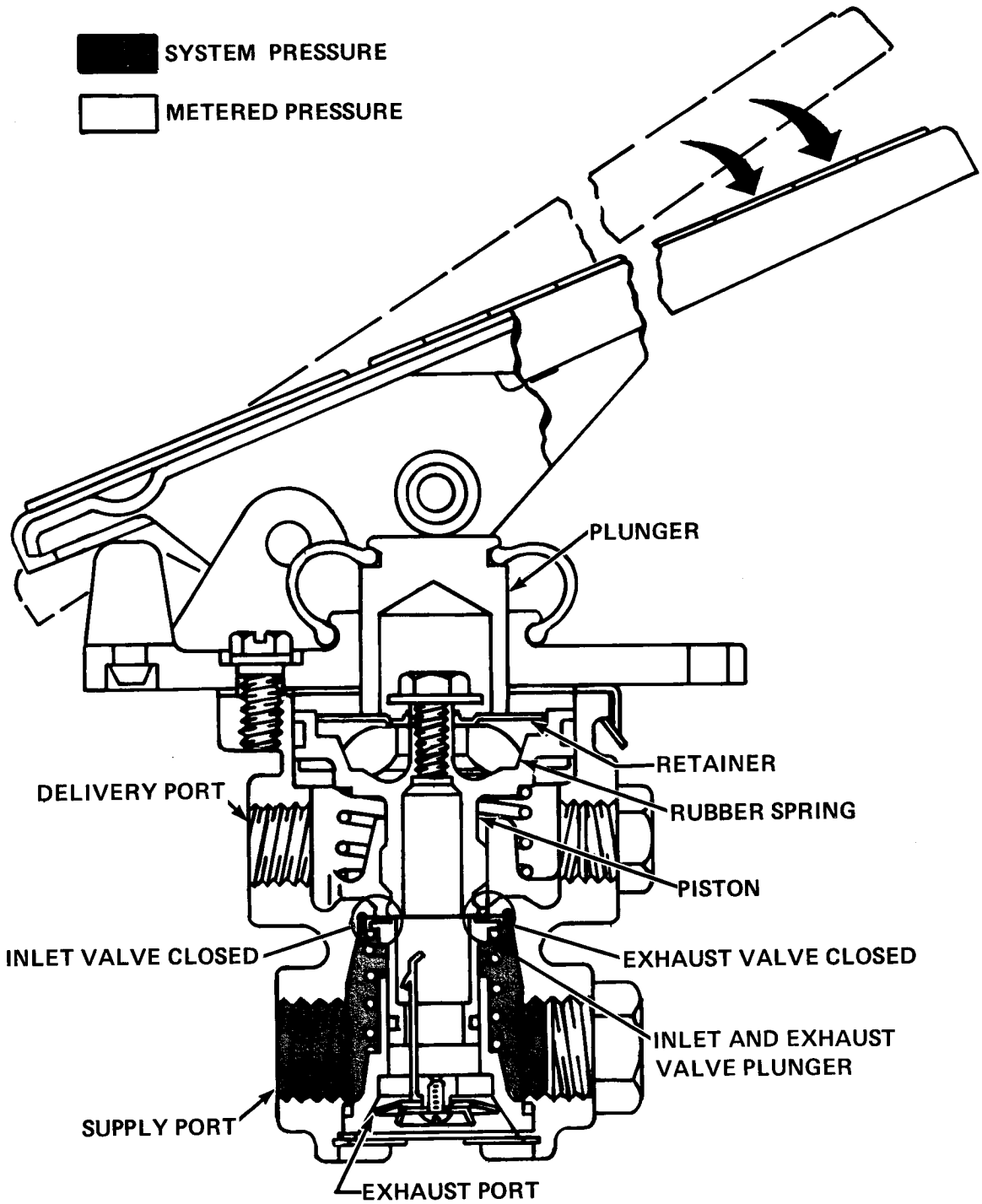
TREADLE VALVE
Brake Pedal Pushed



TS 16062

When the brake pedal is pushed, it pushes the plunger. The plunger pushes the retainer. The retainer pushes the rubber spring. The rubber spring pushes the piston against the inlet and exhaust valve plunger. This closes the exhaust valve. As the piston continues to move, it pushes the inlet and exhaust valve plunger down. This opens the inlet valve. Air from the reservoir now flows in the supply port through the inlet valve and out the delivery port.

Brake Pedal Pushed and Held

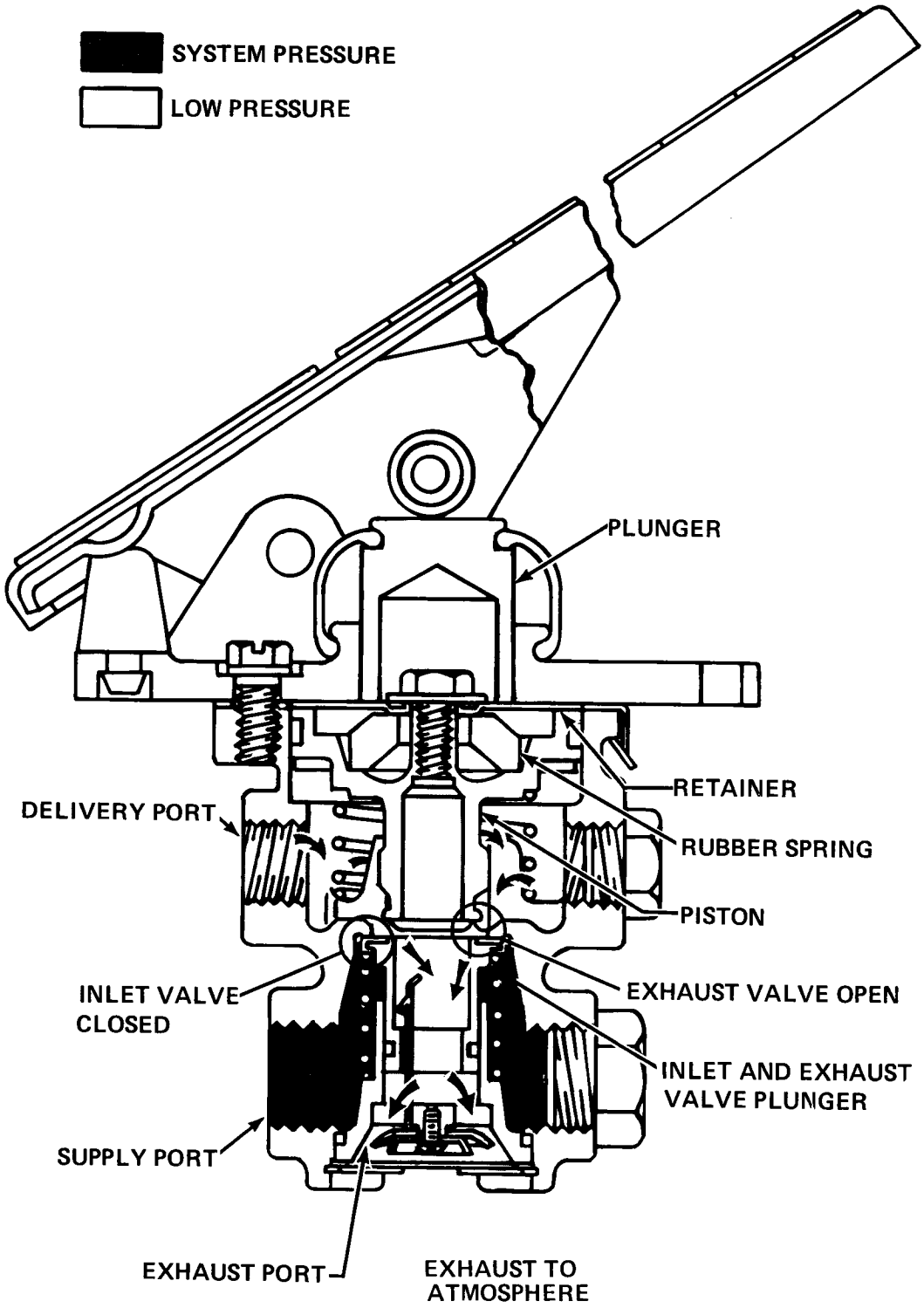


TS 16063

When the pedal is pushed and held, air flows in the supply port, through the inlet valve and out the delivery port. The air pressure in the delivery port is also against the bottom of the piston. As more air flows through the inlet valve, the pressure below the piston increases. As this pressure increases, the piston pushes up and compresses the rubber spring. When the pressure becomes high enough, the piston moves enough so that the inlet valve is closed. The exhaust valve also stays closed. If the pedal is pushed farther, it takes more pressure to compress the rubber spring enough to close the inlet valve. This causes the pressure in the delivery port to increase. If the pedal is released part way, the exhaust valve opens. When the pressure in the delivery port is low enough, the rubber spring pushes the piston down enough to close the exhaust valve.

If the pedal is pushed all of the way, the inlet valve is held open and the exhaust valve is held closed.

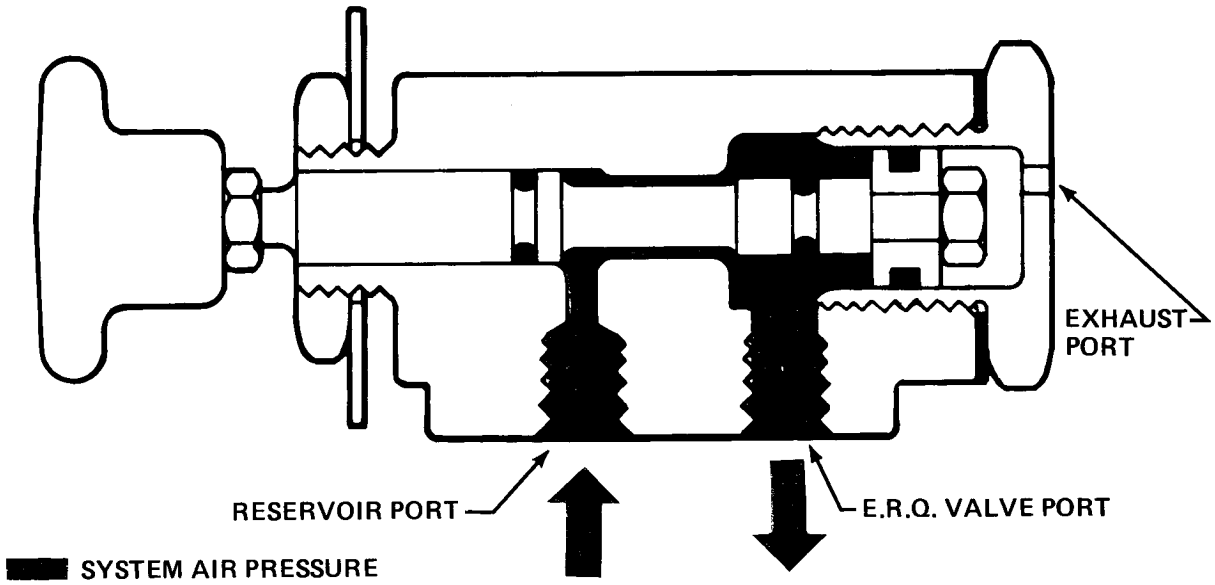
Brake Pedal Released



TS 16064

When the pedal is released, the spring under the piston pushes the piston, rubber spring, retainer and plunger all of the way up. The spring under the inlet and exhaust valve plunger pushes the plunger up. In this position the inlet valve is closed and the exhaust valve is open. Any air in the delivery port can flow through the exhaust valve, the plunger and out the exhaust port.

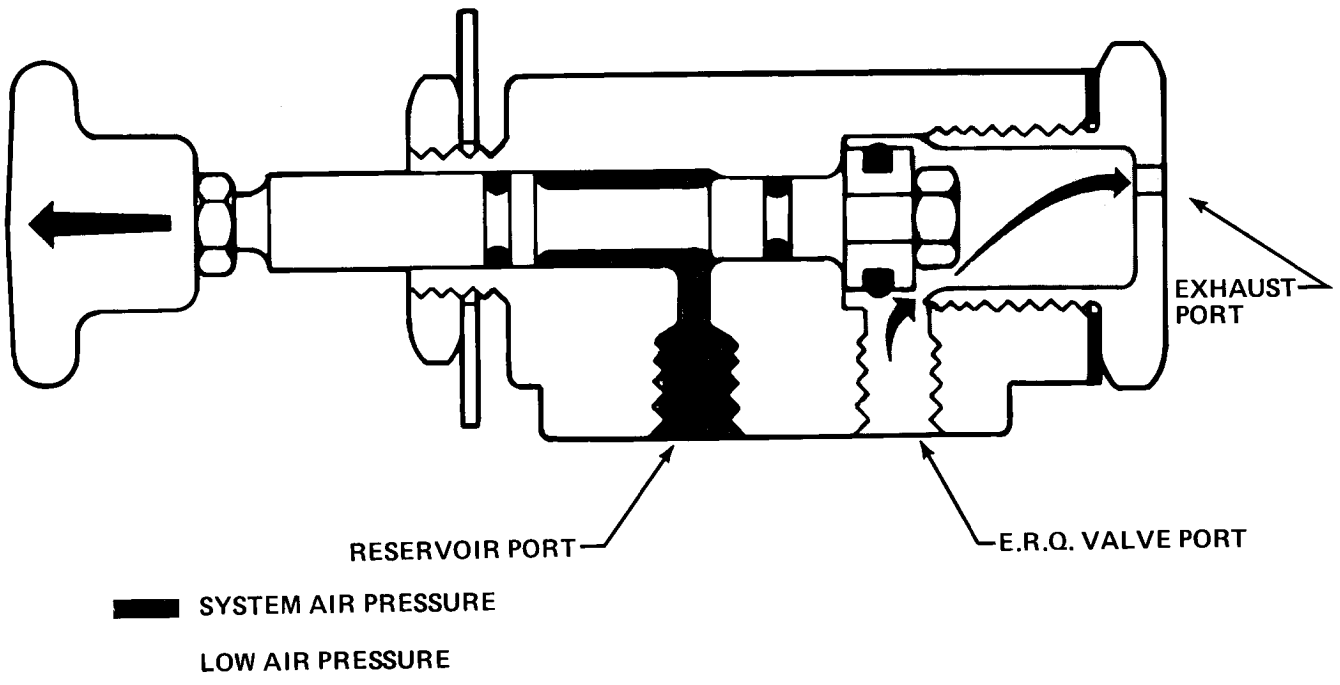
HAND VALVE
Normal Position



TS 16077

When the hand valve is in the normal position, the knob is pushed in. The reservoir port is open to the E.R.Q. valve port. The exhaust port is closed to both the reservoir and E.R.Q. valve ports.

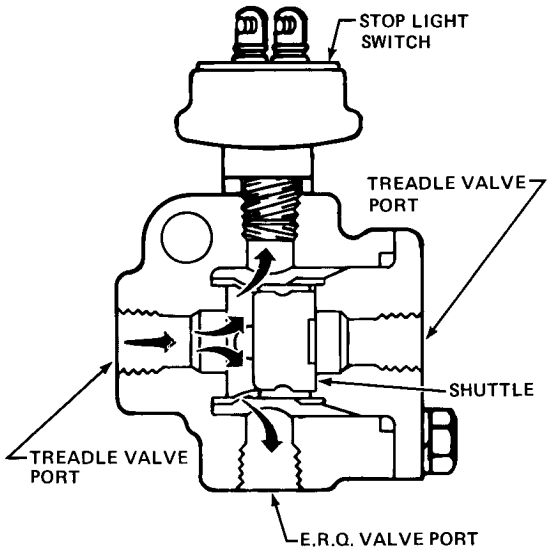
Emergency Position



TS 16078

When the hand valve is in the emergency position, the knob is pulled out. The reservoir port is closed to the E.R.Q. valve port and the exhaust port. The E.R.Q. valve port is open to the atmosphere through the exhaust port.

DOUBLE CHECK VALVE
(Shuttle Valve)



TS 16074

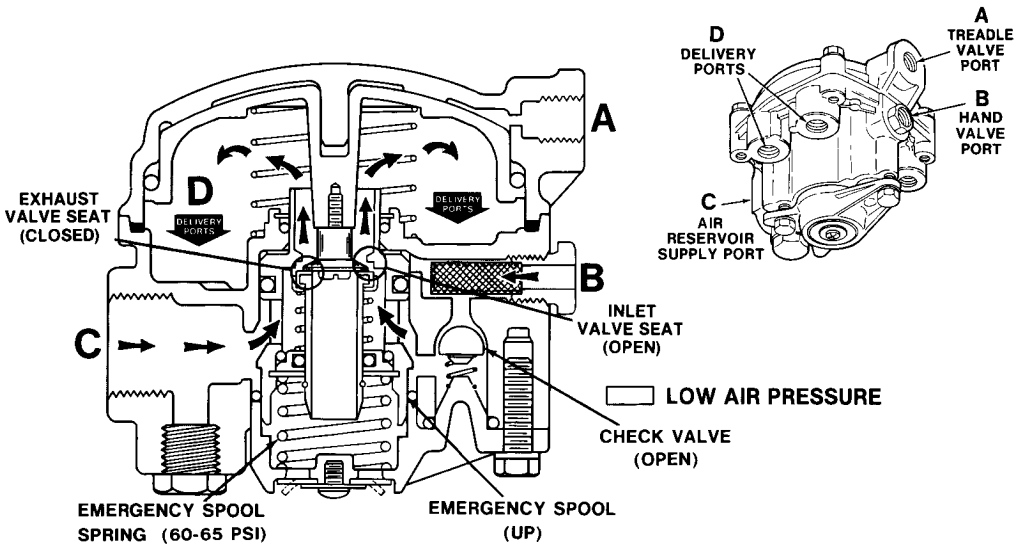
The double check valve lets air from either treadle valve flow to the stop light switch and to the E.R.Q. valves.

As metered air pressure flows into the double check valve from the treadle valve, it pushes the shuttle to the other side. This opens the ports to the stop light switch and the E.R.Q. valve port. The shuttle closes the other treadle valve port so that air cannot flow out the exhaust port of that treadle valve.

EMERGENCY RELAY QUICK RELEASE VALVE

This valve controls the flow of air to and from the power clusters.

System Charging Brakes Automatically Applied.



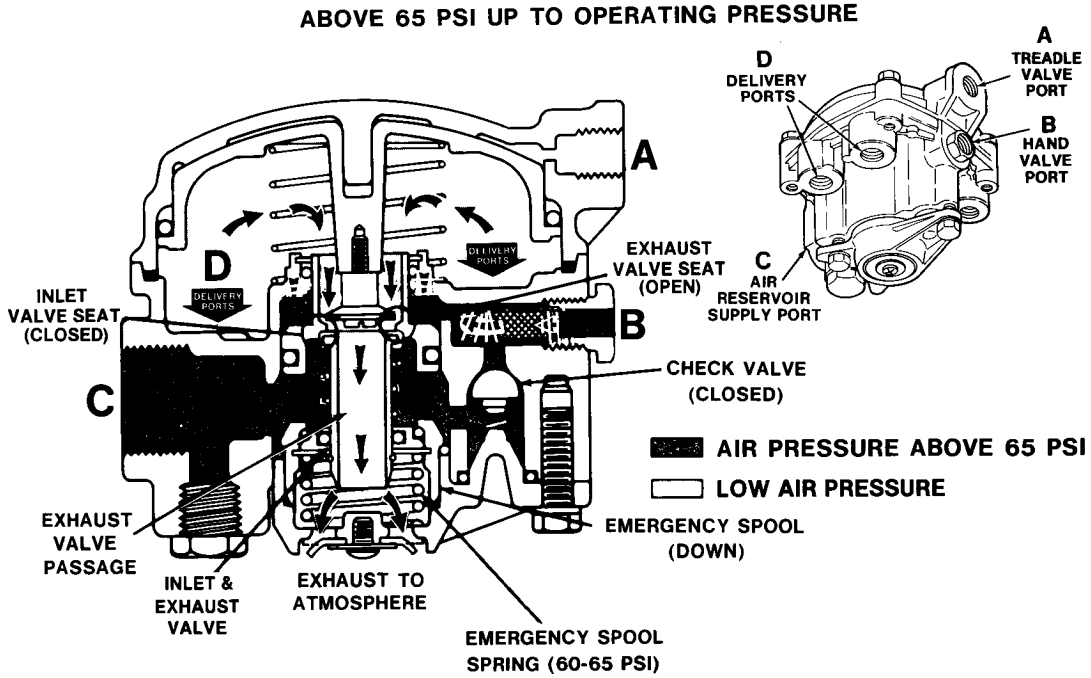
TS 20884

The emergency spool spring pushes the emergency spool up and air pressure from the hand valve port (B) pushes down on it. The spring holds the spool up as long as the pressure above the spool is less than 60-65 psi (413,7-448,2 kPa) (4,2-4,6 kgf/cm²). This keeps the inlet valve seat open. The spring under the inlet and exhaust valve keeps the exhaust valve seat closed. Air from the supply port (C) flows through the inlet valve seat and out the delivery port. If the pressure in port B is higher than in port C, air can open the check valve and flow into port C.

As the air pressure in the hand valve port (B) increases, it pushes the emergency spool down against the spring tension. When this air pressure reaches approximately 65 psi (448,2 kPa) (4,6 kgf/cm²), the spool has moved far enough so that the inlet valve seat is closed. Air from the supply port (C) can not flow through the inlet valve seat to the delivery ports (D). The spool now moves the inlet and exhaust valve with it. As it continues to move down, it opens the exhaust valve seat. Air pressure in the delivery ports (D) flows through the exhaust valve seat, through the exhaust valve passage and out the exhaust.

Some E.R.Q. valves do not have a spring under the relay piston.

Brakes Released



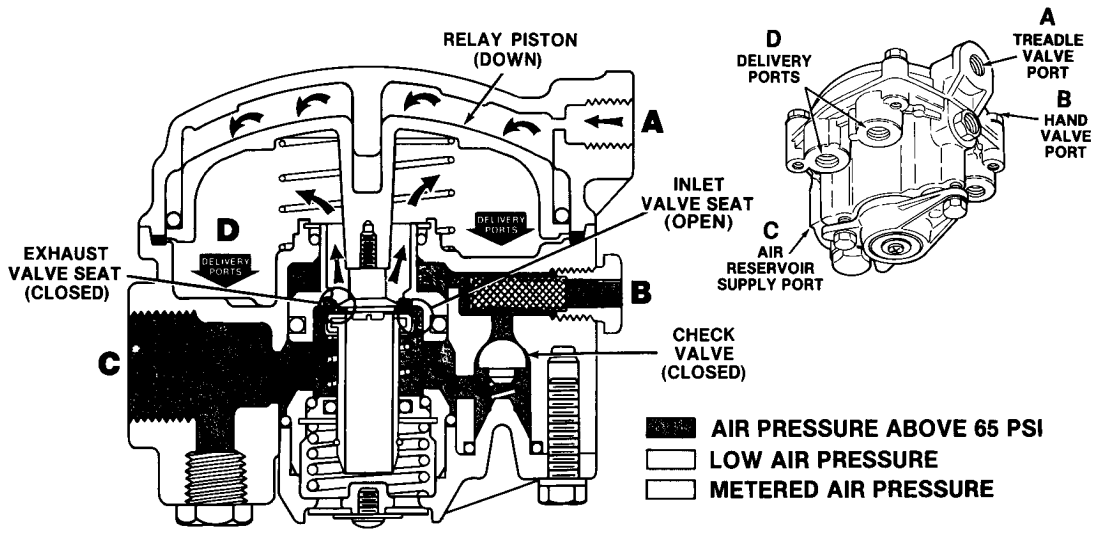
TS 20882

The air pressure in the supply port (C) and the hand valve port (B) is above 65 psi (448,2 kPa) (4,6 kgf/cm²). The air pressure in the hand valve port (B) holds the emergency spool down. If the brakes were applied with a treadle valve, the relay piston was pushed down. The air pressure below the relay piston and the air that flows through the delivery ports (D) then pushes the relay piston up. The inlet valve seat is closed and the exhaust valve seat is open. Air from the air chambers can flow through the delivery ports (D), the exhaust valve seat and out the exhaust.

A spring holds the check valve closed.

Some E.R.Q. valves do not have a spring under the relay piston.

Brakes Being Applied by Treadle Valve



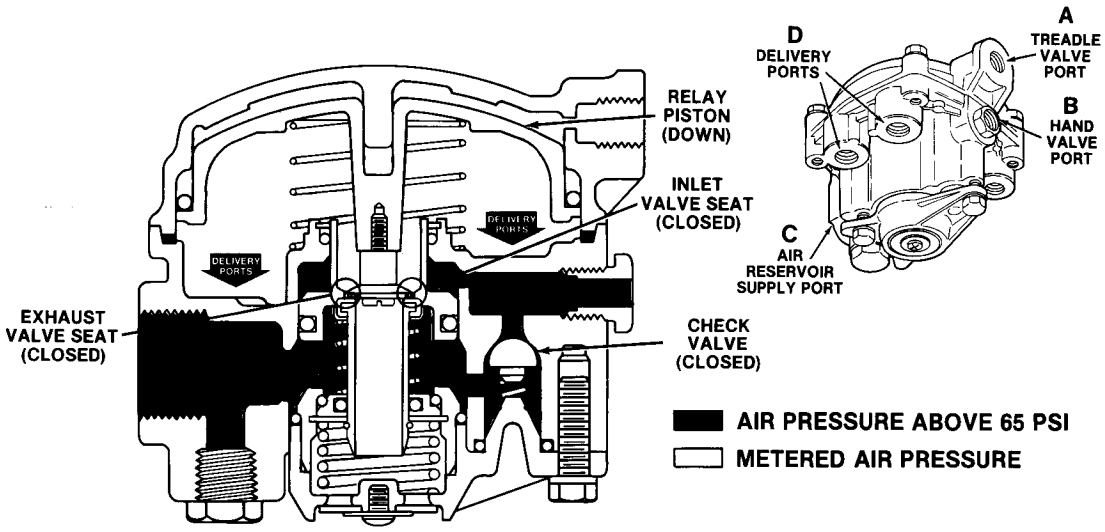
TS 20881

As metered air pressure from the treadle valve enters the treadle valve port (A), it pushes the relay piston down. When the exhaust valve seat on the relay piston makes contact with the inlet and exhaust valve, it closes the exhaust valve seat. The relay piston now pushes the inlet and exhaust valve down. This opens the inlet valve seat. Air from the reservoir supply port (C) now flows through the inlet valve and out the delivery ports. Air flows through the inlet valve as long as the air pressure below the relay piston is less than the pressure above the piston.

A spring holds the check valve closed.

Some E.R.Q. valves do not have a spring under the relay piston.

Brakes Applied by Treadle Valve and Held



TS 20880

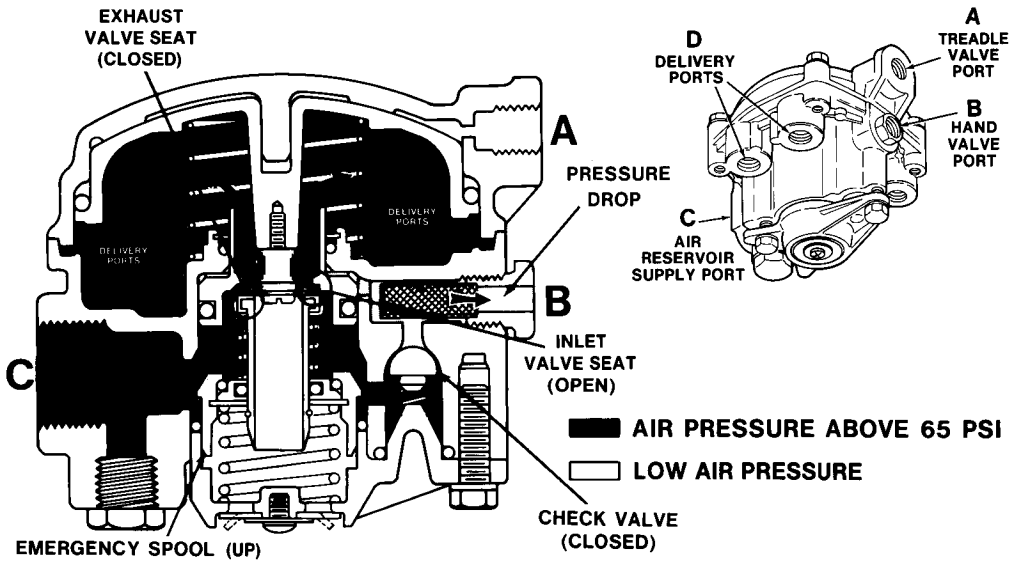
The air pressure at the delivery ports (D) of the E.R.Q. valve will be approximately the same as the pressure in the treadle valve port (A). As the air pressure below the relay piston increases, the piston moves up until the inlet valve seat is closed. The exhaust valve seat is also closed. As long as the pressure is equal on both sides of the relay piston, it will stay in this position. The air pressure to the delivery ports (D) is held and there is no flow of air through the valve.

If the pressure above the relay piston increases, the relay piston will move down and open the inlet valve seat. The inlet valve seat will close when the pressure below the relay piston increases enough to move the piston up. If the pressure above the piston decreases, the piston will move up and open the exhaust valve seat. As the air pressure below the piston flows out the exhaust, the relay piston moves down and closes the exhaust valve seat. This causes the air pressure at the delivery ports to be approximately equal to the pressure in the treadle valve port (A).

A spring holds the check valve closed.

Some E.R.Q. valves do not have a spring under the relay piston.

Emergency Brakes Applied Automatically or with Hand Valve



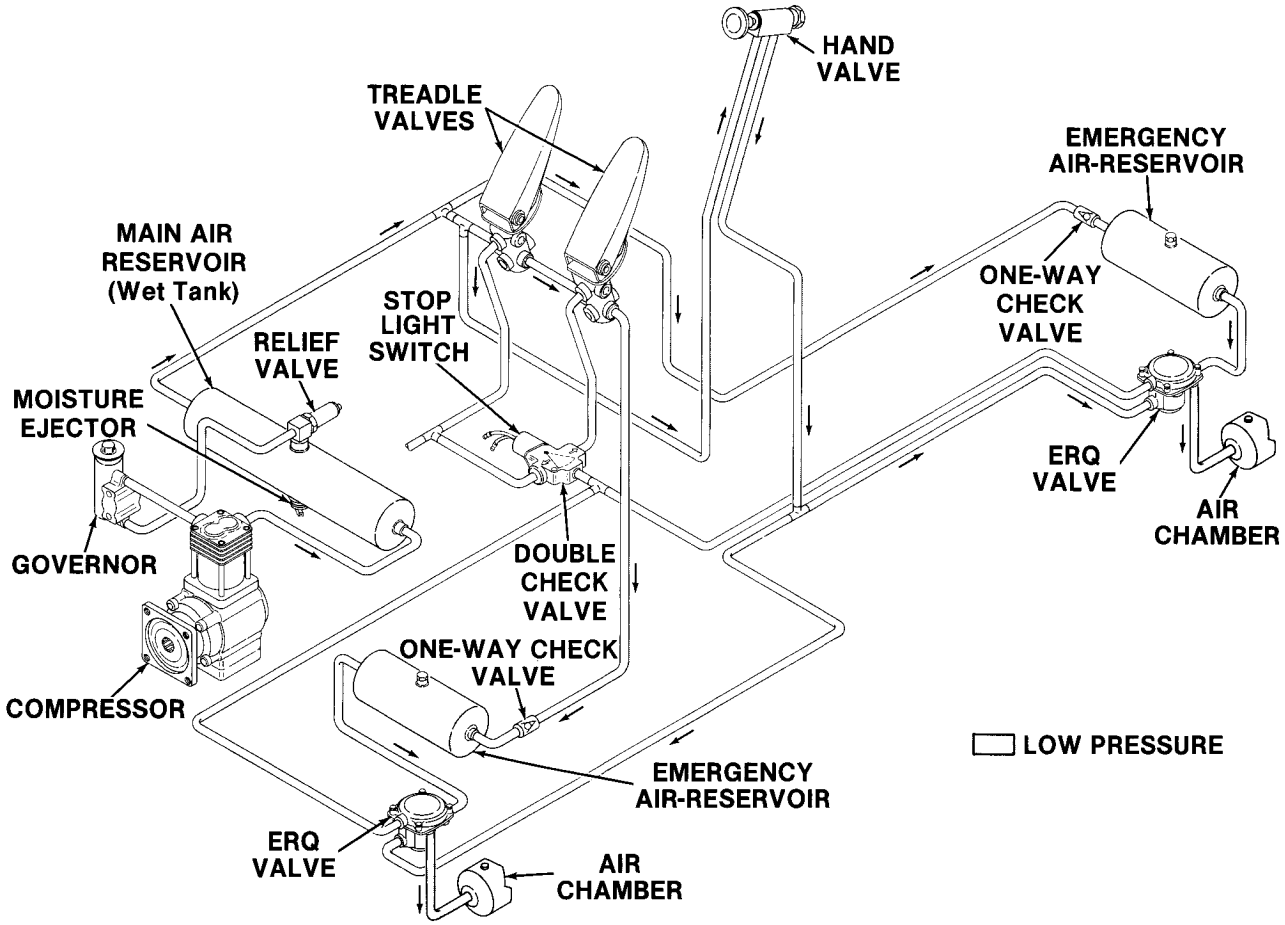
TS 20883

If the air pressure in the hand valve port (B) becomes less than 60-65 psi (413,7-448,2 kPa) (4,2-4,6 kgf/cm^2), the emergency spool moves up. When the emergency spool moves up, the inlet valve seat opens. The air from the air reservoir supply port (C) flows through the inlet valve seat and out the delivery ports (D).

The air pressure below the check valve and the spring hold the check valve closed.

Some E.R.Q. valves do not have a spring under the relay piston.

AIR SYSTEM
System Charging

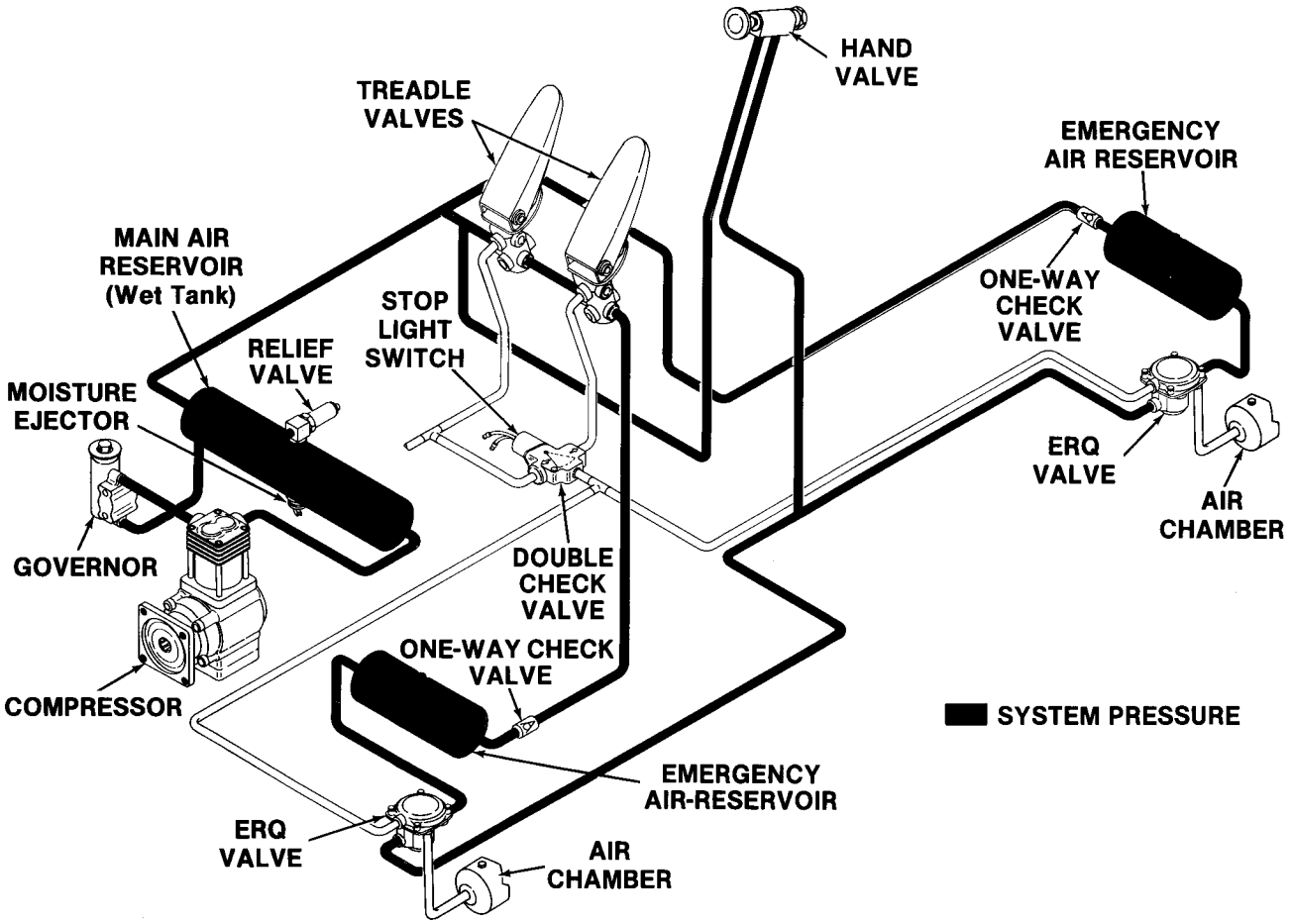


TS 20894

When there is no air pressure in the system the brakes are not applied. As the air pressure in the system increases, the braking torque increases until the system air pressure reaches 60-65 psi (413,7-448,2 kPa) (4,2-4,6 kgf/cm^2).

Air flows from the compressor to the main reservoir and the relief valve. Air flows from the main reservoir to both treadle valves, through the one-way check valves to both emergency air reservoirs and to the hand valve. Air from the hand valve flows to both E.R.Q. valves. Air from each emergency air reservoir flows to the E.R.Q. valve that it is connected to. The air from the hand valve and the air from the emergency air reservoirs flows out of each E.R.Q. valve to the air chamber that it is connected to. This air operates the air chambers on the power clusters and the brakes are applied.

System Charged Breaks Released



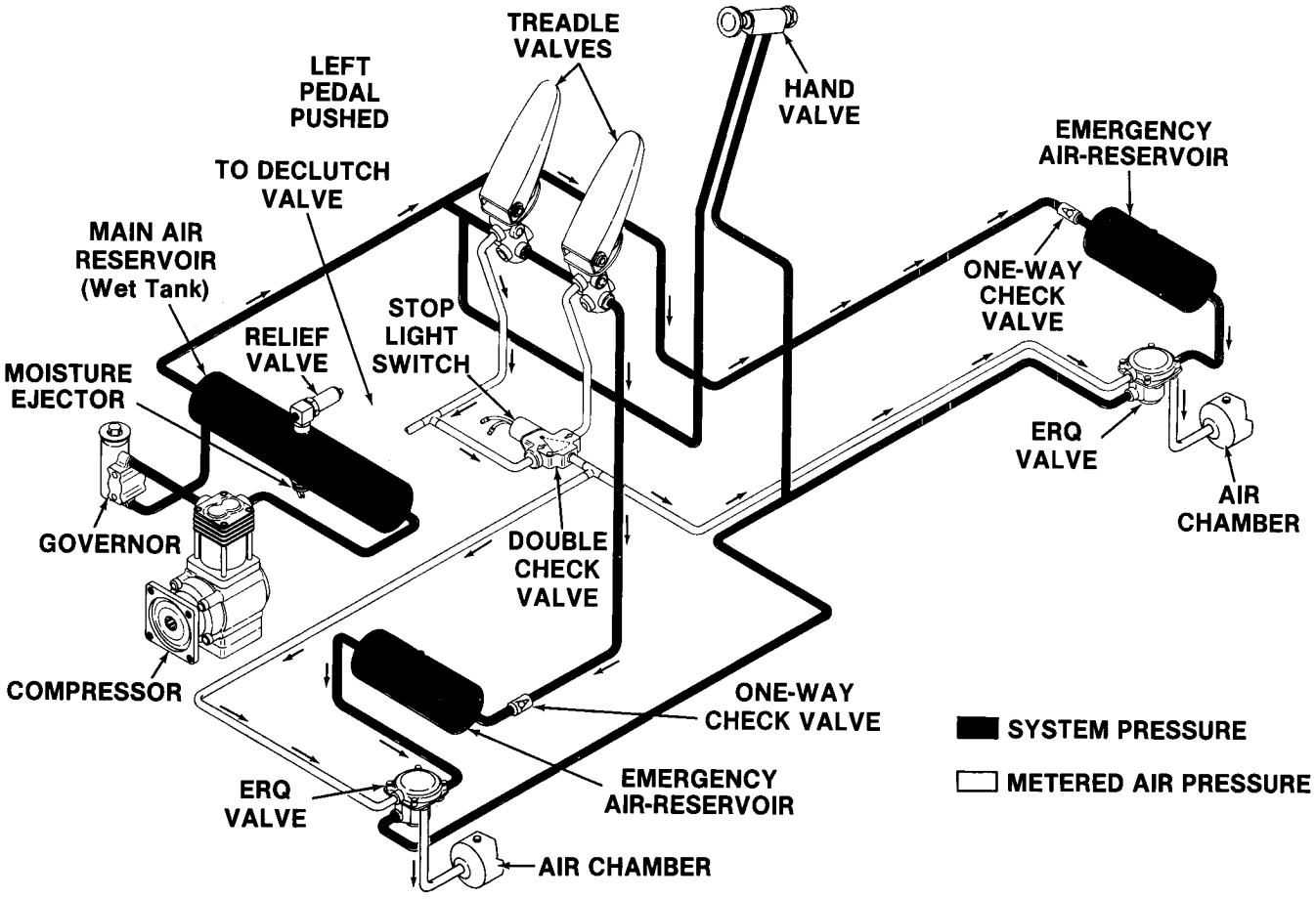
TS 20872

When the system is charged, there is system air pressure through the governor to the compressor. The unloader in the air compressor is activated by this air pressure and no air is sent into the reservoir by the compressor. (See governor in compressor cut-off mode, compressor unloaded.)

There is system air pressure in the main air reservoir, through the one way check valves and to the emergency air reservoirs. There is system air pressure through the hand valve to both E.R.Q. valves. There is system air pressure in the supply ports of both treadle valves. There is system air pressure in the supply ports of both E.R.Q. valves. There is also system air pressure to the relief valve.

The air chambers are open to exhaust through the E.R.Q. valves (See E.R.Q. valve brakes released). The chambers above the pistons in the E.R.Q. valves are open through the double check valve and the exhaust ports in the treadle valves.

Normal Braking (Left Pedal Pushed)



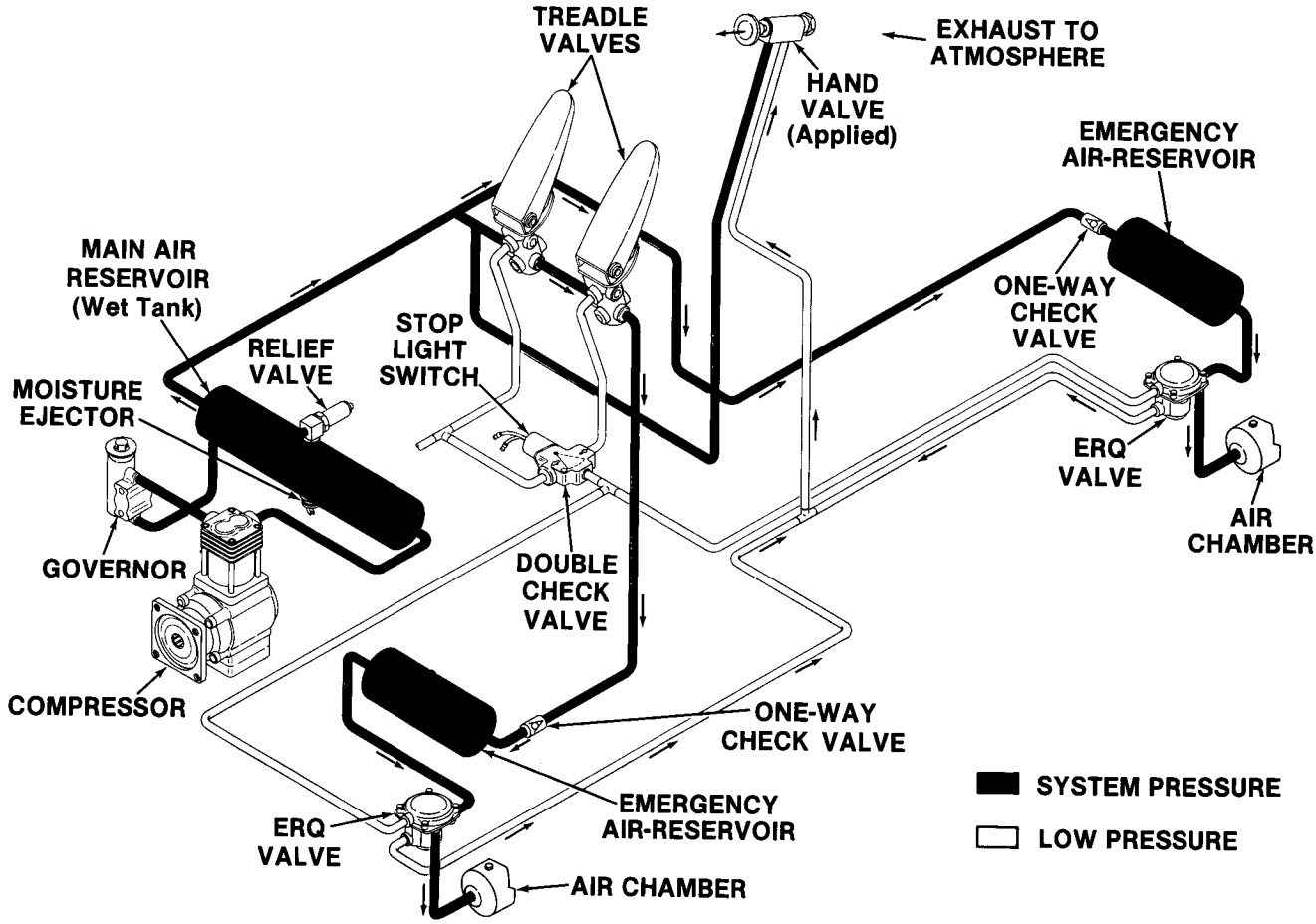
TS 20874

The brakes operate the same whichever pedal is pushed. When the left pedal is pushed, metered air pressure flows to the de-clutch valve, on the transmission, and activates it. If the transmission is in "FORWARD," the pressure to the forward clutch, in the transmission, is released. This causes the transmission to be in "NEUTRAL." The transmission will be in "FORWARD" when the left brake pedal is released. In "REVERSE," the de-clutch valve does not cause the transmission to be in "NEUTRAL."

There is system air pressure in the main reservoir, to the relief valve, both treadle valves and both one-way check valves. There is also system air pressure through both emergency air reservoirs to the E.R.Q. valves. There is also system air pressure through the hand valve to both E.R.Q. valves.

When the left pedal is pushed part of the way, system air pressure is changed in the treadle valve to metered air pressure. This metered air pressure flows through the double check valve, activates the stop light switch and flows to both E.R.Q. valves. When the metered air pressure enters the E.R.Q. valves, it causes the E.R.Q. valves to send metered air pressure to the air chambers. (See E.R.Q. valve, brakes applied by treadle valve and held.) The metered air pressure, from the E.R.Q. valves, operates the air chambers on the power clusters and the brakes are applied.

Brakes Applied with Hand Valve

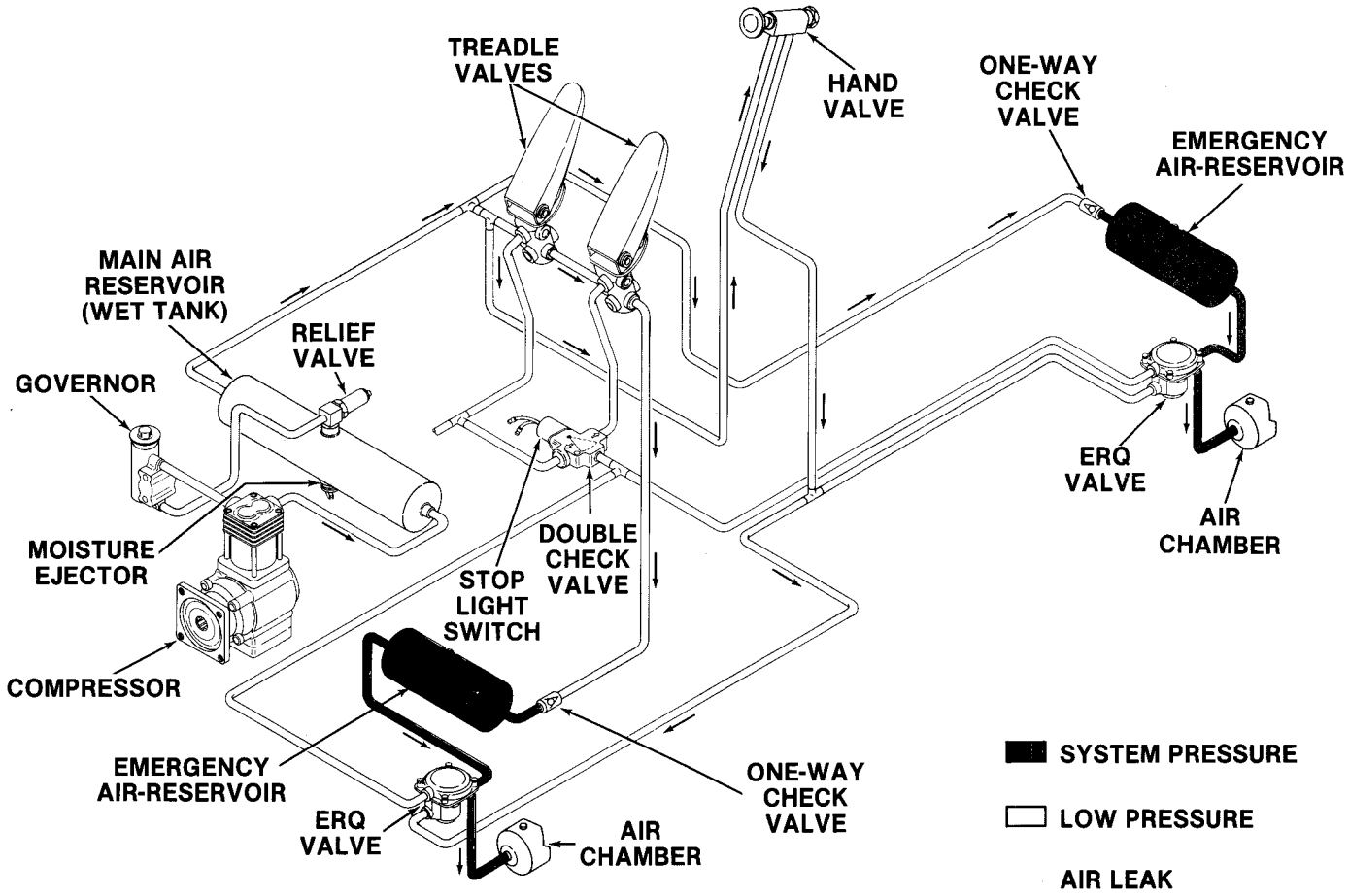


TS 20873

There is system air pressure in the main reservoir, to both treadle valves and both one-way check valves. There is also system air pressure through both emergency air reservoirs to the E.R.Q. valves and to the hand valve.

When the hand valve is applied, the air line from the E.R.Q. valves is open to exhaust through the hand valve. (See E.R.Q. valve, Emergency Brakes applied automatically or with hand valve.) As the pressure in the lines and above the emergency spools in the E.R.Q. valves becomes low enough, the spools move. This causes system air pressure to flow through the E.R.Q. valves and to the air chambers on the power clusters. This air operates the air chambers and the brakes are applied.

Secondary Brakes Automatically Applied



TS 20871

If an air leak or any other problem causes the pressure in the air system to become less than 60-65 psi (413,7-448,2 kPa) (4,2-4,6 kgf/cm²), the brakes are automatically applied. The brakes are applied as long as there is air pressure in the emergency air reservoirs.

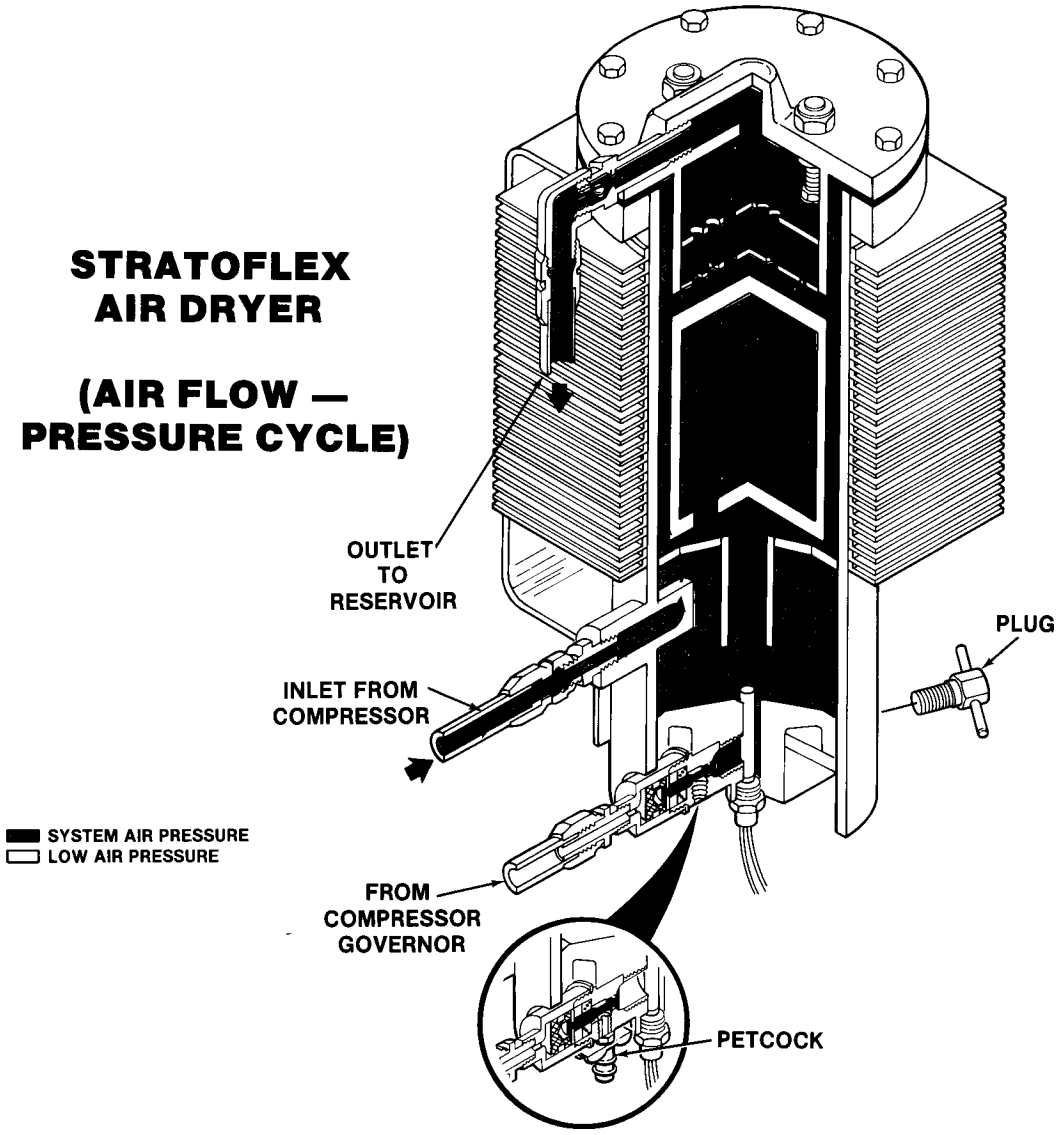
Put the machine in the service position until the brakes are repaired.

When the pressure in the system decreases to less than 60-65 psi (413,7-448,2 kPa) (4,2-4,6 kgf/cm²), the emergency spools in the E.R.Q. valves move. Air from the emergency air reservoirs now flows through the E.R.Q. valves to the air chambers on the power clusters. This air operates the air chambers and applies the brakes as long as there is air pressure in the emergency air reservoirs. When there is no air pressure the brakes release.

AIR DRYER

The air dryer can be put into the air system to remove moisture and contaminants from the compressed air.

Load Cycle (Compressor Chargint the Air System)



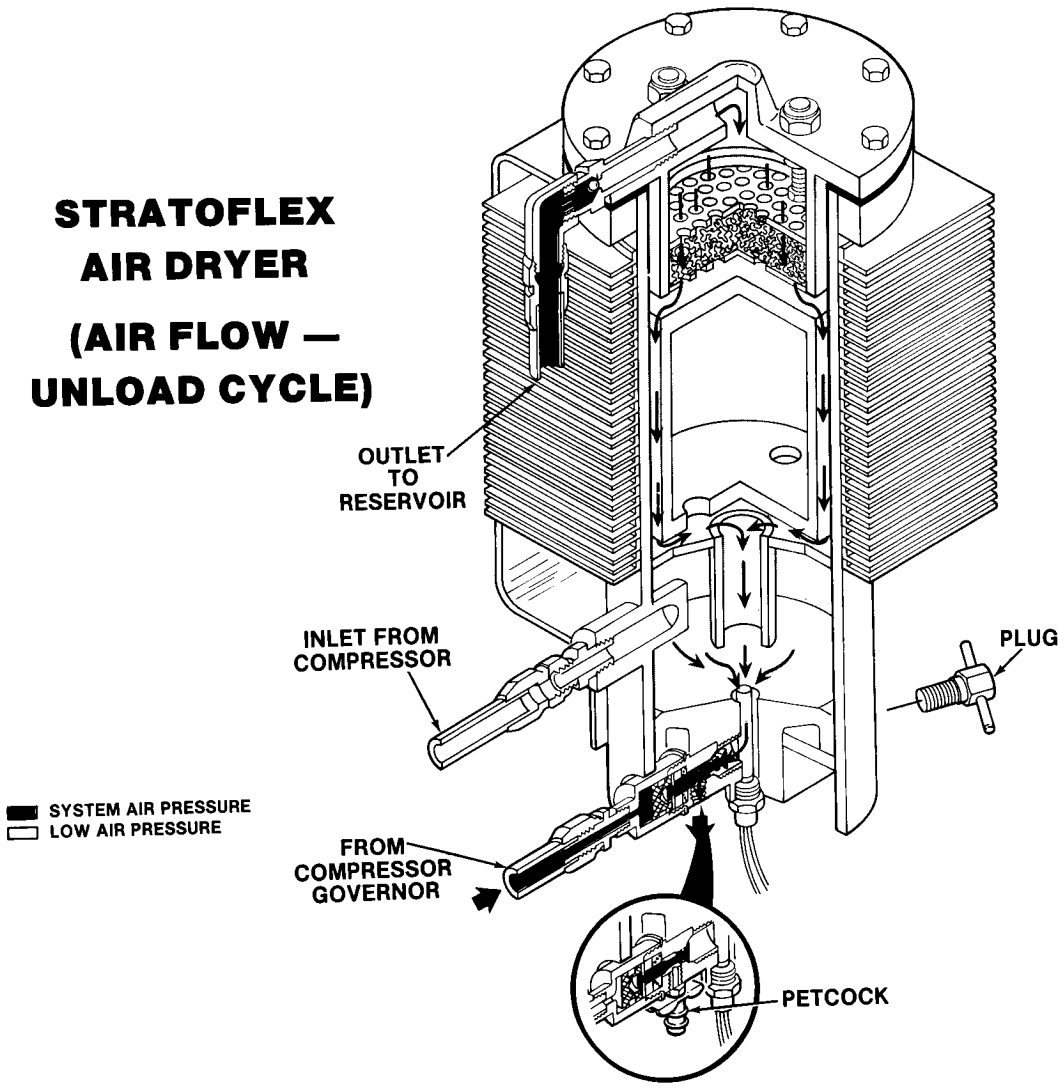
TS 29667-1

As the air is compressed in the compressor, it becomes hot. As this hot air flows into the inlet of the air dryer, it takes moisture and contaminants with it. The air is turned in the inlet so that it flows around inside of the air dryer. This action removes oil and solid contaminants from the air. The air then flows through the exit tube and between the baffle and the housing. As the air flows along the housing, both heat and moisture leave the hot air and go to the housing which is cooler. The heat flows through the housing and the fins and is taken away by the outside air. The moisture flows down the inside of the housing to the unloader valve where it is stopped. The air then flows through the filter which removes the remainder of the moisture droplets and solid contaminants. The air then flows out of the air dryer through the one-way check valve.

If the pressure in the air dryer becomes too high, the relief valves open and let air flow out of the air dryer.

The port from compressor governor on the unloader valve is open to exhaust through the governor. The unloader valve is closed. There is no flow of air out the exhaust port of the unloader valve.

Unload Cycle (Compressor in Unloaded Cycle)

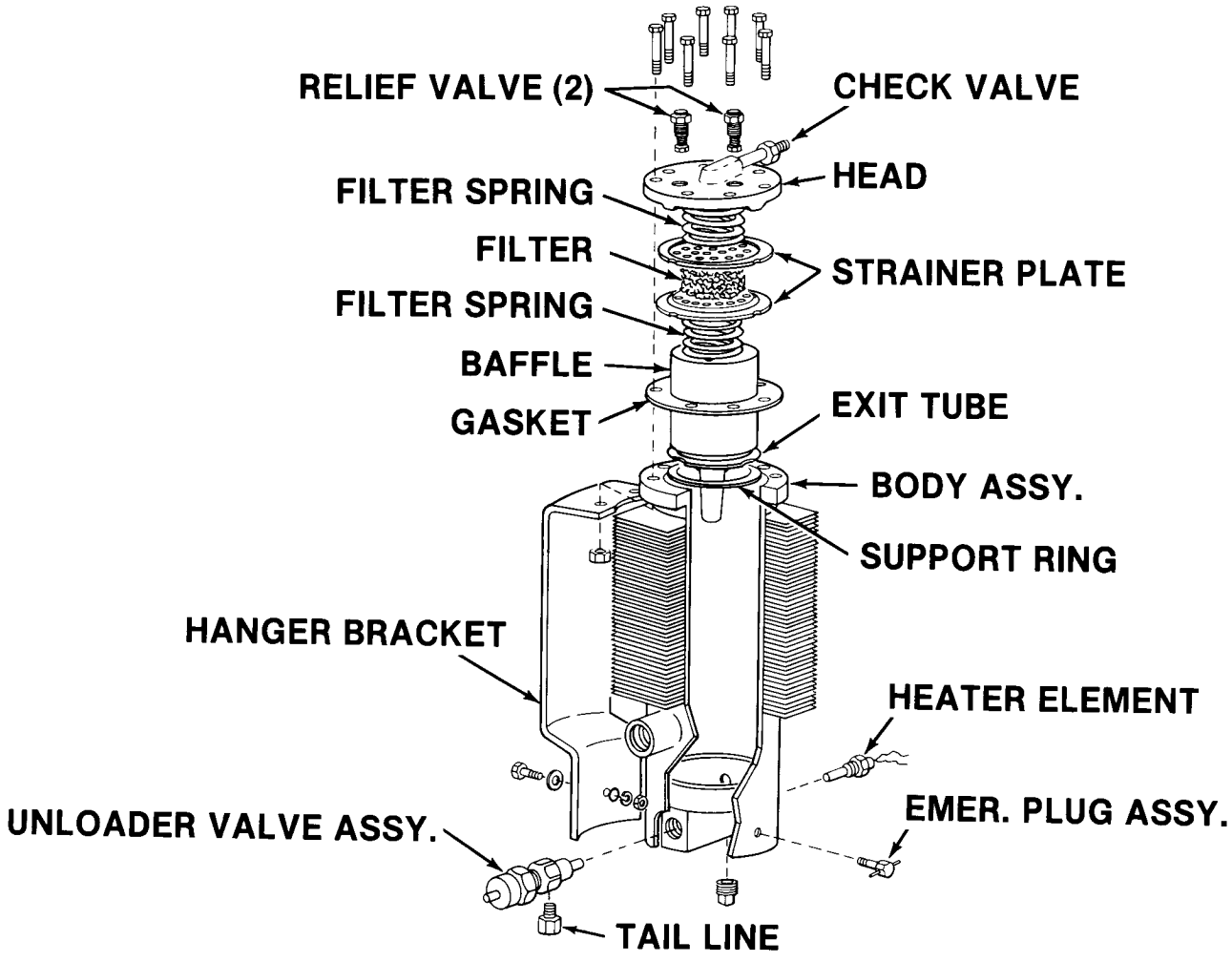


TS 29668-1

When the system air pressure increases to the setting of the governor, the governor sends system air pressure out the unloader port. This air pressure activates the unloader on the compressor so that no air flows through the inlet from the compressor. This same air pressure flows to the unloader valve on the air dryer and opens it. The air pressure inside the air dryer flows through the filter backwards and takes moisture and contaminants from the filter with it. This same air flows between the baffle and housing, through the exit tube and to the bottom of the housing. This air pushes the moisture and contaminants out through the unloader valve. The unloader valve remains open until the system air pressure decreases to the setting of the governor. At this pressure the governor lets the system air pressure, from the unloader valve, flow out to exhaust and the valve closes.

The one-way check valve in the outlet line prevents air from the reservoir from flowing out through the air dryer while the unloader valve is open. Only the air inside the air dryer flows out the exhaust port of the unloader valve.

NOTE: *On models equipped with a petcock, the petcock must be open (turned counterclockwise) for normal operation.*


RELIEF VALVE (2)
CHECK VALVE
HEAD
FILTER SPRING
FILTER
STRAINER PLATE
FILTER SPRING
BAFFLE
GASKET
EXIT TUBE
BODY ASSY.
SUPPORT RING
HANGER BRACKET
HEATER ELEMENT
EMER. PLUG ASSY.
UNLOADER VALVE ASSY.
TAIL LINE
TS-29665

AIR DRYER

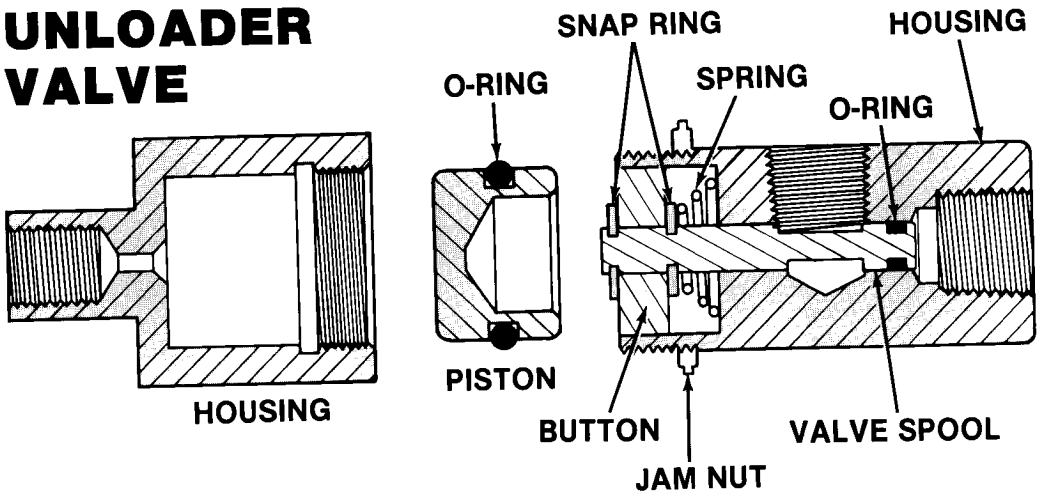
AT 250 HOURS OR SOONER, DEPENDING ON ATMOSPHERIC CONDITIONS AND THE MECHANICAL CONDITION OF THE COMPRESSOR, THE CYCLO-GARD AIR DRYER SHOULD BE CHECKED FOR PROPER OPERATION. THE DRYER SHOULD ALSO BE DISASSEMBLED AND CLEANED AT THIS TIME.

⚠ *Air system must be drained before disassembling the air dryer.*

The only moving parts in the air dryer are the check valve and the unloader valve (See TS-29665). No maintenance is required as long as the unloader valve discharges when the compressor is running in the unload cycle.

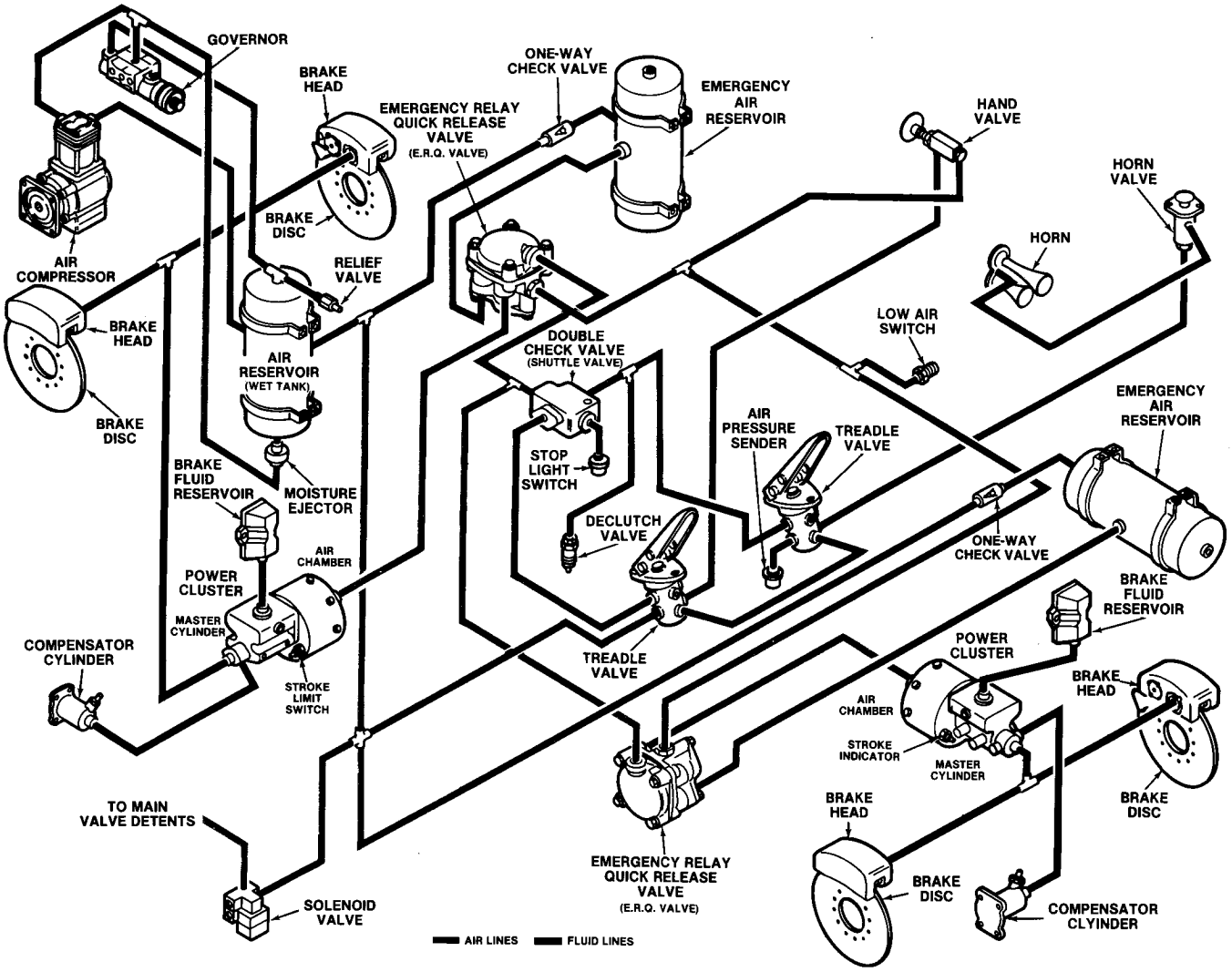
TROUBLESHOOTING:

1. The unloading cycle should last for only a few seconds. If the compressor is cycling at all times and the cycles are 30-50 seconds apart, the problem is the check valve in the discharge port of the air dryer.
2. If the air system cannot be brought up to operating pressure, and air is escaping through the unloader valve:
   - A. Put machine in the service position. Drain all air out of the air reservoirs.
   - B. Disconnect the governor line at the unloader valve, and start the engine.
     1. If air is escaping out the governor line, the governor is faulty.
     2. If air is escaping out the unloader, the unloader valve is stuck in the open position, or it is leaking, replace it. **NOTE:** *The unloader valve can also be rebuilt. See Service Gram 758B for the service kit number and the parts it includes.*
        - a. If ambient temperature is below freezing, check the heater element.
          1. Wiring may be faulty
          2. Heater element may be carbonized from excessive oil in the compressed air.
        - b. If the unloader is defective, a plug can be installed in the valve outlet until the unloader valve can be replaced or repaired. The plug is located in the side of the air dryer (See TS-29665). Remove the adapter in the unloader valve. Remove the plug from the side of the air dryer. Insert the plug in place of the adapter. **NOTE:** *The outlet must not be plugged for more than 2 operating hours. The plug must then be removed and the air dryer allowed to drain.* Completely drain air from main reservoir before removing plug.
3. If there is no blowdown when the compressor is in the unload cycle:
   - A. The unloader valve should be replaced or rebuilt, as soon as possible. (See NOTE in Step 2, Section B).
   - B. Continued operation can allow the water level to build up in the sump of the unit. If the water level becomes higher than the inlet port, the air pressure can lift the water with enough force to damage the baffle, which will not allow the unit to cool the air and will cause moisture in the reservoirs.
4. The air dryer is designed to remove heat from compressed air. If freezing is occurring before or in the dryer:
   - A. High humidity combined with low temperature could cause the air dryer to freeze up.
   - B. It may be necessary to insulate the tubing if freezing is occurring before or in the air dryer.
5. When the air dryer is checked, the air tanks should also be checked and drained. Too much moisture in the tank shows that either the air dryer or the air system is not working properly. Both systems should be checked.



TS 20377

BRAKE SYSTEM



TS 20862

In this system (air over hydraulic) air pressure is used to control the hydraulic part of the brake system. The blue lines are the air part of the system and the red lines are the hydraulic part of the system. Air from the brake system operates the horn and releases the detents on the main hydraulic valve.

The low air switch controls the buzzer and the warning light for "air pressure" on the instrument panel. The light and buzzer both operate when the pressure in the line is less than approximately 60 psi (413,7 kPa) (4,2 kgf/cm^2).

The stop light switch operates the stop lights when air pressure enters the double check valve.

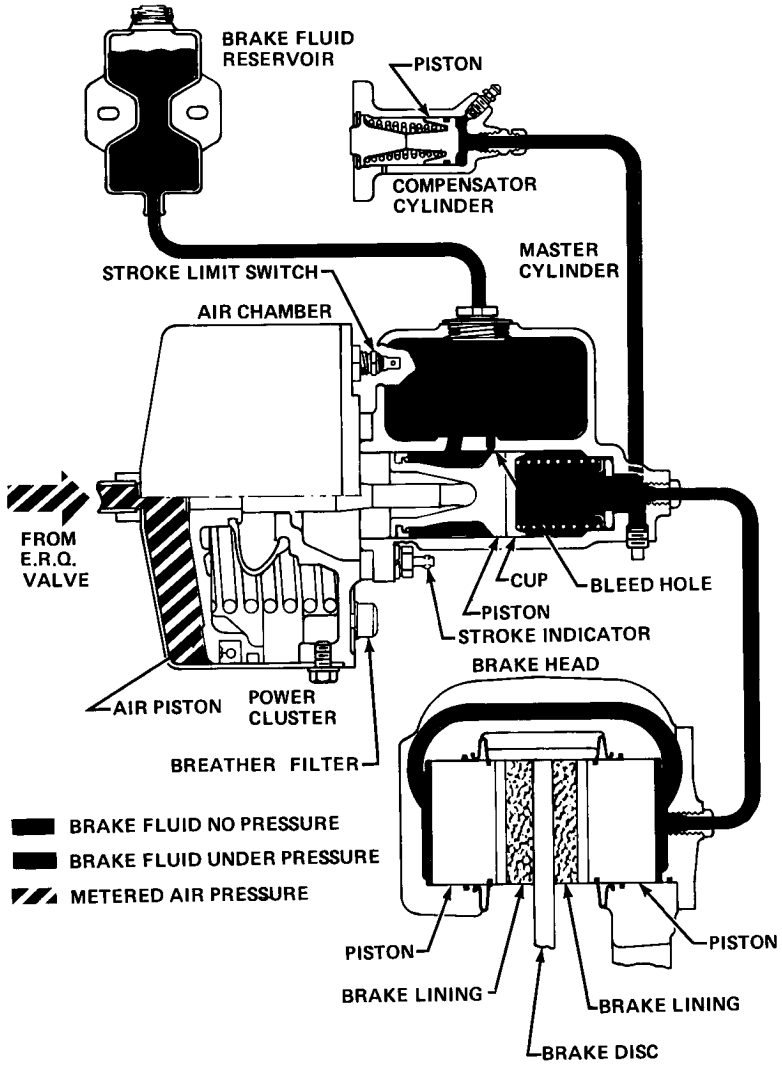
The air pressure sender operates the air pressure gauge on the instrument panel.

The stroke limit switch controls the buzzer and the warning light for "Oil Pressure Brake" on the instrument panel. The light and buzzer both operate when the piston in the air chamber moves to the end of its stroke. There is a stroke limit switch on each air chamber.

The stroke indicator shows how far the piston in the air chamber moves when the brakes are applied.

The operation of the components follows.

BRAKE HYDRAULIC SYSTEM
Brakes Applied



TS 16072

Metered air pressure flows from the E.R.Q. valve into the air chamber of the power cluster, and pushes the air piston. The air piston pushes the piston and cup in the master cylinder. As the cup moves, it pushes brake fluid out of the ports of the master cylinder. As the pressure in front of the cup increases, it pushes the lip of the cup against the bore in the master cylinder. This prevents the leakage of fluid around the cup.

Fluid flows into the compensator cylinder and pushes the piston, against spring tension, until it is against the plug. The compensator cylinder takes brake fluid so that the cup in the master cylinder moves beyond the bleed hole. This prevents high pressure in the master cylinder from pushing the lip of the cup into the bleed hold and damaging it.

After the piston in the compensator cylinder is against the plug, fluid flows to the brake heads. The brake heads have ports so that fluid flows behind all four pistons. The fluid pushes the pistons out and the pistons push the brake linings against the brake disc. The brake linings are held in the brake heads and the brake heads are fastened to the axle housing. The brake discs turn with the wheels. Braking torque is caused by the brake linings being pushed against the brake disc.

As a brake pedal is pushed farther, air pressure increases to the air chamber. This causes the pressure of the brake fluid behind the pistons to increase. The higher pressure causes the braking torque to increase.

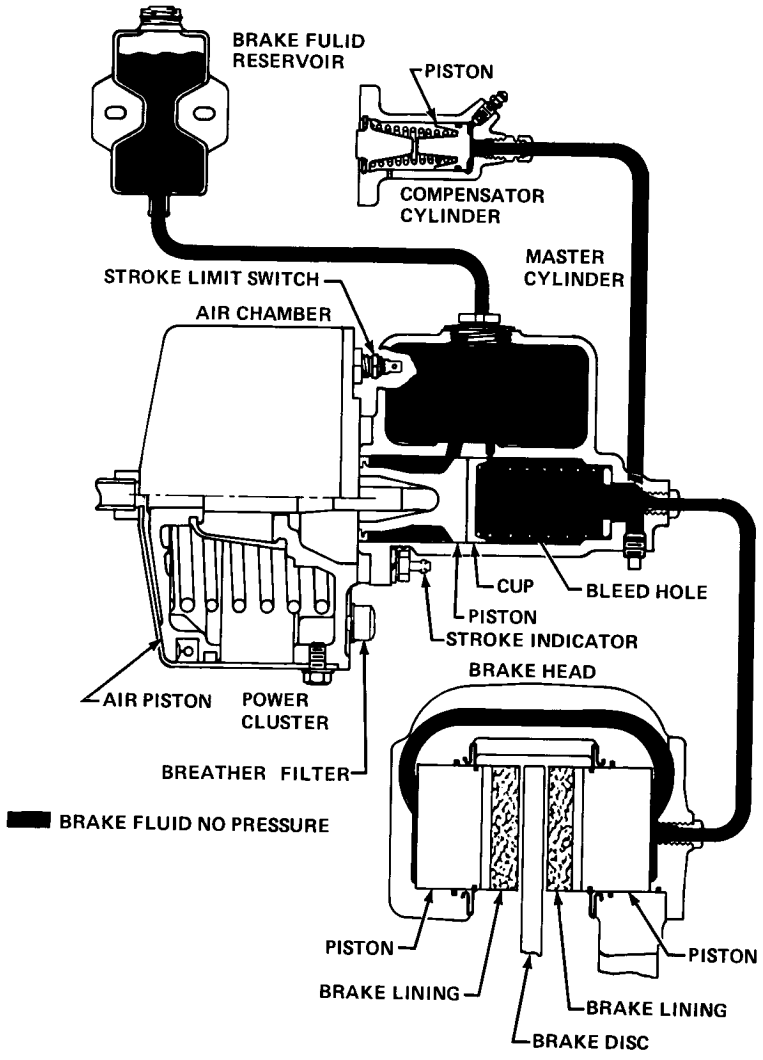
The fluid reservoir gives extra fluid so that the master cylinder is kept full.

The stroke indicator moves with the piston in the air chamber. The indicator will show the length of the stroke of the pistons in the air chamber and master cylinder.

The stroke limit switch controls the buzzer and the warning light for "OIL PRESSURE BRAKE" on the instrument panel. Both the buzzer and the light operate before the piston moves to the full length of its stroke.

There is a breather in the air chamber. The breather lets air flow in and out of the area, behind the piston in the air chamber. The breather must be kept clean so that air can flow freely through it, or the power cluster will not operate correctly.

Brakes Released



TS 16071

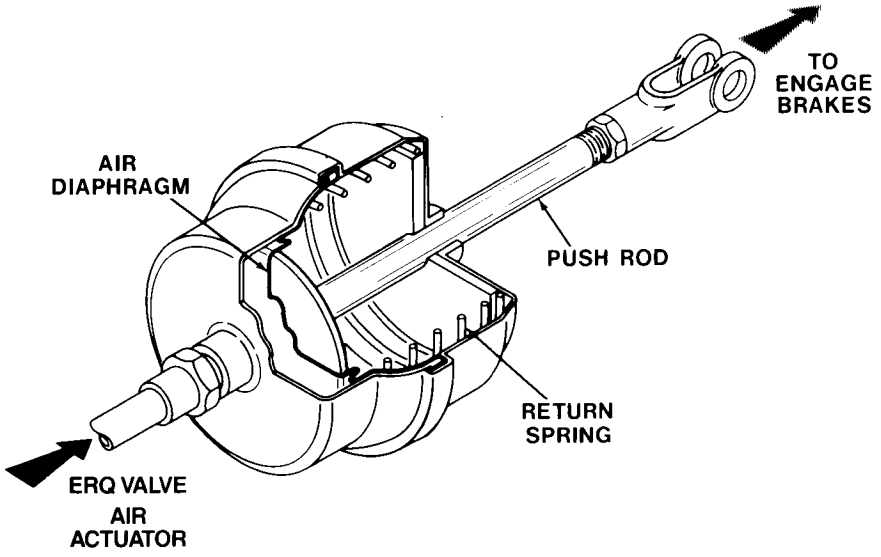
When the brakes are released there is no air pressure in the air chamber. The air is open through the exhaust port of the E.R.Q. valve. The spring pushes the air piston against the air chamber and holds it there. The spring in the master cylinder pushes the cup and piston against the stop. The chamber in front of the cup is now open to the reservoir through the bleed hole. Fluid flows through the bleed hole as needed to keep the chamber in front of the cup full but not under pressure.

The spring in the compensator cylinder pushes the piston against the end of the housing. This pushes brake fluid to the master cylinder.

When the brakes are released, the pistons in the brake heads do not move all of the way into the housing. The piston seals pull the pistons in enough so that the brake lining is not held tightly against the brake disc. Because the pistons stay in position, the brakes are kept in adjustment.

As the pistons in the brake heads move farther out, brake fluid stays in the area behind the pistons. The reservoir gives a supply of brake fluid to keep the master cylinder full as the pistons move.

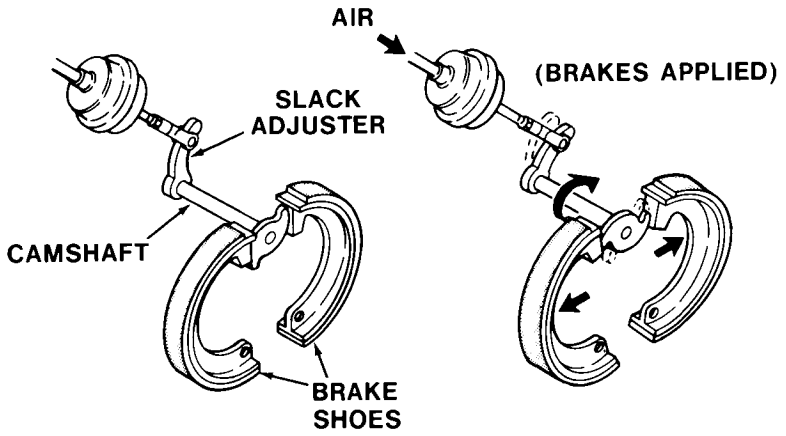
AIR ACTUATOR



TS 17626

Metered air pressure flows from the E.R.Q. valve into the air chamber of the air actuator. The air pressure forces the air diaphragm against the push rod to engage the brakes.

BRAKE ASSEMBLY



TS 17619

When a brake pedal is pushed, air pressure increases in the air actuator. The increased air pressure overcomes the return spring pressure to move the push rod. The push rod then moves a slack adjuster that turns a camshaft that forces the brake shoes against the drums.

The return springs take over when the brake pedal is released. The spring pressures return the push rods, which release the brakes.

Put the machine in the SERVICE POSITION.

PREVENTIVE MAINTENANCE

Regular inspection is the key to preventive maintenance. Daily and other scheduled service checks and adjustments point out signs of wear or leakage. These minor problems can then be fixed before they turn into or cause dangerous problems.

Daily Brake Checks

Always secure the machine in the SERVICE POSITION before making daily brake inspections.

- Steering frame lock connected.
- Bucket on the ground.
- Parking brake applied.
- Engine stopped, ignition key removed.
- Red warning flag on steering wheel.
- Wheels blocked.
- Let the machine become cool.*
- Remove all pressure caps slowly to relieve pressure.

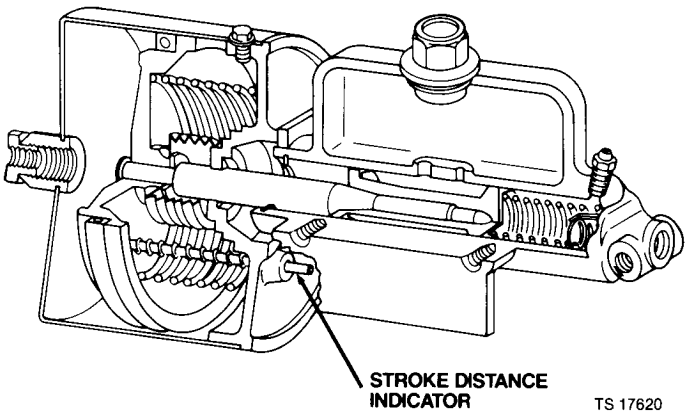
*If work must be done on a warm machine, be careful of hot liquids and components.

1. Drain the moisture collected in the air reservoirs by opening the petcocks. **Close the petcocks after draining.**
2. Visually inspect the machine for damaged hoses and bent or broken piping. Check for loose fittings and leakage. Replace all damaged lines and fittings.
3. Check for loose, worn or frayed belts. Tighten loose belts. Replace worn or frayed belts.
4. On a straight air system, check the air actuator push rod for wear, binding or bending. Replace bad rods after determining the problem.

Other Scheduled Brake Checks

1. On Air Over Hydraulic Systems, check the brake fluid level of both fluid reservoirs. If the levels are low, only use Clark approved brake fluid to fill.
2. Check the brake air chambers.
   a. Be sure the machine is secured in the service position.
   b. Charge the air system.
   c. Have an assistant apply the brakes. (If you are alone, pull the hand valve to manually activate the secondary brake system.)
   d. Check the power cluster or the brake actuator.
      1.) **Power Cluster**
      - Check the stroke indicator on the power cluster for a safe stroke distance. Less than 1.5 in. (38.10 mm).

POWER CLUSTER

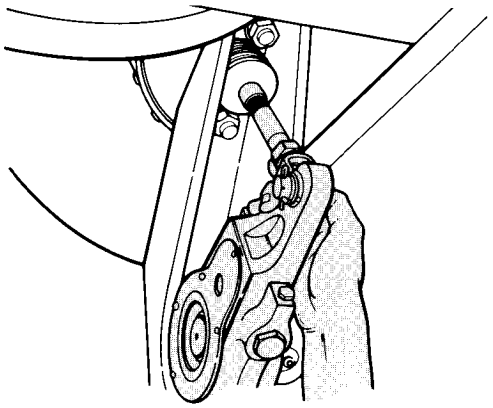


TS 17620

If the indicator shows a stroke distance of approximately 1.5 in. (38.10 mm.) or more, find and correct the brake problem. (See the troubleshooting section in this manual.) Master cylinder damage or loss of braking power could occur if the problem isn't corrected immediately.

2.) **Air Actuator**

- Check to make sure push rods move when brakes are applied and retract when released.



TS 17627

3. Check the brakes for brake wear.
   a. **Disc Brakes (Air Over Hydraulic)**
      1.) Check the discs for warpage or excessive wear. Every 250 hours, use a micrometer to check the disc thickness measurement against the specifications in the Maintenance Manual.
      2.) Inspect the pads for signs of excessive wear.
   b. **Shoe Brakes (Straight Air)**
      - Inspect the shoes and drums for signs of excessive wear. See the Maintenance Manual for adjustment procedures and wear limits.

Remember, most brake problems can be avoided by making regular inspections.

Put the machine in the SERVICE POSITION.

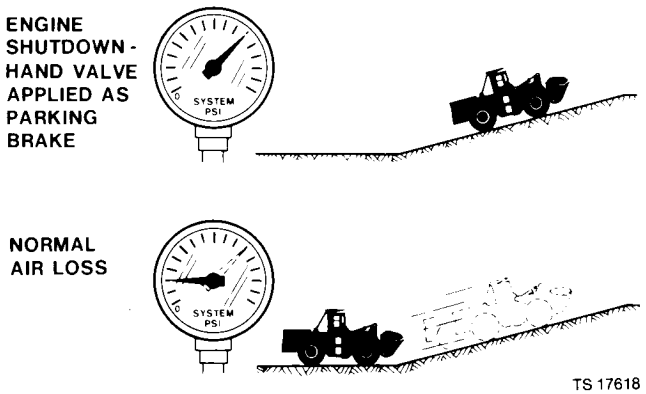
TROUBLESHOOTING

This section deals with problems that can be related to the brake system. All brake system problem causes can be found in one of the following three areas:

1. In the basic system from the air compressor up to the E.R.Q. valves.
2. In one or more E.R.Q. valve(s).
3. In the brake asssemblies:
   - Air actuator or power cluster.
   - Drums and shoes.
   - Discs and pads.
   - Mechanical action of any or all of the above.

Before replacing a suspected brake component, make the following checks to isolate the brake problem:

THE HAND VALVE SHOULD NOT BE USED AS A PARKING BRAKE!



TS 17618

First: Question the operator carefully. Emphasize safe and proper brake operation in the questions. To avoid personal injury due to brake problems, verify all complaints with the following brake tests.

Second: Secure the machine in the service position.

Third: Drain all system air pressure by opening the petcocks on the air reservoirs. **Close the petcocks after draining.**

Fourth: Connect a precision gauge to the wet tank at the drain port. Make sure the hose is long enough so that the gauge can be read in the cab.

Fifth: Start the engine and charge the air system.

Sixth: Read the gauge to isolate the brake problem.

Now proceed with the complaint and the diagnosis.

I. GAUGE READINGS

Normal operating pressure on most machines is 95 to 115 P.S.I. [655,0 to 792,9 KPa] [6.68 to 8.09 Kgf/cm²].

A. LOW OPERATING PRESSURE

1. Check for air leaks.

a. General air leak checking procedure.

1) Charge the air system.

2) Shut down the engine.

3) Walk around the machine to check for air leaks.

a) Listen for the sound of escaping air.

b) Visually inspect all air lines, fittings and valves for leaks by spraying them with a soapy solution.

b. If air lines, hoses or fittings are leaking.

1) Tighten or replace leaking lines, hoses and fittings.

2) Recharge the air system to check the operating pressure.

c. If the relief valve is leaking.

- Air leakage could be due to contamination or damage; disassemble, clean and inspect. Replace the relief valve if it is damaged.

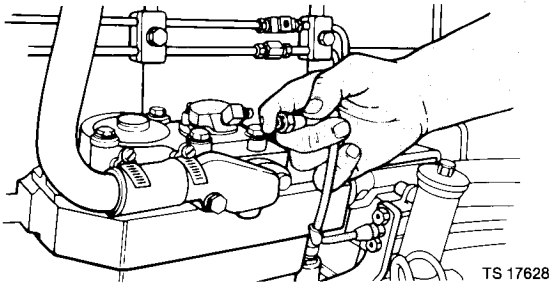
2. Checking governor operation.

a. Exhaust the air system by opening the air reservoir petcocks. **Close the petcocks after draining.**

b. Disconnect the unloader control line at the compressor.

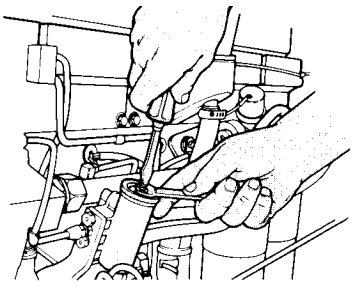
c. Charge the air system.

d. Check for air flow coming from the control line while watching the pressure gauge.



TS 17628

1) If air flow comes through the control line before the system reaches operating pressure, 95 P.S.I. [655,0 KPa] [6.68 Kgf/cm²] the governor is unloading the compressor too soon. Increase the governor pressure setting by turning the adjusting screw counter-clockwise.



TS 17629

- If adjustments do not change the compressor unloading pressure, replace the governor.

2) If air flow comes through the control line at operating pressure, the governor is operating properly. Check the compressor's unloading mechanism.

3. If the unloading mechanism is leaking or stuck open and does not allow the system pressure to properly build, replace the unloading mechanism.

- This unloading mechanism test is only valid if the governor has been checked and tested.

Put the machine in the SERVICE POSITION.

TROUBLESHOOTING (Continued)

B. OPERATING PRESSURE CANNOT BE MAINTAINED

- **Check the air lines, hoses, fittings and valves for leaks. If there is a leak, tighten or replace leaking components.**

C. NORMAL OPERATING PRESSURE

- **If operating pressure can be reached and held (no more than 20 P.S.I. [137,9 KPa] [1.41 Kgf/cm²] loss in 10 minutes), proceed with brake component testing.**

II. TREADLE VALVE OPERATION

A. Check the treadle valve pressure drop.

1. Charge the air system.
2. Depress each treadle valve separately while watching the pressure drop on the gauge.
3. Compare the pressure drops; they should be approximately the same.

a. If the pressure drops are no more than 20 P.S.I. [137,9 KPa] [1.41 Kgf/cm²] and hold, the treadle valves are operating correctly.

b. If the pressure drops are not the same; check for a leaking treadle valve or line leading from the treadle valve to the double check valve (shuttle valve).

1) If the treadle valve is leaking, replace it.

- **The left treadle valve also activates the transmission declutch valve. A leaking valve could cause more pressure at the left treadle.**

2) If the air line is leaking; tighten or replace.

c. If a pressure drop is excessive in both treadle valves (more than 20 P.S.I. [137,9 KPa] [1.41 Kgf/cm²] before it holds) the brakes are probably worn and/or out of adjustment.

1) The air actuator push rod or power cluster stroke indicator should show excessive travel. **Remember: excessive travel of the power cluster stroke indicator can mean:**

a) Low brake fluid.

b) Air in brake lines.

c) Master cylinder internal fluid leak.

d. If there is excessive pressure loss when either treadle valve is depressed, check for an air leak in the following parts; repair or replace.

1) Air actuator (ruptured diaphragm).

2) Power cluster (air leaking from breather).

3) E.R.Q. valve(s).

4) Treadle valve.

5) Air lines, hoses or fittings.

B. If there are no air leaks, but the braking complaint still exists.

STRAIGHT AIR

1. The air actuator must be disassembled and repaired or replaced.

AIR OVER HYDRAULIC

2. The power cluster must be checked for brake fluid leaks.

a. External leaks should be spotted and repaired during the regular inspections.

b. Internal leaking of the piston cup seal in the master cylinder cannot be seen externally. Therefore, the master cylinder must be disassembled, inspected, repaired or replaced.

III. LOCKED OR DRAGGING BRAKE(S)

A. If only one wheel locks up, the problem is most likely a mechanical one in the brake assembly.

1. The straight air system should be checked for binding push rods or slack adjusters. Repair or replace the problem area.
2. The air over hydraulic system should be checked for stuck or binding brake pistons and crushed brake lines. Repair or replace the problem area.

B. If both wheels on one axle are locked, the problem is either in the E.R.Q. valve or the power cluster for that axle.

1. The straight air system automatically points to an E.R.Q. valve problem. The valve needs to be disassembled, repaired or replaced.
2. The air over hydraulic system can have a problem in either component for that axle. Diagnose by following the steps below, then repair or replace.

a) Drain the secondary air reservoir for that axle. If the brakes release, the problem is in the E.R.Q. valve.

b) If the brakes do not release, check the power cluster for mechanical hangups.

1) If the power cluster stroke indicator cannot be seen and there is brake fluid pressure in the brake head, either the power cluster is stuck in the brakes applied position or an improper residual check valve has been installed in the master cylinder.

- A valve problem will usually only cause the brakes to drag.

2) Other problem areas:

- Bent or binding piston rod.
- Blocked by-pass port.
- Swollen piston cup.

C. If all wheels are locked.

1. Low air pressure causes the E.R.Q. valves to apply the brakes. Check system operating pressures. See GAUGE READINGS in this manual.
2. The treadle valve may be stuck in the brakes applied position.

NOTES

NOTES