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## Section 8. Braking system

The braking system helps the loader reduce its speed or park during driving and control its speed when driving downwards or park temporarily on a slope.

It is composed of hand brake, foot brake and their driving mechanisms.

### 8.1 Hand brake and its driving mechanism

#### Composition of the hand brake

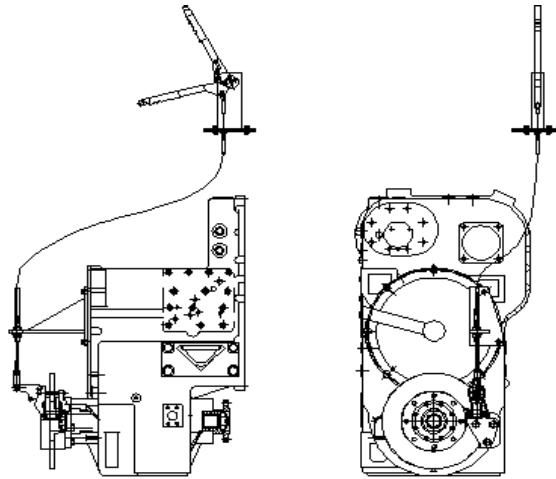
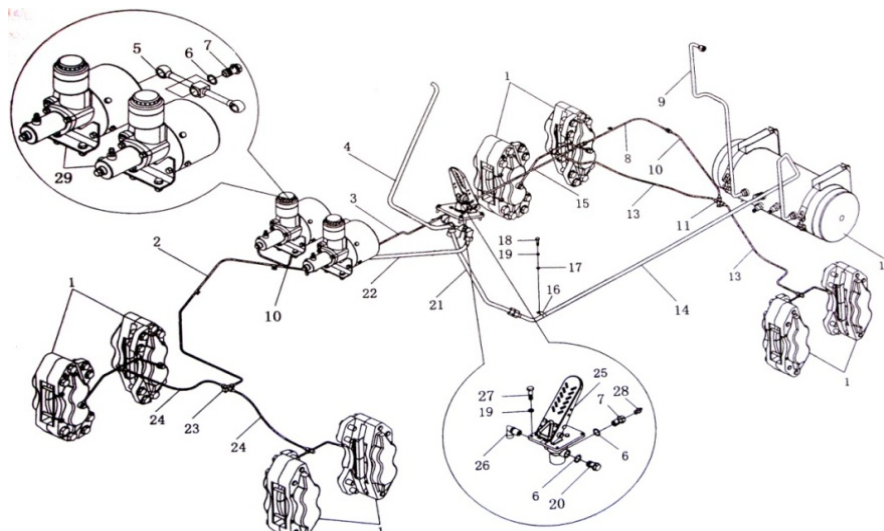


Illustration 8-1 Hand brake system

### 8.2 Application and adjustment of the brake

Hand brake is located at the front output shaft of the transmission. It ensures that when the driver leaves after the loader stops moving, the loader will stay at where it was parked, in particular on a slope. The brake works by operating the control handle through the flexible shaft. The stop nut adjusts the operating location and the u-joint yoke adjusts the length of the flexible shaft by rotation, so as to adjust the location of the brake.

#### 8.2.1 Foot brake and its driving mechanism (Illustration 8-2 Foot brake system)



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The foot brake is called as service brake. It helps the loader reduce its speed or park during driving. The brake starts when the driver depresses the brake pedal, and the brake ends when the driver lifts his foot from the brake pedal. The loader usually uses the air-over-hydraulic caliper disc four-wheel brake system.

### **8.2.2 Composition of the foot brake system**

It is composed of the air compressor, unload valve (fuel-water combination valve), foot brake, air reservoir, booster unit, disc brake caliper, etc.

### **8.2.3 Structures and working principles of foot brake parts and components**

(1) Air compressor: it is a single-stage double-cylinder air-cooled compressor and is directly driven by the diesel engine. The working pressure is  $6.5\text{--}7.0\text{Kg.f/cm}^2$  ( $0.65\text{--}0.7\text{MPa}$ ).

When the diesel engine rotates at a speed of 2000r/min, the maximum air exhaust volume is 135142L/min.

Function of the fuel water separator: firstly, it separates oil, water particulates and other impurities from the air that comes from the air compressor through the filter screen and with the centrifugal force when the air flows; secondly, it inflates tyres; secondly, it limits the air pressure, preventing the air pressure in the air passage from exceeding  $7.0\text{Kg.f/cm}^2$  ( $0.7\text{MPa}$ ).

To ensure the safety of the whole oil passage, an overflow valve is arranged in the system. Its technical parameters have been configured and the valve has been lead-sealed in the system before the shipment of the loader. The valve will automatically open at a pressure of  $7.0\text{Kg.f/cm}$  ( $0.7\text{MPa}$ ).

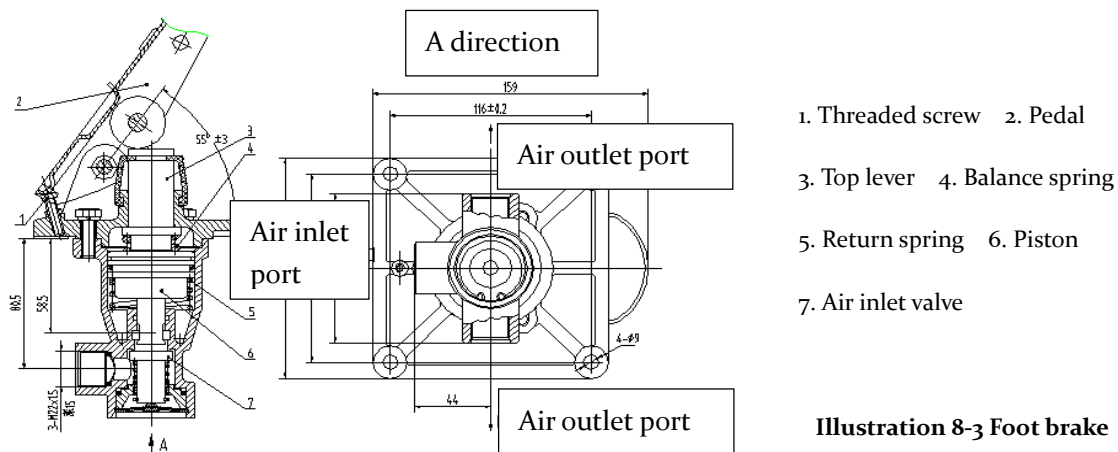
(2) Unload valve (fuel-water combination valve)

Unload valve: the air from the compressor enters the valve body through the air inlet with the moisture and impurities in the air accumulated at the air exhaust port, and then the compressed air flows through the check valve, comes to the air outlet and inflates the air reservoir. After the air pressure in the tank ascends to the opening degree, the air entering the top cover chamber pushes the diaphragm assembly upwards against the action force of the pressure regulating spring and opens the air exhaust valve at the lower part, and then the compressed air in the valve body and the moisture and impurities accumulated at the air

exhaust port are discharged into air through the port, making the air compressor idle; when the air pressure in the tank drops to the degree to stop the air exhaust, the top cover chamber does not have sufficient air pressure to be against the stress of the pressure regulating spring, the diaphragm assembly moves downwards, the air exhaust valve moves upwards to shut off the air exhaust valve port with the action of the spring, so that the valve will continue to inflate the air reservoir.

Fuel-water combination valve: the air from the compressor enters the valve body through the air inlet with the moisture and impurities in the air filtered by the filter screen, and then the filtered compressed air flows through the check valve, comes to the air outlet and inflates the air reservoir. After the air pressure in the tank ascends to the opening degree, the air entering the top cover chamber pushes the control piston assembly upwards against the action force of the pressure regulating spring and opens the air exhaust valve at the lower part, and then the compressed air in the valve body and the filtered moisture and impurities are discharged into air through the air exhaust port, making the air compressor idle; when the air pressure in the tank drops to the degree to stop the air exhaust, the top cover chamber does not have sufficient air pressure to be against the stress of the pressure regulating spring, the control piston assembly moves downwards, the air exhaust valve moves upwards to shut off the air exhaust valve port with the action of the spring, so that the valve will continue to inflate the air reservoir.

### (3) Foot brake



When the brake pedal 2 is depressed, it applies certain stress to the balance spring 4 through the top lever 3, so that the piston 6 is pushed downwards to open the air inlet valve 7, and the compressed air flows from the air inlet to the outlet. When the brake pedal 2 is released, the return spring 5 pushes the piston 6 to

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move upwards, the air inlet valve 7 returns, the channel between the air inlet and outlet is shut, and the residual air pressure at the air outlet is discharged from the air exhaust port.

Right use and maintenance methods:

1. Use instructions

- 1) Before the installation, remove the protective plugs of the air inlet and outlet ports. Make sure that the pedal and the valve body are tightly connected. Adjust the valve clearance (make sure that the pressing interference when the roller compresses the top lever is no more than 0.5mm), and tighten the nut.
- 2) Connect and secure the 4- $\phi$ 9 holes M8.
- 3) When connecting the lines, identify the air inlet port and the air outlet port. The joint marked with “1” is the inlet port, the joint marked with “s” is the outlet port, and the joint marked with “3” is the exhaust port.

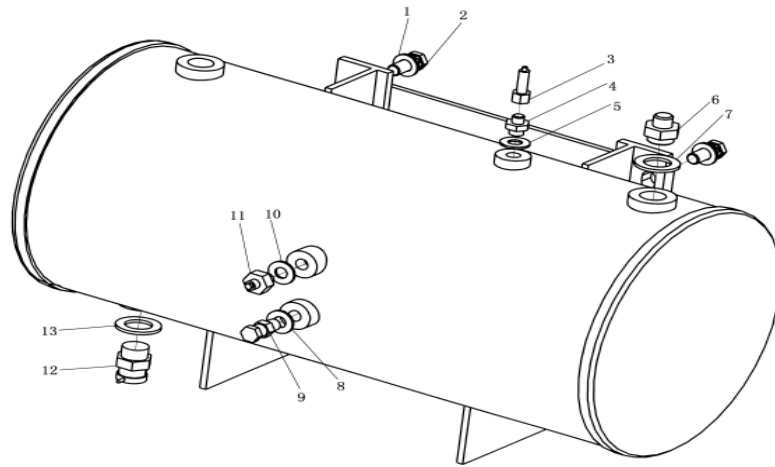
2. Repair and maintenance tips

- 1) Water drainage and filter devices should be located in the air passage to ensure the cleanliness of the air source. The lines and the tank of the compressed-air brake system should be rendered anticorrosive treatment.
- 2) The space should be sufficiently wide for users to operate the pedal freely.
- 3) When replace the quick-wear parts, perform the replacement of parts with the corresponding ones. The securing parts (retainers and bolts) damaged during the process of replacement must be replaced and tightly and reliably installed in the right place without leading to damage to other parts. After the replacement, the parts will not be immediately installed to the loader until they are proved to meet the desired requirements.
- 4) The moving parts of the pneumatic brake valve should be maintained with grease. If the brake does not work or works powerlessly, check the quick-wear parts of the pneumatic brake valve and the braking system.

(4) Air reservoir

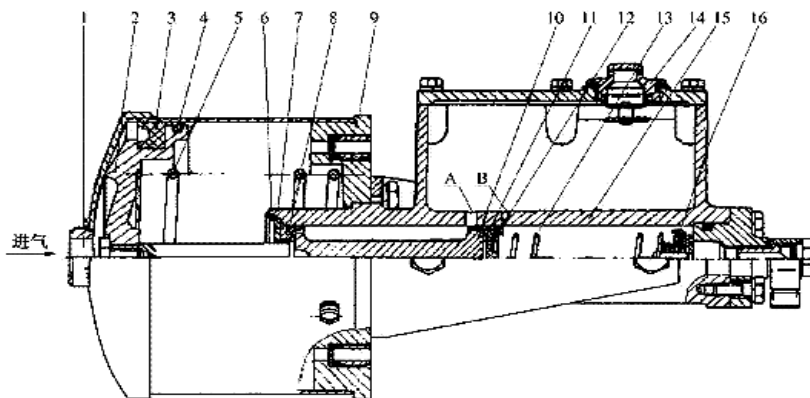
The air reservoir is a round steel barrel. It stores the compressed air to support a certain number of braking operations when the air compressor does not work. On the barrel cover, there is a water drainage valve and a bleed valve that will inflate tyres or complete other auxiliary tasks. For the purpose of safety, the highest

air pressure in the reservoir cannot exceed 7Kg.f/cm (0.7Mpa). To prevent the air pressure in the reservoir going up excessively due to the failure of the pressure control valve, a relief valve can be installed to the reservoir.



**Illustration 8-4 Air reservoir**

(5) Booster and master brake cylinder



**Illustration 8-5 Boosting pump**

The air-over-hydraulic booster of the ZL loader series is shown in the Illustration 8-5. Its structure and working principles are listed as follows.

The booster is an integration of a piston-type air boosting chamber and a master cylinder block (master hydraulic brake cylinder) through bolts. The push rod 7 is installed on the air chamber piston 2. When the compressed air is applied to the piston 2 from the left chamber, the piston drives the push rod 7 to move rightwards, so the master hydraulic cylinder piston 13 is pushed to drive the hydraulic pressure to rise and

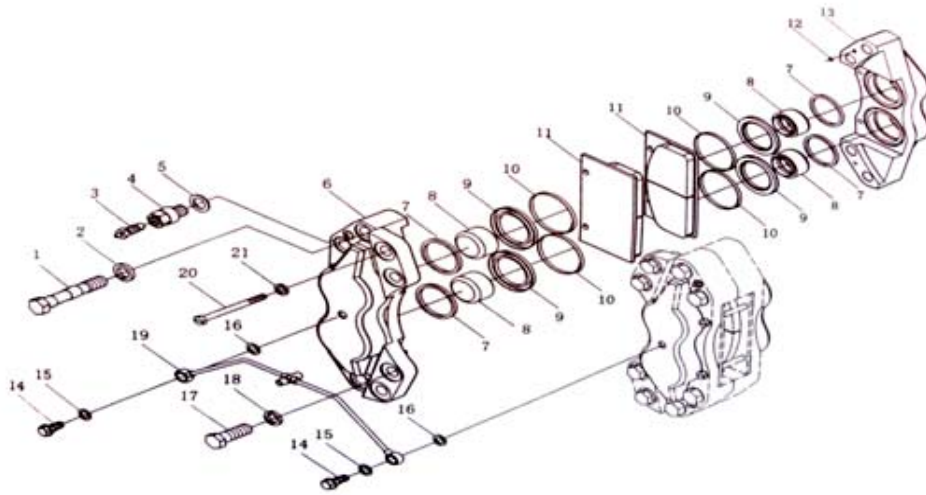
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push the oil outlet valve to enable the brake hydraulic pressure to enter the brake caliper.

When the driver lifts his foot from the brake pedal, the compressed air in the left chamber will be discharged into air, and the chamber piston and the master cylinder piston return with the action of their respective return springs. The brake hydraulic pressure flows back to the master cylinder through the return oil valve. When the master cylinder piston quickly returns, due to the stickiness of the hydraulic pressure and the resistance in the lines, the oil cannot return to the master cylinder and fill the space that is left when the piston moves leftwards, so there will be certain vacuum generated in the right chamber of the master cylinder before the bypass orifice b opens. In this case, the oil that flows into the back of the piston through the compensation ports a and b will press the elastic star valve plate at the back of the master cup seal open, and the left chamber oil flows into the right chamber through six holes on the piston and the clearance between the edge of the master cup seal and the cylinder wall and fills the vacuum to prevent the entry of air; when the master cylinder piston totally returns, the bypass orifice b has opened, and the redundant oil that flows back to the master cylinder through the lines will flow into the oil chamber through the bypass orifice. When the master cylinder does not work, the master cylinder piston and the master cup seal are located between the compensation ports and the bypass orifice. The return oil valve 18 shuts off when the oil pressure of the hydraulic pressure lines and the wheel brake cylinder drops to  $0.7-1.0 \text{ Kg.f/cm}^2 (0.07-0.10 \text{ MPa})$ , the pressure becomes the surplus pressure to prevent the air from entering the system.

#### (6) Brake caliper (Illustration 8-6)

It braces the brake that works by rotating a disc from two sides using clamps 6 and 13 with the friction lining. The disc uses the two ends as the working surface and is tightly secured with wheels and rotates with wheels, so it is called brake disc. The brake friction plates are installed at the brake outer clamp 6 or the inner clamp 13. The two clamps are hung at the two sides of the brake disc and secured to the axle housing.



**Illustration 8-6 Brake caliper**

### **8.3 Common brake system faults and troubleshooting methods**

#### **(I) Insufficient service brake force and overlong brake distance**

Check the appearances of the system elements, make sure whether: 1. There is air leakage or oil leakage in some parts or mechanisms; 2. There is blockage in the breather port at the oil filler cap of the booster's oil storage chamber; 3. There is sufficient brake fluid in the booster's oil storage chamber; 4. The friction plates have been worn to the limits (to the bottom of the friction plate groove); 5. There is oil dirt on the friction plates. If these problems do not exist, observe the reading of the pressure gauge when the loader is in the non-braking state: if the reading is normal (between 0.71 and 0.78MPa), there is a fault with the parts located between the brake valve and the service brake; if the reading is excessively low, there is probably a fault with the parts located between the air compressor and the air reservoir.

#### **1. Normal reading of the pressure gauge**

The parts that are located between the brake valve and the service brake include the brake valve, the booster and the service brake. The inspection should be conducted from the air-related parts to the fluid-related parts.

##### **(1) Check of the brake valve and possible faults**

The common brake valve faults are the damage to the seal plates (or the drum diaphragm) or the piston that gets rusty and stuck.

If the brake pedal is depressed with great force or it does not return flexibly, the piston gets rusty and stuck, preventing the piston from performing shuttling action freely. Disassemble the brake valve, make a

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thorough cleaning, and apply the grease to the outer part of the piston.

If the air exhaust sound emitted from the brake valve is heard when the pedal is depressed and the sound becomes little when the pedal is released; or the air discharged from the air exhaust port of the brake valve is detected when the pedal is depressed, there are damages to with the seal plates (or the drum diaphragm).

### (2) Check of the booster and possible faults

The booster transforms the air pressure into the hydraulic pressure. Its common faults include: the air piston gets stuck, or there are damages to the seal kit of the air piston or the oil piston.

Checking method : remove the dirt accumulated at the oil filler of the booster's oil storage chamber, open the oil filler cap, and observe the fluid surface changes when the brake is actuated or relieved. The booster works normally if: the fluid surface steadily and quickly drops when the brake pedal is depressed; the fluid surface steadily rises due to the timely return of the brake fluid. If the opposite conditions occur, there are faults with the booster, and it needs further inspection. If the brake fluid surges, it is certain that the seal parts of the brake cylinder has deformed or damaged.

### (3) Check of the service brake and possible faults

The service brake is often of the caliper disc type. Its common faults include the oil leakage in the brake cylinder and the brake cylinder piston getting stuck.

For the problem that the brake cylinder may leak oil, it can be ascertained by observing whether there is oil dirt on the brake clamps. When the rectangular seal ring loses its elasticity due to damage or ageing, there will be sealing failure, leading to the oil leakage in the service brake.

For the problem that the brake cylinder may get stuck, it can be ascertained by checking the brake valve and the booster. If no problems are found during the inspection of the brake valve and the booster, there should be faults with the brake cylinder piston. The reason for brake cylinder's getting stuck is: the brake fluid has strong corrosiveness, and this will cause the corrosion of the piston and the dropout of the



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particulates of rubber seal parts and enable the external impurities to enter the brake cylinder, affecting the movement of the piston. The rectangular seal ring is made of rubber, and it will expand after coming into contact with the brake fluid. If the rectangular seal ring is made of low quality material, it will expand excessively and its elasticity will gradually weaken, making the brake cylinder get stuck.

The measurement of the surface temperature of the brake disc can help determine the faulty parts. After the braking, measure the surface temperatures of brake discs of different wheels, and there is a fault with the brake disc with a higher temperature.

If no problems are found during the inspection of the brake valve, the booster and the service brake during the inspection, the fault is caused by the air in the brake hydraulic lines, and necessary air exhaust should be conducted. Refer to the “Air exhaust of the system” in the “System commissioning, repair and maintenance” part for troubleshooting methods.

## **2. Excessively low reading of the pressure gauge**

The parts that are located between the air compressor and the air tank include the air compressor, the pressure control and the fuel-water separation devices, the single-way valve, the air tank and the lines. There are two types of pressure control and the fuel-water separation devices: combination valve, fuel-water separator + pressure controller.

Conduct the inspection in the following order: whether there is air leakage in the air tank and the lines, whether the air exhaust port of the combination valve (or pressure controller) can shut normally, and whether the single-way valve malfunctions, and then check the air compressor.

### **(1) Check of the combination valve or the pressure controller and possible faults**

The combination valve or the pressure controller ensures that the pressure of the brake system is within the required range.

#### **① Check of the combination valve and possible faults**

The common faults of the combination valve include: the bleed piston gets stuck, the single-way valve malfunctions, and the adjustment screw loosens. Start the inspection with the check of the tightness of

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the adjustment screw. If it gets loose, rotate the adjustment screw anticlockwise to make the brake pressure within the required range, and then tighten the locking nut.

If the adjustment screw does not get loose, check that the air exhaust port can normally shut and does not leak air after the combination valve discharges air. If the air leakage is found at the air exhaust port, it means that the bleed piston cannot reset after the air exhaust, because: a small amount of engine oil contained in the compressed air that comes from the air compressor will stick onto the bleed piston and the valve body; it is inevitable that some dust will enter the combination valve from time, and the mixture of the engine oil and the dust will stick onto the bleed piston and the valve body, preventing the bleed piston from moving freely. To fix the fault, unscrew the retaining bolt at the lower cover of the combination valve, remove the lower cover and the bleed valve, clean the bleed piston, the air exhaust port and other parts. Do not clean the rubber parts with oil. During the re-installation, apply grease to the sliding parts, and make sure that the air exhaust valve is not reversely installed (the side against of the axial fan of the air exhaust piston must be glued).

If the air exhaust port can normally shut after the combination valve discharges air, but the system pressure drops when the combination valve discharges air, the single-way valve in the combination valve malfunctions, leading to the reverse flow of the compressed air in the air tank. The single-way valve will not be tightly sealed due to the damages to the spring or to the glued seal plates the foreign articles on the sealing surface of the single-way valve. In this case, remove, inspect and clean the combination valve.

## ② Check of the pressure controller and possible faults

The common faults of the pressure controller include: the adjustment screw gets loose and the check valve gets stuck. Start the inspection with the check of the tightness of the adjustment screw. If it gets loose, rotate the adjustment screw anticlockwise to make the brake pressure within the required range, and then tighten the locking nut.

If the adjustment screw does not get loose, check that the air exhaust port can normally shut and does not leak air after the pressure controller discharges air. If the air leakage is found at the air exhaust port, it means that the check valve cannot reset after the air exhaust, because: a small amount of engine oil

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contained in the compressed air and the dust entering the pressure controller during the use of the loader mix and stick onto the check valve and the valve body, preventing the check valve from moving freely. To fix the fault, disassemble and clean the pressure controller.

If the air exhaust port can normally shut after the pressure controller discharges air, but the system pressure drops when the pressure controller discharges air, the single-way valve malfunctions, leading to the reverse flow of the compressed air in the air tank. The single-way valve will not be tightly sealed due to the damages to the valve spring or to the glued seal plates.

(2) Check of the air compressor and possible faults

If no problems are found during the inspection of the air tank, the lines, the combination valve (or the pressure controller) and the single-way valve, it is certain that there is a fault with the air compressor: the exhaust valve cannot normally shut when the rigidity of the exhaust valve spring drops due to heat or there are foreign articles on the sealing surface of the exhaust valve, leading to the decrease in the output of the compressed air. The problem can be solved through the replacement or cleaning of the spring.

**(II) The service brake cannot be normally relieved, the clamps lock or the friction plates drag**

The reason for the clamps lock or the friction plates drag is that: after the brake pedal is relieved, the brake cylinder piston does not reset, making the friction plates and the brake disc not completely detached.

In this case, check whether there is air in the brake hydraulic lines. If there is air in the lines, it will be compressed during the braking and then expand due to the pressure drop after the brake is relieved, affecting the reset of the brake cylinder piston.

If the problem is not solved after the air exhaust, check the system elements one by one in the order: pneumatic brake valve, booster, and service brake. Normally, when the problem occurs, there will be black smoke or burnt odor. If there is black smoke or burnt odor in the brakes of the front and rear axles, there may be fault with the pneumatic brake valve; if there is black smoke or burnt odor in the brakes on the two sides of an axle, there may be fault with the booster; if there is black smoke or burnt odor in the brake on one side of an axle, there may be fault with this brake.

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## 1. Pneumatic brake valve

The common faults of the pneumatic brake pedal include: there is improper pedal stroke limit; the piston gets stuck or the restoring spring is damaged. For a two-line pneumatic brake valve, there may also be the faults: the improper position of the top lever of the brake valve, and the piston gets stuck.

Firstly, check whether the pedal stroke of the pneumatic brake valve is proper. When the pedal is relieved, loosen the locking nut at the lower part of the pedal, and rotate the adjustment screw clockwise so as to completely loosen the pedal. In the meantime, observe whether there is air being charged from the air exhaust port of the pneumatic brake valve. If there is air being discharged, the stroke limit is excessive, so the compressed air that enters the booster is not totally discharged at the time of braking, and there is residual pressure in the system, making the piston fail to reset completely when the brake is relieved. Therefore, it is necessary to readjust the pedal stroke of the pneumatic brake valve. Refer to the “Adjustment of the pedal stroke of the pneumatic brake valve” in the “Commission, installation and disassembly of the major elements and components of the brake system” part for the adjustment methods. For a two-line pneumatic brake valve, it is also necessary to check the location of the top lever. If it is not properly located, the piston lever will get stuck and the air exhaust port will not fully open after the brake is relieved.

If the pedal stroke of the pneumatic brake valve is proper, check the pneumatic brake valve: loosen (no need to remove) the hose joint that connects with the air outlet port of the pneumatic valve when the pedal is relieved, and observe whether there is air being discharged; if there is air being discharged, the piston gets stuck or the restoring spring is damaged, leading to abnormal air exhaust. In this case, disassembly the pneumatic brake valve for further inspections.

## 2. Booster

The common faults of the booster include: the air piston or the oil piston gets stuck, the return spring is damaged, and the return oil port is blocked. In these cases, when the brake is relieved, the hydraulic fluid cannot flow back normally, and the brake cylinder piston cannot reset, preventing the friction plate and brake disc from detaching completely.

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Checking method : remove the dirt accumulated at the oil filler of the booster's oil storage chamber, open the oil filler cap, and observe the fluid surface changes when the brake is actuated or relieved. The booster works normally if: the fluid surface steadily and quickly drops when the brake pedal is depressed; the fluid surface steadily rises due to the timely return of the brake fluid. If the opposite conditions occur, there are faults with the booster, and it needs further inspection.

Remove the air inlet hose of the booster, and check whether the air piston can rest normally at the air inlet port after the brake is relieved. If it can rest normally, then there is a fault with the master hydraulic cylinder of the booster.

### **3. Service brake**

If no problems are found during the inspection of the pneumatic brake valve and the booster, it is certain that there is a fault with the service brake. The common fault of the service brake is that the brake cylinder piston gets stuck and cannot return after the brake is relieved. In this case, the pressure applied on the friction plates cannot be released completely, and the friction plates and the brake disc cannot be detached completely. To solve the problem, remove and clean the brake.

#### **(III) A desired gear fails to engage after the service brake is relieved**

The problem is caused by the faults with the pneumatic brake valve due to:

- (1) Improper pneumatic brake valve pedal stroke limit
- (2) The pneumatic brake valve piston gets stuck or the spring is damaged
- (3) The improper position of the top lever of a two-line pneumatic brake valve

In these cases, the air exhaust port will not fully open after the brake is relieved, the compressed air that enters the cut-off valve in the speed control valve is not discharged completely, and the speed shift oil passage is not interconnected. To identify and repair the cause of the faults, refer to the "(II) Service brake cannot be normally relieved, the clamps lock or the friction plates drag" part.

#### **(IV) The system pressure quickly drops after the engine shuts down and the park brake is performed**

If the system pressure quickly drops after the engine shuts down and the park brake is performed, the

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system pressure quickly drops (the pressure drops more than 0.1MPa within 30 minutes), there is air leakage in the lines or elements of the system. Check the combination valve (or the pressure controller) first and then the pneumatic brake valve to make sure whether: the line joints get loose, the lines are damaged, and the combination valve, air tank, single-way valve and pneumatic brake valve leak air, and then check the emergency and park brake control valve to make sure whether: the line joints get loose, the lines are damaged, and the emergency and park brake control valve leak air. Normally, the air leakage in the valve is caused by the damage to the seal parts or to the sealing performance due to the impurities in the valve; the air leakage in the air tank is caused by the welding seam fault or the corrosion of the tank.

**(V) The system pressure rises slowly after the compressed-air brake**

The problem is caused by insufficient air supply due to the air leakage in the lines or elements of the system or abnormal performance of the air compressor.

Check the combination valve (or the pressure controller) first and then the pneumatic brake valve to make sure whether the lines or elements leak air, and then check the emergency and park brake control valve (checking order: from the air inlet lines to the brake air chamber) to make sure whether the lines or elements leak air. If no problems are found during the inspection of lines and elements, there is a fault with the air compressor.

**(VI) The loader moves off-tracking during driving when or after the brake is actuated**

When the two wheels on the same axle do not rotate at the same speed, the loader will move off-tracking during driving.

After the brake is actuated, if the brake cylinder piston of the service brake of the wheel on one side gets stuck and fails to return after the brake is relieved, the friction plates and the brake disc are not detached, so the rolling resistance of the wheel on one side is large than that on the other side, the wheels on the two sides do not rotate at the same speed, and the loader moves off-tracking. Normally, when the problem occurs, there is black smoke and burnt odor, so it is easy to identify the faulty parts. To solve the problem, remove and inspect the faulty service brake, and replace the rectangular seal ring.

When the brake is actuated, if the service brake friction plates are severely worn, no equal brake force is applied to the wheels on the two sides, leading to unequal rotational speed of the wheels on the two sides. To solve the problem, replace the friction plates.

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**(VII) The emergency and park brake control valve lever cannot be pressed down**

If the problem occurs, check the pressure gauge to make sure whether the air pressure is excessively low (lower than 0.4MPa). If the air pressure is excessively low, the pressure applied on the valve assembly cannot overcome the initial resistance of the spring, and the lever and the valve assembly will automatically move upwards with the action of the spring tension.

If the pressure is normal, remove and inspect the emergency and park brake control valve. If the seal ring of the emergency and park brake control valve is damaged or the sealing surface of the air exhaust port is covered with dirt, the air exhaust port will not shut completely, and the compressed air entering the valve leaks, so the pressure applied on the valve assembly cannot overcome the initial resistance of the spring, and the lever and the valve assembly will automatically move downwards with the action of the spring tension. In addition, the corrosion of the lever and the valve assembly will make the lever get stuck and move stiffly.

**(VIII) Insufficient park brake force makes the loader slid from a slope**

If the problem occurs, at first, check whether there is oil dirt on the friction plates or whether the friction plates have been worn to the limits. The oil dirt or excessive wear will lower the braking performance. Remove, clean or replace the friction plates if necessary.

Next, check the clearance between the brake drum plates and the friction plates. If the clearance is excessively large, the contact area between the friction plates and the brake drum is not sufficient when the park brake is actuated, leading to insufficient brake force. Adjust the clearance with the methods specified in the “Disassembly and inspection of a shoe brake” part.

If no problems are found in the above-mentioned inspections, it is certain that there is a fault with the brake air chamber. If the brake air chamber piston gets stuck or the restoring spring is damaged, the piston lever cannot fully move to the desired place when the brake is actuated and the contact area between the friction plates and the brake drum is not sufficient, leading to insufficient brake force. To solve the problem, remove, check and clean the brake air chamber. Pay attention to personal safety during the removal of the chamber.

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**(IX) Park brake friction plates get burnt**

If the problem occurs, check the clearance between the brake calipers and the friction plates. If the clearance is excessively small, the brake calipers and the friction plates will not be completely detached. To solve the problem, adjust the clearance.

If the clearance is normal, check whether there is air leakage in the emergency and park brake control valve or in the brake air chamber, and whether the brake air chamber piston gets stuck. The air leakage or the stuck piston will prevent the piston lever from reaching the desired place and the friction drum and the friction plates from detaching completely. Remove, clean or replace the faulty parts if necessary.

Replace the friction plates that are seriously burnt and the brake calipers that are damaged.



## Brake system faults and troubleshooting methods

No.	Fault description	Reason	Troubleshooting method
1	Insufficient service brake force and overlong brake distance	<ol style="list-style-type: none"> <li>1) Air leakage or oil leakage in elements and lines</li> <li>2) Insufficient brake fluid in the booster's oil storage chamber</li> <li>3) Friction plates has worn to the limit</li> <li>4) Damage to the seal plates (or drum diaphragm) of the brake valve</li> <li>5) The piston of the brake valve gets rusty or stuck</li> <li>6) The booster's air piston gets stuck, or the seal parts of the air piston or the oil piston are damaged</li> <li>7) A blockage in the breather port at the oil filler cap of the booster's oil storage chamber</li> <li>8) Oil leakage in the brake cylinder</li> <li>9) Brake cylinder piston gets stuck</li> <li>10) There is air in the brake hydraulic lines</li> <li>11) Low system pressure</li> <li>12) Oil leakage in the wheel hub, oil dirt on the friction plates</li> </ol>	<ol style="list-style-type: none"> <li>1) Check the sealing performance of the parts and lines</li> <li>2) Add brake fluid</li> <li>3) Replace the friction plates</li> <li>4) Replace the brake valve</li> <li>5) Clean the brake valve, and apply the grease to the outer part of the piston</li> <li>6) Clean the booster, and replace the seal parts</li> <li>7) Replace the oil filler cap</li> <li>8) Replace the rectangular seal ring of the brake cylinder</li> <li>9) Clean the booster</li> <li>10) Perform air-discharging operation</li> <li>11) Check the air compressor, the pressure control and the fuel-water separation devices, and the single-way valve</li> <li>12) Check or replace the wheel hub oil seal, and replace the friction plates</li> </ol>
2	The service brake cannot be normally relieved, the clamps lock or the friction plates drag	<ol style="list-style-type: none"> <li>1) There is air in the brake hydraulic lines</li> <li>2) Improper pedal stroke limit</li> <li>3) Improper position of the top lever of the two-line pneumatic brake valve, and the piston gets stuck</li> <li>4) The piston of the pneumatic brake vale gets stuck or the return spring is damaged</li> <li>5) The booster's air piston or the oil piston gets stuck, the return spring is damaged, and the return oil port is blocked</li> <li>6) The brake cylinder piston gets stuck and fails to return after the brake is relieved</li> </ol>	<ol style="list-style-type: none"> <li>1) Perform air-discharging operation</li> <li>2) Readjust the pedal stroke limit</li> <li>3) Readjust the position of the top lever</li> <li>4) Remove, inspect and clean the pneumatic brake valve</li> <li>5) Remove, inspect and clean the booster</li> <li>6) Remove, inspect and clean the pneumatic brake valve</li> </ol>
3	A desired gear fails to engaged after the service brake is relieved	<ol style="list-style-type: none"> <li>1) Improper pedal stroke limit</li> <li>2) Improper position of the top lever of the two-line pneumatic brake valve, and the piston gets stuck</li> <li>3) The piston of the pneumatic brake vale gets stuck or the return spring is damaged</li> </ol>	<ol style="list-style-type: none"> <li>1) Readjust the pedal stroke limit</li> <li>2) Readjust the position of the top lever</li> <li>3) Remove, inspect and clean the pneumatic brake valve</li> </ol>
4	The loader moves off-tracking during driving when or after the brake is actuated	<ol style="list-style-type: none"> <li>1) The loader moves off-tracking after the brake is actuated: the brake cylinder piston of the service brake of the wheel on one side gets stuck and fails to return after the brake is relieved</li> <li>2) The loader moves off-tracking when the brake is actuated: the service brake friction plates are worn</li> </ol>	<ol style="list-style-type: none"> <li>1) Remove, inspect and clean the service brake, and replace the rectangular seal ring</li> <li>2) Replace the friction plates</li> </ol>

5	The system pressure quickly drops after the engine shuts down and the park brake is actuated (the pressure drops more than 0.1MPa within 30 minutes)	<ol style="list-style-type: none"> <li>1) There is dirt on the seal on the piston of the pneumatic brake valve or the piston gets stuck, preventing the air inlet port from shutting completely</li> <li>2) The line joints get loose or the lines are damaged</li> <li>3) The combination valve, air tank, single-way valve and pneumatic brake valve leak air</li> </ol>	<ol style="list-style-type: none"> <li>1) Perform braking operations for a couple of times to blow off the dirt or remove and clean the pneumatic brake valve</li> <li>2) Tighten the joints or replace the lines</li> <li>3) Check the system elements, and identify and repair the cause of the air leakage. Replace the faulty parts if necessary</li> </ol>
6	The system pressure rises slowly after the compressed-air brake	<ol style="list-style-type: none"> <li>1) T line joints get loose or the lines are damaged</li> <li>2) Abnormal performance of the air compressor leads to insufficient air supply</li> <li>3) The oil drain plug of the fuel-water separator is not tightened</li> <li>4) There is air leakage in the combination valve (or the pressure controller), the air tank, the sing-way valve, the emergency and park brake control valve or the quick couple valve</li> </ol>	<ol style="list-style-type: none"> <li>1) Tighten the joints or replace the lines</li> <li>2) Check the working performance of the air compressor</li> <li>3) Re-tighten</li> <li>4) Check the system elements, identify and repair the cause of air leakage, and replace the faulty parts if necessary</li> </ol>
7	The emergency and park brake control valve lever cannot be pressed down	<ol style="list-style-type: none"> <li>1) The air pressure is excessively low (lower than 0.4MPa)</li> <li>2) The seal ring of the emergency and park brake control valve is damaged or the sealing surface of the air exhaust port is covered with dirt, so the air exhaust port cannot shut completely</li> <li>3) The corrosion of the lever and the valve assembly makes the lever get stuck and move stiffly</li> </ol>	<ol style="list-style-type: none"> <li>1) Check the system, and identify the cause of excessively low air pressure</li> <li>2) Remove, check and clean the emergency and park brake control valve</li> <li>3) Remove and clean the emergency and park brake control valve</li> </ol>
8	Insufficient park brake force makes the loader slid from a slope	<ol style="list-style-type: none"> <li>1) The clearance between the brake drum and the friction plates is excessively large</li> <li>2) There is dirt on the friction plates or the friction plates have been worn to the limits</li> <li>3) The brake air chamber piston gets stuck or the restoring spring is damaged, the piston lever cannot fully move to the desired place when the brake is actuated and the contact area between the friction plates and the brake drum is not sufficient</li> </ol>	<ol style="list-style-type: none"> <li>1) Make readjustments according to the requirements</li> <li>2) Clean or replace the friction plates</li> <li>3) Remove, check and clean the brake air chamber</li> </ol>
9	Park brake friction plates get burnt	<ol style="list-style-type: none"> <li>1) The clearance between the brake drum and the friction plates is excessively small, so the brake calipers and the friction plates will not be completely detached.</li> <li>2) There is air leakage in the emergency and park brake control valve or in the brake air chamber, and the brake air chamber piston gets stuck, preventing the piston lever from reaching the desired place and the friction drum and the friction plates from detaching completely.</li> </ol>	<ol style="list-style-type: none"> <li>1) Make readjustments according to the requirements</li> <li>2) Check the system elements, and identify and repair the cause of the air leakage. Replace the faulty parts if necessary</li> </ol>

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## 8.4 Emergency brake system

### 8.4.1 Functions of the emergency and park brake system:

1. Park the loader, so that when the loader stops working, it will not move due to a slope or external force
2. The brake is actuated when there is an emergency when the loader works, and play a protective role when the brake system pressure is excessively low

### 8.4.2 Working principles of the emergency and park brake system:

As is shown in the Illustration 8-7, the emergency and park brake system is composed of the manual brake valve 1, the brake air chamber 2, the brake 3, the brake disc 4 and the cut-off air cylinder.

The emergency and park brake system has two brake types: manual control and automatic control.

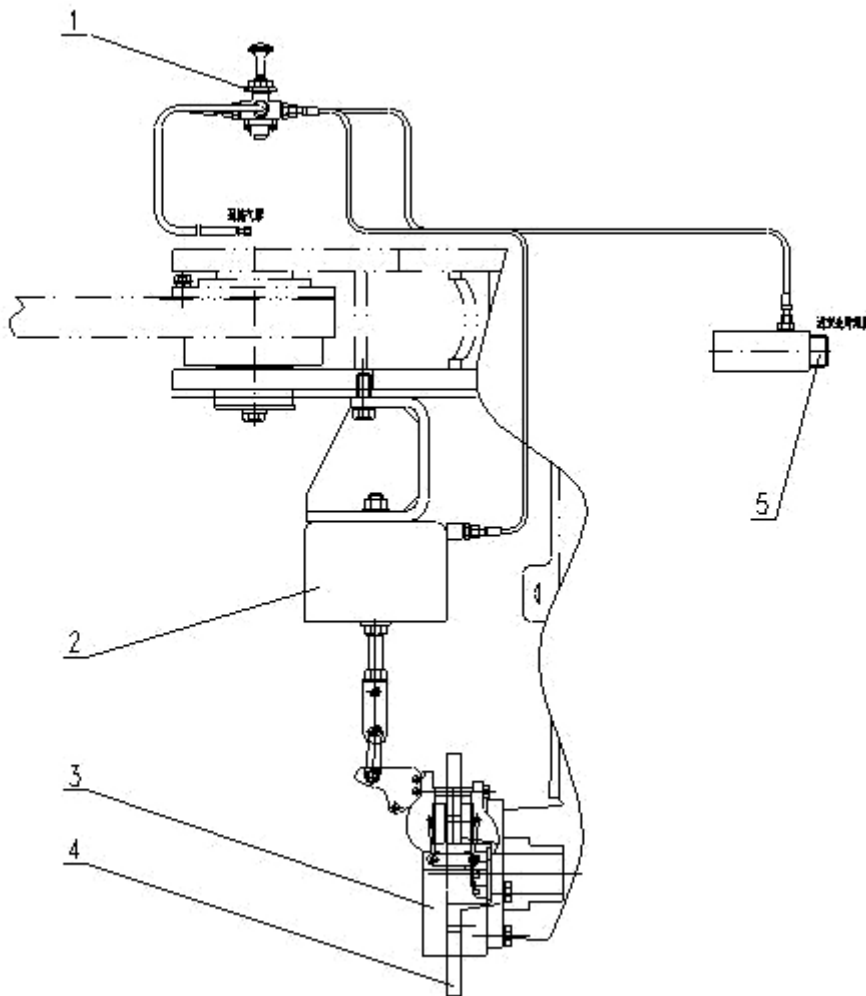


Illustration 8-7 Emergency brake system

1. Manual control

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When compressed air pressure is within a normal range, the compressed air from the air reservoir enters the manual brake valve 1, the valve will open after the manual brake valve button is pressed down, the compressed air enters the brake air chamber 2 through the manual brake valve, the piston in the brake chamber is pressed to drive the lever to move downwards, the brake 3 releases the brake disc 4, and the brake is relieved. When performing emergency brake or parking the loader, pull the manual brake valve button upwards, the manual brake valve shuts down, the compressed air supply is cut off, the left compressed air in the system is discharged from the air exhaust port at the lower part of the manual brake valve, the piston in the brake chamber drives the lever to move upwards, the brake clamps the brake disc tightly, and the brake is actuated.

After the diesel engine is started, before the compressed air in the air reservoir reaches the lowest working pressure of 0.4MPa, the manual brake valve button cannot be pressed down, the manual brake valve cannot open, the brake is in the braking state, the air cannot flow through the cut-off cylinder 5, the transmission is automatically placed at the neutral gear position, and the loader cannot move. At this time, the system is in the state of automatic protection. Users should wait patiently until the compressed air pressure reaches the normal working range, and then the brake will be relieved, and the loader will move after the desired gear position is engaged.

## 2. Automatic control

When the loader works, if there is excessive large air leakage and the air pressure drops below 0.28MPa, the manual brake valve button will automatically rise to cut off the compressed air and to actuate the emergency brake so as to protect the loader. In this case, check the air passage and repair the cause of failure.

**ATTENTION :** when the loader drives, especially when it drives at a high speed, the automatic control system should be used only in emergent conditions, or it will lead to the damages to the system. When the engine does not work, a towing vehicle will be needed to tow the loader back. In this case, it is necessary to detach the brake air chamber lever from the brake, and the towing operation will be performed only after the brake is relieved.