Purpose

Dual Circuit Brake Valves carry the sensitive graded increasing and decreasing of the pressure in the brake cylinders of the motor vehicle. In addition they also control the trailer control valve (if existent).

The brake valves are delivered with tappet, running plate or lever actuation. Both braking circuits lie among each other. In case of failure of one circuit, the other circuit remains unaffected.

Some design types have additional functions (for load-sensing control of the front axle or for upstream actuating of sustained-action brake like retarders).

Design types

461 315

a. **Dual Circuit Brake Valve** actuated by a tappet. It is activated via a brake pedal. This series also serves as a basic valve for the designs shown below.

461 317

b. **Dual Circuit Brake Valve**
with running plate actuator.

461 319

c. **Dual Circuit Brake Valve** actuated by a tappet and an integrated empty/load valve for the 2nd braking circuit. The pressure reduction ratio for the empty/load valve is **1,5 : 1**, **2,0 : 1** or **2,7 : 1**. It is actuated via a brake pedal.

461 318

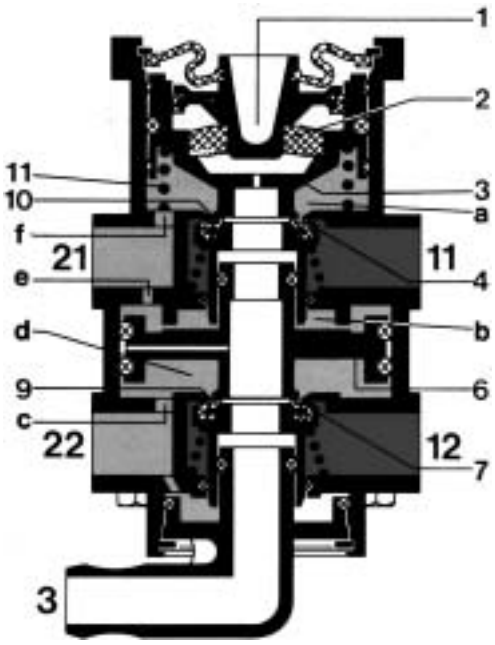
d. **Dual-circuit brake valve** with treadle actuation and integrated electrical endurance brake control. Depending on the variant, the devices are either equipped with three electronic switches or with one proximity switch.

461 324

e. **Dual-circuit brake valve** with treadle actuation and integrated, graduable, pilot valve for pneumatically controlled retarders.

Operation of Brake Valve 461 315:

a. Partial Braking Position

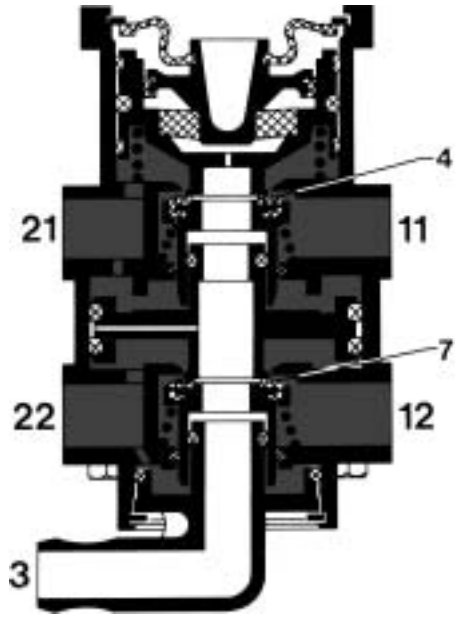


Regardless of the type of actuator used by the brake valve, the driver uses his foot to apply pressure on the thrust member (1), the rubber spring (2) and thus the graduating piston (3). This forces the graduating piston (3) downwards against the force of spring (11), closing outlet valve (10) and opening inlet valve (4). The compressed air from port **(11)** can thus flow via the opened inlet valve (4) to port **(21)**, through hole (e) into chamber (b) and through hole (f) into chamber (a). The compressed air flowing into chamber (b) moves the piston valve (6) downwards. This closes outlet valve (9) and opens inlet valve (7). The compressed air from port **(12)** can now flow to port **(22)**. At the same time, the pressure also reaches chamber (d) through hole (c).

A final braking position in the **1st circuit** has been reached when the compressed air acting in chamber (a), together with the force of spring (11), is capable of raising the graduating piston against the force of the rubber spring (2) and closing the inlet valve (4) once more.

The final braking position in the **2nd circuit** has been achieved when the pressure in chamber (d) can once again raise the piston valve (6) against the pressure in chamber (b). The upwards motion of the piston valve (6) closes inlet valve (7). Thus a final braking position has been reached for both circuits.

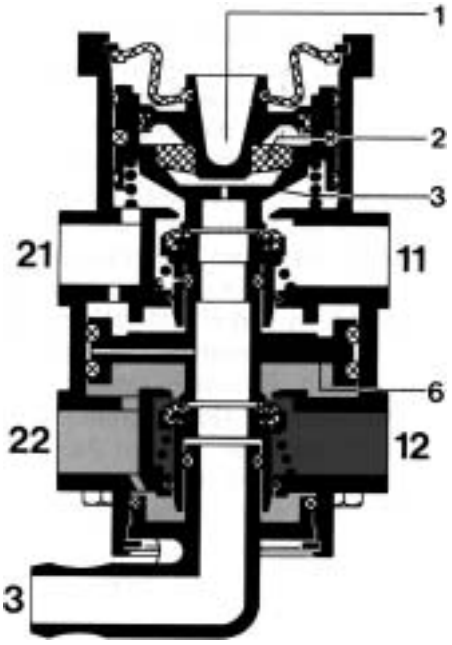
b. Full Braking Position



When the braking system is actuated further, the process described under **"a"** above is repeated gradually. The air reservoir pressure at ports **(11)** and **(12)** reaches the brake cylinders via ports **(21)** and **(22)**. The inlet valves (4) and (7) are fully open in this position.

The increase in pressure till full braking follows, depending on the pedal travel, progressively, whereby the braking system can be actuated more sensitively.

c. Function after Failure of 1st Circuit

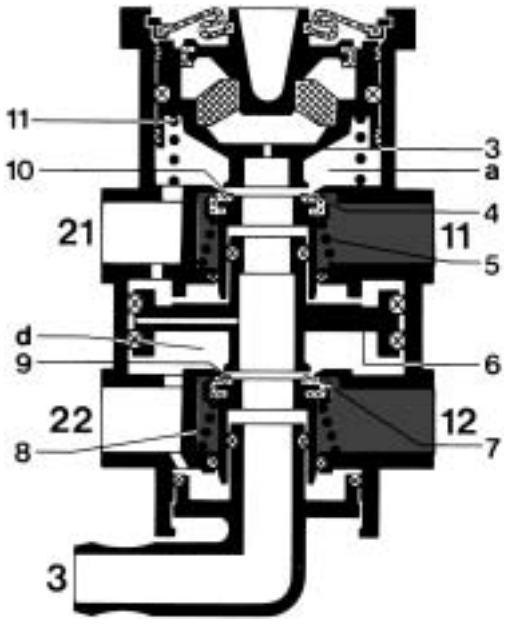


In the event of the **1**st circuit failing, the piston valve (6) can no longer be controlled by compressed air when the brakes are actuated. For this reason, the actuating mechanism must be pushed down to a point where the graduating piston (3) rests on the piston valve (6). During further actuation, the force is now transmitted to the piston valve (6) via the thrust member (1), the rubber spring (2) and the graduating piston. Whilst the **2**nd circuit is being actuated mechanically, the piston valve (6) acts, within the braking range, directly against the force of the rubber spring (2). This ensures grading of the 2nd circuit even if the 1st circuit is defective.

Failure of 2nd Circuit

The function of the 1st circuit is not affected if the 2nd circuit fails.

d. Release Position



When the brakes are released, the compressed air in chambers (a) and (d), in combination with the force of spring (11), raises piston (3) and piston valve (6). Together with the force from springs (5) and (8), inlet valves (4) and (7) are closed and outlet valves (9) and (10) opened. This allows ports **(21)** and **(22)** to be exhausted via the vent (3).

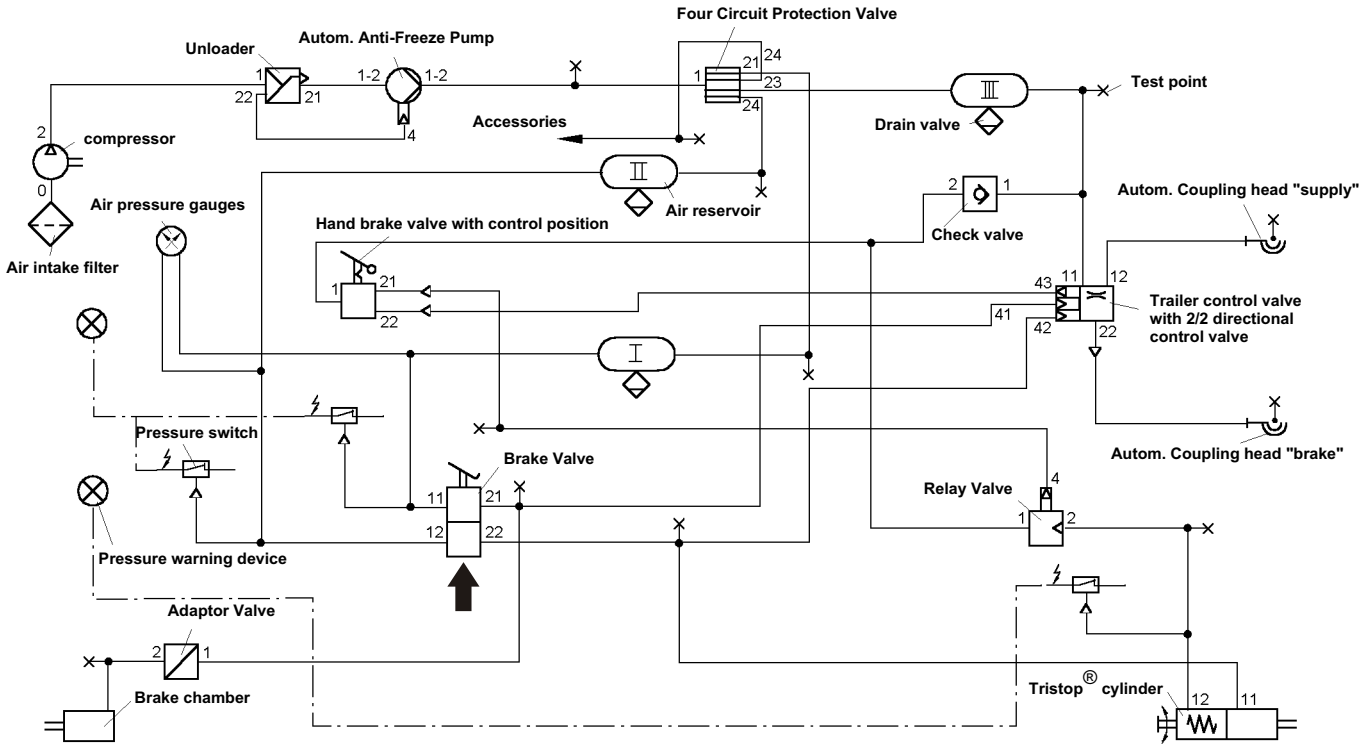
Maintenance

No maintenance is required beyond the checks required by law.

Testing

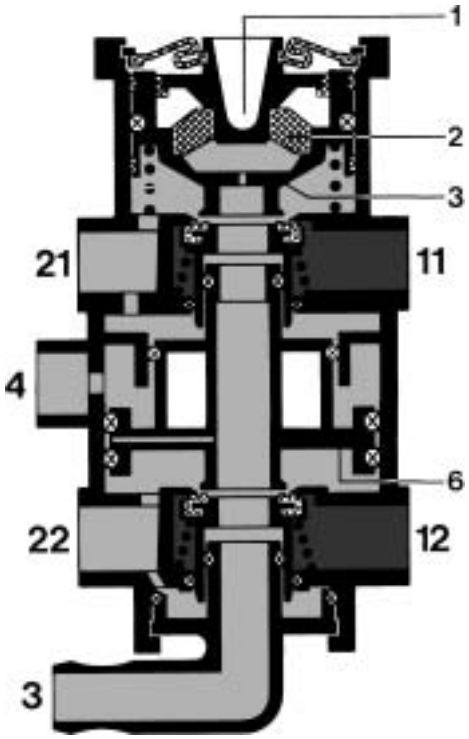
Response pressure:	max. 0.4 bar
Grading:	max. 0.3 bar
Pressure difference between circuit **21** and **22**:	depending on variant. to max: 0.5 bars
Full braking even after failure of one circuit:	Reservoir pressure

Schematic for Testing and Installation



Operation of Brake Valve 461,319 (with integrated empty/load-regulation)

Function



Regardless of the type of actuator used by the brake valve, the driver uses his foot to apply pressure on the thrust member (1), the rubber spring (2) and thus the graduating piston (3). As described for brake valve **461 315** ports **(21)** and **(22)** are pressurized when the brakes are actuated further. The difference between this valve and the one described previously lies in the piston valve (6) which is designed as a step piston. This causes the pressure output at port **(22)** to be stepped down as a function of the load-controlled pressure of the rear axle port **(4)**.

As the load increases, the pressure step-down is reduced and the pressure output at port **(22)** is increased. When the vehicle is fully laden, the pressure step-down is neutralized. The pressure step-down to the front axle is neutralized (also at half loaden), when at full brakings the circuit 2 is mechanical opened through fully depress of the brake pedal.

When the brakes are released, the brake valve reverses and ports **(21)** and **(22)** are exhausted through port **(3)**. The pressure at port **(4)** is expelled to atmosphere via the load-sensing system on the rear axle.

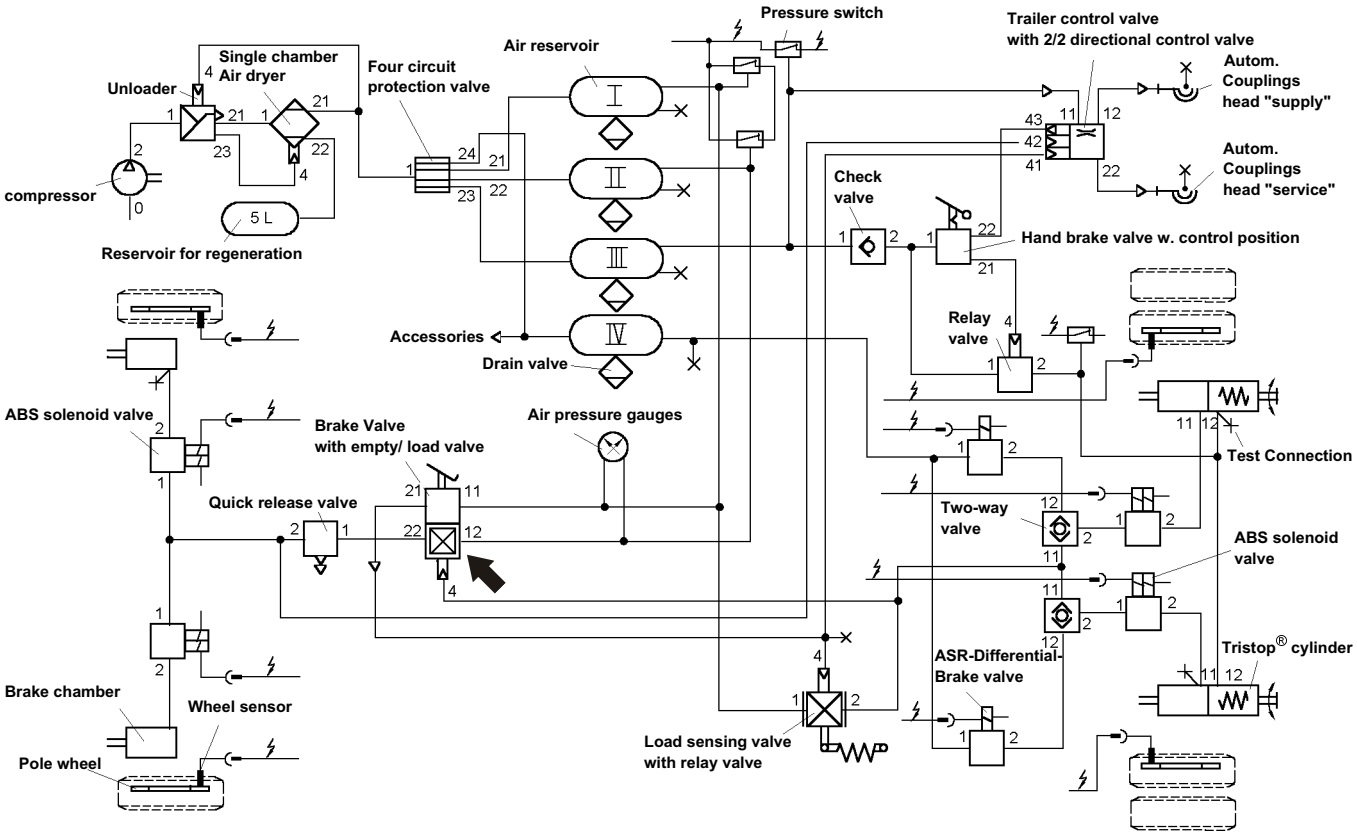
Maintenance

No maintenance is required beyond the checks required by law.

Testing

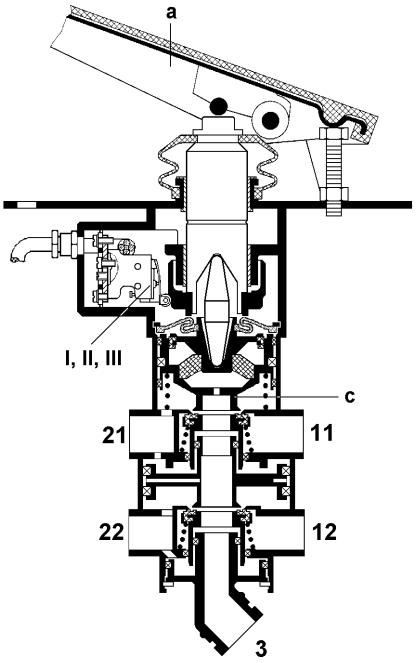
Similar to Dual Circuit Brake Valve 461 315.For checking the output pressure “unladen” for braking circuit “22”, please follow the vehicle manufacturer’s instructions. For the system test pressure of circuit “21” (upstream from the load-sensing valve), please refer to the load-sensing plate on the vehicle. This may be 6.5 bar or 6.8 bar, for example. At fully depress of the brake pedal the pressure step-down of the front axle is however neutralized.

Schematic for Testing and Installation



Operation of Brake Valve 461 318 (with electrical endurance brake control)

Variant 1 (with 3 electronic switches)



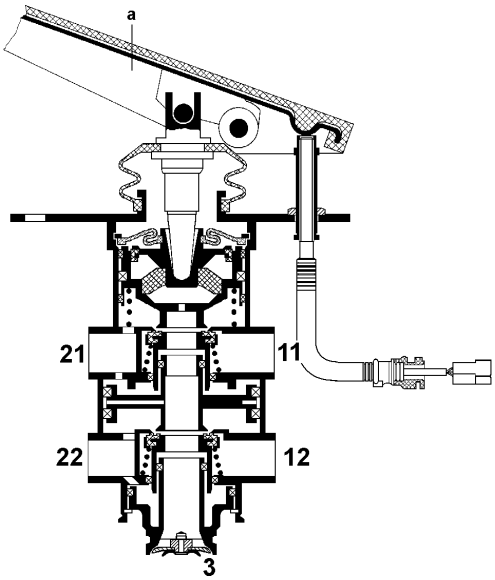
When the treadle (a) is pushed down, Switch I and subsequently, when the mechanical pressure point has been overcome, Switch II are actuated. This causes the first or second braking stage of the retarder to be activated without any compressed air flowing into the service braking system.

As the treadle (a) is pushed down further, Switch III is actuated, activating the third braking stage of the retarder. At the same time, the piston (c) moves downwards and actuates the discharge valve of the service braking system circuit 1.

Further operation is the same as already described for **variant 461 315**.

When the pressure in the two circuits of the service braking system is being decreased, the switching stages of the retarder are deactivated as the treadle (a) moves upwards.

Variant 2 (with proximity switch)



In the second variant, a proximity switch is integrated into the treadle. This is activated when the treadle has moved through approximately 2 degrees. Here too, other functions are the same as in variant 461 315.

Maintenance

No maintenance is required beyond the checks required by law.

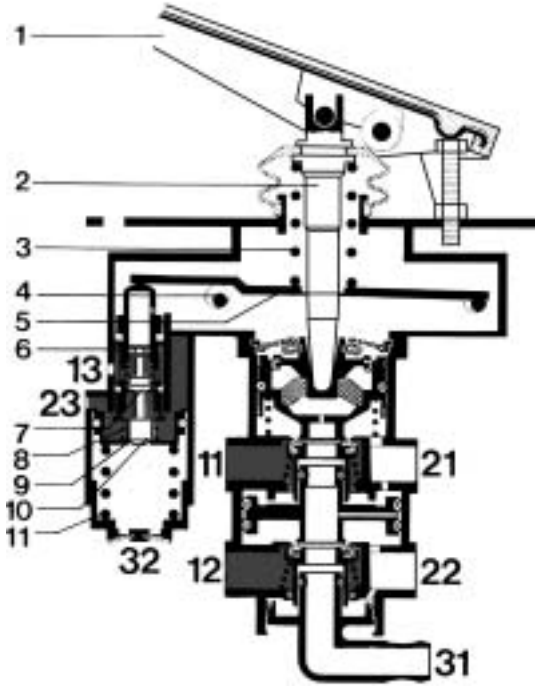
Testing

Same as for dual-circuit brake valve 461 315.

The three electronic switches are adjusted correctly when the brake valve is removed. An appropriate adjustment tool must be used in accordance with WABCO test specifications.

Operation of Brake Valve 461 324 (with pneumatic endurance brake control):

a. Partial Braking Position



When the treadle (1) is pushed down, the force applied by the driver is transferred to the pressure plate (6) via the tappet (2), the spring (3) and the oscillating crank (5). This forces the graduating piston (6) downwards against the force of spring (8), closing outlet valve (10) and opening inlet valve (7). The pressure in port **(13)** (from the accessories circuit) can thus flow via the open inlet valve (7) into port **(23)** and over the effective piston (9) area.

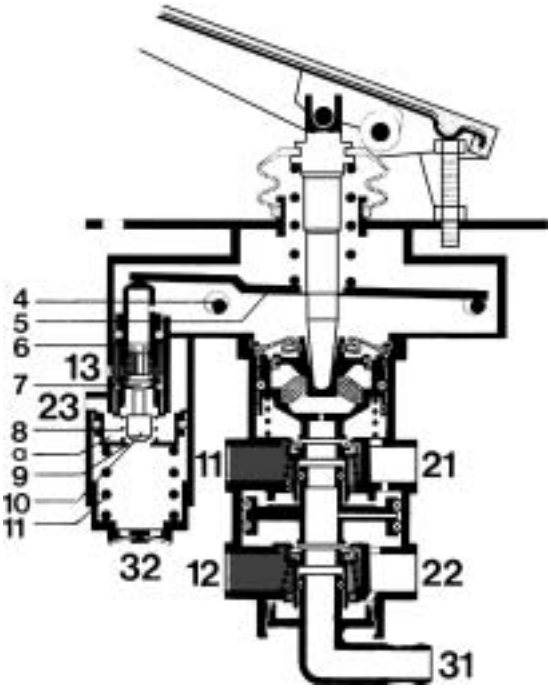
A closed braking position is attained when the pressure applied to the graduating piston (9) produces a force which is capable of overcoming the force of the spring (11) and of closing the inlet valve again. The amount of output pressure depends on the force of the spring (11).

b. Service brake connection

When the oscillating crank (5) reaches the stop point (4), the brake valve is connected via the tappet (2).

Further operation of the service braking part is the same as already described for variant **461 315**.

c. Release position



After service braking system release, the oscillating crank (5) rises from the stop point (4). The compressed air in chamber (a), and the force of springs (8) and (11) push the piston (9) and the pressure plate (6) upwards. This causes the inlet valve (7) to close and the discharge valve (10) to open. Air is thus evacuated from port **(23)** via the exhaust **(32)**.

Maintenance

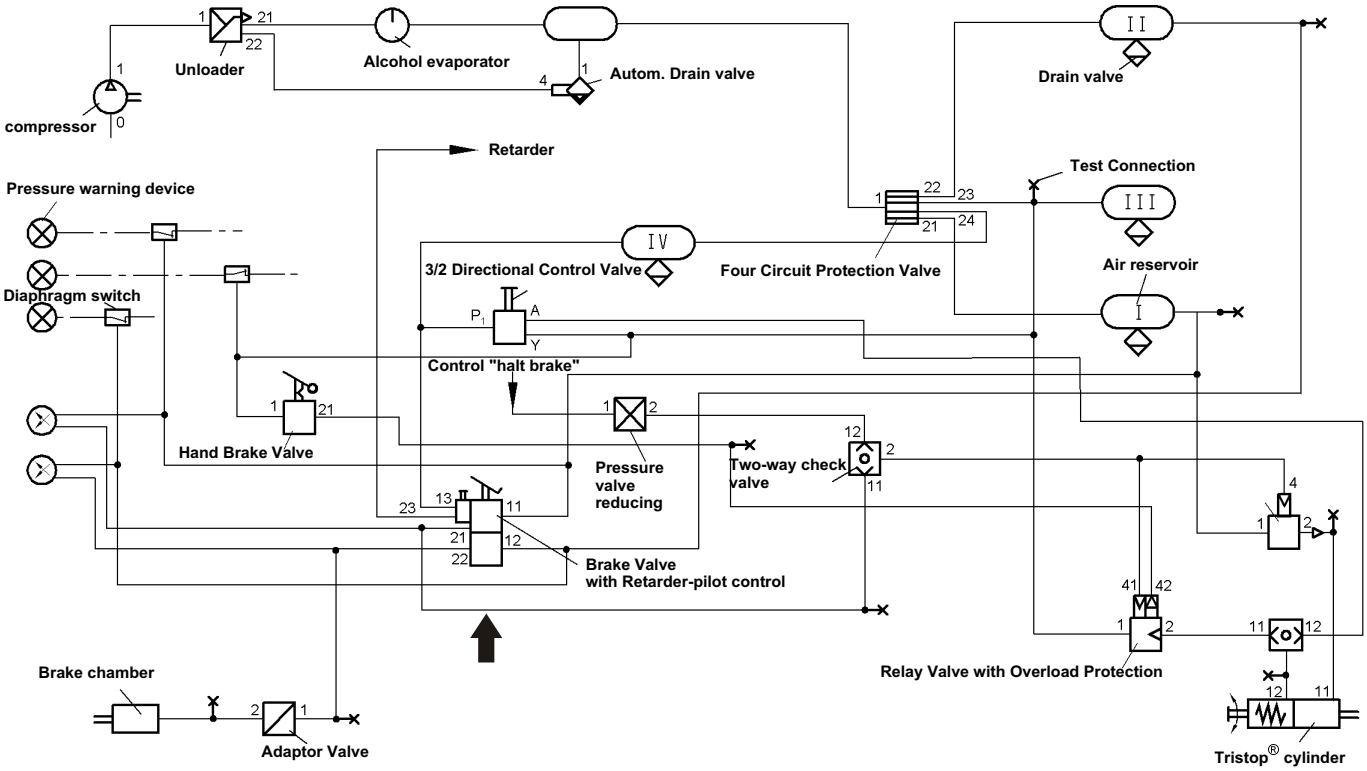
No maintenance is required beyond the checks required by law.

Testing

1. After a slight actuation of the running plate the port **(23)** must output 0.2 to 0.4 bar.
2. When the treadle is actuated further, stages from 0.2 to 0.3 bar have to be reached at port **(23)** and lead to a maximum output of approx. 2.8 bar. If this pressure is reached, the 1.BBA circuit has to output the response pressure at port **(21)** from 0.2 to 0.4 bar simultaneously.

Further testing follows as described for brake valve **461 315**.

Schematic for Installation

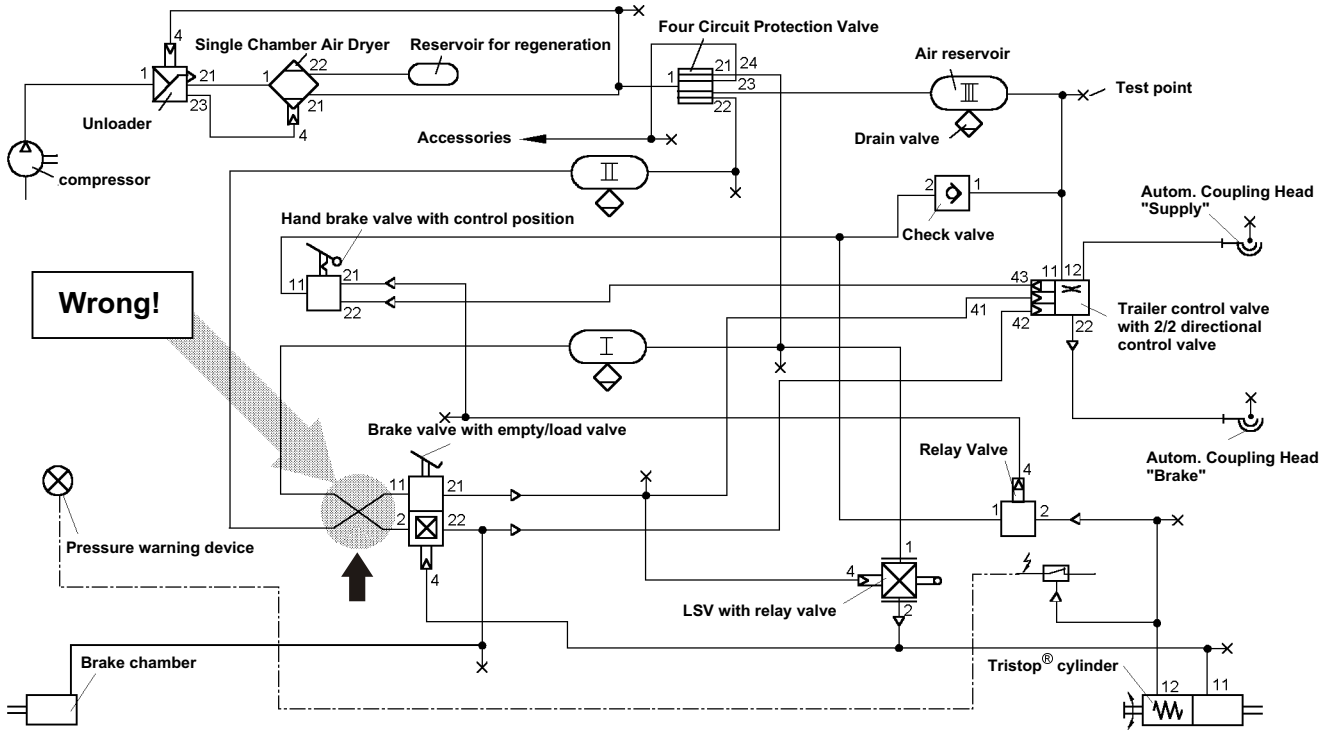


Warning! Possible Defect:

On vehicles which have a load-sensing valve with an integrated relay valve fitted (or a relay valve only if there is no load-sensing), the following defect may occur:

If **ports 11** and **12** or **21** and **22** on the brake valve or the air lines at the air reservoirs of circuits 1 and 2 have been wrongly connected and the rear axle braking circuit becomes defective because of leakages, **this can cause the whole of the service braking system to fail**.

Example for faulty (faulty connection of circuits)



Testing

To avoid or at least to recognize false connections, **the pressure should be checked in the air reservoir** of the service braking system or in the applicable compressed air lines. This can also be done when the brakes are due for testing, at the same time as checking the closing pressure of the quadruple-circuit protection valve.

Connect pressure gauge to test ports of brake cylinders for front and rear axles. If the air reservoir of one service braking circuit is now vented completely (drain valve) and the brake pedal is fully actuated, the cylinders of the braking circuit which is still under pressure must show a rise in pressure.

This is followed by filling the pressureless air reservoir, and by venting the other service braking circuit. When the brake pedal is actuated, the pressure in the other braking circuit must rise.

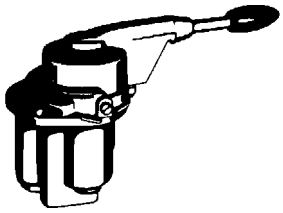
Purpose

Hand brake valves, which when actuated work on exhaust basis, are used with linkage-free auxiliary and parking braking systems.

Their function is to gradually evacuate air from the connected tristop or spring brake actuators. In trailer train operation, the hand brake valve controls the trailer control valve at the same time. Depending on the variant, the device is equipped with an additional control position for the trailer. Dual-circuit variants with integrated emergency release system / pipe rupture safeguard are often used for buses.

Design types

961 702



a. Older **hand brake valve** variant with and without control position. Since the device works in the same way as the following hand brake valves, its function will not be described here.

961 722 **961 723**

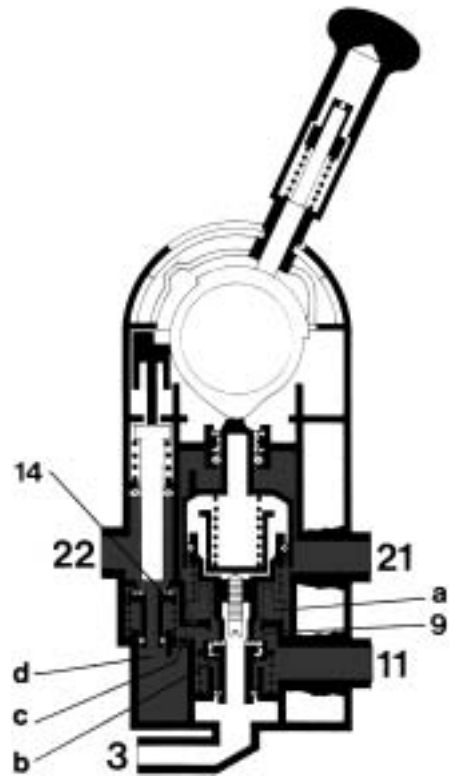
b. The hand brake valves are delivered with and without control position. Both hand brake valves have the same function. Variant **961 723** differs from variant **961 722** only in size.

961 722 26 . 0

c. Hand brake valve with two independent compressed air supply circuits and integrated emergency release system / pipe rupture safeguard.

Operation of Hand Brake Valve 961 722

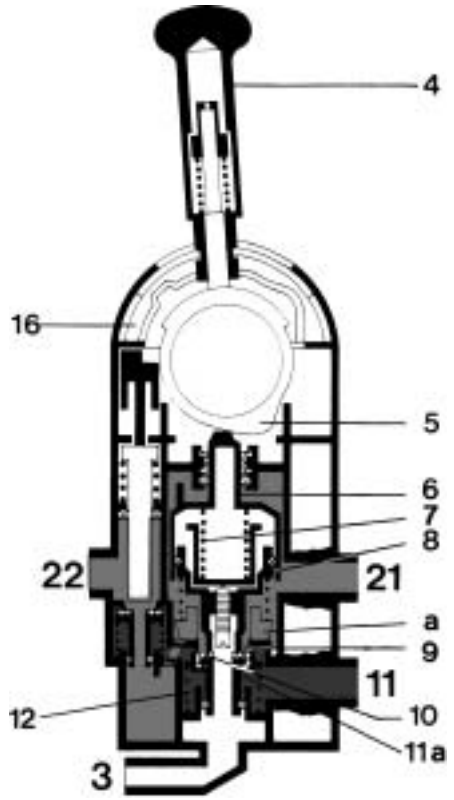
a. Driving Position



The compressed air coming from the air reservoir (circuit III) flows via port **(11)** into chamber (b). Since the inlet valve (9) is open, the compressed air flows into chamber (a) and to port **(21)** of the hand brake valve.

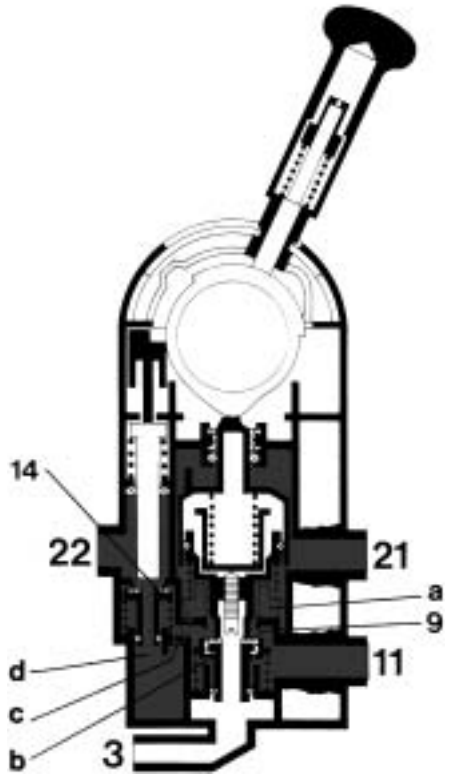
At the same time the compressed air in chamber (b) flows via hole (c) into chamber (d) and from there via the opened outlet valve (14) to port **(22)**.

b. Partial Braking Position



The position of the cam (16) and that of the cam brake (4) changes when the hand lever (1) is actuated. This reduces the load on the piston (6) and the graduating spring (7). The pressure in chamber (a) can thus raise the graduating piston (8) against the force of the graduating spring (7). As spring (12) raises the valve body (11a), the inlet valve (9) is closed. The graduating piston (8) is then raised from the valve body (11a), opening outlet (10). This initially causes ports **(21)** and **(22)** to be vented via vent (3). Depending on the position of the lever (4), this venting position is maintained until the force of the graduating spring (7) against the residual pressure in chamber (a) is once again sufficient to push the graduating piston (8) downwards and to close the outlet valve (10). A partial braking position has now been reached.

c. Full Braking and Parking Position

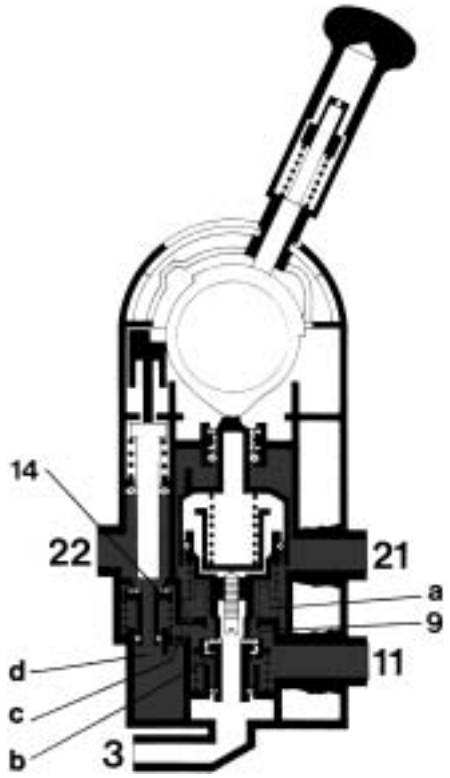


When the hand lever (4) is actuated further, the process described under “b” above is repeated, and is sensitively gradable. In the full braking range, ports **(21)** and **(22)** are pressureless.

If the hand lever is actuated further from the full braking position beyond the centre of pressure, a parking position is reached in which the lever is locked by a catch.

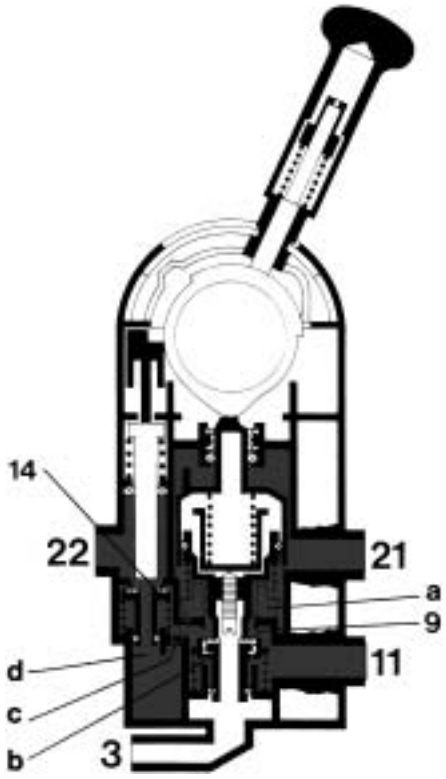
In the emergency braking range from the driving position to the centre of pressure, the hand lever is returned to the driving position when released.

d. Control Position



By pushing in the hand lever (4) from the parking position and continuing in the same moving direction, the valve tappet (15) is pulled by the cam plate (16). This allows the outlet valve (14) to close and the inlet valve (13) to open. The supply pressure in chamber (e) now flows into port **(22)** - with no grading being possible - and port **(21)** remains vented. In this position the hand lever (4) does not lock. When the hand lever (4) is released, it automatically returns to its locking position as described under **“c”** above, and port **(22)** is vented once again.

e. Release Position



By pulling out the hand lever (4), it is released from its locking position and returned to its original position. This causes the hand brake valve to reverse and ports **(21)** and **(22)** are pressurized once more as described under **"a"** above.

Maintenance

No maintenance is required beyond the checks required by law.

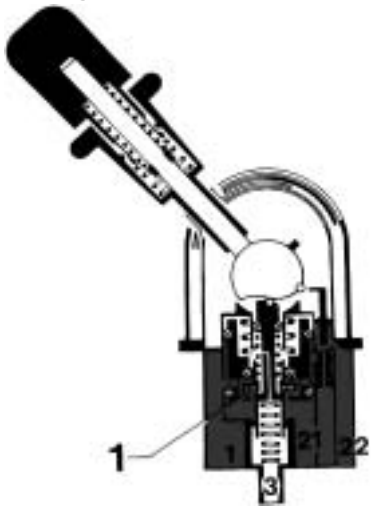
Testing

Release position:	full reservoir pressure
Response pressure:	max. 2.2 bar
Grading:	max. 0.3 bar
Full braking:	0.0 bar
Control position:	full reservoir pressure at port **(22)**, therefore trailer brake released.

In the range of the parking brake, the hand lever (4) must be held by the catch.

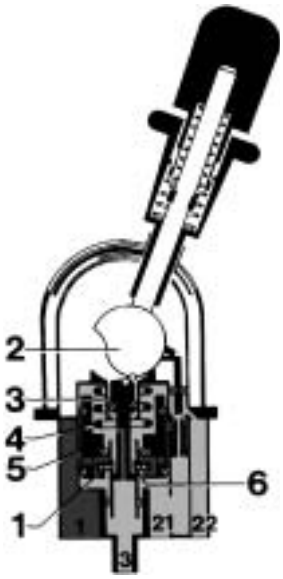
Operation of Hand Brake Valve 961,723

a. Driving Position



The compressed air flows from port **(1)** and the opened inlet valve (1) to ports **(21)** and **(22)**. The spring brake actuator and port **(43)** of the trailer control valve are pressurized.

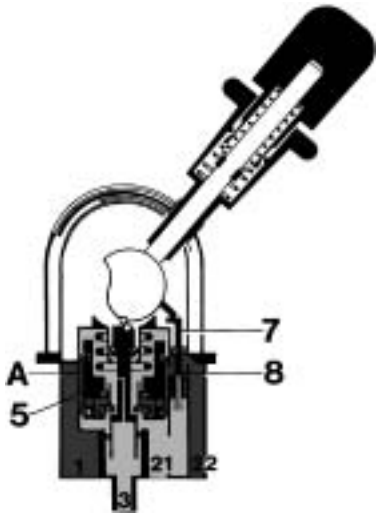
b. Braking Position



The cam (2) moves the tappet (3) downwards. The inlet valve (1) closes and the outlet valve (6) opens. Ports **(21)** and **(22)** are vented via vent **(3)**.

The spring (4) forces the piston (5) downwards, closing the outlet valve without opening the inlet valve. A final braking position has now been reached.

c. EC Control Position



To check the spring-brake performance of the motor vehicle, the hand lever can be moved from its locked position into the control position. The lobe on the cam moves the tappet (7) downwards. The passage to port **(22)** is closed, and inlet (8) is opened. The compressed air from port **(1)** flows via chamber (A) and past piston (5) to inlet (8). Port **(22)** is pressurized and the trailer's brake released. When the hand lever is released, it automatically returns into its locked position.

Maintenance

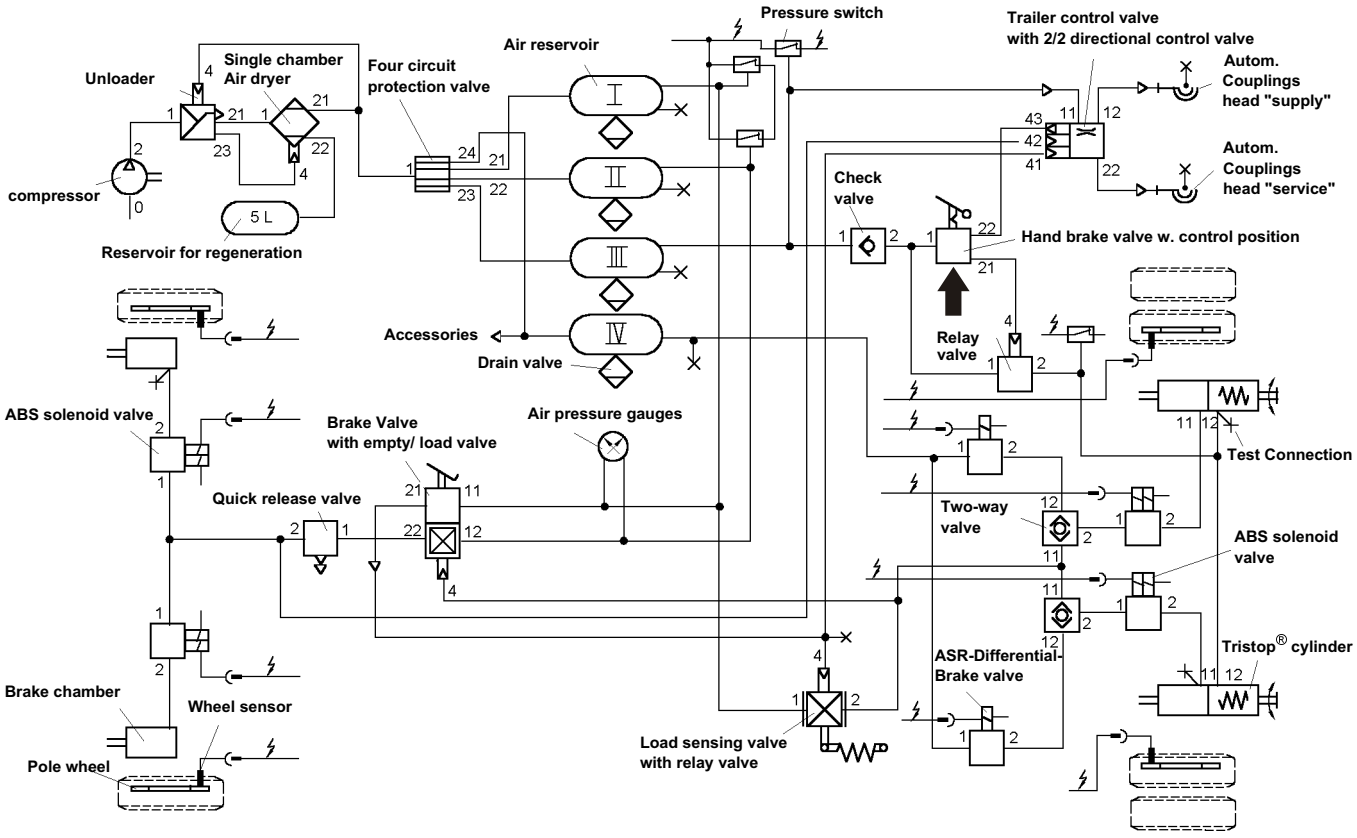
No maintenance is required beyond the checks required by law.

Testing

Release position:	full reservoir pressure
Response pressure:	max. 2.2 bar
Grading:	max. 0.3 bar
Full brake application:	0.0 bar at **(21)** and **(22)**
Control position:	full reservoir pressure at port **(22)**

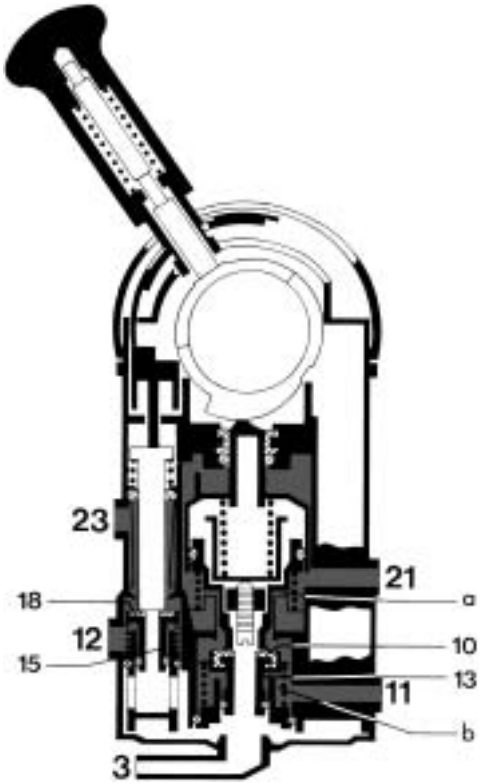
In the range of the parking brake, the hand lever must be securely held by the catch.

Schematic for Testing and Installation



Operation of Hand Brake Valve 961 722 26. 0 (with integrated emergency release system)

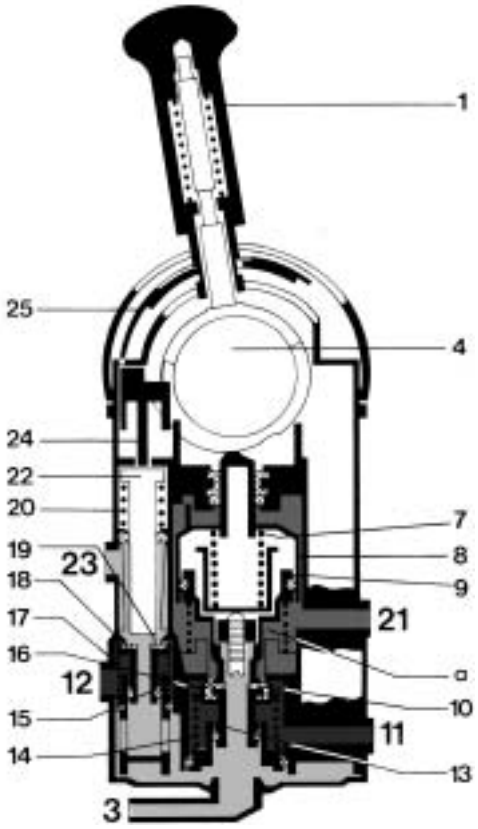
a. Driving Position



The compressed air coming from the air reservoir **(circuit III)** flows via port **(11)** into chamber (b). Since the valve diaphragm (13) inlet (10) is open, the compressed air flows into chamber (a) and then into port **(21)** of the hand brake valve.

At the same time, compressed air flows from the four-circuit protection valve (example: **circuit 4**) into port **(12)**. Since the valve diaphragm (15) inlet (18) is open, the compressed air can again be channelled out via port **(23)**.

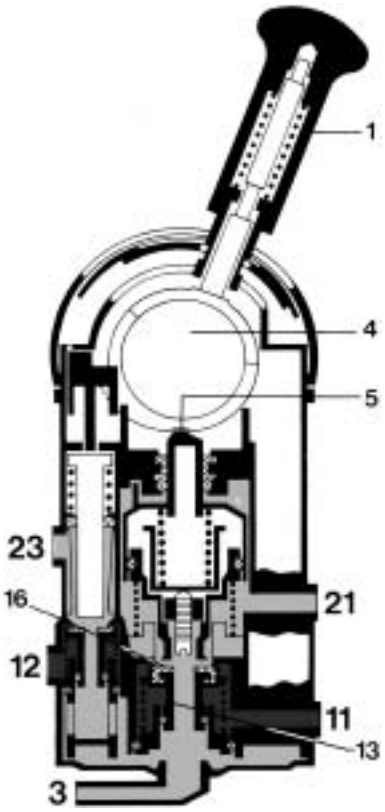
b. Partial Braking Position



The position of the cam (25) and that of the cam brake (4) changes when the hand lever (1) is actuated. This relieves the piston (22) first via the driver (24). Spring (20) pushes the driver (24) and the piston (22) upwards. This causes spring (17) to close the valve diaphragm (15) inlet (18). When the piston (22) rises from the valve diaphragm (15), the outlet (19) opens, and compressed air in port **(23)** can rapidly escape via the exhaust **(3)** into the atmosphere.

Immediately thereafter, pressure is reduced from the piston (8) and the graduating spring (7) via the cam (4). The compressed air in chamber (a) can thus give the graduating piston (9) against the force of the graduating spring (7). This causes the spring (14) to push the valve diaphragm (15) so far upwards until the inlet (10) closes. After that, the graduating piston (9) rises from the valve diaphragm (13) and first opens the inlet (16) . The compressed air in chamber (a) and in port **(21)** is partly reduced via the exhaust **(3)**. Air continues to be evacuated from port **(21)** until the force of the graduating spring (7) is sufficient enough to push down the graduating piston (9) and to close the valve diaphragm (13) outlet (16) again. A partial braking position and, thus, a closed braking position is obtained.

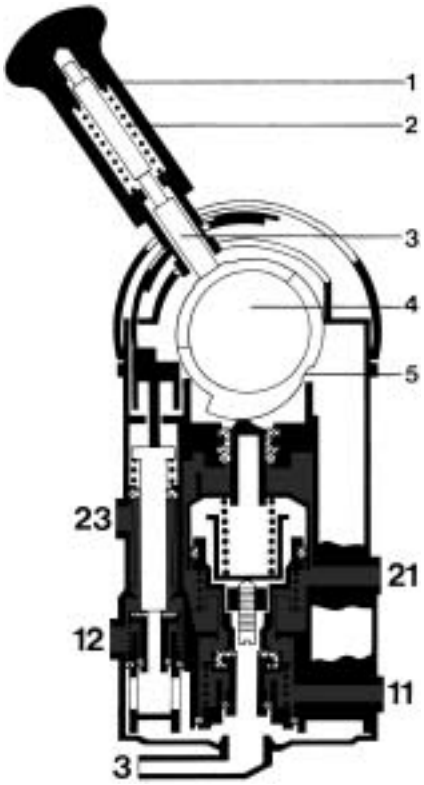
c. Full and Parking Braking Position



When the hand lever (1) is actuated further, the process described under **"b"** is repeated gradually and delicately until full braking. This leaves port **(21)** devoid of pressure, since the valve diaphragm (13) outlet (16) is completely open.

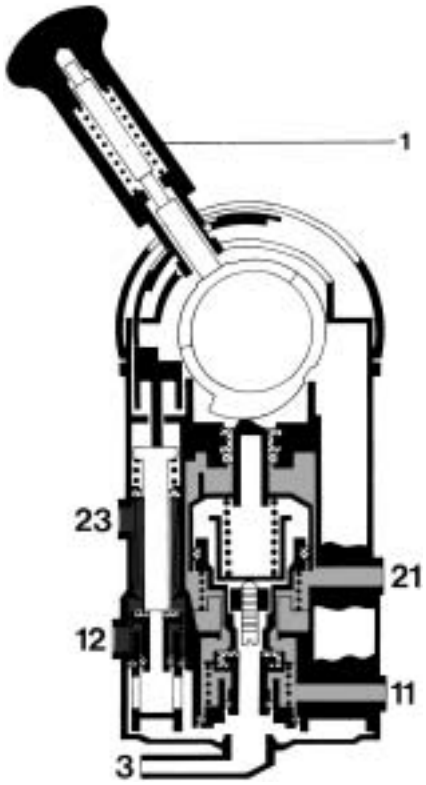
In the parking braking position, the hand lever (1) is engaged in the cam (4) groove (5).

d. Release Position



When the hand lever (1) is raised, the cam (4), which is firmly connected to the cam rod (3), is again pulled out of the cam (5), after the spring force (2) has been overcome. The hand lever (1) returns automatically to the original position – **see driving position**.

e. Function of the release valve



In case of compressed air supply failure in port **(11)** or **(12)**, compressed air supply to the tristop brake actuator is maintained via ports **(12)** and **(23)**. The spring brake actuator cannot respond automatically. This prevents uncontrolled braking.

When the hand lever (1) is actuated, air is quickly evacuated from port **(23)** as described under **"b"**. The effect of the parking braking position is thus maintained.

Maintenance

No maintenance is required beyond the checks required by law.

Testing

Response pressure: max. 2.2 bar
Grading: max. 0.3 bar
Full braking: 0.0 bar

The hand lever must be secured before stopping, in the field of parking braking position.

Testing the emergency release system with pipe rupture safeguard

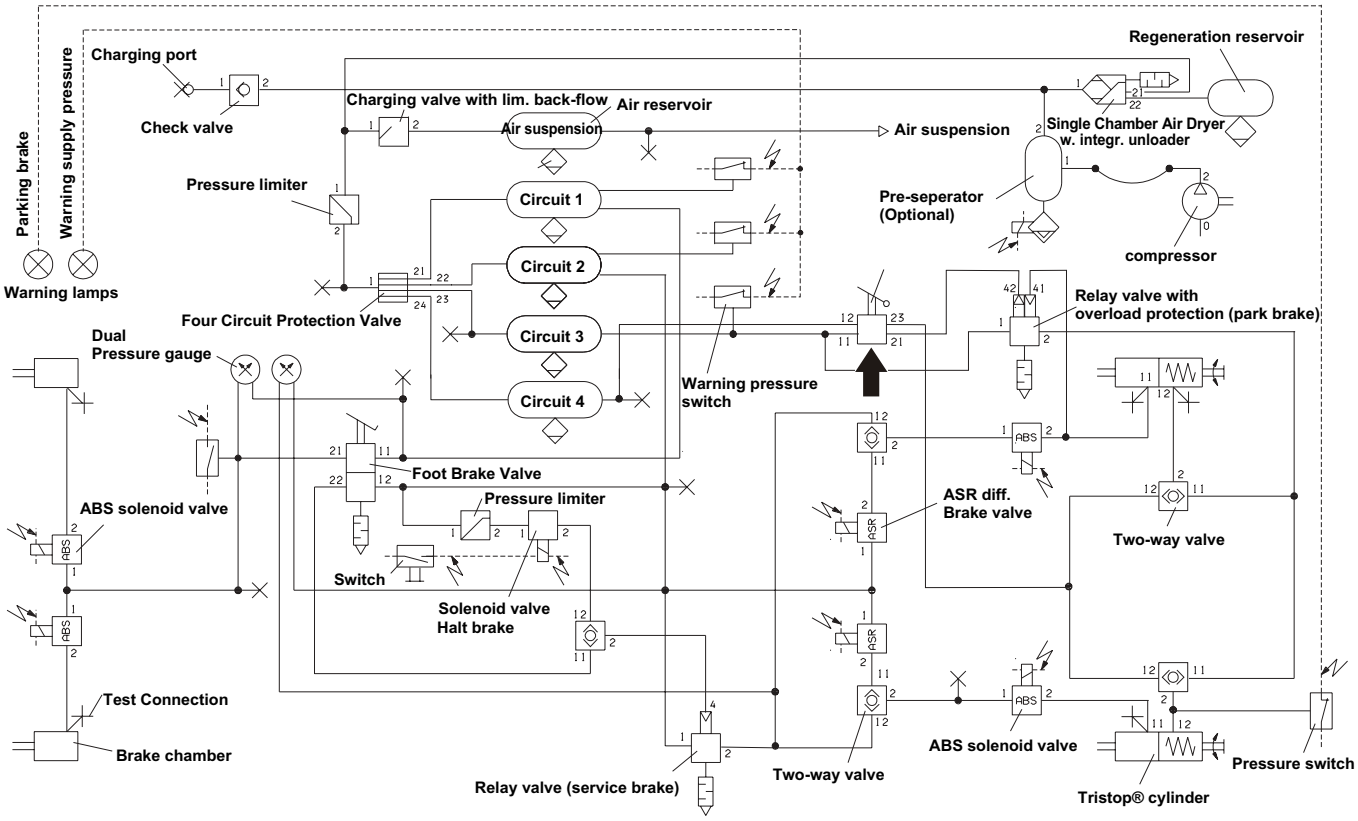
Fill compressed air system until cut-out pressure, and leave the engine in idling state.

Safeguard the vehicle against rolling away and release halt brake and parking brake.

Reduce the air in parking brake (3rd circuit) air reservoir to 0 bar and leave the reservoir open (simulation of pipe rupture).

The pressure in the 4th circuit may first fall down to the closing pressure level (pressure warning light and parking brake warning light go on). The parking brake warning light must go off if required by the brake compressor (i. e. the spring brake actuators are released).

Schematic for Testing and Installation



Purpose

Brake servo units, or brake boosters, are used in combined braking systems within the motor vehicle to increase the pedal force generated by the driver.

Their purpose is to convert a small amount of force applied to the pedal into the greatest possible braking deceleration. Via an air-controlled trailer brake valve, they simultaneously actuate the trailer's braking system.

Design types

421 300

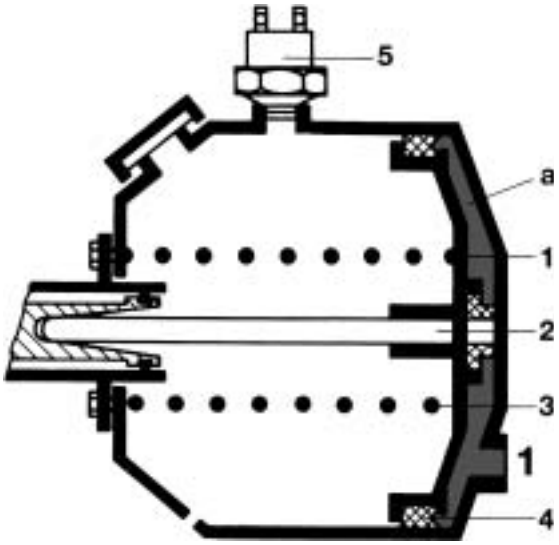
a. Single Chamber Actuator (Air/Hydraulic Actuator) with pneumatic actuation via a brake valve.

470 004

b. Single Chamber Servo Unit with hydraulic actuation via a hydraulic master cylinder.

Operation of Single Chamber Actuator (Piston-Type Air/Hydraulic Actuator) 421 30.

a. Pressurizing Position



When port **(1)** is pressurized with a maximum pressure of 0.5 bar, piston (1) overcomes the frictional resistance of grooved ring (4) and the force of the compression pring (3), pushing the piston (1) with the push rod (2) against the piston of the flanged main brake cylinder. The force acting on piston (1) increases the pressure in the hydraulic brake lines, causing the wheel brake cylinder to respond As the air pressure is increased further, the hydraulic pressure is increased up to full brake application in proportion to the compressed air output by the brake valve.

b. Venting Position

When the pressure at port **(1)** is decreased, piston (1) is pushed back by the force of the compression spring (3) and by the restoring forces of the shoes of the wheel brake.

Please note

Some single chamber actuators are fitted with a warning switch (5) closing the contacts at more than 80 % of the total stroke.

Maintenance

Clean filters every 3 months.

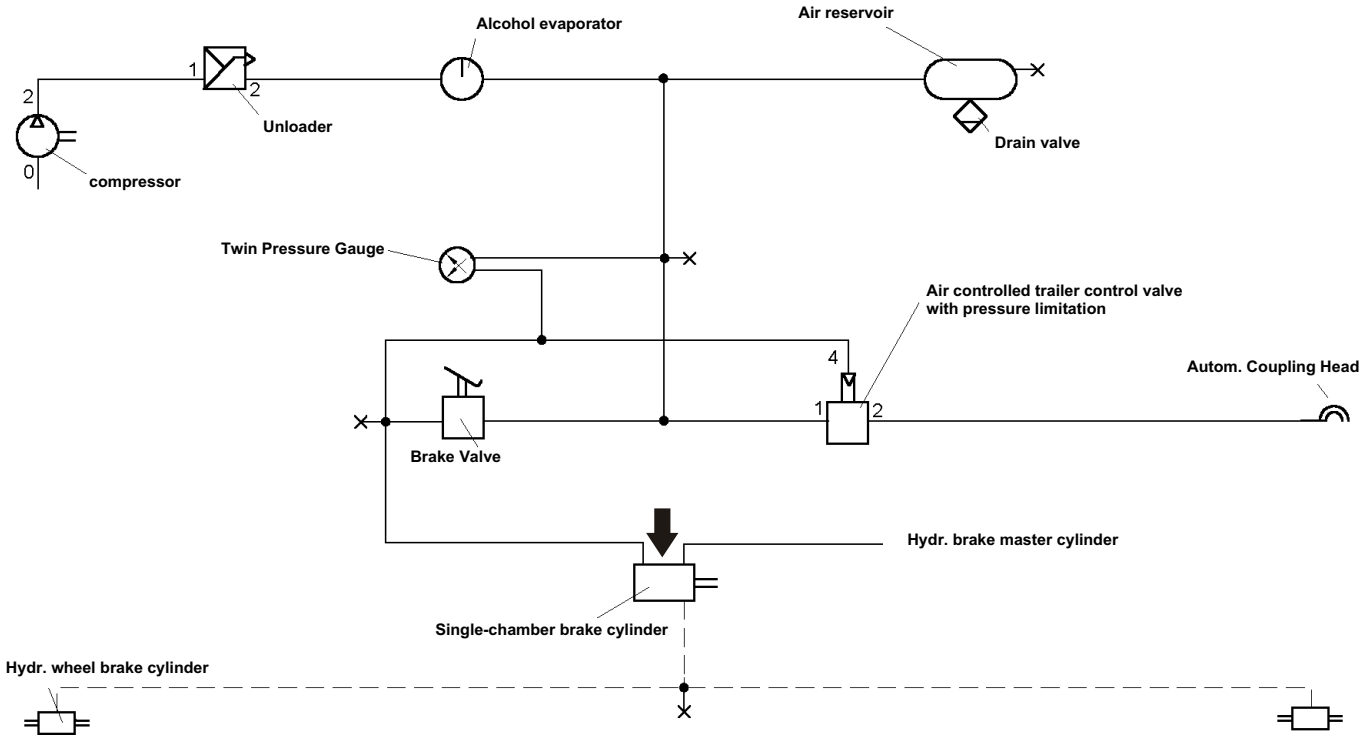
Testing

At a maximum pressure of 0.5 bar in the chamber (a), the hydraulic pressure in the brake lines should rise.

With properly adjusted wheel brakes and full brake application, the piston stroke should be one third of the possible total stroke. If the piston (1) is found to cover half its possible total stroke at full brake application, the braking system should be adjusted. The stroke can be checked after removing a screw plug.

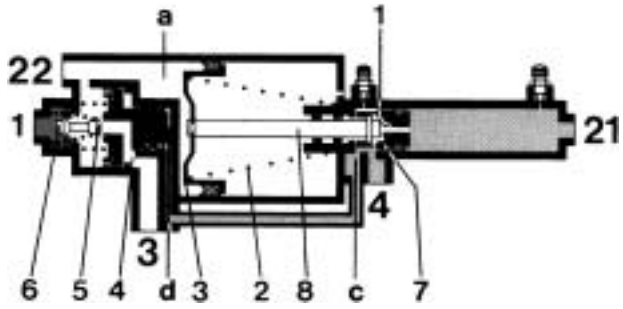
Proper functioning of the warning switch (if any) is checked when venting the hydraulic braking system.

Schematic for Testing and Installation



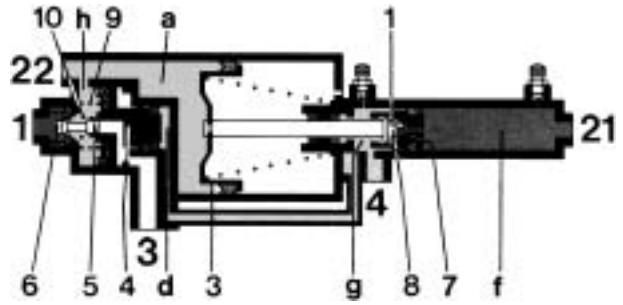
Operation of Brake Servo Unit 470 004

a. Release position



In the release position, the compressed air enters the unit via port **(1)** and reaches the closed inlet valve (6). The restoring forces of the shoes of the wheel brake and the force of the compression spring (2) push the piston **(3)** towards the left against the housing. Chamber (a) is connected with vent (3) via the opened outlet valve (5). The force of compression spring (2) causes piston (3) to return to the stop, raising piston rod (8) off piston (7), connecting ports **(4)** and **(21)** via valve (1). In the connecting line (c) and in chamber (d) the “admission pressure” held by the main brake cylinder prevails.

b. Partial Braking Position



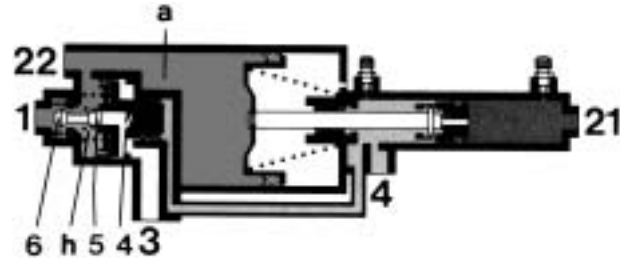
When the brake pedal is depressed, the hydraulic pressure, via port **(4)**, is increased in chambers (g) and (f) and in the wheel brake cylinders.

At a pressure between 3 and 7 bar in chamber (d), the graduating piston (4) moves towards the left. Outlet valve (5) closes, inlet valve (6) opens. Compressed air flows via port (22) to control of the trailer control valve, and to support the force applied by the driver, into chamber (a), acting on piston (3). Piston (3) moves towards the right, closing valve (1) with the piston rod (8) and pushing piston (7) into chamber (f).

This separates the „pilot line“ from the „control lines“ and the hydraulic pressure in the „control lines“ is increased to a greater or lesser extent as a function of the force applied to the pedal of the main brake cylinder and the resulting pressure support.

The increase in volume in chamber (g) allows the compressed air in chamber (h) and compression spring (9) to move the graduating piston to the right until a balance of forces has been achieved. The compression spring (10) pushes the double conical valve back and forth and closes the inlet valve (6). The outlet valve (5) remains closed.

c. Full Braking Position



The pressure in chambers (a) and (h) and the hydraulic pressure at port **(21)** can be sensitively graded as it is increased as a ratio of the pedal force, until the full braking position has been reached.

At full brake application, the reservoir pressure entering chamber (h) is no longer able to move the graduating piston (4) to the right once more. Thus the inlet valve (6) remains open. The outlet valve (5) remains closed.

Maintenance

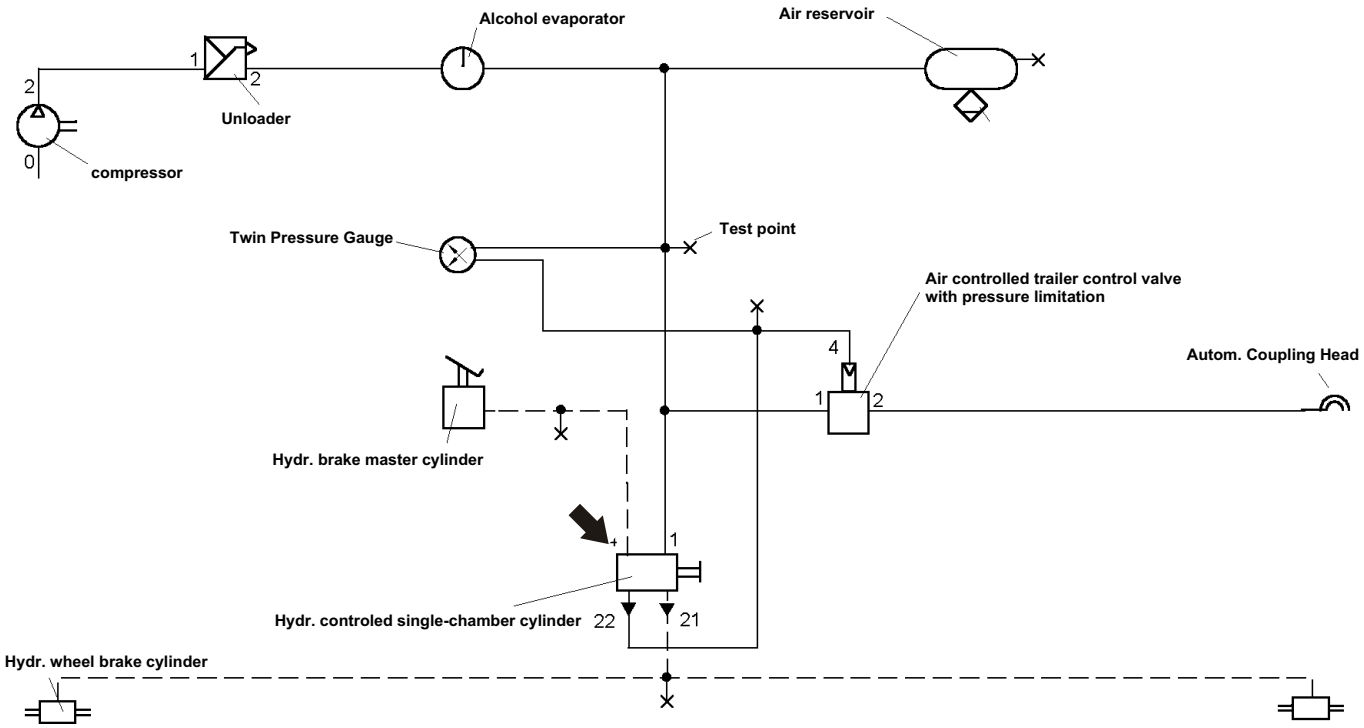
No maintenance is required beyond the checks required by law.

Testing

At a hydraulic pressure of between 3 and 7 bar at port **(4)**, an initial rise in pressure must be measurable at port **(22)**. At port **(21)** the ensuing increase in hydraulic pressure should not exceed 2 bar.

The pressure at port **(21)** must be gradable at least from 3 to 4 bar.

Schematic for Testing and Installation



Technical data

	Control line Required hydraulic pilot pressure in bar at a reservoire pressure of		Control Line Possible hydraulic control pressure in bar at a reservoir pressure of	
Ordering number	4.5 bar	4.5 bar	4.5 bar	6.0 bar
470 004 010 0 **470 004 105 0**	38 38	49 49	84 93	113 126