Purpose

Their purpose is the sensitively gradable control of the trailer - with and without advance. They are actuated via two circuits of the service braking system and one circuit of the emergency and parking braking system.

At articulated buses trailer control valves (without 2/2-way valve) are often used for dual circuit control of the service braking system for axle 3.

Design types

973 002

a. **Trailer Control Valve** with 2/2-way valve for lorries.

973 002

a. **Trailer Control Valve** with 2/2-way valve for semitrailer-tractors. This valve has for some time also been used in lorries.

973 009

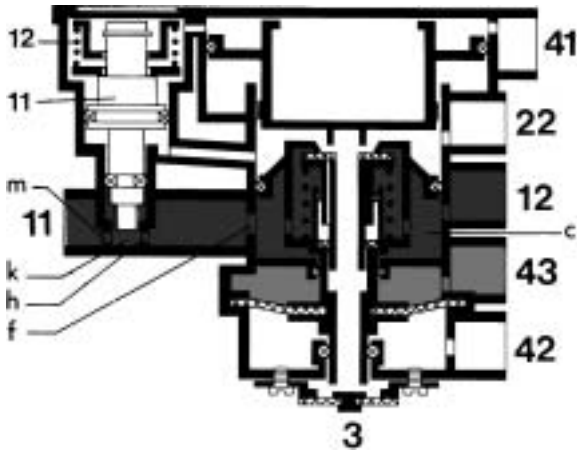
c. **Trailer Control Valve** with integrated 2/2-way valve. This type can be used both in lorries and semitrailer-tractors.

973008

d. **Trailer Control Valve** with integrated 2/2-way valve and proportional pressure reduction. This type is used in lorries and semitrailer-tractors whose service braking system operates at 10 bar.

Operation of Trailer Control Valve 973 002 (Semitrailer-Tractor Type)

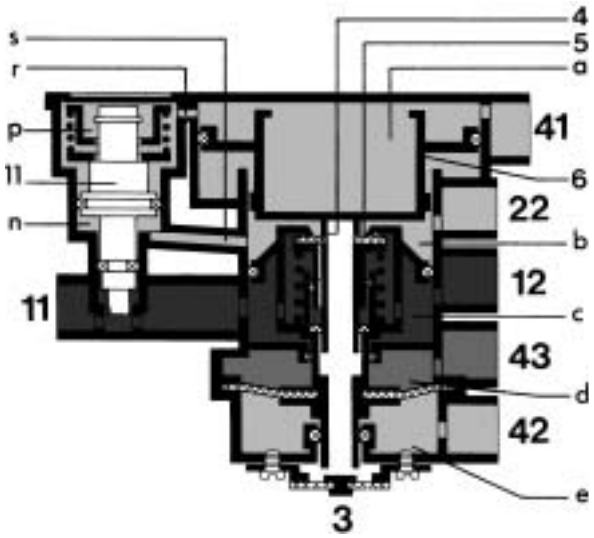
1. Filling and Driving Position



When pressureless, the piston valve (11) is held in its lower central position by the force of the spring (12). When the air reservoirs are being filled, compressed air flows to port (11) of the 2/2-way valve. This causes pressure to build up in chamber (k) which raises the piston valve (11) against the force of the spring (12), releasing in full the cross-sections of holes (m) and (h). The supply pressure can now flow into chamber (c) via hole (f) and from there via port (12) to the **"supply"** house coupling.

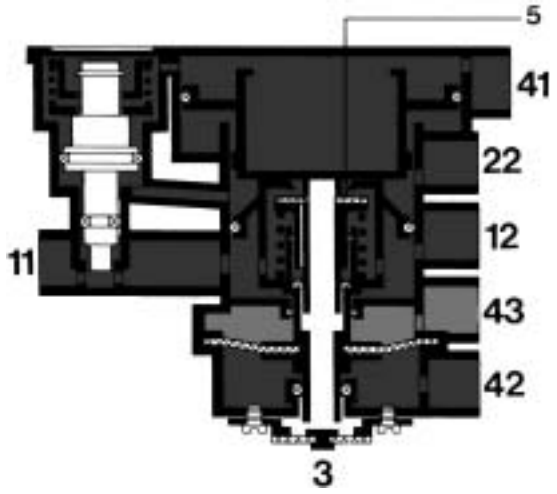
2. Actuating the Service Braking System (SBS)

a. Partial Braking Position



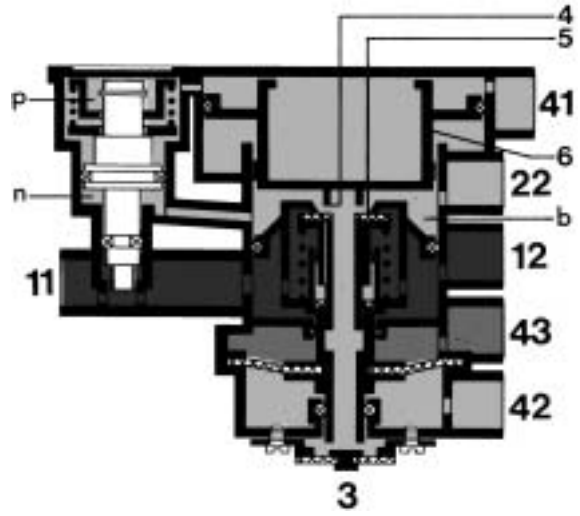
When the dual-circuit service braking system is actuated, ports (**41** = 1st circuit) and (**42** = 2nd circuit) are pressurized. Whilst the pressure in chamber (e) cannot have any dynamic effect because of the back pressure in chamber (d), the compressed air flowing into chamber (a) can force the relay piston valve (6) downwards, closing the outlet valve (4) and opening the inlet valve (5). The supply pressure in chamber (c) can now flow via the opened inlet valve (5) into chamber (b) below piston valve (6). At the same time, compressed air flows via hole (r) into chamber (p) of the 2/2-way valve. A final braking position has been reached when the pressures in chambers (a) and (b) have reached a dynamic balance. This is when the piston valve (6) moves up once more until the inlet valve (5) has closed. The pressure in chamber (b) now flows via port **(22)** into the trailer's control line and via duct (s) into chamber (n) beneath piston valve (11). The 2/2-way valve remains ineffective.

b. Full Braking Position



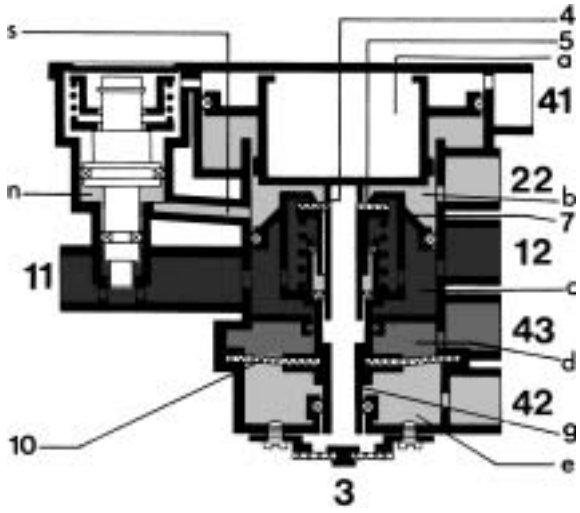
When the brake valve is actuated further, the sensitively gradable process described under **"2a"** is repeated until the reservoir pressure at port **(12)** has reached the trailer's control line in full via the opened inlet valve (5).

c. Release Position



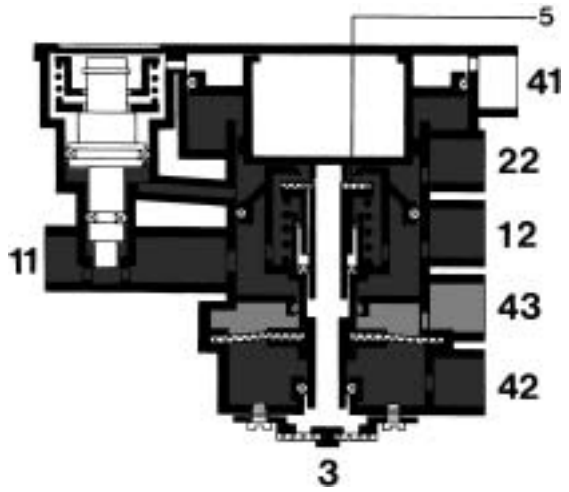
In the release position, the compressed air at ports **(41)** and **(42)** escapes to atmosphere at the brake valve. This allows the pressure prevailing in chamber (b) to raise piston (6) until it reaches the upper housing stop, closing the inlet valve (5) and opening the outlet valve (4). The compressed air in the trailer's control line and in chamber (b) can now escape to atmosphere via vent **(3)**. As the trailer's control line is vented, chambers (n) and (p) of the 2/2-way valve once again become pressureless.

a_1. Partial Braking Position After Failure of the 1st Circuit



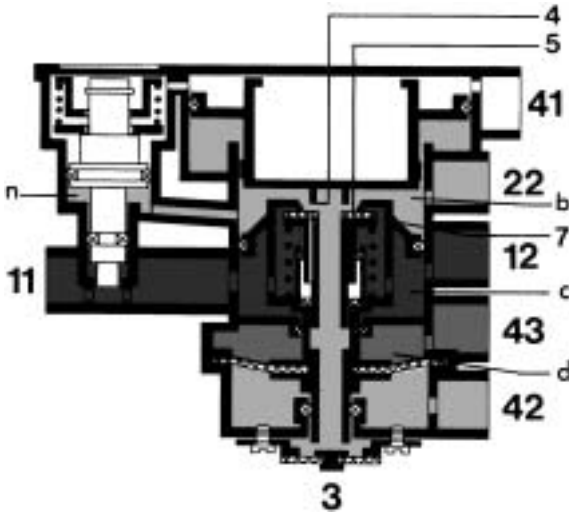
When the pressure at port **(42)** rises to between 0.9 and 1.2 bar, the 2nd circuit takes over the task of controlling the trailer control valve. This is achieved by the fact that the force which has built up in chamber (e), together with the reservoir pressure in chamber (c) acting on the underside of piston (7), is now great enough to overcome the pressure in chamber (d) above diaphragm (10). This causes the piston (7) which is firmly attached to the piston rod (9) and the diaphragm (10), to be raised to the point where the outlet valve (4) closes and the inlet valve (5) opens. The supply pressure in chamber (c) now flows via the opened inlet valve (5) into chamber (b), applying pressure to the effective area of the piston (7) from the top. A final braking position is reached by the forces acting in chambers (b) and (d) are opposite those in chambers (c) and (e). When a balance of forces has been reached, piston (7) is pushed downwards to the point where the inlet valve (5) is closed once again. The pressure in chamber (b) is transmitted to the trailer's control line via port **(22)**. At the same time, the pressure in chamber (n) beneath the piston valve (11) rises via duct (s). The 2/2-way valve remains ineffective.

b_1. Full Braking Position After Failure of the 1st Circuit



A further increase in pressure in port **(42)** causes the trailer control valve to reverse as described under **"a_1"**. After full application of the brakes, the full reservoir pressure in port **(12)** is output via the opened inlet valve (5) at port **(22)**.

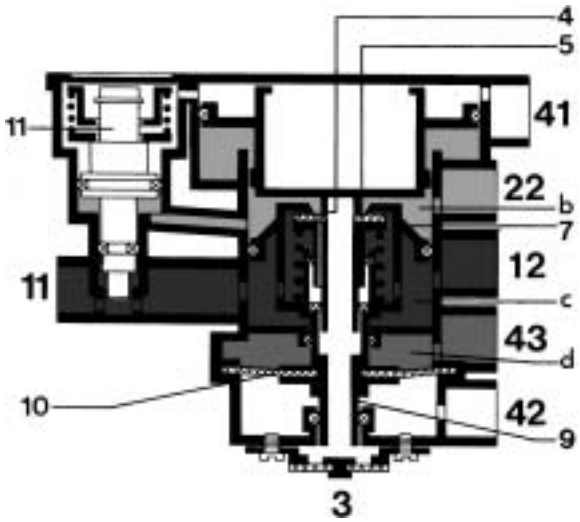
c_1. Release Position After of the 1st Circuit



After a decrease in pressure in port **(42)** the forces in chambers (d) and (b) exceed the reservoir pressure in chamber (c). This allows the piston (7) to reach its lower final position, closing the inlet valve (5) and opening the outlet valve (4). The compressed air in the trailer's control line and in chamber (b) and (n) can now excape to atmosphere via vent **(3)**.

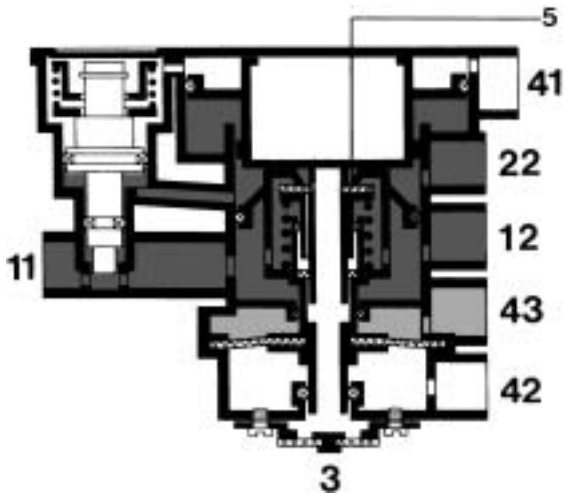
3. Actuation of the Emergency and Parking Braking System

a. Partial Braking Position



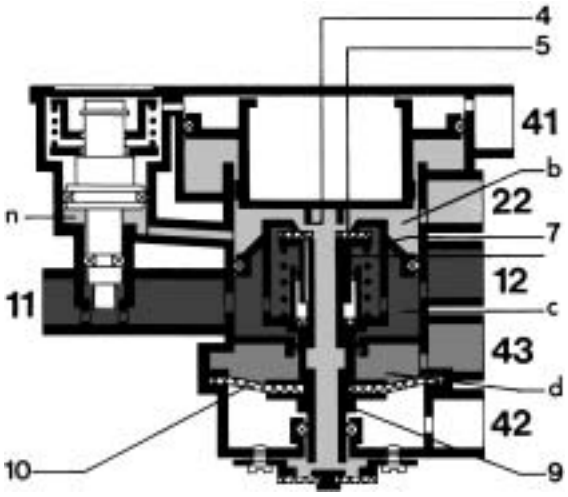
When the hand brake valve is actuated, the air pressure is partially reduced in chamber (d) of port **(43)**. The reservoir pressure in chamber (c) can thus raise the piston (7) together with the piston rod (9) and the diaphragm (10). The outlet valve (4) closes and the inlet valve (5) opens, allowing air to flow from chamber (c) and via port **(22)** into the trailer's control line The pressure building up in chamber (b) above the piston (7), together with the residual pressure in chamber (d), forces the piston (7) downwards again against the reservoir pressure acting in chamber (c) until a balance of forces has been reached. The inlet valve (5) closes, and a final braking position in the trailer control valve has been reached. The piston valve (11) of the 2/2-way valve is not actuated during this process, as described under **"a_1"** above.

b. Full Braking Position



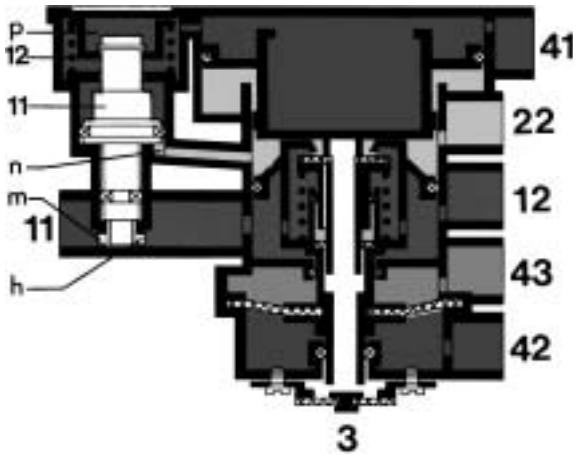
When the air pressure in port **(43)** is reduced further, the valve reverses as described under **"3a"**. When port **(43)** is completely pressureless, the reservoir pressure in port **(12)**, via the opened inlet valve (5), reaches the trailer's control line at a pressure which is lower by up to 1.0 bar.

c. Release Position



When the hand brake valve has been released, the compressed air again builds up, via port (43), in chamber (d). This causes the diaphragm (10) to pull the piston (7) with the piston rod (9) downwards against the pressure in chamber (c), and the double-action valve (8) closes the inlet (5) and opens the outlet (4). The pressure at port **(22)** and in chambers (b) and (n) escapes to atmosphere through vent **(3)**.

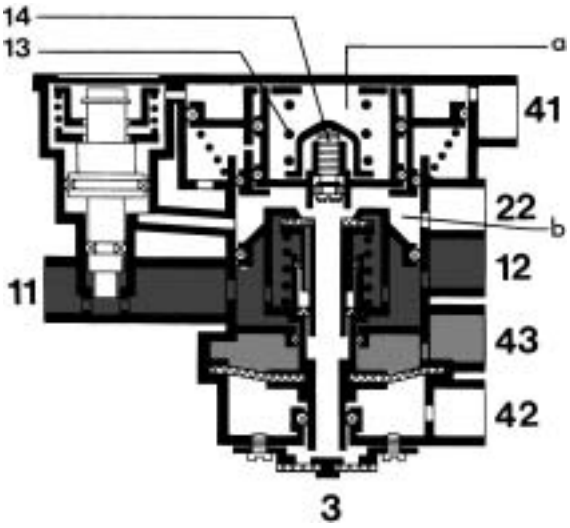
4. Operation of the 2/2-Way Valve After Rupture of the Trailer's Control Line



If the trailer control valve is actuated in a situation of this kind, it reverses as described under **"2a"** and **"2b"** above. Since the trailer control line now allows the pressure output at port **(22)** to escape, no pressure can build up in chamber (n) beneath the piston valve **(11)**. As a consequence, the pressure in chamber (p) can force the piston valve (11) downwards against the force of the spring (12), thus throttling through-holes (h) and (m). This throttling effect causes the pressure in the **"trailer supply line"** to fall more rapidly than more compressed air being delivered from port (11).

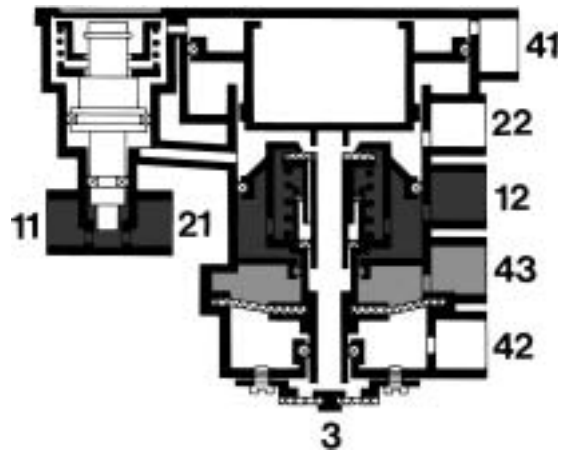
This process causes immediate automatic braking of the trailer. When the brakes have been released, the 2/2-way valve will reverse once again as described under **"1"**.

5. Trailer Control Valve with Adjustable Predominance



To comply with the EC compatibility diagrams, many vehicles have today trailer control valves with adjustable advance fitted. The advance is achieved by the pressure input at port (41) during the braking process compounding its forces with the leading spring (13). In order to get to a final braking position, the trailer control line pressure in chamber (b) needs to overcome the compounding forces resulting from the force of the leading spring (13) and the pressure in chamber (a). The amount of lead, or advance, depends on the setting of the leading spring (13) which can be adjusted by means of the screw (14).

6. Trailer Control Valve for Lorries



This trailer control valve, including the 2/2-way valve, operates identically to the one for semitrailer-tractors, the only difference being that the 2/2-way valve also has ports (11) and (21). The trailer control valve thus receives no supply pressure from the 2/2-way valve but from the **"supply"** hose coupling. (see installation schematic)

Maintenance

No maintenance is required beyond the checks required by law.

Testing

Response level **(41)**:	max. 0.4 bar
Response level **(42)**:	0.9 to 1.2 bar
Response level **(43)**:	1.1 to 1.4 bar (pressure reduction)
Grading:	max. 0.3 bar
Full braking:	full reservoir pressure

When the emergency and parking braking system is actuated, the output pressure in the full braking position at port **(22)** is lower by a maximum of 1.0 bar than the reservoir pressure at ports **(11)** or **(12)**.

Breakaway Test of the Brake Line

Functional testing of the 2/2-way valve after installing has to be done the following way:

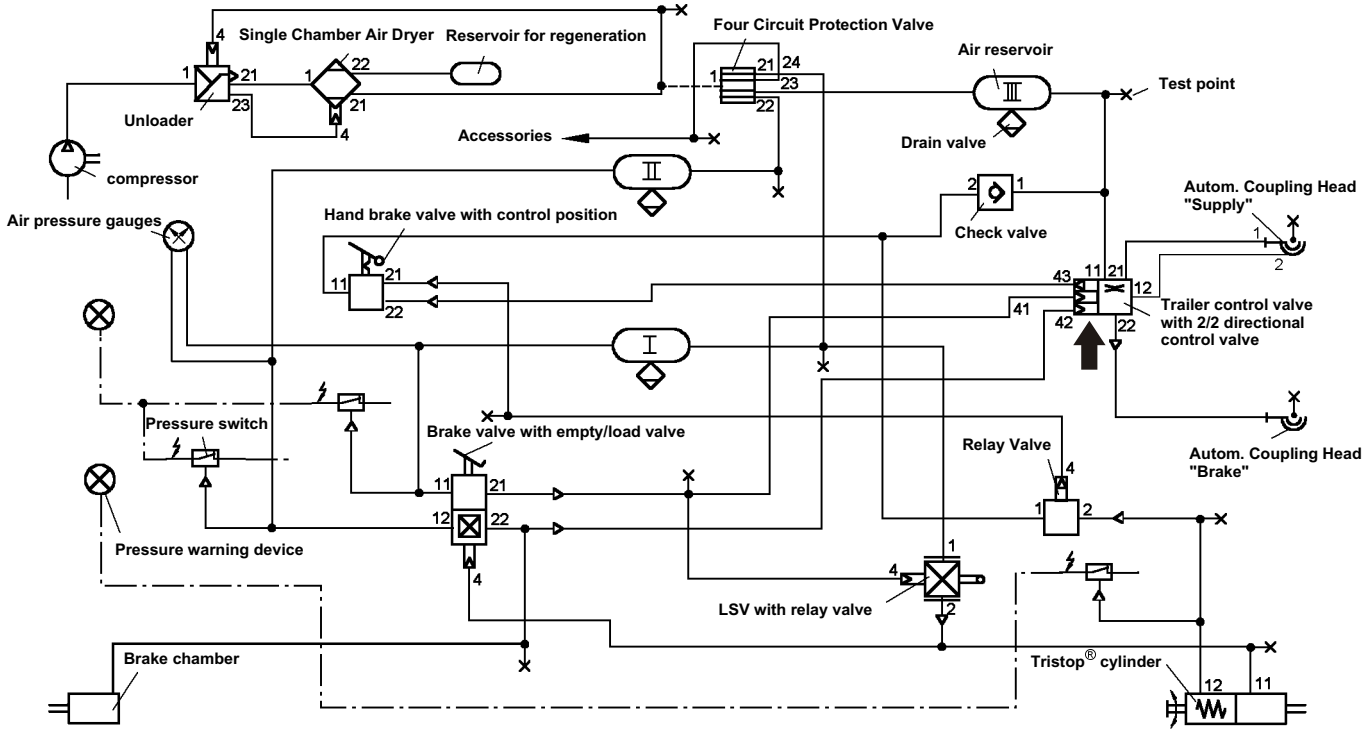
Simulate rupture of the line at the “control” hose coupling (e.g. by using an open test coupling head). When the service braking system is fully actuated, the pressure must initially be expelled suddenly and then more gradually via the opened trailer control line. As a result the pressure at the coupling head of the supply line quickly falls under 1.5 bar.

Testing the adjusted predominance

Trailer control valves with adjustable predominance are adjusted according to the vehicle manufacturer’s instructions. The maximum adjustable predominance is 1.0 bar.

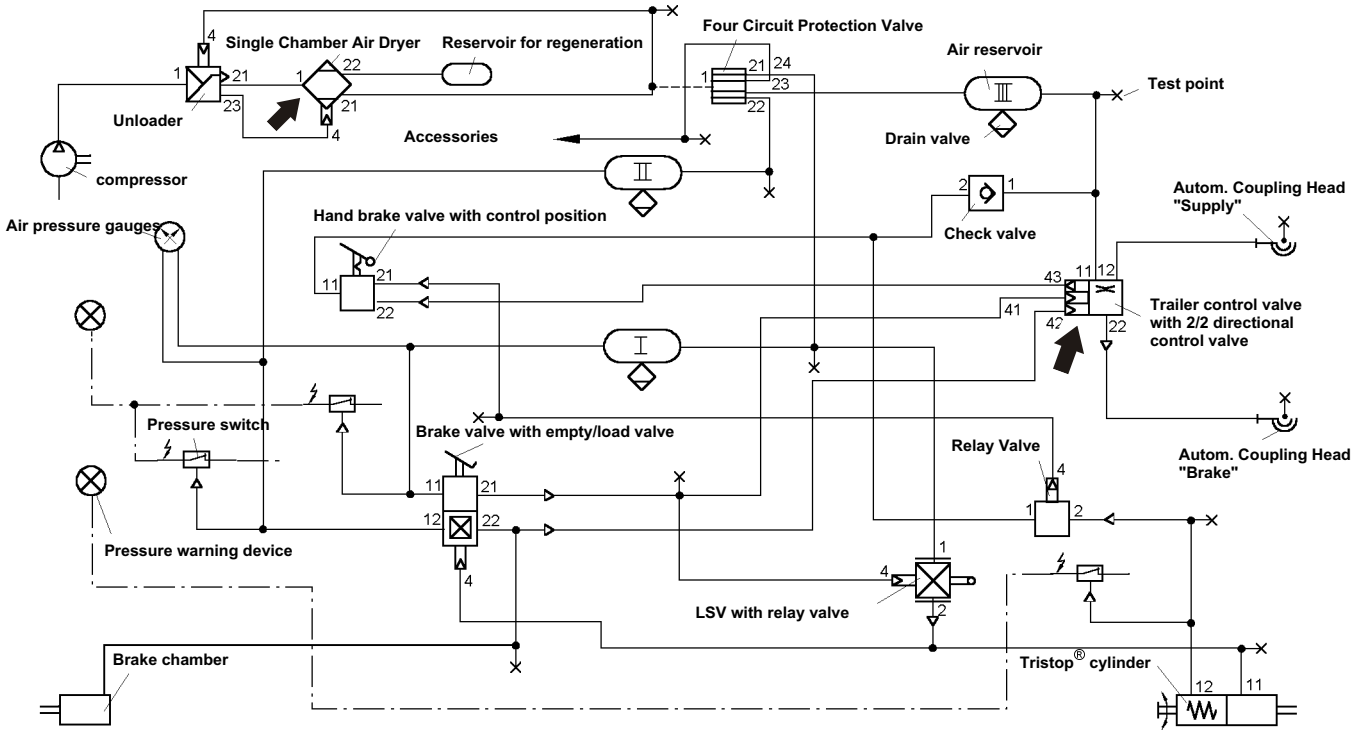
Schematic for Testing and Installation

Lorry Type (today just rarely)



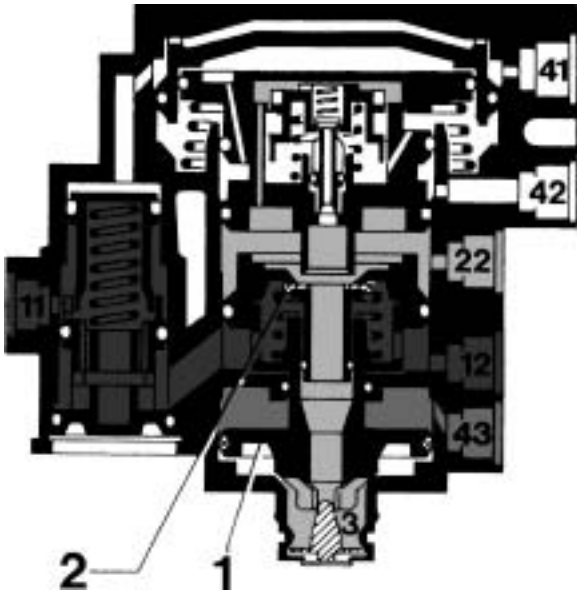
Schematic for Testing and Installation

Semitrailer-Tractor Type (today also in lorries)



Operation of Trailer Control Valve 973 009

a. Driving Position

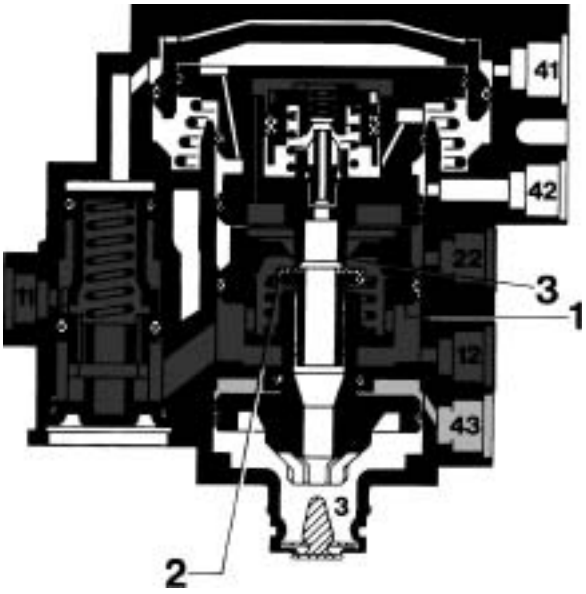


Supply pressure from circuit 3 is always present at port 11, flowing via port **12** to the “supply” hose coupling.

At port **43** the pilot pressure of the emergency and parking braking system acts to hold the piston (1) in its lower final position.

The “control” hose coupling is vented via port **(22)**, outlet valve (2) and vent **(3)**.

b. Actuation of the Parking Brake

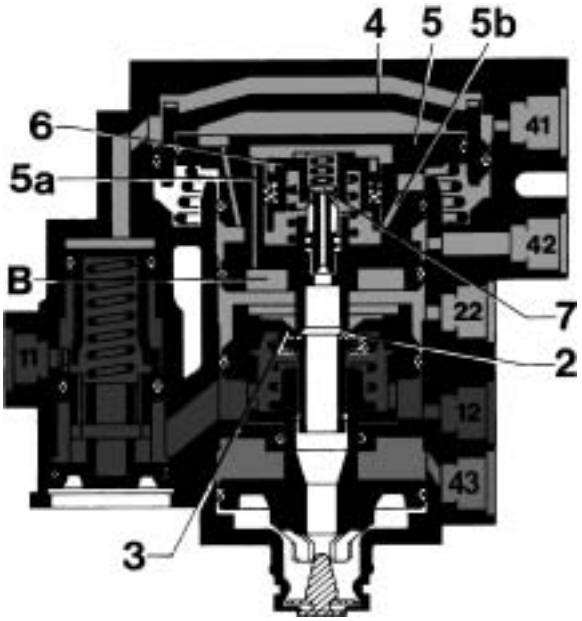


As the parking brake is actuated, the spring brake part of the Tristop-cylinders cause port **(43)** to become pressureless. The supply pressure from port **(11)** forces the piston (1) upwards. This causes the outlet valve (2) to be closed and the inlet valve (3) to be opened. The air supply now flows via the inlet valve (3) and port (22) to the “control” hose coupling.

In partial brake application, the piston (1) is moved to its final position by the output pressure.

When the brake is released, port **(43)** is pressurized, forcing the piston (1) into its lower final position and opening the outlet valve (2). The air from the control line escapes via the outlet valve (2) and vent **(3)**.

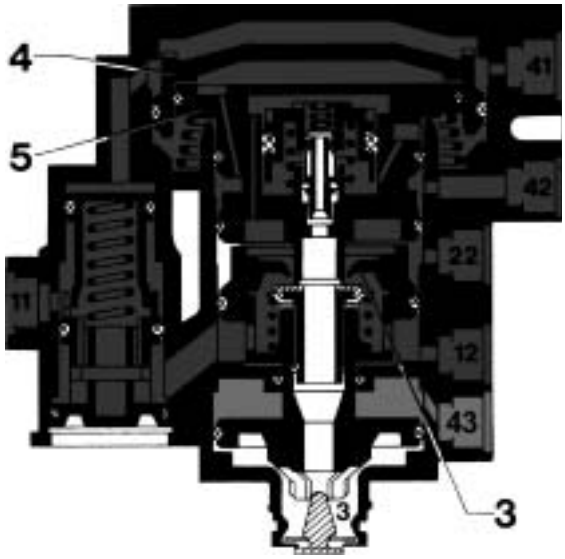
c. Partial Brake Application



Via ports **(41)** and **(42)** the brake pressure reaches the upper side of pistons (4 and 5), forcing them downwards, closing the outlet valve (2) and opening the inlet valve (3). The compressed air now flows from port **(11)** to port **(22)** and into the control line, causing braking of the trailer.

Through the hole (5a) in piston (5), the compressed air reaches the upper side of piston (6), pushing it downwards, thereby opening inlet (7). Through hole (5b), the compressed air flows in the annular duct below pistons (4 and 5), increasing the pressure until a balanced pressure is reached. Pistons (4 and 5) move upwards, closing the inlet valve (3). A final braking position has been reached.

d. Full Braking Position



When the brakes are fully applied, the input brake pressure at ports **(41)** and **(42)** is similar to the pressure at port **(11)**. Pistons (4 and 5) move upwards, the inlet valve (3) remains open. No final braking position is reached.

Testing

Response level **(41)**:	max. 0.4 bar
Response level **(42)**:	max. 0.6 bar*
Response level **(43)**:	1.1 to 1.4 bar (pressure reduction)
Grading:	max. 0.3 bar
Grading:	1.0 bar max.
Full braking:	full reservoir pressure

* if circuit **"41"** fails

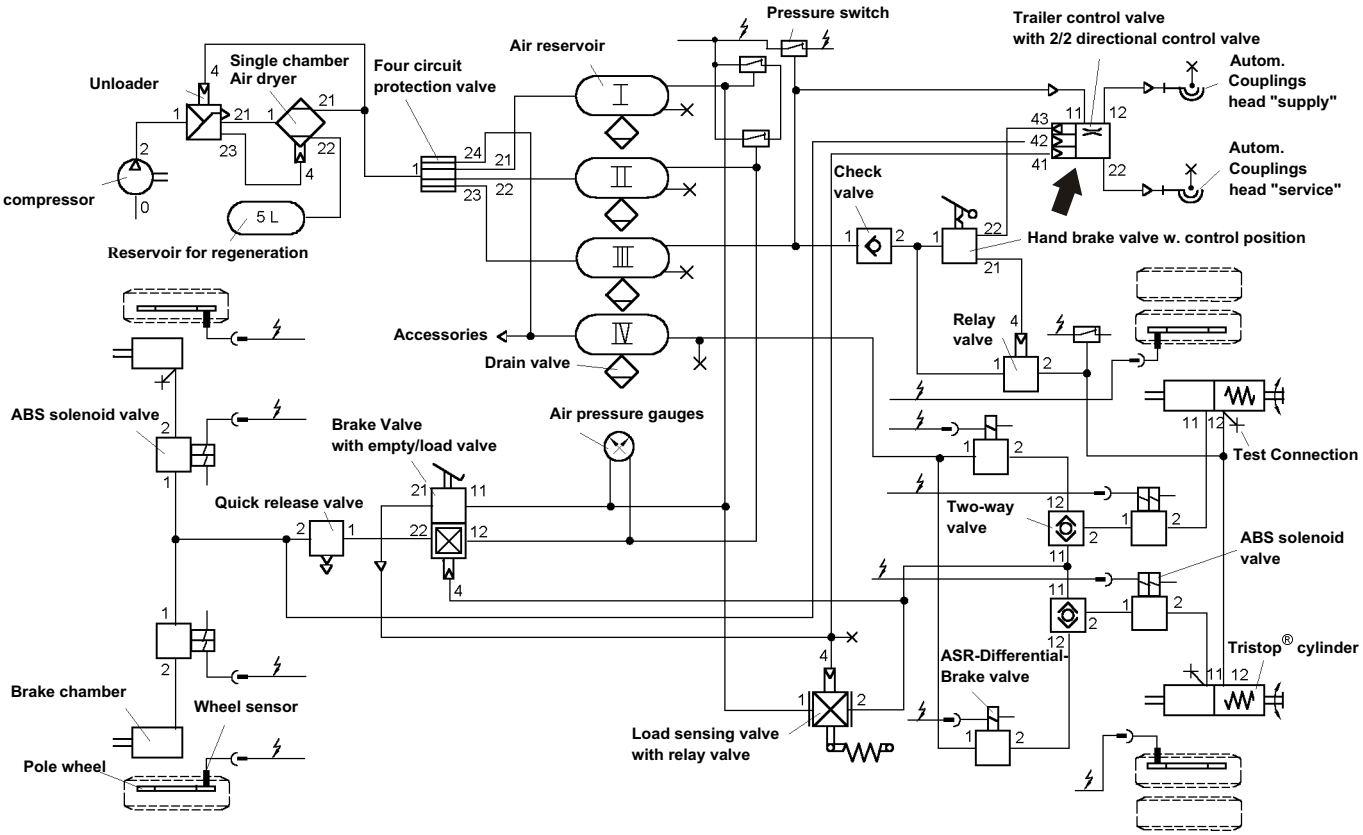
When the emergency and parking braking system is actuated, the output pressure in the full braking position at port **(22)** is lower by a maximum of 1.3 bar than the reservoir pressure at ports **(11)** or **(12)**.

Functional testing of the 2/2-way valve requires neither times nor pressures to be checked. When installed, the pressure must initially be expelled suddenly and then more gradually via the opened trailer control line when the service braking system is actuated.

Maintenance

No maintenance is required beyond the checks required by law.

Schematic for Testing and Installation



Hose Couplings with Cross-Coupling Safeguard

Purpose

Hose couplings are required on the supply and control lines between the towing vehicle and its trailer.

Their purpose is to connect two lines with a built-in safeguard against cross-coupling.

Design types

952 200 021 0

a. Hose Coupling for the supply line with a red cover.

952 200 210 0

a_1. Automatic Hose Coupling for the supply line with two connections and a red cover.

952 200 221 0

a_2. Automatic Hose Coupling for the supply line with one connection and a red cover.

952 200 022 0

b. Hose Coupling for the control line with a yellow cover.

952 200 222 0

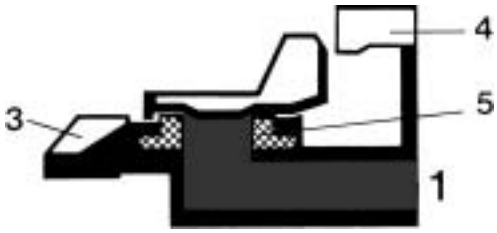
b_1. Automatic Hose Coupling for the control line with one connection and a yellow cover.

Please note

Hose couplings of the older **452 200 series** can be connected to hose couplings of the **952 200 series** without any problem.

Operation of Hose Couplings

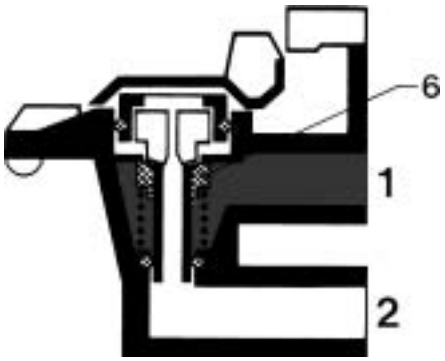
1. Hose Couplings Types “a” or “b”



When connected, the head on the coupling hose is twisted onto the firmly attached hose coupling until the claws (3) of both couplings are in contact with the locking plate (4) and lock into place.

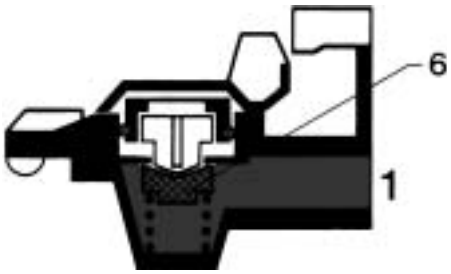
This causes the packing rings (5) to be compressed, achieving the necessary seal. The supply or control pressure can thus flow from the motor vehicle to its trailer.

2. Hose Couplings Type „a_1”



This is connected as described under **“1”** above. During this process, the valve (6) of the **“a_1”** hose coupling is opened by the **“a”** hose coupling. The reservoir pressure at port **(1)** thus flows through the supply line and simultaneously, via port **(2)**, to the trailer control valve.

3. Hose Couplings Type „a_2” and „b_1”



As described under **“1”** above, the only difference being that when the trailer is connected, the valve (6) is opened first by the **“a”** or **“b”** hose coupling. If type **“a_2”** is used, the trailer control valve receives no compressed air from the hose coupling.

Please note

If automatic hose couplings are used, the shut-off cock normally required is dispensible. Whenever the trailer parts from its towing vehicle, the lines will always rupture. The hose couplings do not become disconnected.

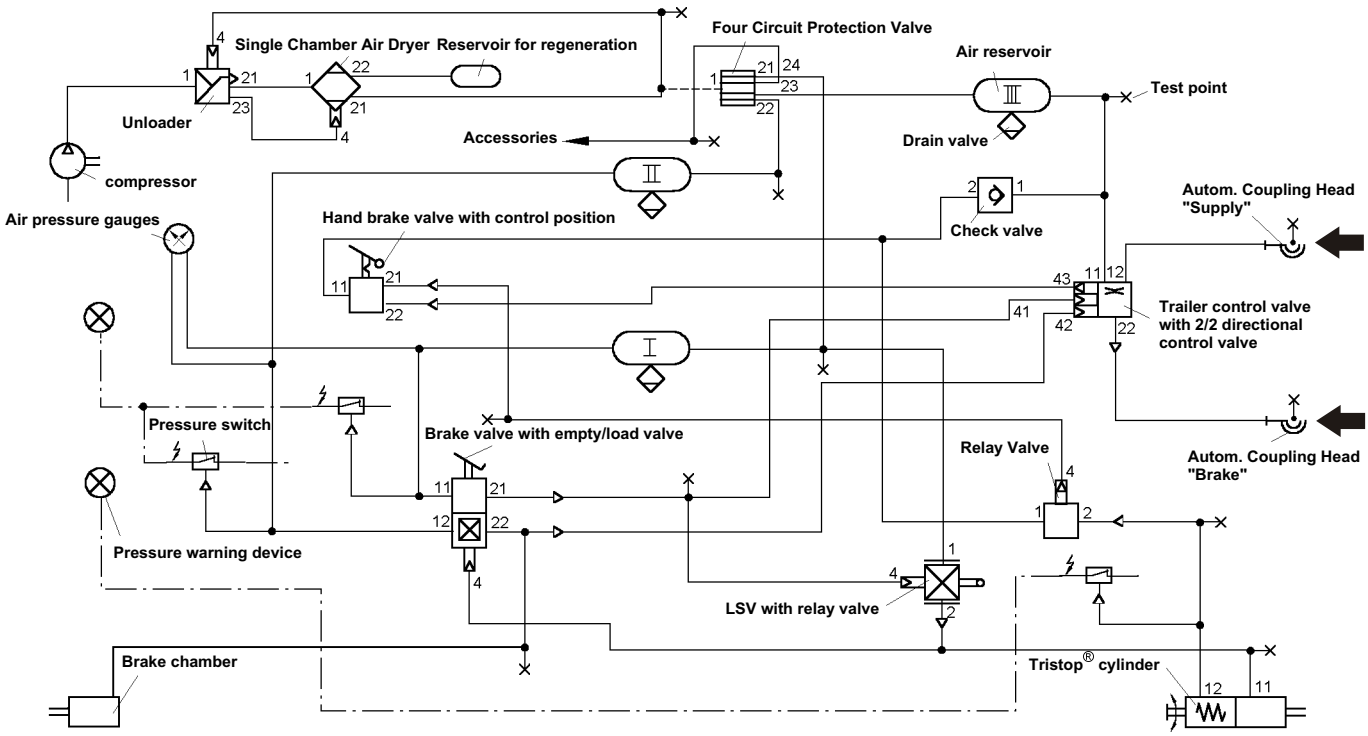
Maintenance

No maintenance is required beyond the checks required by law.

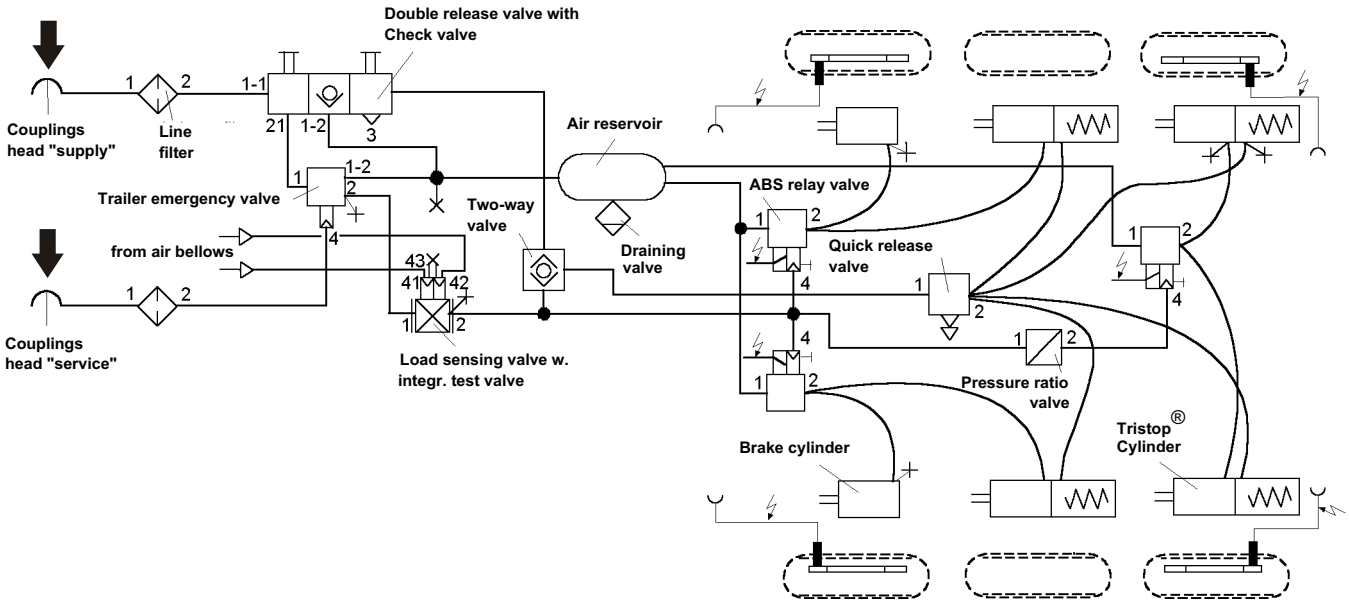
Testing

For leakages only.

Schematic for Installation Motor vehicle



Schematic for Installation Trailer



Adapter valves are supplied with different factory settings.

Purpose

Duo-Matic Quick Couplings connect the Compressed Air Brake System (supply and control lines) of the lory or the semitrailer tractor with the Braking System of the trailer or with the Braking System of the semitrailer with only one coupling process.

Design types

For conventional tractor-trailer combination and semitrailer trains different design types are used.

a. for conventional tractor-trailers

452 802 009 0

Vehicle parts with integrated closing valve. The installation is made on the tail of the truck.

452 804 012 0

Trailer parts without closing valves. The installation is made on the hoses of the supply and control line of the (towbar) trailer.

b. for semitrailer trains

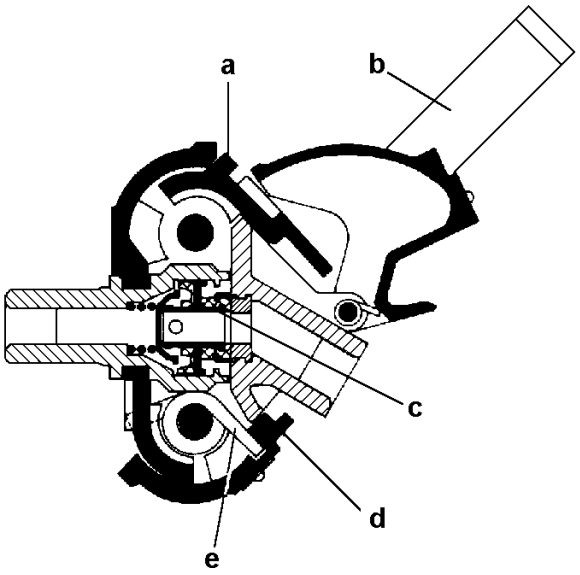
452 805 004 0

Vehicle parts with integrated closing valve. The installation is made on the Susie-lines of the semitrailer-tractor.

452 803 005 0

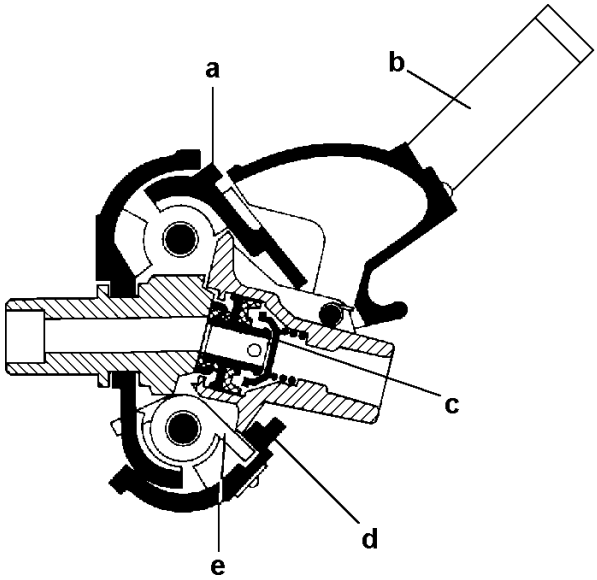
Trailer parts without closing valves. The installation is made on the front of the trailer.

Operation for conventional tractor-trailer combination



During the connection of the trailer the handle (b) is pushed down in which case the protective covers (a and d) will open. The Duo-Matic-Trailer part has to be laid underneath the protective covers and the handle (b) is released The torsion spring (e) acts on the protective covers (a and d) and pulls the trailer parts against the automatically closing valves (c), in which case those will open and the compressed air flows into the trailer.

Operation for conventional tractor-trailer combination



During the connection of the trailer the handle (b) is pushed down in which case the protective covers (a and d) will open. The Duo-Matic-Trailer part has to be laid underneath the protective covers and the handle (b) is released The torsion spring (e) acts on the protective covers (a and d) and pushes the vehicle parts agianst the surface. The automatic closing valves (c) open and the compressed air flows into the trailer.

Maintenance

No maintenance is required beyond the checks required by law.

Testing

For leakages only.