Purpose

Quadruple-circuit protection valves are used with circuits **(1)** and **(2)** for dual-circuit braking systems, and with circuits **(3)** and **(4)** for ancillary consumers.

They are used to supply the independent circuits with compressed air. In the event of any circuit failing, that circuit is switched off automatically, the others continuing to be supplied with compressed air up to the opening pressure in the defective circuit.

Design types

934 702

a. **Quadruple-Circuit Protection Valve** with limited return flow in serial or parallel arrangement, with or without a bypass.

934 702

b. **Quadruple-Circuit Protection Valve** with limited return flow in serial or parallel arrangement, with or without a bypass. This valve is supplied with five or seven ports. The devices with seven connections were often used in light drawbars without air dryer.

934 705

c. **Four-circuit protection valve** in series connection with one or two integrated pressure limiting units and check valves for circuits **(3)** and **(4)**, as well as electronic pressure sensors for circuits **(1)** and **(2)**. This device is connected directly via a screw flange with air dryer 932 400 to the compact Air Processing Unit (APU). To comply with regulation 98/12/EG (see remark on the next page), some variants are equipped with a “bleed-back function”.

934 714

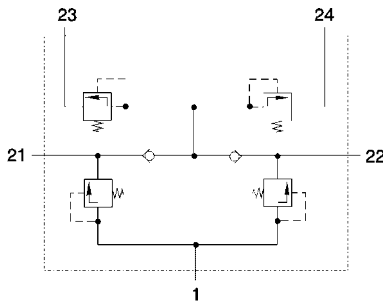
d. **Four-circuit protection valve in series connection**
To comply with regulation 98/12/EG, some variants are equipped with a “bleed-back function”.

Definitions

Opening Pressure:
This is the pressure required to open the individual circuits.

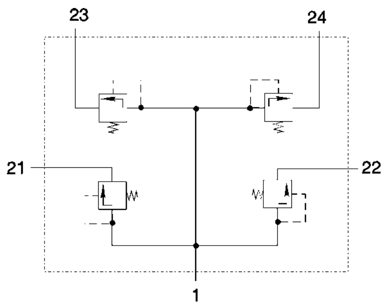
Closing Pressure:
Closing pressure (stabilizing pressure) is the term used for the pressure causing a failed circuit to be switched off automatically (see “Testing”). Limited Return Flow: This allows the pressure of any combined circuits to be balanced up to the closing pressure.

Picture 1



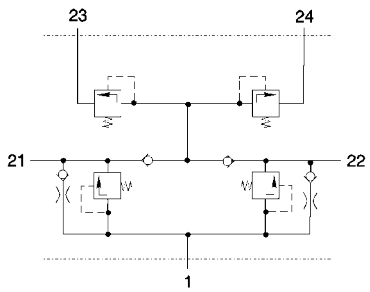
Series Arrangement (picture 1)
This means that the ancillary consumers (circuits 3 and 4) follow the primary consumers (circuits 1 and 2). No return flow is possible from the ancillary consumers to the primary consumers.

Picture 2



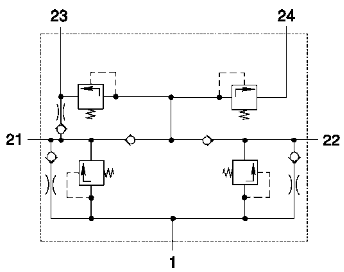
Parallel Arrangement (picture 2)
In a parallel arrangement, all circuits are connected with each other. This means that a limited return flow from the ancillary consumers to the primary consumers is possible.

Picture 3



Bypasses (picture 3)
Even if a circuit has failed and the whole of the system is pressureless, a bypass allows those circuits which have not failed to be filled even if the compressor is working at a slow speed. They are often used in circuit 1 and 2. At valve variants in parallel arrangement bypasses in circuit 3 and 4 can also be used.

Picture 4



Bleed-Back-Function (picture 4)
The FBA-circuit 3 is connected to air circuit 1 via a throttled check valve. If the BBA-circuit 1 fails, circuit 3 is vented too, to fullfill the requirements according to 98/12/EC (see below).

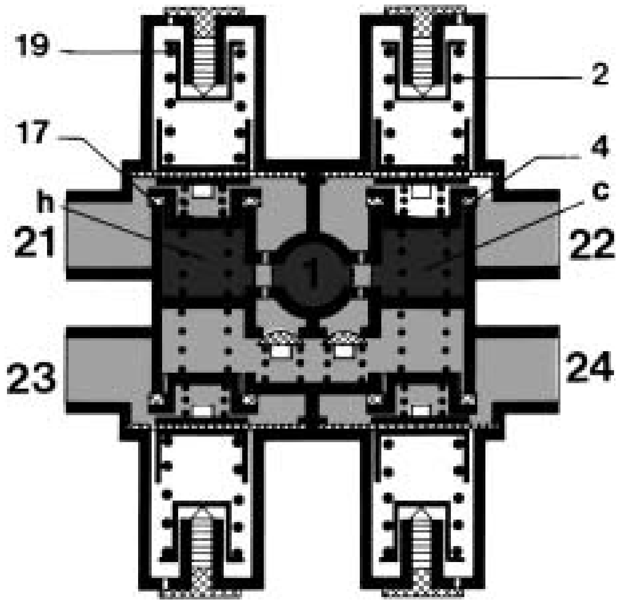
6. 6th Supplementary Guideline 91/422 ECE and EC Directive 98/12/EC

For any vehicles first put into operation after October 1, 1994, the 6th Supplementary Directive 91/422 ECE demands that when the supply circuit is being filled from zero pressure, it is impossible to release the parking brake until the pressure in the service braking circuits is sufficient to achieve the effect demanded for the emergency brake.

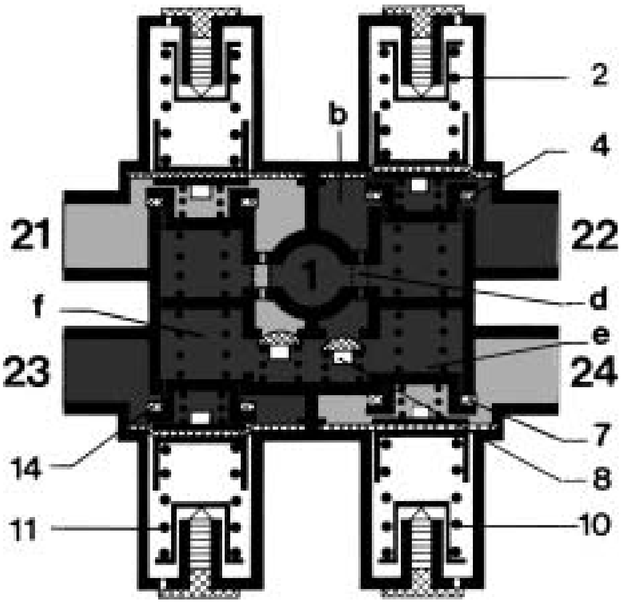
For any vehicles first put into operation from March 2001, the EC Directive 98/12/EC demands that actuated spring braking systems just release, after the pressure in the BBA-circuit at laden vehicles with BBA at least guarantees the rest braking effort.

Operation of Quadruple-Circuit Protection Valve 934 702 in Serial Arrangement Without A Bypass

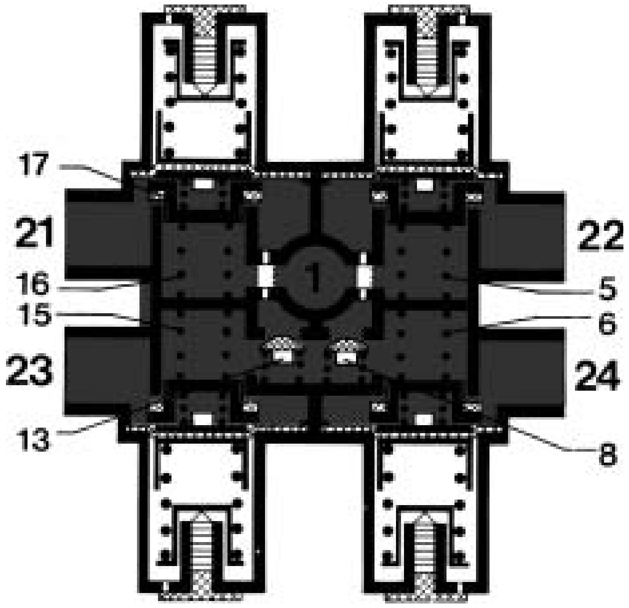
a. Filling Position



The compressed air flowing into chambers (c) and (h) from the unloader valve via port **(1)** initially builds up below the closed valves (4) and (17). If, because of the tolerances for springs (2) and (19)



it is valve (4) which opens first against the force of spring (2), circuit **(22)** and chamber (b) will be pressurized. The compressed air flowing in simultaneously via duct (d) opens check valve (8), allowing chambers (e) and (f) to be pressurized. Depending on the settings for circuit **(23)** or **(24)**, it will, for instance, be valve (14) which is opened first against the force of spring (11). This will initially result in an even rise in pressure in circuits **(22)** and **(23)** until the pressure in chamber (e) has reached the level where valve (7) opens. When this has opened against the force of spring (10), circuit **(24)** is pressurized.



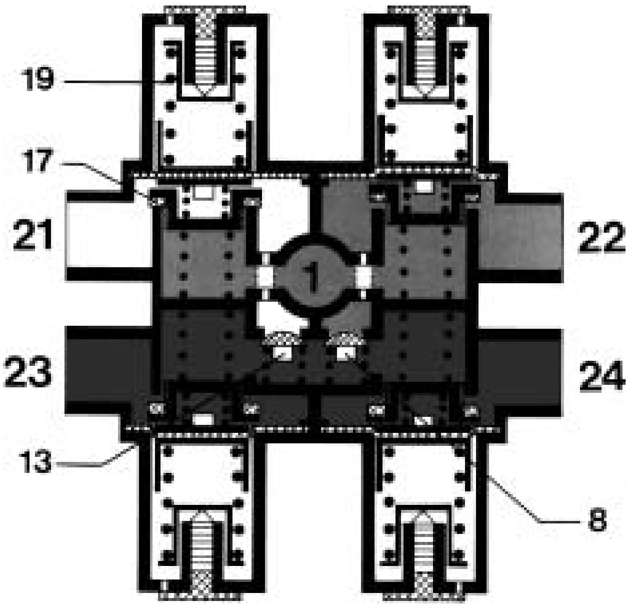
As the compressed air delivered by the compressor continues to fill circuits **(22)**, **(23)** and **(24)**, circuit (21) is filled when the opening pressure of valve (17) is reached At the same time, the check valve (13) can open.

It is only then that the pressure in all circuits rises evenly until the maximum pressure has been reached. Any deviations in pressure in circuits **(21)** and **(22)** or **(23)** and **(24)** are balanced to a limited extent by springs (5) and (6) or (15) and (16). Any return flow of the pressure from **(23)** or **(24)** to **(21)** or **(22)** is prevented by the check valves (8) and (13).

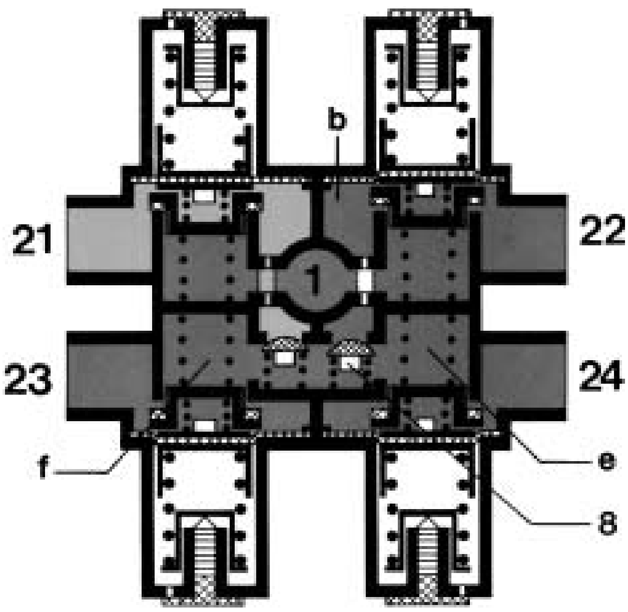
Please note

Of course initial pressurization can also begin via circuit **(21)**. The same subsequently also applies to circuit **(24)**.

b. Reversal if Circuit 21 Fails

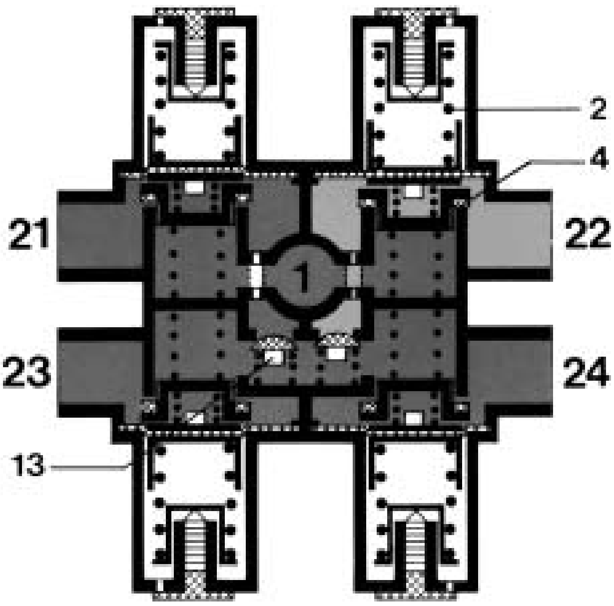


If circuit **(21)** fails, valve **(17)** is closed by the force of spring **(19)**. This will initially cause the pressure in circuit **(22)** to fall below the opening pressure. At this point it is not possible for circuits **(23)** and **(24)** to be affected since the check valves **(8)** and **(13)** close immediately. Due to the fall in pressure in circuit **(21)**, the compressor will once again switch to delivery, continuing to feed the intact circuit **(22)** up to the opening pressure of circuit **(21)**. If the pressure at port **(1)** exceeds the opening pressure of valve **(17)**, the higher pressure will escape at the defective point of circuit **(21)**. This ensures that the intact circuit **(22)** continues to receive compressed air.



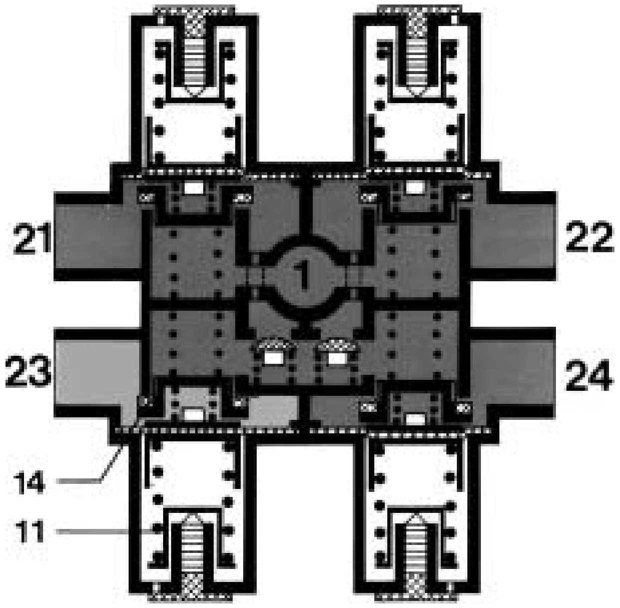
If the ancillary consumers connected to circuits **(23)** and **(24)** use up compressed air, the pressure in chambers (e) and (f) will initially fall below the opening pressure of circuits **(23)** or **(24)**. If the pressure in chambers (e) and (f) is lower than in chamber (b), check valve (8) will open and supply compressed air for the ancillary consumers connected to circuits **(23)** and **(24)** until the opening pressure of the defective circuit (21) has been reached.

c. Reversal if Circuit 22 Fails



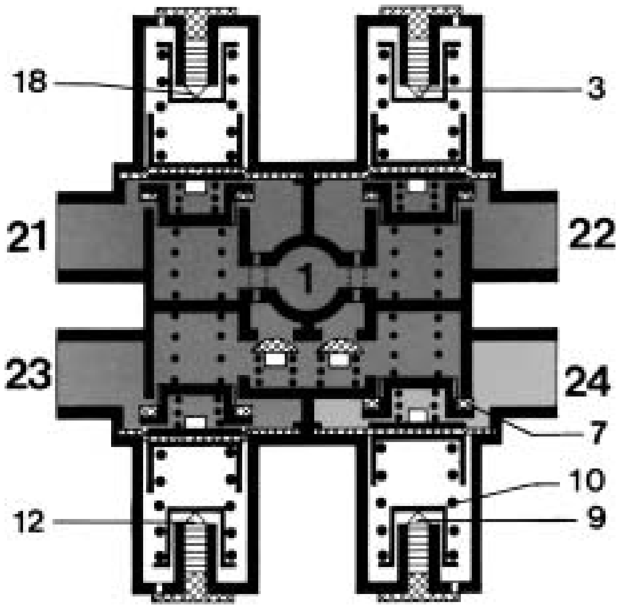
If circuit **(22)** fails, valve (4) is closed by the force of spring (2). The supply of compressed air to the intact circuits as described under **"b"** now becomes effective for circuit **(21)**. Circuits **(23)** and **(24)** are supplied with compressed air via the opened check valve (13).

d. Reversal if Circuit 23 Fails



If circuit **(23)** fails, the force of spring **(11)** closes valve **(14)**. This will initially cause the pressure in circuit **(23)** to fall below the opening pressure. This is followed by circuits **(21)**, **(22)** and **(24)** being supplied with compressed air by the compressor which has been switched to delivery, until the opening pressure of the defective circuit **(23)** has been reached.

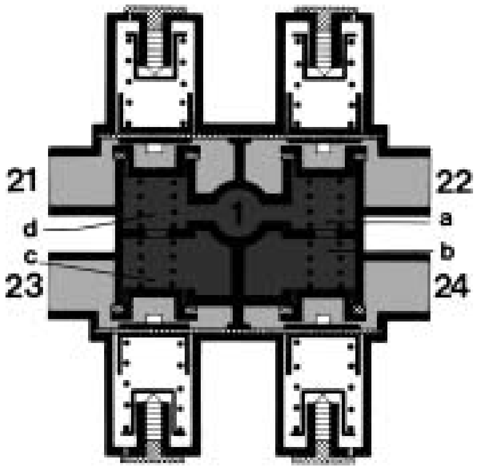
e. Reversal if Circuit 24 Fails



If circuit **(24)** fails, the force of spring (10) closes valve (7). The supply of compressed air to the intact circuits as described under “d” now becomes effective for circuits **(21)**, **(22)** and **(23)**.

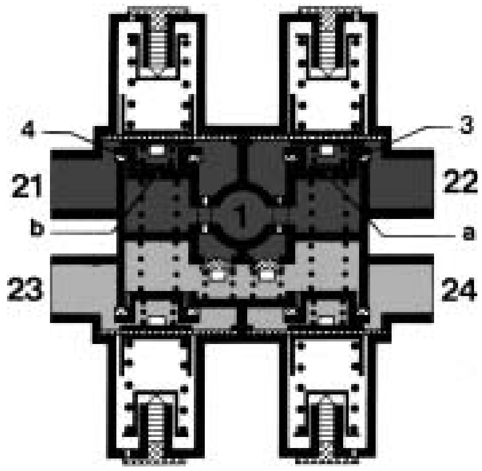
Further Series of Quadruple-Circuit Protection Valve 934 702

1. Parallel Arrangement without a Bypass



As compressed air enters port **(1)**, the pressure will initially build up in chambers (a), (b), (c) and (d). When the opening pressure of one circuit has been reached, compressed air reaches the connected air circuits. It is irrelevant which circuit is the first or the last to be pressurized.

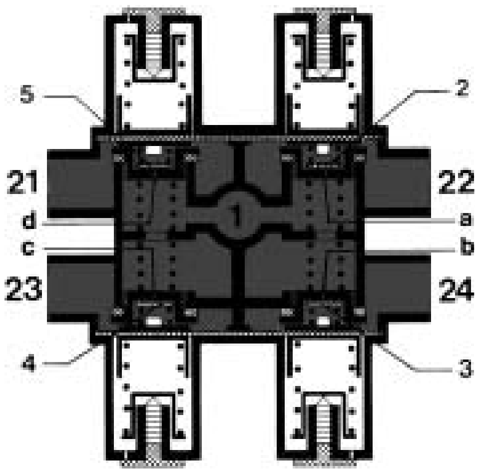
2. Series Arrangement with Two Bypasses



The compressed air from the unloader valve entering via port **(1)** immediately flows through bypasses (a) and (b), via the opening check valves (3) and (4) and into circuits **(21)** and **(22)**.

When the opening pressure of circuits **(23)** and **(24)** has been reached, compressed air reaches any ancillary consumers.

3. Parallel Arrangement with Four Bypasses



As compressed air enters port **(1)**, the pressure will pass bypasses (a), (b), (c) and (d), the opening check valves (2), (3), (4) and (5), and reach all circuits.

If the pressure in one circuit fails, the pressure in all other circuits will initially fall below the opening pressure. Subsequently the pressure will rise in the intact circuits until the opening pressure of the defective circuit has been reached.

Maintenance

No maintenance is required beyond the checks required by law.

Testing

Check the closing pressure:

When one circuit is vented, the pressure in the intact circuits may initially fall to ≥ 4.0 bar (closing or stabilizing pressure). This test must be repeated with a simulated defect in the other circuits after the repeated charging of the system.

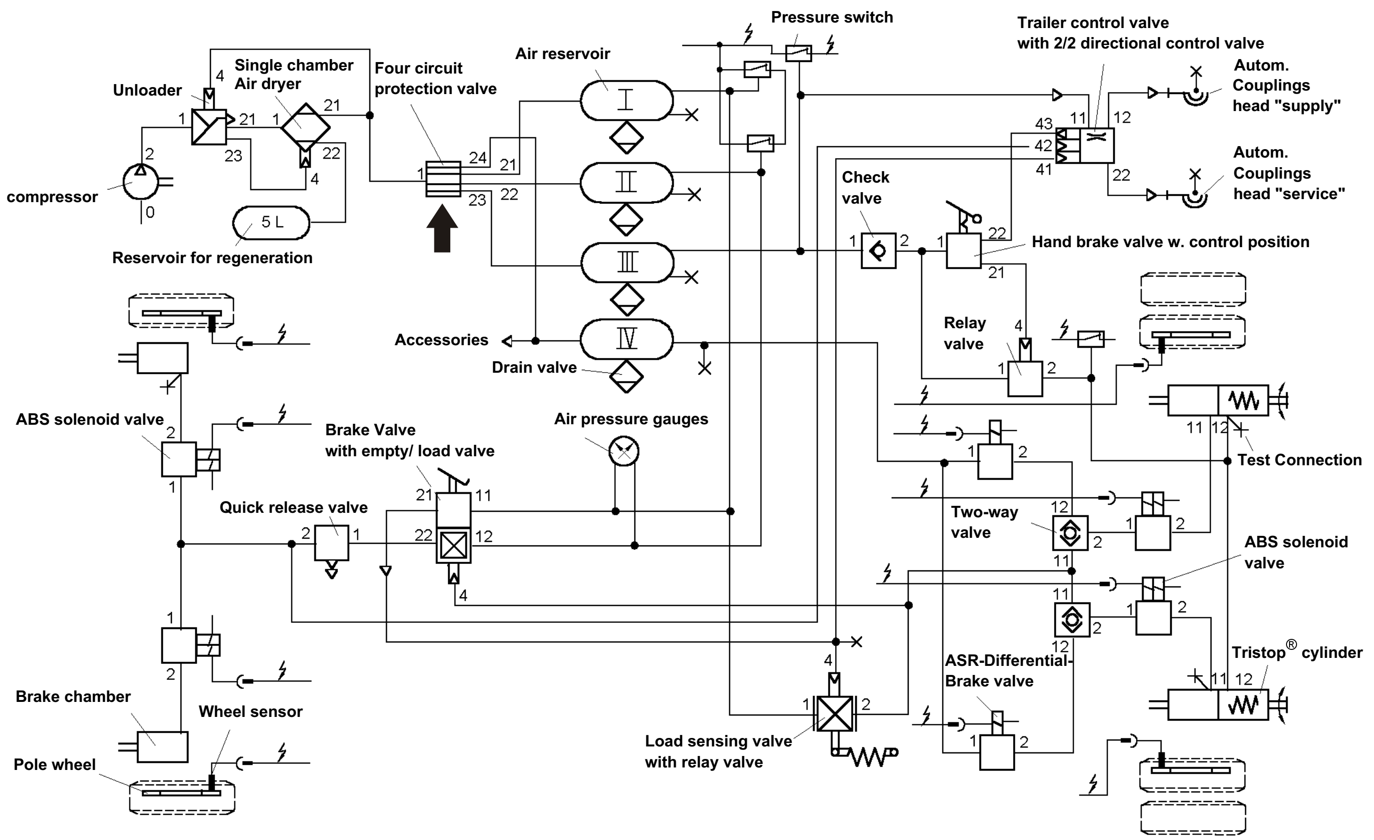
OnValves with Serial Arrangement:(Function of the check valve)

When circuits **(21)** or **(22)** are vented, the pressure in **(23)** and **(24)** must be fully maintained.

On Valves with Parallel Arrangement

If circuits **(21)** or **(22)** fail, the pressure will initially also fall in circuits **(23)** and **(24)** below the opening pressure, as described above.

Schematic for Testing and Installation



Operation of Quadruple-Circuit Protection Valve 934 705

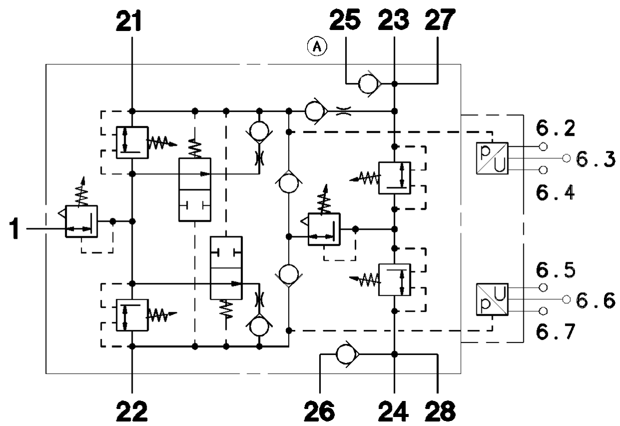
This variant is part of a multi-function device, i.e. a combination of several devices. Connected via the screw flange with a single-circuit air dryer with integrated unloader, safety valve and tyre inflation connection, it constitutes the so-called **APU** (**A**ir **P**rocessing **U**nit)

Depending on the variant, the four-circuit protection valve contains one or two pressure limiting valves, as well as two integrated check valves (in ports **25** and **26**) for particularly secured accessories for which limited return flow is needed.

Moreover, in some versions, a double pressure sensor is mounted on the body, to measure the supply pressures in the two BBA circuits (connections **21** and **22**). Ports **27** and **28** are used for screwing in pressure switches.

Moreover, some variants are (as shown here) equipped with a **"bleed-back function"**. A throttled check valve located between circuit 1 and circuit 3 also evacuates air from here in case of fault in port **21** and, when choked, also from 3rd circuit ports, to prevent the actuated FBA from being released again.

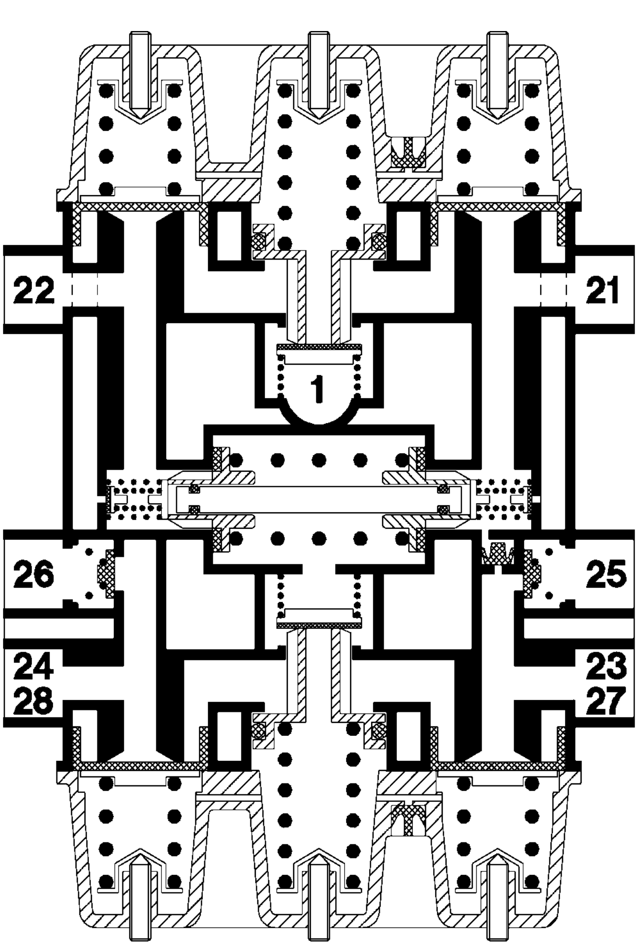
Function



When the supply circuit is being filled:

In case of supply system filling from 0 bar onwards, the service brake circuits (ports **21** and **22**) are filled first, due to the series connection and bypasses in the 1st and 2nd circuits, in accordance with the existing EC regulation. Thereafter, air is supplied to the accessories circuits via ports **23** to **28**.

The integrated pressure limiting valve reduces the pressure in connection **1** in the first limiting phase (10 ± 0.2 bar) to the pressure level required for the service brake circuits, and in the second limiting phase (8.5 -0.4 bar) to the pressure level required for the trailer braking system and other accessories.



Reactions in case of circuit failure

In case of failure of any of the **accessories circuits**, the pressure in the other circuits falls first to the closing pressure level, but rises again if required by the compressor up to the opening pressure level of the faulty circuit.

In case of **failure of the 2nd circuit** (BBA), the pressure in the other BBA circuit (circuit 1) falls first to the closing pressure level, but rises again if required by the compressor up to the opening pressure level of the faulty circuit. The check valves (series connection) prevent accessories circuits 3 and 4 from being affected.

The same situation obtains in devices **without bleed-back function**, also in case of **failure of circuit 1. Circuit**. 2 drops to closing pressure, and circuits 3 and 4 remain unchanged.

In devices with **bleed-back function**, the reactions in case of circuit failure correspond most to the those described above. In case of **failure of circuit 1** (port **21**), air is also evacuated from the 3rd circuit only due to the throttled check valve between circuit 3 and circuit 1. In accordance with regulation 98/12/EC, this prevents a release of the spring brakes via the supply pressure of the 3rd circuit (port **25**), if the pressure in the BBA supply circuits is not sufficient enough to obtain the residual braking performance required by the EC regulation.

Maintenance

No maintenance is required beyond the checks required by law.

Testing

Check the closing pressure:

When one circuit **(23)** or **(24)** is vented, the pressure in the intact circuits may initially fall to 4.0 bar (closing or stabilizing pressure). The pressure in ports **(25)** and **(26)** must be fully maintained due to the check valves integrated there.

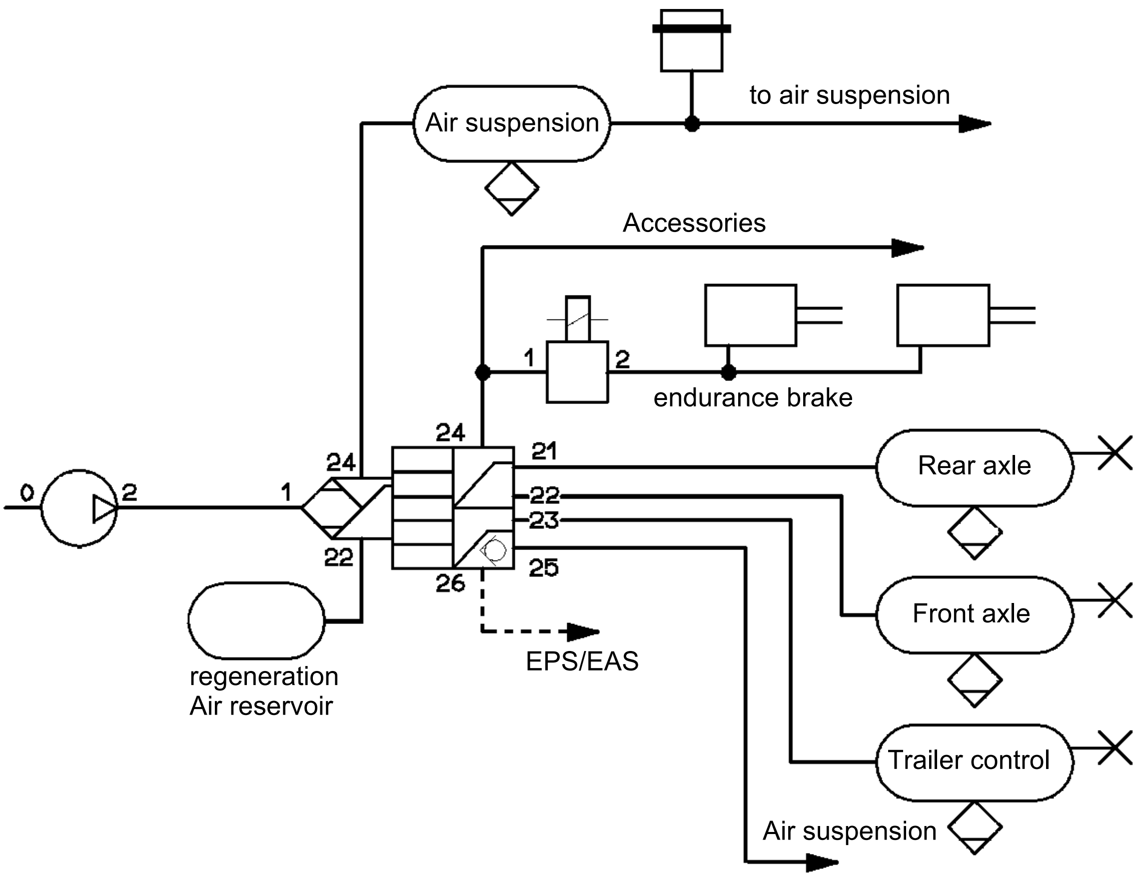
Devices without bleed-back function

When air is evacuated from port **(21)** or **(22)**, the pressure in circuits 3 and 4 must be fully maintained, due to the series connection's integrated check valves, while the other BBA circuits fall down to the closing pressure level.

Devices with bleed-back function

If circuit **(21)** fails (air evacuation), the pressure in the 3rd circuit also falls below the **closing pressure** level. This situation is intentional, i.e. the device has no functional error.

Schematic for Testing and Installation



Purpose

Air Reservoirs are used to store the necessary supply of compressed air.

Design

The reservoir consists of the cylindrical portion in the centre with welded-in arched bases and screw necks for connecting pipes. The use of high-tensile steels of even material thickness for all air reservoir sizes permits operating pressures in excess of 10 bar in air reservoirs of volumes below 60 litres.

The reference plate affixed to the air reservoir shows its type, the manufacturer's serial number, the manufacturer's name, the year it was made, its model number and the number of the ECE Directive 87/404, if applicable.

Please note

The reference plate is covered by a sticker with WABCO-number. After the reservoir is possibly varnished once more by the vehicle manufacturer, the sticker has to be removed to make the actual reference plate visible.

Installation

The air reservoirs should be placed in a position which is as low as possible to allow pipes leading to the air reservoirs to slope downwards. On motor vehicles it is important that the pipe leading from the unloader valve to the air reservoir contains no water pockets which could easily freeze in winter and thus be a hazard to a properly functioning system.

Maintenance

Check the mounting on the frame and the clamp clips regularly. Air reservoirs must be drained daily. The use of drain valves is recommended.

Testing

Air reservoirs must be checked for leakages, damage, and to make sure it bears a reference plate.

Purpose

The purpose of drain valves is to easily drain any condensate which may have collected, bearing in mind the maintenance instructions for air reservoirs. In automatically controlled valves, this is an automatic process.

Design types

934 300

a. **Manually Actuated Drain**
   This valve is screwed from the bottom into the air reservoir and drained by hand.

934 301

b. **Automatically Controlled Drain**
   This valve is screwed into the air reservoir. A line connection (see Schematic for Installation) is not required.

434 300

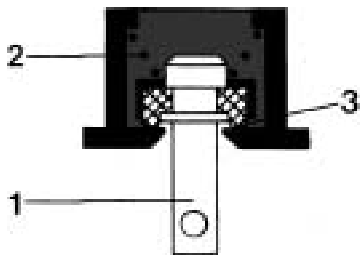
c. **Automatically Controlled Drain**
   On the pipe side it must be connected to the air reservoir, and with a control pulse line (see Schematic for Installation).

Please note

Automatic drain valves are preferably used on an upstream wet air reservoir. In principle manual actuated drain valves are used on air reservoirs with pre-connected air dryers.

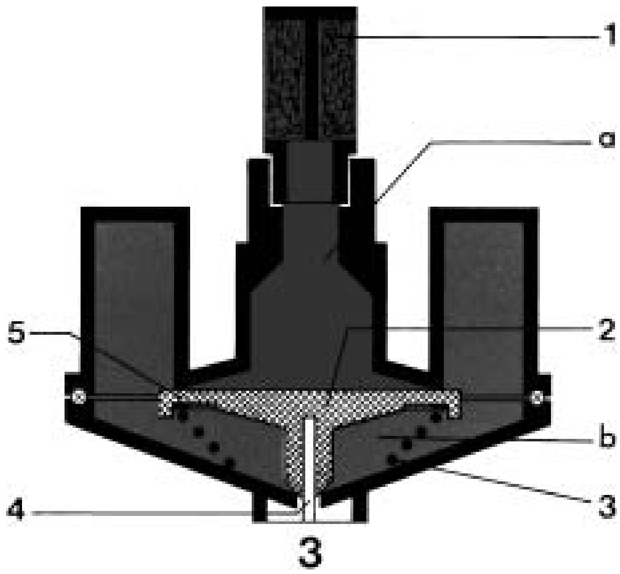
Operation of Drain Valves

a. Manual Drain Valve 934 300



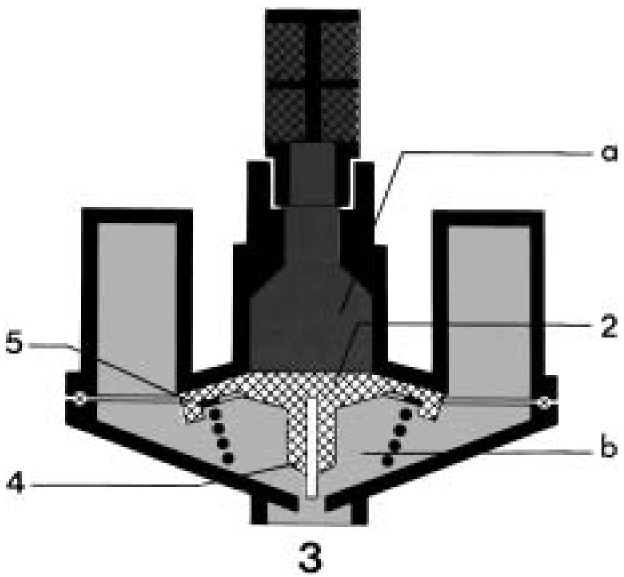
The actuating valve (1) is kept closed on valve seat (3) by the force of the spring (2) and the prevailing reservoir pressure. By pulling or pushing, the actuating valve (1) releases the valve seat (3), and any condensate can escape from the air reservoir together with the compressed air.

b. Automatic Drain Valve 934 301



When the air reservoir is being filled, the compressed air reaches chamber (a) via filter (1). The valve body (2) is forced by the compressed air to overcome the force of the spring (3), thereby opening inlet (5). This allows the compressed air and any condensate to reach the closed chamber (b) via outlet (4).

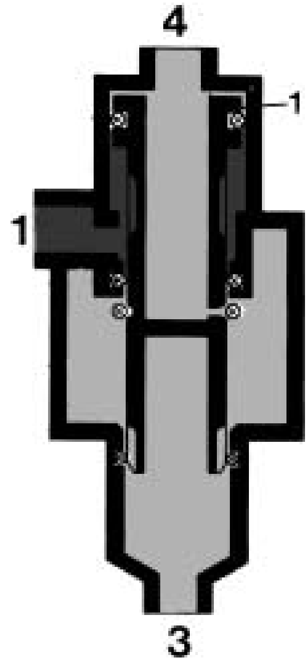
Automatic Draining



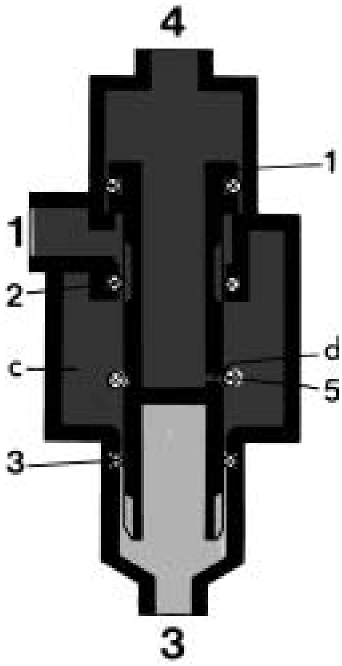
When the pressure in the air reservoir falls - e. g. when the brakes are being actuated - the effective force in chamber (a) falls whilst it remains constant in chamber (b) since inlet (5) is closed. The higher pressure in chamber (b) now raises the valve body (2), opening outlet (4). The condensation water in chamber (b) is thus expelled by the pressure.

This way the drain valve causes the air reservoir to be drained every time the pressure falls by more than 0.15 bar.

c. Automatic Drain Valve 434 300

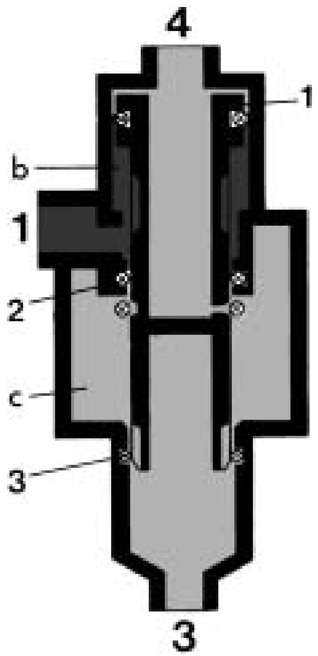


The drain valve is controlled at port **(1)** by the reservoir pressure and via port **(4)** by a pulse pressure. The compressed air at port **(1)** is therefore always subject to the small effective surface of the piston valve **(1)**.



When port **(4)** receives a pressure pulse, for instance from the unloader valve or from the door closing mechanism, the piston valve **(1)** - which has a much larger surface at the top - is forced downwards, the pressure being the same as in port **(1)**. As it moves downwards, the condensate in the pilot line is pushed into chamber (c) through hole (d) and the opening O-ring **(5)**, and during its downward motion the piston valve closes O-ring **(3)** whilst opening O-ring **(2)**. The reservoir pressure at port **(1)** can thus reach chamber (c), together with the condensate.

Automatic Draining



Automatic draining is achieved when the pilot pressure in port (4) is reduced. This is when the reservoir pressure in chamber (b) can push the piston valve (1) upwards. O-ring (2) now closes, separating chamber (b) from chamber (c), allowing the condensate, together with the compressed air from chamber (c), to escape at exhaust (3) via O-ring (3).

Maintenance

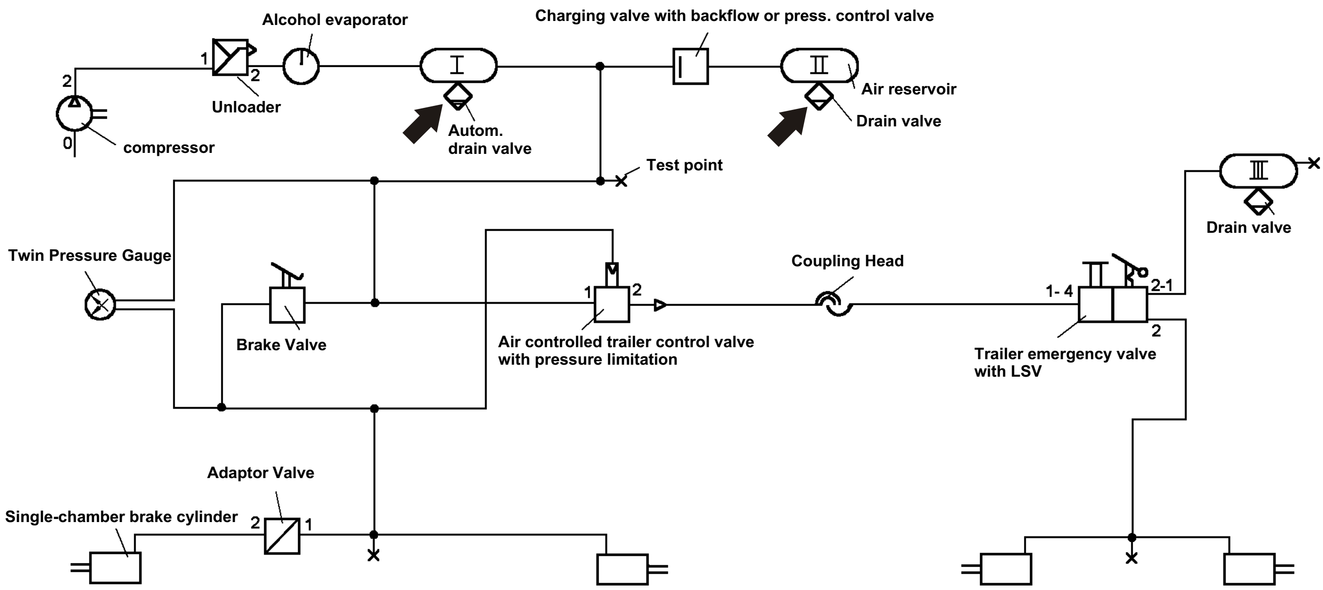
The drain valves are maintenance-free. For drain valve 934 301 we recommend that the valve body housing is cleaned every 3 to 4 months, depending on the prevailing operating conditions. For this purpuse it is unscrewed from the air reservoir, and dismantled. At this time, the air reservoir should be blown out as well.

Testing

The drain valves must be checked for leakages, and proper function.

Schematic for Testing and Installation

Drain Valve 934 300 and 934 301



Schematic for Testing and Installation

Drain Valve 434 300