

APPARATUS FOR CONTROL OF DIFFERENTIAL PRESSURE IN A HEATING AND COOLING SYSTEM

The present invention relates to an apparatus for control of differential pressure in a heating and cooling system according to the preamble of claim 1.

Such an apparatus is designed to keep a pressure difference between a feed pipe and a return pipe at a constant level.

The known apparatuses, used for this purpose, and chiefly pressure difference regulators used in them have various drawbacks. Thus, the possibilities of mounting the regulators are often limited. Thus, a regulator, which is designed to be mounted in a feed duct, is not suitable in a typical case to be mounted in a return duct and vice versa. Also, exchanges and repairs of details often cannot be done during operation. Various regulating elements, which belong to said regulators, e.g. a rubber membrane and a metal piston, are not mutually interchangeable in the same construction. A reconstruction and an adjustment of the regulators to other systems may be difficult or impossible to carry out. Centering problems may arise for important moveable parts, increased friction and other problems possibly resulting therefrom and the desired function becoming impaired or jeopardized. In this connection, seats connected to the housing may be problematic. Principally, required seat variations may be difficult to provide for. The guiding means are often limited and deaeration problems may occur. A precise control and/or the function during varying liquid quantities may result in problems. Finally, the life and the resistance to extreme medium temperatures, such as -40°C and $+180^{\circ}\text{C}$, may be extremely limited.

The object of the present invention is to counteract and to eliminate the above-mentioned problems as much as possible. Also, the object of the invention is to further the development of the state of the art in this field in various respects. Particularly, the object of the invention is to provide a pressure difference regulator, which principally is suitable to be mounted in feed as well as return ducts and which is designed to function at or in a simple way also be adjusted to extreme temperatures or principally varying operating conditions.

These objects are attained according to the present invention by means of an apparatus of the type described in the introduction, principally designed in the way set forth in the characterizing clause of claim 1.

Additional characterizing features of the invention are set forth in the following description, reference being made to the accompanying drawings, which depict a few preferred but not limiting combinations. The drawings show in detail in:

- Fig. 1 schematically an apparatus according to the invention, which is a part of a cooling system with one regulating and one measuring valve, mounted in a feed duct and an adjustment valve as well as a pressure difference regulator according to the invention, mounted in a return duct;
- Fig. 2 an apparatus and a system, respectively, according to Fig. 1, but with the regulating valve on the inlet and the outlet sides connected to a pressure difference regulator according to the invention and without a measuring valve;
- Figs. 3 and 4 schematically reversed mounting suggestions for a pressure difference regulator according to the invention in a return and a feed duct, respectively ;
- Fig. 5 an axial diametrical cross section of a first embodiment of a pressure difference regulator according to the invention having a membrane as a regulating device in a completely open operating position;
- Fig. 6 a corresponding view of the same regulator in an almost completely closed operating position;
- Figs. 7 and 8 views, which correspond to Figs. 5 and 6, of a second embodiment of a pressure difference regulator according to the invention having a piston made of metal or a plastic material as a regulating device; as well as
- Fig. 9 a view corresponding to Fig. 8, in which the piston and the spindle are somewhat modified.

In the drawings, a circulating heating or cooling system is designated 1 in its entirety . It is shown in e.g. Figs. 1 and 2, that the system comprises a heating or cooling source 2 with a feed duct 3, outgoing from source 2, and a return or feed-back duct 4, returning to source 2, which ducts lead to consumption devices 5, such as radiators, convectors and the like. According to Fig.1, an e.g. thermostat-controlled control valve 6 adjacent a device 5 is mounted in the feed duct, which valve 6 is designed to precision control said device 5, and in front of it in the flow direction a guiding point 7, e.g. designed as a control valve with a measuring function, which guiding point is able to preadjust a loop flow, i.e. the flow to a plurality of devices 5. Also, in the return duct adjacent said device 5, an adjustment valve 8 is mounted and after it in the flow direction a pressure difference regulator 9.

In a system 1 according to Fig. 1 or 3, a heated or cooled medium, e.g. water, flows in feed duct 3 from source 2 via guiding point 7 and control valve 6 to a consumption device 5, where heat is emitted or received, respectively. Ducts 3 and 4 may, as indicated, have various branches ahead of and after guiding point 7 and pressure difference regulator 9. At guiding point 7, a pressure diffe-

rence measuring can be carried out for a flow calculation by temporary connection of a measuring instrument (not shown) to two nipples 10 and 11 (Fig. 1).

Also, the guiding point is used to connect a terminal 12, connected to its outlet 14, to a signaling duct 13, which leads to pressure difference regulator 9 on its high pressure regulating side 15 via a terminal 31. A signaling duct 16 also connects a terminal 29 at inlet 17 of the pressure difference regulator to low pressure regulation side 18 of the regulator via a terminal 32. The purpose of the signalling ducts is to keep the pressure difference between the feed duct and the return duct at point 7 and regulator 9 constant.

The system according to Fig. 2 corresponds to a high degree to the system according to Fig. 1, but the guiding point according to Fig. 1 has been omitted and, instead, signaling ducts 19 and 20 between a terminal 33 on outlet side 22 of control valve 6 and the low pressure regulating side of pressure difference regulator 9 and, respectively, between a terminal 34 on inlet side 21 of control valve 6 and the high pressure regulating side of difference pressure regulator 9 are used. Thus, in such a system the possibility of measuring the pressure difference and, consequently, the loop flow at point 7 is not used, but the control signals to the pressure difference regulator are taken from the control region at a consumption device or a series of consumption devices (not shown), connected to the same main line.

Pressure difference regulator 9 is the same in Figs. 1 and 2 apart from the signal duct connections.

Pressure difference regulator 9 is the same also in Figs. 3 and 4. Fig. 3 completely corresponds to the design in Fig. 1 apart from the fact, that guiding point 7 is designed in another way with signaling terminals 12 and 23 at the outlet side and at inlet 24, respectively. In Fig. 4, guiding point 7 and pressure difference regulator 9 have changed places between feed duct 3 and return duct 4, a signaling duct 25 connecting signaling terminal 23 of guiding point 7 on the inlet side to the low pressure regulating side of pressure difference regulator 9, whereas a signaling duct 26 connects a terminal 27 on outlet 28 of pressure difference re regulator 9 to high pressure regulating side 15 of the regulator via a terminal 30.

A pressure difference regulator 9 according to Figs. 5-8 has a housing 35 with a preferred oblique socket 36 between inlet 17 and outlet 28. The socket extends to a partition 37 between the inlet and the outlet, which partition has an opening 38 for a seat 39. A lower regulator part 40 is inserted, e.g. by screwing, into socket 36 and an upper regulator part 41 is fastened to the lower regulator part.

Lower regulator part 40 comprises a cage-like bottom part 42, which with its free end 43 with sealing engages all around an O-ring 44 in opening 38. Shoulder end 45 of bottom part 42 may be screwed into the outer end of socket 36 and an O-ring 47 may surround the socket mouth. A wall section with radial openings 48 between the two ends of bottom part 42 allows a medium to flow through the bottom part, seat 39 being mounted within the bottom part at the link between said wall section with openings and the free end of the bottom part, which is closed all around .

Immediately outside the outer socket end, a cup-like widened connection part 49 is connected to bottom part 42, which connection part with a radial shoulder 50 is supported by the free socket end, through which shoulder threaded bolts 46 can be inserted into the outer socket end as an alternative to threading in the bottom part, which connection part with its free end forms a projecting mounting collar 51 with axial holes (not shown) for mounting bolts 52, by means of which upper part 41 with a matching collar 53 and aligned holes (not shown) is fastened to lower part 40. As shown, a terminal 32 is provided in connection part 49, which also may house several such terminals, distributed around the periphery. Also the upper part of the regulator may be provided with a plurality of terminals 31 at various levels and in various radial directions in order to guarantee a complete deaeration in all possible installation positions. Terminals not used for signaling duct connection are plugged. Thus, the terminals suitably have a double function, i.e. for deaeration and for signaling duct connection. Also, the terminals from the inlet and the outlet suitably have a multiple function, i.e. for the insertion of a test probe (not shown) and/or for signaling duct connection and possibly for the emptying and refilling, respectively, of a circulating medium and deaeration, respectively, and these outlets are also completely or partially plugged, when they are not used.

Into shoulder end 45, a cage-like guiding part 55 is inserted by screwing and it is sealed by means of a surrounding O-ring 54 and is, compared to the bottom part, in the axial direction somewhat shorter and in the radial direction somewhat thicker and it further abuts with a small radial flange 56 the mouth area of the shoulder end. The rear end 57 of the guiding part has an exterior polygonal shape 58, designed to perform the screwing by means of a tool. Also, said rear end 57 is retracted in order to form a constriction 59, through which rear end 60 of a valve cone 61 is inserted. The wider inner part of the guiding part forms a guiding channel 62 for a flange-like expansion 63 on the cone with a recessed surrounding O-ring 64. Said retracted cone part forms a restriction for the opening movement of the cone.

Cone 61 suitably has an axial through hole and its free end is widened to a plate 65, the side of which, which faces seat 39, adjacent the periphery is provided with a recessed O-ring 66, against that part of which, which faces the axial central part, a suitably partially spherical clamping plate 67 with its peripheral part abuts. The clamping plate is by means of a threaded bolt 68 fastened to a holder 69, inserted into the free end of the cone. The clamping plate holds O-ring 66 in place and simultaneously squeezes out a portion of the O-ring material, which portion in an advantageous way being able to be pressed against seat 39 in a closing position. Parts 67-69 alternatively can form a unit, which is inserted by threading into the lower part of the cavity, which extends through the cone, bolt 68 having been replaced by a groove, a hexagonal part or the like, designed for tools to be inserted. Plate 65 is during its entire travel length at a distance surrounded by the wall section with openings 48, which at the same time forms a protective cage 70, which protects the entire cone and its sensitive parts during storage and shipping.

Such a construction solution with one unit, comprising a lower part with a bottom part and a seat disposed in it in a protected way as well as a cone, guided in the bottom part by means of a uniting, locking and controlling guiding part is very advantageous. Partly, this solution requires less machining of the housing, which consequently may be less expensive, partly the solution results in better flexibility as regards the combination and change of details, and partly said unit can be kept during repair work fastened to the housing free from the other regulator parts, which may be exchanged, adjusted etc. without the operation being interrupted. Finally, this solution is particularly important for an extremely precise machining, controlling and centering of all the details in relation to each other in general as well as of the spindle and the cone in relation to the seat in particular.

In the rear end of the cone, one end 71 of a spindle 72 is fastened, e.g. by screwing and/or by pressing, the other end 73 of the spindle preferably being designed with a polygonal shape and inserted into an opening 74, which has a shape, which matches the shape of end 73, in a bushing 75 in a handwheel 76, mounted outside said upper part and which in its turn has a non-rotation symmetrical sleeve part 77, into which a bushing 78 with a matching shape is fitted, which is threaded onto a neck 80, which projects from end 79 of said upper part and which in a bottom opening 81 with a lock ring 82 receives end 83 with a reduced diameter of bushing 75, which end is provided with a hexagonal opening or the like 85 accessible from outside through an opening 84 in the handwheel, for insertion of a hexagonal key or the like (not shown) to make bushing 75 rotate and thus also the spindle in relation to a prestressing device, described below, the handwheel not being rotated, since bushings 75 and 78 can be rotated in relation to each other. The purpose of the handwheel rotation is to, through the pitch of thread of the neck of the upper part and the axial adaptability of bushing

75 in relation to bushing 78, make bushing 75, with its inner end, abut a step 86 on the spindle and then displace the spindle in an axial direction, until the cone seals against the seat. Bushing 75 abuts in its shown end position with a flange 119 at its inner end against the end of the upper part and is, at its outer side, provided with a recessed O-ring 87 in order to seal against the neck of the upper
 5 part.

Said prestressing device comprises a compressing spring 88, e.g. a spiral spring, the small end of which adjacent the handwheel abuts a cross bar 89 as a spring tension means, which is threaded onto the spindle and which may be fastened by means of a locking device 90 in a groove in the
 10 spindle. The ends of cross bar 89 are secured against a rotation, since they are guided in lateral taperings 91 of the upper part.

The end of compression spring 88 close to the cone abuts a holder 92 with a radial plate 93 having a wide, central opening 94 to allow the spindle to pass through and along e.g. arc-shaped openings 95,
 15 distributed along the periphery, which plate is surrounded by a short axial ring wall 96 having an outer ring flange 97 and projections 98, distributed along the inner periphery, between openings 95 in order to center the compression spring. Flange 97 is fastened between a step 99 in mounting collar 51 and collar 53 of the upper part. Ring wall 96 has on both sides of flange 97 outer ring grooves 100 and 101, respectively, designed to receive O-rings or the like 102 and 103, respective-
 20 ly, which are designed to be pressed against the upper part and the lower part, respectively, adjacent the respective mounting collar. At least the O-ring, which is to be pressed against the upper part, is, besides the required sealing properties, regarding its material properties and/or its size together with the groove, which receives the O-ring, designed to perform the precise centering of the spring holder in relation to the upper part and via this part the lower part, i.e. the spring holder will fit into the
 25 upper part and possibly the lower part with a certain radial flexibility, said O-ring being designed to position all the parts, which cooperate with each other in the upper part and the lower part, opposite each other in an optimal way, i.e. without inclined positions and with minimal frictions for the required adjustment movements.

O-ring 103 is, according to Figs. 5 and 6, an end bead of a membrane 104, preferably made of rubber, reinforced with a fabric material. From the bead the membrane extends, at first in parallel to the cup-shaped wall of the lower part, in order to form the one side of a soft rounded fold 104, which then at a distance from said wall is bent upwards to a level, which is at about the same level as the level of the bead or slightly below it, the central parts of the membrane being supported by rotation-
 30 symmetrical support plates 105 having an outer border 106 and an inner cup part 107, which both
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extend towards the shoulder of the lower part. The cup part forms a recess in the support plate and the membrane follows this recess as well as the upper side of the plate and is fastened by curing of these parts. The bottom of the cup part comprises a central bore, designed to allow the spindle to pass through, the membrane being forced through this bore to end at a position on the border side of the bottom of the cup part. Finally, the rear end of the cone suitably has a slightly concave plate, which surrounds the spindle and is made of a friction reducing material, e.g. a fluorethane plastic material, since it must be easy for the spindle and the cone to be rotated in relation to the membrane and the support plate.

Fig. 6 shows, that the pressure difference between spaces 15 and 18 against the compression force of the compression spring has moved the membrane and the membrane plate and consequently also the cone to an almost completely closed valve position, the membrane suspension or bulging being increased, seen from the bead.

As an alternative to a membrane, Figs. 7 and 8 show a metal piston 108, which is designed as a relatively short cylinder 109 with a radial wall 110, the centre of which is designed as a hub 111, which surrounds the spindle and which preferably is at least as long as and preferably somewhat longer than the radial ring wall, the ends of the ring wall and the hub, which face the shoulder, being positioned at roughly the same level. Within this region, the hub surrounds the spindle with an opening 112 with a small play, which allows a certain swinging of the metal piston around the spindle, the other hub end being the swinging centre. In this other hub end, an O-ring 113 is received to seal against the spindle. Between the two hub ends, an annular gap 114 between the inner wall of the hub and the spindle is used to prevent a friction along this length and to generally minimize the friction against said O-ring and the minimal hub wall sections adjacent the ring and against a support region inside opening 112, which is not more than point-shaped. Cylinder 109 is guided by a relatively short extension of ring wall 96, which receives an O-ring 115. The extension houses the metal piston with a play and only has such a length, that the wall material will be sufficient to keep O-ring 15 in place. In this way, this metal piston is able to perform a limited swinging movement, which is very important in order to be able to eliminate centering problems and prevent squeezing and friction. In this way, a satisfactory function of this metal piston alternative is always secured. When such a design with a piston made of a metal or a plastic material is used, there is no need of a friction reducing plate at the rear end of the cone. The concave or convex recess within this region allows instead in an advantageous way swinging movements of the hub, and at the same time a cone, designed in this way, can be used for a membrane as well as a piston design.

The embodiment according to Fig. 9 is different from the embodiment according to Fig. 8 only by reversion of the regions for an O-ring fastening in the hub. According to Fig. 9, the O-ring is positioned at the same level as the plate, whereas the upper or rear free hub end at a certain distance surrounds the spindle, which, when the plate goes against the cone, can present a step 117 all around with a reduction of the spindle diameter towards said cross bar. This step can allow a somewhat inwardly bent collar-shaped edge adjacent the free hub end to be positioned closer to the spindle. Also, within the region of the last-mentioned O-ring, the spindle may have a reduced diameter. Thus, in this design the swinging movement takes place around the center of the plate. It is also feasible to place an O-ring in the axial centre of the hub. Also, it may be advantageous to alter the diameter of the spindle in the longitudinal direction of the spindle in order to change the pressure on the O-ring of the hub. A smaller spindle diameter results in a small pressure on the O-ring, the latter and thus the piston being able to yield somewhat in the radial direction. See e.g. the position according to Fig. 9. If the piston then is displaced upwards in Fig. 9, the O-ring will be displaced into a spindle section having a larger diameter, where the O-ring will be compressed harder. Fig. 9 shows also an asymmetrical groove cross section for the O-ring with a shorter groove length in relation to the cone, which with a press ring 120, which corresponds to its rear end, in the shown position, goes against the O-ring and this renders a sealing in an axial direction possible.

It is of course also possible to mount O-rings in the two hub ends and/or in the middle of the axial length of the hub and/or through e.g. dimensioning and/or O-ring choice etc. achieve swinging possibilities around one of the hub ends or around the axial hub centre. It is very important, that a swinging movement on the whole is possible in order to facilitate precise centering and reduce friction.

The present invention is not limited to what has been described above and the embodiments shown in the drawings, but it can be supplemented and modified in an arbitrary fashion within the scope of the inventive idea and the following claims. Thus, the O-rings may have another cross-sectional design than a circular or oval cross section, e.g. an X-shaped design, and they can be made of another material than rubber, e.g. a fluorethene plastic material.

CLAIMS

1. An apparatus (1) for controlling the pressure difference in a heating or cooling system, which comprises a heating or a cooling source (2), and a feed duct (3) and a return duct (4) connected to this source with a consumption devices (5) thereinbetween, which emit or receive heat, at least some valve or the like (6,7,8, respectively) being used to control the flow through a loop provided in this way, a pressure difference regulator (9) being used to keep the pressure difference between the feed duct and the return duct constant , **characterized in that** the pressure difference regulator (9) is provided for optional mounting in one of said ducts (3 or 4) and is provided with signaling terminals (29 and 27 and 32 and 30,31, respectively), connected to the inlet (17) and the outlet (28), respectively, as well as to the low pressure regulating side (18) and the high pressure regulating side (15), respectively, that at least one valve or the like (6 and 7, respectively), mounted in the other duct (4 and 3, respectively), in relation to the duct (3 and 4, respectively) of the pressure difference regulator, is provided with signaling terminals (23;24 and 12;33), connected to their inlet (24 and 21, respectively) and outlet (14 and 22, respectively), and that the pressure difference regulator is designed to be controlled via optional signaling ducts (13 and 16 and 19 and 20 and 25 and 26, respectively) between said terminals.
2. An apparatus according to claim 1, **characterized in that** in the feed duct (3) adjacent a consumption device (5) an e.g. thermostat controlled control valve (6) is mounted, which is designed to precision control said device (5) and in front of it in the flow direction a guiding point (7) , e.g. in the form of a control valve with a measuring function, which guiding point is useable for a preregulation of a loop flow, i.e. the flow to a plurality of devices (5), in that in the return duct (4) adjacent said device (5) an adjustment valve (8) is mounted and after it in the flow direction a pressure difference regulator (9), that a signaling wire (13) is connected to the outlet (14) of the guiding point via a terminal (12) and leads to a terminal (13) on the high pressure regulating side (15) of the pressure difference regulator (9), and that a signaling duct (16) connects a terminal (29) at the inlet (17) of the pressure difference regulator with a terminal (32) on the low pressure regulating side (18) of the regulator.
3. An apparatus according to claim 1, **characterized in that** in the feed duct (3) adjacent a consumption device (5) an e.g. thermostat controlled control valve (6) is mounted, which is designed to precision control said device (5), in that in the return duct (4) adjacent said device (5) an adjustment valve (8) is mounted and after it in the flow direction a pressure difference regulator (9), and in that signaling ducts (19,20) connect a terminal (33) on the outlet side (22) of the control

valve (6) to a terminal (32) on the low pressure regulating side (18) of the pressure difference regulator (9) and a terminal (34) on the inlet side (21) of the control valve (6) to a terminal (31) on the high pressure regulating side (15) of the pressure difference regulator (9), respectively.

- 5 4. An apparatus according to any of claims 1-3, **characterized in that** the pressure difference regulator (9) is mounted in the return duct (4), whereas a guiding point (7) is mounted in the feed duct (3), a signaling duct (13) connecting the outlet (14) of the guiding point to the high pressure regulating side (15) of the regulator and another signaling duct (16) connecting the inlet (17) of the regulator to the low pressure regulating side (18) of the regulator, or that the pressure difference regulator (9) is mounted in the feed duct (3), whereas a guiding point (7) is mounted in the return duct (4), a signaling duct (26) connecting the outlet (28) of the regulator to the high pressure regulating side (15) of the regulator, whereas another signaling duct (25) connects the low pressure regulating side (18) of the regulator to the inlet (24) of the guiding point.
- 15 5. An apparatus according to any of claims 1-4, **characterized in that** the pressure difference regulator (9) has a housing (35) with a socket (36), preferably oblique, between its inlet (17) and its outlet (28), that the socket extends to a partition (37) between the inlet and the outlet, which partition has an opening (38) for a seat (39), that in the socket a lower part (40) of the regulator is inserted and preferably fastened by screwing by means of bolts (46), on which lower part an upper part (41) of the regulator is fastened, that the lower part (40) of the regulator comprises a cage-like bottom part (42), its free end (43), all around with sealing by means of an O-ring (44), being inserted into the opening of the partition, the bottom part with its shoulder end being pressed into or screwed into the outer end of the socket, preferably with an O-ring (47), which surrounds the mouth of the socket, that between the two ends of the bottom part (42) a wall section with radial openings (48) is provided, which allows a flow to pass through the bottom part, and that the seat (39) is mounted within the bottom part at the transition region between said wall section with an opening and a free end of the bottom part, which is closed all around.
- 20 6. An apparatus according to claim 5, **characterized in that** immediately outside the outer socket end, the bottom part (42) changes to a cup-like widened connection part (49), which with a radial shoulder (50) is supported by the free socket end and preferably is fastened to it through bolts (46), and which with its free end forms a projecting mounting collar (51) with axial holes for mounting bolts (52), by means of which the upper part (41) with a matching collar (53) and opposite axial holes is fastened to the lower part (40), and that the lower part (40) as well as the

upper part (41) are provided with terminals (30,31,32) at various levels and/or in various radial directions for deaeration and/or signaling duct connection.

7. An apparatus according to claim 6, **characterized in that** in the shoulder end (45), a
 5 guiding part (55) is inserted by screwing and sealed by means of a surrounding O-ring (54), which guiding part e.g. with a radial flange (56) abuts the mouth region of the shoulder end and the rear end (57) of which is designed to receive a tool and is bent inwards in order to form an inner constriction (59), through which the rear end (60) of a valve cone (61) is inserted, that the wide inner part of the guiding part forms a guiding channel (62) for a flange-like expansion (63) on the cone
 10 with a recessed surrounding O-ring (64), and that said inwardly bent cone part forms a limitation for the opening movement of the cone.

8. An apparatus according to claims 1-7, **characterized in that** the cone (61) suitably has through axial holes, that its free end is widened into a plate (65), the side of which , which faces
 15 the seat (39), adjacent the periphery is provided with a recessed O-ring (66), against that part of which, which faces the axial central part , a suitably partly spherical clamping plate (67) with its peripheral part abuts, that the clamping plate by means of a threaded bolt (68) is fastened to a holder (69), inserted into the free end of the cone, or that the clamping plate (67), the holder (69) and a part (68) for tool insertion form a unit, which can be inserted into the cone, and that the plate (65) during
 20 its entire stroke at a distance is surrounded by a wall section of the bottom part with openings (48) , which also forms a protective cage (70) around the sensitive parts of the cone and the seat (39) during storage and shipping.

9. An apparatus according to claim 7 or 8, **characterized in that** in the rear end of the
 25 cone one end (71) of a spindle (72) is fastened, e.g. by screwing and/or pressing, the other end (73) of the spindle preferably having a polygonal shape and being inserted into an opening (74), which fits said other end, in a bushing (75) in a handwheel (76), mounted outside the upper part and which in its turn has a non-rotation symmetrical housing (77), in which a handwheel bushing (78) is inserted, which fits said part and which is threaded onto a neck (80), which projects from the end (79) of
 30 the upper part and which in a bottom opening (81) with a locking ring (82) receives the preferably diameter-reduced end (83) of the spindle bushing (75), which end is provided with a hexagonal opening or the like (85), accessible through an opening (84) in the handwheel, which opening is designed to receive a tool, which will rotate the spindle bushing and consequently also the spindle in relation to a prestressing device without causing the handwheel to rotate, that the rotation of the
 35 handwheel is provided to make, by the pitch of thread on the neck of the upper part and the axial

adaptability of the spindle bushing (75) in relation to the bushing (78), the spindle bushing (75) with its inner end abut a step (86) on the spindle in order to displace the spindle in an axial direction, until the cone seals against the seat, and that the spindle bushing (75) in its pushed-out end position abuts with a flange (119) at its inner end the end of the upper part and on its outer side is provided with a recessed O-ring (87) in order to seal against the neck of the upper part.

10. An apparatus according to claim 9, **characterized in that** said prestressing device includes a compression spring (88), e.g. in the form of a spiral spring, the small end of which adjacent the handwheel abuts a cross bar (89) as a spring tension-device, which is threaded onto the spindle and which preferably is secured outside the thread by means of a locking device (90) in a groove in the spindle, that the ends of the cross bar (89) are secured against a rotation by guiding them in lateral taperings (91) of the upper part, and that the end of the compression spring (88) adjacent the cone abuts a holder (92) with a radial plate (93) with a wide, central opening (94) for the spindle to pass through and with circular arc-shaped openings (95), preferably distributed along the periphery.

11. An apparatus according to claim 10, **characterized in that** the plate is surrounded by a short axial ring wall (96) with an outer ring flange (97) and preferably along the inner periphery distributed projections (98) between the plate openings (95) in order to center the compression spring, that the ring flange is fastened between a step (99) in the mounting collar (51) and the collar (53) of the upper part, and that the ring wall (96) has outer annular grooves (100 and 101, respectively) on both sides of the ring flange to receive O-rings or the like (102 and 103, respectively), which abut the upper part and the lower part, respectively, adjacent the respective mounting collar.

12. An apparatus according to claim 11, **characterized in that** the O-ring (103) of the ring wall, which abuts the lower part is an end bead of a membrane (104), preferably made of rubber, reinforced with a fabric material, that from the bead the membrane extends at first in parallel to the cup-shaped wall of the lower part in order to obtain the one side of a soft rounded fold (104), which then at a distance from said wall is bent upwards to a level, which is about the same as the level of the bead or somewhat lower, where the central parts of the membrane are supported by a rotation symmetrical support plate (105), preferably with an outer border (106) and an inner cup part (107), which both extend towards the shoulder of the lower part, that the cup part forms a recess in the support plate and the membrane follows said recess as well as outer upper side of the plate and is fastened by vulcanization on these parts, that in the bottom of the cup part a central bore is provided, designed to let the spindle pass through, the membrane preferably being

pressed through this bore and ending at a short distance from the lower side of the bottom of the cup part, and that the rear end of the cone suitably has a slightly concave or conic surface and receives a sliding plate, which surrounds the spindle and is made of a friction reducing material, e.g. a fluor-ethene plastic material.

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13. An apparatus according to claim 11, **characterized in that** as a regulating device between the high and the low pressure regulating side (15 and 18, respectively) a piston (108) made of metal and/or a plastic material is used, which is a relatively short cylinder (109) with a radial wall (110), the centre of which is a hub (111), which surrounds the spindle, which hub preferably
 10 has the same length as and preferably is somewhat longer than the radial ring wall, the ends of the ring wall and the hub, which face the shoulder, being positioned at roughly the same level, that the hub between its ends surrounds the spindle with a relatively wide annular gap (114), that at least the inner opening (112) of the one hub end has a larger diameter than the spindle, that in at least one of said inner hub openings and/or in the axial middle area of the hub an O-ring (113) is recessed,
 15 which allows a certain swinging of the piston around the spindle to occur, the other hub end and the axial hub centre, respectively, being used as a swinging centre.

14. An apparatus according to claim 13, **characterized in that** the cylinder (109) is guided by a relatively short extension of the ring wall (96), in which an O-ring (115) is recessed,
 20 that the extension houses the piston with a play and has such a length, that the wall material will be sufficient to keep the O-ring (115) in place and to allow the swinging movement of the piston within the peripheral area to be carried out.

15. An apparatus according to claim 13 or 14, **characterized in that** the spindle
 25 diameter varies in the longitudinal direction of the spindle within the region of the movement of the O-ring (113) of the piston, which abuts the spindle, in order to vary the pressure on this ring, and/or that this ring is mounted in a groove with an asymmetrical cross section with a short groove wall in relation to the cone, which with a press ring (120), the shape of which fits the rear end of the cone, is designed to abut the O-ring and have a sealing effect in the axial direction.

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