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(54) Valve for high-vacuum installations

(57) An all-metal valve for high-vacuum installations, with a housing (1,2,3,4) and a valve flap (7) adjustably mounted therein and a valve-seat ring (13). The outer edge of the valve-seat ring (13) is connected with two Belleville springs (15,16) lying coaxial to one another and to the valve-seat ring, disposed in opposing directions and having different diameters. The Belleville spring (16) with the smaller diameter is connected at its outer edge to the valve-seat ring (13) and the Belleville spring (15) of larger diameter is connected thereto at its inner edge. The two Belleville springs form with the housing parts (1,2) a chamber (17) which can be acted upon by a pressure medium. The boundary wall of this chamber (17) formed by the Belleville springs is deformable elastically. The deformability of this boundary wall serves for the closure of the seat ring on the valve flap. When the chamber (17) is relieved of pressure, the valve is automatically opened. The annular body of V-shaped cross-section formed by the two Belleville springs makes possible an extraordinarily compact construction.

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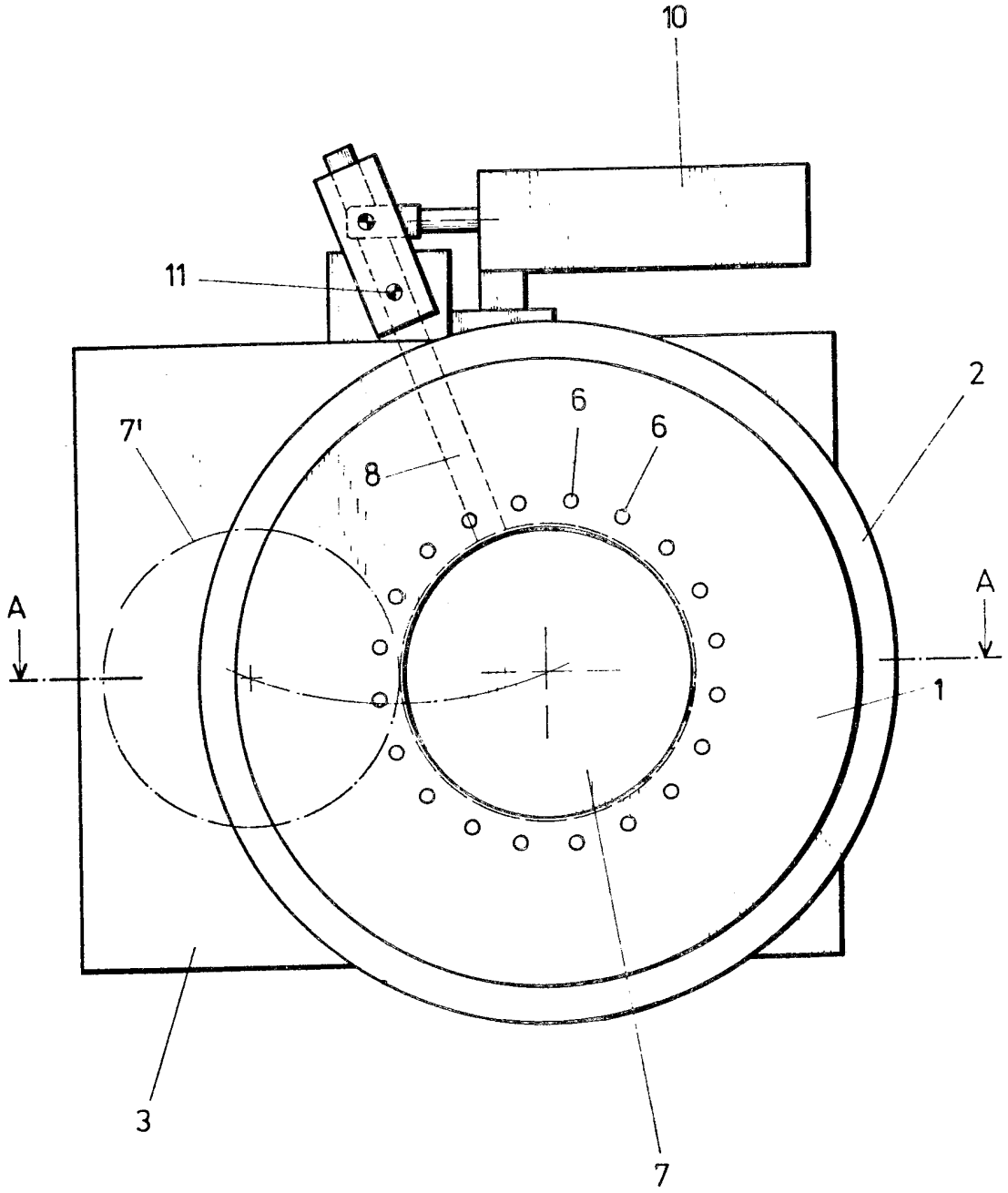
Fig. 1



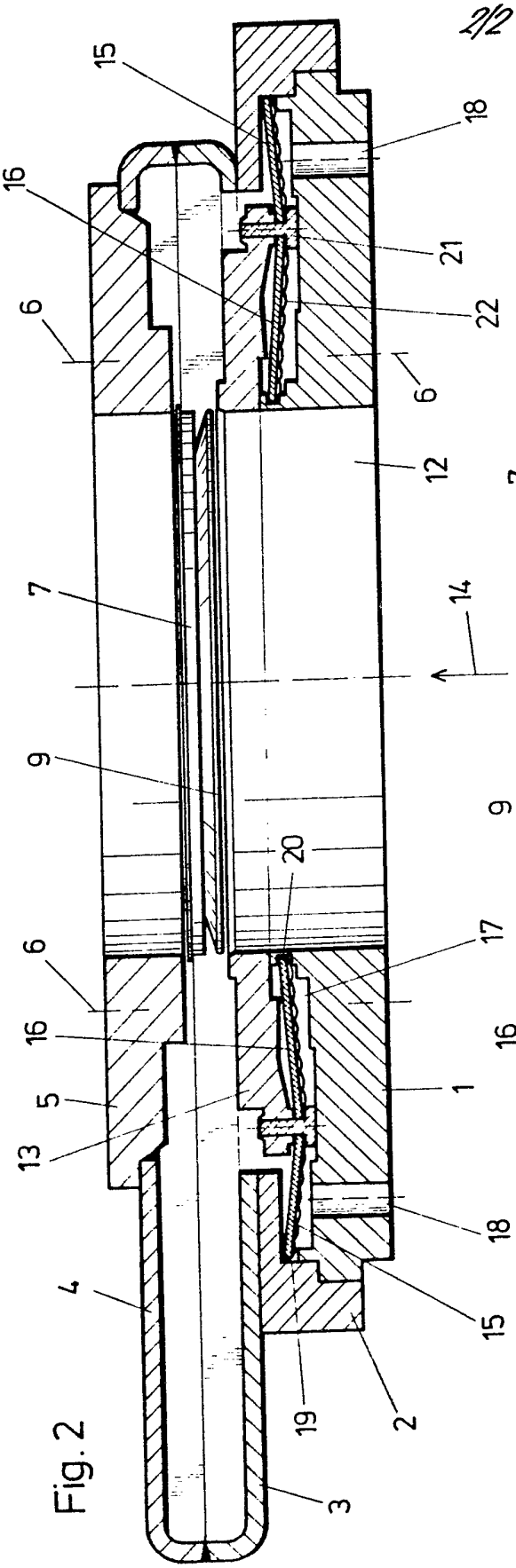

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Fig. 2

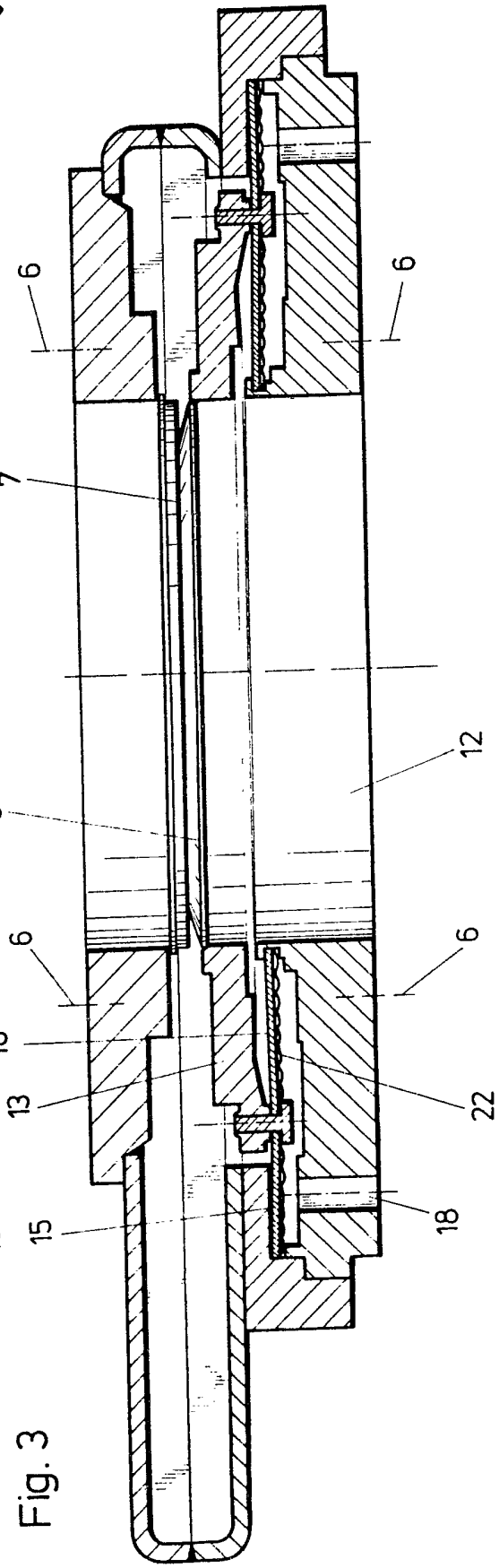
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Fig. 3

SPECIFICATION

Pipe seal, such as an all-metal valve actuator for high-vacuum installations

The invention relates to a tube or pipe seal, such as an all-metal valve slide or actuator for high-vacuum installations, with a housing and a valve flap adjustably mounted therein, in which case the valve flap can be brought by a sliding and/or swinging movement taking place in its plane into a position which closes the passage aperture of the valve actuator or into a position which frees this passage aperture, and, to effect a sealed closure, a valve-seat ring lying coaxial to the passage aperture is axially adjustable and can be pressed towards the valve flap, while the resetting of the valve-seat ring is effected by means of spring force and the valve-seat ring and the valve flap having sealing elements coming into operative contact with one another respectively on the inside and peripherally.

Pipe seals of this type are known *per se*. For the axial adjustment of the valve-seat ring there are used substantially cylindrical metal bellows which are coaxially arranged and define an annular chamber and which can be acted upon by means of a pressure medium. While being acted upon by the pressure medium, the aforementioned metal bellows become extended in the axialy direction and thereby cause displacement of the valve-seal ring which is fluidtightly connected to these bellows. Additional return or restoring springs have to be provided for the resetting of the valve-seal ring during opening of the valve actuator. Because not inconsiderably forces are required to apply the necessary valve-closing pressure, which forces also have to overcome the force of the return springs, the known design required strong metal bellows which took up a lot of space for their installation and arrangement.

Therefore, it is the object of the invention to propose for a pipe seal of the type in question a design for the adjusting mechanism of the valve-seat ring, which has only a small space requirement so as to keep as short as possible the axial constructional length of the pipe seal, in particular of the valve actuator. According to the invention, this is achieved in that the outer edge or rim of the valve-seat ring is connected with at least two conical springs (Belleville springs) which lie coaxial to one another and to the valve-seat ring, which are disposed in opposing directions and which have different diameters, the Belleville spring with the smaller diameter is connected at its outer edge to the valve-seat ring and the Belleville spring with the larger diameter is connected to the valve-seat ring at its inner edge, and the annular body formed by the two Belleville springs, which body is of V-shaped cross-section, defines with its side remote from the valve-seat ring and with the housing a chamber which can be acted upon by a pressure medium, and is supported on the housing with its edges, and the apex of the annular body having V-shaped cross-section projects into this chamber. As a result of the proposal according to the invention it is possible for the pipe seal to be produced with very short overall axial length; accodingly, a requirement can be satisfied which in practice has constantly confronted the designer of such pipe seals.

In another aspect the invention provides a valve comprising a housing having a bore, a disc mounted to close or open the bore, a ring mounted in the housing coaxial with the bore adjacent to and for axial movement to and from the disc, two conically extending annular springs mounted in the housing coaxial with the bore and the ring and on the other axial end of the ring to the disc, the springs being disposed one radially inside the other and converging axially and radially inwardly in opposing directions, the radially outer spring converging axially from the ring, the radially outer periphery of the inner spring and the radially inner periphery of the outer spring being connected to the ring, and the radially inner periphery of the inner spring and the radially outer periphery of the outer spring being axially fixed with respect to the housing, and a pressure chamber formed by the housing and the two springs on the other axial end of the springs to the ring, all such that when the bore is closed by the disc and the pressure chamber is pressurised, the springs are resiliently deformed and axially force the ring into sealing engagement with the disc, and when the pressure chamber is relieved, the springs return to their relaxed position and axially bring the ring away from and out of contact with the disc.

One example of an embodiment of the invention will be illustrated in detail below with reference to the drawing, in which:

Figure 1 shows an elevation of a valve actuator for high-vacuum installations;

Figure 2 shows a cross-section along the line A–A in Fig. 1, in which the valve flap has been swung into the passage aperture of the pipe seal, but in which the actuator has not yet been fluidtightly closed; and

Figure 3 is likewise a section along the A–A in Fig. 1 with the valve flap swung into the passage aperture of the pipe seal, in which case, however, the valve is shown already fluidtightly closed.

The valve actuator or slide according to Figs. 1 to 3 has an actuator housing which comprises housing parts 1, 2, 3, 4 and 5. These parts are advantageously welded together. The axial or side-end valve-housing parts 1 and 5 have means for the possible connection to the flanges of pipelines, for example a ring of threaded bores 6 which in

the sectional views in Figs. 2 and 3 are indicated by their centre line. The vale flap or disc 7, having peripherally arranged sealing strips or sealing lips 9 is fastened to a supporting rod 8. The supporting rod 8 protrudes through the valve housing and is sealed relative thereto. A piston/cylinder unit 10 enables this supporting rod 8 to swing or pivot about the axis 11. By swinging the valve flap 7, the latter is brought into a position in which the passage aperture or bore 12 of the valve actuator is freed or opened (see chain line 7' in Fig. 1) or else into a position in which this passage aperture is closed (Figs. 2 and 3). Instead of such a swinging movement, it is also possible to design the valve actuator structurally so that the valve flap can be brought into the two aforementioned positions by a rectilinear movement.

In order to close the valve actuator when the valve flap 7 has been swung in (Fig. 2), it is necessary for the valve-seat ring 13 to be pressed in axial direction (arrow 14) towards the valve flap 7. This valve-seat ring 13 may be of multipart design, for example by making the higly-stressed sealing zone from a different material to the remainder of the valve-seat ring. The outer edge of the valve-seat ring 13 is here connected with two conical springs (Belleville springs) 15, 16 lying coaxial to one another and to the valve-seat ring 13, disposed in opposing directions and having different diameters. The Belleville spring 16 with the smaller diameter is connected at its outer edge to the valve-seat ring 13 and the Belleville spring 15 with the larger diameter is connected to the valve seat ring at its inner edge. These two Belleville springs 15 and 16 form a ring of V-shaped cross-section, in which case the groove or recess angle of the cross-sectional V may be close to 180°, but is preferably slightly less than 180° when this ring of V-shaped cross-section is unstressed or in its relaxed state or position. This ring, which is of V-shaped cross-section and is formed by the two Belleville springs 15 and 16, defines with its side or axial end remote from the valve-seat ring 13 a pressure chamber 17 which, *via* one or more outwardly directed bores 18, can be acted upon by a pressure medium or can be vented *via* these bores.The outer and inner edges 19 and 20 or the ring, which is V-shaped cross-section and is formed by the two Belleville springs 15 and 16, are supported in the valve housing both in axial and radial direction. The ring or V-shaped cross-section formed by the two Belleville springs 15 and 16 is so arranged that its apex is directed towards the chamber 17 (Fig. 2) when this chamber is relieved. For mounting the adjacent edges of the Belleville springs 15 and 16 the valve-seat ring 13 carries a ring 21 of T-shaped cross-section. The edges of the Belleville springs 15 and 16 rest on the shoulders formed by the cross-bar of this essentially T-shaped ring 21. For the sealing of the chamber 17 relative to the inner valve spaces, the annular body formed by the two Belleville springs 15, 16 carries on its side or axial end facing the pressure chamber 17 at least one sealing diaphragm 22, the edges of which are soldered or welded to the housing and to the T-shaped ring 21. A thin-walled element can be used for this diaphragm 22, since this diaphragm is supported on one side by the ring, even when the chamber 17 is pressurised.

The mode of operation of the described device is evident from the two sectional illustrations according to Figs. 2 and 3, in which Fig. 2 illustrates the device when the pressure chamber 17 in the relieved condition and Fig. 3 illustrates the device when the pressure chamber 17 is pressurised. The unstressed ring of V-shaped cross-section, formed by the two Belleville springs 15 and 16, assumes a position evident from Fig. 2, in which the valve-seat ring 13 is displaced from the already swung-in valve flap 7. If the chamber 17 is now placed under pressure, the ring of V-shaped cross-section is thereby splayed and flattened, its apex being pressed axially towards the valve flap 7 (Fig. 3). The diaphragm 22 keeps the chamber 17 sealed relative to the inner valve spaces. The pressure to be built up in the chamber 17, has to overcome the splaying force of the ring with V-shaped cross-section and has to apply the closing force for the valve actuator. If the chamber 17 is relieved of pressure, the Belleville springs 15 and 16 return because of their elastic behaviour their original position and thus open the valve actuator.

Two Belleville springs 16 and 15 have been used in the illustrated example of the embodiment. Basically it would be possible, if necessary, to provide multilayer or laminated Belleville spring assemblies should this be necessitated by the required restoring forces, which may depend on the size of the valve actuator, and on the nature of its use. Both in the case of the illustrated design and in the case of a design which uses laminated Belleville springs, the adjusting mechanism for the valve-seat ring can be designed extraordinarily compactly, so that it is possible to produce valve actuators with a short constructional axial length.

In the illustrated and described example of an embodiment of the invention, the chamber 17 is sealed relative to the valve inner spaces by a thin, extraordinarily flexible diaphragm 22 which is soldered or welded at its edges relative to the valve housing. This diaphragm may be designed to be very thin-walled and thus very flexible, since even when the chamber 17 is under pressure the diaphragm is always applied against the Belleville springs and is supported thereby, so that this diaphragm is able to perform only sealing func-

tions. In principle; it would also be possible seal the edges of the Belleville springs 15 and 16 directly relative to the valve housing, for example by inserted sealing strips. If the relevant industry makes available elastic shoulders, the possibility cannot be excluded of soldering the edges of the Belleville springs 15 and 16 themselves to the corresponding housing parts. The Belleville springs 15 and 16 themselves may in all cases have either the same or different annular widths.

CLAIMS

1. Pipe seal, such as an all-metal valve slide or actuator for high-vacuum installations, with a housing and a valve flap adjustably mounted therein, in which the valve flap can be brought by a sliding and/or swinging movement taking place in its plane into a position which closes the passage aperture of the valve actuator or into a position which frees this passage aperture, and, to effect a sealed closure, a valve-seat ring lying coaxial to the passage aperture is axially adjustable and can be pressed towards the valve flap, while the resetting of the valve-seat ring is effected by means of spring force and the valve-seat ring and the valve flap have sealing elements coming into operative contact with one another respectively on the inside and peripherally, wherein the outer edge or rim of the valve-seat ring (13) is connected with at least two conical springs (Belleville springs) (15,16) which lie coaxial to one another and to the valve-seat ring (13), are disposed in opposing directions and have different diameters, the Belleville spring (16) with the smaller diameter is connected at its outer edge to the valve-seat ring (13) and the Belleville spring (15) with the larger diameter is connected to the valve seat ring at its inner edge, and the annular body of V-shaped cross-section formed by the two Belleville springs (15,16) defines with its side remote from the valve-seat ring (13) and with the housing (1,2) a pressure chamber (17) which can be acted upon by a pressure medium, and is supported on the housing (1,2) with its edges (19,20) and the apex of the annular body having V-shaped cross-section projects into this chamber (17).

2. Pipe seal according to Claim 1, wherein the valve-seat ring (13) carries at its outer edge and on its side remote from the valve flap (7) a ring (21) of substantialy T-shaped cross-section and the adjacent edges of the Belleville springs (15,16) rest on the shoulders formed by the cross-bar of the ring (21) of T-shaped cross-section.

3. Pipe seal according to Claim 1 or Claim 2, wherein the annular body formed by the two Belleville springs (15,16) carries on its side facing the pressure chamber (17) at least one sealing diaphragm (22), the edges of which are preferably soldered or welded to the housing and to the T-shaped ring (21) respectively.

4. A valve comprising a housing having a bore, a disc mounted to close or open the bore, a ring mounted in the housing coaxial with the bore adjcent to and for axial movement to and from the disc, two conically extending annular springs mounted in the housing coaxial with the bore and the ring and on the other axial end of the ring to the disc, the springs being disposed one radially inside the other and converging axially and radially inwardly in opposing directions, the radially outer spring converging axially away from the ring, the radially outer periphery of the inner spring and the radially inner periphery of the outer spring being connected to the ring, and the radially inner periphery of the inner spring and the radially outer periphery of the outer spring being axially fixed with respect to the housing, and a pressure chamber formed by the housing and the two springs on the other axial end of the springs to the rings all such that when the bore is closed by the disc and the pressure chamber is pressurised, the springs are resiliently deformed and axially force the ring into sealing engagement with the disc, and when the pressure chamber is relieved, the springs return to their relaxed position and axially bring the ring away from and out of contact with the disc.

5. A valve substantially as herein described with reference to and as shown in the accompanying drawings.

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