(19) DANMARK

(10) DK/EP 4185796 T3

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: *F 16 K 31/122 (2006.01)* *F 16 K 1/36 (2006.01)* *F 16 K 27/02 (2006.01)* *F 16 K 37/00 (2006.01)*

(45) Oversættelsen bekendtgjort den: **2024-07-01**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2024-05-08**

(86) Europæisk ansøgning nr.: **21743467.9**

(86) Europæisk indleveringsdag: **2021-07-12**

(87) Den europæiske ansøgnings publiceringsdag: **2023-05-31**

(86) International ansøgning nr.: **EP2021069356**

(87) Internationalt publikationsnr.: **WO2022017856**

(30) Prioritet: **2020-07-21 DE 102020004369**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(73) Patenthaver: **GEA Tuchenhagen GmbH, Am Industriepark 2-10, 21514 Büchen, Tyskland**

(72) Opfinder: **BURMESTER, Jens, , 23883 Grambek, Tyskland**
DIRKS, Stephan, , 21493 Schwarzenbek, Tyskland

(74) Fuldmægtig i Danmark: **CHAS. HUDE A/S, Langebrogade 3B, 1411 København K, Danmark**

(54) Benævnelse: **Ventilapparat**

(56) Fremdragne publikationer:
EP-A1- 1 592 905
WO-A1-2017/076411
DE-A1- 3 342 405
US-A- 3 211 418

VALVE DEVICE

Description

The invention relates to a valve device according to the preamble of the first claim.

Fluids with powdery components present a challenge for processing technology. Such fluids occur, for example, in spray drying systems for food processing technology. Due to this area of application, such systems are subject to very strict requirements regarding the hygienic conditions in them. In order to meet such high standards, what is known as "cleaning-in-place" (CIP) is performed.

The components of the spray drying and processing system should therefore be designed such that little to no buildup forms in them from the outset, and such that they can be cleaned well during CIP. The components include valve devices for switching the fluid flow, for example, lifting valve devices.

WO 2017/076411 A1 shows a lifting valve designed for this use with a closing body. On an end face, the closing body has a contour that is adapted to a contour of the tank or of the line to which the lifting valve is connected. A rinsing channel surrounding the closing body is arranged between a seal, which surrounds the closing body and interacts with a valve seat, and the tank.

WO 2009/100920 A1 presents a compact lifting valve that can be cleaned well. The spring package of a pneumatic drive for the closing body is integrated at least in portions into the closing body. WO 2017/088938 A1 presents how the concept from WO 2009/100920 A1 can be advantageously used in the aforementioned applications with powdery media.

A valve with a valve housing and a valve cover is known from EP 1 592 905 A1. Part of the valve cover is a fixedly arranged valve holder, on which a valve element is arranged so as to be axially movable. The valve element is designed to engage with a valve seat in

a closed position and thus to block a passage between a first opening and a second opening of the valve and to unblock it in a state that is lifted from the valve seat.

US 3211418 A describes a shut-off valve having a piston body with a conical outer side, which is designed to interact with a conical bore of a housing of the valve, said bore forming a valve seat. A sealing ring is held on the piston body and, in a closed position of the valve, tightly abuts the conical bore. In one exemplary embodiment, a distance between the conical outer side of the piston body and the conical bore exists in the closed state, such that the sealing effect in the closed state is ensured by the sealing ring at all times.

A high-pressure water shut-off valve is known from DE 33 42 405 A1, having a sealing cone that is formed on an actuation plunger and can be pressed against a seal seat in the valve housing by the fluid pressure and a spring-loaded restoring force. A sealing cone coming to rest on the cone jacket-shaped seal seat is an end-face component of a cylindrical choke piston and a sealing face is arranged on the end face of a cylindrical receiving bore for a choke piston. By dimensioning the outer diameter of the choke valve accordingly in comparison to the inner diameter of the receiving bore, a choke gap is formed between the receiving bore and the choke piston. The choke gap is intended to create an operating state shortly before the sealing cone is placed onto the sealing face as well as immediately after the sealing cone is lifting from the sealing face in which there is hardly any fluid pressure in the sealing face region. With this, the flow speed in the sealing gap should be very small, such that the wear-promoting effect of the highly pressurized fluid is ineffectual.

The object was therefore to create a valve device with improved hygienic properties and improved CIP capability.

This object is achieved by a valve device having the features of the first claim. The depending claims present advantageous developments.

The starting point is a valve device, in particular a lifting valve device, comprising a housing, a valve seat, a movable closing body which can be brought into an open position in an opening movement and into a closed position in a closing movement, in which closed position the closing body and the valve seat are in sealing contact, and comprising a piston to which pressure medium can be applied and which is received in a cylinder. This valve device is now designed such that the cylinder is part of the closing body. In contrast to typical pneumatic drives, according to the claimed solution the piston is a resting component while the cylinder is moved as part of the closing body. Thus, the drive for the closing body, or respectively an adjustment device, is integrated into this closing body. The valve device is therefore compact. This results in a reduction of the product-contacting surface of the closing body and in turn better cleanability, and consequently an improved CIP capability. The valve device is also cost-effective to produce. These advantages arise to a large degree because a part of the drive to which a pressure medium can be applied is integrated into the closing body and thus space for installing a spring package is unnecessary.

One development relates to conducting the pressure medium for applying to the piston. A cost-effective solution provides that the piston is connected to an inner hollow rod which houses an air channel that passes through the inner hollow rod and the piston and is connected to a first pressure chamber, which is surrounded by the piston and the cylinder. This hollow rod can run along the lift axis. The pressure medium supply takes place in this manner through a resting component, which is advantageously simply to implement.

According to the invention, it is also provided that the closing body extends through a housing part and a first sliding bearing and a second sliding bearing are provided which are arranged on opposite ends of the housing part. The goal is to achieve a distance between the sliding bearings that prevents tilting in relation to the lift axis. On the other hand, the distance should not unnecessarily increase the space required for the valve device. Therefore, this distance can be approximately a diameter of the piston or of the closing body, wherein the diameter is measured in a plane perpendicular to the lift axis. The distance is advantageously approximately a third to half of the length of the closing body along the lift axis.

In another development, the valve device is designed such that a seal, which is received at the closing body in a groove and fills same, and a valve seat are designed to be semi-axial. This design ensures improved centering of the closing body in the closed position of the valve.

According to the invention, an annular channel surrounding the closing body is also arranged between a housing part and the closing body. A rinsing or barrier medium, for example, a rinsing gas such as sterile air, can be applied to the annular channel. As an advantage, this allows buildup to be greatly reduced in the region of the passage, for example, in applications with powdery media.

The previous design is additionally improved in that a choke gap is formed between the housing part and the closing body from the annular channel towards a connection. Rinsing or barrier medium can flow through this choke gap against the product flow and thus reduce buildup to a large degree.

According to another development of the valve device, it comprises a guide rod which extends in parallel to a lift axis and, in a plane to which the lift axis is perpendicular, is enclosed at least in portions by a plate provided on the closing body. A positive-locking connection between the plate and the guide rod is created in a circumferential direction about the lift axis. This prevents a rotation of the closing body about the lift axis. This is advantageous, for example, for the design and matching of the components with each other, in which undesired gaps between the components can be largely avoided and the desired gaps, for example, the choke gap, can be reliably set.

In another development, the valve device is designed such that a first housing part has a first flange which is brought together with a second flange provided on a second housing part, and a bolt is provided which is engaged with each of the two flanges. This secures the spatial arrangement of the components in relation to each other and prevents in particular the flanges from being installed rotated in relation to each other. This also

simplifies the matching of the component with each other and thereby creates greater precision and thus better hygienic conditions.

Another improvement of the valve device is achieved in that an end face of the closing body is designed to be adapted so as to be flush, or respectively terminating flush with, an inner wall of a connection. This allows the closing body and the inner wall to be cleaned at the same time, for example, with a pipeline pig. This development is particularly effective in conjunction with the developments that prevent a rotation of the closing body and the flange about the lift axis.

Integration of the valve device into a processing system is improved in that the valve device comprises a sensor system with a first position sensor and a second position sensor, which are arranged on opposite ends of a displacement path of the closing body.

The invention will be explained in more detail on the basis of an exemplary embodiment and its developments. The advantages will also be presented in more depth. In the drawings:

Fig. 1 shows a section through a valve device in its open position;
Fig. 2 shows a section through the valve device in its closed position;
Fig. 3 shows a view of the detail X, of a valve seat region of the valve device;
Fig. 4 shows a view of the detail Y, of a flange connection of the valve device.

Fig. 1 shows a valve device with a multi-part housing. A first housing part 1 has a first connection 2. In a second housing part 3, a second connection 4 is provided. A passage 5 is provided between the connections 2 and 4.

A valve seat 6 is arranged in the passage 5. The valve device has a closing body 7 which can be brought into sealing contact with the valve seat 6 in order to disconnect a fluid connection between the first and second connection 2 and 4. The fluid connection can be re-established by releasing the sealing contact.

The closing body 7 extends through a third housing part 8 of the valve device and can be displaced into an interior space of a hood 9. On a side of the closing body 7 facing away from the passage 5, a cylinder 10 with a running surface 11 is provided in said closing body. A piston 12 in sealing and displaceable contact with the running surface 11 divides a volume of the cylinder 10 into a first pressure chamber 13 and a second pressure chamber 14. A cover 15 closes the cylinder in an air-tight manner.

The piston 12 is connected to an inner hollow rod 16 which houses an air channel 17 that passes through the inner hollow rod 16 and the piston 12 and is connected to the first pressure chamber 13. The inner hollow rod 16 is received in an outer hollow rod 19, forming an air gap 18. At least one bore 20 in the outer hollow rod 19 connects the air gap 18 to the second pressure chamber 14.

As soon as a pressure medium, for example, pneumatic air, is fed through the air channel 17 into the first pressure chamber 13 and the pressure in the first pressure chamber 13 exceeds the pressure in the second pressure chamber 14, the closing body 7 is moved in the direction of the valve seat 6 and then brought into sealing contact with it. The valve device is now located in a closed position shown in Fig. 2. The fluid connection between the connections 2 and 4 is disconnected. Preferably, the second pressure chamber 14 is vented in this step.

Conversely, a pressure medium can be supplied to the second pressure chamber 14 via the air gap 18 and the bore 20. If the pressure in the second pressure chamber 14 exceeds the pressure in the first pressure chamber 13, the closing body moves into the open position shown in Fig. 1. The first pressure chamber 13 can be vented in this step.

During the movements of the closing body 7, the cylinder 10 moves while the piston 12 can remained fixed in place, preferably remains fixed in place.

Due to this structure, the means, also called the drive, necessary for adjusting the closing body 7 is integrated compactly into the valve device. The closing body 7 is a part of the drive. This structure is cost-effective and simple to produce and maintain. Another

advantage is that the closing body 7 can be guided on a large diameter, such that narrow gap dimensions can be maintained, for example, in the region of the valve seat 6.

For guidance, a first and a second sliding bearing 21 and 22 are provided, which are arranged on opposite ends of the third housing part 8 and can be shaped in the form of a band, enclosing the cylinder 10. A good guidance of the closing body 7 is achieved in that the sliding bearings 21 and 22 have, in the direction of the lift axis A, a distance from each other that is in the range of a diameter of the piston, measured transversely to the lift axis A, or of an outer diameter of the closing body 7, measured transversely to the lift axis A, and in the range of the cylinder 10.

The closing body 7 can be designed to be secured against rotation about a lift axis A. For this purpose, a guide rod 23 extending parallel to the lift axis A can be provided below the hood 9. In a plane to which the lift axis A is perpendicular, this guide rod 23 is enclosed at least in portions by a plate 24 fastened to the closing body 7, such that a positive-locking connection arises that suppresses the rotation of the closing body 7 about the lift axis but allows the movement along the lift axis A. In this arrangement, the rotation lock is designed on a large diameter which is greater than the diameter of the cylinder 10. This results in high precision. Since the rotation lock is arranged outside of the pressure medium or product-conducting region, additional sealing measures are unnecessary.

Under the hood 9, a sensor system can be provided, with which the position of the closing body 7 can be detected. This sensor system can comprise, for example, a first position sensor 27 and a second position sensor 28. The position sensors 27 and 28 are arranged at opposite ends of the displacement path of the closing body. They can be designed as proximity switches which interact with a matching target mounted on the cylinder 10. A third position sensor can be provided between the first and second position sensor 27 and 28, with which an intermediate position of the closing body can be verified. The intermediate position can be achieved by corresponding application of pressure medium to both sides of the piston. An intermediate position can be advantageous during cleaning of the valve in order to disrupt the cleaning agent flow in a targeted manner, for example, to induce eddy formation. These eddies can then improve the elimination of buildup.

The design that is secured against rotation allows an end face 25 of the closing body 7 to be designed to be adapted to, for example, flush with, an inner wall 26 of the second connection 4, such that the end face 25 forms a wall portion of the inner wall 26 in the closed position of the closing body 7. This improves the cleanability of the valve device. When the second connection 4 is designed, for example, as a line, this results in an arrangement that can be cleaned with a pig. If static flow areas arise on the closing body 7 due to the end face 25 being designed to terminate flush with the inner wall 26, at least one transverse bore in the closing body 7, which bore connects the region of the static flow area to a flow-contacted part of the closing body 7, for example, the end face 25, can be provided.

In Fig. 3, the detail X from Fig. 1 and 2 is shown enlarged. The detail X is shown in the closed position according to Fig. 2.

A seal 30, which is received at the closing body 7 in a groove and fills same, contacts the valve seat 6 and seals the valve seat 6 against the closing body 7 in a fluid-tight manner. The seal 30 and the valve seat 6 can be designed to be semi-axial, which improves the centering of the closing body 7 in the valve seat 6.

An annular channel 31 surrounding the closing body 7 is arranged between the second housing part 3 and the closing body 7. It is preferably in a plane to which the lift axis A is perpendicular, wherein an axis of symmetry of the rotationally symmetrical ring coincides with the lift axis A.

The contact between the valve seat 6 and the closing body 7 seals the annular channel in the fluid flow direction toward the first connection 2. The seal 30 can be arranged immediately adjacent to the annular channel 31.

A choke gap 32 is formed between the second housing part 3 and the closing body 7 in the fluid flow direction from the annular channel 31 towards the second connection 4. The choke gap 32 allows a slight flow from the annular channel 31 through the choke gap

32 in the direction of the second connection 4. The guidance and bearing of the closing body 7 in the first and second sliding bearings 22 and 23 on a wide diameter and the rotation lock enable the choke gap 32 to be designed along a complete circumference of the closing body 7 and a width of this choke gap to be adapted to the requirements.

At least one inlet 33 opens into the annular channel 31; preferably, multiple inlets are distributed along the annular channel 31 in the circumferential direction, advantageously in an equidistant arrangement. It has been shown that a particularly good result can be achieved with four equidistantly distributed inlets. The inlets can be seen well in the open position of the valve device in Fig. 1. A medium that escapes through the choke gap 32 can be let in through the inlet 33. The medium can be, for example, a barrier gas, which prevents contaminants from settling in the annular channel 31 and the choke gap 32. Alternatively or in a second method step, the medium can be a cleaning agent.

In Fig. 4, the detail Y from Fig. 1 and 2 is shown enlarged.

The first housing part 1 has a first flange 34 which is brought together with a second flange 35 that is arranged on the second housing part 8. A clamp 36 presses the flanges 34 and 35 releasably against each other. A bolt 37 which is engaged with each of the two flanges 34 and 35 is provided so that the flanges 34 and 35 cannot be rotated in relation to each other. This is advantageous when the end face 25 of the closing body 7 is not rotationally symmetrical, in order to orient the closing body 7. This embodiment interacts with the rotation lock described above with the guide rod 23 and the plate 24 and reinforces its advantages.

List of Reference Signs

1	First housing part
2	First connection
3	Second housing part
4	Second connection
5	Passage
6	Valve seat
7	Closing body
8	Third housing part
9	Hood
10	Cylinder
11	Running surface
12	Piston
13	First pressure chamber
14	Second pressure chamber
15	Cover
16	Inner hollow rod
17	Air channel
18	Air gap
19	Outer hollow rod
20	Bore
21	First sliding bearing
22	Second sliding bearing
23	Guide rod
24	Plate
25	End face
26	Inner wall
27	First position sensor
28	Second position sensor
29	Electronic system
30	Seal

31	Annular channel
32	Choke gap
33	Inlet
34	First flange
35	Second flange
36	Clamp
37	Bolt
A	Lift axis
x	Detail
y	Detail

PATENTKRAV

1. Ventilapparat, navnlig løfteventilapparat, med et hus, et ventilsæde (6), et bevægeligt lukkelegeme (7), som kan bringes i en åbneposition ved en åbnebevægelse og i en lukkeposition ved en lukkebevægelse, i hvilken lukkeposition lukkelegemet (7) og ventilsædet (6) er i tætnende kontakt, og omfatter et stempel (12),der kan påvirkes af trykmedium, og som er modtaget i en cylinder (10), hvorved cylinderen (10) er en del af lukkelegemet (12),
kendetegnet ved, at lukkelegemet (7) strækker sig gennem en husdel (8), og et første glideleje (21) og et andet glideleje (22) er tilvejebragt og er arrangeret på modsatte ender af husdelen (8), og
ved, at en ringformet kanal (31), der omgiver lukkelegemet (7), er arrangeret mellem en husdel (3) og lukkelegemet (7), hvorved en drosselspalte (32) er dannet fra den ringformede kanal (31) hen imod en forbindelse (4) mellem husdelen (3) og lukkelegemet (7).

2. Ventilapparat ifølge krav 1,
kendetegnet ved, at stemplet (12) er forbundet til en indre, hul stang (16), som rummer en luftkanal (17), der passerer gennem den indre, hule stang (16) og stemplet (12) og er forbundet til et første trykkammer (13), som er omgivet af stempel (12) og cylinder (10).

3. Ventilapparat ifølge et af de foregående krav,
kendetegnet ved, at en tætning (30), som er modtaget på lukkelegemet (7) i en rille og udfylder denne, og ventilsædet (6) er udført som halvaksial.

4. Ventilapparat ifølge et af de foregående krav,
kendetegnet ved, at der er tilvejebragt en føringsstang (23), som strækker sig parallelt med en løfteakse (A) og, i et plan, som løfteaksen (A) står vinkelret på , i det mindste afsnitsvist er omsluttet af en plade (24), der er tilvejebragt på lukkelegemet (7).

5. Ventilapparat ifølge et af de foregående krav,

kendetegnet ved, at en første husdel (1) omfatter en første flange (34), der er bragt sammen med en anden flange (35), som er tilvejebragt på en anden husdel (3), og der er tilvejebragt en bolt (37), som er i indgreb med hver af de to flanger (34, 35).

6. Ventilapparat ifølge et af de foregående krav,
kendetegnet ved, at en endeflade (25) på lukkelegemet (7) er udført tilpasset som flugtende med en indre væg (26) i en tilslutning (4).

7. Ventilapparat ifølge et af de foregående krav,
kendetegnet ved, at et sensorsystem omfatter en første positionssensor (27) og en anden positionssensor (28), der er arrangeret ved modsatte ender af en forskydningsstrækning for lukkelegemet (7).

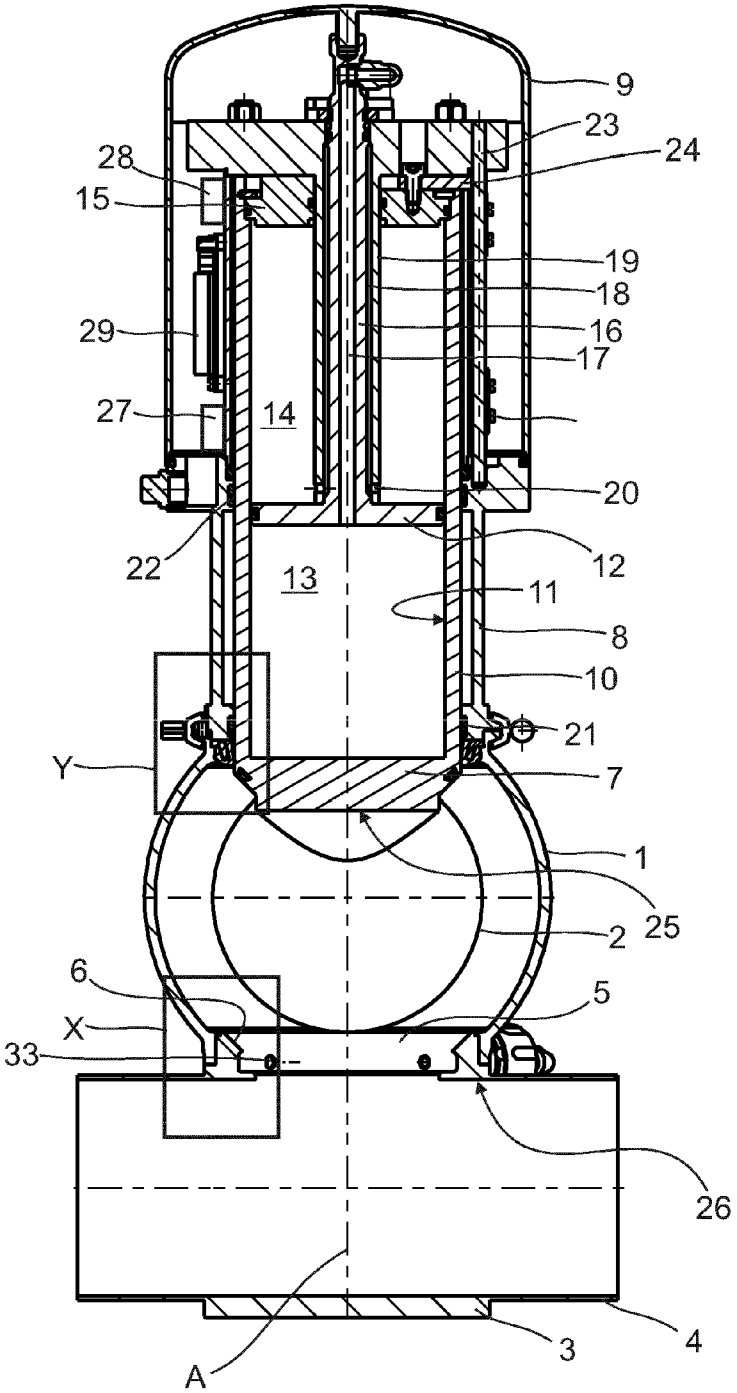
9
23
24
28
15
19
18
29
16
17
27
14
20
22
12
13
11
8
10
21
Y
7
1
25
2
6
5
X
33
26
A
3
4

Fig. 1

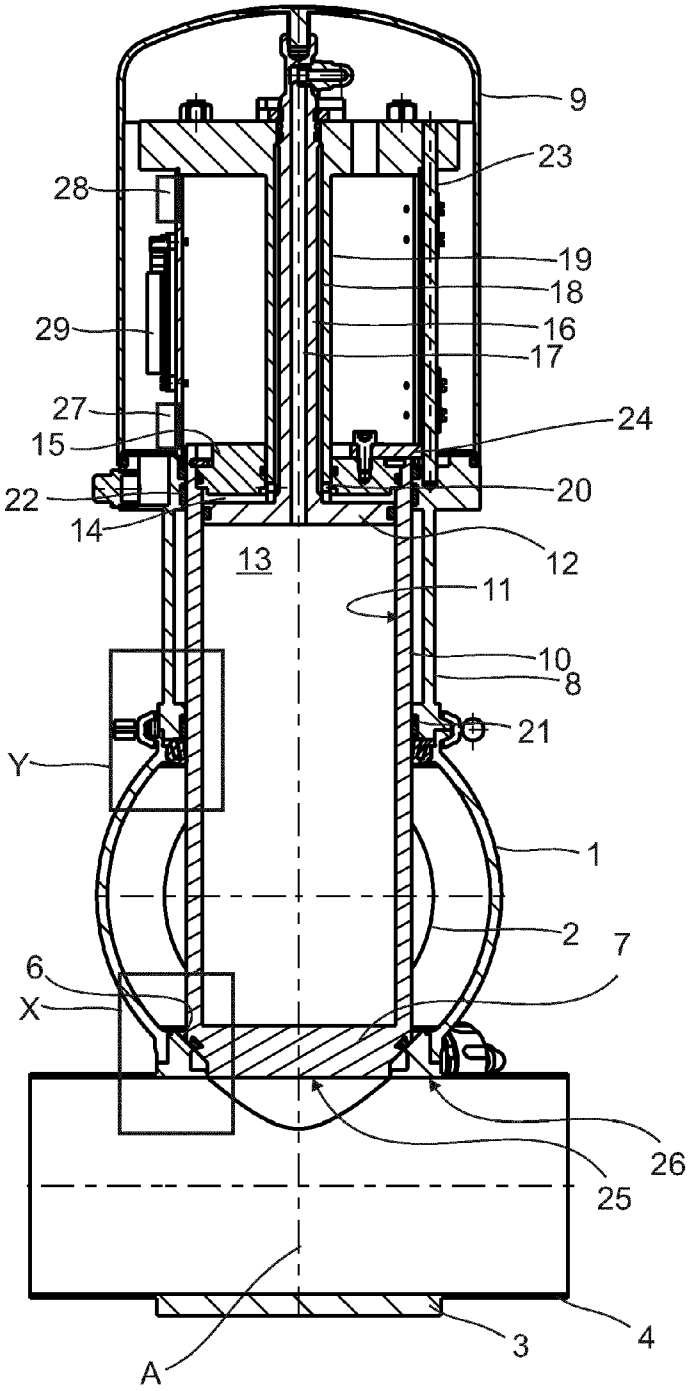
9
23
28
19
18
29
16
17
27
24
15
20
22
14
12
13
11
10
8
21
Y
1
2
7
6
X
26
25
4
3
A

Fig. 2

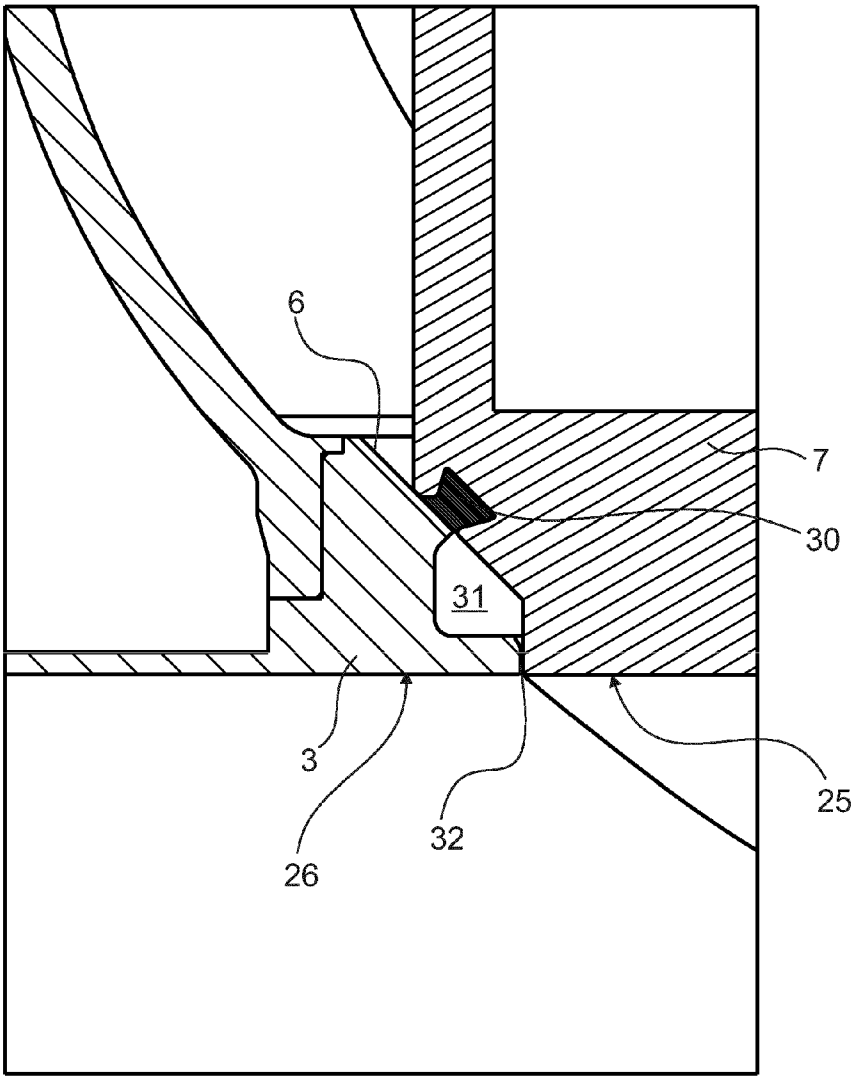

Fig. 3

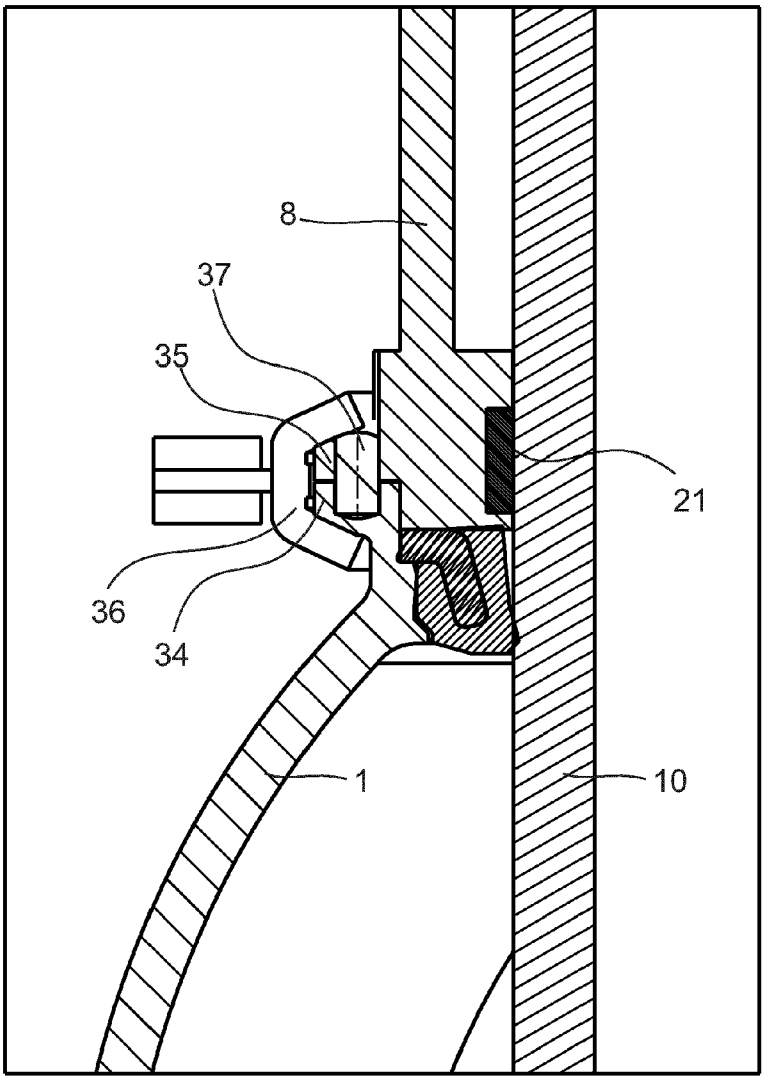

Fig. 4