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(73) Patenthaver: **GEMÜ Gebr. Müller Apparatebau GmbH & Co. Kommanditgesellschaft, Fritz-Müller-Strasse 6-8, 74653 Ingelfingen, Tyskland**

(72) Opfinder: **Haidt, Harald, Nussbaumweg13/4, 74613 Öhringen, Tyskland**

(74) Fuldmægtig i Danmark: **Zacco Denmark A/S, Arne Jacobsens Allé 15, 2300 København S, Danmark**

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Description

The invention relates to a valve device having a diaphragm to separate a fluid-carrying region from a non-fluid-carrying region, in accordance with the preamble to claim 1.

Valve devices having a diaphragm of this kind are known. What in particular is known is for the diaphragm to be supported by means of a supporting region.

Known from DE 10 2007 023 469 B3 is for example a diaphragm valve in which a mechanical supporting means has at least two supporting members. The two supporting members each have a different supporting contour on a side adjacent a sealing diaphragm. As a function of the position of a valve closure member, the supporting contour can be brought into contact with the sealing diaphragm to form a supporting surface.

Known from EP 0 572 966 Al is a diaphragm assembly for pneumatic regulators in which an intermediate piece joins a diaphragm plate 12 on one side of a diaphragm and a valve element on the other side of the diaphragm. From DE 10 2008 031 652 Al is known a diaphragm valve having a sealing diaphragm for the static sealing of a flow space. From DE 2 727 993 Al is known a device for keeping two adjacent spaces separated by a diaphragm.

Known from EP 1 710 481 Al is a diaphragm valve in which a supporting means resembling a fan impeller is used to strengthen and support an inserted diaphragm. From EP 0 109 626 Al there is known a diaphragm valve having a supporting surface. From EP 0 581 287 Al is known a regulator valve having diaphragm support.

Known from DE 7 241 059 Al is a diaphragm valve having a valve closure member, there being an elastomeric diaphragm whose free part rests against a support throughout the entire travel. Other published patents in the relevant field are DE 10 2006 025 653 Al, JP 2011 237039 A, US 6 123 320 A, JP Hll 37329 A, WO 2008/113516 Al and WO 2009/019036 Al. A valve device in accordance with the preamble to claim 1 is also shown in DE 18 98 241 U.

It is an object of the invention to provide a valve device which operates reliably, which has a long life and which can be produced at low cost.

The problem underlying the invention is solved by claim 1. Advantageous refinements are specified in the dependent claims. Features important to the invention can also be found in the description below and in the drawings, in which case the features may be important to the invention both when considered in isolation and in different combination, although no further explicit reference will be made to this fact.

What is advantageously achieved by the fact that a first supporting region and/or a second supporting region and/or a diaphragm are of a form such that the diaphragm, in particular as a result of a movement of the actuating stem and/or in both the end-positions of its travel, i.e. the opened position of travel and the closed position of travel, is able to bear against the first and/or second supporting region in such a way that the diaphragm, in particular when subject to a fluid pressure in a fluid-carrying region, is loaded substantially transversely to the longitudinal axis of the actuating stem, is on the one hand that a thinner diaphragm can be used and longer travels become possible for the actuating stem. On the other hand, the pressure in the fluid-carrying region can be increased at the same time. There is thus provided a valve device which, advantageously, has not only lengthened travel but also, at the same time, increased resistance to pressure.

Also forming part of the invention is the fact that, in an opened position of travel, a radially inner portion of the diaphragm, which is spaced away from the second supporting region, is more sharply curved than a radially outer portion of the diaphragm, which bears against the first supporting region, and, in a closed position of travel, the radially outer portion of the diaphragm, which is spaced away from the first supporting region, is more sharply curved than the radially inner portion of the diaphragm, which bears against the second supporting region. This, once again, has a beneficial effect on the stresses. Also, a longer valve travel can be achieved as a result of the curvatures of different sharpnesses of the diaphragm in the respective end-positions of travel.

For the same wall thickness, a small radius (as in the case of a thin tube) to which pressure is applied is subject to lower stresses than a larger radius (a thicker tube) and is thus more resistant to pressure. The operation and layout of the supporting regions provide, as the diaphragm rolls over them, a defined contour in the regions which bear against the diaphragm which is selected in such a way that the maximum permitted stresses on the edge fibres of the diaphragm material are allowed for and are not exceeded. In the unsupported regions, the contours compel there to be as small a radius as possible in the diaphragm (and one which is smaller than in the supported regions), which means that there too the permitted stress levels are not exceeded. The result is thus a correspondingly high strength under pressure. By virtue of the invention, the diaphragm is also not forced into the contour for rolling contact under pressure and any kinking of the diaphragm is thus prevented.

In accordance with the invention, the first and the second supporting regions are of a concave curvature. This gives the diaphragm a shape in the opened and closed positions of travel which is particularly beneficial as far as stresses are concerned.

In a refinement, it is proposed that the first supporting region be arranged at a first angle to the longitudinal axis and the second supporting region be arranged at a second angle thereto, the first and the second angles being substantially equal. What is thereby achieved is even deformation of the diaphragm at the time of actuation which is thus kind to its material.

Also advantageous is that refinement in which, in a state where no force is applied to it, the diaphragm is in the form of a semi-torus whose curvature in the radial direction is approximately constant. In this case, the shape of the diaphragm, which corresponds to that of a torus sliced in half in the state where it is not subject to force, is preferably changed to a geometry which is in part similar to that of a truncated cone in the two end-positions of travel in which the diaphragm bears against one of the supporting regions.

It is also proposed that the diaphragm and a closure portion which bears against a valve seat in the closed position of travel are all in one piece. This reduces production and assembly costs and improves the reliability of sealing even at high pressures.

The diaphragm may comprise the material polytetrafluoroethylene (PTFE) or a modified PTFE. This is a relatively inelastic material compared with elastomeric diaphragms, and with it the advantages according to the invention are particularly pertinent.

The principle of operation according to the invention can be further assisted by using for the diaphragm a wall-thickness which varies in the radial direction, with the greatest wall-thickness being on the inside radially.

Also, at least one supporting region may be in one piece with the actuating stem in the valve device. This simplifies assembly and reduces production costs. It also increases reliability of operation.

In an advantageous embodiment, the first supporting region and the second supporting region are arranged substantially concentrically to one another. Because of this concentric arrangement, the diaphragm is advantageously tensed over a region which extends substantially between the supporting regions and which is aligned transversely to a longitudinal axis of the actuating stem. The advantageous result is thus that kinking of the diaphragm or uneven loading thereof is prevented.

In an advantageous embodiment, first and/or second supporting regions are situated in the non-fluid-carrying region of the valve device, whereby edges and transitions between materials are advantageously reduced in the fluid-carrying region. Hence, contamination can be prevented in the fluid-carrying region.

In a further advantageous embodiment, the first supporting region flares towards the fluid-carrying region and is securely connected to the valve body. The second supporting region tapers towards the fluid-carrying region and is securely connected to the actuating stem. Because of this design, the returning force on the actuating stem in a direction opposite to that of actuation can advantageously be defined by means of the second supporting region. In addition, the valve device thus leaves clear a region in which the diaphragm can move and can come to bear against the respective supporting regions. As well as this, support is also advantageously made possible in every state of operation with, at the same time, an increase in the travel.

In a further advantageous embodiment, the first and/or second supporting regions, when seen in plan looking from the direction of an actuator, are each of an annular form, with the corresponding annuluses being of substantially an equal radial width. Starting from a central position, this makes it possible for approximately equally long distances to be covered in both directions of travel, starting from the central position.

In a further advantageous embodiment, an outside diameter of the second supporting region and an inside diameter of the first supporting region are adapted to one another in such a way that the second supporting region can penetrate into an inner opening in the first supporting region with substantially no clearance. This advantageously prevents any jamming of the diaphragm and at the same time ensures that there is a supporting surface which is as large as possible in any position along the travel.

In a further advantageous embodiment, the first supporting region has a first supporting surface and the second supporting region a second supporting surface. The first and/or the second supporting surfaces are of a concave form in cross-section. This concave form makes it possible for the diaphragm to be received with as even as possible a distribution of forces in the diaphragm. At the same time, withdrawal and re-application of the diaphragm can be assisted in an advantageous way. In addition, a mating of the supporting surfaces to the shape of the diaphragm can occur in this way.

A further advantageous embodiment makes provision for the diaphragm to be more sharply curved in cross-section than the first and/or the second supporting surface in a state where no force is applied to it. If the diaphragm has an appropriate intrinsic curvature, this advantageous embodiment results in application of the diaphragm to the relevant supporting surface, and withdrawal of it therefrom, being assisted.

In a further advantageous embodiment, the first supporting surface and the second supporting surface make a first and a second included angle respectively in cross-section, with the first and the second angles being substantially equal. This leaves clear a space which, when there is a movement in travel, prevents the diaphragm from kinking. In addition, supporting surfaces of approximately the same kind are created for the diaphragm both in a radially inward direction and in a radially outward direction.

In a further advantageous embodiment, at least one of mutually adjacent edges of the supporting regions has a radius, whereby damage to the diaphragm is prevented particularly when the said diaphragm is bearing against the second supporting region.

Other features, possible applications, and advantages of the invention can be seen from the following description of embodiments of the invention, which are shown in the drawings. In this case, all the features which are described or shown, on their own or in any desired combination, form the subject matter covered by the invention, regardless of how they are brought together in the claims or of how they are referred back to one another and regardless of how they are worded and shown in the description and drawings respectively. The same reference numerals are used in all the drawings for parameters and features which perform equivalent functions even where the embodiments are different.

Illustrative embodiments of the invention are explained in what follows by reference to the drawings. In the drawings:

Fig. 1 is a schematic cross-section through a first embodiment of valve device;

Fig. 2 is an exploded view of the valve device;

Fig. 3 shows various components of the valve device in a view in section;

Fig. 4 shows the valve device in a first position of travel;

Fig. 5 shows the valve device in a second position of travel; and

Fig. 6 is schematic section through part of a second embodiment of valve device.

Fig. 1 shows a valve device 2 having a diaphragm 4 in a schematic view in cross-section. The diaphragm 4 is intended to separate a fluid-carrying region 6 from a non-fluid-carrying region 8. In addition, a first supporting portion 10 and a second supporting portion 12 for the diaphragm 4 are shown.

To open and close the valve device 2, an actuating stem 14 is moved, substantially along its longitudinal axis 16, by means of an actuator. The actuating stem 14 passes through the diaphragm 4. The actuating stem 14 has a closure portion 22 which co-operates with a valve seat 18 belonging to a valve body 20 and which is arranged towards the valve seat 18. As well as the fluid-carrying region 6, in which the closure portion 22 moves, the valve body 20 has ports 24 and 26 which open into the fluid-carrying region 6. The valve device 2 which is shown here takes the form of an angle-seat valve but may of course also take the form of a straight-seated valve or a 90° angle valve, or else may take some other form.

The diaphragm 4 is connected to the body 20 of the valve device 2 in a first fastening section 28. Alternatively, the diaphragm may also be connected to an actuating member in the first fastening section. The fastening section 28 is formed to be substantially symmetrical in rotation about the longitudinal axis 16.

In addition, the diaphragm 4 is connected to the actuating stem 14 in a second fastening section 30 which is situated radially inside the first fastening section 28. Like the first fastening section 28, the fastening section 30 too is formed to be symmetrical in rotation about the longitudinal axis 16. In addition, the valve body 20 has the first supporting region 10. The actuating stem 14 has the second supporting region 12. In the present case, the two supporting regions 10 and 12 are parts separate from the valve body 20 and from the actuating stem 14. However, as will be seen below in connection with Fig. 6, at least the supporting region 12 may also be formed directly on the actuating stem 14, i.e. may be in one piece therewith.

Other embodiments of the diaphragm 4 are of course also conceivable. In this way, the diaphragm 4 may for example be held in place by a pin, in which case fluid is only applied to the diaphragm 4 from a side opposite from the pin and the pin is moved by an actuator. In another embodiment, the diaphragm 4 and the actuating stem form a unit.

The actuator for the valve device for moving the actuating stem 14 along the longitudinal axis 16 is arranged, in a form which is not shown, in the direction indicated by an arrow 32. The supporting regions 10 and 12 are situated in the non-fluid-carrying region 8 of the valve device 2.

In Fig. 1, the diaphragm 4 is shown in a state where no force is applied to it and in which the diaphragm 4 has a constant curvature.

Fig. 2 shows parts of the valve device 2 in an exploded view. In an assembly operation, the diaphragm 4 is first placed over the actuating stem 14 by the passage through it and is inserted in the valve body 20. A sleeve-like intermediate part 34 has the first supporting region 10 and in the course of the assembly is inserted in the valve body 20 after the diaphragm 4. A further intermediate part 36 has the second supporting region 12 and is fastened to the actuating stem 14, as an interference fit for example.

In an embodiment which is not shown, one supporting member, in the form of an intermediate part, is arranged in a fixed position, whereas the other supporting member, in the form of a positionable member, is arranged to be movable relative to the fixed member. In this way, it is ensured that the support means for whichever supporting function is required can be easily and effectively provided in an alternating way in line with the position of the valve body.

A capping part 38 has an outside thread which corresponds to the inside thread in the valve body 20, thus allowing the capping part 38 to be screwed into the valve body 20. The screwing-in of the capping part 38 allows the first fastening section 28 to come into being by the clamping in place of an outer edge of the diaphragm 4 between the intermediate part 34 and the valve body 20. Rather than the clamping in place, there may equally well be a securing by screwing, a bonding into place, etc.

Fig. 3 shows various components of the valve device 2 in a view in section. In an illustrative way, for the purposes of further explanation, the components are shown laid out along the longitudinal axis 16. In addition, the intermediate parts 34, 36 and the diaphragm 4 are each of a form which is substantially symmetrical in rotation about the axis 16.

The first supporting region 10, on the intermediate part 34, comprises a first supporting surface 40 and an inner edge 42 and an outer edge 44. In the cross-section shown, the first supporting surface 40 is of a substantially concave form. The first supporting surface 40 substantially corresponds to the inside surface of the wall of a truncated paraboloid. The first supporting surface 40 may also substantially correspond to the inside surface of the wall of a truncated cone and be of concave form. In addition, the first supporting surface 40 makes a first included angle 46 in cross-section. In addition, the first supporting region 10 faces into the fluid-carrying region 6, which is situated in the direction indicated by an arrow 48.

The inner edge 42 of the supporting region 10 has a bevel but it may also take the form of a radius. Starting from the inner edge 42 of the first supporting region 10, the intermediate part 34 has an opening 50 running in the direction indicated by the arrow 49.

The other intermediate part 36 has the second supporting region 12. The second supporting region 12 has a second supporting surface 52, an inner edge 54 and an outer edge 56. An opening 58 is provided for the actuating stem 14 to pass through. The second supporting surface 52 makes a second included angle 66. In addition, the second supporting region 12 tapers towards the fluid-carrying region 6, i.e. in the direction indicated by the arrow 48. When the valve device 2 is in the fully assembled state, the second supporting region 12 is solidly connected to the actuating stem 14. The outer edge 56 has a radius. Rather than the radius, the outer edge 56 may also have a bevel. The second supporting surface 52 substantially corresponds to the inner surface of the wall of a truncated cone and is substantially concave in form in cross-section.

In a state where no force is applied to it, which is the state shown in Fig. 3, the diaphragm 4 takes substantially the form of a section through a torus, where the section through the torus is taken orthogonally to the central axis of rotation of the torus concerned, which corresponds to the longitudinal axis 16. In colloquial terms, the diaphragm 4 thus looks like half a doughnut or car-tyre (i.e. one sliced through on its centre plane) whose curvature is substantially constant in the radial direction. A toroidal geometry of this kind is particularly resistant to high pressures and has a long life or in other words good resistance to fatigue. The diaphragm 4 has a flat outer edge 68 which, by means of the first fastening section 28, connects the diaphragm 4 solidly to the valve body 20 by, in the present case, being clamped in place between the intermediate member 34 and the valve body 28.

In addition, the diaphragm 4 has an inner edge 70 which, by means of the second fastening section 30, is solidly connected to the actuating stem 14 by, in the present case, being clamping in place between the intermediate part 36 and a collar (not indicated by a reference numeral) on the actuating stem 14. The connection of the outer edge 68 to the valve body 20 and the connection of the inner edge 70 to the actuating stem 14 may for example each be a connection by clamping, a connection by bonding or a connection by screwing. The convexity 72 is oriented in the direction indicated by the arrow 49 and is thus oriented away from the fluid-carrying region 6.

The diaphragm 4 comprises the material polytetrafluorethylene (PTFE) or a modified PTFE. This is a relatively inelastic material compared with elastomeric diaphragms. By virtue of the invention, the diaphragm is compelled into the contour for rolling contact even when no pressure is applied and kinking of the diaphragm is thus prevented. In the state where no force is applied to it and in the region of the convexity 72, the diaphragm 4 is of a substantially constant convexity in Fig. 3 in the cross-section shown.

As can be seen for example by reference to the dashed lines 73 and 74, the first supporting region 10 and the second supporting region 12 are arranged concentrically to one another when the valve device 2 is in the fully assembled state, with the first supporting region 10 being situated radially outside the supporting region 12, or in other words with the second supporting region 12 being situated radially inside the first supporting region 10. When seen in plan looking in the direction indicated by the arrow 49 towards the actuating member, both the first and the second supporting regions 10, 12 are each of an annular form. The two corresponding annuluses are of substantially an equal radial width, the radial width being in a direction transverse to the longitudinal axis 16. Starting from the central position, approximately equally long distances can thus be covered in both directions of travel. It is of course also possible for respective distances of different lengths to be covered in the two directions of travel depending on the form taken by the diaphragm 4.

An outside diameter of the second supporting region 12 on the intermediate part 36 is measured orthogonally to the longitudinal axis 16, in the region of the outer edge 56. An inside diameter of the first supporting region 10 on the intermediate member 34 is measured orthogonally to the longitudinal axis 16, in the region of the opening 50. The outside diameter of the second supporting region 12 and the inside diameter of the first supporting region 10 are adapted to one another in such a way that the second supporting region 12, and particularly the intermediate part 36, can penetrate into the inner opening 50, and can emerge therefrom, with substantially no clearance.

The first angle 46 and the second angle 66 are either substantially equal in size or differ by a maximum of 20°, and in particular by a maximum of 10° and particularly by a maximum of 5°. A different relationship between the angles 46 and 66 may of course also be selected where the shape of the diaphragm 4 in cross-section is of some other form.

In one embodiment, a radial width 76 of the annulus represented by the second supporting region 12 may be made smaller than a second radial width of the annulus represented by the first supporting region 10, in order to reduce the pressure from the fluid in the region 6 which acts on the actuator in the direction indicated by the arrow 49.

In a state where no force is applied to it, as shown in Fig. 3, the diaphragm 4 is more sharply curved than the first and/or the second supporting surface 40, 52.

The valve device 2 of Fig. 1 is shown in Fig. 4 in a view in section, with the actuating stem 14 in a top state of travel. The closure portion 22 is at its furthest from the valve seat 18 in this top state of travel. The diaphragm 4 bears against substantially the whole of the first supporting region 10. Against the second supporting region 12, the diaphragm substantially does not bear at all, or only a small portion thereof does so. In addition, in the region of the fastening section 30, a portion of the diaphragm 4 is situated in the opening 50.

The top position of travel of the valve device 2, which position is shown in Fig. 4, may also be referred to as its opened end-position. The closure portion 22, and with it the diaphragm 4, is brought to the opened end-position by an appropriate movement of the actuating stem 14 in the direction indicated by the arrow 32, and the diaphragm 4 is also deformed in a desired way. Because of the parameters selected, a radially inner portion of the diaphragm 4, which is adjacent the inner edge 70 or in other words the fastening section 70 and which is spaced away from the second supporting region 12, is more sharply curved (is thus of a shorter radius) in this opened end-position of the valve device 4 than a radially outer portion of the diaphragm 4, which is adjacent the outer edge 68 or in other words the fastening section 28, and which bears against the first supporting region 10. Influencing parameters may be the axial position of the inner edge 70 relative to the outer edge 68 of the diaphragm 4 in the opened end-position, the axial and radial position of the supporting region 10, the curvature of the supporting region 10, and the angle of the supporting region 10 as a whole and/or in the region of the outer edge 68.

In Fig. 5, the valve device 2 is shown in a bottom position of travel, in which the valve device 2 is closed. The closure portion 22 bears against the valve seat 18. In this bottom position of travel, the diaphragm 4 bears against substantially the whole of the second supporting region 12. On the other hand, the diaphragm 4 scarcely rests against the supporting region 10 or does not do so at all. In this bottom position of the valve, the intermediate member 36 penetrates into the fluid-carrying region 6 while shielded by the diaphragm 4.

The top position of travel and the bottom position of travel, which are shown in Figs. 4 and 5 and to which the diaphragm 4 and the closure portion 22 are moved by the actuating stem 14, illustrate the fact that the first supporting region 10 and/or the second supporting region 12 and/or the diaphragm 4 are so designed that the diaphragm 4 bears against the first and/or the second supporting region 10, 12 in these end-positions in such a way that the diaphragm 4 is loaded substantially transversely to the longitudinal axis 16 of the actuating stem 14, particularly when subject to a fluid pressure in the fluid-carrying region 6.

This load is characterised in that it is particularly the fluid pressure in the fluid-carrying region 6 which acts on the diaphragm 4 and the supporting regions 10 and 12 situated behind it, doing so in such a way that forces are generated in the diaphragm which are directed substantially transversely to the longitudinal axis 16 of the actuating stem 14. The vector of a force directed substantially transversely to the longitudinal axis 16 lies in a plane which passes through the longitudinal axis 16. The resistance to back pressure is thus increased in the region of the diaphragm 4 by the valve which is proposed and at the same time the travel of the valve stem 14 is increased.

The bottom position of travel of the valve device 2 which is shown in Fig. 5 may also be referred to as the closed end-position. The closure portion 22, and with it the diaphragm 4, is brought to this closed end-position by an appropriate movement of the actuating stem 14 in the opposite direction from that indicated by the arrow 32, and the diaphragm 4 is also deformed in a desired way when this happens. Because of the parameters selected, a radially outer portion of the diaphragm 4, which is adjacent to the outer edge 68, or in other words to the fastening section 28, and which is spaced away from the first supporting region 10, is more sharply curved (is thus of a shorter radius) in this closed end-position of the valve device 4 than a radially inner portion of the diaphragm 4, which is adjacent the inner edge 70, or in other words the fastening section 30, and which bears against the second supporting region 12. In this case too, influencing parameters may be the axial position of the inner edge 70 relative to the outer edge 68 of the diaphragm 4 in the closed end-position, the axial and radial position of the supporting region 10, the curvature of the supporting region 10, and the angle of the supporting region 10 as a whole and/or in the region of the outer edge 68.

The shape of the diaphragm 4 in the state where no force is applied, which corresponds to that of a torus sliced in half, is thus changed to a geometry of which a portion is similar to a truncated cone in both the end-positions of travel, where the diaphragm bears against one, 10 or 12, of the supporting regions.

The convexity 72 of the diaphragm 4 is thus received and supported in a space which is formed by the supporting regions 10, 12 in one of the possible positions of travel. As a result of the movement of the actuating stem 14 in the opening direction (the direction indicated by the arrow 32), the geometry of the diaphragm 4 is changed in such a way that the angle in the opened position of travel (Fig. 4) between the longitudinal axis 16 and the diaphragm 4, immediately inwards of the outer edge 68, or in other words the fastening section 28, is approximately equal to the angle in the closed position of travel (Fig. 5) between the longitudinal axis 16 and the diaphragm 4, immediately outwards of the inner edge 70, or in other words the second fastening section 30. In the same way, the geometry of the diaphragm 4 is changed by the movement of the actuating stem 14 in the closing direction (the direction opposite from that indicated by the arrow 32) in such a way that the angle in the closed position of travel (Fig. 5) between the longitudinal axis 16 and the diaphragm 4, immediately outward of the inner edge 70, or in other words the fastening section 30, is approximately equal to the angle in the opened position of travel (Fig. 4) between the longitudinal axis 16 and the diaphragm 4, immediately inwards of the outer edge 68, or in other words the first fastening section 28. As a result of the curvatures of differing sharpnesses of the diaphragm 4 in the respective end-positions which this results in, it is possible to achieve a long travel in the valve.

In a further embodiment which is shown in Fig. 6, the diaphragm 4 and the closure portion 22, which is in the form of a spigot and which is flattened on its underside, are produced all in one piece, preferably from a PTFE or a material similar to PTFE. Also, the supporting portion 12 is formed on the actuating stem 14 in one piece therewith, which latter is screwed by means of a thread into a recess in the form of a blind hole in the closure portion 22. Outwards therefrom radially, there is integrally formed on the diaphragm 4 a fastening annulus 80, which is clamped in place in a fluid-tight fashion between the valve body 20 and the intermediate part 34. It can also be very clearly seen from Fig. 6 that, in the intermediate state where no force is applied which is shown there - as in Fig. 1 which relates to the first embodiment - the diaphragm 4 is in the form of a torus sliced in half whose curvature is largely constant in the radial direction.

It will be appreciated that in all the embodiments the first supporting region 10 and/or the second supporting region 12 and/or the diaphragm 4 are of a form such that the fluid pressure which acts on the diaphragm 4 substantially produces force in the diaphragm 4 which are directed substantially transversely to the longitudinal axis 16 of the actuating stem 14. It can also be seen that the first supporting region 10 and the second supporting region 12 are arranged substantially concentrically to one another.

P a t e n t k r a v

1. Ventilindretning (2) med en membran (4) til separation af et fluidførende område (6) fra et ikke-fluidførende område (8), med et første og et andet støtteområde (10, 12) til membranen (4), og med en drivstang (14), der kan bevæges langs sin langsgående akse (16), hvor det første støtteområde (10) og/eller det andet støtteområde (12) og/eller membranen (4) er udformet på en sådan måde, at membranen (4) ved en bevægelse af drivstangen (14) kan ligge an på det første og/eller andet støtteområde (10, 12) på en sådan måde, at membranen (4) under et fluidtryk i det fluidførende område (6) belastes i det væsentlige på tværs af drivstangens (14) langsgående akse (16), hvor et radialt indre afsnit af membranen (4), der har afstand til det andet støtteområde (12), i en åbnet løftestilling krummer mere end et radialt ydre afsnit af membranen (4), der ligger an mod det første støtteområde (10), og det radialt ydre afsnit af membranen (4), der har afstand til det første støtteområde (10), i en lukket løftestilling krummer mere end det radialt indre afsnit af membranen (4), der ligger an mod det andet støtteområde (12), **kendetegnet ved, at** det første og det andet støtteområde (10, 12) krummer konkavt.

2. Ventilindretning (2) ifølge krav 1, **kendetegnet ved, at** det første støtteområde (10) er anbragt i en første vinkel (46), og det andet støtteområde er anbragt i en anden vinkel (66) i forhold til den langsgående akse (16), hvor den første og anden vinkel (46, 66) i det væsentlige er ens.

3. Ventilindretning (2) ifølge et af de foregående krav, hvor membranen (4) i en ikke kraftpåvirket tilstand har form som en halv torus med en i radial retning ca. konstant krumning.

4. Ventilindretning (2) ifølge et af de foregående krav, hvor membranen (4) og et lukkeafsnit (22), der i den lukkede løftestilling ligger an mod et ventilsæde (18), er i ét stykke.

5. Ventilindretning (2) ifølge et af de foregående krav, hvor membranen (4) er fremstillet af et PTFE-materiale.

6. Ventilindretning (2) ifølge et af de foregående krav, hvor membranens (4) form, der i kraftfri tilstand svarer til en halveret torus, i begge slut-løftestillinger dér, hvor membranen (4) ligger an mod et af støtteområderne (10, 12), overføres til en afsnitsvist keglestumplignende geometri.

7. Ventilindretning (2) ifølge et af de foregående krav, hvor mindst et støtteområde (12) er i ét stykke med drivstangen (14).

8. Ventilindretning (2) ifølge et af de foregående krav, hvor det første og/eller andet støtteområde (10, 12) befinder sig i det ikke-fluidførende område (8) af ventilindretningen (2).

9. Ventilindretning (2) ifølge et af de foregående krav, hvor det første støtteområde (10) åbner hen mod det fluidførende område (6) og er fast forbundet med et ventillegeme (20), og hvor det andet støtteområde (12) tilspidser hen mod det fluidførende område (6) og er fast forbundet med drivstangen (14) af et drev.

10. Ventilindretning (2) ifølge et af de foregående krav, hvor det første og det andet støtteområde (10, 12) i en visning oppefra er udformet cirkelringformet i retning af et drev, og hvor de tilsvarende cirkelringe i det væsentlige har en ens ringbredde (76, 78).

11. Ventilindretning (2) ifølge et af de foregående krav, hvor en udvendig diameter af det andet støtteområde (12) og en indvendig diameter af det første støtteområde (10) er afstemt i forhold til hinanden på en sådan måde, at det andet støtteområde (12) i det væsentlige spilfrit kan rage ind i en indre udsparing (50).

12. Ventilindretning (2) ifølge et af de foregående krav, hvor membranen (4) i en ikke kraftpåvirket tilstand i tværsnit krummer mere end den første og/eller den anden støtteflade (40, 52).

13. Ventilindretning (2) ifølge et af de foregående krav, hvor mindst en af støtteområdernes (10, 12) kanter (42, 54), der vender mod hinanden, har en affasning af afrundingen.

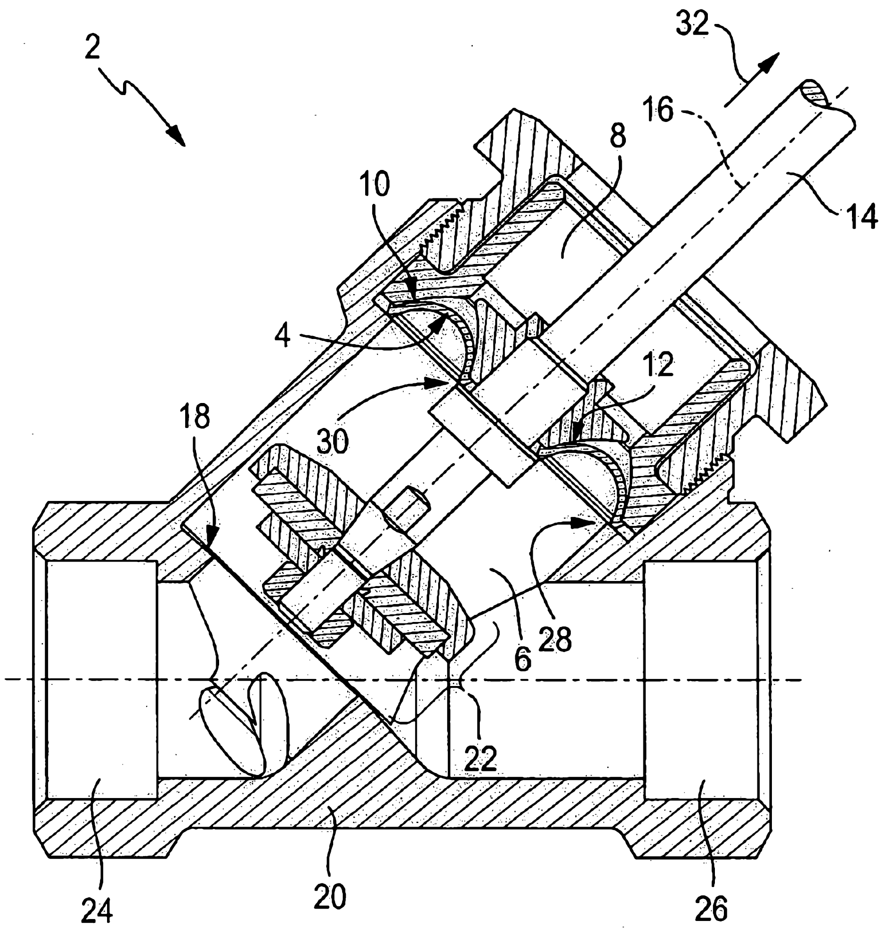

Fig. 1

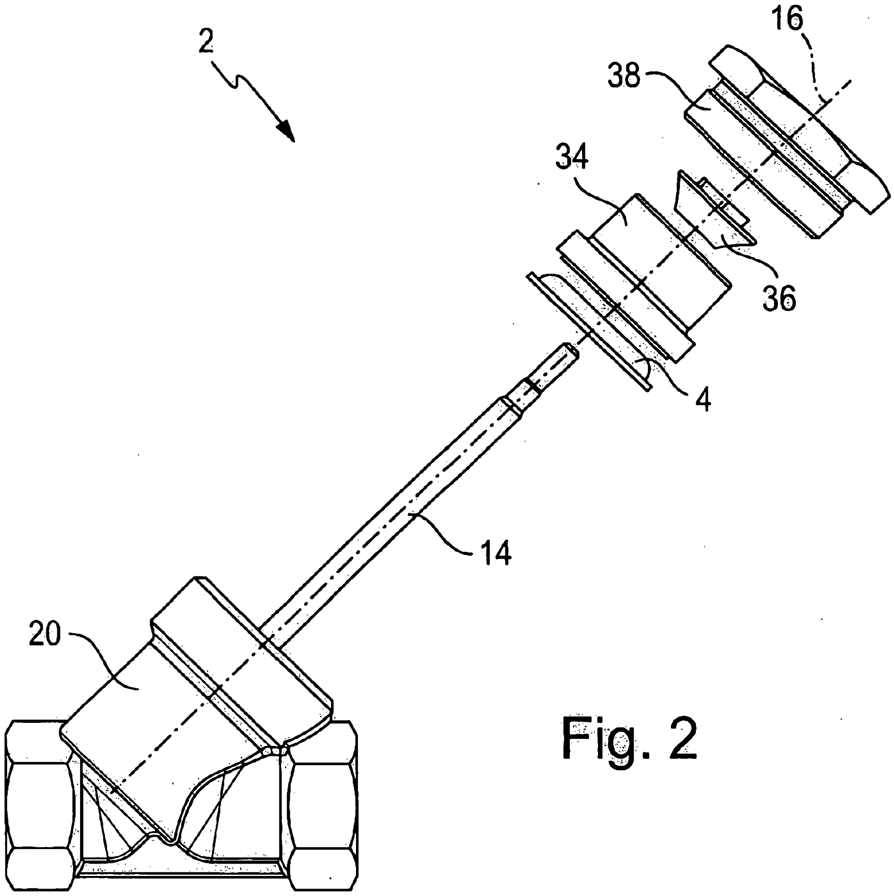

Fig. 2

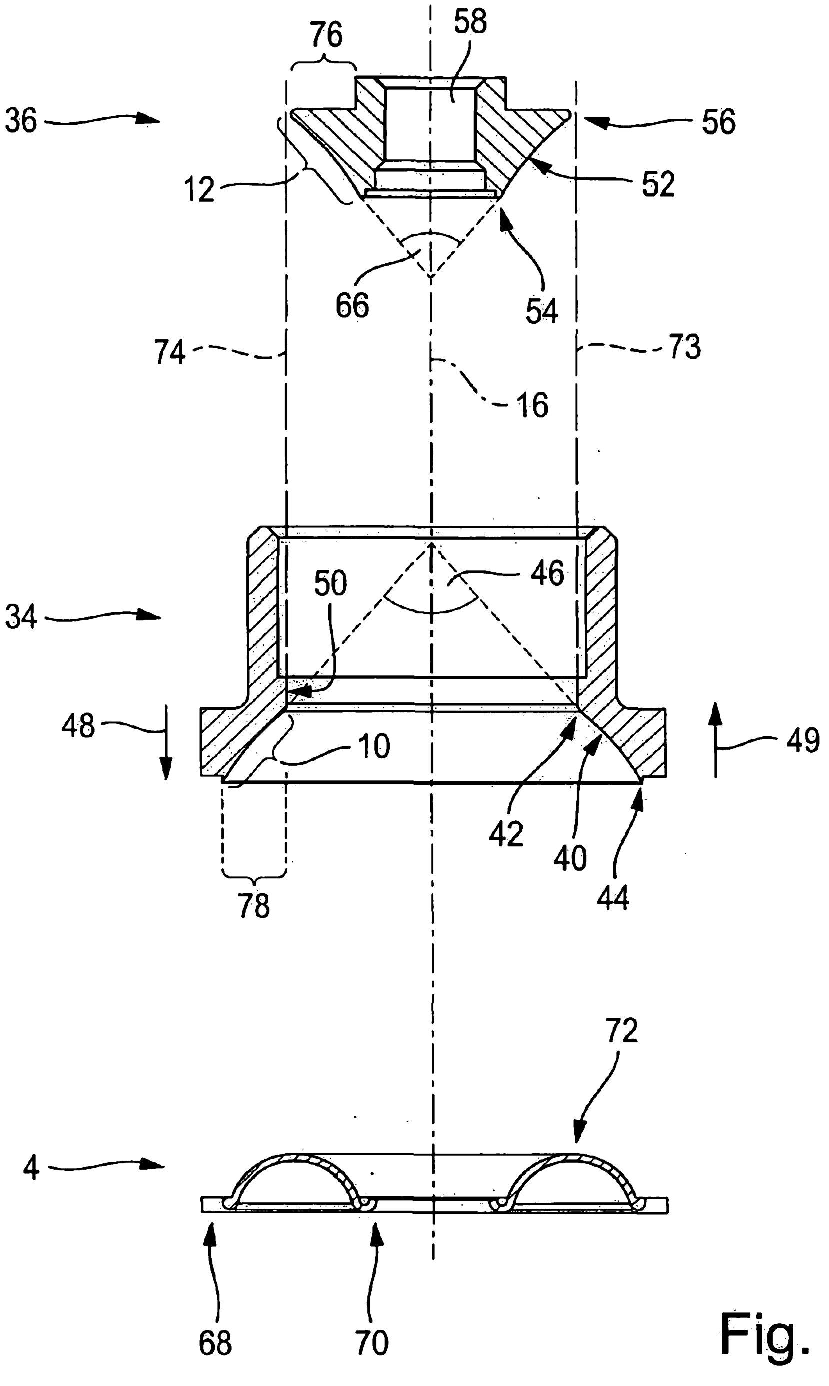

Fig. 3

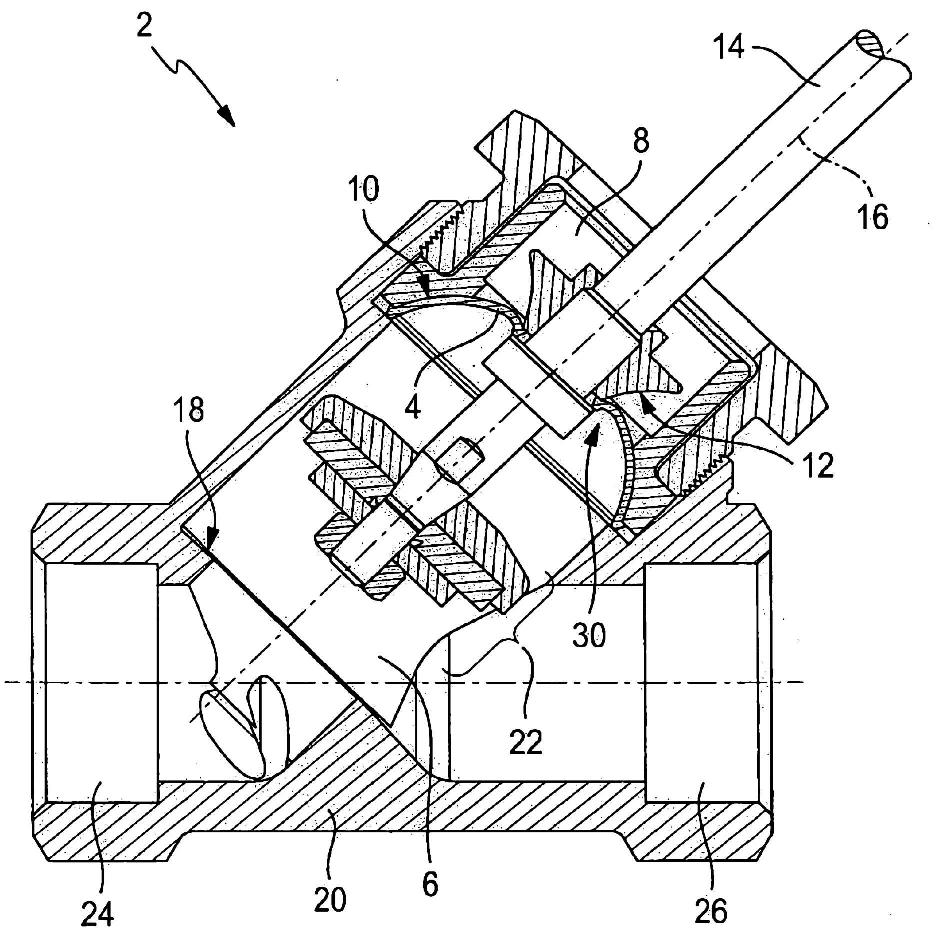

Fig. 4

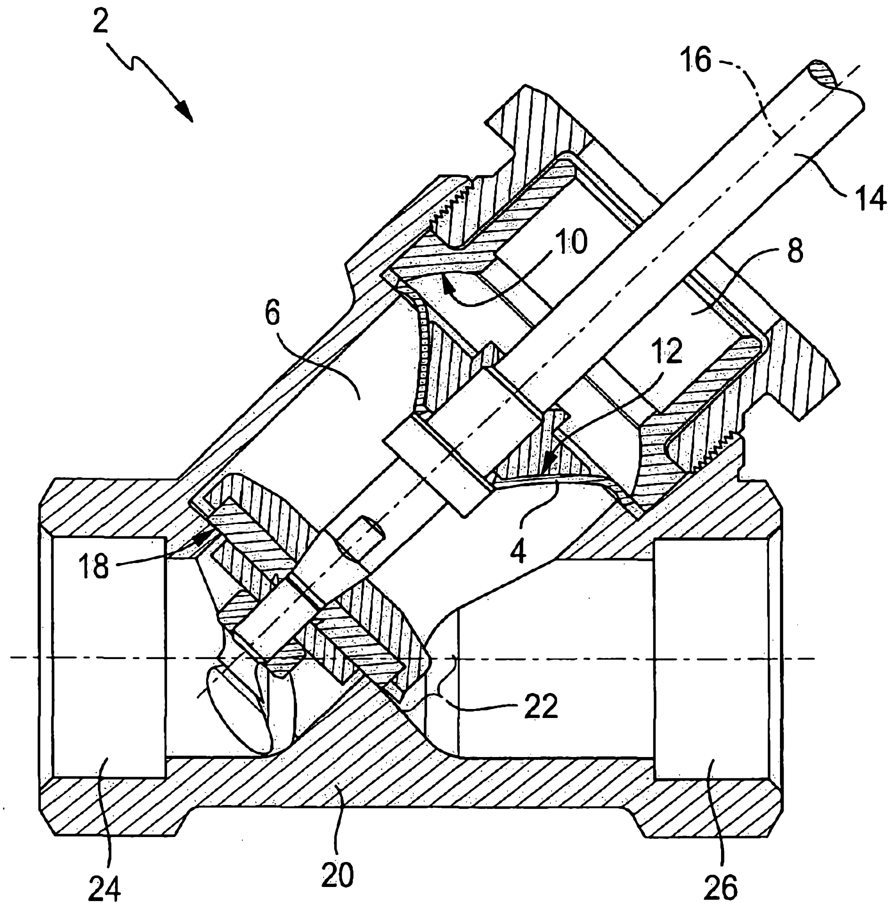

Fig. 5

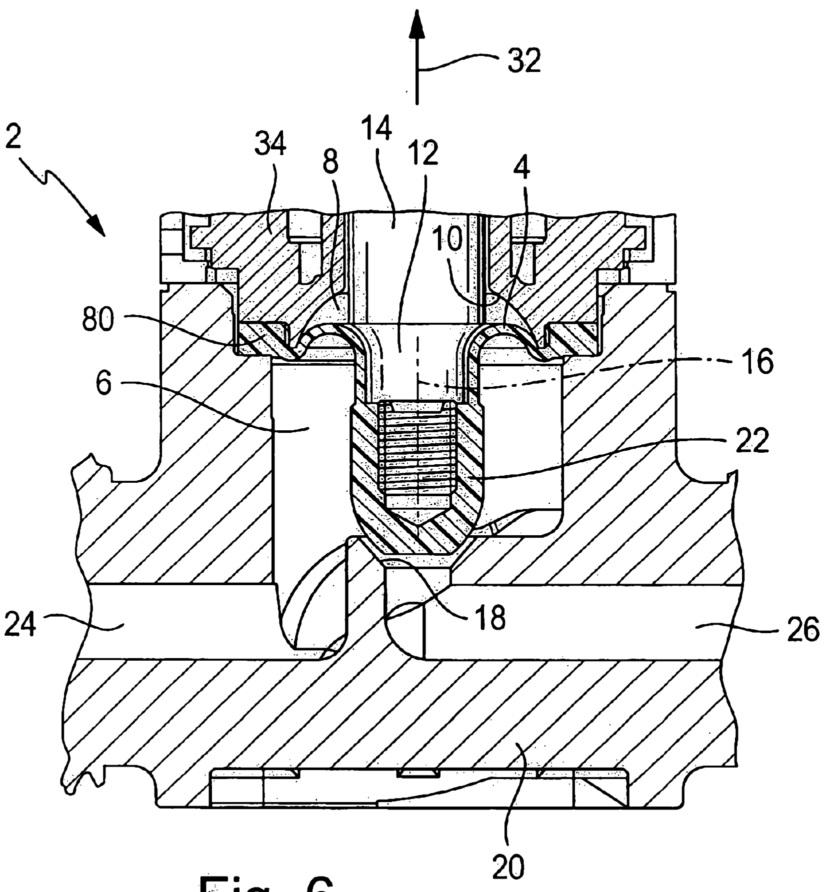

Fig. 6