

(19) **DANMARK**

(10) **DK/EP 2898387 T5**



(12) **Rettet oversættelse af
europæisk patentskrift**

Patent- og
Varemærkestyrelsen

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- (51) Int.Cl.: **G 05 D 16/10 (2006.01)**
- (45) Oversættelsen bekendtgjort den: **2022-02-28**
- (80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2016-10-12**
- (86) Europæisk ansøgning nr.: **13770628.9**
- (86) Europæisk indleveringsdag: **2013-09-19**
- (87) Den europæiske ansøgnings publiceringsdag: **2015-07-29**
- (86) International ansøgning nr.: **DK2013050298**
- (87) Internationalt publikationsnr.: **WO2014044282**
- (30) Prioritet: **2012-09-20 DK 201270579**
- (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**
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- (54) Benævnelse: **Differenstrykstyringsventil**
- (56) Fremdragne publikationer:
WO-A1-90/01657
WO-A1-2006/136158
WO-A2-2009/135490

Description

[0001] The invention relates to a differential pressure control valve for maintaining a substantially constant differential pressure over a device, such as a heating or cooling convector, or a circuit of a number of devices, such as comprising several heating or cooling

5 convectors, comprising
 a valve housing with an upstream inlet for connection to a capillary tube communicating with an upstream flow, i.e. a flow upstream from said device or circuit, a valve inlet for communicating with a downstream flow, i.e. a flow downstream from said device or circuit, and a valve outlet, the upstream inlet extending into the valve housing from outside of the
 10 valve housing, and
 a pressure maintaining arrangement for maintaining a substantially constant differential pressure between an upstream pressure and a downstream pressure, said arrangement comprising a diaphragm and a valve member movable along an axis of the valve, the valve member by means of the diaphragm being adapted to set itself in a balance between the
 15 upstream pressure on the one hand and the downstream pressure as well as a spring force on the other hand, the spring force being provided by means of a spring member positioned on a side opposite to the valve inlet in relation to the valve member,
 the valve member at a lower end facing a valve seat, which is fixed in relation to the housing, the valve member abutting the valve seat in a closed position of the valve and being movable
 20 such as to vary an opening area of an opening between the lower end of the valve member and the valve seat, establishing fluid communication between the valve inlet and the valve outlet depending on the balance setting of the valve member,
 the downstream flow in use entering into the valve through an inlet orifice.

[0002] Differential pressure control valves (DPCVs) of this type are known in the art and
 25 are typically applied to keep differential pressure constant over for example heating or cooling convectors in liquid circulation heating or cooling plants, for example in residential property or apartment buildings. As is known to the skilled person, keeping the differential pressure constant has a number of advantages, such as noise reduction and improved flow control.

[0003] In one prior art DPCV of this type the diaphragm of the pressure maintaining arrangement is in the form of a relatively large diameter disc diaphragm. The upstream inlet is positioned above the diaphragm and connects the valve with an inlet to the device, system or circuit over which it is desired to maintain a constant differential pressure. A lower part of a centrally provided valve member of relatively small diameter abuts a similarly centrally
 35 provided valve seat of relatively small diameter to open and close an opening between the valve inlet and the valve outlet. The lower part of the valve member is shaped like a solid frustum of a cone, i.e. with a chamfered circumferentially extending surface and a lower, plane surface. The chamfered surface of the lower part of the valve member abuts the valve seat positioned below, whereby axial movement of the valve member varies the distance
 40 between skirt and valve seat and thus size of the opening between valve inlet and valve outlet. The downstream flow enters an interior of the valve in an axial direction through an

inlet orifice and thus exerts an axial flow force on the lower, plane surface as well as on the chamfer of the valve member.

[0004] In such DPCVs it is desired that the upstream and downstream forces (as well as the spring force) are the only forces working on the diaphragm and valve member since otherwise a less precise pressure differential regulation or control is achieved. In the above prior art DPCV the contribution from the flow forces exerted on the valve member on the axial position of the valve member is sought to be minimized by the provision of a relatively large diameter diaphragm. With a large diaphragm the contribution to the overall equilibrium of forces of the forces exerted on its upper and lower surfaces are similarly larger, thus to some extent negating the influence of the flow forces.

[0005] WO 90/01657 A1 discloses a valve according to the precharacterizing portion of claim 1.

[0006] On this background the object of the present invention is to provide a DPCV that can be made smaller and/or has improved features.

[0007] This object is achieved by means of a valve according to the introduction, which is characterized in that

a first member in the form of either the valve member or the valve seat comprises a circumferentially extending skirt, which is located at an end facing the other, opposite member in the form of the valve seat or the valve member, respectively, an inner diameter of the skirt being smaller than an outer diameter of the opposite member, the flow passing between the first member and the opposite member through said opening in a generally radially outwards direction,

the skirt comprises an abutment surface facing an opposing surface of said opposite member, the abutment surface extending in said generally radial direction, an inner surface of the skirt extending in a generally axial direction and facing the downstream flow for blocking or closing off part of or all flow through said opening, and an outer surface opposed to the inner surface facing the valve outlet flow and extending at an angle to the abutment surface, and an inner corner formed between said abutment surface and said inner surface is chamfered or establishes a non-linear transition between the abutment surface and the inner surface, said chamfer or transition extending less than a distance of 0.1 mm from the inner surface in a direction towards the abutment surface and less than a distance of 0.1 mm from the abutment surface in a direction towards the inner surface.

[0008] In the following explanation of the advantages and effects of the invention it is presumed that the first member is in the form of the valve member, and the second, opposing member is in the form of the valve seat. The skilled person will realize that similar or comparable advantages and effects are achieved in embodiments, in which the first member is the valve seat, and the second member the valve member.

[0009] The valve according to the present invention functions in a way somewhat similar to the above-described prior art DPCV. Upstream water enters into the valve housing via a capillary tube and is led to a volume above the diaphragm where upstream pressure is exerted on the upper surface of the diaphragm. Since the flow direction of flow through the

opening area between the skirt and the valve seat will be generally radial, i.e. at a substantially right angle to the inner surface of the lower part of the skirt, and the chamfer or transition at the corner between the inner surface and the abutment surface of the skirt is extremely small (less than 0.1 mm in each direction), almost no axial flow forces are exerted on the valve member. More specifically, the axial component of the flow forces exerted on the valve member will be close to zero.

[0010] Therefore, the need to compensate for the contribution of the axial flow forces exerted on the valve member is very small, and the radial extent or the diameter of the diaphragm can be made substantially smaller than what is the case in the prior art DPCV. Hereby, the overall size of the DPCV according to the invention can similarly be made significantly smaller; and even with a relatively small diaphragm size it is possible to achieve differential pressure control, which is improved over the prior art.

[0011] The dependent claims define preferred embodiments of the invention.

[0012] In one embodiment said abutment surface extends a distance (C) less than 0.5 mm, preferably less than 0.3 mm, more preferred less than 0.15 mm, most preferred less than 0.1 mm towards the outer surface of the skirt. If the flow through the opening between skirt and valve seat is in a generally radial direction, a small extent of the abutment surface ensures that the flow forces exerted on it will be minimal. In this context it is noted that, as will be recognizable by the skilled person, in most or all cases the flow within the valve will not be entirely radial or entirely axial since the complex most often turbulent flow within the valve will mean that force components of the flow will also be inserted in many other, varying directions. Along this line the expressions "generally radially" or "generally axially" refers to the overall flow direction and are not to be construed literally.

[0013] In another embodiment the size of an inner diameter of the lower part of the skirt is between 0.2 to 0.9, preferably between 0.3 to 0.8, more preferred 0.4 to 0.7 times the size of a diameter of the inlet orifice. Hereby is provided a minimum distance between the edge of the inlet orifice and the edge of the lower part of the skirt so that the flow direction is substantially radial, i.e. at a substantially right angle to the inner surface of the lower part of the skirt, when it reaches this. Furthermore, the skirt should not have a too large diameter so as to keep the overall size of the DPCV relatively small.

[0014] In another embodiment the spring force of said spring member, which is preferably in the form of a helical spring, is adjustable, preferably by means of a threaded spindle, which is rotatable from at an outer end positioned at the top of the valve. Hereby the substantially constant value of the differential pressure can be adjusted.

[0015] An exemplary embodiment of the present invention will be described in the following with reference to the schematic drawings in which

Fig. 1 is a front view of an embodiment of the DPCV according to the invention,

Fig. 2 is a side view of the DPCV according to Fig. 1 seen from the right,

Fig. 3 is a perspective view of the DPCV according to Fig. 1,

Fig. 4 is an perspective view of the DPCV according to Fig. 1, in which a valve insert is shown separated or dismounted from the other part of the valve,

Fig. 5 is a sectional view of the DPCV according to Fig. 1 taken through the plane V-V (axis a) in Fig. 1,

Fig. 6 is an exploded view of the valve insert according to Fig. 4 shown in perspective,

Fig. 7 is an enlarged view of an embodiment of the detail D shown in Fig. 5,

5 Fig. 8 is an enlarged view of another embodiment of the detail D shown in Fig. 5,

Fig. 9 is a diagrammatic view of a system or circuit comprising a DPCV according to Fig. 1, and

Fig 10 is a view corresponding to the view of Fig. 8 in an alternative embodiment of the DPCV according to the invention.

10 **[0016]** In Figs 1 to 6 an embodiment of a DPCV according to the invention is shown in different views. The DPCV is adapted for maintaining a substantially constant differential pressure over a device, such as a heating or cooling convector, or a circuit of a number of devices, such as comprising several heating or cooling convectors. The functioning of the DPCV will be explained in more detail further below with reference to Fig. 9.

15 **[0017]** In the valve of Figs 1 to 6 a valve housing 1 consists of a lower part 4 and an upper part 5, the upper part 5 encasing a replaceable valve insert comprising a pressure maintaining arrangement for maintaining a substantially constant differential pressure between an upstream pressure P1 and a downstream pressure P2 (Fig. 5). The valve insert is shown separated from the housing part 4 in Fig. 4 and in exploded view in Fig. 6.

20 **[0018]** The upper housing part 5 comprises to upper housing portions 5a and 5b. The upper housing part 5, specifically portion 5a, comprises an upstream inlet 6 for connection to a capillary tube (not shown) communicating with the upstream flow F1 (Fig. 9), i.e. the flow upstream from the device or circuit. In a mounted position the upstream inlet 6 connects the valve housing 1 with an inlet I to the device, system or circuit over which the valve maintains a constant differential pressure (Fig. 9). The valve inlet 2 communicates with a downstream flow F2 entering the valve from a downstream outlet U from the device, system or circuit over which the valve maintains a constant differential pressure (Fig. 9), i.e. a flow downstream from said device or circuit. The valve outlet 3 communicates with an outlet flow F3. The upstream inlet 6 extends into the upper housing part 5 from outside of the valve housing 1 on a side opposite to the valve inlet 2 when seen in relation to a valve member 7.

25 **[0019]** The valve member 7 forms part of the pressure maintaining arrangement, which also comprises a roller diaphragm 8. The valve member 7 is movable along a central axis a (Figs 1 and 5) of the valve, the valve member by means of the diaphragm 8 being adapted to set itself in a balance between the upstream pressure P1 on the one hand and the downstream pressure P2 as well as a spring force on the other hand.

30 **[0020]** As is seen best in Figs 5 and 6 the valve member 7 is shaped like a cup (which is in two parts), the lower part of which forming a circumferentially extending skirt 9, the downstream flow F2 in use entering in a generally axial direction into an interior of the housing 1 and an interior or hollow of the cup through a circumferentially extending inlet orifice 10, which is coaxial with the axis a, and passing below the skirt 9 in a generally radially outwards direction (which extends at a right angle to the axis a). The outer diameter

40

of the diaphragm 8 (28 mm) is a little below twice the diameter of the inlet orifice 10 (14 mm).

5 **[0021]** The skirt 9 comprises a circumferentially extending lower part 11 (Figs 5, 7 and 8) facing a circumferentially extending valve seat 12, which is fixed in relation to the housing 1, the lower part 11 being axially movable together with the valve member such as to vary an area of an opening O (Figs 7 and 8) between the skirt 9 and the valve seat 12, establishing fluid communication between the valve inlet 2 and the valve outlet 3 depending on the balance setting, i.e. the position in the axial direction of the valve member 7.

10 **[0022]** The circumferentially extending diaphragm 8 has an outer circumferential edge, which is fixed in a groove between the lower and upper housing parts 4, 5, and an inner circumferential edge, which is fixed in a groove of the valve member 7 (Fig. 5). Hereby the inner edge moves with the valve member 7, whereas the outer edge is fixed in relation to the housing 1. A mean diameter size measured between an outer diameter size and an inner diameter size of the diaphragm 8 is substantially equal to the size of an inner diameter of the lower part 11 of the skirt 9. The size of an outer diameter of the diaphragm 8 (28 mm) is about 1.1 times the size of an inner diameter of the lower part 11 of the skirt 9 (25.5 mm).

15 **[0023]** Liquid and thus pressure from the capillary tube entering into the upstream inlet 6 communicates with a narrow, circumferentially extending channel 6a and a volume V above the diaphragm 8.

20 **[0024]** The spring force is provided by means of a spring member in the form of a (helical) spring 13 positioned on a side opposite to the valve inlet 2 in relation to the valve member 7, more specifically within a hollow interior 14 in the upper housing part 5. The spring force of the spring 13 is adjustable by means of an adjustment device 15, which may be rotated by means of insertion of a key into slot or orifice 16 at the outer end of the device 15. The adjustment device 15 further comprises a hexagonal rod 15a positioned inside spindle 15b, which again is positioned inside spindle casing 15c. The spring 13 is positioned encompassing the device 15 coaxially with axis a. The spring 13 urges the valve member 7 towards its top position in cooperation with the downstream pressure P2, against the upstream pressure exerted on top of the valve member 7 and diaphragm 8.

25 **[0025]** In use, a balance is established between the inlet pressure P1 and the outlet pressure P2 plus the spring force from the spring 13. The differential pressure across the device, system or circuit at the downstream end of which the DPCV is installed will therefore be constant with a given spring force, the latter being variable.

30 **[0026]** The DPCV shown in the figures also comprises a number of other parts such as gaskets, screws and casings, the general structure and function of which will be immediately understandable to the skilled person when considering the drawings. These include (plastic) cap 21, diaphragm retaining ring 22, O-ring gaskets 23, 24 and 25, locking clip 26, washer 27a, and retaining screw 27b.

35 **[0027]** Figs 7 and 8 show a detail D of Fig. 5, more specifically the area in which the lower part 11 of the skirt 9 of the valve member 7 is positioned opposed to the valve seat 12. In Figs 5, 7 and 8 the DPCV is shown in an open position in which liquid is allowed to pass the

valve seat 12 from the downstream flow F2 of the valve inlet 2 to the outlet flow F3 at the valve outlet 3. The lower part 11 comprises an abutment surface 17 extending in a radial direction for axial movement towards and away from an opposed surface 17a of the valve seat 12. An inner surface 18 of the lower part 11 extends in a direction parallel to axis a to face the downstream flow F2 of pressure P2 and thus block or close off part of or all flow through opening O between the lower part 11 and the valve seat 12 depending on the axial position of the valve member 7. An outer surface 20 of the lower part 11 is located opposed to the inner surface 18 facing the valve outlet flow F3 and extending about 0.5 to 1 mm, more specifically about 0.7 mm, at an angle of about 45 degrees to the abutment surface 17 until it reaches a further surface that extends upwards in a direction parallel to the axis a. An inner corner formed between the abutment surface 17 and the inner surface 18 is chamfered to establish a linear (Fig. 7) or non-linear (Fig. 8) transition 19 between the abutment surface 17 and the inner surface 18, said chamfer or transition 19 extending less than a distance of 0.1 mm from the abutment surface 17 in a direction towards the inner surface 18. The transition 19 follows the lower part 11 to extend circumferentially about axis a.

[0028] In Fig. 8 the transition 19 is shown as curved. The corner or transition 19 may have other shapes than linear or curved, often it will in reality have a somewhat "undefined" shape because of the extremely small dimensions of the corner. This also applies to the other corners shown in Figs 7 and 8; in Fig. 8 the two corners at the ends of surface 20 are also shown as curved.

[0029] According to the present invention the important feature of the corner or transition 19 is that it is very small (i.e. the corner is extremely pointed or sharp) such as to minimize the axial component of a flow force F_f exerted on it (Figs 7, 8). In the optimum situation the size of the corner or transition 19 would be zero; however, in reality this is very difficult or impossible to manufacture. The chamfer or transition 19 extends less than a distance A of 0.1 mm from the inner surface 18 in a direction towards the abutment surface 17 and less than a distance B of 0.1 mm from the abutment surface 17 in a direction towards the inner surface 18. Due to the limitations of the manufacture techniques of today, a good compromise between a small transition 19 (i.e. a pointed or sharp corner) and manufacturing costs is about 0.03 to 0.08 mm, preferably 0.03 to 0.06 mm. In the context of measuring how much the transition or chamfer 19 extents, generally the chamfer or transition can be defined as starting where a general angle of the surface (i.e., the chamfer surface) differs with an angle of more than about 5 degrees from a general direction of the inner 18, respectively the lower 17 surface of the lower part 11 of the skirt 9. This definition also applies to the claims.

[0030] In the embodiment shown the distances A, B are both approximately 0.05 mm, whereby a relation between the distances A, B, respectively, to an inner diameter of an inlet pipe (not shown) leading to the valve inlet 2, corresponding to the inner diameter of the valve inlet 2 ($\varnothing$ 19.5 mm), is about 0.26 % for both (note that in the embodiment shown both valve inlet 2 and valve outlet 3 each are provided with inner threading for connection

with inlet and outlet pipes, respectively). A relation between the distances A, B, respectively, to the inner diameter of the lower part 11 of the skirt 9 (25.5 mm) is similarly about 0.2 % for both. Furthermore, the size of the diameter of the lower part 11 of the skirt 9 (25.5 mm) is about 1.8 times the size of the diameter of the orifice inlet (14 mm).

5 **[0031]** The abutment surface 17 extends a distance C of about 0.06 to 0.1 mm towards the outer surface of the skirt 9. Similar to the transition 19, it is preferable that the lower 17 surface is very small to minimize flow forces exerted on it.

[0032] Reverting to an example of the functioning or purpose of the DPCV according to the present invention and as shown in the previous figures, Fig. 9 shows part of a system or
10 circuit of a heating plant of a residential building with two heating or cooling convectors 28 positioned in parallel.

[0033] The upstream inlet 6 connects via a capillary tube 29 the DPCV housing 1, specifically the housing portion 5a, with an inlet I to the system. The valve inlet 2 communicates with a downstream flow F2 entering the DPCV from a downstream outlet U
15 from the system, i.e. a flow downstream from the system. Flow is achieved by means of pump U. The valve outlet 3 communicates with an outlet flow F3 from the DPCV. As is visible also in Fig. 9 the pressure at the flows F1, F2 and F3 are defined as P1, P2 and P3, respectively.

[0034] Referring also to Figs 1 to 8, upstream liquid (water) from flow F1 enters (or, more
20 precisely, the pressure is carried over) into the valve housing 1 via the capillary tube 29 and is led to the volume V above the diaphragm 8 via channel 6a, where upstream pressure P1 is exerted on the upper surface of the diaphragm 8. Hereby, the DPCV maintains a substantially constant differential pressure over the system, i.e. between P1 and P2. The value of the constant differential pressure is determined by the setting of the spring 13. In
25 this context, please note that in each of the different locations or group of interior spaces in the valve system in which the pressures have been denoted P1, P2 and P3 in the above, the pressure can in reality be expected to vary to a certain degree. The above explanation of the relationship between the pressure inside the system is thus somewhat simplified compared to the actual conditions within the system. However, the overall functional descriptions are
30 accurate.

[0035] Fig. 10 shows a view corresponding to that of Fig. 8 in an alternative embodiment of the DPCV according to the invention. More specifically, the view is a detail of the opposite, lower side of the valve member 11 compared to the detail D in Fig. 8 in an alternative embodiment of the DPCV shown in Fig. 5.

35 **[0036]** In Fig. 10, 100 has been added the reference numbers of elements with reference numbers functionally corresponding to the reference numbers of elements in the previous embodiment.

[0037] Now, in the embodiment of Fig. 10, in contrast to the previous embodiment the valve seat 112 comprises a skirt 109, and the second, opposing member is in the form of
40 the valve member 107. An upper part 111 of the skirt 109 is embodied and shaped similarly to the lower part 11 of the skirt 9 in the previous embodiment, and thus comprises abutment

- surface 117, inner surface 118, outer surface 120 and transition 119, which in function all correspond to the corresponding reference numbers of the previous embodiment. An inner diameter of the skirt 109 is smaller than an outer diameter of the lower part of the valve member 107. The valve member 107 (or at least the lower part of this) is in this case a solid member, specifically a solid cylinder, i.e. with a plane bottom surface denoted 117a in Fig. 10. This bottom surface 117a extends on the entire lower surface of the valve member, but could in principle comprise one or more indentations or be cup-shaped similar to the previous embodiment. The opening O as well as the distances A, B and C also correspond to those in the previous embodiment.
- 10 **[0038]** The skilled person understands that a DPCV corresponding to the above alternative embodiment advantages and effects similar to or comparable to those of the first embodiment will be achieved.

P A T E N T K R A V

1. Differenstrykstyringsventil til at opretholde et i det væsentlige konstant dif-
ferenstryk over en indretning, såsom en varme- eller kølekonvektor, eller et kredsløb af
5 et antal af indretninger, såsom omfattende flere varme- eller kølekonvektorer, hvilken
differenstrykstyringsventil omfatter

et ventilhus med et opstrømsindløb til forbindelse med et kapillærrør, der er i for-
bindelse med en opstrømsstrøm, dvs. en strøm opstrøms for indretningen eller kredsløb-
et, et ventilindløb til forbindelse med en nedenstrømsstrøm, dvs. en strøm neden-
10 strøms for indretningen eller kredsløbet, og et ventiludløb, hvor opstrømsindløbet ud-
strækker sig ind i ventilhuset fra ydersiden af ventilhuset, og

en trykopretholdende anordning til at opretholde et i det væsentlige konstant dif-
ferenstryk mellem et opstrømstryk og et nedenstrømstryk, hvor anordningen omfatter
en membran og et ventilelement, der er bevægeligt langs en akse af ventilen, hvor ven-
15 tilelementet ved hjælp af membranen er indrettet til at indstille sig selv i en ligevægt
mellem opstrømstrykket på den ene side og nedenstrømstrykket tillige med en fjeder-
kraft på den anden side, hvor fjederkraften er tilvejebragt af et fjederelement, der er
placeret på en side, som er modstående til ventilindløbet i forhold til ventilelementet,

hvor ventilelementet ved en nedre ende vender mod et ventilsæde, der er statio-
20 nært i forhold til huset, hvor ventilelementet ligger an mod ventilsædet i en lukket posi-
tion af ventilen og er bevægeligt for at kunne variere et åbningsareal af en åbning mel-
lem den nedre ende af ventilelementet og ventilsædet, hvilken åbning skaber fluidfor-
bindelse mellem ventilindløbet og ventiludløbet afhængigt af ligevægtsindstillingen af
ventilelementet,

25 hvor nedenstrømsstrømmen under anvendelse strømmer ind i ventilen gennem en
indløbsåbning,

k e n d e t e g n e t ved at

et første element (11, 12) i form af enten ventilelementet (11) eller ventilsædet
(12) omfatter et rundtgående skørt (9), der er arrangeret ved en ende, som vender
30 mod det andet, modstående element (12, 11) i form af henholdsvis ventilsædet (12)
eller ventilelementet (11), hvor en indre diameter af skørtet (9) er mindre end en ydre
diameter af det modstående element (12, 11), hvor strømmen passerer mellem det før-
ste element (11,12) og det modstående element (12,11) gennem åbningen (O) i en i
det væsentlige radialt udadgående retning,

35 skørtet omfatter en anlægsflade (17), der vender mod en modstående overflade
(17a) af det modstående element (12, 11), hvor anlægsfladen (17) udstrækker sig i
den i det væsentlige radiale retning, en indre overflade (18) af skørtet (9), der ud-
strækker sig i en i det væsentlige aksial retning og vender mod nedenstrømsstrømmen
(F2) for at blokere eller lukke af for en del af eller hele strømmen gennem åbningen

(O), og en ydre overflade (20), som er modstående til den indre overflade (18), som vender mod ventiludløbsstrømmen (F3), og som udstrækker sig med en vinkel i forhold til anlægsfladen (17), og

5 et indre hjørne, der er tilvejebragt mellem anlægsfladen (17) og den indre overflade (18), er affaset eller tilvejebringer en ikke-lineær overgang (19) mellem anlægsfladen (17) og den indre overflade (18), hvilken affasning eller overgang (19) udstrækker sig mindre end en afstand (A) på 0,1 mm fra den indre overflade (18) i en retning imod anlægsfladen (17) og mindre end en afstand (B) på 0,1 mm fra anlægsfladen (17) i en retning imod den indre overflade (18).

10 2. Styringsventil ifølge krav 1, hvor mindst én, fortrinsvist begge, af afstandene (A, B) af affasningen eller overgangen er mindre end 0,08 mm, fortrinsvist mindre end 0,07 mm, mere fortrinsvist mindre end 0,06 mm, mest fortrinsvist mindre end 0,05 mm.

15 3. Styringsventil ifølge krav 1 eller 2, hvor anlægsfladen udstrækker sig en afstand (C) mindre end 0,5 mm, fortrinsvist mindre end 0,3 mm, mere fortrinsvist mindre end 0,15 mm, mest fortrinsvist mindre end 0,1 mm, imod den ydre overflade af skørtet.

20 4. Styringsventil ifølge et hvilket som helst af de foregående krav, hvor et forhold mellem afstandene (A, B) af affasningen eller overgangen til en indre diameter af et indløbsrør af huset, som fører til ventilindløbet, henholdsvis er i et interval på 0,04 til 0,8 % for begge, fortrinsvist 0,06 til 0,7 %, mere fortrinsvist 0,1 til 0,6 %, mest fortrinsvist 0,2 til 0,5 %.

25 5. Styringsventil ifølge et hvilket som helst af de foregående krav, hvor et forhold mellem afstandene (A, B) af affasningen eller overgangen i retningen imod anlægsfladen og i retningen imod den indre overflade til den indre diameter af skørtet henholdsvis er i et interval på 0,04 – 0,5 % for begge, fortrinsvist 0,06 til 0,4%, mere fortrinsvist 0,1 til 0,3 %.

30 6. Styringsventil ifølge et hvilket som helst af de foregående krav, hvor størrelsen af en indre diameter af den nedre del af skørtet er mellem 0,2 til 0,9, fortrinsvist mellem 0,3 til 0,8, mere fortrinsvist 0,4 til 0,7 gange størrelsen af en diameter af indløbsåbningen (10).

7. Styringsventil ifølge et hvilket som helst af de foregående krav, hvor membranen er en rullemembran med en ydre rundtgående kant, der fortrinsvist er fastgjort til huset, og en indre rundtgående kant, som fortrinsvist er fastgjort til ventilelementet, hvor en gennemsnitlig diameterstørrelse, der er målt mellem en ydre diameterstørrelse og en indre diameterstørrelse af membranen fortrinsvis i det væsentlige er lig med størrelsen af en diameter af den nedre del af skørtet, og/eller

35

hvor størrelsen af en ydre diameter af membranen fortrinsvis udstrækker sig i et interval på 1 til 6 gange en diameter på indløbsåbningen, og/eller

hvor størrelsen af en ydre diameter af membranen fortrinsvis er mindre end 1,3 gange, mere fortrinsvist mindre end 1,2 gange, mest fortrinsvist mindre end 1,1 gange størrelsen af en diameter af den nedre del af skørtet.

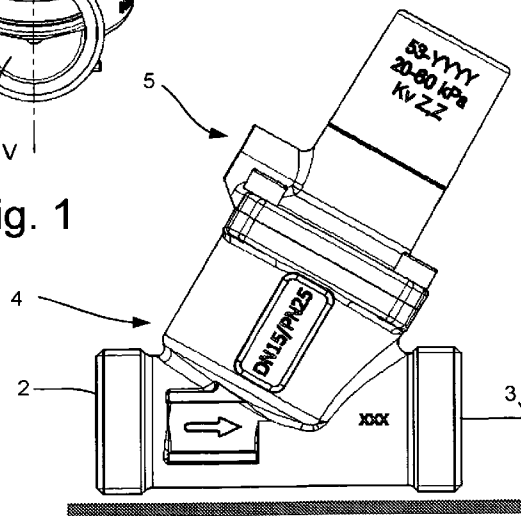
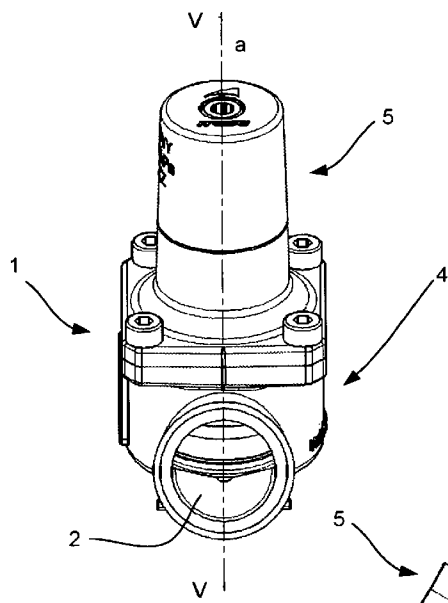
5 8. Styringsventil ifølge et hvilket som helst af de foregående krav, hvor fjederkraften af fjederelementet, der fortrinsvist er en spiralfjeder, er justerbar, fortrinsvis ved hjælp af en spindel med gevind, der er roterbar via en ydre ende, som er placeret ved toppen af ventilen.

10 9. Styringsventil ifølge et hvilket som helst af krav 1 til 7, hvor opstrømsindløbet er placeret på siden, der er modstående til ventilindløbet set i forhold til ventilelementet, i lighed med fjederelementet.

10. Styringsventil ifølge et hvilket som helst af krav 1 til 9, hvor den trykopretholdende anordning er i form af en separat tilvejebragt ventilindsats, der kan monteres i huset, så at der dannes en samlet styringsventil, hvor den trykopretholdende anordning fortrinsvist er udskiftelig.

15 11. Styringsventil ifølge et hvilket som helst af de foregående krav, hvor det første element (11, 12) er i form af ventilelementet (11), og det andet, modstående element (12, 11) er i form af ventilsædet (12).

DRAWINGS



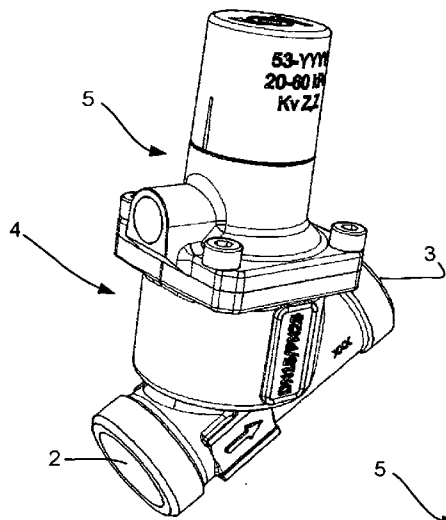


Fig. 3

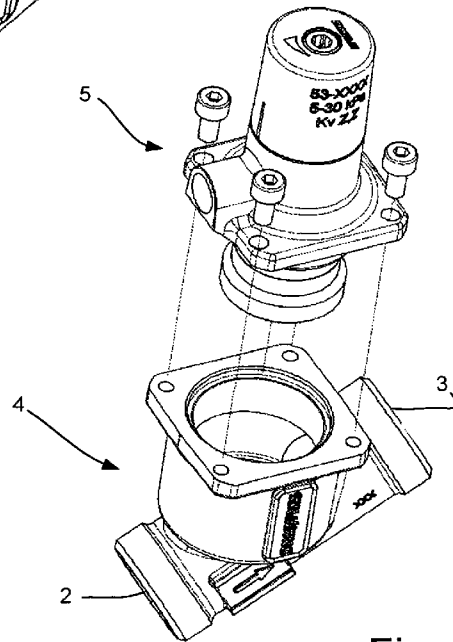


Fig. 4

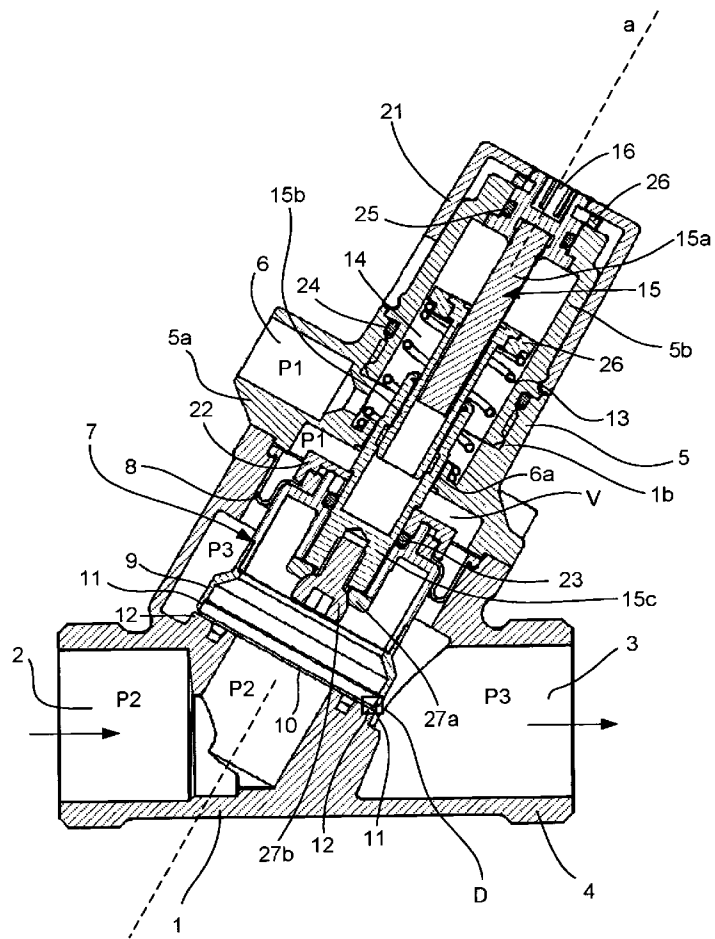


Fig. 5

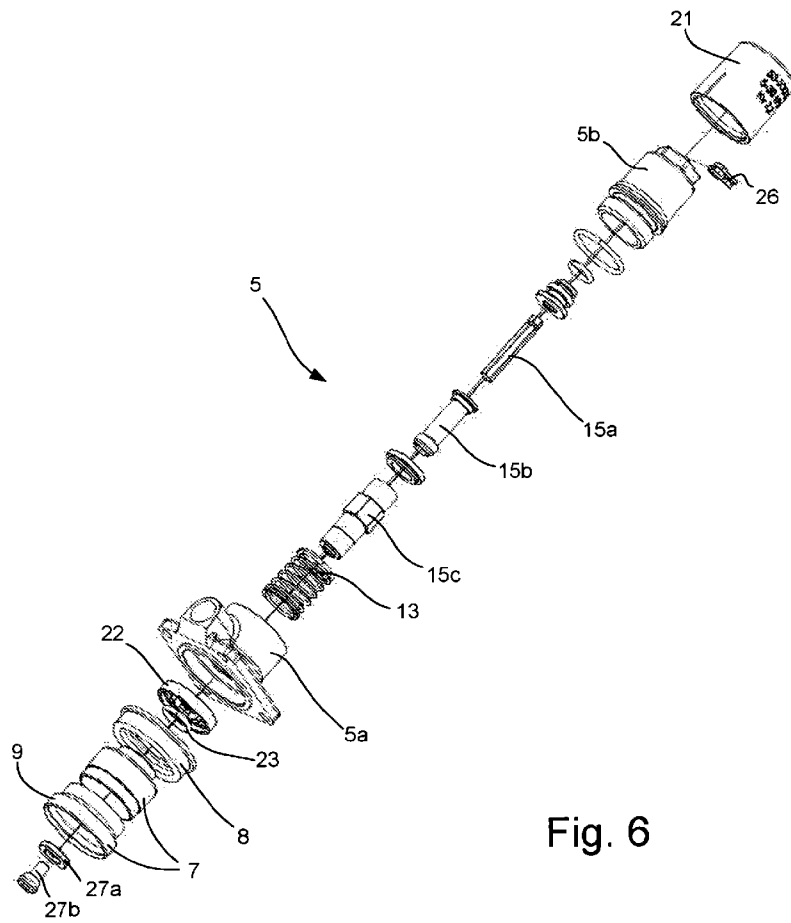


Fig. 6

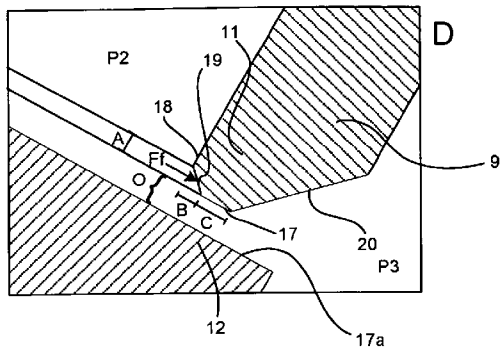


Fig. 7

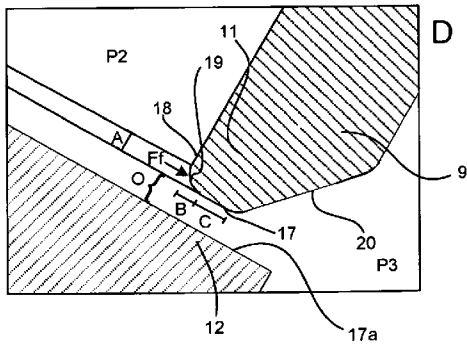


Fig. 8

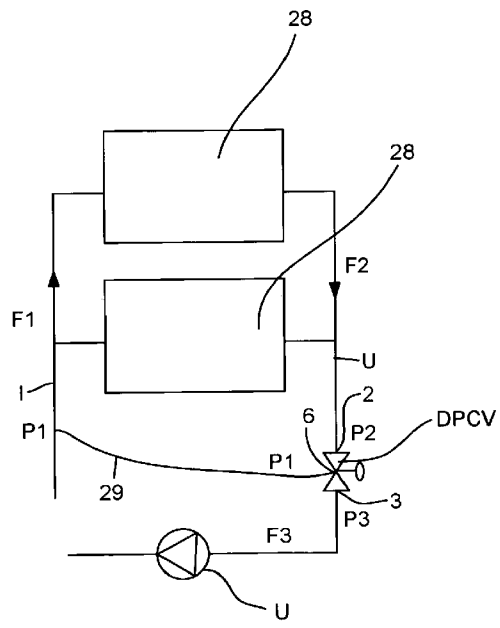


Fig. 9

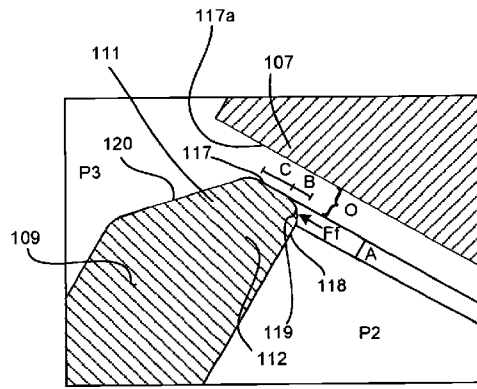


Fig. 10