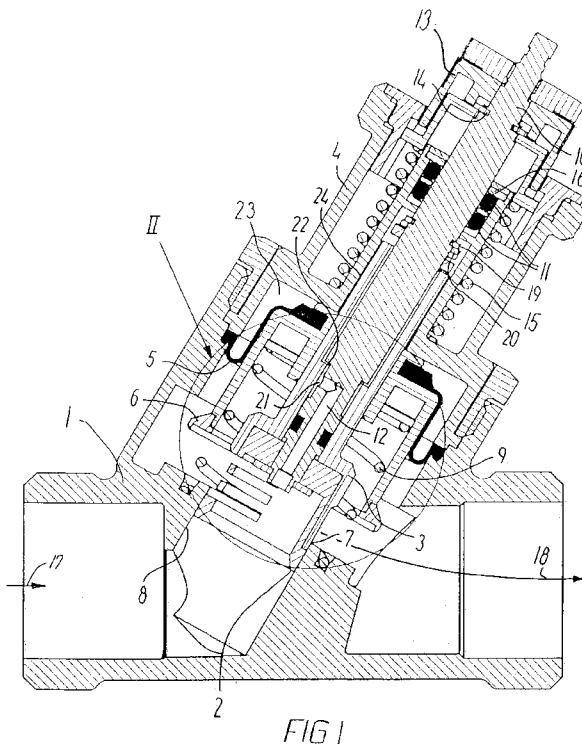




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[Continued on next page]

(54) Title: A CONTROL VALVE



(57) Abstract: The control valve according to the invention is for use in liquid-carrying systems. It comprises a valve housing (1) having an inlet side (17) and an outlet side (18), said valve housing being provided with a pressure maintaining arrangement for maintaining a constant differential pressure between the inlet and outlet sides, as well as an amount control arrangement for setting the maximum flow amount through the valve and adjustment of it. The control arrangement comprises two cylinder shell elements (2 and 3) cooperating in the flow path, both having material removed from otherwise overlapping areas, thereby generating an uncovered area (25) in the flow path of the control valve. The outer cylinder shell element (3) is stationarily rotatable relative to the valve housing, while the inner cylinder shell element (2) may be rotated by means of a rotatable handle (13), whereby a larger or smaller opening (25) between the cooperating cylinder shell elements (2 and 3) may be provided. Both cylinder shell elements (2 and 3), which cooperate with the seat hole (8) of the valve housing, may also be displaced (26) in the axial direction, resulting in an increase or a decrease of the generated opening (25). Thereby, the flow amount may be adjusted prior to the presetting, e.g. by means of an actuator.

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A CONTROL VALVE

The prior art

5 The invention relates to a control valve having an inlet side and an outlet side in a valve housing, in which a pressure maintaining arrangement is mounted for maintaining a constant differential pressure between the inlet and outlet sides, said assembly comprising a rolling diaphragm and a throttle member which sets itself in a balance between the inlet pressure and the outlet pressure as well as between the inlet pressure on the one
10 hand and the outlet pressure as well as spring force on the other hand, respectively, and with an amount control arrangement having an adjustable basic setting and a flow opening reducing arrangement, which may be activated via a spindle connected with an actuator, wherein the amount control
15 is established by mutual rotation of an orifice having cooperating outer and inner slide shell faces, and wherein the reduction of the flow established by means of the actuator as a basic setting takes place by axial movement of the downstream cylinder shell face, said object carrying a sealing area for cooperation with the valve housing for downstream blocking.

20 Known in the art are control valves which contain a differential flow governor combined with an arrangement for presetting and adjustment of the liquid amount flowing therethrough. In such a control valve, a differential pressure governor is used as a pressure maintaining arrangement for
25 maintaining a constant differential pressure across an inlet side and an outlet side independently of the liquid amount flowing therethrough, as a throttle member sets itself in a balance under the action of the inlet pressure on the one hand and the outlet pressure as well as a spring force on the other hand, so that the pressure difference will always be the same,
30 irrespective of the other circumstances, such as the flow amount through the governor. The arrangement for presetting and adjustment of the liquid

flow amount includes an orifice as an amount control arrangement, which may be adjustable from the outside to a basic setting providing an opening for maximum flow, and, in addition, a flow opening reducing arrangement, which may be activated via an outer actuator, may be included.

5

The description of WO 2006 136158 A discloses a control valve for use in liquid-carrying systems with a valve housing having an inlet side and an outlet side, wherein the valve housing is provided with a pressure maintaining arrangement for maintaining a constant differential pressure between the inlet and outlet sides independently of the liquid amount flowing therethrough, as a contained throttle member together with a rolling diaphragm sets itself in a balance under the action of the inlet pressure on the one hand and the outlet pressure as well as a spring force on the other hand.

15

Further, the valve housing is provided with an amount control arrangement disposed upstream of the pressure maintaining arrangement and including an orifice which may be adjusted to a basic setting providing an opening for maximum flow, and additionally including a flow opening reducing arrangement, which may be activated via an outer actuator, wherein the basic setting of the flow control arrangement is provided by mutual rotation of two concentric rings of the orifice with recesses through approximately 180 degrees, thereby providing an uncovered area in the flow path of the control valve, and wherein the reduction of the uncovered area in the flow path, thus realized by actuator impact as a basic setting, takes place by axial movement of the downstream concentric object, said object carrying a sealing area for cooperation with the valve housing for downstream blocking in a position most axially pressed-in by the actuator, i.e. as stated in the introductory portion of claim 1.

25
30

The drawbacks of this control valve are not related to the function of the

valve, but are caused in particular by the high raw material prices, such as of copper, which constitutes a substantial proportion of the brass alloys used as profile rods as a starting material for many inner components in such control valves. Control valves require much machining of many different objects, which are mainly of brass, which per se is very costly and moreover involves losses in the sense that the copper-containing brass material purchased in rod shape for the production has a price per kg which is considerably higher than the sales price per kg of the same brass alloy, which is sold as chips from the object production for renewed processing into rod material.

To this should be added that the rolling diaphragm incorporated in the pressure maintaining arrangement to maintain the constant differential pressure is easily overloaded, since no pressure relief of the inlet pressure takes place on its outer side, when the throttle member is in its pressed-in position. This permanent pressure impact on the diaphragm wears and extends the material, which is weakened thereby.

The object of the invention

The object of the invention is to remedy these deficiencies and drawbacks, and this is achieved according to the invention by a control valve, wherein the reduction of the uncovered area in the flow direction realized by actuator impact as a basic setting takes place by axial movement of also the object which includes the cooperating upstream cylinder shell face, and wherein the sealing area for cooperation with the valve housing for downstream blocking is carried at a greater distance from the axis of the cylinder shell faces than the radius of the cooperating downstream cylinder shell face.

This ensures that the material for the cooperating coaxial cylinder shell

faces of the orifice is essentially always present within the diameter of the carried sealing area. Since, in terms of size, control valves of this type are effectively compared by having the same effective closing diameter of the carried sealing area, the importance of this is that the objects with the cooperating cylinder shell elements of the orifice may be made of round rod material having a significantly smaller diameter and thereby much less content of material than previously known relevant control valves, in which the cooperating cylinder shell faces of the orifice are present on diameters which are larger than the effective closing diameter.

10

When, as stated in claims 2 and 3, a capillary channel is configured such that it is blocked from the pressure from the inlet on the outer side of the rolling diaphragm when the spindle is most pressed-in, the diaphragm will be relieved in its passive position.

15

When, as stated in claim 4, the spindle is provided with a return spring, it will hereby be returned when the pressing-in by the actuator ceases, following which the diaphragm will again operate against external pressure impact.

20

When, as stated in claim 5, the valve housing is made in one piece by casting or forging, an additionally simplified machining is achieved, as machining of associated joining faces on valve housing parts is avoided, just as it is possible to achieve a saving of material.

25

When, as stated in claim 6, the pressure maintaining arrangement and the amount control arrangement are mounted in the same opening in the valve housing, a saving of material is likewise achieved.

30

When, as stated in claim 7, the cooperating coaxial cylinder shell faces are given the same axial movement, a control valve having a more unique, re-

producible and safe function in response to the impact from the external actuator is achieved.

5 When, as stated in claim 8, the object is configured such that the cooperating downstream cylinder shell face is surrounded fully or partly by the throttle member, a saving of material is likewise achieved.

10 Finally, as stated in claim 9, it is expedient to provide an externally accessible rotatable handle for an object including a rotatable, cooperating coaxial cylinder shell face, whereby the basic setting of the amount control arrangement may readily be adjusted exactly to a desired basic setting after the system in which the control valve of the invention is mounted, has been put to service.

15 The drawing

A working example of a control valve according to the invention will now be described more fully with reference to the drawing, in which

20 fig. 1 shows a control valve seen in a vertical section,

fig. 2 shows an enlarged view of the valve area designated II in fig. 1,

25 fig. 3 shows the same area, but with the spindle in a pressed-in position, and

figs. 4 – 7 show a partially sectional view of four different basic settings.

30

Description of the working example

In fig. 1, a control valve according to the invention is shown in a sectional view, consisting of a valve housing 1 having an inlet 17 and an outlet 18.

5 The pressure maintaining mechanism consists of a rolling diaphragm 5 and a throttle member 6 which supports the rolling diaphragm. The pressure at the inlet 17 is transferred to the outer side 23 of the rolling diaphragm 5 through a bore 12 in the spindle 10 and a capillary channel 22 between the spindle and the cylinder shell element 3. From there, the inlet pressure will
10 propagate along the outer side 24 of the cylinder shell element 5 to the space 23 and thereby the outer side of the diaphragm 5.

A spring 9 urges the throttle member 6 to its top position in cooperation with the pressure within the closing diameter of the throttle member 6.

15

In use, a balance is established between the inlet pressure 17 and the outlet pressure 18 plus the spring force from the spring 9. This differential pressure will therefore be constant with a given spring force.

20

Fig. 2 shows the arrangement for adjusting and optionally blocking the flow amount. An outer cylinder shell element 3 is provided with an annular recess which extends over approximately half the circumference. Within this and coaxially with it, there is an inner cylinder shell element 2 having a corresponding annular recess. The inner cylinder shell element 2 is connected
25 with a rotatable handle 13 by means of the spindle 10, so that its angular position relative to the outer cylinder shell element 3 may be adjusted by means of the rotatable handle 13. Thereby, the overlap in the circumferential direction between the cooperating cylinder shell elements 2 and 3 and thereby the maximum flow amount through the governor may be adjusted
30 manually.

The cylinder shell elements 2 and 3 are axially stationary relative to each other. However, both are axially displaceable relative to the seat hole 8 and thereby also the edge 7 of the seat hole against the action of a compression spring 15.

5

The axial overlap between the cooperating cylinder shell elements 2 and 3 and the edge 7 of the seat hole may be changed by axial displacement, whereby the amount flowing through the governor may be set or adjusted within the limits of the preset maximum value.

10

In the one outer position, blocking of the flow may be established in that the cylinder shell element 3 after the recess is provided with a radius which is larger than the radius of the seat hole 8, and is caused to cooperate with the edge 7 of the seat hole 8 by the axial displacement.

15

It is shown in an enlarged view in figs. 2 and 3 how the inlet pressure on the outer side of the rolling diaphragm 5 may be cut off, when the spindle 10 and the cylinder shell element 2, 3 are set in an open position, as shown in fig. 2, and in the most pressed-in position, which is shown in fig. 3, by means of an actuator (not shown).

20

It appears from fig. 2 that the pressure may spread via the channel 12 in the spindle 10 and a capillary channel 21 provided in a recess 22 and a connection 24, which extends externally in the cylinder shell element 3 and into the space 23 above the rolling diaphragm 5.

25

When, as shown in fig. 3, the spindle 10 is pressed-in completely, the outer cylinder shell element 3 is caused to contact the edge 7 of the seat hole 8, whereby the flow is interrupted, just as the capillary connection 21 is interrupted at the recess 22 after the spindle 10 has moved a further small distance relative to the cylinder shell element 3. This small spindle movement

30

of about 0.5 mm ensures that the blocking takes place after the closure, and then a small return spring 20, see fig. 1, which is disposed between a stop 19 on the spindle 10 and the upper portion of the cylinder shell 3, will return the spindle 10 by its spring force.

5

This is gentle to the rolling diaphragm 5, as the inlet pressure is relieved on its outer side, when this pressure impact is not needed for the function of the diaphragm. This ensures that the flexible diaphragm is not subjected to undue pressure loading.

10

Figs. 4, 5, 6 and 7 illustrate the adjustment and control principle.

15

Fig. 4 shows a relatively small angular rotation 27 between the cylinder shell elements 2 and 3, axially displaced 26 to their greatest distance from the edge 7 of the seat hole, where the generated flow area is indicated by a black field 25.

20

Fig. 5 shows the same angular rotation 27, but with the cylinder shell elements 2 and 3 displaced in an axial direction 26 relative to the edge 7 of the seat hole, and the flow area generated in this position is likewise indicated by the smaller, black field 25.

25

Fig. 6 shows a greater angular rotation 27 between the cylinder shell elements 2 and 3 by axial displacement 26 to their greatest distance from the edge 7 of the seat hole, where the generated maximum flow area is indicated by a black field 25.

30

Fig. 7 shows the same greater angular rotation, but with the cylinder shell elements 2 and 3 displaced in an axial direction 26 relative to the edge 7 of the seat hole, and the flow area generated in this position is likewise indicated by a black field 25.

PATENT CLAIMS

1. A control valve having an inlet side and an outlet side in a valve housing, in which a pressure maintaining arrangement is mounted for maintaining a constant differential pressure between the inlet and outlet sides, said assembly comprising a rolling diaphragm and a throttle member which sets itself in a balance between the inlet pressure and the outlet pressure as well as between the inlet pressure on the one hand and the outlet pressure as well as spring force on the other hand, respectively, and with an amount control arrangement having an adjustable basic setting and a flow opening reducing arrangement, which may be activated via a spindle connected with an actuator, wherein the amount control is established by mutual rotation of an orifice having cooperating outer and inner slide shell faces, and wherein the reduction of the flow established by means of the actuator as a basic setting takes place by axial movement of the downstream cylinder shell face, said object carrying a sealing area for cooperation with the valve housing for downstream blocking, c h a r a c t e r i z e d i n

that the reduction of the uncovered area in the flow direction realized by actuator impact as a basic setting takes place by axial movement of also the object which includes the cooperating upstream cylinder shell face, and

that the sealing area for cooperation with the valve housing for downstream blocking is carried at a greater distance from the axis of the cylinder shell faces than the radius of the cooperating downstream cylinder shell face.

2. A control valve according to claim 1, c h a r a c t e r i z e d i n that the pressure maintaining arrangement comprises transfer of the pressure from the inlet to the outer side (23) of the rolling diaphragm (5) via a capillary channel (12, 21, 22, 24) in the spindle (10) and the outer cylinder element (3), said channel being closed for transfer in the position most pressed-in

by the actuator.

3. A control valve according to claim 2, c h a r a c t e r i z e d in that the closure is formed by a valve arrangement having a recess (22) provided
5 internally on the cylinder shell element (3), with which a cooperating external recess on the spindle (10) is in engagement.

4. A control valve according to claims 2 and 3, c h a r a c t e r i z e d in that the spindle (10) is provided with a return spring (20) between a fixed
10 stop (19) mounted on the spindle and the outer cylinder element (3).

5. A control valve according to claim 1, c h a r a c t e r i z e d in that the valve housing (1) is in one piece.

15 6. A control valve according to claims 1 – 5, c h a r a c t e r i z e d in that the pressure maintaining arrangement and the flow control arrangement are mounted in the same opening in the valve housing (1).

20 7. A control valve according to claim 1, c h a r a c t e r i z e d in that the cooperating coaxial cylinder shell faces (2, 3) are simultaneously given the same axial movement.

8. A control valve according to claims 1 – 7, c h a r a c t e r i z e d in that the object including the cooperating downstream cylinder shell face is sur-
25 rounded fully or partly by the throttle member (6).

9. A control valve according to one of the preceding claims, c h a r a c -
t e r i z e d in that a rotatable handle (13) is non-rotatably connected with the spindle (10) and the cooperating coaxial cylinder shell face (2).

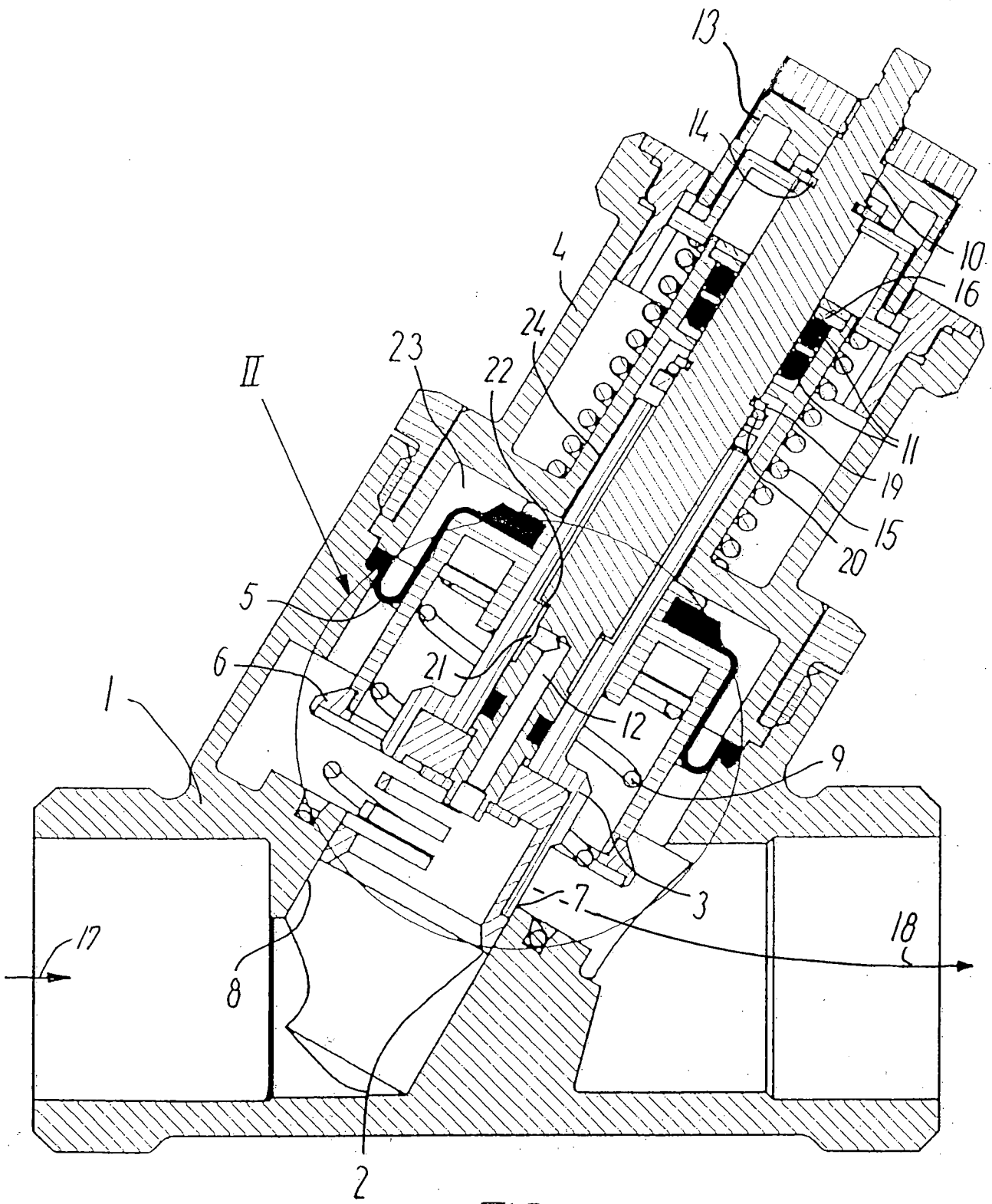


FIG. 1

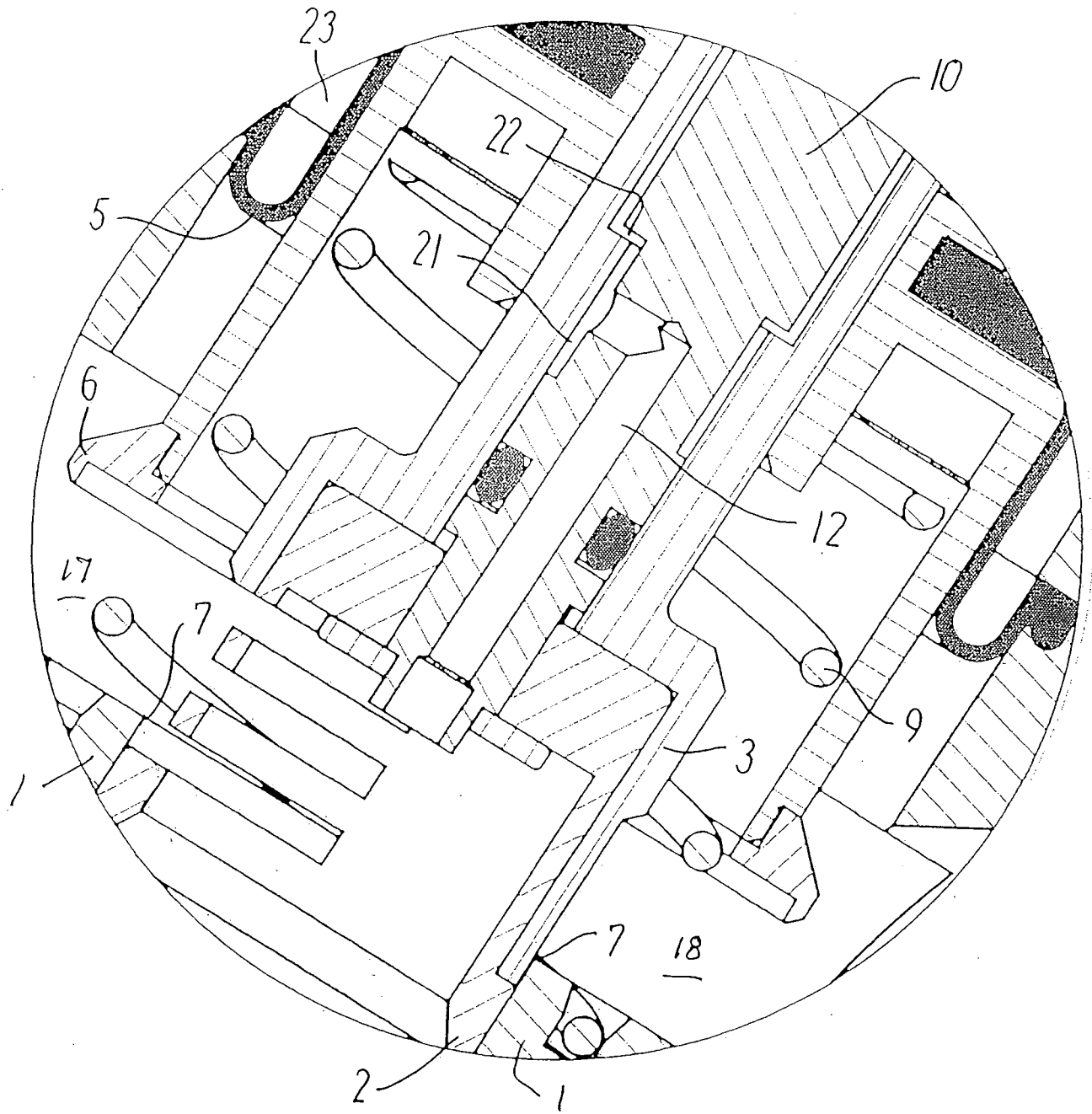


FIG. 2

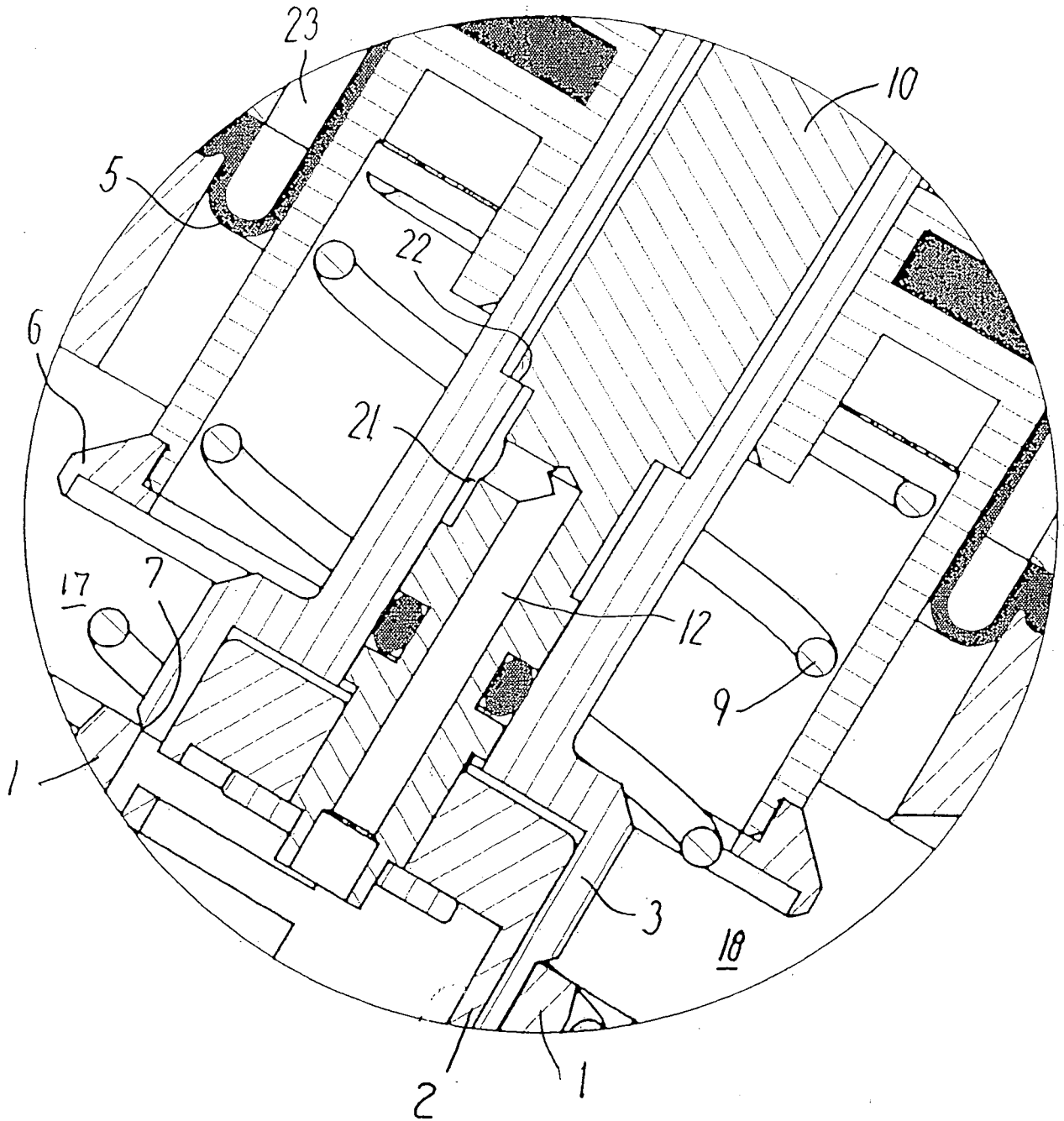


FIG. 3

