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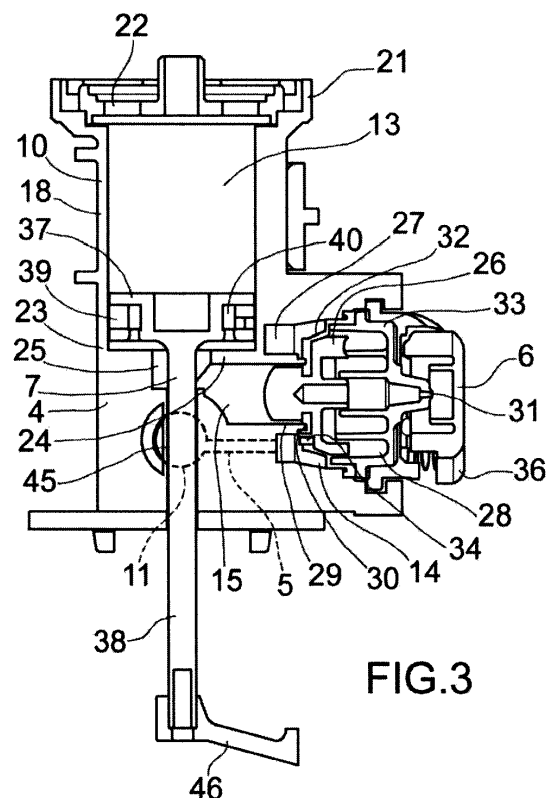
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(74) Representative: **Cernuzzi, Daniele****Studio Torta S.p.A.****Via Viotti, 9****10121 Torino (IT)**(54) **Flush tank drain valve control device**

(57) A flush tank drain valve control device has a hydraulic circuit (5) connectable to a water mains; a shutter (6) which acts on the circuit (5) and is operated by an actuator assembly (3); and a movable piston (7) inserted inside a slide chamber (13) along the circuit (5), and connectable to, to open, the drain valve; the shutter (6) is movable by the actuator assembly (3) to permit or cut off water flow along the circuit (5) to the slide chamber (13), so as to push the piston (7) inside the slide chamber (13).

**FIG.3****EP 2 685 014 A1**

Description

[0001] The present invention relates to a flush tank drain valve control device.

[0002] As is known, flush tank drain valves are normally operated by a control device, which is either user-operated, e.g. by one or more pushbuttons, or operated automatically, e.g. by a presence sensor.

[0003] The control device normally comprises a mechanism which acts on a valve body of the drain valve to open a drain hole; the valve body is defined by a tube (which also acts as an overflow) with an end seal, and the control device raises the valve body vertically.

[0004] Various types of control devices are known, but all leave room for improvement, especially in terms of easy operation, efficiency and reliability.

[0005] More specifically, to effectively raise the valve body of the drain valve, many known control devices require the application of a certain amount of force. If this is applied directly by the user (as, for example, in the case of purely mechanical devices), the user may fail to apply just the right amount of force, thus resulting in only partial opening of the valve (if not enough force is applied) or in potential damage to the mechanism (if too much force is applied).

[0006] In the case of control devices assisted, for example, by pneumatic or electric actuators, the actuators must be designed to provide sufficient force to raise the valve body.

[0007] It is therefore an object of the present invention to provide a flush tank drain valve control device that is both highly efficient and reliable.

[0008] According to the present invention, there is provided a flush tank drain valve control device as defined substantially in the attached Claim 1 and, as regards its preferred features, in the dependent Claims.

[0009] The control device according to the invention is easy to produce, assemble and install, while at the same time being highly efficient and reliable.

[0010] The invention is substantially based on using the force of the water fed (at normal mains pressure) into the flush tank to reduce the effort required to operate the drain valve. Using the device according to the invention, the effort required to raise the valve body of the drain valve is, in fact, reduced, thus making the drain valve easier to operate.

[0011] A non-limiting embodiment of the invention will be described by way of example with reference to the attached drawings, in which :

Figure 1 shows a schematic view in perspective of a flush tank drain valve control device in accordance with the invention;

Figure 2 shows an exploded view in perspective, with parts removed for clarity, of the Figure 1 device;

Figures 3 and 4 show two longitudinal sections of a detail, in particular of a hydraulic assembly, of the Figure 1 device in respective operating positions;

Figure 5 shows a partial view in perspective of a variation of the Figure 1 device;

Figures 6 and 7 show two longitudinal sections of a detail, in particular of an actuator assembly, of the Figure 5 device in respective operating positions.

[0012] Number 1 in Figures 1 and 2 indicates as a whole a flush tank drain valve control device. As explained below, device 1 is designed to fit inside the flush tank (known and not shown for the sake of simplicity), and is connectable to a known drain valve (also not shown) housed inside the flush tank.

[0013] Device 1 comprises at least one hydraulic assembly 2 connectable to and to open the drain valve; and at least one actuator assembly 3 which acts on hydraulic assembly 2.

[0014] More specifically, device 1 comprises one hydraulic assembly 2 connected to one actuator assembly 3, or two hydraulic assemblies 2 connected to respective actuator assemblies 3, depending on whether device 1 is designed for use, respectively, with a single-flush drain valve (i.e. that always discharges the same amount of water), or with a dual-flush drain valve (i.e. for selectively discharging two different amounts of water).

[0015] In the example shown, device 1 comprises two hydraulic assemblies 2, but only one actuator assembly 3 is shown for the sake of simplicity.

[0016] With reference also to Figures 3 and 4, each hydraulic assembly 2 comprises a casing 4 with a hydraulic circuit 5; a shutter 6 which acts on circuit 5 and is operated by actuator assembly 3; and a movable piston 7 inserted partly in circuit 5 and connected in use to the drain valve, and more specifically to a valve body of the drain valve.

[0017] Casing 4 comprises a hollow body 10 having an inlet 11 and outlet 12, e.g. substantially aligned along an axis X and on opposite sides of body 10; and, internally, body 10 has a slide chamber 13 and a pressure chamber 14, which, for example, are substantially cylindrical, extend along respective perpendicular axes Z and Y, and are connected hydraulically to each other by a channel 15.

[0018] Inlet 11 is connected to a water feed conduit 16 (in turn connected to the water mains feeding the flush tank); outlet 12 is closed by a cap 17; when device 1 comprises two hydraulic assemblies 2 and therefore two bodies 10, the hydraulic assemblies 2 are connected hydraulically in series, so that body 10 of the first hydraulic assembly 2 has its inlet 11 connected to a feed conduit 16, and its outlet 12 connected by a further feed conduit 16 to inlet 11 of body 10 of the second hydraulic assembly 2; and outlet 12 of body 10 of the second hydraulic assembly 2 is closed by cap 17.

[0019] Slide chamber 13 extends (substantially vertically in use) along axis Z, and is bounded by a lateral, e.g. substantially cylindrical, wall 18; slide chamber 13 has an open top end 21 with one or more outlet holes 22, and a bottom end 23 opposite top end 21 and closed

by a bottom wall 24; bottom wall 24 has a central through hole 25 communicating with channel 15 and therefore with pressure chamber 14.

[0020] Pressure chamber 14 extends along axis Y and houses a cap 26, which is positioned crosswise to pressure chamber 14 to divide pressure chamber 14 into two adjacent zones 27, 28 aligned along axis Y; zone 27 communicates with inlet 11 and, via a passage 29 in an end wall of pressure chamber 14, with channel 15; passage 29 is bounded by a sealing seat 30 defined, for example, by a front edge of an annular collar; and zone 28 has a vent hole 31 opposite passage 29.

[0021] Cap 26 advantageously has a substantially rigid disk body made of plastic, and a flexible, e.g. rubber, hood 32, the outer peripheral edge of which contacts a lateral wall of pressure chamber 14.

[0022] Cap 26 is movable inside pressure chamber 14 to selectively open/close passage 29. For example, guided by a guide 33, cap 26 slides along axis Y for selectively resting against sealing seat 30 (thus closing passage 29) and releasing sealing seat 30 (thus opening passage 29). Cap 26 has two opposite faces facing zones 27 and 28 respectively.

[0023] Zones 27 and 28 communicate via at least one service conduit 34 formed, for example, through cap 26.

[0024] Shutter 6 is movable to allow or cut off water flow through vent hole 31. More specifically, shutter 6 cooperates with, and is movable to selectively open/close, vent hole 31. For example, shutter 6 is fitted to a lever 36 hinged to body 10 and connected to actuator assembly 3.

[0025] Actuator assembly 3 is generally designed to move lever 36, or more generally speaking shutter 6, to open/close vent hole 31, and so comprises a mechanism for moving shutter 6 (e.g. together with lever 36) from a closed position, in which shutter 6 closes vent hole 31, to an open position, in which shutter 6 leaves vent hole 31 open, and then restoring lever 36 and shutter 6 to the closed position.

[0026] Actuator assembly 3 may be a known type, such as a pneumatic actuator assembly as shown in Figure 1, or a mechanical or electromechanical actuator assembly, and may be either user-operated directly, e.g. by means of a pushbutton, or automatically, e.g. by a presence sensor.

[0027] Piston 7 comprises a head 37 and a rod 38. Head 37 is housed in slide chamber 13, and has an annular gasket 39 surrounding head 37 and cooperating radially with lateral wall 18. More specifically, gasket 39 is housed in a peripheral groove 40 on head 37. Gasket 39 is substantially annular, and comprises a number of sectors 41, which cooperate with and slide laterally with respect to one another to alter the radial size of gasket 39.

[0028] More specifically, each sector 41 has two opposite stepped portions 42 located at respective angularly opposite ends of sector 41; and angularly adjacent sectors 41 are connected to one another by respective axially overlapping stepped portions 42 cooperating ra-

dially with one another.

[0029] Rod 38 projects axially from head 37, and is inserted loosely through hole 25, so as not to close hole 25 completely, and so as to define about rod 38 an annular passage communicating with channel 15; rod 38 is then inserted inside a seat 45 through body 10; between rod 38 and seat 45, there is a small radial clearance (smaller than that between rod 38 and hole 25); and rod 38 projects downwards from seat 45 and body 10, and has a hook 46 which hooks onto the valve body of the drain valve.

[0030] Device 1 advantageously comprises a support 47, which fits to the flush tank and supports hydraulic assemblies 2.

[0031] Support 47 comprises a plate 48, which has fasteners 49 for fixing plate 48 to the flush tank, and supporting members 50 located on the top face of plate 48 to receive and support one or more hydraulic assemblies 2. In the example shown, each supporting member 50 has a seat 51 shaped to receive a tubular member and/or a flange on the tubular member. More specifically, seat 51 has a curved bottom surface 52, on which a tubular member rests, and which has a slot 53 in which to insert a flange on the tubular member. In the example shown, support 47 has three substantially aligned supporting members 50; and one of supporting members 50, e.g. the middle one, has a fastening bracket 54, which fits onto plate 48 to close the top of seat 51 of supporting member 50.

[0032] In actual use, device 1 is connected to the water mains by feed conduit 16.

[0033] In circuits 5 of series-connected hydraulic assemblies 2, water therefore circulates at normal mains pressure.

[0034] When the flush tank is full and the drain valve closed, each hydraulic assembly 2 assumes a rest position (Figure 3), in which vent hole 31 is closed by shutter 6, passage 29 is closed by cap 26, and piston 7 rests on bottom wall 24 of slide chamber 13. The water fed into hydraulic assembly 2 through inlet 11 fills both zones 27, 28 of pressure chamber 14, thus balancing the pressure on the opposite faces of cap 26, which therefore remains positioned against sealing seat 30 to prevent water from flowing into channel 15 and reaching slide chamber 13.

[0035] When a flush is activated by an actuator assembly 3, actuator assembly 3 moves lever 36 of respective hydraulic assembly 2 to move shutter 6 and open vent hole 31.

[0036] Hydraulic assembly 2 assumes a flush position (Figure 4), in which shutter 6 leaves vent hole 31 open; the water flows out through vent hole 31, so the water pressure in zone 27 is higher than that in zone 28, and pushes cap 26 away from sealing seat 30 and towards vent hole 31 to open passage 29. The water then flows along channel 15 to slide chamber 13, thus pushing head 37 of piston 7 upwards, and raising piston 7 together with the valve body of the drain valve.

[0037] The water then flows out of hydraulic assembly

2 through outlet holes 22 and into the flush tank; and part of the water may also seep into seat 45 of rod 38. Water is allowed to flow out through outlet holes 22 by the water pressure in slide chamber 13 expanding and parting sectors 41 of gasket 39, to allow water to flow between sectors 41 to outlet holes 22.

[0038] One flushing is completed, hydraulic assembly 2 moves back to the rest position : shutter 6 again closes vent hole 31, and cap 26 again closes passage 29; slide chamber 13 empties, piston 7 moves down, and the drain valve closes.

[0039] In the Figure 5 and 6 embodiment, shutter 6 is located remotely with respect to hydraulic assembly 2, and, more specifically, is integrated in actuator assembly 3 and, as opposed to directly contacting vent hole 31, cooperates with an auxiliary hole 61 communicating with vent hole 31, to allow or cut off water flow through vent hole 31.

[0040] More specifically, actuator assembly 3 (or each actuator assembly 3) comprises a hollow supporting body 62, which is connected hydraulically to hydraulic assembly 2 by a tube 63, and supports shutter 6, and a pushbutton 64 connected to and for moving shutter 6.

[0041] More specifically, inside, supporting body 62 has a chamber 65 housing pushbutton 64, and a chamber 66 housing shutter 6; and chambers 65 and 66 are separated by a partition 67 and connected by auxiliary hole 61 formed, for example, through partition 67.

[0042] Chamber 65 has an outlet 68 formed, for example, in a lateral wall 69 of chamber 65, and communicating with the flush tank (e.g. by means of an outlet tube 68a). Pushbutton 64 is movable, e.g. rocks, inside chamber 65 to cooperate with and move shutter 6. In the example shown, pushbutton 64 comprises a substantially rigid, cup-shaped body 70 hinged to supporting body 62, and more specifically to lateral wall 69; and a flexible, e.g. rubber, hood 71 covering body 70 and fixed in fluidtight manner to a peripheral edge 72 of chamber 65 to close chamber 65.

[0043] Pushbutton 64 cooperates with shutter 6 by means of a pin 73 housed slidably inside auxiliary hole 61, and the opposite ends of which contact pushbutton 64 and shutter 6.

[0044] Chamber 66 has an inlet 74 formed, for example, in a lateral wall 75 of chamber 66; and tube 63 connects inlet 74 to vent hole 31 of hydraulic assembly 2.

[0045] Chamber 66 houses a closing member 76, which divides chamber 66 into two adjacent zones 77, 78 connected by a service conduit 79 formed, for example, through member 76. Member 76 has two opposite faces facing zones 77 and 78 respectively, and supports shutter 6.

[0046] Member 76, for example, comprises a flexible membrane 81 with a peripheral edge 82 fixed to lateral wall 75 of chamber 66, and a rigid insert 83 located in zone 78 and guided by a guide 84 which also closes chamber 66. Auxiliary hole 61 and inlet 74 are located in zone 77.

[0047] Member 76 is movable inside chamber 66 together with shutter 6. More specifically, shutter 6 is defined by a portion 85 of member 76 (e.g. of membrane 81) positioned contacting a front edge 86 of auxiliary hole 61; and shutter 6 is movable - pushed by pushbutton 64 by means of pin 73 - to selectively open/close auxiliary hole 61. In the example shown, shutter 6 is rocked by the flexibility of membrane 81, which defines an elastic hinge.

[0048] In actual use, shutter 6 is normally set to a closed position (Figure 6) closing auxiliary hole 61 to prevent water flow from chamber 66 into chamber 65. Shutter 6 is kept in the closed position by member 76 and by the pressure of the water filling both zones 77, 78 and exerting the same pressure on the opposite faces of member 76.

[0049] When the user presses pushbutton 64 to activate the drain valve (Figure 7), pushbutton 64 pushes pin 73 against shutter 6, which moves to open auxiliary hole 61. Water flows from chamber 66 to chamber 65 through auxiliary hole 61, and a flow of water circulate therefore into circuit 5 of hydraulic assembly 2, via tube 63. The water can now also flow out of vent hole 31 of hydraulic assembly 2, which assumes the flush position, in which water flows through vent hole 31 : in hydraulic assembly 2, as described previously, water flows out through vent hole 31, moves cap 26 to open passage 29, and ultimately moves piston 7 to open the drain valve.

[0050] The water flowing through actuator assembly 3 is drained through outlet 68, e.g. into the flush tank along outlet tube 68a.

[0051] Clearly, other changes may be made to the control device as described and illustrated herein without, however, departing from the scope of the accompanying Claims.

Claims

1. A flush tank drain valve control device (1) comprising a hydraulic circuit (5) connectable to a water mains; a shutter (6) which acts on the circuit (5) and is operated by an actuator assembly (3); and a movable piston (7) inserted inside a slide chamber (13) along the circuit (5), and connectable to the drain valve for opening the drain valve; the shutter (6) being movable, operated by the actuator assembly (3), to selectively permit or cut off water flow along the circuit (5) to the slide chamber (13), so as to push the piston (7) inside the slide chamber (13).
2. A device as claimed in Claim 1, wherein the circuit (5) comprises a vent hole (31) and the shutter (6) cooperates with the vent hole (31) or with an auxiliary hole (61) communicating with the vent hole (31) to selectively permit or cut off water flow through the vent hole (31) and, hence, along the circuit (5).

3. A device as claimed in Claim 2, wherein the shutter (6) is movable to selectively open/close the vent hole (31) or the auxiliary hole (61).
4. A device as claimed in Claim 2 or 3, comprising a cap (26) that is movable inside a pressure chamber (14) to selectively open/close a passage (29) that feeds water to the piston (7); and wherein the cap (26) is movable by the pressure of the water flowing in the circuit (5), and opens the passage (29) when water flows through the vent hole (31). 5
5. A device as claimed in Claim 4, comprising a casing (4) internally provided with the slide chamber (13), which houses a head (37) of the piston (7), and with the pressure chamber (14), which is connected to the slide chamber (13) by a channel (15); and wherein the passage (29) connects the pressure chamber (14) to the channel (15). 10 15
6. A device as claimed in Claim 4 or 5, wherein the cap (26) divides the pressure chamber (14) into two adjacent zones (27, 28), which communicate hydraulically with each other via at least one service conduit (34) and are provided with the passage (29) and the vent hole (31) respectively. 20 25
7. A device as claimed in Claim 6, wherein, in use, the cap (26) keeps the passage (29) closed as long as the vent hole (31) is closed by the shutter (6); both zones (27, 28) of the pressure chamber (14) being full of water at the same pressure. 30
8. A device as claimed in one of Claims 2 to 7, wherein the actuator assembly (3) comprises a hollow supporting body (62), which is connected hydraulically to the vent hole (31) by a tube (63) and houses the shutter (6) and a pushbutton (64) connected to and for moving the shutter (6); the supporting body (62) being internally provided with a first chamber (65) housing the pushbutton (64), and a second chamber (66) housing the shutter (6); the first and second chamber (65, 66) being separated by a partition (67), and being connected by the auxiliary hole (61) formed, for example, through the partition (67). 35 40 45
9. A device as claimed in Claim 8, wherein the pushbutton (64) cooperates with the shutter (6) by means of a pin (73) housed slidably inside the auxiliary hole (61), and the opposite ends of which contact the pushbutton (64) and the shutter (6). 50
10. A device as claimed in one of the foregoing Claims, wherein the piston (7) is provided with an annular gasket (39) cooperating radially with a lateral wall (18) of the slide chamber (13); the gasket (39) being formed by a plurality of sectors (41) which cooperate mutually to slide laterally with respect to one another. 55
11. A device as claimed in Claim 10, wherein each sector (41) has two stepped portions (42) located at respective angularly opposite ends of the sector (41); angularly adjacent sectors (41) being connected to one another by respective axially overlapping stepped portions (42) contacting radially with one another.
12. A device as claimed in Claim 10 or 11, wherein the slide chamber (13) has a top end (21) with one or more outlet holes (22) located above the gasket (39) of the piston (7), and through which water seeping through the sectors (41) of the gasket (39) flows out.
13. A device as claimed in one of the foregoing Claims, and comprising at least one hydraulic assembly (2), which comprises a casing (4) housing at least part of the circuit (5), the slide chamber (13), and at least a portion of the piston (7); and wherein the shutter (6) is integrated in the hydraulic assembly (2) or the actuator assembly (3).
14. A device as claimed in Claim 13, and comprising two hydraulic assemblies (2) connected hydraulically in series; and one or two actuator assemblies (3) connected to respective hydraulic assemblies (2).

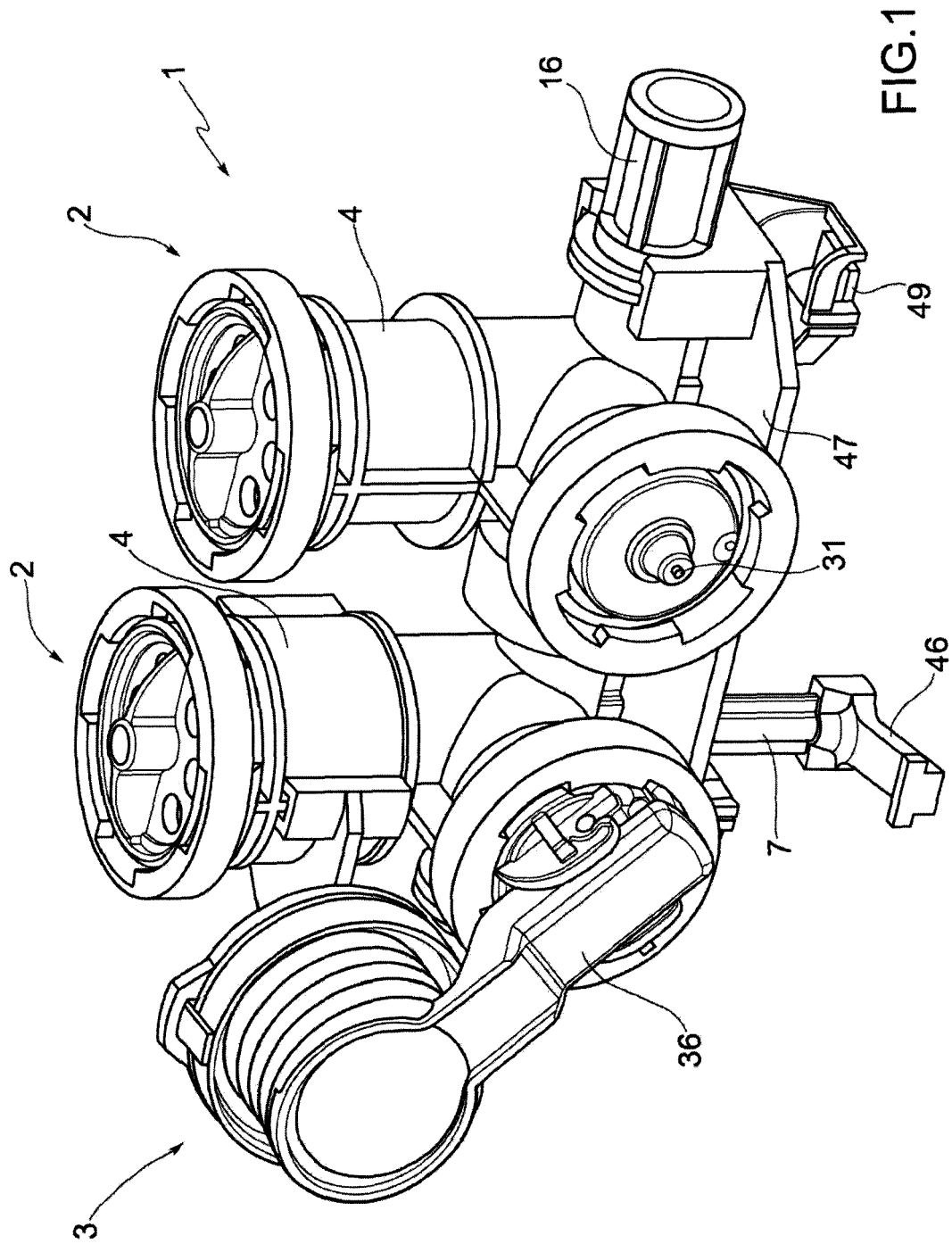
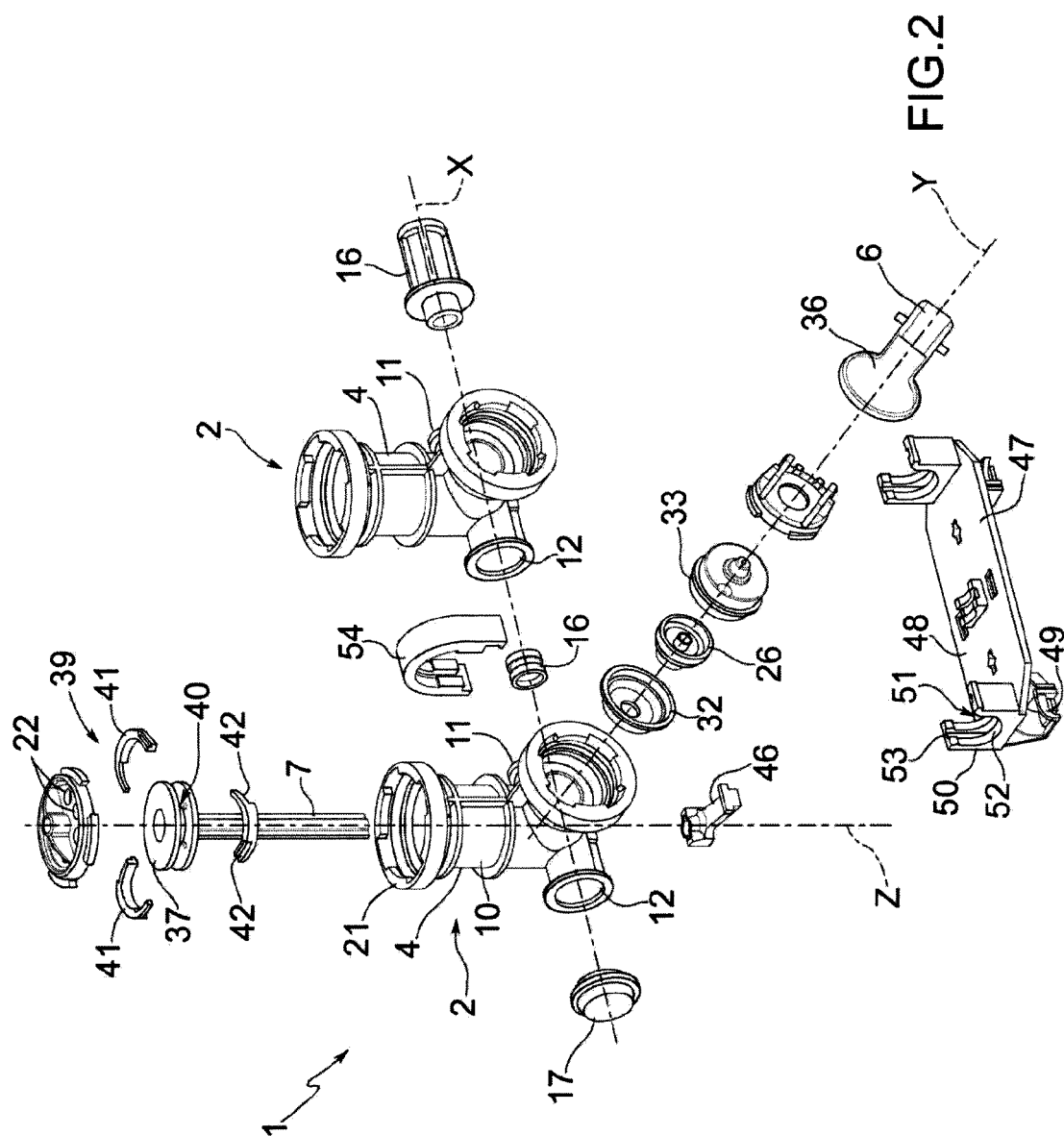


FIG.1



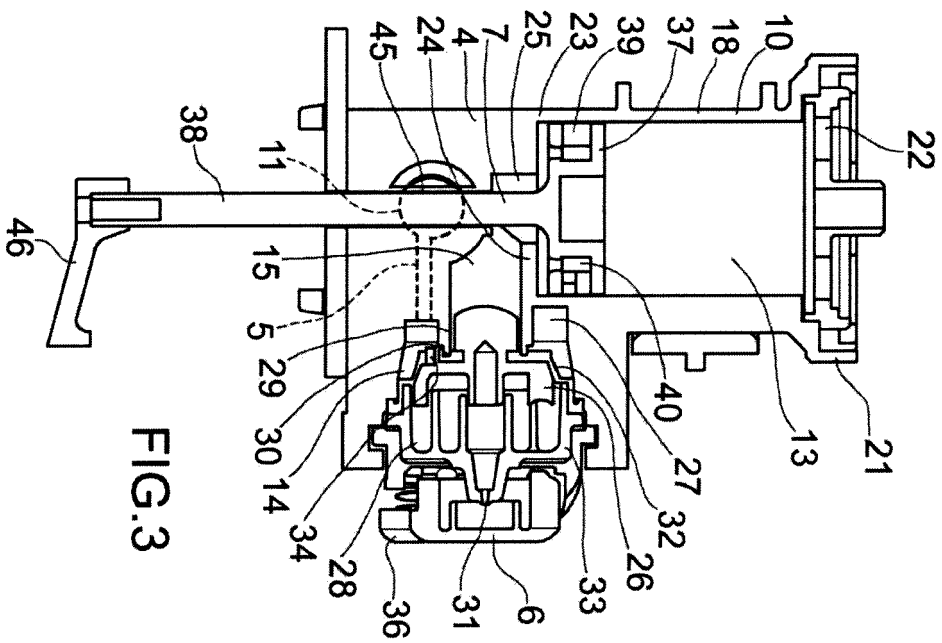


FIG. 3

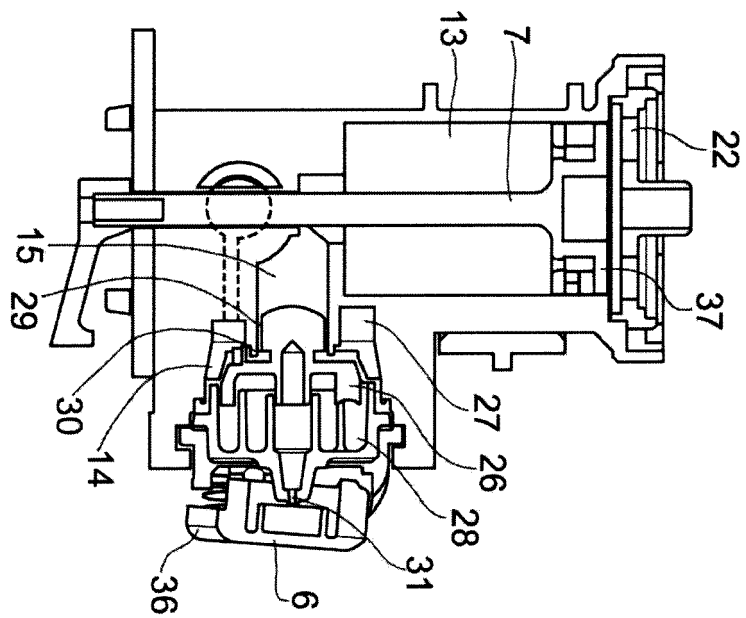


FIG. 4

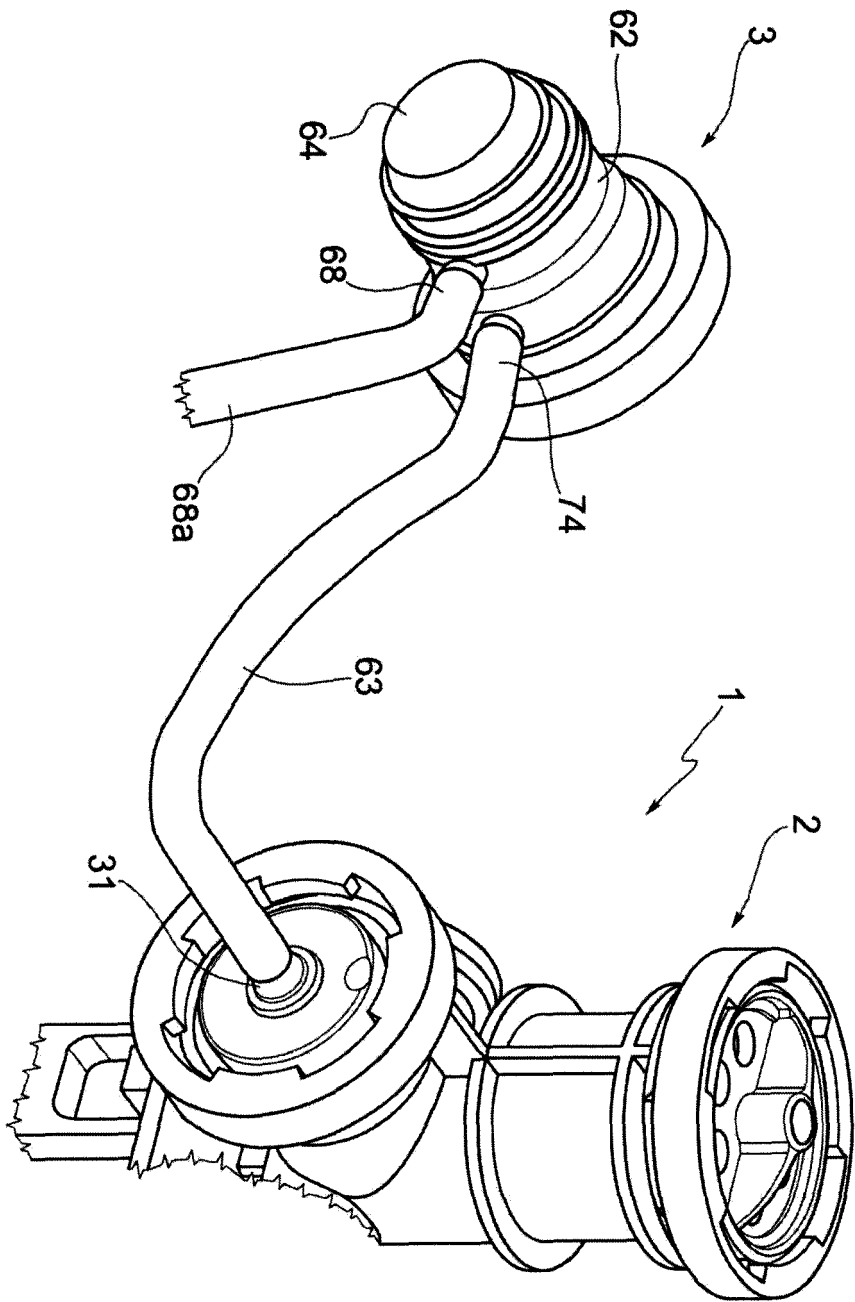


FIG. 5

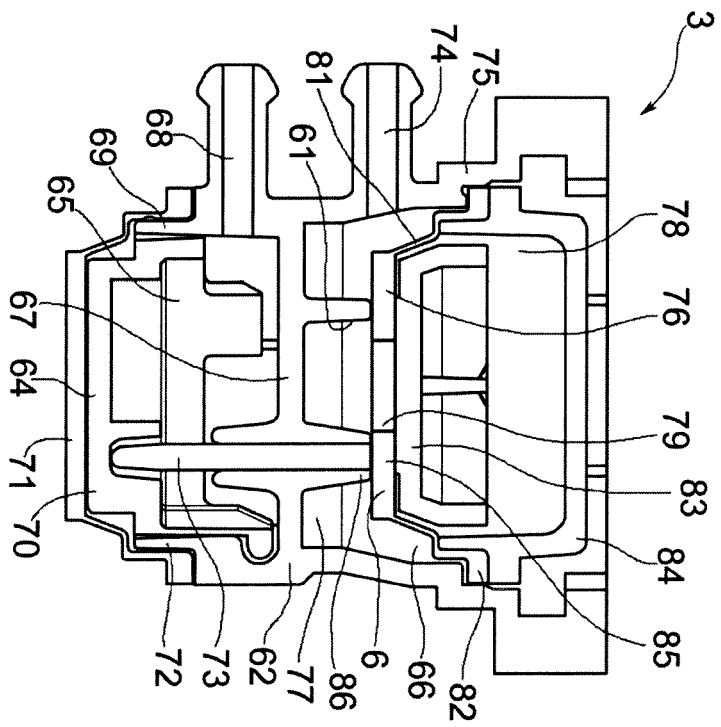


FIG. 6

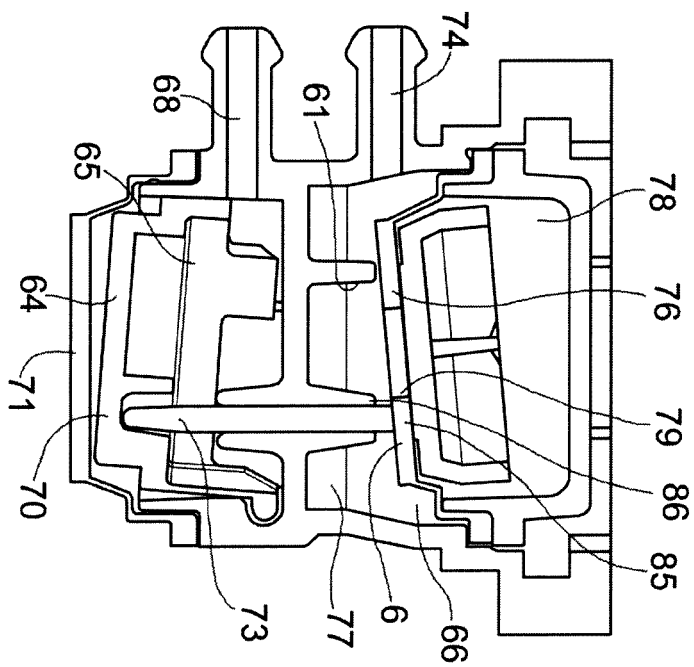


FIG. 7



EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 12 September 2013	Examiner Leher, Valentina
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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