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(54) Pneumatic device for activating a flush tank drain valve assembly

(57) A pneumatic device (3) for activating a valve assembly (2) of a flush tank (1) - wherein the valve assembly (2) has a valve body (9), and a shutter (10) movable with respect to the valve body (9) between an open position and a closed position - has an extensible pneumatic actuator assembly (15) for raising the shutter from the closed position to the open position when air is fed into the pneumatic actuator assembly (15) along a first air feed/return pipe (16) or along a second air feed/return pipe (17); and delaying means for delaying return airflow along the second pipe.

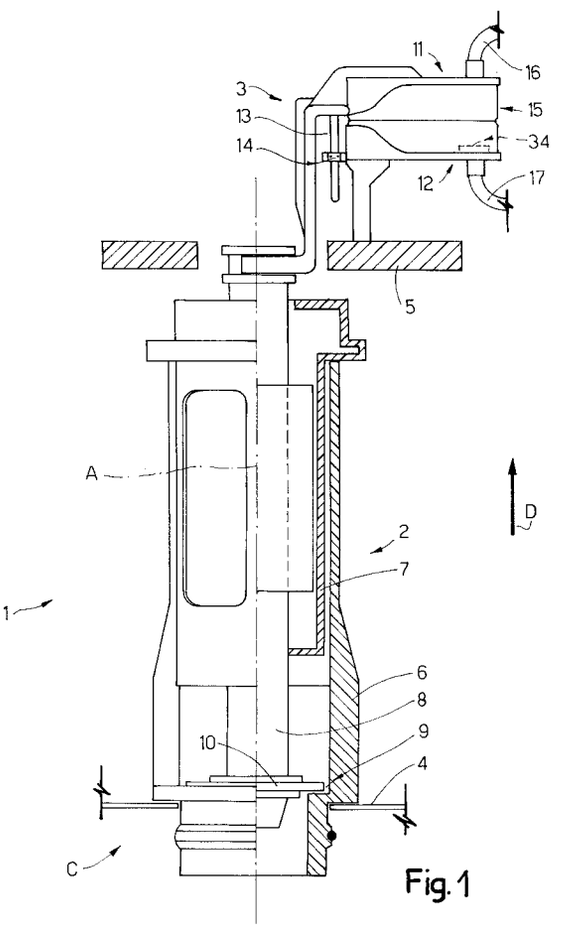

Fig.1

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Description

[0001] The present invention relates to a pneumatic device for activating a flush tank drain valve assembly.

[0002] A flush tank valve assembly comprises a valve body; and a shutter movable between an open position and a closed position with respect to the valve body, and which is raised to drain the water from the tank. In top-range flush tanks, the valve assembly shutter is known to be raised using a pneumatic device, known types of which normally comprise a button which activates a piston to feed air to a pneumatic actuator to raise the shutter and so drain the water from the tank.

[0003] To save water, flush tanks are commonly equipped with dual controls, i.e. two separate buttons for full and partial drainage of the tank. Dual controls, however, pose complications which, on the one hand, increase cost and, on the other, impair the reliability of the flush tank.

[0004] It is an object of the present invention to provide a pneumatic device for activating a flush tank drain valve assembly, and which provides in a straightforward, low-cost manner for selective full and partial drainage of the flush tank.

[0005] According to the present invention, there is provided a pneumatic device for activating a flush tank drain valve assembly, as claimed in Claim 1.

[0006] A number of preferred, non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a partly sectioned front view, with parts removed for clarity, of a pneumatic device for activating a flush tank drain valve assembly;

Figure 2 shows a larger-scale, partly sectioned front view of a detail of the pneumatic device in Figure 1;

Figure 3 shows a plan view of a component part of the Figure 1 pneumatic device;

Figures 4, 5 and 6 show schematic views of the Figure 1 pneumatic device in three different operating positions;

Figure 7 shows a partly sectioned front view of a variation of the Figure 2 pneumatic device;

Figures 8, 9 and 10 show schematic views of the Figure 7 device in three different operating positions.

[0007] Number 1 in Figure 1 indicates as a whole a flush tank comprising a vessel C, a valve assembly 2, and a pneumatic device 3 for activating valve assembly 2. Only part of vessel C of tank 1 is shown in Figure 1, which shows a bottom wall 4 supporting valve assembly 2; and a rib 5 supporting pneumatic device 3. Valve assembly 2 extends along a vertical axis A, and comprises a tubular structure 6 secured to wall 4 of vessel C; a cup 7 sliding inside tubular structure 6; and an overflow pipe 8 in turn sliding inside cup 7. Tubular structure 6 comprises a valve body 9 which cooperates with a shutter 10 located at the bottom end of overflow pipe 8.

[0008] Device 3 provides for raising pipe 8 and shutter 10 to drain the water from vessel C through valve body 9, and comprises a member 11 connected to the top end of overflow pipe 8; and a member 12 fitted to rib 5 and connected rigidly through vessel C to valve body 9. Members 11 and 12 are connected to each other in sliding manner by an appendix 13 which is parallel to axis A, is integral with member 11, and engages a hole 14 in member 12. Device 3 comprises a pneumatic actuator assembly 15 housed inside two seats associated respectively with members 11 and 12, and for raising member 11 with respect to member 12, and shutter 10 with respect to valve body 9; and two pipes 16 and 17 connected to pneumatic actuator assembly 15. Each of pipes 16 and 17 supplies air to, and allows air to flow back from, pneumatic actuator assembly 15. The air flowing along pipes 16 and 17 is supplied by two respective known pistons (not shown) activated by respective known buttons (not shown) which are pressed selectively for partial and complete drainage of tank 1. When no air is supplied, pneumatic actuator assembly 15 assumes a compressed position (Figures 1, 2, 4 and 7), and is extensible in direction D depending on the air supplied to pneumatic actuator assembly 15 along pipe 16 or pipe 17 (Figures 5, 6, 9 and 10).

[0009] With reference to Figure 2, assembly 15 comprises two bellows 18 and 19 housed inside the seat of member 11 and the seat of member 12 respectively. Each bellows 18, 19 is made of elastic material and defined by an expandable chamber defined by two mutually connected membranes 20 and 21. Membrane 20 comprises a central disk 22, from which a fitting projects, and in which an air hole 23 is formed (for the sake of clarity, the holes in bellows 18 and 19 are indicated 23a and 23b respectively); an outer edge 24 having a seat 25 engaged by membrane 21; and an annular portion 26 which is undulated in the rest position, connects disk 22 to edge 24, and is thinner than disk 22 and edge 24. Portion 26 has an annular appendix 27 which extends inside the chamber, opposite disk 22, to form an annular seat 28 between appendix 27 and disk 22.

[0010] Membrane 21 comprises a flat central disk 29 with no hole; an outer annular lip 30 engaging seat 25; and an annular portion 31 which is undulated in the rest position, connects disk 29 to lip 30, and is the same thickness as portion 26. Bellows 18 is fitted to member 11 by inserting the fitting inside a tube 32, which is integral with member 11 and connects the bellows to pipe 16. And bellows 19 is connected to member 12 in exactly the same way, by inserting the respective fitting inside a tube 33 integral with member 12. Pipe 16 therefore communicates with the chamber of bellows 18 via hole 23a, and pipe 17 communicates with the chamber of bellows 19 via hole 23b. Bellows 18 and 19 are substantially identical, are positioned opposite each other with respective central disks 29 facing and contacting each

other, and differ solely by the chamber of bellows 19 housing a member 34 for delaying outflow of the air from bellows 19. As shown more clearly in Figure 3, member 34 is in the form of a disk with a jagged edge, and is elastically deformable. That is, member 34 has a central body 35, from which project radial lobes 36 equally spaced about central body 35 and alternating with gaps 37. Member 34 is housed in seat 28 opposite hole 23b. That is, the ends of lobes 36 occupy seat 28 to permit airflow through a passage between disk 22 and central body 35, and through gaps 37.

[0011] Figures 4, 5 and 6 show operation of pneumatic device 3. In Figure 4, device 3 is in the rest position, bellows 18 and 19 are both in the compressed position, and shutter 10 is down. Figure 5 shows the operating position assumed by device 3 when the partial-drainage control button (not shown) is pressed : bellows 19 is in the compressed position, while bellows 18 is in the extended position, as a result of feeding air into bellows 18, thus raising member 11 and shutter 10 (not shown in Figure 5). Once member 11 is raised, the air in bellows 18 is expelled along pipe 16, and member 11 is restored to the Figure 4 rest position, thus lowering shutter 10.

[0012] Figure 6 shows what happens when the full-drainage control button (not shown) is pressed : bellows 18 is in the compressed position, and air is fed into bellows 19 along pipe 17, and deforms member 34 so as to flow easily through hole 23b and gaps 37. Extension of bellows 19 produces the same travel of member 11 as that produced by extension of bellows 18. When air is expelled from bellows 19, deformation of member 34 is prevented by disk 22, and air leaks slowly through gaps 37 and an annular passage formed by body 35 and disk 22, so that downward travel of member 11 is slower than that produced by compression of bellows 18. Between air being fed into and expelled from bellows 18 along pipe 16, valve assembly 2 remains open for a relatively short period sufficient to partly drain tank 1, whereas activation of bellows 19 by the airflow along pipe 17, given the slowness with which bellows 19 returns to the rest position, keeps the valve assembly open for a relatively long period enabling full drainage of tank 1.

[0013] In a second embodiment of the invention (Figure 7), pneumatic actuator assembly 15 comprises a single bellows 38 comprising parts similar to those described with reference to bellows 19 in Figure 2, and which are indicated using the same reference numbers as for bellows 19. Bellows 38 comprises a membrane 20 identical with membrane 20 of bellows 19; and a membrane 21 which differs from membrane 21 of bellows 19 by comprising a hole 39 formed in central disk 29 of membrane 21, and a relative fitting. Delay member 34 is housed in seat 28 of membrane 20, opposite hole 23b, and operates in the same way as described with reference to the Figure 2 embodiment.

[0014] Operation of the Figure 7 embodiment is shown in Figures 8, 9 and 10. In Figure 8, bellows 38 is in the rest position; in Figure 9, bellows 38 is in the extended position, as a result of feeding in air along pipe 16, and so returns rapidly to the rest position to partly drain tank 1; and, in Figure 10, bellows 38 is in the extended position, as a result of feeding in air along pipe 17, and so returns slowly to the rest position to drain tank 1 completely.

[0015] In connection with the second embodiment, it should be pointed out that the known pistons (not shown) for supplying air to bellows 38 do not communicate with the outside, at least in the rest position, so that the air fed along pipe 16 necessarily flows back along pipe 16, and the air fed along pipe 17 necessarily flows back along pipe 17.

[0016] Pneumatic device 3 is extremely straightforward in both embodiments. The Figure 2 embodiment employs two separate bellows 18 and 19, but which are identical in design and can therefore be produced using the same molds. The only difference between bellows 18 and 19 lies in member 34, which is fitted inside bellows 19.

[0017] The Figure 7 embodiment is even more straightforward by comprising a single bellows 38.

[0018] Moreover, neither embodiment comprises complex mechanisms, thus enabling considerable saving in terms of component parts in the manufacture of tank 1.

Claims

1. A pneumatic device for activating a valve assembly (2) of a flush tank (1), wherein the valve assembly (2) comprises a valve body (9), and a shutter (10) movable, in a given direction (D) and with respect to the valve body, between an open position and a closed position; the pneumatic device (3) comprising an extensible pneumatic actuator assembly (15) for raising the shutter (10) from the closed position to the open position when air is fed into the pneumatic actuator assembly (15); and a first pipe (16) along which air is fed to and flows back from said pneumatic actuator assembly (15); and the pneumatic device being **characterized by** comprising a second pipe (17) along which air is fed to and flows back from said pneumatic actuator assembly (15); and delaying means (34) for delaying backflow of the air along the second pipe (17).

2. A device as claimed in Claim 1, **characterized by** comprising a first member (11) integral with the shutter (10), and a second member (12) integral with the valve body (9); said pneumatic actuator assembly (15) being located between the first and second member (11, 12) and connected to the first and second member (11, 12).

3. A device as claimed in Claim 2, **characterized in**

that said first and said second member (11, 12) are connected to each other to slide in said direction (D).

4. A device as claimed in any one of the foregoing Claims, **characterized in that** said pneumatic actuator assembly (15) comprises a first hole (23a; 39) to which said first pipe (16) is connected, and a second hole (23b; 23b) to which said second pipe (17) is connected; said delaying means (34) being located at the second hole (23b; 23b).

5. A device as claimed in Claim 4, **characterized in that** said delaying means (34) are in the form of a disk made of elastic material and having airflow gaps (37).

6. A device as claimed in Claim 5, **characterized in that** said pneumatic actuator assembly (15) comprises a seat (28) for housing said delaying means (34); said seat (28) extending about said second hole (23b).

7. A device as claimed in Claim 6, **characterized in that** said seat (28) is annular; said delaying means (34) comprising a central body (35) having radial lobes (36) alternating with gaps (37); the free ends of said lobes (36) engaging said seat (28).

8. A device as claimed in any one of the foregoing Claims, **characterized in that** said pneumatic actuator assembly (15) comprises a first and a second bellows (18, 19) arranged in series; the first bellows (18) being fed by the first pipe (16), and the second bellows (19) being fed by the second pipe (17).

9. A device as claimed in Claim 8, **characterized in that** the first bellows (18) produces a given first travel of the shutter (10), and the second bellows (19) produces a given second travel of the shutter (10); the first and second travel being substantially equal.

10. A device as claimed in any one of Claims 1 to 7, **characterized in that** said pneumatic actuator assembly (15) comprises a single third bellows (38); said third bellows (38) being fed selectively by the first and second pipe (16, 17).

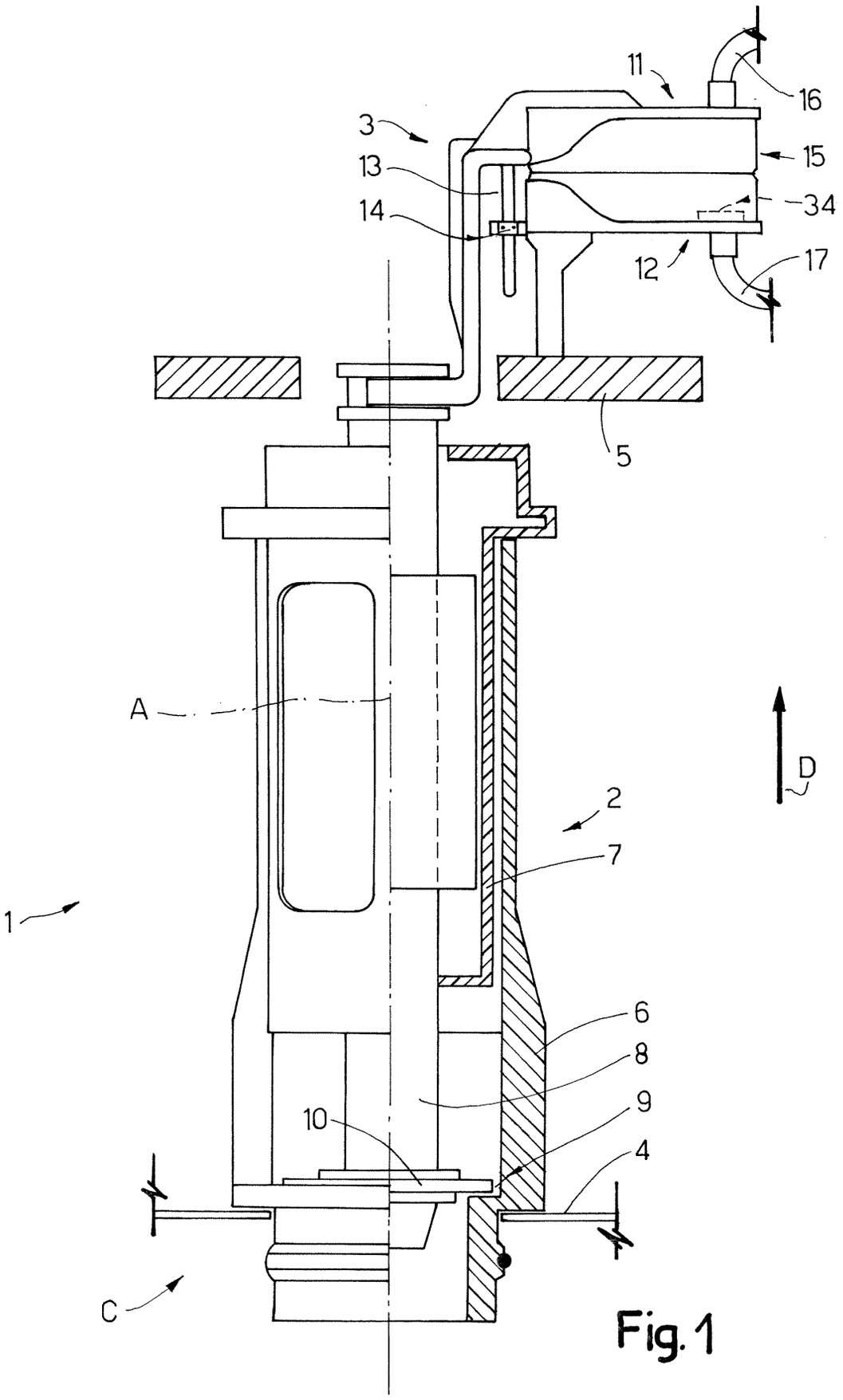

Fig. 1

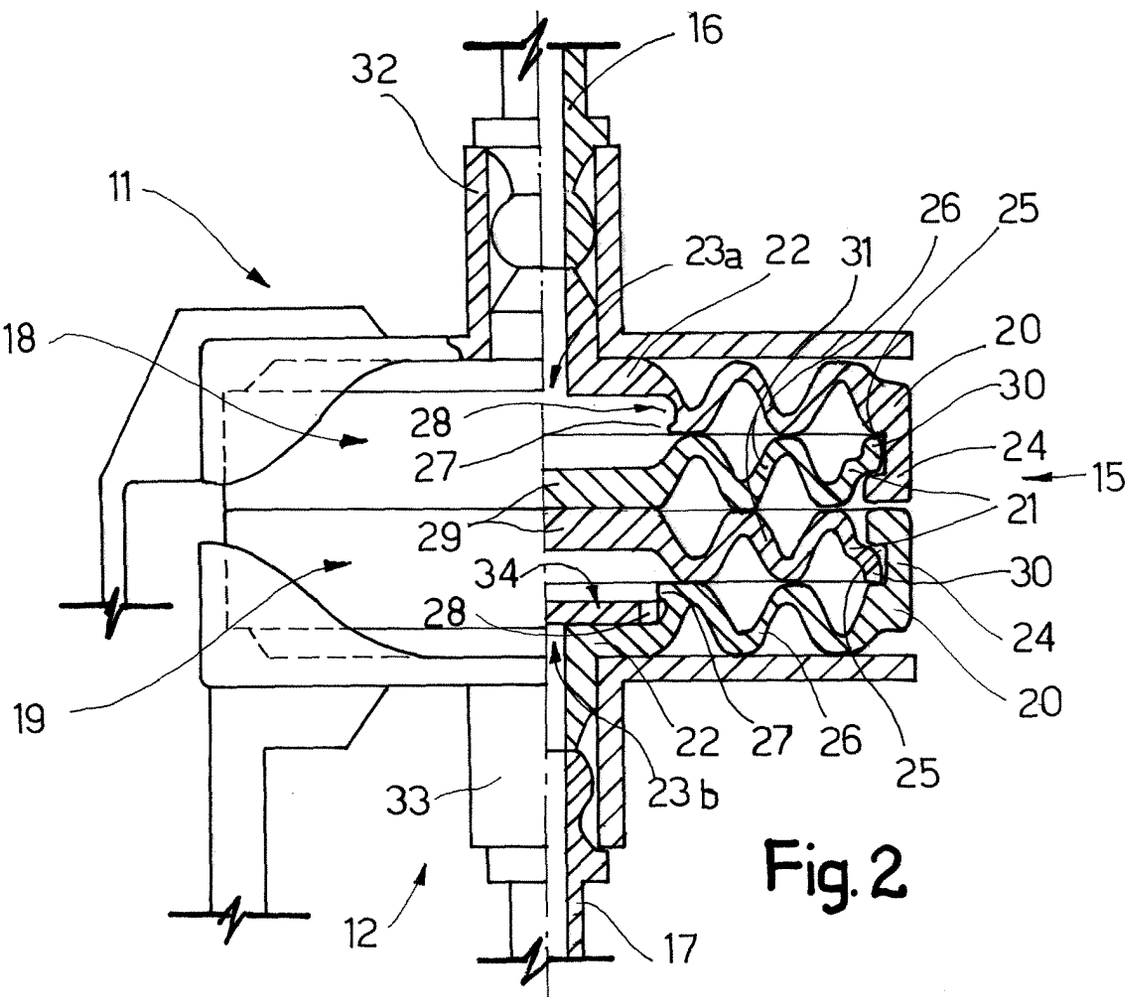
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Fig. 2

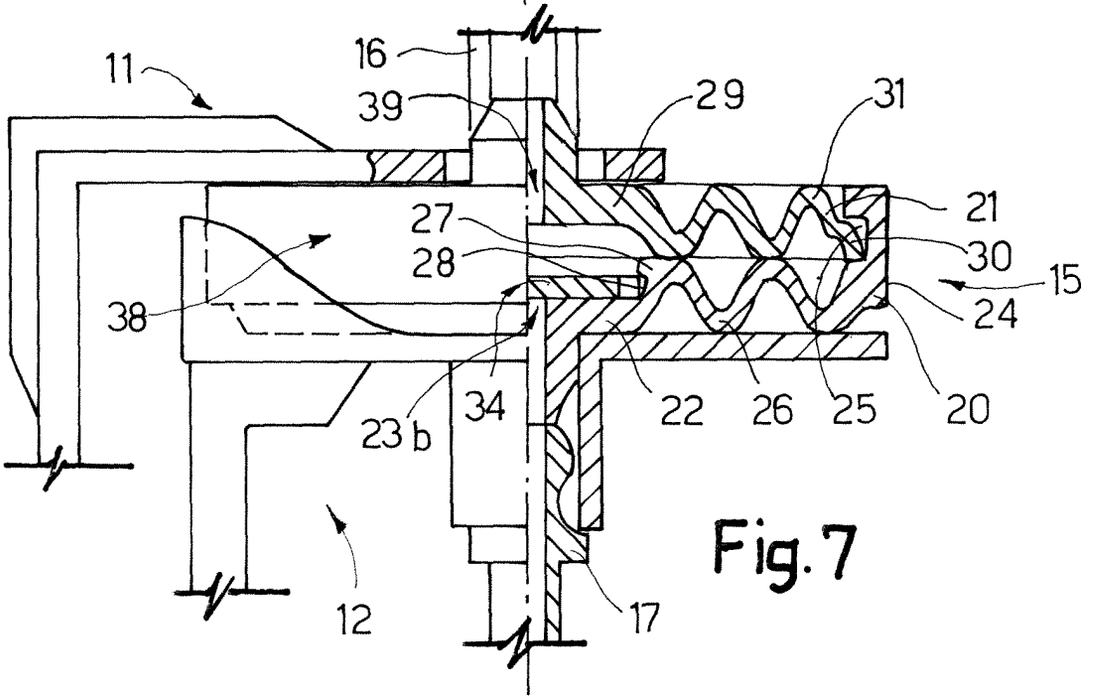
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Fig. 7

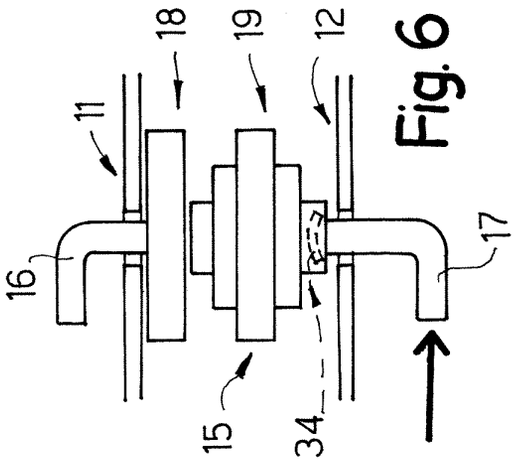

Fig. 6

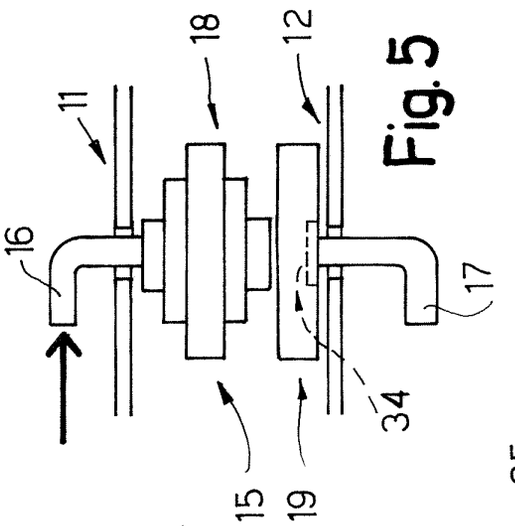

Fig. 5

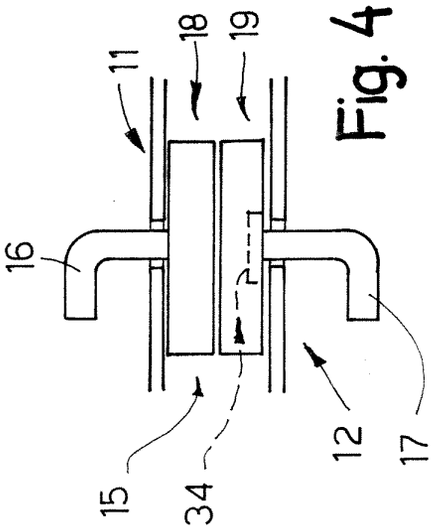

Fig. 4

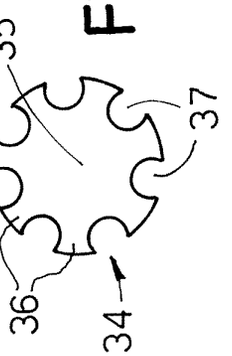

Fig. 3

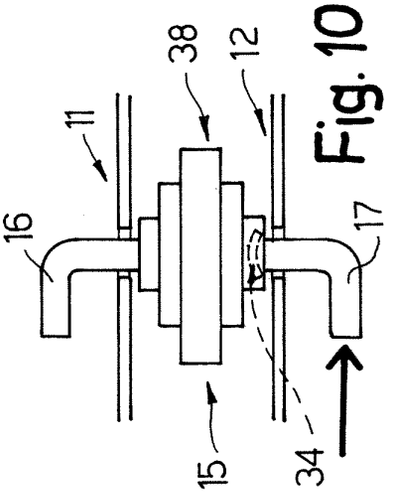

Fig. 10

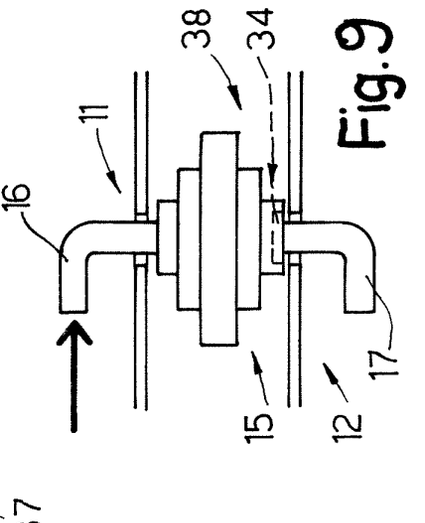

Fig. 9

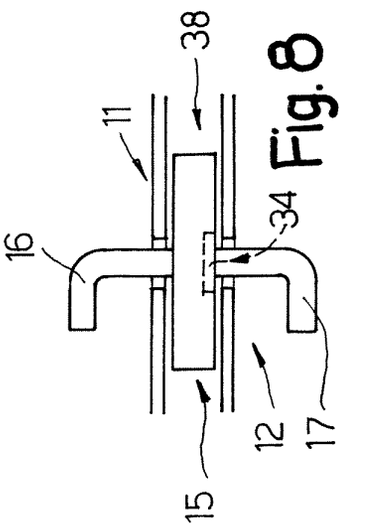

Fig. 8