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(71) Applicant: **FLOTRONIC CONTROLS LIMITED**
Ricebridge House
Bolney West Sussex(GB)

(72) Inventor: **Marchant, Derek Noel**
11, Wolstonbury Close,
Hurstpierpoint, Sussex(GB)

(74) Representative: **Brooke-Smith, Fred et al**
STEVENS, HEWLETT & PERKINS 5 Quality Court Chancery Lane
London WC2A 1HZ(GB)

(54) Double-diaphragm pump.

(57) In a double-diaphragm pump in which non-return valve means controlling the flow of the fluid being pumped are housed in a centre section between two end sections of the pump body, the centre section comprises two parts which respectively provide two axial end walls of the centre section, one of said parts having a portion projecting from its axial end wall and providing said valve seats and one of said parts having an enclosing portion which encloses said axially projecting portion and forms a seal with the other part, said parts being axially separable and the arrangement being such that when the parts are separated, ready access to the valve seats and valve members is provided.

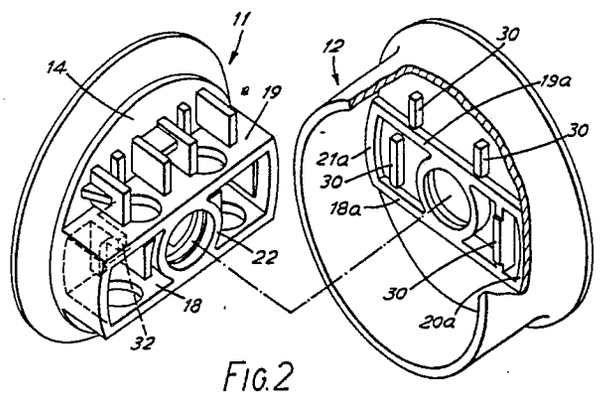

FIG.2

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IMPROVEMENTS RELATING TO DOUBLE-DIAPHRAGM PUMPS

This invention relates to double-diaphragm pumps such as are described in our European Patent Applications Nos. 84302390.4 and 85308000.0.

According to the present invention there is provided a double-diaphragm pump comprising a body having a centre section and two end sections secured at opposite sides respectively of the centre section, each of said end sections being divided by a diaphragm into first and second chambers whereof the second chamber adjoins the centre section and the first chamber is further from the centre section, and a push-rod extending between the centres of the two diaphragms and through the centre section, the centre section having an inlet means and an outlet means for the pumped fluid and housing two non-return valves communicating with the two second chambers respectively and arranged to permit flow of the pumped fluid from the second chambers to the outlet means, wherein the centre section comprises two parts which respectively provide two axial end walls of the centre section, one of said parts having a portion projecting from its axial end wall and providing said valve seats and one of said parts having an enclosing portion which encloses said axially projecting portion and forms a seal with the other part, said parts being axially separable and the arrangement being such that when the parts are separated, ready access to the valve seats and valve members is provided.

In a preferred construction, the axially projecting portion and the enclosing portion are provided on the two parts respectively.

The valve members are preferably in the form of balls and the valve seats preferably extend about flow apertures formed in walls extending axially from said end wall of one of said parts into sealing engagement with said other part.

The invention will now be described in more detail with reference by way of example to the accompanying drawings in which:

Figure 1 is a diagrammatic axial section of a double diaphragm pump of the type to which the invention relates,

Figure 2 shows diagrammatically the two body components of the centre section of a double-diaphragm pump according to the invention,

Figure 3 is a sectional plan view of the assembled body components on the line 3-3 of Figure 5,

Figure 4 shows sectional elevations, of the two axially-separated body components

Figure 5 is a sectional end view on the line 5-5 of Figure 4, and

Figure 6 is an end view of the direction of the arrow 6 in Figure 4.

Referring first to Figure 1 of the drawings there is shown diagrammatically a double diaphragm pump of the kind to which the present invention relates. The body of the pump comprises a centre section 10 and two end sections 2 which jointly define two end spaces each divided axially into two chambers 3a, 3b by a diaphragm 4. The pump is shown at one end of its stroke. The two chambers 3b adjoining the centre section 10 constitute pumping chambers for the pumped fluid, and the centre section provides an inlet 5 and an outlet 6 for the pumped fluid, and non-return ball valves 7a, 7b, 7c, 7d, controlling the flow of pumped fluid from the inlet 5 to the pumping chambers 3b, and from the pumping chambers to the outlet 6. Each of the two chambers 3a remote from the centre section is alternately supplied with compressed air and connected to exhaust under the control of valve means 8. The air is conveyed to and from chambers 3a through passages (not shown) extending along a fixed rod 9 extending axially between and secured to the end sections 2. The two diaphragms 4 are coupled together by a hollow rod 10 extending about and sealed with respect to rod 9, so that the assembly of the rod 10 and diaphragms 4 reciprocates and causes the two pumping chambers 3b to pump fluid from the inlet 5 to the outlet 6. The components of the body are secured together by the rod 9.

In operation, the right hand chamber 3b would be full of the fluid to be pumped, and during leftward movement of the diaphragms 4 and rod following admission of air under pressure to the right hand chamber 3a, the fluid is expelled through ball valve 7b to the outlet 6, ball valve 7d being held closed by the pressure applied to the fluid. Also during leftward movement of the diaphragms 4 and rod 10, the volume of the left hand chamber 3b increases so that fluid to be pumped is drawn into the chamber through ball valve 7c, while the depression in the chamber holds valve 7a closed. When the diaphragms 4 and rod 10 reach the left hand extremity of their movement, air is admitted to the left hand chamber 3a and the right hand chamber 3a is connected to exhaust. During the resulting rightward movement of the diaphragms and rod 10, the fluid is expelled from the left hand chamber 3b through ball valve 7a, to the outlet 6 while ball valve 7c is held closed by the pressure in the chamber, and a fresh charge of fluid is drawn through the inlet 5 and ball valve 7d into the right hand chamber 3b, ball valve 7b being held closed by the depression in that chamber.

Figures 2 to 6 of the accompanying drawings show a form of the centre section which is particularly advantageous in providing ready access to the valve members and valve seats and which also enables the number of locations at which leakage of the pumped fluid can occur to be reduced. The illustrated construction also enables the number of components in the pump to the reduced.

Referring now to Figures 2 to 6 of the drawings, the centre section 10 has two body components, i.e. a platform component 11 and a cylinder component 12 which fit together axially and are secured together and to the other body components 2 by the rod 9. The components 11 and 12 are castings made from aluminium alloy, or stainless steel or other material inert to the fluid which is to be pumped.

The platform component comprises an end wall 14 which is of dished form having a concave face 14a on its axially outer side and which has a peripheral rebate 14b to accommodate the peripheral bead of one of the diaphragms. The bead of the diaphragm is sealingly clamped in the rebate 14b by the peripheral flange of a dished cover plate (not shown), so that the end wall 14 and the diaphragm together define a pumping chamber, and the diaphragm and the cover plate together define an air chamber.

The cylinder component 12 comprises an end wall 15 with a concave outer face 15a and a peripheral rebate 15b to accommodate the bead of the second diaphragm, clamped in place by a second dished cover plate (not shown), and a cylindrical wall 16. The concave outer face 15a and the second diaphragm together define the second pumping chamber and the second diaphragm and the second dished cover plate define the second air chamber. In the assembled centre section the cylindrical wall 16 has its free axial end in abutment with a sealing ring 17 disposed in an axially-facing slot 14c in the end plate 14.

Two parallel horizontal walls 18, 19 project axially inward from the end wall 14 and are interconnected at their ends by arcuate walls 20, 21 and in their central region by an annular wall 22. The lower wall 18 has at opposite sides of the wall 22 two apertures with peripheral seating 24a, 25a for two spherical valve members 24, 25 which constitute inlet valves for the pumped fluid. The upper wall 19 has at opposite sides of wall 22 two apertures with peripheral seatings 26a, 27a for two spherical valve members 26, 27 which constitute outlet valves for the pumped fluid. Radial and axial projections 28, 29 on the walls 20, 21, 22 and end wall 14 and axial projections 30 on the facing end wall 15 of the cylinder component 12 co-operate to guide the movement of the spherical valve members towards and away from their slots. Vertical projections 32 on the underside of horizontal wall 18 restrict the extent of movement of members 24, 25away from their seats, and the encompassing cylindrical wall of the cylinder component 12 performs a similar function in relation to outlet valve members 26, 27.

In the assembled centre section 10, the cylindrical wall 16 encircles the axially-projecting parts of the platform component 11 and defines with horizontal walls 18, 19 respectively a suction chamber 34 below valve members 24, 25 and a delivery chamber 35 above valve members 26, 27. Inlet and outlet connections 36, 37 in wall 16 open to chamber 34 and 35 respectively. The chamber 38 between valve members 24 and 26 communicates with the right hand pumping chamber (as viewed in Figure 3) through an aperture 40 in wall 15, and chamber 41 between valve members 25 and 27 communicates with the left hand pumping chamber through an aperture 42 in wall 14.

In operation, rightward movement of the diaphragms (considering Figure 3) produces a delivery pressure in the left hand pumping chamber L and a suction pressure in the right hand pumping chamber R. This suction R from the suction chamber 34 through chamber 38, lifting valve member 24 from its seat and tending to maintain valve member 26 on its seat. At the same time the delivery pressure in the left hand pumping chamber L forces the fluid through aperture 42 into chamber 41 lifting valve member 27 off its seat so that the fluid is delivered to the delivery chamber 35, while valve member 25 is pressed on to its seat. On return movement of the diaphragms the valve members are moved into their opposite positions so that the fluid is discharged from chamber R and a fresh charge is drawn into chamber L.

It will be seen that the illustrated arrangement presents an elegant solution to the problems of rapid servicing of the valves in that when the central bolt holding the housing components of the pump together is removed the central section can be removed as a unit, the two components 11 and 12 being held together by a single screw 43 for this purpose. When the two components are separated the valve members and valve seats can be examined and are readily accessible to enable any necessary repairs and replacements to be effected, and since the valves are on the platform component 11 and the circuit connections 36, 37 are on the cylinder component 12, the servicing of the valves can be carried out without detaching the body from the suction and delivery pipes, although it would be possible if desired to form the cylindrical wall 16 integrally with the platform component 11. Moreover the positional relationship of the valve members and valve seats can be checked visually and is not altered during assembly, dis-

mantling and re-assembly of the centre section, as would be the case of the valve members and their seats were carried by respective components. A further advantage of the illustrated construction is that there is only one point of potential leakage of the pumped fluid from the casing to its surroundings, i.e. at the location of the seal 17. An internal seal is provided between the axially abutting surfaces of walls 18, 19, 20 and 21 and co-operating projections 18a, 19a, 20a and 21a on the opposing face of wall 15 by a sealing ring 44 disposed in a groove in the end faces of walls 18, 19, 20 and 21.

Claims

1. A double-diaphragm pump comprising a body having a centre section and two end sections secured at opposite sides respectively of the centre section, each of said end sections being divided by a diaphragm into first and second chambers whereof the second chamber adjoins the centre section and the first chamber is further from the centre section, and a push-rod extending between the centres of the two diaphragms and through the centre section, the centre section having an inlet means and an outlet means for the pumped fluid and housing two non-return valves communicating with the two second chambers respectively and arranged to permit flow of the pumped fluid from the second chambers to the outlet means, wherein the centre section comprises two parts which respectively provide two axial end walls of the centre section, one of said parts having a portion projecting from its axial end wall and providing said valve seats and one of said parts having an enclosing portion which encloses said axially projecting portion and forms a seal with the other part, said parts being axially separable and the arrangement being such that when the parts are separated, ready access to the valve seats and the valve members is provided.

2. A double-diaphragm pump as claimed in claim 1, wherein the axially projecting portion and the enclosing portion are provided on the two parts respectively.

3. A double-diaphragm pump as claimed in claim 1 or claim 2, wherein the valve members are in the form of balls guided for movement towards and away from sealing engagement with valve seats extending about flow apertures formed in walls extending axially from said end wall of one of said parts into sealing engagement with said other part.

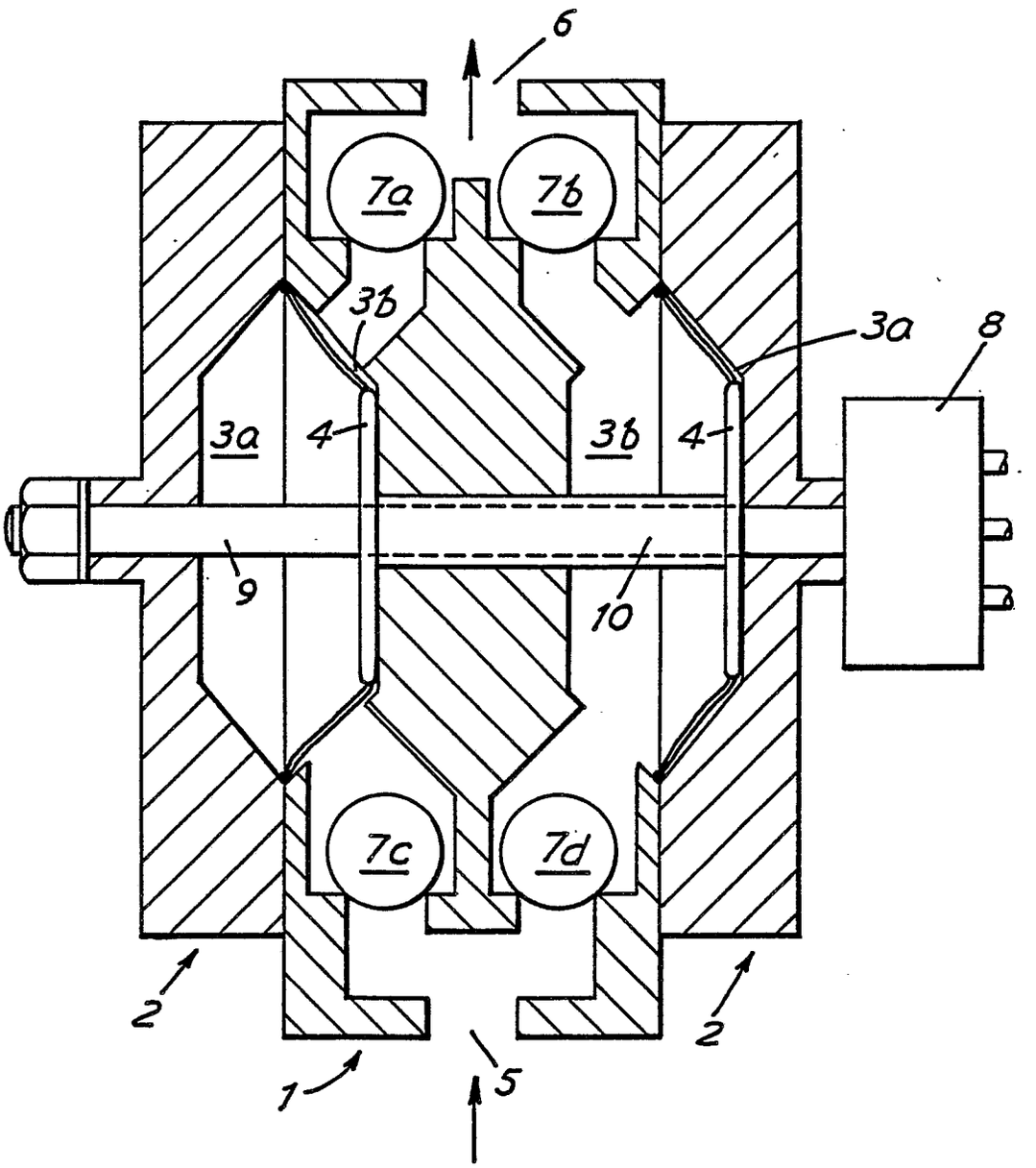

FIG.1

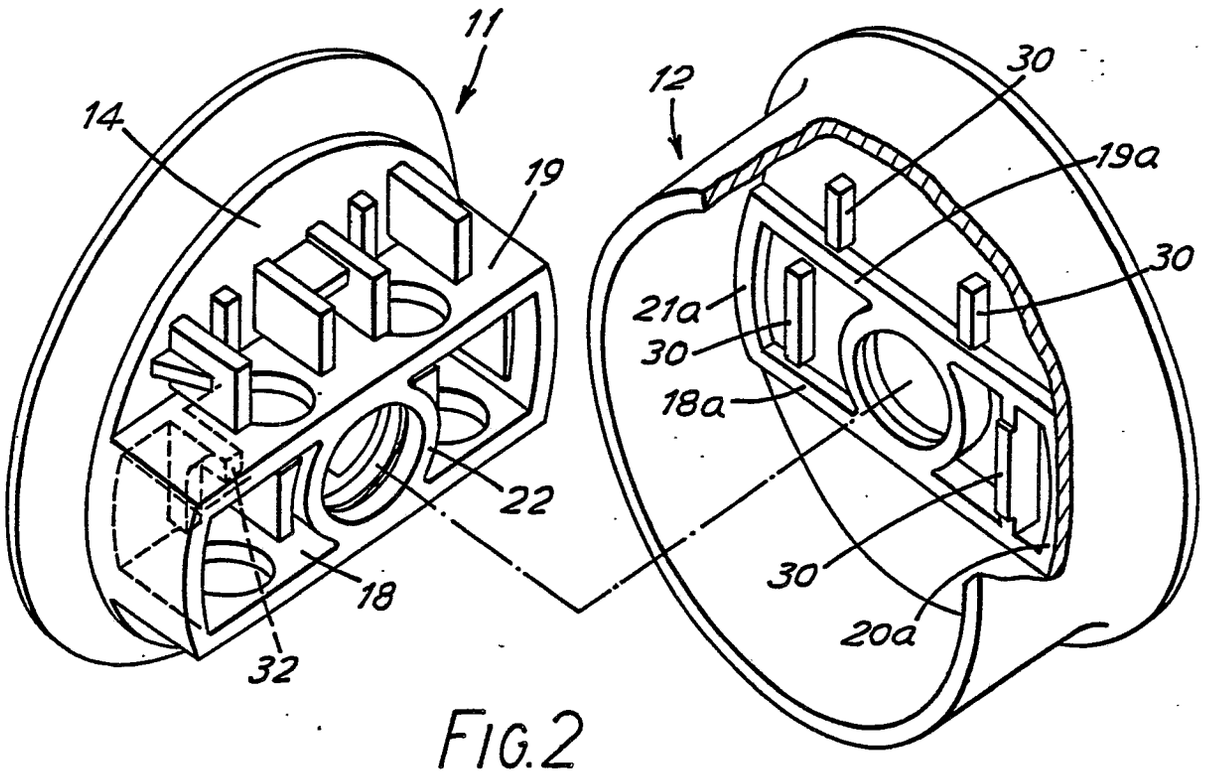

FIG.2

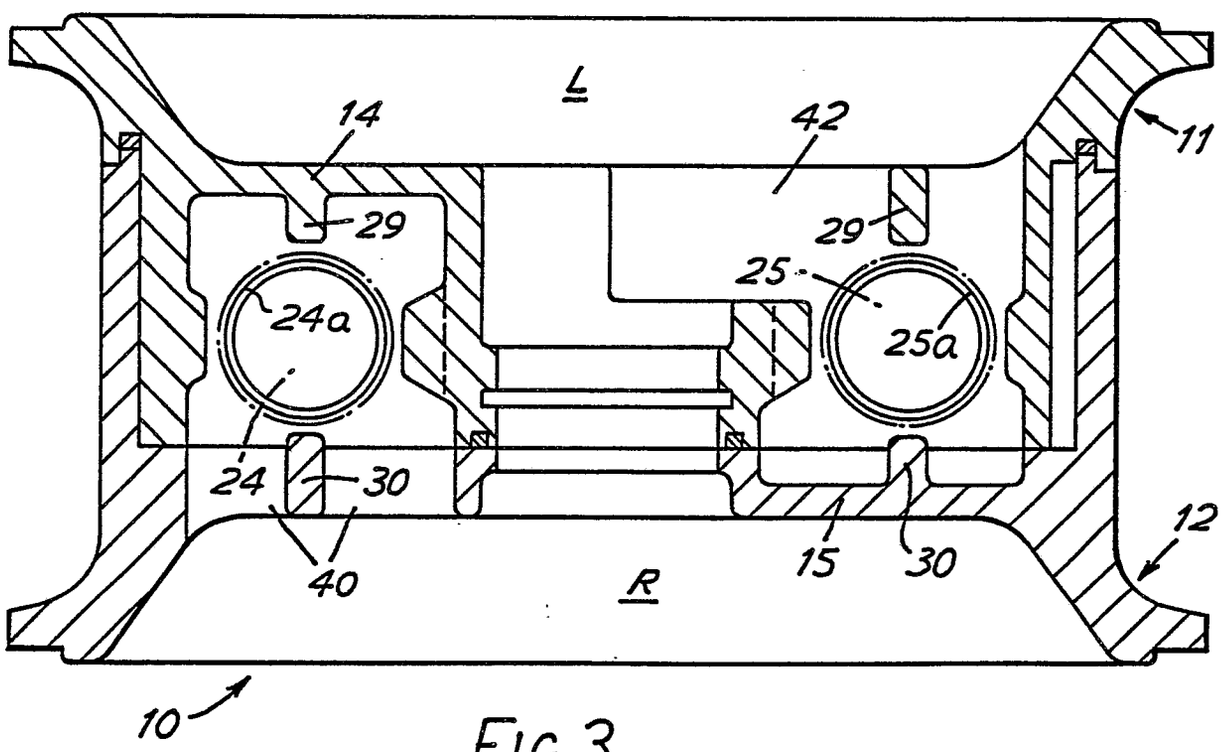

FIG.3

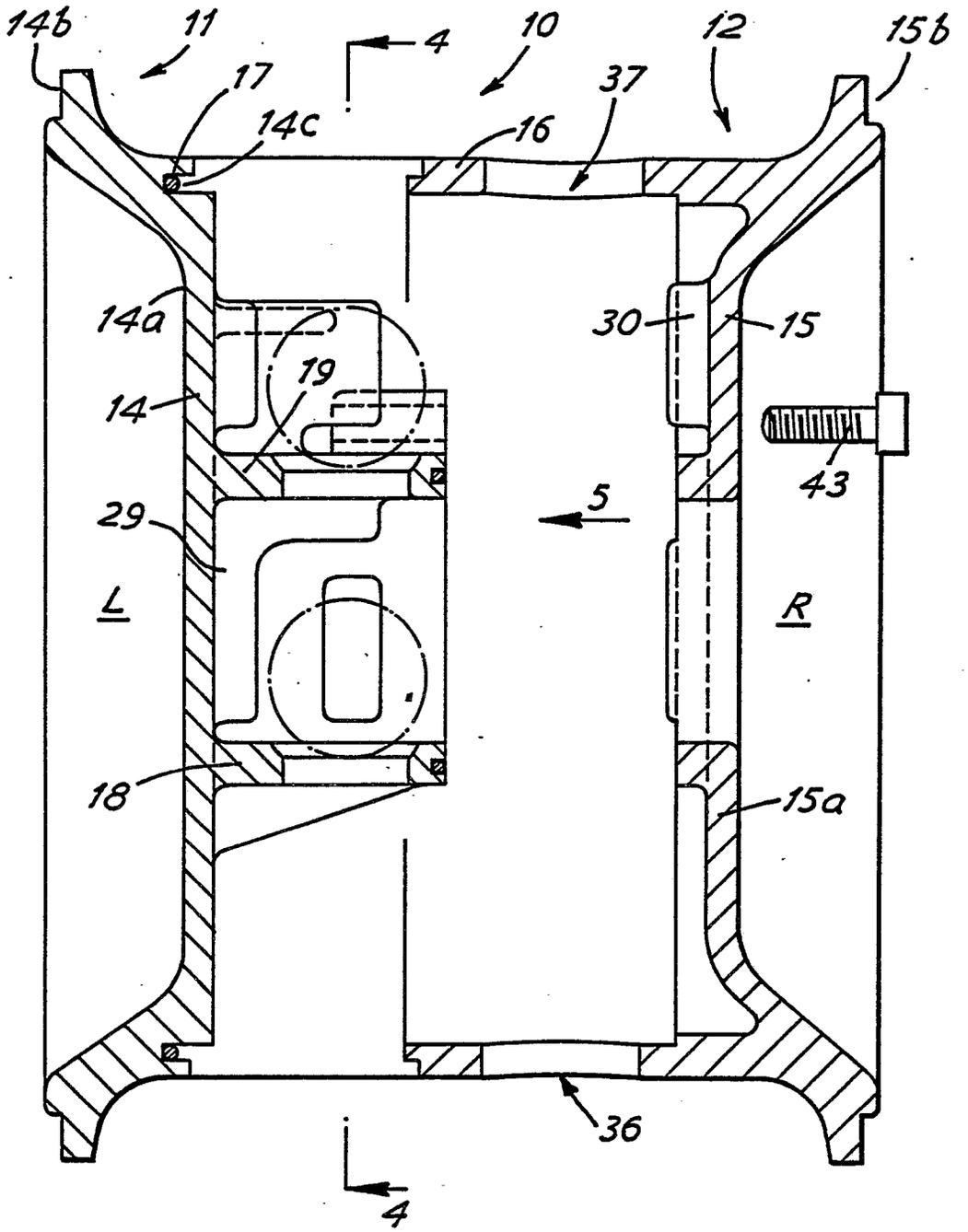

FIG.4

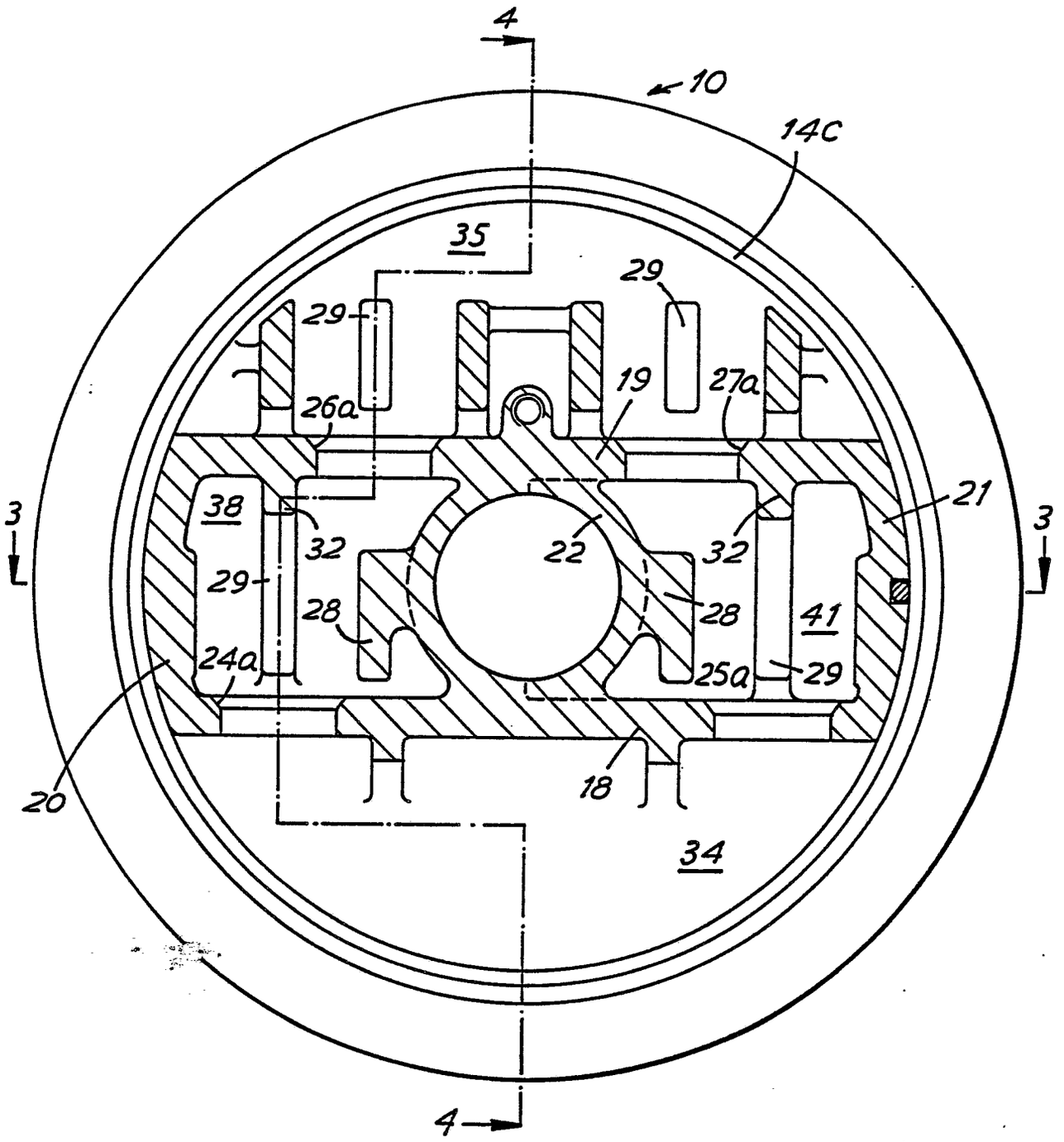

FIG.5

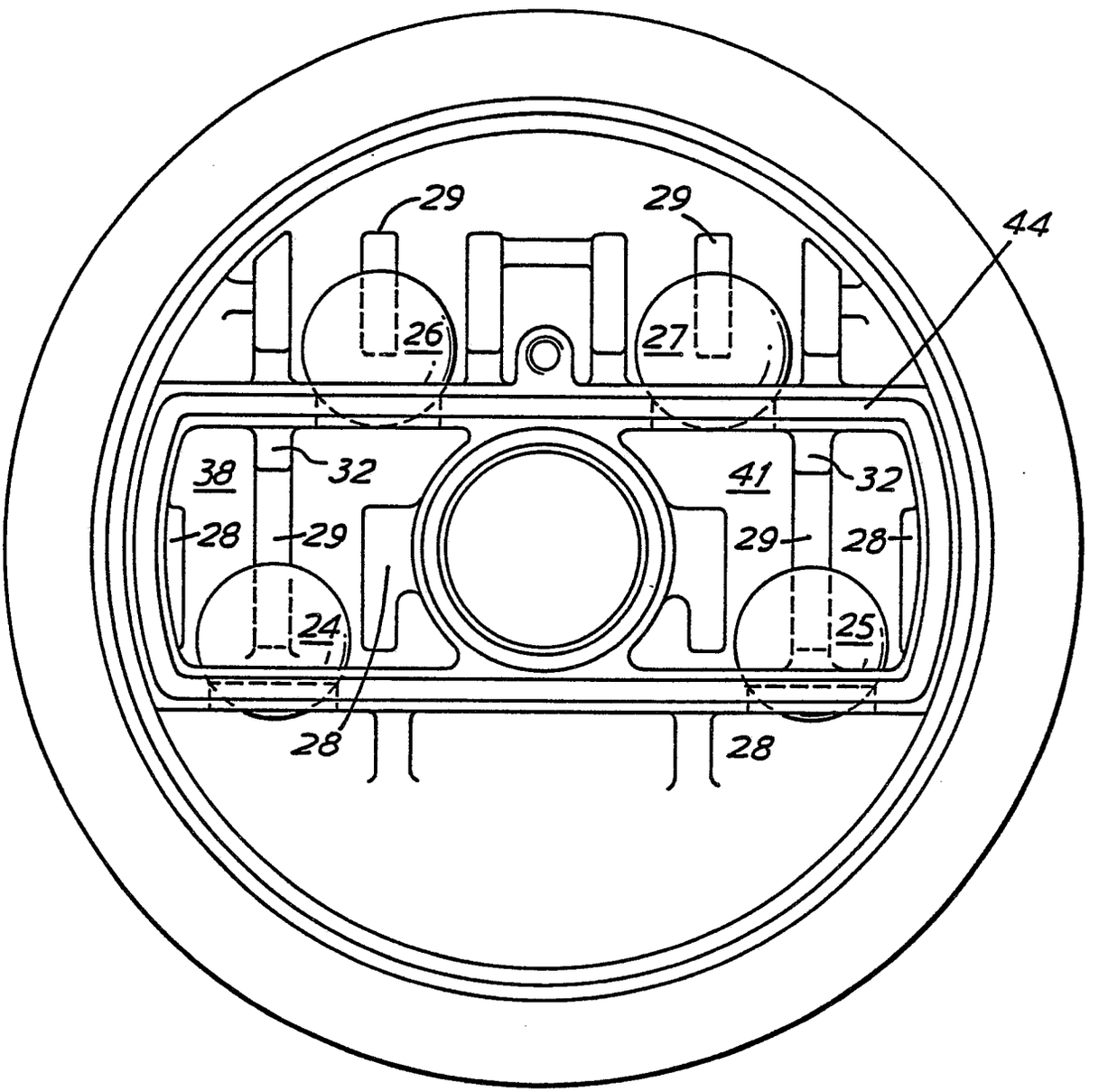

FIG.6