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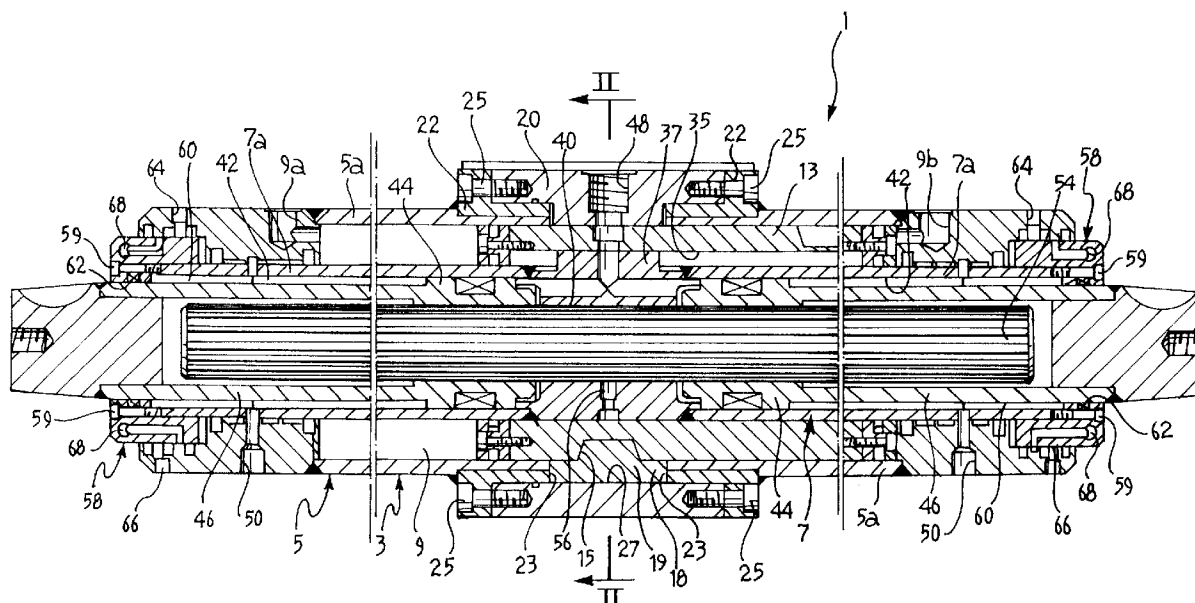
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I-12023 Caraglio (Cuneo) (IT)(74) Representative: **Marchitelli, Mauro et al****c/o JACOBACCI & PERANI S.p.A.****Corso Regio Parco, 27****10152 Torino (IT)**(54) **A rotary fluid actuator**

(57) A rotary fluid actuator comprises a body (3) defining a cylindrical chamber (9) in which a piston (13) can slide axially. A surface of the piston (13) has at least

one helical groove (15) cooperating with a sliding block (18) of complementary shape fixed removably to the body (3) of the actuator (1). Each sliding block is preferably made of an anti-friction material.

FIG. 1



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Description

The present invention relates to a rotary fluid actuator comprising a body defining a cylindrical chamber in which a piston can slide axially, a surface of the piston having at least one helical groove for cooperating with guide means which include a sliding block of complementary shape for each groove, each sliding block being supported by the body of the actuator.

In known actuators of the type indicated above, the sliding blocks are in the form of blocks, each block being complementary with a portion of the respective helical groove and having a central hole, normally a through-hole, for the engagement of an articulation pin fixed radially relative to the body of the actuator. In this known solution, the material constituting each sliding block has to have good resistance to mechanical stresses since the structure of the sliding block is weakened in the narrow sections adjacent the hole and because the forces produced by the actuator in operation, which are sometimes very intense, are concentrated in these regions.

A practically essential solution is therefore to use high-strength steel for the construction of the sliding blocks. However, this involves the risk of the sliding blocks seizing in the respective helical grooves in the event of malfunction due, for example, to a lubrication fault, with consequent serious damage to the helical grooves and hence to the entire main piston of the actuator, since the main piston is also normally made of steel.

The main object of the present invention is to propose an actuator of the type indicated above which is free of the aforementioned problems.

This object is achieved by virtue of the fact that each sliding block is fixed to the body of the actuator.

By virtue of this characteristic, it is no longer necessary to form holes in the sliding blocks since they do not have to be articulated about pins and hence the sliding blocks are no longer structurally weakened by holes or narrow sections, which previously had a great bearing on the selection of the construction material.

It is therefore possible to construct the sliding blocks using weaker materials, that is, materials having less mechanical strength than those used previously and, in particular, with less mechanical strength than the material used for the construction of the piston so that, in the event of seizure, only the sliding blocks are damaged and not the main piston.

Moreover, since it is possible to use a weaker material than in the past, the operations necessary to produce the sliding blocks, which are normally carried out by means of numerically-controlled machines, are quicker and the overall cost of the sliding blocks is thus reduced.

Advantageously, each sliding block is mounted on the body removably so that it can be replaced quickly in the event of damage.

The sliding blocks are preferably made of an anti-

friction material.

Further characteristics and advantages of the present invention will become clearer from the following detailed description, given with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1 is an elevational view of an actuator according to the invention, sectioned longitudinally,

Figure 2 is an elevational cross-section taken on the line II-II of Figure 1,

Figure 3 is a perspective view of a sliding block of the actuator according to the invention,

Figure 4 is a view similar to Figure 1 of a portion of the body of an actuator according to a first variant of the invention,

Figure 5 is an elevational cross-section taken on the line V-V of Figure 4,

Figure 6 is a view similar to Figure 1 of a portion of the body of an actuator according to another variant of the invention, and

Figure 7 is an elevational cross-section taken on the line VII-VII of Figure 6.

With reference initially to Figures 1 to 3, a double-acting, rotary fluid actuator, normally a hydraulic actuator, according to the invention, also known as a helical actuator, is indicated 1. The actuator 1 can be used in machines of various kinds when it is necessary to convert the power generated by the pressure of a fluid into a mechanical power which enables one or more members to be rotated about an axis, for example, through a predetermined angle of between 0° and 360°. In particular, the actuator 1 is advantageously used in devices associated with vehicles for lifting and tipping refuse bins, for example, of the type described in the Applicant's Italian patent application No. T095A000462.

The actuator 1 comprises a cylindrical body 3 including a tubular outer wall 5 and a tubular inner wall 7 sealingly mounted for rotation relative to the wall 5. An annular piston 13 is slidable axially and sealingly in a cylindrical chamber 9 defined between the walls 5 and 7. Ducts 9a and 9b, for the admission and discharge of the fluid used to bring about the movement of the piston 13, open in the opposite ends of the chamber 9.

The piston 13, which is normally made of steel, has a plurality of helical grooves 15, for example three grooves, on its radially outer surface, which grooves have the same pitch and are thus spaced equiangularly, and each of which is engaged by a respective sliding guide block 18 fixed to the body 3 and having a shape complementary to a portion of the respective groove 15.

In particular, each sliding block 18 is made in one piece, that is, integrally with an arcuate base portion 19 having the function of a support element for the active portion of the sliding block 18, that is, the portion which is intended to engage the respective groove 15.

Both the groove 15 and the active portion of the sliding block 18 preferably have trapezoidal sections transverse the axis of the actuator 1, with respective sides converging substantially towards this axis.

The sliding blocks 18 and the respective arcuate base portions 19 can advantageously be made of an anti-friction material such as bronze or of a self-lubricating plastics material but, in any case, of a material less strong than that constituting the cylinder 13.

The surface of each base portion 19 which faces towards the axis of the actuator 1 is wider than the active portion of the block 18 so that it constitutes a portion of the wall of the cylindrical chamber 9.

The sliding blocks 18 are mounted removably on the body 3 so that they can easily be replaced in the event of damage. In particular, they are carried by a support ring 20 which is connected to the wall 5 of the body 3, also removably, in a substantially central portion thereof. For this purpose, the wall 5 comprises two symmetrical tubular portions 5a, to each of which a respective connecting flange 22 is anchored at one end. The ring 20 is thus fixed between the flanges 22 by means of clamping screws 25.

The ring 20 is shaped so as to define internally a seat which houses the support elements 19 of the sliding blocks 18 and clamps them radially relative to the piston 13 so that they can engage the grooves 15 correctly.

The ring 20 may also contribute to the angular restraint of the sliding blocks 18 relative to the ring. In this case, as shown in Figure 2, it has a number of recesses 27 equal to the number of sliding blocks 18, the recesses being arranged around its inner periphery and each having a shape corresponding to the base portion 19 of a block 18, and opposed pairs of radial shoulder walls 27a.

Moreover, each block 18 is clamped axially relative to the body 3 by opposed radial end faces 23 of the flanges 22 so that the flanges 22 act as axial shoulders for the base portions 19.

According to the structural variants shown in Figures 4, 5, 6 and 7, the seat defined by the ring 20 for housing the blocks 18 consists of a single annular seat delimited radially by a circular wall 28 concentric with the axis of the piston 13. In this case, the wall 28 provides for the radial clamping of the base portions 19 abutting it and, in both cases, the portions 19 are restrained angularly by means of elongate members which extend axially from the connecting flanges 22 towards the blocks 18.

According to the variant shown in Figures 4 and 5, these members are constituted by cylindrical pins 30 which engage axial holes formed both in the portions 19 and in the flanges 22.

According to another variant shown in Figures 6 and 7, these members are constituted by axial appendages 24 which extend integrally from the connecting flanges 22 beyond the faces 23 and are intended to be interposed to act as angular shoulders between adjacent base portions 19.

The radially inner surface of the piston 13 has a plurality of axial grooves 35, for example three grooves, each of which is engaged by a guide element 37 which may be constituted by an axial rib projecting radially from a sleeve 40 fixed in a position intermediate two symmetrical tubular portions 7a of the wall 7.

Each tubular portion 7a defines an inner cylindrical chamber 42 which is inside and coaxial with the chamber 9 and in which a respective auxiliary, double-acting, linear piston 44, rigidly connected to a hollow rod 46, can slide. The rods 46 project outside the actuator 1 so as to be able to control the movement of a handling member (not shown in the drawings) keyed to each of them and constituted, for example, by a gripping arm transverse the axis of the actuator.

The auxiliary pistons 44 are opposed, that is, both facing towards the sleeve 40, and ducts for the admission/discharge of a fluid open into the opposite ends of the chambers 42. In particular, the admission of fluid under pressure to both of the chambers 42 through a first common duct 48 formed so as to extend radially through the ring 20 and the piston 13 and both radially and axially through the sleeve 40, enables the pistons 44 to be moved apart, bringing about an axial extension of the portion of the actuator 1 which is rotatable relative to the body 3, so that the handling members keyed to the ends of the rods 46 projecting from the actuator 1 are moved apart telescopically. Conversely, the supply of fluid under pressure through a pair of interconnected ducts 50 causes the pistons 44 to move towards one another, thereby reducing the axial distance between the handling members at the ends of the rods 46.

A splined shaft 54, which extends axially through the sleeve 40 and is fixed thereto by means of a transverse pin 56 engages corresponding axial holes formed through the pistons 44 so that the pistons 44 and hence the hollow rods 46 can slide relative to one another but remain fixed together for rotation.

Thus, if fluid is supplied under pressure to the actuator 1 through the duct 9a or 9b and the other duct 9b or 9a is connected to the exhaust, the piston 13 is caused to slide inside the chamber 9 and is simultaneously rotated about the axis of the actuator, guided by means of the grooves 15 and the sliding blocks 18. Owing to the engagement of the guide elements 37 in the axial grooves 35, this rotation brings about a corresponding rotation of the unit comprising the sleeve 40, the splined shaft 54, the tubular portions 7a and the auxiliary pistons 44 and, in particular, of the rods 46 with the handling members keyed to their ends outside the actuator 1.

At each end of the actuator 1 there is also an annu-

lar head 58 which is free to rotate relative to the body 3 and is connected rigidly and removably to a respective tubular portion 7a by means of axial screws 59. Each head 58 is drilled to allow the respective rod 46 to extend through it and a sliding bearing 60 and sealing rings 62 are interposed between it and the rod 46.

The body 3 may comprise ducts 64, 66 in the vicinity of the heads 58 for the supply of fluid to any tools carried by the handling members fixed to the rods 46. In this case, the ducts 64, 66 open in respective annular chambers formed in the vicinity of the ends of the body 3 and facing the rods 46 radially so as to surround them. Moreover, ducts 68 formed in the heads 58 open radially into the respective annular chamber and open axially from the heads for the connection of an external distribution pipe (not shown in the drawings).

Claims

1. A rotary fluid actuator comprising a body (3) defining a cylindrical chamber (9) in which a piston (13) can slide axially, a surface of the piston (13) having at least one helical groove (15) for cooperating with guide means which include a sliding block (18) of complementary shape for each groove (15), each sliding block (18) being supported by the body (3) of the actuator (1), characterized in that each sliding block (18) is fixed to the body (3) of the actuator (1).
2. An actuator according to Claim 1, characterized in that each sliding block (18) is mounted removably on the body (3).
3. An actuator according to Claim 1 or Claim 2, characterized in that the section of each groove (15) transverse the axis of the piston (13) is trapezoidal, the sides of each groove (15) converging substantially towards the axis of the piston (13).
4. An actuator according to Claim 2 or Claim 3, characterized in that each sliding block (18) is integral with an arcuate support element (19).
5. An actuator according to Claim 4, characterized in that a surface of each arcuate support element (19) from which the respective sliding block (18) projects constitutes a portion of the wall of the cylindrical chamber (9).
6. An actuator according to any one of Claims 2 to 5, characterized in that the sliding blocks (18) are made of an anti-friction material.
7. An actuator according to Claim 6, characterized in that the anti-friction material is bronze.
8. An actuator according to Claim 6, characterized in

that the anti-friction material is a self-lubricating plastics material.

9. An actuator according to any one of Claims 1 to 6, characterized in that the piston (13) has a plurality of radially outer and equiangularly spaced helical grooves (15), and in that the respective sliding blocks (18) are carried by a support ring (20) connected to the body (3) in a substantially central portion thereof.
10. An actuator according to Claim 9, characterized in that the support ring (20) has a seat (27; 28) for housing the arcuate support elements (19) of the sliding blocks (18), axial restraint means (23) and angular restraint means (24; 27; 30) being provided for restraining the sliding blocks (18) relative to the support ring (20).
11. An actuator according to Claim 10, characterized in that the axial restraint means for the sliding blocks (18) are constituted by end faces (23) of a pair of flanges (22) for connecting the support (20) to the body (3) of the actuator (1).
12. An actuator according to Claim 11, characterized in that the housing seat consists of a plurality of recesses (27) disposed around the periphery of the cylindrical chamber (9) and each having a shape corresponding to a respective support element (19) of a sliding block (18).
13. An actuator according to Claim 11, characterized in that the housing seat consists of an annular seat (28) delimited radially by a circular wall concentric with the axis of the piston (13), the annular seat (28) being able to house the support elements (19) of the sliding blocks (18) in abutment with the circular wall, and in that the angular restraint means for the support elements comprise elongate members (24; 30) which extend from the connecting flanges (22) axially relative to the piston (13).
14. An actuator according to Claim 13, characterized in that the elongate members are pins (30) which engage corresponding axial holes formed in the support elements (19) of the sliding blocks (18) and in the connecting flanges (22).
15. An actuator according to Claim 13, characterized in that the elongate members are axial appendages (24) of the connecting flanges (22) which are intended to be interposed to act as shoulders between adjacent support elements (19).
16. An actuator according to any one of Claims 1 to 15, characterized in that the piston (13) is annular and its radially inner surface has at least one axial

groove (35) for engagement by a guide element (37) projecting radially from an internal, axially extensible unit which comprises a pair of opposed linear fluid actuators (7, 44, 46) aligned with one another.

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17. An actuator according to Claim 16, characterized in that each linear actuator comprises an auxiliary piston (44) connected to a respective control rod (46) to which a handling member is keyed outside the actuator (1), guide means (54) being provided for keeping the auxiliary pistons (44) fixed for rotation with one another.

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18. An actuator according to Claim 17, characterized in that it comprises a pair of annular end heads (58) through which respective control rods (46) extend, each head (58) being connected rigidly and removably to one end of the axially extensible unit and being in abutment with an end of the body (3), with freedom to rotate.

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FIG. 1

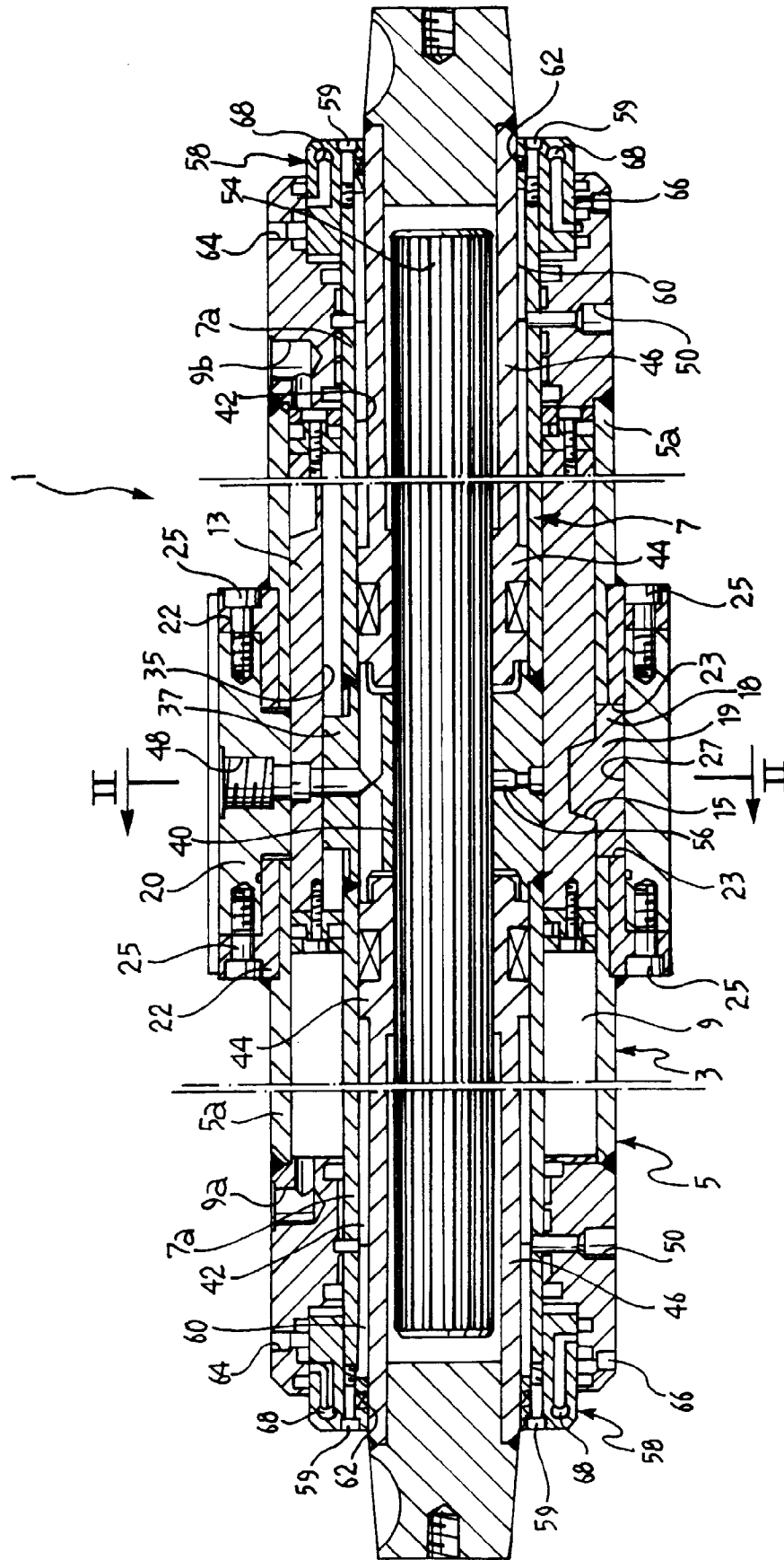
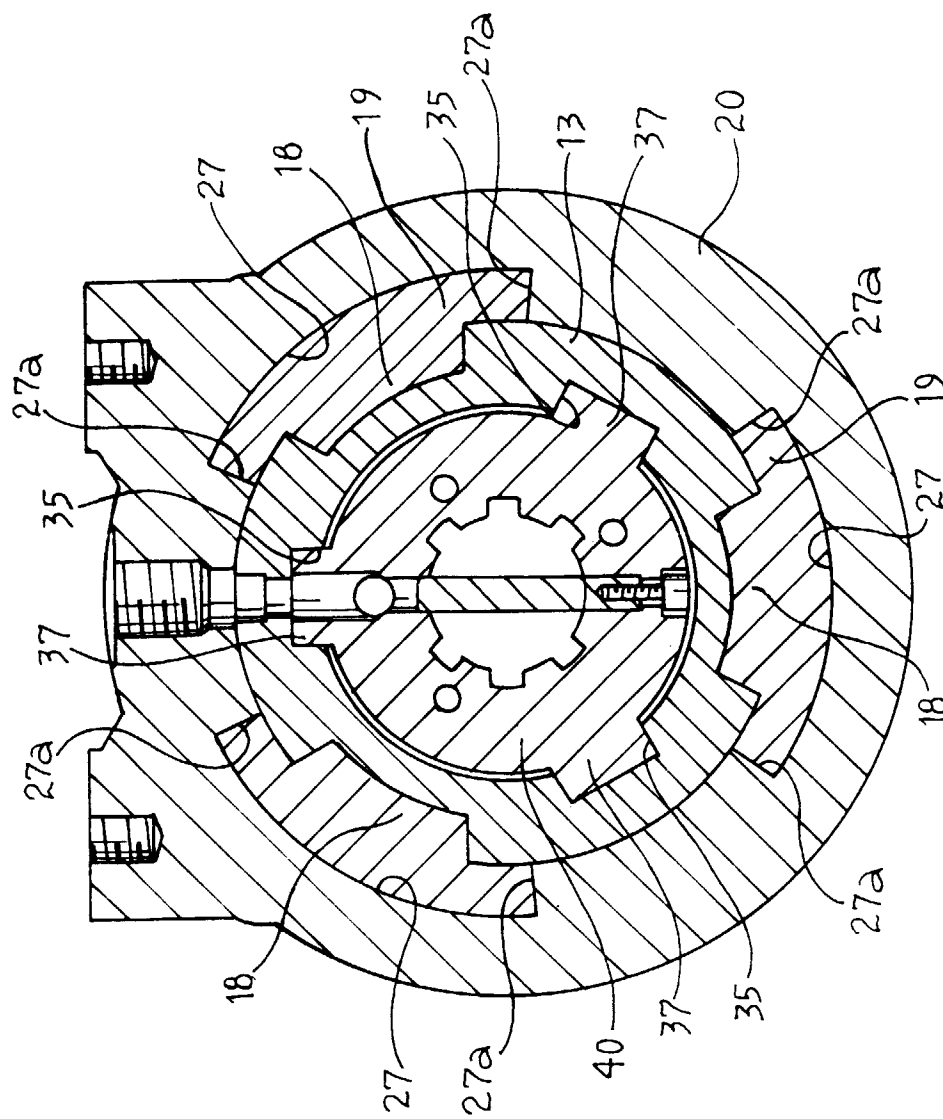


FIG. 2



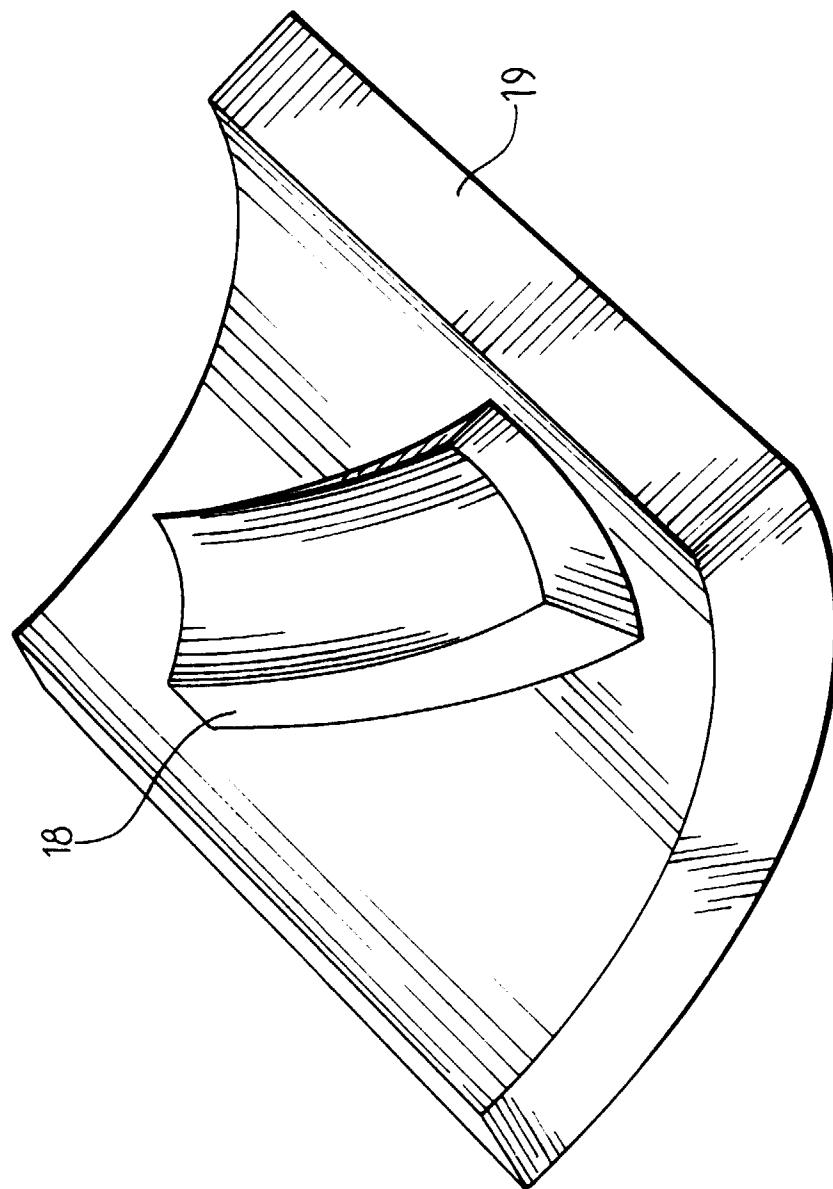


FIG. 3

FIG. 4.

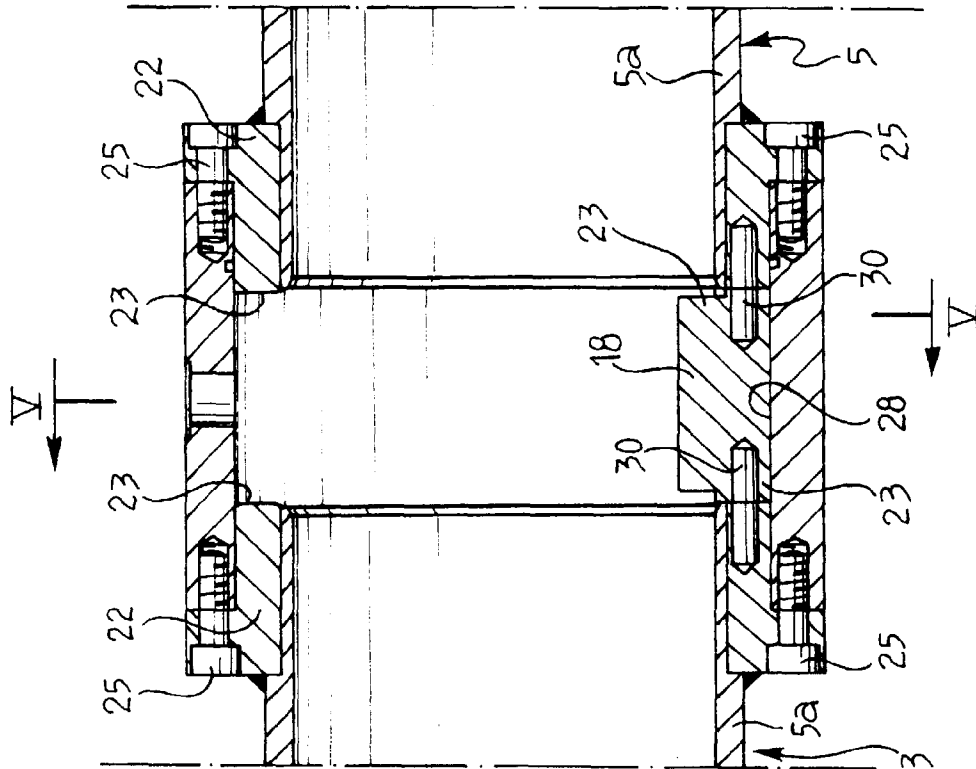


FIG. 5

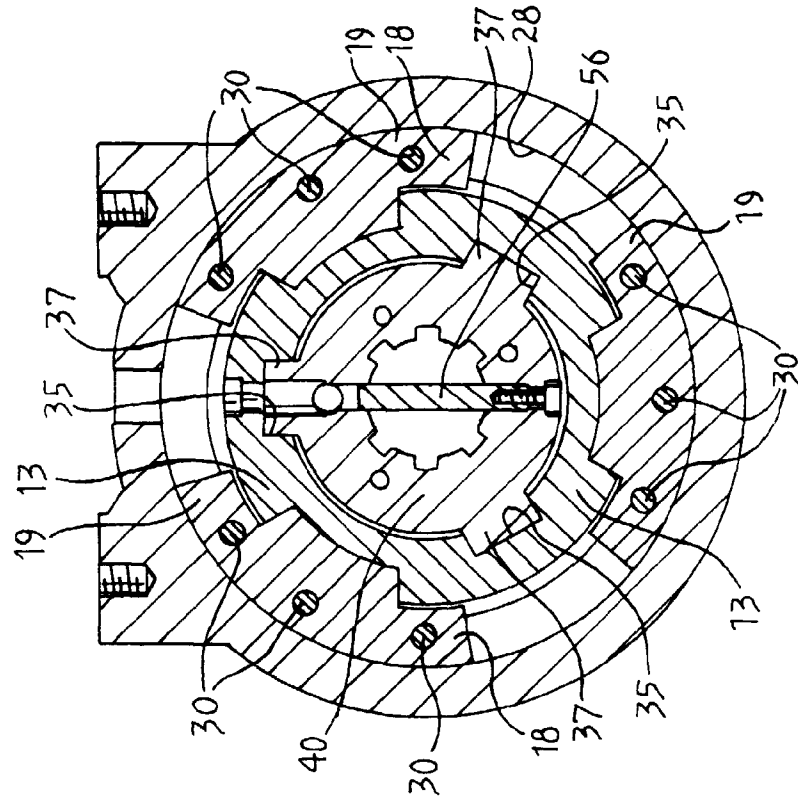


FIG. 6

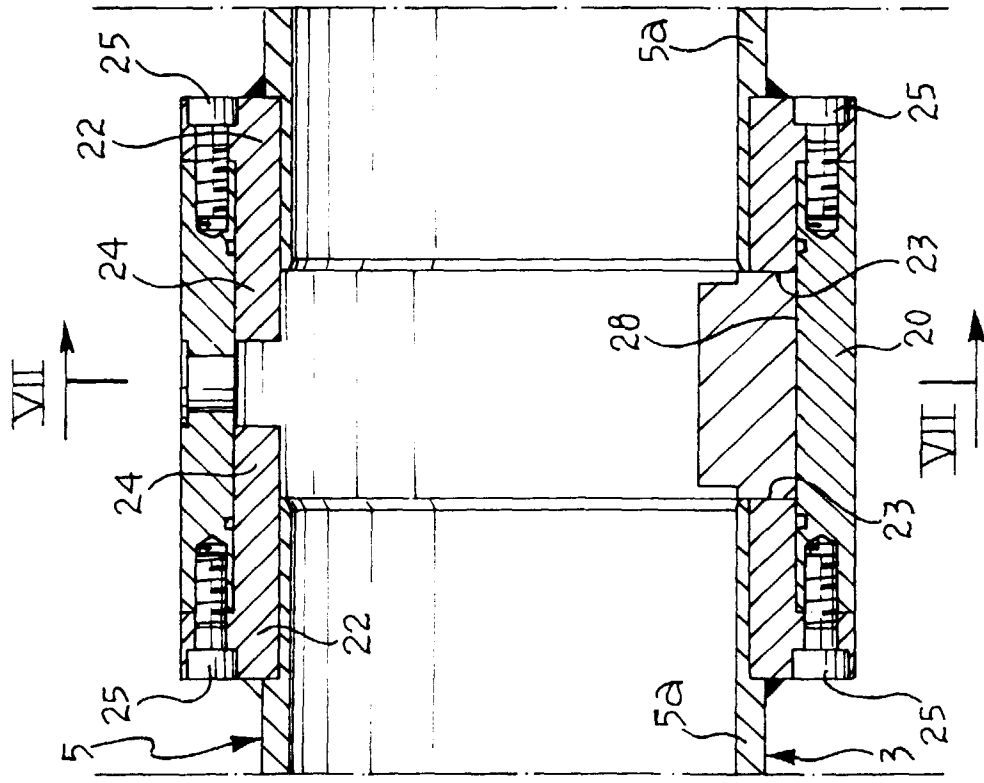


FIG. 7

