(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 046 691**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **81303879.1**

(22) Date of filing: **25.08.81**

(51) Int. Cl.³: **F 03 C 1/24**

(30) Priority: **26.08.80 GB 8027617**

(43) Date of publication of application:
03.03.82 Bulletin 82/9

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(71) Applicant: **STAFFA PRODUCTS LIMITED**
Staffa Works Argall Avenue
London E10 7QB(GB)

(72) Inventor: **Chapple, Peter John**
1, the Kangels Langley Upper Green
Saffron Walden Essex(GB)

(74) Representative: **Bubb, Antony John Allen et al,**
Chancery House Chancery Lane
London WC2A 1QU(GB)

(54) Improvements in and relating to hydraulic motors.

(57) In a hydraulic motor of the kind comprising radial pistons (5) having cam followers (8) for engagement with a circumferential cam track, the cam followers (8) comprise rollers of which the axial length substantially corresponds to the diameter of the pistons (5), and the cylinders (4) of the motor are provided with radial recesses (4A) to accommodate the axial ends of the cam follower rollers (8). Guide means (10) for the end faces of the cam follower rollers (8) are provided at the ends of the recesses (4A). The recesses (4A) may comprise transverse slots in the rotor (1), the latter being recessed to receive two axial end rings (10) providing the guide means for the end faces of the cam follower rollers (8).

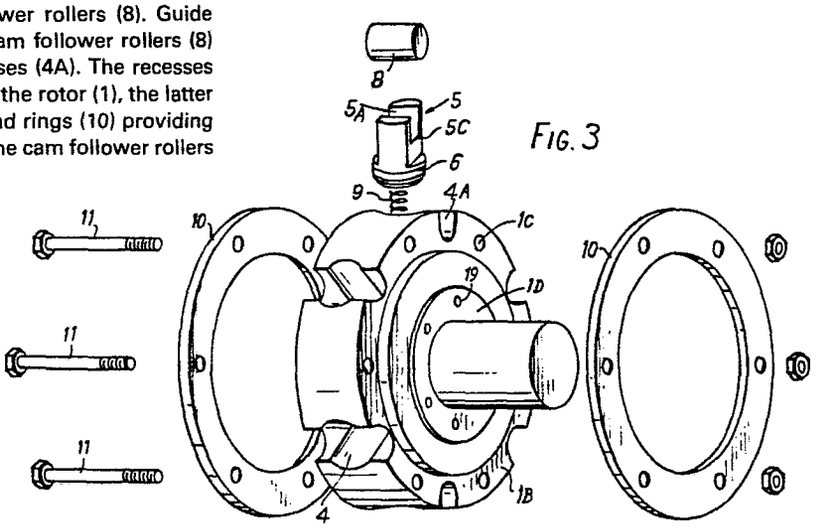


FIG. 3

EP 0 046 691 A2

IMPROVEMENTS IN AND RELATING TO HYDRAULIC MOTORS

This invention concerns improvements in and relating to hydraulic motors, and more especially to hydraulic motors of the kind comprising a rotor incorporating a plurality of radial cylinders, and an outer casing provided with a circumferential cam track surrounding the periphery of said rotor, each cylinder of the rotor containing a piston having a cam follower for engagement with said cam track, and valve means being provided for supplying pressure fluid to and exhausting it from each of the cylinders of said rotor in timed relation to the rotary movement thereof, whereby during the working cycle of each piston and cylinder, the piston is driven outwardly under fluid pressure, in order, via said cam follower and cam track, to cause relative rotary motion of said rotor and casing, and is then returned by way of said cam track and cam follower to exhaust fluid from the cylinder.

Hydraulic motors of the above kind are well known, and are particularly suitable for the transmission of high torque at relatively low speed, such as is required, for example, in the case of wheel motors for heavy duty vehicles.

Known motors of the above type have drawbacks as regards the construction and arrangement of the cam followers for transmitting forces between the pistons and the peripheral cam track surrounding the rotor. The cam followers are generally in the form of rolling members such as balls or rollers. Ball-shaped cam followers have the disadvantage that the peripheral cam track is required to be of relatively complicated shape, and is correspondingly expensive to manufacture, as are the ball-seatings in the pistons. In comparison, cam followers in the shape of rollers have the advantage that a cam of flat transverse profile can be used, with correspondingly reduced friction in the area of contact between the cam and the cam follower. They have the corresponding disadvantage, however, that they need to be maintained accurately in alignment with the axis of the rotor, thus requiring additional guide means for this purpose.

In one prior proposal utilising roller cam followers, the rollers have an axial length which is less than the diameter of the corresponding pistons, the rollers being retained captive within the pistons and penetrating into the cylinders of the rotor together therewith. Guide means making sliding contact with the end faces of the rollers are provided on the motor casing at the lateral boundaries of the cam track, in order to maintain the rollers in alignment with the axis of the rotor. Such an arrangement, however, has the disadvantage that the axial length of the rollers, and thus the area of contact with the cam track is relatively small. Moreover, the area of contact between the guide means and the end faces of the cam followers is necessarily reduced as the rollers penetrate the cylinders of the rotor to approach the rotary axis

thereof.

It is accordingly an object of the present invention to provide a hydraulic motor of the general type referred to above, wherein the pistons are provided with cam followers in the form of rollers, and wherein improved guide means for the cam follower rollers is provided.

The present invention accordingly provides a hydraulic motor of the kind initially referred to, wherein each cam follower comprises a roller rotatably mounted within the corresponding piston with its rotary axis in alignment with the rotary axis of the rotor, characterised in that the axial length of each roller is approximately the same as the diameter of the piston within which it is located, that each cylinder of the rotor has lateral recesses to receive the axial ends of the roller mounted within the corresponding piston, that said rotor is further provided with guide means bounding said lateral recesses of the cylinder, and that the end faces of each cam follower roller are arranged to make sliding engagement with said guide means whereby the roller is maintained in axial alignment with the rotary axis of the rotor.

The arrangement in accordance with the invention has the advantage that since the guide means for the cam follower rollers are mounted on the rotor, rather than on the motor casing, there is less sliding friction between the guide means and the end faces of the cam follower rollers, with correspondingly lower wear and frictional losses. Moreover, the axial length of the cam follower rollers can be greater than in hitherto known constructions in which the cam followers are

arranged to penetrate the cylindrical recesses of the rotor.

In accordance with a particularly advantageous embodiment of the invention, the axial ends of said rotor have circumferential recesses at the outer periphery of the rotor to define a central portion of generally cylindrical configuration, said central portion containing the outermost portions of said radial cylinders, the axial dimension of said central portion corresponding substantially to the diameter of said radial cylinders, and said central portion being provided with a plurality of open-ended axially extending grooves or slots extending across the said outermost portions of said radial cylinders to define the above-mentioned lateral recesses. This configuration of the rotor essentially simplifies the machining operations required to form the rotor, and enables the guide means to be formed in a simple manner as a pair of annular guide rings located in the said circumferential recesses to close the open ends of said transverse grooves or slots in the rotor. Preferably, the said guide rings are held in place in said circumferential recesses by means of axially extending clamping bolts arranged to extend through bores in the said rotor at positions between the said radial cylinders.

In order to avoid contact between the said pistons and the guide means for the cam follower rollers, the said pistons are preferably provided with diametrically opposed, recessed faces on their sides adjacent the axial ends of said rollers. An effective seal between the piston and the walls of its corresponding radial cylinder may be maintained by providing a sealing ring adjacent the inner end of the piston, at a point spaced from

the recessed faces of the piston.

The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a sectional elevation of a hydraulic motor in accordance with the invention,

Figure 2 is a cross-section on the line II-II of Figure 1,

Figure 3 is an exploded perspective view of the rotor and piston assembly of the motor of Figure 1,

Figure 4 is a view of the valve face of the motor shown in Figure 1, on the line IV-IV, and

Figure 5 is an end view of the motor shown in Figure 1, in the direction of the arrow X.

Referring to the drawings, a motor in accordance with one embodiment of the invention comprises a rotor 1, mounted for rotation within an outer casing 2 by means of bearings 3. The rotor 1 comprises a plurality of radial cylindrical recesses 4, within each of which is located a corresponding piston 5. Each piston 5 has a peripheral piston ring 6 in sealing engagement with the wall of the cylinder 4. The outer casing 2 incorporates a peripheral cam track 7, the annular profile of which is shown in Figure 2. Each of the pistons 5 contains a cam follower roller 8 which is held captive within a part cylindrical recess 5A of the piston, the recess 5A extending over an arc of a cylinder which subtends slightly more than 180^{o}, such that the roller 8 is retained against outward displacement from the piston

5. The cam followers 8 are relatively rotatable within the recesses 5A, which may be lined with an anti-frictional material such as an appropriate synthetic plastics material. The pistons 5 are spring loaded in an outward direction by means of cylindrical compression springs 9 held in locating bores 1A and 5B of the rotor and piston respectively, such that in the idle condition and in the absence of hydraulic forces acting in the cylinders 4, the rollers 8 are held lightly in engagement with the periphery of the cam track 7.

The cam follower rollers 8 are located with their rotary axes in alignment with the rotary axis of the rotor 1, by means of guide rings 10 which are located in corresponding circumferential recesses 1B in the axial ends of that portion of the rotor 1 containing the cylinders 4, the cylindrical walls of the cylinders 4 also having transverse slots 4A to receive the axial ends of the cam follower rollers 8, which are of substantially the same axial length as the pistons 5. The guide rings 10 are located in position by means of securing bolts 11 passing through apertures 1C in the central portion of the rotor 1 between the cylinders 4, as can be seen more clearly by reference to Figures 2 and 3. The distance between the guide rings 10 corresponds substantially to the diameter of the cylinders 4, and the portions of the pistons 5 adjacent the axial ends of the rotor 1 are recessed as shown at 5C, in order to provide a clearance between the pistons 5 and the guide rings 10.

Referring to Figures 1 and 4, the motor casing 2 is provided with hydraulic supply and return conduits 12 and 13, which communicate with annular channels 14 and 15 defined between the motor casing 2 and an an-

nular valve insert 16. The valve insert 16 is axially slidable within the motor casing 2, being spring urged to the left, as viewed in Figure 1, by means of a series of compression springs 17 located within bores 16A of the valve insert. The springs 17 maintain the position of the valve insert 16 during start up or reversal of the motor until the hydraulic pressure loading on the stepped portions of the valve insert is established. The valve insert is held against rotation within the valve casing by means of a peg 18. An end face 16B at the left-hand axial end of the valve insert 16, as viewed in Figure 1, makes sliding engagement with a corresponding end face 1D of the rotor 1, whereby, during rotation of the rotor 1, hydraulic conduits 19 formed in the rotor 1 and communicating with the cylinders 4, are respectively placed in communication with corresponding hydraulic supply and return conduits 20 and 21 of the valve insert 16, the ducts 20 and 21 communicating with arcuate ports 20A and 21A at the end face 16B of the insert 16, and with the annular channels 14 and 15. The conduits 20, 21 and the ports 20A and 21A are arranged in alternation around the circumference of the valve insert 16, as shown more clearly in Figure 3. Thus, each piston 15 is alternately driven outwardly towards the cam track 7 by hydraulic fluid supplied under pressure through the conduit 20, and returned towards the rotor axis by the cam track 7 to discharge hydraulic fluid through the exhaust conduits 21. It will be appreciated that by reversing the supply of hydraulic fluid to the ports 12 and 13, the direction of rotation of the hydraulic motor may be reversed.

From the above description it will be seen that there has been provided a novel construction of hydraulic motor, wherein the transmission of forces between the pistons of the motor and the outer peripheral cam track

is effected by means of cam follower rollers, the cam follower rollers being reliably guided to maintain their axes in alignment with the rotor axis, by guide means so constructed and arranged that the cam follower rollers may be of increased axial length, whilst the friction between the end faces of the cam follower rollers and the guide means is reduced.

CLAIMS

1. A hydraulic motor comprising a rotor incorporating a plurality of radial cylinders, an outer casing provided with a circumferential cam track surrounding the periphery of said rotor, each cylinder of the rotor containing a piston having a cam follower in the form of a roller rotatably mounted within the piston with its rotary axis in alignment with the rotary axis of the rotor, the roller being arranged to engage said cam track, and valve means for supplying pressure fluid to and exhausting it from each of the cylinders of the roller in timed relation to the rotary movement thereof, characterised in that the axial length of each roller (8) is approximately the same as the diameter of the piston (5) within which it is located, that each cylinder (4) of the rotor has lateral recesses (4A) to receive the axial ends of the roller (8) mounted within the corresponding piston (5), that said rotor (1) is further provided with guide means (10) bounding said lateral recesses (4A) of the cylinder, and that the end faces of each cam follower roller are arranged to make sliding engagement with said guide means (10) whereby the roller (8) is maintained in axial alignment with the rotary axis of the rotor.

2. A motor as claimed in Claim 1, characterised in that the axial ends of said rotor (1) have circumferential recesses (1B) at the outer periphery of the rotor to define a central portion of generally cylindrical configuration, said central portion containing the outermost portions of said radial cylinders (4), that the axial dimension of said central portion substantially corresponds to the diameter of said radial cylinders (4), that said central portion contains a plurality

of open ended axially extending grooves or slots (4A) extending across the outermost portions of said radial cylinders (4) to define said lateral recesses and that the said guide means (10) comprise a pair of annular guide rings located in said circumferential recesses to close the open ends of said grooves or slots (4A).

3. A motor as claimed in Claim 2, characterised in that the said guide rings (10) are held in place in said circumferential recesses (1B) by axially extending clamping bolts (11) extending through bores (1C) located in said rotor between the said radial cylinders (4).

4. A motor as claimed in any one of Claims 1 - 3, characterised in that the said pistons (5) are provided with diametrically opposed, recessed faces (5C) on their sides adjacent the axial ends of said rollers (8), whereby said pistons remain out of contact with said guide means (10).

5. A motor as claimed in Claim 4, characterised in that each piston incorporates a sealing ring (6) adjacent its inner end, said sealing ring being spaced from said recessed faces (5C) of the piston.

6. A motor as claimed in any one of Claims 1 - 5, characterised in that the said outer casing (2) is formed in two portions between which is clamped a portion defining the said cam track (7).

FIG. 1

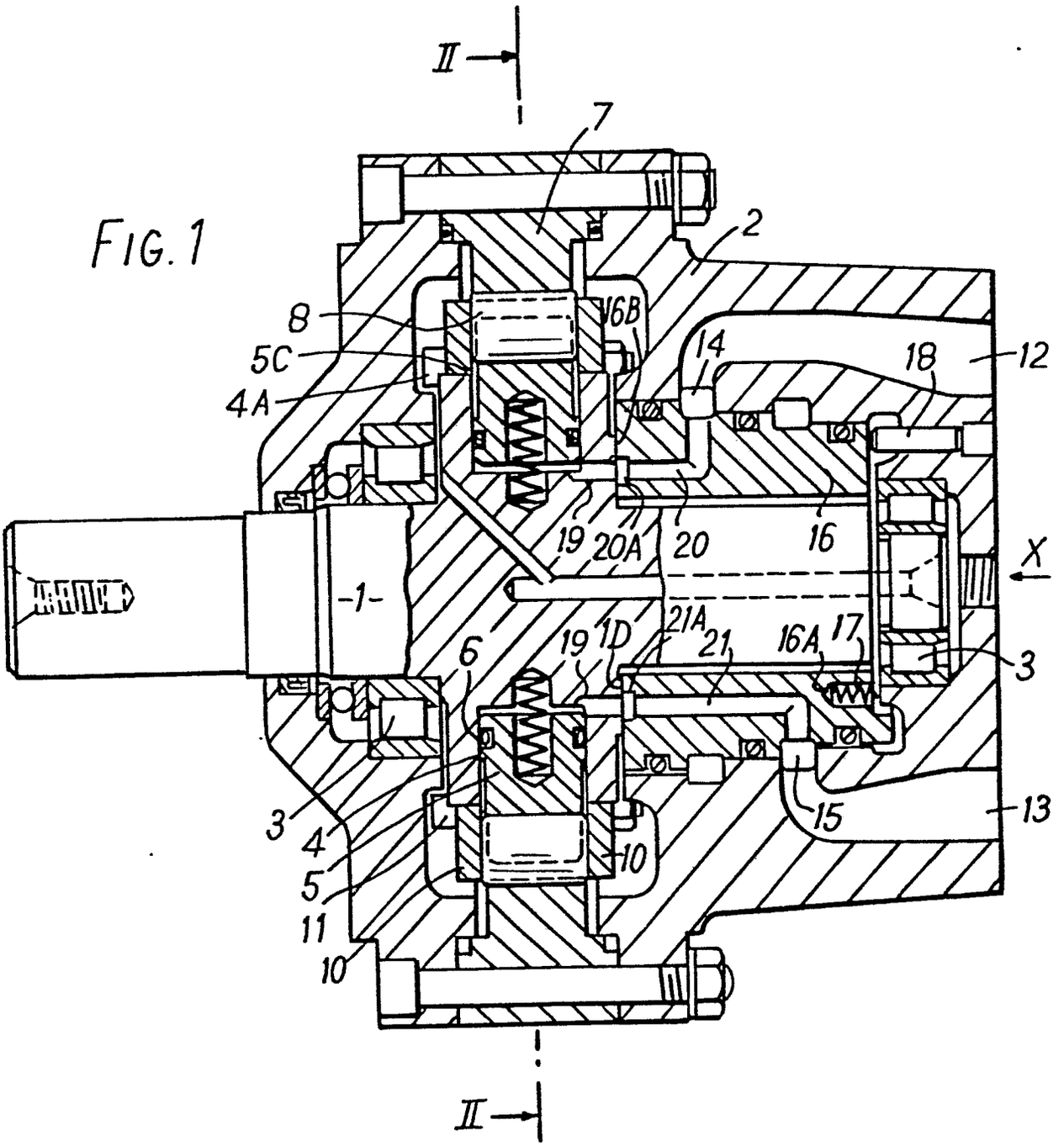
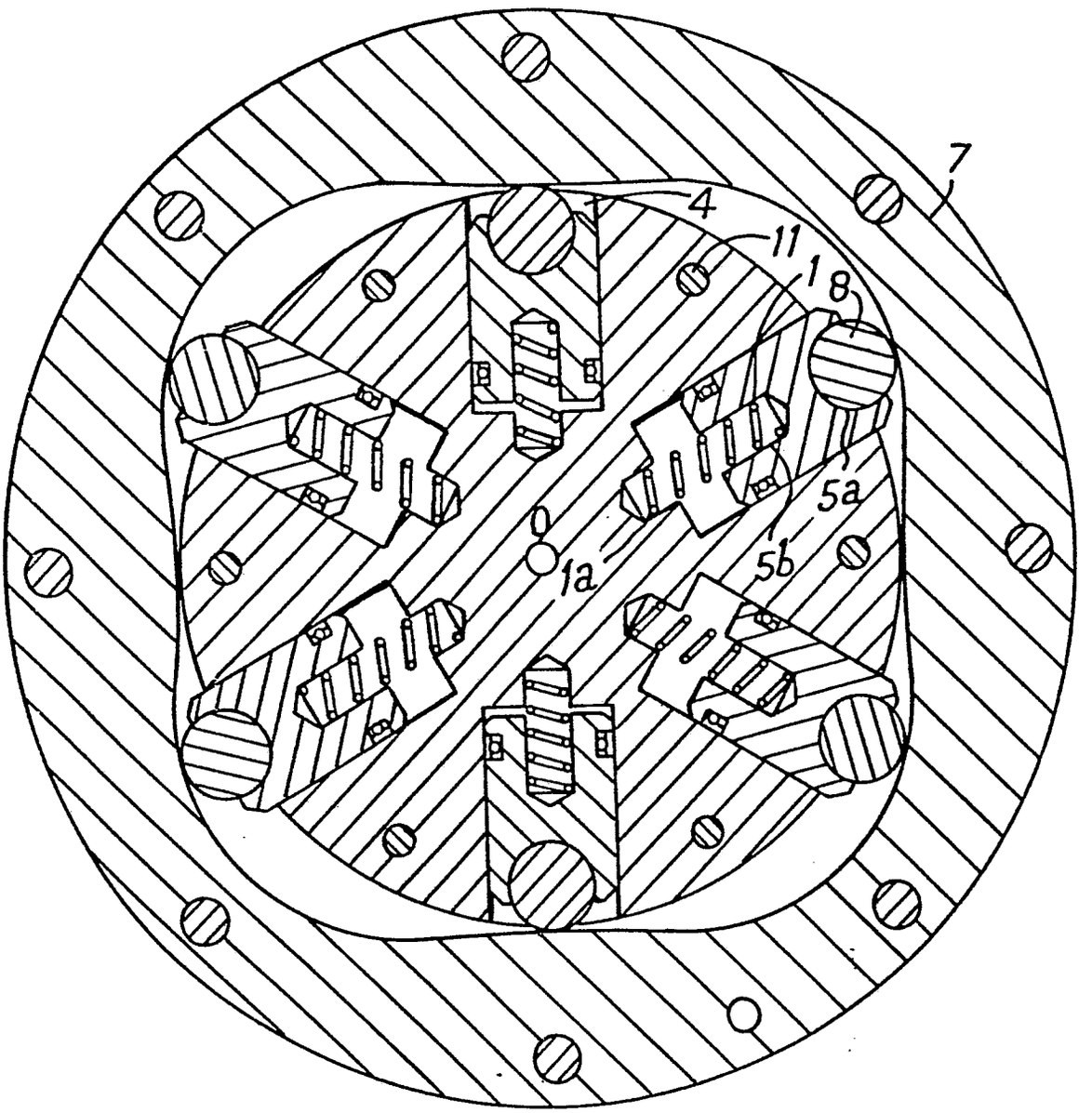

II
7
2
8
16B
5C
14
18
12
4A
19
20A
20
16
X
1
21A
21
16A
17
6
19
1D
3
3
4
5
11
10
15
13
10
II

FIG. 2



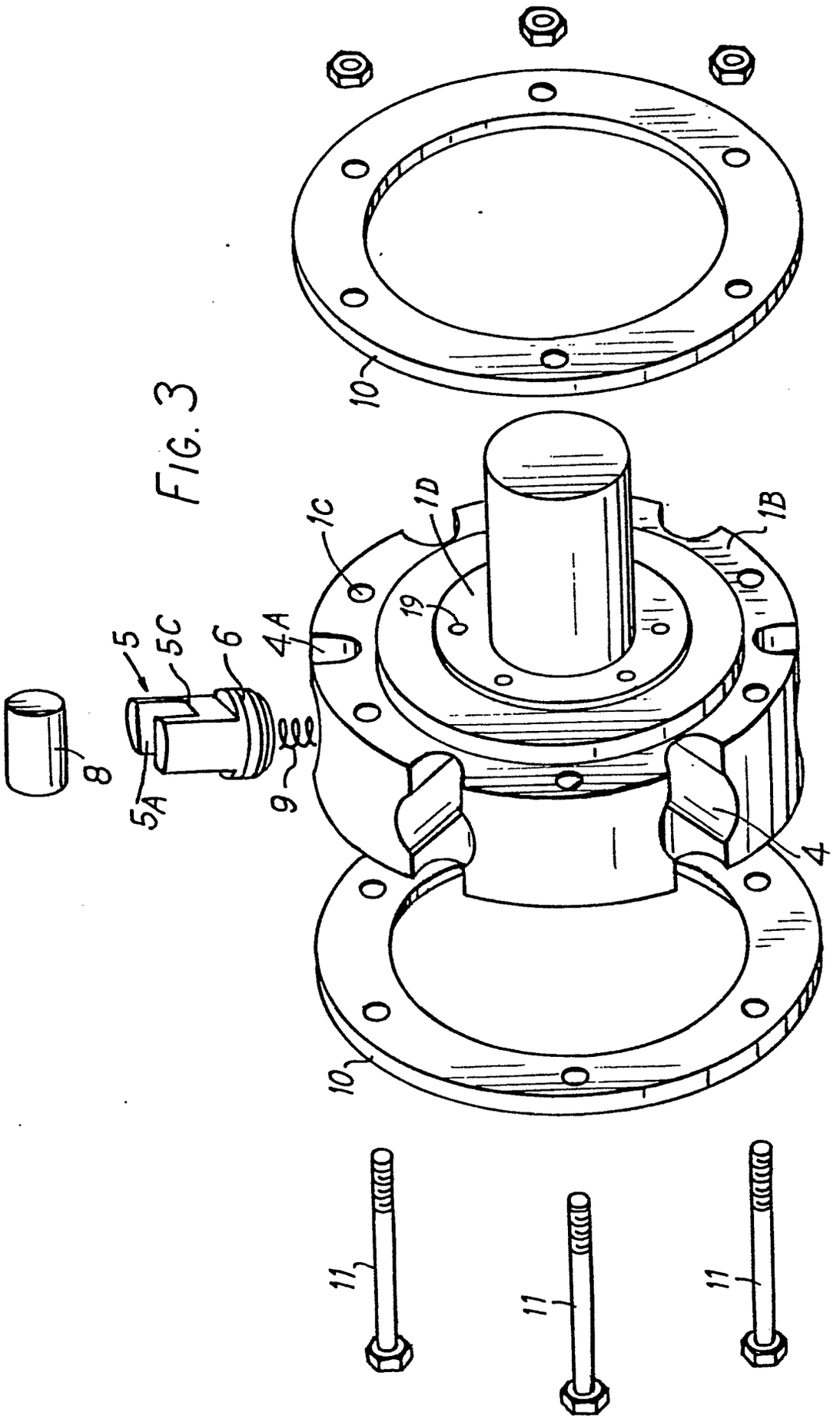


FIG. 3

FIG. 4

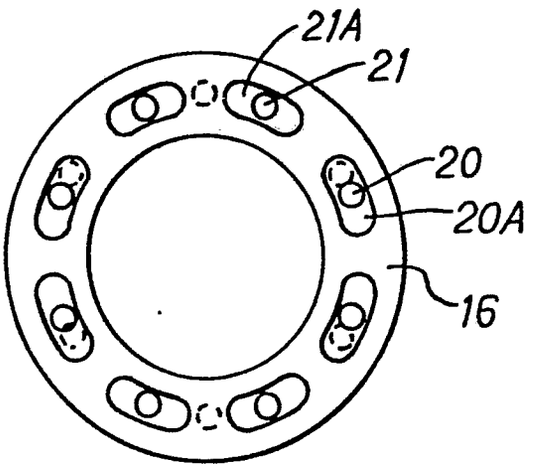


FIG. 5