United States Patent [19]

Berlich

[11] **3,871,798**

[45] **Mar. 18, 1975**

[54] **ROTARY AND ORBITING PISTON MACHINE WITH INTERNAL SHAFT**

[75] Inventor: **Bodo Berlich,** Obertshausen, Germany

[73] Assignee: **Danfoss A/S,** Nordborg, Denmark

[22] Filed: **Dec. 3, 1973**

[21] Appl. No.: **420,936**

[30] **Foreign Application Priority Data**

Dec. 2, 1972 Germany 2259117

[52] **U.S. Cl.** ..... **418/39,** 418/61 B

[51] **Int. Cl.** **F04c 29/00**

[58] **Field of Search** ..... 418/61 B, 39, 16, 19, 171, 418/166, 252, 270

[56] **References Cited**

UNITED STATES PATENTS

2,623,469	12/1952	Gray	418/39
3,244,111	4/1966	Shelhart	418/171
3,460,481	8/1969	White	418/61 B
3,619,089	11/1971	Pierrat	418/171

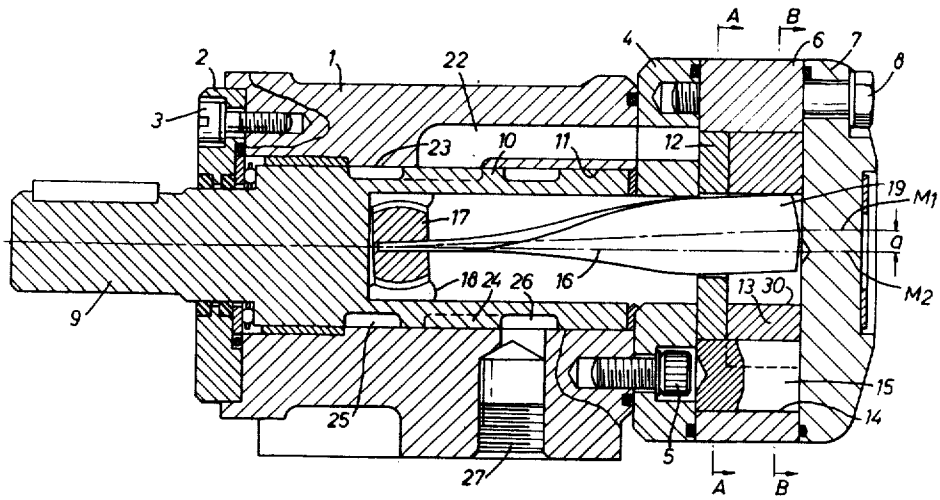
Primary Examiner—C. J. Husar

Assistant Examiner—O. T. Sessions

[57] **ABSTRACT**

The invention relates to a gerotor type rotary piston machine. The casing has a main axis and the gerotor gear set includes an internally toothed ring member with the teeth thereof in the form of rollers and an externally toothed star member which is rotatable about its own axis and orbital about the casing main axis. A main drive shaft is rotatable about the casing axis and a universal type wobble shaft connects the main shaft to the gerotor star member. An insert member is disposed internally of the ring member which has recesses for receiving the rollers of the ring member. The star gear and the insert member have a combined thickness equal to the width of the ring gear. The star gear has a centrally disposed slot and the wobble shaft has a blade shaped portion disposed in the slot. The insert member has a central bore and the blade portion of the wobble shaft extends through the star gear into the central bore. The dimensions of the recesses of the insert member are selected that the axially parallel lines of contact between the rollers and the star gear lie within these recesses.

3 Claims, 3 Drawing Figures



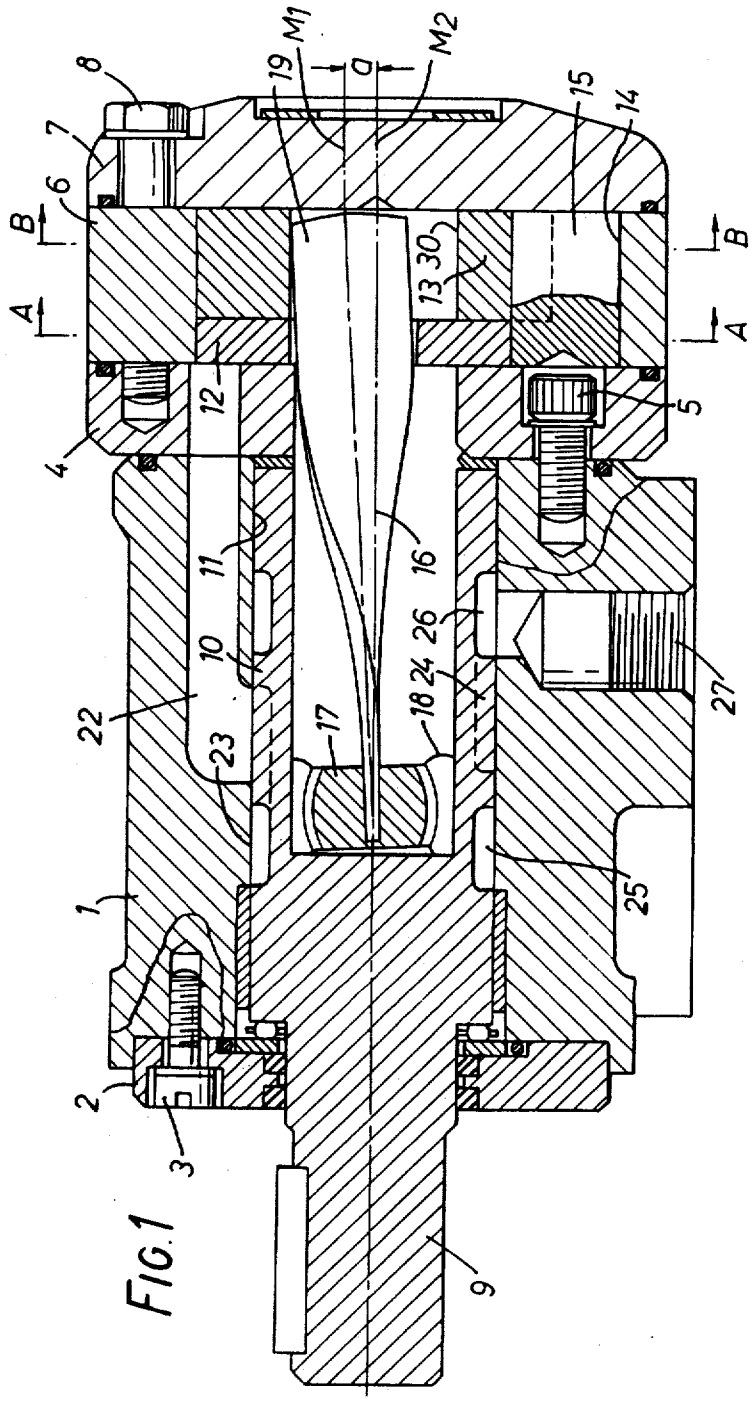

M1
M2
a
19
8
7
6
B
A
15
14
13
30
12
4
5
11
16
10
26
24
18
22
23
17
27
25
1
2
3
9

FIG. 1

Fig. 2

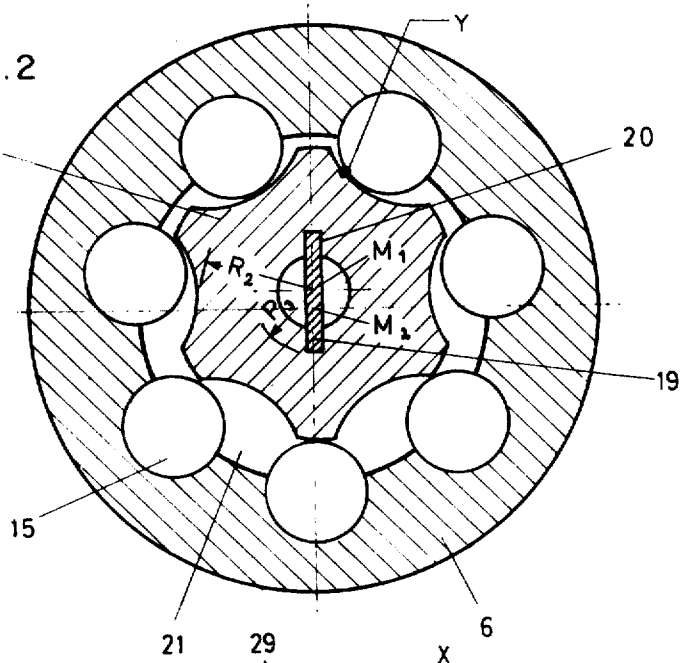
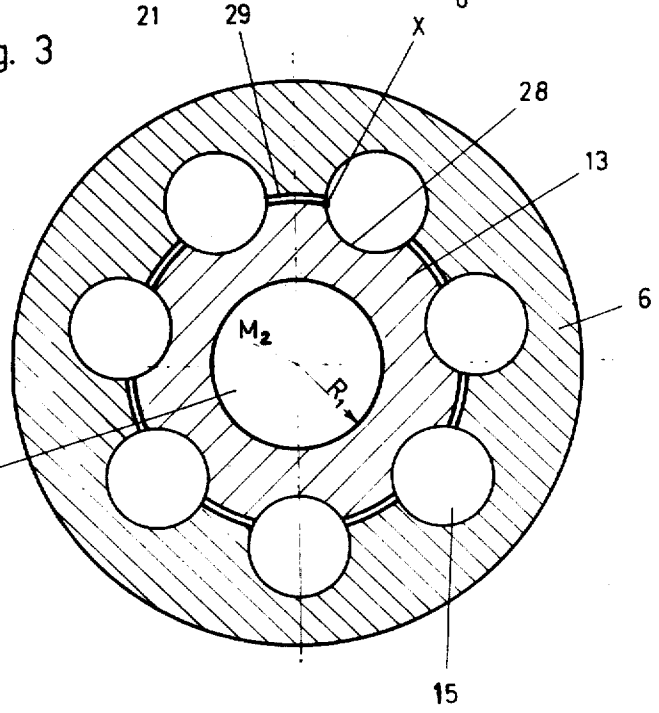


Fig. 3



ROTARY AND ORBITING PISTON MACHINE WITH INTERNAL SHAFT

The invention relates to a rotary piston machine having a parallel internal shaft and meshing engagement between an internally toothed ring, the teeth of which are in the form of rollers having a length equal to the width of the ring, and a pinion arranged to move eccentrically with respect to the ring.

A machine of this kind is known wherein the rollers are held in part cylindrical recesses in the ring, the circumference of each recess extending over rather more than 180°. Surprisingly, it has been found that, in otherwise similar conditions, the service life of these machines becomes shorter with diminishing intake volume.

Furthermore, controllable gear pumps having a rotating ring, the idea of providing two juxtaposed pinions which rotate about an axis offset from that of the ring, the axis of one of the pinions being displaceable relatively to that of the other pinion over an arcuate path are known. In this system, for the purpose of altering the control range of the two pinions can be replaced by pinions of other widths, but the sum of the widths of the two pinions remains equal to that of the ring.

The object of the present invention is to provide a machine of the initially stated kind which has a normal service-life even when the intake volume is small.

According to the invention, this object is achieved by the pinion having a smaller width than the ring, and the space resulting from the difference in the widths of the pinion and the ring being occupied by an insert, the outer contour of which contains recesses for accommodating the rollers, the dimensions of the recesses being so selected that the axially parallel lines of contact between the rollers and the pinion follow paths which lie within the recesses.

The invention is based upon the consideration that the rollers should not be too short in the axial direction, since otherwise the clearance necessary to enable the rollers to rotate leads to tilting and the like that would result in increased wear. On the other hand however, the intake volume of the machine in many cases can only be reduced by decreasing the width of the working parts, since limits are set to a reduction of the size of the machine in the diametral direction. By using the insert it is possible simply to shorten the pinion in the axial direction, i.e. to keep the rollers and the ring which accommodates them at an accepted favourable axial length. The axial length of the rollers is preferably approximately equal to or greater than the diameter of the rollers. Using such dimensions, there arises no danger of the rollers tilting. Instead, they are guided in a particularly efficient manner by the insert.

A further advantage that is achieved is that with the aid of a single basic construction and simply by changing the pinion and insert, machines having very different intake volumes can be provided, and this represents a considerable rationalization.

Particular advantage results if the insert has a central bore, the radius of which is less than the smallest radius of the pinion minus the distance between the centre points of the pinion and ring. The presence of such central bore does not adversely affect the performance of the insert, but results in the latter being of very low weight.

Furthermore, the central opening in the pinion may have a maximum radius for accommodating the head

of a shaft, which radius is less than the radius of the central bore in the insert minus the distance between the centre points of the pinion ring. In this way it becomes possible to pass a universal-joint shaft through the central bore of the insert, or to use a universal-joint shaft the head of which is greater than the axial width of the pinion.

Also, a pinion, which cannot be engaged by a universal-joint shaft having a normal head, may have a slot-like central opening, and the head of the shaft may be in the form of a flat strip-like portion. A flat strip-like portion of this kind is also able to transmit torque in an efficient manner even when the axial dimension of the pinion is very small. Furthermore, this head portion of the shaft can be readily reduced in length to suit a particular width of pinion.

The invention will now be described in greater detail by reference to a form of construction illustrated in the drawing, in which:

FIG. 1 is a longitudinal section through a machine in accordance with the invention,

FIG. 2 is a cross-section on the line A — A of FIG. 1, and

FIG. 3 is a cross-section on the line B — B of FIG. 1.

The drawing illustrates an orbiting-piston machine in which a cover plate 2 and an end disc 4 are secured to a case 1 by means of screw-bolts 3 and 5 respectively. A ring 6 and a cover plate 7 are attached to the end disc 4 with the aid of screw-bolts 8. A machine shaft 9 is formed integrally with a rotary slide-valve 10 which is mounted in a bore 11 of the casing.

A pinion 12 and an insert 13 are disposed one behind the other in the ring 6. Rollers 15 are mounted for rotation in part-cylindrical recesses 14 formed in the ring. The head 17 of a universal-joint shaft 16 engages with the teeth 18 of the machine shaft 9, and a flat strip-like portion 19 of the shaft engages in a slot-like central opening 20 in the pinion 12.

Displacement chambers 21, each of which communicates with a duct 22 in the casing, are formed between the ring 6 and the pinion 12. These seven ducts begin at control openings 23 which move into register with twelve channels 24 which communicate in turn with two annular chambers 25 and 26 which are associated with the two ports, only one of which, designated by the numeral 27, is shown here. During rotation of the machine shaft 9, the displacement chambers 21 are therefore connected to the supply and discharge sides in the correct sequence. In the case of a motor, and in the position shown in FIG. 2 for example, the chambers 21 on the right-hand half may be connected to the pressure side, and the chambers 21 on the left-hand half to the suction side, whereas the top chamber is positioned precisely in the zone of transition from the pressure side to the suction side. The piston 12 then rotates in the clockwise direction.

The insert 13 (FIG. 3) has an external contour bearing on the rollers 15 at recesses 28. The circumferential distance over which each recess is in contact with a roller should be so great that in all operating positions the axially parallel line of contact Y between each roller 15 and the pinion 12 lies within a recess 28, i.e. does not pass beyond the end point X. The line of contact Y therefore moves from a median position (lowest roller seen in FIG. 2) to an extreme position (top roller seen in FIG. 2). If this requirement is fulfilled, it is of no im-

portance that a gap **29** remains between the insert **13** and the ring **16.**

The insert **13** has an internal bore **30,** the radius R_1 of which is less than the smallest radius R_2 of the pinion **12** minus the distance *a* between the centre point M1 of the pinion and the centre point M2 of the ring.

Also, the slot-like central opening **20** in the pinion **12** has a maximum radius R_3 which is less than the radius R_1 of the central bore **13** minus distance *a* between the centre points of the pinion and the ring.

It thus becomes possible always to use the same universal-joint shaft **16,** whatever the ratio of the width of the pinion **12** to that of the insert **13.** As an alternative, an insert **13** having no central bore **30** can be used if the flat strip-like portion **19** is correspondingly shortened.

I claim:

1. A gerotor type rotary piston machine comprising an internally toothed ring gear having an axis and having teeth in the form of rollers equal in length to the width of said ring gear, a cooperating externally toothed star gear having fewer teeth than said ring gear disposed eccentrically relative to said ring gear axis, said star gear having rotational movement about its own axis and orbital movement about the axis of said ring gear with the teeth of said gears intermeshing in sealing engagement to form expanding chambers on one side of a line of symmetry and contracting chambers on the other side of said line during relative movement between said gears, wall means on opposite sides of said ring gear, an insert member disposed internally of said ring member and having recesses for receiving said rollers, said star gear and said insert member having a combined thickness equal to the width of said ring gear, a drive shaft, drive means between said star gear and said drive shaft for rotating said drive shaft at the rotating speed of said star gear.

2. A gerotor type rotary piston machine according to claim **1** wherein said star gear has a centrally disposed slot, said drive means having a blade shaped portion disposed in said slot.

3. A gerotor type rotary piston machine according to claim **2** wherein said insert member has a central bore, said drive means blade shaped portion extending through said star gear and into said bore.

* * * * *