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Giversen

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[54] **ROTARY PISTON MACHINE FOR LIQUIDS**

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[52] **U.S. Cl.** ..... **418/61 B**; 418/186

[51] **Int. Cl.** **F04c 17/18**; F04c 29/08

[58] **Field of Search** ..... 418/61 R, 61 B, 186, 188, 418/171

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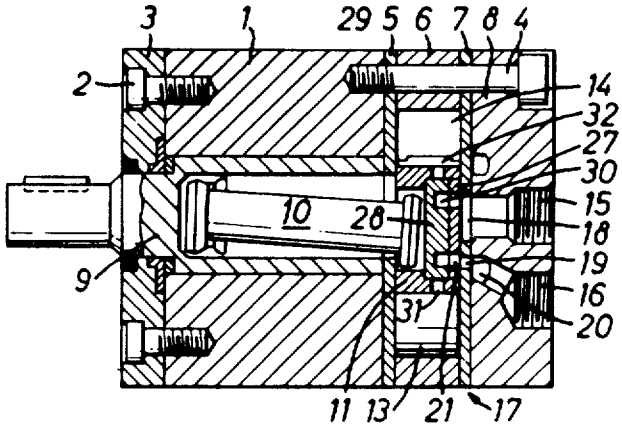
[57] **ABSTRACT**

The invention relates to a fluid pressure operated motor or pump of the type having a gerotor displacement mechanism. Such devices normally have a separate valve member for directing pressurized fluid from the casing inlet to the expanding chambers of the gerotor and exhaust fluid from collapsing chambers to the casing outlet. In this invention there is no separate valve member and a unique valve passage arrangement is provided in a stationary casing port wherein a centrally located port is surrounded by a ring of ports. The centrally located port may be the inlet or outlet port and the ring of ports is the opposite thereof.

1 Claim, 3 Drawing Figures



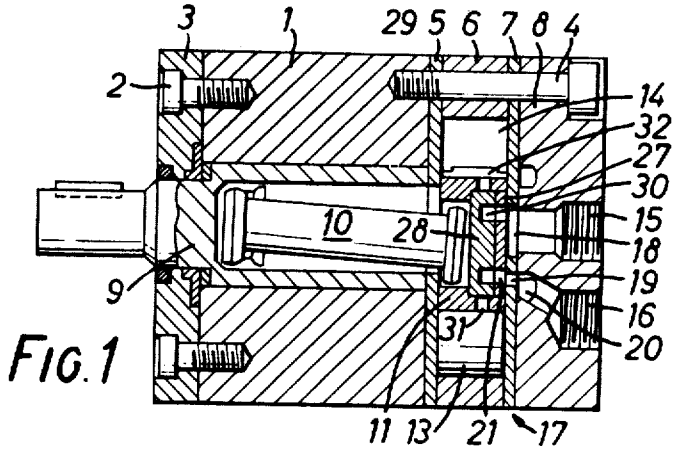


FIG. 1

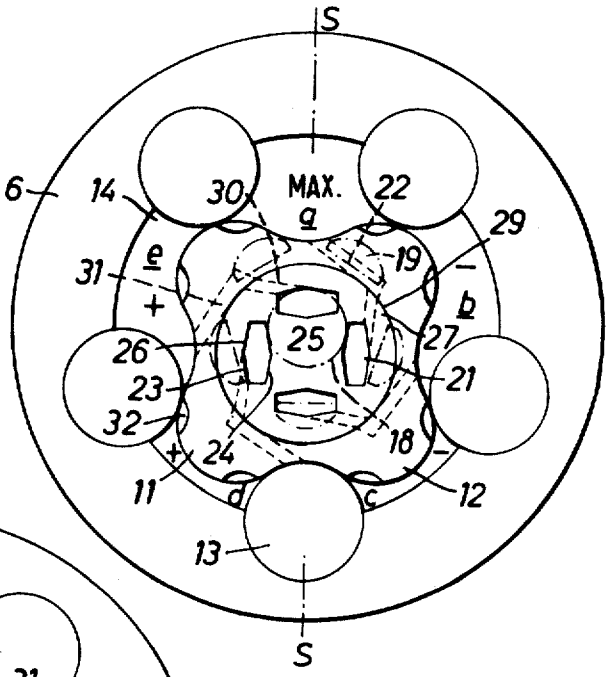


FIG. 2

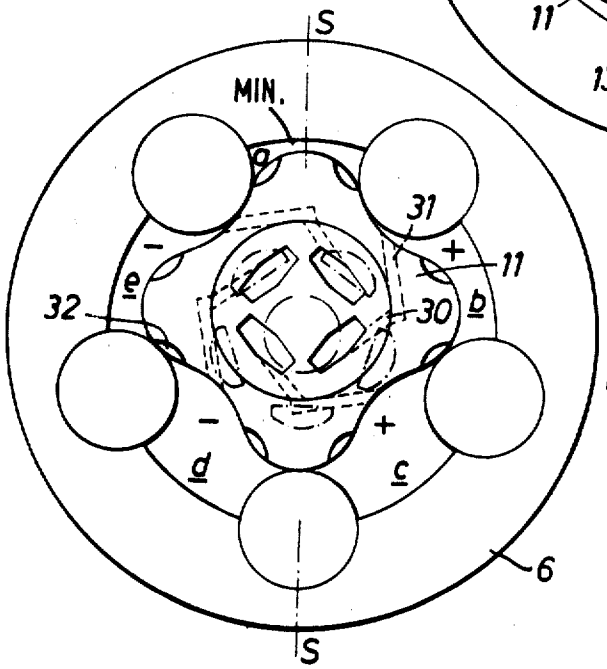


FIG. 3

ROTARY PISTON MACHINE FOR LIQUIDS

The invention relates to a rotary piston machine for liquids having a toothed wheel and a toothed ring which surrounds the toothed wheel. Said toothed ring having one more tooth than the wheel and forming displacement chambers with the wheel, a distributor valve comprising two parts one of which is coupled to one of the toothed elements and has first control openings which overlap second control openings in the other valve part and connecting ducts which lead from the second control openings to the displacement chambers.

The object of the present invention is to provide a rotary piston machine, the distributor valve of which is of very simple, space saving construction and is particularly suitable for small machines.

According to the invention, this object is achieved by a rotary piston machine having two sets of control openings. One of said sets is connected to the supply line and the other to the discharge line. The difference in the positioning of the two sets relative to the eccentricity of the movement of one of the toothed elements provides a commutator type fluid feeding and exhausting arrangement.

The advantage of a machine of this kind resides in the fact that the two parts of the distributor valve are firmly connected to the toothed wheel and to the toothed ring or can even be formed directly on one of these toothed elements. A disadvantage, on the other hand, is that the distributor valve gives a poorer control performance than distributor valves having two parts arranged concentrically with each other. In particular, during transition from one set of the first control openings to the other, the second control openings are completely covered over a greater angle of rotation of the associated toothed element.

When, however, this distributor valve is used as a primary distributor valve in conjunction with a secondary distributor valve, a machine of simple construction and having an accurate control function is obtained. In a preferred arrangement, one set is formed by a central bore and the other set is in surrounding relation thereto.

In particular the above arrangement enables very small rotary piston machines to be produced which have for example a toothed wheel with four teeth and a toothed ring with five teeth.

It is advisable for reasons of construction for the toothed wheel to have a central cavity in which is fitted an insert incorporating the second control openings. The portions of the connecting duct formed in the insert and in the toothed wheel being at an angle to each other. This results in the control opening being connected to a displacement chamber offset through 90°; the connecting duct however does not interfere with the adjacent control opening.

Manufacture is rendered easier if the insert consists of two parts, one of which incorporates the portions of the connecting duct, and the other the second control openings.

The invention will now be described in greater detail by reference to a preferred embodiment illustrated in the drawing in which:

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

FIG. 2 is a side view, on a greater scale, of the toothed elements and the control openings, one displacement chamber being seen at its maximum size, and

FIG. 3 is an illustration similar to that of FIG. 2 showing one displacement chamber at its minimum size.

The rotary piston machine has a casing **1** to one end face of which a cover plate **3** is secured by means of screw bolts **2**, while at its other end face an intermediate plate **5**, a toothed ring **6**, an intermediate plate **7** and a connection plate **8** are secured by means of screw bolts **4**. A main shaft **9** is mounted in the casing **1**. This shaft is connected to a toothed wheel **11** through a universal joint shaft **10**.

The toothed wheel **11** has four teeth **12**, and the toothed ring **6** has five teeth **13** in the form of cylindrical rollers. Displacement chambers **14** are formed between these teeth and the intermediate plates **5** and **7**. The displacement chambers **14** are connected through a valving arrangement in the correct working manner to two ports **15** and **16** in the plate **8** associated with the supply and discharge lines.

This valving arrangement is represented by a distributor valve **17** in which a first stationary port is the plate **7**, and a second movable port is the wheel **11** and inserts **27** and **28** fastened thereto so as to be integral therewith. Plate **7** constitutes a valve plate with a central bore **18** which is directly connected to the port **15**, and five openings **19** along a circle concentric with port **15** which openings **19** are connected to the port **16** by way of an annular channel **20** in the connection plate **8**. The bore **18** and the circle of control openings **19** are disposed concentrically with the central axis of the toothed ring **6**. Four openings **21** are provided in inserts of the toothed wheel, and these openings are disposed along a circle around the central axis of the toothed wheel **11**.

The control openings **19** extend in the peripheral direction. Their inwardly directed limiting edge **22** runs tangentially to a circle concentric with the bore **18**. The lines **23**, **24**, **25** and **26** defining the control openings **21** are so selected that, in the position illustrated in FIG. **2** in which one displacement chamber **14** is at its maximum volume, said lines extend parallel to the limiting line **22** of the control openings **19** and thus lie between the bore **18** and these control openings **19**.

The second control openings **21** are provided in a first insert part **27**, which part, together with a second insert part **28**, is accommodated in a cavity **29** in the toothed wheel **11**. In the second insert part **28** there are provided first connecting duct portions **30** which take the form of channels and are covered by the first insert part **27**. Provided in the toothed wheel **11** are second connecting duct portions **31** and these extend from the periphery of the cavity **29** to the base of the gap between two consecutive teeth. The two connecting duct portions **30** and **31** are at an angle to each other.

Auxiliary ducts **32** are also provided on the toothed wheel **11**. They take the form of channels at the two end faces of the toothed wheel and are disposed on the flanks of each tooth. They extend over a distance such that they each enable a connection between adjacent displacement chambers **14** to be established, this connection however being interrupted by the remaining tooth configuration bearing on the tooth of the toothed ring **6** in the zone of the line of symmetry S.

This arrangement results in the following operating cycle. If it is assumed that pressurized fluid is supplied through the port **15**, and that the union **16** is connected

to the return line, then the upper control opening **21** seen in FIG. **2** receives pressurized fluid over the hatched portion of its area, whereas the lower control opening **21** is connected to the return line over the cross hatched area. If, proceeding in the clockwise direction, the displacement chambers **14** are designated by the letters *a*, *b*, *c*, *d* and *e*, then the chamber *a* is at maximum volume and is sealed off at the two sides. The chamber *e* is under supply pressure; the same also applies as regards chamber *d* which is connected to chamber *e* through auxiliary ducts **32.** Conversely, the chambers *b* and *c* are under return pressure. The toothed wheel **11** and consequently the main shaft **9** are therefore turned in the clockwise direction. After a distance corresponding to a half tooth pitch, the toothed wheel occupies the position shown in FIG. **3** in which the chamber *a* is at its minimum size. In this position too the auxiliary ducts **32** each connect adjacent chambers *b* and *c*, and *d* and *e*, but this connection is cut off in the zone of the line S of symmetry of the toothed ring. When the toothed ring turns from the position shown in FIG. **2,** the return pressure should be communicated to the chamber *a* as rapidly as possible. This is achieved by connecting the chamber *a* to the chamber *b* through an auxiliary duct **32.** No importance therefore attaches to the size of the angle through which the toothed wheel must turn before the right hand control opening **21** associated with the chamber *a* at this moment moves into contact with the control opening **19.**

The same applies as regards the position seen in FIG. **3,** where the chamber *a*, after turning through a small angle, is connected through an auxiliary duct **32** to the chamber *b* which is under supply pressure, even if a very considerable rotary movement is required before an associated connecting duct receives pressure.

Instead of the illustrated auxiliary ducts **32** in the flanks of the teeth of the toothed wheel, there are other types of auxiliary ducts which may be utilized.

I claim:

1. A fluid pressure motor comprising an internally toothed ring gear having an axis, 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 rotating line of symmetry and contracting chambers on the other side of said line during relative movement between said gears, an end wall fixedly attached to said ring gear and forming fixed wall means for said chambers, valve means comprising a first valve part formed by said end wall and a second movable valve part integral with said star gear, a first set of inlet and outlet fluid ports in said first valve part comprising a centrally located port surrounded by a ring of ports, said centrally located port being one of said ports and said ring of ports being the remaining ones of said ports, said second valve part having a single set of ports arranged in a circle between said centrally located port and said ring of ports which alternately communicates with said inlet and outlet ports and have sequential fluid communication with (**1**) said centrally located port and with (**2**) said ring of ports, to continuously route fluid to said expanding chambers and away from said contracting chambers, and passage means in said second valve part providing fluid communication between said single set of ports and said chambers.

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