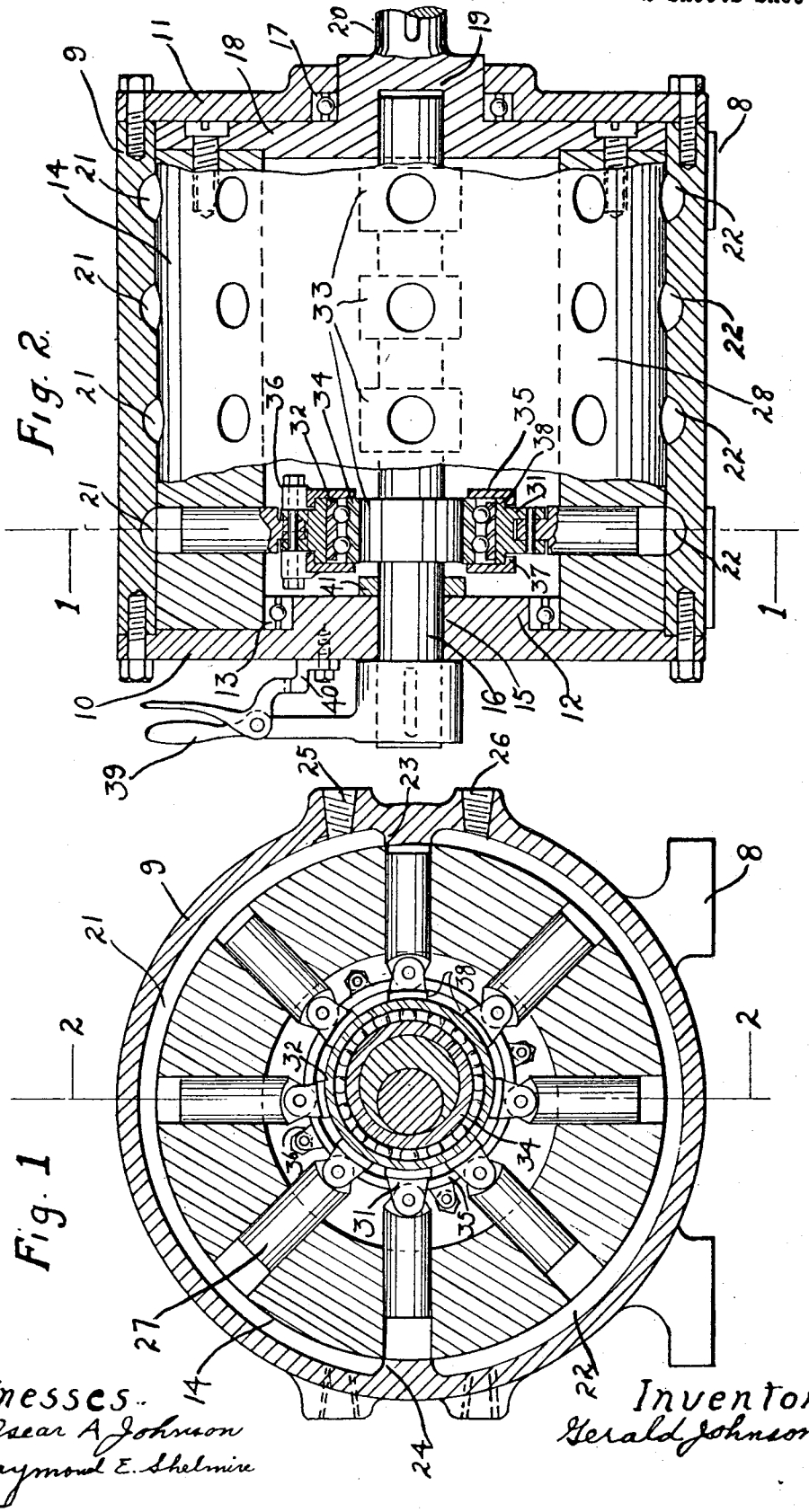
Sept. 25, 1934. G. JOHNSON 1,974,961

VARIABLE DISPLACEMENT PUMP OR MOTOR

Filed March 4, 1931 2 Sheets-Sheet 1



Witnesses.
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Fig. 4

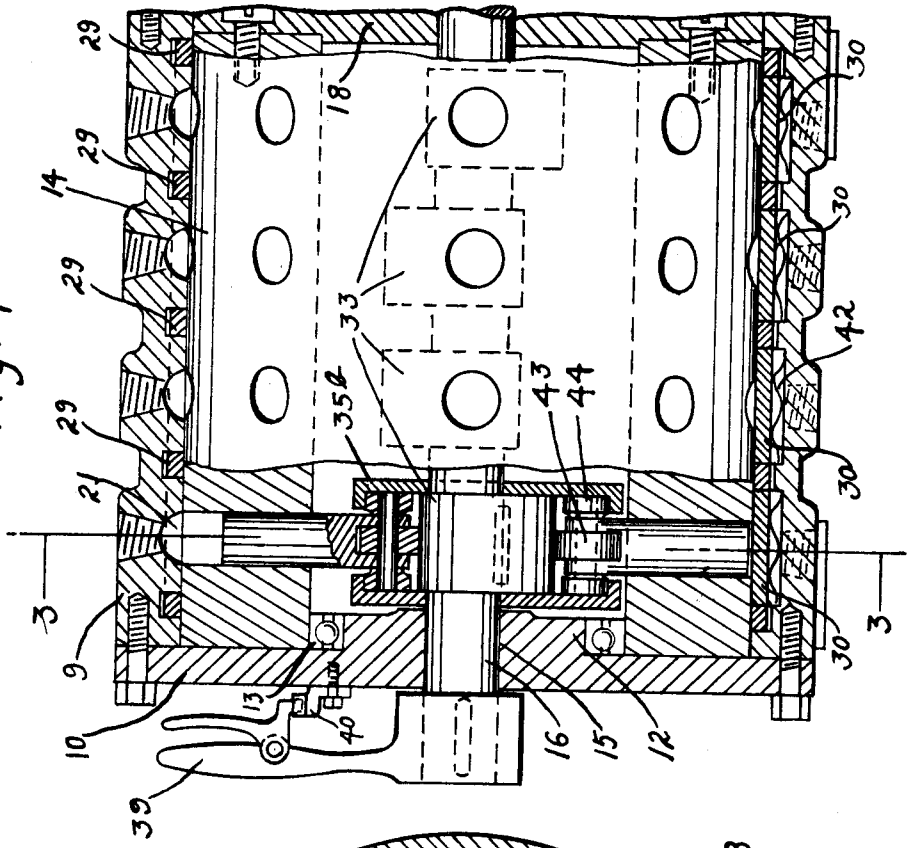
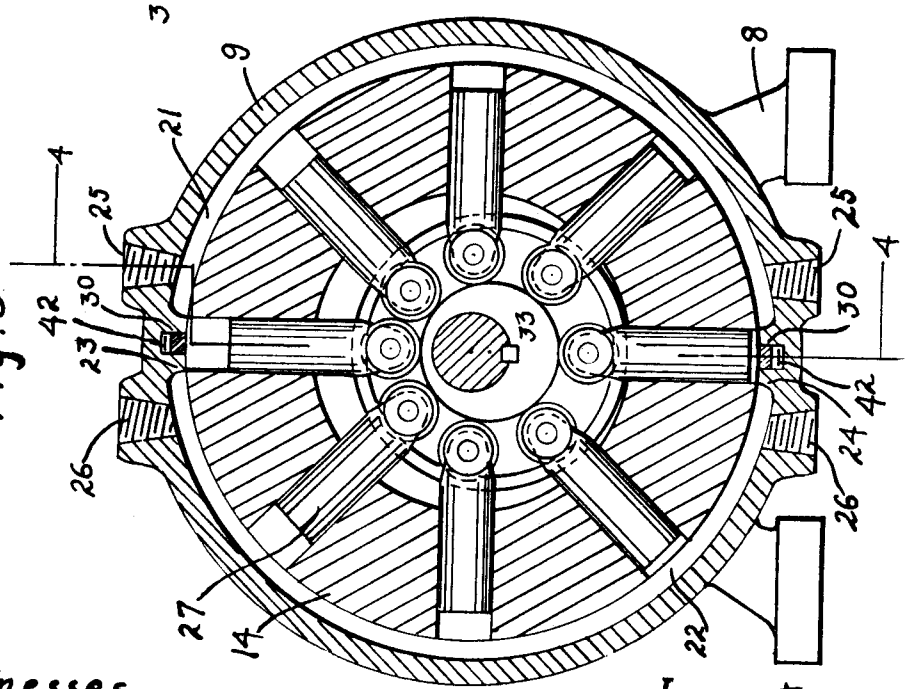


Fig. 3



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VARIABLE DISPLACEMENT PUMP OR MOTOR

Gerald Johnson, Glenside, Pa.

Application March 4, 1931, Serial No. 519,947

5 Claims. (Cl. 103—161)

This invention relates to improvements in hydraulic apparatus and has particular reference to a machine which can be used as a pump or as a motor, or where two similar machines are connected in a fluid circuit as a variable transmission.

The present invention has reference to prior mechanisms of the type, for example, where radially disposed cylinders rotate relatively to a central valve or pintal.

The object of my invention is to provide a means by which such a machine can be operated without the provision of a central valve or pintal.

A further object is to provide a simple means for varying the discharge of pump.

A further object of my invention is to provide simple means for varying the rotative speed of the pump when used as a motor.

A further object is to provide a simple structure whereby a plurality of cylinders can be employed either as a single stage or a multiple stage pump or motor.

A further purpose is to provide a device by which fluid pressure can be applied simultaneously to opposite sides of adjacent stages of a pump or motor, thereby creating a better pressure balance thruout the pump or motor.

A further purpose is to provide a motor in which the power factor will remain constant at various speeds of rotation.

A further purpose is to provide a machine which is adapted to simultaneously deliver fluid to a number of fluid circuits each independent of the other.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment, when read in connection with the accompanying drawings, in which:

Figure 1 shows a section of a pump or a motor taken on line 1—1 of Fig. 2.

Figure 2 shows a section with cylinder rotor in part elevation taken on line 2—2 of Fig. 1.

Figure 3 shows a section taken on line 3—3 of Fig. 4.

Figure 4 shows a broken section with cylinder rotor in part elevation taken on line 4—4 of Fig. 3.

Figure 1 shows a machine equipped with shoes on the ends of the pistons, said shoes contacting against a roller race.

Figures 3 and 4 show a similar machine except that the ends of the pistons are provided with rollers which contact directly on eccentric cams and retainer rings.

Figures 3 and 4 also show a machine provided with packing means to prevent the by-passing of fluid between the discharge passages and delivery passages.

In the drawings 8 represents the base of a pump or motor having a casing 9 mounted thereon, provided with heads 10 and 11, the head 10 having a hub 12 on which a roller bearing 13 is mounted and acting as a bearing for the cylinder rotor 14, the hub 12 also acts as a bearing at 15 for the shaft 16.

Head 11 carries a roller bearing 17 which acts as a bearing for the cylinder rotor flange 18.

Flange 18 is bolted to cylinder rotor 14 and has a bearing at 19 which supports the end of cam shaft 16, cylinder flange 18 is also provided with a shaft 20 for connection to a prime mover in the case of a pump, or as a connection to a driven member in the case of a motor.

The casing 9 is provided with passages 21 and 22 for the delivery or discharge of fluid, also with partitions 23 and 24 which separate the delivery passages from the discharge passages, each set of passages being provided with a delivery or a discharge port 25 and 26, in Fig. 1 said partitions and ports are shown on a horizontal line, but they may be placed at any other position around said casing as shown in Fig. 3.

Cylinder rotor 14 is rotatably mounted in the casing 9 and provided with pistons 27 operating therein, the cylinder bores being open at their outer ends and cooperating with the casing passages 21 and 22.

Cylinder rotor 14 is provided with solid surfaces 28 for effectively sealing the fluid from by-passing to various passages.

Cylinder rotor 14 may also conveniently be provided with packing rings 29, and with packing strips 30, to effectively seal against by-passing of light fluids, or for sealing against air or gas by-passing when the pump is used for such, springs 42 being provided to press the packing strips against the rotor.

Pistons 27 are provided on their inner ends with shoes 31 bearing on but having no definite connection to ball race 32, as there is a slight angular sliding movement between said shoes 31 and ball races 32 during each revolution, the shoes must therefore be provided with sufficient bearing surface on the ball races to carry imposed loads, when loads are light rollers 43 and 44 may be substituted for the said shoes.

Shaft 16 is supported on its ends and is pro-

vided with eccentric cams 33 intermediate thereof, shaft 16 is normally stationary, but is rotatably adjustable to vary the discharge of a pump or the speed of rotation of a motor as the case may be.

Pressed on said eccentric cams are ball bearing races 34, the outer race 32 being free to revolve.

The eccentric cams may be placed at any angular position relative to each other, the preferred position for a four stage pump or motor being as shown in Fig. 4, the two inside eccentric cams being in opposite position to the end eccentric cams.

In the case of a pump rotating clock-wise the two end stages would have pressure in discharge passages 21 and the two intermediate stages would have pressure in the discharge passages 22.

In the case of use as a motor rotating clockwise the two end stages would have pressure in the passages 22 and the two intermediate stages would have pressure in the passages 21.

Retaining rings 35 are bolted together at lugs 36 which are integral with retaining rings 35.

The retaining rings are provided with projecting surfaces 37 engaging extensions 38 on piston shoes 31, constraining pistons 27 to travel in the path prescribed by the eccentric cams.

The retaining rings being free to revolve independent of ball bearing 34 or eccentric cams 33 and are normally carried around by the pressure of the piston shoes 31.

A locking lever 39 is provided with a notched locking segment 40 bolted to the casing 9, the hub of said locking lever and the shaft collar 41 restraining shaft 16 against longitudinal movement. Said locking lever 39 is adapted to position the shaft 16 for any angular adjustment.

Variable displacement of pump or motor is accomplished by the rotatable adjustment of the cam shaft 16, since this adjustment always allows the pistons to travel their full stroke.

Variable displacement of a pump or motor constructed in accordance with my invention, is accomplished as follows.

The pump will have its greatest displacement when the eccentrics 33 are positioned so that the pistons 27 travel their entire inward movement during their rotation when in cooperation with their respective delivery passage and their entire outward movement when in cooperation with their respective discharge passage.

If said eccentrics are positioned so that the pistons have part of their inward movement and part of their outward movement while cooperating with delivery passage, and part of their outward and inward movement while in cooperative relation with the discharge passage the pump will have a decreased displacement depending upon the particular setting of the eccentric cam shaft 16.

If, for example, the eccentrics 33 are rotated 180 degrees from any adjusted position the fluid in said passages will be reversed.

When the above conditions are applied to a motor, the effect is to increase the speed of rotation and decrease the torque, or decrease the speed of rotation and increase the torque in direct relation to speed, thereby maintaining constant horse-power.

When cam shaft 16 is rotated 180 degrees the direction of rotation is reversed.

Figure 3 and Figure 4 show a pump or motor arranged with a series of rollers on the inner ends of the pistons instead of shoes 31. In the triple roller arrangement as shown, the centre rollers contact with the eccentric cams 33 during the stroke when pressure is imposed on the top of the pistons, the outer rollers being smaller do not contact with the eccentric cams, but do contact with the inner projecting surface of retainers during that part of the stroke when the centrifugal force overcomes imposed pressure.

The rollers 43 contacting with the eccentric cams are always revolving in a given direction and the rollers 44 contacting with the inner surface of retainer rings 35^b are always revolving in the opposite direction.

In the case of a multiple stage pump each stage may supply an independent fluid circuit or all stages may discharge in to a common fluid circuit.

The pump or motor may effectively be used with air or gas when provided with suitable packing means.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a reversible fluid variable displacement pump or motor, a casing, the said casing having a series of sets of internal annular chambers, each set of chambers being divided by partitions, diametrically opposite to each other, separating the chambers into an intake and a discharge chamber respectively, each set of the said chambers being separated from the adjacent set of chambers, and from the ends of the casing by internal annular solid surfaces, the said solid surfaces having cut into their internal periphery an annular groove, approximately located between the adjacent set of chambers and between the chambers and the ends of the casing, the said grooves having therein movable fitted packing rings, a rotor centrally located in the said casing, the said rotor having a series of sets of piston bores cooperating in sets with the said sets of casing chambers, each of the said sets of piston bores being separated by a solid surface, the above said packing rings, which are movably fitted in the casing groove, have a tight fit on the said rotor solid surface, so as to revolve with the rotor and slide in the casing grooves, pistons in the said piston bores, a cam shaft for reciprocating said pistons, and casing heads supporting said shaft.

2. A reversible variable displacement pump as set out in claim 1 in which each of said partitions has an axial groove formed therein, packing strips movably fitted in said axial grooves and means for pressing said packing strips snugly against the rotor.

3. A reversible variable displacement pump as set out in claim 1 in which said cam shaft is centrally and adjustably disposed in the casing and has a series of cam surfaces whose throws are circumferentially displaced whereby the volume and direction of fluid handled by each of said sets of pistons and cylinders may be regulated simultaneously at will.

4. In a fluid reversible variable displacement pump or motor a casing, the said casing having an annular chamber, the said annular chamber being divided into an intake and discharge chamber by partitions upon diametrically opposite portions of the casing, the said chambers being separated from the ends of said casing by internal annular solid surfaces, said solid surfaces hav-

ing cut into their internal periphery annular grooves approximately located between the said chambers and the ends of said casing, the said annular grooves having packing rings which are movably fitted therein, a rotor centrally located in said casing, the said rotor having a plurality of piston bores cooperating with the said casing chambers, the said rotor having solid surfaces adjacent said piston bores, the said packing rings having a tight fit on the said solid surfaces of said rotor so as to revolve with the said rotor and slide in the said casing grooves, pistons in the said piston bores, a cam shaft for reciprocating the said pistons and heads supporting the said cam shaft.

5. In a fluid reversible variable displacement pump or motor as set out in claim 4 in which each of said partitions have an axial groove formed therein, packing strips movably fitted in said axial grooves and means for pressing said strips snugly against the rotor.

GERALD JOHNSON.

CERTIFICATE OF CORRECTION.

Patent No. 1,674,961. Granted June 26, 1928, to

GRANT S. DIAMOND.

It is hereby certified that the name of the assignee in the above numbered patent should have been written and printed as "The Electro Refractories Corporation", of Buffalo, N. Y., instead of "The Electric Refractories Corporation", of Buffalo, N. Y., as shown by the records of assignments in this office; and that said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of August, A. D. 1928.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.