June 6, 1950 W. W. TINGLE 2,510,609

VARIABLE CAPACITY HYDRAULIC ROTARY PUMP OR MOTOR

Filed Dec. 23, 1946 3 Sheets-Sheet 1

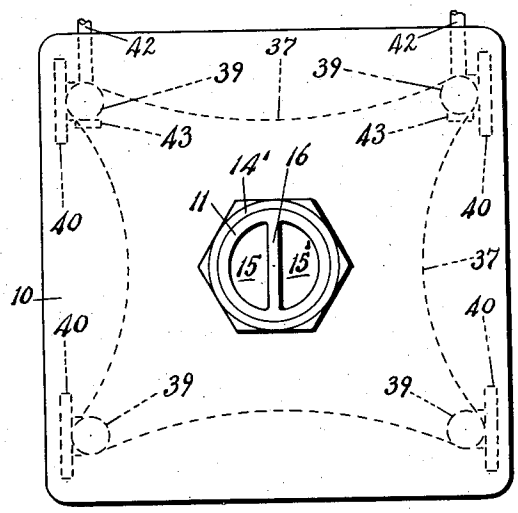


Fig. 1

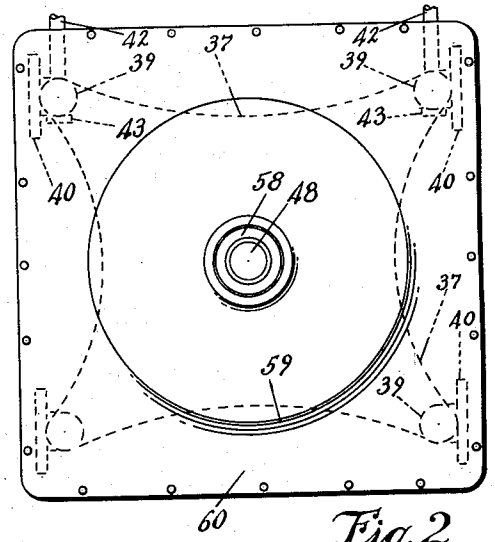


Fig. 2

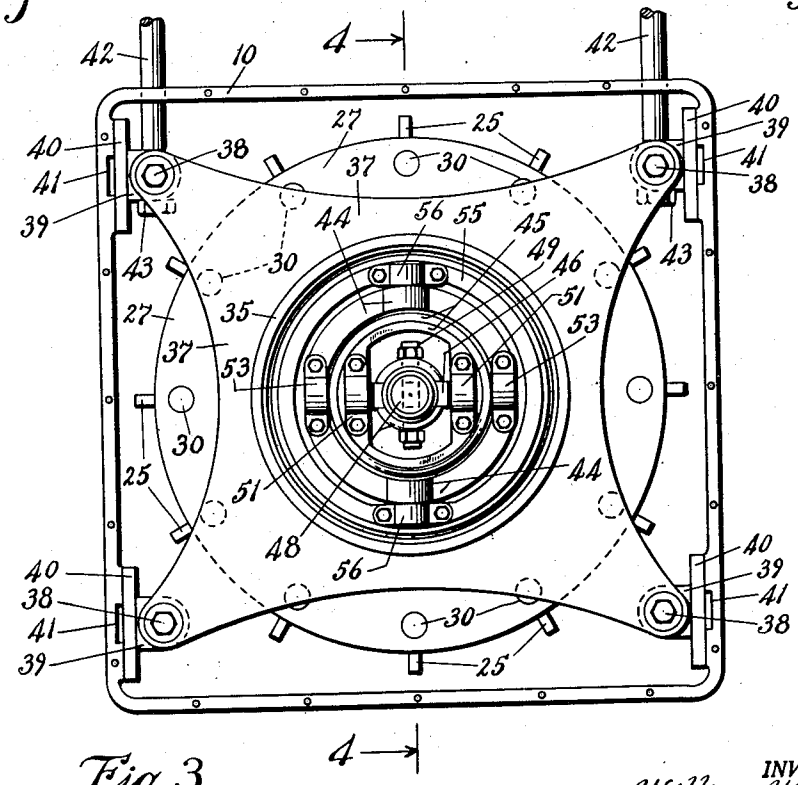


Fig. 3

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VARIABLE CAPACITY HYDRAULIC ROTARY PUMP OR MOTOR

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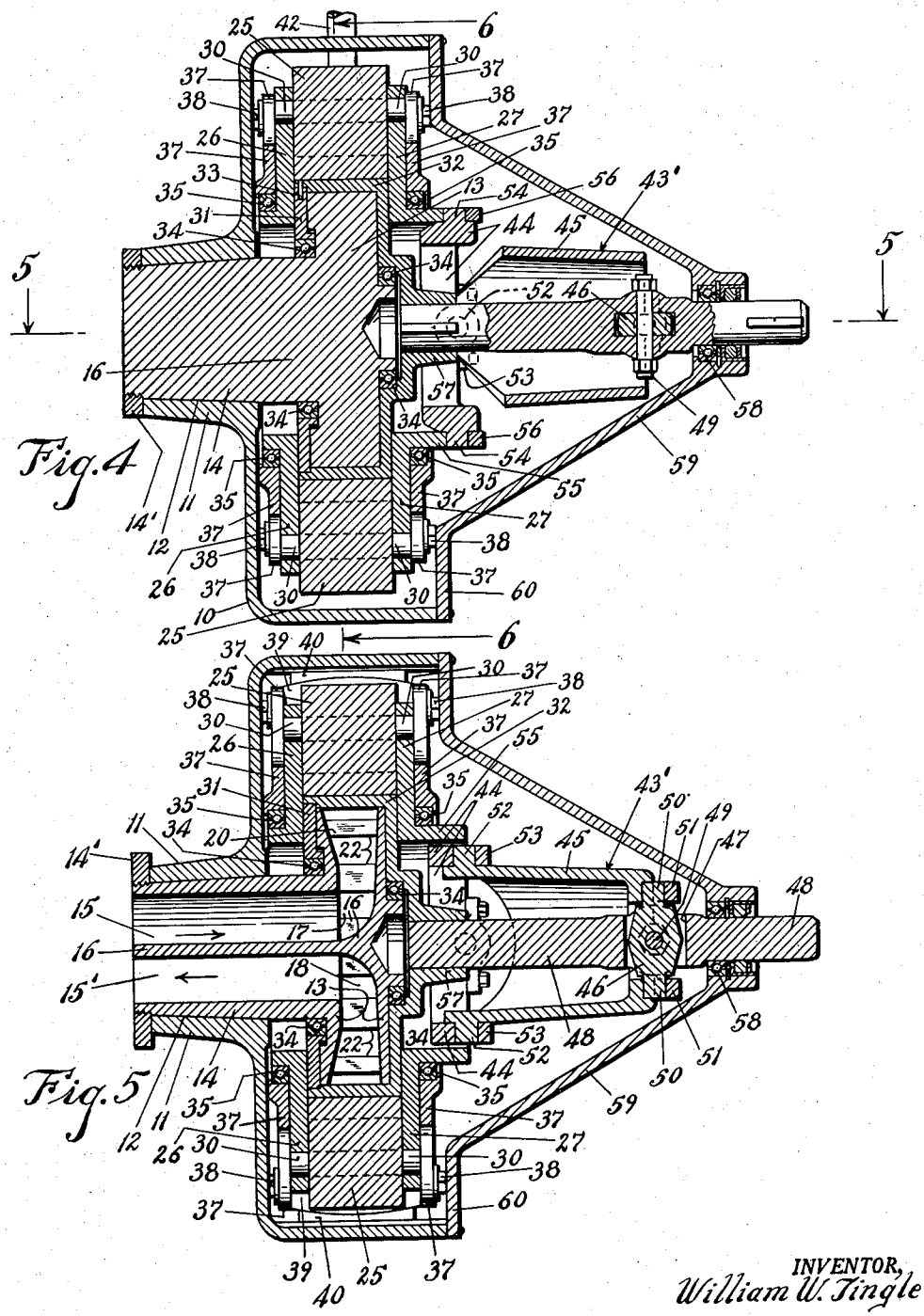


Fig. 4

Fig. 5

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VARIABLE CAPACITY HYDRAULIC ROTARY PUMP OR MOTOR

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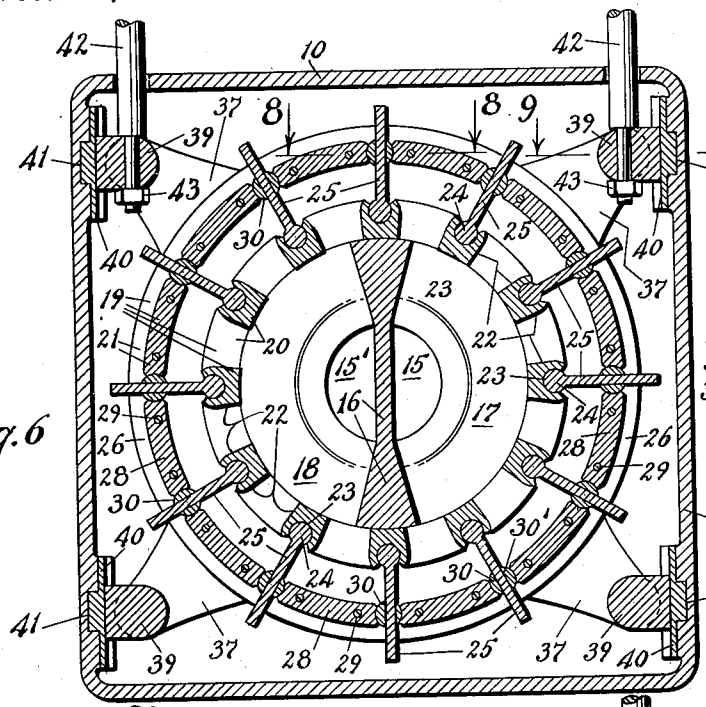


Fig. 6

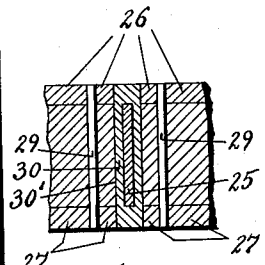


Fig. 8

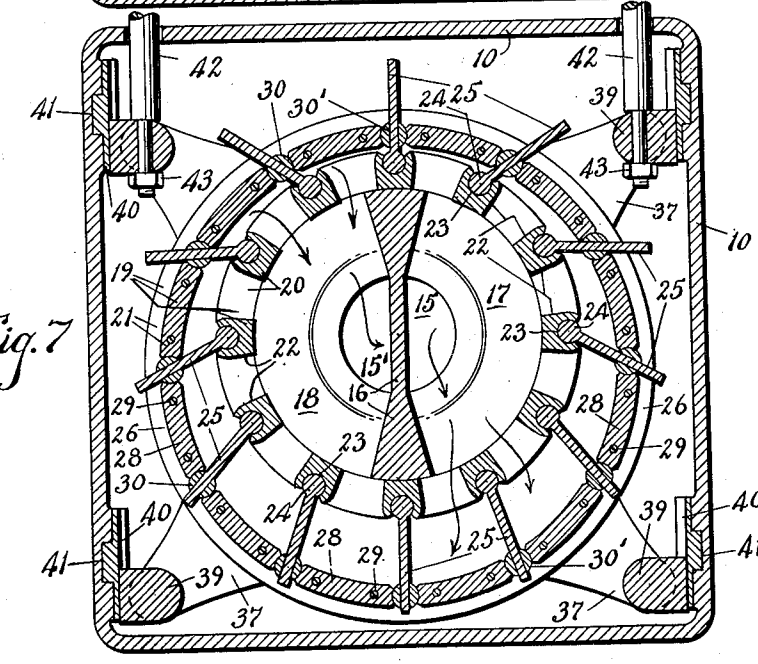


Fig. 7

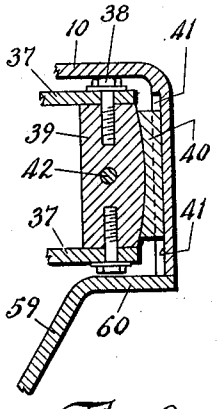


Fig. 9

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Patented June 6, 1950 2,510,609

UNITED STATES PATENT OFFICE

2,510,609

VARIABLE CAPACITY HYDRAULIC ROTARY PUMP OR MOTOR

William W. Tingle, Glendale, Calif.

Application December 23, 1946, Serial No. 717,995

4 Claims. (Cl. 103—120)

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The principal object of my invention is to provide in a hydraulic machine, a rotary pump of variable capacity while maintaining a constant speed and functioning as a motor at will;

It is therefore an object of my invention to provide a hydraulic rotary pump functioning by direct means for varying the volumetric displacement of the pump during operation, and thereby vary the delivery of fluids.

A further object is the provision of a hydraulic rotary pump possessing structural characteristics whereby the direction of flow can be reversed during operation of the pump, and this without reversing its rotation, and while maintaining its constant speed;

A further object of the herein invention is the provision of a hydraulic rotary pump for forcibly ejecting a smooth continuous flow of fluid in large quantities at high speed, and with a minimum of power loss. In this respect, I believe my invention to be of greater capacity for its size than any existing type of variable displacement pump;

A further object of the herein invention is the provision of a hydraulic rotary pump which is free from cavitation at high speeds because centrifugal force aids the intake of fluid rather than opposing it, due to the central admission of fluid;

A still further object of the herein invention is the provision of a hydraulic rotary pump adaptable for use in a variable speed transmission wherein any ratio may be chosen between neutral and high speed;

And a still further object of the herein invention is the provision of a hydraulic rotary pump whereby the output can be controlled to meet the requirements of a hydraulic system without subjecting the system to the conventional power loss due to by-pass.

I attain these objects by the hydraulic rotary pump illustrated in the accompanying drawings, in which:

Figure 1 is an end elevation of the invention;

Figure 2 is an end elevation opposite to that shown in Fig. 1;

Figure 3 is a view as in Fig. 2, but with the cover removed;

Figure 4 is a section on line 4—4 of Fig. 3;

Figure 5 is a section on line 5—5 of Fig. 4;

Figure 6 is a section on line 6—6 of Fig. 4, with the pump in the neutral or zero pumping position;

Figure 7 is a section on the same line as Fig. 6, but with the pump in its maximum output position;

Figure 8 is a section on line 8—8 of Fig. 6, and

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Figure 9 is a section on line 9—9 of Fig. 6.

Similar numerals of reference indicate like parts throughout the several views.

Referring thereto, a housing 10 is provided with a boss 11 having a tapered bore 12.

A cylindrical stator 13 is provided with a tapered tubular extension 14 which is fitted into the bore 12 from the inside of the housing 10.

A nut 14' threaded upon the extension 14 adjacent the end of the boss 11 causes the extension 14 to be drawn into the bore 12 so that the stator 13 is fixed against rotation.

The extension 14 is provided with a bore which is divided into two passageways 15 and 15' by a vertical partition 16 which extends into the interior of the stator 13 and divides the latter into two chambers 17 and 18 respectively.

The stator 13 is open at its periphery except at the two points where the partition 16 becomes part of the periphery.

A rotor 19 embodies an inner cylindrical shell 20 and an outer cylindrical shell 21. The former is provided with a plurality of ports 22 through its periphery whereby communication is provided between the chambers 17 and 18 and the interior of the shell 21.

The periphery of the shell 20 is provided with a plurality of cavities 23 wherein are retained ribs 24 of circular cross section formed on the inner ends of a plurality of radial vanes 25 whereby said vanes are mounted so as to oscillate when the shell 21 is adjusted.

The shell 21 embodies a pair of end plates 26 and 27 abutting the ends of a plurality of arched blocks 28 which are supported by pins 29 through said end plates and said blocks. The latter are concave at their edges so as to snugly fit against a plurality of pins 30 which are journaled at their ends in the plates 26 and 27.

The blocks 28 and the pins 30 are positioned in a circle so as to form the periphery of the shell 21. The pins 30 are slotted at 30' to receive the vanes 25 which slide through the pins 30.

The shell 20 is formed of two parts 31 and 32 for assembly purposes. They may be secured to one another as by a plurality of pins 33, one only being shown in Fig. 4.

The shell 20 is supported for rotation about its axis upon ball bearings 34 which are supported upon the stator 13.

The shell 21 is supported for rotation about its axis by ball bearings 35 which are in turn supported by a pair of plates 37 secured as by bolts 38 to four slidable blocks 39. The blocks 39 are convex on one of their sides so as to fit

into concave sides of four blocks 40 having lugs formed thereon designed to fit into grooves 41 formed into the walls of the housing 10.

A pair of vertical control rods 42 are secured to the upper pair of the blocks 39 as by nuts 43.

The plates 37 are supported for vertical movement by the control rods 42, the latter being adaptable for either up or down movement for the operation of the machine.

The shell 20 is fixed coaxially with the stator 13 by the bearings 34, but the axis of the shell 21 is susceptive to a vertical movement eccentric to the axis of the shell 20, while both shells are revolving at the same R. P. M. This is provided for by means of a double universal joint 43' comprising in part a ring 44, a short tube 45 and a swivel block 46. The latter is pivotally mounted in a slot 47 through an axially movable shaft 48 by means of a bolt 49 having its ends journaled through the shaft 48.

The block 46 is provided on its ends with a pair of trunnions 50 pivotally attached to one end of the tube 45 by bearing caps 51. The other end of said tube is provided with a pair of trunnions 52 pivotally attached to the ring 44 by bearing caps 53.

The ring 44 is provided with a pair of trunnions 54 pivotally attached to a hub 55 of one of the plates 27 by bearing caps 56.

The inner end of the shaft 48 is keyed or splined to a hub 57 of the shell 20 to permit of axial motion of said shaft as the offset of the shell 21 is varied to either increase or decrease the fluid output, and the outer end of said shaft is journaled in ball bearings 58 provided in a conical shaped boss 59 of a cover 60 for the housing 10.

The pump functions when the axis of the shell 21 is moved vertically eccentric to the axis of the shell 20, output increasing as the offset increases, the speed of rotation remaining constant.

In Fig. 7 the control rods 42 have lowered the plates 37 and the thereby supported ball bearings 35 supporting the shell 21 so that the axis of the shell 21 is below the axis of the shell 20. As the shells 20 and 21 are rotated together in a clockwise direction at the same R. P. M., the area between the vanes 25 increases on the right hand side of the partition 16 and creates a suction which draws fluid through the passageway 15, the chamber 17, and the ports 22 into the area between the vanes 25.

Fluid is carried between the vanes 25 from the right hand side of the partition 16 around clockwise to the left hand side of the partition 16 where the area between the vanes 25 is progressively decreased and thereby forcing the fluid back through the ports 22 into the chamber 18 and out therefrom through the passageway 15'.

When the control rods 42 are adjusted to lift the shell 21 so that the axis of said shell is above the axis of the shell 20 and the clockwise direction of rotation is maintained, the direction of fluid flow will be reversed and fluid will be drawn into the chamber 18 through the passageway 15' and expelled out of the chamber 17 through the passageway 15.

Due to small deflections under various operating conditions the shell 21 must be free to align itself about the shell 20 and the stator 13. Said alignment is provided for by the particular mounting of the plates 37 upon the blocks 39 and 40. This mounting permits a slight rotation of the plates as a unit about the vertical axis of the pump, also about the horizontal axis of the

pump perpendicular to the drive shaft 48 and a slight movement axially of said shaft while an increased movement vertically is accomplished by means of the control rods 42.

The double universal joint permits vertical movement of the outer rotor 21 due to the axial sliding movement of the shaft 48 as takes place when the inner end of the universal joint 43' moves upwardly and the out end of said universal joint moves to the left as will be apparent with reference to Fig. 4.

My invention, used in conjunction with another unit (either constant or variable displacement pump) to convert oil pressure back into usable motion, could be used as a variable speed transmission readily adaptable to automobiles, trucks, tractors, etc. It could also be used singly in hydraulic systems such as for ships steering gear, aircraft hydraulics, and numerous other fields where a machine of its characteristics would appropriately function.

Used as a variable speed transmission its advantage over geared transmission is that any ratio may be chosen between zero and its maximum, whereas geared transmissions operate at fixed ratios and require clutches to disconnect the power when a shift is made from one gear to another.

When used in hydraulic systems it requires no by-pass to take care of excessive discharge because the output can be controlled to the requirements. Consequently there is no power loss due to by-passed fluid. Moreover, due to the central admission of the oil, my invention is not subject to cavitation at high speeds because centrifugal force aids the intake of oil rather than to oppose it.

The invention may readily be produced from materials the open market affords and at no unreasonable cost.

I am aware that slight structural changes may from time to time suggest themselves, but within the scope of the herein disclosure. Hence, I do not limit my invention to the exact arrangement and component parts herein described, but what I do claim is:

1. In a rotary pump, a housing, a cylindrical stator fixed in said housing and provided with peripheral openings, separate chambers and a fluid passage leading from each chamber through a wall of the housing for ingress and egress of fluid; an inner rotor mounted on and surrounding said stator in permanently concentric relation thereto and being provided with peripheral ports affording flow of fluid between said chambers, an outer rotor surrounding and being circumferentially spaced from the inner rotor, a plurality of vanes slidable through outer rotor and pivoted at their inner ends to said inner rotor and constructed and arranged so as to define in the circumferential space between said rotors a series of pump chambers each having one of said ports in communication therewith, a drive shaft drivingly coupled to said inner rotor, means for adjusting said outer rotor from a position concentric with the inner rotor into various eccentric positions and vice-versa, and a flexible drive connection between said outer rotor and said drive shaft for driving the outer rotor in all positions of adjustment at the same rate as the inner rotor.

2. In a rotary pump, a housing, a cylindrical stator fixed in said housing and provided with peripheral openings, separate chambers and a fluid passage leading from each chamber through a wall of the housing for ingress and egress of

fluid; an inner rotor mounted on and surrounding said stator and being provided with peripheral ports affording flow of fluid between said chambers, an outer rotor surrounding and being circumferentially spaced from the inner rotor, a plurality of vanes slidable through the outer rotor and pivoted at their inner ends to said inner rotor and constructed and arranged so as to define in the circumferential space between said rotors a series of pump chambers each having one of said ports in communication therewith, a drive shaft drivingly coupled to said inner rotor, supporting plates bodily adjustably mounted in said housing, bearing means for rotatably supporting the outer rotor between and on said plates for bodily movement therewith, means for adjusting said plates to dispose said outer rotor in different eccentric positions, and a drive connection between said outer rotor and said drive shaft.

3. In a rotary pump, a housing having a tubular seat in one wall thereof, a cylindrical stator open about its periphery and mounted in said housing, a tubular extension on said stator extending axially therefrom and being fixed in said seat, a partition extending the length of said extension and into said housing to define parallel passages in the bore of said extension and separate chambers within said stator whereby fluid may enter and be discharged from said chambers through said passages, an inner rotor concentric with said stator and having a plurality of peripheral ports affording flow of fluid between said chambers during rotation of said rotor, a cylindrical outer rotor surrounding said inner rotor and being circumferentially spaced therefrom, means supporting said outer rotor for adjustment to dispose it in various eccentric positions to either side of a position of concentricity with said inner rotor, a plurality of vanes slidably extensible through the peripheral portion of said outer rotor and pivoted at their inner ends to said inner rotor and constructed and arranged to define in the circumferential space between said rotors a plurality of pump chambers each having one of said ports in communication therewith and being subject to variation of its cubic capacity responsive to eccentric adjustments of said outer rotor, a drive shaft directly connected to said inner rotor, a drive connection between said shaft and said outer rotor affording adjustment of the outer rotor while the outer rotor is being driven at the same rate as the inner rotor, and means operable exteriorly of said housing for adjusting said outer rotor to move it into and out of various eccentric positions.

4. In a rotary pump, a housing, a cylindrical stator fixed in said housing and provided with peripheral openings, separate chambers and a fluid passage leading from each chamber through a wall of the housing for ingress and egress of fluid; an inner rotor mounted on and surrounding said stator in permanently concentric relation thereto and being provided with peripheral ports affording flow of fluid between said chambers, an outer rotor surrounding said inner rotor for adjustment into positions variously eccentric to said inner rotor and being circumferentially spaced from the inner rotor, a plurality of vanes slidable through the outer rotor and pivoted at their inner ends to said inner rotor and constructed and arranged so as to define in the circumferential space between said rotors a series of pump chambers each having one of said ports in communication therewith, a drive shaft drivingly coupled to said inner rotor, means for adjusting said outer rotor from a position concentric with the inner rotor into various eccentric positions and vice versa, a flexible drive connection between said outer rotor and said drive shaft for driving the outer rotor in all positions of adjustment at the same rate as the inner rotor, said adjusting means including plates vertically adjustably supported on opposite walls of said housing, means operable exteriorly of the housing for adjusting said plates, bearing means rotatably supporting said outer rotor between said plates, slide blocks fixed to said plates and having convex bearing faces and fixed bearing blocks on said housing having concave bearing faces in contact with said convex faces.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,930,059	Muller	Oct. 10, 1933
1,961,592	Muller	June 5, 1934
2,049,092	Strum	July 28, 1936

FOREIGN PATENTS

Number	Country	Date
98,594	Austria	Nov. 25, 1924
439,155	Great Britain	Nov. 29, 1935