

Aug. 28, 1951

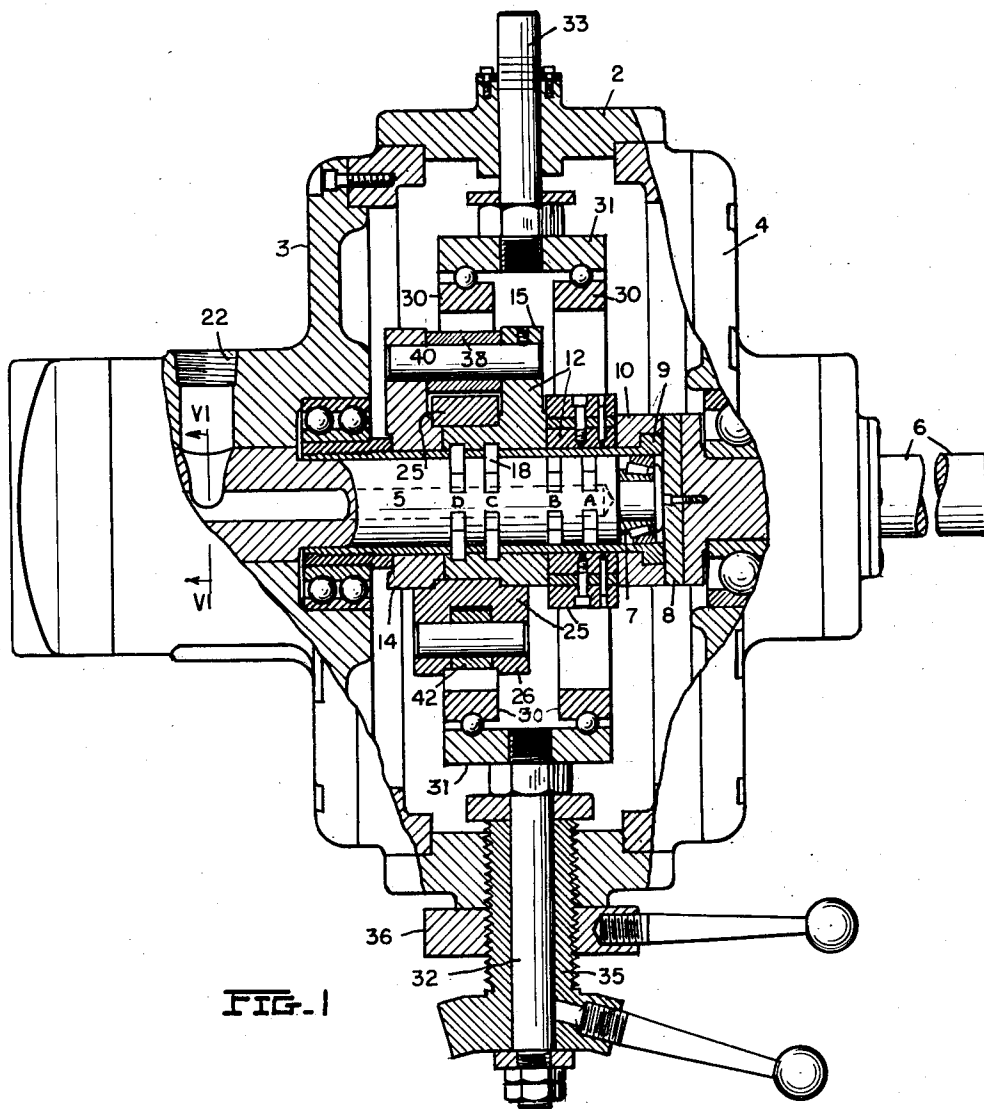
T. J. LESTER

2,565,860

VARIABLE DELIVERY ALTERNATING PISTON PUMP

Filed July 24, 1945

4 Sheets-Sheet 1



INVENTOR.
THOMAS J. LESTER

BY
Oberlin & Limbach
ATTORNEYS

Aug. 28, 1951

T. J. LESTER

2,565,860

VARIABLE DELIVERY ALTERNATING PISTON PUMP

Filed July 24, 1945

4 Sheets-Sheet 2

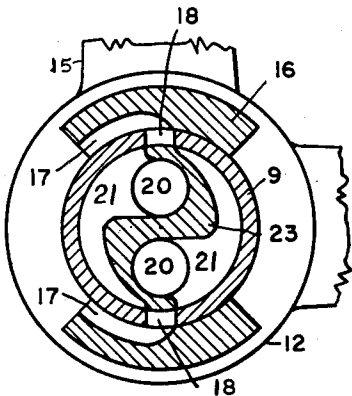


FIG. 2

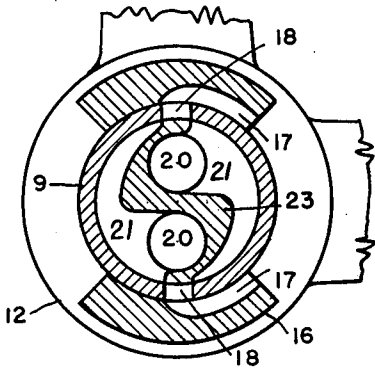


FIG. 3

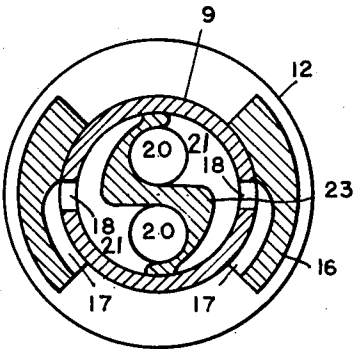


FIG. 4

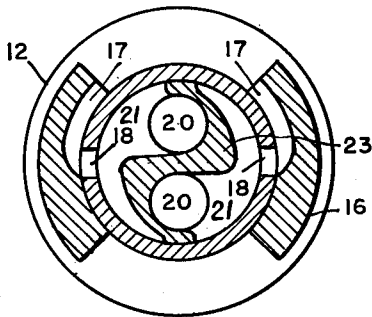


FIG. 5

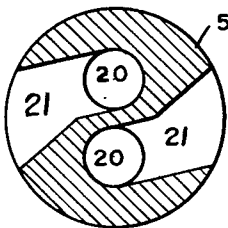


FIG. 6

INVENTOR.
THOMAS J. LESTER

BY

Oberlin + Limbach
ATTORNEYS

Aug. 28, 1951

T. J. LESTER

2,565,860

VARIABLE DELIVERY ALTERNATING PISTON PUMP

Filed July 24, 1945

4 Sheets-Sheet 3

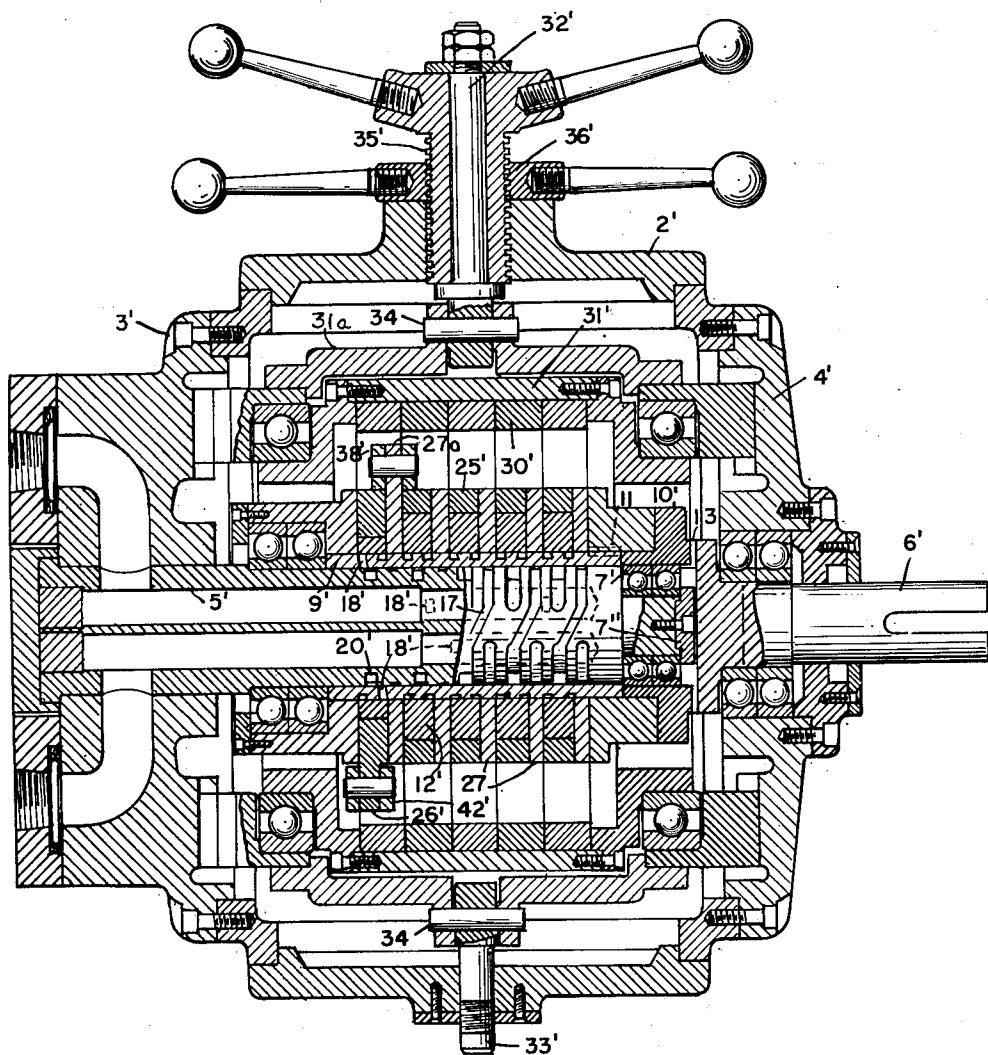


FIG. 7

INVENTOR.
THOMAS J. LESTER

BY

Oberlin & Limbach
ATTORNEYS

Aug. 28, 1951

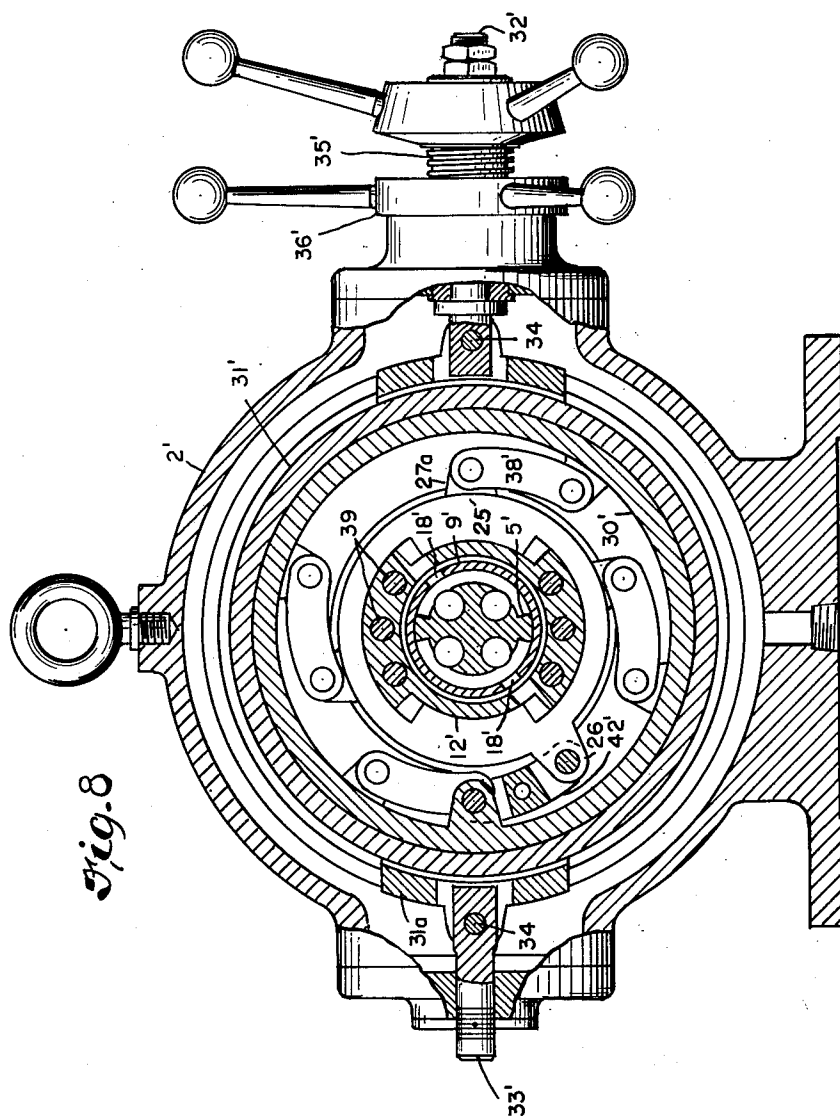
T. J. LESTER

2,565,860

VARIABLE DELIVERY ALTERNATING PISTON PUMP

Filed July 24, 1945

4 Sheets--Sheet 4



INVENTOR.

THOMAS J. LESTER

BY

Oberlin & Limbach
ATTORNEYS

UNITED STATES PATENT OFFICE

2,565,860

VARIABLE DELIVERY ALTERNATING
PISTON PUMP

Thomas J. Lester, Shaker Heights, Ohio, assignor
to Lester Engineering Company, Cleveland,
Ohio, a corporation of Ohio

Application July 24, 1945, Serial No. 606,815

11 Claims. (Cl. 103—120)

1

In my patent application Serial No. 468,370, issued as Patent No. 2,426,361, there is set forth a mechanism for variable delivery pumps or like power devices, of rotary type and embodying concentrically rotating elements which have an oscillating movement with respect to each other. The present invention carries this type of construction further, and in particular provides for high pressure delivery in which there is no surge or pulsation, and in which particular convenience of assembly is had. Other objects and advantages will appear from the following description.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described, and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

Fig. 1 is an axial sectional view, partly in elevation, showing an embodiment of the invention;

Figs. 2-5 inclusive are transverse sectional details taken on planes substantially at A, B, C and D, respectively, Fig. 1;

Fig. 6 is a fragmentary transverse sectional view taken on the plane substantially indicated by line VI—VI, Fig. 1;

Fig. 7 is an axial sectional view of a further modification; and

Fig. 8 is a transverse sectional view of the same. In general, the construction involves a housing in which is a fixed shaft and a drive shaft in axial alignment therewith, and sets of concentric inner and outer rotors, and control rings, the latter being adjustable eccentrically of the rotors.

As shown in Fig. 1, the housing 2 of generally cylindrical form, integral or in sections as desired, is closed by end members 3, 4, the former carrying a fixed shaft 5, and a drive shaft 6 being journaled in the member 4, in axial alignment with the fixed shaft 5, and having bearing engagement with the end thereof, as for instance by roller bearings 7. Fastened to the inner end of the drive shaft 6 is an extension 8 to which is secured a sleeve 9 by means of a collar 10 and suitable screws and keys, detail of which it is unnecessary to show, and carried by such sleeve are inner rotor members 12, alongside each other and between the collar 10 and a member 14 against the end bearing. The inner rotors 12 have radially projecting arms 15, and these are oriented at arcuate distances from each other.

2

As shown more clearly in the transverse section of Fig. 2, these inner rotors have projecting vane-pistons 16 at diametrically opposite points, and in such pistons are bores 17 which allow communication with the ports 18 in the sleeve 9. The fixed shaft 5 is provided with openings 20 which communicate with openings 22 externally for inlet and discharge of fluid, and a partition 23 is in the shaft 5, suitably shaped that the various portions of its extent separate the inlet and outlet passageways, while allowing the rotating sleeve 9 as driven by the drive shaft 6, to appropriately move its ports into communication with the inlet and outlet passageways.

Surrounding each inner rotor 12 is an outer rotor 25, and these again have radially projecting arms 26, which are set at angles to each other. In Fig. 1, the radial arms 15 and 26 of one set of inner and outer rotors are cut in section, while the corresponding arms of the set of inner and outer rotors to the right thereof, being at an angle, are not seen. The outer rotors have chambers corresponding generally to the vane-pistons 16, and sufficiently longer to allow the desired relative movement for pumping, the relationship being such as shown for the vane-pistons and chambers of the rotors 12 and 25 in Fig. 8. Outside of the sets of rotors are control rings 30, desirably mounted with ball bearings in a carrier ring 31. Extending at diametrically opposite points from the latter are stems 32, 33 which pass through suitable bearings in the housing 2, and the stem 32 is provided with screw-threaded engagement 35 in the housing wall, whereby to allow adjustment of the carrier ring 31 and its contained control rings 30 transversely with respect to the shaft 5. A lock nut 36 serves to lock the stem in the desired position.

Extending from a lug on the inside of a control ring 30 is a link 38 which is between and pivotally connects to an arm 15 of an inner rotor and the end member 14, by a suitable pin 40. Similarly, a link connects from a lug on the other control ring 30 to the arm of its adjacent inner rotor. Such connection, being angular to that of the first rotor, is not seen on Fig. 1. The character of these links will be more fully understood from their appearance in side elevation as shown in Fig. 8, these being generally similar in all forms of the invention. Another link 42 connects from an internal lug on control ring 30 to a radial arm 26 of an outer rotor 25. These links being the same as in the form of the invention shown in Fig. 8, their arrangement of connection will be readily understood by reference to that figure.

3

With such arrangement, the inner rotors and the outer rotors are connected to the control rings by respective links, and while the entire assemblage rotates with the drive shaft within the mounting ring or casing 31, the latter is capable of being positioned more or less eccentrically to the axis of the drive shaft, the link connections permitting such relative position and having the effect of accelerating and decelerating the rate of relative movement of the inner rotor pistons. As shown in Fig. 7, the housing 2' is of a size to contain a larger number of sets of concentric rotors and control rings, five such sets being shown for illustration. And, again, the end member 3' has a fixed shaft 5' with respective passages for inlet and outlet of fluid, and ports 18' at appropriate points for each set, and again the drive shaft 6' is in axial alignment, and is mounted with relation to the fixed shaft by suitable ball bearing 7', which may be held by an end cap 7''. Again, there is secured to the drive shaft 6' a sleeve 9', this being secured, as by suitable keys 11 and collar member 19', to the drive shaft 6'. In effect, the collar 19' is integral with the drive shaft, being fastened thereto by suitable screws or the like, and an opening 13 may be provided if desired for lubricant admission. On the sleeve 9' are inner rotors 12', five of these being shown, and surrounding each inner rotor is an outer rotor 25', these having radially extending arms 26'. Between each set of an inner and outer rotor is a separating plate 27, having a radially projecting lug 27a. In turn, surrounding each set of inner and outer rotors is a corresponding control ring 30', these being enclosed in the ring member 31'. The latter is inside carrier means 31a which is in fact the casing therefor and which has stems 32', 33', projecting at diametrically opposite points, and preferably connected by pins 34 through lugs on extensions 31a. Stem 32' is provided with a screw-threaded bushing 35' which engages in the housing wall 2', and lock-nut 36' permits locking in desired position of adjustment.

The inner rotors 12' and adjacent separating plates 27 are held together by suitable means, as bolts or screws 39, Fig. 8, from the end collars therethrough. From an external lug on each separating plate a link 38' pivotally connects to an internal lug on the corresponding control ring 30', such link being cut in section in Fig. 8, and from each radially projecting arm 26' of the outer rotors 25', a link 42' pivotally connects to an internal lug on the same control ring. The links of the separating plates are spaced apart arcuately around the inner circumference of the control rings, and similarly the links of the outer rotors are spaced arcuately. Thus, each control link is connected to its adjacent outer rotor separating plate and inner rotor assembly.

As readily understood, with the drive shaft in operation, and fluid supplied through the feed inlet, the sleeve rotating about the fixed shaft successively ports for inlet and outlet communication with the chambers in the outer rotor, and the vane-pistons therein correspondingly forward the fluid. Thus, with five sets of piston-chamber rotors 25' and inner vane-piston rotors 12', Fig. 7, spaced around the 360° of perimeter, a rapid succession of discharges of fluid is provided in each rotation; and at the instant with the parts and the positions shown, the first pair of rotors 25', 12', at the left is in the late stage of discharging fluid from the vane-piston through its port 18' into the inclined channel leading

4

within to the discharge duct (in Fig. 7 the upper one); while the next set of rotors, advanced by 72°, is in the first stage of taking in fluid from the feed inlet side; and the middle set of rotors as shown in the transverse section at Fig. 8 is in mid-position, taking in feed; and the further two sets of rotors correspondingly are advanced in discharge stage. With such a close series of discharges, the output stream is freed from the marked pulsations which are characteristic of simpler unit pumps. By reason of the plurality of sets of such pumping elements, particularly smooth high pressure discharge may be had, and the device operates without vibration.

The circumferential channels 21 in the outer surface of the fixed shaft communicating the intake and delivery passages with the ports in the form in Fig. 1, are arcuate, less than 180° in extent, and the bores or passages in the vane-pistons permit utilizing the full pumping stroke of the pistons and prevent throttling or partial closing of the ports near the end of stroke. By connecting the rotors to the eccentrically mounted control rings at arcuately spaced points, the movement of a piston is non-coincident in phase or out of phase with that of another, and the eccentric connection, which can be adjusted from zero to maximum, occasions a faster rate of travel of the pistons in the mid-portion of their stroke than near the ends, as detailed in my aforementioned application Serial No. 468,370, issued as Patent No. 2,426,361, of which this application is a continuation in part and as to common subject matter.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In a pump, a housing, a plurality of sets of concentric rotary members, interfitted abutments on each set of said members forming arcuately shaped displacement chambers between the rotary members of each set, motion transmitting means surrounding and connected to the rotary members for accelerating and decelerating the rate of rotation of each one of said rotary members of each set with respect to the other of said rotary members of the said set, and adjusting means therefor comprising diametrically attached stems projecting through the housing walls, one stem having threaded engagement with said housing and having locking means in association, and the other stem being smooth and axially slidable.

2. In a pump, a plurality of sets of concentric rotary members, interfitted abutments on each set of said members forming arcuately shaped displacement chambers and vane-pistons therein having arcuate bores for passage of fluid, and motion transmitting means surrounding and connected to the rotary members for accelerating and decelerating the rate of rotation of each one of said rotary members of each set with respect to the other of said rotary members of the same set, said motion transmitting means being connected to one of said sets at a point angularly removed from the point of connection to the other of said sets, whereby the movement of said rotary members of one set with respect to each other are out of phase with the corresponding movement of said rotary members of the other set.

5

3. In a pump, a housing, inner rotors each having a plurality of pistons thereon, axially spaced from each other, outer rotors concentric with said inner rotors and having chambers for receiving said pistons, rotatable rings mounted surrounding and eccentrically of said rotors, and connecting arms between said inner rotor and said rings and between said rings and said outer rotors, said connecting arms being connected to said inner rotor at arcuately spaced points whereby the cycle of alternating movement imparted to one of said pistons is non-coincident with that of another of said pistons, and means connected to said rings to adjust their eccentricity and vary the capacity of the pump comprising diametrically attached stems projecting through the housing walls, one said stem having threaded engagement with said housing and having locking means in association, and the other stem being smooth and axially slidable.

4. In a pump, a housing, concentric rotors, driving means for imparting a relative oscillation to said rotors, arcuately shaped pistons carried by one of said rotors, arcuately shaped chambers carried by the other of said rotors for receiving said pistons, a fixed shaft supporting said rotors, intake and delivery passages within said shaft, and passages in said pistons adapted to place said intake and delivery passages in communication with said chambers, said piston passages leading from the arcuate end of said pistons to the arcuate mid-point thereof, and means projecting diametrically at both sides through the housing for supporting and adjusting the eccentricity of the rotors in the housing to vary the capacity of the pump, comprising two stems, one having screw threaded engagement with the housing wall and having locking means in association, and the other stem being smooth and axially slidable.

5. In a pump, a housing, concentric rotors, driving means for imparting a relative oscillation to said rotors, arcuately shaped pistons carried by one of said rotors, arcuately shaped chambers carried by the other of said rotors for receiving said pistons, a fixed shaft supporting said rotors, intake and delivery passages within said shaft, circumferentially disposed channels in the outer surface of said shaft, said channels communicating with said intake and delivery passages and being of less than 180° circumferential extent, and passages in said pistons adapted to place said channels in communication with said chambers, said piston passages leading from the arcuate end of said pistons to the arcuate mid-point thereof, said driving means including means surrounding and carrying said rotors, and means for adjusting the relative oscillation of the rotors to thereby vary the capacity of the pump including diametrically attached stems from said means surrounding and carrying the rotors projecting through the housing, one stem being smooth and axially slidable and the other stem having screw-threaded engagement with the housing wall and being provided with locking means.

6. In a pump, a housing, concentric rotors, driving means for imparting a relative oscillation to said rotors, arcuately shaped pistons carried by one of said rotors, arcuately shaped chambers carried by the other of said rotors for receiving said pistons, a fixed shaft supporting said rotors, intake and delivery passages within said shaft, circumferentially disposed channels in the outer surface of said shaft, said channels communicat-

6

ing with said intake and delivery passages and being located on diametrically opposite sides of said shaft, for said intake and delivery passages, and passages in said pistons, adapted to place said channels in communication with said chambers, said piston passages leading from the arcuate end of said pistons to the arcuate mid-point thereof, there being two of said piston passages in each piston, each piston passage leading from an opposite arcuate side of each piston and being in radial alignment with one of said channels, respectively, and means projecting diametrically at both sides through the housing for supporting and adjusting the eccentricity of the rotors in the housing and thereby vary the capacity of the pump, comprising two stems, one having screw threaded engagement with the housing wall and having locking means in association, and the other stem being smooth and axially slidable.

7. In a device of the character described, a housing, a plurality of concentric inner and outer rotors with coacting pistons and chambers, a plurality of rotatable control rings surrounding said rotors, a casing surrounding and supporting said rings, and means for adjusting said casing transversely to the axis of said rotors, said means including stems connected to said casing at diametrically opposite points and guided in openings in said housing, a screw-threaded bushing on one of said stems engaging the housing, and a coacting lock nut for securing the casing in desired position, the other said stem being smooth for sliding axially.

8. In a device of the character described, a housing, a fixed shaft therein with axial bores for inlet and outlet of fluid, a drive shaft in axial alignment with said fixed shafts, ports and arcuate grooves connecting to said ports in said fixed shaft, a sleeve about said fixed shaft having grooves and ports and being connected to said drive shaft, a plurality of inner rotors about said sleeve and being connected to said drive shaft and having arcuate piston projections, an outer rotor about each said inner rotor and having arcuate chambers for said pistons, separating plates between the assemblies of rotors and being connected to the inner rotors, a control ring surrounding each such assembly of inner and outer rotors, means mounting the control rings, stems extending from said means at diametrically opposite points and guided in openings in said housing for adjustment whereby to vary the eccentricity of the control rings to vary the capacity of the pump, one stem having threaded engagement with the housing wall, locking means coacting with said stem, and links connecting each said control ring with its facing outer rotor and with an adjacent separating plate, said links being arcuately spaced.

9. In a device of the character described, a housing, a fixed shaft therein with axial bores for inlet and outlet of fluid, a drive shaft in axial alignment with said fixed shaft, ports and arcuate grooves communicating with said ports on said fixed shaft, a sleeve about said fixed shaft having grooves and ports and being connected to said drive shaft, a plurality of inner rotors about said sleeve and being connected to said drive shaft and having arcuate piston projections, an outer rotor about each said inner rotor and having arcuate chambers for said pistons, separating plates between the assemblies of inner and outer rotors and being connected to the inner rotors, a control ring surrounding each such as-

sembly of inner and outer rotors, a generally cylindrical casing surrounding said control rings, means mounting the control rings, stems connected to said means at diametrically opposite points and guided in openings in said housing for adjustment of the position of said casing to vary its eccentricity and thereby vary the capacity of the pump, including a bushing in screw-threaded engagement with the housing, and links connecting each said control ring with its adjacent outer rotor and with the adjacent separating plate, said links being arcuately spaced.

10. In a device of the character described, a housing, a fixed shaft therein with axial bores for inlet and outlet of fluid, a drive shaft in axial alignment with said fixed shaft, ports and arcuate grooves communicating with said ports on said fixed shaft, a sleeve about said fixed shaft having grooves and ports and being connected to said drive shaft, a plurality of inner rotors about said sleeve and having arcuate piston projections and being connected to said sleeve, an outer rotor about each said inner rotor and having arcuate chambers for said pistons, separating plates between the assemblies of inner and outer rotors and being connected to the inner rotors, a control ring surrounding each such assembly of inner and outer rotors, a casing surrounding said control rings, stems having pinned connections to said casing at diametrically opposite points and guided in openings in said housing, and one such stem being provided with a screw-threaded bushing engaging the housing wall and having a lock nut, whereby to vary the eccentricity of the casing and vary the capacity of the pump.

11. In a device of the character described, a housing, a fixed shaft therein with axial bores for inlet and outlet of fluid, a drive shaft in axial alignment with said fixed shaft, ports and arcuate grooves communicating with said ports on said

fixed shaft, a sleeve about said fixed shaft having grooves and ports and being connected to said drive shaft, a plurality of inner rotors about said sleeve and having arcuate piston projections, an outer rotor about each said inner rotor and having arcuate chambers for said pistons, separating plates between the assemblies of rotors and being connected to the inner rotors, means connecting the inner rotors to said sleeve, a control ring surrounding each such assembly of inner and outer rotors, whereby to vary the eccentricity of the casing and vary the capacity of the pump, and links connecting each said control ring with its adjacent outer rotor and with its adjacent separating plate, said links being arcuately spaced.

THOMAS J. LESTER.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
25 Re. 21,583	Bancroft	Oct. 1, 1940
498,618	Boyd	May 30, 1893
550,466	Westinghouse	Nov. 26, 1895
1,013,139	Dittlinger	Jan. 2, 1912
1,308,352	Green	July 1, 1919
30 1,370,810	Hansen	Mar. 8, 1921
1,583,379	Whipple	May 4, 1926
2,096,074	Stevens	Oct. 19, 1937
2,148,282	Stevens	Feb. 21, 1939
2,149,143	Landenberger	Feb. 28, 1939
35 2,426,361	Lester	Aug. 26, 1947

FOREIGN PATENTS

Number	Country	Date
541,344	France	May 1, 1922
40 654,347	France	Nov. 28, 1928