Feb. 17, 1953 W. H. DE LANCEY ET AL 2,628,567

REVERSIBLE VARIABLE CAPACITY FLUID PUMP

Filed Dec. 12, 1946 2 SHEETS—SHEET 1

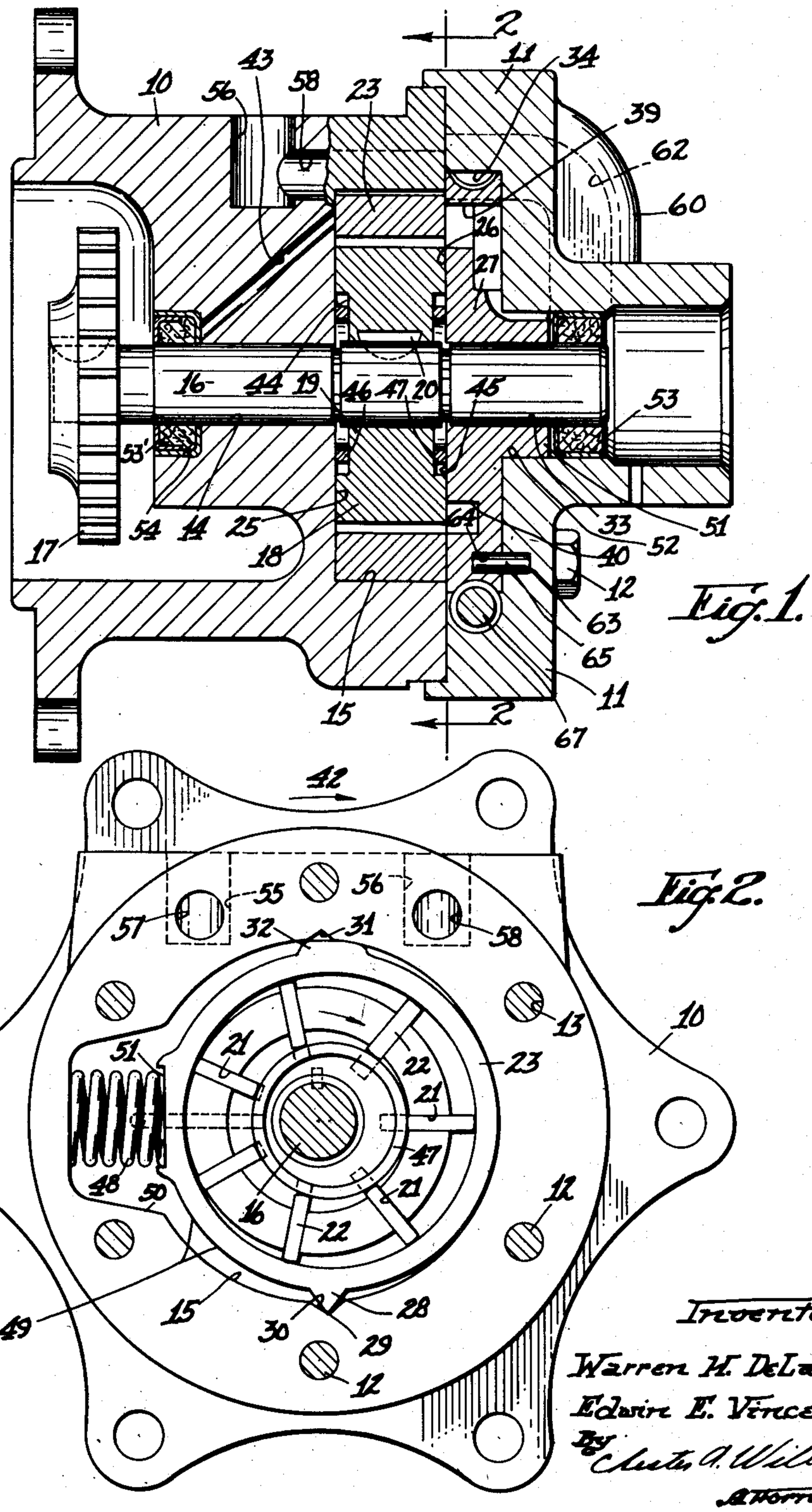

Fig. 1.

Fig. 2.

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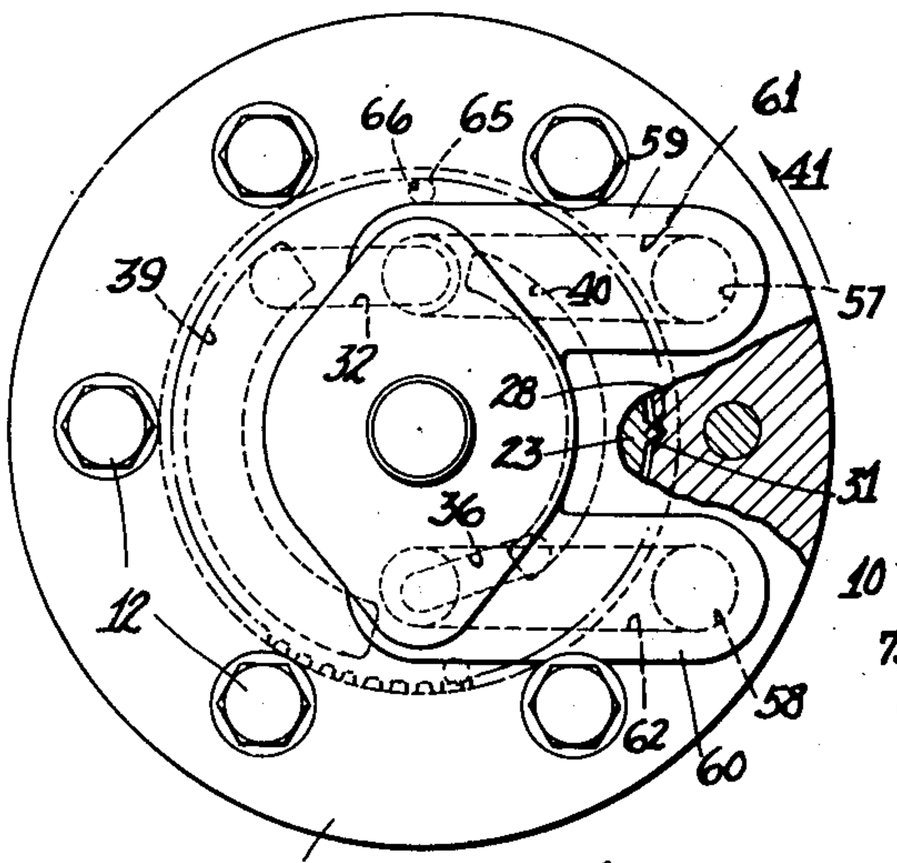

Fig. 3.

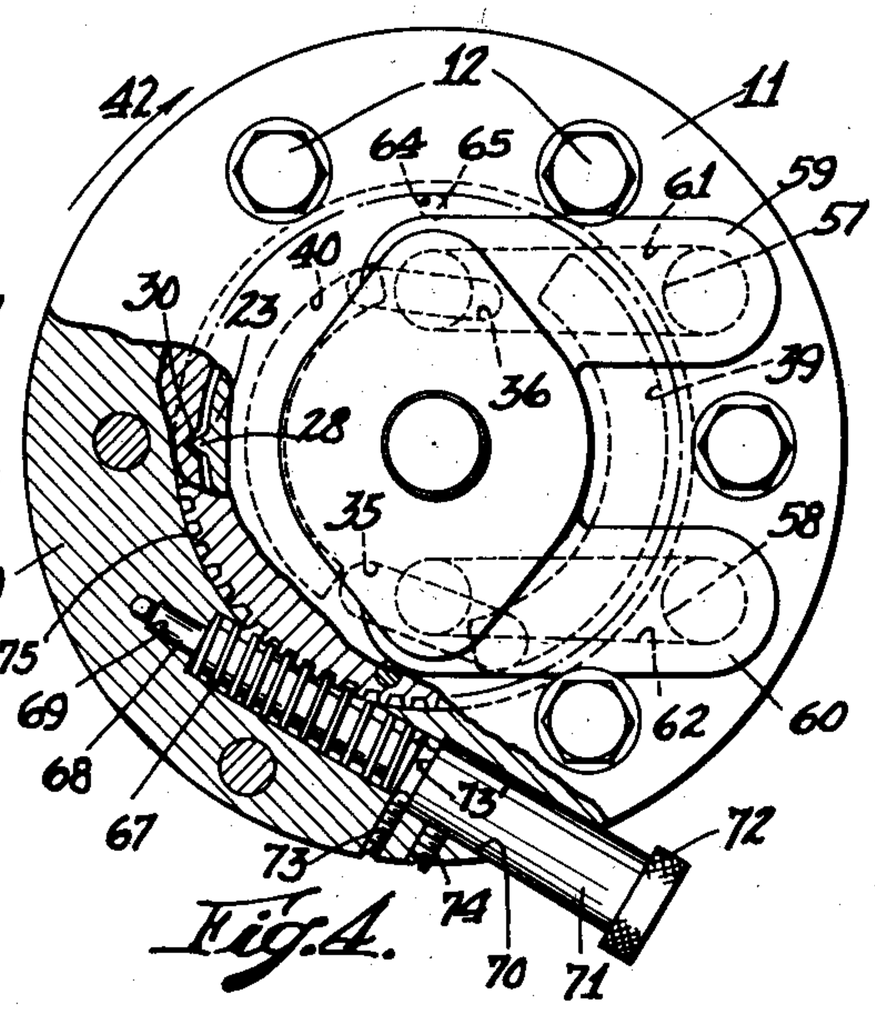

Fig. 4.

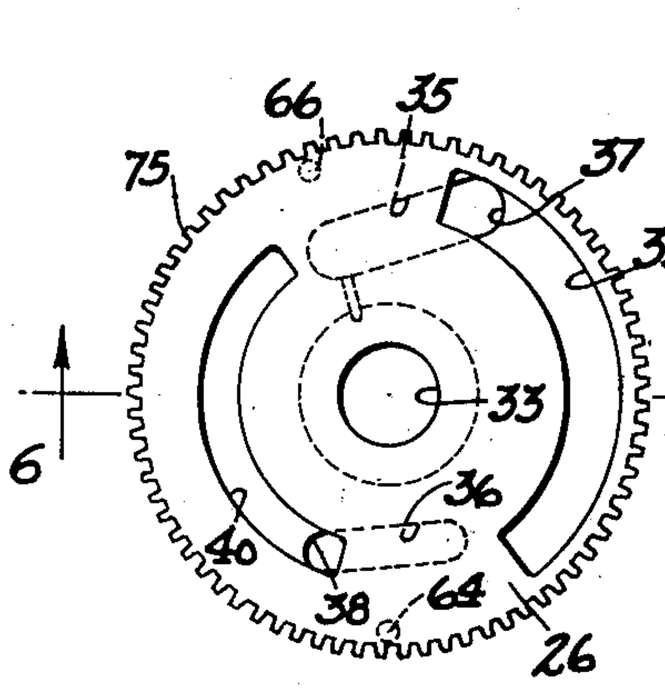

Fig. 5.

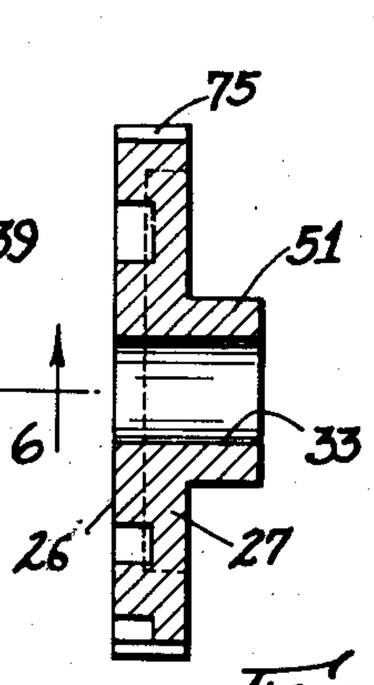

Fig. 8.

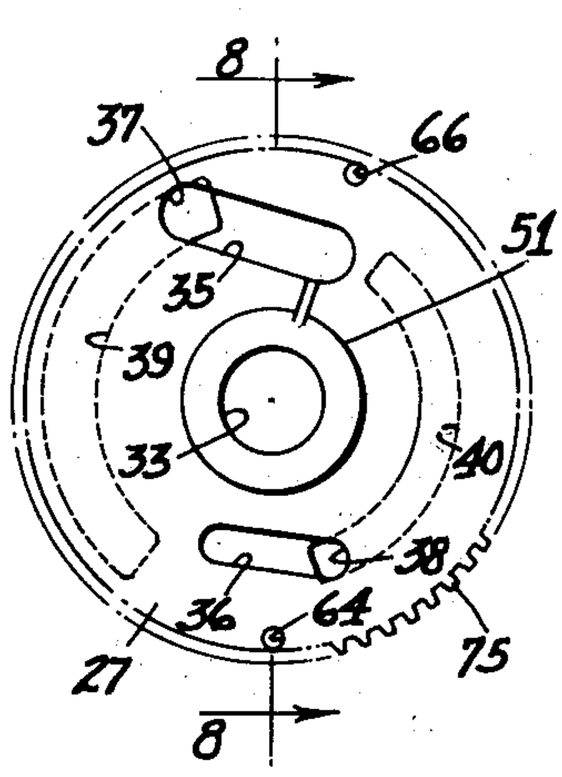

Fig. 7.

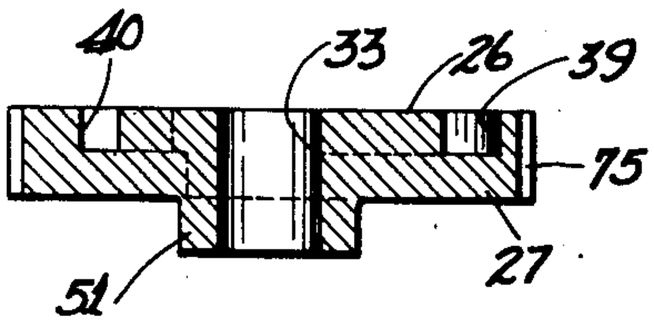

Fig. 6.

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REVERSIBLE VARIABLE CAPACITY FLUID PUMP

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Application December 12, 1946, Serial No. 715,844

13 Claims. (Cl. 103—120)

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This invention relates to a variable capacity fluid pump of the vane type, and more particularly to that type of variable capacity pump in which the displacement automatically adjusts itself to compensate for variations in the driving speed or output requirements—the displacement being modulated from maximum to zero by comparatively slight increases of pressure after reaching a predetermined point. That is, the volume of the pump's output decreases as the delivery pressure increases, so that the pump is not required to operate under any appreciable back pressure in periods of zero output requirements.

A primary object of the present invention is to provide such a variable capacity pump with component parts such that the direction of the pump rotor may be reversed by merely altering the relative positions of these parts thereby to permit the pump to be operated efficiently in either a clockwise or a counterclockwise direction depending upon the disposition of these component parts.

Another object of the present invention is to provide such a variable capacity pump with means whereby the fluid pressure produced by the pump may be varied.

A further object of this invention is to simplify the construction of pumps having the above noted capabilities to the end that they may be manufactured at a minimum expense.

With the above and other objects in view as will hereinafter appear, the invention comprises the devices, combinations and arrangements of parts hereinafter set forth and illustrated in the accompanying drawings of a preferred embodiment of the invention from which the several features of the invention and the advantages attained thereby will be readily understood by those skilled in the art.

In the accompanying drawings:

Fig. 1 represents a sectional view of a pump incorporating the present invention, the section being taken transversely of the rotor shaft.

Fig. 2 represents a sectional view taken substantially along line 2—2 of Fig. 1.

Fig. 3 represents a front view, in reduced scale, of the device as disclosed in Fig. 1 with the component parts thereof so assembled as to enable the rotor shaft to rotate in a counterclockwise direction.

Fig. 4 represents a front view, in reduced scale, of the present device as disclosed in Fig. 1 with the component parts thereof assembled in a manner such as to enable the rotor shaft thereof to rotate in a clockwise direction.

Fig. 5 represents a face view of a port-containing disk.

Fig. 6 represents a sectional view of the element disclosed in Fig. 5 and taken substantially along the line 6—6 of Fig. 5.

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Fig. 7 illustrates the rear end view of the element disclosed in Fig. 5.

Fig. 8 represents a sectional view of the element disclosed in Fig. 7 and taken substantially along the line 8—8 of Fig. 7.

Like reference characters refer to like parts in the different figures.

Referring particularly to Figs. 1 and 2, the present invention is incorporated in a pumping unit which comprises a housing element 10 of a generally annular form and having an end plate 11 secured over one end thereof by means of a plurality of suitable bolts 12 which pass through holes 13 provided in the end plate 11 thus to be threaded directly into the housing 10. The housing 10 is formed with a central bore 14 opening directly into a substantially cylindrical chamber 15 which is closed over by means of the end plate 11.

Rotatably journaled within the bore 14 is a rotor shaft 16 which may be driven in any suitable manner, as by means of a driving gear, not shown herein, which may mesh with a gear 17 keyed or otherwise suitably secured upon the distal end of the rotor shaft 16. The shaft 16 passes through the chamber 15 and carries within this chamber a pump rotor 18, the latter having an inner hub portion 19 which surrounds said shaft and is keyed thereto as shown at 20. The pump rotor is formed in the usual manner with a series of radial slots 21, in each of which is disposed a radial slidable vane 22. The outer ends of said vanes are adapted, according to this invention, to work against the interior periphery of a ring-like modulator member 23 which surrounds the rotor 18 in the pump space provided by the cylindrical chamber 15 of the housing 10, said member 23 as well as the several vanes 22 extending across said space from side to side, between opposed inner faces 25 and 26 of the housing 10 and a port-containing member 27 which will be hereinafter described.

The ring-like member 23 on its outer periphery is appreciably smaller in diameter than the chamber of bore 15, and on its inner periphery is appreciably larger in diameter than the pump rotor 18, in consequence of this, there is ample opportunity in the pump space surrounding the rotor 18 for free movement of said member 23, into positions of varying eccentricity relative to the rotor 18, to vary the pumping action of the latter's slidable vanes 22, 22.

A simple and highly advantageous mounting of member 23, for purposes of such eccentricity-movements is obtained by providing on the outside surface of said member 23, and preferably across its entire width a rib 28 of substantially triangular cross section, and with side surfaces

at an acute angle to each other so as to form at their intersection a virtual knife edge, as indicated at 29. For the reception of the rib 28 the surface of bore 15, as shown in Fig. 2, is provided with a two-side indentation or cleft 30, somewhat shallower than the rib 28 and with its intersecting sides at an appreciably larger angle to each other than the intersecting sides of said rib, thus to give ample clearance for free and frictionless rocking movements of the ring 23 on the axis afforded by the bottoming of the rib edge 29 in the angular indentation 30. A similar indentation or cleft 31 is formed in the bore 15 at a point diametrically opposite the indentation 30. By providing this second indentation 31 the ring 23 may be assembled into the pumping unit in either of two positions thereby to permit, as hereinafter described, the shaft 16 to be rotated in either a clockwise or a counterclockwise direction. Provided on the outside periphery of the modulator ring 23, at a point diametrically opposite the rib 29, is an arcuate boss 32 which is adapted to engage the inner periphery of the bore 15 for the purpose of maintaining the rib 28 within its proper indentation, whether it be indentation 30 or 31.

The ring 23 presents a continuous unbroken interior cylindrical surface to the ends of the vanes 22, 22 there being no need to provide said ring with fluid openings to the spaces between the vanes since the ingress of fluid to and its exit from said spaces is obtained laterally by way of passages leading into the pumping spaces through the port-containing member 27.

Referring particularly to Figs. 1, 5, 6, 7, and 8, the forward end of the shaft 16 projects into a bore 33 provided axially of the port-containing member 27 which is snugly positioned within a cylindrical recess 34 provided within the inner face of the end plate 11. As herein shown, the member 27 provides a fluid intake passage 35 and a fluid delivery or offtake passage 36. Both of these passages 35 and 36 communicate with the opposite face of the member 27 by means of conduits 37 and 38 respectively. Formed on the inner face 26 of the member 27 are arcuately shaped fluid-conducting passages 39 and 40 which communicate respectively with the conduits 37 and 38. As shown in Figs. 3 and 4, the elongated passageway 39 is disposed in the fluid intake zone and the elongated passage 40 is disposed in the fluid delivery zone of the path of travel of the vanes 22, 22. The function of these grooves is principally to insure an unrestricted internal flow of fluid as drawn into and expelled from the spaces between the vanes 22, 22 by the rotation of the rotor 18 within the ring 23 in the directions of the arrows 41 and 42 associated with the Figs. 3 and 4 respectively.

The intake groove 39 is preferably made wide enough to overlap the ring 23 on both sides, thereby to give the entering fluid access to the space between said ring and the bore 15, and to reduce the fluid's tendency to become aerated by reason of undue restriction of its flow. Furthermore, this construction will permit the delivery of a small portion of the fluid to a conduit 43 disposed within the housing 10 for the purpose of providing a means whereby fluid may be delivered from the chamber 15 to the outer periphery of the shaft 16 thereby to lubricate the latter element. This conduit also functions to prevent the pumping elements from forcing fluid from the chamber 15 out of the casing 10 along the shaft 16.

As best shown in Fig. 1, the rotor's inner hub

portion 19 is of less width, axially of the shaft 16, than the vanes 22, 22, this reduction of the width resulting from the rotor's opposite faces being formed with circular recesses 44 and 45. Since these recesses 44 and 45 are intersected by the inner ends of the radial slots 21, 21, it follows that the end extremities of the inner edges of the several vanes 22, 22 are located in these face recesses 44 and 45 of the rotor 18. Also located in such recesses 44 and 45 are loose rings 46 and 47, respectively, each encircling the shaft 16 and having an external diameter that gives it virtual peripheral contact with the inner edge portion of each of the several vanes 22, 22 of the rotor. Each of the rings 46 and 47, by its ability to move about freely in its associated recess, serves as a shiftable backing for the vanes 22, 22, the said rings 46 and 47 changing their positions in the respective recesses as the eccentricity between the rotor 18 and the surrounding ring 23 is increased or decreased, as the case may be, and in the operation of the pump. Whatever the pumping position may be, said rings 46 and 47 maintain their peripheral contact with the inner edges of the vanes 22, 22 and thus insure the vanes contact by the outer edges with the inner periphery of the modulating ring 23.

In Fig. 2 the ring 23 is shown in its position of maximum eccentricity, relative to the rotor 18, its movement to this position (of maximum pumping action by the vanes 22, 22) being obtained by the thrust thereupon of a suitable spring 48 disposed within an opening or socket 50 provided in the peripheral wall of the bore 15. One end of this spring engages the deepest or base portion of the opening or socket 50 and the other end of the spring is seated within a recess 51 provided in the peripheral portion of the ring 23 opposite the socket 50. The pressure of the spring 48 against the ring 23 biases the ring about its pivot rib 28 to the end that the lower portion of the ring (as depicted in Fig. 2) will normally approach contacting relation with the lower portion of the bore 15. It is to be understood that the spring 48 virtually floats between the ring 23 and the base portion of the opening 50 thereby to provide a movable direction of spring thrust. Should the ring 23, with its pump inactive or at rest, be in any way displaced under pressure from the spring 48, from the position of Fig. 2, so as not to sit perfectly on its edge 29 in its angular indentation 30, it is evident that upon starting up of the rotor's rotation in the direction of the arrow 42, the ring 23 will be immediately and automatically moved to correct seating position due to the pressure of fluid against the interior surface of the ring in the zone of said seating, which causes the edge 29 to bottom in the indentation 30. If fluid in excess of output requirements is being delivered to the pump, the resulting increase of fluid pressure in the wedge shaped zone 49 between rotor and modulator ring becomes immediately effective against the ring's surface in said zone to move said ring, against the pressure of the spring 48, towards a less eccentric position relative to rotor 18 which automatically reduces the pumping action of the vanes 22, 22 to a point in keeping with the output requirements. Thus, under all conditions, the pump will automatically adjust itself to deliver fluid under pressure only in the amounts required by the device or devices which it is supplying.

Referring particularly to Figs. 1, 2, 3, and 4,

the hub portion 51 of the port-containing member 27 is received within an axial bore 52 provided in the end cap 11. The one end of the shaft 16 projects forwardly of the member 27 and into the bore 52 for the purpose of providing a means upon which an oil seal 53 may be placed within the end cap 11 thereby to prevent the egress of fluid along the shaft 16 and out through the axial opening of the end cap 11. A similar oil seal 53' is provided about the other end of the shaft 16 and within an aperture 54 provided in the rear wall of the housing 10. This oil seal 53' will prevent the egress of oil along the shaft and out through the rear end portion of the housing 10.

Provided in the peripheral portion of the housing 10 is a pair of spaced apertures 55 and 56 which communicate respectively with a pair of longitudinally disposed passageways 57 and 58 which are formed in the housing 10 thus to communicate with the end cap 11. Referring particularly to Figs. 1, 3, and 4, the end cap 11 is provided with raised portions 59 and 60 which contain passageways 61 and 62 respectively. When the end cap 11 is placed in its proper position over the housing 10 the passageways 61 and 62 are disposed in register over the passageways 57 and 58, respectively, for the purpose of placing these latter passageways in communication with the passageways 36 and 35 respectively of the port-containing member 27. Referring particularly to Fig. 4, it is to be understood that the passageway 58 is adapted to deliver oil to the intake or low pressure side of the rotor through the passageway 62 and the oil passageway 35 the latter of which is formed in the port-containing member 27. It is also to be understood that the oil which is forced under pressure through the outlet passageway 36 of the member 27 will find its way out of the housing 10 by way of the passageway 61 and the passageways 57 and 55.

In the event that it is desired to rotate the shaft 16 in the direction of the arrow 41 as disclosed in Fig. 3, it is merely necessary in the present device to reverse the position of the ring 23 as shown in Fig. 2 so that the rib member 28 will be positioned within the cleft 31 rather than within the cleft 30. This will, of course, not affect the efficiency of the pumping unit as it will merely permit the ring 23 to function within the cleft 31 in exactly the same manner as it functioned within the cleft 30. When this change is made, however, some provision must be made whereby the inlet and outlet ports may be shifted so that they may properly conduct oil to and from the pumping unit. In order to accomplish this objective, the present port-containing member 27 has been so designed that it may be shifted from the position shown in Fig. 4 to the position shown in Fig. 3. This change involves merely turning the member 27 within the bore 34 of the end plate 11 until it is disposed in the position as disclosed in Fig. 3. It is to be understood that when the member 27 is so shifted there is a complete reversal of the functions of the oil intake and outtake passages which are provided within the housing 10. In other words, whenever the plate 27 is so shifted the intake aperture 37 provided in the member 27 is moved from register with the passageway 62 of the end plate 11 into register with the passageway 61 of the end plate, and by the same token the outlet passage 38 is shifted from register with passageway 61 of the end plate 11 into register with the passageway 62 of the end plate. Therefore, to reverse the present pumping unit completely one need only shift the member 27 as hereinabove described, reverse the position of the ring 23, and switch the fluid intake and inlet lines which would normally be attached to the bores 55 and 56 of the housing 10.

As shown particularly in Fig. 1, the members 27 and 11 are provided with dowel pin apertures 63 and 64, respectively, for the purpose of receiving a dowel pin 65 which functions to place the member 27 in its proper position relative to the rotor. As may be noted in Fig. 7, the member 27 is provided with a second dowel pin hole 66 which may be utilized whenever the member 27 is shifted into the position as indicated in Fig. 3 thereby to permit the dowel pin 65 to align the dowel pin hole 66 with the dowel pin hole 63 of the member 11. From this it will be understood that the member 27 may be accurately positioned within the end cap 11 for either clockwise or counterclockwise rotation of the shaft 16.

Referring particularly to Figs. 2 and 4, it is to be understood that as the port-containing member 27 is shifted slidingly in a counterclockwise direction about the shaft 16 the area of applied thrust outwardly against the ring 23 will shift from zone 49 to a point closer to the rib 28. By so shifting the direction of thrust the oil will be required to produce a greater force upon the ring 23 in order to shift the same to its position of minimum eccentricity. By the same token, it is to be understood that if the member were to be shifted in a clockwise direction, as viewed in Fig. 4, the oil would be required to produce a lesser force upon the ring 23 in order to shift the same to its position of minimum eccentricity. This is for the reason that the effective lever distance from the spring 48 to the fulcrum point 29 of the ring 23 remains substantially constant while the effective lever distance from the area of applied thrust against the ring to the fulcrum point 29 is decreased or increased, depending upon whether the member 27 is rotated in a counterclockwise or a clockwise direction.

From the above it is to be understood that by so shifting the member 27 about the shaft 16 the effective pressure of the oil flowing out of the pump casing will be increased as the member is turned in a counterclockwise direction and will be decreased as it is turned in a clockwise direction. However, when the member 27 is positioned within the pump unit as illustrated in Fig. 3, it must be adjusted in a manner just opposite to that as above described in order to effect the same results. But in order to so alter the position of the member 27 some adjusting means is required. The present invention contemplates the provision of such means.

It will be understood that whenever it is desired to incorporate the hereinabove noted adjusting means within the present oil pump, the dowel pin 65 must be omitted from the assembly. In lieu of this dowel pin there is provided a worm gear 67 which is journaled within the end plate 11. The inner end of the worm gear 67 may be formed with a bearing member 68 adapted to be received within a cylindrical seat 69 formed in the bottom portion of a bore 70 which is adapted to receive the large cylindrical end portion 71 of the worm 67. The outer end of the member 71 projects out of the bore 70 and has formed thereon a head member 72 the function of which is to provide means whereby the worm may be rotated.

A screw 73 is threaded into the plate 11 for the purpose of projecting into an annular groove 73' formed about the member 71. Thus, the worm is prevented from shifting lengthwise of itself. A set screw 74, also threaded into the plate 11, is adapted to engage the member 71 thereby to lock the same in any desired position.

The worm 67 is adapted to mesh with gear teeth 75 provided on the outer periphery of the member 27. Referring particularly to Fig. 7, it will be seen that the teeth 75 are disposed about the peripheral portions of the member 27 for the purpose of providing means whereby the member 27 may be rotatably adjusted whether it be in the position disclosed in Fig. 3 or in Fig. 4. From this it is to be understood that the rotation of the worm 67 will be effective to rotate the member 27 within the bore 34 of the end plate to the end that the pressure of the oil flowing from the pump may be varied. It will occur to those skilled in the art that other means could be provided for adjusting the member 27 about the shaft 16. For example, link and crank elements could be substituted in lieu of the worm and wheel expedient herein used. However, such modifications all come within the scope of the present invention.

From the above it is to be understood that the present invention provides a novel and extremely efficient pump which is adapted to be assembled in two different ways thereby to produce a pump which will rotate in either of two directions. Furthermore, this pump is so constructed that by a very simple manipulation the unit may be effective to produce various pressures upon the oil which is forced therethrough.

We claim:

1. In a variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a rotor having radially slidable vanes and rotatable in said chamber, a ring-like member pivotally mounted at one side thereof within said chamber and disposed so as to surround said rotor and cooperating by its inner surface with said vanes to produce the pumping action, yieldable means biasing said member about its pivotal mounting to eccentric position relative to said rotor for maximum pumping action by said vanes, said intake and delivery connections being so disposed relative to said ring-like member as to cooperate with said rotor in producing a pumping pressure acting on an inner surface area of said ring-like member between said pivotal mounting and said biasing means, in a direction to move said ring in opposition to said biasing means toward concentric or non-pumping position to minimize the pumping action, means adjustable to alter the position on said inner surface of said ring-like member at which said pumping pressure is applied, and means extending out of said housing for effecting the adjustment of said last named means.

2. In a reversible variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a rotor having radially slidable vanes and rotatable in said chamber, a ring-like member pivotally mounted at one side thereof within said chamber and disposed so as to surround said rotor and cooperating by its inner surface with said vanes to produce the pumping action, yieldable means biasing said member about its pivotal mounting to eccentric position relative to said rotor for maximum pumping action by said vanes, said

biasing means thrusting said member to move pivotally in the same general direction as the direction of rotation of said rotor and in opposition to a tendency of the member to pivot in the opposite direction responsive to pumping pressure acting on an inner surface area of said member between said pivotal mounting and said biasing means for modulating the pumping pressure, means provided in said housing so that the relative positions of said pivotal mounting and said biasing means may be reversed whenever the direction of rotation of said rotor is to be reversed thereby to permit said biasing means to urge said member about its pivotal mounting in the same general direction as the direction of rotor rotation in either of said positions of the pivotal mounting, means adjustably disposed within said housing and having spaced intake and delivery ports therein connecting said intake and delivery connections with said chamber, and means for adjusting said last named means within said housing so that a portion of its delivery port may be selectively positioned at various locations between said biasing means and said pivotal mounting in either of said positions of the pivotal mounting of the member.

3. In a reversible variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a modulator ring, said housing and said modulator ring having means cooperating to define a pair of spaced selectively usable fulcrum points with respect to which the modulator ring is adapted to be rockably mounted in said chamber to rock about either selective one of said pair of spaced fulcrum points, a rotor having radially slidable vanes and being rotatable in said ring in either direction so as to produce the pumping action by cooperation of said vanes with the interior surface of said ring, means movably disposed within said housing and having spaced intake and delivery ports therein connecting said intake and delivery connections with said chamber, means for maintaining said last mentioned means in a selective one of two positions to which it may be moved within said housing depending upon about which of the selective fulcrum points the modulator ring is rockable, a portion of said ring's interior surface in the zone of said delivery port being acted on by the pumping pressure in a direction tending to shift said ring toward a position concentric with said rotor to thereby minimize the pumping pressure, and spring means acting on said ring in opposition to the pumping pressure and tending to rock said ring to a position eccentric to said rotor for increasing the pumping pressure.

4. In a variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a pair of fulcrum means disposed substantially at diametrically opposed points relative to each other at the inner peripheral portion of said chamber, a ring-like member having a pivotal element formed on the periphery thereof, said ring-like member being assembled into said chamber with its pivotal element in engagement with a selective one of said fulcrum means, a rotor having radially slidable vanes and the rotor being selectively reversely rotatable in said ring-like member so that in either direction of rotation said vanes will produce the pumping action, and spring means disposed substantially 90 degrees out of phase with each of said fulcrum means for urging said ring-like member into eccentric posi-

tion relative to said rotor for maximum pumping action by said vanes said selective fulcrum means enabling reversal of the ring-like member for engagement of the pivotal element with either selective one of said fulcrum means conformable to the direction of rotation of said rotor to thereby enable the ring-like member to rock about either fulcrum in the general respective direction of rotation of the rotor.

5. In a variable delivery fluid pump, a housing providing a chamber and having fluid intake and delivery passages, a modulator movably mounted in said chamber and having a circular pump chamber therein, a selectively reversibly rotatable rotor having pumping means engaging the wall defining said pumping chamber within the modulator to effect fluid displacement upon rotation of the rotor, the modulator being movable in said housing chamber to vary the relationship of the pumping chamber wall eccentrically with respect to the rotor for variable fluid displacement by the pumping means, a member assembled within said housing between the modulator and rotor and said fluid intake and delivery passages and having spaced intake and delivery ports therein for connecting said intake and delivery passages with said pump chamber, said member being movable within the housing and relative to said rotor for adjusting the relative positions of said intake and delivery ports to accommodate the respective reverse pumping rotations of the rotor, and an element having engagement with the housing and with said member for retaining the latter in any position to which said member may be moved within the housing for proper relationship of the intake and delivery ports with respect to the direction of rotation of the rotor.

6. A pump construction as defined in claim 5 wherein said element comprises a dowel and the housing and said member have respective dowel sockets for interengagement therein of the dowel.

7. A pump construction as defined in claim 5 wherein said element comprises a manually operable screw having a manipulating portion externally of the housing.

8. In a reversible variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a ring-like modulator member pivotally mounted at one side thereof within said chamber, a rotor having radially slidable vanes and rotatable within said ring-like member to produce the pumping action, means biasing said member about its pivotal mounting to eccentric position relative to said rotor for maximum pumping action by said vanes, the thrust of said biasing means on said member being in the same general direction as the direction of rotation of said rotor, said biasing means being yieldable to enable pivoting of said member in opposition to said thrust for varying the pump capacity responsive to pumping pressure acting on an inner surface of said member between said pivotal mounting and said biasing means, means provided in said housing so that the relative positions of said pivotal mounting and said biasing means may be reversed whenever the direction of rotation of said rotor is to be reversed thereby to permit said biasing means to urge said member about its pivotal mounting in the same general direction as the reversed direction of rotor rotation, means disposed within said housing for movement within and relative to the housing and having spaced intake and delivery ports therein connecting said intake and

delivery connections with said chamber, and means for securing said last named means in a selective one of two positions to which it is moved within said housing so that at least a portion of its delivery port may be positioned substantially between said biasing means and the pivotal mounting in either of said pivotal mounting positions of said member to accommodate said reversals of rotation of the rotor.

9. In a reversible variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a pair of fulcrum means disposed substantially at diametrically opposed points relative to each other at the inner peripheral portion of said chamber, a ring-like modulator member movably mounted in said chamber, a rotor of smaller diameter than the inner diameter of said modulator member and rotatable within the modulator member and having radially movable elements cooperating with the modulator member to produce a pumping action upon rotation of the rotor in the modulator member, means disposed upon the outer portion of said modulator member for selected engagement with one of said pair of fulcrum means to thereby provide with either of said fulcrum means a pivotal mounting for said modulator member for varying pump displacement by swinging of the modulator member about the selected pivot, means disposed substantially 90 degrees out of phase with each of said fulcrum means for urging said modulator member to swing about the selected one of said fulcrum means into an eccentric position relative to said rotor for maximum pumping action by said radially movable elements, and means movably disposed within said housing for effecting operative connection between said intake and delivery connections in either of the selective pivotal mountings of the modulator member, said movably disposed means having intake and delivery ports connected with said intake and delivery connections and being adapted to be selectively moved and positioned within said housing complementary to the respective pivotal mountings of the modulator member to control the application of pumping pressure to an inner surface area of said modulator member located between the selected one of said fulcrum means engaged by said means on the outer portion of the fulcrum member and said biasing means for moving the modulator member towards concentric or non-pumping position relative to the rotor and in opposition to said biasing means for reducing the pumping action of said elements.

10. In a reversible variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a pair of fulcrum means disposed substantially at diametrically opposed points relative to each other at the inner peripheral portion of said chamber, a ring-like modulator member movably mounted in said chamber, a rotor of smaller diameter than the inner diameter of said modulator member and rotatable within the modulator member and having radially movable elements cooperating with the modulator member to produce a pumping action upon rotation of the rotor in the modulator member, means disposed upon the outer portion of said modulator member for selected engagement with one of said pair of fulcrum means to thereby provide with either of said fulcrum means a pivotal mounting for said modulator member for varying pump displacement by swinging of the modulator member about the

selected pivot, means disposed substantially 90 degrees out of phase with each of said fulcrum means for urging said modulator member to swing about the selected one of said fulcrum means into an eccentric position relative to said rotor for maximum pumping action by said radially movable elements, means movably disposed within said housing for effecting operative connection between said intake and delivery connections in either of the selective pivotal mountings of the modulator member, said movably disposed means having spaced intake and delivery ports therein for connecting said intake and delivery connections with the interior of the modulator member, and means for securing said movably disposed means in a selective one of two positions into which it may be moved within said housing so that at least a portion of its delivery port may be positioned substantially between said biasing means and the selected fulcrum means that is engaged selectively by said means disposed on the outer portion of the modulator member and the inner peripheral wall of the modulator member thereby subjected to pump pressure in opposition to said biasing means for automatically varying the pump pressure responsive to increase of pump pressure beyond a predetermined value.

11. In a reversible variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a pair of fulcrum means disposed substantially at diametrically opposed points relative to each other within said chamber, a ring-like modulator member movably mounted in said chamber, a rotor of smaller diameter than the inner diameter of said modulator member and rotatable within the modulator member and having radially movable elements cooperating with the inner peripheral wall defining the modulator member to produce a pumping action upon rotation of the rotor in the modulator member, means disposed upon the outer portion of said modulator member for selected engagement with one of said pair of fulcrum means to thereby provide with either of said fulcrum means a pivotal mounting for said modulator member for varying pump displacement by swinging of the modulator member about the selected pivot, means disposed substantially 90 degrees out of phase with each of said fulcrum means for urging said modulator member to swing about the selected one of said fulcrum means into an eccentric position relative to said rotor for maximum pumping action by said radially movable elements, and means movably disposed within said housing for effective operative connection between said intake and delivery connection in either of the selective pivotal mountings of the modulator member, said movably disposed means having two different selective positions of assembly within the housing corresponding generally to the respective reverse mounting positions of the modulator member so that in either of said reverse mounting positions of the modulator member at least a portion of the delivery port of said movably disposed means will be positioned substantially between said biasing means and the respective engaged fulcrum means.

12. In a variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a ring-like modulator member within said chamber and having

pivotal connections at one side of the member for rocking thereof within the chamber, a rotor rotatable on a fixed axis and disposed within said modulator member and having radially movable elements cooperating with the inner surface of the modulator member to produce a pumping action, means biasing said modulator member about its pivotal mounting to eccentric position relative to said rotor for attaining maximum pumping action by said elements, said biasing means being yieldable responsive to internal pumping pressure within the modulator member to permit movement of the modulator member to positions of less eccentricity with respect to the rotor in order to vary the pump displacement, and means for connecting said fluid intake and delivery connections with the interior of the modulator member, said last mentioned means being adjustable relative to the modulator member to alter the effective fluid pressure upon the modulator ring to shift it in opposition to said biasing means during rotation of the rotor.

13. In a variable delivery fluid pump, an outer housing providing a hollow chamber and fluid intake and delivery connections, a ring-like modulator member within said chamber and having pivotal connections at one side of the member for rocking thereof within the chamber, a rotor rotatable on a fixed axis and disposed within said modulator member and having radially movable elements cooperating with the inner surface of the modulator member to produce a pumping action, means biasing said modulator member about its pivotal mounting to eccentric position relative to said rotor for attaining maximum pumping action by said elements, said biasing means being yieldable responsive to internal pumping pressure within the modulator member to permit movement of the modulator member to positions of less eccentricity with respect to the rotor in order to vary the pump displacement, means for connecting said fluid intake and delivery connections with the interior of the modulator member, and means for adjusting and maintaining said last mentioned means relative to said housing in predetermined respective positions of said ports relative to said modulator member.

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