

Sept. 15, 1953

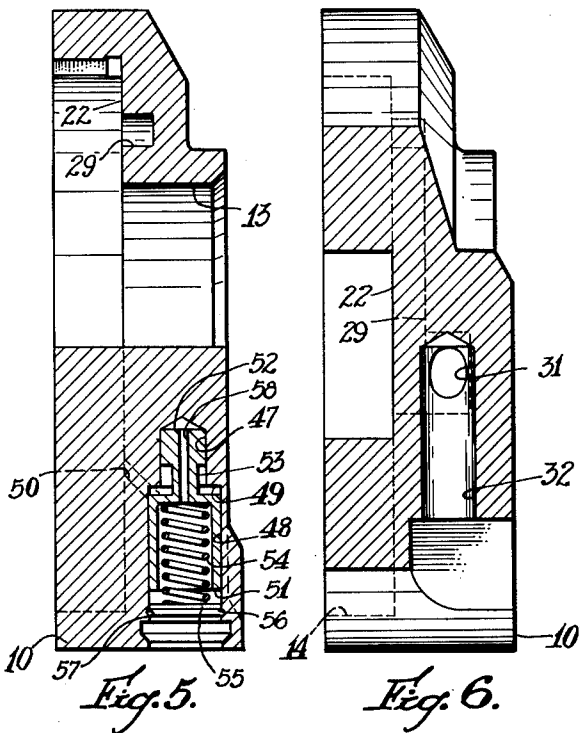
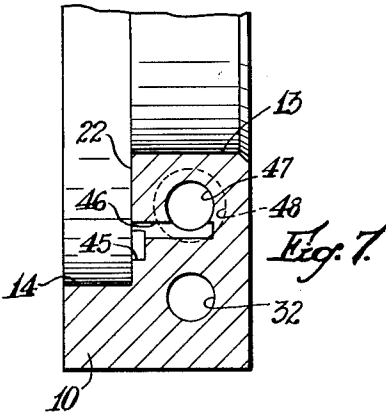
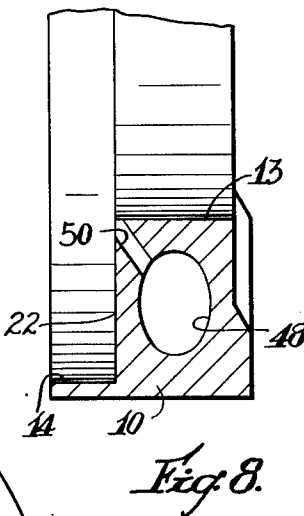
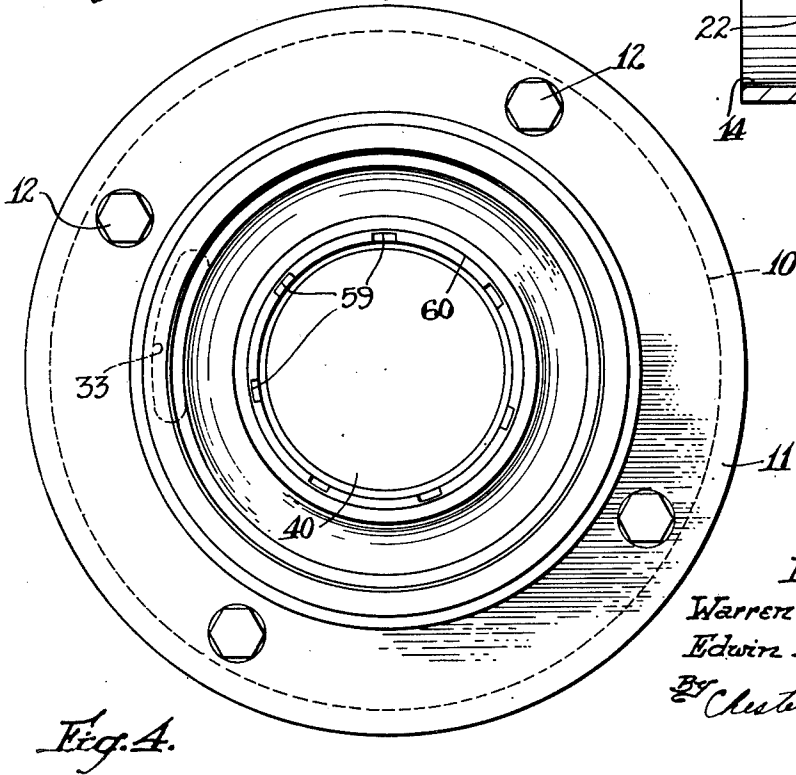
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2,651,994

VARIABLE CAPACITY PUMP WITH DUAL DISCHARGE MEANS

Filed Dec. 12, 1946

2 Sheets-Sheet 2



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2,651,994

VARIABLE CAPACITY PUMP WITH DUAL DISCHARGE MEANS

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Application December 12, 1946, Serial No. 715,843

7 Claims. (Cl. 103—2)

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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 fluid 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 against 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 means whereby the pump may produce automatically a secondary flow of fluid whenever the primary flow of fluid therefrom is at a minimum.

Another object of the present invention is to provide such a variable capacity pump with means whereby the above noted secondary flow of fluid will be ejected from the pump under a pressure substantially different from that found in the primary flow of fluid.

A still further object of the present invention is to construct a pump having the above noted capabilities in a most simple and rugged manner to the end that it may be inexpensive of manufacture and have a long operative life.

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 the line 2—2 of Fig. 1.

Fig. 3 represents a bottom view of the device as disclosed in Fig. 2.

Fig. 4 represents a front view of the pumping unit taken substantially along the line 4—4 of Fig. 1.

Fig. 5 represents a sectional view taken substantially along the line 5—5 of Fig. 2.

Fig. 6 represents a sectional view taken substantially along the line 6—6 of Fig. 2.

Fig. 7 represents a sectional view taken substantially along the lines 7—7 of Fig. 2.

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Fig. 8 represents a sectional view taken substantially along the lines 8—8 of Fig. 2.

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 generally annular form and having an end plate 11 secured over one end thereof by means of a plurality of suitable bolts 12, 12 which pass through holes provided in the end plate 11 thereby to be threaded directly into the housing 10. This housing 10 is formed with a central bore 13 opening directly into a substantially cylindrical chamber 14 which is closed by means of the end plate 11. Rotatably journaled within the bore 13 is a rotor shaft 15 which may be driven in any suitable manner. This shaft 15 passes through the chamber 14 and carries within this chamber a pump rotor 16, the latter having an inner hub portion 17 which surrounds said shaft and is keyed thereto as shown at 18 in Fig. 2. The pump rotor is formed in the usual manner with a series of radial slots 19, in each of which is disposed a radial slidable vane 20. The outer ends of said vanes are adapted, according to this invention, to work against the interior periphery of a ring-like member 21 which surrounds the rotor 16 in the pump space provided by the cylindrical chamber 14 of the housing 10, said member 21 as well as the several vanes 20 extending across said space from side to side, between opposed inner faces 22 and 23 of the housing 10 and the end cap 11.

The ring-like member 21 on its outer periphery is appreciably smaller in diameter than the chamber of the bore 14 and on its inner periphery is appreciably larger in diameter than the pump rotor 16, in consequence of this, there is ample opportunity in the pump space surrounding the rotor 16 for free movement of said member 21 into positions of varying eccentricity relative to the rotor 16 to vary the pumping action of the latter's slidable vanes 20, 20.

A simple and highly advantageous mounting of member 21 for purposes of such eccentricity-movements is obtained by providing on the outside surface of the member 21, and preferably across its entire width, a rib 24 of a substantial 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 25. For the reception of the rib 24 the surface of the bore 14, as shown in Fig. 2, is provided with a two-sided indentation or cleft 26, somewhat shallower than the rib 24 and with

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its intersecting sides at an appreciably larger angle to each other than the intersecting sides of the rib, thus to give ample opportunity for free and frictionless rocking movements of the ring 21 on the axis afforded by the bottoming of the rib edge 25 in the angular indentation or cleft 26. Provided on the outside periphery of the ring 21, at a point substantially diametrically opposite to the rib 24, is an arcuate boss 27 which is adapted to engage the inner periphery of the bore 15 for the purpose of maintaining the rib 24 within its indentation 26.

The ring 21 presents a continuous unbroken interior cylindrical surface to the ends of the vanes 20, 20, there being no need to provide said ring with fluid openings to the spaces between the vanes since the ingress of oil to and its exit from said spaces is obtained laterally by way of passages leading into the pumping spaces through the housing 10.

Referring particularly to Figs. 1 and 2, the face 22 of the chamber 14 provides an arcuately shaped fluid intake passage 28 and an arcuately shaped fluid delivery or offtake passage 29. The one end portion of the fluid intake passage 28 communicates directly with a radial aperture 30 formed in the housing 10. This aperture 30 is adapted to be connected with a fluid-conducting tube which in turn is connected with a source of fluid. The fluid delivery or offtake passage 29 communicates directly at one end thereof with a conduit 31 which leads directly to a bore 32 which in turn opens at the outside of the housing 10 thereby to be connected with a conduit for the purpose of delivering the fluid under pressure to any suitable mechanism not herein disclosed. (See Figs. 2 and 6.) Referring particularly to Fig. 4, the end plate 11 is provided on its inner face 23 with an arcuately shaped passage 33 which is positioned in the fluid intake zone opposite to the arcuate passageway 28. It is the function of these arcuately shaped passageways to insure an unrestricted internal flow of fluid as drawn into and expelled from the spaces between the vanes 20, 20 by the rotation of the rotor 16 within the ring 21 in the direction of the arrow 35 which is associated with Fig. 2. The intake passageway or groove 28 is preferably made wide enough to overlap the ring 21 on both sides, thereby to give the entering fluid access to the space between the ring and the bore 14, and to reduce the fluid's tendency to become aerated by reason of undue restriction of its flow.

As best shown in Figs. 1 and 2, the rotor's inner hub portion 17 is of less width axially of the shaft 15 than the vanes 20, 20. This reduction of the width results from the rotor's opposite faces being formed with circular recesses 36 and 37. Since these recesses 36 and 37 are intersected by the inner ends of the radial slots 19, 19 it follows that the end extremities of the inner edges of the several vanes 20, 20 are located in these face recesses 36 and 37 of the rotor 16. Also located in such recesses 36 and 37 are loose rings 38 and 39, respectively, each encircling the reduced end 40 of the shaft 15 and having an external diameter that gives it virtual peripheral contact with the inner edge portions of each of the several vanes 20, 20 of the rotor 16. Each of the rings 38 and 39, by its ability to move about freely in its associated recess, serves as a shiftable backing for the vanes 20, 20, the said rings 38 and 39 changing their positions in the respective recesses as the

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eccentricity between the rotor 16 and the surrounding ring 21 is increased or decreased, as the case may be, and in the operation of the pump. Whatever the pumping position may be the rings 38 and 39 maintain their peripheral contact with the inner edges of the vanes 20, 20 and thus insure the vanes' contact by the outer edges with the inner periphery of the modulating ring 21.

In Fig. 2 the ring 21 is shown in its position of maximum eccentricity relative to the rotor 16, its movement to this position (of maximum pumping action by the vanes 20, 20) being obtained by the thrust thereupon of a suitable spring 41 disposed within an opening 42 provided in the peripheral wall of the bore 14. One end of this spring engages the bottom portion of the opening 42 and the other end of the spring is seated within a circular recess 43 provided in the peripheral portion of the ring 21. The pressure of the spring 41 against the ring 21 biases the ring about its pivot rib 24 to the end that the top portion of the ring will normally approach contacting relation with the upper portion of the bore 14. It is to be understood that the spring 41 virtually floats between the ring 21 and the lower portion of the opening 42 thereby to provide a movable direction of spring thrust. Should the ring 21, with its pump inactive or at rest, be in any way displaced under pressure from the spring 41, from the position of Fig. 2 so as not to sit properly on its edge 25 in its indentation 26, it is evident that upon starting up of the rotor rotation in the direction of the arrow 35 the ring 21 will be immediately and automatically moved to correct seating position due to the pressure of the fluid against the interior surface of the ring in the zone of said seating, which causes the edge 25 to bottom in the indentation 26. If fluid in excess of the output requirements is being delivered by the pump, the resulting increase of fluid pressure in a wedge shaped zone 44 between the 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 41, towards a more concentric position relative to the rotor 16 which automatically reduces the pumping action of the vanes 20, 20 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. From the above, it is to be understood that fluid is adapted to be drawn into the pumping unit by way of the conduit 30 and through the groove or passageway 28. The rotor with its accompanying vanes will, of course, increase the pressure upon this fluid and deliver the same out of the housing by means of the groove 29, the conduit 31 and the bore 32.

The present invention also contemplates the provision of means whereby the present pump may supply a secondary flow of fluid whenever the primary flow of fluid, which was hereinabove described, is being supplied at a minimum rate. The present invention also contemplates that this secondary flow of fluid may be delivered out of the pumping unit at a pressure which is substantially less than that found in the primary flow. In order to accomplish these objectives, the present pumping unit is provided with an arcuately shaped port 45 which is positioned within the face 22 of the chamber 14 at a point normally covered

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by the ring 21 when the latter is in its position of maximum eccentricity. Referring particularly to Figs. 2 and 7, this port 45 has extending therefrom a conduit 46 which communicates directly with an intermediate portion of a bore 47 formed in the housing 10. The lower portion of the bore 47 is enlarged as at 48 and extends outwardly so as to open at the peripheral portion of the housing 10. Between the axial aligned bore portions 47 and 48 is a shoulder 49 into which opens an inclined conduit 50 which places the bore portion 48 in communication with the recess 36 of the rotor 16 (see Figs. 1, 5, and 8).

Disposed within the bore portions 47 and 48 is a pressure control valve comprising a hollow cylindrical shell 51 which is slidably disposed within the portion 48 and which has an upper cylindrical head element 52 which is similarly disposed within the smaller bore portion 47. The elements 51 and 52 of the valve are connected by means of a reduced neck portion 53. In order to retain the valve within the bore portions 47 and 48 there is provided a coil compression spring 54 the upper end of which is received within the cylindrical member 51 and the lower end of which bears against a plate 55 which in turn is held within the bore portion 48 by means of a split ring 56 seated within a recess 57 provided within the peripheral portion of the bore 48 in the usual manner. A longitudinal bore 58 is formed within the head element 52 of the valve thereby to prevent the same from being locked in its upper position by atmospheric pressure. From the above it is to be understood that the valve unit is normally biased by the spring 54 into the position disclosed in Fig. 5, and in this position it is to be understood that the bore 46 is in direct and free communication with the inclined bore 50 which leads to the recess 36 provided in the rotor 16. In this latter connection, reference may be had to Figs. 2, 5, and 7, from which it will be clear that the neck 53 is disposed adjacent the bore 46 whenever the valve is in its upper position, as shown in Fig. 5.

Whenever the flow of fluid from the present pumping unit is unrestricted by any back pressure, the ring 21 will assume its position of maximum eccentricity as disclosed in Fig. 2. However, whenever this normal flow of the primary source of fluid is interrupted and a back pressure is built up, the ring 21 will move in a direction in opposition to the spring 41 thereby to uncover the port 45 and to expose the same to the fluid pressure existing between the inner peripheral portion of the ring 21 and the outer peripheral portion of the rotor 16. Whenever the ring 21 thus moves from its position of maximum eccentricity to its position of minimum eccentricity, the pressure of the primary flow of fluid is not appreciably altered but the quantity of fluid flowing therefrom is materially reduced. Therefore, when the port 45 is so uncovered, the fluid will be forced to flow into the bore 47 in the same manner as the fluid is forced through the port 31 and into the bore 32. Thus, it will be understood that initially this oil from the port 45 will flow into the bore 47, through the inclined conduit 50, and finally into the recess 36 provided within the rotor 16.

Referring particularly to Figs. 1 and 2, the inner periphery 59 of the rotor 16 is provided with a series of longitudinally disposed grooves 59', 59' which place the recesses 36 and 37 of the rotor 16 in communication with each other. Referring particularly to Fig. 1, the end cap 11 is

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provided with a central bore 60 which communicates directly with the recess 37 of the rotor 16 and with the recess 36 by way of the grooves 59', 59'. From this it will be understood that the secondary flow of fluid from the port 45 will find its way, under pressure, from the recess 36 into the bore 60. This is for the reason that the rings 38 and 39 are fitted loosely within the recesses 36 and 37 and, therefore, they form no substantial obstruction to the passage of oil from one recess to the other. The bore 60 may be connected with some suitable device which is adapted to be operated by this secondary flow of fluid.

As hereinabove noted, the present invention contemplates the provision of means whereby this secondary flow of fluid from the pumping chamber may be ejected from the pumping unit at a pressure substantially less than that which exists in the primary flow of fluid. In order to accomplish this objective the valve spring 54 is selected so that the fluid flowing through the bore 47 and about the neck 53 will be effective to shift the valve downwardly whenever the pressure within this fluid reaches a predetermined point. Since the exposed area of the top portion of the cylindrical member 51 is greater than that area which is exposed by the lower portion of the member 52, the oil or fluid disposed within the bore 47 will be effective to shift the valve downwardly in opposition to the spring 54. Whenever the valve unit is so shifted downwardly it is to be understood that the portion 52 of the valve will be effective to block off the bore 46 to the end that no fluid may flow from the bore 46 into the valve bore 47. Thus, the valve will move up and down thereby to open and close the port 46 so as to meter oil into the inclined conduit 50, which oil will be delivered into the conduit 50 under a predetermined pressure which is established initially by the selection of a proper spring 54. For example, if we assume that the normal oil pressure within the pumping unit is 80 lbs. per square inch, one can, by selecting a proper spring 54, be assured that the oil delivered into the inclined conduit 50 will be maintained at a pressure of 40 lbs. per square inch.

From the above it is to be understood that the present pumping unit is effective normally to produce a single or primary flow of fluid therefrom. But whenever this primary flow drops to a minimum point (that point at which the fluid pressure within the pump rises slightly above a predetermined point) the pump will be effective to produce a secondary flow of fluid which will be ejected from the pumping unit under a pressure substantially less than that found in the primary flow. It will be further understood that, although the present drawings disclose the secondary flow as being directed into the recess 36 and through the bore 60, those skilled in the art will readily understand that other modifications could be substituted therefor, as for example, the inclined conduit 50 could lead directly through the housing 10 thereby to be connected with a conduit for the purpose of leading the same directly to some suitable device which is adapted to be operated by this secondary fluid flow. In any event, as soon as the back pressure existing in the primary fluid flow system is reduced, the ring 21 will again move, under the force of the spring 41, into its position of maximum eccentricity, thus to again increase the rate of fluid flow of the primary system and at the same time cut off all fluid flow through the port 45 of the secondary system.

We claim:

1. In a variable delivery fluid pump, an outer housing providing a hollow chamber having a fluid intake port and first and second delivery ports, a modulator ring rockably mounted on a pivot axis adjacent to its outer periphery to swing within said chamber and presenting a substantially unbroken interior surface, a rotor rotatable within said ring and having radially slidable vanes cooperating with the interior surface of said ring, and spring means normally biasing the ring into eccentric position relative to the rotor so that the vanes will produce the pumping action thereby to force fluid under pressure through said first delivery port, a portion of said ring's interior surface in the zone of said first delivery port being acted on by the pumping pressure in a direction to shift said ring in opposition to said spring toward a position concentric with said rotor, said ring being effective when in its position of minimum eccentricity to expose said second delivery port to the pumping action, said ring being effective while in said first mentioned eccentric position to close off said second delivery port from said pumping action.

2. In a variable delivery fluid pump, an outer housing providing a hollow chamber defined by a pair of flat laterally spaced surfaces, said chamber having formed in its flat surfaces a fluid intake port and first and second delivery ports, a modulator ring rockably mounted on a pivot axis adjacent to its outer periphery to swing within said chamber and having its opposite edge portions slidably engaging said spaced surfaces, a rotor rotatable within said ring and having radially slidable vanes cooperating with the interior surface of said ring, and spring means normally biasing the ring into eccentric position relative to the rotor so that the vanes will produce the pumping action thereby to force fluid under pressure through said first delivery port, a portion of said ring's interior surface in the zone of said first delivery port being acted on by the pumping pressure in a direction to shift said ring in opposition to said spring toward a position concentric with said rotor, said ring being effective when in its position of minimum eccentricity to expose said second delivery port to the pumping action, said ring being effective while in said first mentioned eccentric position to close off said second delivery port from said pumping action.

3. In a variable delivery pump having an outer housing providing a hollow chamber defined by a pair of flat laterally spaced surfaces, said chamber having formed in its flat surfaces a fluid intake port and a fluid delivery port, a modulator ring rockably mounted on a pivot axis adjacent to its outer periphery to swing within said chamber and having its opposite edge portions slidably engaging said spaced surfaces, a rotor rotatable within said ring and having radially slidable vanes cooperating with the interior surface of said ring, and spring means normally biasing the ring into eccentric position relative to the rotor so that the vanes will produce the pumping action thereby to force fluid under pressure through said delivery port, 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 to shift said ring in opposition to said spring toward a position concentric with said rotor; the improvement which consists in the provision of a secondary fluid discharge means for de-

livering a relatively small stream of fluid from said pump whenever said ring is in its position of minimum eccentricity, said means comprising, a second delivery port substantially smaller in size than said first mentioned delivery port formed within one of said flat chamber surfaces at a location which is closed over by the edge portion of said ring whenever the latter is in its position of maximum eccentricity, said second delivery port being exposed to the fluid pressure created by said pumping action whenever said ring is in its position of minimum eccentricity, and a fluid delivery conduit formed within said housing and connected with said second fluid port for delivering the secondary fluid stream from said pump.

4. In a variable delivery pump having an outer housing providing a hollow chamber defined by a pair of flat laterally spaced surfaces, said chamber having formed in its flat surfaces a fluid intake port and a fluid delivery port, a modulator ring rockably mounted on a pivot axis adjacent to its outer periphery to swing within said chamber and having its opposite edge portions slidably engaging said spaced surfaces, a rotor rotatable within said ring and having radially slidable vanes cooperating with the interior surface of said ring, and spring means normally biasing the ring into eccentric position relative to the rotor so that the vanes will produce the pumping action thereby to force fluid under pressure through said delivery port, 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 to shift said ring in opposition to said spring toward a position concentric with said rotor; the improvement which consists in the provision of a secondary fluid discharge means for delivering a relatively small stream of fluid from said pump whenever said ring is in its position of minimum eccentricity and at a pressure substantially less than that existing within said pump, said means comprising a second delivery port substantially smaller in size than said first mentioned delivery port formed within one of said flat chamber surfaces at a location which is closed over by the edge portion of said ring whenever the latter is in its position of maximum eccentricity, said second delivery port being exposed to the fluid pressure created by said pumping action whenever said ring is in its position of minimum eccentricity, a spring-actuated pressure reducing valve disposed within said housing and connected with said second port, and a conduit formed within said housing and connected with said valve for delivering the secondary fluid stream from said pump.

5. In combination in a variable delivery fluid pump, an outer housing providing a hollow chamber having a fluid intake port and first and second delivery ports, a modulator member movably mounted in said chamber and having a circular internal pump chamber surface, a rotor rotatably disposed on a fixed axis within said pump chamber and having fluid impelling elements engaging said pump chamber circular surface, and means normally biasing the modulator member into a position wherein the pump chamber is eccentrically disposed relative to the rotor so that said pumping elements will produce a pumping action to impel fluid from said intake port under pressure through said first delivery port, fluid pressure created by the pumping action of the rotor and said elements acting on a surface of said modulator member to move the same in opposition to said biasing means toward

a position to effect a concentric relation of said pumping chamber with respect to said rotor, said modulator member being effective when in position of minimum eccentricity with respect to the rotor to expose said second delivery port to the fluid pressure created by said pumping action of the pump, said modulator member being effective while in said first mentioned eccentric position to close off said second delivery port from the fluid pressure created by said pumping action of the pump.

6. In combination in a variable delivery fluid pump, an outer housing providing a hollow chamber having a fluid intake port and first and second delivery ports, a modulator member movably mounted in said chamber and having a circular internal pump chamber surface, a rotor rotatably disposed on a fixed axis within said pump chamber and having fluid impelling elements engaging said pump chamber circular surface, means normally biasing the modulator member into a position wherein the pump chamber is eccentrically disposed relative to the rotor so that said pumping elements will produce a pumping action to impel fluid from said intake port under pressure through said first delivery port, fluid pressure created by the pumping action of the rotor and said elements acting on a surface of said modulator member to move the same in opposition to said biasing means toward a position to effect a concentric relation of said pumping chamber with respect to said rotor, said modulator member being effective when in position of minimum eccentricity with respect to the rotor to expose said second delivery port to the fluid pressure created by said pumping action of the pump, said modulator member being effective while in said first mentioned eccentric position to close off said second delivery port from the fluid pressure created by said pumping action of the pump, the housing having a passage therein for delivery of pressure fluid from said second delivery port, and pressure-responsive control means disposed in said passage for metering the pressure fluid delivered through said passage.

7. In combination in a variable delivery fluid pump, an outer housing providing a hollow chamber having a fluid intake port and first and second delivery ports, a modulator member movably mounted in said chamber and having a cir-

cular internal pump chamber surface, a rotor rotatably disposed on a fixed axis within said pump chamber and having fluid impelling elements engaging said pump chamber circular surface, and means normally biasing the modulator member into a position wherein the pump chamber is eccentrically disposed relative to the rotor so that said pumping elements will produce a pumping action to impel fluid from said intake port under pressure through said first delivery port, fluid pressure created by the pumping action of the rotor and said elements acting on a surface of said modulator member to move the same in opposition to said biasing means toward a position to effect a concentric relation of said pumping chamber with respect to said rotor, said modulator member being effective when in position of minimum eccentricity with respect to the rotor to expose said second delivery port to the fluid pressure created by said pumping action of the pump, said modulator member being effective while in said first mentioned eccentric position to close off said second delivery port from the fluid pressure created by said pumping action of the pump, said housing having passage means therein comprising one passage portion in direct communication with said second delivery port and a second passage portion separated from said one portion by the rotor, and the rotor having passage means therethrough effecting intercommunication between said passage means portions, whereby to accommodate delivery flow of fluid as impelled by the pumping action through said second delivery port when the latter port is exposed as aforesaid.

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