April 27, 1965 P. HARTMANN 3,180,271

VARIABLE VOLUME PUMP

Filed Jan. 11, 1962 2 Sheets-Sheet 1

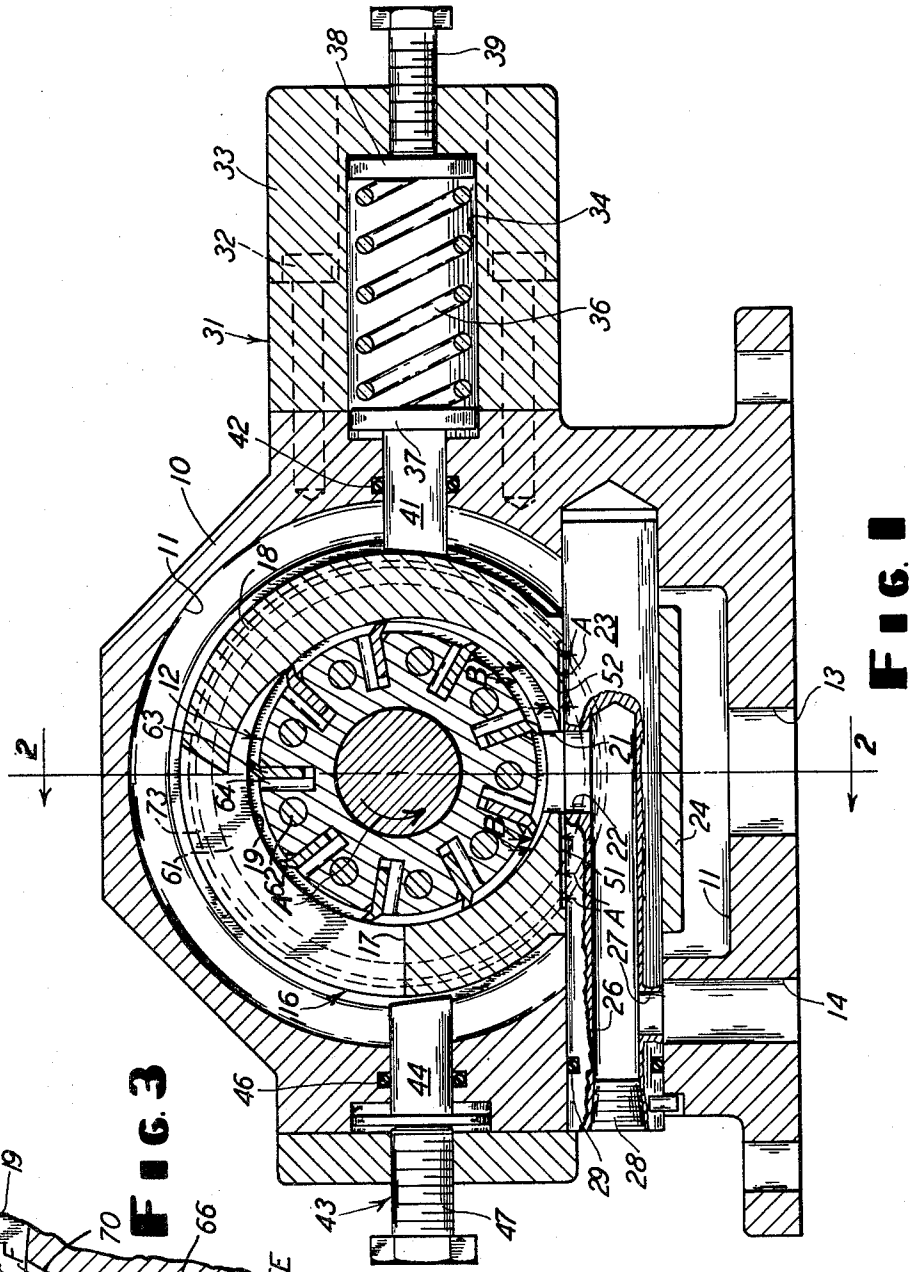

FIG. 1

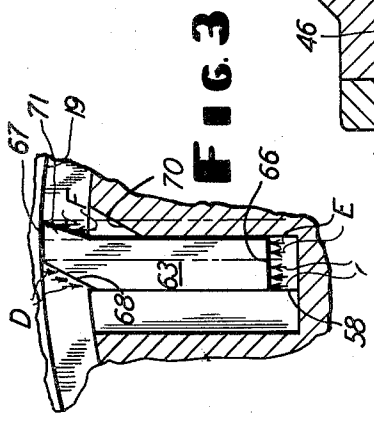

FIG. 3

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VARIABLE VOLUME PUMP

Filed Jan. 11, 1962 2 Sheets-Sheet 2

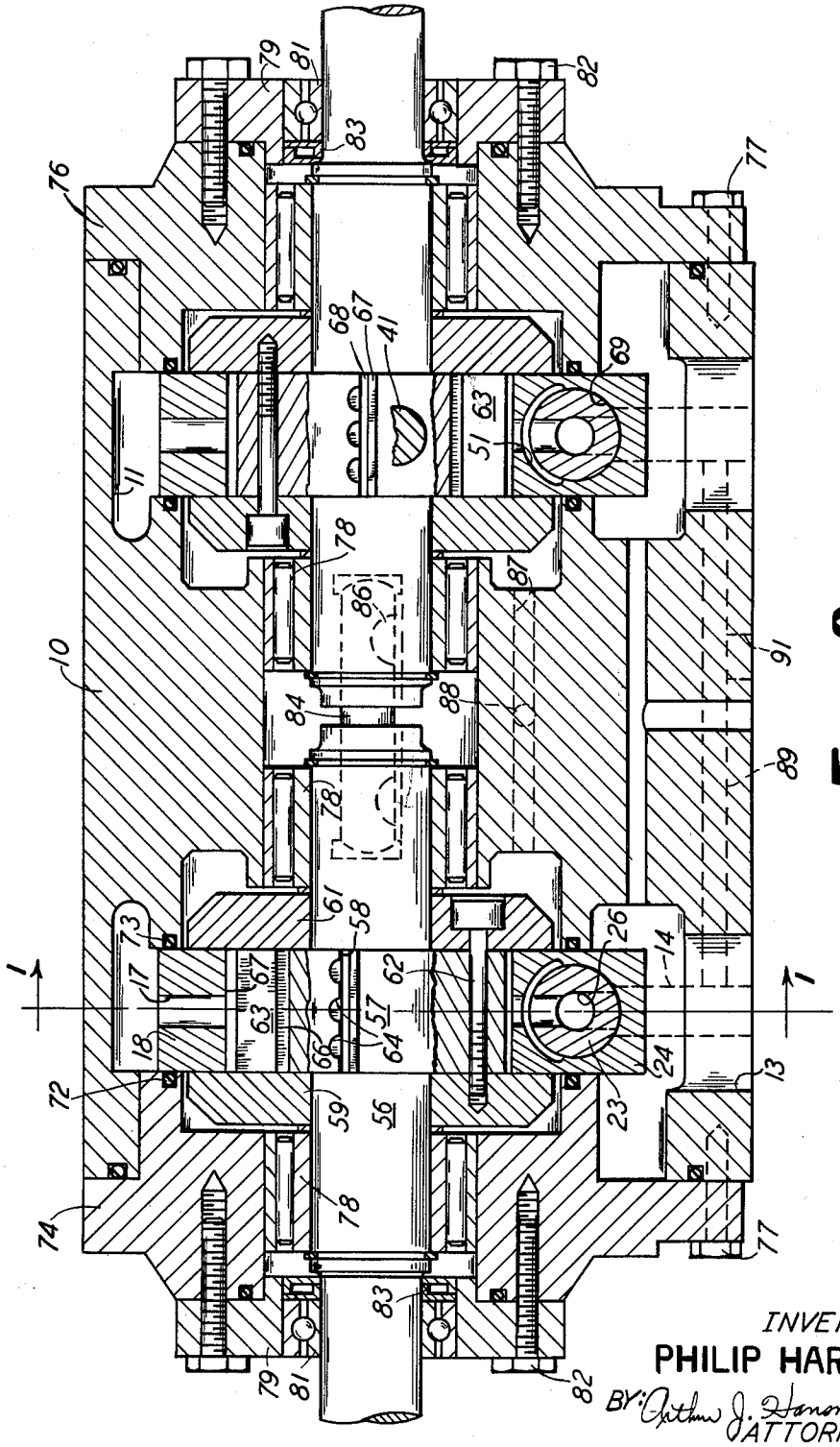

FIG. 2

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3,180,271

VARIABLE VOLUME PUMP

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14 Claims. (Cl. 103—120)

This invention relates to a variable volume hydraulic pump.

It is a general object of this invention to provide an improved variable volume hydraulic pump wherein the volume of the oil or like hydraulic medium may be varied by means of adjusting the pump, but to do so without affecting the efficiency of the pump or without unduly loading various parts of the pump.

A more specific object of this invention is to provide a variable volume pump wherein a movable ring is employed, but the ring is hydraulically balanced to at least minimize internal unbalancing pressures, and wherein also vanes are employed and they are hydraulically balanced to again minimize excessive unbalancing pressures acting on the vanes.

Thus, in accomplishing this particular object, the porting ring surrounding the vane rotor is hydraulically balanced by the pressure of the working medium itself, and the ring is also guided in its displaceable movement so that it can be readily and accurately positioned as desired.

Still another object of this invention is to provide a variable volume pump which is hydraulically balanced and which also has the inlet and outlet passages so arranged that they do not interfere with the size and location of the bearings supporting the rotor and thus these bearings can be made of an adequate size to support the loads applied to the pump.

Still another object of this invention is to provide a variable volume pump which is of a cartridge type such that the rotor and its port plate can be readily inserted into and removed from the pump housing, and also the pump can be arranged in a housing with another pumping unit so that a multiple or dual pump is provided in one housing. In accomplishing this particular object, it is also an object to provide the multiple pump with means that the two pump rotors can be driven in unison through a connector if desired, and also so that the pumps can be positioned out of phase to minimize pulsations and attending noise and vibration, and also so that the outlets of the two pumps can be joined together so that increases and decreases in outlet pressures are further minimized. Also, the multiple pump arrangement is such that the individual pumps can be driven separately so that separate and different outlet pressures can be obtained with the two pump units, if desired.

Still a further object of the invention is to provide a pump wherein the slip oil can be drained from the housing chamber so that fresh oil will be supplied thereto as a replacement for the slip oil, and therefore the pump will not be inclined to overheat since the fresh oil is brought into the pump. This particular feature is of course important in the dead-heading position of the pump where the pump is actually not delivering any quantity of oil or the like, but is instead simply retaining an outlet pressure as desired.

Other objects and advantages will become apparent upon reading the following description in light of the accompanying drawing wherein:

FIG. 1 is a sectional view through a preferred pump of this invention and taken on the line 1—1 of FIG. 2.

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1.

FIG. 3 is an enlarged view of a fragment of that shown in FIG. 1.

The same reference numerals refer to the same parts throughout the several views.

In the preferred embodiment of this invention, there is a housing 10 have a central chamber 11 with a rotor generally designated 12 rotatably disposed therein. The housing 10 has a fluid inlet passageway 13 and a fluid outlet passageway 14, both of which are in fluid-flow communication with the chamber 11. Thus the passageway 13 is in direct fluid-flow communication with the bottom of the chamber 11, and the working parts of the pump, generally designated 16 and also referred to as a cartridge, are disposed within the chamber 11 and are of a size such that the incoming working medium or oil can flow around the cartridge 16 and come into contact with the rotor 12 through an inlet opening 17 in a port ring 18, which is a part of the cartridge designated 16. The inner bore 19 of the ring 18 thus provides the circular surface on which the rotor 12 operates in rotating in the direction shown by the arrow designated A. In this manner, the fluid enters the inlet 13 and comes into the working chamber of the pump to be engaged by the rotor 12. At this time it might also be noted that the port ring 18 has a fluid outlet opening 21 which is in fluid-flow communication with a fluid passageway 22 in a pin or guide member 23 which is stationarily mounted in the housing 10. The pin 23 is shown to be cylindrical and a boss or projection 24 of the ring 18 encircles the pin 23, and further the ring 18 is slidable along the pin 23 to provide the adjustment required for a variable volume pump.

The pin 23 has another fluid passageway 26 extending therethrough and communicating with a passageway 27 which in turn is in communication with the outlet passageway 14. In this manner, the fluid is exhausted from the rotor 12 through the outlet passageway 14.

A plug 28 and an O-ring 29 are employed on the pin 23 to seal at the respective points so that fluid cannot leak therepast.

A governor generally designated 31 is mounted on the housing 10 by means of the bolts 32 such that a governor body 33 is provided with a bore 34. The latter contains a compression spring 36 which has a plunger 37 and a plunger 38 on each end of the spring so that the plungers are displaceable along the axis of the bore 34 and are of course influenced by the spring 36. An adjusting bolt or control 39 is extended through the housing 33 to abut the plunger 38 and a shank 41 is extended through the pump housing 10 to abut the port ring 18. Further, an O-ring 42 is shown to seal around the plunger 41. Thus it will be understood that threading the adjustment or bolt 39 in or out with respect to the housing 33 will cause a varying pressure on the spring 36 and this will in turn influence the position of the plunger 37 and its shank 41 to in turn influence the position of the port ring 18. Therefore, the ring 18 can be displaced, for instance to the left as viewed in FIG. 1 and the ring will therefore be out of the so-called dead-heading position which it is now in, that is, its concentric position with respect to the rotor 12. Of course in the event the ring 18 is shifted to the left, a greater quantity of fluid would be moved by the pump, and conversely if the ring 18 were shifted to the right, a lesser amount would be moved and therefore the desirable, variable volume feature is achieved.

A volume limit control is generally designated 43 and is shown on the diametrically opposite side of the pump with respect to the governor 31 and it will here be noted that a plunger 44 abuts the opposite side of the ring 18 and an O-ring 46 seals around the plunger 44. Also, an adjusting member or bolt 47 is provided to give positive control over the plunger 44. Therefore,

the maximum amount to which the ring 18 can shift to the left or toward the limit 43 is established by the position of the bolt 47, and this is therefore a limit control.

Since the pump is designed to operate at high pressures, and to also be adjustable for accurate control of volume, an important feature of the invention is the hydraulic balancing of the ring 18. To accomplish this, it will be noted that balancing pockets 51 and 52 are provided in the ring 18 at the point where the ring surrounds the upper circumferential portion of the pin 23. Thus the outlet pressure of the pump will be exerted on the ring 18 at the pockets 51 and 52 to counter-balance the downward pressure which will be exerted on the bore 19 of the ring 18 at the interior of the pump. Thus the pressure arrows designated A show outlet fluid pressure effective in the pockets 51 and 52 acting upwardly on the ring 18 to counter-balance the pressure indicated by the arrows B on the bore 19 of the ring 18. In this manner, the ring 18 is balanced according to the pressure it creates in pumping the fluid and thus no excessive unbalancing pressure is created, and the ring 18 is therefore free to move on the pin 23 in response to adjustment of the governor 31. To accomplish this fluid-balancing, the upwardly projected area on a horizontal plane, of the pockets 51 and 52 is substantially the same as the downwardly projected area, on a horizontal plane, of the bore 19 where the latter is of course subjected to the higher or outlet pressure in the lower half of the rotor 12, and the outlet opening 21 is omitted from these projected area considerations.

The rotor 12 consists of the shaft 56 and the central portion 57 which includes the vane slots 58 radially disposed around the portion 57. Side plates 59 and 61 are secured to the portion 57 by means of bolts 62, and it will be noted that the plates 59 and 61 thus flank the port ring 18 and rotate thereover upon rotation of the rotor 12.

Vanes 63 are radially, slidably disposed in the vane slots 58 and it will be noted that fluid openings 64 communicate the periphery of the member 57 with the radially, inner end of the slots 58 so that fluid pressure can be applied to the lower surface or base 66 of the vanes 63. In this manner, the vanes 63 are held radially outwardly so that the outer surfaces or tips 67 are held in sliding contact with the ring bore 19 to be fluid-tight therewith as desired.

An important feature of the fluid-balancing with respect to the vanes 63 is shown particularly in FIG. 3 where it will be noted that the fluid pressure applied at the base 66 of the vanes 63 is designated by the arrows C, and this pressure is radially balanced by the same fluid pressure applied on an angled or chamfered surface designated 68 on the outer end of the vane 63 and the pressure on the surface 68 is indicated by the arrows designated D. Also, pressure arrows designated E are unbalanced since the vane outer surface 67 is in contact with the bore 19 so that no pressure exists therebetween, and thus only the small force created by the pressure arrows designated E holds the vane 63 radially outwardly as desired. There would also be a small force as designated by the pressure arrows F acting radially outwardly on the offset 71 of the vane, but this would of course be only inlet pressure.

With this arrangement of a vane 63 with the chamfer 68 and the projection 71, the full outlet pressure of the fluid is not effective against the vane base 66 so that the usual excessive force is not acting on the vane to hold it outwardly and thereby create friction and wear which is unnecessary. Instead only the small area and the pressure of the arrows indicated E is effective on the vanes at the higher or outlet pressures of the pump while also only the small area and pressure indicated by the arrows F is effective on the vane at the inlet pressures which are not excessive for the vane. In this manner, both the ring 18 and the vanes 63 are hydraulically balanced so that no excessive pressures are applied thereto.

Also the rotor has a cutout 70 which receives the vane projection 71 when the vane is radially inward on the rotor. Further, the angles of the projection 71 and the cutout 70 are different so that fluid pressure can always be effective between the two and thus force the vane outwardly. Thus the pressure shown by the arrows C is more than the pressure shown by the arrows E and therefore the radially inwardly projected area on the angle or chamfer 68 is greater than the area covered by the arrows E so the outward pressure on the vane is not too great and thus friction between the vane and the bore 19 is not too great. Still further, the offset 71 and its underneath surface with the pressure designated by the arrows F hold the vane outwardly when the pump is in the dead-heading position. Thus in the variable volume pump, the vanes are always held outwardly though the ring 18 is moved back and forth.

Further, the area on which the pressure arrows A act on the ring 18 is at least one-half of the area on which the pressure arrows B act, and, as previously described, the projections of these areas are substantially equal. Thus most of the pressure on the ring 18 is balanced in the pockets 51 and 52 which are therefore sufficient for substantially balancing the ring 18.

An important feature is the arrangement of the outlet 21 and the passageway 22 communicating with the guide pin 23 so that the outlet pressure is effective around the circumference of the pin 23 and in the bore 69 of the ring 18. Thus the outlet pressure will fluid-balance and lubricate the ring 18 on the pin 23 and there will therefore be no seizing or binding of the ring 18 on the pin 23 as the ring will be free to move as desired.

Also, O-rings 72 and 73 are applied on opposite sides of the port ring 18 to seal the latter with the housing 10.

With particular reference to FIG. 2, it will also be noted that the housing 10 also has end pieces 74 and 76 secured thereto by bolts 77 and roller bearings 78 are shown along the rotor shaft 56 to rotatably mount the latter in the housing 10. Still further, it will of course be noted that two pumps having the cartridges 16 are shown in the housing 10 and these pumps are slightly out of phase so that the vanes of one pump are unloading at a time different from that of the other pump, and therefore the pulsations and vibrations are minimized. FIG. 2 therefore shows that the vanes are staggered between the two cartridges 16. It will further be noted that since the inlets and outlets of the respective pumps are substantially in the plane of the rotor 12, the bearings 78 can be as large as needed for supporting the loads on the shaft 56 since the inlets and outlets of the pump do not limit or restrict the size of the bearings 78. Still further, end caps 79 with bearings 81 are applied ot the end pieces 74 and 76 and are secured thereto by bolts 82. A seal 83 is applied around the outer end of the shaft 56 to seal therewith.

With respect to the multiple or dual units of the pumps, it will therefore be understood that the cartridge units 16 can be readily inserted into and removed from the housing 10. Also, FIG. 2 shows that the shaft 56 can be connected by means of a shaft 84 being keyed thereto with the keys 86 so that the shafts 56 can rotate together if desired. Still further, fluid passageway 87 is provided between the housing rotors 11 so that any slip oil getting beyond the plates 59 and 61 will be drained from the housing through the drain 88 so that fresh oil can replace the slip oil. With the arrangement of the passages 87 and 88, the slip oil is drained from the housing and then fresh oil will be taken in when the pumps are in the dead-heading position, and thus the pumps will run cooler with the fresh oil brought in at the lower temperature.

With the arrangement of the single housing 10, and the offset of one cartridge 16 with respect to the other cartridge 16 to minimize pulsations, the outlets 14 can be connected together through the passageway designated 89

so that a steady flow of oil under a uniform pressure is exhausted into the passageway 89 and the outlet 91. Of course, the passageway 89 may be eliminated or shut off by conventional means if it is desired that the cartridges 16 be run independent of each other without the connecting shaft 84 so that separate pressures can be exhausted by each of the pumping units.

Of course, with the multiple unit shown in FIG. 2, each of the port rings 18 are independently governed by their respective governors, and therefore the outlet volume of each pump can be controlled as desired.

In conclusion, a multiple pump is provided with removable cartridges which can be driven together or separately, and discharged together or separately. The ring 18 is fluid balanced by the pockets 51 and 52, while the guide 23 is fixed in the housing, and the outlet pressure is effective entirely around the bore 69 to also fluid balance and lubricate the ring 18 on the guide 23. Only the guide 23 is required so that its fit with the ring 18 can be easily achieved to permit fluid pressure to seep therebetween for the lubrication desired, and no seal or O-ring is required. O-rings 72 and 73 seal the cartridges 16 for the desired pumping action, but slip oil can discharge through passageways 87 and 88 so fresh oil will replace the slip oil to keep the oil cool. The fit on the pin 23 is honed and with a clearance of perhaps .0002 inch so that oil can seep into the bore 69.

The fluid pressure within the ring 18 urges the ring 18 to the left as viewed in FIG. 1, and against the limit control 43, with the governor 31 and control 43 being on diametrically opposite sides of the pump and effective transverse to the outlet 21.

Also, the vanes 63 have offsets 71 and chamfers 68 for controlling the radial fluid pressures on the vanes 63, and the vanes can readily move entirely inward and outward on the rotor in response to the position of ring 18.

While a specific embodiment of this application has been shown and described, it should be obvious that certain changes could be made therein and the invention therefore should be determined only by the scope of the appended claims.

What is claimed is:

1. A variable volume pump comprising a housing having a chamber therein and an inlet passageway and an outlet passageway in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and having a fluid inlet and a fluid outlet therein in respectively fluid-flow communication with said inlet and said outlet passageways, a guide pin in said housing and extending through said port ring beyond both sides thereof in the direction parallel to the movement of said port ring and extending through a portion of said port ring adjacent said fluid outlet and being in sliding engagement with said port ring for guiding the movement of the latter and restraining same in the direction transverse to said parallel direction, said guide pin having a fluid passageway in fluid-flow communication with said fluid outlet of said port ring, said guide pin and said port ring defining a fluid pocket to the side of said guide pin toward said fluid outlet and with said pocket being in fluid-flow communication with said fluid outlet for fluid pressure balancing said port ring in said transverse direction, a governor on said housing for controlling movement of said port ring, and a rotor rotatably mounted in said housing and inside said port ring for moving fluid therein.

2. A variable volume pump comprising a housing having a chamber therein and a fluid inlet passageway in fluid-flow communication with said chamber, a port ring movably disposed in said chamber, a guide member in said housing and including a surface extending in a direction parallel to the movement of said port ring and with said port ring being in sliding engagement therewith for guiding the movement of said port ring, a governor on said housing for controlling movement of said port ring, a rotor rotatably mounted in said housing and inside said port ring for moving fluid therein, said port ring and said guide member at said surface having fluid outlet openings therein in fluid-flow communication and having a fluid pocket therebetween in fluid-flow communication with said outlet openings and exposed to said port ring in a projected area more than-one-half the oppositely projected area of said rotor to fluid-pressure balance said port ring, and said port ring having a fluid inlet on the side thereof opposite said fluid outlet opening.

3. A multiple variable volume pump comprising a housing having two axially aligned chambers therein and inlet passageways in fluid-flow communication with said chambers and a common outlet passageway, a port ring movably disposed in each of said chambers, guide members in said housing and extending through said port rings and beyond opposite sides thereof in a direction parallel to the movement of said port rings and being in sliding engagement with said port rings for guiding the movement of the latter, governors on said housing for controlling movement of said port rings, rotors rotatably mounted in axial alignment in said housing and inside said port rings for moving fluid therein, shafts on said rotors and being axially aligned, and a coupler connected to said shafts for transmitting rotation therebetween and maintaining said rotors in rotative related positions for alternate pumping action.

4. A variable volume pump comprising a housing having a chamber therein and an inlet passageway and an outlet passageway both in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and having a bore defined by an arcuate surface and being in fluid-flow communication with said chamber, a guide member in said housing and extending through said port ring and beyond the sides thereof in a direction parallel to the movement of said port ring and being in sliding engagement with said port ring for guiding the movement of the latter, a governor on said housing for controlling movement of said port ring, a rotor rotatably mounted in said housing and inside said port ring bore for moving fluid therein and having vane slots radially disposed therein, and vanes radially slidably disposed in said slots and with the radially outer surfaces of said vanes being in contact with said arcuate surface upon radial projection of said vanes and with each of the latter having a chamfer on the radially outer end thereof toward the forward side of rotation of said vanes and having a projection on said radially outer end on the other side thereof.

5. A variable volume pump comprising a housing having a chamber therein and an inlet passageway in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and having a fluid inlet and fluid outlet therein and a bore in fluid-flow communication with said inlet and said outlet and having an arcuate surface defining said bore, a guide pin in said housing and extending through said port ring beyond both sides thereof in the direction parallel to the movement of said port ring and extending through a portion of said port ring adjacent said fluid outlet and being in sliding engagement with said port ring for guiding the movement of the latter, said guide pin having a fluid outlet in fluid-flow communication with said fluid outlet of said port ring, said guide pin and said port ring defining a fluid pocket to the side of said guide pin toward said fluid outlet and with said pocket being in fluid-flow communication with said fluid outlet for fluid pressure balancing said port ring, a governor on said housing for controlling movement of said port ring, a rotor rotatably mounted in said housing and inside said port ring bore for moving fluid therein and having vane slots radially disposed therein, and vanes radially slidably disposed in said slots and with the radially outer surfaces of said vanes being in contact with said surface when said vanes are radially projected, and said vanes having a chamfer on the radially outer end thereof toward the side of rotation of said vanes and having a

projection on the radially outer end on the other side thereof.

6. A variable volume pump for pumping a hydraulic fluid comprising a housing having a chamber therein and an inlet passageway in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and having a fluid inlet and a fluid outlet therein and with said inlet being in fluid-flow communication with said chamber, said port ring having a circular opening extending therethrough across diametrically opposite sides and intersecting said fluid outlet, a guide pin in said housing and extending in the direction parallel to the movement of said port ring and having a circular cross-section extending through said circular opening of said port ring and being in sliding engagement with said port ring for guiding the movement of the latter and being in a snug fit therewith capable of admitting said hydraulic fluid with clearance, said guide pin having a fluid outlet extending transversely through said circular cross-section and being in fluid-flow communication with said fluid outlet of said port ring, a governor on said housing for controlling movement of said port ring on said guide pin, and a rotor rotatably mounted in said housing and inside said port ring for moving fluid therein.

7. A variable volume pump for pumping a hydraulic fluid comprising a housing having a chamber therein and an inlet passageway and an outlet passageway with both in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and being spaced from said housing and having a fluid inlet and a fluid outlet therein and with said fluid inlet being in fluid-flow communication with said chamber, a guide pin fixedly disposed in said housing and extending across said chamber in the direction parallel to the movement of said port ring and having an arcuately shaped surface extending through a portion of said port ring adjacent said fluid outlet and being in sliding engagement with said port ring for guiding the movement of the latter and being in a snug fit therewith capable of admitting said hydraulic fluid with clearance, said guide pin having a fluid passageway extending transversely through said arcuately shaped surface in fluid-flow communication with said fluid outlet of said port ring and being in flow communication with said fluid passageway of said housing, a governor on said housing for controlling movement of said port ring on said guide pin, and a rotor rotatably mounted in said housing and inside said port ring for moving fluid therein.

8. A variable volume pump comprising a housing having a chamber therein and a fluid inlet passageway in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and being radially spaced from the wall of said chamber and having flat faces on opposite sides in siding contact with said housing, a fluid seal between said faces and said housing, a guide member disposed in said housing and said port ring being in sliding engagement therewith for guiding the movement of said port ring, a governor on said housing for controlling movement of said port ring, a rotor rotatably mounted in said housing and inside said port ring for moving fluid therein, said port ring and said guide member having fluid outlet openings therein in fluid-flow communication, said housing having a fluid outlet passageway in fluid-flow communication with said outlet openings, and said port ring having a fluid inlet in fluid-flow communication with said chamber on the side thereof opposite said fluid outlet opening in said port ring.

9. A variable volume pump comprising a housing having a chamber therein and an inlet passageway and an outlet passageway both in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and having a bore defined by an arcuate surface and having an inlet opening and an outlet opening both in fluid-flow communication with respective ones of said passageways, a guide member in said housing and extending through said port ring and beyond the sides thereof in a direction parallel to the movement of said port ring and being in sliding engagement with said port ring for guiding the movement of the latter and having a fluid passageway in fluid-flow communication with said outlet opening of said port ring, means on said housing for controlling movement of said port ring, a rotor rotatably mounted in said housing and inside said port ring bore for moving fluid therein and said rotor having vane slots radially disposed therein, and vanes radially slidably disposed in said slots and with the radially outer edges of said vanes being in contact with said arcuate surface upon radial projection of said vanes, and said vanes having a projection on the radially outer ends thereof toward the trailing side of rotation of said vane and being subjected to fluid outlet pressure upon rotation of said rotor.

10. A variable volume pump comprising a housing having a chamber therein and an inlet passageway and an outlet passageway and with said inlet passageway being in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and spaced clear of said housing and having a bore defined by an arcuate surface and having an inlet opening and an outlet opening with said inlet opening being in fluid-flow communication with said chamber, a guide member fixedly mounted in said housing and extending through said port ring in a direction parallel to the movement of said port ring and with the latter being in sliding engagement with said guide member and with the latter having a fluid passageway in fluid-flow communication with both said outlet passageway and said outlet opening, means on said housing for controlling movement of said port ring, a rotor rotatably mounted in said housing and inside said port ring bore for moving fluid therein and said rotor having vane slots radially disposed therein, and vanes radially slidably disposed in said slots and with the radially outer edges of said vanes being in contact with said arcuate surface upon radial projection of said vanes, and said vanes having a projection on the radially outer ends thereof toward the trailing side of rotation of said vane and being subjected to fluid outlet pressure upon rotation of said rotor.

11. A variable volume pump comprising a housing having a chamber therein and an inlet passageway and an outlet passageway both in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and spaced clear of said housing and having a bore defined by an arcuate surface and having an inlet opening in fluid-flow communication with said inlet passageway, a guide member fixedly mounted in said housing and extending through said port ring in a direction parallel to the movement of said port ring and with the latter being in sliding engagement with said guide member and with the latter having a fluid passageway in fluid-flow communication with both said outlet passageway and said outlet opening, means on said housing for controlling movement of said port ring, a rotor rotatably mounted in said housing and inside said port ring bore and defining the latter in two equal halves of a suction side and a pressure side in said bore and with said pressure side being adjacent said guide member and with said rotor having vane slots radially disposed therein, said port ring having an outlet opening in fluid-flow communication with said bore and said fluid passageway of said guide member, said guide member and said port ring defining a fluid pocket therebetween of a projected area along with the area of said fluid outlet opening substantially equal to the projected area of one of said halves of said port ring, and said fluid pocket being in fluid-flow communication with said fluid outlet opening, and vanes radially slidably disposed in said slots and with the radially outer edges of said vanes being in contact with said arcuate surface upon radial projection of said vanes, and said vanes having a projection on the radially outer ends thereof toward the trailing side of rotation of said vane and being disposed

in said pressure side of said bore to be subjected to fluid outlet pressure upon rotation of said rotor.

12. A variable volume pump comprising a housing having a chamber therein and a fluid inlet passageway in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and adapted to be radially spaced from the wall of said chamber and having a central bore and flat faces endlessly surrounding said bore on opposite sides and in sliding contact with said housing, a fluid seal endlessly between said faces and said housing, a guide member disposed in said housing and said port ring being in sliding engagement therewith for guiding the movement of said port ring, a governor on said housing for controlling movement of said port ring, a rotor rotatably mounted in said housing and in said port ring bore for moving fluid therein, said rotor including side plates endlessly and fluid-tightly disposed on said flat faces of said port ring for fluid-tightly rotating thereover, said port ring and said guide member having fluid outlet openings therein in fluid-flow communication with each other and with said bore, and said port ring having a fluid inlet in fluid-flow communication with said chamber and said bore on the side thereof opposite said fluid outlet opening in said port ring.

13. A variable volume pump comprising a housing having a chamber therein and a fluid inlet passageway in fluid-flow communication with said chamber, a port ring movably disposed in said chamber and having a suction side and a pressure side and a fluid inlet and a fluid outlet disposed respectively to said sides and with said fluid inlet being in fluid-flow communication with said chamber, a guide pin in said housing and extending through said port ring beyond both sides thereof in the direction parallel to the movement of said port ring and extending through a portion of said port ring adjacent said fluid outlet and being in sliding engagement with said port ring for guiding the movement of the latter and supporting the same against movement in the direction transverse to said parallel direction, said guide pin having a fluid passageway in fluid-flow communication with said fluid outlet of said port ring, said pump having a fluid outlet opening in fluid-flow communication with said fluid passageway, a governor on said housing for controlling movement of said port ring, and a rotor rotatably mounted in said housing and inside said port ring for moving fluid therein.

14. A multiple variable volume pump comprising a housing having two axially aligned chambers therein and inlet passageways in fluid-flow communication with said chambers, a port ring movably disposed in each of said chambers and each having a fluid inlet in respective fluid-flow communication with said chambers, guide members in said housing and extending through said port rings and beyond opposite sides thereof in a direction parallel to the movement of said port rings and being in sliding engagement with said port rings for guiding the movement of the latter, said port rings and said guide members having fluid outlet passageways for exhausting fluid from said housing, governors on said housing for controlling movement of said port rings, rotors rotatably mounted in axial alignment in said housing and inside said port rings for moving fluid therein and including pumping means operable to pump fluid through said outlet passageways, shafts on said rotors and being axially aligned, and a coupler connected to said shafts for transmitting rotation therebetween and maintaining said rotors with the respective said pumping means in rotative related positions for alternate pumping action.

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