

Jan. 28, 1969

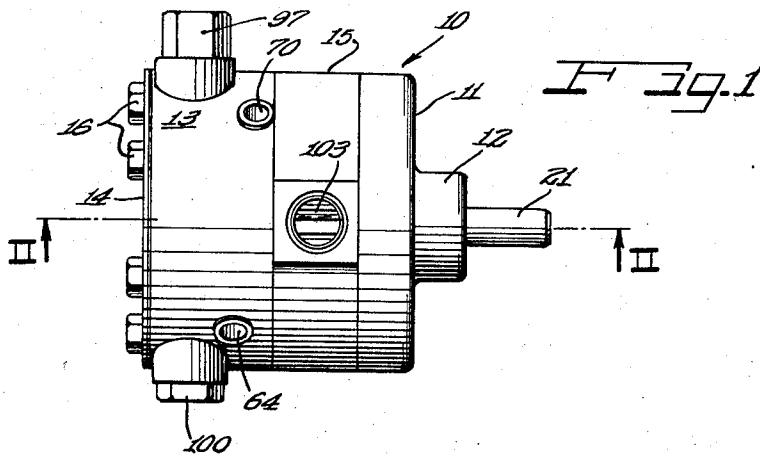
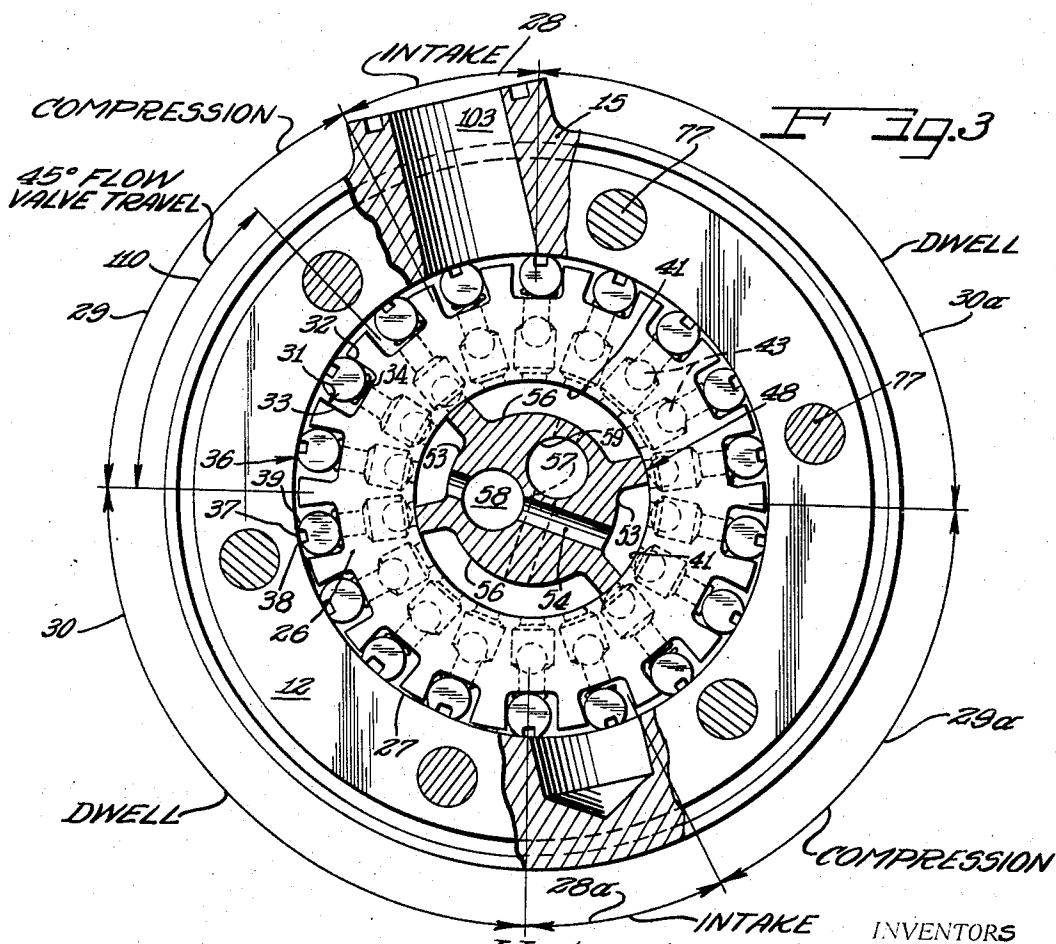
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3,424,094

VARIABLE DELIVERY PUMP OR COMPRESSOR

Filed Dec. 23, 1966

Sheet 1 of 4



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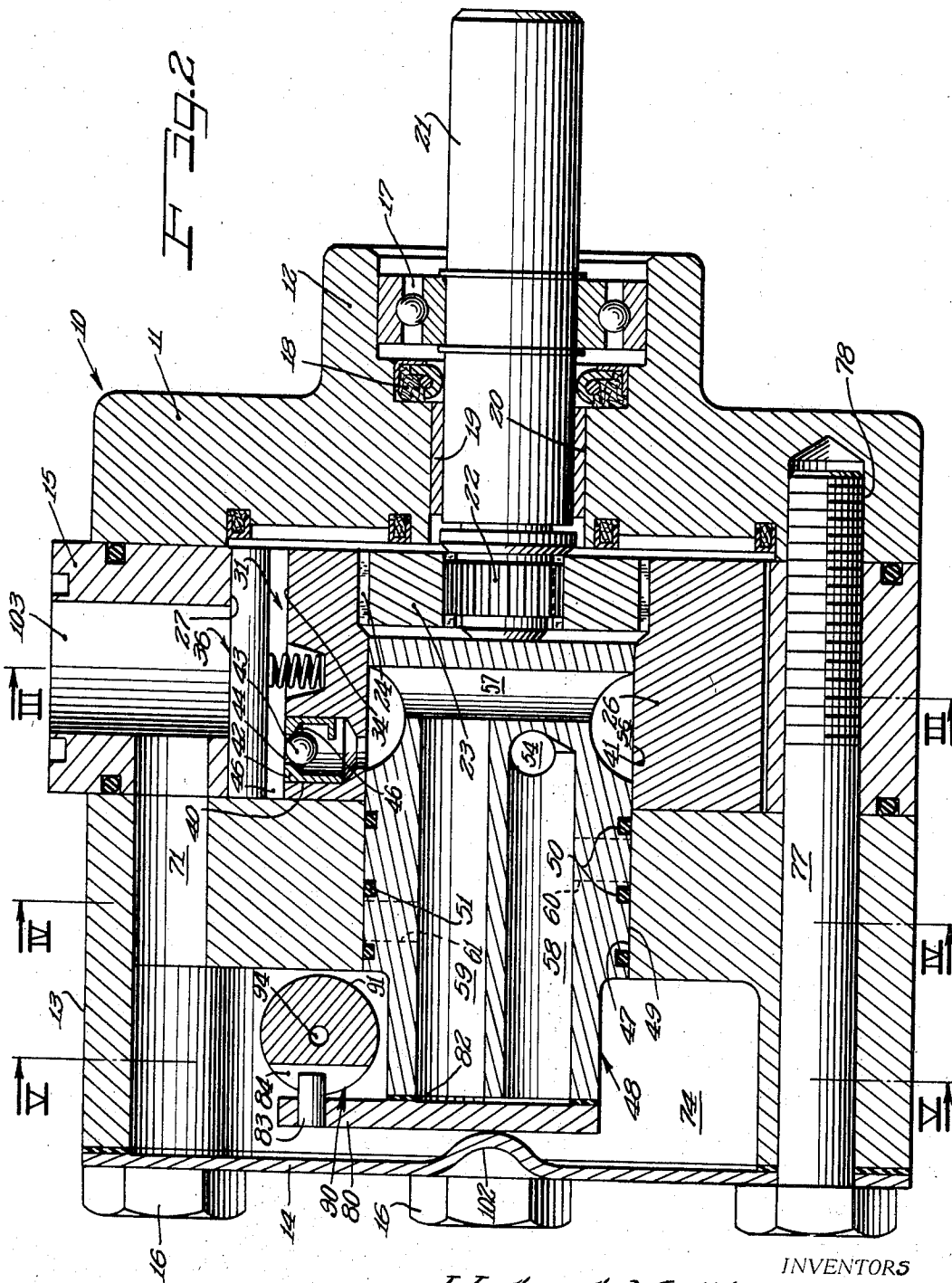
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VARIABLE DELIVERY PUMP OR COMPRESSOR

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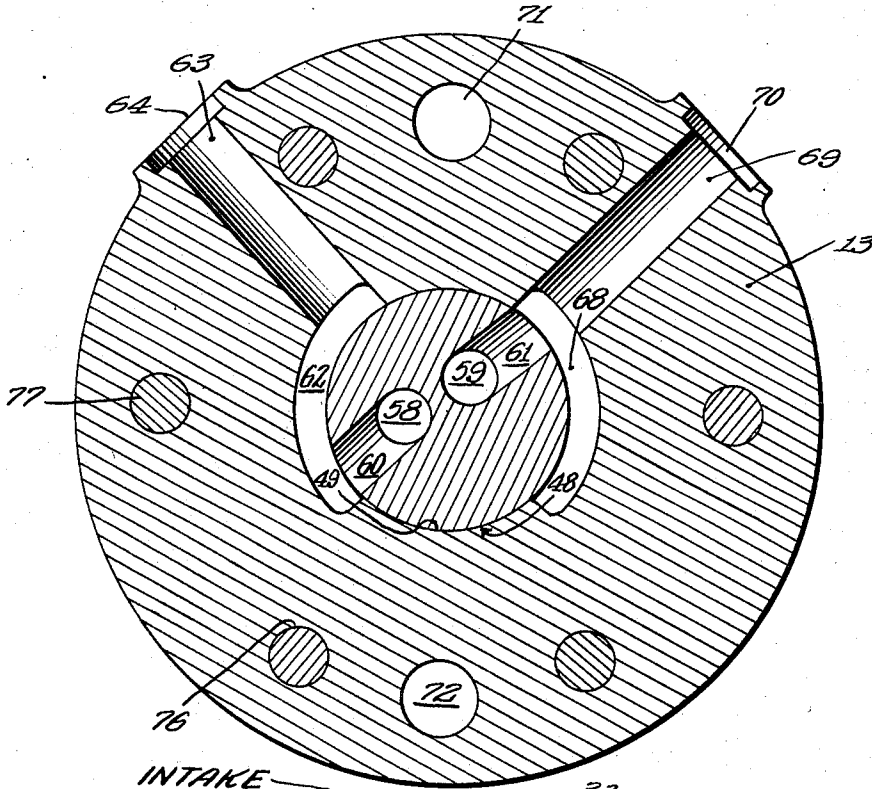
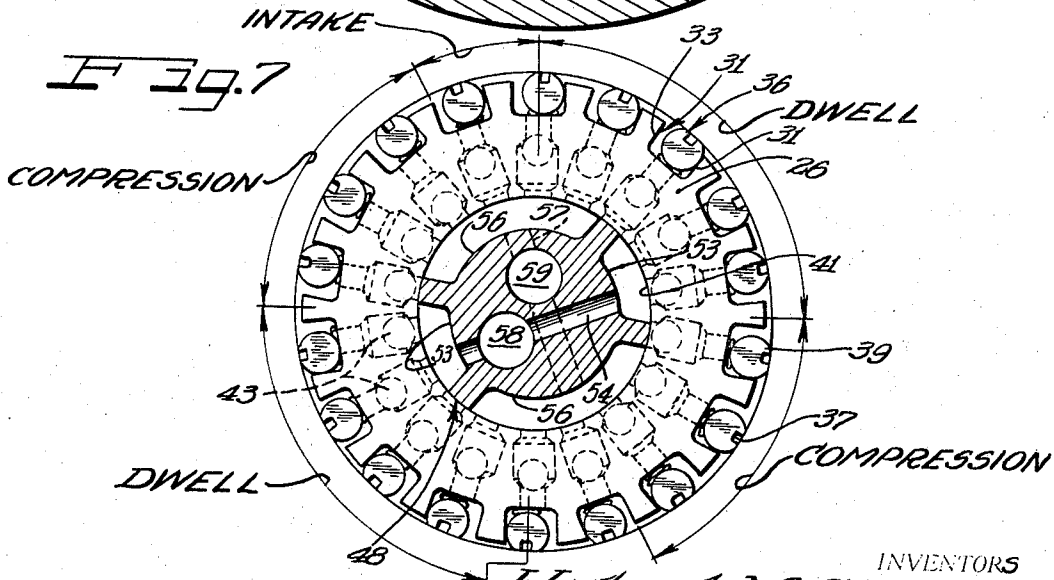
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Fig. 4



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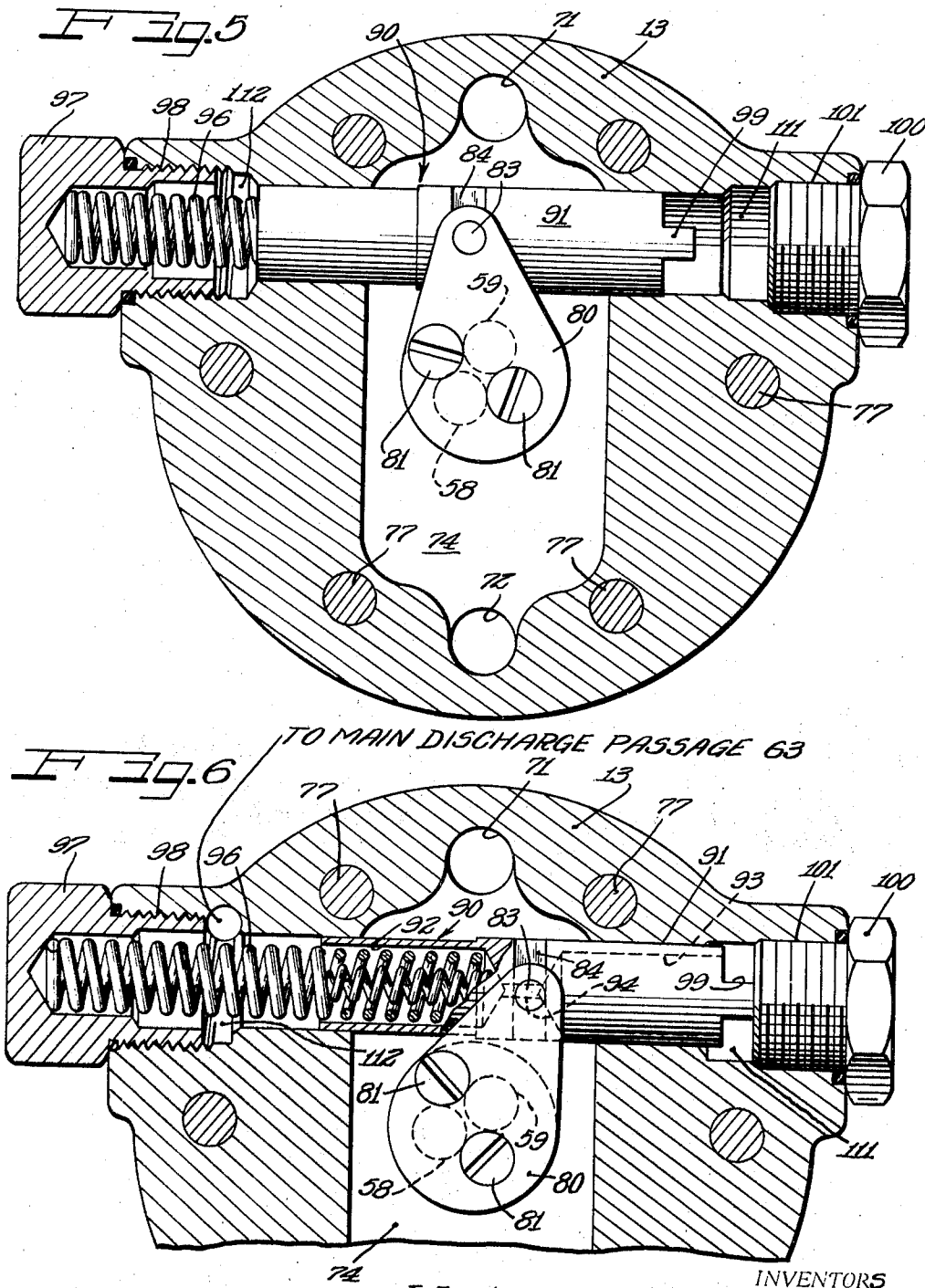
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VARIABLE DELIVERY PUMP OR COMPRESSOR

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3,424,094

VARIABLE DELIVERY PUMP OR COMPRESSOR

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U.S. Cl. 103—120

Int. Cl. F04c 15/04; F04b 1/10, 49/00

5 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates generally to pumps and more particularly relates to a slipper-type pump particularly characterized by a commutator pintle situated inwardly of a ring-shaped rotor whereby peripheral channels in the pintle may be presented as alternate port positions upon angular adjustment of the pintle to correspondingly vary the pumping delivery of the slippers as such slippers rock angularly and move radially in following the contour of an adjoining pumping chamber wall.

BACKGROUND OF THE INVENTION

Field of the invention

The invention pertains to the field of art pertaining to variable delivery pumps or more specifically to pumps having an angularly adjustable control means for varying the delivery of the pump.

Description of the prior art

Pintle porting in variable displacement pumps is taught in such prior art patents as Newberg 1,482,807; Anderson 2,420,806 and Nubling 2,749,843. Slipper pumps are also known as evidenced by prior patent of the present inventors No. 3,081,706. Prior art patents, however, have not solved the problem of modulating pump output volume in a slipper-type pump and the present invention solves that problem by using the forward and rearward pumping volumes between the slippers or vanes of a slipper pump as a means of modulating the pump output volumes. Thus, conventional porting practices are changed by the use of a pintle in a slipper-type pump having separated channels so that intake stroke will produce increasing volume between the slippers, as well as a dwell where a constant discharge is achieved through a so-called working arc and there is an exchange cycle in the converging bore of the outlet port, whereby oil from the underside of the slippers goes to the top side of the slippers without changing the output of the flow on the upstream hydraulic circuit.

SUMMARY

The present invention provides a variable delivery principle in a slipper type pump wherein a method of utilizing forward and rearward pumping volumes between slippers may be exploited as a means of modulating pump output volume. Further, the slipper pump unit of the present invention has a multiple pump impulse arrangement reducing vibration control problems and utilizes a simple balanced construction which is particularly compact with respect to the displacement ratio of the pump and which is comprised of inexpensive parts economical to fabricate and assemble.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an elevational view of a pump provided in accordance with the principles of the present invention;

FIGURE 2 is a cross-sectional view taken on the line II—II of FIGURE 1;

FIGURE 3 is a cross-sectional view taken on line III—III of FIGURE 2;

FIGURE 4 is a cross-sectional view taken on line IV—IV of FIGURE 2;

FIGURE 5 is a cross-sectional view taken on line V—V of FIGURE 2 and shows the commutator pintle at a position of adjustment for maximum main flow as illustrated in cross-section in FIGURE 3;

FIGURE 6 is a fragmentary view similar to FIGURE 5 but showing the commutator pintle at a position of adjustment corresponding to FIGURE 7 and with parts broken away to show additional details of the pintle adjustment means; and

FIGURE 7 is a view similar to FIGURE 3 but showing a different position of adjustment for the commutator pintle corresponding to the adjustment of FIGURE 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The pump of the present invention is shown generally at 10 and comprises a casing means including a first end section 11, a main pump body 15, a second end section 13 and a cover 14 which is retained in firm assembly with the end section 13 by a plurality of fasteners 16.

The end section 11 has an axially extending boss 12 in which is positioned a bearing assembly 17 and adjacent thereto is located a shaft seal shown generally at 18. A bearing sleeve 19 is also provided axially inwardly within a bore 20, thereby to journal a shaft 21 having splines 22 for engaging a driving member 23 which, in turn, is splined as at 24 to a ring-shaped rotor 26.

The ring-shaped rotor 26 is thus rotatably driven upon connecting the shaft 21 to a suitable source of motive power within a pumping chamber 27 formed interiorly of the pump body part 15. As shown in FIGURE 3, the pump body part 15 is formed with a bore wall providing the pumping chamber 27 having a contour shaped to provide a double-lobed pumping cavity. Accordingly, there is a first intake arc shown at 28 of limited angular extent and immediately adjacent thereto the bore wall has a contour shaped to provide a compression arc 29. Thereafter, the bore wall has a constant curvature to provide a dwell arc 30.

A second intake arc is shown at 28a and a second compression arc is shown at 29a and a second dwell arc is shown at 30a.

The rotor 26 is particularly characterized by a multiple element pumping means arrangement. Thus, in the peripheral surface of the rotor 26 is formed a plurality of generally rectangular notches and each respective notch is shown at 31 and includes spaced parallel side walls 32 and 33 with a bottom wall 34.

Situated within each notch 31 is a slipper of the type which can rock angularly and move radially in following the contour of the adjoining bore wall 27. Each slipper is designated generally at 36 and includes a recess 37, thereby to provide spaced bearing area 38 and 39 on opposite sides of the recess for engaging the bore wall and developing a planing action whereby the slipper tends to ride on a film of the pumping medium as it is rotated in the pumping chamber.

It will be apparent, therefore, that the bore wall 27 in cooperation with the rotor 26 and the pumping elements provided by the slippers 36 will provide pumping areas of increasing volume as the rotor moves respective pairs of slippers 36 through the intake arcs 28 and 28a. The respective volumes between the slippers is decreasing as the rotor drives the slippers through the compression arcs 29 and 29a, thereby increasing the pressure of the fluid and such pressure is maintained at a constant level in

the non-pumping section of the pump as the rotor moves through the dwell arcs 30 and 30a.

The rotor 26 is particularly characterized by the formation therein of a flow passage 40 extending radially inwardly from each respective notch 31 to an internal through bore 41 formed in the rotor 26. Each passage 40 has a cage 42 in which is contained a ball check valve 43. The cage has a reduced size opening 44 thereby to form a valve seat 46 against which the ball check valve 43 may engage to close the passage 40.

The end section 13 is formed with an internal bore 47 which corresponds in size to the bore 41, thereby to facilitate reception of a commutator pintle shown generally at 48.

The commutator pintle 48 is a generally cylindrical member having an outer peripheral wall 49 which slidably engages the bore wall provided by the bores 41 and 49 in the rotor 26 and the end section 13, respectively. To provide a seal, the wall 49 has a plurality of axially spaced recesses 50 each receiving a sealing member such as an O ring 51.

The pintle 48 is further characterized by a pair of peripheral channels shown at 53 and which are interconnected by a diametrically extending passage 54. A second pair of channels 56, 56 are interconnected by a diametrically extending passage 57.

The channels 53, 53 and 56, 56 are in the rotor area of the pintle only and are sealed by lands from intercommunication and axial leakage.

First and second axial flow passages 58 and 59 are formed interiorly of the pintle 48 and lead to radially outwardly extending passages 60 and 61, respectively. It will be noted upon referring to FIGURE 4 that the body section 13 of the casing means has a recess 62 extending through approximately 45° of arc communicating with the passage 60 and an outwardly extending main discharge passage is shown at 63 terminating in an outlet 64 and which outlet may be connected to a point of utilization.

The section 13 also has a recess 68 which likewise extends through approximately 45° of arc and is connected to passage 69 terminating in a port 70 and which likewise may be connected to a secondary point of utilization such as a hydraulic circuit requiring cooling or lubricating flow. The body section 13 has two axially extending passages shown at 71 and 72 which are for the purpose of communicating the space 74 inwardly of the cover 14 to the respective inlet areas. Circumferentially spaced openings 76 are also provided for passing the shanks 77 of the fasteners 16 and it will be noted that the ends of the bolts are threaded into correspondingly threaded recesses 78 formed in the first end section 11. Thus, the entire pump assembly is clamped in firm assembly. It will be understood that the usual recesses and sealing means may be provided to insure adequate sealing between the assembled components and which need not be further described.

The pintle 48 may be angularly adjusted relative to the casing means and such adjustment may be effected either manually or automatically in response to flow conditions. In the present embodiment, an automatic adjustment is contemplated. Thus, it will be noted there is provided an end plate 80 which is fastened to the end of the pintle 48 by means of a pair of screws 81 and a sealing gasket 82 may be interposed between the plate member 80 and the end of the pintle 48.

A radially projecting crank arm portion on the plate 80 is provided with a driving pin 83 which is received in a recess 84 of an axially movable flow control actuator shown generally at 90. The actuator 90 has a spool 91 having a differential area (see FIGURES 5-6) formed with axial recesses 92 and 93 interconnected by an orifice 94. The recess 92 bottoms coil spring means 96, the opposite end of which is bottomed against a high pressure adjustment knob 97 screw-threaded as at 98 into the end

section 13. The opposite end of the spool 91 has a stop projection 99 which is engageable with a closure plug 100 screw-threaded as at 101 into the other end of the casing section 13.

It will be noted that the cover 14 has an embossment 102 which forms a stop disposed closely adjacent the plate 80 and retaining the movable components in correct axial alignment when the pump is assembled.

The body section 15 has a pump inlet 103 formed therein which is intersected by the passage 71. The inlet 103 is extended radially inwardly to intersect the inlet arc 28. It will be noted that the slipper pump of the present invention is particularly characterized by a multiple element arrangement wherein many more slippers are utilized than in conventional slipper pumps. In this regard, it will be noted that the number of notches 31 and the corresponding number of pumping elements or slippers 36 provided in the rotor 26 are of such a number and spacing dimension that at least a pair of slippers will be in the intake area at all times.

Intake fluid from the inlet 103 is also conducted via the passage 71 through the open area 74 and through the passage 72 to the opposite inlet arc 28a. Thus, the increased number of slippers decreases rapid changes in output and maintains a very low stroke-to-diameter ratio.

In operation, the cam contour of the bore wall 27 converges in the compression arc 29 which convergence terminates at the beginning of the dwell arc 30. The commutator pintle 48 with the two pairs of channels 53, 53 and 56, 56 passes flow from each slipper egress passage 40 to separate lines. Thus, by rotating the commutator pintle 48, it is possible to present the channels in the pintle 48 as alterable port positions. In this manner, the fluid to the front or rearward of any slipper position can communicate with the channel to which it is open. Rotation of the pintle 48, therefore, results in the discharge of the pump being directed to a main flow or to a secondary flow point of utilization. Thus, assuming the pump of the present invention to have a 30 gallon per minute capacity, it will be noted that the pintle is at minimum main flow position when the pintle 48 is positioned as illustrated in FIGURES 5 and 7. In that position, approximately 25 gallons per minute would be directed to the cooler flow discharge outlet 70 and 5 gallons per minute directed to the main flow discharge outlet 64.

With the control actuator positioned in the relationship of FIGURE 6 and with the pintle adjusted correspondingly, as shown in FIGURE 3, approximately 5 gallons per minute would be directed to the cooler flow discharge outlet 70 and 25 gallons per minute would be directed to the main flow discharge outlet 64. Such variable capacity is effected through adjustment of the pintle through approximately 45° of arc adjustment as illustrated by the arc indicated by legend and at the reference numeral 110.

It is contemplated that fluid at pump-generated pressure would be communicated into the pressure control chamber 112 communicating with the recess 92 in the spool actuator 91. The spool actuator 91 has a small and a large diameter providing a differential area. Outlet pressure is communicated through recesses 92 and 93 and orifice 94 to the area 111 and the resultant force opposes the spring 96. The orifice 94 acts as a dash-pot. By virtue of such provision, the rotation of the pintle 48 may be achieved through a pressure sensitive control so that reduction in the output of the high pressure flow results in an increase in the low pressure back-flow in an equal amount of displacement and vice versa.

By virtue of the multiple pumping element or impulse arrangement, vibration control problems are reduced. Furthermore, by use of a back-flow commutation, a divided outlet flow can be exploited with the design of the present pump, thereby providing cooling or lube flow for hydraulic circuits. This flow can be used for supercharging the inlet or can be returned direct to either the inlet or a sump.

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Although minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. A pump comprising a pump body having a pumping chamber,
 - a ring-shaped rotor in said chamber,
 - and a commutator pintle inwardly of said rotor, said pintle having first and second peripheral channels for handling inlet and outlet fluid respectively,
 - said pump body having an inlet and an outlet and having a bore contour in said pumping chamber forming together with said rotor in circumferential series disposition an inlet arc of increasing volume, a compression arc of decreasing volume and a dwell arc of constant volume,
 - said rotor having a plurality of peripheral notches each containing a slipper which is free to rock angularly and move radially in following the adjoining bore contour of said pumping chamber, said notches and said slippers being sufficient in number and circumferential spacing relation to form multiple pulsing chambers between slippers of lesser angular extent than the angular extent of said inlet arc,
 - and means to angularly adjust said pintle to present said channels as alternate port positions, thereby to vary the output of the pump by presenting alternate porting positions so that the fluid to the front or to the rear of any slipper position can communicate with the pintle channel to which it is open.
2. A pump comprising:
 - casing means including means forming a pumping chamber having a bore wall and an inlet and an outlet,
 - a rotor in said pumping chamber having a plurality of pumping elements engaging said bore wall, each pumping element comprising a slipper free to rock angularly and to move radially in said rotor in following the contour of said bore wall, said pumping chamber having an inlet formed with a filling portion at said bore wall in which the volume of the space between adjoining slippers increases during rotation of the rotor to fill the space,
 - said pumping chamber having a compression arc formed to decrease the volume of the space between adjoining slippers during rotation of the rotor to compress the fluid,
 - said pumping chamber having a dwell arc formed to maintain the volume of the space between adjoining slippers constant,
 - said rotor having means forming a valve controlled passage extending inwardly of each respective pumping element,
 - and a commutator pintle inwardly of said rotor having longitudinally - extending, circumferentially - spaced channels communicating with said passages, said pintle having radial connecting passages communicating with said channels to connect said passages with said inlet and said outlet respectively,
 - and means for angularly adjusting said pintle relative to said casing means, thereby to vary the delivery of the pump.
3. A slipper pump comprising:
 - an angularly adjustable cylindrical commutator pintle

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- having two pairs of interconnected peripheral channels,
- a rotor ring journaled on said pintle and having a plurality of circumferentially spaced peripheral notches, each notch having a passage extending radially inwardly for connection with said channels in said pintle,
- a check valve in each said passage,
- a slipper in each notch sized to rock angularly and to move radially in following an adjoining bore wall of a pumping chamber,
- and a means forming a pump body including means forming a double-lobed pumping chamber cooperating with said slippers and said rotor to form two pumping units each including an intake arc wherein the spaces between said slippers increase in volume, a compression arc wherein the spaces between said slippers decrease in volume and a dwell arc wherein the spaces between said slippers remains substantially constant in volume,
- and means to angularly adjust said commutator pintle to present said channels as alternate port positions, thereby to correspondingly vary the delivery of the pump and to achieve two separate displacements each of which is inversely proportional to each other and in proportion to the maximum displacement.
4. A slipper pump as defined in claim 3 wherein said means to adjust said commutator pintle comprises a flow responsive regulator means.
5. A pump comprising:
 - a casing having a bore wall forming a double-lobed pumping chamber and forming in circumferential series disposition an intake arc, a compression arc, and a dwell arc,
 - a ring-shaped rotor in said pumping chamber and having a plurality of notches formed in the periphery thereof,
 - a slipper in each notch which is free to move radially and to rock angularly in following the contour of the adjoining bore wall,
 - a peripherally channeled pintle in said rotor forming a flow valve through which the discharge of said pump is directed,
 - said rotor having passages extending inwardly from said notches for communication with said flow valve,
 - and means for adjusting said pintle angularly, thereby to vary the output of the pump by presenting alternate porting positions so that the fluid to the front or to the rear of any slipper position can communicate with the pintle channel to which it is open.

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