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2,411,602

PUMP FOR POWER TRANSMISSION

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FIG- 1

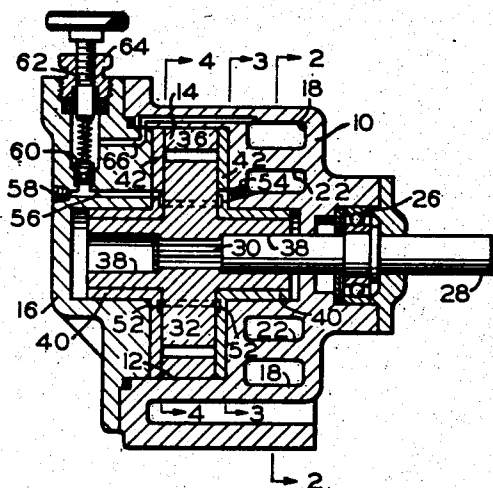


FIG- 2

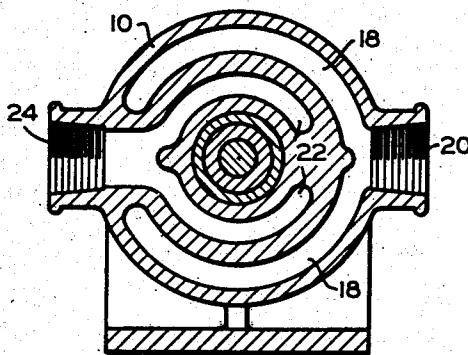
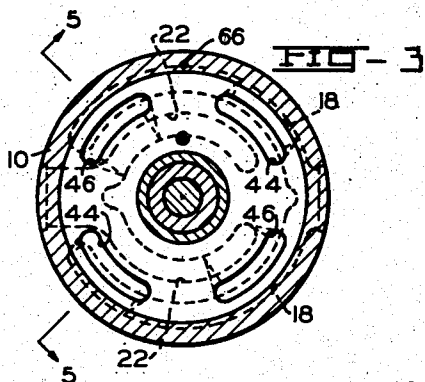
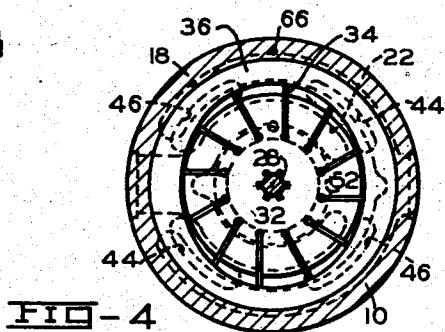
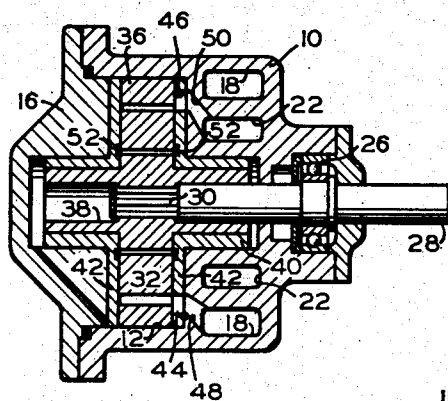


FIG- 5



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PUMP FOR POWER TRANSMISSIONS

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4 Claims. (Cl. 103—120)

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This invention relates to power transmissions, particularly to those of the type comprising two or more fluid pressure energy translating devices, one of which may function as a pump and another as a fluid motor.

The invention is more particularly concerned with a pumping unit of the rotary type and with control means for regulating the volumetric discharge thereof.

A form of pump in common use in the hydraulic power transmission field utilizes a rotor having a plurality of substantially radial vanes rotatable therewith and slidable relative thereto. The rotor and vanes cooperate with a stator member which defines one or more pumping chambers through which the vanes pass carrying fluid from the inlet port to the outlet port. Pumps of this character have heretofore been provided with pressure relief valves for bypassing the fluid delivered by the pump and returning it to the pump suction inlet through a bypass passageway, either for limiting the maximum pressure in the pump discharge line or for completely unloading the pump to permit it to circulate fluid idly.

It is an object of the present invention to provide an improved pumping unit which may be so controlled as to act as its own relief valve or unloading valve, as the case may be.

A further object is to provide a unit of this character wherein the radial movement of the vanes relative to the rotor may be variably controlled to thereby regulate the pumping action and reduce or increase, to any degree desired, the volumetric rate of delivery.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of the present invention is clearly shown.

In the drawing:

Figure 1 is a longitudinal cross section of a pump incorporating a preferred form of the present invention.

Figure 2 is a cross section on line 2—2 of Figure 1.

Figure 3 is a cross section on line 3—3 of Figure 1.

Figure 4 is a cross section on line 4—4 of Figure 1.

Figure 5 is a cross section on line 5—5 of Figure 3.

A body 10 is provided with a cylindrical recess 12 in which is fitted a pumping cartridge 14, being retained therein by a head plate 16 re-

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movably secured to the body 10 by bolts, not shown. The body 10 is provided with an arcuate suction port 18 communicating with a suction pipe connection 20 and radially inward thereof 5 is provided with a smaller arcuate pressure port 22 communicating with a pressure pipe connection 24.

Journalled upon a bearing 26 in the housing 10 is a drive shaft 28 which at its inner end has a splined connection 30 with a cylindrical rotor block 32 in the cartridge 14. The block 32 is provided with a plurality of generally radial slots in which are positioned vanes 34, as seen in Figure 4, the vanes being radially movable inwardly 15 and outwardly within the slots.

The cartridge 14 includes a ring member 36 having a cylindrical external shape and an approximately oval internal shape against which the ends of the vanes 34 contact. The rotor 32 is provided with hollow hubs 38 which run in bearings 40, forming part of the cartridge 14. The bearings 40 have integral flange portions 42 which overlie the side faces of the rotor 32 and the ring 36. The righthand flange 42 is provided 25 with arcuate suction ports 44 and arcuate discharge ports 46 which appear in Figures 3 and 5. The ports 44 communicate by inclined passages 48 with the suction passageway 18, while the ports 46 communicate by an inclined passage 50 with the discharge passageway 22.

The flanges 42 are provided with grooves 52 which extend 360 degrees around their inner faces at a point adjacent the inner end of the slots in the rotor. The grooves 52 thus provide 35 access connection to the space in the slots beneath the vanes 34. The righthand groove 52 connects with the discharge passage 22 by means of a restricted passage 54 in Figure 1. The lefthand groove 52 connects by means of a passageway 56 with a pipe connection 58 and with a pilot relief valve 60. The latter is spring-loaded to open at a predetermined pressure in the passage 56, which pressure may be adjusted through the medium of a spring-adjusting screw 62 having a lock nut 64. When the valve 60 is open, fluid passing therethrough is carried to the suction passage 18 through a duct 66 formed in the end plate 16 and the body 10.

With the exception of the restricted passage 50 54 and the parts which lead off from the passage 56, the pump may be constructed similarly to that illustrated in the patent to Harry F. Vickers, No. 1,989,900, to which reference is made for disclosure of certain detail features omitted from the present drawing for the sake of clarity.

In operation, assuming that the inlet connection 20 is connected with a suitable reservoir of oil or other liquid, and that the outlet connection 24 is in communication with a suitable work circuit, with the shaft 28 being driven, the rotor 32 revolves counterclockwise in Figure 4, carrying with it the vanes 34. At pressures below the setting of the pilot relief valve 60, the operation of the pump is identical to that described in the previously mentioned Vickers patent, and oil is carried from the suction ports to the discharge ports, the vanes 34 sealing the space between the rotor 32 and ring 36 at the diametrically opposite top and bottom points in Figure 3.

It will be noted that the liquid in the grooves 52 is under the full pressure of the pump discharge since there is no flow through the restricted orifice 54 and consequently no pressure drop therethrough. This is because there is always the same number of vanes moving inwardly as there are moving outwardly at any instant and the total volume of fluid in the groove 52 and the slots connected thereto remains constant. Thus, the vanes 34 are projected outwardly as they pass across the suction ports 44 in Figure 4. This is the normal pumping action of the device.

When the delivery pressure against which the pump discharges rises to a value higher than that for which valve 60 is adjusted, the valve opens, permitting liquid to escape from the groove 52 through passage 56, valve 60 and passage 66. This causes a flow to take place through the restriction 54, and, as the flow rate increases, the pressure drop through the restriction 54 increases, and there is accordingly less pressure applied to the under surface of the vanes 34. When this tendency has progressed to the point where the difference in pressure between that applied to the outer end of a given vane as it approaches one of the pressure ports 46 and the pressure applied to the inner end of the same vane is a greater difference than the centrifugal force applied to that particular vane, then the vane will be forced slightly inwardly, permitting oil to escape between the outer face of the vane and the inner face of the ring 36. In this way, high pressure oil from the discharge port 46 may flow back past the end of the vanes 34 to the suction port 44. Thus, the net delivery of the pump is reduced, and consequently tends to reduce the pressure in the discharge passage 22 until it eventually falls to a value where the valve 60 again closes, and normal action is restored.

In applications where it is never necessary to completely unload the pump, the pipe connection 58 may be plugged with a suitable pipe plug, and the device then provides merely overload pressure-limit protection. In the event, however, that it is desired to interrupt the delivery of fluid by the pump without stopping the rotation of shaft 28, the connection 58 may be used as a "vent" connection to unload the pump at will. Thus, the duct 56 may be opened by removing the plug in connection 58 or it may be connected to a remotely operable on-off valve which, when it is opened, will connect the duct 56 to an exhaust point, such as the oil reservoir, and instantly drop the pressure beneath the vanes to a very low value. Accordingly, the vanes will be pushed inwardly as they approach the pressure port, and this action will continue until the discharge pressure has fallen to a value just neces-

sary to overcome the centrifugal force tending to push the vanes outwardly.

In addition, it may be desired to vary the quantity of fluid delivered by the pump without completely unloading it. In such case, the plug may be loosened to permit leakage or the on-off valve may be so constructed or operated (e. g., a needle valve) as to variably restrict the exhaust from groove 52. By loosening the plug or opening this valve to a greater or less extent, its resistance may be varied relative to the resistance of restriction 54, and consequently the pressure beneath the vanes may be regulated to become any desired percentage of the discharge pressure, and the degree of slippage of the pump is correspondingly varied.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A rotary vane type pump having a pump stator having a fluid working chamber having inlet and outlet ports, a rotor member mounted in the fluid working chamber, one of said members having recesses therein, alternately retractable and extendable vanes mounted in said recesses for sealing the passage of fluid between the pump outlet and inlet, means forming a pressure chamber communicating with the recesses, the pressure in which is effective to urge the vanes outwardly, a permanently open, restricted passage connecting the pressure chamber with the pump outlet, and a pressure responsive relief valve connected between the chambers and an exhaust point responsive to and limiting the maximum pressure in the chamber to vary the amount of extension of the vanes when a predetermined pressure is reached at the pump outlet to thereby vary the amount of slippage past the vanes in a manner to maintain pump outlet pressure constant.

2. A single, self-contained, self-regulating pump unit comprising a single pump of the rotary, multiple-vane type, a pump stator having a fluid working chamber having inlet and outlet ports, a rotor member mounted in the fluid working chamber, one of said members having recesses therein, vanes mounted in said recesses for inward and outward movement, fluid pressure means for causing movement of the vanes outwardly during a phase of pump rotation, a pressure-responsive relief valve of small capacity with respect to the pump capacity, means for causing said relief valve to govern the outward movement of the pump vanes whereby the slippage of the pump may be purposely increased to maintain pump discharge pressure within a predetermined limit, and additional means governing movement of the pump vanes by cooperation with said first means and effective to unload the pump independently of said relief valve.

3. A single self-contained, self-regulating pump unit comprising a single pump of the rotary vane type, a pump stator having a fluid working chamber having inlet and outlet ports, a rotor member mounted in the fluid working chamber, one of said members having recesses therein, vanes mounted in said recesses for inward and outward movement, a pressure chamber in permanently open but restricted communication with the discharge side of the pump and effective to maintain the vanes fully projected into pumping position wherein slippage is

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a minimum, and means effective to vent said chamber and prevent full projection of the vanes whereby pump slippage may be increased to substantially 100 per cent.

4. A rotary pump comprising in combination a stator having a pumping chamber therein, a rotor in said chamber and having a plurality of recesses and vanes rotatable therewith and movable relative to the rotor in a generally radial direction in said recesses, said chamber and rotor being formed to provide a working space, means forming an inlet port and an outlet port for fluid

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being pumped, said ports being spaced apart and separated by said vanes in passing through said working space, and means selectively operable to vary the movement of the vanes relative to the rotor and thereby connect the inlet and outlet ports, said means including a permanently-open restricted connection between the outlet port and said recesses and a normally-closed passage leading to an exhaust point and means to open said passage for at times exhausting said recesses.

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