

July 2, 1957

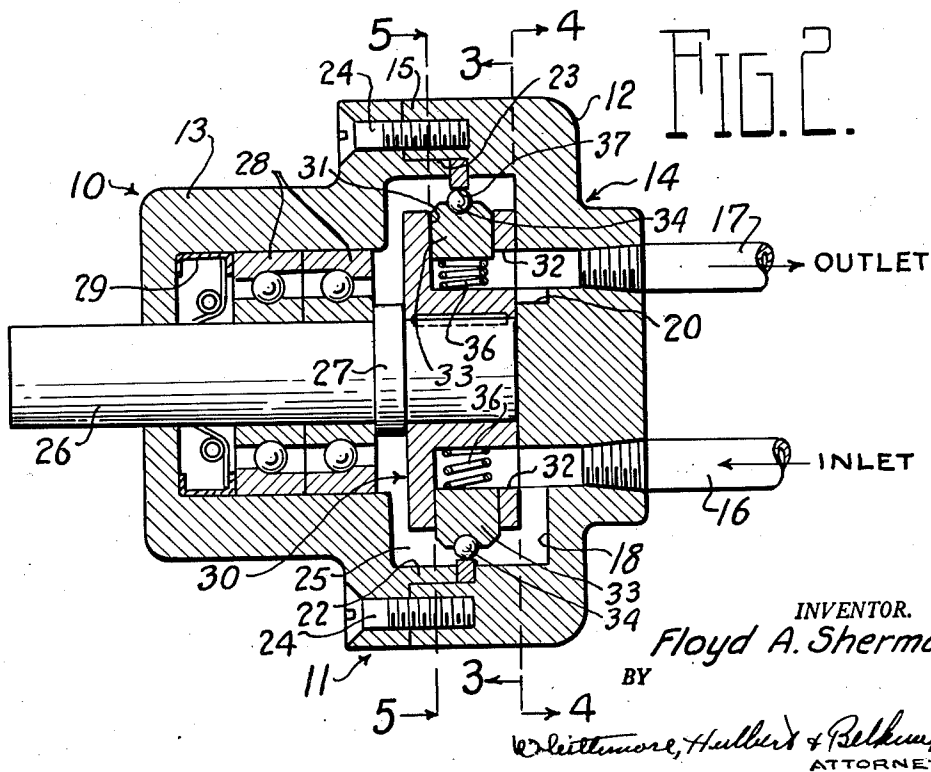
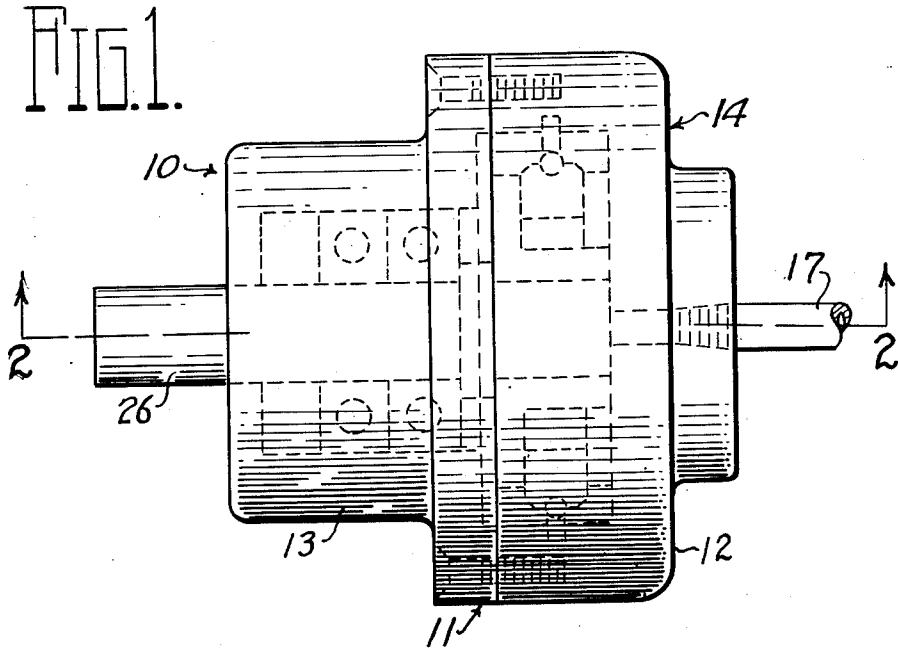
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HYDRAULIC PUMP STRUCTURE

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FIG. 3.

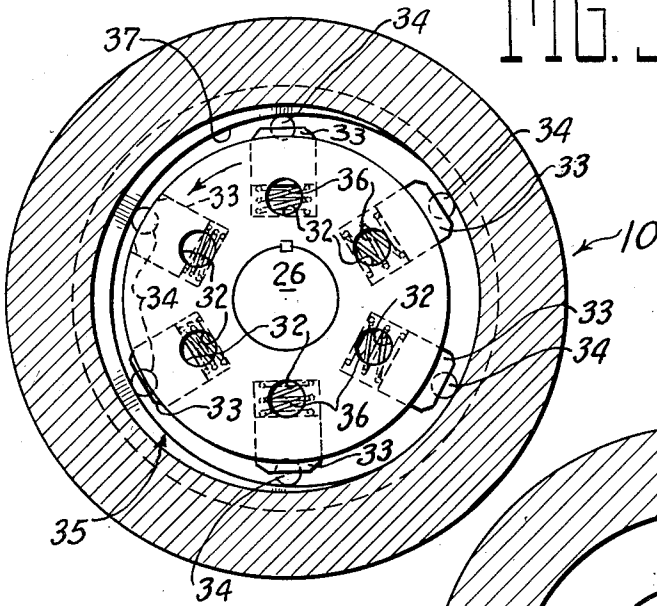


FIG. 4.

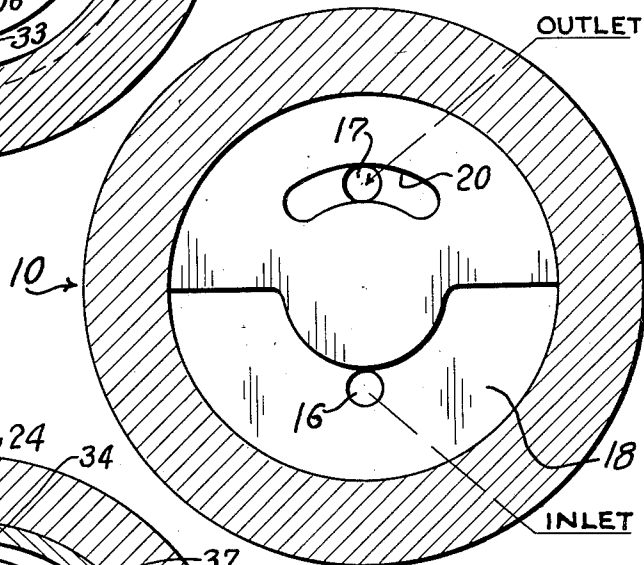
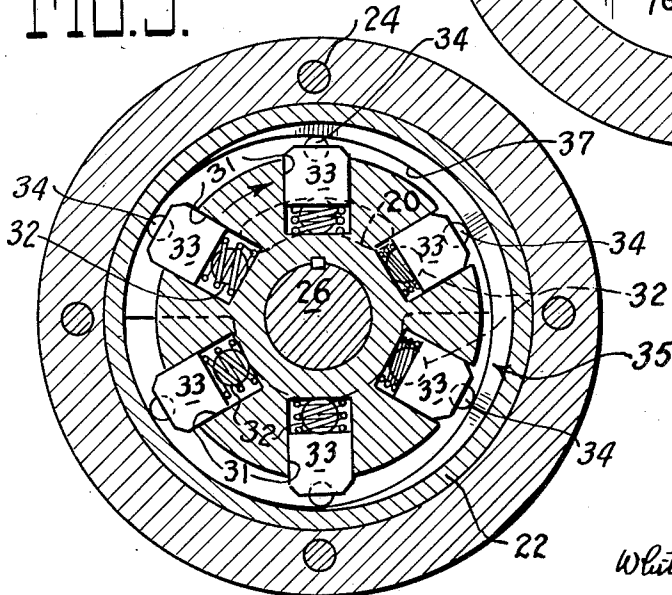


FIG. 5.



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HYDRAULIC PUMP STRUCTURE

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1 Claim. (Cl. 103—38)

This invention relates generally to pumps and refers more particularly to improvements in rotary displacement pumps.

It is an object of this invention to provide a compact pump structure having a high output capacity in comparison to its size and capable of supplying fluid at relatively high pressures.

It is another object of this invention to provide a pump structure composed of a relatively few simple parts capable of being inexpensively manufactured and installed.

It is still another object of this invention to provide means operated by the pressure of the fluid at the discharge side of the pump for varying the output of the pump and rendering it possible to displace a substantially uniform quantity of fluid at practically constant fluid pressure regardless of variations in the speed of the pump.

The foregoing as well as other objects will be made more apparent as this description proceeds especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a side elevational view of a pump embodying the features of this invention;

Figure 2 is a sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a cross sectional view taken on the line 3—3 of Figure 2;

Figure 4 is a sectional view similar to Figure 3 looking in the opposite direction;

Figure 5 is a cross sectional view taken on the line 5—5 of Figure 2;

Figure 6 is a semi-diagrammatic sectional view of a modified pump structure; and

Figure 7 is a sectional view similar to Figure 6 showing the control valve in a different position.

Referring now more in detail to the drawings, it will be noted that the numeral 10 designates a rotary pump of the displacement type having a casing 11 comprising two parts 12 and 13. The part 12 has a rear wall 14 and has an annular wall 15 projecting forwardly from the rear wall 14. The rear wall 14 is fashioned with diametrically opposed inlet and outlet ports 16 and 17 respectively. The front surface of the rear wall 14 is fashioned with an arcuate recess 18 which, in the present instance, extends for approximately 180° and communicates with the inlet port 16. The front surface of the rear wall 14 adjacent the recess 18 is formed with an arcuate slot 20 concentrically arranged with respect to the recess 18 and positioned diametrically opposite the latter. The slot 20 extends for approximately 90° and communicates with the outlet port 17.

The part 13 of the casing 10 is generally cup-shaped and has a radially outwardly extending annular flange 21 at the rear end arranged to abut the front end of the annular wall 15 on the part 12. The part 13 is centered with respect to the part 12 by an annular flange 22 which extends axially rearwardly from the radial flange 21 and engages the inner surface of the annular wall 15 on the part 12. As shown in Figure 2 of the drawings, the in-

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ner surface of the flange 15 is fashioned with a recess 23 for receiving the axially extending flange 22, and the radial flange 21 is removably clamped to the wall 15 of the part 12 by fastener elements, such as screws 24. The arrangement is such that the two casing parts cooperate with one another to form a chamber 25 which communicates with the recess 18 to receive fluid under pressure admitted through the inlet port 16.

Journalled in the casing part 13 is a drive shaft 26 having an enlargement 27 intermediate the ends thereof. The rear end of the shaft 26 abuts the rear wall 14 of the casing part 12 and the front end of the shaft extends through an opening formed in the front wall of the casing part 13. Suitable ball bearings 28 are supported within the casing part 13 in side by side relationship and engage the shaft 26 at the front side of the enlargement 27 on the shaft. A suitable seal 29 is provided in the casing part 13 between the front wall of the latter and the adjacent bearing 28 to prevent the escape of fluid from the chamber 25.

Secured to the rear end of the shaft 26 is a rotor 30 having a plurality of radially extending circumferentially spaced cylinders 31 formed therein. The cylinders 31 open at the radially outer ends thereof into the chamber 25 and each cylinder has a port 32 at the radially inner end positioned to successively register with the recess 18 and arcuate slot 20 in response to rotation of the rotor 30 by the shaft 26. As shown particularly in Figure 2 of the drawings, the rear side of the rotor 30 has a bearing engagement with the front surface of the rear wall 14 to provide in effect a seal around the arcuate slot 20.

Slidably supported in each cylinder 31 is a piston 33 having a ball 34 rotatably supported at the outer end thereof in a position to have a rolling engagement with the inner surface of a cam ring 35. The peripheral portion of the ring 35 projects into the annular recess 23 and is clamped to the casing part 12 by the axially extending flange 22 on the casing part 11. The balls 34 on the outer ends of the pistons 33 are yieldably urged into engagement with the inner surface of the ring 35 by coil springs 36 respectively located within the cylinders 31 between the radially inner ends of the pistons 33 and the bottom walls of the cylinders.

As shown in Figure 5 of the drawings, the inner surface of the ring 35 is contoured to provide a cam surface 37. The cam surface 37 is shaped to control movement of the pistons 33 in their respective cylinders 31. More particularly, the cam surface 37 is designed to move the pistons 33 radially outwardly as they move past the recess 18 so that fluid flows from the chamber 25 through the ports 32 into the cylinders 31 at the radially inner ends of the pistons 33. When the cylinders thus filled with fluid move beyond the recess 18, the ports 32 are closed by the surface of the rear wall 14 and as the filled cylinders approach the arcuate slot 20, the pistons 33 in the cylinders are moved radially inwardly against the action of the springs 36 by the cam surface 37 to force fluid under pressure through the ports 32 and slot 20 into the outlet port 17. The outlet port 17 is connected to the equipment requiring fluid under pressure for operation and this equipment is not shown herein.

The embodiment of the invention shown in Figure 6 is identical to the one previously described with the exception that provision is made for adjusting the ring 35 to vary the position of the cam surface 37 and thereby alter the displacement of the pump. As shown in Figure 6 of the drawings, the cam ring 35' is formed with diametrically opposed flat surfaces 38 which respectively slidably engage corresponding surfaces on the part 12 of the casing 11. Sliding movement of the cam 35' in opposite directions relative to the casing 11 is accomplished by a pair of pistons 39 and 40 positioned to respectively engage

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diametrically opposite sides of the ring 35' midway between the flat surfaces 38. The pistons 39 and 40 are respectively slidably supported in cylinders 41 and 42. In practice, the cylinders 41 and 42 may be formed integral with the casing part 12.

It will also be noted from Figure 6 of the drawings that the cylinders 41 and 42 have ports 43 at the outer ends of the pistons and these ports are respectively connected to tubes or conduits 44 and 45.

The conduits 44 and 45 are alternately connected by a valve 46 to the high pressure side of the system or, in other words, to the outlet port 17 and to an exhaust passage or drain which will be presently described. The valve 46 comprises a casing 47 and a plunger 48 slidably supported in a bore or chamber 49 extending axially through the casing 47. The valve casing 47 has axially spaced ports 50 and 51 intermediate the ends thereof communicating with the chamber 49 and respectively connected to the conduits 44 and 45. The front end of the chamber 49 has a port 50' which is adapted for connection to the pressure side of the system or, in other words, to the outlet port 17 of the pump. The rear end of the chamber 49 is closed by a stop 51' slidably mounted in the chamber 49 and secured to the front end of a stud 52 which is threadably mounted in a bushing 53 fixed in the rear end of the chamber 49. A spring 54 is interposed between the stop 51 and the adjacent end of the valve plunger 48 tending to move the latter in a forward direction to the position thereof shown in Figure 6 of the drawings.

The valve plunger 48 has axially spaced reduced portions which provide the plunger with three enlargements, 55, 56, and 58. Also the valve casing 47 has two bypasses 59 and 60. The bypass 59 connects the front end of the chamber 49 to the intermediate portion of the chamber located between the ports 50 and 51. The bypass 60 connects axially spaced portions of the chamber 49 to a drain or exhaust passage 61.

The above construction is such that when the valve plunger 48 is in its forwardmost position shown in Figure 6 of the drawings, the enlargement 55 closes the front end of the bypass 59 and thereby prevents the flow of fluid under pressure to either of the conduits 44 and 45. However, should the force acting on the enlargement 55 exceed the force applied by the coil spring 54, the valve plunger 48 will move rearwardly against the action of the spring 54 to a position depending upon the setting of the stop 51 or upon the resistance offered by the spring 54 to continued movement of the valve plunger 48. In the event the pressure acting on the front end of the valve plunger 48 becomes sufficient to move the plunger to the position shown in Figure 7 of the drawings, the rear end of the bypass 59 is opened by the enlargement 56 and the drain passage 61 is opened by the enlargement 58. Hence, fluid under pressure flows through the bypass 59 into the conduit 45 and cylinder 42 to shift the cam 35' in an upward direction. As a result the displacement of the cylinders 31 in the pump 10 is reduced and the output of the pump is correspondingly reduced.

Assuming now that the pressure acting on the enlargement 55 of the valve plunger 48 drops below the pressure exerted by the spring 54, it will be noted that the valve plunger 48 is shifted forwardly. Upon predetermined forward movement of the plunger 48, the enlargement 58 on the plunger closes the drain passage 61 and the rear end of the bypass 59 is connected to the conduit

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44. Also, the bypass 60 is opened by the enlargement 55 so that the drain passage 61 communicates with the conduit 45. As a result, the cam 35' is shifted downwardly relative to the valve casing 11 and displacement of the cylinders 31 in the pump 10 is increased. It follows from the above that shifting movement of the cam 35' to vary displacement of the pump pistons depends on the force applied to the plunger 48 by the spring 54 and, hence, the output of the pump may be varied by adjusting the stop 51. It also follows that for a given spring adjustment the valve 46 renders it possible to assure obtaining substantially uniform pressure at the outlet port 17 of the pump regardless of variations in the speed of rotation of the pump rotor 30.

15 What I claim as my invention is:

A pump structure comprising a housing having a chamber provided with an intake port and a discharge port, a rotor supported for rotation in said chamber and provided with pump spaces which successively communicate in the rotation of said rotor with said intake and discharge ports, a pump member movably supported in each pump space, a cam engaged by said members in the rotation of said rotor and mounted for adjustment relative to the latter to vary the displacement of said pump members, a pair of fluid pressure actuated pistons acting oppositely on said cam to adjust the same, a valve housing having an axial chamber and a pair of passages each communicating with one of said pistons; said valve housing also having two other passages communicating respectively with said discharge port and a drain port, a control means comprising a piston valve having three spaced enlargements for closing said passages, and biasing means for moving said valve to a position where both of the passages communicating with said pistons are closed by a first pair of said enlargements, said valve being subjected to fluid pressure in said discharge port and opposing said biasing means, said valve when subjected to a predetermined increase of said opposing fluid pressure being moved to a second position in which one of the passages communicating with one of said pistons is in communication with said discharge port and the other of said passages communicating with the other of said pistons is in communication with said drain port, said valve when subjected to a greater predetermined increase of said opposing fluid pressure being movable to a third position in which said piston valve interrupts communication between the fluid pressure controlled pistons and the drain port, said valve when subjected to a still greater pressure being movable to a fourth position in which said one passage is in communication with said drain port and said other passage is in communication with said discharge port.

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