April 30, 1968 J. H. BOERS 3,380,392

LOW-PRESSURE ROLLER PUMP

Filed May 12, 1966

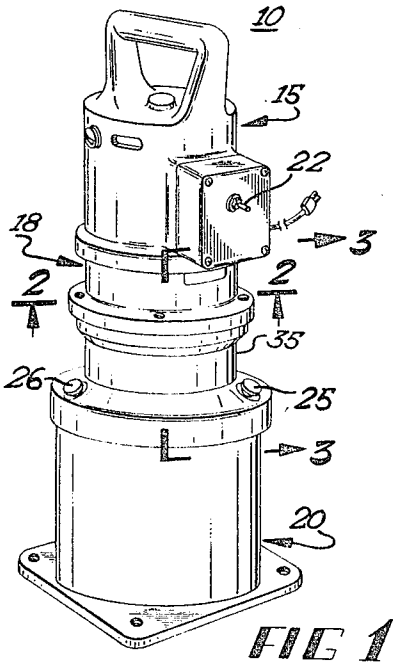


FIG 1

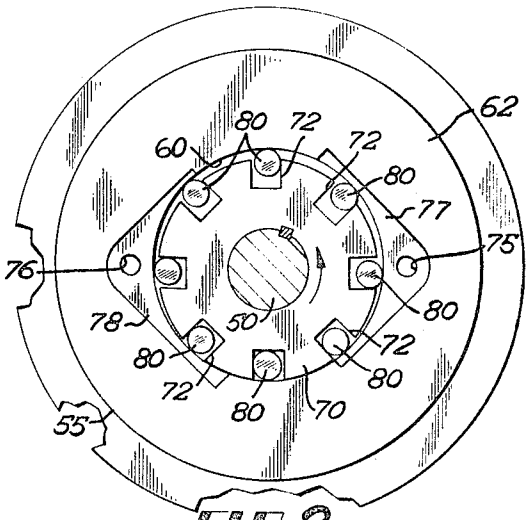


FIG 2

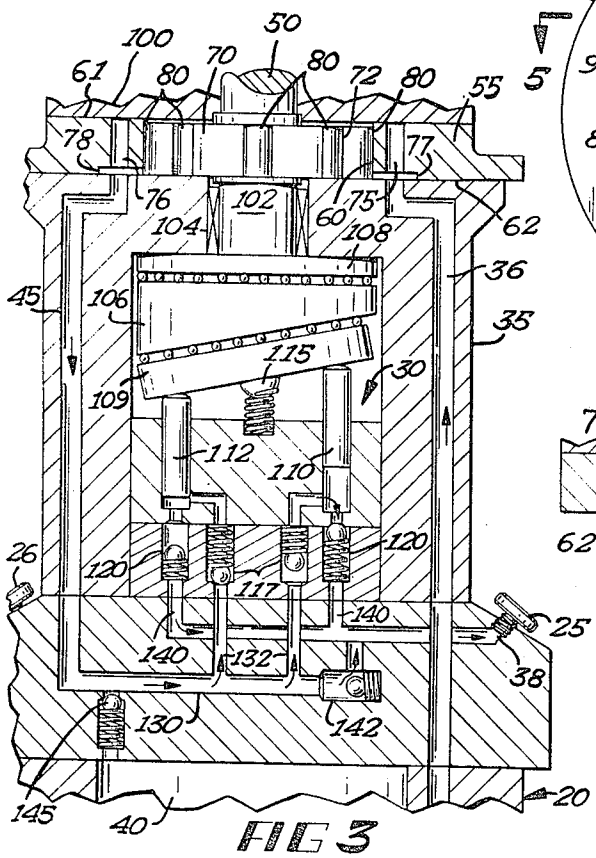


FIG 3

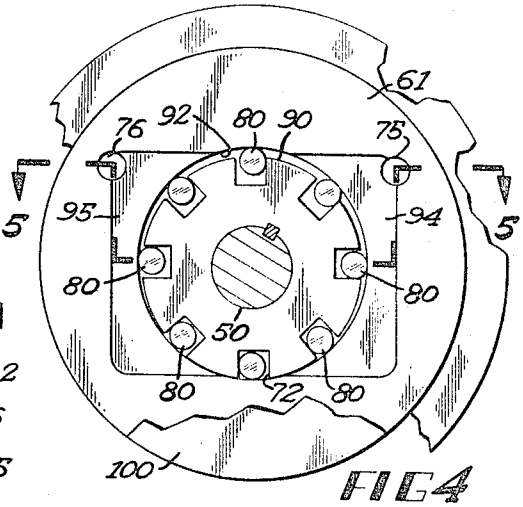


FIG 4

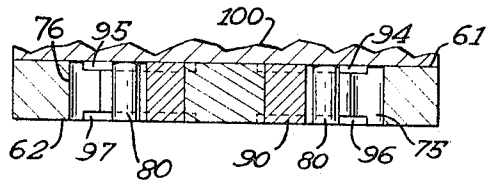


FIG 5

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LOW-PRESSURE ROLLER PUMP

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ABSTRACT OF THE DISCLOSURE

A low-pressure roller pump having a pump body with a cylindrical recess therein and a cylindrical rotor member positioned in the recess of the pump body and eccentric therewith for rotation therein. The rotor member has notches with roller members therein and the pump body has a pair of passages for intake and exhaust of fluid which extend through the body between opposed surfaces thereon and with connecting recesses on the opposed body surfaces which connect the pair of passages to the cylindrical recess and the rotor member.

This invention relates to pumps and more particularly to an improved low-pressure roller type rotary pump.

In this type of pump, the pump body includes a recess in which a rotor is positioned, the rotor having a plurality of notches with roller members therein which are disposed to rotate or roll on the surface of the recess in the pump body and cause fluid to be pumped or move ahead of the roller from one port to another. Such a type of pump is well recognized and in use.

The present invention is directed to a simplified and improved structure for such a rotary type pump which substantially reduces the cost of the same and improves the operation of the pump. The improvement herein resides in the valving to admit fluid to the rotor member and remove fluid therefrom. In the past, pumps of this type have required special machining in the pump body to provide the porting from inlet to outlet passages or ports in the pump body. Further, such pumps were limited in capacity in accord with the passages through which fluid is directed from the ports to the rotor assembly. In pumps of this type the capacity was increased by special machining of the valve body to increase the pump area. In the improved design, a single cylindrical recess is positioned in the pump body with passages or ports located on opposite sides of the recess and removed therefrom to provide for inlet and outlet of fluid to the pump. The rotor member is also cylindrical with the plurality of notches about the peripheral edge of the same. The rotor is mounted eccentrically from the geometric center of the cylindrical recess in the pump body. Cylindrical roller members positioned in the notches in the rotor member carry the fluid in the pump. These roller members are of a smaller dimension than the notches to permit movement of the cylindrical roller members therein and additional space for carrying fluid being pumped. Rotation of the rotor member from an external source will cause the cylindrical members in the rotor to move under the influence of centrifical force against the surface of the cylindrical recess and trap fluid to be pumped therebetween moving the fluid between inlet and outlet ports. The improvement in the present pump is a simplified porting or passage which may be utilized at the upper or lower surface of the pump body or on both surfaces connecting the inlet and outlet passages or ports with the cylindrical recess in which the rotor of the pump is positioned to increase the capacity for the fluid flowing through the pump and to simplify machining of the same.

Therefore it is the principal object of this invention

to provide an improved rotary pump of the low-pressure roller pump type.

Another object of this invention is to provide in a pump of this type a simplified porting for valving in the pump.

A still further object of this invention is to provide in a pump of this type an arrangement of valving which eliminates special machining in the valve body.

A still further object of this invention is to provide an improved pump having an increased volumetric output.

Another object of this invention is to provide an improved pump of this type which is low in cost, simple in design and has a high volumetric capacity output.

These and other objects of this invention will become apparent from a reading of the attached description together with the drawings wherein:

FIGURE 1 is a perspective view of the improved low-pressure roller pump,

FIGURE 2 is a sectional view of the improved roller pump taken along the lines 2—2 in FIGURE 1,

FIGURE 3 is a sectional view of the improved roller pump taken along the lines 3—3 in FIGURE 1,

FIGURE 4 is a top view of the pump body showing an alternate embodiment of the pump porting, and

FIGURE 5 is a sectional view of the pump body taken along the lines 5—5 in FIGURE 4.

My improved rotary pump of the low-pressure roller type is shown in perspective in FIGURE 1 in connection with a self-contained portable unit which is adapted to be connected to various types of tools or other apparatus using fluid under pressure such as to receive such fluid therefrom and return fluid to the pump. Thus as will be seen in FIGURE 1, the improved pump indicated generally at **10** incorporates a motor unit **15** connected to the pump unit **18** and mounted on a fluid reservoir **20** all connected together and enclosed through a suitable housing or cover. For simplicity, the details of the motor and reservoir together with the connecting housing are omitted. The improved rotary pump will utilize an electric motor which is adapted to be connected to a suitable electric source and controlled through a suitable control element such as an electric switch indicated generally at **22**. The electric motor provides a rotary input to the pump which takes fluid, such as hydraulic fluid from a reservoir and directs it to an outlet port such as indicated at **25** to a remote device (not shown) through suitable fluid couplings (not shown) to supply the remote device with fluid under pressure. A return line (not shown) from the device to the pump unit **10** will be connected to a return port **26** in the reservoir and will provide for circulation of the hydraulic fluid to the device to be operated from the pump.

For the purposes of the present disclosure, the improved roller type pump is shown herein in connection with a piston type pump indicated generally at **30** which may or may not be incorporated therewith. The entire piston type pump assembly is enclosed in a casting or body **35** having inlet **36** and outlet ports **38** which extend through the body **35** and operates to take fluid from a reservoir **40** of the reservoir section **20** in the housing and direct it through the housing returning the same from the body to the outlet passage **38** connected to the outlet port **25**. The aperture or port **26** in the reservoir, as previously indicated, provides the return passage for fluid directly thereto. In the body **35** the passage **36** leads directly to the low-pressure roller type rotary pump and a passage **45** directs the same either through or by passing the piston type pump **30** to the outlet passage **38**.

Motor **15** has an output shaft **50** connected to the low-pressure pump **18** and through the low-pressure pump to the piston type pump or high pressure pump **30** and the rotary element thereof. Thus as will be seen in FIG-

URE 2, the shaft 50 extends through a body 55 of the low pressure pump which body has a cylindrical recess 60 therein extending through the body from an upper surface 61 to a lower surface 62 thereof. Positioned in this cylindrical recess and eccentric thereof is a cylindrical type rotor element 70 having a plurality of notches or grooves 72 about the peripheral surface of the same. In the body 55 of the low-pressure pump, the passages 36 and 45 connect to passages 75, 76 respectively which passages extend through the pump body between the surfaces 61, 62. These passages are located generally at diametrically opposed positions in the body 55 on opposite sides of the recess 60 and may be varied from this diametrical relationship to one which locates them generally on opposite sides of the recess depending upon the configuration of the body 55 and the location of the passages. The passages 75, 76 are connected to the cylindrical recess by a simplified porting or grooved recess which extends from the undersurface of the body 55 to a shallow depth, as indicated at 77, 78 respectively. Such machining of the surface of the valve body is readily accessible and easily accomplished. Thus this surface of the body with this portion of the material removed therefrom provides communication of the respective passages 75, 76 to the peripheral edge of the cylindrical recess extending over a substantial portion of the surface of the recess on opposite sides of the recess. Thus as will be seen in FIGURE 2, the recesses 77, 78 extend over approximately 45 angular degrees of the cylindrical recess and connect the passages 75, 76 to the cylindrical recess 60 on opposite sides of the recess. Rotor 70 is connected to the shaft 50 of the motor 15 and located in the cylindrical recess to be slightly off-center thereof so that one edge of the cylindrical rotor element 70 will be disposed adjacent and substantially in contact with a portion of the cylindrical surface of the recess 60 while at a diametrically opposed position, a definite gap will exist between the opposite surface of the cylindrical recess and the surface of the rotor.

Positioned in the notches 70 are a plurality of cylindrical roller members 80 which extend in length substantially the thickness of the rotor element and are of a diametrical dimension slightly less than the width of the notches 72 and the depth of the same. In this type of pump, rotation of the rotor element with the cylindrical roller members 80 therein will, through the operation of centrifical force applied to the cylindrical roller members 80, cause the same to be directed against the surface of the cylindrical recess. Thus the cylindrical roller members 80 will slide in the notches 72 against the surface of the cylindrical recess 60 and roll thereon as the rotor element 70 is rotated through operation of the shaft 50. Fluid directed through the passage 36 and the passage 75 in the pump body 55 will be directed through the grooved recess 77 and into the spacing between the edge of the rotor element 70 and the cylindrical recess 60. The roller members will trap such fluid and cause the fluid to move with the rotor element in the gap between the cylindrical recess and the roller members and within the notches 72 to the opposite side of the pump body where the fluid will be discharged through the similar grooved recess 78 and passages 76 and 45 to the outlet side of the pump. This type of roller pump action is well recognized and the oversized notches and grooved recesses or passages on the surface of the pump body increase the carrying capacity of the pump and greatly simplify the manufacturing and cost of the same.

An alternate embodiment of the low-pressure pump in FIGURES 4 and 5 shows the passages 75, 76 through the pump body, indicated at 90, being located on opposite sides of the cylindrical recess 92 in which the rotor element is positioned but slightly offset from the diametrically opposed relationship. In this embodiment, the grooved recesses 94, 95 in the pump body connect the respective passages 75, 76 to the cylindrical recess over substantially 135 degrees of the peripheral surface of the cylindrical recess on opposite halves of the recess in the body 90. Further the recesses 94, 95 have corresponding recesses 96, 97 on the opposite surface of the valve body and connecting through the passages 75, 76 in the same manner. The rotor configuration for this embodiment is identical with that shown in FIGURE 2 and the cylindrical members operate to direct fluid from the passage 75 through the recesses 94, 96 around the peripheral surface of the cylindrical recess 90 and to the opposite recesses 95, 97 to the outlet passage 76. This simplified arrangement further increases the fluid carrying capacity in the pump and greatly simplifies the manufacturing and machining of the same since it requires no special passages or ports. In this embodiment, the housing or lower pump body 35 serves to seal one surface of the rotary pump and an upper seal plate 100 suitably positioned on the upper surface of the pump body seals the upper side thereof.

For purposes of the present disclosure, a low-pressure pump is shown connected to a high-pressure pump 30 which is driven from the shaft 50 through a shaft extension 102 directly connected thereto and suitably journaled through bearing means 104 to drive a wobble plate 106 guided by suitable bearing plate 108 and operating the second wobble plate 109 engaging a plurality of pistons 110, 112 in the high-pressure pump body 35. The truncated cylindrical shape of the wobble plate 106 will cause the plate 109 to pivot about a spherical bearing 115 and direct the pistons 110, 112 up and down in the valve body in a conventional lateral type pumping action. Inlet and outlet control valves for high-pressure, such as is shown at 117 and 120, control fluid flow therethrough. The passage 45 of the outlet side of the low-pressure pump extends through a transversely extending passage 130 and through inlet ports 132 to the inlet check valves 117, directing flow into the chambers of the pistons 110, 112 in the valve body in a conventional manner. The outlet valves 120 control the flow therefrom in accordance with loading of the outlet line of the pump, as will be hereinafter described. The inlet ports or passage 130 to the high-pressure pump includes a bypass valve 142 connecting the passage 130 to the port 38 to allow low-pressure fluid to flow directly to the outlet port 25 bypassing the high-pressure pump upon certain conditions of loading of the pump. Also included in this section is a bypass valve 145 connecting the outlet passage 45 common to the inlet port or passage 130 of the low-pressure pump to the reservoir 40.

The improved low-pressure roller type rotary pump includes the circular cavity, the notched rotor and the plurality of roller members which are designed to fit freely into the notches in the rotor. The bearing for the rotor of the low-pressure pump is so located that the rotor fits snugly against one side of the pump cavity leaving a gap on the opposite side. During operation, the rollers are thrown to the periphery of the cavity by centrifical force thus sealing the adjacent spaces between the rollers. In this fashion the roller members trap and transport the hydraulic fluid within the pump. As the rotor revolves, it creates a partial vacuum at the intake port to draw fluid from the reservoir. At the opposite side the space between the rotor and the wall of the cavity decreases and the rollers compress the fluid and discharge it at the outlet port. The location of the porting and machining of the same greatly reduces tolerances and cost of the pump.

In the operation of the pump with no loading or with light loading on the outlet line, for example 200 p.s.i., fluid is channeled directly from the outlet of the low-pressure pump through the bypass valve 142 to provide the high volume delivery. The low-pressure fluid is also delivered to the high-pressure pump to keep the pistons seated against the wobble plate. During high-pressure delivery, the low-pressure pump continues to function as it did down the low-pressure cycle but with a system loaded at a pressure higher than that for which the low-pressure

pump is designed, for example 200 p.s.i., a build up in pressure in the line forces the bypass valve **145** to open so that a portion of the low-pressure fluid is returned to the reservoir **40**. As the line pressure continues to increase it closes the bypass valve **142** and enough low-pressure fluid flow is maintained to satisfy the low volume requirements of the high-pressure pump. The low-pressure fluid is forced through the intake valves of the high-pressure cylinder and is compressed by the pistons to line pressure. This pressure is considerably higher than the output of the low-pressure pump, for example up to 10,000 p.s.i. The actual line pressure depends upon the loading of the outlet or system to which the pump is connected. In the event that system loading exceeds a predetermined maximum, suitable relief valving (not shown) is normally included in the line or may be included in the pump to prevent damage to the equipment. Thus the improved pump may be utilized for high and low-pressure operation although the high pressure side is a conventional pump unit and its details may vary.

The improved low-pressure roller type rotary pump incorporates a simplified pump body with a rotor and roller configuration mounted in a cylindrical recess in the pump body which permits movement of fluid through the pump body from the inlet to outlet passages therein. The connecting of the inlet and outlet passages to the inlet and outlet ports and in communication with the rollers eliminates the necessity of special machining in that the grooved recesses are positioned on the exposed surfaces of the pump body **55** and directly connect the cylindrical recess in the pump body with the passages **75, 76** therein. This greatly reduces the cost of the unit and increases the efficiency of operation of the same by substantially increasing the fluid flow characteristics of the low-pressure pump.

In considering this invention it should be remembered that the present disclosure is intended to be illustratively only and the scope of the invention should be determined by the appended claims.

What is claimed is:

1. A rotary pump comprising, a pump body having a cylindrical recess therein extending between two axially opposite surfaces of the body, a pair of passages in said body extending to one of the axially opposite surfaces of the body and being located outside of the cylindrical recess, a pair of grooved recesses positioned in the pump body each extending from said one surface thereof a given depth toward said other axially opposite surface and connecting a portion of the cylindrical recess respectively with one of said passages to define flow passages into and out of a working chamber of the pump, a cylindrical rotor member positioned in said cylindrical recess of said body and eccentric therewith, said rotor member having a thickness dimension such that axially opposite surfaces thereof extend to the axially opposite surfaces of the pump body and with a plurality of notches extending therethrough at the peripheral edge of the same, a plurality of cylindrical roller members positioned respectively in said notches and freely movable therein and having a length dimension such as to extend between the axially opposite surfaces of the rotor member, means connected to said rotor member to rotate the same in said cylindrical recess to cause said roller members in said notches to engage and roll on the inner surface of said cylindrical recess being adapted to cause fluid from one of said passages to move through the flow passage defined by the grooved recess in communication therewith and ahead of said roller member between the surface of said cylindrical recess and the peripheral surface of said rotor member to the other of the flow passages defined by said other grooved recess and the other of said passages, and means enclosing the body and the rotor member at said axially opposite surfaces and cooperating with the grooved recesses in the pump body to define said flow passages to and from the working chamber of said pump.

2. The rotary pump of claim **1** in which the pair of passages are inlet and outlet passages in said body which are located therein on substantially opposite sides of said cylindrical recess.

3. The rotary pump of claim **2** in which each of said grooved recesses abut over at least one-quarter of the peripheral surface of said cylindrical recess of said body on at least one surface thereof.

4. The rotary pump of claim **3** in which the pair of passages are inlet and outlet passages in said body which are located therein on diametrically opposite sides of said cylindrical recess.

5. The rotary pump of claim **3** in which the grooved recesses are positioned on each of the opposite surfaces of said body and on opposite sides of said cylindrical recess to connect said two passages at said opposite surfaces of said body and on opposite surfaces of said body.

6. The rotary pump of claim **5** in which each of the grooved recesses in said body extend over approximately 37½% of the peripheral surface of said cylindrical recess.

7. The rotary pump of claim **6** in which the notches in the rotor members are substantially rectangular in cross section and equally spaced about the peripheral edge of the same.

8. The rotary pump of claim **7** in which the notches in said rotor member have dimensions which are greater than the diametrical dimension of said cylindrical roller members such that fluid may flow around said roller members in said notch and be carried with the rotor member between said passages.

9. The rotary pump of claim **8** in which the opposite surfaces of the body member and the rotor member are disposed at substantially coinciding planes.

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