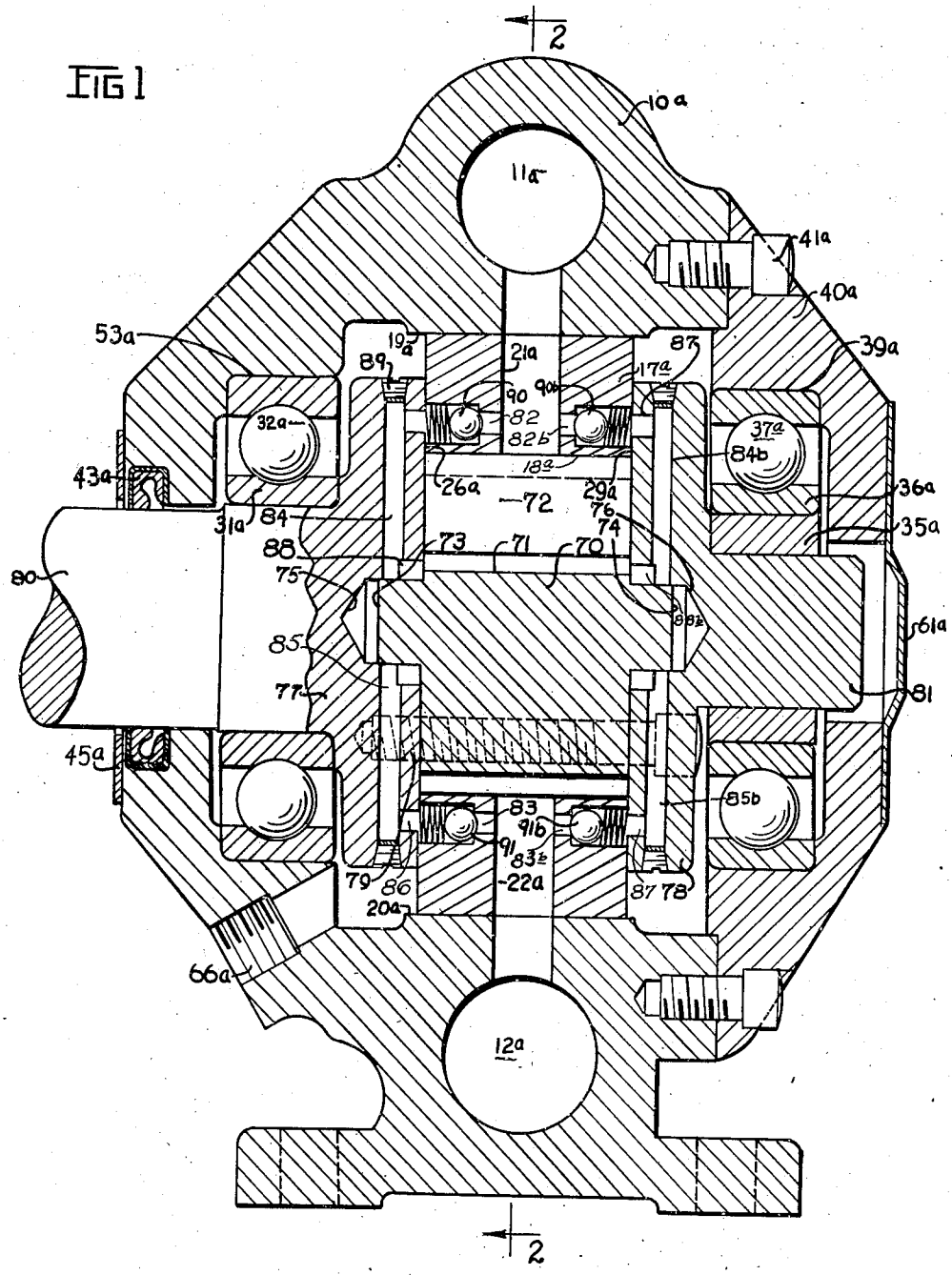
Nov. 7, 1944. W. R. TUCKER ET AL 2,362,420

VANE PUMP

Original Filed Feb. 6, 1941 2 Sheets-Sheet 1

FIG 1



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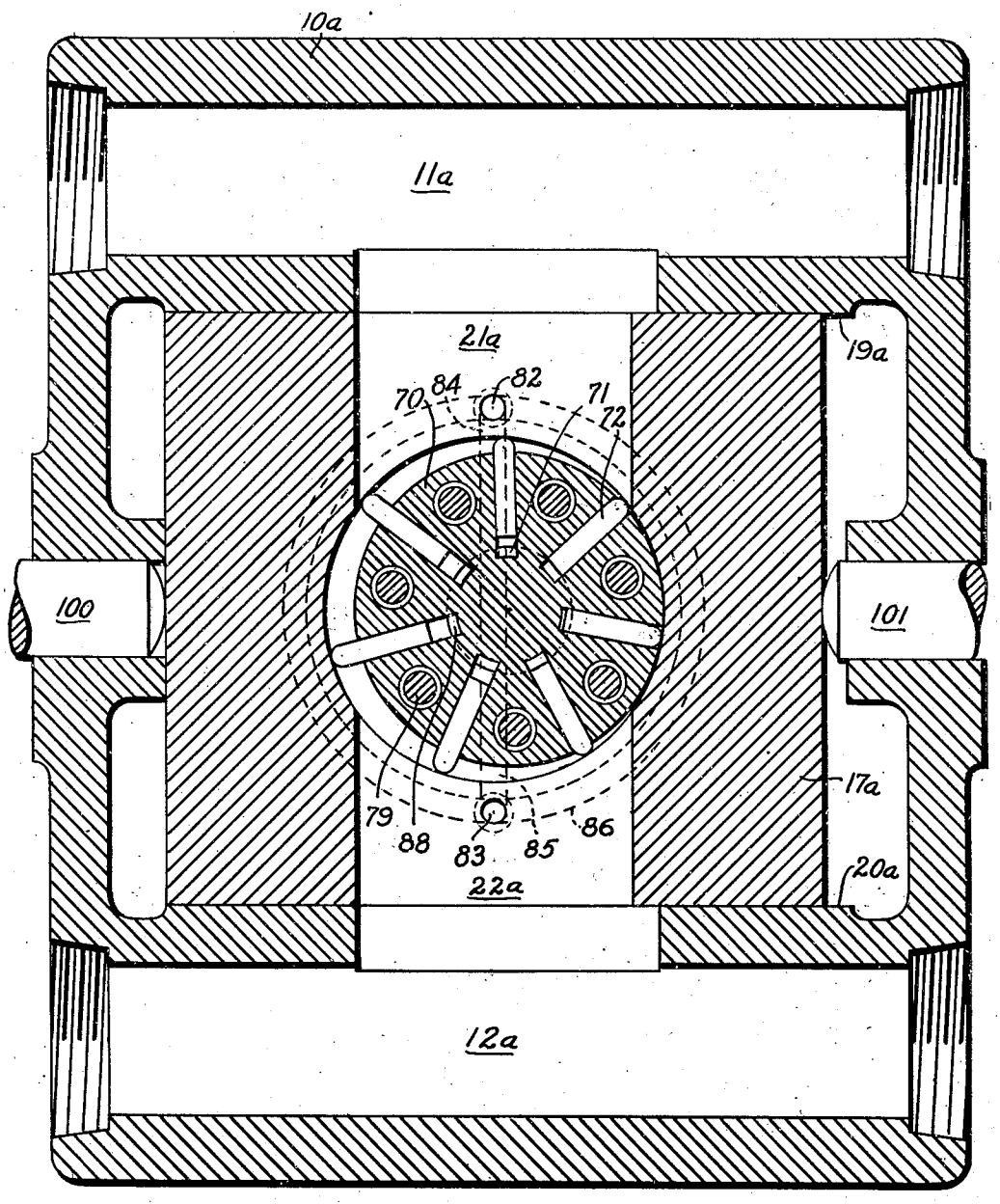


FIG 2

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2,362,420

VANE PUMP

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Original application February 6, 1941, Serial No. 377,709. Divided and this application December 17, 1941, Serial No. 423,339

5 Claims. (Cl. 103—136)

This invention relates to fluid pumps of the vane type, and more particularly to fluid pumps which are adapted for circulating liquids and for producing pressure with said liquids for actuating various operating elements.

In this invention the fluid pump is adapted to pump hydraulic fluid from a storage chamber to a hydraulically actuated device, such as a press, molding machine or other conventional hydraulically actuated mechanisms. There are many types of pumps which are adapted for placing fluids under pressure including the radial piston type of liquid pump. This type of pump produces high pressure with relatively low power consumption and has been the most efficient type for use in producing high fluid pressures for actuating mechanical presses requiring high fluid pressures.

In this invention, however, mechanical alterations have been made to a vane type of fluid pump which makes it adaptable for producing high fluid pressures, and particularly, high liquid pressures which are of sufficient value that the pump can be used as the pressure supply mechanism for actuating hydraulic mechanisms. In former vane type pumps considerable difficulty has been encountered in producing high pressures, since the liquid slip past the vane has been considerable. There have been attempts to secure the vanes in constant engagement with the cylindrical wall of the cylinder and to increase the volumetric efficiency of vane type pumps when used for liquid delivery. These applicants have produced a mechanism which promotes the maximum efficiency of a vane type liquid delivery pump and which retains the vanes of the pump in constant engagement with the cylindrical wall of the cylinder to prevent liquid slip past the ends of the vanes which are in engagement with the cylinder wall.

It is an object of this invention to provide an improved pump structure for use as a liquid pump.

It is another object of the invention to provide means for retaining the vanes of a vane type pump in engagement with the cylindrical wall of the cylinder.

It is another object of the invention to provide a mechanism in accordance with the foregoing object which resiliently urges the vanes outwardly into engagement with the cylinder wall.

It is another object of the invention to retain the vanes of a vane type pump in engagement with the cylinder wall by means of fluid or liquid under pressure.

It is another object of the invention to provide a vane type liquid delivery pump having means for retaining the vanes in constant engagement with the walls of the cylinder, and which cylinder is adapted to be moved with respect to the pump rotor in order to change the direction of delivery of the pump.

It is another object of the invention to provide a variable delivery reversible flow liquid pump of the vane type having a mechanism for maintaining the vanes in engagement with the cylinder wall, and which is constructed and arranged for movement of the cylinder with respect to the rotor without effecting the mechanism for maintaining the vanes in constant engagement with the cylindrical wall of the cylinder.

It is another object of the invention to provide a variable delivery reversible flow fluid pump with means for conducting fluid under pressure under the vanes to force the same outwardly into engagement with the cylinder walls, wherein means are provided for changing the flow of pressure fluid in the conducting means when the flow of fluid through the pump is reversed.

It is another object of the invention to provide a vane type pump for liquid delivery which has a straight-through liquid flow through the pump.

Further objects and advantages will become apparent from the description and the drawing.

In the drawings:

Figure 1 is a longitudinal cross-sectional view of the pump of this invention.

Fig. 2 is a cross-sectional view taken along line 2—2 of Fig. 1.

In this invention the fluid or liquid pump consists of a casing 10*a* having passageways 11*a* and 12*a* extending therethrough providing inlet and outlet passages. A substantially rectangular member 17*a* forms a cylinder block within which there is provided a cylindrical bore 18*a* which extends transversely of the block 17*a*. This bore 18*a* forms the cylinder wall of the cylinder of the

pump. The cylinder block 17a is carried between parallel faces 19a and 20a provided on the casing 10a, the parallel faces provided on the cylinder block 17a slidably engaging the faces 19a and 20a to permit the cylinder block 17a to be reciprocated thereon. A passageway 21a provided in the cylinder block 17a communicates with the passageway 11a, and a passageway 22a provided diametrically opposite the passageway 21a communicates with the passageway 12a.

The rotor 70 consists of a cylindrical body having a plurality of radial slots 71 therein in which the vanes 72 are adapted to reciprocate. The rotor 70 has axially extending hub portions 73 and 74 which extend into axial bores 75 and 76 provided in the end plates 77 and 78 respectively. Bolts 79 extend from the end plate 78 through the body of the rotor 70 and into threaded engagement with the end plate 77 to thereby retain the rotor and the end plates together in an integral structure, the rotor 70 being friction bound between the end plates 77 and 78.

The end plates 77 and 78 engage the sealing surfaces 26a and 29a of the cylinder block 17a and thereby provide a chamber in which the vanes 72 can function to provide the desired pumping action.

The end plate 77 carries a shaft 80 which extends exteriorly of the casing 10a and is connected to suitable driving means. The end plate 78 is provided with a shaft 81. The shafts 80 and 81 are carried by the inner races 31a and 36a respectively of the ball bearings 32a and 37a which are mounted in the recesses 53a and 39a provided in the casing 10a. The unit rotor consisting of the rotor body 70, the end plates 77 and 78 and the shafts 80 and 81 is thus carried directly by the ball bearings 32a and 37a to relieve the friction of distortion of the pump.

The unit rotor structure is carried between the ball bearings 32a and 37a in a manner whereby any distortion within the pump caused by production of high pressures therein will be carried directly by the bearings and not by any friction surfaces. While the surfaces 26a and 29a are in close engagement with the end plates 77 and 78, yet there is always sufficient clearance between these faces to provide a film of lubricating oil therebetween. Any distortion within the pump due to the production of high pressure will be upon an axis at right angles to the axis of the supporting bearings 32a and 37a, whereby the movement of the shafts 80 and 81 parallel to the axis of rotation thereof will be absorbed by the bearings 32a and 37a, the end plates 77 and 78 merely slide parallel with respect to the engaging surfaces 26a and 29a.

It is thus seen that this structure provides a pump which has a minimum of friction when developing high pressure and which can develop high pressure without slippage of fluid past the vanes since the vanes are retained in constant engagement with the cylinder bore 18a.

An oil seal 43a is provided around the shaft 80, while an inspection plate 61a closes the bore into which the shaft 81 extends in the end plate 40a.

To provide pressure upon the inner ends of the vanes 72 to retain the outer ends thereof in constant engagement with the cylinder bore 18a, fluid under pressure from the discharge side of the pump is conducted to the slots 71 whereby the pressure acts on the inner edge of the vanes 72 to thereby force the vanes outwardly. Since the fluid or liquid pump is of the reversible flow type, either of the passages 11a or 12a can become the discharge or pressure side of the pump. It is therefore necessary that porting of the discharge side of the pump to the slots 71 be duplicated and suitable means be provided for checking the flow of fluid from one side of the pump when the opposite side thereof is the high pressure discharge.

To conduct the fluid under pressure from the discharge side of the pump transversely extending passageways 82, 82b, 83 and 83b are provided in the cylinder block 17a adjacent the flow passages 21a and 22a respectively. Diametrically opposite radially extending passages 84 and 85 are provided in the end plate 77 which communicate with the passageways 82 and 83 respectively by means of an annular groove 86 provided in the face of the end plate 77. The end plate 78 is provided with diametrically opposed radially extending passageways 84b and 85b which communicate with the passageways 82b and 83b by means of an annular groove 87 provided in the face of the end plate 78. The passageways 84 and 85 communicate with a recess bore provided axially in the end plate 77. The passageways 84b and 85b communicate with a similar axial bore 88b provided in the end plate 78. The axial bores 88 and 88b are of such diameter that they provide interconnection between the inner ends of all of the radial slots 71 provided in the rotor 70. The passageways 84, 85, 84b and 85b are closed at their ends by suitable plugs 89.

It may thus be seen that regardless of the direction of flow of fluid through the pump the slots 71 communicate with the pressure side of the pump. It is of course necessary that means be provided within the conducting passageways to prevent by-passing of high pressure fluid from the high to the low pressure side of the pump through the conducting passageways. The passageways 82 and 82b are provided with check valves 90 and 90b, while the passageways 83 and 83b are provided with check valves 91 and 91b respectively. These check valves are arranged to permit flow of fluid from the passageways 21a and 22a respectively and prevent flow of fluid in the reverse direction. Thus, when passageway 21a is the high pressure or discharge side of the pump, fluid under pressure will be conducted through the passageways 82 and 82b and their interconnecting passageways heretofore described, the flow of fluid to the passageway 22a, at this time being the suction side of the pump, being prevented by the check valves 91 and 91b. The reverse condition is of course true when the passageway 22a becomes the discharge side of the pump when the flow of fluid is reversed therethrough by shifting of the cylinder block 17a.

Suitable plunger means 100 and 101 extends through the casing 10a to engage the cylinder block 17a for shifting the cylinder block 17a with respect to the rotor 70 to vary the eccentricity therebetween, and thus vary the discharge output of the pump. Various types of manual or automatic controls operate the plunger means in conventional and well known manner.

This application is a division of my copending application Serial No. 377,709, filed February 6, 1941.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A reversible variable delivery pump including a cylinder, a rotor, a plurality of vanes carried in slots in said rotor for engaging said cyl-

inder, end plates carried by said rotor for rotation therewith and engaging said cylinder to form a compression chamber in co-operation with said cylinder and rotor, fluid flow passages in said cylinder for conducting fluid to and from said cylinder, said cylinder being movable with respect to said rotor to change the output capacity thereof and reverse the direction of delivery from said cylinder, a fluid passage in an end plate interconnecting all of said slots, independent fluid passages in said cylinder connecting said last mentioned passage with the first mentioned fluid flow passages in said cylinder, and check valve means in each of said independent passages for permitting fluid to enter said independent passages but preventing return flow therefrom, thereby continuously applying pressure from one of said first mentioned passages to beneath said vanes regardless of the direction of discharge of pressure fluid from said pump.

2. A reversible variable delivery fluid pump comprising a cylinder, an inlet and an outlet passage for said cylinder used as reversible function passages, a rotor within said cylinder, said cylinder being movable relative to said rotor to change the direction of flow of fluid through said cylinder, a plurality of slots in said rotor, vanes in said slots, end plates carried by said rotor for rotation therewith and engaging said cylinder to form a compression chamber in co-operation with said cylinder and rotor, passage means in one of said end plates interconnecting all of said slots in said rotor, fluid flow passages extending outwardly from said passage means in said end plate, individual fluid flow passages in said cylinder communicating with said inlet and said outlet passages independently, additional fluid flow passage in said plate interconnecting said first mentioned flow passages and said second mentioned flow passages, and unidirectional check valve means in said second mentioned flow passages to permit flow of pressure fluid from the prevailing discharge side of said pump into said first mentioned flow passages.

3. A reversible variable delivery fluid pump comprising a cylinder, an inlet and an outlet passage for said cylinder used as reversible function passages, a rotor within said cylinder, said cylinder being movable relative to said rotor to change the direction of flow of fluid through said cylinder, a plurality of slots in said rotor, vanes in said slots, end plates carried by said rotor for rotation therewith and engaging said cylinder to form a compression chamber in co-operation with said cylinder and rotor, passage means in one of said end plates interconnecting all of said slots in said rotor, fluid flow passages extending outwardly from said passage means in said end plate, individual fluid flow passages in said cylinder communicating with said inlet and said outlet passages independently, additional fluid flow passage in said plate interconnecting said first mentioned flow passages and said second mentioned flow passages, and spring pressed check valve means in said second mentioned flow passages urged in closed position to prevent flow of fluid from said passages in said end plate to the prevailing inlet passage of said cylinder.

4. A reversible variable delivery pump including, a cylinder, a rotor, a plurality of vanes carried in slots in said rotor for engaging said cylinder, end plates carried by said rotor for rotation therewith and engaging said cylinder to form a compression chamber in co-operation with said cylinder and rotor, flow passages in said cylinder for conducting fluid to and from said cylinder, said cylinder being movable with respect to said rotor to change the output capacity thereof and reverse the direction of delivery from said cylinder, a fluid chamber arranged axially in an end plate interconnecting all of said slots, fluid passages in the aforesaid end plate extending outwardly thereof from said fluid chamber, independent fluid passages in said cylinder independently connected with said first mentioned fluid flow passages and continuously operably connected with said outwardly extending passages in said end plate, and check valve means in the operably interconnected passages between said first mentioned fluid flow passages and said fluid chamber in said end plate for permitting fluid to enter said fluid chamber but preventing return flow therefrom, thereby continuously applying pressure from one of said first mentioned fluid flow passages to beneath said vanes regardless of the direction of discharge of pressure fluid from said pump.

5. A reversible variable delivery pump including, a cylinder, a rotor, a plurality of vanes carried in slots in said rotor for engaging said cylinder, end plates carried by said rotor for rotation therewith and engaging said cylinder to form a compression chamber in co-operation with said cylinder and rotor, flow passages in said cylinder for conducting fluid to and from said cylinder, said cylinder being movable with respect to said rotor to change the output capacity thereof and reverse the direction of delivery from said cylinder, a fluid chamber arranged axially in an end plate interconnecting all of said slots, fluid passages in the aforesaid end plate extending outwardly thereof from said fluid chamber and terminating in an annularly arranged passage in the aforesaid end plate, independent fluid passages in said cylinder interconnecting said first mentioned fluid flow passages with said annularly arranged passage, and check valve means in the passage means interconnecting said first mentioned fluid flow passages with said annularly arranged passage for permitting fluid to enter said annularly arranged passage but preventing return flow therefrom, thereby continuously applying pressure from one of said first mentioned passages to beneath said vanes regardless of the direction of discharge of pressure fluid from said pump.

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