April 2, 1946. J. D. BUCHANAN 2,397,594

HYDRAULIC MOTOR OR PUMP

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Fig. 1.

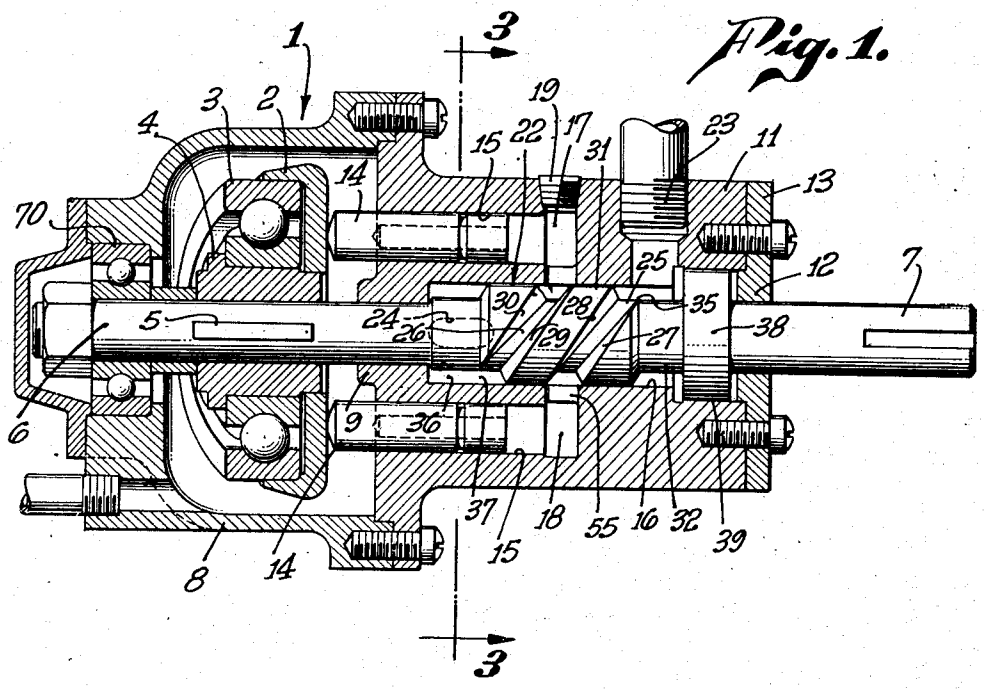
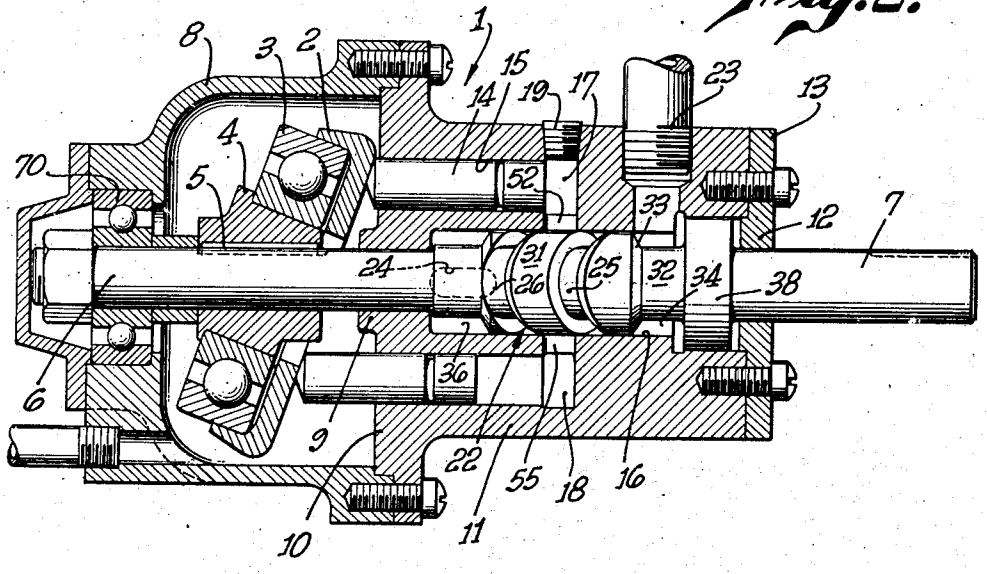


Fig. 2.



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Fig. 3.

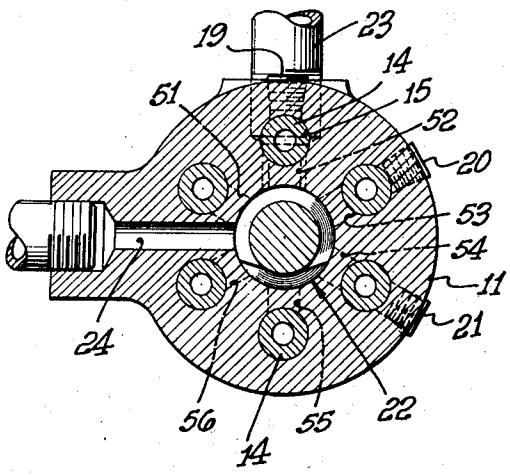


Fig. 4.

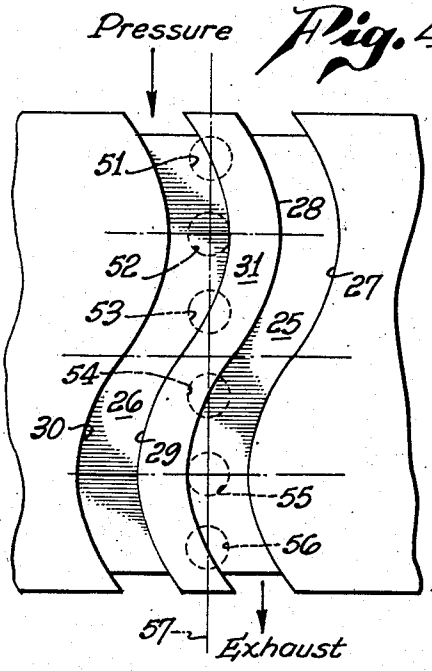
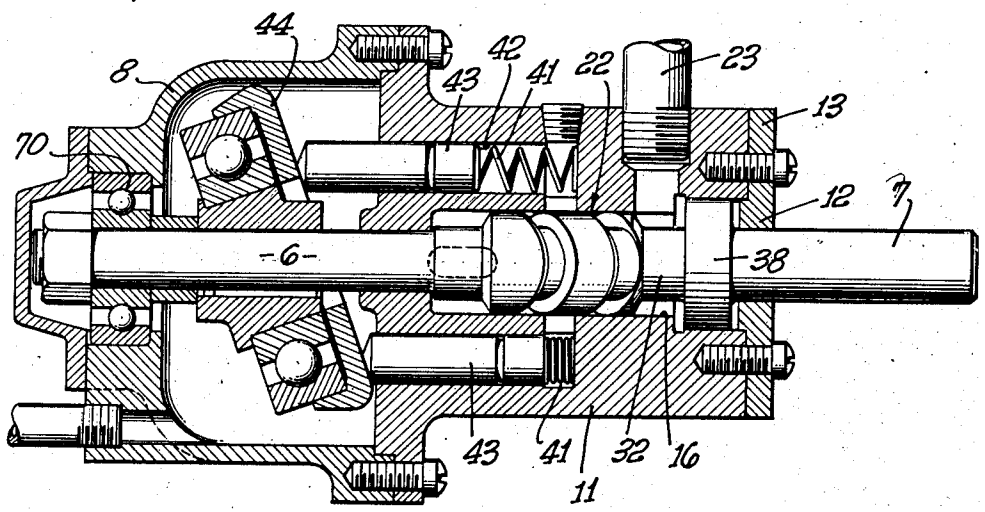


Fig. 5.



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UNITED STATES PATENT OFFICE

2,397,594

HYDRAULIC MOTOR OR PUMP

J. D. Buchanan, Burbank, Calif.

Application January 6, 1945, Serial No. 571,631

5 Claims. (Cl. 103—173)

The invention relates to a hydraulic or fluid motor or pump of the well-known type wherein the rotor is provided with a wobble plate actuated by or actuating a series of plungers, depending upon whether the device is employed as a motor or pump. The rotor of the device is provided with a rotary valve to control the fluid flow.

In one type of wobble plate motor or pump, as constructed heretofore, the rotary valve is in the form of a channel on the periphery of the rotor, one side of the channel lying in a plane which is at right angles to the longitudinal axis of the rotor, the other side of the channel being in the form of a curve to supply the fluid pressure to or from the plungers in sequence. The disadvantage of this construction is that the side walls of the channel are not symmetrical as to their angular position with respect to the axis of the rotor, whereby the inclined side wall has a lateral component resulting in lateral or side thrust on the rotor.

An object of the present invention is to avoid the above defect and this is accomplished by providing an improved rotary valve having a construction which reduces or to a large extent eliminates the lateral thrust on the rotor.

Another object of the invention is to reduce or substantially eliminate longitudinal thrust on the rotor due to the longitudinal thrust on the rotary valve and on the plungers associated with the wobble plate. This is accomplished by providing at one end of the rotary valve a piston area which offsets the sum of the longitudinal thrust on the rotary valve and on the plungers, and by arranging at the other end of the valve a piston area which offsets the difference in those thrusts. The casing is provided with a pair of passages either of which may serve as in inlet when the other is serving as an outlet, so that the direction of rotation may be reversed. The feature last mentioned substantially balances the rotor for longitudinal thrust, regardless of whether one passage or the other is used as an inlet.

For further details of the invention, reference may be made to the drawings, wherein:

Figure 1 is a longitudinal sectional view through an improved motor or pump according to the present invention.

Fig. 2 is a view corresponding to Fig. 1 with the rotor in a different position.

Fig. 3 is a sectional view on line 3—3 of Fig. 1.

Fig. 4 is a developed view of the rotary valve of Figs. 1 to 3.

Fig. 5 is a longitudinal sectional view of the same construction shown in the other figures with the addition thereto of springs for operating the plungers.

Referring in detail to the drawings, the motor or pump 1 is of the well-known wobble plate type wherein a wobble plate 2 is mounted on a ball bearing 3 suported on a bearing block 4 in a tilted position as shown. The bearing block 4 is secured by a key 5 to the shaft 6 of the rotor 7. Shaft 6 is supported in a bearing 10 in a cap 8 and also in a bearing 9 in one end wall 10 of the casing 11 and in a bearing 12 in a cap 13 at the other end of casing 11.

The wobble plate 2, as well known, is operated by, or operates a series of plungers 14 here shown as six in number, although any other suitable number may be used. Each of the plungers 14 slides in a bore such as 15 which extends parallel to the axis of shaft 6. The casing 11 is provided with a valve bore 16 and all of the plunger bores such as 15 open into the bore 16. Preferably the piston bores 15 are arranged in pairs diametrically opposite each other so that the cross passages like 17 and 18 which connect the piston bores 15 with the valve bore 16 may be drilled one pair at a time and the outer end of the passage may then be sealed off by a plug as indicated at 19. The plugs for the other two pairs of plunger bores are indicated in Fig. 3 at 20 and 21.

The shaft 6 is provided with a rotary valve 22 which controls the fluid pressure to and exhaust from the plungers 14. At one end of valve 22 the casing 11 is provided with a passage 23 which may be an inlet or an outlet and at the other end of valve 22 casing 11 is provided with a passage 24 adapted to serve as an outlet when 23 is an inlet, and as an inlet when 23 is an outlet.

According to the present invention, the valve 22 is provided with a pair of channels 25 and 26 each having side walls 27, 28 and 29, 30, respectively, which are similarly inclined with respect to the longitudinal axis of the rotor 7 whereby side or lateral thrust on the rotor 7 is, to a large extent, eliminated.

The two channels 25 and 26 are separated by the inclined wall 31 so that each channel is always sealed off from the other channel. In other words, if we start at the top of channel 25 in Fig. 1 and follow around this channel, we will arrive back at the starting point, and the same is true of channel 26. This is further illustrated in the developed view in Fig. 4 wherein it is clear that if this figure were rolled up into a cylinder, the opposite ends of channel 25 as shown in this figure would be connected together, and the same is true of channel 26.

Opposite the passage 23, the rotor 7 has a diameter or a reduced section 32 which is smaller than the bore 16, the left side of the reduced section 32 merging with a wall portion 33 which extends at right angles to the axis of rotor 7. Around the reduced section 32 is a chamber 34 which communicates with the passage 23, and

groove 25 opens into this chamer at one side of rotor 7 where the inclined wall 27 intersects the straight wall 33 as indicated at 35. The opening 35 thus maintains the groove 25 always in communication with the passage 23.

The channel 26 is similarly constructed except that its inclined wall 30 opens into the chamber 36 at a point 37, which is diametrically opposite the point 35. Chamber 36 always communicates with the passage 24.

When passage 23 is serving as an inlet, fluid pressure in channel 25 exerts a lateral pressure on wall 28 in one direction of an amount just the same as that exerted on wall 27 in the opposite direction, except for the difference in the length of the lateral components of these walls, due to the cut away portion 35 where channel 25 opens into the chamber 34. In one design, it was found that this difference is about ten per cent (10%) which is permissible. The same considerations apply to walls 29 and 30 of channel 26, when passage 24 serves as an inlet. The rotor, therefore, is substantially balanced against lateral thrust regardless of which of the passages 23 and 24 serves as an inlet.

Each of the plunger passages like 17 and 18 terminates in a plunger port shown at 52 and 55 in Fig. 2, the six ports being indicated at 51 to 56 in Fig. 4. The center lines of the plunger ports 51 to 56 lie in a plane which is at right angles to the axis of the rotor 7, and this plane is indicated by the line 57 in Fig. 4. Also, as will be apparent from Fig. 1, and Fig. 4, that plane intersects both of the channels 25 and 26 whereby certain of the plunger ports are connected to the inlet supply at the time when other plunger ports are connected to the exhaust. Also, one of the ports such as 52 is fully opened to the inlet pressure at the time that a diametrically opposite port 55 is fully open to the exhaust. The channels 25 and 26 serve to connect the various plunger ports 51 to 56 to the supply and exhaust, in a progressive manner as the rotor 7 rotates.

When passage 23 serves as an inlet there is a longitudinal thrust to the left on rotor 7 due to the sum of the thrusts on the pressure operated plungers 14 and the longitudinal thrust at the right end of valve 22 over the area equal to the difference in area of bore 16 and the area of the reduced section 32, and the sum of these thrusts is offset by a substantially equal thrust in the opposite direction on the left end of piston 38, which is provided with an annular area 39 sufficient to counterbalance those thrusts.

When passage 24 serves as an inlet, the longitudinal thrust on the left end of valve 22 is in a direction to the right, over an area equal to the difference in cross sectional area of wall 31 in bore 16 and the area of shaft 6 in bearing 9 while an equal thrust on the rotor due to the pressure operated plungers 14 is to the left. The rotor shaft 6 is, therefore, balanced against longitudinal thrust regardless of which of the passages 23 and 24 is used as an inlet.

In the modification shown in Fig. 5, a compression spring like 41 may be arranged in each plunger bore 42 in order to urge each plunger like 43 against the wobble plate 44. Otherwise, the construction in Fig. 5 is the same as that described above.

It will be apparent that various improvements may be made in the invention without departing from the spirit of the following claims.

I claim:

1. In a wobble plate type of motor or pump having a stator with inlet and exhaust passages and a series of plungers, and a cooperating rotor having a wobble plate, and having a rotary valve having a pair of peripheral channels controlling fluid supply to and exhaust from said plungers, the improvement in said rotary valve wherein said channels have side walls similarly inclined with respect to the axis of said valve to offset lateral thrust on said valve from fluid pressure at said inlet.

2. In a wobble plate type of motor or pump having a stator with inlet and exhaust passages and a series of plungers, and a cooperating rotor having a wobble plate and having a rotary valve having a pair of peripheral channels controlling fluid supply to and exhaust from said plungers, the improvement which comprises a piston on said rotor to offset longitudinal thrust on said rotor due to the sum of the thrusts on said rotary valve and on said plungers.

3. In a wobble plate type of motor or pump having a stator with inlet and exhaust passages and a series of plungers, and a cooperating rotor having a wobble plate and having a rotary valve having a pair of peripheral channels controlling fluid supply to and exhaust from said plungers, the improvement in said rotary valve wherein said channels have side walls similarly inclined with respect to the axis of said valve to offset lateral thrust on said valve from fluid pressure at said inlet, and a piston and shaft on said rotor at opposite ends of said rotary valve, said piston offsetting longitudinal thrust on said rotor due to the sum of the longitudinal thrusts on said rotary valve and on said plungers, and the thrust on the difference in cross sectional area of said valve and said shaft offsetting longitudinal thrust on said rotor due to said plungers, whereby said rotor is substantially balanced for longitudinal and lateral thrusts for flow in one direction or the reverse direction through said passages.

4. In a wobble plate type of motor or pump, a casing having inlet and exhaust passages and plunger ports, a rotary valve in said casing, said valve having two reversely inclined parallel channels of which one opens into one of said passages at one side of said valve and the other channel opens into the other passage at the other side of said valve, the centers of said plunger ports lying in a plane at right angles to the valve axis, said plane intersecting one portion of one of said channels and another portion of the other channel and said channels being constructed and arranged to connect said plunger ports to supply and exhaust in a progressive manner.

5. A wobble plate motor or pump having a stator with inlet and exhaust passages and a series of plungers, a bearing in said stator, a cooperating rotor having a shaft, said rotor having a wobble plate on said shaft at one side of said bearing and having a rotary valve on said shaft at the other side of said bearing, said rotary valve having a pair of peripheral channels controlling fluid supply to and exhaust from said plungers, said inlet communicating with the end of said rotary valve adjacent said bearing, the thrust of said plungers on said wobble plate being effective in one direction of said rotor, and the cross-sectional area of said shaft being smaller than the cross-sectional area of said rotary valve to provide a thrust in the opposite direction which offsets said thrust of said plungers.

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