July 4, 1950 W. H. BROWN 2,513,447

ROTARY PUMP OR MOTOR

Filed May 17, 1946 3 Sheets-Sheet 1

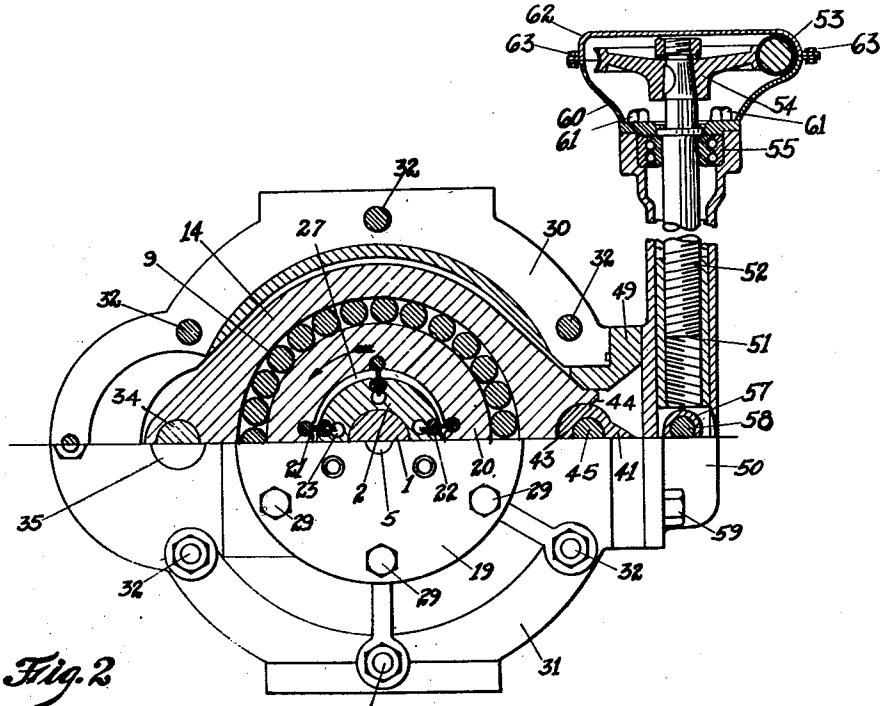


Fig. 2

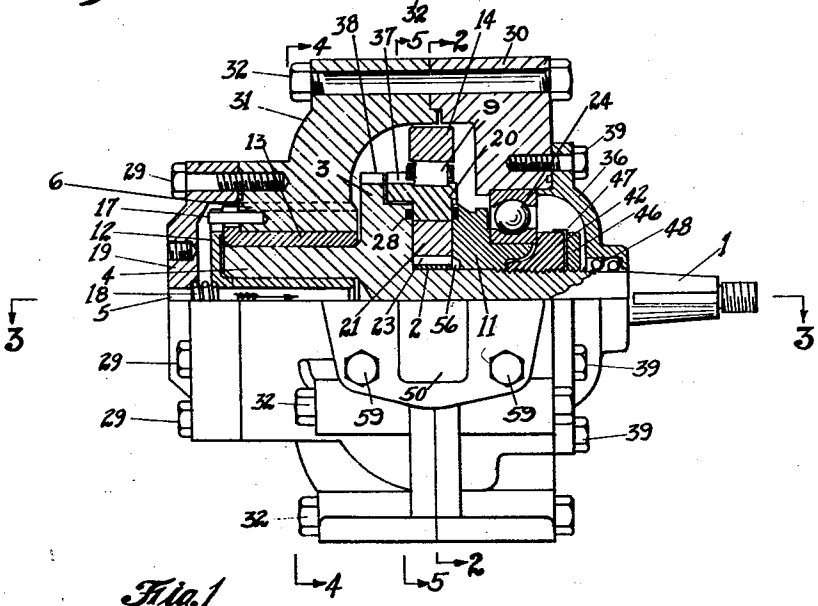


Fig. 1

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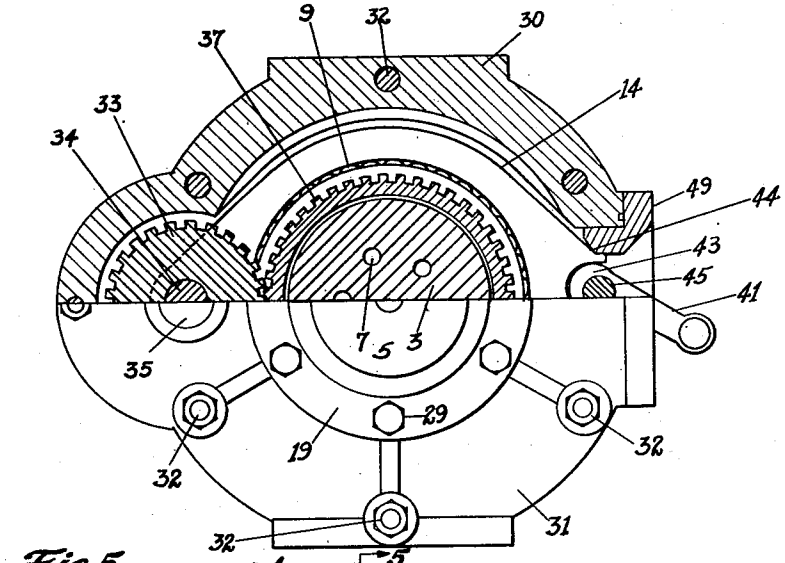


Fig. 5

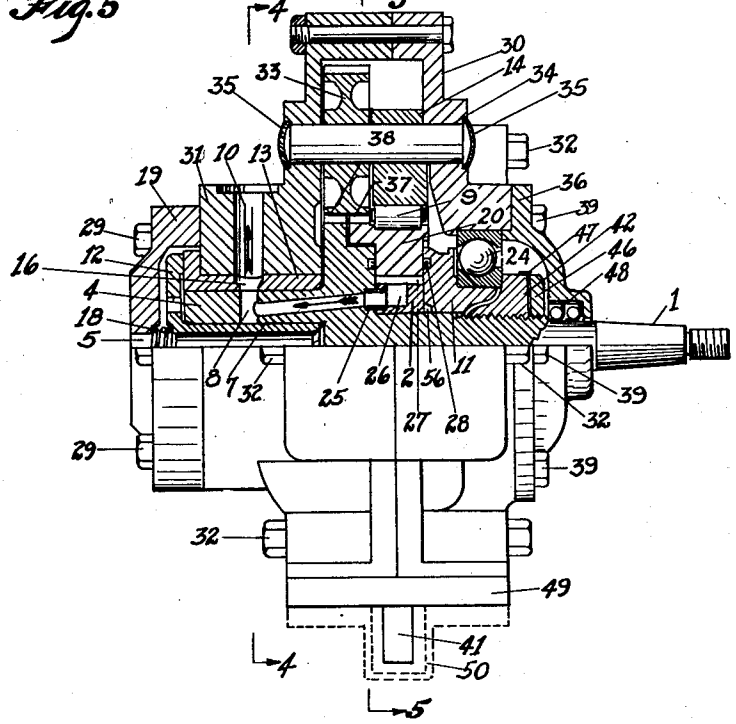


Fig. 3

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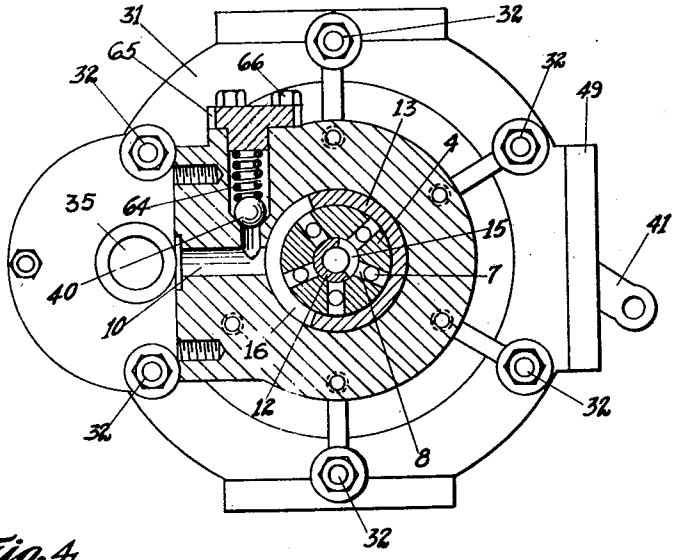


Fig. 4

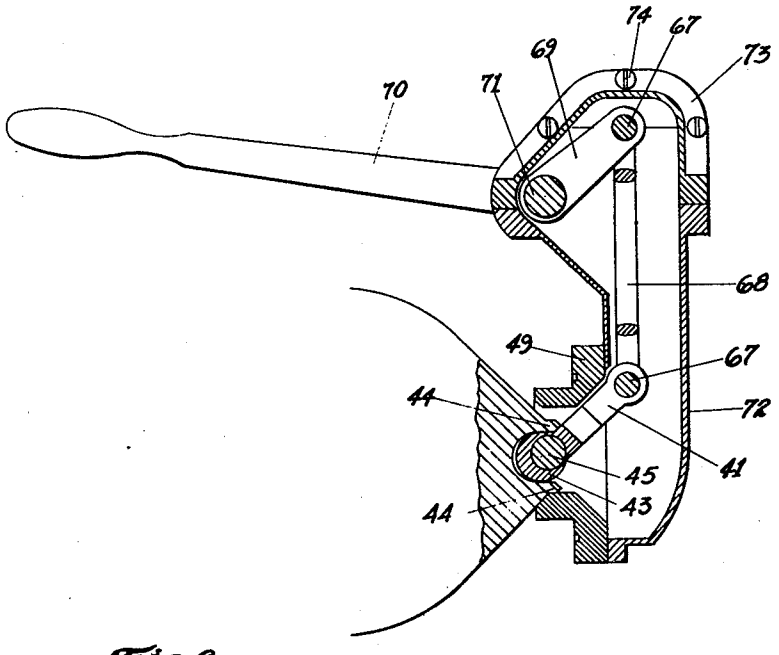


Fig. 6

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2,513,447

ROTARY PUMP OR MOTOR

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Application May 17, 1946, Serial No. 670,593

4 Claims. (Cl. 103—120)

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This invention relates to an improved type of rotary pump or motor, and more particularly to a type of pump whose displacement can be varied, thus providing a variable discharge with constant rotative speed. Such a pump may be used in connection with rotary- or piston-type hydraulic motors, hydraulic plunger devices, etc., as used for driving stokers, machine tool feeds, hydraulic presses, and control devices of many kinds, etc.

The pump is of the general type which embodies two rotors or vane driving members, one within the other, between which the vanes are mounted. In a preferred form of the invention one edge of each vane is formed with an enlarged cylindrical boss or head which fits into an appropriate socket in one of the driving members, and each vane is adapted to oscillate radially in a rocker in the other driving member and to rotate back and forth through a small angle while held in the rocker.

Instead of driving the vanes in the conventional manner, each edge of each of the vane surfaces exposed to fluid pressure is embraced by one of the driving members and moved with it. This permits the pump to be operated against high fluid pressures which tend to produce bending and sticking of the vanes in the sliding vane-type pumps.

According to one form of the invention, each driving member (or means connected with each driving member) is provided with a toothed cylindrical surface. Both of these surfaces are of the same diameter and mesh with an idler gear. An advantageous way of providing such a surface on the inner driving member is to enlarge one end of the shaft on which it is mounted and finish this enlargement off as a toothed cylindrical surface of the same diameter as the toothed cylindrical surface on the outer driving member. By this arrangement, the idler is driven from the driving shaft (through its enlarged portion), and the outer driving member is driven from the idler. Alternatively, an adaptation of an Oldham coupling or other means for driving one rotating member from another, one being located within the other and with the relation of their axes changing, may be used.

In the preferred form of the invention the two driving members are flanked by flanges

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which prevent the lateral passage of liquid to or from the vaned spaces between the driving members. The enlarged end of the driving shaft is provided with a central bore in which a stationary sleeve is fitted. The liquid enters through this sleeve and passes from a port in the sleeve through one of a series of channels in the shaft (as the shaft revolves) and through registering channels in the inner driving member to the expanding spaces between the driving members. At that stage of the cycle in which the size of the spaces is decreasing, the liquid passes back through channels in the inner driving member and the shaft, through an opening in a bushing which surrounds the enlarged end of the shaft to a discharge port located radially outwardly from the shaft. The outwardly radial intake and discharge facilitate high-speed operation.

To provide for control of the rate of discharge of the pump, the outer driving member revolves in a bearing which is pivoted at one point so that the outer driving member may be concentric with, or eccentric to, the inner driving member; and is eccentric, the degree of eccentricity may be varied. Thus, the pump may be made to idle by having the driving members concentric, or the volume of discharge may be increased, up to the pump's maximum quantity, by increasing the degree of eccentricity of the two driving members.

Referring to the drawings:

Fig. 1 is a side quarter-sectional elevation of the pump;

Fig. 2 is an end quarter-sectional elevation taken on the line 2—2 of Fig. 1 with means for controlling the volume of discharge of the pump added;

Fig. 3 is a quarter-sectional plan view taken through the axis on the line 3—3 of Fig. 1 with the housing for the control means of Fig. 2 indicated in dotted lines;

Fig. 4 is a sectional elevation on the line 4—4 of Figs. 1 and 3;

Fig. 5 is a half-sectional elevation on the line 5—5 of Figs. 1 and 3; and

Fig. 6 is a detail, largely in section, of a quick-acting hand control to be used in lieu of the worm-gear-driven screw and nut control shown in Fig. 2.

The elevations are taken at different angles,

the elevation of Fig. 1 being at right angles to the elevations of Figs. 2, 4, and 5.

When used as a pump, the rotors or driving members are driven by the drive shaft 1 to which the inner rotor 2 is doweled or otherwise suitably fastened so that this rotor turns with the shaft. The shaft is formed with the flange 3 abutting the rotor 2, and beyond the flange the shaft comprises the annular portion 4 into which is rotatably fitted inlet sleeve 12 through which the driving liquid enters the motor. This annular portion 4 of the flange is provided with the channels 7 (Figs. 3 and 5) which connect with the radial channels 8. Some of these channels 7 and 8 are supplying liquid to the pump from the inlet 5, inlet sleeve 12, and port 15 to fill the pump while others are delivering the used liquid to the outlet 10 (Figs. 3 and 4).

The direction of the flow of the liquid through the channels 7 and 8 is best understood from Fig. 4. The sleeve 12 fits inside of the hollowed-out portion of the shaft. The bushing 13 surrounds the annular portion 4 of the shaft. Neither the sleeve 12 nor the bushing 13 forms a complete annular wall at the longitudinal position corresponding with the radial passages 8 in annular shaft extension 4. Each remains stationary as the annular portion of the shaft 4 revolves between them. Liquid passing from the inlet opening 5 of the end plate passes through the open port 15 in the sleeve 12 (Fig. 4) into certain of the radial passages 8 and thence through the channels 7 to the inner rotor, and the returning liquid passes through other channels 7 to the radial passages 8 and from these radially through the open portion 16 of the bushing 13 to the outlet 10.

The sleeve 12 is closely fitted in the central bore of the enlarged end of the drive shaft and is prevented from turning therewith by dowel pin 17. It is retained longitudinally within the bore by the spring 18 and end cap 19 affixed to the housing half 31 by cap screws 29.

The pump is composed of the two rotors or driving members 2 and 20 with the vanes, rockers, and enclosing flanges. The vanes 21 which divide the space between the two driving members into compartments are adapted to move in and out of the rockers 22 which are rotatably mounted in the driving member 2. When the driving members are concentric, the rockers remain motionless in their sockets. When they are eccentric, the rockers move through a small angle at each revolution of the driving members. The channels 23 which extend longitudinally of the driving member 2 provide for movement of the vanes 21 as the driving members approach one another.

When the driving members are in concentric relation, there is no flow of the liquid through the pump. The compartments defined by the vanes and the driving members are then all of substantially the same size and remain the same size as the driving members rotate. By moving one of the driving members radially with respect to the other, the compartments are made of different sizes, and then as the driving members rotate, liquid is drawn into the compartments in that portion of the cycle of rotation in which the driving members become separated from one another and is discharged in that portion of the cycle in which the driving members are brought closer to one another. This is best illustrated by reference to Fig. 2. Here the two driving members are relatively close to one another at the bottom of the pump and are separated at the top of the pump. As the driving members rotate in the direction indicated by the arrow, the compartments between them increase in size as they move from the bottom to the top of the pump, and they decrease in size as the cycle is completed and they move from the top to the bottom of the pump. It is possible to reverse the flow of liquid without changing the direction in which the driving members are rotated by changing the relative position of the two driving members so that they are close to one another at the top of the cycle of rotation and are separated at the bottom. This reversal of flow will, however, reduce the efficiency of the pump when operated at high speeds, as the flow through the pump will then be radially inward instead of outward.

As the two driving members become spaced from one another, the liquid is drawn through the inlet opening 5 and passes through the opening 15 in the sleeve 12 (Fig. 4) and through channel 7 and the hollow dowels 25 and radial passages 26 to the space or compartment 27 between the two rotors. The liquid enters this space as the compartments between the rotors increase in size and is discharged under pressure as they decrease in size.

The pump housing is advantageously divided into two parts; namely, the right half 30 and the left half 31, held together by bolts 32. Mounted within the housing is the idler gear 33 rotatably mounted on the pivot pin 34. This pivot pin is retained in suitable bosses in the housing halves 30 and 31 by expansion plugs 35. The teeth of the idler gear 33 mesh with the teeth 37 on the cylindrical outer surface of the outer driving member and the teeth 38 on the cylindrical surface of the flange on enlarged portion 3 of the driving shaft.

The eccentric ring 14 is supported on one side by the pivot pin 34 and at the other side by the control cam 43 which is embraced by lugs 44 on the eccentric ring 14. This cam is diametrically opposite the pivot pin 34 and is supported by the pin 45. The openings 15 and 16 (Fig. 4) in the sleeve 12 and bushing 13 are substantially bisected by a line passing through the pins 34 and 45 (Fig. 2).

The inner circumference of the eccentric ring 14 forms the outer race for rollers 9, the inner race being a smooth portion of the outer surface of the driving member 20. The arm 41 is integral with the cam 43 and extends outwardly into the control housing 50 which guides the sliding nut 51 and housing 60 and encloses the screw 52, the worm 53, the worm wheel 54, and the bearing 55. The sliding nut 51 is moved vertically in the housing 50 by the screw 52 which is fixed vertically by the bearing 55 and is rotated by the worm wheel 54 and worm 53, which is driven by an outside control device. It may be driven mechanically or electrically or may be hand operated. The sliding nut 51 is connected to the arm 41 of the cam 43 by link 57 and pin 58. Bearing 55 is retained in the housing 50 by the worm gear housing 60 held by the screws 61. The control housing 50 and control bracket 49 are attached to the pump housing 30 and 31 by cap screws 59. The worm and gear are enclosed by cover 62 retained by screws 63.

The flange 11 is splined or keyed to the shaft 1 and held in place by the nut 42, the lock nut 46, and the nut lock 47. This end of the shaft is supported by the bearing 24, and the other end, which is enlarged, is rotatably fitted in the bush-

ing 13 which is pressed in the left half 31 of the pump housing. The bearing 24 is retained in the right half 30 of the pump housing by the cap 36 and cap screws 38. Seals 48 prevent loss of liquid around the shaft. The circular groove 56 in the flange 11 permits the free flow of liquid displaced by the inner ends of the radially moving vanes between the counterbores 23. Packing 28 prevents loss of liquid over the sides of the outer driving member 20. End plate 19 is fastened to the housing half 31 by the cap screws 29.

The pump is operated by the drive shaft 1. The flange 3 of the drive shaft, of course, rotates with the drive shaft and turns the idler 33. This, in turn, rotates the outer rotor 20 at the same speed as the inner rotor 2 which is connected by the hollow dowels 25 to the flange 3 of the drive shaft. The worm 53 is used to move the eccentric ring 14 about the pin 34 and thus adjust the relation of the two driving members, making them concentric or bringing them together at the top or the bottom of the hollow interior of the outer rotor. Thus, the pump may be made to idle or may force the liquid in variable quantities. The rate of flow of the liquid depends upon how far from concentric the rotors are. The liquid is supplied through the inlet sleeve 12, if operating normally, or through discharge opening 10 and port 16 of bushing 13, if operating in reverse. It travels through the longitudinal channels 7 in the drive shaft, flowing toward the inner rotor at one stage of each revolution and flowing away from the inner rotor at another stage. When operating at high speeds, it is advantageous to discharge radially outwardly through the port 10 and induct through the hollow center of the shaft.

Fig. 4 shows a relief valve connected with the outlet 10. The valve 40 is held on its seat by springs 64 retained by cap 65 and screws 66. The relief valve discharges within the housing, the interior of which is open to the inlet sleeve through passage 6 (Fig. 1) and the space between the flange of the inlet sleeve 12 and cover plate 19.

Fig. 6 illustrates an alternative method of controlling the volume of discharge of the pump. The cam 43 is operated by the cam arm 41 in the manner described in connection with the preceding drawings. The cam arm 41 is connected by the yoke pin 67 and arm 69 to the hand lever 70 through pin 67 and shaft 71. The control housing 72 is closed at its top by the diagonal cap 73 affixed by screws 74. The diagonal opening in the housing which is closed by the cap 73 provides for assembling the shaft 71 and arm 68 in the housing as a unit after which the hand lever is attached.

Various changes may be made in the construction of the pump or motor without departing from the invention as defined in the appended claims.

What I claim is:

1. A variable-discharge, rotary, hydraulic pump with inlet and outlet ports, which pump comprises a hollow outer vane-driving member with an inner vane-driving member located eccentrically within the outer vane-driving member, and vanes connecting the two vane-driving members to divide the space between the two vane-driving members into compartments, a shaft, a gear, an eccentric arm one end of which is movable to change the relative position of the two vane-driving members and the other end of which is mounted concentrically with said gear, the inner vane-driving member being fastened to the shaft and the outer vane-driving member being supported in the eccentric arm, there being teeth operatively connected with each vane-driving member which teeth mesh with the teeth of the gear for driving each vane-driving member independently of the vanes.

2. A pump formed of a hollow outer vane-driving member, an inner vane-driving member located eccentrically within the outer vane-driving member, vanes dividing the space between the two vane-driving members into compartments, a shaft on which the inner vane-driving member is mounted, one end of the shaft being hollow, passages in said shaft equal in number to the number of said compartments which passages extend radially outward from said hollow, channels passing longitudinally through the shaft which connect each radial passage with one of said compartments whereby the inner and outer ends, respectively, of the radial passages serve as inlet and outlet, respectively, for the compartments, a stationary sleeve fitted in the hollow of the shaft in a substantially liquid-tight manner, an opening through the wall of the sleeve communicating with the inner ends of the radial passages as the shaft rotates about the sleeve and thus serves as the inlet valve port for said passages, and surrounding said hollow portion of the shaft a bushing, an opening through the wall of the bushing diametrically opposite said opening in the sleeve, the opening in the bushing communicating with the outer ends of the radial passages as the shaft rotates within the bushing and thus serves as the outlet valve port for said radial passages, and means for moving one of said vane-driving members radially with respect to the other vane-driving member.

3. A variable-discharge, rotary, hydraulic pump with inlet and outlet ports, the pump comprising a hollow outer vane-driving member with an inner vane-driving member located eccentrically within the outer vane-driving member, and vanes connecting the two vane-driving members to divide the space between the two vane-driving members into compartments, an eccentric arm by which the outer vane-driving member is supported and in which it rotates and one end of which arm is movable to change the relative position of the two vane-driving members, and the other end of which arm is mounted concentrically with rotatable driving means, a shaft, the inner vane-driving member being fastened to the shaft, driving means for simultaneously driving the shaft and the rotatable driving means, and means for rotating the outer vane-driving member from the rotatable driving means.

4. A rotary, hydraulic pump comprising a hollow outer vane-driving member with an inner vane-driving member located eccentrically within it and vanes connecting the two to divide the space between them into compartments, a housing, a driving shaft to which the inner vane-driving member is fastened, the shaft being hollow at one end, a bushing in which the shaft turns which bushing is fastened to the housing, in the hollow end of the shaft a sleeve fastened to the housing so as to prevent its rotation, passages in the shaft radiating from the hollow portion thereof, an outlet port in the housing with which said radial passages connect, an inlet port in the housing connecting with the sleeve, conduits in the shaft between the compartments and the radial passages, openings in the sleeve and bushing communicating with the radial passages which openings are angularly of the same length

and serve as inlet and outlet valve openings, respectively, to alternately connect the respective compartments with the inlet and outlet ports.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,370,810	Hansen	Mar. 8, 1921
1,497,741	Schneider	June 17, 1924
1,580,713	Ensign	Apr. 13, 1926
1,636,799	Berntsen	July 26, 1927
1,869,787	Trumble	Aug. 2, 1932
1,941,651	Behlmer	Jan. 2, 1934
1,961,592	Muller	June 5, 1934
2,029,554	Berggren	Feb. 4, 1936
2,061,950	Ott	Nov. 24, 1936
2,227,631	Carter	Jan. 7, 1941
2,309,148	Wilson et al.	Jan. 26, 1943
2,348,428	Tucker	May 9, 1944

FOREIGN PATENTS

Number	Country	Date
24,512	Great Britain	1908
205,815	Great Britain	Sept. 18, 1924
419,421	Great Britain	Nov. 12, 1934
439,155	Great Britain	Nov. 29, 1935