

Nov. 7, 1950

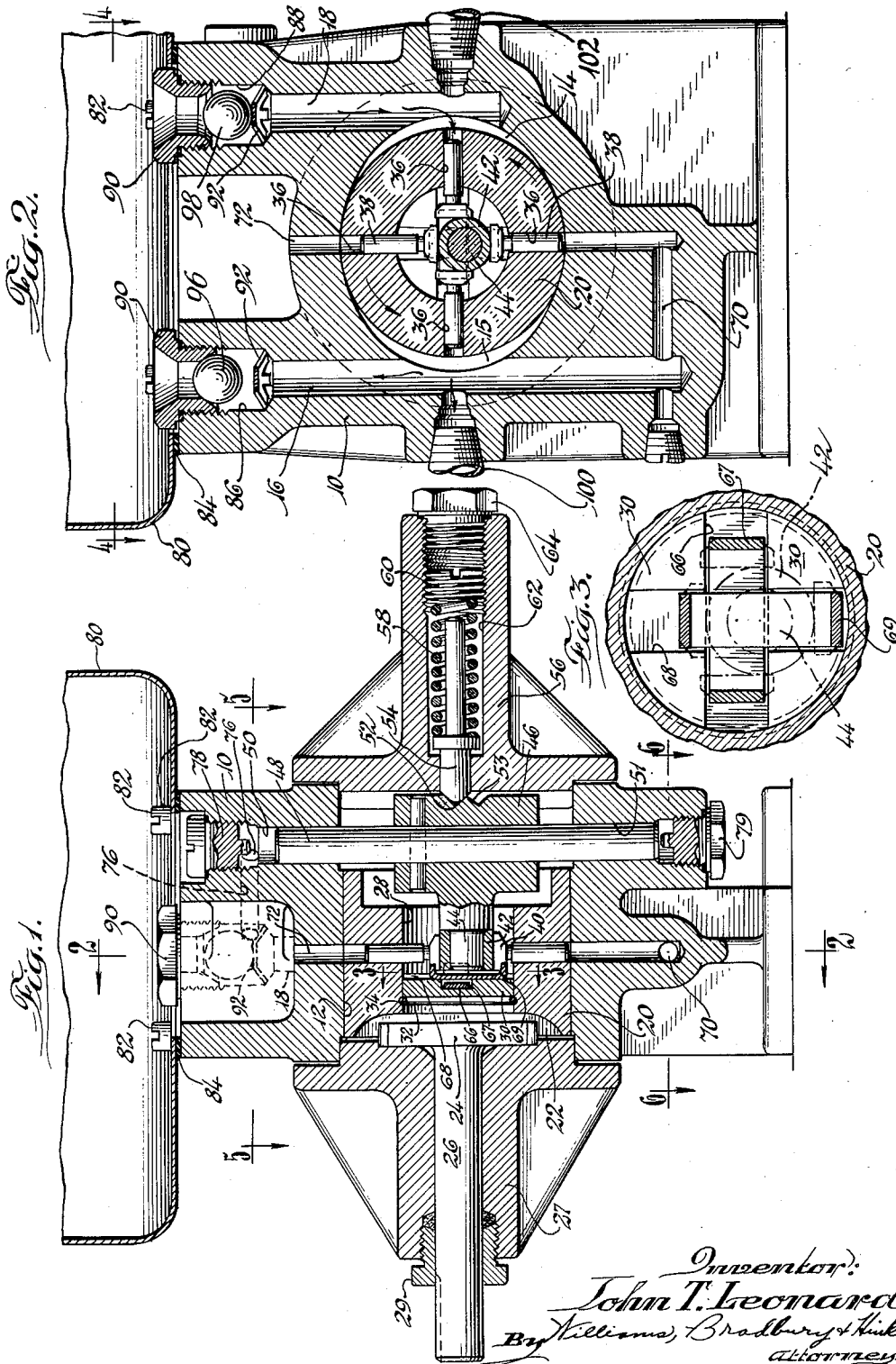
J. T. LEONARD

2,528,764

REVERSIBLE FLOW ROTARY PUMP

Filed April 6, 1946

3 Sheets-Sheet 1



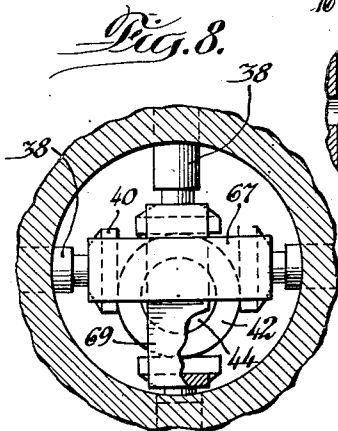
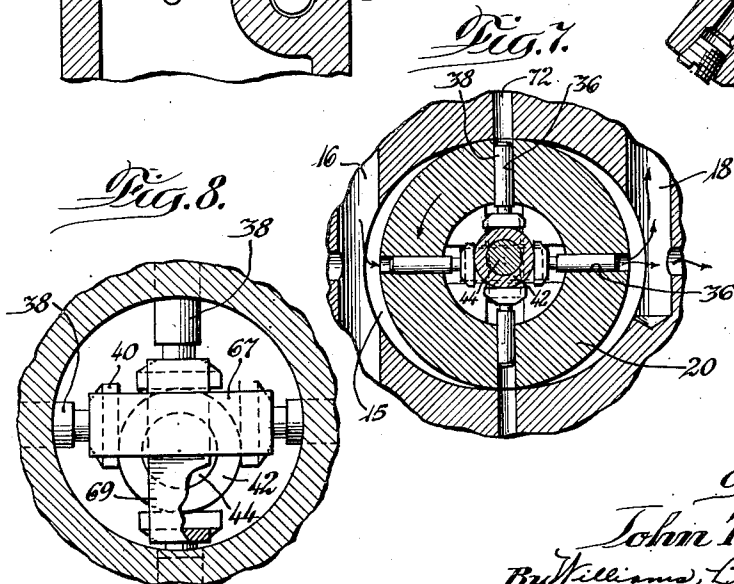
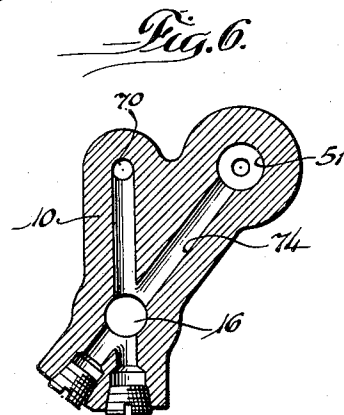
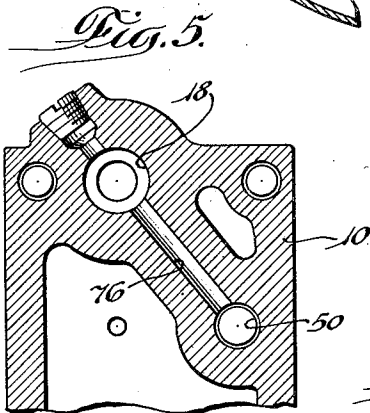
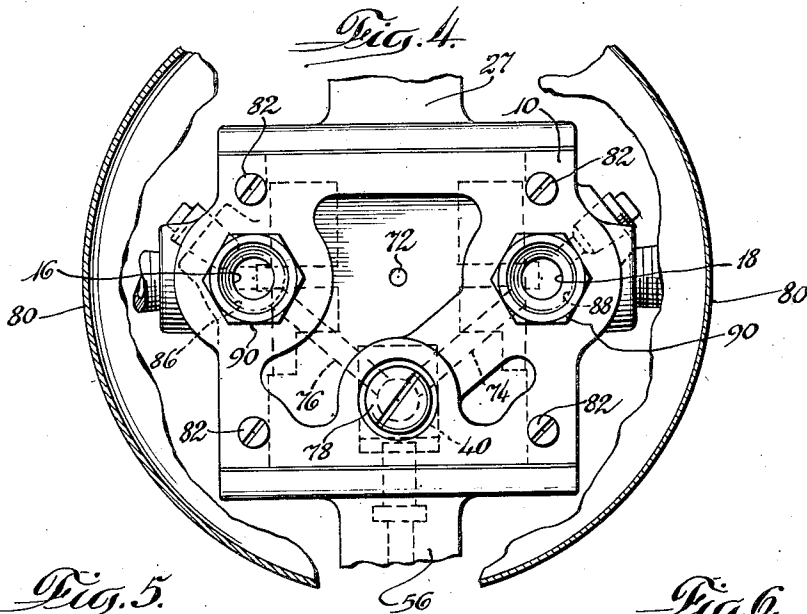
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3 Sheets-Sheet 2



Inventor:
John T. Leonard
By *Williams, Bradbury & Hinkle*
Attorneys

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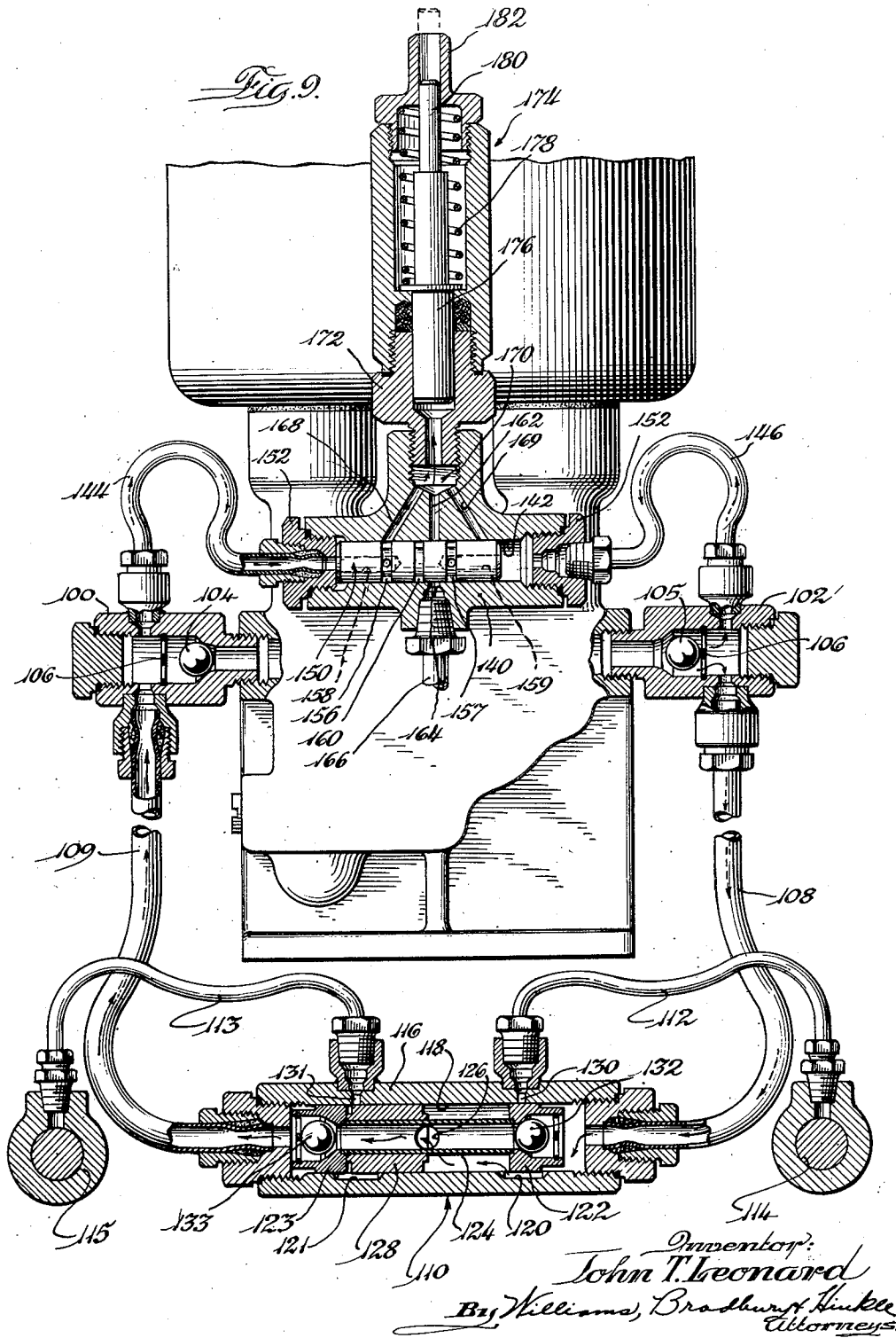
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UNITED STATES PATENT OFFICE

2,528,764

REVERSIBLE FLOW ROTARY PUMP

John T. Leonard, Evanston, Ill.

Application April 6, 1946, Serial No. 660,055

8 Claims. (Cl. 184—26)

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My invention relates generally to pumps, and more particularly to rotary pumps in which the direction of flow of the liquid may readily be reversed.

In some uses of liquid pumping apparatus, it is desirable to pump the liquid into one conduit until the pressure therein attains a predetermined value, and then to vent such conduit and supply the liquid under pressure to a second conduit. For example, in lubricating systems of the so called "dual progressive" type, each of a plurality of bearings is supplied with a measuring valve or feeder. These measuring valves are connected in series by suitable piping, and lubricant under pressure is alternately supplied to opposite ends of the piping. This is ordinarily accomplished by alternately connecting a conventional pump to the opposite ends of the conduit system, or by providing a four-way valve effectively to reverse the connections between the pump and the ends of the conduit.

In accordance with the principles of my invention, the necessity of using a reversing valve or of using detachable couplings for connecting the pump to the conduit system is avoided, since the pump itself is effective to pump in either direction, that is, into either end of the conduit system, while relieving lubricant pressure at the other end of the conduit.

It is therefore a fundamental object of my invention to provide an improved reversing rotary pump.

A further object is to provide an improved reversing pump in which the direction of pumping action is reversed when the pressure at the outlet of the pump attains a predetermined maximum value.

A further object is to provide an improved rotary pump in which the direction of flow may be readily reversed.

A further object is to provide an improved means for indicating the operating condition of the pump and of the lubricating system with which it is used.

A further object is to provide an improved pump especially adapted for dual progressive lubricating systems, which is simple and compact, and may be economically manufactured.

Other objects will appear from the following description, reference being had to the accompanying drawings, in which:

Fig. 1 is a central vertical sectional view;

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

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Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary sectional view taken on the line 4—4 of Fig. 2;

Figs. 5 and 6 are fragmentary sectional views taken on the lines 5—5 and 6—6, respectively, of Fig. 1;

Fig. 7 is a fragmentary sectional view taken on the plane of the line 2—2 of Fig. 1, and showing the eccentric in the position opposite to which it is shown in Fig. 2;

Fig. 8 is a detail view showing the straps employed to hold the plungers in contact with the eccentric; and

Fig. 9 is a sectional, partly diagrammatic, view of a lubricating apparatus with which the pump is designed to be used.

Referring particularly to Figs. 1 and 2, the pump comprises a body casting 10 having a bore 12 formed therein. The bore 12 is cylindrical except for the provision of crescent shaped grooves 14 and 15, which are milled in the casting in line with passageways 16 and 18. Within the bore 12 is a rotor 20, one end of which is provided with a key slot 22 for the reception of a key 24 formed at the end of a drive shaft 26. The drive shaft 26 has a suitable bearing in a cap 27 closing one end of the bore 12, and is sealed by a packing gland 29.

The rotor 20 has a bore 28 formed therein, one end of this bore being closed by a plate 30 held in place by a split ring spring 32 which fits in a groove 34. The rotor 20 is provided with four pump cylinders 36, in which plungers 38 are reciprocable. Each of the plungers has a head 40 which engages a hardened steel roll 42 which rotates on a stem 44 located eccentrically of the rotor 20.

The stem 44 is preferably formed integrally with a block 46 which is pinned to a plunger 48, the plunger being capable of limited longitudinal movement in aligned bores 50 and 51. The block 46 has a pair of notches 52, 53, which are adapted to be engaged by the wedge-shaped end of a detent pin 54. The pin 54 is slidably mounted in an end cap 56 which serves as a closure for the end of the bore 12, and is held in one or the other of the notches 52, 53, by a relatively strong compressed coil spring 58. The degree of compression of the spring 58 may be adjusted by a plug 60 which is threaded in the end of the bore 62. The bore 62 has its outer end sealed by a plug 64.

The plate 30 is provided with a horizontal groove 66 and an intersecting vertical groove 68. A retainer clip 67 is slidable in the groove 66,

while a similar retainer clip 69 is guided in the vertical groove 68. The ends of the clips 67 and 69 are flanged over the heads 40 of the plungers 38 and thus hold the heads of the latter in engagement with the roll 42.

One end of an L-shaped passageway 70 communicates with the passageway 16 while its other end is in alignment with the row of cylinders 36. A vent port 72 is provided in the upper part of the body casting 10, this port also being in alignment with the cylinders 36.

As best shown in Fig. 6, the lower end of bore 51 is connected by a passageway 74 to the passageway 16, while as shown in Fig. 5, the upper end of bore 50 is connected by a passageway 76 with the passageway 18. The upper end of bore 50 is closed by a plug 78, while the lower end of bore 51 is closed by a plug 79.

A lubricant reservoir 80 is secured to the top of the casting 10 by cap screws 82, a suitable gasket 84 being provided to seal the joint.

The upper ends of passageways 16 and 18 terminate in check valve chambers 86 and 88, respectively. Each of these chambers is provided with a check valve seat bushing 90 and a valve retaining spider 92. Ball check valves 96 and 98 are located in chamber 86 and 88 respectively.

Assuming that the plunger 48 is in its lower position as shown in Fig. 1, and that the rotor 20 is being driven counterclockwise as indicated by the arrow in Fig. 2, the lubricant will flow in the direction indicated by the arrows and will be discharged through outlet fitting 100 which communicates with passageway 16. A similar outlet fitting 102 communicates with passageway 18.

When the pressure in passageway 16 exceeds a predetermined value, it acts upon the lower end of plunger 48, overcoming the force applied by the spring pressed detent pin 54. The upward movement of the plunger 48 is limited by the tip on the plug 78, and when in this position the detent pin 54 engages in the notch 53. The eccentric roller 42 will thus have its pivotal axis shifted above the axis of the rotor 20 and the piston plungers 38 will thus be oscillated through cycles displaced in phase 180° from their former cycles. As a result, the direction of the flow of lubricant caused by the pump will be reversed, so that the flow will take place in directions opposite to those shown by the arrows in Fig. 2. The resultant pressure in the passageway 18 will cause the check valve in chamber 88 to seat, while the check valve in chamber 86 will open due to the drop in pressure in the passageway 16.

Subsequently, when the pressure in passageway 18 increases to a predetermined value, this pressure will be exerted upon the upper end of the plunger 48 and return the latter to the position in which it is shown in Figs. 1 and 2, whereupon the eccentric roller 42 will be in such position as to cause the piston plungers 38 to pump lubricant from the passageway 18 to the passageway 16, as indicated by the arrows in Fig. 2.

Thus, while the rotor 20 rotates continuously in one direction, the direction in which the lubricant is pumped is automatically reversed whenever the discharge pressure exceeds a predetermined value.

As best shown in Fig. 9, the fittings 100, 102 are formed to provide seats for ball valves 104 and 105, these valves being held adjacent their seats by spiders 106. The fittings 100, 102, are T fittings, the fitting 102 having a conduit 108 connected thereto leading to one end of a lubricant measuring or feeder valve 110. The other end of

the feeder valve 110 is connected by conduit 109 to the other T fitting 100.

The feeder valve 110 may be of any well known construction, such as shown in my prior Patent No. 2,115,637, and has a pair of outlets connected by conduits 112 and 113 to bearings 114 and 115 which are to be lubricated. The feeder valve 110 is representative of any reasonable number of similar valves which may be connected in series for the lubrication of the bearings on a single machine or on a group of machines.

The feeder valve 110 comprises a body 116 having a cylindrical bore 118 relieved near its ends by by-passes 120 and 121. These by-passes are controlled by valves 122 and 123, the valves being preferably secured to a connecting tube 124, the latter having a central port 126. A charge measuring piston 128 is freely slidable on the tube 124. This piston has its end faces relieved along their peripheral edges so as to permit complete discharge of measured charges of lubricant through the discharge ports 130 and 131 which lead to the conduits 112 and 113, respectively. The valve members 122 and 123 are provided with seats for ball check valves 132 and 133.

Thus when the pump is operating to force lubricant under pressure through the T fitting 102, the lubricant flows past the check valve 105, through the conduit 108, and into the right-hand end of the feeder valve body 116, thereupon forcing the check valve 132 against its seat. The pressure building up at the right-hand end of the body 116 forces the valve members 122, 123, and their connecting tube 124 to the left, the valve 122 thereby uncovering the by-pass 120 and permitting flow of lubricant into the space surrounding the tube 124. Lubricant pressure is thus exerted upon the right-hand end face of the hollow piston 128, and forces the latter to the left. As the piston 128 moves to the left, the lubricant contained in the space to the left of it is forced through the outlet 131 and conduit 113 to the bearing 115. As the piston 128 approaches the end of its leftward stroke, it uncovers the port 126 in the tube 124, permitting lubricant to flow into this tube, past the check valve 133, through the conduit 129 to the next feeder valve of the series, and eventually, to the fitting 100.

Upon reversal of the direction in which the lubricant is pumped, the valve members 122, 123, together with tube 124 and piston 128, are moved to the right in a manner similar to that previously described, and the lubricant stored in the bore 118 around the tube 124 is discharged through port 130 and conduit 112 to the bearing 114. Upon completion of this discharge stroke, the port 126 is uncovered by piston 128 and lubricant may flow past the check valve 132 into the conduit 108 and hence through any other feeder valves connected in this conduit, the lubricant pressure eventually being applied to the fitting 102.

It is desirable, in the use of lubricating systems of the character described, that there be provided an indicator to show when a lubricating operation has been completed, and that all of the feeder valves have operated. One form of such indicator is disclosed in Fig. 9 as comprising a body 140 having a valve bore 142 formed therein. The ends of the bore 142 are suitably connected as by conduits 144 and 146 with the fittings 100 and 102, respectively. A valve member 150 is freely reciprocable in the bore 142, the stroke thereof being limited by bushings 152 threaded in the ends of the body 140. The piston

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valve 150 is provided with annular grooves 156, 157, which are in communication with the adjacent ends of the bore 142 through axially drilled passageways 158 and 159, respectively. The piston valve 150 also has a central annular groove 160 which, during the course of the travel of the piston valve 150, is adapted for a brief interval of time to connect a vent passageway 162 with a port 164, the latter being connected by a conduit 166 with the lubricant reservoir.

The body 140 is also provided with sloping passageways 168 and 169, the passageways 162, 168, and 169 opening into a passage 170 threaded to receive a connecting bushing 172 of a pressure indicator 174. The pressure indicator may be of any suitable construction, but is illustrated as comprising a plunger 176 reciprocable in a bore in the bushing 172, and normally forced downwardly by a compression coil spring 178. The reduced diameter upper end portion 180 of the plunger 176 is guided in a cap 182, and is adapted to be projected therefrom, as indicated by the dotted lines in Fig. 9, when lubricant under sufficiently high pressure is supplied to the bushing 172.

It will be recalled that upon commencement of an operating cycle, lubricant under pressure is initially supplied to the fitting 102. In addition to applying this lubricant pressure to the lubricating feeder valve 110, this pressure is also transmitted through the conduit 146 to the right-hand end of the bore 152, thereby forcing the piston valve 150 to the left to the position in which it is shown in Fig. 9.

After completion of the operation of the series of feeder valves, lubricant under pressure will also be supplied to the fitting 100, and this lubricant may flow through the conduit 144 into the left-hand end of the bore 142 and thence through the passageway 158, annular groove 156, and passageways 168 and 170, to the bushing 172, the lubricant pressure being applied to the end of the plunger 176 and forcing the latter upwardly until, by projection of its end 180 above the cap 182, it provides an indication that the lubricating operation has been completed.

When the pressure in the return line 109 and return fitting 100 is sufficient to operate the indicator, it will also operate the flow direction reversing mechanism of the pump, by exerting pressure upon the plunger 48. As the direction in which the lubricant is pumped is reversed, suction is applied by the pump to the fitting 102, thereby drawing the ball check valve 105 to its seat. This valve is permitted to move a sufficient distance from its seat that a certain amount of lubricant will be drawn into the inlet of the pump before the valve 105 seats, and this lubricant will be drawn from the right-hand end of the bore 142 permitting the piston valve 150 to be forced to the right by the pressure still retained in the fitting 100. As the piston valve 150 moves past its central position, the groove 160 connects passageway 162 to the port 164, and the spring pressed plunger 176 moves downwardly, discharging the lubricant from its cylinder through the vent passage 162, groove 160, port 164, and conduit 166, to the lubricant reservoir. The piston valve 150 continues moving to the right until arrested by the bushing 152, in which position the groove 157 will be in alignment with the lower end of the passageway 169, and thus be in a position to conduct lubricant under pressure from the right-hand end of the bore 142 to the bushing 172 upon completion of the next half

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cycle of operation, to enable the pressure indicator 174 to indicate the completion of the second half cycle.

The pump and indicator may also be used with centralized lubricating systems of the "dual line" type, such as that disclosed in Whitted Patent No. 2,260,497, in which the feed valves are connected in parallel between the two conduits leading from the pump. In such systems when lubricant is applied to one of the conduits, the feeder valves operate to supply measured charges of lubricant to associated bearings, and there is no flow of lubricant from the conduit in which the lubricant is under pressure, to the other conduit, but instead, the feeder valves which are connected in parallel between the conduits after operation block the flow of lubricant from the conduit in which the lubricant is under pressure, so that the pressure in the latter builds up to a value sufficiently high to cause reversal of the direction in which the lubricant is pumped by the pumping mechanism. When the pressure thus increases, it attains a value sufficient to operate the pressure indicator 174, but in such systems the piston valve 150 is so constructed that when moved to the left, for example, the right-hand end of the bore 142 is placed in communication with the passageway 169, so that as the pressure in the fitting 182 builds up, the piston valve will be moved to a position in which the pressure in the fitting 182 may be applied to the plunger 172 of the pressure indicating device 174. The piston valve may be of substantially the same construction as shown in Fig. 9, except that the grooves 158 and 157 will be spaced closer to the ends of the piston valve. For example, the groove 157 would be located so that with the piston valve in the position in which it is shown in Fig. 9, it will be in alignment with the lower end of the passageway 169, and since the groove 158 will be correspondingly displaced, it will not be in alignment with the lower end of passageway 168.

From the foregoing, it will appear that when the pump is continuously driven and is connected to feeder valves, such as 110, connected in series, or to a group of feeder valves of the type which are connected in parallel, the pump will operate alternately to supply lubricant under pressure to the outlet conduits, such as the conduits 108, 109, which are connected to the feeder valves. After the series of feeder valves have been operated, each to supply measured charges of lubricant to its associated bearings, the pressure in the discharge line of the pump builds up sufficiently to move the plunger 48, and thereby cause reversal of the pump inlet and discharge, as previously described.

The drive shaft 26 of the pump may be connected directly to a moving part of the machine, the bearings of which are being lubricated, or may be driven by an electric motor preferably connected so as to be energized whenever the machine being lubricated is in operation. In other installations, the pump may be arranged to be driven at timed intervals through the use of a suitable timing mechanism which energizes the pump driving motor at certain intervals, for example, during ten minutes of each hour while the machine being lubricated is in operation.

Irrespective of the manner in which the pump is driven, it will be clear that while it is operating it will alternately supply lubricant under pressure to the two conduits, as conduits 108,

109, the alternation being effected whenever the pressure in the discharge conduit builds up to a valve sufficient to move the plunger 48 in opposition to the force tending to hold it in one position, which is applied by the spring 58 through the detent plunger 54.

The pump is of a simple construction, and by removal of the end caps 27 and 56, the working parts of the pump are accessible for servicing or replacement.

While I have shown and described a preferred embodiment of my invention, it will be apparent that numerous variations and modifications thereof may be made without departing from the underlying principles of the invention. I therefore desire, by the following claims, to include within the scope of the invention, all such variations and modifications by which substantially the results of my invention may be obtained through the use of substantially the same or equivalent means.

I claim:

1. A pump for centralized lubricating systems comprising a body having two passageways, a lubricant reservoir, ports connecting the reservoir to the passageways, check valves cooperable with the ports to permit flow of lubricant from the reservoir to the passageways and to prevent lubricant flow in the reverse direction, two outlet ports for said passageways respectively, check valves cooperable with the outlet ports to permit flow of lubricant from the passageways but preventing flow in the reverse direction, means within the pump body to pump lubricant from either passageway to the other, and means to reverse the effective pumping action of said last named means whenever the pressure in one of the passageways exceeds the pressure in the other passageway by a predetermined amount.

2. In a pump capable of pumping a fluid in either direction between two passageways, the combination of a cylindrical bore having ports at diametrically opposite sides and communicating with the passageways respectively, a member rotatable in said cylindrical bore, said member having a plurality of pairs of cylinders formed therein, a plurality of plungers one reciprocable in each of said cylinders, an eccentric member engaging the ends of said pistons and operable to reciprocate them in their cylinders as said member rotates, fluid pressure operated means for changing the direction of eccentricity of said eccentric means thereby effectively to reverse the direction of pumping action of the pistons, and means to rotate said member, and means connecting the passageways respectively to the fluid pressure operated means, whereby the relative pressures of the fluid in said passageways determines the direction in which the fluid is pumped.

3. In a pumping mechanism, a body having a bore extending therethrough, a rotor mounted for rotation in the bore, said rotor having a plurality of radially extending cylinders formed therein, headed plungers respectively reciprocable in said cylinders, a normally stationary cylindrical means eccentric of the axis of the rotor, means engaging the heads of said plungers to hold them in rotary sliding engagement with said normally stationary means, means providing a source of the liquid to be pumped, and pas-

sageways in the body extending from the source to opposed substantially semi-circumferential portions of the outer surface of the rotor in alignment with the cylinders formed therein.

4. A rotary reversible flow lubricant pump comprising a body provided with a pair of inlet passageways, means connecting said inlet passageways to a source of lubricant, a check valve in each of said passageways operable to close the passageway when the lubricant therein tends to flow toward the reservoir, a rotor in said pump body, said rotor having a plurality of cylinders formed therein, the outer ends of each of said cylinders being in communication with each of said passageways during slightly less than one-half of a revolution of the rotor, plungers reciprocable in said cylinders, a normally stationary member engageable by said plungers and located eccentrically with respect to the axis of rotation of the motor, means for holding said plungers in engagement with said member, lubricant pressure operated means for changing the eccentricity of the member through an angle of substantially 180°, said last named means being operable when the discharge pressure in one of said passageways exceeds a predetermined value, and detent means to hold said lubricant pressure operated means in position until the pressure in the other of said passageways attains said predetermined value.

5. The combination set forth in claim 4, in which the means for holding the plungers in engagement with the member comprises a pair of relatively movable straps each embracing opposite plungers.

6. The combination set forth in claim 1, in which the means for reversing the pumping action comprises a cylinder having its ends connected respectively to said passageways, a plunger reciprocable in the cylinder, and in which the pumping means includes an element the direction of eccentricity of which may be varied by movement of the plunger.

7. The combination set forth in claim 3, in which means are provided to move the normally stationary eccentric means in one direction or the other along a diameter of the rotor in response to substantial differences in the liquid pressure in the passageways.

8. The combination set forth in claim 3, in which means are provided to move the normally stationary eccentric means in one direction or the other along a diameter of the rotor in response to substantial differences in the liquid pressure in the passageways, and in which a relatively powerful detent means is provided to hold the eccentric means stationary.

JOHN T. LEONARD.

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