March 30, 1937. D. R. HILLIS 2,075,719

REVERSIBLE FLUID DISTRIBUTING SYSTEM

Filed Aug. 6, 1934 3 Sheets-Sheet 1

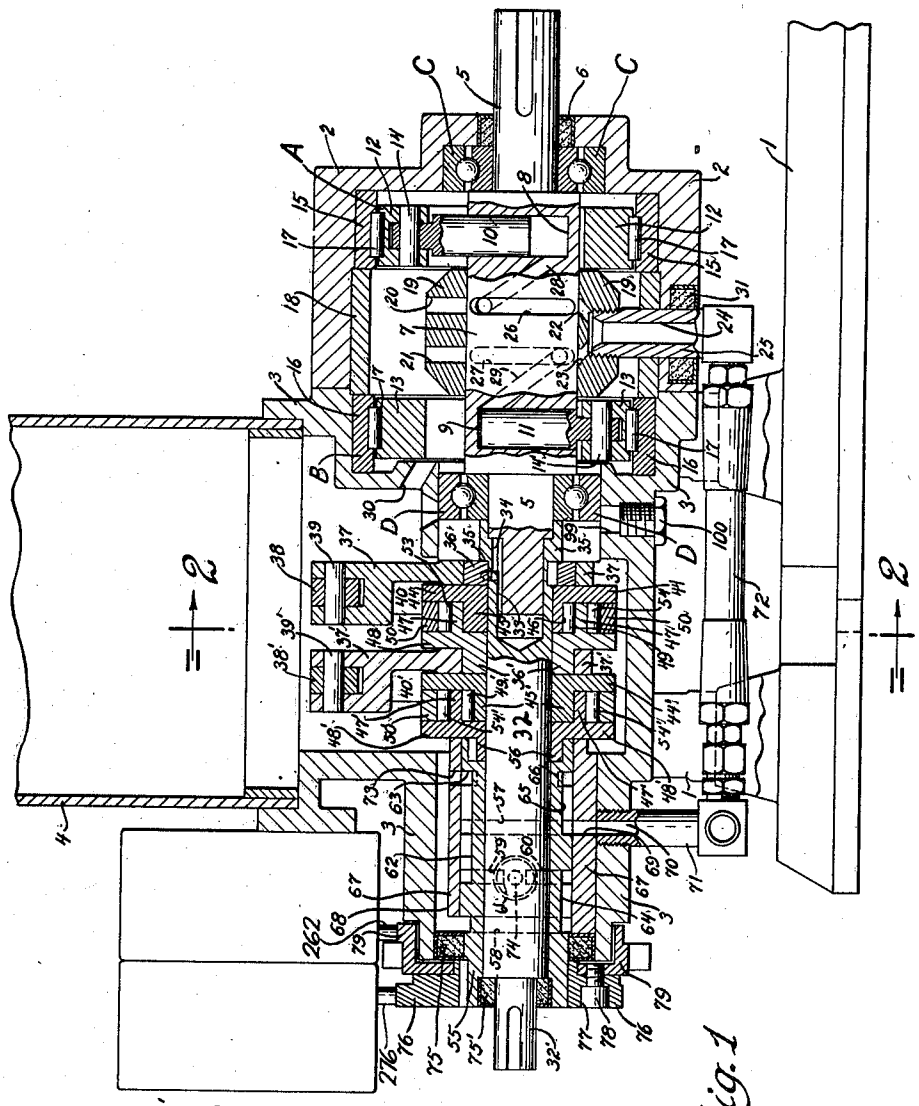

Fig. 1

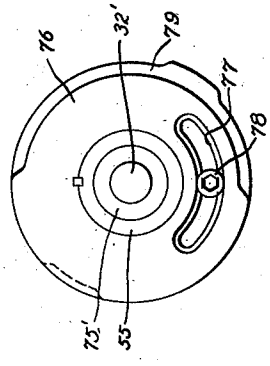

Fig. 7

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REVERSIBLE FLUID DISTRIBUTING SYSTEM

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Fig. 3

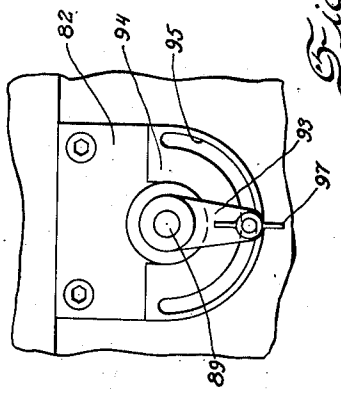


Fig. 4

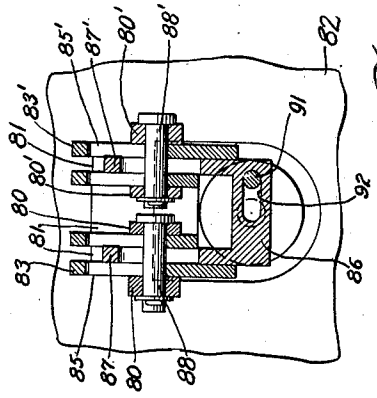
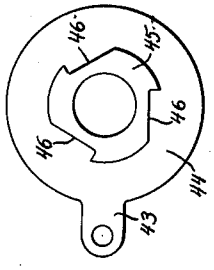


Fig. 6



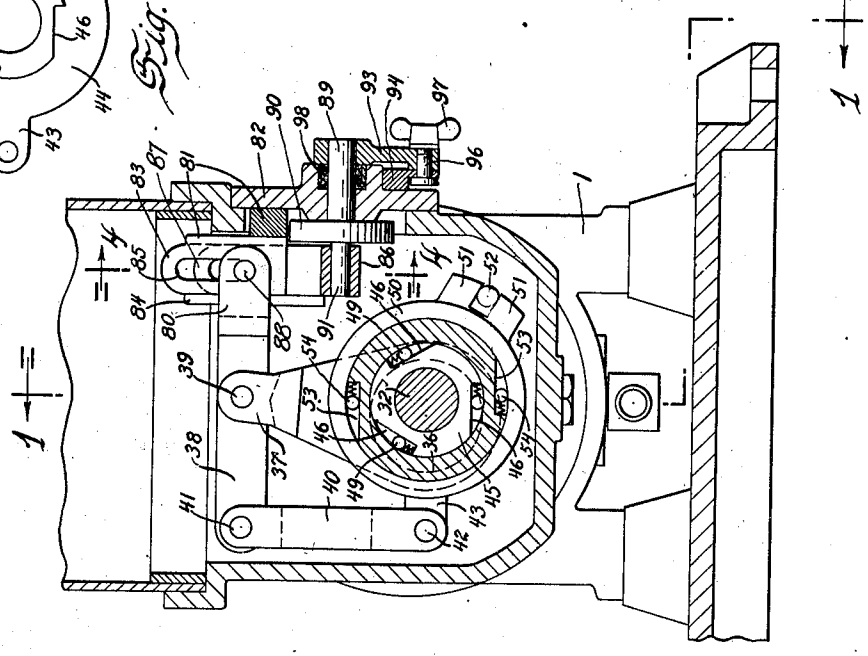


Fig. 2

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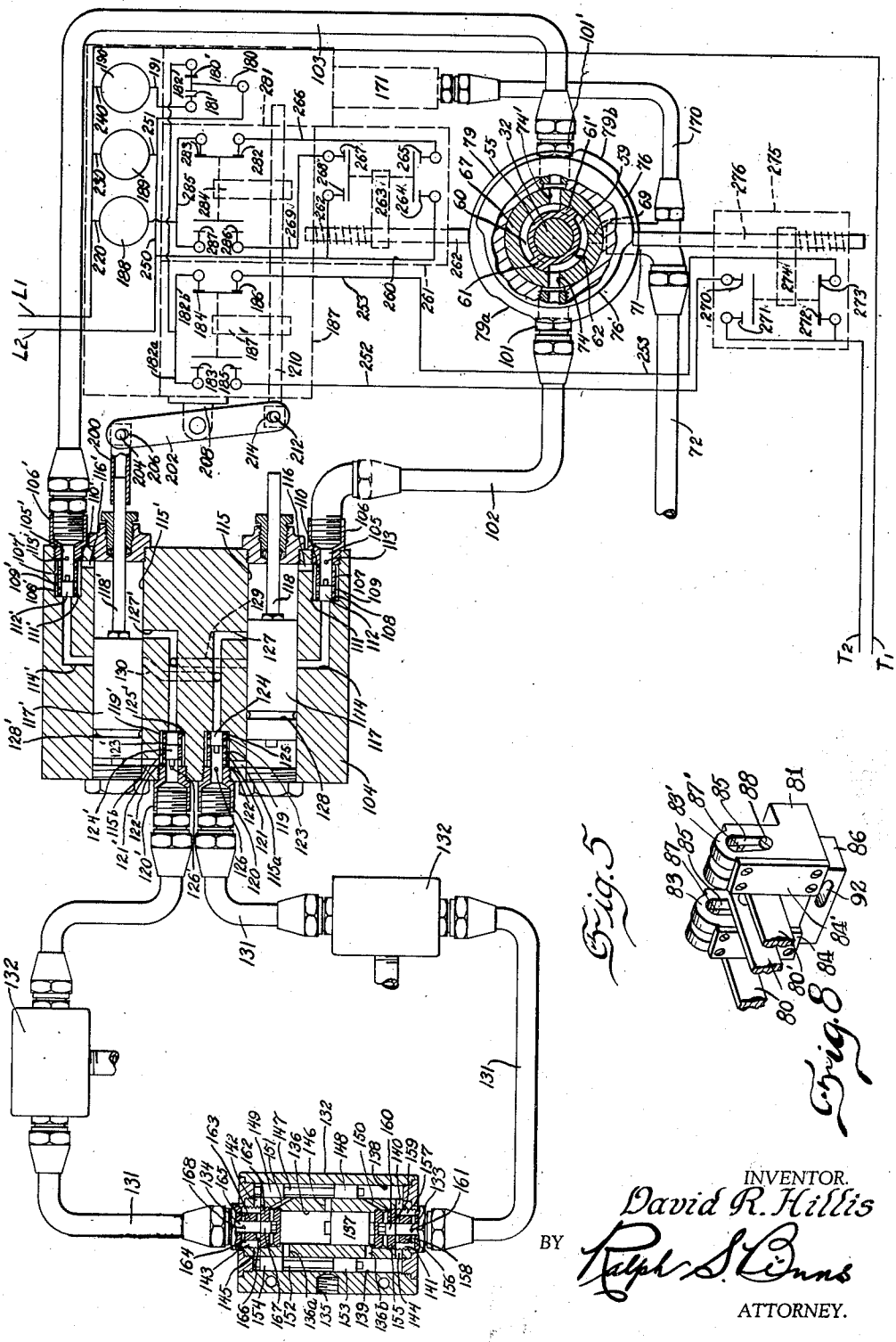

Fig. 5

Fig. 8

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UNITED STATES PATENT OFFICE

2,075,719

REVERSIBLE FLUID-DISTRIBUTING SYSTEM

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Application August 6, 1934, Serial No. 738,656

14 Claims. (Cl. 184—7)

The present invention relates to fluid distributing systems, and more particularly to a reversible fluid distributing system for distributing lubricant to a plurality of bearings.

In my application, Serial No. 523,149, filed March 16, 1931, I have heretofore disclosed a single-pipe circuit, flow-reversing, telltale lubricating system which will distribute fluids, gases, air or plastic material and particularly lubricant to a plurality of associated devices through a series of feeders or measuring devices connected thereto when the same is forced through the feeders in either direction of flow and which will indicate whether or not there is a leak in the circuit, or a clogged bearing or whether the circuit is obstructed or whether the system is working satisfactorily. While that system has been quite successful, the automatic flow-reversing valve there shown, is quite complicated and quite expensive to manufacture, and, although an automatic pump may be substituted for the hand pump there shown, no pump control means was provided in said former system nor were any means provided to indicate that the system was tardy in completing a circuit, nor that an excessive pressure was being built up in the system.

Therefore, the main object of the present invention is to devise control means for a power pump, whereby it may be operated intermittently and to devise separate means for actuating the flow-reversing valve and to devise an adjustable speed reducing device whereby the flow-reversing valve may be set to reverse the flow of fluid through the fluid circuit at regular periods, varying the same as desired, and to devise additional control means for stopping the pump and giving a warning signal whenever excessive pressure is encountered in the system and also to devise means for indicating when the system is tardy, and to devise a novel means for indicating when the fluid in the system has completed a circuit.

A subsidiary object of the invention is to devise a novel pump especially adapted to a fluid distributing system.

Another object of the invention is to devise a means for mechanically driving a flow-reversing valve which is adjustable, whereby a wide range for controlling the frequency of lubrication is secured.

Another object of the invention is the provision of speed reduction devices especially applicable to this lubricating system.

Another object of the invention is the provision of adjustable means for controlling the warning signal that tells whether or not the lubricant has completed its circuit in the required time.

These and other objects will appear as the description progresses, reference being had to the accompanying drawings in which

Fig. 1 is a longitudinal sectional view taken on the line 1—1 of Fig. 2 showing the pump and its associated drive shaft and a portion of the lubricant container and the flow-reversing valve and its associated operating members and the motor switch operating cam and the overtime switch operating cam;

Fig. 2 is a cross section view taken on the line 2—2 of Fig. 1 showing one of the speed reducing mechanisms and the means of adjusting the same;

Fig. 3 is a detail plan view showing a portion of the control means of the adjustable speed reducing mechanisms;

Fig. 4 is a section taken on the line 4—4 of Fig. 2;

Fig. 5 is a schematic general view of my new and improved lubricating system, showing some of the parts in section.

Fig. 6 is a detail of the clutch actuating member.

Fig. 7 is a detail plan view of the switch operating cams.

Fig. 8 is a perspective view showing a portion of the adjusting mechanism, as viewed from the rear.

Reference will now be made to the drawings in which like reference characters designate like parts throughout.

The numeral 1 represents a frame member supporting a housing or body, preferably made of two parts 2 and 3, for a pump mechanism and for a flow reversing valve mechanism and its associated speed reducing devices, the said housing being open at the top to receive the base portion 4 of a lubricant container or reservoir shown partly broken away.

Mounted in the housing is a pump drive shaft 5 and suitable sealing means 6 prevent lubricant within the housing from extruding through the opening for the shaft.

The shaft 5 has an enlarged inner portion 7 suitably bored to provide cylinders 8 and 9 for reciprocating pistons 10 and 11 respectively secured by wrist pins 14 and 14' to the inner races 12 and 13 of bearing assemblies A and B having outer races 15 and 16 respectively and a series of rollers 17 between each inner and outer race,

the races being suitably formed to receive the said rollers.

Located within the housing portion 2 is a spacing ring 18 to hold the outer races 15 and 16 in their proper places.

Surrounding the pump shaft 5 is a pump valve sleeve 19 which cooperates with the enlarged portion 7 of the said shaft in forming a valve, the said sleeve having two inlet ports 20 and 21 and two outlet passageways 22 and 23 discharging into an outlet port 24 in a fitting 25 having threaded engagement with said sleeve.

The enlarged portion 7 of the pump shaft 5 is provided with two grooves 26 and 27 adapted to register with the inlet ports 20 and 21 while the said shaft makes approximately one half a revolution and to register with the outlet passageways 22 and 23 while the said shaft completes the revolution. Connecting passageways 28 and 29 are bored in the said shaft 7 respectively connecting the cylinders 8 and 9 with the grooves 26 and 27 in such manner that when the grooves 26 and 27 register with the inlet ports 20 and 21 the pistons are making their suction strokes to draw lubricant into said cylinders 8 and 9 and when the grooves 26 and 27 register with the outlet passageways the pistons 10 and 11 are making their respective power strokes, forcing lubricant from the cylinders 8 and 9 through passageways 28 and 29, through grooves 26 and 27 and through outlet passageways 22 and 23 and out of outlet port 24. As the pistons are shown, piston 10 has just completed its suction stroke and piston 11 has just completed its power stroke.

The reciprocation of the pistons is caused by mounting the rings or races carrying the same off center of the shaft 7 which the said races surround. The rotation of the shaft carries the pistons around with it and the resulting cam action, occasioned by the off-center location of the races with respect to the shaft, causes the pistons to reciprocate as they turn around with the shaft.

Lubricant from the container or reservoir 4 enters the pump housing through a passage or port 30, thus lubricating all the working parts of the pump and having continuous flow to the inlet ports 20 and 21.

While the pump mechanism may be rigidly mounted in the housing, I prefer to avoid the resultant friction and wear and tear, and therefore I have shown bearing assemblies C and D supporting the shaft in the housing 2 and 3 which is suitably formed to hold them.

As a consequence of the non-rigid form of mounting, the fitting 25, which passes through the spacing ring 18, is slidably mounted in the housing 2, suitable packing means 31 being provided to prevent lubricant from extruding through the opening of the housing where the fitting passes through. The said fitting 25 also holds the spacing ring 18 and the sleeve 19 from tending to turn with the shaft 7.

The shaft 5 may be driven by any power means, preferably an electric motor or any other means having an electric switch for starting and stopping the same.

The pump hereinabove described has now been claimed in a divisional application, Serial No. 52,106, filed November 29, 1935.

The inner end of the shaft 5 protrudes from the bearing assembly D and is reduced in order to be loosely received within the hollow end of another power shaft 32, having a reduced extending portion 32' adapted to be driven by machinery to be lubricated or by any other power means. I have shown the shafts 5 and 32 provided with keyways 33 and 34 as it is evident that but one power shaft is necessary where continuous operation of the pump is desired. A key may therefore be inserted in the construction shown, or a continuous shaft may be used where intermittent operation of the pump is not required.

The inner portion of the shaft 32 is also provided with a shoulder 35 against which one side of a circular cam member 36 abuts. The cam member 36 is rigidly secured to the shaft 32 and a connecting rod 37 is mounted on said cam in such manner that the rotation of the cam member 36 causes the connecting rod 37 to reciprocate in the usual manner.

In Fig. 2 the cam 36 is shown in dotted lines as is also the lower portion of the connecting rod 37. The top of the connecting rod 37 is forked and is pivotally secured to a rocker arm 38 by a wrist pin 39. One end of the rocker arm is connected to one end of a link 40 by a pin 41 and the other end of the link 40 is connected by pin 42 to the arm 43 of driving clutch or clutch actuating member 44, shown in Fig. 1 surrounding shaft 32 to the left of the cam member 36. The said clutch actuating member 44 has an extending hub portion 45 provided with a series of grooves 46, and an extending sleeve portion 47 of a driven clutch member 48 also mounted on the shaft 32 is adapted to surround the hub portion 45 of said clutch actuating member 44.

Located in each of the grooves 46 of the hub portion 45 of the clutch actuating member 44 and between said member and the sleeve portion 47 of the driven clutch member 48, is a spring pressed roller 49 adapted to be gripped between the hub portion 45 of the clutch actuating member 44 and the sleeve portion 47 of the driven clutch member so as to drive the latter on each downward stroke of the connecting rod 37 and its connected linkage.

A retaining clutch ring 50, see Fig. 2, is provided with lugs 51, between which a rod 52 is passed and said rod is suitably bolted to the housing to prevent rotation of said ring.

The exterior of the sleeve portion 47 of the driven clutch member 48 is also provided with grooves 53, in each of which is a spring pressed roller 54 adapted to prevent the driven clutch member 48 from turning when the clutch actuating member turns to take its next bite.

The driven clutch member has an extending cam portion 36' upon which a second connecting rod 37' is mounted and this rod is provided with similar respective connecting parts, clutch actuating and driven clutch members etc., 38', 39', 40', 41', 42', 43', 44', 45', 46', 47', 48', 49', 50', 51', (and same rod 52 secures lugs 51'), 53', and 54'.

Also mounted on the shaft 32' is a flow-reverser valve 55, the inner end of which is keyed to an extending portion 56 of driven clutch member 48'. The valve 55 is provided with an inner circumferential groove 57 and an outer circumferential groove 58. Intermediate the grooves 57 and 58 are two semi-circular grooves 59 and 60 having lands 61 and 61' between them, only one land 61 being shown in Fig. 1, the other being diametrically opposite to it as shown in Fig. 5.

At ninety degrees (90°) from the lands, longitudinal grooves are provided in said valve; one longitudinal groove 62 connects the semi-circular groove 59 with the inner circumferential groove 57 and with a short semi-circular groove 63 in the valve, said groove 63 having a length equal to that of the land 61; another longitudinal groove 64, on the side one-hundred and eighty

degrees (180°) from longitudinal groove 62, connects the semi-circular groove 60 with the outer circumferential groove 58; another longitudinal groove 65, also one-hundred and eighty degrees (180°) from longitudinal groove 62, connects the circumferential groove 57 with another short semi-circular groove 66, said groove 66 having a length equal to the other land 61'.

Surrounding the inner portion of the flow-reverser valve 55 is a valve sleeve 67 having a longitudinal groove 68 permitting lubricant to flow from circumferential groove 58 into the open top portion of the housing 3 communicating with the lubricant reservoir 4.

The valve sleeve 67 is also provided with an inlet port 69 which registers at all times with circumferential groove 57 and said inlet port 69 also registers with a passageway 70 in a fitting 71 having threaded engagement with the housing 3. The passage 70 of the fitting 71 has a connecting passageway communicating with the passage or outlet port 24 of the pump, said outlet 24 being in the fitting 25. Any suitable pipe connection or other passage can be used where the pump mechanism is rigidly mounted in the housing, but where a ball bearing mounting is used, a flexible connection must be used, hence I have shown a flexible tubing 72 with suitable connecting parts between the fittings 25 and 71.

As shown in Fig. 1, there is also a by-pass port 73 in the valve sleeve 67 which permits lubricant entering the valve 55 through passage 70, port 69, and groove 57 to return to the reservoir through longitudinal groove 62 and short semi-circular groove 63 while the land 61 blocks the flow of lubricant out of the valve circuit outlet and return port 74 located in the valve sleeve 67, and said by-pass port 73 also permits lubricant to return to the reservoir through longitudinal groove 65 and short semi-circular groove 66 when the land 61' blocks the flow of lubricant out of the valve circuit outlet and return port 74'.

The valve circuit outlet and return ports are dual-service ports, due to the fact that when lubricant is discharged out of port 74 to the circuit to be hereafter described, lubricant also returns to the valve through port 74', which at that time is registering with semi-circular groove 60, from whence it passes through longitudinal groove 64 to circumferential groove 58 thence through longitudinal groove 68 in the valve sleeve 67 to the lubricant reservoir.

Likewise, when dual-service port 74' is acting as a discharge port to the circuit, lubricant returns from the circuit to the valve through port 74, which will then register with semi-circular groove 59, from whence it passes through grooves 64, 58, and 68 back to the reservoir.

Suitable sealing means 75 is provided at the outer end of the valve sleeve 67 and between it and the valve 55 and other parts to be hereinafter described, and suitable sealing means 75' seals the opening between the valve and the shaft to prevent extrusion of lubricant at those points.

Keyed to the outer extremity of the flow-reverser valve 55 is a rotary cam member, hereafter referred to as the pump motor switch-operating cam 76. This cam member 76 is provided with a semi-circular slot 77, more clearly shown in Fig. 7, through which passes an adjustment screw 78 for an inner adjustable rotary cam 79, hereafter referred to as the overtime warning signal switch-operating cam.

The fulcrum end of each of the rocker arms 38 and 38' is forked as at 80 and 80', see Figs. 2 and 4, in order to engage the adjusting means to be hereafter described.

An adjusting means is provided in order to vary the ratio of speed between the drive shaft 32 and the flow-reverser valve 55, as the double clutch mechanism acts as a speed reducer and the adjusting means now to be described, acting in combination with said double clutch mechanism, constitutes a variable speed reducer.

A stationary member 81 is mounted upon the inner side of plate 82 forming part of the housing. This stationary member 81 has a pair of grooved members 83 and 83' as here shown, in its preferred form, cooperating with separate plates 84 and 84' which are secured thereto in any suitable manner as by means of screws, in forming guide members for a slidable member hereafter described although any other suitable guide means may be used. The sides of these grooved guide members 83 and 83' are respectively provided with slots 85 and 85'.

A slidable member 86 is provided with two upwardly extending slotted portions 87 and 87' adapted to slide in the guide members 83 and 83'. Each of the respective forks 80 and 80' on the respective fulcrum ends of each rocker arm embraces the respective plates 84 and 84' and their respective guide members 83 and 83' and respective slotted slidable portions 87 and 87' of the guide member 86. Fulcrum pins 88 and 88' are respectively bolted therethrough so that the fulcrum end of each rocker arm may rise from its lowermost position in the fixed slotted guide members 83 and 83' till the said pins engage the top of the slotted portions 87 and 87' of the slidable member 86, in whatever position the latter is held by the adjustable locking means hereafter to be described.

A crank shaft comprising a shaft 89, passing through plate 82, and a flange 90 and an offset pin 91 is employed to move the slidable member 86 by having the pin 91 extend into a slot 92 in the base portion of the slidable member 86.

The crank is manually turned by crank lever 93 to the position desired. A member 94 having a semi-circular slot 95 is rigidly secured to plate 82 and a bolt 96 passes through the crank lever 93 and the slot 95 and a wing nut 97 is provided to lock the bolt and crank arm in the desired position. Any suitable packing means 98 may be used to prevent grease from extruding through the opening in plate 82 where shaft 89 passes through.

The bottom of the pump and valve housing is provided with a drain port 99 and a drain plug 100, having screw threaded engagement with said housing, normally closes said drain port.

Referring now to the motor switch-operating cam 76, looking at Fig. 5, it will be seen that one half of said cam member is provided with a depressed portion 76' and it will also be seen that the overtime warning signal switch-operating cam 79 has a depressed portion 79^a and, that diametrically opposite to said depressed portion, there is a raised portion 79^b. The purpose of these cams will become apparent when the circuit and the electrical control switches to be hereafter described, are understood.

The portion of the housing 3 surrounding the distributing valve is provided with suitable threaded openings to receive hollow fittings 101 and 101', see Fig. 5, the openings of which register with valve sleeve dual service ports 74 and 74' respectively. One end of a pipe line 102 is con-

nected to fitting 101, and one end of a pipe line 103 is connected to fitting 101'.

Each of these pipe lines 102 and 103 forms the ends of a lubricant circuit, the lubricant passing from one pipe line into an indicator block 104, thence passing through an additional pipe line equipped with by-pass feeders, returning to the block, thence through the other pipe line and back to the valve, from whence it is returned to the reservoir.

The indicator block 104 is provided with two dual-service ports 105 and 105', the former being suitably connected to one end of pipe line 102 and the latter being suitably connected to one end of pipe line 103.

The dual-service ports 105 and 105' of the indicator block are located in fittings 106 and 106' respectively, having screw threaded engagement with the indicator block 104. These fittings are, in turn respectively provided with extending ported sleeves 107 and 107', extending into respective cylinders or valve chambers 108 and 108' of larger dimension than that of the said sleeve. The sleeves 107 and 107' are respectively provided with ports 109 and 109' and with ports 110 and 110'. Passageways 111 and 111' are thus respectively provided in the respective valve chambers 108 and 108' around the inner ends of the respective sleeves 107 and 107' and between them and the said respective valve chambers, whereby lubricant may pass around the valves to be hereafter described when the valves are located between the ports in their respective sleeves.

Mounted to reciprocate in the respective sleeves 107 and 107' are piston valves 112 and 112', the valve 112 being in sleeve 107 and the valve 112' being in the sleeve 107'. Stop pins 113 and 113' are respectively mounted in the sleeves 107 and 107' which are adapted to engage the usual abutment members on the valves in such manner as to permit lubricant returning to the distributing valve to enter the sleeve through ports 110 and 110' respectively.

The inner ends of the valve chambers 108 and 108' respectively connect with passages 114 and 114', registering with the respective sleeves 107 and 107', but having smaller diameters than the latter, hence the respective piston valves 112 and 112', on completion of their inward strokes, are adapted to close the entrance to said passages.

Valve chambers 108 and 108' respectively connect with one end of indicator-piston cylinders 115 and 115' through the respective passages 116 and 116'. Mounted to reciprocate in said respective cylinders 115 and 115' are the respective indicator pistons 117 and 117', provided with extending piston rods 118 and 118' respectively, each of which respectively slides through a perforated nut and sealing gland closing one end of said respective cylinders, thus indicating the movement of their respective associated pistons.

The other ends of said cylinders 115 and 115' respectively connect through ducts 115^a and 115^b respectively with valve chambers 119 and 119' which have fittings 120 and 120' respectively screwed therein, said fittings being respectively provided with ported sleeves 121 and 121' extending into said valve chambers 119 and 119' respectively.

The sleeves 121 and 121' are respectively provided with ports 122 and 122' and with ports 123 and 123', which permits lubricant to pass from one side of the respective sleeves around the respective reciprocating valves 124 and 124' when the same are located between the respective ports in their respective sleeves, by passing into the valve chambers 119 and 119' which are of larger diameter than the exterior of said sleeves, thus providing passageways 125 and 125' respectively around the sides and inner portions of the said sleeves.

Stop pins 126 and 126' are respectively mounted in the sleeves 121 and 121' which are adapted to engage the abutment members on said valves 124 and 124', so as to stop them between the respective pair of ports in their respective sleeves when lubricant flows from the indicator block to the feeder circuit through the respective valve chambers.

The inner ends of the valve chambers 119 and 119' respectively connect with passages 127 and 127' which open into said valve chambers 119 and 119' respectively, opposite the inner ends of the respective sleeves 121 and 121', said passages having smaller diameters respectively than those of the respective sleeves, hence the respective ends of said passages are adapted to be closed by the respective valves in the respective sleeves opposite to said respective openings.

Passage 114 connects valve chamber 108 with indicator-piston cylinder 115, entering the latter midway between its ends. Passage 114' similarly connects valve chamber 108' with indicator-piston cylinder 115' entering the latter midway between its ends.

Passage 127 connects valve chamber 119 with indicator-piston cylinder 115, entering the same at such point that when lubricant enters the said cylinder 115 from passage 116 and forces piston 117 to make its complete stroke to the left, when viewed in Fig. 5, said piston 117 will uncover one end of the passage 127, and similarly, passage 127' connects valve chamber 119' with indicator-piston cylinder 115', entering the same at such point that when lubricant enters the said cylinder 115' from passage 116' and forces piston 117' to make its complete stroke to the position shown in Fig. 5, said piston 117' will uncover one end of the passage 127'.

A circumferential groove 128 is provided on piston 127 and a similar circumferential groove 128' is provided on piston 127'. A by-pass passage 129, opposite the entrance port of passage 114 into cylinder 115, connects said cylinder 115 with passage 127', thus permitting lubricant to flow from passage 127' through passage 129, thence around groove 128 into passage 114 when piston 117 completes its stroke to the right, when viewing the device as shown in Fig. 5. Similarly, a by-pass passage 130, opposite the entrance port of passage 114' into cylinder 115', connects said cylinder 115' with passage 127, thus permitting lubricant to flow from passage 127 through passage 130, thence around groove 128' into passage 114', when piston 117' completes its stroke in the opposite direction to that shown in Fig. 5.

Suitably connected to fitting 120 is one end of a circuit pipe-line or conduit 131 which is equipped with a plurality of reversible feeders 132 provided with by-pass means hereinafter described. The other end of said pipe-line or conduit is suitably connected to fitting 120'.

Each feeder 132 is provided with two ports 133 and 134 connected to the pipe line or conduit 131 and with a discharge port 135 connected to an associated device or to a bearing or receiving device.

Each feeder is provided with a cylinder 136 having a fluid pressure-operated piston 137 adapted to reciprocate therein.

Each feeder also is provided with two cylindrical valve chambers 138 and 139. The valve chamber 138, at one end, has a duct 140 communicating with port 133 through a valve chamber 141 and, at the other end, said valve chamber 138 has a duct 142 communicating with port 134 through a valve chamber 143.

One end of valve chamber 139 has a duct 144 communicating with port 133 through the valve chamber 141 and the other end of said valve chamber 139 has a duct 145 communicating with port 134 through valve chamber 143. At each end of the cylinder 136 there is a duct, one being designated as 136a and the other as 136b, and these ducts communicate with intermediate portions of the valve chamber 139 as hereinafter described.

The discharge port 135 communicates with the central portion of the valve chamber 139 and a communicating passage 146 connects the central portion of valve chamber 138 with the central portion of cylinder 136.

A dumb-bell piston type valve 147 having two heads 148 and 149 is mounted in the valve chamber 138 in such manner that the annular passage surrounding the reduced portion between said valve heads 148 and 149 always registers, when the valve is shifted to either of its extreme positions, with the communicating passage 146 and with one or the other of two by-pass ducts 150 and 151 communicating respectively with valve chambers 141 and 143.

The valve chamber 139 has a similar dumb-bell piston type valve 152 having heads 153 and 154 so arranged that the annular passage surrounding the reduced portion between said valve heads 153 and 154 always connects one of the ducts 136a or 136b with the discharge port 135, when the valve 152 is in either one of its shifted positions, and, at the same time, opens the other duct 136a or 136b to the flow of fluid from the conduit.

Mounted in the valve chamber 141 outwardly of opening of by-pass duct 150, is a valve disk 155 having a central opening with an outwardly extending ported sleeve 156 communicating with the port 133, the said sleeve having an outer diameter less than the inner diameter of the valve chamber 141, thus providing a passage 157 around said sleeve. Said sleeve 156 is ported at 158 and at 159 and mounted in said sleeve and in said disk is a reciprocating piston valve 160 having a length equal to the portion of the sleeve between the two ports 158 and 159. A stop pin 161 is mounted in said sleeve 156 to stop the outward movement of said valve 160 in such position that lubricant or other fluids flowing into the valve chamber 141 from the by-pass passage 150 may flow through the disk 155 and into its extending sleeve and out of port 159, thence through passageway 157 and back into sleeve 156 through port 158, and thence through port 133 into the pipe line 131, when flow of lubricant through the circuit is passing in that direction.

Mounted in the valve chamber 143 outwardly of opening of by-pass duct 151, is a valve disk 162 having a central opening with an outwardly extending ported sleeve 163 communicating with port 134, the said sleeve having an outer diameter less than the inner diameter of the valve chamber 143, thus providing a passage 164 around said sleeve. Said sleeve 163 is ported at 165 and at 166, and mounted in said sleeve and in said disk is a reciprocating piston valve 167 having a length equal to the portion of the sleeve between the two ports 165 and 166. A stop pin 168 is mounted in said sleeve 163 to stop the outward movement of said valve 167 in such position that lubricant or other fluids flowing into the valve chamber 143 from the by-pass passage 151 may flow through the disk 162 and into its extending sleeve and out of port 166, thence through passage-way 164 and back into sleeve 163 through port 165, and thence through port 134 into the pipe line 131, when flow of lubricant through the circuit is passing in that direction.

Any suitable means such as the abutment members shown on the inner ends of valves 160 and 167 may be used to stop the respective inner strokes of said valves in such position that lubricant may enter behind them, when necessary, to make the return strokes.

The feeder herein described has now been claimed in application Serial No. 78,784, filed May 9th, 1936, being a continuation in part of this application.

By reference to Fig. 5 it will be seen that the fitting 71 is provided with a fluid connecting branch pipe-line 170, and this leads to a conventional plunger device 171, controlled by a very strong spring mechanism, not shown, for operating a conventional electrical switch 180 which, when connected to terminal 181 completes a circuit, hereinafter described, to turn on a red light 190. Said pressure switch is normally connected to the terminal 181, being in series with the motor switches hereinafter described. This conventional spring-controlled pressure-operated plunger device is adjusted to require greater pressure for operating it than that desired to be maintained in the system, hence if the pump is delivering fluid or lubricant into pipe 72 under pressure of 1,000 pounds per square inch, and it meets a resistance in the system greater than that, such pressure will also be built up in the plunger device 171 and will cause pressure switch 180 to contact terminal 181, thereby stopping the pump and turning on the red light. By this signal the attendant is then informed that something is resisting the flow of fluid through the system and building up a back pressure. He may then examine each bearing or associated receiving device, to which feeders are connected, to see if lubricant or other fluid is being discharged or has been discharged there recently and thus locate the trouble.

Referring now to the indicator block 104, and more particularly to the indicator-piston rod 118', it will be seen that I provide a hollow sleeve 200 in which the outer end of said piston rod is adapted to slide during part of its outward stroke. The said sleeve 200 is loosely connected to one end of a rocker arm 202 by means of a wrist pin 204 passing therethrough and through an elongated slot 206. The rocker arm 202 is pivotally mounted on a bracket 208 supported upon the housing of a conventional electrical switch mechanism hereinafter described. The other end of said rocker arm is loosely connected to an electrical switch-operating plunger 210 which passes through the housing of the conventional switch mechanism hereinafter to be described, said plunger being connected to said rocker arm by the wrist pin 212 passing through the same and through elongated slot 214 of said rocker arm.

The red light indicator 190 which, as heretofore described, indicates excessive pressure in the system, forms part of the electrical circuits now to be described.

Two conventional lead in wires L1 and L2, connect warning signalling and switch operating cir-

cuits with the lines T1 and T2 leading to the pump motor or power means utilized for rotating pump-shaft 5.

The wire L1 has branch wires 220, 230 and 240 respectively leading to a green light bulb 188, a yellow light bulb 189 and the red light bulb 190, respectively, and said wire L1 passes on and terminates in wire T1 leading to the pump motor or power means.

The wire L2 branches into wires 250 and 260, respectively, the former leading to conventional switch 180. The branch wire 250 has a branch wire 251 connecting it to the bulb 189, thus, whenever current is on, there is a circuit through bulb 189. Therefore when this bulb is burning, the attendant is informed that the main current switch is connected, and that the device is either in operation or in readiness for operation.

One terminal 181 of conventional switch 180 is connected to bulb 190 by wire 191, thus, when switch 180 connects with said terminal a circuit through bulb 190 is completed, and the attendant is informed that excessive pressure has developed in the system.

The other terminal 180' of conventional switch mechanism 180 is connected by a branched wire 182 to branch wires 182^a and 182^b which lead to two terminals 183 and 184 respectively of a conventional double limits switch mechanism 187. The other terminals of this switch mechanism are designated by the numerals 185 and 186. The conventional double limits switch mechanism is provided with switch lever 187', which is operated by plunger 210, and said switch lever is provided with the usual contacts and is adapted to connect terminals 183 and 185 or terminals 184 and 186.

Conductor wire 252 connects terminal 185 with terminal 270 of motor switch mechanism 275, also of the double limits type. Three additional terminals 271, 272 and 273 are provided in said switch mechanism 275, and the switch lever or member 274 is adapted to connect terminals 270 and 271, or terminals 272 and 273.

Both terminals 271 and 272 are connected to the wire T2, while terminal 273 is connected by conductor wire 253 to the terminal 186 of switch mechanism 187. Hence current may flow through line L2, branch wire 250, switch mechanism 180, terminal 180', branch wire 182, and then down to line T2 through either of the following ways; first, the way shown in Fig. 5, viz, through branch 182^b, terminal 184, switch lever 187', terminal 186, branch 253, to terminal 273, switch 274 to terminal 272 connected to said wire T2, or, secondly, through branch 182^a, terminal 183, switch lever 187', terminal 185, branch 252 to terminal 270, switch 274, to terminal 271 connected to said wire T2.

Switch lever 274 is operated by a spring pressed plunger 276, which rides upon the cam member 76, the spring moving the plunger 276 and switch lever 274 from the position shown in Fig. 5, to such position as to make contact with the terminals 270 and 271 when the plunger rides down the cam incline into the camway 76', and the raised portion of the cam will return the parts to the position shown in Fig. 5 when the end of the plunger 276 comes in contact therewith.

The green light bulb 188 is connected to line L2 through the branch wire 260 and two double limits switch mechanisms 261 and 281 which are so arranged that a circuit through said bulb 188 from lines L2 to L1 can only be made when fluid has not completed its circuit so as to move one of the indicator piston rods 118 or 118' within the time that the adjustable cam member 79 has been set for operation of switch mechanism 261.

For instance, if lubricant will pass through a circuit of a given length with a given number of feeders, in two minutes, then the cam member 79 is so adjusted that within two and one half minutes, it will operate spring pressed plunger 262 and its associated double limits switch lever 263 which normally is maintained in neutral position, to make contact between terminals 264 and 265, the former being connected to branch line 260 and the latter being connected by conductor wire 266 to terminal 282 of switch mechanism 281, which, at that time, will be connected with terminal 283 through switch lever 284 and its contacts, unless indicator piston rod 118' moves rocker arm 202 prior to the said time limit; said terminal 283 is connected to bulb 188 by branch wire 285, thus completing the circuit. Or the circuit may be completed if the raised portion 79^b of cam member 79 moves plunger 262 and its switch lever 263 to such position as to connect terminals 267 and 268, the latter being connected to branch wire 260 and the former being connected by branch wire 269 to terminal 286, which will then be connected by contacts on switch lever 284 to terminal 287 which is connected to bulb 188 by branch wire 285.

The indicator piston rod 118', on making its full outward stroke, rocks rocker arm 202 from the position shown in Fig. 5 to its reverse position, thus operating both switch levers 187' and 284, by means of the plunger 210 so that they make contact between their respective opposite terminals.

The motor or power means driving shaft 5 will thereupon be stopped until the plunger 276 rides off the raised position of cam 76 into the camway 76' whereupon the power means is again started, since contact is now established between terminals 183 and 185 and between terminals 270 and 271.

Indicator rod 118 is adapted, on completion of its outward stroke, to move rocker arm to the position shown in Fig. 5 and whenever lever 284 of switch mechanism 281 is moved within the prescribed or allotted time, it prevents the completing of the circuit through the green light bulb 188 even though cam member 79 operates lever 263 of switch mechanism 261, as should now be apparent from the foregoing description.

It should also be apparent that the pressure switch 180 is in series with the motor switches 187 and 275.

Operation

Let it be assumed that an electric motor is employed for driving shaft 5 and that shaft 32' is being driven by one of the machines having bearings to be lubricated, and that the pump is maintaining a pressure of 1,000 pounds per square inch on the lubricant in the system, and that pressure switch 180 has been set to operate whenever the pressure in the system reaches 1,500 pounds per square inch.

Let it further be assumed that the entire system is filled with lubricant and the reservoir 4 is full.

Let it further be assumed that, by previous test, we have ascertained that it takes two and one half minutes for lubricant to complete the circuit so as to operate one of the indicators 118' or 118 and that cam member 79 has been adjusted by adjustable screw 78 to such position

that three minutes after the pump begins to operate, said cam will cause plunger 262 to operate switch mechanism 261.

Let it further be assumed that the adjustable control means for the speed reducing mechanism has been so adjusted that it will take 40 minutes for the distributing valve to make one complete revolution or 20 mintues to turn 180°, thus permitting cam member 76 to operate motor switch 275 every 20 minutes. In other words, the pump motor will operate during the first two and one half to three minute period of each 20 minute period.

Let it further be assumed that valve parts are in the position shown in Fig. 5.

The main switch is turned on, lighting bulb 189, the device commences to operate. Lubricant passes from reservoir 4 into pump housing through port 30, due to the suction strokes of pistons 10 and 11, which reciprocate due to their being mounted in their respective offset races.

Of course the pistons 10 and 11 could be arranged to operate simultaneously or otherwise than shown, but I prefer to have one making a power stroke while the other makes its suction stroke.

Piston 10 sucks lubricant through port 20 in sleeve 19, which registers with groove 26 of enlarged portion 7 of shaft 5 during the major part of one half revolution of the said shaft, thence through passage 28 into cylinder 8, and is then forced out of the cylinder, as the continued rotation of the shaft not only causes the piston to take its power stroke but also causes the groove 26 to then register with outlet passage 22 into passage 24.

As the action of piston 11 is similar to that of piston 10, its operation is apparent.

Lubricant is thus caused to be continuously pumped from the reservoir 4 to the outlet passage 24, when the pump is constructed of two cylinders with pumps operating one the reverse of the other, although it is evident that one piston or a plurality may be used.

Lubricant then passes from passage 24 through pipe 72 into fitting 71, some passing into pipe 170 and into its pressure-plunger switch operating device 171. From passage 71 the lubricant passes into distributor valve 55 through valve sleeve port 69, thence around circumferential valve groove 57, and (the valve and cam members being in the position shown in Fig. 5,) the lubricant will pass through elongated groove 62 to semi-circular groove 59, (then registering with it), from whence it will pass through valve sleeve dual-service port 74 and out of fitting 101 into pipe line 102.

The system being full of lubricant, immediately that additional lubricant begins to flow through port 101, all lubricant ahead of it begins to move, hence, piston 112 is shown as immediately moved down to close passage 114, as the lubricant flows from pipe 102, through port 105 of fitting 106 and its associated sleeve, passing out through port 110, passage 111, duct 116 into indicator piston chamber 115 forcing piston 117 to the left, Fig. 5; the lubricant on the other side of said piston 117 passes out of said piston chamber 115 through duct 115a and into valve chamber 119 and its associated fitting and sleeve which then has valve 124 in the position showr in Fig. 5.

This displaced lubricant then causes all the lubricant ahead of it in the circuit to move the dumbbell pistons 147 and 152 to the position shown in the cut-away section of feeder shown in Fig. 5, and to return a small quantity to the indicator block through the fitting 120'.

Continued flow of the lubricant will cause indicator piston 117 to make its complete stroke to the left, as viewed in Fig. 5, whereupon lubricant will flow out of piston chamber 115 into passage 127, move piston 124 to the left as it enters valve chamber 119, thence through sleeve 121 out through 123, thence through annular passage 125, returning into sleeve 121, through port 122, thence through fitting 120 into pipe line 131, thence into the first feeder 132, and by-passing through said feeder after discharging the measured quantity of lubricant displaced by piston 137, and so on until it returns to the indicator block 104. It enters lubricating block 104 through fitting 120' and its associated parts, valve 124' then closing passage 127'. The lubricant therefore passes through duct 115b into cylinder 115', moving piston 117' to the right, causing indicator piston rod 118' to move, thus notifying the attendant that the circuit has been completed.

The outer end of the indicator piston rod 118' first slides in the sleeve 200 and then causes the rocker arm 202 to rock, thereby, through plunger 210, shifting switches 187' and 284 of the respective switch mechanisms 187 and 281. This action thus cuts off the circuit to the pump motor or power means as current terminals 184 and 186 are no longer connected and the branch line 252 cannot transmit current through to line T2 until the valve has made a half revolution, at which time spring pressed plunger will operate switch lever 274 of switch mechanism 275, thus connecting terminals 270 and 271, (the valve making a half turn every 20 minutes).

If switch 284 of switch mechanism 281 shifts within three minutes after the pump motor and valve motors have started, then when plunger 262 slides into depression 79a of cam member 79 and switch lever 263 connects terminals 264 and 265, no circuit will be made through the green light, as terminals 282 and 283 will not then be connected, but if switch 284 remains in position shown in Fig. 5 for 3 minutes, then, the warning signal bulb will be lit and the attendant will investigate the cause of the delay.

The lubricant in cylinder 115', on the right of cylinder 117', passes through duct 116' into valve chamber 108' and back to the distributor valve, and in case the shafts 5 and 32 are keyed or made integrally, or in the event that the motor switch is not set for intermittent operation, the lubricant on the left side of piston 117', after forcing the piston to the right, will pass into passage 114' and thence through the valve chamber 108' and pipe 103 back to the distributor valve.

Such returning lubricant enters the valve housing through the opening receiving fitting 101', thence enters the valve sleeve through dual-service port 74', returning to reservoir in the manner heretofore shown.

When the device is set for operation under the assumed circumstances, very little lubricant returns to the reservoir as the pump motor switch will cut off the pump shaft power means until the valve has completed its half revolution; thereafter the lubricant will pass out of dual-service port 74' in the manner heretofore described, and the lubricant will pass through the system in reverse order.

In case excess pressure is encountered in the system, plunger mechanism 171 will throw switch

180 which is in series with the motor switches, thus stopping the power means and lighting red light bulb 190 as heretofore explained.

Thus it will be seen that there are two motor control switches and three warning signal lights, and a switch operating one of the signal lights also acting as a control of the motor switches, being in series therewith. The three lights are preferably yellow, green and red; the yellow one informing the attendant that the device is electrically connected for operation; the red one informing him that an excessive resistance has been encountered, building up an excessive pressure in the system; and the green light informing him that the system is tardy and requires investigation.

The movement of either of the indicator rods also informs the attendant that fluid has completed a circuit through the conduit in one direction and that all feeders have discharged their measured quantity of fluid to bearings or associated receiving devices.

It is further seen that I have provided a mechanical flow-reversing valve driven by an adjustable speed reducer which gives a wide range for controlling the frequency of lubrication. It is thought that the operation of this speed reducer and its adjusting means is clear from the description heretofore given.

The passageways 129 and 130 also serve as bypass means for fluid to cut out the balance of the feeder circuit, if the pump shaft and valve shaft are keyed together or made integral, after the fluid has completed the feeder circuit in one direction and before the flow of fluid through the system is reversed.

Having thus fully described my invention, it is apparent that many modifications thereof may be made. My invention therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit and scope of the appended claims.

What I claim is:—

1. In combination, a pump, a flow-reversing valve connected thereto for receiving fluid therefrom under pressure and having two discharge ports and means for alternately directing fluid out of one of said ports and then out of the other, a fluid fitting having two receiving ports respectively connected with the respective discharge ports of said valve and having two discharge ports respectively having fluid connection with the respective receiving ports, a conduit connected to and leading from one of the discharge ports of the fitting and returning to the other, the fitting having means for indicating when the fluid has made a complete circuit through the conduit, and a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when the fluid is moved through the conduit in either direction of flow.

2. The combination with a reversible fluid-distributing system having a power driven pump, a flow-reversing member, a conduit leading therefrom and returning thereto and a fluid-discharging feeder connected to said conduit provided with means for first discharging a quantity of fluid to a receiving device and for then uncovering a passage permitting fluid under pressure to flow on through the conduit and back to the flow-reversing member, of means for automatically starting the pump when the flow of fluid through the system is about to be reversed and means automatically stopping the pump when the fluid has completed a circuit through the conduit.

3. The combination with a reversible fluid-distributing system having a power driven pump, a flow-reversing member, a conduit leading therefrom and returning thereto and a fluid-discharging feeder connected to said conduit provided with means for first discharging a quantity of fluid to a receiving device and for then uncovering a passage permitting fluid under pressure to flow on through the conduit and back to the flow-reversing member, of means for automatically stopping the pump and giving a warning signal indicating that an excessive fluid pressure has developed in the system whenever such pressure exceeds a pre-determined amount.

4. The combination with a reversible fluid-distributing system having a power driven pump, a flow-reversing member, a conduit leading therefrom and returning thereto and a fluid-discharging feeder connected to said conduit provided with means for first discharging a quantity of fluid to a receiving device and for then uncovering a passage permitting fluid under pressure to flow on through the conduit and back to the flow-reversing member, of means for automatically giving a warning signal indicating that the flow of fluid through the conduit circuit is tardy whenever the said flow through the circuit has not been completed within a pre-determined time.

5. In combination, a pump having an extending shaft adapted to be driven by power means, a flow-reversing valve having fluid connection therewith, means for actuating said valve, a circuit-indicating block having fluid connection with said flow-reversing valve and provided with hydraulically operated circuit-indicating members projecting therefrom, a conduit leading from said circuit-indicating block and returning thereto, a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when fluid is moved through the conduit in either direction of flow, an electric circuit controlling the operation of the pump drive shaft power means, means for automatically closing the said circuit when the flow-reversing valve is ready to reverse the flow of fluid and means for automatically breaking the circuit when fluid has made a complete circuit through the conduit.

6. In combination, a pump having an extending shaft adapted to be driven by power means, a flow-reversing valve having fluid connection therewith, means for actuating said valve, a circuit-indicating block having fluid connection with said flow-reversing valve and provided with hydraulically operated circuit-indicating members projecting therefrom, a conduit leading from said circuit-indicating block and returning thereto, a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when fluid is moved through the conduit in either direction of flow, an electric circuit controlling the operation of the pump drive shaft power means, switch mechanism controlled by the movement of the flow-reversing valve for automatically closing the said circuit and switch mechanism controlled by the movement of the circuit-indicating member for automatically breaking the said electric circuit.

7. In combination, a pump having an extending shaft adapted to be driven by power means, a flow-reversing valve having fluid connection therewith, means for actuating said valve, a

sleeve and housing for delivering fluid to and for receiving fluid from a circuit, and passageways in said valve member and in said valve sleeve adapted to control the flow of fluid through said valve whereby fluid will be directed out of one dual-service port to the circuit and into the other dual-service port from the circuit while the valve is making a partial rotation and for reversing the flow of fluid to the circuit during a part of the continued rotation of the shaft.

14. In combination with a flow-reversing fluid-distributing system having a conduit circuit, of circuit-indicating means interposed therein comprising a block having a plurality of cylinders with working pistons therein, circuit-indicating members actuated by said pistons, valve means and connecting passageways for controlling the flow of fluid to actuate said pistons whereby a circuit-indicating member makes an outward stroke on each completion of the flow of fluid through the circuit.

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circuit-indicating block having fluid connection with said flow-reversing valve and provided with hydraulically operated circuit-indicating members projecting therefrom, a conduit leading from said circuit-indicating block and returning thereto, a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when fluid is moved through the conduit in either direction of flow, an electric circuit controlling the operation of the pump drive shaft power means, switch mechanism and controlling means actuated by the movement of said circuit-indicating members for breaking said circuit and switch mechanism and controlling means actuated by the movement of said valve for making said circuit.

8. In combination, a pump having an extending shaft adapted to be driven by power means, a flow-reversing valve having fluid connection therewith, means for actuating said valve, a circuit-indicating block having fluid connection with said flow-reversing valve and provided with hydraulically operated circuit-indicating members projecting therefrom, a conduit leading from said circuit-indicating block and returning thereto, a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when fluid is moved through the conduit in either direction of flow, an electric circuit controlling the operation of the pump drive shaft power means, switch mechanism adapted to break said electric circuit, means actuated by the movement of said circuit-indicating members for actuating said switch mechanism, and a switch mechanism adapted to remake said electric circuit automatically when the flow-reversing valve is ready to reverse the flow of fluid.

9. In combination, a pump having an extending shaft adapted to be driven by power means, a flow-reversing valve having fluid connection therewith, means for actuating said valve, a circuit-indicating block having fluid connection with said flow-reversing valve and provided with hydraulically operated circuit-indicating members projecting therefrom, a conduit leading from said circuit-indicating block and returning thereto, a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when fluid is moved through the conduit in either direction of flow, an excess pressure warning signal light bulb, an electric circuit connected to said light bulb, a switch mechanism for making and breaking said circuit, and a pressure controlled plunger operated mechanism having fluid connection with the conduit for actuating said switch mechanism whereby to make the circuit whenever a pre-determined fluid pressure is exceeded in the conduit.

10. In combination, a pump having an extending shaft adapted to be driven by power means, a flow-reversing valve having fluid connection therewith, means for actuating said valve, a circuit-indicating block having fluid connection with said flow-reversing valve and provided with hydraulically operated circuit-indicating members projecting therefrom, a conduit leading from said circuit-indicating block and returning thereto, a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when fluid is moved through the conduit in either direction of flow, an automatically operated overtime warning signal light bulb, an electric circuit adapted to light said bulb, two double limits switch mechanisms adapted to control said circuit, one adapted to prevent the making of said circuit whenever it operates in advance of the other, the other adapted to make said circuit whenever it operates in advance of the former, means operable by the circuit indicating-members for actuating the switch mechanism which prevents the making of said circuit and means operable by the movement of the valve for actuating the other switch mechanism.

11. In combination, a pump having an extending shaft adapted to be driven by power means, a flow-reversing valve having fluid connection therewith, means for actuating said valve, a circuit-indicating block having fluid connection with said flow-reversing valve and provided with hydraulically operated circuit-indicating members projecting therefrom, a conduit leading from said circuit-indicating block and returning thereto, a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when fluid is moved through the conduit in either direction of flow, an electric circuit controlling the operation of the pump drive shaft power means, automatically operable means for making and breaking the said circuit at pre-determined periods, an overtime signal light bulb electrically connected to said circuit, switch mechanisms adapted to break the connections to said circuit whenever the flow of fluid through the conduit in any one direction exceeds a pre-determined fixed time.

12. In combination, a pump having an extending shaft adapted to be driven by power means, a flow-reversing valve having fluid connection therewith, means for actuating said valve, a circuit-indicating block having fluid connection with said flow-reversing valve and provided with hydraulically operated circuit-indicating members projecting therefrom, a conduit leading from said circuit-indicating block and returning thereto, a fluid-discharging feeder connected to said conduit, said feeder having means for discharging a quantity of fluid to a receiving device when fluid is moved through the conduit in either direction of flow, an electric circuit controlling the operation of the pump drive shaft power means, automatically operable means for making and breaking the said circuit at pre-determined periods, an overtime signal light bulb having electrical connections to said circuit, switch mechanism adapted to break the said connections to said circuit whenever the flow of fluid through the conduit in any one direction exceeds a pre-determined time, an excess pressure warning signal light bulb having electrical connections to said circuit, said circuit also having a pressure controlled switch mechanism adapted to break said circuit and to make a circuit through said last mentioned light bulb whenever a pre-determined pressure of the fluid in the conduit is exceeded.

13. A flow-reversing valve for a reversible fluid-distributing system comprising a housing having an inlet port communicating with a source of fluid supply and an exhaust port communicating with a fluid reservoir, a power driven shaft journaled in said housing, a rotary valve member surrounding said shaft, speed reducing means operable by said shaft for rotating said valve, a valve sleeve surrounding said valve member, a pair of duel-service ports in said valve