May 12, 1931. F. S. BARKS 1,805,303

LUBRICATING SYSTEM

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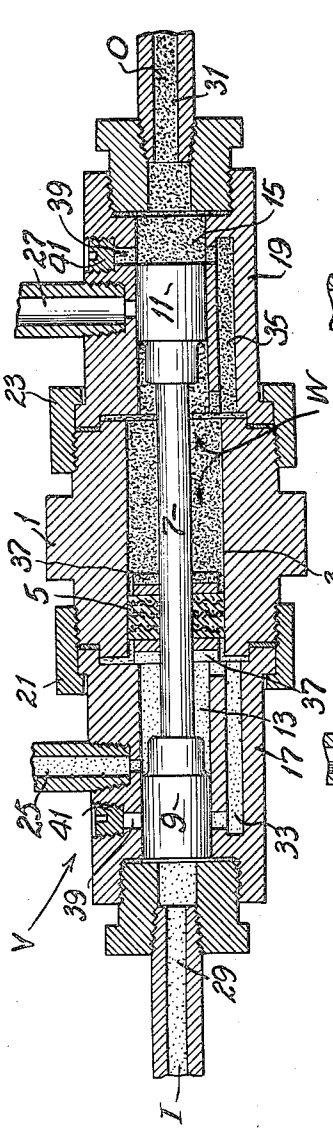


Fig. 1.

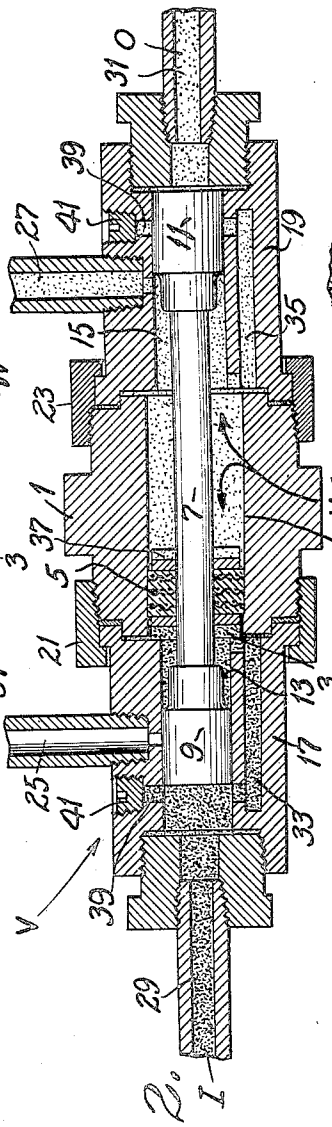


Fig. 2.

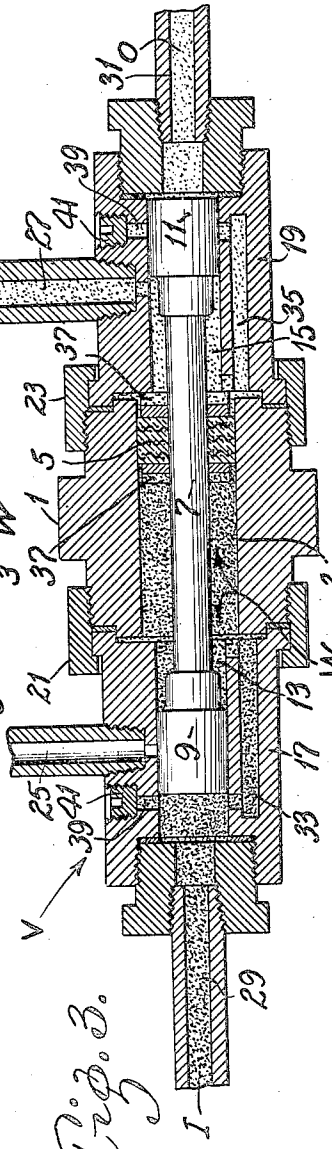


Fig. 3.

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LUBRICATING SYSTEM

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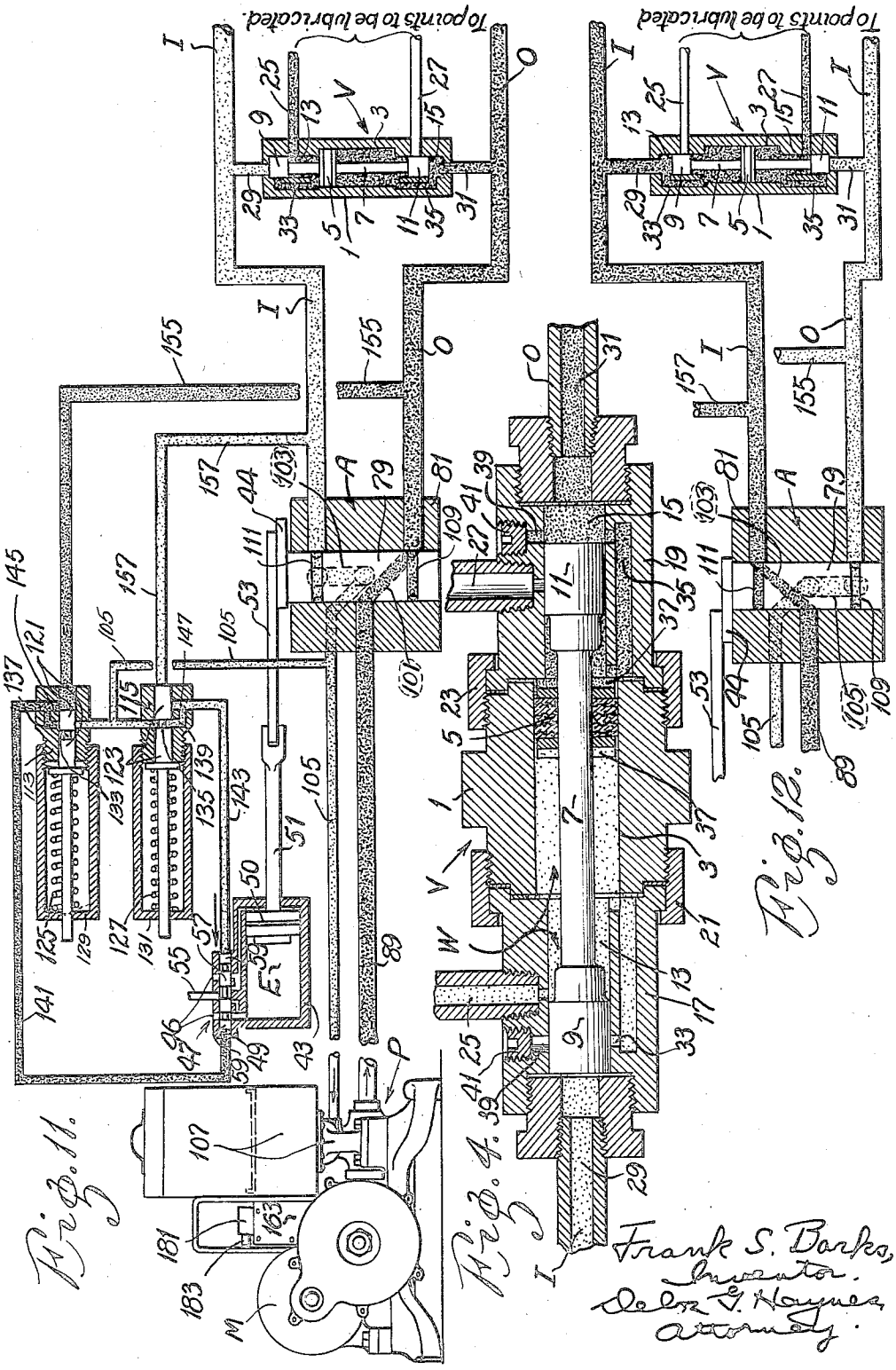


Fig. 11.

Fig. 4.

Fig. 12.

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LUBRICATING SYSTEM

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Fig. 5.

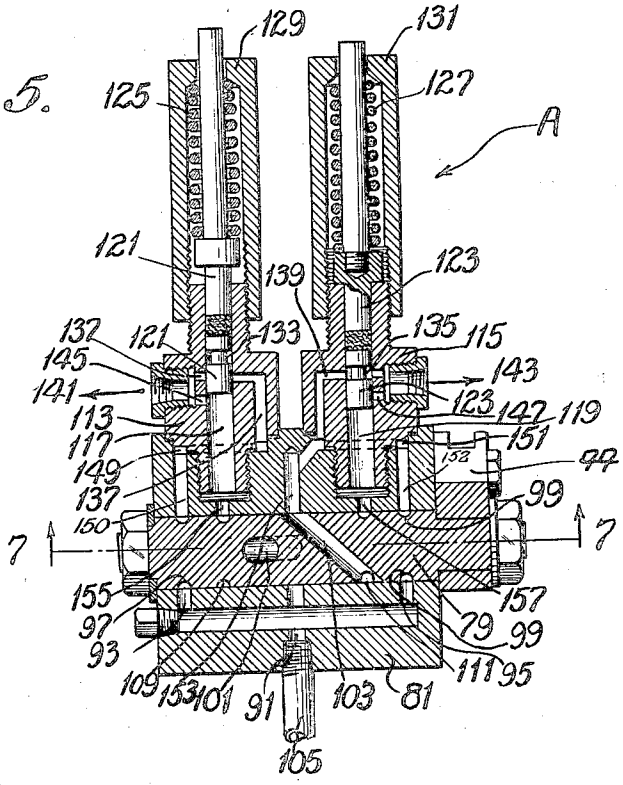


Fig. 6.

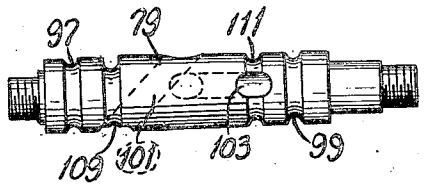
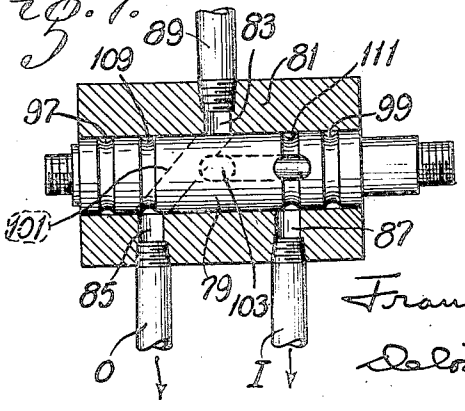


Fig. 7.



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Fig. 15.

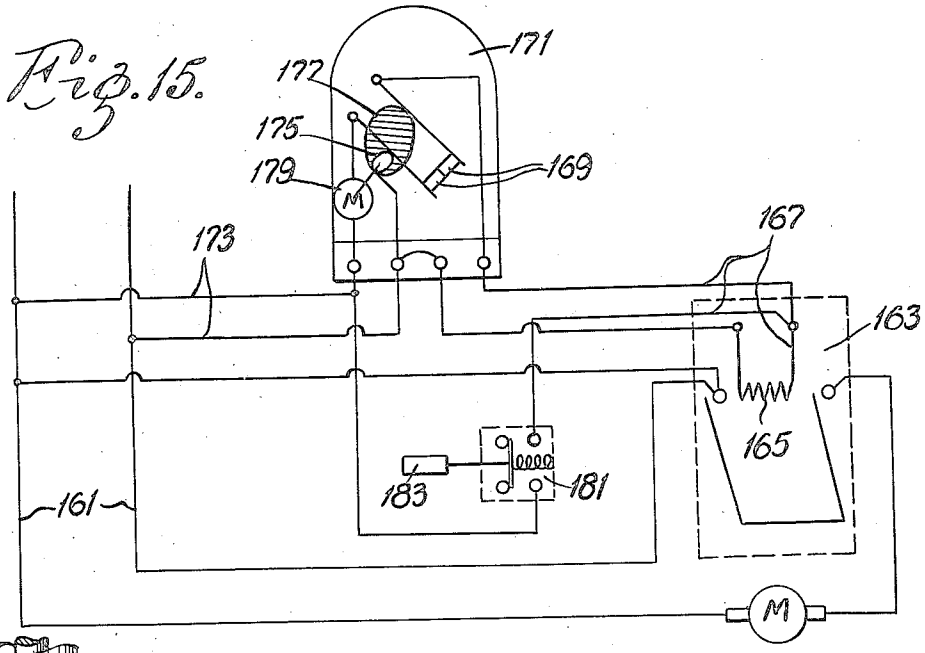
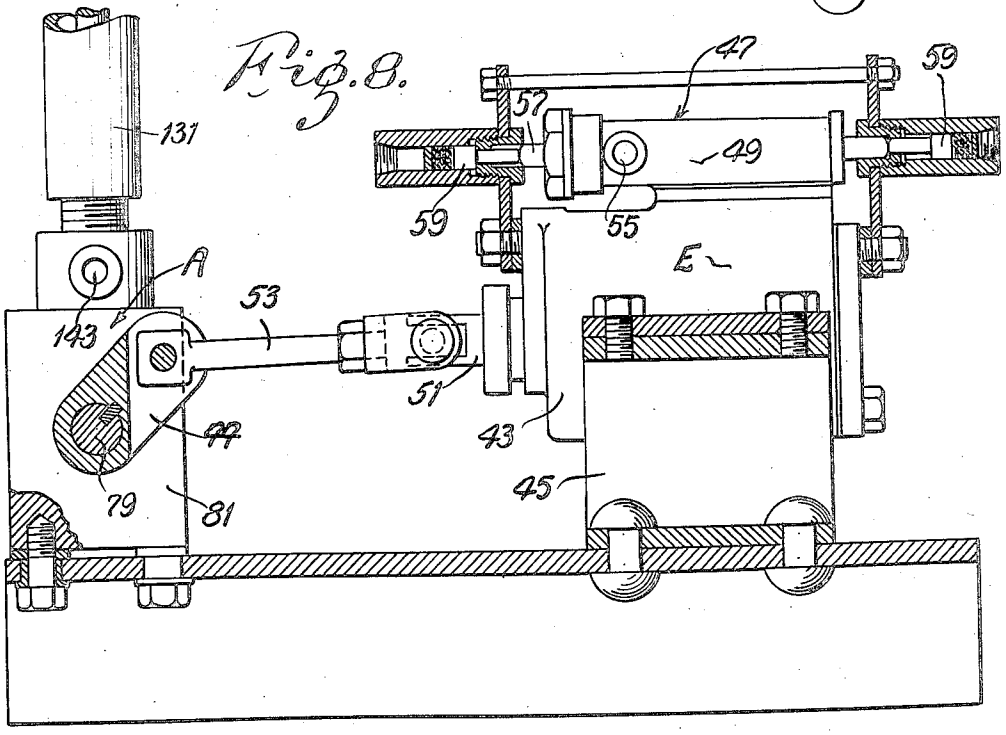


Fig. 8.



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Fig. 10.

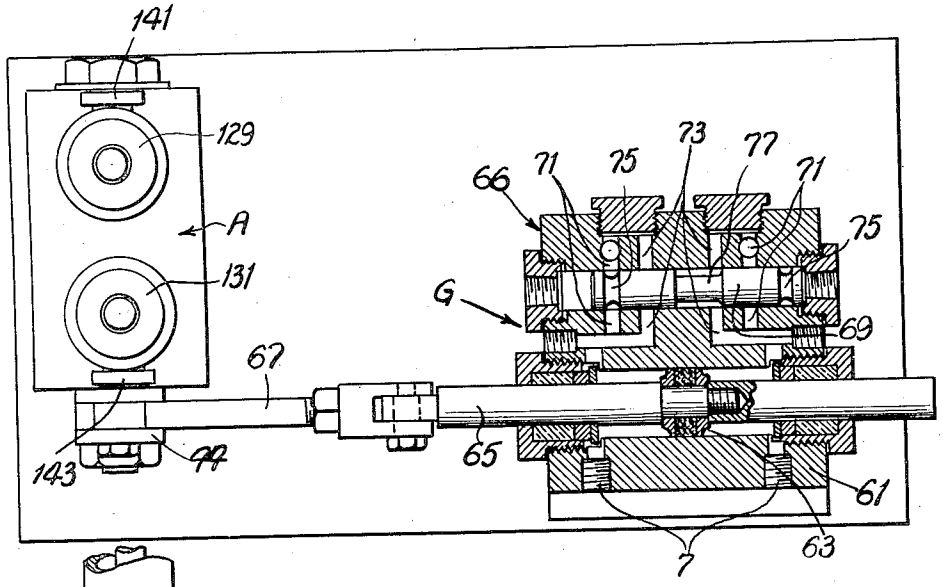
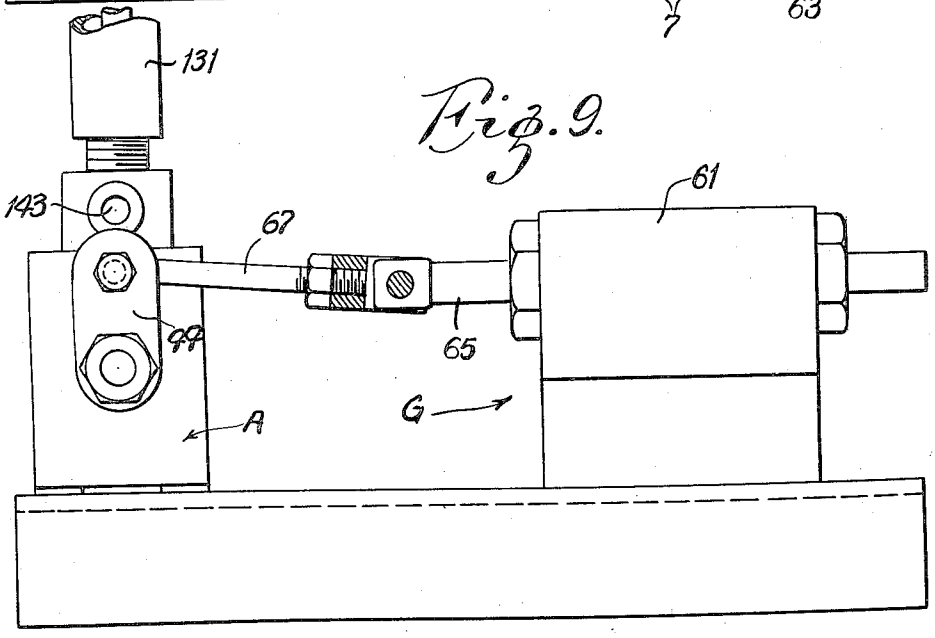


Fig. 9.



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LUBRICATING SYSTEM

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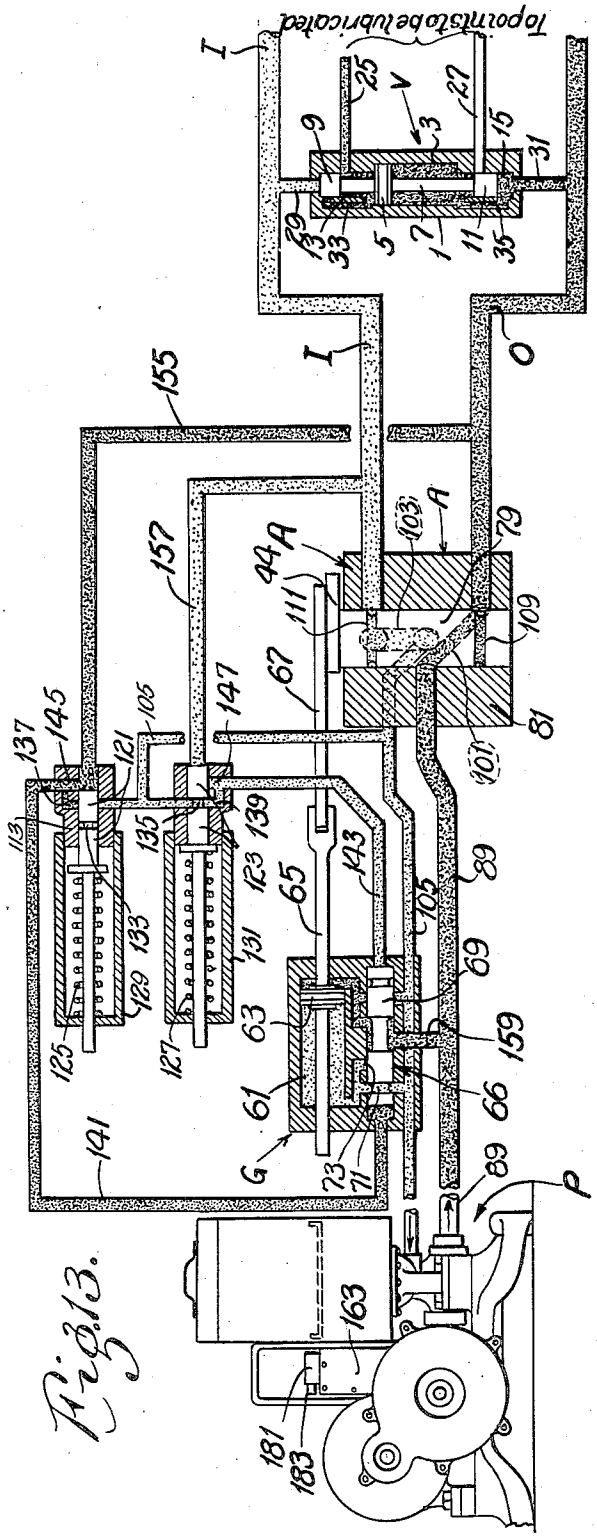


Fig. 13.

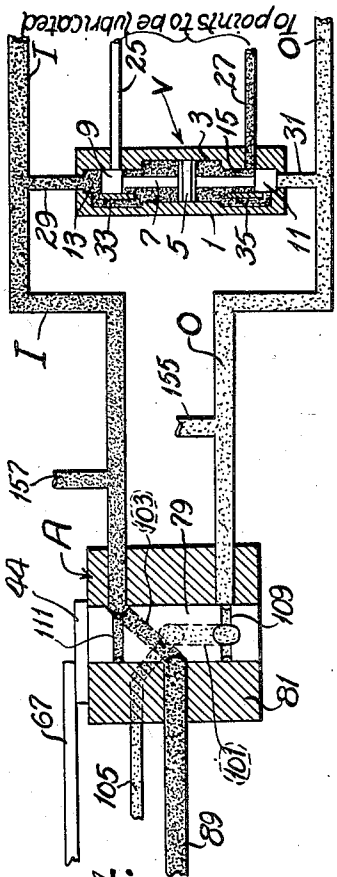


Fig. 14.

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Patented May 12, 1931 1,805,303

UNITED STATES PATENT OFFICE

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LUBRICATING SYSTEM

Application filed December 1, 1930. Serial No. 499,172.

This invention relates to lubricating systems, and with regard to certain more specific features, to a lubricating system operable to distribute under pressure, measured or metered quantities of lubricants or the like, such as grease.

This invention includes in combination certain particular features shown and described in my copending application Serial No. 495,596, for lubricating apparatus, filed November 14, 1930.

Objects

Among the several objects of the invention may be noted the provision of a lubricating system which, from a single pump is adapted to distribute measured quantities to a plurality of bearings, there being provided means whereby some bearings may receive different quantities than others; the provision of a system of the class described wherein a proper and positive distribution of material is effected to all bearings or points lubricated by the system independently of relative degrees of resistance in the lines to the points served; the provision of the apparatus of the class described which is adjustable to provide lubricant at various adjustable pressures and for various timed intervals; the provision of a system of the class described which may be modified to operate with or without a pressured air supply; and the provision of a system of this class which is flexible in operation and control and which is characterized by having relatively few parts which are adapted to be ruggedly built, having only a minimum number of springs and points of articulation. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arangements of parts which will be exemplified in the structure hereinafter described, and the scope of the application of which will be indicated in the following claims.

Drawings

In the accompanying drawings, in which are illustrated several of various possible embodiment of the invention,

Fig. 1 is a detail, longitudinal section showing a measuring distributor portion of the invention in a position in which it has just completed a leftward stroke;

Fig. 2 is a view similar to Fig. 1 showing a stroke starting in the right-handed direction, and wherein a piston valve head has been thrown to the right, but a main piston has not yet started to move;

Fig. 3 is a view similar to Fig. 2 in which said main piston has effected its right-hand stroke;

Fig. 4 is a view similar to Fig. 1, but in which the main piston has not yet returned to its left-hand position;

Fig. 5 is a detail, vertical section of a pressure alternating and regulating device;

Fig. 6 is a side elevation of a valve stem used in the alternating and regulating device of Fig. 5;

Fig. 7 is a horizontal section taken on line 7—7 of Fig. 5, but showing said valve stem turned through ninety degrees from the position of Fig. 5;

Fig. 8 is a side elevation of an air motivated engine, parts being broken away;

Fig. 9 is a side elevation of an alternative form of grease motivated engine, parts being broken away;

Fig. 10 is a plan view of Fig. 9, parts being broken away to show a section of the grease motivated engine;

Fig. 11 is a diagrammatic flow chart showing a form of the invention under certain conditions of flow (this form of the invention including the air engine of Fig. 8).

Fig. 12 is a fragmentary view similar to parts of Fig. 11, showing the same form of the invention but an alternative condition of flow;

Fig. 13 is a view similar to Fig. 11 showing a form of the invention in which the grease motivated engine of Fig. 10 is used;

Fig. 14 is a fragmentary view similar to parts of Fig. 13, but showing an alternative condition of flow; and,

Fig. 15 is a wiring diagram showing a timing arrangement.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

In order that the operation and advantages of the system hereinafter to be described may be fully understood, certain new and novel elements thereof will be set forth in detail.

Measuring distributor valve V (Figs. 1 to 4 and 11 to 14)

Referring now more particularly to Fig. 1, there is illustrated at numeral 1 a body portion forming a cylinder 3 for slidably accommodating a packed, main piston 5. The main piston 5 is annular and slidably rides upon and seals against a stem 7 of a piston valve, said valve comprising said stem 7 and two heads 9 and 11 at the left and right respectively.

The heads 9 and 11 of said piston valve reciprocate in cylinders 13 and 15 respectively, formed in bodies 17 and 19. Said bodies 17 and 19 are held to the body 1 by means of couplings 21 and 23 which permit of angular adjustment of the bodies 1, 17 and 19, when they are assembled, so that outlets 25 and 27, in said bodies 17 and 19 communicating with said cylinders 13 and 15, may be adjusted to assume predetermined positions. It will be understood from the drawings that the cylinders 3, 13 and 15 are concentric, as well as the main piston 5 and the piston heads 9 and 11. Thus provision is made for the piston 5 and the piston heads 9, 11 and the stem 7, to float freely within the concentric bores 3, 13 and 15.

The cylinders 13 and 15 are provided with inlets 29 and 31 respectively. Cylinder 13 also has a by-pass 33 which, when the head 9 is in its right-hand position (see Figs. 2 and 3), by-passes fluid around from the outer face of the head 9 to the rear thereof. Likewise, the cylinder 15 is provided with a by-pass 35 which communicates between opposite sides of the head 11, when said head 11 is in its left-hand position (see Figs. 1 and 4). It will be noted that when the head 9 is in its left-hand position (Figs. 1 and 4) the by-pass 33 is cut off; and when the head 11 is in its right-hand position (Figs. 2 and 3) the by-pass 35 is cut off. Moreover, when the head 9 is set at the left, so as to cut off its by-pass 33, it permits communication between the outlet 25 and the cylinder 13 (Figs. 1 and 4); and also, the head 11 when in its right-hand position and cutting off the by-pass 35 (Figs. 2 and 3) permits communication between the outlet 27 and the cylinder 15.

In order to facilitate the building up of full pressure upon the faces of the main piston 5, said faces are slotted as shown at numeral 37. These slots permit the pressure to be immediately applied over the whole area of the face, by always providing a space between the abutting edges of the cylinder 13 and the face. The blind passages 39 and the plugs 41 are for manufacturing and clean-out purposes.

It is to be understood that the main fluid inlets 29 and 31 are in communication with pressure grease or main fluid conduit lines I and O which are adapted to be alternatively placed under pressure, as will be clarified hereinafter. That is to say, first one inlet (for instance, inlet 29) is put under pressure while the inlet 31 is relieved of pressure; and thereafter the inlet 31 is put under pressure while inlet 29 is relieved of pressure.

A description of the operation of this measuring and distributor element or ejecting or delivery means of the invention is as follows, starting with the position of the mechanism shown in Fig. 1, and also assuming that the pressure of the inlet 31 is about to be cut off and that the pressure in the inlet 29 is about to be built up (dense stippling represents higher pressure and less dense stippling representing lower pressure of the fluid):

In Fig. 1 the inlet 29 is out of communication, both with the outlet 25 and the by-pass 33. Immediately upon pressure building up in the inlet 29 (at which time pressure is relieved at the inlet 31), the condition of Fig. 2 is attained, wherein the piston valve comprising the elements 7, 9 and 11, and hereinafter to be referred to by the letter W, is pushed to the right, because of the differential pressure on the heads 9 and 11. This causes the head 9 to cover the outlet 25 and uncover the by-pass 33 so that the increased pressure at the inlet 29 is communicated through said by-pass, around the head 9 and to the main piston 5.

Next, as illustrated in Fig. 3, the by-passed, pressured grease from the inlet 29 pushes the main piston 5 to the right, and the main piston presses the charge of grease ahead of it out of the outlet 27. It will be seen that the outlet 27 is now in communication with the cylinder 15, and that the cylinder 15 is in communication with the cylinder 3 in which the main piston slides. Thus, the pressure of the inlet 29 causes the discharge of a measured volume of grease or the like from the outlet 27, said measured volume being determined by the effective volume (subtracting clearance volume) between the piston 5, in a retracted position, and a head such as 11 (Fig. 1).

After the charge has been ejected (Fig. 3), the pressure builds up in the inlet 31 and the pressure in the inlet 29 decreases (due to causes to be shown herein). The piston valve W is then immediately thrown to the left, as shown in Fig. 4, and thereby cuts off the outlet 27 by means of the head 11. At the same time the by-pass 35 is opened so as to communicate pressure from the inlet 31, to the main piston 5. This drives the

main piston 5 from the Fig. 4 position to the position shown in Fig. 1, thus ejecting a measured charge of grease or the like from the outlet 25.

From the above, it will be seen that the piston valve W is affected by the differential pressure existing between the inlets 29 and 31. Hence the device or valve V, taken as a whole, functions as a combined shunt or measuring valve for the grease, and as a forcing means therefor. It is to be understood that when pressure is relieved from either of the inlets 29 and 31, that the means for relieving said pressure is so arranged that re-compression into that inlet may be effected. For instance, when transition takes place from the Fig. 1 to the position of Fig. 2, the pressure in inlet 31 is relieved and the head 11 may force grease into said inlet 31. Briefly, the inlet 31 then exhausts to the supply for both lines, as will be shown.

From the above it will be clear that a definitely measured charge is forced out. Furthermore, the volume of the charge may readily be changed by changing the length of the main piston 5, and this is easily accomplished.

Air operated engine (Figs. 8 and 11)

When the invention herein described is used in locations where air is available and/or in situations where it is desirable or necessary that relatively heavy grease be used which requires air pressure thereon at the source of supply in order to properly force it into the pressure pump to be described, an air engine E is used for driving a pressure alternator or fluid directing means and regulator A (to be described). The air engine E (Fig. 8) comprises a cylinder 43 suitably mounted on a base 45 and carrying valve gear 47. Within the cylinder 43 is slidably located a piston 50 (Fig. 11). A piston rod 51 reaches from the piston 50 exteriorly of the cylinder 43 and is joined with a connecting rod 53 which reaches to a crank 44 of said pressure alternator A.

The valve gear 7 comprises a housing 49 suitably ported, as shown in Fig. 11, to permit communication between an air pressure pipe 55 and the interior of the cylinder 43 upon movement of a valve stem 57. The valve stem 57 moves under the influence of differential grease pressure operating on two plugs 59 facing against and receiving alternating high and low pressures from lines 141, 143. The plugs 59 contact with the stem 57 and cause movement thereof as said plugs are moved under said pressure. It will be apparent that excess pressure on either one of the plugs 59 will result in throwing the valve stem 57 into a predetermined position, thus controlling the position of the piston 50 and the angular position of the crank 44 of said pressure alternator A. The position of the valve stem 57 depends upon the plug on which the excess pressure is exerted. In the one position of the stem 57 the air line 55 is put into communication with one end of the cylinder 43, thus forcing piston 50 to the other end of the cylinder 43, said other end of the cylinder at this time being exhausted through one of the exhaust ports 46. When the stem 57 is in its opposite position, the air pipe 55 communicates with the opposite end of the cylinder 43, thus forcing the piston 50 back again and permitting exhaust of air from the other side of said piston 50. Thus it will be seen that the operation of the air engine E is dependent upon pressure differential between said lines 141, 143. Exhaust outlets are shown at numeral 46.

Engine G for operating fluid directing means or alternator A (lubricant operated; see Figs. 9, 10 and 13)

In Figs. 9, 10 and 13 is shown an alternative form of the engine for operating the alternator A and is for use more particularly where either lighter greases are being used, which do not require air pressure on the source of supply in order for the pump to handle them; and/or to be used where air pressure is not available.

In this form of the engine there is used a cylinder 61 in which is located a piston 63 adapted to be operated directly by grease under pressure, instead of by air, as was the case with the engine above described. The piston has a piston rod 65 reaching outwardly and to which is connected a connecting rod 67 reaching to the crank 44 of the distributor A. A valve gear 66 is used comprising a stem 69 which upon assuming alternate positions under influence of differential pressure in lines 141, 143, causes high pressure grease to be delivered first to one end of the cylinder 61 and then to the other end of said cylinder, the opposite end of the cylinder under either condition exhausting. Exhaust outlets are shown at numerals 71 and inlets at numerals 73. The outlets 71 are controlled from grooves 75 in the stem 69 and the inlets are controlled from the wider groove 77. Thus this engine, instead of using air as a motivating agent, uses grease from a high pressure grease line. It thus differs from the engine E in being motivated from a high pressure grease line instead of from a high pressure air line. However, the valve stems of both engines are under control of differential lubricant pressure lines in said 141, 143, and thus the operation of said engines is under this control.

Fluid directing means or pressure alternator and regulator A (Figs. 5 to 7 and 11 to 14)

This device carries the crank 44 which may be driven to oscillate through a predeter-

mined angle by either the air engine E or the grease engine G, the choice of either engine E or engine G depending upon facts referred to above. This crank or lever 44 is attached to, and drives a valve stem 79 oscillably carried in a body 81.

As shown in Fig. 7, said body 81 is provided with an inlet port 83 and two outlet ports 85 and 87. The main fluid inlet port 83 is connected by means of a line 89 with a suitable pump P adapted to engender pressure and deliver lubricant to the alternator and regulator A (see for instance Figs. 11 and 13). The outlets 85 and 87 are in connection with main fluid outlet lines O and I respectively (Figs. 11 to 14). The alternator A is also provided with an exhaust port 91 in a plane at right angles to the plane of Fig. 7 (see Fig. 5). The exhaust port 91 connects with branch portions 93 and 95 in the body 81, said branch portions 93 and 95 in said body communicating with grooves 97 and 99 respectively in said valve stem 79.

The valve stem 79 is provided with sloping ports 101 and 103 placed through the stem 79 in diagonal directions and in planes substantially at right angles to one another. As will be seen from Figs. 5 to 7, under a ninety degree movement of the crank 44, said ports 101 and 103 are adapted alternatively to place the high pressure inlet 83 in communication with the outlets 85 and 87 of the body 81. Thus the lines O and I are alternatively placed in communication with the high pressure line 89. It will be noted, also, that when a given port, such as 101, is not in position to connect an inlet such as 83 with an outlet such as 85, it is adapted to place the exhaust outlet 91 in communication with that one of the lines O and I which is not receiving pressure from the other port, such as 103. Inasmuch as the exhaust outlet 91 is connected with the supply of the pump P by line 105, exhausting action is possible to said pump supply. The supply is indicated at numeral 107. The lines O and I are always in communication with the ports 101 and 103 respectively because of grooves 109 and 111, respectively, in said valve stem 79. Thus each outlet O and I is by reason of the valve stem 79 and its ports in communication with the pressure line 89 or the exhaust line 105, said lines O and I alternating their respective connection.

In connection with the body 81 is associated regulating or relief means comprising bodies 113 and 115 formed, as illustrated at numerals 117 and 119, respectively, to accommodate plungers 121 and 123 respectively. Springs 125 and 127 react against said plunger 121 and 123, said springs being backed by adjustable heads 129 and 131 respectively, adjustably threaded to said bodies 113 and 115.

Suitable grooves 133 and 135 are formed in the plungers 121 and 123 for communicating with ports 137 and 139 in the bodies 113 and 115 when said plungers 121 and 123 are in their lowermost position under the influence of the springs 125 and 127. The ports 137 and 139 lead to lines 141 and 143, said last-named lines being the ones which produce the differential pressure at the ends of either the valve stem 57 for the air engine E, or the valve stem 69 of the grease engine G (depending upon which of the engines is to be used in a given application). In either event the valve stems of the engines are acted upon by differential pressures in the lines 141 and 143. Ports 145 and 147, also communicating with said lines 141 and 143 are adapted to be alternatively opened by the plungers 121 and 123 when said plungers move upwardly under pressure, the ports 137 and 139 at this time being cut-off (Fig. 5).

The ports 137 and 139 are, by means of counterbores or annular passages 149 and 151 and passages 150 and 152 respectively, in communication with said grooves 97 and 99 and hence in communication with the exhaust 91. The bores 117 and 119 in which the plungers 121 and 123 reciprocate are at the proper times in communication with said exhaust 91 by way of the ports 101 and 103, this being accomplished by way of the respective grooves 109 and 111, that is to say, this communication occurs whenever the ports 101 and 103 are in communication with said exhaust 91; otherwise not. An exhaust bore 153 serves purposes to be described.

The lines I and O may be called the main fluid conduit lines; and the lines 155 and 141, alone or together (Figs. 11 and 13), and lines 157 and 143, alone or together, may be called the secondary fluid conduit lines.

Operation of the system (pneumatic form; see Figs. 11 and 12)

Consider the pump P to be operating. The engine E has thrown the alternator A to the position shown in Fig. 11. The pressure in line 89 is delivered to line O by way of the now horizontal port 101. The line I at this time is in communication with the exhaust line 105 by way of groove 111, vertically located port 103, passage 153 (Fig. 5), counterbore or annular passage 151, passage 152, groove 99, port 95, exhaust 91 to line 105. Thus there is effected in the main differential pressure lines O and I a differential pressure, the line O being the line with the higher pressure. Only friction pressure exists in line I at this time.

The above causes the measuring distributor valve V to take up the location shown in Figs. 1 and 11. The action of the valve V is first as shown in Fig. 4, in which the piston valve is thrown to the left by the differential pressures in the lines O and I, thus closing off the line I and by-passing the material from the line O to a position behind the main pis-

ton 5, so that said main piston 5 forces grease for lubricant from the outlet 25 to its respective bearing or bearings attached thereto. It will be seen inasmuch as the line I is in communication with the exhaust line 105, that the movement of the piston valve head 9 effects a recompression into said line I and a re-delivery of a small amount of grease to the supply 107.

It is clear that as many distributor valves V may be placed in parallel across the lines O and I as desired, each serving two bearings or sets of bearings or the like. Thus the lines O and I in Figs. 11 to 14 are shown as continuing beyond the points of connection of the one valve V shown.

After the piston 5 of each distributor valve V reaches the end of its stroke, pressure continues to build up in the line O. This increased pressure communicates itself to the underside of plunger 121 by way of the passage 155. It will be appreciated that the passage 155 is shown diagrammatically in Fig. 11 and as constructed in Fig. 5. In both Figs. 5 and 11, the passage 155 communicates with the grove 109.

This communication of pressure through the passage 155 results in lifting the plunger 121 so as to open the port 145 and permit passage of high pressure lubricant to one end of the valve stem 57 of the air engine E; whereas the other end of said valve stem 57 of the engine E does not receive high pressure. This is because the passage 157 (in communication between the line I and underside of plunger 123) does not have high enough pressure to lift said plunger 123. Hence, the line 143 remains closed and under low pressure. Said line 143 is in communication with the exhaust line 105 by way of passage 139, counterbore 151, passage 152, port 95, exhaust 91 to line 105. In the diagram of Fig. 11 only the passage 139 is indicated for simplicity.

It will be seen that the pressure at which the plunger 121 will lift is adjustable by adjusting the threaded position of the cap 129 on its body 113. Thus if it be found that the piston 5 of the distributor valve V is not being pushed completely over to supply a bearing in connection with line 25, the cap 129 may be screwed down so that more pressure is required in the line O before the valve of the engine E will be thrown. This regulation provides means for effecting the removal of any obstruction in the line or bearing in question that is causing the piston 5 to stop before the end of its stroke is reached.

To continue the operation, it will be seen that under differential pressure in the secondary differential pressure lines 141 and 143, the valve stem of the air engine E is thrown so as to reverse the admission of air in respect to the piston 50. This drives the piston 50 back from the Fig. 11 position, throws the crank 44 into its alternate position and the arrangement of Fig. 12 is then effected.

Under these conditions of Fig. 12, the high pressure from line 89 is delivered to the line I instead of to the line O. At the same time, the line O is put into communication with the exhaust line 105, as shown. This causes the distributor valve V to assume the position as shown in Figs. 2, 3 and 12, the differential pressure between line I and O effecting the reverse operation, as shown above and described. Hence, the grease is delivered to and pushed out of the line (or lines) 27 to the respective bearing or bearings connected therewith. The line (or lines) 25 are at this time cut off by the valve head 9. At the same time the passages 155 and 157 reverse their relative pressure so that the plunger 123 of the alternator A is lifted to cause a reversal of the differential pressure in lines 141 and 143. At this time the plunger 121 is down, there being only a low pressure in the passage 155.

The pressure in line I depends upon the setting of the cap 131. After the grease has been discharged from the line 27 (or upon abnormally high pressure existing in said line 27), the valve of the engine E is again thrown so that the engine is reversed to again reverse the position of the valve stem 79. Thus, as long as the pump P is operating to produce pressure, the fluid directing means or alternator will alternate pressure in the lines O and I and cause alternate delivery from the lines 25 and 27.

The distributor valve V effects the distribution to the two said lines 25 and 27 and also provides means for building up pressure in the respective delivery line until the regulator or relief portion of the alternator causes the proper differential in the lines 141 and 143 to reset the alternator under power of engine E.

Operation (alternative form; Figs. 13 and 14)

Figs. 13 and 14 illustrate the operation of the piston when the grease engine G is used for operating alternator A, instead of the air engine E. The operation is substantially the same, corresponding reference numeral indicating corresponding connections. Differential pressures in the lines O and I as before, effects differential pressures in the lines 141 and 143. The differential pressure in the lines 141 and 143 is not permitted to take place until the differential pressure in the lines O and I has built up to a predetermined amount, as determined by the adjustment of the caps 129 and/or 131. The difference between the two forms of the invention is that in Figs. 13 and 14 there is led off from the main pressure line 89 a branch line 159 which supplies grease to the grease engine G

through its valve gear. This valve gear is, as was the case in the previously described form, under the influence of the differential pressure in said lines 141 and 143.

It will be seen that this form of the invention does away with the necessity for an air supply. It is to be used wherever air is not available, or where it is difficult to obtain and where is not required upon the supply of grease in the supply chamber 107 in order to properly force the grease into the reciprocating parts of the pump P when the suction event occurs therein.

Electric circuit for driving (Fig. 15)

The pump P may be of the electrically driven type such as described more particularly in my co-pending application for dispensing apparatus, Serial No. 344,719, filed March 6, 1929, with the exception that the pressure circuits are as hereinbefore described. The pump carries a motor M for driving certain reciprocating elements adapted to engender pressure in the line 89. The motor is energized from the circuit shown in Fig. 15.

In Fig. 15, numeral 161 represents a main line or a main supply circuit. The motor M of pump P is placed across the line 161 and carries in the circuit thereof a switch 163 operable from a trip coil 165. When the switch 163 is energized the motor runs; otherwise it does not. It will be understood that the magnetic switch 163 automatically re-opens when its trip coil 165 is de-energized.

The trip coil 165 of the switch 163 is energized by a shunt 167 connected across swingable contact points 169. The contacts 169 are located in a main or central timing switch 171 which is supplied current by means of a supply circuit 173 connected with the main line 161. It will be understood that the timing switch, as well as the switch 163 are of known type and that there is shown and described herein only enough of their elements to make clear the functions of the system herein described.

The contacts 169 are timed to open and close at predetermined intervals by means of a set of cams 175, 177 connected to the same shaft, such shaft being driven by a suitable synchronous or other constant-speed motor 179 energized from said circuit 161 by said supply circuit 173. It is to be understood that where alternating current is not available, a mechanical timing device may be used for driving the cam shaft.

For purposes of explanation, the cam 175 is shown composed of conducting material and connects so as to continuously maintain the circuit 173 closed. Hence it will be seen that the motor 179 which is energized from said circuit 173 continuously drives the shaft on which the cams 175, 177 are mounted. The cam 177 is shown as non-conducting. It will thus be seen that the period of time which the contact 169 remains closed depends upon the relative positioning of the cams 175, 177 and upon the rate at which they revolve. The rate at which they revolve is a fixed quantity in a given switch. The relative angular positions of the cams 175, 177 may be adjusted to suit particular conditions. Thus it will be seen that by means of the timing switch 171, the trip coil 165 of the switch 163 is intermittently energized so as to intermittently close the main circuit across the terminals of motor M.

A push button switch 181 (manually operable) is used in connection with the timing switch 171 and magnetic switch 163 for energizing the trip coil 165 of the magnetic switch 163 independently of the action of the timing switch 171. This is done by shorting out the timing switch 171 as shown in Fig. 15. A manually controllable handle 183 serves as means for performing the manual operation.

From the above it will seen that the synchronous motor 179 in the timing switch 171 is continuously driven by the constantly closed circuit 173. Thus the motor 179 continuously drives the cams 175, 177. The cams are angularly adjusted on their shaft for providing a suitable period of closure of the contacts 169. The trip coil 165 of the magnetic switch 163 is intermittently energized so as to intermittently close said switch 163. Thus the motor M of the pump P is intermittently energized for suitable periods of time, said periods being adjustable. These periods are also adapted to be cut into and out of operation manually, for periods of time differing from those required under automatic operations.

As shown in Figs. 11 and 13, it is preferable that the automatic switch 163 and the manually operable switch 181 be placed on the pump itself so that temporary adjustments in the system may be made at a location which is more or less close to the bearings being lubricated. However, the location of these switches, as well as the switch 171 is optional.

Advantages

Among the advantages of the invention is the fact that the total weight of grease or lubricant that is pumped may be controlled by suitably adjusting the period of the timing switch 171. This controls the net period of time that the pump P operates and hence the net pumpage of lubricant. The adjustment for weight of lubricant being pumped is thus independent of the rate of operation of the pump P when it is moving.

Another advantage of the invention is that each distributor valve V causes a positively definite amount to be pumped to each point of application and effects an independ-

ence between different sets of bearings or the like, so that each set may positively receive its supply of lubricant.

The distributor valve V also insure that the differential pressure in the lines O and I builds up at the end of a stroke of each of the pistons 5. They also cause building up of pressure when motion of the piston 5 is resisted by increased pressure in the outlet line due to a clogged bearing or the like. Hence, this valve, in cooperation with the regulator A provides a means for temporarily or permanently increasing pressure. It should be noted in this connection that should any bearing or set of bearings be found to be excessively resisting flow, a temporary or permanent increase of pressure may be effected by adjustments at the caps 129 and/or 131.

Another advantage is that the relative pressures in the outlet lines 25 and 27 may be different, thus providing for different pressures at different bearings or points of application.

The system is perfectly flexible permitting the addition or removal of as many valves V as may be desirable without deviating from the use of a single pump. The weight discharged may be adjusted both under automatic and manual operation.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In apparatus of the class described, fluid conduit lines, delivery means associated with said lines for delivering a fluid alternately to a plurality of points, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines to effect alternation of the action of said delivery means, and means operating said directing means to redirect said fluid into another of said lines upon the attaining of a predetermined adjustable maximum pressure in the line into which the fluid is then being directed.

2. In apparatus of the class described, fluid conduit lines, delivery means associated with said lines for delivering a fluid alternately to a plurality of points, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines to effect alternation of the action of said delivery means, and means operating said directing means to redirect said fluid into another of said lines upon the attaining of a predetermined maximum pressure in the line into which the fluid is then being directed.

3. In apparatus of the class described, lubricant conduit lines, delivery means associated with said lines for delivering a lubricant alternately to a plurality of points, a source of lubricant under high pressure, means for directing said lubricant under high pressure alternately to said lines to effect alternation of the action of said delivery means, and means operating said directing means to redirect said lubricant into another of said lines upon the attaining of a predetermined maximum pressure in the line into which the lubricant is then being directed.

4. In apparatus of the class described, fluid conduit lines, delivery means associated with said lines for delivering a fluid alternately to a plurality of points, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines to effect alternation of the action of said delivery means, and means operating said directing means to redirect said fluid into another of said lines upon the attaining of a predetermined maximum pressure in the line into which the fluid is then being directed, said last-named means having independent adjustments whereby different fluid pressures may be effected at said points of delivery.

5. In apparatus of the class described, fluid conduit lines, means associated with said lines for distributing fluid therefrom, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines, and means operating said directing means to redirect said fluid into another of said lines upon the attaining of a predetermined maximum pressure in the line from said directing means into which the fluid is then being directed.

6. In apparatus of the class described, fluid conduit lines, means associated with said lines for distributing fluid therefrom, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines, and means operating said directing means to redirect said fluid into another of said lines upon the attaining of a predetermined maximum pressure in the line from said directing means into which the fluid is then being directed, said last-named means including means for independently determining the respective maximum fluid pressures in said lines.

7. In apparatus of the class described, main fluid conduit lines, means associated with said main lines for distributing fluid therefrom, secondary fluid conduit lines associated with said main fluid lines, a source of fluid under high pressure, reversing means for directing said fluid under high pressure alternately to said main lines, regulating means operating said reversing means to redirect said fluid into another of said main lines upon the at-

taining of a predetermined maximum pressure in the main line into which fluid is then being directed, said regulating means comprising means for effecting communication from said main line into which fluid is then being directed, through the secondary line associated with such main line, to said reversing means, whereby the fluid pressure in such main line serves to operate said reversing means.

8. In apparatus of the class described main fluid conduit lines, means associated with said main lines for distributing fluid therefrom, secondary fluid conduit lines associated with said main fluid lines, a source of fluid under high pressure, reversing means for directing said fluid under high pressure alternately to said main lines, regulating means operating said reversing means to redirect said fluid into another of said main lines upon the attaining of a predetermined maximum pressure in the main line into which fluid is then being directed, said regulating means comprising means for effecting communication from said main line into which fluid is then being directed, through the secondary line associated with such main line, to said reversing means, whereby the fluid pressure in such main line serves to operate said reversing means, said regulating means also including means for independently determining the respective maximum fluid pressures in said main lines.

9. In apparatus of the class described, fluid conduit lines, delivery means associated with said lines for ejecting fluid therefrom under pressure, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines to effect ejaculation of said fluid from said delivery means, and means operating said directing means to redirect said fluid into another of said lines upon the attaining of a maximum fluid pressure in the line into which fluid is then being directed in excess of the pressure required to operate said delivery means.

10. In apparatus of the class described, fluid conduit lines, delivery means associated with said lines for ejecting fluid therefrom under pressure, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines to effect ejaculation of said fluid from said delivery means, means operating said directing means to redirect said fluid into another of said lines upon the attaining of a maximum fluid pressure in the line into which fluid is then being directed in excess of the pressure required to operate said delivery means, and adjustable means for determining said maximum fluid pressure.

11. In apparatus of the class described, fluid conduit lines, delivery means associated with said lines for ejecting fluid therefrom under pressure, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines to effect ejaculation of said fluid from said delivery means, and means operating said directing means to redirect said fluid into another of said lines upon the attaining of a maximum fluid pressure in the line into which fluid is then being directed in excess of the pressure required to operate said delivery means, and means for independently determining the respective maximum fluid pressures in said lines.

12. In apparatus of the class described, fluid conduit lines, delivery means associated with said lines for ejecting fluid therefrom at a predetermined fluid ejaculation pressure, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines to effect ejaculation of said fluid from said delivery means, and means operating said directing means to redirect said fluid into another of said lines upon the attaining of a maximum fluid pressure in the line into which fluid is being directed normally in excess of said fluid ejaculation pressure.

13. In apparatus of the class described, fluid conduit lines, delivery means associated with said lines for ejecting fluid therefrom at a predetermined fluid ejaculation pressure, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines to effect ejaculation of said fluid from said delivery means, means operating said directing means to redirect said fluid into another of said lines upon the attaining of a maximum fluid pressure in the line into which fluid is being directed normally in excess of said fluid ejaculation pressure, and adjustable means for determining said maximum fluid pressure.

14. In apparatus of the class described, lubricant conduit lines, a source of lubricant under high pressure, and means for directing and redirecting said lubricant under high pressure alternately to said lines, said directing means being actuated to redirecting operation by the lubricant pressure in the line from said directing means into which lubricant is then being directed.

15. In apparatus of the class described, a fluid pump, a pair of main fluid conduit lines for receiving fluid from said pump, a pair of secondary fluid conduit lines individually connected to said main lines, means for directing said fluid from said pump alternately into said main lines, ejecting means associated with said main lines including a movable element which, when motion thereof is resisted, causes said pump to increase the fluid pressure in said main line into which fluid is then being directed and the secondary line connected thereto, and means in said secondary lines operated by increased pressure in the

one of said secondary lines connected to the main line into which the fluid is then being directed, for operating said directing means to redirect said fluid from said pump into the other of said main lines.

16. In apparatus of the class described, a fluid pump, a pair of main fluid conduit lines for receiving fluid from said pump, a pair of secondary fluid conduit lines individually connected to said main lines, means for directing said fluid from said pump alternately into said main lines, ejecting means associated with said main lines including a movable element which, when motion thereof is resisted, causes said pump to increase the fluid pressure in said main line into which fluid is then being directed and the secondary line connected thereto, alternating means in said secondary lines operated by increased pressure in the one of said secondary lines connected to the main line into which the fluid is then being directed, for operating said directing means to redirect fluid from said pumps into the other of said main lines, and regulating means in said secondary lines between said alternating means and said main lines, said regulating means permitting communication between said alternating means and the main line into which fluid is then being directed and preventing communication between said alternating means and the main line into which fluid is not then being directed.

17. In apparatus of the class described, a fluid pump, a pair of main fluid conduit lines for receiving fluid from said pump, a pair of secondary fluid conduit lines individually connected to said main lines, means for directing said fluid from said pump alternately into said main lines, ejecting means associated with said main lines including a movable element which, when motion thereof is resisted, causes said pump to increase the fluid pressure in said main line into which fluid is then being directed and the secondary line connected thereto, alternating means in said secondary lines operated by increased pressure in the one of said secondary lines connected to the main line into which the fluid is then being directed, for operating said directing means to redirect fluid from said pump into the other of said main lines, and regulating means in said secondary lines between said alternating means and said main lines, said regulating means permitting communication between said alternating means and the main line into which fluid is then being directed and preventing communication between said alternating means and the main line into which fluid is not then being directed, said regulating means also including means for independently determining the respective maximum fluid pressures in said main lines.

18. In apparatus of the class described, a grease pump, grease conduit lines, means for directing said grease from said pump alternately into said lines, an engine for intermittently operating said directing means, at least one ejector valve associated with said lines, said ejector valve forcing grease therefrom under grease pressure transmitted by said lines in alternating succession, said ejector valve upon forcing grease therefrom occasioning increased grease pressure in said line into which grease is then being pumped, and means controlling said engine to operate said directing means to redirect grease into another of said lines, said controlling means being actuated by said increased grease pressure.

19. In apparatus of the class described, a grease pump, grease conduit lines, means for directing said grease from said pump alternately into said lines, an engine for intermittently operating said directing means, at least one ejector valve associated with said lines, said ejector valve forcing grease therefrom under grease pressure transmitted by said lines in alternating succession, said ejector valve upon forcing grease therefrom occasioning increased grease pressure in said line into which grease is then being pumped, and means controlling said engine to operate said directing means to redirect grease into another of said lines, said controlling means being actuated by said increased grease pressure, said controlling means including adjustable means whereby actuation thereof takes place only upon the attaining of a predetermined maximum grease pressure.

20. In apparatus of the class described, a source of fluid under high pressure, a pair of main fluid conduit lines, means for directing said fluid under high pressure alternately to said main lines, an ejector valve positioned across said main lines, fluid delivery lines leading from said valve, said ejector valve delivering measured quantities of fluid alternately to said delivery lines, means for causing increase in fluid pressure in said ejector valve when predetermined conditions of resistance are met in said delivery lines and/or said valve, an engine operating said directing means, a valve gear for said engine, a pair of secondary fluid conduit lines associated with said main lines and communicating with said valve gear, and regulating means interposed in said secondary lines between said main lines and said valve gear permitting communication only when said main lines are provided with fluid under increased pressure as described.

21. In apparatus of the class described, a source of fluid under high pressure, a pair of main fluid conduit lines, means for directing said fluid under high pressure alternately to said main lines, an ejector valve positioned across said main lines, fluid delivery lines leading from said valve, said ejector valve delivering measured quantities of fluid alter-

nately to said delivery lines, means for causing increase in fluid pressure in said ejector valve when predetermined conditions of resistance are met in said delivery lines and/or said valve, an engine operating said directing means, a valve gear for said engine, a pair of secondary fluid conduit lines associated with said main lines and communicating with said valve gear, and regulating means interposed in said secondary lines between said main lines and said valve gear permitting communication only when said main lines are provided with fluid under increased pressure as described, said regulating means being adjustable, whereby the maximum fluid pressure in said delivery lines is determined.

22. In apparatus of the class described, a source of grease under high pressure, a pair of main grease conduit lines, means for directing said grease under high pressure alternately to said main lines, an ejector valve positioned across said main lines, grease delivery lines leading from said valve, said ejector valve delivering measured quantities of grease alternately to said delivery lines, means for causing increase in grease pressure in said ejector valve when predetermined conditions of resistance are met in said delivery lines and/or said valve, an air-operated engine operating said directing means, a valve gear for said engine, a pair of secondary grease conduit lines associated with said main lines and communicating with said valve gear, and regulating means interposed in said secondary lines between said main lines and said valve gear permitting communication only when said main lines are provided with grease under increased pressure as described.

23. In apparatus of the class described, a source of grease under high pressure, a pair of main grease conduit lines, means for directing said grease under high pressure alternately to said main lines, an ejector valve positioned across said main lines, grease delivery lines leading from said valve, said ejector valve delivering measured quantities of grease alternately to said delivery lines, means for causing increase in grease pressure in said ejector valve when predetermined conditions of resistance are met in said delivery lines and/or said valve, a grease-operated engine operating said directing means, a valve gear for said engine, a pair of secondary grease conduit lines associated with said main lines and communicating with said valve gear, and regulating means interposed in said secondary lines between said main lines and said valve gear permitting communication only when said main lines are provided with grease under increased pressure as described.

24. In apparatus of the class described, a fluid pump, main fluid conduit lines, secondary fluid conduit lines associated with said main lines, means for directing fluid from said pump alternately into said main lines, ejecting means associated with said main lines including means for causing said pump to increase the fluid pressure in said main line and associated secondary line into which fluid is then being pumped, when movement of said last-named means is resisted, and means operating said directing means to redirect said fluid into another of said main lines upon increase in fluid pressure as described.

25. In apparatus of the class described, fluid conduit lines, a source of fluid under high pressure, and means for directing said fluid under high pressure alternately to said lines, means for delivering fluid under pressure from said lines, automatic means operating said directing means to redirect said fluid into another of said lines, and means for individually separately adjusting the pressure in said lines at which said automatic means is brought into operation.

26. In apparatus of the class described, fluid conduit lines, a source of fluid under high pressure, means for directing said fluid under high pressure alternately to said lines, automatic means operating said directing means to redirect said fluid into another of said lines upon the attaining of a predetermined maximum fluid pressure in the line into which fluid is then being directed, and ejecting means associated with said lines for ejecting fluid therefrom under pressure, said ejecting means including means for setting up a resistance under predetermined conditions thereby causing the building up of said predetermined maximum fluid pressure.

27. In fluid directing means, a body portion having an inlet and a pair of outlets, means for receiving fluid under pressure at said inlet, and an exhaust outlet, and oscillable means in said body portion delivering fluid under pressure alternately to said outlets and simultaneously connecting the outlet not then receiving fluid to said exhaust outlet.

28. In fluid directing means, a body portion having an inlet and a pair of outlets, means for receiving fluid under pressure at said inlet, and an exhaust outlet, oscillable means in said body portion delivering fluid under pressure alternately to said outlets and simultaneously connecting the outlet not then receiving fluid to said exhaust outlet, and means for independently limiting the respective fluid pressures at the respective outlets.

29. In fluid directing means, a body portion having a main fluid inlet and a pair of main fluid outlets, regulating means associated with said body portion having outlets adapted to be individually connected to said main fluid outlets, said body portion also having an exhaust outlet, means in said body portion delivering fluid under pressure

from said main inlet alternately to said main outlets, said last-named means simultaneously connecting the main outlet not connected to said main inlet to said exhaust outlet, and means for independently limiting the respective fluid pressures at the respective main outlets.

30. In fluid directing means, a body portion having a main fluid inlet and a pair of main fluid outlets, regulating means associated with said body portion having outlets adapted to be individually connected to said main fluid outlets, said body portion also having an exhaust outlet, means in said body portion delivering fluid under pressure from said main inlet alternately to said main outlets, said last-named means simultaneously connecting the main outlet not connected to said main inlet to said exhaust outlet, whereby a difference in fluid pressures at said main outlets is occasioned, said regulating means operating to prevent the generation of fluid pressures at said outlets in excess of a predetermined value and also operating to connect said main outlets and the outlets of said regulating means.

31. In fluid directing apparatus, a body having at least one inlet, at least two main outlets, and at least two secondary outlets, means associated with said body for delivering fluid from said inlet alternately to said main outlets, and regulating means interposed between said main outlets and said secondary outlets, said regulating means operating to prevent the generation of fluid pressures in said main outlets in excess of a predetermined value.

32. In fluid directing apparatus, a body having at least one inlet, at least two main outlets, at least two secondary outlets, and at least one exhaust outlet, means associated with said body delivering fluid from said inlet alternately to said main outlets, and for connecting the main outlet not then receiving fluid to said exhaust outlet, and regulating means interposed between said main outlets and said secondary outlets, said regulating means operating to prevent the generation of fluid pressures in excess of a predetermined value.

33. In fluid directing apparatus, a body having at least one inlet, at least two main outlets, at least two secondary outlets, and at least one exhaust outlet, means associated with said body delivering fluid from said inlet alternately to said main outlets, and for connecting the main outlet not then receiving fluid to said exhaust outlet, and regulating means interposed between said main outlets and said secondary outlets, said regulating means operating to prevent the generation of fluid pressures in excess of a predetermined value, said regulating means also operating to connect said secondary outlets to said exhaust outlet when said secondary outlets are not in communication with said main outlets.

34. In fluid directing apparatus, a body having at least one inlet, at least two main outlets, and at least two secondary outlets, means associated with said body delivering fluid under pressure from said inlet alternately to said main outlets, and regulating means interposed between said main outlets and said secondary outlets including means for adjustably regulating the fluid pressures at which respective main outlets communicate with their respective secondary outlets.

35. In fluid directing apparatus, a body having at least one inlet, at least two main outlets, and at least two secondary outlets, means associated with said body delivering fluid under pressure from said inlet alternately to said main outlets, and regulating means interposed between said main outlets and said secondary outlets including means for independently adjustably regulating the fluid pressures at which respective main outlets communicate with their respective secondary outlets.

36. In a fluid directing apparatus, a body having at least one inlet, at least two main outlets, at least two secondary outlets, and at least one exhaust outlet, means associated with said body delivering fluid under pressure from said inlet alternately to said main outlets and simultaneously connecting the main outlet not receiving fluid to said exhaust outlet, and regulating means interposed between said main outlets and said secondary outlets including means for independently adjustably regulating the fluid pressures at which respective main outlets communicate with their respective secondary outlets.

In testimony whereof, I have signed my name to this specification this 25th day of November, 1930.

FRANK S. BARKS.