July 2, 1940. L. C. ROTTER ET AL 2,206,335

LUBRICATING APPARATUS

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FIG. 1.

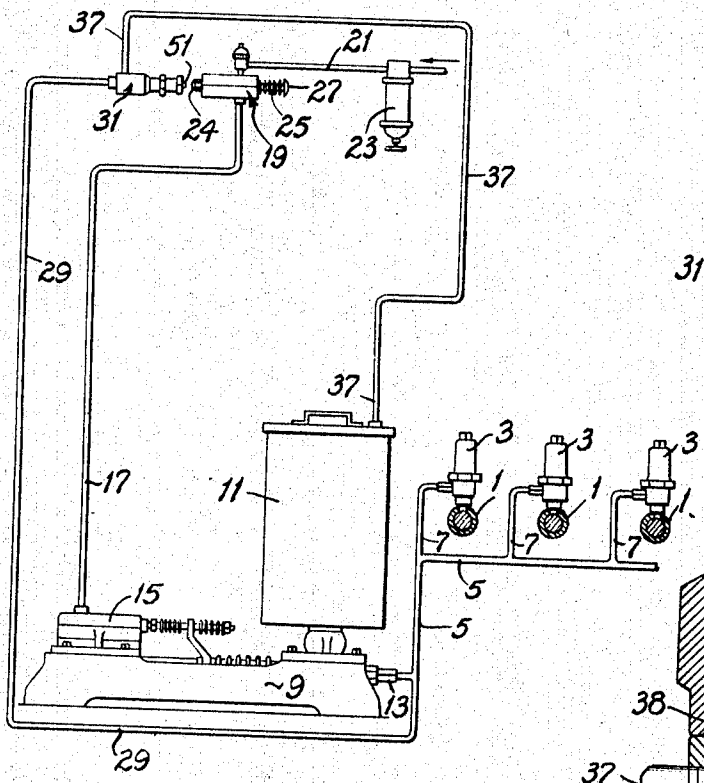


FIG. 7.

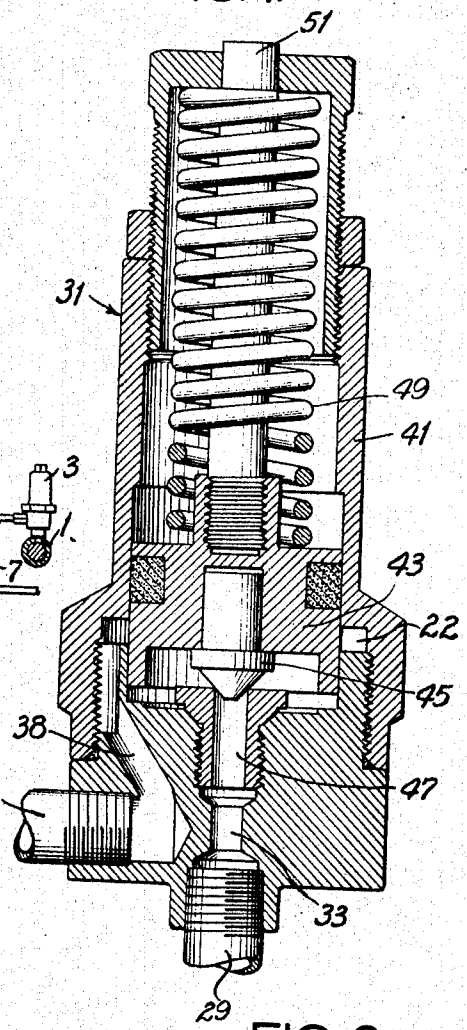


FIG. 2.

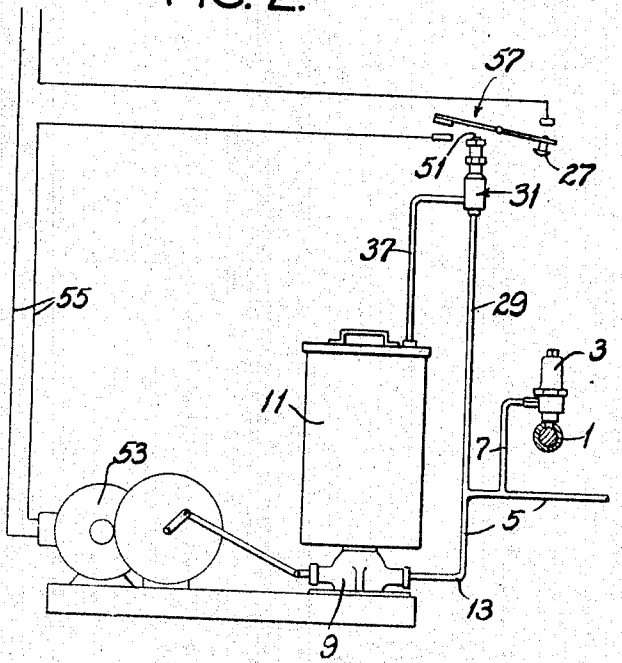
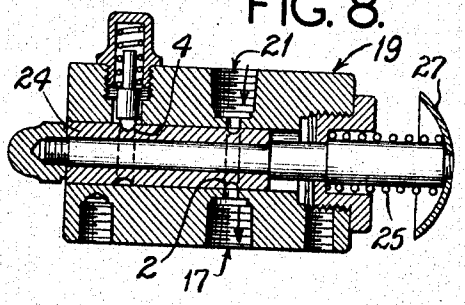


FIG. 8.



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FIG. 3.

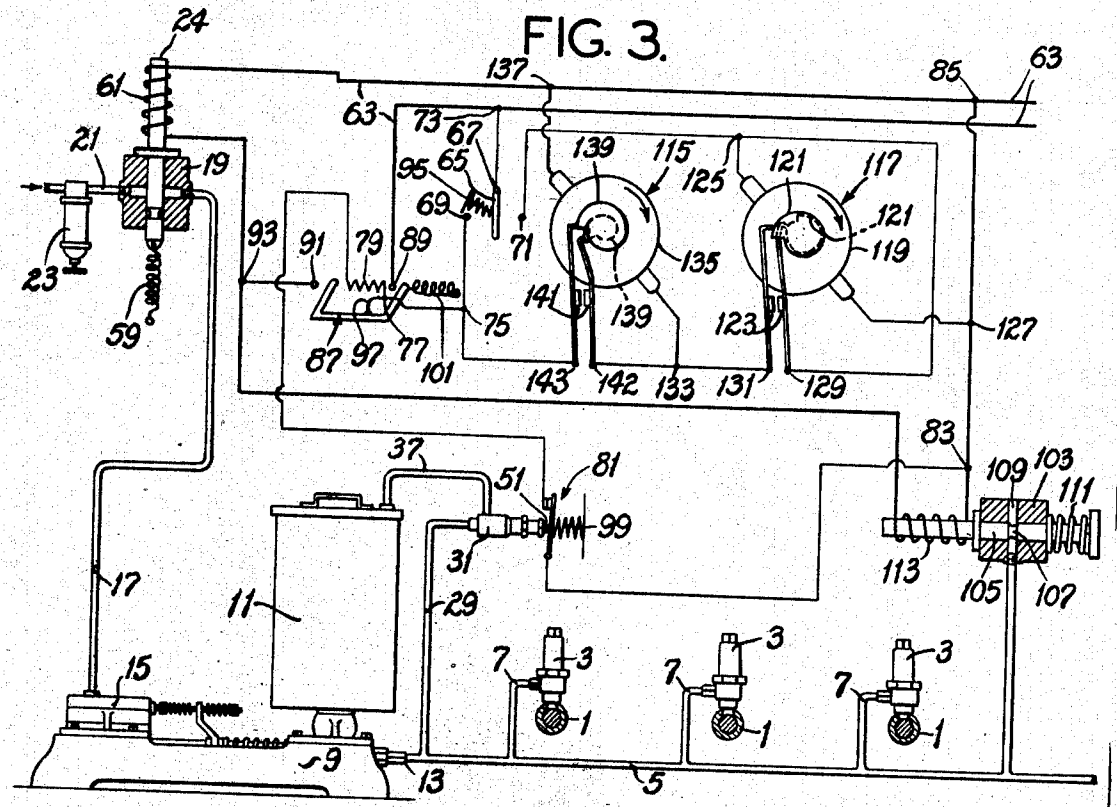
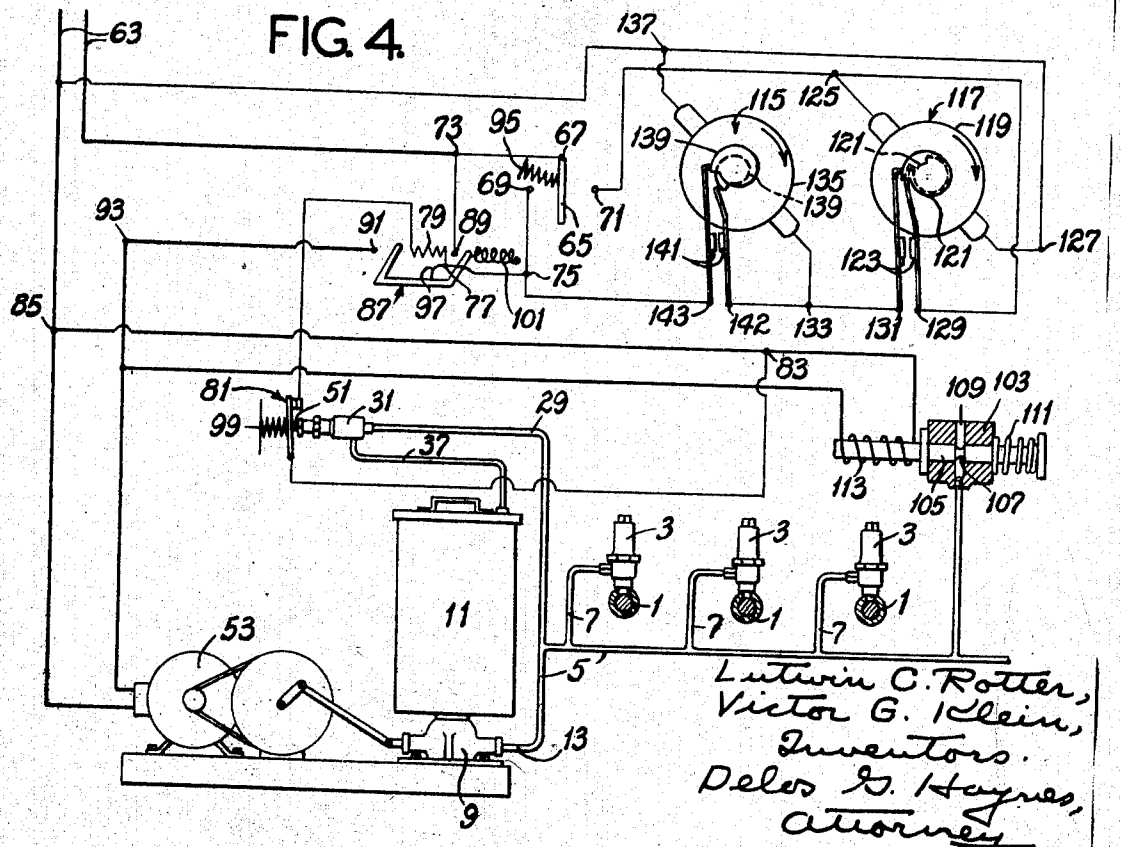


FIG. 4.



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LUBRICATING APPARATUS

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FIG. 5.

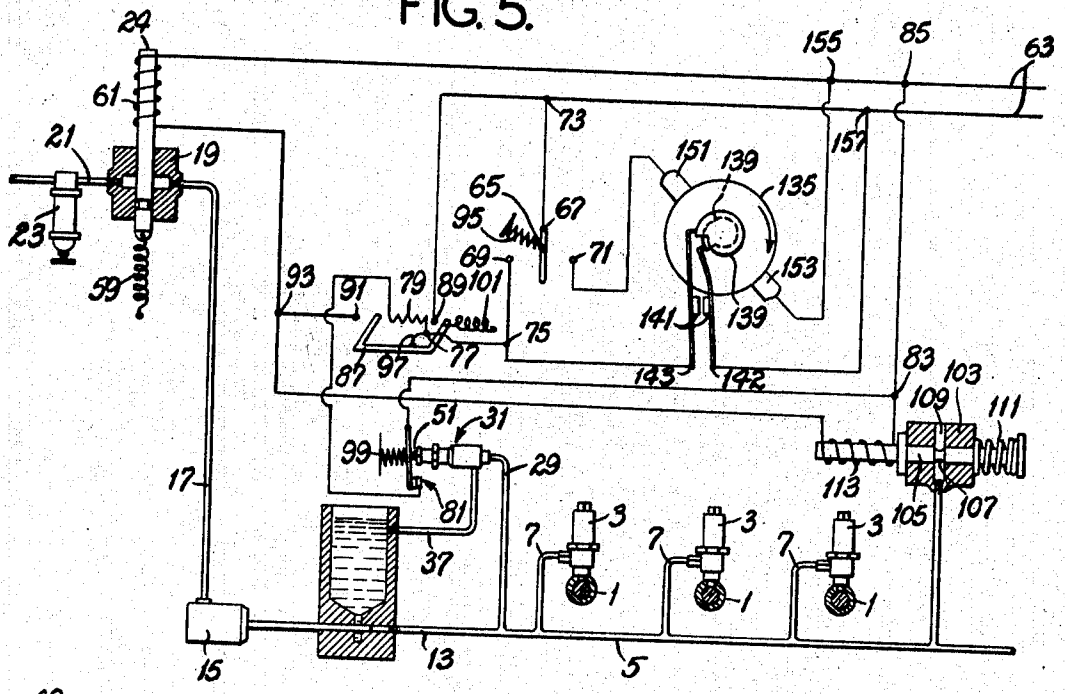
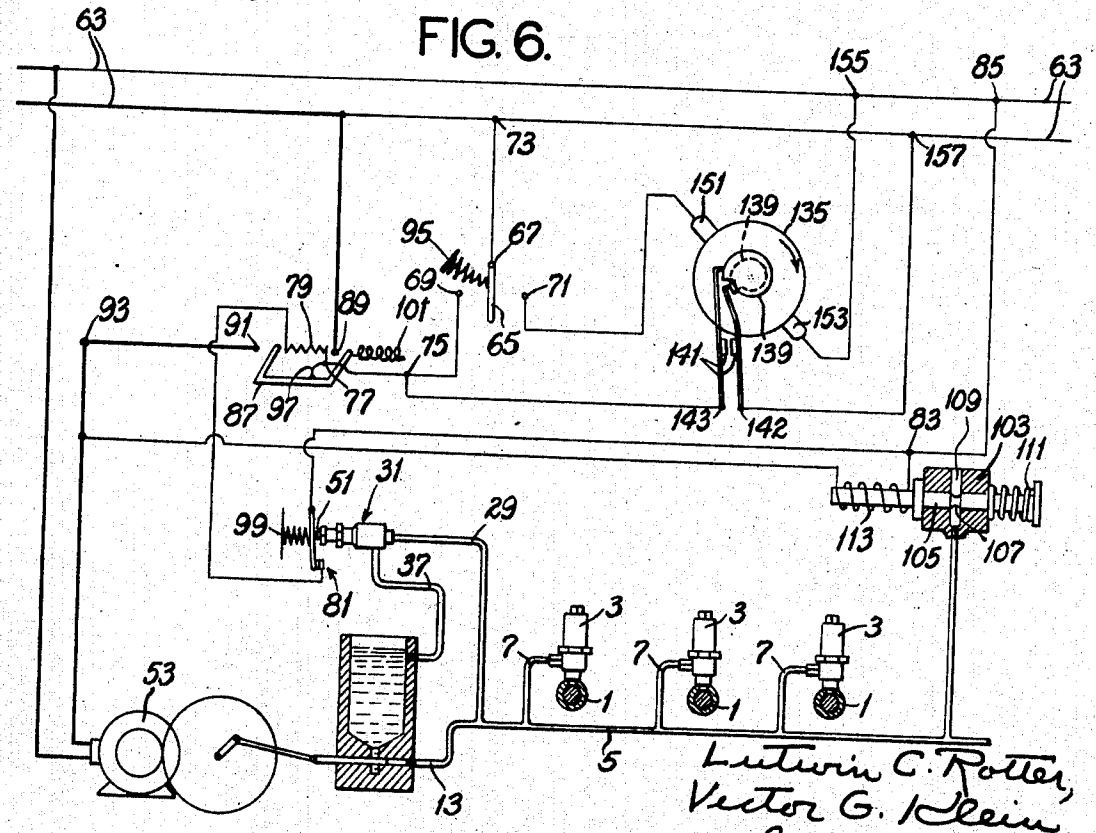


FIG. 6.



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2,206,335

UNITED STATES PATENT OFFICE

2,206,335

LUBRICATING APPARATUS

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Application February 23, 1938, Serial No. 191,908

9 Claims. (Cl. 184—7)

This invention relates to lubricating apparatus, and with regard to certain more specific features to automatically controlled lubricating apparatus.

The invention is an improvement upon the apparatus disclosed in the following United States patents of Lutwin C. Rotter: No. 2,141,022, dated December 20, 1938; and No. 2,162,898, dated June 20, 1939.

Among the several objects of the invention may be noted the provision of means for timing the starting of the lubricant measuring and pressure delivery system; the provision of apparatus of this class in which, after pressure delivery has been initiated and lubricant delivered in the measured quantities desired, the necessary pressure automatically cuts off the previously initiated timing action; the provision of apparatus of the class described in which the timing is automatic; and the provision of the apparatus of the class described in which an improved construction is used for automatically bleeding pressure from relatively long lines. Other objects will be in part obvious and in part pointed out hereinafter. The above applications make this fact clear.

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

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

Fig. 1 is a diagrammatic layout of the simplest form of the invention showing the use of a pneumatically driven pump;

Fig. 2 is a view similar to Fig. 1, showing an electrically driven pump substituted for the pneumatic pump;

Fig. 3 is a diagrammatic layout of another form of the invention in which a pneumatically driven pump is used;

Fig. 4 is a view similar to Fig. 3, but illustrating the use of an electrically driven pump;

Fig. 5 is a diagrammatic layout of another form of the invention in which a pneumatically driven pump is used;

Fig. 6 is a view similar to Fig. 5 showing the application to this form of the invention of an electrically driven pump;

Fig. 7 is a detailed section of a relief valve; and,

Fig. 8 is a detailed section of an air valve.

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

Referring now more particularly to Fig. 1, numeral 1 diagrammatically illustrates bearings to be lubricated. Numeral 3 indicates lubricant-measuring devices used respectively in connection with the bearings 1. The devices 3 receive lubricant under pressure and deliver it in measured charges to the bearings 1. The devices 3 may be referred to by the short title of injectors. These injectors 3 have been fully described in said Patent No. 2,141,022.

Briefly, the function of each injector 3 is to become filled with lubricant to a measured degree, the lubricant being temporarily under pressure in branches 7 from a pressure line such as 5. Then each injector discharges a quantity. After the discharge, pressure tends to build up under continued pumping action of the pump. It is the purpose of the present apparatus to start this pressure, either by manual or automatic means, and to cut it off automatically. It is also the purpose thereafter to bleed the pressure in line 5 so that the injectors 3 may become filled upon the next operation of the apparatus. This the injectors cannot do unless the pressure in the line 5 is relieved to a point below that required for injection. This is by reason of the nature of the injectors 3, as is clear from said Patent 2,141,022.

At numeral 9 is shown a lubricant pump which draws lubricant from a lubricant supply tank 11 to force it through an outlet 13 to the line 5. An air engine 15 automatically operates the pump 9 as long as compressed air is delivered to said engine 15 over an air line 17.

The air line 17 leads from an air valve 19. The valve 19 receives its air supply from a supply line 21 in which is a strainer 23. The air valve 19 is shown in Fig. 8 wherein is shown a stem 24 suitably grooved to align with a passage 2 through the valve when the groove is in one position, and to block passage of air therethrough in another position. A detent 4 holds the valve in open position against the compression of spring 25, after the valve has been manually set. A right-wise push (Fig. 8) disconnects the detent 4 and permits spring 25 fully to return the valve to closed position. Button 27 on the stem 24 is for manual manipulation and for receiving the closing reaction from spring 25.

When the valve 19 is in its right-hand position, it blocks passage of air through lines 21 and 17. When it is pushed to the left (Fig. 8), it per-

mits passage of air from the lines 21 to the line 17 so that the air engine 15 becomes operative.

Exemplary working details of the air engine and pump apparatus 9, 11, 15 may be found in various patents, such as, for example, Barks Patents 1,633,304, 1,654,673, and 1,704,238.

From the above it will be seen that, when the button 27 is pushed to the left, the line 21 is put into communication with the line 17 and that the air engine 15 is started and continues to operate, thus providing pressure in lines 13, 5 and 7 and in the lubricators 3.

It is desirable, after the lubricators 3 have expelled their measured charges, that the pump 9 cease pumping, so that the pressure does not continue to rise in the lines to the lubricator, and it is also desirable that these lines be bled so that the lubricators may later start their operations over again. For this purpose, a branch line 29 is led from the outlet 13 to a relief valve 31.

The relief valve 31 is shown in detail in Fig. 7, and has been described in detail in said Patent No. 2,162,898. Briefly, it comprises a cylinder 41 in which is a slidable piston 43 having a conical valve portion 45 associated therewith for seating on the edge of a passage 47 which is located beyond inlet passage 33. The passage 33 communicates with the lubricant pressure line 29. An outlet 38 leads to a by-pass line 37. The line 37 leads back to the supply in the container 11. The counterbore 22 communicating with outlet 38 to the by-pass line 37 is normally covered by the piston 43, and when the pressure in line 29 reaches a value above that required for operating the injectors 3, the valve portion 45 is lifted from the seat, thus permitting the pressure to spread over the bottom area of the piston 43 so as to force the piston further upwardly to relieve pressure to the by-pass 37. After the relief valve has once opened, it remains open until a much lower pressure is reached than was required initially to open it. This is because the unit pressure on the small area of the valve 45 may be much higher for a given total value than is required against the relatively large area of the piston 43 for the same total value. A spring 49 normally presses the piston 43 toward its seat around the opening 47. A stem 51 extending from the upper end of the relief valve is placed opposite the stem 24 of the manually controlled valve 19. Thus, when the valve 19 is pushed in to the left, the stem 25 comes close to the stem 51, when the stem 51 is in the position shown in Fig. 7.

Under the last-named conditions, the valve 19 is open, pump 9 is energized, and the injectors 3 are driven to fill and inject. They do this at a certain pressure in the line 5, determined by normal operating conditions. Then when the injectors 3 have delivered their charges, they block further reception of lubricant from line 5 and the pump 9 builds up pressure in said line 5 to deliver it by way of line 29 to the port 47 of the relief valve 31. This pressure builds up until it finally results in unseating of the closure 45 and movement of the pin 51. This relieves pressure to line 37 and causes stem 51 to force stem 25 to the right to return the valve 19 to closed position.

Inasmuch as the relief valve 31 is adapted to remain open until pressure in lines 29, 5, and 7 has leaked away to a value below the value of pressure for opening said valve 31, the pressure in said lines is relieved to a point where the injectors 3 can re-assume their starting positions.

In Fig. 2 is shown another form of the invention in which like numerals designate like parts. In this form the pump 9 is driven by an electric motor mechanism 53, to which current is supplied over a supply line 55. Connected in series in this line is an electric switch 57 which is located adjacent the stem 51 of the relief valve 31, so that when the stem 51 moves in response to excessive pressure in the lines 5, 7, 13, and 29, the stem 51 strikes the switch 57 to open it. After the pressure bleeds off, the stem 51 returns to the position shown, under which circumstances the switch 57 may again be closed for starting operation of the motor 53 and pump 9.

It will be seen that, in the forms of the invention shown in Figs. 1 and 2, starting is manually effected, either by means of the manual operation of the air valve 19 (Fig. 1), or manual operation of the switch 57 (Fig. 2). Cessation of pumping is in each case automatically determined by a rise in pressure in the lubricant line leading to the injectors 3. In many cases, it is desirable that the operation of the starting valve or switch to starting position be effected automatically at timed intervals. Various provisions for such operations are made in Figs. 3 to 6.

Referring to Fig. 3, like numerals designate like parts. In this case an air valve 19 is again used but its stem 24 is normally forced to an air blocking position by a spring 59, but may be pulled into an air-transmitting position by a solenoid 61. The solenoid is energized from a circuit connected to an electric line 63.

The circuit elements comprise a control switch 65 having points 67, 69, and 71. Point 67 receives current from junction 73. The switch 65 may be moved manually to the position joining points 67 and 69, but when released, automatically springs back to open position. The switch 65 may also be set manually to join points 67 and 71, but it remains in position until manually reopened.

Point 69 forms the starting point for a pilot relay circuit consisting of said point 69, junction 75, junction 77, relay coil 79, switch 81, junction 83, and junction 85 on the main line 63. Thus it will be seen that, when the switch 65 is temporarily manually pushed into the left-hand position, said pilot relay circuit is closed. When this pilot relay circuit is closed, the coil 79 draws shut contactor switch 87 which then receives current over the following part of a control circuit: junction 73, point 89, switch 87, point 91, junction 93, solenoid coil 61, and junction 85 on the main line 63. The coil 61 then draws up the valve stem 25 into position so that air flows over line 17 to the engine 15, which drives the pump 9. The switch 65 may promptly be released, and it returns to open position under action of spring 95. Current for coil 79 is then supplied by the following circuit: junction 73, point 89, switch 87, pigtail 97, coil 79, switch 81, junction 83, and junction 85.

The pump 9 then operates to apply pressure through the lines 13, 5 and 7 to the injectors 3 which operate to fill and to inject their respective charges. When they cease injecting, they block reception of lubricant from the line 5 and pressure then builds up until the pressure in the line 29 causes the relief valve 31 to open to by-pass fluid back to the container 11. At the same time, the stem 51 of the relief valve 31 pushes against the switch 81 to open it against its return spring 99. This breaks the circuit through the coil 79 and the switch 87 reopens under return action of spring 101. This breaks the cir-

cuit through the coil 61 and the spring 59 draws back the stem 24 of valve 19 to closed position, and the pump ceases operation. Bleeding of the line 5 is effected through the relief valve 31.

In cases where a long line 5 is used, the friction in the line may be so great that, although the valve 31 relieves the pipe which is adjacent the outlet 13, more distant pipe may not have its pressure relieved before the valve 31 recloses. Thus distant injectors may become inoperative for want of pressure relief after injection. To take care of such distant pipe, bleeder valves are used, an example of one of which is shown at numeral 103. These valves have stems 105 with grooves 107 normally located to open ports 109. The stems 105 are normally pushed into the open position by springs 111. Extensions from the stems 105 form armatures which are associated with operating coils 113. The operating coils 113 are supplied with current to close the valves 103 whenever the switch 87 is closed, the circuit then comprising the remainder of the control circuit and being as follows: junction 73, point 89, switch blade 87, point 91, junction 93, coil 113, and junctions 83 and 85. Thus, as long as the switch 87 is closed, the bleeder valve is closed so that pressure may be built up in the line 5 by means of the pump 9. Whenever the switch 87 opens and the air line 17 is cut off, and the pump 9 ceases to operate, then the lines 5 are bled not only at the relief valve 31 but at such points as the valves 103 are located, said valves opening automatically when the above-outlined circuit breaks, and remaining open until the pumping again starts.

In order that automatic and timed starting of the pump may be accomplished, the timing mechanisms shown generally at numerals 115 and 117 are used. Timing mechanism 117 comprises a motor 119 which through a speed reducer drives the shaft upon which are two relatively adjustable cams 121. These cams, by their relative adjustments, control followers so that contacts 123 are caused to be opened and closed over a certain period during each revolution of the cam shaft.

The circuit through the motor 119 is as follows, assuming the switch 65 to be set across points 67 and 71: junction 73, points 67, 71, junction 125, motor 119, junction 127, and junction 85. Thus, as long as the switch 65 is closed across points 67 and 71, the motor 119 operates to close the contacts 123 at intervals.

Whenever the contacts 123 are closed, they close the following circuit: junction 73, points 67, 71, junction 129, contacts 123; junction 131, junction 133, motor 135 of timing mechanism 115, and junction 137. Thus, the motor 135 is operated intermittently for a predetermined period of time per revolution of the cams 121.

The motor 135, through suitable reduction gear, drive cams 139. These cams 139 control followers of contacts 141. The contacts 141 open and close the following circuit: junction 73, points 67 and 71, junction 129, contacts 123, junctions 131, 133, 142, contacts 141, junctions 143, 75, 77, coil 79, switch 81, and junctions 83 and 85. Thus the switch 87 closes in response to closure at contacts 141.

It will thus be seen that the timer 117 moves constantly and that it permits the contacts 123 to close a predetermined time interval for each cycle of cams 121 and that whenever the contacts 123 close the motor 135 somewhat advances the cams 139. Thus the cams 139 move intermittently and close the contacts 141 at periods which differ from the periods of opening of contacts 123. By relatively adjusting cams 121 various intervals may be obtained for closure of switch 87.

The momentary contactor 115 operates by one of the contacts 141 falling against the other and then by said other point promptly falling away from the first-named one, according to the adjustments of the cams 139.

It will be understood that the cams 121 and 139 are shown diagrammatically, both as to form and adjustment.

From the above, it will be seen that when the switch 65 is thrown to the automatic position across points 67 and 71, the timer 117 continues its rotation thereby repeatedly closing contacts 123 to cause the motor 135 to run intermittently. Thus the period between closures of the contacts 141 is extended beyond what it would be, were only the motor 135 used without contacts 123.

Automatic operation of the form of the invention shown in Fig. 3 is as follows: The switch 65 is across points 67 and 71. The adjustable time clock 117 operates continuously, thus intermittently closing the contacts 123. Hence the momentary contactor 115 runs cyclically and according to a predetermined period closes the contacts 141. When the contacts 141 momentarily close, the action is the same as momentarily closing the switch 65 to its left-hand position, that is, the switch 87 is closed so that the valve 19 is opened and the valves 103 are closed. This starts the pump 9 which continues to pump until the injectors 3 have delivered their measured charges. Then the pressure in line 39 goes up until the relief valve 31 operates to break the circuit of switch 81, thus causing the switch 87 to reopen. It will be understood that once the switch 87 is closed, its holding coil 79 holds it closed, irrespective of the fact that the contacts 141 or 123 may have reopened, although the switch 87 will reopen upon opening of switch 81. The device, after operation of switch 81, is then ready for the next closure operation by the time clock and momentary contactor.

In Fig. 4, like numerals designate like parts, compared with Fig. 3, and with the other figures herein. The operation is similar and will be clear by tracing the circuits above traced. The chief difference is that the switch 87, instead of energizing a solenoid such as 61 for relay operation of an air valve, directly energizes the motor 53.

It will be seen that the electrical embodiment of Fig. 4 is to the pneumatic embodiment of Fig. 3, as the electric embodiment of Fig. 2 is to the pneumatic embodiment of Fig. 1. But in Figs. 1 and 2, there is manual starting; whereas in Figs. 3 and 4, besides the auxiliary bleeder feature, there is the possibility of either manual starting or automatically timed starting. It should be noted that in all cases where manual starting is employed, the operator may make the necessary manual movement and then leave the machine without attention. This is useful where, for example, special lubrication is desired, as of idle machines at noon hour. A manual setting for starting the machine results in a measured charge being delivered from each injector 3, under pump action and thereafter the pump is automatically cut off without attention from the operator.

Referring now to Figs. 5 and 6, these figures show pneumatic and electric forms, respectively.

In both of these forms a simplified timing machine is used employing a simplified form of timing clock which is available on the market. The combination of timing clock 117 and momentary contact 115 used in Figs. 3 and 4 provides a wide range and a great number of timing adjustments. The momentary contactor 135 of Fig. 5 is arranged to accomplish one revolution in various periods, for example, in one, two, five, ten, fifteen, thirty, forty-five, or sixty minutes, whichever is desired. Change gears provide the means for choosing a desired period. Such a momentary contactor is employed also in Fig. 6. In these figures like numerals designate like parts.

Referring to Fig. 5, the point 71, instead of being wired to the time-clock motor, is wired directly through the momentary contactor 135 as shown at 151, 153, and 155. The momentary contactor 135 then is operated when the switch 65 is placed across points 67 and 71, the operation being at the desired period. Thus every time that the cams 139 make one revolution, the contacts 141 are momentarily closed to close the following circuit: 157, 142, 141, 143, 75, 77, 79, 81, 83 and 85. This closes the switch 87 and its circuit is then as already traced above. The operation is otherwise the same, the stem 51 on the relief valve 31 being responsible for reopening the switch 81 after the injectors 3 have delivered their measured charges.

Fig. 6 employs the same type of momentary contactor 135 as is shown in Fig. 5, and like numerals designate like parts. The difference is that the switch 87 controls the circuit for motor 53, instead of the circuit of an air-valve solenoid.

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

As may 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.

We claim:

1. Lubricating apparatus comprising an injector, a lubricant supply, a pump, a connection between the pump and the injector, said pump being adapted to force lubricant from the supply to the injector, the injector being operative to inject at one pressure in the connection and after injection blocking the connection, whereby the pump when energized increases said pressure, means for energizing the pump, an electrically operated relief valve at a point in the connection remote from the pump, electrically operated means for controlling energization of said pump, and means responsive to the increased pressure in said connection adapted to cause deenergization of the pump and operation of said relief valve to relief position.

2. Lubricating apparatus comprising an injector, a lubricant supply, a pump having a connection with the injector adapted to force lubricant from the supply to said injector, a relief valve associated with said connection but remote from said supply, the injector being adapted to inject under one pressure condition in the connection, and to block the connection after injection so that continued operation of the pump increases the pressure, means for energizing the pump, and a second relief valve responsive to the increased pressure in said connection and adapted to deenergize the pump and at the same time to open said remote relief valve.

3. Lubricating apparatus comprising an injector, a lubricant supply, a pump having a connection with the injector, the injector being adapted to inject under one pressure condition in the connection, and to block the connection after injection so that continued operation of the pump increases the pressure, means for pneumatically energizing the pump, a normally closed electromagnetic control valve for pneumatic control of the pump, a normally open electromagnetic relief valve associated with said connection, an electric circuit, means for energizing the electric circuit to cause opening of the pneumatic valve and closing of the relief valve, and means responsive to higher pressure in said connection adapted to break said circuit.

4. Lubricating apparatus comprising a lubricant line, a lubricant supply, a pump adapted to pump lubricant from the supply to the line, means for energizing the pump, energy control means including an electric coil and biasing closure means, movable pressure-responsive means in the line adapted to move in response to predetermined pressure in the line, at least one relief valve in the line including an electric coil and a biasing opening means, an electric circuit supplying current to said coils, said circuit when open permitting biasing of the energy control means to closed position and biasing of the relief valve to open position and when closed to effect opening of the energy control means and closing of the relief valve, and a switch associated with said circuit and located adjacent said pressure-responsive means and operable thereby to open position when the pressure-responsive means responds to said predetermined pressure, whereby said coils are de-energized to permit the respective biasing means to become effective.

5. Lubricating apparatus comprising a lubricant line, a lubricant supply, a pump adapted to pump lubricant from the supply to the line, means for energizing the pump including an electrical control, pressure-responsive means in the line, a relief valve in the line having an electrical control, a control circuit for the electrical controls, a relay circuit, a holding relay energized by the relay circuit to permanently connect the control circuit for energization, timing means for temporarily closing the relay circuit to close the relay and connect the control circuit, and means in the relay circuit responsive to said pressure-responsive means to reopen the relay circuit to cause deenergization of the control circuit.

6. Lubricating apparatus comprising a lubricant line, a lubricant supply, a pump adapted to pump lubricant from the supply to the line, means for energizing the pump comprising an electric motor, movable pressure-responsive means in the line adapted to move in response to predetermined pressure in the line, at least one relief valve in the line including an electric coil and a biasing opening means, an electric circuit supplying current to said coil and to said motor, and circuit means adapted to effect closure of said circuit whereby the motor is started and the relief valve is closed, and a switch responsive to the pressure-responsive means adapted to open said circuit means to cause deenergization of the motor and reopening of the relief valve.

7. Lubricating apparatus comprising a lubricant line, a lubricant supply, a pump adapted to pump lubricant from the supply to the line, an electric motor for energizing the pump, an energizing cir-

cuit for the motor, pressure-responsive means in the line, a relief valve in the line having a circuit connected to the motor circuit, a relay circuit adapted to close the motor and valve circuits for energization, timing means for closing the relay circuit, said timing means comprising a continuously operable timer, an intermittently operable timer in the relay circuit operated by current from said continuously operated timer, and means in the relay circuit responsive to said pressure-responsive means to reopen the relay circuit after an initial closure to cause deenergization of the motor and valve control circuits.

8. Lubricating apparatus comprising a lubricant line, a lubricant supply, a pump adapted to pump lubricant from the supply to the line, an electric motor for energizing the pump, an energizing circuit for the motor, pressure-responsive means in the line, a relief valve in the line, a control circuit for the relief valve, a relay circuit, a holding relay energized by the relay circuit to permanently connect the energizing and control circuits for energization, timing means for temporarily closing the relay circuit to close the relay, said timing means comprising a switch in the relay circuit, a single moving means for continuously opening and closing said switch according to a predetermined timing, and means in the relay circuit responsive to said pressure-responsive means to reopen the relay circuit to cause deenergization of the energizing and control circuits after an initial closure of the relay circuit by said timing means.

9. Lubricating apparatus comprising a lubricant line, a lubricant supply, a pump adapted to pump lubricant from the supply to the line, pneumatic means for energizing the pump, an air line extending to the pneumatic means, a valve in said air line normally biased to closed position, at least one relief valve in the lubricant line normally biased to open position, control circuit means associated with the air valve and relief valve which when energized opens the former and closes the latter, a relay circuit which when energized is adapted to cause energization of said control circuit means, timing means for operating the relay circuit, said timing means comprising a continuously operable timer, an intermittently operable timer energized from said continuously operated timer from time to time, and means in the relay circuit responsive to said pressure-responsive means to reopen the relay circuit to cause deenergization of the control circuit after an initial closure of the relay circuit by said timing means.

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