

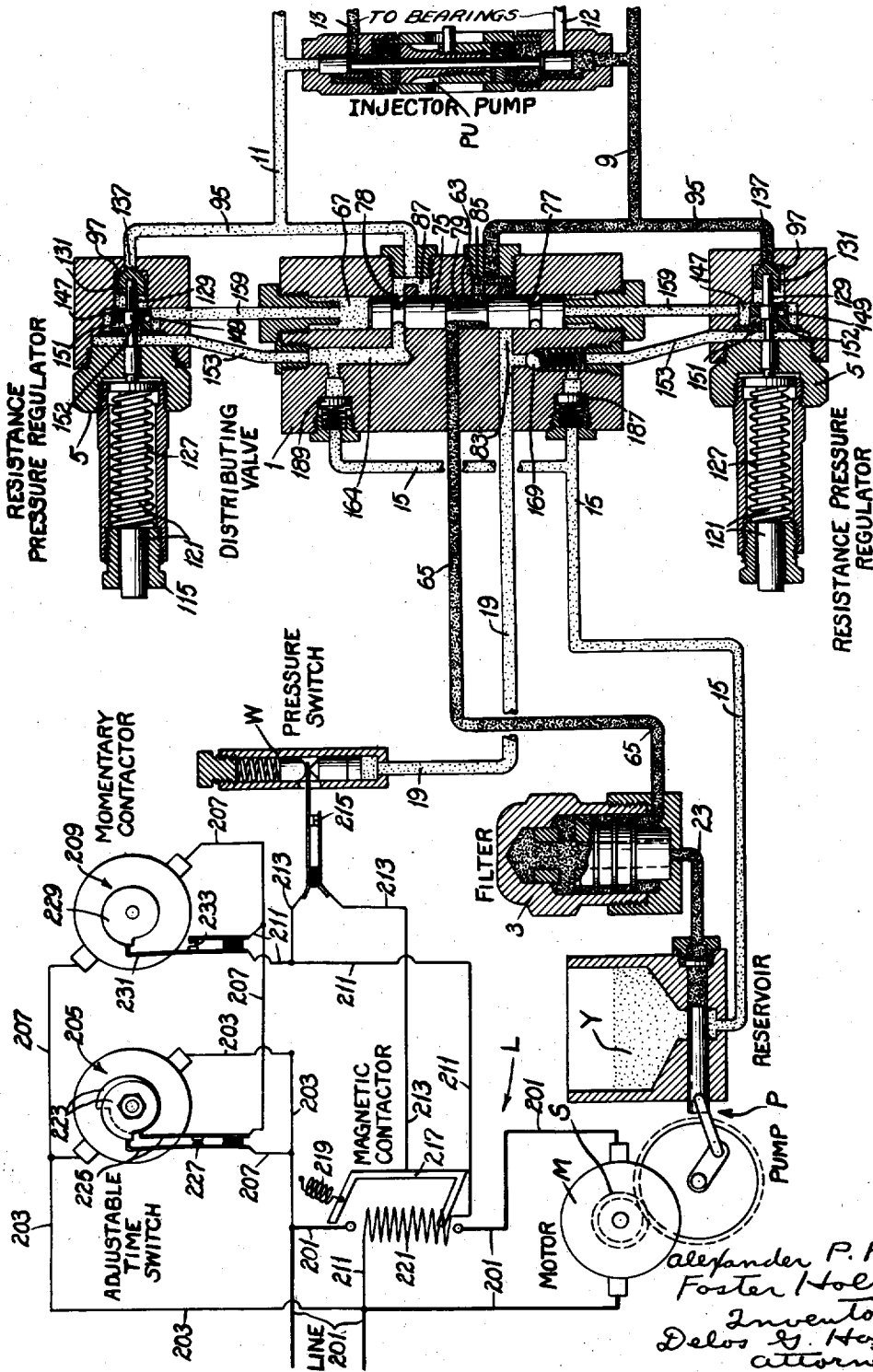
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LUBRICATING APPARATUS

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LUBRICATING APPARATUS

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This invention relates to lubricating apparatus and with regard to certain more specific features, to lubricating apparatus operable to distribute controlled quantities of lubricant or the like to two or more pipes, under pressure.

The invention is an improvement upon the structure described in United States Patent 1,805,303, issued to Frank S. Barks, dated May 12, 1931, and United States Patent 1,990,986, issued to Alexander P. Fox, dated February 12, 1935, for Lubricating apparatus.

Among the several objects of the invention may be noted the provision of apparatus of the class described which is self-timed and self-actuating to effect complete single cycles of operation, as distinguished from multi-cycle operations or fractional cycle operation; and the provision of apparatus of the class described which is simple and reliable. 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 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 drawing, in which is illustrated one of various possible embodiments of the invention, the single figure is a schematic layout.

Similar reference characters indicate corresponding parts throughout the drawing.

Inasmuch as the essential features of the hydraulic parts of the invention have already been described in detail in said patents, these will be described herein in terms of operation as follows:

Broadly, there is provided a fluid supply Y from which fluid is withdrawn by means of a pump P and delivered to a line 23, through a strainer 3 and to an inlet 65 and to an alternating distributor 1, there being within the distributor 1 a directing valve 75 which directs fluid into one or the other of outlet lines 9 or 11. These lines 9 and 11 correspond to similar lines in said Patent 1,805,303. From these lines the grease is measured out in predetermined quantities by suitable measuring injector pumps or valves PU. Further detailed description of valves PU is believed to be unnecessary in view of the detailed description in United States Patent 1,935,150, issued to Alexander P. Fox and William Z. Linders, dated November 14, 1933.

Each line 9 and 11 is provided with a branched pressure regulating resistance valve 5 operated

by fluid from the respective line 9 or 11. Each of these resistance valves permits the pressure in its respective line to build up to a predetermined maximum, after which the respective valve operates to release and shunt fluid from the line 5 under pressure to operate said directing valve 75 so that the latter redirects fluid into the other line. The outlet line which is not in communication with the inlet 65 is exhausted to the supply by the directing valve 75, whereby the back pressure of fluid in that line is relieved or reduced. Also, means is provided whereby the fluid used for operating the directing means is relieved of pressure and re-delivered to the supply after it has ceased its function of shifting the directing 15 valve.

Specifically, the pump P is actuated by an electric motor M acting through a suitable speed reducer S. The motor circuit L is adapted to be opened by a pressure responsive switch W under 20 predetermined conditions of pressure in a line 19. Further electrical circuit features are comprised in the invention and will be particularized hereinafter.

In the drawing, the dark stippling indicates 25 grease under high pressure, and the light stippling indicates grease under a lower release pressure.

As shown, lubricant, such as grease, or like material, enters under considerable pressure 30 through the inlet 23, and passes into and through the filter 3. The motor M and the pump P build up the pressure while they are running. Next, the filtered grease passes through the inlet line 65 and reaches an annular region 63 formed by a 35 groove 79 in piston valve stem 75.

Depending now upon the position of the piston 75, which determines the position of groove 79, the grease passes, by way of said groove 79, to either a passage 85 or a passage 87. For the 40 present, the grease will be considered as passing to the passage 87 implying that the valve 75 is in a position opposite to that shown. The passage 87 conducts the grease to delivery pipe 11. It will be assumed that the pipe 11, and devices 45 connected thereto, are already filled with grease, so that pressure is promptly built up in line 11. This pressure forces some of the grease out through the respective passage 95 to approach the space provided by counterbore 97 but here it 50 is stopped by the valve element 131. The pressure of grease builds up until it is great enough to unseat the valve element 131 against spring 127, which has been set at a predetermined pressure by manipulation of adjusting plug 115. It 55

will be noted that the backing plugs 115 for the springs 127 are screw threaded into the bodies which hold the springs. Unseating of the valve element 131 moves pin 121, and hence gives a visible signal at the exterior of the device.

Having unseated valve element 131, the grease passes into counterbore 97. After unseating, the area pressed against by the grease is increased. Hence with the small projected area at 137 when the valve 131 is closed, a relatively small spring 127 may be adapted to maintain closure against high pressures but after opening, the increased area presented insures maintenance of opening. With the upward movement of the pin 121, its lowermost, narrowest portion 129 is moved so that a passage is provided therearound from bore 97 through bore 149, to annular region 147. An exhaust opening 151 has meanwhile been shut off by plug 152.

From the annular space 147 the grease is now compressed through passage 159 into a central, main bore 67 which holds valve 75, but in this case at the end of said bore. As the grease fills the bore 67, it exerts a pressure upon the end of piston element 75, and ultimately drives said piston to the left to the other end of the bore 67. This change of position of the piston 75 changes the position of notch 79 to the extent that lubricant is now directed into line 85 and pipe 9, instead of into line 87 and pipe 11. Also, pressure is relieved in line 11 by notch 78 in valve 75. Relief occurs through a check valve 189 to a return line 15 leading to the supply. The parts are shown in the drawing to represent this last condition.

The pressure in line 9 is communicated to pump PU, as well as to its respective valve 131 to lift the same and to cause delivery of a charge to the opposite end of the piston valve 75, thus returning the valve 75 to the original position. The return causes a groove 77 to be aligned with passage 83 so that pressure is relieved in the pipe 9 through the check valves 169 and 187 to the return pipe 15. At the same time the surge engendered as this high pressure is relieved, is not instantaneously dissipated, because of friction in the lines and the resistance of check valves 169 and 187. Hence instantaneous building up of pressure occurs in a branch line 19 which leads to the switch W. This causes opening of the switch W and deenergization of the motor M as will be further particularized. It will thus be seen that the apparatus has made a complete cycle of operation and then is automatically cut out of operation by its own functions.

The surge above referred to is dissipated through the check valves 169 and 187 shortly after occurring. This causes a reclosing of the switch W but by this time independently controlled apparatus in the line L causes an opening of the circuit at another point. This apparatus in connection with line L will be described shortly. Thus, although the switch W is closed to potentially restart the motor M, the circuit L is open. Restarting is effected by said other means in the line.

When alternation takes place, the supply of high pressure grease is at once cut off from the respective passage 95, and counterbore regions 97. Thus the respective valve 131, under the influence of spring 127, at once seats. With seating of the valve, pin 121 moves downwardly, blocking off bore 149 but opening bore 151. Thus grease in the respective end of bore 67 can flow back to passage 159, annular space 147, bore 151,

passage 153, check valve 189 to exhaust 15, thus relieving the pressure.

In order to prevent the piston 75 from at any time being held on "dead center" (such that grease is supplied to neither passage 85 nor passage 87), the notch 79 is preferably made a little longer than the distance between the closest edges of passages 85 and 87, so that it is, at all times, necessarily in communication with one of said passages.

The check valves 187 and 189 prevent the surge engendered by the release of high pressures in the respective lines 9 and 11 from being improperly delivered to the opposite ends of the valve 75. They prevent the valve 75 from being balanced after partial movement by the pressure engendered at each end by the surge effected when relieving the respective lines 9 or 11 of pressure. Thus these respective check valves 187 and 189 each protect one end of the valve stem from being subjected to the surge or exhaust pressure while the other end is being acted on by pressure shunted from the lines 9 or 11 under pressure.

As to the check valve 169, it will be noted that it has no counterpart in the passage 164, because the passage 164 does not communicate with any line such as 19. As will be remembered, the line 19 communicates back pressure to the pressure switch which controls the operation of a compressor for delivering grease to the inlet line 23. The check valve 169 prevents pressure of trapped grease which is exhausting from behind the adjacent or lower end of valve stem 75 from reaching passage 19, said returning grease being delivered through the check valve 187 to the line 15.

The combination of parts indexed on the drawing as pump, reservoir, filter, resistance pressure regulator and distributing valve are shown and claimed in said Patent 1,990,986.

It is the purpose of the present invention to combine with the above apparatus, a timing apparatus, such that the motor M is energized only for whole, single cycles of action of the valve 75, and thus to obtain exactly measured quantities forced into lines 12 and 13 by the pump PU, rather than unknown and variable quantities. The circuit for accomplishing this end is shown at L.

The circuit L comprises a line circuit 201 serving the motor M. At this point, it is to be understood that said line circuit 201 may open and close a solenoid air valve, if it be desired to control an air engine which may be used for actuating the pump P instead of the motor M. The line circuit 201 may be referred to as a motorizing circuit for initiating and maintaining pump action.

Lines 203 indicate a time-switch circuit for the motor of an adjustable time switch 205. This switch motor revolves continuously.

Lines 207 indicate a momentary contactor circuit. The momentary contactor circuit 207 feeds the motor of a momentary contactor mechanism 209 by way of contacts 227 of said adjustable time switch 205. The contacts 227 are in circuit 207.

Numerals 211 indicate a magnetic switch pick-up circuit energized through the switch 233 of said momentary contactor 209. The contacts 233 are in circuit 211.

Numerals 213 indicate a magnetic switch keeper and break circuit having therein the contact 211 of the pressure switch W.

A magnetic contactor 217 is used to make and break the motor circuit and also to complete

circuit 213, said contactor being normally held open by a spring 219 and closed by the magnetic action of a coil 221 in the magnetic switch pick-up circuit 211.

Referring to the adjustable time switch 205, it will be seen to comprise a pair of adjustable cams 223 controlling by their rotation and by their relative positions a pair of leaf spring followers 225, said followers controlling the opening and closing of the contact points 227.

The momentary contactor 209 comprises a motor driven cam 229 which controls a leaf spring follower 231 for controlling opening and closing of the contacts 233. The period of closing of the switch contacts 233 is preferably slower than the period of closing of switch contacts 227. This is because the angular velocity of cam 229 is less than that of the cams 223. Hence the cam 229 may revolve only a part of 360 degrees for every 360 degrees of movement of cams 223. Also, relative adjustment of cams 223 determines the time of closure of contacts 233 and this determines the advance of cam 229 per revolution of cams 223.

The operation of the circuit is as follows:

The line 201 is suitably energized. The motor M is not running because the magnetic contactor 217 is open. However, the time switch circuit 203 is always closed through the motor of time switch 205. Thus the motor of time switch 205 is running continuously. The relative adjustment of the pair of time switch cams 223 is such that the contacts 227 are closed for a suitable period of time, say at intervals of one minute. Closing of the contacts 227 causes energization of the momentary contactor circuit 207, thus causing rotation of the motor of the momentary contactor 209 so as to ultimately close the contacts 233 by means of cam 229. It is to be understood that several cyclic closures of contacts 227 may be required to cause a closure of contacts 233. The number depends upon the time of closure of contacts 227 which in turn depends upon the adjustment of cams 223. It also depends upon the period of cam 229.

Closure of the contacts 233 results in the magnetic switch pick-up circuit 211 being energized to close the magnetic contactor 217, whereby the motor M is energized to cause the pump P to operate.

As soon as the circuit 211 becomes energized, the magnetic switch keep and break circuit 213 also becomes energized, through the now closed contactor 217, and this circuit also includes the holding coil 221 so that the magnetic contactor 217 remains shut against the action of its holdout spring 219, as long as the contacts 215 of pressure switch W are closed. Under these circumstances, the momentary contactor 209 may cause reopening of the contacts 233 without affecting the closed condition of the magnetic contactor 217.

In view of the above, it will be seen that the motor M will run and cause the distributing valve 1 to operate, and the latter will pass through one cycle of operation, after which the described surge in line 19 will operate the pressure switch W so that its contacts 215 part, thereby to open the magnetic switch keep and break circuit 213. The solenoid 221 becoming deenergized permits the magnetic contactor to reopen under action of its spring 219. The motor circuit is thus opened and pumping positively ceases and another cycle of action of the distributor 1 is prevented. A further consequence is that cyclic action does not start in the mid-portion of a cycle.

In the meanwhile, the adjustable time switch

205 has been continuing to move so that after a predetermined open period, the contacts 227 again close and the cycle repeated, but perhaps requiring several revolutions of cams 223 in order to cause cam 229 to again operate the contacts 233.

The reason for using the momentary contactor 209 in conjunction with the time switch 205 is to gain a range of adjustments of cyclic periods which would otherwise be fixed by the initial rate assigned to the time switch 205, if, as might be, the contacts 227 were used to energize coil 221. For instance, if the gearing in the momentary contactor 209 is such that the cam 229 has a lower angular velocity than the angular velocity of cams 223, then it may require a plurality of closures of contacts 227 (revolutions of cams 223) in order to cause one closure of switch 233 (revolution of cam 229). And it will be noted that the relative adjustment of cams 223 determines the time of closure of contacts 227 and hence the time during which advance of cam 229 takes place per revolution of cams 223. Hence the angle of advance of the cam 229 per closure of switch 227 is a function of the angular adjustments between cams 223. If the advance time of cam 229 is relatively great, the contacts 233 will close oftener; whereas if the time of advance is relatively less, the contacts 233 will close less often. The time is controlled by the adjustment of cams 223. Thus is effected a wider range of periods of closure of contacts 223 than could be had were the contacts 227 used to directly energize the coil 221.

From the above it will be seen that there is an assurance that at adjustable predetermined intervals of time the switches 205 and 209 will operate to cause energization of the motor M. The motor M will be energized as long as the pressure switch W is not under influence of any momentary surge such as determines the completion of one cycle of operation of the distributing valve 1. Only after such a cycle has been completed will the momentary opening of pressure switch W cause opening of the motor circuit. Furthermore, the pressure action on the switch W needs only be momentary (a surge), because upon the contacts 215 reclosing, the magnetic contactor 217 has opened the circuits 211, 213, until the cycle is again initiated by a complete revolution of the contactor 209.

Among the advantages of the invention are the following:

1. At specifically timed intervals and not otherwise the pump P is started so as to feed fluid through the distributing valve 1 to the injector pump, PU, the latter receiving a charge at both ends because of the complete cyclic operation of the distributing valve 1.

2. Once the operation of the distributing valve 1 is started, it continues throughout one complete cycle so as to ensure all bearings receiving lubricant, regardless of the further action of the time switch 205 and the momentary contactor 209.

3. After the distributing valve 1 has completed one cycle, the pump ceases to operate and thus there is no possibility of several cycles of operation occurring to overload the bearings and cause waste of lubricant.

4. There is no possibility of a distributing valve 1 ceasing nor starting operation in the mid-part of a cycle.

5. All bearings receive predeterminedly calculated and accurate charges according to the predetermined timing.

6. The pressure in lines 9 and 11 may be regulated so as to meet various resistances in lines 12 and 13 without interfering with the accurately timed action.

7. A wide variation of timing of the cycles of action is possible by the use of the combination of devices 205 and 209.

While the device has been herein described in connection with the handling of lubricants, particularly grease, it will be apparent that other fluids might also be handled without departing from the field of the invention.

Period of closure is herein defined as the time between successive closures of a given switch contact such as 227 or 233. The time of closure (significant only in connection with switch 205) is the time during which contacts (227) are closed per period.

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 drawing shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. In lubricating apparatus, a lubricant supply, a pump adapted to force lubricant from said supply, a hydraulic system adapted to receive said lubricant, a pressure switch, means in said hydraulic system whereby said pressure switch is temporarily opened for each cycle of action of said hydraulic system, a drive for the pump, an electrical circuit for initiating action of the driving means, adjustable timing means adapted to periodically temporarily close said circuit to effect said initiation, said pressure switch being adapted to maintain closure of said circuit after temporary closure thereof by said timing means, and means for automatically opening the circuit when said pressure switch temporarily opens.

2. In lubricating apparatus, a lubricant supply, a pump adapted to force lubricant from said supply, a hydraulic system adapted to receive said lubricant, a pressure switch, means in said hydraulic system whereby said pressure switch is temporarily opened for each cycle of action of said hydraulic system, a drive for the pump, an electrical circuit for initiating action of the driving means, timing means adapted to periodically temporarily close said circuit to effect said initiation, said pressure switch being adapted to maintain closure of said circuit after temporary closure thereof by said timing means, and means for automatically opening the circuit when said pressure switch temporarily opens at the end of each cyclic action of said hydraulic circuit.

3. In apparatus of the class described, compression means, an electric system adapted to initiate and maintain action of said compression means, a pressure switch controlling said system, a body having an inlet, said compression means supplying fluid to the inlet, said body also having a plurality of outlets, a plurality of exhausts and a pressure switch connection, a movable distributing valve in said body adapted in alternate positions to connect the inlet with one outlet while independently connecting the other outlet to one of said exhausts, resistance valves associated with said outlets adapted to assume open and closed positions, means connecting said outlets with opposed areas on the distributing valve

whereby movement of the distributing valve is effected under outlet pressure when the respective resistance valves are open, means connecting said distributing areas to the respective exhausts when said resistance valves are closed, a throttle connection opening from said switch connection to one of said exhausts, a port on said distributing valve adapted in one position of said distributing valve to connect one of said outlets with the pressure switch connection when said distributing valve is in exhaust position with respect to the last-named outlet, said electric system comprising a motorizing circuit, a magnetic contactor therein, a magnetic coil for holding closed said contactor, an adjustable time switch adapted to operate continuously, a momentary contactor controlled by said time switch, said momentary contactor energizing said coil to close the magnetic contactor, said pressure switch being normally closed and thus adapted to maintain the magnetic contactor in closed position, and means for opening the magnetic contactor when said pressure switch temporarily opens under surge conditions in the pressure switch line due to said throttle connection.

4. Apparatus made in accordance with claim 3 and including regulating means for said resistance valves adapted to determine the outlet pressures at which the respective valves shall open without affecting the timing of electrical operation.

5. Apparatus made in accordance with claim 3 and including means for independently regulating the resistance of said resistance valves to control the respective pressures in the respective outlets at which said respective resistance valves shall open, without affecting the timing of said adjustable time switch.

6. In apparatus of the class described, a fluid reservoir having an outlet, a hydraulic system connected with said outlet adapted to operate cyclically, a pressure switch, said hydraulic system operating said pressure switch to open temporarily after each cycle of operation, a pump adapted to pump fluid from said reservoir and deliver it to said hydraulic system, means for driving said pump, an electrical circuit for initiating energization of said pump driving means, an automatically opening magnetic contactor in said circuit, a holding coil adapted to hold said contactor closed, the contact of said pressure switch being in series with said holding coil, a time switch, means for energizing said time switch, means adapting said time switch to temporarily energize said holding coil when the magnetic contactor is open, said pressure switch permanently energizing said holding coil when its contacts are closed and after the holding coil has been initially energized, but when opened effecting the reopening of said magnetic contactor.

7. In apparatus of the class described, a fluid reservoir having an outlet, a hydraulic system connected with said outlet adapted to operate cyclically and to produce a surge once per cycle, a pressure switch subject to and opened temporarily by said surge, a pump adapted to pump fluid from said reservoir and deliver it to said hydraulic system, means for driving said pump, an electrical circuit for initiating energization of said pump driving means, an automatically opening magnetic contactor in said circuit, a holding coil adapted to hold said contactor closed, the contact of said pressure switch controlling said holding coil, a time switch, means for energizing said time switch, means adapting said time switch

to temporarily energize said holding coil when the magnetic contactor is open, said pressure switch energizing said holding coil when its contacts are closed and after the holding coil has been initially energized, but when opened permitting the re-opening of said magnetic contactor.

8. In apparatus of the class described, a fluid reservoir having an outlet, a hydraulic system connected with said outlet adapted to operate cyclically to produce a surge, a normally closed pressure switch subject to the surge and adapted to open in response thereto, a pump adapted to pump fluid from said reservoir and deliver it to said hydraulic system to cause the system to operate, means for driving said pump, an electrical circuit for energizing the driving means for said pump, a contactor in said circuit, means adapted to close said contactor and so hold it including said pressure switch, and means to cause the contactor to open and remain open when the pressure switch is temporarily opened.

9. In apparatus of the class described, a fluid reservoir having an outlet, a hydraulic system connected with said outlet adapted to operate cyclically, a pressure switch, said hydraulic system operating said pressure switch to open temporarily after each cycle of operation, a pump adapted to pump fluid from said reservoir and deliver it to said hydraulic system, means for driving said pump, an electrical circuit for initiating energization of said pump driving means, an automatically opening magnetic contactor in said circuit, a holding coil adapted to hold said contactor closed when the coil is energized, the contact of said pressure switch being in series with said holding coil, an adjustable timing switch to operate to make and break a circuit, means for energizing said timing switch, a momentary contactor energized intermittently by said last-named time switch circuit to temporarily energize said holding coil from time to time to close the magnetic contactor, said pressure switch further energizing said holding coil after each closure thereof and causing the holding coil to reopen when the pressure switch opens.

10. In apparatus of the class described, a fluid reservoir having an outlet, a hydraulic system connected with said outlet adapted to operate cyclically, a pressure switch, said hydraulic system operating said pressure switch to open temporarily after each cycle of operation, a pump adapted to pump fluid from said reservoir and deliver it to said hydraulic system, means for driving said pump, an electrical circuit for initiating and maintaining energization of said pump driving means, a magnetic contactor in said circuit, a holding coil adapted after closure of said contactor to hold the same closed, the contact of said pressure switch when closed energizing said holding coil, a time switch, a circuit therefor, means for energizing said time switch to repeatedly make and break its circuit, a momentary contactor switch in the switch time circuit, a contactor circuit therefor, said holding coil being initially and temporarily energized by said contactor switch after closure of the contactor switch by repeated operations of the time switch, said holding coil being maintained in energized condition after reopening of the contactor switch by a closed condition of the pressure switch and being deenergized when said pressure switch opens.

11. In apparatus of the class described, a fluid reservoir having an outlet, a hydraulic system connected with said outlet adapted to operate

cyclically, a pressure switch, said hydraulic system operating said pressure switch to open temporarily after each cycle of operation, a pump adapted to pump fluid from said reservoir and deliver it to said hydraulic system, means for driving said pump, an electrical circuit for initiating and maintaining energization of said pump driving means, a magnetic contactor in said circuit, a holding coil adapted after closure of said contactor to hold the same closed, the contact of said pressure switch when closed energizing said holding coil, a time switch, a circuit therefor, means for energizing said time switch to repeatedly make and break its circuit, a momentary contactor switch in the time switch circuit, a contactor circuit therefor, said holding coil being initially and temporarily energized by said contactor switch after closure of the contactor switch by repeated operations of the time switch, said holding coil being maintained in energized condition only by a closed condition of the pressure switch and being deenergized when said pressure switch opens, the period of the contactor switch being in a fixed ratio less than that of the timing switch.

12. In apparatus of the class described, a fluid reservoir having an outlet, a hydraulic system connected with said outlet adapted to operate cyclically, a pressure switch, said hydraulic system operating said pressure switch to open temporarily after each cycle of operation, a pump adapted to pump fluid from said reservoir and deliver it to said hydraulic system, means for driving said pump, an electrical circuit for initiating and maintaining energization of said pump driving means, a magnetic contactor in said circuit, a holding coil adapted after closure of said contactor to hold the same closed, the contact of said pressure switch when closed energizing said holding coil, a time switch, a circuit therefor, means for energizing said time switch to repeatedly make and break its circuit, a momentary contactor switch in the time switch circuit, a contactor circuit therefor, said holding coil being initially and temporarily energized by said contactor switch, after closure of the contactor switch by repeated operations of the time switch, said holding coil being maintained in energized condition only by a closed condition of the pressure switch and being deenergized when said pressure switch opens, the period of the contactor switch being in a fixed ratio less than that of the timing switch, and means for adjusting the period of timing switch closure.

13. In lubricating apparatus, a pump, means for driving the pump, an electric circuit including means for initiating movement of the driving means, a constantly operating timing switch repeatedly closing accordingly to a predetermined period and for predetermined times, means for adjusting the times of closure, a circuit connected with said timing switch, a momentary contactor driven from said timing switch circuit and controlling said initiating means, the period of closure of said momentary contactor while being driven being slower than the period of closure of said timing switch while operating.

14. In lubricating apparatus, a pump, means for driving the pump, an electric circuit including means for initiating movement of the driving means, a constantly operating timing switch repeatedly closing according to a predetermined period, a circuit connected with said timing switch, a momentary contactor driven from said

timing switch circuit and controlling said initiating means, the period of closure of said momentary contactor while being driven being slower than the period of closure of said timing switch while running.

15. In lubricating apparatus, a pump, means for driving the pump, an electric circuit including means for initiating movement of the driving means, a constantly operating timing switch closing according to a predetermined period, means for adjusting the time of closure during each period, a circuit connected with said timing switch, a momentary contactor driven from said circuit and controlling said initiating means, the period of closure of said momentary contactor while being driven being slower than the period of closure of said timing switch while running, a pressure switch, means whereby said pressure switch when closed maintains closure of said initiating circuit and means for opening said initiating circuit when said pressure switch is open.

16. In lubricating apparatus, a pump, means for driving the pump, an electric circuit including means for initiating movement of the driving means, a constantly operating timing switch closing according to a predetermined period, means for adjusting the time of closure during each period, a circuit connected with said timing switch, a momentary contactor driven from said circuit and controlling said initiating means, the period of closure of said momentary contactor while being driven being slower than the period of closure of said timing switch while running, a pressure switch, means whereby said pressure switch when closed maintains closure of said initiating circuit and means for opening said initiating circuit when said pressure switch is open, said last-named means being operable independently of said timing switch and contactor.

17. In lubricating apparatus, a pump, means for driving the pump, an electric circuit including means for initiating movement of the driving means, a constantly operating timing switch closing according to a predetermined period, a circuit controlled by said timing switch, a momentary contactor driven from said circuit and periodically controlling said initiating means, the period of said momentary contactor being slower than the period of said timing switch while running, a pressure switch, said pressure switch being subjected to pressure engendered by said pump, and periodically operating fluid controlling means between said pump and said pressure switch whereby said pressure is applied to said pressure switch in periodic surges according to periodic movement of said fluid controlling means.

18. In lubricating apparatus, a pump, means for driving the pump, an electric circuit including means for initiating movement of the driving means, a constantly operating timing switch closing according to a predetermined period, a circuit controlled by said switch, a momentary contactor driven from said circuit and periodically controlling said initiating means, the period of said momentary contactor being slower than the period of said timing switch while running, a pressure switch, said pressure switch being subjected to pressure engendered by said pump, periodically operating fluid controlling means between said pump and said pressure switch whereby said pressure is applied to said pressure switch in periodic surges according to periodic movement of said fluid controlling means and means for adjusting the intervals of closure of said timing switch.

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