Aug. 21, 1934. F. S. BARKS 1,970,591

LUBRICATING APPARATUS

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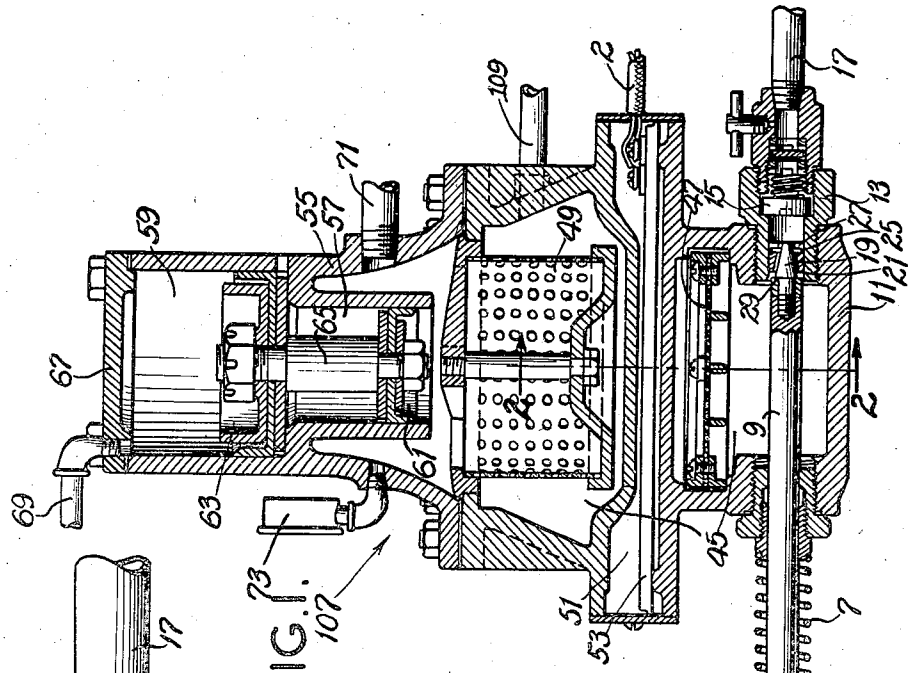


FIG. 1.

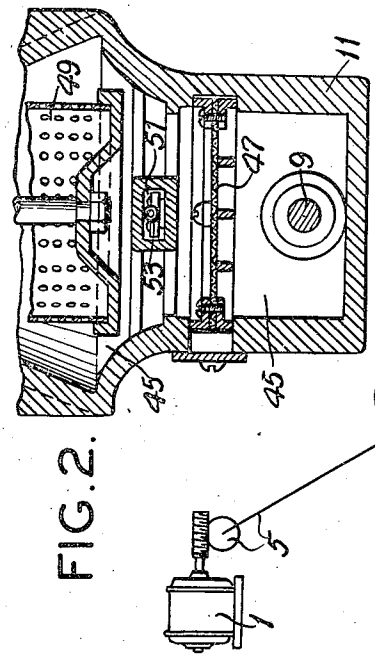


FIG. 2.

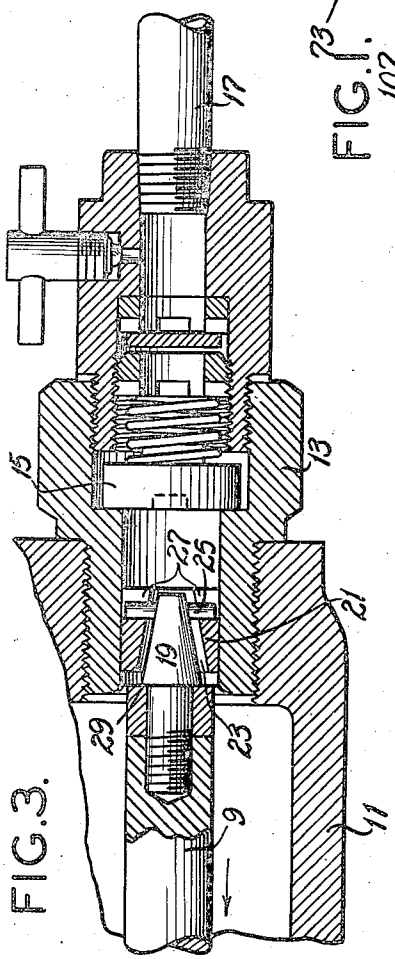


FIG. 3.

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FIG. 10.

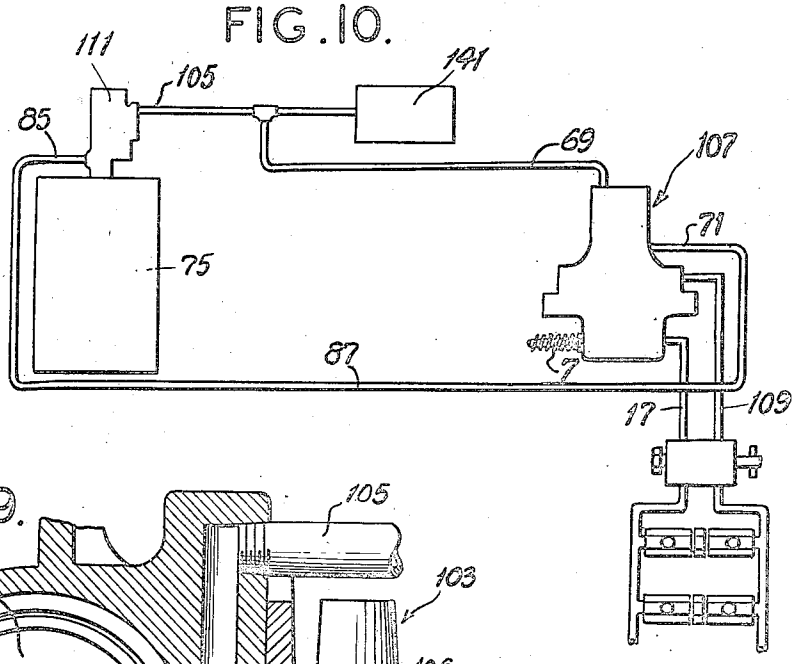


FIG. 9.

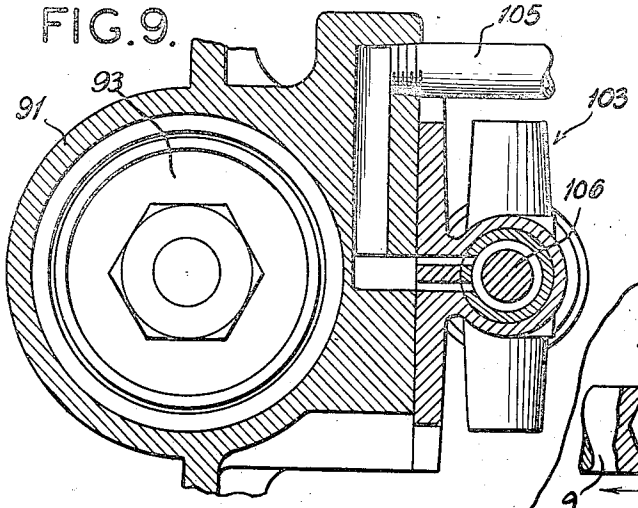


FIG. 4.

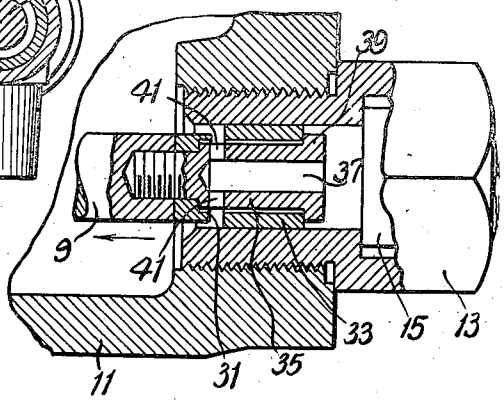
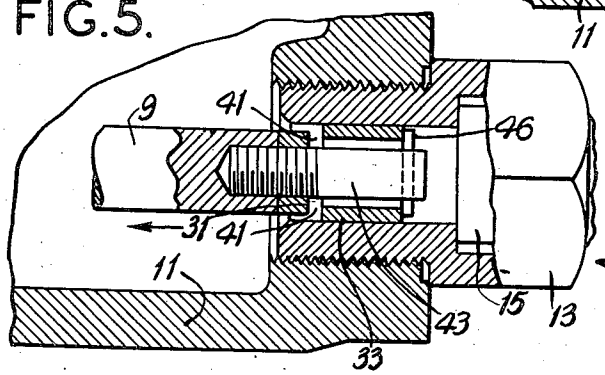


FIG. 5.



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FIG.6.

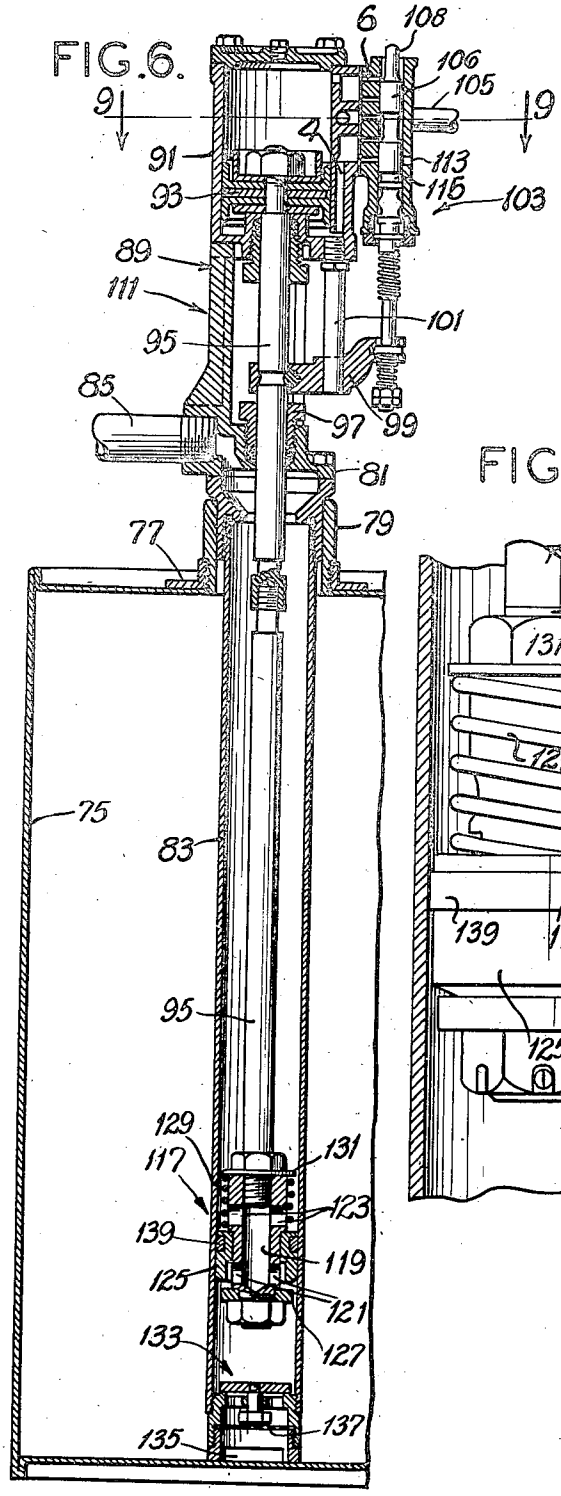
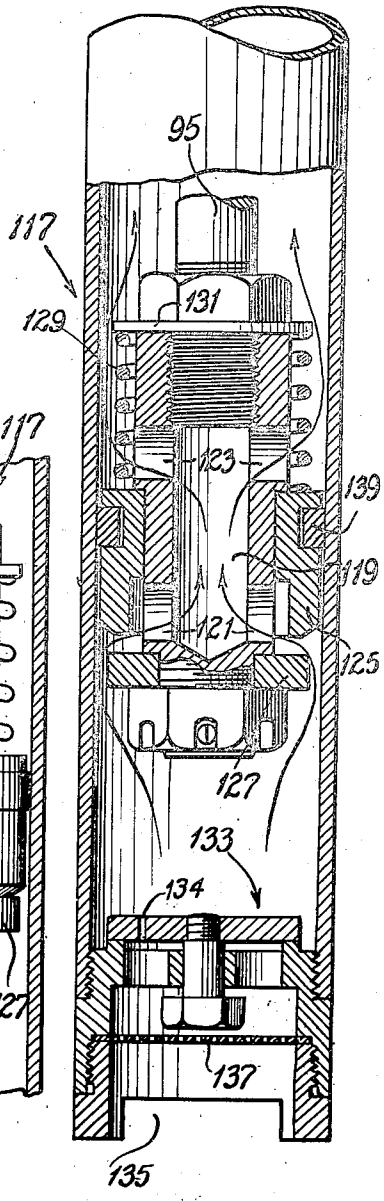


FIG.8.

FIG.7.



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UNITED STATES PATENT OFFICE

1,970,591

LUBRICATING APPARATUS

Frank S. Barks, St. Louis, Mo., assignor to Lincoln Engineering Company, St. Louis, Mo., a corporation of Missouri

Application May 7, 1931, Serial No. 535,712

10 Claims. (Cl. 184—7)

This invention relates to lubricating apparatus, and with regard to certain more specific features, to apparatus of this class for more effectively handling high pressures.

Among the several objects of the invention may be noted the provision of improvements upon the structure described in my United States Patent No. 1,805,303, dated May 12, 1931, for Lubricating apparatus; the provision of apparatus of the class described which shall eliminate excessive pressures in grease return lines and parts associated therewith; the provision of apparatus of the class described including improved plunger apparatus and heating means; and the provision of apparatus of this class which shall be simple in construction and effective in operation. 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 structure 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 primarily a longitudinal section showing certain organized elements of the invention (parts being diagrammatic);

Fig. 2 is a cross section taken on line 2—2 of Fig. 1;

Fig. 3 is an enlarged detail of the lower right-hand portion of Fig. 1;

Fig. 4 is a view similar to Fig. 3 showing a modified form;

Fig. 5 is a view similar to Fig. 4 showing another modified form;

Fig. 6 is a vertical section taken through a barrel pump, which may be used in connection with the present invention;

Fig. 7 is an enlarged fragmentary section of a plunger portion of the construction shown in Fig. 6;

Fig. 8 is a view similar to Fig. 7, but showing an alternative position of parts, said parts being shown in elevation, rather than in section as in Fig. 7;

Fig. 9 is a horizontal section taken on line 9—9 of Fig. 6 on an enlarged scale; and,

Fig. 10 is a circuit diagram illustrating the use of the invention.

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

Referring now more particularly to Fig. 1, there is illustrated at numeral 1 a driving motor or motivating means adapted to drive a cam 3 through gear reduction means 5. The cam 3, in coordination with a return spring 7 reciprocates a plunger 9 of a main pump 107 (see also Fig. 10) within a housing 11, the latter having an outlet bushing 13 in which is located an outlet check valve 15 leading to a pressure line 17.

At the end of the plunger 9 (Fig. 3) is affixed a head 19 which loosely fits into a sleeve piston 21, the latter slidably fitting the bore of said bushing 13. The central opening 23 of the piston 21 is of shape similar to that of the head 19 but does not closely engage therewith. Across the head 19 is positioned a pin 25 fitting into a groove 27 of the piston 21. The effective space between the pin 25 and the forward hardened face 29 of the plunger 9 is such that a lost-motion engagement is effected between the plunger and piston. Furthermore, there is ample clearance between the plunger 9 and bore of bushing 13 to transmit fluid when they are separated.

When the plunger 9 is withdrawn to the left, the piston 21 tends to lag, as shown in Fig. 3. The check valve 15 being shut, the induced suction in the bore of bushing 13 immediately draws fluid between the head 19 and piston 21, thus to fill said bore to the right of the plunger and piston. When next the plunger 9 moves to the right, the face 29 contacts with the piston 21 to drive the latter forward and thus to expel fluid from the bushing 13 and to drive the same past the check valve 15.

The advantage of the above construction is that neither the piston 21 nor plunger 9 needs to cross any port over which there is a machined fit. Thus a perfect seal and higher pressures may be more effectively maintained. The volumetric efficiency of the device is high, because no excessive vacuums are drawn before crossing a valve port. The fluid is drawn in from the very beginning of the suction stroke, rather than being delayed in its entry for a period of time and then quickly delivered over a small duration of time, as in prior ported devices of this class.

Fig. 4 shows an alternative form of plunger organization in which the plunger 9 is provided with a sealing face 31 for contacting with an annular piston 33. The head 35 of the plunger is annularly spaced from the piston 33 and is hollow as shown at numeral 37. A collar 39 is provided to withdraw the piston 33, the distance between collar 39 and face 31, as compared with the length of piston 33, providing the desirable

lost-motion engagement. Communicating passages 41 connect the opening 37 with the rear of the piston 33 when the plunger 9 is withdrawn. Thus fluid is driven to a position ahead of the piston 33. When the plunger returns, the seat 31 engages the piston 33 to push the same, thus closing off the communications 41 and driving the charge past the check valve 15.

In Fig. 5 is shown another embodiment of the punger, wherein like numerals designate like parts. This form is like the form of Fig. 4, except that the head 43 is not hollow and a pin 46 is substituted for the collar 39 in order to effect lost-motion engagement. Thus this form partakes of the Fig. 1 form in the pin construction and external delivery, but also of the Fig. 4 form as to the cylindrical spacing between head and piston, rather than conical as in Fig. 1.

Referring again to Fig. 1, the housing 11 is built upwardly to effect an upward directed passage 45 in the lower end of which is positioned a relatively fine strainer 47 and in the upper end of which is positioned a relatively coarse screen 49. The purpose of the upper screen 49 is to stop relatively large particles or concretions of grease from passing to the lower, finer screen 47, the latter screening out finer undesirable particles.

Between the screen 47 and 49 is crosswise located a chamber 51, the purpose of which is to carry an electrical heating element 53. The element 53 softens the grease or the like and thus enhances the flow from above, particularly when the grease would be otherwise cold. The heater 53 is energized from a suitable circuit 2.

Above the casting 11 is fitted a cap 55 having coaxial cylinders 57 and 59 carrying pistons 61 and 63 respectively. The pistons 61 and 63 are joined by a piston rod 65. It will be seen that the pistons 61, 63 and their piston rods 65 float freely in the cylinders 57 and 59. The upper cylinder 59 is capped as shown at numeral 67. An air connection 69 is made above the piston 63 and a grease connection 71 is made below the piston 61. A gauge 73 is applied as an auxiliary to ascertain pressures below the piston 61.

Referring to Figs. 6 to 8, a description will be given of a pump 111 which is to be used in connection with the pumping apparatus of Fig. 1. This description is given at this point in order that the operation of the invention as a whole may be understood more clearly.

In Fig. 6 is shown a barrel 75 of a class in which lubricants and the like are ordinarily delivered. This barrel carries a bushing 77 adapted to have threaded therein a closing cap. When the barrel 75 is received, said cap is removed, and a bushing 79 screwed therein. This bushing 79 has for its purpose the receiving of an outlet connection 81 associated with a pump barrel or tube 83, the latter being adapted to enter the lower reaches of the barrel 75. Associated with the outlet member 81 is a grease outlet 85 which, as shown in Fig. 10, is in connection with the grease inlet 71 by means of a line 87.

Above the member 81 is a supporting structure 89 for an air pump cylinder 91 having therein a reciprocating piston 93 which has a piston rod 95 extending down into said cylinder 83, the rod 95 passing through a stuffing gland 97.

The piston rod 95 carries a cross head 99 which rides on a guide 101. The purpose of the cross head 99 is to drive a full-stroke valve gear 103. The valve gear 103 makes inlet and exhaust connection on opposite sides of the piston 93 for purposes of reciprocating it.

Full-stroke valve gear of this general class has already been described in connection with my United States Patent 1,858,979, dated May 17, 1932, for Pump. It will here suffice to state that the inlet for air is brought into one side of the valve gear, as shown in numeral 105 in Fig. 9. When the valve stem 106 is in a position such as shown in Fig. 6, air may flow through passage 4 to the lower side of the piston 93, thus tending to lift the piston. Exhaust occurs from the upper side of the piston 93 through the outlet 6 and out around the end 108 of the stem 106. In its alternate position, the stem 106 covers the outlet port 6, air being then charged above the piston 93 and exhaust occurring from below the piston 93 through a port 113 opposite which at this time is located a recess 115 in the valve stem 106.

The lower end of the piston rod 95 carries a hollow piston 117, shown more particularly in Figs. 7 and 8. This piston 117 comprises a hollow head 119 having inlet ports 121 and outlet ports 123. The inlet ports 121 are slidably covered and uncovered by a sleeve 125 which, at its lower end, seats upon the closure 127. The sleeve 125 is normally pressed into closed position on the closure 127 by means of a compression spring 129 reacting against a collar 131. The sleeve 125 of the piston 117 is slidably sealed to the cylinder 83 by means of a piston ring 139.

A foot valve 133 at the lower end of the cylinder 83 permits entry of grease but prevents reverse exit therethrough. A castellated open bottom 135 to the cylinder 83 permits entry of grease into the cylinder 83 from below, even though the cylinder 83 be resting on the bottom of the barrel 75. A strainer 137 ensures that foreign material will not clog the valve 133. A small opening 134 is provided in the valve 133. This opening has a resistance to air flow which is relatively low and resistance to grease flow which is relatively high. A diameter of the order of $\frac{1}{8}$ of an inch and over has been found effective for the purpose to be set out. The exact size depends upon the weight of grease being pumped, the diameter given being for medium grease.

The operation of the elements shown in Figs. 6 to 8 is as follows:

When the piston 117 is driven down, the foot valve 133 closes. The charge trapped above the foot valve 133 forces the sleeve 125 against the spring 129 thus exposing the inlet ports 121. Hence, grease is forced through the inlet ports 121 and out of the outlet ports 123 to a position above the piston 117. Upon retraction of the piston 117, the sleeve 125 re-seats on the closure 127. This results in the charge above the piston 117 being driven out of the outlet 85; whereas below the piston 117, the foot valve 133 is opened permitting drawing in of a charge below said piston 117. The opening 134 substantially resists return of grease but does not resist return of air. Hence the spring 129 will effect opening to grease passage but not to air passage, as when the supply in the barrel is exhausted. The result is that this construction does not pump air after the grease is exhausted. It is therefore of advantage in other applications where meters are used in the outlet such as 85.

An air compressor 141 delivers air to the inlet 105 of the engine on the barrel pump. It also delivers air pressure to the inlet 69 of the pressure boosting pump shown in Fig. 1.

It is clear that whenever the pressure in the lines 85 is above a predetermined amount, de-

termined by the ratio of the diameters of pistons 117 and 93, that the barrel pump will cease to operate under the air pressure available from the compressor 141. In other words, the barrel pump (Fig. 6) will not start to operate until the pressure in line 87 has dropped to a predetermined amount. On the other hand, said pressure will not drop until grease is withdrawn from the casting 11 by means of the main pump 107 shown in Fig. 1. Thus the barrel pump of Fig. 6 is a class example of automatically starting pump for supplying fluid to the main pump 107 shown in Fig. 1.

The pump 107 (which is a booster) pumps to the line 17 and said line 17 passes to measuring valve apparatus such as described in said Patent 1,805,303, which includes a line analogous to line 17 and another line analogous to the return line 109 shown herein. This return line (109 herein), as shown in said patent, sends certain grease returns to the suction side of the pump 107 (see connection 8). The returns are under pressure which, if not relieved, will rise to a degree liable to burst the castings of the pump 107. The present invention prevents said bursting action and other deleterious results, by causing the pressure of said returns to be exerted against the piston 61, thus compressing the air above the piston 63. The ratio of the areas of the pistons 61 and 63 is such that the air pressure available at the air pump 141 will by pressure force grease through the strainers 47 and 49 to the suction side of the pump 107. The grease pressure is not of the order of the pressures that would be built up by the returning grease were it confined.

The operation is as follows:

The barrel pump 111 is supplied air by the air pump 141 or its equivalent. The air pump 141 also supplies air above the piston 63. Whenever the pump 107 pumps grease to the line 17, the pressure drops in the line 87. The drop is below the predetermined value adapted to permit starting of the grease pump 111 which supplies grease to the pump 107 through the lines 85, 87, 71 (Fig. 10).

When return of grease under pressure occurs over the line 109 to the suction side of the pump 107, either when the pump 107 is operating or when it is idle, the tendency is for the pressure within the casting 11 to rise. When this occurs, the pressure is exerted on the piston 61 which is reacted against by the pressure on piston 63. Thus the grease pressure of the returns, instead of rising deleteriously, rises only enough to cause compression in the cylinder 59 which, by the relative areas of the pistons 61 and 63 is calculated to prevent rise in return pressure such as might otherwise cause breakage. The pressure thus accumulated in the casting 11 is again used when the pump 107 is required to deliver more grease through the line 17, because the compressed air in the cylinder 59 re-expands to deliver grease from below the piston 61 to the plunger 9.

The device may be seen to comprise in effect an accumulator for the pressure of the grease returns. The energy of the non-expansive grease is stored in the expansive air above the piston 63. Whenever re-expansion of air above the piston 63 goes below that which the air pump 141 is adapted to supply, said pump 141 automatically starts and supplies the deficiency. It is to be understood that the pump 141 may have substituted therefor stored air supply in communication with the cylinder 59, this being done by way of a check valve or by direct communication. It is to be understood that the grease may be supplied to the pump 107 by other means than the barrel pump 111.

The motor 1 (Fig. 1) may be manually started and stopped, or clocked means may be used for starting and stopping the same, or it may be responsive to the pressure in line 17 through a pressure-operated switch. These alternatives form no part of the present invention and will not be detailed herein.

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, a lubricant supply, a pump for receiving lubricant from said supply and compressiong the same and delivering the lubricant to measuring means which requires for operation relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for maintaining pressure on said supply, and an expansible chamber for housing said supply, the pressure on the supply being less than the pressure caused by the pump in the return line.

2. In apparatus of the class described, a lubricant supply, a pump for receiving lubricant from said supply compressing the same and delivering the lubricant to measuring means which requires for operation relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for maintaining pressure on said supply, a housing for said supply, movable means associated with said housing for varying the volume therein, said movable means being subjected to lubricant pressure inside the same and external pressure outside of the same said external pressure being such as to cause less pressure on the supply than the pressure caused by the pump in the return line.

3. In apparatus of the class described, a chamber for lubricant supply, a pump for delivering lubricant from said supply and delivering the lubricant to measuring means which requires for operation relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for automatically delivering lubricant under pressure to said chamber as said pump delivers lubricant from the chamber, expansive means associated with said chamber for preventing excessive rise in pressure upon entry of said returned lubricant, and means for placing pressure on the expansive means, said last-named pressure being such as to cause less pressure on the supply than the pressure caused by the pump in said return line.

4. In apparatus of the class described a supply for lubricant, a pump adapted to deliver lubricant therefrom under pressure and delivering the lubricant to measuring means which requires for operation relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for supplying lubricant to said container, an expansible portion associated with

said container, and means for placing pressure on the expansive means, said last-named pressure being such as to cause less pressure on the supply than the pressure caused by the pump in said return line, said expansible portion responding by substantial increasing volume to increase in pressure in said container.

5. In apparatus of the class described, a chamber for lubricant supply, a pump for delivering lubricant from said supply and delivering the lubricant to measuring means which requires for operation relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for automatically delivering lubricant to said chamber under pressure as said pump supplies lubricant from the chamber to the measuring means, said measuring means building up pressure in the return line and causing return of lubricant through the return line, expansive means associated with said chamber for preventing excessive rise in pressure upon entry of said returned lubricant, and means for maintaining pressure on said expansive means externally of the chamber, said last-named pressure effecting pressure inside said chamber which is less than the pressure built up in said return line by the measuring means.

6. In apparatus of the class described, a chamber for a lubricant supply, a pump for delivering lubricant from said supply and delivering the lubricant to measuring means which requires for operation relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for automatically delivering lubricant to said chamber under pressure as said pump supplies lubricant from the chamber to the measuring means, said measuring means building up pressure in the return line and causing return of lubricant through the return line, expansive means associated with said chamber for preventing excessive rise in pressure upon entry of said returned lubricant, means for maintaining external pressure on said expansive means, said last-named means comprising compressed fluid having a pressure which exerts less pressure on the supply than the measuring means on the lubricant in said return line, said expansive means comprising a plurality of connected pistons having area ratios inversely as the pressures on opposite faces thereof.

7. In apparatus of the class described, a chamber for lubricant supply, a pump for delivering lubricant from said supply and delivering the lubricant to measuring means which requires for operation relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for automatically delivering lubricant to said chamber under pressure as said pump supplies lubricant from the chamber to the measuring means, said measuring means building up pressure in the return line and causing return of lubricant through the return line, expansive means associated with said chamber for preventing excessive rise in pressure upon entry of said return, means for maintaining external pressure on said expansive means, said last-named means comprising compressed fluid having a pressure which exerts less pressure on the supply than the measuring means on the lubricant in said return line, said expansive means comprising a plurality of connected pistons having area ratios inversely as the pressure to be balanced thereby, the smaller area being presented interiorly of the chamber.

8. In apparatus of the class described, a container for a lubricant supply, a pump for delivering compressed lubricant from said container and delivering the lubricant to measuring means which requires for operation thereof relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for automatically maintaining pressure in said container on lubricant delivered to said pump as said pump supplies lubricant from the chamber to the measuring means, said measuring means building up pressure in the return line and causing return of lubricant through the return line, and expansible means for maintaining the pressure in said container within a predetermined range below that which is transmitted to the relieved lubricant by the measuring means.

9. In apparatus of the class described, a container for a lubricant supply, a pump for delivering compressed lubricant from said container and delivering the lubricant to measuring means which requires for operation thereof relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for automatically maintaining pressure in said container on lubricant delivered to said pump as said pump supplies lubricant from the chamber to the measuring means, said measuring means building up pressure in the return line and causing return of lubricant through the return line, and expansible means for maintaining the pressure in said container within a predetermined range below that which is transmitted to the relieved lubricant by the measuring means and to store energy for use in delivering lubricant to said pump.

10. In apparatus of the class described a container for lubricant, a pump adapted to deliver lubricant therefrom under pressure and delivering the lubricant to measuring means which requires for operation relief of lubricant under pressure to a line leading therefrom, a return line adapted to convey relieved lubricant from said line to the supply, means for supplying lubricant to said container as said pump supplies lubricant from the container to the measuring means, said measuring means building up pressure in the return line and causing return of lubricant through the return line, an expansible portion associated with said container, and means for placing pressure on the expansive means, said last-named pressure being such as to cause less pressure on the supply than the pressure caused by the measuring means in said return line, said expansible portion responding by substantial increase in volume to increase of pressure in said container, said expansible means comprising rigidly joined members of different areas, means for impressing on the respective areas pressures in a predetermined ratio, whereby said members are held in one extreme position, said members moving to another position upon increase in pressure in said container and being adapted to return to the original position when said delivery pump withdraws lubricant from the container, and thereby reducing the pressure in the container acting upon the expansible means.

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