March 18, 1941. F. E. WOLD 2,235,544

GREASE PUMP

Filed June 20, 1938 3 Sheets-Sheet 1

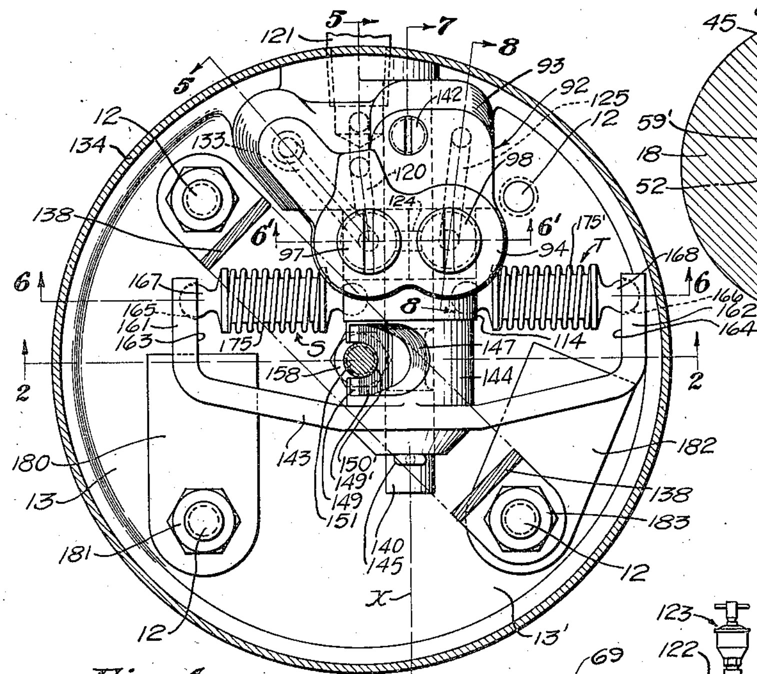


Fig. 4.

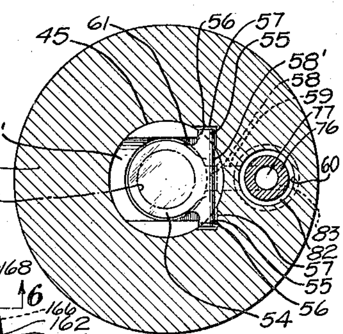


Fig. 9.

Fig. 5.

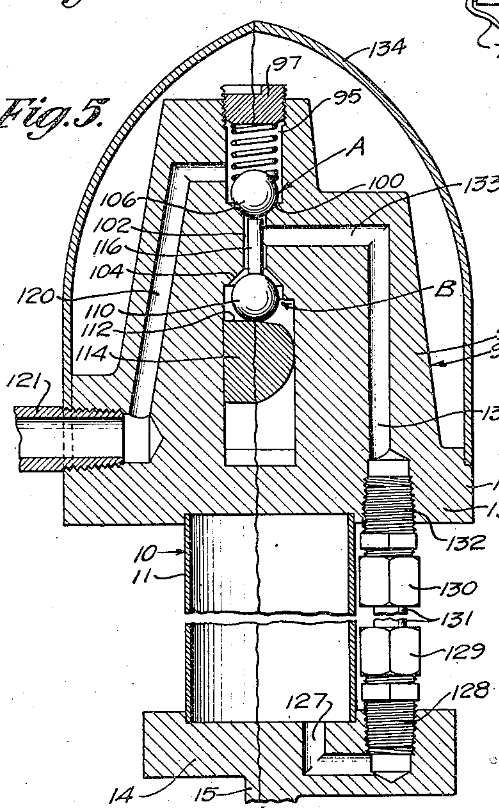
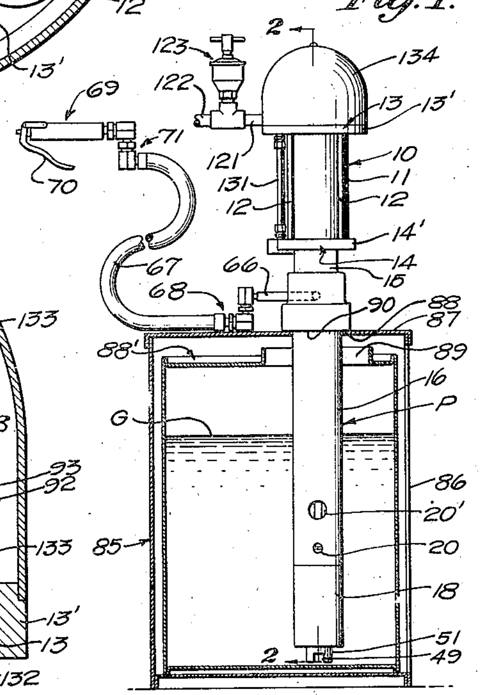


Fig. 1.



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Filed June 20, 1938 3 Sheets-Sheet 2

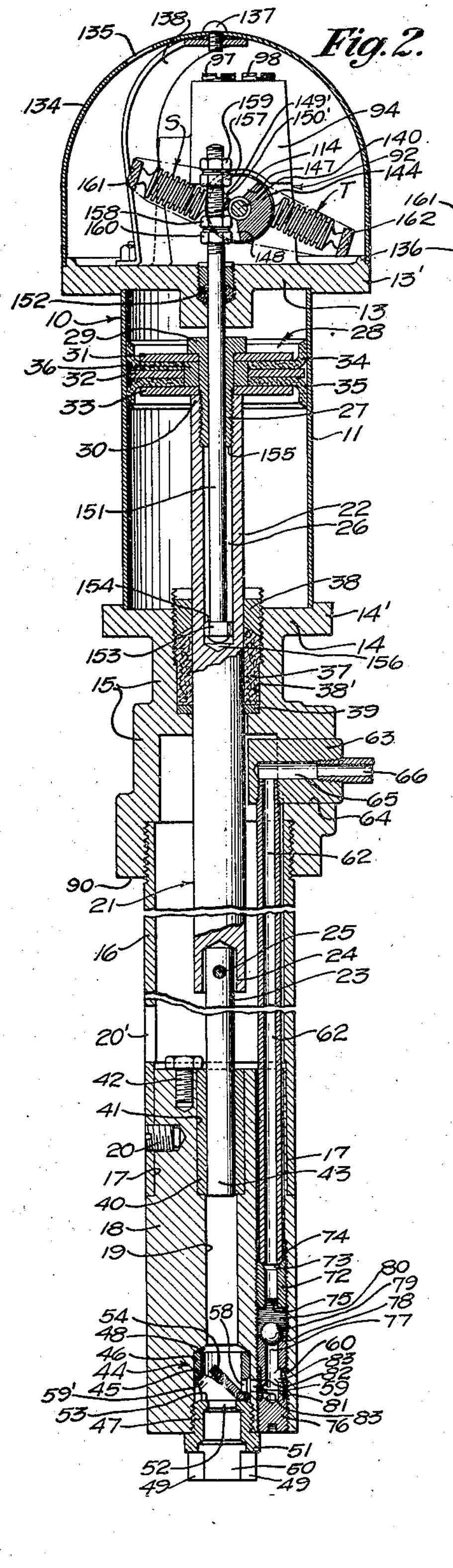

Fig. 2.

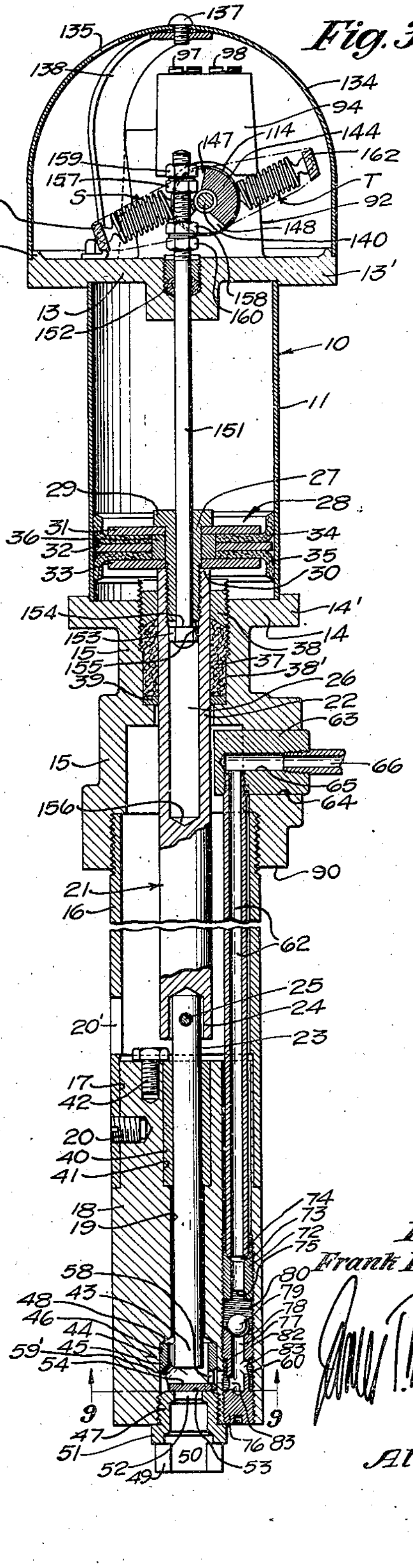

Fig. 3.

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Fig. 6.

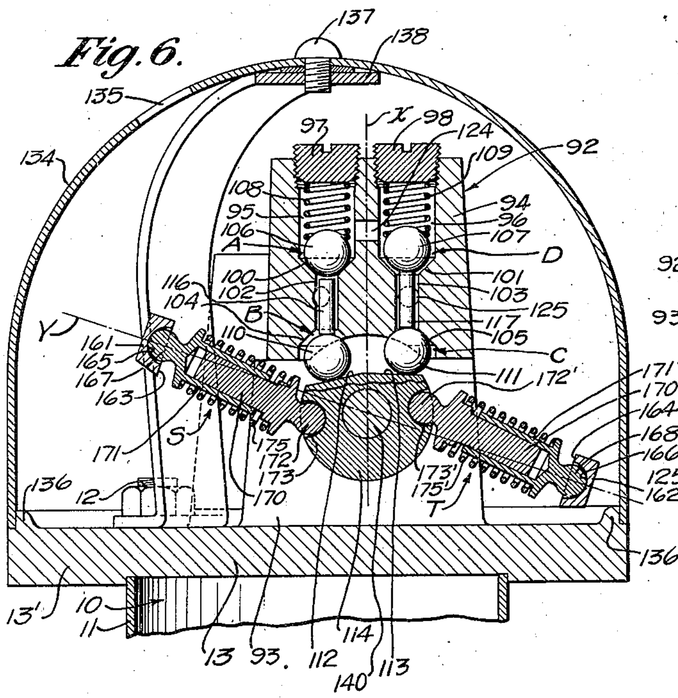


Fig. 8.

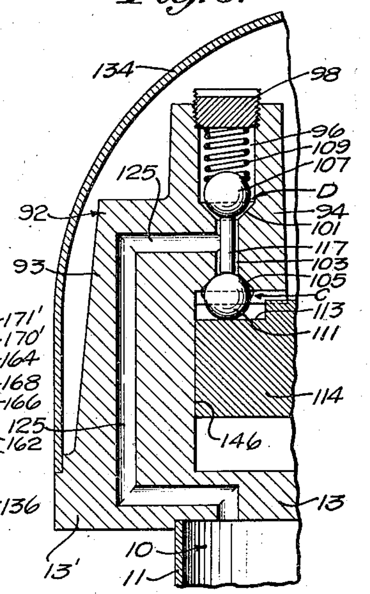
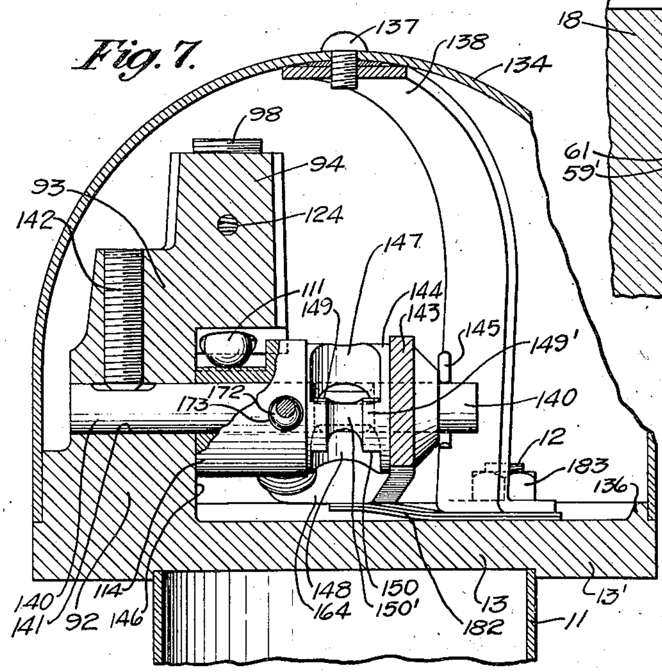


Fig. 7.



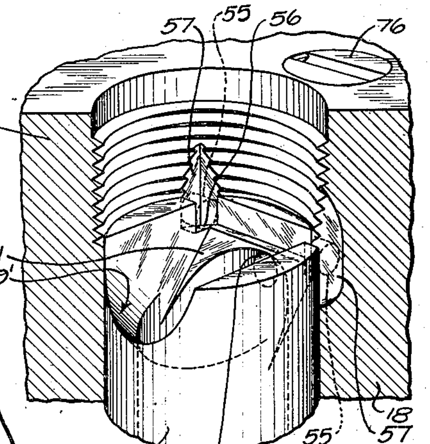


Fig. 10.

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2,235,544

UNITED STATES PATENT OFFICE

2,235,544

GREASE PUMP

Frank E. Wold, Santa Monica, Calif., assignor of one-half to Donald E. Woolard, Los Angeles County, Calif.

Application June 20, 1938, Serial No. 214,805

4 Claims. (Cl. 103—50)

This invention has to do generally with pumps or the like, and is more particularly concerned with pumps especially well adapted for the delivery of relatively heavy greases used in the lubrication of motor vehicles, or in any situation where it is necessary or desirable to inject grease under relatively high pressure between the parts to be lubricated.

In lubricating the shackles or other working parts of motor vehicles, it is preferable to use grease supplied in large cans and to pump the lubricant directly from those cans to the hose of a "grease-gun" adapted to be applied to pin-fittings on the spring-shackles and the like. It is among the objects of this invention to provide a particularly efficient, automatically operating pump for use in such a system, the pump continuously standing in readiness to apply delivery pressure to the grease the instant the outlet valve of the gun is opened, and continuing automatically to supply that pressure so long as the valve is held open.

I have provided a pumping unit which includes a relatively low pressure cylinder for motivating fluid, such as air under pressure, the piston for that cylinder being operatively connected to a piston within a relatively high pressure cylinder, the entire unit being self-contained and so arranged that it may be lowered to and from a position where the inlet to the high pressure cylinder lies below the grease level in the container. A self-contained high pressure line extends upwardly from the high pressure cylinder into connection with a hose which carries a usual valve-controlled grease gun.

The motivating fluid for the low pressure cylinder may be supplied by the usual air-pressure line such as is commonly present in service stations, the valves for controlling the passage of this air to and from the lower pressure cylinder being included in the pumping unit, as will presently be described.

The general arrangement is such that the instant the valve of the grease gun is opened, the motivating fluid is effective within the low pressure cylinder to reciprocate the high pressure piston and thus deliver grease under high pressure so long as that valve is opened.

I have so arranged the parts that leakage in the high pressure line is reduced to a minimum, and such fluid as may leak, in spite of the precautionary measures, merely returns to the body of grease in the container, rather than discharging exteriorly in a manner to cause damage or unsightliness.

An additional object of the invention is to provide a mechanism which is simple and sturdy of construction, and thus well adapted to withstand the extremely severe service conditions to which apparatus of this type is exposed.

I have also provided a novel valve-actuating mechanism for controlling the passage of motivating fluid to and from the low pressure cylinder. Certain of the broader features of this mechanism are shown and claimed in my copending application entitled Vibrator mechanism, filed October 26, 1936, Ser. No. 107,619, but additional features are here shown and claimed.

Other objects and features of the invention will be made apparent in the following detailed description, wherein reference is made to the accompanying drawings, in which:

Fig. 1 is a side elevation showing an embodiment of my invention wherein the supporting cabinet and grease can are shown in section;

Fig. 2 is an enlarged section on line 2—2 of Fig. 1, or may be considered as a reduced section on line 2—2 of Fig. 4;

Fig. 3 is a view similar to Fig. 2 but showing the pistons at the opposite ends of their strokes;

Fig. 4 is an enlarged plan view of Fig. 2 but sectionally showing the cap, the cap-attaching strap, and the valve-rod; while the snap-actuator lever is shown in a position midway between the positions it occupies in Figs. 2 and 3;

Fig. 5 is a section on broken line 5—5 of Fig. 4, being somewhat in the nature of a developed section;

Fig. 6 is a section taken mainly on line 6—6 of Fig. 4, though the section through the valve is taken on line 6′—6′ of Fig. 4, and the snap-actuator has been moved to the position of Fig. 2;

Fig. 7 is a section on line 7—7 of Fig. 4, but with the valve-rod omitted, and certain parts being shown in elevation;

Fig. 8 is a section on line 8—8 of Fig. 4;

Fig. 9 is an enlarged section on line 9—9 of Fig. 3; and

Fig. 10 is an enlarged and inverted fragmentary perspective showing the foot-valve sleeve in its association with the supporting barrel.

Referring particularly to Figs. 1 and 2, I will first describe the general structure of the high and low pressure cylinders and their assembly.

Low pressure cylinder 10, for receiving motivating fluid such as air under pressure, is made up of cylindrical tube 11 clamped by bolts 12 between upper and lower cylinder heads 13 and 14, respectively, said bolts being angularly spaced about the exterior of tube 11 and extending between head flanges 13' and 14'.

Head 14 has a depending, tubular extension 15 which takes the threaded end of housing or tubular spacing jacket 16, the lower end of said jacket having telescopic fit at 17 with the upper end of the relatively thick-walled barrel 18. The bore 19 of barrel 18 serves as the high pressure, grease cylinder.

In one aspect, jacket 16 may be considered as a continuation of head-extension 15, and in another aspect head-extension 15 may be taken as a continuation of jacket 16, considering the latter as a spacer. This is stated in order that the terminology of certain of the claims may be made clear.

Set screw 20 holds jacket 16 and barrel 18 against both relative rotation and relative longitudinal movement, the jacket maintaining cylinders 10 and 19 substantially in coaxial alinement and in predetermined longitudinally spaced position. I have here shown the pump as extending vertically, but it will be understood that under certain conditions it may be extended otherwise. Accordingly, in those claims where the vertical arrangement is not essential to the functioning of the elements specified, the terms "vertically," "upper" and "lower" are used, not in a limitative sense, but merely to locate the parts relatively.

As will later appear, jacket 16 is not exposed to high internal fluid pressures and may therefore be relatively thin-walled and made of relatively inexpensive stock. To prevent the building-up of internal pressure within the jacket due to leakage from the high pressure cylinder, the jacket is preferably provided with a vent port 20'.

Piston rod 21 is made up of sections 22 and 23, section 23 being of less diameter than section 22 and its upper end fitting into the oversize socket 24 in the lower end of section 22. The sections are pinned together at 25, but there is sufficient looseness of fit to allow the piston sections to accommodate themselves to the parts with which they coact, thus avoiding binding effects even though cylinders 10 and 19 are slightly misalined.

The upper end of section 22 is axially bored at 26 and internally threaded to take tubular nut 27, the assembly 28, which makes up the low-pressure piston head, being clamped between head 29 of nut 27 and the upper end 30 of rod-section 22. Piston head 28 includes alternately arranged metal disks 31, 32, 33, and cups 34, 35, of leather or other suitable material, a metal spacing sleeve 36 being interposed between plates 31 and 33 and being encircled by metal plate 32 and cups 34, 35.

Rod section 22 extends through packing 37 and gland 38 provided in the counterbore 38' of head 14 and extension 15; washer 39 at the lower end of the counterbore closely fitting the rod section and serving as a stop for the packing.

Rod section 23 extends, preferably with ground fit, through hardened bushing 40 which is held seated in counterbore 41 of barrel 18 by the overhanging head of bolt 42. This ground fit between rod and bushing dispenses with the need of packing between the rod and barrel, as it is sufficiently snug to prevent any major leakage, and such minor leakage as may occur at this point is not damaging since barrel 18 and housing 16 are disposed within the grease container, as will be described later, and the products of leakage will merely drain back into the container.

The lower end 43 of rod section 23 is adapted to be reciprocated through cylinder 19 and thus acts as a high pressure piston. The fit of piston 43 in cylinder 19 need not be as close as that between the piston or section 23 and bushing 40.

The standing valve assembly indicated generally at 44, is made up of a sleeve 45 slipped into counterbore 46 at the lower end of barrel 18, and tubular nut 47 which is threaded into that counterbore and detachably holds the sleeve in place, though the sleeve may have limited end-play between barrel-shoulder 48 and the top of nut 47. Side ports 49 open into the bore 50 of nut extension 51 which projects below barrel 18, while inlet port 52 at the upper end of bore 50 opens, at times, into the bore of sleeve 45. The annular end face 53 of nut 47, where it extends around port 52, forms the seat of valve 44, the stopper of the valve being of the "flap" type, the flap here being shown as a disk or circular plate 54 carrying trunnions 55 which extend through channels 56 cut up from the bottom of sleeve 45 (Fig. 10). The ends of the trunnions have portions which extend beyond the periphery of sleeve 45 into square-cut notches 57 in the defining wall of bore 46. The trunnions and the rounded portion 58' which connects them, have rotational bearing on the upper end face of nut 47 or, expressed otherwise, on seat 53 at one side of inlet port 52.

Sleeve 45 has a side outlet port 58, while its opposite side is cut away at 59' to prevent interference with the swinging of flap 54.

The entrance of the trunnion ends in notches 57 not only holds the flap from shifting in the direction of the trunnion axis but also holds the flap and hence the sleeve against rotation with respect to barrel 18, and thus maintains outlet port 58 in registration with port 59 which leads to bore 60, the latter extending in axially parallel relation with cylinder bore 19. Angular shoulder 61 in sleeve 45 limits the opening movement of flap 54 so it can never move to a position closing outlet 58, and so it is assured that the flap will close when the opening force is relieved therefrom, or, at least, upon initiation of the pressure stroke of piston 43. The fit of trunnions 55 in grooves or channels 56 prevents flap 54 from shifting laterally in the direction of the axis of port 58.

In assembling valve 44 with barrel 18, the barrel is turned upside down and sleeve 45 is dropped into place so channels 56 register with notches 57, it thus being assured that ports 58 and 59 are in register. Flap 54, with the trunnions extending approximately diametrically across bore 47 is lowered until the trunnions engage end-face 62 of sleeve 45, whereupon the flap is shifted laterally to enter the trunnion ends in notches 57, thus allowing them to drop into channels 56. Nut 47 is then screwed in to hold the valve parts in assembly.

The lower end of high pressure pipe 62 extends, with annular clearance, through the upper end of bore 60, while the upper end of the pipe is threaded into cylindrical block 63 which is, in effect, an elbow. Block 63 is positioned within side bore 64 in head-extension 15, and its passageway 65 puts pipe 62 into communication with the outlet nipple 66 to which the usual high pressure hose 67 (Fig. 1) is connected as, for instance, by usual swivel joint 68. Any suitable type of grease gun, here conventionally illustrated at 69 and whose outlet valve (not shown) is controlled by hand lever or trigger 70, is connected to the other end of the hose by swivel joint 71.

A tubular sealing gland 72 is threaded through the lower end of bore 60, and has a conical seat 73 adapted to engage the lower and complementarily tapered end 74 of pipe 62. The lower end of the gland has a screw-driver slot 75 whereby, when the lower end of bore 60 is cleared of all other parts, the gland may be reached by a screw-driver for adjustment into tight engagement with pipe 62, thus providing a seal to prevent leakage around the outside of the pipe.

Threaded into the lower end of bore 60 is plug 76 having an upwardly opening bore 77, the upper end of the plug being fashioned as a conical seat 78 to receive a check-valve ball 79. The ball is adapted to play vertically within valve chamber 80 to and from its seat 78, the valve chamber being vertically defined by the spaced and opposed ends of gland 72 and plug 76.

The central portion 81 of plug 76 is of reduced diameter, thus providing an annular chamber 82 to which port 59 opens. A plurality of ports 83 are adapted to maintain chamber 82 and bore 77 in communication.

Before describing the actuating mechanism for the control of the motivating-fluid valves, I will describe a preferred installation of the pump and the operation of the mechanism so far set forth. However, it will be understood that this showing of one type of installation is made for illustrative purposes and is not to be considered as limitative on the other aspects of the invention.

I have provided a cabinet 85 (Fig. 1) with an open side 86. The top 87 has an opening 88 through which the lower end of the pump may be elevated from or lowered to place. When the pump, indicated as a whole at P, is lifted from the cabinet, a usual can or container 88′ filled with grease G, may be slid through open side 86 into the position shown in Fig. 1, where its uncapped opening 89 lies directly beneath opening 88. Pump P is then lowered into the position of Fig. 1, the downwardly facing shoulder 90 of head-extension 15 coming to rest on top 87 and thus supporting the entire pump assembly on that top.

Assuming the pump to be in the condition of Fig. 3 and that motivating-fluid be admitted beneath piston 28, it will be apparent that the consequent up-stroke of piston 43 will cause a depression in cylinder 19, it resulting that valve 44 will be opened and grease will enter cylinder 19. Upon subsequent downward movement of pistons 28 and 43, valve 44 is closed, and piston 43 forces the grease from cylinder 19 through ports 58, 59, chamber 82, ports 83, bore 77, check-valve 79, and chamber 80, passing thence through the bore of gland 72 into the pipe 62 and on to hose 67 and grease-gun 69.

It will be seen that due to the differential existing between the effective cross-sectional areas of pistons 28 and 43, relatively low pressure applied to piston 28 will result in the application of relatively high pressure to the grease in cylinder 19. While the following proportions are not controlling on the invention, in the illustrated embodiment the ratio of effective cross-sectional area of piston 28 to the effective cross-sectional area of piston 43 is about of the order of 43 to 1, so, with the relatively low air pressure of 100 lbs. per square inch applied to the upper piston, an effective force of 4300 lbs. per square inch is exerted on the grease by piston 43. With this tremendous advantage, relatively low air pressure is effective to force the grease through the gun and into restricted or clogged lubrication spaces which would otherwise effectively resist entrance.

Now it will be seen that pipe 62 and block 63 are exposed to very high internal pressures, and therefore they are made of material which is well adapted to withstand the strains incident to those pressures. For instance, pipe 62 may be "double strength" pipe and block 63 of mild steel. On the other hand, head-extension 15 and jacket 16 are not exposed directly to these internal pressural strains, and therefore may be constructed of relatively light and cheap material. For instance, extension 15 may be cast iron, and jacket 16 may be "standard" pipe.

It will also be observed that leakage occurring within any part of the high pressure line up to the point where block 64 emerges from extension 15, will merely result in drippage back into the body of grease G. Yet in spite of the effective sealing of the high pressure line, it is a comparatively simple matter to disassemble the entire high pressure line and the various valves for purposes of inspection or repair, and just as simple to reassemble them for subsequent use.

I will now describe the various valved passageways having to do with the controlled flow of motivating fluid into and out of the low pressure cylinder.

Extending upwardly from head 13 is a valve block 92 made up of post portion 93 and overhanging head portion 94. Extending vertically through head portion 94 are parallel valve or inlet chambers 95 and 96, which chambers are equally spaced from and at opposite sides of vertical plane X (Fig. 6). Plugs 97 and 98 close the upper ends of the chambers, while the lower ends of chambers 95 and 96 are defined by conical seats 100 and 101, respectively, which surround the upper ends of vertical passages 102 and 103, respectively. The lower ends of passages 102 and 103 are provided with conical valve seats 104 and 105, respectively, which taper oppositely from seats 100 and 101.

Valve balls 106 and 107 are pressed toward their respective seats by springs 108 and 109, while valve balls 110 and 111 are held beneath their respective seats by cam faces 112 and 113 on rock-cam 114. The details of this cam will be later described, but it may be here noted that when the cam is in the position of Figs. 2 and 6, ball 111 is held against its seat 105 by cam face 113, while ball 110 is lowered from its seat 104 due to the relatively low position of cam face 112.

Loosely fitting in passages 102 and 103, respectively, are tappet pins 116 and 117, these pins being of such length that when a given ball 110 or 111 is seated by cam 114, the overlying ball will be raised from its seat 100 or 101 by the corresponding tappet. Such a condition is shown in connection with balls 111 and 107 in Fig. 6, it being further noted that tappet 116 does not interfere with the seating of ball 106 when ball 110 is lowered fully from its seat 104.

Obviously, when cam 114 is rotated in a clockwise direction (as viewed in Fig. 6) to a position seating ball 110 and unseating ball 106, ball 111 will be lowered from its seat and ball 107 will be lowered or spring-pressed to its seat. Seats 104 and 105 are of such vertical extent and the vertical separative movement between those seats and the underlying cam faces is so slight, that balls 110 and 111 are confined against bodily dislodgement.

For later convenience, ball 106 and its seat 100 will be considered together as making up inlet valve A; ball 110 and its seat 104 as exhaust valve B; ball 111 and its seat 105 as exhaust valve C; and ball 107 and its seat 101 as inlet valve D. Thus, it will be seen that passages 102 and 103 each comprise a chamber having an inlet valve at its upper end and an outlet valve at its lower end.

Inlet passageway 120 leads from nipple 121 to valve chamber 95 (Fig. 5) nipple 121 being connected to a line 122 (Fig. 1) leading to a source (not shown) of motivating fluid such as air under pressure. Preferably, though not necessarily, an oil cup 123 is introduced in this line and adapted to supply a small amount of oil to the air stream as it passes into nipple 121, this oil being thence carried by the air stream to the various working parts of the valves, the valve-actuating mechanism and the piston and cylinder walls to maintain them always in a well lubricated condition.

Chambers 95 and 96 are maintained in constant communication by cross-passage 124 (Figs. 6 and 7), it following that chamber 96, as well as chamber 95, is normally filled with air under pressure.

With the valves in the condition of Figs. 5, 6 and 8, air flows from chamber 96 through open valve D into chamber 103 whence it passes through passageway 125 (Fig. 8) into the upper end of cylinder 10, thus tending to depress piston 28. In order to allow such depression, the air below piston 28 is exhausted through passageway 127 in the lower cylinder head 14 (Fig. 5) said passageway leading to nipple 128 which, through unions 129, 130 and pipe 131 (Figs. 1 and 5) is connected to nipple 132 which communicates with the lower end of passageways 133 provided in valve-block 92 (Fig. 5). Passageway 133 opens to chamber 102, and exhaust air admitted thereto passes outwardly through valve B to the atmosphere by way of the interior of cap or dome 134 and cap-vent 135 (Fig. 2).

The lower edge of cap 134 fits over annular bead 136 on flange 13', while screw 137 detachably holds the cap to inverted yoke 138 which, in turn, is held to flange 13' by the nuts on a pair of diametrically opposite bolts 12.

Upon rocking cam 114 in a clockwise direction, (as viewed in Fig. 6) valves A and C will be opened and valves B and D will be closed. As will be described, this cam and valve actuation occurs when the pistons are approximately at the bottom of their strokes (Fig. 3). Thereupon, the motivating fluid is admitted beneath piston 28 through the following path; chamber 95, valve A, chamber 102, passageway 133, pipe 131, and passageway 127 (Fig. 5, although here the valves A and B are in the position opposite those they would occupy under such conditions). Air from above piston 28 is exhausted through the following path; passageway 125, chamber 103, valve C, and thence to the atmosphere through the interior of cap 134 and through vent 135 (see Fig. 8, although here the valves D and C are in positions opposite those they would occupy under such circumstances).

The valve actuating means includes cam 114 which is mounted for oscillation or rocking movement on shaft 140, the latter being held rigidly in post-bore 141 by set screw 142 (Fig. 7). The axis of cam oscillation lies in vertical plane X (Fig. 6) and is thus midway between valves B and C. Mounted for oscillation on shaft 140 independently of cam 114, is actuating lever 143 which has a hub portion 144 held in end engagement with cam 114 by cotter key 145, the wall 146 of post 93 limiting the movement of the cam-and-lever assembly to the left, as viewed in Fig. 7.

Hub 144 is cut away at 147 and 148 to provide vertically spaced, upper and lower, radially extending shoulders 149 and 150, respectively, the arm 149' thus defined at top and bottom by these shoulders being centrally slotted at 150' to take the upper end of valve rod 151 (Figs. 2, 4 and 7, though the valve rod is omitted in Fig. 7). It will be seen that shoulders 149 and 150 are offset from the axis of lever-oscillation, so that force vertically applied thereto tends to move the hub angularly. In effect, of course, arm 149' may be considered as a lever which is so associated with actuating lever 143 that vertical movement of rod 151 is translated into angular movement of actuating lever 143.

Rod 151 extends through packing assembly 152 in cylinder head 13 and through the bore of nut 27 into bore 26. A terminal nut or head 153 on the rod provides an upwardly facing shoulder 154 adapted, at times, to contact the downwardly facing stop shoulder 155 presented by the lower end of tubular nut 27. An opposing stop shoulder 156 is formed by the bottom-defining wall of bore 26, which shoulder is adapted, at times, to be contacted by the lower end of rod 151 or the lower face of nut 153.

Threaded on rod 151 in opposition to shoulders 149 and 150, respectively, are nuts 157 and 158 which may be threadably adjusted along the rod to vary the timing of the actuator, as will later be apparent, lock nuts 159 and 160 serving to hold nuts 157 and 158, respectively, in adjusted position.

It will be seen that piston rod section 22 and rod 151 are telescopically associated so they are normally capable of relative vertical movement though, at times, piston-rod movement initiates valve-rod movement.

Lever 143 is in the form of a yoke, as viewed in plan (Fig. 4) the legs or in-turned ends 161 and 162 presenting opposed faces 163 and 164 which are socketed at 165 and 166, (Fig. 6) to take, respectively, the spherical heads 167 and 168 of the snap-actuators generally indicated at S and T, which, upon piston 28 reaching predetermined positions in cylinder 10, act to snap cam 114 from the position of Fig. 2 or 6 to the position of Fig. 3, and vice-versa—thereby actuating valves A, B, C and D, as has been described.

Actuators S and T are identical and they act together to rotate the cam in a given direction when they come into play; thereafter yieldably holding the cam in its new position until they again come into play to rotate the cam reversely. Only one of the actuators need be described in detail, but corresponding parts of the other will be given the same, but primed, reference numerals.

Actuator S comprises telescopically arranged plunger 170 and sleeve 171, head 167 being integral with the outer end of the sleeve. Plunger 170 carries integral head 172 which is seated in socket 173 sunk in the peripheral face of cam 114. Sockets 173 and 173' are diametrically opposite one another.

In discussing the action of the actuator and control means therefor, I will refer to a certain "line of centers." This line of centers is here indicated by the reference letter Y, and extends through the axis of rotation of cam 114 and the centers of the two outermost heads 167 and 168; or this line of centers may be considered as passing through the axis of rotation of lever 143 and the centers of sockets 165 and 166.

Compression springs 175 and 175' constantly tend relatively to extend the plungers and sleeves of the corresponding actuators. When piston 28 is at the upper end of its travel, the actuator parts occupy the positions indicated in Figs. 2 and 6, where, since heads 172 and 172' are oppositely offset from the line of centers Y, springs 175 and 175' exert such pressure on cam 114 as tends to rotate it in a counterclockwise direction, thus holding valve C tightly closed and valve D fully opened, while allowing valve B to remain open and valve A to remain closed.

The extent of angular movement of cam 114 in this direction, is, of course, limited by ball 111 in its position of engagement with seat 105, and it will be seen that subsequent clockwise movement of the cam will be limited by ball 110 in its position of engagement with seat 104. At the same time, it will be seen that by virtue of this arrangement, wear of the balls or their seats is automatically compensated, for springs 175 and 175' will, in the event of such wear, merely rotate the cam to a greater extent and thus move the balls through a sufficiently greater distance to insure their ultimate seating.

Now assume that the parts are in the position of Fig. 2 (except that valve 44 will probably have been closed by gravity) with air under pressure standing in cylinder 10 above piston 28 and with the high pressure line from cylinder 19 to gun 69 charged with grease. When the gun is applied to a lubricating fitting (not shown) and trigger 70 is actuated to open the gun-valve (not individually shown) the motivating fluid is immediately effective to depress piston 28 and thus, through the consequent depression of piston 43, to discharge grease under high pressure from the gun to the fitting. If the gun-valve be closed before piston 43 reaches its lowermost position, the piston will merely come to rest, but will be in condition immediately to resume its delivery stroke when the gun-valve is subsequently opened.

On the other hand, if the gun-valve is maintained in open position, piston 43 will continue through its deliver stroke. As piston 28 now approaches the limit of its down-stroke (Fig. 3 represents the position of parts when that limit is reached) shoulder 155 on nut 27 engages shoulder 154 on nut 153 and thus exerts a downward pull on valve rod 151 and, through nut 157 and lever 149', sets up counterclockwise movement of lever or yoke 143 (as viewed in Fig. 2). Since, at this time heads 172 and 172' do not move bodily, the initial pivotal movement of the yoke relatively collapses the telescopic joints of the actuators and thus causes further compression of springs 175, 175'. After the angular movement of lever 143 has carried the line of centers Y just past the position where the centers of heads 172 and 172' lie within that line, actuators S and T will act by the sudden extension of their springs to snap cam 114 in a clockwise direction to the position of Fig. 3. The sudden extension of the actuator springs will also snap lever 143 in a counterclockwise direction (as viewed in Fig. 3) and through lever 149' will snap rod 151 to its lowermost position (Fig. 3) which accounts for the development of the vertical space indicated in Fig. 3 between shoulder 155 and shoulder 154. The shock of lever-impact is absorbed, at least in part, by fatigue spring 180 which is held to the upper face of head 13 by the nut 181 on one of the bolts 12.

The snap-over of cam 114 reverses all valves A, B, C and D from the positions of Fig. 6, resulting in a reversal of the flow of motivating and exhaust fluid, as has been described, and piston 28 will be moved upwardly, a new charge of grease following piston 43 into cylinder 19. Just before piston 28 reaches its upper limit of travel, shoulder 156 at the bottom of bore 26 will engage rod 151 or nut 153, whereupon the rod 151 will be pushed upwardly, nut 158 consequently thrusting lever 149' and hence lever 143 in a clockwise direction, as viewed in Fig. 3. As the line of centers Y passes just beyond the centers of head 172 and 172', springs 175 and 175' become effective to extend telescopic joints of the actuators and thus snap the cam 114 and lever 143 back to the position of Figs. 2 and 6, restoring valves A, B, C and D to their original positions, whereupon the motivating fluid is effective again to depress piston 28 and thus to force piston 43 through its deliver stroke. In returning to the piston of Fig. 2, the shock of impact is taken from between lever 143 and cylinder head 13 by fatigue spring 182 (Figs. 4 and 7) which is held to the head by nut 183 on one of the bolts 12.

Thus, reciprocation of pistons 28 and 43 continues, and grease is expelled under high pressure from gun 69 until the valve of that gun is closed, whereupon all parts of the pump come to rest, though they are left in condition to resume pumping action the instant the gun-valve is reopened.

It will be seen that with cam 114 acting on the valves at points equally removed from oscillatory axis X, and with the snap-actuators applying their effective force to the cam at points similarly related to that axis, the entire system is well balanced, thus contributing to even and positive action.

It is believed a full understanding of the invention will be had from the foregoing, but it will be understood that various changes in design, structure and arrangement may be made without departing from the spirit and scope of the appended claims.

I claim:

1. In a device of the character described, a pair of vertically arranged cylinders, a tubular spacer structurally interconnecting the cylinders to hold them substantially in vertical alinement and at predetermined spacing, a pair of pistons, one in each cylinder, connected for coincident reciprocation, means whereby pressure fluid may be alternately admitted to and exhausted from the ends of the upper cylinder to reciprocate the pistons, there being a valved grease-inlet and a grease-outlet for the lower cylinder, both inlet and outlet being near the bottom of the lower cylinder, a check valve for the outlet, and a discharge line extending upwardly from said outlet and within the spacer.

2. In a device of the character described, a vertically arranged, upper cylinder having upper and lower heads, a tubular, axial extension depending from the lower head, a barrel supported at the lower end of the extension and having a lower cylinder in substantial alinement with the upper cylinder, a pair of pistons, one in each

cylinder, connected by a rod, extending through said extension, for coincident reciprocation, means whereby pressure fluid may be alternately admitted to and exhausted from the ends of the upper cylinder to reciprocate the pistons, there being a valved inlet for the lower end of said lower cylinder, and there being a bore in said barrel parallel to the lower cylinder and in communication therewith, a discharge pipe extending upwardly from said bore and through the bore of said extension, means connecting the upper end of the pipe with delivery means located exteriorly of the pump, and a check valve preventing return flow from the delivery means toward the valved inlet.

3. In a device of the character described, a vertically arranged, upper cylinder having upper and lower heads, a tubular, axial extension depending from the lower head, a barrel supported at the lower end of the extension and having a lower cylinder in substantial alinement with the upper cylinder, a pair of pistons, one in each cylinder, connected by a rod, extending through said extension, for coincident reciprocation, means whereby pressure fluid may be alternately admitted to and exhausted from the ends of the upper cylinder to reciprocate the pistons, there being a valved inlet for the lower end of said lower cylinder, and there being a bore in said barrel parallel to the lower cylinder and in communication therewith, a discharge pipe extending upwardly from said bore and through the bore of said extension, a check valve in said barrel bore below said pipe, and means connecting the upper end of the pipe with delivery means located exteriorly of the pump.

4. In a device of the character described, a vertically arranged, upper cylinder having upper and lower heads, a tubular, axial extension depending from the lower head, a barrel supported at the lower end of the extension and having a lower cylinder in substantial alinement with the upper cylinder, a pair of pistons, one in each cylinder, connected by a rod, extending through said extension, for coincident reciprocation, means whereby pressure fluid may be alternately admitted to and exhausted from the ends of the upper cylinder to reciprocate the pistons, there being a valved inlet for the lower end of said lower cylinder, and there being a bore in said barrel parallel to the lower cylinder and in communication therewith, a discharge pipe extending upwardly from said bore and through the bore of said extension, and a member extending transversely through one side of the upper end of the extension and having a bore opening at one end outwardly of the extension and opening at its other end to the pipe-bore at a point within the extension.

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