

Feb. 23, 1960

C. W. BLOXOM
DISPENSING APPARATUS

2,925,941

Filed June 28, 1956

4 Sheets-Sheet 1

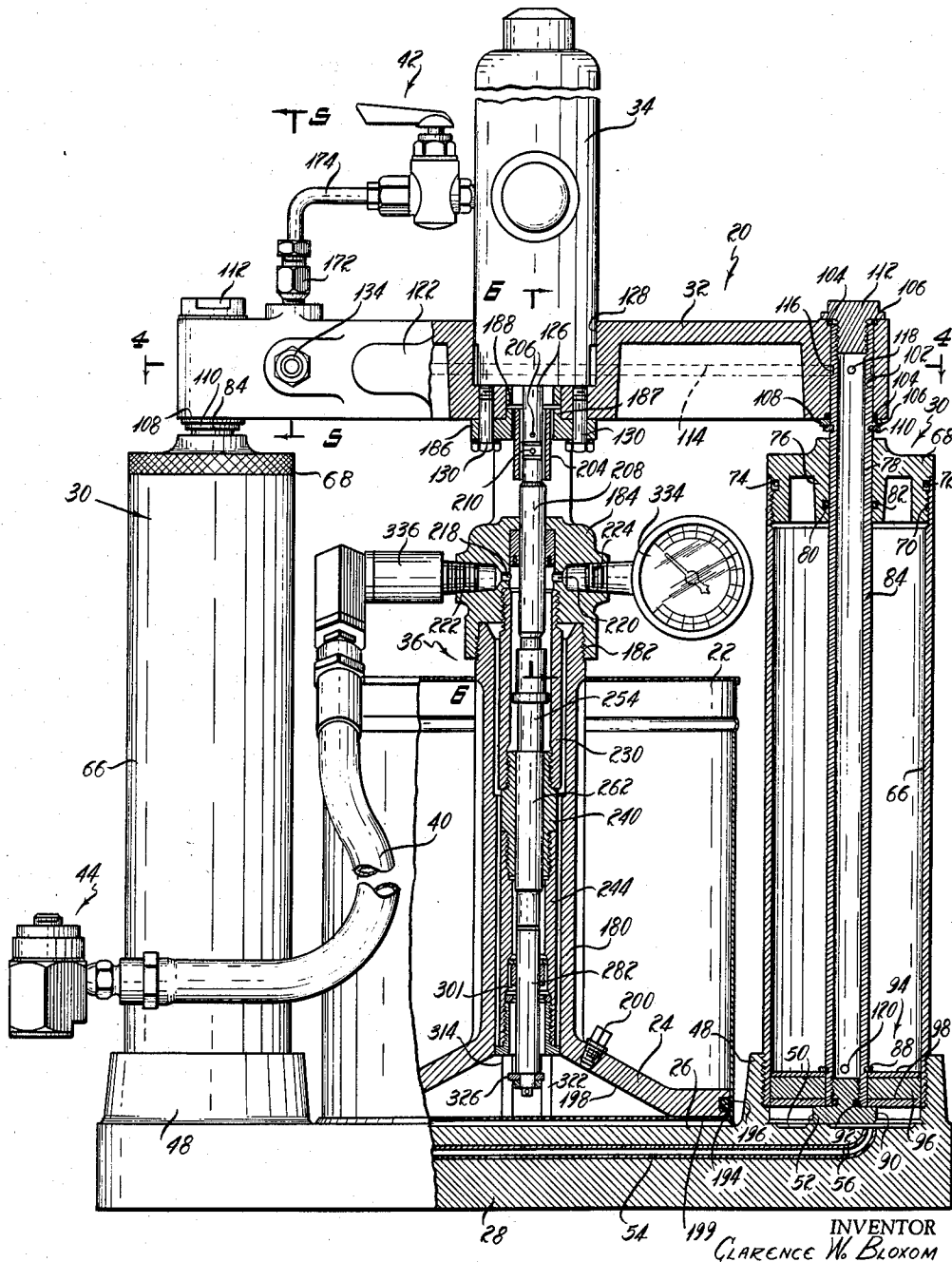


Fig. 1

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4 Sheets-Sheet 2

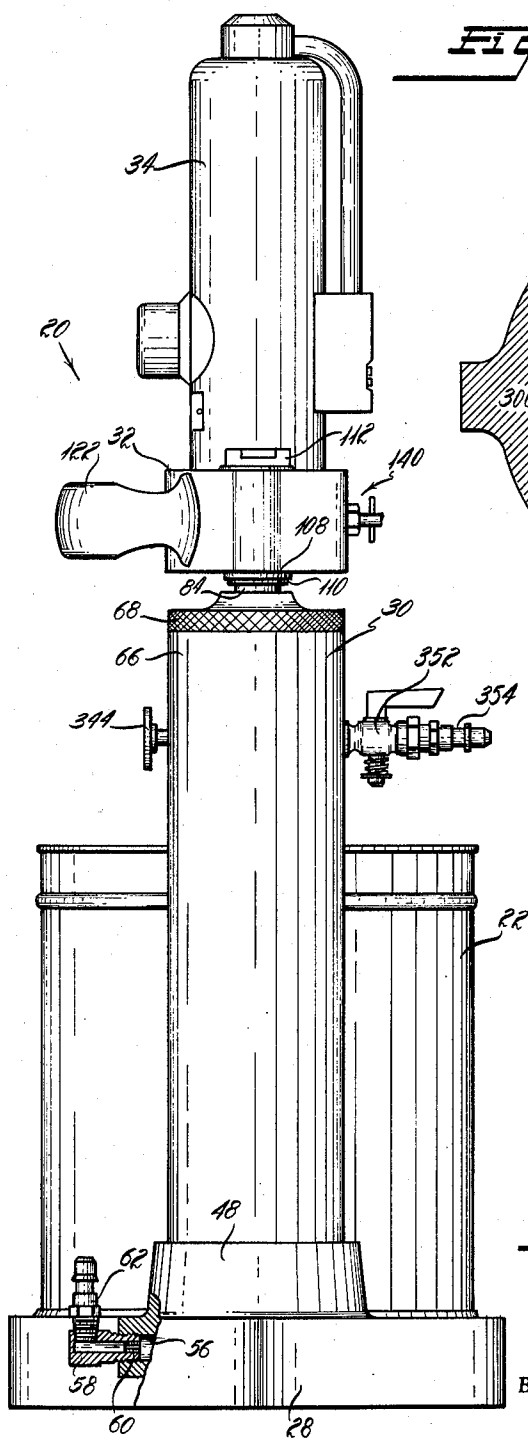


Fig. 2

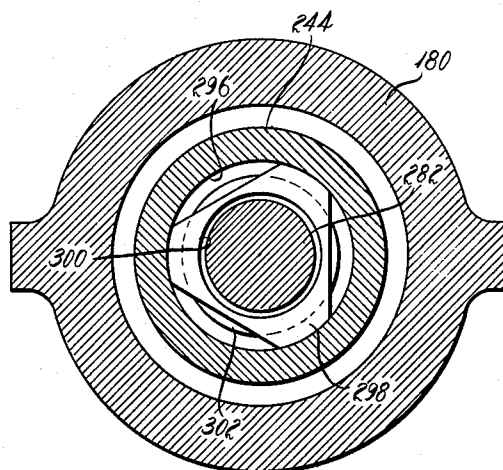
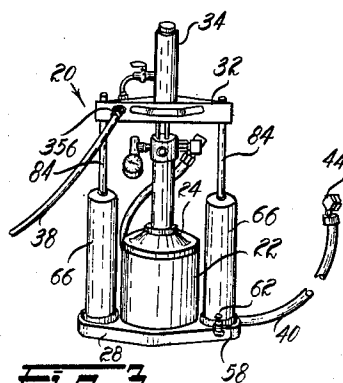


Fig. 3



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4 Sheets-Sheet 3

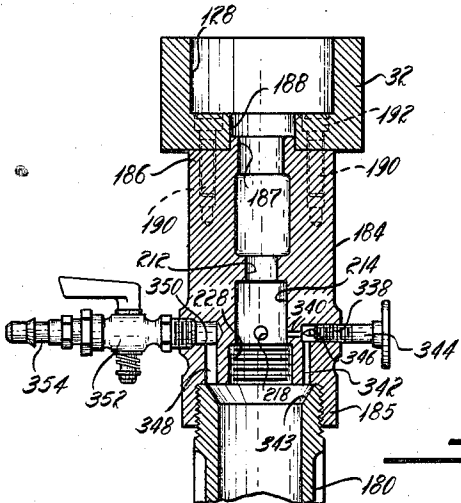
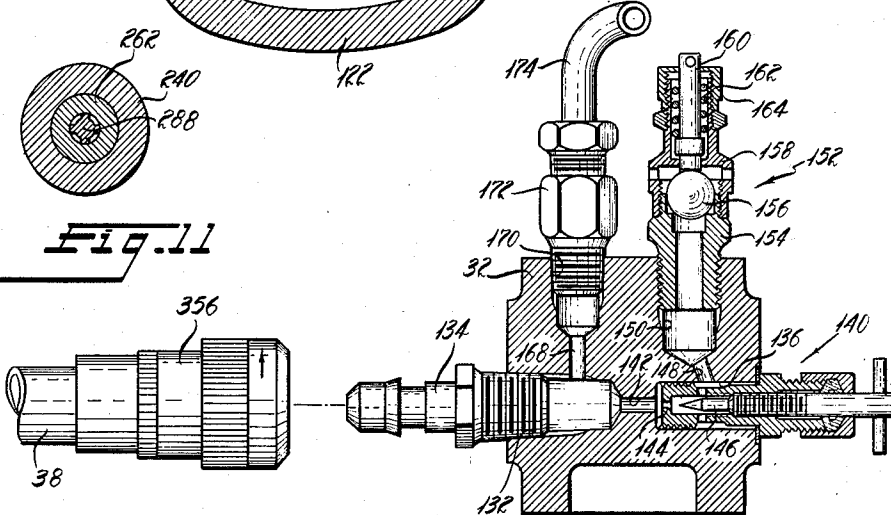
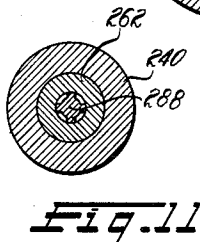
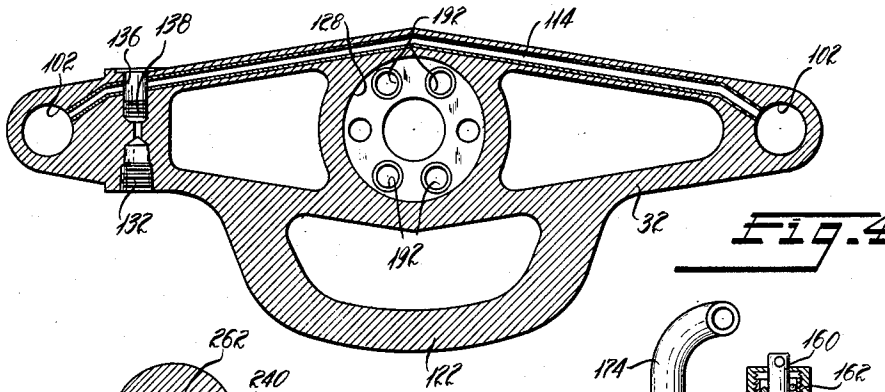


Fig. 9

Fig. 10

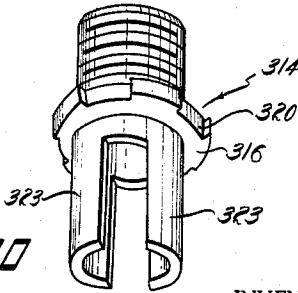


Fig. 6

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4 Sheets-Sheet 4

Fig. 1

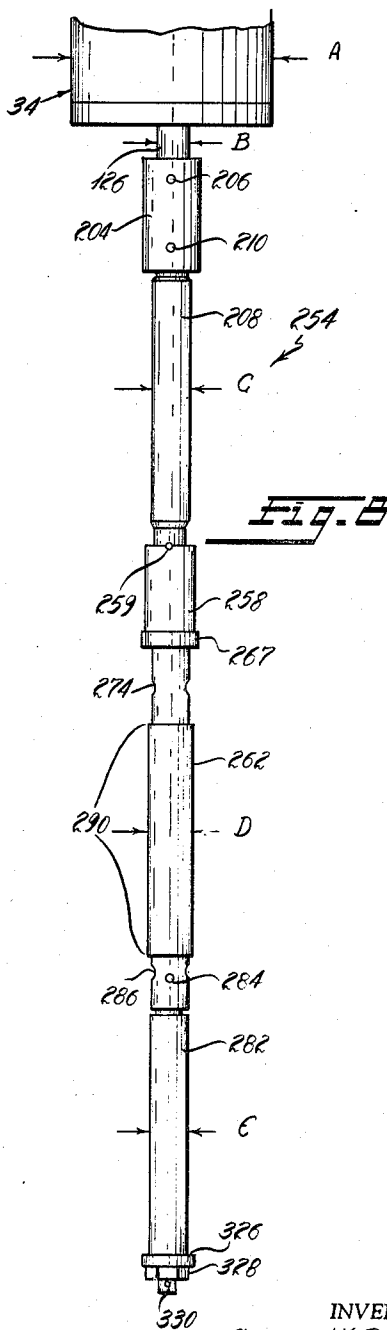
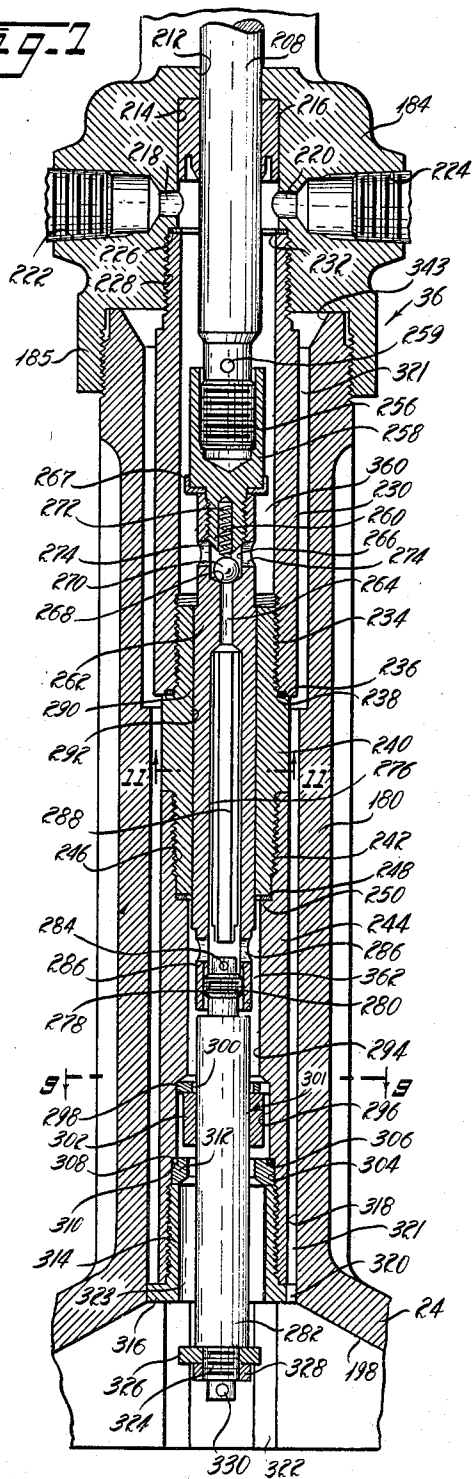


Fig. 2

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DISPENSING APPARATUS

Clarence W. Bloxom, Bakersfield, Calif., assignor to Rockwell Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application June 28, 1956, Serial No. 594,640

7 Claims. (Cl. 222—254)

This invention relates to a high pressure dispensing apparatus and particularly to an air operated, high pressure lubricant or pressure grease gun assembly.

This gun assembly is a combination of air cylinders and pistons assembled in such a manner as to cooperate with a container of lubricant to force lubricant toward a pickup foot which feeds the lubricant to the inlet of an air motor operated high pressure pump. The gun is rugged, compact and extremely efficient and was particularly developed to serve field and plant maintenance needs of lubricated valve users. It provides an ideal portable means for large scale valve lubrication and jacking in refineries, compressor stations, gasoline plants, cycling plants, pipe lines, and Christmas tree installations, among others. The assembly includes a travelling gun mechanism operated by a low pressure pneumatic motor which feeds the gun mechanism into a lubricant container causing the lubricant to be forced into the intake of the high pressure gun mechanism. The actual gun mechanism is a reciprocating piston type arrangement that provides output under pressures up to 15 thousand pounds per square inch on both strokes of the piston with intake occurring only during one stroke. The gun mechanism utilizes a conventional dual acting, automatically reverse cycling, reciprocating air motor which is lowered and raised with the gun mechanism pump unit. This extremely high pressure lubricant gun assembly derives its operating force from a low pressure air line adapted to be coupled to different ones of several nipple connections in the lubricating unit. One of these nipple connections provides power for lowering the gun mechanism into the lubricant container while simultaneously furnishing the power to operate the gun mechanism air motor. After the lubricant container has been exhausted, the entire mechanism can be raised by changing the position of the low pressure air inlet to a second nipple. By making a third change of the low pressure air inlet connection to a third nipple, the exhausted container can be easily removed from the gun mechanism.

Presently known prior art lubricant gun mechanisms do not provide an efficient dependable portable unit such as proposed in this invention. Some of the prior art gun mechanisms together with their operating motor did use a follower plate lowered into a lubricant container to create low pressure on the lubricant thereby forcing it into the gun intake. However, the force causing the plate to lower into the lubricant container was furnished by means such as springs or the weight of the gun mechanism assembly. It is not known that any prior art portable lubricant gun assembly of this type has ever used an air piston ram arrangement for forcing the gun mechanism into the lubricant container. This invention utilizes positive pneumatic lowering of the gun mechanism into the lubricant can by an efficient, force balanced twin ram.

In the past, flat follower plates were used to cooperate with the interior of the lubricant container, but flat follower plates have the disadvantage that the auxiliary pickup or priming mechanism, which at times protruded from

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the bottom of the follower assembly, would abut the bottom of the lubricant container before the container was substantially exhausted. This abutment usually occurred approximately at the center of the container and could result in rupture of the container or disabling of the gun mechanism itself. To obviate this disadvantage, the follower plate mechanism in the present invention has been formed as a shallow inverted dish-shaped or generally conical member with a peripheral seating and sealing surface and an annular base portion that will initially engage the bottom of the lubricant container at the extreme downward end of its stroke. This permits the use of a projected gun priming device centrally located in the conical follower plate. The conical arrangement also deflects the lubricant in the container, which is being placed under compression by pneumatic lowering of the follower assembly, toward the center of the conical follower plate. In this manner substantially all lubricant in the container is available for high pressure pumping.

As distinguished from the known prior art high pressure lubricant guns which have an intake on one stroke and an exhaust on the other stroke or have a dual function of intake and exhaust on both strokes, this invention utilizes a new type high pressure pump assembly which creates up to fifteen thousand pounds per square inch on both strokes and has the expansible chambers and pump valving so arranged to permit sufficient intake during only one stroke to supply the lubricant required for the output on both strokes.

Accordingly, a primary object of this invention resides in providing a novel compact, air operated, high pressure gun assembly.

A further object resides in providing a high pressure lubricating gun assembly movable into and out of a lubricant container and in this connection a novel balanced pneumatic feeding arrangement is provided.

A still further object resides in providing a compact portable air operated lubricating gun having provision for placing a disposable lubricant container below a travelling gun mechanism, the gun mechanism including a follower plate that cooperates with the sides of the lubricant container in a sealed fashion and has a conical deflecting member for guiding lubricant into the gun mechanism intake.

Another object of this invention resides in providing a high pressure gun mechanism of the reciprocable piston type in which high pressure output of pumped medium occurs during both strokes of the piston and intake occurs only during one stroke of the piston. In this connection a two-section pumping chamber is provided in the gun, both sections of which are utilized to create output during one stroke of the piston and, during the other stroke only one of the sections is used to create output while the other chamber section is being utilized to create pump intake during the opposite stroke of said piston.

Still another object of this invention resides in providing a high pressure pump including a two-section pumping chamber, both sections being in fluid communication during pumping strokes in one direction, with provision for isolating the two pumping sections during pumping strokes in the other direction so only one chamber section is exhausting while the other section is acting as an intake chamber. The dimensions of the pistons and piston rods relative to the chamber dimensions are so proportioned relative to each other that the intake volume during the one stroke in the one direction is equal to the output volume during pumping strokes in both directions.

Further novel features and objects of this invention will become apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings showing a preferred embodiment thereof, in which;

Figure 1 is a partially sectioned elevation view illustrating the low pressure air rams, air motor and high pressure gun mechanism in accordance with this invention;

Figure 2 is a side elevation of the lubricant gun shown in Figure 1;

Figure 3 is a perspective view illustrating the operational condition of the lubricant gun with the follower plate inserted in a full can of lubricant;

Figure 4 is a sectional view taken on line 4—4 of Figure 1 showing details of the yoke;

Figure 5 is an enlarged section view taken on line 5—5 of Figure 1 illustrating the ram control valve;

Figure 6 is a detail section taken on line 6—6 of Figure 1 illustrating details of the venting valves and omitting the pump rod and air motor;

Figure 7 is an enlarged sectional view of the high pressure pumping structure in the follower plate sleeve;

Figure 8 is a detail elevation view of the pump rod assembly with the air motor illustrated diagrammatically to show the relationship between the diameters of the various components;

Figure 9 (on Sheet No. 2) is an enlarged section taken on line 9—9 of Figure 7 illustrating the shape of the foot valve stop washer;

Figure 10 (on Sheet No. 3) is a detail perspective view of the primer body located at the center of the follower plate; and

Figure 11 is a section taken on line 11—11 of Figure 7 illustrating the cross section shape of the pump piston plug.

With specific reference to the drawings, Figures 1, 2 and 3 illustrate the operative construction of the grease gun 20, Figure 3 showing the position assumed when a full container of lubricant grease is cooperatively fitted in the gun and Figure 1 showing the position assumed when the lubricant container is empty. The follower plate 24 is constructed of such a diameter to cooperate in sealing relationship with the diametral dimension of commercially available lubricant cans 22. Can 22 fits in a circular depression 26 formed in a base casting 28. Dual air ram motors 30 are fixed to and project upwardly from base 28 on diametrically opposed sides of the can depression 26. A yoke casting 32 is fastened to the movable portions of ram motors 30 and is reciprocated upward or downward by actuation of ram motors 30 in a vertical path. Supported on the upper side of yoke 32 is an automatically reversing dual acting, reciprocating air motor 34, a conventional item, operable under relatively low pressure, e.g., a maximum of 150 p.s.i. In coaxial alignment with and connected to be operated by the air motor 34 a high pressure pump 36, and the follower plate 24 depend from the yoke 32. A low pressure inlet air hose 38 is connected to a fitting in the yoke 32 for pressure operation and a high pressure lubricant conduit 40 is connected to the outlet of high pressure pump 36. Suitable valves and controls, to be hereinafter described in detail, are incorporated in the various components just described.

Briefly, the operation requires that a can of lubricant 22 be inserted in the base depression 26 when ram motors 30 are in extended position as shown in Figure 3. Air pressure is then admitted to the ram motors 30 which press the follower plate 24 into the can 22 under relatively low pressure to place the lubricant in the can under a low pressure causing it to feed toward the intake of high pressure pump 36. The same air pressure source which actuates ram motors 30 is also connected to operate the automatic air motor 34 under control of a throttle valve 42 to automatically reciprocate the high pressure pump 36. This will create high pressure lubricant pressure up to a maximum of 15 thousand p.s.i. The lubricant under pressure is directed through conduit 40 to a slide head coupler 44, an example of which is

disclosed in copending application Serial No. 378,382, filed September 3, 1953 by Barnard Last et al., now Patent No. 2,783,063, granted Feb. 26, 1957.

Base casting, ram motors and yoke

Figures 1 and 2 illustrate the structure of base 28 which has the circular recess 26 in its upper surface to receive can 22. At diametrical locations relative to recess 26, two upstanding internally threaded annular collars 48 are formed on base 28. Each collar 48 provides a short cylindrical chamber having inside end wall 50 with a shallow boss 52 projecting upward therefrom and located slightly eccentric to the center of the collar. To provide fluid communication between the two chambers formed by annular collars 48, a tubular conduit 54, that can be cast integrally in the base 28, extends horizontally through base 28 opening into the collar chambers through their end walls 50. Shown in Figure 2, a cross passage 56 intersects conduit 54 and has a threaded inlet receiving an elbow 58 with restrictor orifice 60. The outside end of elbow 58 has a suitable air connection, such as the nipple 62, threadedly received therein.

An upright cylinder 66 is threadedly secured in each annular collar 48 and the upper end of each cylinder is closed by a cylinder head 68 secured by threaded connection 70. An external annular groove 72 above the threads on cylinder head 68 retains an O-ring 74 to provide a fluid tight seal between the cylinder head 68 and cylinder 66. The center of cylinder head 68 has a sleeve-like hub 76 with an axial, concentric through bore 78. An internal groove 80 in bore 78 receives an O-ring 82 to cooperate with the external surface of a hollow piston rod 84, which is disposed through the bore 78 in cylinder head 68, and thus forms a fluid tight seal between cylinder head 68 and the vertically reciprocable piston rod 84.

Adjacent the end of piston rod 84 disposed inside cylinder 66 an annular groove 86 is provided and receives a retaining ring 88. The lower end of piston rod 84 is internally threaded and receives a piston retaining screw 90, the shank of which is undercut to carry a sealing O-ring 92 that provides a fluid tight seal between retaining screw 90 and the interior of piston rod 84. Clamped between the head of retaining screw 90 and retaining ring 88 is a piston 94 consisting of suitable piston packing 96 sandwiched between two packing retaining washers 98, the piston 94 being suitably apertured to fit over the end of piston rod 84.

Yoke 32, illustrated in horizontal detail section in Figure 4 and partial vertical section in Figure 1, extends over the tops of the diametral cylinders 66. Each end of yoke casting 32 is formed with a vertical bore 102, dimensioned to receive the upper end of piston rod 84 [Figure 1]. The upper and lower ends of bores 102 are counter-recessed at 104 to receive O-rings 106 providing a fluid tight seal between piston rods 84 and the yoke bores 102. A yoke retaining washer 108 fits over the piston rod 84 and abuts the lower surface of yoke 32 adjacent the associated bore 102 and is retained against axial movement on rod 84 by a clip ring 110 fitted in an appropriate annular groove in piston rod 84. An upper end yoke retaining screw 112 engages internal threads in the upper end of piston rod 84 and its flanged head is disposed over the edge of counter-recess 104 and the upper O-ring 106 causing the O-ring to compress into sealing engagement in the counter-recess. Tightening of screw 112 clamps the yoke on the upper end of piston rod 84 between the head of screw 112 and the retaining ring 108. Identical reference numbers are used for both ram motors 30 and the component parts. The rigid connection between the two piston rods 84 and the opposite ends of yoke 32 together with the vertical guide function provided by cylinder head hubs 76 enable an accurate guide for yoke 32 during reciprocation.

A conduit 114 is integrally cast in the yoke (Figure 4) 32 to form a fluid communication between the end bores 102. Each of the piston rods 84 has an annular groove 116, adjacent its upper end, so located as to be disposed in alignment with the associated end of conduit 114 when the piston rods 84 and yoke 32 are clamped together as previously described. In Figure 1, it will be seen that cross passages 118 intersecting annular groove 116 will enable fluid communication between conduit 114 and the interior of hollow piston rod 84. A second cross passage 120 at the lower end of hollow piston rod 84 provides fluid communication between the interior of cylinder 66 above piston 94 and the interior of piston rod 84. Suitable related abutment cooperation between the piston 94 and the cylinder head 68 (not shown) is provided so free communication through the cross passage 120 to the interior of cylinder 66 is maintained even when the piston 94 is at the upper end of its stroke.

Air pressure admitted to the yoke conduit 114, in a manner to be later described, will be directed through each of the hollow piston rods 84 to the interior of cylinder 66 above piston 94 to force both pistons 94 and the yoke 32 downwardly with them. Air from the cylinders, below the pistons 94, will be exhausted through the base conduit 54 and through the cross passage 56, restricted orifice 60, elbow 58 and nipple 62, to be exhausted to atmosphere. Orifice 60 in elbow 58 provides sufficient restriction to prevent high speed travel of the ram motors 30. Note low pressure actuates air motors 30 and is preferably no greater than 150 p.s.i. line pressure.

A handle 122 is attached to the yoke 32 by integral casting as shown, or by separable attachment. The handle provides a manual means for moving the yoke casting up or down relative to the base casting and also provides means for carrying the grease gun from one location to another.

A conventional dual acting, automatically reversing air motor 34 with a reciprocating motor shaft 126 is secured in an annular recess 128 formed in the upper side of yoke 32 and the axis of motor shaft 126 is disposed vertically and parallel to the ram motor piston rods 84. Motor 34 is secured by two bolts 130 passing up through the yoke 32. Threadedly connected in one side of air motor 34 is a throttle valve 42 used to control the rate of reciprocation of the motor shaft 126.

Shown adjacent the left hand side of Figures 1 and 4, yoke 32 has a threaded inlet 132 that receives an air hose nipple connection 134 similar to nipple 62 in the base 28. The opposite side of yoke 32 has a bore 136 intersecting conduit 114, the inner end 138 of bore 136 being threaded. Received in and secured by threads 138 in bore 136 [Figure 5] is a needle valve 140 to control ram motor operation. A cross passage 142 connects through the end wall of needle valve bore 136 to inlet bore 132. An orifice 144 in the needle valve 140 is controlled by needle 146 to permit communication between the cross passage 142 and the yoke casting conduit 114.

A short vertical passage 148 connects needle valve bore 136 to a tapped hole 150 in the upper side of yoke 32. Received within the tapped hole 150 is a ball type adjustable relief valve 152 consisting of a seat body 154, ball 156, an outlet body 158, a plunger 160, a coil spring 162 and an adjustment cap 164. By adjusting cap 164, the operational pressure for ram motors 30 can be reduced from the fixed pressure of the air pressure source to a desired lower value for a purpose as will appear hereinafter.

Also shown in Figure 5 a short cross passage 168 leads from air pressure inlet 132 in yoke 32 to a second vertical tapped hole 170 in the upper side to the yoke. An end fitting 172 for an air pressure conduit 174 is secured in tapped hole 170, with conduit 174 connected to the inlet side of throttle valve 42. When an air pressure

connection is made to nipple 134, air under pressure is furnished through ram control valve 140 and conduit 114 to each of the ram motors 30 and also through cross passage 168, conduit 174 and throttle valve 42 to the automatic air motor 34. Operation of ram motor 30 is controlled through the ram needle valve 140 and relief valve 152 while operation of the automatic air motor 34 is controlled by throttle valve 42.

Follower plate and high pressure pump

The follower plate 24 and high pressure pump 36 are fastened to the lower side of yoke casting 32 and, as a unit, can be moved up or down by the ram motors 30. Details of the follower plate 24 and pump 36 are illustrated in section in Figures 1 and 6 and in enlarged sectional detail in Figure 7. The pump rod assembly including the air motor piston is illustrated in elevation in Figure 8 in order to clearly show the construction and relationship between the various sections of the pump plunger which reciprocates as a unit with the automatic air motor shaft 126.

Follower plate 24 is integrally cast with an upstanding hollow sleeve 180 the top of which has external threads 182. A pump body casting 184 with a cup shaped lower end 185 having internal threads is screw threaded tightly on upper end threads 182 of the follower sleeve 180. The upper end of pump body casting 184 constitutes a mounting pad 186 with a center axially directed flange 187 piloted in a through bore 188 coaxial with automatic motor recess 128 in yoke 32. Shown in Figure 6 the pump body casting 184 is rigidly secured to yoke 32 by four bolts 190 passing downwardly through counter-sunk bores 192 in the yoke recess 128. The aforementioned air motor mounting bolts 130, shown in Figure 1, pass through the pump body mounting pad 186 and help to rigidly maintain the pump body casting 184 on the yoke 32. It will thus be seen that movement of yoke 32 by the ram motors 30 will, through pump body casting 184, cause vertical movement of the follower plate 24. When a can 22 of lubricant grease is placed below the upraised follower plate 24 as seen in Figure 3, the periphery of plate 24 is of such dimension as to pass vertically into the can 22 with a close free fit. The periphery of follower plate 24 has a groove 194 that receives an O-ring 196 that engages the wall of lubricant can 22 and provides a fluid seal between the follower plate 24 and the can 22.

The central portion of follower plate 24 is formed with a slight conical shape resulting in a conical recess 198 on its lower peripheral side surrounded by a plane annular shoulder 199. As the follower plate 24 is moved downward under the force of ram motors 30, the lubricant in can 22 will be placed under a pressure, escape being prevented by cooperation between the O-ring 196 and the wall of the can 22. This pressure will tend to force the lubricant into the conical recess 198 on the under side of follower plate 24 to be there directed up toward the center of the hollow follower sleeve 180. In a preferred construction, the relationship between the areas of ram pistons 94 and the follower plate 24 is such that pressure exerted on the lubricant will be approximately 35 to 40 p.s.i. when 150 p.s.i. line pressure is directed into the ram motors. Shown in Figure 1, a pipe plug 200 is fitted in a threaded aperture in the upper surface of follower plate 24. Upon initial placement of the follower plate 24 in a new full can of lubricant, air trapped in the conical recess 198 can be vented by removing plug 200. This is an auxiliary means for venting and will not normally be used. A more convenient venting mechanism is provided and will be later described.

With particular reference now to Figure 7, the high pressure pump 36 will be described. Before fastening the air motor 34 to yoke 32, its reciprocating shaft 126

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is threaded into one end of a coupling 204 and fixed by a roll-pin 206. A motor shaft extension 208 is threaded into the lower end of coupling 204 and fixed by a second roll-pin 210. The pump body casting 184 is then bolted in place on the yoke 32 with the motor shaft extension 208 passing through a lower bore 212 which is coaxial with the threaded cup shaped connection 185 to the follower plate sleeve 180. Motor shaft extension 208 passes through bore 212 with a close running fit. Placed in a counter-bore 214, in pump casting 184 immediately below the bore 212, a piston end packing 216 forms a high pressure seal between the pump body casting 184 and motor shaft extension 208. Just below the pump end packing 216, two radial passages 218 and 220 connect the counterbore 214 with two radially disposed tapped openings 222 and 224 respectively, the purpose of which will be later described. Just below radial passages 218 and 220 an end shoulder 226 is formed by a threaded counterbore 228. Received and threadedly secured in the counterbore 228 is a downwardly projected sleeve extension 230 which provides annular clearance spaces between the shaft extension 208 and sleeve 230 and between the follower sleeve 180 and sleeve 230. Tightly compressed between the upper end of the sleeve extension 230 and the counterbore shoulder 226 is a high pressure gasket 232 providing a high pressure fluid tight seal between sleeve 230 and pump casting head 184. The lower end of sleeve extension 230 is internally threaded at 234 with the lower annular edge provided with a counterbored recess 236 retaining a high pressure gasket 238. All high pressure gaskets are preferably copper.

Secured to the lower end of sleeve extension 230 by engagement with threads 234 is a pump cylinder 240 whose annular mid portion provides external shoulders, the upper one clamping gasket 238 tightly in its annular recess 234 to form a high pressure fluid tight seal between cylinder 240 and extension sleeve 230. Lower end portion 242 of pump cylinder 240 is externally threaded and its lower end is formed in a radially plane surface. The external circumferential dimension of the mid portion of cylinder 240 provides a free annular space between the cylinder and the surrounding follower sleeve 180.

A lower sleeve extension 244 with an upper end bore 246 is internally threaded and secured to the lower threaded end portion 242 of pump cylinder 240. The threaded bore 246 terminates in a radial shoulder 248 and an annular high pressure gasket 250 is clamped between the lower end of cylinder 240 and shoulder 248 to provide a fluid tight high pressure seal between the cylinder 240 and the lower sleeve extension. Lower sleeve extension 244 has an external dimension to leave an annular space between the sleeve 244 and follower sleeve 180.

The high pressure pump rod assembly 254 shown in detail in Figure 7 and assembled in Figures 1 and 8 includes the motor shaft extension 208 which is coupled to the dual automatic air motor shaft 126. The externally threaded lower end 256 of shaft extension 208 is threadedly secured in the female end of a male-female rod coupling 258 and locked by a lock pin 259. The male end of coupling 258 includes a coaxial blind bore 260 and is externally threaded. A high pressure piston 262 with a coaxial through bore 264 and an upper end internally threaded counterbore 266 is secured to the male end of coupling 258 and locked with lock washer 267. The intersection of bore 264 and counterbore 266, provides a check valve seat 268 surrounding the upper end of bore 264. Disposed within the counterbore 266 and resting on valve seat 268 is a valve ball 270 and a spring 272 is retained in the blind bore 260 in the lower end of coupling 258 to lightly resiliently bias ball 270 into engagement with the valve seat 268. Sufficient clearance is provided between the lower end 260 of coupling 258 and ball 270 to permit ball 270 to move up and unseat.

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Adjacent the ball 270, radial side passages 274 provide fluid communication between the interior of piston counterbore 266 and the interior of upper sleeve extension 230.

The lower part of through bore 264 in piston 262 is enlarged by a counterbore 276, the lower end of which is internally threaded at 278 to receive the threaded upper end 280 of a primer rod section 282. After primer rod 282 is threadedly secured into the lower end of piston 262 it is rotatably fixed therein by means of a pin 284 which passes through the piston and the upper end 280 of the primer rod. Immediately above the end 280 of primer rod 282, radial side passages 286 in piston 262 provide fluid communication between the piston counterbore 276 and the interior of lower sleeve extension 244. Contained within the piston counterbore 276 is an elongated floating plug 288 which has a plurality of external axial grooves (Figure 11) to enable fluid communication from the lower end of counterbore 276 to its upper end and through the bore 264. The purpose of piston plug 288 will be described in connection with the unit operation.

The intermediate extent 290 of piston 262 is provided with a smooth finish cylindrical external portion of a specified dimension, correlated hereinafter with the other sections of piston rod 254, which is disposed with very close sliding fit within the bore 292 of cylinder section 240.

Primer rod 282 extends down through the sleeve extension 244 into the conical recess 198 of the follower plate 24. The length of stroke of the piston rod 254 is such that the lower end of primer rod 282 will never contact the bottom of can 22.

Lower extension sleeve 244 has a through bore 294 that surrounds the lower end of piston 262 with its radial passages 286. Below the bore 294, sleeve extension 244 is counterbored to form a foot valve chamber 296. Disposed with a sliding fit in the chamber 296 is a generally triangular foot valve stop washer 298, centrally apertured at 300 for a free spaced fit surrounding primer rod 282. The surface of primer rod 282 is a smooth cylindrical finish and disposed thereon, immediately below the foot valve stop washer 298, is a sliding foot valve sleeve 302. Sleeve 302 has a very close running fit on primer rod 282 so that passage of grease between sleeve 302 and primer rod 282 is prevented.

The sleeve extension 244 has a further counterbore 304 below counterbore 296, providing an annular shoulder 306 at the lower edge of counterbore 296. Disposed against shoulder 306 is a high pressure gasket 308, which is clamped between the shoulder and an annular recess 310 on the upper end of an annular valve seat 312. Seat 312 is centrally apertured to provide an annular space between the valve seat and primer rod 282. The lower edge of the foot valve sleeve 302 seats on the upper surface of seat 312 to provide a closed foot valve. Valve seat 312 is retained at the smooth walled end of counterbore 304 against the gasket 308 and is thus retained in fluid tight engagement against shoulder 306, by a sleeve-like primer body element 314 which is threaded in the lower portion of counterbore 304 which is the end portion of sleeve extension 244. As seen in Figure 10 (Sheet 3) the primer body 314 includes an intermediate external flange 316 whose peripheral surface pilots into the lower opening of bore 318 in follower sleeve 180. Suitable cutouts 320 are provided in the periphery of flange 316 to enable free communication between the conical recess 198 in the underside of follower plate 24 and the annular space 321 between the assembled sleeve extension 230, cylinder 240 and sleeve extension 244 and the bore 318 of follower sleeve 180.

The inner dimension of primer body 314 is sufficiently large to enable an annular space 323 between the primer rod 282 and the primer body. The lower portion of primer body 314 has spaced dependent legs 322 extend-

ing to a position substantially coextensive with the bottom edge of follower 24. Lower end 324 of primer rod 282 is reduced and threaded and carries a steel washer 326 of slightly smaller diameter than the inside of primer body 314. Washer 326 is secured on the end of primer rod 282 by a nut 328 which is retained in position by a cotter key 330.

The follower plate 24 and integral sleeve 180 can be removed from around the pump 36 by unscrewing from pump head 184 and slipping relatively downward. This feature enables use of different follower plate units, with plate peripheries to fit inside different sized cans, on the same pump assembly.

Whenever the pump rod assembly 254 is reciprocated, the foot valve sleeve 302 will move upwardly until it abuts the stop washer 298 and downwardly until it abuts the valve seat 312 at which positions the primer rod can continue to shift axially relative to the foot valve sleeve 302 and still maintain a sealing engagement between primer rod 282 and sleeve 302. Looking now at the upper end of the high pressure pump assembly (Figure 1), a high pressure gage 334 (15,000 p.s.i.) is threadedly secured in tapped opening 224. A high pressure fitting 336 is threadedly secured in the opposed tapped opening 222. Connected in fluid communication with fitting 336 is a high pressure conduit 40 having a button head coupling 44 connected on its opposite end. Button head coupling 44 can be readily, removably coupled to any desirable grease fitting, as for example, the grease fittings on lubricated valve assemblies. Until such time as coupling 44 is fitted on a suitable grease fitting it is automatically maintained in a closed position.

Figure 6 is a section through the upper end of the pump assembly taken 90 degrees from the section shown in Figures 1 and 7 with the pump rod assembly 254 omitted for clarity and illustrates the provision for normally venting any entrapped air beneath the conical recess 198 of follower plate 24 or to eliminate air binding of the high pressure pump assembly 36. On substantially the same horizontal plane in the pump head casting 184 as the pressure outlets 222 and 224, is a threaded bore 338 with its inner end connected by a short passage 340 with the counterbore 214 in the pump body casting. A vertical side passage 342 connects between the side of threaded bore 338 and the upper end of the annular space 321 (Figure 7) between sleeve extension 230 and the follower sleeve 180. The upper end of follower sleeve 180 has an internal countersink 343 to prevent blocking of the vent passages. A needle valve 344 is threaded in the threaded bore 338 with its needle 346 coacting with the seat end of short passage 340. When needle valve 344 is opened the pump head counterbore 214 is in fluid communication, through passages 340 and 342, with the annular space 321. At the rear side of the pump body casting 184, a second short vertical passage 348 intersects a radial passage 350 which is threaded and receives a cock valve 352. The free end of cock valve 352 contains a nipple fitting 354 similar to the afore mentioned nipple fittings 62 and 134. When needle valve 344 and cock valve 352 are opened there is free communication between the pump body counterbore 214 and the space 321 within sleeve 180 and from that space to atmosphere enabling trapped air on the discharge side of high pressure pump 36 to be vented to atmosphere as will be described.

Operation

Operational factors are given for an exemplary 15,000 p.s.i. gun structure, and various values may differ depending upon structural modifications for different gun dimensions and pressure values.

Prior to initiating operation and using the lubricant gun, yoke 32 with pistons 94, high pressure gun 36 and follower plate 24 must be raised to a position approximate their upper limit of travel. This can be accomplished in several ways. Without air pressure con-

nections, the ram motor control needle valve 140 is turned to an open position. The yoke and attached apparatus can then be raised by grasping the handle 122 and exerting an upward force. The air above piston 94 will be exhausted through passage 120, hollow piston rod 84, upper passage 118, conduit 114, needle valve 140 and thence through the nipple 134. Movement will necessarily be slow because of the orifice restriction 60 in the base casting 28 and the orifice 144 in needle valve 140. The preferred method of raising the assembly is to attach the low pressure air hose connection 356 to the base nipple 62 and admit air pressure below pistons 94. This will easily raise the yoke 32 together with high pressure pump 36 and followed plate 24. It will be understood that any suitable gas equivalent to air may be used.

If an empty lubricant can 22 is on the follower 24 it will be raised with the follower. To remove it for replacement with a full can, valve 140 should be closed to prevent the yoke and associated members from moving slowly down as air escapes from the orifice elbow 58. Air hose fitting 356 is removed from nipple 62 and placed on nipple 354 in the pump head 184. Cock 352 is then opened, admitting air under pressure into the space 321 inside follower sleeve 180 and down past the primer body 314 into the can 22 to blow the can off the follower 24. Cock 352 is then closed.

The can of lubricant or lubricant grease appropriately sized to the follower plate of the gun apparatus being used will be positioned below follower plate 24 in recess 26 in base 28 (Figure 1). The air pressure fitting is placed on the yoke nipple 134 and the follower plate 24 will be moved down into the lubricant can when the ram motor control valve 140 is opened. Needle valve 140 admits air at a maximum of 150 pounds per square inch pressure through the yoke conduit 114, piston rod passages 118 and 120, into the upper ends of cylinders 66 above pistons 94 to force the yoke, high pressure pump 36 and follower plate 24 into the lubricant can. The concave construction of the conical recess 198 in follower plate 24 together with the pressure exerted on the contained lubricant (35-40 p.s.i. under 150 p.s.i. line pressure) and the O-ring seal at the periphery of the follower plate forces the lubricant grease toward the center opening of follower plate 24. At this point the grease is picked up by the primer foot washer 326 which reciprocates with the pump rod 254.

When the air pressure connection 356 is fastened to the yoke nipple 134, that air under pressure also passes through conduit 174 to the dual acting automatic air motor throttle valve 42. By appropriate adjustment of throttle valve 42 the automatic air motor 34 can be set to operate at a preferred 150 strokes per minute. As lubricant is picked up by primer washer 326 it is fed up into the space 323 between the primer body 314 and the primer rod 282, passing up through the valve seat 312 on up strokes of pump rod assembly 254 into the annular chamber 296 surrounding the foot valve sleeve 302. On down strokes of the pump rod assembly 254 the primer rod portion 282 will carry the foot valve sleeve 302 until the sleeve 302 seats on valve seat 312 which seals off lubricant return from foot valve chamber 296 into the can.

The lubricant pressure build up is attained through a pressure differential due to reduced area of chambers through which the lubricant progresses upward along the reciprocating pump rod, together with the foot valve and ball check valve which prohibit lubricant return. The piston plug 288 acts as an air emulsifier, i.e., it breaks up air bubbles which may be forced into the pumping chamber by the pick up foot assembly 326. Pumping action will be described in full but before actually pumping pressure can build up to the high pressures desired, entrapped air between the follower plate 24 and the lubricant in the can must be exhausted.

With the automatic air motor in operation, the vent cock 352 is fully opened and needle valve 344 opened several turns. As the air motor 34 operates, air and lubricant will be pumped through pump 36 and vent into space 321 in the follower sleeve, the air being thence vented out passages 348, 350 and vent cock 352. A small amount of lubricant may pass out of the cock 352 during venting but most entrained lubricant will pass down into space 321 while the air vents overboard. After venting is complete the needle valve 344 and cock 352 should be closed and the reading on pressure gauge 334 noted. If it does not immediately build up to several thousand pounds further venting may be required. The same venting procedure is used in the event the gun becomes air bound during operation.

The high pressure pump has been hereinbefore described as a reciprocating piston pump that has output pumping functions during both strokes and has its intake function during one of those strokes, the upstroke of pump rod assembly 254. Therefore the intake volume of medium being pumped during an upstroke of pump rod assembly 254 must be equal to the output during both the upstroke and the downstroke of the pump rod assembly. To accomplish this function, an expandable pumping chamber consisting of an upper section 360 (Figure 7) and a lower section 362 is provided by structural cooperation between the reciprocable pump rod assembly 254 and the pump body casting 184, upper sleeve extension 230, cylinder section 240, lower sleeve extension 244 and the foot valve 301. Cooperation between the intermediate section 290 of the pump rod piston 262 and the cylinder bore 292 provides a division wall between sections 360 and 362 of the pumping chamber.

The pump rod piston 262 includes the upper side passages 274 opening into the upper pump chamber section 360, the ball check valve 270, the axial through passages 264 and 276 connecting with side passages 286 opening into the lower pump chamber section 362. Ball check valve 270 isolates the pump chamber sections 360 and 362 as individual separate chambers during an upstroke and permits fluid communication between the two chambers during a downstroke, in effect making the two sections 360 and 362 act as a single pump chamber.

Output of the pump during an upstroke will be determined by the decrease in volume of pump chamber section 360 which, because ball check valve 270 is closed, is equal to the difference between the cross section areas of the intermediate section 290 of piston 262 and the air motor shaft extension 208 times the length of pump rod stroke.

Output of the pump during a downstroke will be determined by the decrease in volume of the combined pump chamber sections 360 and 362 which, because ball check valve 270 will open and foot valve 301 will close, is equal to the difference between the cross-section areas of the primer rod 282 and the air motor shaft extension 208 times the length of pump rod stroke. The intermediate section 290 of piston 262, being by-passed by ball check valve 270, does not affect the downstroke pumping output.

Intake occurs only during the upstroke and then only in lower pump chamber section 362. It is accomplished by inspiration and is determined by the increase in volume of the lower pump chamber section 362 which is equal to the difference between the cross-section areas of the intermediate section 290 of piston 262 and the primer rod 282 times the length of pump rod stroke.

To create output on the upstroke when air motor shaft extension 208 is moving out of and intermediate piston section 290 is moving into the upper pump chamber section 360, the intermediate piston section 290 must have the larger cross section area of the two. To create output on the down stroke when air motor piston rod shaft extension 208 is moving into the upper chamber section 360 and primer rod 282 is moving out of lower chamber

section 362, the air motor shaft extension 208 must have the larger cross section area of these two components. To create intake by inspiration on the upstroke, when the intermediate piston section 290 is moving out of and the primer rod 282 is moving in the lower chamber section 362, the intermediate piston section 290 must have the larger area of these two components.

Thus the intermediate piston section 290 has a greater cross-section than air motor piston rod shaft extension 208, which has a greater cross section area than primer rod 282. Also the volumetric change in lower chamber 362 on upstroke must equal volumetric change in the upper chamber 360 on an upstroke plus the volumetric change in both chambers on a down stroke.

Referring to Figure 8, the air motor and high pressure pump rod diameters are designated by letters as follows:

- A—Air motor piston
- B—Air motor piston rod
- C—Air motor piston extension
- D—Pump piston intermediate section
- E—Primer rod.

Using L to designate the length of the pump rod stroke, the following relationship shows that intake will equal output.

Upstroke output will equal:

$$\pi/4(D^2-C^2)L$$

Downstroke output will equal:

$$\pi/4(C^2-E^2)L, \text{ and}$$

Upstroke intake will equal:

$$\pi/4(D^2-E^2)L$$

The intake equals output:

$$\pi/4(D^2-E^2)L = \pi/4(D^2-C^2)L + \pi/4(C^2-E^2)L$$

$$(D^2-E^2=D^2-C^2+C^2-E^2=D^2-E^2)$$

To provide a 15,000 p.s.i. pump output for 150 p.s.i. input (100 to 1 design output ratio) to the air motor exemplary values can be calculated using an efficiency (friction loss) of 87 percent.

$$(1) \quad \text{Upstroke pressure} = \frac{150 \text{ p.s.i. } (A^2-B^2).87}{D^2-C^2} = 15,000 \text{ p.s.i.}$$

$$(2) \quad \text{Downstroke pressure} = \frac{150 \text{ p.s.i. } (A^2).87}{C^2-E^2} = 15,000 \text{ p.s.i.}$$

Knowing the air motor dimensions A and B, and choosing a reasonable pump rod piston diameter D, the above Formulas 1 and 2 will enable the pump rod diameters C and E to be calculated.

If A equals 2.068 inches, B equals 0.429 inch and D is chosen as 0.510 inch, the diameter C from Formula 1 can be found and is equal to 0.474 inch. Then diameter E can be calculated from Formula 2 and will equal 0.433 inch.

Pump rod dimensions are maintained at low values to keep weight low and also to present small sealing area requirements at the 15,000 p.s.i. pressures. Note that increases in air motor operating pressure will directly affect the pump output pressure. The length of stroke of the exemplary structure is approximately 1.5 inches but it is not particularly critical insofar as the pressure is concerned.

The 15,000 p.s.i. output is developed on both the up and down strokes. In theory, more pressure is required below the ball check valve 270 to cause lubricant to flow on the downstroke. It amounts to approximately 2½ p.s.i. which can be disregarded. Ball check spring 272 has a compressive strength of approximately ½ ounce.

In the foregoing description, a relatively lightweight (approximately 39 pounds for the exemplary unit) compact, portable lubricant gun has been disclosed. It uses a conical follower plate that sealingly cooperates with the side wall of a lubricant container to efficiently direct lubricant to the gun intake. It provides a balanced air ram assembly for moving the gun into proximity with the lubricant and creating low pressure on the lubricant. It further incorporates a two section pumping chamber and a suitably dimensioned reciprocable pump rod assembly that results in high pressure output during both strokes with intake during only one stroke.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letter Patent is:

1. A compact lubricating gun assembly comprising: means for supporting a lubricant container; a vertically shiftable lubricant gun mechanism including a follower member provided with a downwardly facing means for guiding lubricant into the intake of said gun mechanism, the periphery of said follower member being formed to fit within said container to sealingly cooperate with the lubricant container; means for vertically shifting said gun mechanism and mounting said gun mechanism on said supporting means; and means for operating said gun mechanism, said gun mechanism embodying a high pressure double-acting motor driven plunger pump having a multiple stepped diametered plunger and means defining two interconnected constant length pumping chambers surrounding axially spaced portions of said plunger intermediate the ends thereof, one of said chambers having an inlet, the other of said chambers having an outlet, check valve means interposed in the connection between said chambers and in said inlet to prevent return flow therethrough and sealing means preventing fluid ingress to or egress from said chambers along the exterior surface of said plunger.

2. A lubricating apparatus comprising: a support; a frame on the support; means for selectively raising and lowering said frame with respect to said support; closure means on the frame for closing the top of a lubricant container and movable into the container to follow the lubricant level as the frame lowers and the lubricant is dispensed from the container; and means carried by the frame for pumping lubricant out of said container through the closure means, said pumping means comprising a high pressure double-acting plunger pump having a multiple stepped diametered plunger and means defining two interconnected fixed length pumping chambers surrounding axially spaced portions of said plunger intermediate the ends thereof, one of said chambers having an inlet, the other of said chambers having an outlet, check valve means interposed in the connection between said chambers and in said inlet to prevent return flow therethrough, and sealing means preventing fluid ingress to or egress from said chambers along the exterior surface of said plunger.

3. A high pressure lubricant gun assembly comprising: an automatically cycling fluid motor; a vertically shiftable frame mounting said fluid motor; a high pressure double-acting reciprocable plunger pump mounted on the under side of said frame and connected to said fluid motor for operation; a follower member on the lower end of the casing of said pump adapted to sealingly fit down into a lubricant container; power means connected between the base of the container and said frame for shifting the frame, fluid motor and pump downwardly

relative to said container; a pump intake on the lower side of said follower member; and a pump outlet above the follower member; said pump including an elongate pumping chamber extending of fixed length between said intake and said outlet and provided with a fixed intermediate apertured wall and a pump plunger rod having portions of differing diameters and extending axially through the entire length of said chamber and including an intermediate plunger section slidably cooperating with said intermediate wall to divide said chamber into two sections each of fixed length; valve means in said pump operative to isolate said sections during pump rod strokes in one direction so one section and a portion of said pump plunger rod will provide an intake action and the other section and a portion of said pump plunger rod will provide an output action, and to place said sections in fluid communication during pump plunger rod strokes in a direction opposite to said one direction so the entire pumping chamber and the pump plunger rod will provide output action, and sealing means preventing fluid ingress to and egress from said chamber along the exterior surface of said pump rod.

4. A high pressure lubricant gun assembly as defined in claim 3, wherein an end of said pump rod projects through said intake, a primer body is fastened adjacent said intake, and means on the projected end of said pump rod cooperates with said primer body to initially move lubricant into said intake.

5. A high pressure lubricant gun assembly as defined in claim 4 wherein the bottom of said follower member surrounding said intake has a concave recess for diverting lubricant from adjacent the follower plate periphery to said intake and said primer body.

6. A compact lubricating gun assembly comprising: means for supporting a lubricant container; a vertically shiftable high pressure lubricant gun mechanism including a follower member provided with a downwardly facing means for guiding lubricant into the intake of said gun mechanism, the periphery of said follower member being formed to fit within said container to sealingly cooperate with the lubricant container; means for vertically shifting said gun mechanism and mounting said gun mechanism on said supporting means; and means for operating said gun mechanism; said high pressure lubricant gun mechanism comprising: a cylindrical pump body having coaxial upper and lower chamber sections with an apertured division wall therebetween, an end wall at one end of said body coaxially apertured, the opposite end of said body including an annular internal valve seat surrounding an intake opening coaxial with said pump body, an outlet means in the pump body adjacent said end wall; a reciprocable pump plunger rod extending through said apertured end wall and projected past said intermediate wall and out through said annular valve seat, sealing means between said rod and said end wall aperture, comprising an upper portion having a close sliding fit in the end wall aperture, an intermediate piston portion having a close sliding fit in the intermediate wall aperture and a lower portion having a free spaced relationship to said lower end intake providing an annular intake space to said lower chamber section, said piston portion having a larger cross sectional area than the upper portion and the upper portion having a larger cross sectional area than said lower portion; a close fitting sleeve element mounted in sealed relation on said lower pump rod portion for valving coaction with said valve seat to provide a first one way intake valve to said lower chamber section; and means providing fluid communication between said upper and lower chamber sections including a second one-way valve permitting fluid communication from said lower section to said upper section.

7. A high pressure lubricant gun mechanism as defined in claim 6 wherein said means providing fluid communication between the upper and lower chamber sections comprises passages through said pump rod from below

said piston portion to above said piston portion and said
second one-way valve is disposed inside said pump rod.

References Cited in the file of this patent

UNITED STATES PATENTS

2,221,763 Ginter Nov. 19, 1940

5

2,280,708
2,394,486
2,630,248
2,636,441
2,749,845
2,787,225

Klein et al. Apr. 21, 1942
Rotter et al. Feb. 5, 1946
Hinz Mar. 3, 1953
Woelfer Apr. 28, 1953
Bahniuk June 12, 1956
Rotter Apr. 2, 1957