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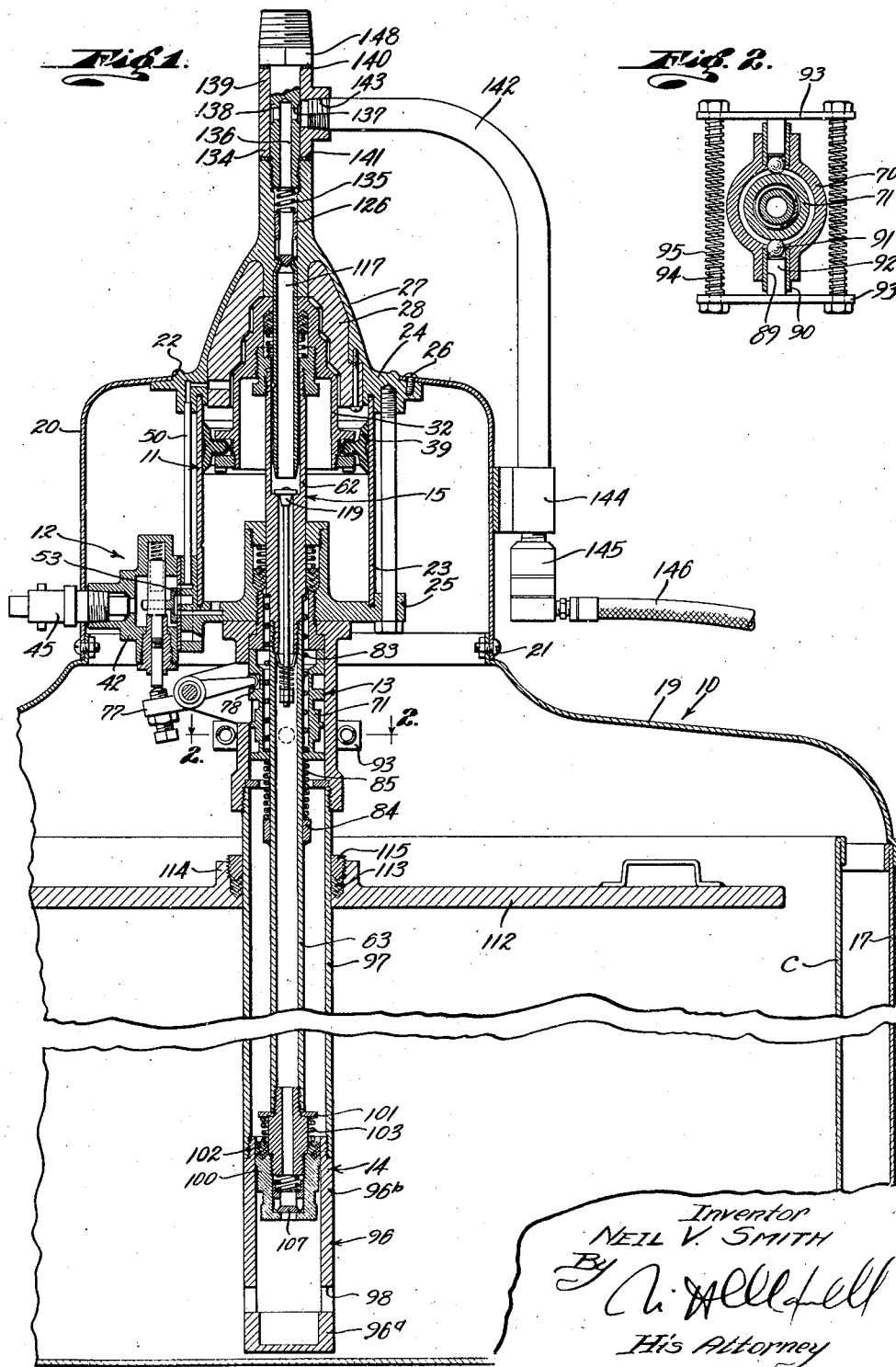
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LUBRICANT HANDLING DEVICE

Filed March 11, 1941

2 Sheets-Sheet 1



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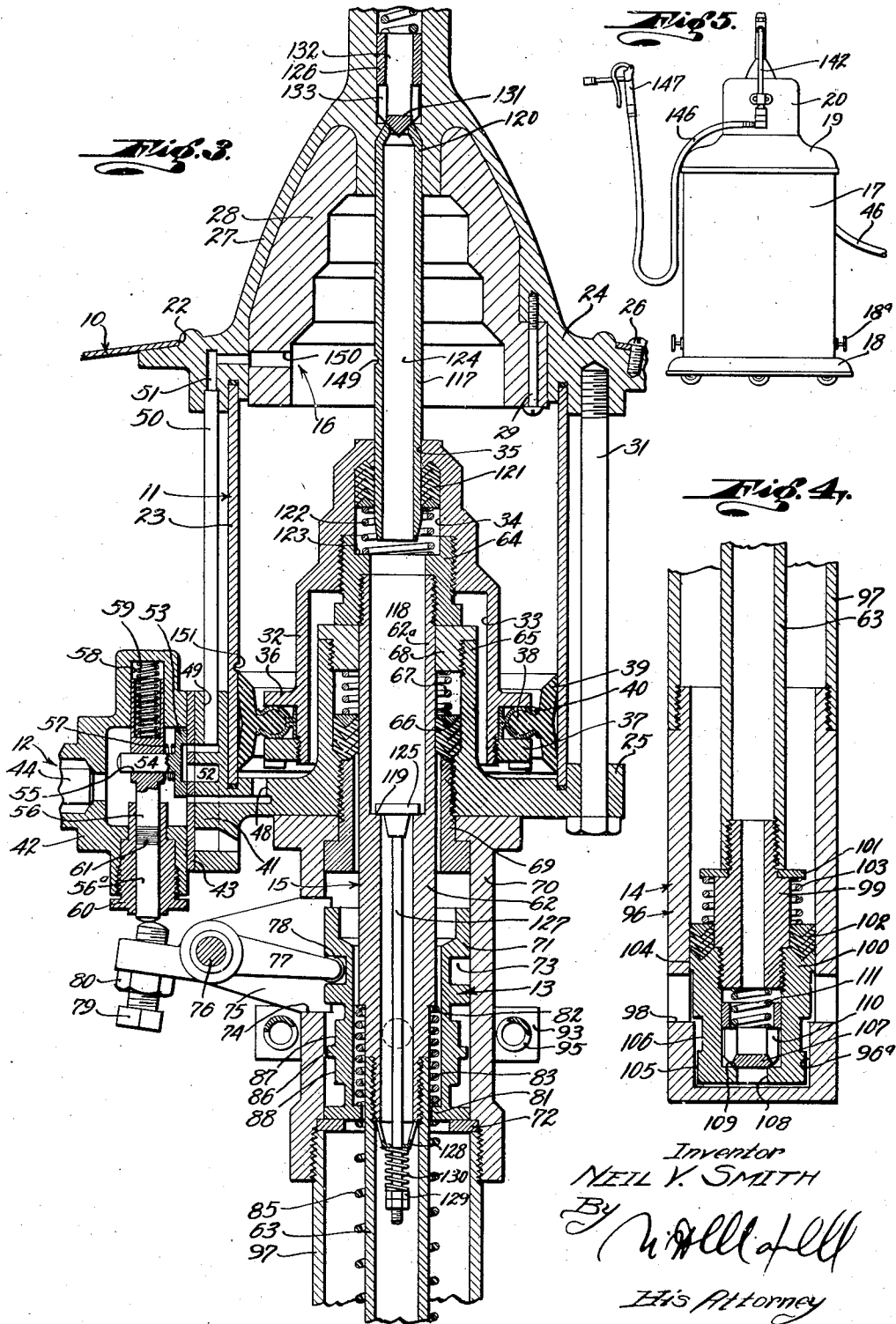
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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LUBRICANT HANDLING DEVICE

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14 Claims. (Cl. 103—5)

This invention relates to lubricant handling devices and relates more particularly to grease guns or lubricant pumps for forcing lubricant under pressure to the bearings and working parts of automotive vehicles and other devices and machines. A general object of this invention is to provide a practical, highly effective apparatus of the character referred to adapted to pump semi-fluid greases and lighter greases from original grease containers.

Grease guns or pumps handling tacky semi-fluid lubricants, and more particularly those pumps employed to force lubricant under pressure from the original containers to the bearings or working parts of automatic machines, are often called upon to pump mixtures of grease and air or straight air. This is particularly true when handling very heavy greases and when handling lighter greases in cold weather, and results from the formation of air pockets in the grease container during the initial filling of the container or during the transfer of grease from one container to the other. The pumps are also obliged to handle air and air and grease mixtures because of the development of air pockets along side of the pump column when the pump is being mounted for operation, or because of the presence of air in a new, recently cleaned or overhauled pump. A grease gun or pump that is not designed or adapted to pump air is made inoperative under such conditions, or must be operated for a substantial period to clear it of air before it is conditioned for use, resulting in undesirable delay. The presence of air in tacky greases or in light grease at low temperature may appreciably reduce the volume of grease discharged by the pump. "Air locks" sometimes develop in the pump, in which trapped air compresses and expands with the pump strokes and greatly reduces the actual discharge of lubricant.

An important object of the present invention is to provide a lubricant gun or pump that is operable to pump grease, a mixture of air and grease, or straight air from the bottom of an original grease container such as a drum, barrel or large can, and discharge it into bearings or machine parts under high pressure. A distinguishing attribute of the pump of the present invention is its ability to pump air and mixtures of air and grease and to discharge the same under high pressures without interruption in operation or retention of air which might impair its efficiency or reduce its delivery rate.

Another object of this invention is to provide a lubricant handling apparatus of the character

referred to embodying or employing a follower plate arranged in the original lubricant container to travel from the top of the container to substantially the bottom of the container to provide for the removal or pumping of substantially the entire contents from the container without the formation of air channels or pockets at the pump column.

Another object of this invention is to provide a lubricant pump of the character referred to having means for assuring a complete charging or filling of the high pressure cylinder on each charging stroke, particularly when handling heavy greases, or lighter greases in cold weather.

Another object of this invention is to provide a lubricant pump of the character referred to embodying a priming pump whose piston is of larger diameter than the piston of the high pressure pump and whose inlet ports are of large capacity and in direct communication with the lubricant supply to offer a minimum of resistance to the flow of lubricant into the priming cylinder whereby the apparatus is adapted to handle very heavy lubricants as well as lighter lubricants and always discharge at full capacity throughout a wide range of lubricant viscosities.

Another object of this invention is to provide a lubricant handling apparatus of the character referred to embodying a high pressure pump of small piston diameter and long piston stroke operating to discharge the lubricant at high pressure and a priming pump having a piston of larger diameter and equal stroke for priming the high pressure pump, the two pumps being rigidly connected for operation by a single motor.

In the pumping of lubricant it is essential to employ a discharge or high pressure pump of small piston diameter and long piston stroke to develop the required pressure and handle the necessary volume of lubricant on each pump stroke. Such a pump is difficult to fill with viscous lubricant, consequently it has been found necessary heretofore to employ a booster pump of large piston diameter and short stroke to supply a full charge to the long stroke high pressure pump when handling heavy viscous materials. Because of the difference in the strokes of the two pumps it has been necessary to provide separate motors for operating the booster pump and the high pressure pump. The priming pump of the present invention has a stroke equal to that of the high pressure pump and hence can be operated by the same motor as the high pressure pump. Since the present invention requires only a single motor for the operation of both the high

pressure pump of small piston diameter and the priming pump of large piston diameter, the apparatus of the present invention is much simpler and less costly than the prior apparatuses.

Another object of this invention is to provide a lubricant pump of the character mentioned in which the high pressure discharge valve is readily accessible for cleaning. The high pressure discharge valve is the most frequent source of trouble in devices of this nature by reason of solid matter particles becoming lodged on the valve or its seat. In prior devices where the valves are difficult of access, considerable delay is occasioned when the valve becomes jammed or inoperative. In the apparatus of the present invention the high pressure discharge valve may be easily and quickly removed and cleaned.

Another object of this invention is to provide a pump or apparatus of the character mentioned constructed so that there are minimum clearances in the pump structure to assure the rapid pumping of air and air and grease mixtures. The pump mechanism of the present invention is constructed to clear or discharge air at maximum speed.

Another object of this invention is to provide a lubricant handling apparatus of the character referred to embodying particularly effective means for automatically operating or reversing the air valve of the air motor. The automatic air valve operating means of the invention is exceptionally rugged and is provided with a simple, readily accessible adjusting means for synchronizing the valve and pump action.

A further object of this invention is to provide a lubricant pump of the character referred to in which all parts of the air motor are automatically and efficiently lubricated. Practical and highly efficient means are incorporated in the apparatus for automatically lubricating the air motor parts by a lubricant mist.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a fragmentary vertical detailed sectional view of the principal parts of the lubricant pumping apparatus with the reciprocable element of the high pressure pump at or approaching the end of its discharge stroke and with the low pressure pump plunger at or adjacent the end of its suction stroke. Fig. 2 is a transverse detailed sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is an enlarged fragmentary vertical detailed sectional view of the upper portion of the pump mechanism illustrating the air motor and the high pressure lubricant pump elements showing the high pressure pump cylinder at or adjacent the end of its return stroke. Fig. 4 is an enlarged fragmentary vertical detailed sectional view of the lower portion of the lubricant pumping mechanism showing the low pressure pump plunger at or adjacent the end of its discharge stroke, and Fig. 5 is a reduced elevation view of the apparatus.

The lubricant pumping apparatus of the present invention may be said to comprise, generally, a supporting structure 10 for housing a lubricant container C and for supporting the pump mechanism, an air motor 11 mounted in the upper portion of the structure 10, valve means 12 for the motor 10, shuttle means 13 for automatically operating the valve means 12, a low pressure posi-

tive lubricant pump 14 for receiving or pumping lubricant from the lower portion of the container C, a follower plate 112 movable downwardly in the container C, a high pressure lubricant pump 15 above the container C, the high and low pressure pumps 14 and 15 being operated by the motor 11, and means 16 for lubricating the air motor 11.

The supporting structure 10 may be varied considerably without departing from the invention to suit the apparatus, for use with containers of various sizes, shapes, etc. In the case illustrated the container C is an upright, open topped can or drum of substantial capacity and the structure 10 includes a shell 17 fitting around the container C with suitable clearance. The container C may be the original drum or container in which the lubricant is marketed. The container C and the shell 17 are supported on a suitable wheeled base 18, and releasable latches 18^a secure the shell to the base. A top or cover 19 is fixed on the upper end of the shell 17 and in turn carries, what I will term, a dome 20. The dome 20 is a centrally disposed upstanding generally cylindrical part with a rounded upper end. I have shown the dome 20 secured to the cover 19 by suitable bolts 21. A central vertical opening 22 of substantial diameter is provided in the upper wall of the dome 20.

The motor 11 serves to drive or operate the low and high pressure pumps 14 and 15. The motor 11 is a cylinder and piston type pneumatic power means and is supported within the dome 20 to be above the container C. The cylinder 23 of the motor 11 is vertically disposed within the dome 20 and is provided with upper and lower heads 24 and 25, respectively. The upper cylinder head 24 may have an outwardly projecting flange secured to the under side of the dome top by suitable screws or bolts 26. The head 24 extends upwardly through the opening 22, having a hollow upwardly and inwardly tapered extension 27 projecting beyond the top of the dome 20. A filler 28 of wood, or the like, is provided in the extension 28 to partially occupy its interior. Screws 29 threaded in the lower portion of the extension 27 may hold the filler 28 in place. The interior of the inner wall of the filler 28 is stepped upwardly and inwardly for the purpose to be hereinafter described.

The upper and lower edge portions of the cylinder 23 are received in annular grooves 30 in the heads 24 and 25 where they are sealed with gaskets as illustrated. Studs 31 are passed upwardly through openings in the lower head 25 and are threaded into openings in the head 24 to connect the heads and to clamp the cylinder 23 in place. With the construction just described the air motor 11 is vertically disposed in the dome 20 and depends from the top wall of the dome.

The motor 11 further includes a piston 32 operable in the cylinder 23. The body of the piston 32 is a stepped or graduated tubular member having a large elongate socket 33 entering its lower end, a smaller socket 34 continuing upwardly from the socket 33 and a reduced opening 35 extending through its upper end wall. The exterior of the piston 32 may be correspondingly stepped and is receivable in the stepped interior of the filler 28 when at the upper end of its movement. An external annular flange 36 is provided adjacent the lower end of the piston 32 and a nut 37 is threaded on the piston to oppose the flange 36.

The sealing element of the piston 32 includes an annular bead 38 received between the flange

36 and the nut 37 and upwardly and downwardly projecting annular wings or lips 39 on the bead for slidably sealing with the interior of the cylinder 23. A metal clip or carrier 40 grips the bead 38 and is held or clamped between the flange 36 and the nut 37 to secure the sealing element to the piston 32. The sealing lips 39 flare outwardly to leave a confined space between their active cylinder engaging surfaces and the outer ends or edges of the lips are preferably tapered. The sealing element is constructed of synthetic rubber, or other flexible resilient material, and the sealing lips 39 are actuated or expanded by pressures within the cylinder 23 to effectively seal with the cylinder walls. It will be observed that the cylinder and piston 23 and 32 of the motor 11 may be of substantial diameter.

The valve means 12 for the motor 11 is adapted for automatic or mechanical operation by the shuttle means 13. The valve means 12 is preferably arranged on the motor 11 within the head or dome 20. In the construction illustrated, the lower cylinder head 25 has a flat faced vertically disposed flange 41 and a valve chest 42 is arranged to oppose the face of the flange 41. A hard wear-resisting plate 43 is clamped between the opposing surfaces of the flange 41 and the chest 42. The chest 42 is hollow or chambered and has an inlet opening 44 equipped with a fitting 45 for an air supply hose 46. The fitting 44 may have an automatic coupler valve and the hose 46 may be supplied with air under suitable pressure from any convenient source. A port 48 extends outwardly through the lower head 25, flange 41 and plate 43 to connect the lower end of the motor cylinder with the interior of the valve chest 42. A similar port 49 is provided in the flange 41 and the plate 43 and a conduit 50 extends from the port 49 to a port 51 in the upper cylinder head 24 to put the valve chest 42 in communication with the upper end of the cylinder 23. The ports 48 and 49 are spaced apart vertically at the faces of the plate 43. An exhaust port 52 is provided in the flange 41 and the plate 43 and is spaced between the ports 48 and 49.

A slide valve 53 of the D-type operates on the face of the plate 43 to control the ports. The valve 53 has a stem 54 slidably received in a transverse opening 55 in a reciprocal rod 56. A spring 57 is arranged under compression between the valve 53 and the rod 56 to hold the valve in sliding engagement with the plate 43. The upper portion of the rod 56 is tubular and is slidably guided in a socket 58 in the upper wall of the valve chest 42. A spring 59 is arranged under compression in the socket 58 and the tubular portion of the rod 56 to urge the rod and the valve 53 downwardly. A tubular guide bushing 60 is threaded through an opening in the lower wall of the chest 42 and the rod 56 slidably enters the upper end of the bushing. A rod 56^a enters the lower end of the bushing and a set of plug gaskets 61 is engaged between the opposing ends of the rods 56 and 56^a to slidably seal with the bushing 60. The rod 56 projects beyond the bushing 60 for engagement by the shuttle means 13.

The shuttle means 13 is operated by the piston 32 to actuate or reverse the valve 53. The means 13 is a loaded spring snap action mechanism operable to cause sudden reversal of the valve 53 at the ends of the piston strokes. In the preferred arrangement the means 13 is arranged below the motor 11 to be operated by a part or assembly extending downwardly from the

air motor piston 32. In accordance with the invention this part or assembly includes a reciprocating element 62 associated with the high pressure lubricant pump 15 and the low pressure transfer tube 63 which extends from the element 62 to the low pressure pump 14. The element 62 is fixed or threaded in a tubular nut 64, which in turn is threaded in the socket 34 of the piston 32. The element 62 extends downwardly to pass through a gland or packing means on the cylinder head 25. A socketed or tubular upstanding boss 65 is provided in the head 25 to carry the packing means. The gland or packing means comprises chevron packing 66 seated in the boss 65 and actuated or compressed by a spring 67 held under compression between the packing and a tubular guide plug 68 threaded in the upper end of the boss. The plug 68 may assist in guiding the element 62. The socket 65 of the piston 32 receives the boss 65 and the plug 68 with ample clearance when the piston 32 moves downwardly in the cylinder 23. The high pressure pump element 62 passes downwardly, with suitable clearance, through a tubular nut 69 threaded in the head 25. The nut 69 is shouldered or flanged at its lower end to support or mount a tubular bracket or carrier 70. The low pressure transfer tube 63 is threaded on a reduced lower part of the high pressure pump element 62 and the tube and element pass through or are received in the carrier 70 with substantial clearance.

The means 13 includes a tubular shuttle 71 slidably guided in the carrier 70 and surrounding the high pressure pump element and transfer tube assembly 62—63 with clearance. The lower end of the nut 69 may limit the upward travel of the shuttle 71 and an inwardly projecting stop 72 in the carrier 70 may limit the downward travel of the shuttle. The travel of the shuttle 71 is materially shorter than the stroke of the air motor piston 32. An external annular groove 73 is provided in the upper portion of the shuttle 71. A longitudinal slot 74 is formed in the wall of the carrier 70 and a bracket 75 is mounted on the carrier at the slot. A horizontal shaft or pin 76 on the bracket 75 supports a double armed lever 77. The lever serves to transmit movement between the shuttle 71 and the valve rod 56^a. The inner end of the lever 77 is yoked or provided with a roller 78 which engages in the groove 73 of the shuttle 71. The outer arm of the lever 77 is shorter than the inner lever arm and carries an adjustable screw 79 equipped with a lock nut 80. The screw 79 is engageable with the outer end of the valve rod 56 for the transmission of movement between the shuttle lever 77 and the rod 56.

The shuttle means 13 further includes yielding means for transmitting movement from the cylinder and tube assembly 62—63 to the shuttle 71 when the air motor piston 32 approaches the ends of its strokes. The shuttle 71 is provided at its lower end with an internal annular flange 81 and the lower portion of the element 62 has a downwardly facing external annular shoulder 82. A spring 83 surrounds the element 62 between the shoulder 82 and the flange 81 and is initially under compression. When the air motor piston 32 approaches the lower end of its downward movement the compression on the spring 83 increases substantially and tends to move the shuttle 71 downwardly. The means for transmitting upward movement from the assembly 62—63 to the shuttle 71 comprises a collar 84 fixed on the transfer tube 63 and a spring

85 surrounding the tube and arranged under compression between the flange 81 and the collar. This structure is illustrated in Fig. 1.

The shuttle means 13 further includes a releasable holding mechanism for resisting movement of the shuttle 71 until a given amount of energy has been stored in the springs 83 and 85 or until the springs are fully compressed, whereupon it releases to allow the shuttle to suddenly move either upward or downward, as the case may be, to cause a substantially instantaneous reversal of the air controlling valve 53. This holding means includes an annular ridge 86 on the exterior of the shuttle 71 and plain or cylindrical lands 87 and 88 formed on the shuttle above and below the ridge 86. Diametrically opposite radial openings 89 are provided in the walls of the carrier 70 and are lined with tubular bushings 90, as illustrated in Fig. 2. Detent balls 91 are shiftably arranged in the inner portions of the bushings 90 and are adapted to cooperate with the lands 87 and 88 and the ridge 86. Plungers 92 extend into the bushings 90 and their inner ends bear on the detent balls 91. Horizontal cross heads 93 are fixed to the plungers 92 and are provided at their outer ends with inwardly projecting screws or pins 94. Helical springs 95 are arranged under tension between the outer portions of the spaced opposing cross heads 93. The end parts of the springs 95 engage over the pins 94. The pins 94 are left hand threaded and are screwed in the springs 95 which have a right hand convolution. The springs 95 serve to urge the balls 91 inwardly with substantial force.

When the piston 32 of the air motor 11 approaches one end of its stroke, say the end of its downward movement, the shoulder 82 comes into compressing engagement with the spring 83. As the piston 32 moves downwardly the spring 83 is compressed. At this time the detent balls 91 are engaged on the land 88 and their cooperation with the ridge 86 holds the shuttle 71 against downward movement. When the spring has been fully compressed the cooperation of the ridge 86 with the balls 91 overcomes the springs 95 and results in outward retraction of the balls 91. When the balls 91 retract the shuttle 71 is suddenly moved downward by the spring 83. The accompanying pivotal movement of the lever 77 causes upward movement of the valve rod 56—56^a to reverse the valve 53. A similar action takes place when the air motor piston 32 approaches the end of its upward stroke. In this case, the balls 91 suddenly snap over the ridge 86 from the land 87 to the land 88 when the spring 85 has been fully compressed. The shuttle means 13 just described provides for the mechanical or automatic instantaneous reversal of the air motor valve 53 at the completion of the piston strokes to produce continued operation of the air motor.

The low pressure lubricant pump 14 is operable to positively force or pump the lubricant and any air there may be present, from the container C to the high pressure pump 15. In accordance with the invention the low pressure pump 14 is located in the lower portion of the container C to receive lubricant from adjacent the bottom of the container so that substantially the entire contents of the container C may be cleared or pumped out by the apparatus. This places the low pressure pump 14 at a point

removed from the air motor 11 and the high pressure lubricant pump 15. The low pressure pump 14 includes a cylinder 96 and a piston or plunger operable in the cylinder. The means for suspending or supporting the low pressure lubricant pump cylinder 96 adjacent the lower end of the container C includes the carrier 70 described above and a supporting tube or suspension tube 97 extending downwardly from the carrier. The tube 97 is threaded in the lower end of the carrier 70 and extends vertically downward through the container C to a point a short distance above the bottom wall of the container. The low pressure lubricant cylinder 96 is a tubular or socketed member attached to the lower end of the suspension tube 96 as by threading to extend downwardly therefrom to immediately adjacent the bottom of the container. The lower end of the cylinder 96 is closed and two or more spaced lateral openings or ports 98 are provided in the wall of the cylinder in a plane above its closed lower end. The ports 98 form the low pressure lubricant inlet ports of the pump mechanism. The portion 96^a of the cylinder 96, which is below the ports 98, is reduced in internal diameter and forms the pressure developing portion of the low pressure cylinder while the portion 96^b above the ports forms the suction developing part of the cylinder.

The low pressure lubricant pump piston or plunger is secured to the lower end of the low pressure transfer tube 63, referred to above. The transfer tube 63 is secured to the lower end of the high pressure lubricant cylinder 62, as above described, and extends downwardly through the suspension tube 97 with considerable clearance to the low pressure lubricant plunger. The low pressure lubricant plunger is a sectional structure comprising a tubular upper section 99 and a tubular lower section 100. The upper plunger section 99 is threaded or otherwise fixed on the lower end of the low pressure transfer tube 63 and is proportioned to be received in the suspension tube 97 and the cylinder 96 with considerable clearance. A collar 101 is clamped between the section 99 and the lower end of the low pressure transfer tube 63. Packing 102, such as chevron packing, is engaged against the upper end of the lower plunger section 100 and a spring 103 is arranged under compression between the collar 101 and the packing 102 to maintain the packing under compression so that it seals with the wall of the cylinder 96. The spring actuated packing 102 serves to prevent air leakage around or past the low pressure plunger.

The lower plunger section 100 forms the body or main element of the low pressure lubricant plunger and is of special formation to cooperate with the reduced lower portion 96^a of the cylinder 96 for the purpose of forcing the lubricant upwardly through the plunger 96 and transfer tube 63 and to permit the main body of the lubricant charge, which is usually in excess of that required to charge the high pressure pump, to escape from the lower portion of the cylinder 96 when the plunger moves downwardly. The lower plunger section 100 presents an upper active peripheral guide surface 104, which closely slidably fits the suction portion 96^b of the cylinder 96 and a lower surface 105 which fits the pressure developing portion 96^a with "controlled" or limited clearance. The plunger section 100 is reduced in external diameter immediately above the lower surface 105 to have a clearance groove

106. As the low pressure plunger moves downwardly through the cylinder 96 the excess lubricant is forced out through the ports 98 and when the reduced or lower plunger surface 105 enters the pressure developing cylinder portion 96^a it cuts off or traps a given charge of lubricant fully sufficient to charge the high pressure pump. Thus, the ported portion of the cylinder 96 and the surface 105 serve as an inlet valve means for the low pressure lubricant pump 14. During the action just described, the groove 106 thereabove allows any excess lubricant in the pressure developing cylinder portion 96^a to pass back through the ports 98 to the main supply of lubricant in the container. The control of clearances between the cylinder portion 96^a and the low pressure plunger surface 105 provides for the return to the container C of lubricant trapped in the portion 96^a in excess of that required to charge the high pressure cylinder 62 of the high pressure pump 15. Upward movement of the low pressure plunger in the suction cylinder portion 96^b causes a large volume of lubricant, or lubricant and air mixture, to be drawn into the low pressure cylinder for the next discharge stroke. The ports 98 are large and in direct communication with the container C, and the capacity of suction cylinder 96^b is greater than the capacity of the pressure developing portion 96^a. This proportioning of the suction and pressure developing sections of cylinder 96 serves to develop a high suction effect on the main body of grease adjacent the inlet ports 98 whereby a full charging of cylinder 96^a with lubricant is assured even when handling heavy greases, or lighter lubricants at low temperatures, in the presence of a considerable volume of occluded air.

The low pressure pump 14 further includes a discharge valve 107. The lower section 100 of the low pressure plunger is tubular and is provided at its lower end with a reduced discharge opening 108 which leaves or provides an annular upwardly facing internal seat 109 in the plunger section. The valve 107 is shiftable vertically in the section 100 and is adapted to engage downwardly against the seat 109 to close the port 108. The valve 107 is socketed from its upper end and its side walls are provided with slots 110 which extend upwardly from adjacent its lower corner. The lower outer corner or edge of the valve 107 is preferably bevelled off to permit the rapid free flow of lubricant through the valve when the valve is open. A spring 111 is arranged under compression between the lower end of the section 99 and an internal shoulder of the valve 107 to urge the valve to its closed position. The discharge valve 107 of the low pressure lubricant pump 14 is closed during the up strokes of the plunger and during the initial portions of the down strokes and serves to prevent the downward return of the lubricant or air.

The follower plate 112 is provided to assure the full delivery or clearance of lubricant from the container C to the low pressure lubricant pump 14, and to prevent the channeling of air from the upper surface of the lubricant to the inlet ports 98. The follower plate 112 operates in the container C and travels down the suspension tube 97 as the lubricant is withdrawn or pumped down from the container, see Fig. 1. The follower plate 112 is shaped to conform generally to the container C and, in most instances, is a disc-like member presenting a flat horizontal face for evenly bearing against the top

surface of the body of grease or lubricant. It is preferred to make the follower plate 112 relatively heavy, to maintain a flat horizontal upper surface on the lubricant. The follower plate 112 has means for slidably sealing with the suspension tube 97 so that air cannot leak past the follower plate to flow down around the tube 97 to the inlet ports 98 of the low pressure pump 14. The sealing means may be in the nature of chevron packing 113 seated in a central boss 114 of the plate 112 and actuated or compressed by a follower 115 threaded into the boss. The periphery of the follower plate 112 has clearance with or is spaced from the wall of the container C.

The high pressure lubricant pump 15 receives the lubricant, or mixture of air and lubricant, under pressure from the transfer tube 63 and discharges it under a greatly increased pressure to the bearings or machine parts being lubricated. The pump means 15 is located above the container C and is within or extends through the air motor 11. Accordingly, the high pressure pump 15 is a substantial distance from the low pressure pump 14 and is connected with the low pressure pump through the medium of the elongate low pressure transfer tube 63. The pump 15 includes the upper portion of the element 62 referred to above and a stationary piston 117. The upper portion 62^a of the element 62 forms the high pressure cylinder while the lower portion of the element is in effect an extension or continuation of the low pressure transfer tube 63. The high pressure cylinder 62^a is an elongate hollow or tubular part which reciprocates relative to the stationary piston 117, and is fixed to the nut 64 of the air motor piston 32. The cylinder 62^a is enlarged in internal diameter to have a cylinder chamber 118 and to provide an upwardly facing internal annular shoulder or seat 119. The seat 119 is at the lower end of the chamber 118 and the opening of the lower portion of the element 62 extends downwardly from the seat 119 to communicate with the upper end of the transfer tube 63. The upper end of the cylinder chamber 118 communicates with the tubular nut 64 and the interior of the socket 34, the nut 64 and the socket 63 in effect constituting continuations of the cylinder chamber.

The high pressure piston 117 is an elongate tubular member cast or otherwise fixed in the central vertical opening 120 of the head 27. The piston 117 extends downwardly from the opening 120 and passes through the opening 35 in the air motor piston 32 to project into the socket 34 and cylinder chamber 118. Packing means is provided in the socket 34 to slidably seal about the piston 117. In the construction illustrated, chevron type packing 121 seats upwardly against the upper wall of the socket 34 and is actuated or held active by a spring 122 engaged against an upwardly facing shoulder 123 in the nut 64. The piston 117 is a displacement ram or piston operating to displace a given volume or quantity of lubricant from the chamber 118 for each up stroke of the high pressure cylinder 62. At each up stroke of the piston 32 a given volume of the lubricant, together with any air that may be with the lubricant, is displaced upwardly through the longitudinal opening 124 of the piston 117 to pass through the discharge assembly, as will be later described.

The high pressure pump 15 further includes a high pressure inlet valve 125 for governing com-

munication between the cylinder chamber 118 and the low pressure transfer tube 63 and a high pressure discharge valve 126 governing the discharge of the lubricant from the pump means. The high pressure inlet valve 125 forms the foot valve of the high pressure pump 15 and, in the preferred construction, is located at the lower end of the cylinder chamber 118. This places the valve 125 a considerable distance above the discharge valve 107 of the low pressure pump 14 and the valve 125 serves to separate the high pressure cylinder chamber 118 from the lubricant in the tube 63 during the discharge stroke of the high pressure cylinder 62. The valve 125 engages downwardly against the seat 119 and has a stem 127 extending downwardly through the lower portion of the element 62 with considerable clearance. A ported web or spider 128 is fixed on the lower end of the element 62 and guides the lower portion of the valve stem 127. Nuts 129 are provided on the lower portion of the stem 127 below the spider 128 and a spring 130 is arranged under compression between the spider 128 and the nuts 129. The spring 130 normally urges the valve 125 downwardly to its closed position against the seat 119.

The valve 125 is normally closed and is open only during the last phase of the downward stroke of the cylinder 62 when a charge of lubricant or air is displaced upwardly from the tube 63 by the action of the low pressure plunger 100 operating in the low pressure cylinder section 96^a. It is to be observed that the closed valve 125 forms a positive closure for the lower end of the relatively short cylinder chamber 118 and definitely separates the lubricant in the cylinder chamber from the lubricant in the low pressure transfer tube 63. This assures the displacement of a full charge of lubricant and the clearance of any air there may be present in the chamber 118 during each upward stroke of the high pressure cylinder 62 and the high pressure inlet valve 125 conditions or adapts the pump for the positive pumping of air and air mixed with the lubricant.

The discharge valve 126 of the high pressure pump 15 is characterized by its ready accessibility. The valve 126 is shiftably held in the central vertical opening 120 of the head extension 27 and has a pointed lower end for sealing inwardly or downwardly against a limited bevelled seat 131 formed on the upper end of the stationary piston 117. A longitudinal opening 132 extends downwardly in the valve 126 from its upper end and joins spaced radial slots 133 adjacent the lower end of the valve. The bevelled or pointed lower portion of the valve 126 provides for the free rapid up flow of the lubricant when the valve is in its open position. An elongate fitting 134 is threaded in the upper portion of the opening 120 and a spring 135 is arranged under compression between the lower end of the fitting 134 and the upper end of the valve 126 to urge the valve to its closed position. A longitudinal port 136 extends outwardly in the fitting 134 and has lateral branches 137 at its outer end joining an annular external groove 138 in the fitting. A collar or tube 139 turnably engages around the fitting 134 and is clamped between the upper end of the head 27 and a downwardly facing shoulder 140 on the fitting 134. Sealing gaskets 141 serve to prevent the leakage of lubricant under pressure at the ends of the tube 139. A conduit or pipe 142 has an end threaded in an opening 143 in the tube 139 to communicate with

the groove 138. The pipe 142 extends outwardly and then downwardly to a supporting bracket 144 on the dome 20. A swivel coupling 145 on the lower end of the pipe 142 serves to connect a flexible discharge hose 146 with the pipe.

A discharge fitting or nozzle 147 equipped with the customary manually controllable discharge valve is provided on the outer end of the hose 146. When the valve of the nozzle 147 is closed the lubricant pump is stalled but when the valve of the nozzle 147 is opened the pump automatically goes into operation to discharge the lubricant under high pressure. The fitting 134 has a polygonal part 148 above the tube 139 readily engageable by a wrench, or the like, to facilitate the assembly and detachment of the fitting. Upon unthreading and removal of the fitting 134 the high pressure discharge valve 126 and its seat 131 are readily accessible for cleaning, repair, etc. The fitting 134 may be easily and quickly removed and reinstalled without disturbing any other parts of the apparatus.

The means 16 for lubricating the air motor 11 operates to automatically create or generate a lubricant mist in the cylinder 23 to lubricate all of the various parts of the motor 11 and its valve 12. The means 16 includes an outwardly or radially facing depression or pocket 149 in the stationary high pressure piston 117. The pocket 149 is located to be above the upper end of the cylinder and is, therefore, within the hollow or socketed filler 28. The pocket 149 is located to be received in or to communicate with the socket 34 or the cylinder chamber 118 when the piston 32 is travelling through the upper portions of its strokes. The pocket 149 thus receives and traps a measured limited quantity of lubricant each time the cylinder 32 moves up and down on the fixed piston 117. The air port 51, for supplying air under pressure to the upper end of the cylinder 23, terminates in an inwardly directed or radial arm. The filler 28 has a radial port 150 communicating with this radial arm of the port 51 and discharging inwardly at the interior of the filler. The discharge end of the port 150 is radially aligned with the pocket 149, that is, it directly faces the pocket. When the air motor valve 53 moves to the position where it admits air under pressure to the port 49 a blast of air under pressure is discharged from the port 150 to impinge against the piston 117. This air blast is directed toward the pocket 149 and blows the limited charge of lubricant from the pocket 149 and breaks the lubricant up to create a mist within the cylinder 23. Thus, during each complete operation or stroke cycle of the air motor 11 a limited given quantity of lubricant is supplied to the cylinder 32 and is broken up into mist form.

The automatic lubricating means 16 may further include a pocket 151 in the wall of the cylinder 23. The pocket 151 is located at the same vertical plane as the inner end of the port 48 or immediately adjacent that plane, and is spaced above the cylinder head 25 a distance somewhat greater than the width of the pair of sealing lips 39 of the piston 32. During each complete stroke cycle of the piston 32 the pocket 151 receives a limited quantity of lubricant from the lubricated upper portion of the cylinder and when the piston 32 moves upwardly under the action of the air being discharged under pressure from the port 48, this lubricant is blown from the pocket and broken up into a mist by the blast of air is-

suing from the port 48. The pocket 151 is not always essential as it has been found that the lubricant supplied to the upper portion of the cylinder by the pocket 149 and broken into mist form, as described above, finds its way to the lower portion of the cylinder under the piston 32. The lubricant mist generated in the cylinder 23 not only lubricates the cylinder and piston mechanism of the motor 11 but finds its way through the port 48 into the valve chest 42 where it also lubricates the valve 53 and the parts associated therewith.

In using the apparatus the parts are arranged and assembled as illustrated with the shell 17 latched to the base 18 by the latches 18^a and with the follower plate 112 engaged against the upper surface of the body of lubricant in the container C. In this connection it is to be understood that the container C may be the original barrel or drum in which the lubricant is marketed. The pump mechanism is arranged so that the low pressure lubricant cylinder 96 has its end immediately adjacent the bottom wall of the container C to provide for the removal by pumping of substantially the entire contents of the container C. In inserting the pumping apparatus in the container C there may be voids or air pockets left around the supporting tube 97 and the low pressure cylinder 96, but this air is quickly cleared or pumped away when the pump is put into operation. The air hose 46 is coupled with the valve means 12 by the valved coupler 45 so that air under pressure is delivered to the valve chest 42 and the hose 146 carrying the discharge nozzle 147 is attached to the swivel coupling 145. With the parts assembled, as just described, the apparatus is in condition for operation. Prior to the actual operation of the pump for the delivery of lubricant to machine bearings and parts it may be necessary to prime the apparatus and to clear it of air. This is done by merely opening the valve at the nozzle 147. With the nozzle 147 open the air motor 11 operates the low and high pressure lubricant pumps 14 and 15 to pump out the air in the apparatus and to clear or evacuate any air pockets there may be around the cylinder 96. This priming and air clearing puts the equipment in condition for use.

Assuming that the valve of the discharge nozzle 147 is open the shuttle means 13 produces automatic operation or reversal of the valve 53 so that the air motor 11 is operated. The shuttle means 13 operates to automatically suddenly reverse the valve 53 at or adjacent the end of each stroke of the air motor piston 32, this action having been described above. During each down stroke of the piston 32 the low pressure plunger moves downwardly through the cylinder 96 to displace or pump a charge of lubricant upwardly into or through the low pressure transfer tube 63. The section or surface 105 of the low pressure plunger moves down through the cylinder 96 to cut off the ports 98 and to positively displace the lubricant from the cylinder portion 96^a. In this connection it is to be observed that the surface 105 has limited clearance with the wall of the cylinder portion 96^a to allow the escape of excess lubricant through the groove 106 and ports 98 back into the container. The clearance is "controlled" or very limited, and the plunger 100 moving downwardly in the cylinder portion 96^a at a high speed positively displaces a full charge of lubricant, and any entrapped air, upwardly past the valve 107. During the pumping action

at the low pressure pump 14 the high pressure cylinder 62^a is moved downwardly on the stationary high pressure piston 117 and the inlet valve 125 of the high pressure pump opens to admit a charge of the lubricant to the cylinder chamber 118. Thus, the high pressure cylinder chamber 118 is positively charged simultaneously with and by reason of the positive displacement of lubricant under pressure from the cylinder 96^a into the transfer tube 63. The low pressure pump 14 positively pumps a charge of lubricant into the transfer tube 63 and an equivalent charge is displaced into the cylinder chamber 118 past the open valve 125. The transfer tube 63 contains a column of lubricant and possibly some air under pressure at all times by reason of the positive pumping action of the pump 14 so that the charge of lubricant is positively pumped into the cylinder chamber 118 during the suction strokes of the high pressure cylinder 62. This positive displacement or pumping action assures the clearance or delivery of air from the transfer tube 63 to the limited capacity high pressure cylinder chamber 118.

During the upward stroke of the air motor piston 32 the plunger of the low pressure pump moves upwardly through the cylinder 96 so that a charge of lubricant is drawn into the suction portion 96^b of the low pressure cylinder. During this action the valve 107 remains closed preserving the pressure within the transfer tube 63 and preventing the return of the pumped lubricant and/or air to the cylinder 96. As the air motor piston 32 and the high pressure cylinder 62^a move upwardly the charge of lubricant in the chamber 118 is displaced outwardly through the piston 117. The valve 125 is closed during the high pressure pumping stroke and the stationary piston 117 operating or received in the chamber 118 of the upwardly moving cylinder 62 positively displaces a given charge of lubricant with its accompanying air, if any. In practice, the lubricant or air is displaced from the chamber 118 at a pressure many times greater than the pressure existing in the transfer tube 63. The discharge valve 126 opens to permit the discharge of the lubricant from the chamber 118 when a given pressure builds up and the lubricant under high pressure flows out through the pipe 142 and hose 146 to the nozzle 147 and the machine parts.

The apparatus of the invention embodies two complete pumps, namely, the pump 14 and the pump 15, each equipped with an inlet valve means and a discharge valve means, and each constructed for the positive handling of air as well as lubricant. The transfer tube 63 operatively associates the two widely separated pumps and serves to conduct the lubricant under pressure from the pump 14 to the pump 15 during the charging stroke of the high pressure pump 15, and serves to retain a continuous column of lubricant or air under pressure during the discharge strokes of the high pressure pump. This combination of pumps 14 and 15 and connecting transfer tube 63 provides for the clearance or removal of any air there may be present in the mechanism and any air pockets that may be encountered in the container C. Air that reaches the ports 98 is quickly cleared or discharged from the apparatus and cannot render the apparatus inoperative and does not necessitate any delay in the pumping of the lubricant.

As the lubricant is evacuated from the container C the follower plate 112 moves down-

wardly on the top surface of the lubricant body. The plate, with its packing 113, prevents the atmospheric air from channeling down through the lubricant to the ports 98 and reduces to a minimum the amount of air that reaches the pumping equipment. The follower plate 112 is adapted to move down to adjacent the bottom of the container C to provide for substantially complete evacuation of lubricant from the container C. The suspension tube 97 and the cylinder 96 form a continuous column of uniform external diameter which may be readily pulled upwardly through the follower plate 112 despite the vacuum which resists raising of the follower plate proper. With the pumping unit removed, the follower plate 112 may then be separately freed and readily removed. The apparatus may be successively employed on new or replacement containers C, or for the pumping of lubricant that has been transferred from other containers to the container C.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. Lubricant handling apparatus for pumping lubricant from a supply body of lubricant comprising low pressure pump means adapted to be within said supply body of lubricant, high pressure pump means adapted to be at the exterior of said supply body, a reciprocable transfer tube for conducting lubricant under pressure from the low pressure pump means to the high pressure pump means and mechanically connecting the pump means for simultaneous operation, a motor for operating the pump means through the transfer tube, a valve operable to control the motor so that the motor will operate the pump means, and means operatively connected with said tube between the pump means for operating the valve.

2. In apparatus for pumping lubricant from a lubricant supply, a low pressure pump adapted to be positioned in said lubricant supply comprising cylinder and piston elements fitted with limited clearance, one of which is reciprocable, lubricant inlet means for said cylinder element in communication with said supply, and a lubricant discharge valve for said cylinder element, a reciprocable transfer tube receiving the lubricant under pressure from the discharge valve and connected with the reciprocable element to reciprocate the same, a high pressure pump remote from the low pressure pump comprising cylinder and piston elements one of which is reciprocable and connected with the transfer tube to move therewith, the piston element of the high pressure pump being of less diameter than the piston element of the low pressure pump, an inlet valve for the cylinder of the high pressure pump for admitting lubricant under pressure from the transfer tube, and a discharge valve for the cylinder of the high pressure pump for discharging the lubricant under high pressure, and operating means operatively connected with the assembly of the transfer tube and the reciprocating elements of the pumps to reciprocate the same.

3. Lubricant pumping apparatus for pumping lubricant from a lubricant supply comprising a high pressure pump including cylinder and piston elements, one of which is reciprocable, an

inlet valve for the cylinder element, and a discharge valve for the cylinder element, a reciprocable low pressure transfer tube connected with said reciprocable element to reciprocate therewith and adapted to conduct lubricant under pressure to the inlet valve of the high pressure pump, and a low pressure pump in the lubricant supply including relatively reciprocable cylinder and piston elements, one of which is connected with the tube to be reciprocated thereby, inlet means for the cylinder element of the low pressure pump in direct communication with the lubricant supply, the inlet valve and the cylinder and piston elements of the low pressure pump being related so that excess lubricant escapes into the lubricant supply, and a discharge valve for the cylinder of the low pressure pump discharging the pumped lubricant into the transfer tube, the piston element of the low pressure pump being larger in diameter than the piston element of the high pressure pump.

4. Lubricant pumping apparatus for pumping lubricant from a lubricant supply including a ported cylinder arranged in receiving relation to the supply to receive lubricant therefrom, a plunger operable in the cylinder with limited clearance, a discharge valve in the plunger, a transfer tube connected with the plunger to receive the pumped lubricant therefrom, and a high pressure pump at the exterior of the supply comprising a stationary piston of smaller diameter than the plunger, a reciprocable cylinder connected with the transfer tube receiving said piston and adapted to receive said pumped lubricant from the transfer tube, an inlet valve in the reciprocable cylinder governing the admission of lubricant to the reciprocable cylinder, and a discharge valve in the piston for discharging lubricant from the reciprocable cylinder.

5. In a lubricant pumping apparatus, a pump for handling the lubricant, comprising cylinder and piston elements, an inlet valve controlling delivery of lubricant to the pump, and an outlet valve, an air motor for operating the pump comprising a cylinder and a piston on the cylinder attached to the reciprocating element of the pump, means for discharging air under pressure into the end portions of the cylinder, and means for lubricating the motor comprising means for carrying lubricant from the cylinder of the pump into the air pressure cylinder of the motor.

6. In a lubricant pumping apparatus, a pump for pumping the lubricant, comprising cylinder and piston elements, an inlet valve controlling delivery of lubricant to the pump, and an outlet valve, an air motor for reciprocating one of said elements to operate the pump comprising a cylinder and a piston in the cylinder attached to said assembly, and means for discharging air under pressure into the end portions of the motor cylinder, and means for lubricating the motor comprising a pocket in said assembly for carrying lubricant from the cylinder of the high pressure pump into the cylinder of the motor and located to be in the blast of air under pressure entering one end of the cylinder so that the lubricant in the pocket is broken up into a mist.

7. In a lubricant pumping apparatus, a high pressure pump, a low pressure pump, a reciprocal transfer tube connecting the pumps, the low pressure pump including a cylinder having a closed end and one or more inlet ports spaced from the closed end, means for reciprocating the transfer tube to operate the pumps, and a

plunger operable in the cylinder with limited clearance to displace lubricant therefrom to the transfer tube for passage to the high pressure pump when moving toward said end, the capacity of that portion of the cylinder between the ports and said end being at least as large as the lubricant discharge capacity of the high pressure pump, the plunger being adapted to move away from said end beyond said ports a distance sufficient to draw a large volume of lubricant into the cylinder.

8. In a lubricant pumping apparatus, a high pressure pump, a low pressure pump, a reciprocal transfer tube connecting the pumps, the low pressure pump including a cylinder having a closed end and one or more inlet ports spaced from the closed end, means for reciprocating the transfer tube to operate the pumps, and a plunger operable in the cylinder with limited clearance to displace lubricant therefrom to the transfer tube for passage to the high pressure pump when moving toward said end, the capacity of that portion of the cylinder between the ports and said end being at least as large as the lubricant discharge capacity of the high pressure pump, the plunger being adapted to move away from said end beyond said ports a distance sufficient to draw a volume of lubricant into the cylinder several times greater than the capacity of the high pressure cylinder, that portion of the plunger which enters said portion of the cylinder having controlled clearance with the cylinder to allow the escape of excess lubricant out through said ports.

9. In a lubricant pumping apparatus, a lubricant pump including cylinder and piston elements, one of which is reciprocable relative to the other, a motor for operating the pump, and means for transferring limited quantities of lubricant from the pump to the motor comprising a pocket alternately in receiving relation to the pump and in discharging relation to the motor during reciprocation of the reciprocable element of the pump.

10. In a lubricant pumping apparatus, a lubricant pump including cylinder and piston elements, one of which is reciprocable relative to the other, a motor for operating the pump, and means for transferring limited quantities of lubricant from the pump to the motor comprising a pocket alternately in receiving relation to the pump and in discharging relation to the motor during reciprocation of the reciprocable element of the pump, and means for directing a stream of air to impinge against the lubricant in the pocket to atomize the lubricant therein when the pocket is in said discharging relation to the motor.

11. In lubricant pumping apparatus, a pump for the lubricant comprising two relatively reciprocable elements, one a cylinder, the other a piston reciprocable in the cylinder, a motor for operating the pump including an air pressure cylinder and a piston operable in the cylinder and connected to the reciprocable element of the pump to operate the same, and means for lu-

bricating the motor comprising a surface on the pump piston alternately exposed to the interiors of the two cylinders during each reciprocation of the motor piston and adapted to carry lubricant from the pump cylinder to the motor cylinder, and means for introducing air under pressure into the motor cylinder to impinge against said surface.

12. Lubricant pumping apparatus for use with a lubricant supply comprising a high pressure pump including a reciprocable element, a reciprocable operating and transfer tube connected with said element to operate the same and serving to supply lubricant to the high pressure pump, and a priming pump for feeding lubricant to the transfer tube comprising a cylinder having two portions separated by at least one port of large capacity in lubricant-receiving relation to said supply, and a piston operated by said tube and operable in both portions of the cylinder during one stroke of the tube to draw lubricant into the cylinder, and operable in one portion of the cylinder during the other stroke of the tube to force lubricant out through the tube under pressure.

13. Lubricant pumping apparatus for use with a lubricant supply comprising a high pressure pump including a cylinder and piston related for relative reciprocation, a reciprocable operating and transfer tube for operating the high pressure pump and for conducting lubricant thereto, and a priming pump to deliver lubricant to the tube to be conducted thereby to the high pressure pump comprising a piston on the tube of larger diameter than the first named piston, and a cylinder receiving the second named piston having port means for admitting lubricant from the supply to the priming pump cylinder during one stroke of said second named piston and operable to discharge excess lubricant back into the supply during the other stroke of said second named piston.

14. Lubricant pumping apparatus for use with a lubricant supply comprising a high pressure pump including a cylinder and piston related for relative reciprocation, a reciprocable operating and transfer tube for operating the high pressure pump and for conducting lubricant thereto, and a priming pump to deliver lubricant to the tube to be conducted thereby to the high pressure pump comprising a piston on the tube of larger diameter than the first named piston, and a cylinder receiving the second named piston having a first portion and a second portion, there being at least one port of large capacity in the cylinder communicating with the supply and with said first cylinder portion where it joins the second cylinder portion to permit the free passage of lubricant into the cylinder during the suction stroke of said second named piston, and to permit the return to the supply of excess lubricant during the pressure developing stroke of the piston.

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