This invention relates to lubricating apparatus and relates more particularly to lubricant pumps for forcing lubricant under pressure to the bearings and working parts of machines such as automotive vehicles and the like. A general object of this invention is to provide a dependable, efficient and highly effective pump for dispensing or pumping lubricants from the original lubricant containers or drums.

Lubricant pumps have been introduced for pumping the lubricant directly from the original lubricant containers and for discharging it under high pressure in the bearings and working parts of the vehicles and machines. To meet the demand for large volume discharge in such devices when handling heavy lubricants, or lighter lubricants at low temperature, it has been found necessary to employ the combination of a low pressure pump with a cylinder of large diameter and short stroke to draw in sufficiently large charges of lubricant from the container, and a high pressure pump with a cylinder of small diameter and large stroke for receiving the lubricant from the low pressure pump and discharging it at high pressure. A separate motor has been required for the operation of each pump. The two separate pumps and the two separate motors make such apparatus expensive and bulky.

An object of the present invention is to provide a lubricant pumping apparatus for pumping lubricant, from an original container and for discharging it under high pressures which embodies a low pressure pump of large cylinder diameter and relatively short stroke for the ready handling of heavy lubricants and lighter lubricants at low temperatures, a high pressure pump of relatively small cylinder diameter and of longer stroke receiving the lubricant from the low pressure pump and discharging it under increased pressure, and a yielding connection between said pumps which permits the operation of the two pumps by a single or common motor, the yielding connection allowing for the differential in strokes of the two pumps.

Another object of this invention is to provide a lubricant pumping apparatus of the character referred to in which the large diameter low pressure cylinder has a capacity in excess of the capacity of the higher pressure cylinder to assure the complete charging of the latter when handling heavy lubricants and lubricants at low temperatures under such conditions that the low pressure cylinder is only partially filled on a suction stroke. With this cylinder arrangement, the yielding connection between the two pumps permits the operation of the two pumps by a single motor without stalling the motor when handling light lubricants and lubricants at higher temperatures under such conditions that the low pressure cylinder is more completely filled. The yielding connection embodied in the pump mechanism of the present invention provides for an automatic adjustment of the stroke of the low pressure pump as conditions may require, and permits the employment of a low pressure cylinder of larger capacity than the higher pressure cylinder to assure the full charging of the latter under all conditions. When handling lighter lubricants and lubricants at higher temperatures the above mentioned connection yields so that the stroke of the low pressure pump is shortened or reduced when its charge is in excess of the capacity of the higher pressure cylinder, the extent of yielding of the said connection being in proportion to the amount of excess charge drawn into the low pressure pump.

Another object of this invention is to provide a lubricant pump of the character referred to embodying a positive priming means or low pressure pump in direct communication with the lubricant container to receive the lubricant therefrom and operating to positively force full charges of the lubricant under pressure to a second higher pressure pump to assure a full charging of the latter at each stroke cycle.

Another object of this invention is to provide a pump of the character mentioned embodying a multiple stage pumping action with a single or common motor for operating a plurality of pumps or pump means.

Another object of this invention is to provide a lubricant pump of the character mentioned embodying a yielding connection between two of the multi-stage pump means with a novel spring means actuated by the common motor to produce full operation of the related pump means on each stroke of the motor.

Another object of this invention is to provide a lubricant pump that is operable to pump out or evacuate substantially the entire contents of the lubricant drum or container.

A further object of the invention is to provide a pump of the character referred to embodying a follower plate in the lubricant container for assuring the evacuation or pumping of the entire contents of the container without the formation of air channels or air pockets in the lubricant around the pump column.

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

Fig. 1 is a side elevation of a pumping apparatus embodying the invention. Fig. 2 is an enlarged, fragmentary longitudinal detailed view of the principal portion of the apparatus with the motor piston and motor valve means appearing in side elevation. Fig. 3 is an enlarged fragmentary vertical detailed sectional view of the upper portion of the apparatus showing the motor piston at the upper end of its movement and Fig. 4 is an enlarged fragmentary vertical detailed sectional view of the lower portion of the pump means showing the intermediate pressure pump plunger and low pressure pump means at the upper ends of their movements.

The pumping equipment of the present invention may be said to comprise, generally, means for housing a lubricant container C and for supporting the pump mechanism, an operating motor 11 in the upper portion of the means, valve means 12 for the motor 11, shuttle means 13 for operating the valve means 12, high, intermediate and low pressure pump means 14, 15 and 16 operated by the motor 11 for pumping lubricant from the container C, and a follower plate 17 movable downwardly in the container C to assure the removal or pumping or substantially the entire contents of the same.

The means 10 for housing and supporting the various other elements of the apparatus may be varied considerably to adapt the equipment for use with original lubricant containers of different sizes, shapes, etc., and to adapt the apparatus for given uses. In the drawings the apparatus is shown associated with an upright, generally cylindrical drum or container C of substantial capacity. The supporting and housing means includes the wheeled base 18 carrying the container C and an upright shell 19 surrounding the container C with clearance and suitably connected with the base 18. A top or cover 20 is secured to the upper end of the shell 19 and extends upwardly and inwardly over the mouth of the container C to carry what I will call a dome 21. The dome 21 may be removable and secured to the cover 20 by a flanged connection 22 and projects upwardly from the cover 20 to carry and house the motor 11 and associated parts. A central opening 23 of substantial diameter is formed in the upper wall of the dome 21.

The motor 11 is provided to operate the three stages of pumps, that is, the high, intermediate and low pressure pump means 14, 15 and 16, and in the preferred form of the invention the power means is in the form of an air motor of the cylinder and piston type. The cylinder 24 of the motor 11 is a centrally located, vertically disposed member secured in the dome 21. An upwardly and inwardly tapered or rounded head 25 extends upwardly from the top of the dome 21 and has a lower portion 26 extending through the opening 23 and threaded in the upper end of the cylinder 24. A flange 27 on the head 25 rests on the upper wall of the dome 21 to support or suspend the cylinder 24 and the parts connected therewith.

The interior of the head 25 is open to the cylinder 24 and a central vertical opening 28 is formed in the reduced upper end part of the head. The motor cylinder 24 has a lower head or wall 29 provided with an upsetting central boss 30. A socket 31 enters the boss 30 from its lower end and a reduced opening 32 continues from the socket 31 up through the top of the boss.

The piston 33 of the motor 11 is shaped or formed to move down over the boss 30 with suitable clearance and has a central socket 34 in its upper portion leading to a reduced opening 35 which continues to the top of the piston. An external annular flange 36 is provided on the piston 33 and a nut 37 is threaded on the lower portion of the piston 33 to be spaced below the flange 36. The sealing member of the piston 33 has an annular bead 38 received between the flange 36 and the nut 37 and annular lips 39 which extend axially in opposite directions from the bead. The sealing element is formed of flexible resilient material and the lips 39 flare or diverge outwardly to have effective sealing contact with the wall of the cylinder 33. A metal clip 40 is provided on the bead 38 and is gripped and held between the opposing surfaces of the flange 36 and the nut 37. It will be observed that the cylinder 24 of the pump 11 may be of substantial diameter.

The valve means 12 is operable under the control of the shuttle means 13 to supply air under pressure to the opposite ends of the cylinder 24 and is such that the motor 11 operates automatically and continuously so long as the lubricant discharge of the apparatus is open, the motor being such that it stalls and stops when the discharge is closed. The means 12 includes a valve housing or chest 41 preferably at one side of the cylinder 24. In the construction illustrated the cylinder 24 has a thickened portion or flange 42 and the chest 41 and this flange 42 have flat opposing vertical surfaces. A hard wear resisting plate 43 is clamped between the opposing surfaces of the flange 42 and the chest 41 to present a smooth, long wearing surface at the interior of the chest. A pressure inlet port 44 enters the chest 41 and is supplied with air under pressure by a line or hose 45 equipped with an automatic coupler valve 46. An exhaust port 47 extends through the plate 43 and the flange 42 to discharge freely in the dome 21. A port 48 is spaced below the exhaust port 47 and passes inwardly through the plate 43 and cylinder wall to communicate with the lower end of the cylinder 24. A similar port 49 is provided in the plate 43 and cylinder wall to have its lower end communicate with the chest 41 at a point spaced above the exhaust port 47 and to have its upper end communicate with the upper portion of the cylinder 24.

The valve means 12 further includes a slide valve 50 of the D-type slidable or shiftable on the plate 43 between a position where it places the port 49 in communication with the exhaust port 47, while leaving the port 48 open to the interior of the chest 41 and the position illustrated in Fig. 3 of the drawings, where the port 48 is connected with the exhaust port 47 and the port 49 has communication with the chest 41. A reciprocable rod 51 slidable passes through a guide bushing 52 in the wall of the chest 41 and has a transverse opening 53 slidable receiving a stem 54 on the valve 50. A spring 55 surrounds the stem 54 and is arranged under compression between the valve 50 and the rod 51 to maintain the valve in correct sliding engagement with the plate 43. A bracket 56 is suitably attached to the valve chest 41 and has an opening 57 slidable passing the valve rod 51. Spring pressed
packing 58 is provided on the bracket 55 to seal about the valve rod 51. The upper or inner portion of the valve rod 51 is tubular or socketed and is slidably guided in a socket 59 formed in the wall of the chest 41. A spring 60 is seated in the socket 59 and the upper portion of the rod 51 to urge the rod and the valve 50 downwardly. The shuttle means 43 is operated by the motor piston 33 to actuate or reverse the valve 50. The shuttle means 43 is preferably positioned immediately below the motor 11 to be operatively connected with an element of the pump mechanism which is turn is connected with the piston 33. In the construction illustrated this element is a tubular assembly comprising an upper tubular section 61 and a transfer tube 62. The section 61 has its upper end threaded in a nut 63 which in turn is threaded in the lower portion of the piston socket 34. The transfer tube 62 is shown larger in diameter than the section 61 and is threaded with the lower end of the section 61. The shuttle means 43 includes a guide and carrier 64 secured to the lower end of the cylinder 24. In the construction a tubular nut 65 is threaded in the socket 31 and has shoudered engagement 66 with the carrier 64 to secure the carrier to the cylinder wall 23. A shuttle 67 shifts or reciprocates in the carriage 68. The shuttle 67 is a tubular member surrounding the section 61 with ample clearance and slidably fitting the carrier 64 to be guided thereby. In accordance with the invention the shuttle 67 is operatively connected or associated with the valve rod 51 for the operation of the valve 30 and the piston 33. An annular groove 68 is formed in the exterior of the shuttle 67 and a double lever 69 is secured to the bracket 55 by a pivot pin 70 and has a roller 71 on its outer end engaged in the groove 68. The outer arm of the lever 69 has a readily adjustable screw 72 engageable with the lower end of the valve rod 51. A lock nut 73 is provided to secure the screw 72 in the adjusted position.

The shuttle means 43 is a loaded spring snap action mechanism embodying spring means for causing sudden movement of the shuttle 67 at the end of each stroke or movement of the motor piston 33. An internal annular flange 74 is provided in the shuttle 67 and is cooperable with a coiled spring 75 surrounding the section 61 and resting on the upper end of the transfer tube 62. A similar spring 76 rests on the flange 74 and is engageable by a collar 77 fixed on the reciprocable section 61. Two annular external grooves 78 are formed in the shuttle 67 and are spaced apart by what may be termed an annular ridge 79. Spring held detent elements cooperate with the grooves 78 and the separating ridge 79. Diametrically opposite radial openings 80 are formed in the wall of the carrier 64 and inwardly facing cua 81 are threaded in the openings 80. Balls 82 are shiftable in the cups 81 and are urged inwardly against the shuttle 67 by compression springs 83. The balls 82 cooperate with the grooves 78 to yieldingly hold the shuttle 67 in its upper and lower positions and retract by reason of the engagement of the ridge 79 with them when the shuttle shifts.

When the motor piston 33 is moving downwardly the balls 82 are in cooperation with the lower groove 78, as shown in Fig. 3. During the downward movement of the piston 33 the collar 77 comes into engagement with the spring 76 and when the piston 33 approaches the end of its downward stroke the spring 76 becomes fully compressed and positive downward movement is transmitted to the shuttle 67. When this occurs the ridge 79 is forced past the spring urged balls 82 and the shuttle 67 moves rapidly downward under the compressed spring 76 to reverse the valve 50. The balls 82 are thus engaged in the upper groove 78 for the upward stroke of the piston 33. As the piston 33 moves upwardly the upper end of the spring 75 comes into engagement with the flange 74 and as the movement continues the spring 15 is compressed. When the spring 75 is fully compressed the shuttle 67 is positively moved upward so that the ridge 78 moves past the balls 82 and the shuttle is rapidly shifted to reverse the valve 50. The shuttle means described above operates to automatically reverse the valve 50 at the end of each movement of the motor piston 33 and is readily adjusted to produce the desired motor operation by means of the adjusting screw 72.

The high pressure pump means 14 receives a given or definite charge of lubricant under pressure from the intermediate pump means 18 during each down stroke of the piston 33 and discharges a like volume of lubricant under greatly increased pressure during each up stroke of the piston 33. The high pressure pump means 14 is at or within the motor 11 and, in the construction illustrated, comprises a stationary piston or ram 84 and a reciprocating cylinder. The upper portion of the longitudinal opening 85 in the section 81 is enlarged in diameter to constitute the cylinder 86 of the high pressure pump means 14 and the ram 84 is fastened to the stationary head 25 to be received in this cylinder 86. The cam 84 is suitably fixed in a reduced lower portion of the opening 89 and passes downwardly through the opening 89, the socket 86 and the nut 83 to enter the cylinder 86. The ram 84 is tubular having an extension longitudinal opening 87 leading upwardly from the cylinder 86 to the opening 89. Packing 88, preferably of the chevron type, is seated in the socket 84 to seal about the ram 84. A spring 89 is arranged under compression between the nut 83 and the lower end of the packing assembly to hold the packing 88 in effective engaging with the ram 84.

The high pressure pump means 14 further includes a discharge valve 90. The valve 90 is arranged in the opening 89 of the head 25 and has a pointed lower end for sealing downwardly against a seat on the upper end of the stationary ram 84. The upper portion of the valve 90 is socketed or tubular and the valve is provided with lateral ports 91 to provide for the passage of lubricant upwardly through it when open. A spring 92 is arranged under compression between the upper end of the valve 90 and a fitting 91 to urge the valve to its closed position. The fitting 91 is threaded in the upper end of the opening 89 and a discharge hose 93 extends from the fitting. The hose 93 is provided at its outer end with a manually controlled nozzle or discharge valve 94 for discharging the lubricant into the bearings and machine parts.

The intermediate pump means is located within the container C to receive the lubricant from the low pressure pump means which is in direct communication with the lower portion of the container. The pump means 15 includes a stationary element suspended from the carrier
64 and a reciprocable element carried by or operated by the piston 33 of the motor 11. A carrier tube 55 is threaded in the lower end of the carrier and extends downwardly in the container C to a point a short distance from its bottom. A cylinder block 98 is threaded or otherwise secured to the lower end of the carrier tube 95 and continues downwardly from the tube to have its lower end immediately adjacent the bottom of the container. A cylinder bore or opening 97 enters the block 98 from its upper end and extends downwardly in the block. The upper end of the opening 97 is closed. The cylinder opening 97 has a lower portion of enlarged diameter which I will term a cylinder 98. The lower part 98 of the cylinder block 96 is reduced in external diameter and the lower corner portion of the block has spaced notches 99 of substantial size. One or more inlet ports 100 are provided in the wall of the cylinder block 98 to communicate with the cylinder 98. In the preferred construction illustrated, there are diametrically opposite ports 100 at the upper end of the reduced block portion 96 communicating with the upper portion of the cylinder 98 where the cylinder joins the opening 91. The ports 100 are supplied with lubricant under pressure by the low pressure pump means 16, as will be later described.

The reciprocable element of the intermediate pressure pump means 15 is a ram or plunger 101 connected with the motor piston 33 through the medium of the section 61 and the transfer tube 62 mentioned above. The section 61 is attached to the nut 63 of the piston 33 and passes downwardly through the opening 32 and socket 31 to carry the collar 71 and to connect with the tube 62, as above described. Packing 102 is provided in the socket 31 to seal about the section 61 and is actuated or compressed by a spring 103 engaged against the upper end of the nut 65. The transfer tube 62 is attached to the lower end of the section 61 to move with the section and the piston 33 and to communicate with the opening 97 of the section 61. The transfer tube 62 passes downwardly through the carrier tube 95 with considerable clearance and the intermediate pressure plunger 101 is fixed to the lower end of the transfer tube as by a threaded connection. The plunger 101 is tubular and its longitudinal opening 104 is in full communication with the transfer tube 62. The plunger 101 slidably fits or operates in the upper portion of the cylinder block opening 97, and is movable between a position where its lower end is above the ports 105, as shown in Fig. 4, and a position where its lower end is adjacent the bottom wall of the cylinder 98. The plunger 101 is received in the cylinder 98 with controlled or limited clearance to permit the escape of excess lubricant out through the ports 105 during the down stroke. The cylinder 98 preferably has a capacity greater than that of the high pressure cylinder 86 to make allowances for manufacturing tolerances while assuring the full charging of the high pressure cylinder.

The intermediate pressure pump means 15 further includes a discharge valve 105 in the lower portion of the plunger 101. The valve 105 acts as the inlet valve for the high pressure pump 14. An internal seat 106 is formed in the plunger 101 and the valve 105 has a pointed or bevelled lower portion for seating downwardly against the seat 106. The upper portion of the valve 105 is socketed and ported to allow for the free up-flow of lubricant when in the open position. The valve 105 is normally urged to its closed position. A spring 107 is arranged under compression between the upper end of the valve 105 and the lower end of the transfer tube 62 to urge the valve closed. With the pump mechanism primed and in the operating condition there is a continuous column of lubricant occupying the communicating openings of the transfer tube 62, the section 61, and the high pressure pump 14. The high pressure pump 108 in addition to serving as the inlet valve for the pump 14 and the discharge valve for the pump 15, serves to prevent a down flow or return movement of this column of lubricant. When the plunger 101 moves downwardly in the cylinder 98 to displace lubricant 111 the lowering of the valve 105 opens and a given or definite charge of the lubricant is displaced from the cylinder 98 into the plunger 101. The parts are formed and proportioned so that the charging action of the intermediate pressure pump means 15 completely charges the high pressure cylinder 86 during each down stroke of the motor piston 33.

The low pressure pump means 16 is operable during each down stroke of the motor piston 33 to receive a charge of lubricant from the container C and operates during each upward stroke of the piston 33 to pump sufficient charge of lubricant under pressure through the ports 100 into the cylinder 98 of the intermediate pressure pump means 15. The low pressure pump means 16 includes a reciprocating or floating tube 108 surrounding the carrier tube 95 with substantial clearance to leave an annular space. The floating tube 108 is sufficient long to extend from above the top of the container C to adjacent the lower end of the stationary cylinder block 96 when in its lowest position. The upper portion of the floating tube 108 is free to float and the lower end of the carrier 64. In the construction illustrated the tube 108 comprises upper and lower sections connected by a thick walled threaded coupling 109. The sections of the tube 108 and the coupling 109 are uniform in external diameter. The tube 108 passes downwardly around the cylinder block 96 and is provided at its lower end with a valve cap or head 110. The valve head 110 is of the same external diameter as the tube 108 and slidably cooperates with the reduced lower part 86 of the cylinder block 96 to close the lower end of the carrier 64. The construction illustrated in Fig. 2 the socket 111 in full communication with the upper parts of the notches 99 to put the lower pressure pump means 16 in communication with the lubricant container C. When the tube 108 is in its lowermost position illustrated in Fig. 2 the socket 111 is in communication with the upper parts of the notches 99 to put the lower pressure pump means 16 in communication with the lubricant container C. When the tube 108 is in the upper position, shown in Fig. 4, the socket 111 is out of communication with the notches 99.

Sealing or packing means is provided for sealing between the cylinder block 96 and the traveling tube 103 at a point or zone above the ports 105. A flange 112 is provided on the exterior of the traveling tube 103 and is formed in the flange 112. A washer 114 engages against the lower side of the body of packing 113 and a spring 115 engages upwardly against the washer 114 to compress the packing 113 and hold it operative. The lower end of the spring 115 bears against a ring 117 set in the block 96. The valve head 110 and the packing 113 define the upper and lower ends
of the low pressure pump cylinder 118. It will be observed that this cylinder 118 has controlled or valved communication with the lubricant container C by reason of the cooperation of the control block 110 with the notched block portion 96, and has controlled or valved lubricant discharge communication with the intermediate pressure cylinder 98 by reason of the cooperation of the control block 110 with the notched block portion 96.

The intermediate pressure cylinder 98 has a capacity considerably greater than the length of the intermediate pressure cylinder 98 to assure the creation of sufficient suction to effect inflow of lubricant charges of ample size to completely fill the cylinder 98 when the apparatus is handling heavy lubricants at low temperatures. The tube 108 of the low pressure pump means 16 has a yielding lost motion connection with the reciprocating elements of the high pressure and intermediate pressure pump means 14 and 15. This yielding connection provides for movement of the tube 108 in a given timed relation with the elements of the pump means 14 and 15 for the forcible or positive delivery of lubricant under pressure from the cylinder 118 to the cylinder 98 under all conditions of operation, without regard to the varying length of stroke of the reciprocating elements of the pump means 14 and 15 and without stalling the motor 11. The lost motion connection between the tube 108 and the reciprocating elements of the pump means 14 and 15 includes a collar or ring 119 moving with clearance in the annular space between the transfer tube 62 and the carrier tube 95. Longitudinal slots 120 of limited length are provided in the carrier tube 95 and screws 121 are threaded in openings in the ring 119 and have their heads operating in the slots 120. The plain or unthreaded heads of the screws 121 are the openings 9 in the coupling 109 for the transmission of movement to the tube 108. The screws 121 are engageable with the ends of the slots 120 to limit the stroke of the tube 108.

The operation means of the yielding lost motion connection includes a compression spring 122 engaged against the upper end of the ring 119. The spring 122 is under compression at all times, being engaged against the ring 119 and a collar 123 which turns against a bead 124 on the stationary carrier tube 95. The tension of the spring 122 acts to move the floating tube 108 downwardly during the down stroke of the piston 33, as will be later described. The spring controlled lost motion connection between the reciprocating elements of the pump means 14 and 16 and the floating tube 108 of the pump means 16 further includes a spring 125 for transmitting upward movement of the tube 108. The spring 125 is supported on a collar 126 which is clamped between the upper end of the plungers 101 and a shoulder on the transfer tube 62. The upper end of the spring 125 opposes and is cooperable with the lower side of the ring 119. The spring 125 is quite heavy, being considerably stronger than the spring 122, and is proportioned so that its upper end is spaced below and is entirely clear of the ring 119 when the travelling or floating tube 108 is in its lowermost position.

Assuming that the motor piston 33 is starting from the lower end of its movement the socket 111 is in communication with the notches 99 and the ring 119 is spaced above the spring 125. As the piston 33 moves upwardly the space between the upper end of the spring 125 and the lower end of the ring 119 is first taken up, that is, the spring 125 moves upwardly to the ring 119. It will be apparent that this initial action produces no movement of the tube 108. As the upward movement of the piston 33 continues the heavy spring 125 engages the rod 126 and transmits upward movement to the tube 108 and the tube moves upwardly to move the socket 111 out of communication with the notches 99. This traps a charge of lubricant in the cylinder 118. The initial upward movement of the tube 108 just mentioned is accompanied by compression of the light spring 122 but does not compress the heavier spring 125 because there is little resistance to upward travel of the tube 108 until all voids associated with the trapped lubricant in the cylinder 118 have been taken up. With the ports or notches 99 closed and all voids removed from the charge of lubricant trapped in the cylinder 118, further upward movement of the tube 108 temporarily stops and the tube 108 remains stationary until the piston 101 clears or begins to clear the ports 100. In the meantime continued upward movement of the motor piston 33 results in compression of the spring 125 with the result that the lubricant in the cylinder 118 is put under compression. The piston 101 of the intermediate pressure pump means 15 is of course moving upwardly during the operations just described and when the lower end of the plunger 101 reaches and begins to clear the ports 100 the lubricant under pressure in the low pressure cylinder 118 is forced into the cylinder 98. It is to be understood that the low pressure lubricant is thus positively pumped or forced into the intermediate pressure cylinder 98.

The upward movement of the piston 33 continues until the plunger 101 clears the ports 100 or reaches the position shown in Fig. 4. Under most operating conditions the quantity of lubricant trapped in the chamber 118 is so large that the final upward movement of the tube 108, accompanying charging of the cylinder 98, is stopped by a complete filling of the cylinder 98 before the screws 121 reach the upper ends of the slots 120. The low pressure cylinder 118 is considerably larger than the intermediate pressure cylinder 98 to assure a complete charging of the cylinder 98 even though voids may be present in the chamber 118 when handling heavy lubricants or lighter lubricants at low temperatures.

During the charging of the intermediate pressure cylinder 98 by the operations just described the cylinder 98 is moving upwardly on the stationary ram 94 and lubricant is being displaced or pumped from the cylinder 86 through the ram 84 under a very high pressure. This lubricant passes through the hose 93 and is discharged at the valve nozzle 94.

At the top of the up-stroke of the motor piston 33 the spring 122 is under substantial compression and the plunger 101 is at the top of or above the ports 100. The motor 11 is reversed by the action of the shuttle means 13 and valve 12, as described above, and the piston 33 begins to descend. Downward movement of the piston 33 first relieves the compression on the spring 125 and then allows the weaker spring 122 to expand so that the tube 108 is moved downwardly. The downward movement of the tube 108 occurs concurrent with the downward movement of the piston 33, the movement of the tube being produced by expansion of the compressed spring 122. As above described, the cylinder 118 is of large capacity and downward movement of the tube 108 creates a substantial negative pressure or vacuum in the cylinder. The tube 108 moves down-
wardly to the position where the socket 111 communicates with the notches 99 before the intermediate pressure plunger 101 reaches the lower end of its stroke. By the time the socket 111 communicates with the notches 99 a substantial negative pressure is present in the chamber 118. When the socket 111 reaches the notches 99 this negative pressure serves to suck or draw a charge of lubricant into the chamber 118 from the container C. An appreciable time elapses between the registering of the socket 111 with the notches 99 and the completion of the down stroke of the plunger 101, and this period is utilized in drawing a charge of lubricant into the chamber 118. Ample time is provided for the filling of the chamber 118 and a substantial vacuum is created so that the large diameter rather short chamber receives sufficient lubricant to completely fill the cylinder 98 during the succeeding up stroke of the motor piston 33 even when handling heavy lubricants and when handling lighter lubricants at low temperatures.

Downward movement of the plunger 101 in the cylinder 98 simultaneously displaces the lubricant from the cylinder 98 up into the plunger opening 104. Any excess lubricant there may be in the cylinder 98 escapes through the controlled or limited clearance around the plunger 101 and passes back through the ports 102 into the present cylinder 118. The upward displacement of lubricant from the cylinder 98 results in the delivery of a like charge of lubricant to the cylinder 86 of the high pressure pump means 14. When the piston 33 has reached the lower end of its downward movement the long small diameter high pressure cylinder 86 is fully charged, and the low pressure cylinder 118 is in full communication with the container C as illustrated in Fig. 2. The motor 11 is reversed at this time and the upward stroke is started.

The follower plate 17 is provided to assure the delivery of substantially the entire contents of the container C to the low pressure pump means 16 and to prevent the channeling of air around the tube 108 as the pumping operations progress. The follower plate 17 is a generally flat member shaped to substantially conform to the container C. The periphery of the follower plate 17 may have suitable clearance with the wall of the container C and need not engage the container. In accordance with the invention the follower plate 17 rides or rests on the upper surface of the body of lubricant in the container C and travels down on the tube 108. Packing means is provided for sealing between the follower plate 17 and the tube 108. A packing gland 130 is provided on the follower plate 17 for slidably sealing with the tube 108 to prevent air from being drawn downwardly around the tube. One or more lifting handles 131 may be provided on the follower plate 17 to facilitate the installation and removal of the plate.

In employing the lubricant pumping apparatus of the invention the parts are assembled as illustrated to have the shell 19 engage about the container C and to have the tube 108 and the parts therein extend downwardly into the container. The follower plate 17 is associated with the tube 108 to rest upon the upper surface of the lubricant. It is to be understood that the container C may be the original barrel or drum in which the lubricant is marketed. The air hose 45 is connected with the valve means 12 by the coupling 46 and the hose 93 is connected with the pumping apparatus by the coupling 81. Prior to the actual lubricant dispensing operation of the equipment it may be necessary to prime or condition the apparatus by opening the valve nozzle 44. When this is done the motor 11 is put into operation to actuate the high, intermediate and low pressure pump means 14, 15 and 16. This pumps out or clears any air there may be in the apparatus and primes the pump. So long as the nozzle 94 remains closed the motor 11 is idle. When the nozzle 94 is opened the motor 11 immediately comes into operation to operate the pump means 14, 15 and 16. The pump means 14, 15 and 16 operate as described above, the low pressure pump means 16 serving to positively deliver a full charge of lubricant under pressure to the intermediate pressure pump means 15, the means 15 operating to transfer a given charge of lubricant under increased pressure to the high pressure pump means 14, and the latter means operating to discharge the lubricant under a greatly increased pressure. It is to be particularly noted that the low pressure pump means 16 operates to force a full charge of lubricant to the intermediate pressure pump means 15 when handling heavy as well as lighter lubricants. Thus, the low pressure pump means 16 assures the full charging of the intermediate pump means under various operating conditions. The intermediate pressure pump means 15 and the high pressure pump means 14 are fully charged at each stroke. The apparatus may be operated continuously or intermittently as required until substantially the entire contents of the container C are exhausted. The pump mechanism may then be removed from the container for use on another container.

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 pumping apparatus for use with a lubricant container comprising two axially aligned pump means arranged one within the other, one forcing lubricant to the other under pressure and the latter delivering the lubricant under increased pressure, a motor operatively connected with one of the pump means to operate the same, and a resilient slack connection between the pump means whereby the pump means are both operated by the motor, said connection being adapted to allow substantial relative axial movement between the pump means.

2. Lubricant pumping apparatus for use with a lubricant container comprising low, intermediate and high pressure pump means for pumping the lubricant from the container and increasing the pressure on the lubricant by stages, the low pressure pump means being in direct lubricant receiving relation to the container, the intermediate pressure pump means directly receiving the lubricant from the low pressure pump means and the high pressure pump means being above the high pressure pump means, and the motor operatively connected with the uppermost pump means for operating the several pump means.

3. Lubricant pumping apparatus for use with a lubricant container comprising low, intermediate and high pressure pump means for pumping the lubricant from the container and increasing the
pressure on the lubricant by stages, the low pressure pump means being in direct lubricant receiving relation to the lower portion of the container, the intermediate pressure pump means being in direct lubricant receiving relation to the low pressure pump means and the high pressure pump means having a discharge valve above the contents of the container, a transfer tube for conducting lubricant from the intermediate pressure pump means to the high pressure pump means and a single motor above the contents of the container for operating the several pump means.

4. Lubricant pumping apparatus for use with a lubricant container comprising high pressure pump means above the lubricant level of the container, a column extending into the container, a reciprocating part extending from the high pressure pump means downwardly through the column, two communicating low pressure pump means at the lower end of the column, one lubricant receiving relation to the container, the other in lubricant delivering relation to the high pressure pump means, separate operative connections between said low pressure pump means and said part, one of said connections being yieldable, and means for operating the high pressure pump means and for operating said part to actuate said low pressure pump means.

5. Lubricant pumping apparatus for use with a lubricant container comprising high pressure pump means above the lubricant level of the container, a column extending into the container, a reciprocating part extending through the column and operatively connected with the high pressure pump means, two low pressure pump means at the lower portion of the column for pumping lubricant from the container to the high pressure pump means in stages, one of the last named pump means being positively connected with said part, springs for transmitting operating force from said part to the other of the last named pump means, and a single motor for operating the high pressure pump means and said part.

6. Lubricant pumping apparatus for use with a lubricant container comprising high pressure pump means above the lubricant level of the container, a column extending downwardly in the container, an intermediate pressure pump means in the column for pumping lubricant to the high pressure pump means, a low pressure pump means for pumping lubricant from the container to the intermediate pressure pump means and including a reciprocating tube in surrounding relation to the column, a follower plate engaged against the lubricant in the container and movable downwardly on the tube, a reciprocating part extending downwardly in the tube and connected with the intermediate pressure pump means and said tube to operate the same and power means for operating the high pressure pump means and said part.

7. Lubricant pumping apparatus of the character described a lubricant container, a first cylinder and piston pump means, a second cylinder and piston pump means surrounding and in coaxial relation to the first mentioned pump means said cylinder for pumping the lubricant to the first pump means and having a shorter stroke and greater piston diameter than the first pump means, a yielding operative connection between the two pump means whereby they may be operated in series by a single power means and a power means for the two pump means.

8. Lubricant pumping apparatus for use with a lubricant container comprising high pressure pump means above the lubricant level of the container, a column extending downwardly in the container, an intermediate pressure pump means in the column for pumping lubricant to the high pressure pump means and including a cylinder on the column having an inlet port, a low pressure pump means comprising a reciprocating tube around the cylinder moved into lubricant receiving relation to the container during a portion of one stroke and forcing a charge of lubricant through said port during the other stroke, a reciprocating part extending through the column for operating the intermediate pressure pump means, a slack connection between the tube and said part, a spring engaged between the tube and said part to be compressed during said other stroke and to expand when the tube is in its first named stroke, and power means for reciprocating said part.

9. Lubricant pumping apparatus for use with a lubricant container comprising high pressure pump means above the lubricant level of the container, a column extending downwardly in the container, an intermediate pressure pump means in the column for pumping lubricant to the high pressure pump means and including a cylinder on the column having an inlet port, a reciprocating part extending through the column for operating the intermediate pressure pump means, a slack connection between the tube and said part, a yielding spring for transmitting movement from said part to the tube for said other strokes of the name, a spring compressed during said other stroke and expandable to move the tube through its first named stroke, and power means for reciprocating said part.

10. Lubricant pumping apparatus for use with a lubricant container comprising high pressure pump means above the lubricant level of the container, a column extending downwardly in the container, an intermediate pressure pump means in the column for pumping lubricant to the high pressure pump means and including a cylinder on the column having an inlet port, a low pressure pump means comprising a reciprocating tube around the cylinder moved into lubricant receiving relation to the container during a portion of one stroke and forcing a charge of lubricant through said port during the other stroke, a reciprocating part extending through the column for operating the intermediate pressure pump means, a slack connection between the tube and said part, a yielding spring for transmitting movement from said part to the tube for said other strokes of the name, a spring engaged between the tube and column compressed during said other stroke and expandable to move the tube through its first named stroke, and power means for reciprocating said part.

11. Lubricant pumping apparatus for use with a lubricant container including a cylinder and piston pump means located in the container, one a priming pump means with a large piston diameter, the other pump means having a smaller piston diameter and located within the first mentioned pump means and operating to discharge the lubricant under increased pressure, a single power means for operating the two pump means,
and a yielding connection between the pump means yieldable to allow a full stroke of said other pump means.

12. Lubricant pumping apparatus including a lubricant container, a low pressure pump located within the container, a higher pressure pump within and receiving the lubricant from the first named pump, said first named pump having a larger piston area than the second named pump, a yielding reciprocative connection between the two pumps whereby they may be operated by a single power means, and a reciprocative power means for operating the two pumps.

13. Lubricant pumping apparatus for use with a supply of lubricant comprising a column, a high pressure pump means at one end of the column, a reciprocating part extending through the column and operatively connected with the high pressure pump means, two low pressure pump means located at the other end portion of the column with one of the low pressure pump means in lubricant receiving relation to said supply, the low pressure pump means being operable to pump the lubricant from said supply to the high pressure pump means in stages, one of the low pressure pump means being positively connected with said part to be operated thereby, spring means for transmitting operating force from said part to the other of said low pressure pump means, and a power means for operating the high pressure pump means and for reciprocating said part.

14. Lubricant pumping apparatus for use with a lubricant container comprising a plurality of axially aligned pump means arranged within the container and one within the other for increasing the pressure on the lubricant by progressive stages, a reciprocating operating means operatively connected with a pump means, and reciprocative operative connections between the plurality of pump means whereby they may be operated by the single power means, one of said connections being a resilient lost motion connection allowing substantial relative longitudinal movement between the pump means which it connects.

15. In a lubricant pumping apparatus of the character described, a high pressure pump means, a low pressure pump means surrounding and in coaxial relation with the first named pump means for pumping lubricant under pressure to said first named pump means, an operating motor operating said first named pump means, and a lost motion connection between the two pump means whereby the second named pump means is operated by the motor through the medium of said first named pump means, said connection including a yielding force transmitting spring.

16. In a lubricant pumping apparatus, a lubricant container, a pump means arranged in the container, a pump means surrounding and in coaxial relation with the first named pump means for pumping lubricant under pressure to the first named pump means, reciprocative operating means for said first named pump means, and a yielding spring connection between the two pump means whereby the second named pump means is actuated by the operating means.

17. Lubricant pumping apparatus for use with a lubricant container comprising pump means located in the container and one within the other and connected in communicating series for increasing the pressure on the lubricant by progressive stages, one of said pump means being a low pressure pump means having a larger piston area than the other pump means, operative connections between the pump means whereby the several pump means may be operated by a single power means, the operative connection of said one pump means with the other pump means being a yielding slack connection, and a single motor for operating the several pump means.

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