To all whom it may concern:

Be it known that I, Roscoe W. Stephens, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Pump and Method of Packing the Same, of which the following is a specification.

This invention relates to pumps of the character used in pumping liquids from wells sunk in the earth to tap a stratum producing oil or other liquid, and an object of the invention, in general, is to provide a pump having relatively great pumping efficiency.

Another object is to overcome the tendency to "sanding" of the pump.

Another object is to reduce wear on the pump piston to a minimum.

Another object is to make provision for feeding a relatively heavy lubricant to the space between the plunger and working barrel of the pump.

Another object is to provide a construction in which a packing ring is held in wiping engagement with the plunger by the pressure of the column of oil above the ring or rings.

Other objects and advantages will appear in the subjoined detailed description.

The accompanying drawings illustrate various forms of the invention:

Figure 1 is an elevation mainly in vertical mid section of a pump made in accordance with the provisions of this invention, portions of the lubricant reservoir and plunger being broken away to contract the view.

Figure 2 is an enlarged vertical section of the lower end portion of Fig. 1.

Figure 3 is a plan section on line indicated by $a^{3} - a^{5}$, Fig. 2.

Figure 4 is an enlarged inverted plan section on line indicated by $a^{4} - a^{3}$, Fig. 1.

Figure 5 is an enlarged plan section on line indicated by $a^{7} - a^{5}$, Fig. 1.

Figure 6 is an elevation mainly in vertical mid section of a modified form of the invention, portions of the lubricant reservoir and plunger being broken away to contract the view.

Figure 7 is an enlarged plan section on line indicated by $a^{7} - a^{5}$, Fig. 6.

Figure 8 is an elevation mainly in vertical mid section of another modified form of the invention, portions of the lubricant reservoir and plunger being broken away to contract the view.

Figure 9 is an enlarged plan section on line indicated by $a^{9} - a^{9}$, Fig. 8.

Figure 10 is an elevation mainly in vertical mid section of another modified form of the invention.

Figure 11 is an enlarged vertical mid section of the upper portion of the pump shown in Fig. 10.

Figure 12 is a plan section on line indicated by $a^{12} - a^{12}$, Fig. 11.

Figure 13 is a plan section on line indicated by $a^{13} - a^{13}$, Fig. 11.

Figure 14 is an elevation mainly in vertical mid section of another modified form of the invention.

Figure 15 is an enlarged elevation mainly in vertical mid section of the middle portion of the pump shown in Fig. 14.

Figure 16 is a plan section on line indicated by $a^{16} - a^{16}$, Fig. 15.

Figure 17 is a perspective view of one of the packing rings in Figs. 14 and 15.

Figure 18 is a perspective view of another of the packing rings in Figs. 14 and 15.

This invention, in its broader phases, makes provision for feeding a relatively heavy lubricant to the space between the plunger and working barrel of the pump and the invention may be embodied in various forms. Insofar as the various forms of the pump are alike, the pumps are constructed as follows: The pump may be provided with a tail pipe, such tail pipe being indicated at 1, and connecting the tail pipe with a working barrel 2 is a valve seat member 3 for a standard valve cage 4 which may be of any desired construction and provided with a half valve 5. The valve cage 4 is adapted to be inserted in the seat member 3 by any well known or preferred means, and the seat member 3 is provided with a tapered seat 6 to correspond with the tapered base 7 of the valve cage. The base 7 is preferably provided with V-shaped notches 8 adapted, when the valve cage is lowered into place, to engage lugs 9 which may be in the form of pins projecting inwardly from the valve seat member 3. The advantage of the notches 8 and lugs 9 will be set forth hereinafter.

The upper end of the valve cage 4 is provided with a stem 10 which may be an integral part of the cage 4 or may be screw
threaded into the cage as is readily understood. The stem 10 may be screw-threaded to receive a Garbut rod, not shown, whereby the valve cage 4 may be inserted and withdrawn from its seat in a manner well understood in the art pertaining to oil pumps or other suitable means may be employed for inserting and withdrawing the valve cage. The stem 10 is provided with laterally extending lugs 11 adapted to be engaged by V-shaped notches 12 in the lower end of a hollow pump plunger 13 when said plunger is moved downward below the limit of its usual working stroke. The working barrel 2 may or may not be provided with a liner, and, in the drawings, a liner is indicated at 14. The plunger 13 is provided at its upper end with a valve cage 15 in which plays a ball valve 16.

In all forms of the invention excepting that shown in Figs. 10 to 13, the valve cage 15 is connected by a box and pin coupling 17 with the usual sucker rod string 18 and the coupling 17 is provided with laterally projecting fingers 19 adapted to maintain the upper end of the plunger 13 in alignment with the axis of the working barrel 2 during reciprocating pumping movement of the plunger.

The differentiating features of the different forms of the invention will now be described. First referring to the form shown in Figs. 1 to 5 inclusive, the working barrel 2 is joined at its upper end to a lubricant reservoir 20 adapted to hold a quantity of hard grease or other suitable lubricant 21 in the space surrounding the plunger 13, the inside diameter of the reservoir 20 being greater than that of the working barrel 2. In the instance shown the reservoir is formed separately from the working barrel 2, though it is understood that it may be of separate construction if desired. The reservoir 20 is preferably of a length substantially equal to the length of that portion of the plunger which projects above the working barrel when the plunger is at the end of its down stroke and the lengths of the plunger and reservoir will depend a great deal upon the different conditions to be met with in the particular well in which the pump is installed. The plunger is much longer than the usual well pump plunger. The reservoir is connected at its upper end by a coupling 22 to pump tubing 23.

In the form of the invention shown in Figs. 6 and 7 the working barrel 2 is connected by a coupling 24 with a lubricant reservoir 25. In this instance the lubricant reservoir 25 is of the same external diameter as the working barrel 2, but is of less internal diameter, the difference in diameter equaling the thickness of the liner 14. The reservoir 25 holds a body of relatively heavy lubricant 26, and in reality constitutes a portion of the pump tubing, and the length of the reservoir and working barrel combined substantially equals the length of the plunger 13 which is much longer than the working barrel.

In practice the forms of the invention shown in Figs. 1 to 7 operate as follows: The plunger 13 is reciprocated in the usual way to cause the liquid in the well to flow through the valve cage 4 into the plunger 13, thence through the valve cage 15 into the pump tubing. The relatively heavy lubricant in the reservoir 20 or 25, as the case may be, serves to lubricate the external surface of the plunger 13 and internal surface of the working barrel 2 and prevents sand and grit from working downwardly between the plunger and working barrel. If the well being pumped is an oil well, it is clear that the relatively heavy lubricant will prevent the lighter oil in the well from coming into contact with that portion of the plunger 13 which works in the working barrel 2. The lubricant 21 is placed in the reservoir 20 before the pump is installed in the well and when the supply of lubricant gives out the pump is pulled and the reservoir filled with a new supply of lubricant. The level of the lubricant is never higher than the upper end of the pump plunger when said plunger is at the end of its down stroke.

Now referring more particularly to the form of the invention shown in Figs. 8 and 9, the working barrel 2 is provided with one or more series of perforations 30 and the liner 14 is omitted at the perforations so as to form an annular space or spaces 31 between the pump plunger and the working barrel. This space 31 is filled with lubricant which is forced through the perforations 31 by the pressure of the liquid in the well upon a body of lubricant 32 which surrounds the working barrel 2. The lubricant 32 is contained within a lubricant reservoir 33, the inside diameter of which is sufficiently great to form an annular space between its inner surface and the outer surface of the working barrel 2. In this instance the reservoir 33 connects at its lower end with the seat member 3. At its upper end the reservoir 33 is screw-threaded onto the lower end of the pump tubing 34. The reservoir 33 not only surrounds the working barrel 2 throughout the length of said barrel, but extends to a considerable distance above the upper end of said working barrel, and the upper end of the working barrel is connected by a union 35 with an upwardly extending tube 36. Thus the pump, before installation, may be provided with lubricant 32 not only in the annular space formed between the working barrel and reservoir but also in the annular space formed between the tube 36 and the reservoir 33.
and the reservoir. The upper end of the tube 36 is open and terminates within the reservoir 33 near the upper end of said reservoir. The reservoir is substantially as long as the combined lengths of the working barrel and tube 36 and the plunger is of the usual plunger length.

In the operation of the forms of the invention shown in Figs. 8 and 9, the plunger 13 is reciprocated, as before described, and the liquid being pumped passes from the cage 15 into the tube 36 and from said tube into the upper portion of the reservoir and thence into the pump tubing 34. The column of liquid being pumped produces pressure upon the lubricant 32 in the reservoir 33 and said pressure forces said lubricant through the perforations 30 into the spaces 31 so as to efficiently lubricate the plunger 13 as it works up and down in the working barrel. In this form of the invention the pressure being inward through the perforations 30 the lubricant is forced upward between the working barrel and pump plunger, thus preventing sand and grit from working downward between the barrel and plunger.

In the form of the invention shown in Figs. 10 to 13 inclusive, the plunger 2 comprises spaced outer and inner tubes 37, 38 respectively, the outer tube 37 constituting a reservoir for lubricant 39 and the inner tube 38 forming the usual bore of the plunger for passage therethrough of the liquid being pumped. The lower end of the tube 38 is seated in a socket member 40 forming the lower end of the plunger, and the upper end of the tube 38 is seated inside of a coupling member 41 which connects the valve cage 15 to the plunger. The lower end of the tube 37 is screw-threaded onto the socket member 40 and the upper end of the tube 37 is screw-threaded onto the coupling member 41. The plunger tube 37 is provided with one or more series of perforations 45, in Fig. 10 there being shown a series near the upper end of the plunger and another series near the lower end thereof. Communicating with the interior of the outer plunger tube 37 is a duct or ducts 43, said ducts extending longitudinally in the peripheral wall of the valve cage 15 and coupling member 41 and upper end of the tube 37, as clearly shown in Fig. 11. The lower ends of the ducts 43 communicate with the space between the tubes 37, 38. The upper ends of the ducts 43 communicate with an upper reservoir 44 which is screw-threaded onto the valve cage 15. The upper end of the reservoir 44 is formed by a perforated cap 45 which is connected by a pin and box coupling 46 to the sucker rod string 47, there being laterally projecting fingers 48 on the coupling member 46 to keep the upper end of the reservoir 44 in axial alignment with the axis of the working barrel when the plunger is in operation.

Before the pump is installed in the well the tube 37 and the reservoir 44 will be filled with lubricant and, when the plunger 2 reciprocates in the pumping action, the lubricant will gradually feed from the interior of the tube 37 through the perforations 42 to the space between the plunger and working barrel. The lubricant will feed from the reservoir 44 through the ducts 43 into the tube 39 to replenish the lubricant supply in said tube. During the pumping operation the liquid being pumped will pass through the valve cage 4 into the tube 38, thence through ports 40 in opposite sides of the valve cage 15 to the interior of the pump tubing 50. The ports 49 and the space in the valve cage 15 above the ball valve 16 do not communicate with the ducts 43 but are separate and distinct therefrom so that the liquid being pumped will pass upward through the center of the valve cage and then laterally through the ports 49 and the lubricant will pass downward from the reservoir 44 through the portions of the peripheral wall of the valve cage 15 lying between the ports 49. This construction has an advantage that the form of the invention shown in Figs. 8 and 9 has, since the lubricant is pressed outward through the perforations 42 and upward between the plunger and working barrel by reason of the column of lubricant above said perforations, thus tending to prevent sand and grit from passing downward between the plunger and working barrel. Another advantage of this form of the invention is that the lubricant can be renewed in the plunger and reservoir 44 by pulling the reservoir and attached plunger out of the working barrel, then unscrewing the cap 45 and forcing the lubricant into the reservoir 44. Thus this construction overcomes the necessity of pulling the working barrel and the pump tubing when it becomes desirable to supply lubricant to the pump.

In the form of the invention shown in Figs. 14 to 18, a reservoir 51 is provided surrounding the working barrel 2 substantially the same as in the form of the invention shown in Figs. 8 and 9 and said reservoir is connected at its upper end to the pump tubing 52. The working barrel 2 is connected at its upper end by a coupling 53 with a tube 54 similar to the tube 36 in Fig. 8, said tube 54 being open at its upper end and communicating with the interior of the reservoir 51. The reservoir 51 is filled with lubricant 55, and perforations 56 are provided in the working barrel in one or more series, if desired. At its upper end the working barrel 2 has its bore enlarged as indicated at 57 to receive a packing ring or series of packing rings.
Figs. 14 and 15 a series of packing rings is shown and said packing rings are designated by the characters 58, 59. The packing rings 58, 59 may be of any suitable material. For instance they may all be of metal, or the rings may be and preferably are alternatively of metal and resilient non-metallic packing material. In Figs. 14 and 15 it may be assumed, for example, that the rings 58 are of non-metallic material and the rings 59 of metal. The rings 58, 59 are compressible and for that purpose are slit or split as indicated at 60, Figs. 17 and 18. The rings 58, 59 are held in position by a nut 61 screw-threaded into the upper end of the working barrel 2. Adjacent the space occupied by the rings 58, 59, the working barrel 2 is provided with perforations 62 so that the lubricant 55 from the reservoir 51 can come into contact with the peripheries of the rings 58, 59, especially the non-metallic rings 58, to compress the same against the plunger 13. The rings 58 thus act as wipers during the reciprocation of the plunger to wipe off the heavy lubricant on the upstroke of the plunger and wipe off the sand, grit and relatively thin liquid on the down stroke of the plunger, thus to prevent the sand, grit and pumped liquid from working down between the plunger and working barrel. The lubricant 55 is pressed through the perforations 62 so as to come into contact with the plunger as it moves on its up and down strokes, thus thoroughly lubricating said plunger. In this type of construction as in that shown in Figs. 1, 6, 8 and 10, the lubricant is subjected to the pressure of the liquid being pumped so that in actual practice the fluid pressures adjacent the packing rings will substantially balance one another.

When it is desired to install any of the hereinbefore described forms of the pump, the space provided for holding the lubricant will first be filled with said lubricant and the pump, with the standing valve in place, will be lowered into the well by successively adding sections of pump tubing, in a manner well understood in the art relating to oil wells. When thus being inserted in the well the notches 8 will engage the lugs 9 and the notches 12 will engage the lugs 11. Then the line of sucker rods will be lowered into the pump tubing and screwed onto the valve cage or onto the coupling member 21. During the operation of screwing fast the line of sucker rods to the pump the notches 8, 12 and lugs 9, 11 prevent turning of the plunger 13 so as to facilitate connecting the line of sucker rods to the pump plunger.

It is to be noted that by the constructions above described the plunger is effectively packed by an oil or grease of much greater specific gravity than that of the liquid being pumped and the packing effect of the lubricant is maximized by reason of the lubricant being subjected at its surface to the pressure developed by the pump.

Also it is readily understood that in any of the forms of the pump above described, a Garbut rod or other device may be employed to pull and reinsert the standing valve cages, the stem 10 being provided with screw-threaded sockets 63 as shown in Fig. 8 of the drawings.

The invention is not limited in its broader phases to the exact details of construction described above and shown in the accompanying drawings, but is understood as embracing such modifications and changes as lie within the spirit and scope of the appended claims.

I claim:

1. In a pump, the combination of a working barrel, a plunger in the working barrel, means to gradually feed a relatively heavy lubricant to the space between the plunger and working barrel, said means exposing the surface of the lubricant to the pressure of the fluid being pumped, a standing valve for the working barrel, and a valve for the plunger.

2. In a pump, the combination of a working barrel, a plunger in the working barrel, pump tubing, a lubricant reservoir surrounding the plunger and communicating with the pump tubing, a standing valve for the working barrel, and a valve for the plunger discharging the fluid being pumped from the plunger into the pump tubing.

3. In a pump, the combination of a working barrel, a lubricant reservoir connected at its lower end with the working barrel, pump tubing communicating with the upper end of the reservoir, a plunger in the working barrel extending to the upper portion of the reservoir when the plunger is at the end of its down stroke, a standing valve for the working barrel, and a valve for the plunger discharging the fluid being pumped from the plunger into the pump tubing.

4. In a pump, the combination of a working barrel, a plunger in the working barrel projecting a substantial distance above the working barrel when the plunger is at the end of its down stroke, and means to increase the upper projecting portion of the plunger with a relatively heavy lubricant, said means exposing the surface of the lubricant to the pressure of the fluid being pumped.

5. In an inserted pump, the combination of means forming a lubricant reservoir in communication with the space between the plunger and working barrel of the pump, said means exposing the surface of the lubricant to the pressure of the fluid being pumped.

6. In an inserted pump, the combination of a lubricant reservoir connected with the working barrel of the pump to feed lubri-
cant thereto, the surface of the lubricant in the reservoir being exposed to the pressure of the fluid being pumped.

7. The method of packing a pump, which consists in supplying a lubricant of greater specific gravity than that of the liquid being pumped between the pump plunger and working barrel, and exposing the surface of said lubricant to the pressure of the liquid above the lubricant to force said lubricant downwardly between the plunger and working barrel.

Signed at Los Angeles, California, this 15th day of February, 1919.

ROSCOE W. STEPHENS.

Witnesses:

GEORGE H. HILES,
L. BELLE WEAVER.