March 6, 1962 H. D. LOWRY 3,023,707

DEEP WELL PUMPS

Filed Sept. 4, 1959 2 Sheets-Sheet 1

FIG. 1.

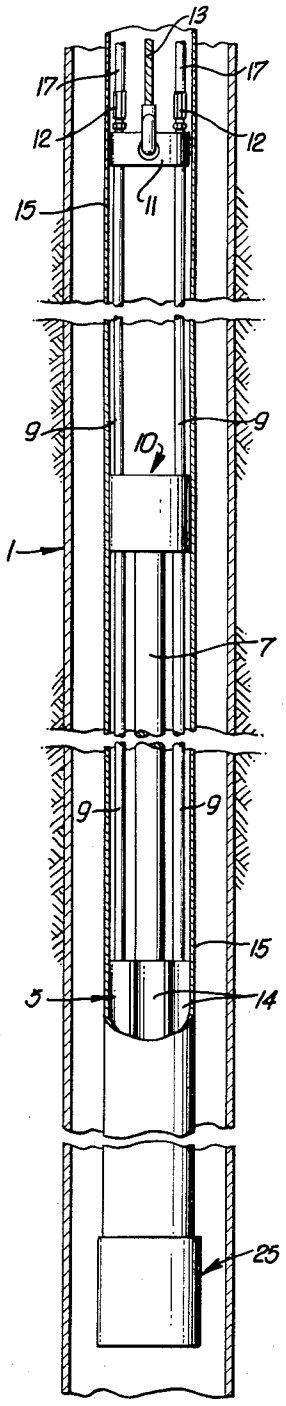

FIG. 3.

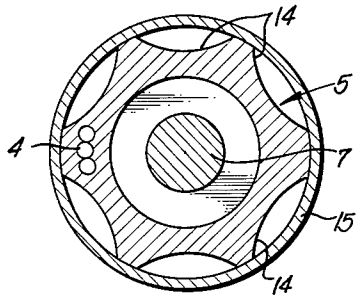

FIG. 4.

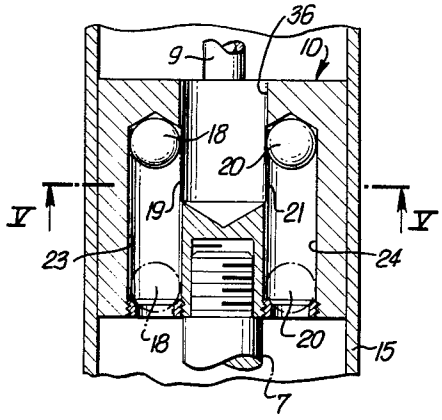

FIG. 5.

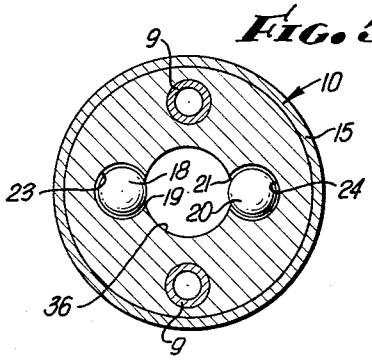

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FIG. 2.

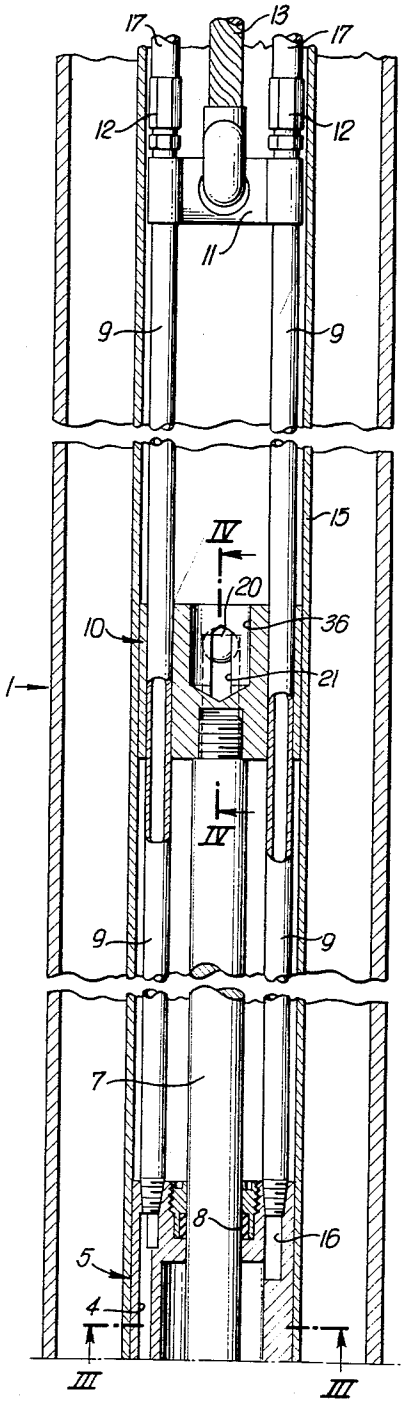
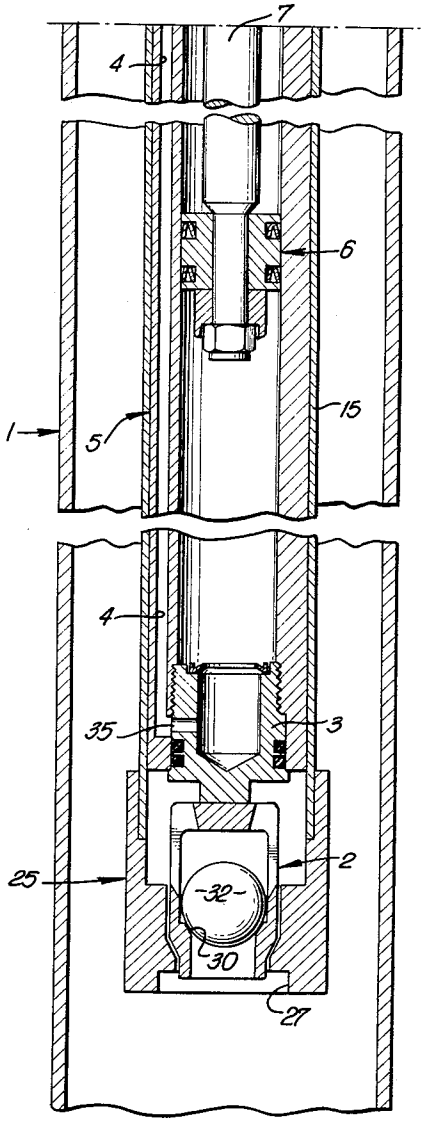


FIG. 2a.



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DEEP WELL PUMPS

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My invention relates generally to hydraulic pumps and an inter connecting system for pumping oil and/or water from wells, sumps or reservoirs.

While many pumps and pumping systems have been invented and been in use for years, all of these pumps and systems have expensive and complex maintenance problems.

Most of the pumps and pumping systems in use today are examples of design comprises that are really secondary solutions, which, while doing the work required, they are of course, not the primary solution in the field of cost and maintenance for hydraulic pumping systems.

A brief summary of a few of the systems now in use, while pointing out their deficiencies, will tend to bring into focus the desirability of the many features of my pumping system.

The standard tubing type, down well pump is operated with heavy and cumbersome machinery above ground and the plunger is actuated by a long string of sucker rods. These sucker rods wear out and break. After breaking, the rods must be fished out of the well and laboriously disconnected section by section and replaced in the same way.

The weight of a string of sucker rods in a 5,000 foot well equals about five tons. If the well operates at twelve strokes per minute, the well is lifting 3,600 tons of non-productive weight each hour of operation. My pump and pumping system eliminates the sucker rod.

Bearing in mind the above difficulties encountered in most down well pumps of the class described, it is a major object of my invention to provide a pump and pumping system which will fit various sizes of production tubing, will be easily and quickly removed for maintenance, will eliminate sucker rods and since the equipment above ground consists of an electric motor, gear pump, various valves and a hydraulic fluid tank, much saving in space is attained, unsightly machinery is eliminated and a much more quiet and efficient operation is assured.

Furthermore, my system allows for the removal of the down well pump without pulling the production tubing or disconnecting the cable that holds the pump or pumps suspended in the well, or disconnecting the flexible tubing that transmits the pressurized fluid power to the down well pump.

Another object of my invention is to provide a pumping system that has no high speed impellers that fail under the wear of sand laden oil or water.

Still another object of my invention is to eliminate need for electrical circuits under ground.

The foregoing and other objects and advantages of my invention will become apparent from the following detailed description of the pump and system, the description being considered in connection with the accompanying drawings in which:

FIG. 1 is a sectional view of a well casing having the pump of the present invention mounted within the production tube in the casing.

FIG. 2 and FIG. 2*a* together constitute a vertical sectional view on an enlarged scale of the pump mounted within the production tube, the views being respectively the upper and lower portions of the device.

FIG. 3 is a fragmentary sectional view taken on line III—III of FIG. 2.

FIG. 4 is a fragmentary sectional view taken on line IV—IV of FIG. 2.

FIG. 5 is a sectional view looking upwardly on the arrows V—V of FIG. 4.

Referring now in detail to the drawing, and first to FIG. 1 thereof, there is indicated genereally at **1** a casing of conventional construction in a well for pumping oil, water or other liquid. Within the casing **1** and substantially concentric therewith is production tube **15** which is provided at its bottom end with a lower apertured cap indicated generally at **25**, the aperture **27** of the cap affording fluid communication between the interior of the casing and the interior of the production tube. Within cap **25** is a lower check valve housing indicated generally at **2** and provided with a circular seat **30** for supporting a ball **32**, the ball being in sealing contact with the seat **30** when in its lower position as shown, and being movable upwardly within the housing **2** by fluid flow upwardly through aperture **27** and past the seat **30**.

Within production tube **15** and above the valve housing **2** is the cylinder of the present invention indicated generally at **5** and provided at its lower end with a cylinder head **3** closing the lower end of the cylinder and in contact with and being supported by the upper portion of the valve housing **2**.

A piston indicated generally at **6** is slidably mounted within the cylinder **5** and a thrust rod or piston rod **7** extends upwardly from the piston through a conventional packing gland **8** at the upper end of the cylinder, being connected at its upper end to production tube piston indicated generally at **10** which is slidably carried in the production tube **15**. Means are provided for supplying pressure fluid to and removing fluid from the interior of cylinder **5**. In the present embodiment of the invention such means include a pair of preferably rigid tubular members **9** extending upwardly from the upper end of the cylinder and being slidably received in longitudinally extending bores formed in the piston **10**. The left-hand tubular member **9** as seen in FIG. 2 at its lower end is in fluid communication with vertically extending channel **4** formed in the side wall of cylinder **5** and communicating at its lower end through the opening **35** in the side wall of the cylinder head **3** with the lower end of the interior of the cylinder. The right-hand tubular member **9** as seen in FIG. 2 is in communication at its lower end through a pasageway **16** with the upper end of the interior of cylinder **5**. The upper ends of tubular members **9** are received in a pair of laterally-spaced bores in a yoke member **11** and at their uppermost ends are connected through connectors **12** to a pair of laterally-spaced flexible hoses **17**. The yoke **11** is connected to a support cable **13** which extends to the surface and serves to raise and lower the entire cylinder and pump assembly within the production tube **15**.

Means are provided in the production tube piston **10** for permitting only upward fluid flow through said piston. As will be best seen by reference to FIGS. 4 and 5, these means include a pair of balls **18** and **20** which are freely vertically movable in a pair of laterally-spaced channels **23** and **24** respectively which communicate at their upper ends through openings **19** and **21** respectively with a central bore **36** opening upwardly into the interior of production tube **15**. The vertical channels **23** and **24** are downwardly open and provided with seats against which the balls may be in sealing engagement when in their lower positions as shown in dotted outline in FIG. 4, thereby preventing fluid flow downwardly of the piston **10**.

In operation, hydraulic pressure fluid is forced downwardly through the left-hand tube **9** as seen in FIGS. 1 and 2 by suitable surface pump means not shown and thence downwardly through the channel **4** formed in the side wall of cylinder **5** and passageway **35** into the lower

portion of the interior of cylinder **5**. The pressure of the hydraulic fluid in the right-hand tubular member **9** as seen in FIGS. 1 and 2 is simultaneously relieved by suitable surface means not shown through the passageway **16** communicating with the upper end of the interior of the cylinder, thus permitting piston **6** to rise within the cylinder under the force of pressure fluid beneath it. Such upward motion of the piston is transmitted through piston rod **7** to production tube piston **10**, and upward movement of the latter forces upwardly the oil or other liquid existing in the production tube **15**. During this motion, the upper check valve balls **18** and **20** are in their lower sealing positions seen in dotted outline in FIG. 4, thus preventing downward movement of liquid relative to the piston **10**. At the same time the lower check valve **2** is in open position, the ball **32** rising within the check valve housing away from sealing engagement with its seat **30**, permitting fluid within the casing **1** to be drawn upwardly through the opening **27** and along the fluted portions **14** of cylinder **5** to the space above the cylinder.

Under the control of suitable surface control means not shown, the direction of hydraulic fluid flow in the tubular members **9** is reversed when the pistons have risen to their uppermost positions, thus forcing downwardly piston **6** and its associated parts, including piston rod **7** and piston **10**. During such downward movement, lower check valve **2** is in closed position, the ball **32** assuming the position seen in FIG. 2*a*, thus trapping above it the oil or other liquid, while the upper check valve balls **18** and **20** are in open position as seen in solid lines in FIGS. 2 and 4 to permit the downward movement of piston **10** through the trapped oil.

This cycle of reciprocating piston movement is repeated at a suitable speed and frequency for the requirements of a given installation.

Desirably, the tubular members **9** are of rigid construction, of metal or the like, and they thus serve to support, from the cable **13**, any desired portion of the weight of the pump members just described.

While the pumping system shown and described herein is fully capable of achieving the objects and providing the advantages herein before stated, they are capable of considerable modification within the spirit of the invention. Therefore I do not mean to be limited to the forms

shown and described herein but rather to the scope of the appended claims.

I claim:

1. A well pump for operation within a production tube in a well, the tube havng a cylindrical inner surface comprising: an elongated housing having formed therein an elongated cylindrical chamber provided with a piston slidably mounted therein and with ports for communicating pressure fluid to opposite ends of the chamber; a second piston disposed above the housing and in slidable contact with the production tube inner surface, said second piston being provided with a pair of longitudinal bores extending therethrough and with a passage extending therethrough; means rigidly connecting said pistons; check valve means carried by the second piston for permitting fluid flow only upwardly through said passage; a pair of rigid pipes fixed to the upper portion of said housing and projecting upwardly therefrom and extending slidably through said bores, said pipes at their lower ends being in fluid communication with said housing ports; means provided with a passageway extending therethrough for communicating the interior of the production tube beneath said second piston with the well to permit well fluid to flow into said interior including second check valve means preventing fluid flow outwardly of the interior through said passageway; and support means connected to the upper ends of said pipes maintaining the pipes in parallel relation, the housing being of substantially smaller cross-sectional area throughout its length than the interior cross-sectional area of the tube.

2. The invention as stated in claim 1 wherein the exterior wall of the housing is longitudinally fluted.

3. The invention as stated in claim 1 wherein said piston connecting means comprises an elongated piston rod extending between and fixed to said pistons.

4. The invention as stated in claim 1 wherein said second check valve means is disposed beneath said housing.

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