Aug. 16, 1938. R. U. GRANT 2,127,168

HYDRAULIC DEEP WELL PUMP

Original Filed July 23, 1936 2 Sheets-Sheet 1

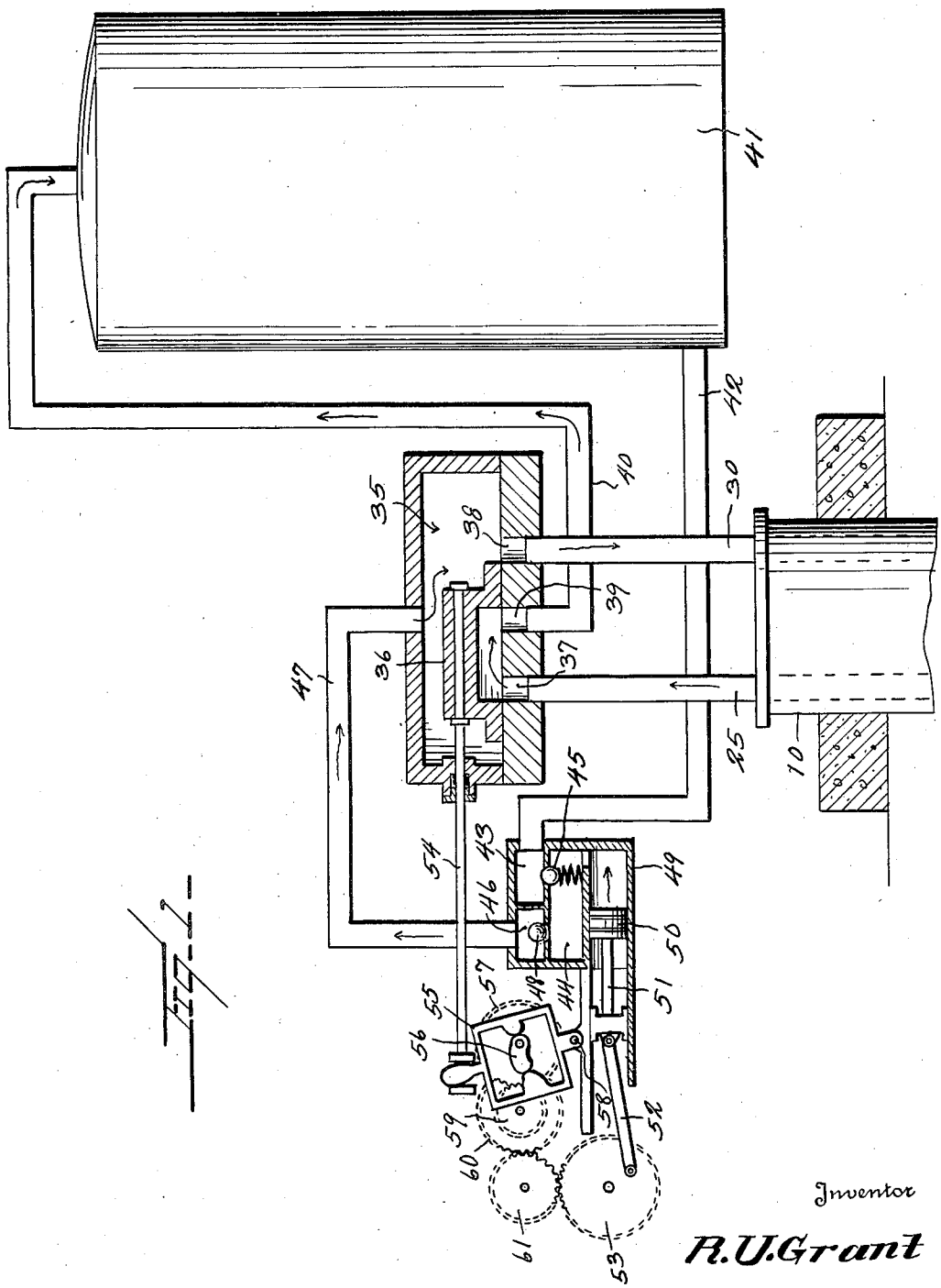


Fig. 1

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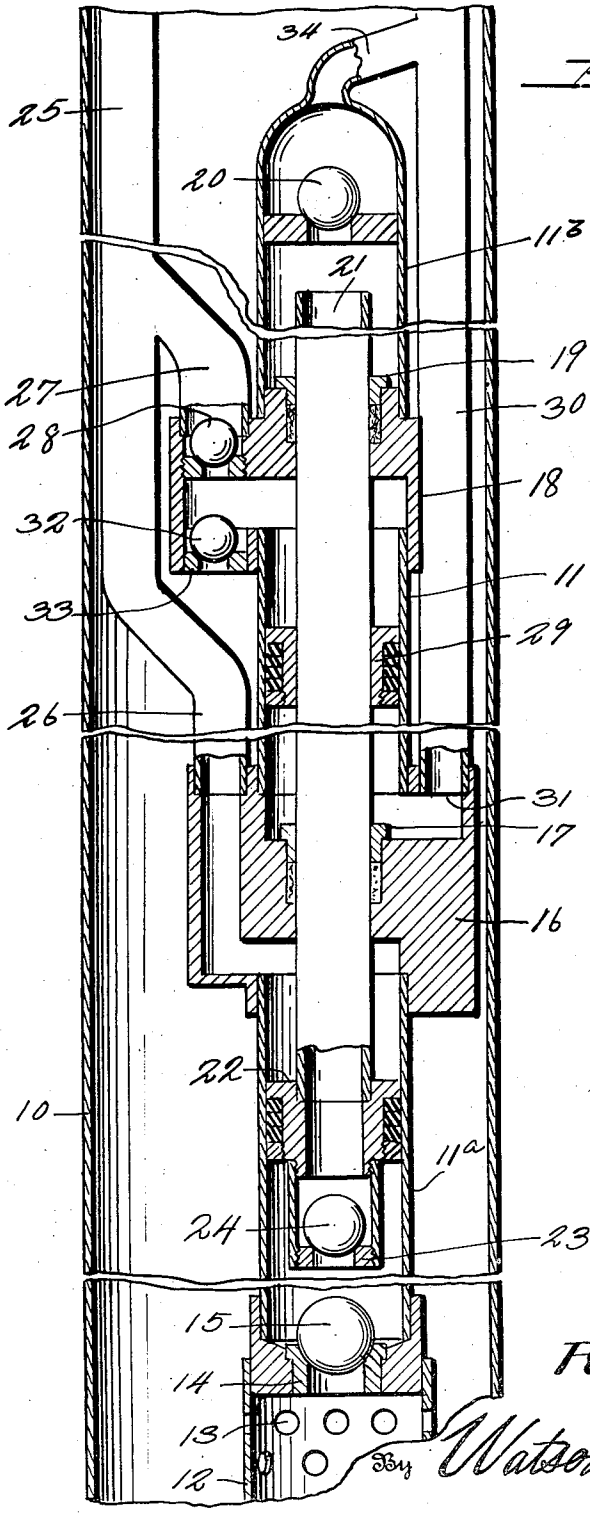


Fig. 2

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HYDRAULIC DEEP-WELL PUMP

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4 Claims. (Cl. 103—46)

This invention relates to pumps and particularly to deep-well hydraulic pumps wherein the piston of the pumping mechanism in the working barrel of the well is reciprocated by the liquid being pumped, the power liquid used to operate the piston in the working barrel being in turn forced in one direction or the other by a pump located at the ground level.

One of the objects of the invention is to provide a structure of this character which is extremely simple, and has no parts liable to get out of order.

Another object is to provide a structure of this character which includes two pistons located within the working barrel of the pump, the power liquid forced into the working barrel by the ground pump operating alternately against one of the other of said pistons to thereby reciprocate the pair of pistons and cause a constant discharge of liquid from the well.

A further object is to provide a closed system for the passage of the liquid being pumped, the power liquid being taken to the power or ground pump from a storage tank while the liquid ejected by the pump pistons in the working barrel is forced into said storage tank.

Other objects will appear in the course of the following description.

My invention is illustrated in the accompanying drawings wherein:

Figure 1 is a diagrammatic elevation of the pumping mechanism at the ground surface of the well, the reciprocating valve being shown in section;

Figure 2 is a fragmentary vertical section through the well casing and showing the submerged portion of the pumping mechanism.

Referring to the drawings, 10 designates the well casing. Disposed within this well casing is the working barrel formed of three sections, 11, 11a and 11b, and supported therein an any suitable manner. The lower end of the working barrel is provided with the usual strainer 12 having perforations 13. Above this strainer, the working barrel is provided with the valve seat 14, and resting upon this valve seat is the ball valve 15 which opens upwardly. Receiving the upper end of the lower section 11a of the working barrel is an element 16 constituting a septum or partition having therein the packing gland 17. Engaging the upper end of the middle section 11 of the working barrel is a valve casing 18, whose central portion supports the upper section 11b of the working barrel, this central portion being provided with a packing gland 19. The upper end of the working barrel is provided with a check valve 20. Operating through the glands 17 and 19 is a tubular piston rod 21, the upper end of the piston rod being open and discharging into the upper section 11b of the working barrel. The lower end of the rod 21 carries upon it the piston 22 provided with the usual packing. That portion of the piston rod 21 which passes through the section 11 of the working barrel carries on it a piston 29. The piston is annular in form to provide a valve seat 23 upon which is disposed the upwardly opening valve 24. This piston 22 reciprocates within the lower section of the working barrel 11a. The valve 15 constitutes the lower intake valve.

Extending downward into the well casing is a power line 25 which communicates, as will be later described, with a valve casing and with a power operated pump on the surface of the ground. The power line 25 extends downward into the element 16 which forms a coupling between the sections 11 and 11a of the working barrel. This coupling member 16 is provided with a passage 26 into which the power line 25 discharges, this passage communicating with the space above the piston 22. The power line 25 is also provided with a branch 27 which opens into the valve casing 18. This valve casing is provided with the upwardly opening upper discharge valve 28 which permits liquid from above the piston 29 to be discharged upward into the branch 27 upon an upward movement of the piston 29.

A second power line designated 30 extends downward from the ground level and at its lower end opens into the coupling 16, as at 31, and thus opens into the space below the piston 29. The valve chamber 18 is provided with an inwardly opening valve 32 coacting with a seat 33. This constitutes an upper intake valve. The power line 30 is connected by a branch 34 to the upper end of the upper section 11b of the working barrel, the upper end of this upper section being provided with the check valve 20, as before described.

At the surface of the ground, that is associated with the upper end of the well casing 10 and disposed in any desired position, is a valve casing 35 within which operates the D-valve 36. This valve casing is provided with two ports 37 and 38, the port 37 communicating with the power line 25 while port 38 communicates with the power line 30. Between these two ports 37 and 38, a discharge port 39 is formed which is connected by a pipe 40 to the upper end of a storage tank 41. From the lower end of this storage tank leads a supply pipe 42 which communicates with a valve

casing 43. This communicates with a manifold 44 and the port between the casing 43 and the manifold is normally closed by a downwardly opening valve 45. The manifold 44 has a port opening into the valve casing 46 which communicates by a pipe 47 to the interior of the valve casing 35. An upwardly opening check valve 48 permits the passage of the liquid from the manifold 44 into the casing 46 but prevents the reverse passage of liquid. The valve 45 permits the passage of liquid from the valve casing 43 into the manifold but prevents the reverse movement of the liquid.

Associated with the manifold 44 is a pump cylinder 49 having therein a piston 50, there being communication between the pump cylinder 49 and the manifold 44. Upon the retraction of the piston 50, liquid will be drawn into the pump cylinder and upon a reverse movement of the piston, liquid will be forced out through the manifold into the pipe 47.

While I do not wish to be limited to the particular means for operating the piston 50, I have shown the piston rod 51 as being connected by a rod 52 to a wrist pin on a gear wheel 53 which may be motor driven. For the purpose of shifting the valve 36, I provide a valve rod 54 extending through the casing 35. This rod is reciprocated by means of a Scotch yoke 55 or any equivalent construction, the yoke in turn being oscillated by means of the cam or eccentric 56 carried by the shaft of a gear wheel 57. The yoke is pivoted at 58. The gear wheel 57 is driven by a pinion 59 carried upon the shaft of a gear wheel 60 which is driven by an intermediate gear wheel 61 from the gear wheel 53. While I have illustrated a particular valve operating means which I have found to be singularly effective, I do not wish to be limited to this specific means except as defined in the appended claims.

As illustrated in Figure 1, the D-valve 36 is disposed to connect the ports 37 and 39, while the port 38 is in communication through the valve casing 35 with the pipe 47. The piston 51 is moving in the direction of the arrow in Figure 1, and, therefore, liquid is being forced past the valve 48 through the pipe 47 into the valve casing 35 and down the power line 30. Liquid cannot pass into the upper end of the working barrel by reason of the check valve 20 and, therefore, liquid is forced downward through the pipe 30 into the space below the piston 29, forcing this piston upward, as shown by the arrow in Figure 2. The check valve 32 is closed by the pressure within the valve casing 18 above the piston 29 and the liquid above piston 29 is forced out through the valve 28 into the line 25 and thus to the storage tank. While the piston 29 and its piston rod 21 is moving upward, the piston 22 will draw oil or other liquid into the lower section 11a of the working barrel.

Upon a reverse movement of the piston 51, that is, the movement of the piston toward the left in Figure 1, the D-valve 36 is shifted to connect the port 38 to the storage tank discharge port 39 and connect the port 37 to the pipe 47. Upon the reverse movement of this piston 51, liquid is drawn from the chamber 43 into the manifold 44. The D-valve remains in its shifted position connecting the ports 38 and 39 upon the next power stroke of the piston 51. Liquid is thus forced from the pump through the valve chamber 35 and downward through the power line 25. The check valve 28 prevents this liquid from passing into the space above the piston 29 and the power liquid passes downward into the space above the piston 22. This causes the descent of the piston 22 with the piston rod 21.

It will be understood, of course, that upon the upward movement of the piston 22 previously described, liquid will flow past the valve 15 into the section 11a. Upon a descent of the piston 22, the pressure of this liquid will open the valve 24 and cause the liquid to be discharged through the tubular piston rod 21 into the upper section of the working barrel and past the check valve 22 and thus into the storage tank. While the piston 22 is descending and delivering liquid through the piston rod 21, the piston 29 is also descending, forcing the liquid below this piston into the line pipe 30 and drawing in liquid through the upper intake valve seat 33 and past the valve 32 into the space above the piston 29. Thus upon a stroke of the piston rod 21 in a downward direction, liquid will be delivered into one power line through the piston 21 and also through the port 31, while upon a reverse movement of the piston rod 21, the liquid above the piston 22 will be forced upward throught the port 26 and the other power line 25 and well liquid will be forced upward by the piston 29 into this line 25. Thus, upon each reciprocation, the power liquid previously used to force the piston in one direction will be returned to the storage tank and liquid from the well will also be forced into the storage tank.

While I have illustrated a certain detailed arrangement of the valves 28 and 32 and the valve 24 with its casing, I do not wish to be limited to this arrangement as obviously the valves might be differently arranged and yet secure the same result, though I believe the arrangement as shown, to be a preferable arrangement. Neither do I wish to be limited to the details of construction as illustrated, it being understood that the drawings are largely diagrammatic, particularly as regards the power pumping mechanism and the mechanism for operating the D-valve 36.

A pump constructed in accordance with my invention is more economical to operate than other deep-well pumps known to me. It has a larger stroke up to fifty feet and there are oniy two moving parts to the pump. There are no parts to wear or get out of order except the cups or packing rings for the pump pistons. This lack of wear permits cheaper motor power to be used as my pump cannot mud or paraffin up the well. The load is always balanced. This pumping mechanism can be operated with oil or water. If pumping an oil well, crude oil is used, and water is, of course, used in a water well. In actual practice, this mechanism has been found to pump water at less than one cent per thousand gallons.

What is claimed is:

1. A deep-well pumping system, including three cylinders disposed one above the other, the lower cylinder having an inlet valve at its lower end, the uppermost cylinder having an outlet valve at its upper end and the intermediate cylinder having an inlet valve at its upper end, two power pipe lines, one extending into the upper end of the lowest cylinder and having a branch extending into the upper end of the intermediate cylinder, an upwardly opening check valve in this branch, the other power pipe line opening into the lower end of the intermediate cylinder and having a branch opening into the upper end of the uppermost cylinder, a tubular piston

rod extending from the interior of the lowermost cylinder through the intermediate cylinder and into the interior of the uppermost cylinder, a piston on the lower end of the rod and operating within the lowermost cylinder, a piston on the intermediate portion of the rod and operating within the intermediate cylinder, an upwardly opening valve at the lower end of the tubular piston rod, a storage tank above the ground level, and means for forcing liquid under pressure from the storage tank alternately into one or the other of the pipe lines and discharging liquid from the other pipe line into the storage tank.

2. A deep-well pumping system, including a well casing, a working barrel in the casing divided into three cylindrical sections, the lowest section and the uppermost section having each an upwardly opening valve, a pressure operated piston operating in the lowermost section and having a tubular piston rod extending through the intermediate section and discharging into the uppermost section, a second piston on the rod and operating within the intermediate section, the lower end of the rod having an upwardly opening valve, the intermediate section of the working barrel having an inwardly opening intake valve, a discharge valve casing and an outwardly opening valve therein, two power lines one discharging into the lower end of the intermediate section and having a branch opening into the upper end of the uppermost section of the barrel, the other power line discharging into the upper end of the lower section of the barrel and having a branch opening into the discharge valve casing of the intermediate section, a storage tank, and means for forcing liquid under pressure from the storage tank alternately into one or the other of the power lines while discharging liquid from the other power line into the storage tank.

3. A deep-well pump, including three cylinders disposed one above the other and constituting three sections of a working barrel adapted to be disposed within a well casing and submerged within the liquid therein, the lowermost cylinder having an upwardly opening inlet valve at its lower end, the uppermost cylinder having an upwardly opening discharge valve at its upper end and the intermediate cylinder having an inwardly opening intake valve at its upper end, a piston rod extending through the intermediate cylinder and into the uppermost and lowermost cylinders and carrying a pressure operated piston at its lower end and a second piston operating within the intermediate cylinder, the piston rod being tubular, an upwardly opening valve carried by the piston rod at its lower end, a power pipe line extending from the surface of the ground into said well and opening at its lower end into the upper end of the lowermost cylinder and having a branch opening into the upper end of the intermediate cylinder, an upwardly opening valve in said branch, a second power pipe line extending down from the surface of the ground into said well and discharging into the lower end of the intermediate cylinder and having a branch opening into the upper end of the uppermost cylinder, a storage tank, and power operated means for forcing liquid from the storage tank alternately into one or the other of the power pipe lines and simultaneously connecting the other power pipe line with the storage tank.

4. A deep-well pump, including three cylinders disposed one above the other and constituting three sections of a working barrel adapted to be disposed within a well casing and submerged within the liquid therein, the lowermost cylinder having an upwardly opening inlet valve at its lower end, the uppermost cylinder having an upwardly opening discharge valve at its upper end and the intermediate cylinder having an inwardly opening intake valve at its upper end, a piston rod extending through the intermediate cylinder and into the uppermost and lowermost cylinders and carrying a pressure operated piston at its lower end and a second piston operating within the intermediate cylinders, the piston rod being tubular, an upwardly opening valve carried by the piston rod at its lower end, a power pipe line extending from the surface of the ground into said well and opening at its lower end into the lower end of the lowermost cylinder and having a branch opening into the upper end of the intermediate cylinder, an upwardly opening valve in said branch, a second power pipe line extending down from the surface of the ground into said well and discharging into the lower end of the intermediate cylinder and having a branch opening into the upper end of the uppermost cylinder, a storage tank, a valve casing associated with the storage tank and into which the upper ends of the pipe lines open, the valve casing having an intermediate pipe leading from the valve casing between the pipe lines into the storage tank, a power operated pump having a pumping chamber, an inlet pipe from the storage tank to the pumping chamber, an outlet pipe from the pumping chamber to the valve casing, valves controlling the inlet and outlet of the pumping chamber, and a power operated valve disposed within the casing and alternately connecting one of said pipe lines with the pipe leading to the storage tank and the other pipe line to the pipe leading to the pump.

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