March 30, 1937. J. T. DICKSON 2,075,428

PUMP

Filed April 15, 1936

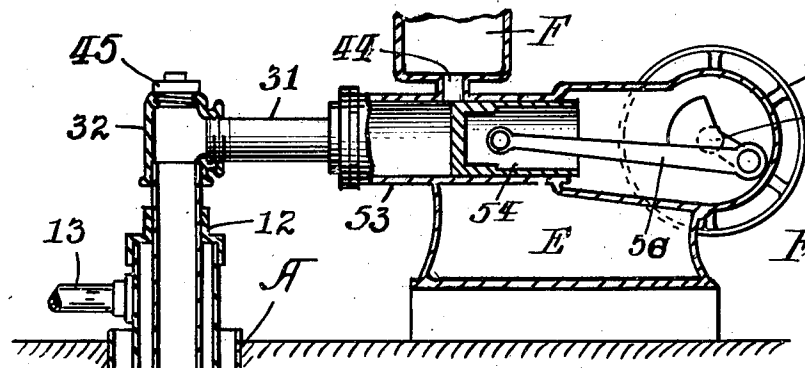


Fig. 1.

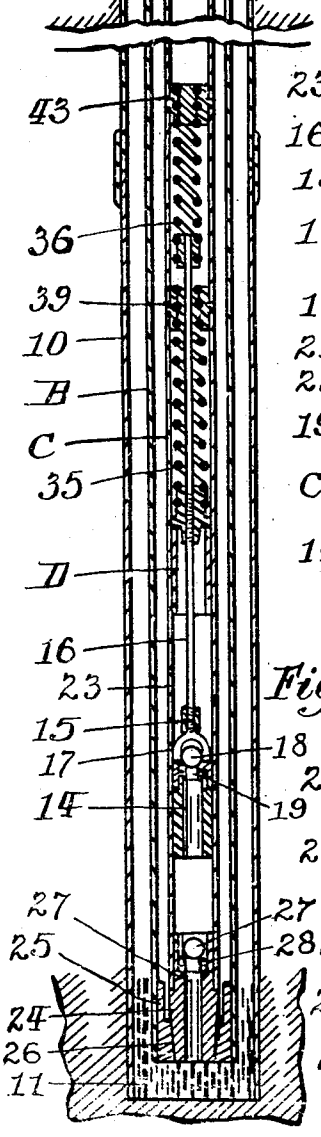
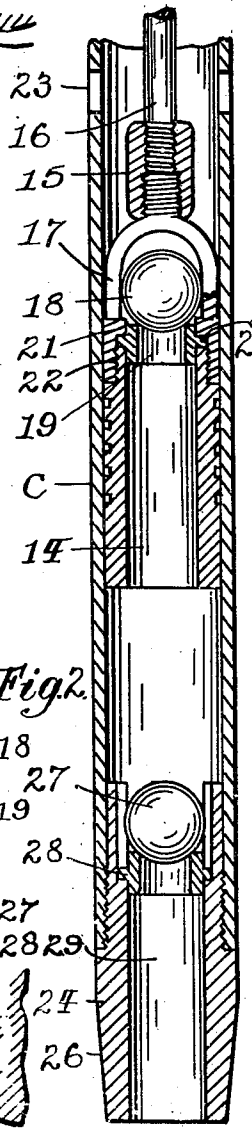


Fig. 2.



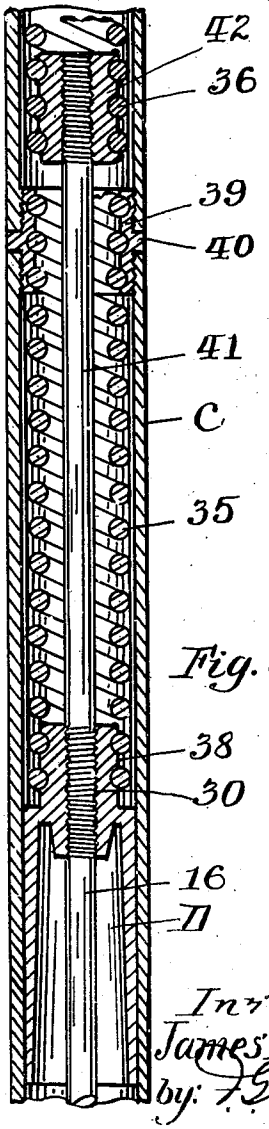


Fig. 3.

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2,075,428

PUMP

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5 Claims. (Cl. 103—44)

My invention relates to improvements in pumps and more particularly to that type which is fluid actuated and adapted for pumping liquid such as oil and water.

The primary object of my invention is the production of pumping apparatus which is simple in construction and operation and which is more effective than heretofore for lifting liquid from the bottom of deep or shallow wells. A further object and more specifically is to provide an apparatus which is not influenced by any irregularities in the well such as crookedness, whereby the pumping apparatus can be operated as efficiently and effectively as if the well were uniform and straight. A further object is to provide a pump of the type stated which is fluid actuated from the surface above the well, whereby a simpler and more effective apparatus is produced than heretofore and one which is less liable to disorder than if the customary reciprocating rod is used from top to bottom for operating a pump. Among still further objects is to provide a pump having an inner actuating column of liquid and an outer column of pumped liquid, which columns are normally and during variations of gas pressure in the well counter balanced so that the only work required is substantially the effort of forcing liquid from the outer column at the surface of the well.

With these and other objects in view my invention comprises the features of construction and combination of parts hereinafter described and claimed.

In the accompanying drawing, forming part of this specification, Fig. 1 is a typical vertical section of a portion of a deep well and of my improved pump applied thereto; Fig. 2 is an enlarged vertical section of the conventional pump portion of my improved pumping apparatus removed from the well, and Fig. 3 is an enlarged vertical section of another portion of my improved pump removed from the well showing the spring actuating mechanism which is employed above the pump in the well shown in Fig. 3 for operating the pump.

For the purpose of showing my improved pump applied in use, a portion of a deep oil or water well A in the ground is shown in Fig. 1 of the drawing, in which the customary string of casing 10 is shown extending from the top to the bottom and the usual filter produced by slotting the casing at 11 is employed at the lower end, through which the oil or water is adapted to percolate. Lowered into the casing and spaced from its inner wall is a string of tubing B forming an egress duct up which the liquid produced by the well is adapted to be forced above the surface of the ground, the upper extremity of said liquid conducting tubing being closed by a cap 12 and provided with an outlet pipe 13 by which the liquid is adapted to be conducted away from the well. Lowered through cap 12 into the liquid conducting tubing and spaced inwardly from the inner wall of the latter is a string of inner pump tubing C, the lower end of which is sealed in the lower end of egress duct B as will be hereinafter described.

The pump tubing C has incorporated into its lower end a conventional suction pump, of which the wall of tubing C forms the cylinder. Reciprocable in this cylinder is a hollow piston 14 which is secured through a coupling 15 with an upwardly extending sectional sucker rod 16. The cylinder is attached to coupling 15 by a valve housing or cage 17 which holds a ball check valve 18 having free play above the valve seat 19. This seat is held in place by annular shoulders 20 and 21 on the valve seat and valve cage and by the threaded connection 22 between the wall of cage housing 17 and the upper end of piston 14. The valve seat 19 provides an orifice which is closed automatically during the up stroke of piston 14 and is opened automatically during the return down stroke of the piston, thus causing liquid admitted from below and through piston 14 to be lifted in tubing C by each pumping or suction stroke. Liquid conducting passages 23 through the wall of tubing C and above the piston serve to conduct the pumped liquid from tubing C into egress duct B. The lower end of the pump tubing C is sealed by an inner coupling 24 and a socket member 25 in the lower end of egress duct B. Coupling 24 is threaded into the pump tubing C and socket member 25 is seated by a downwardly tapering socket joint in coupling 24. Coupling member 24 is passaged longitudinally at 29 and at the lower end of said passage is valve orifice seat 28 upon which a ball valve 27 closes to permit the ingress of liquid into the pump tubing during the upward stroke of piston 14 and check the return of said liquid automatically during the return downward stroke of piston 14. Thus by reciprocating piston 14, liquid is pumped from the bottom of the well into the egress duct B where it accumulates in the form of an outer column of liquid.

Sucker rod 16 is propelled by a fluid actuated hollow piston D, which reciprocates in the pump tubing C as a cylinder, said rod being secured to the upper inner end of the piston by threaded

engagement 30 (see Fig. 3). This piston is propelled downwardly by a column of liquid in the pump tubing above the piston which is impelled by a master pump or ram E. The master pump has its cylinder 53 connected by duct 31 and coupling 32 with the upper extremity of the pump tubing C. Pump E may be of any suitable type. As shown it has the conventional cylinder 53, reciprocable piston 54, crank shaft 55, connecting rod 56 and drive pulley 57 by which the piston is reciprocated. In use, the connection between the cylinder of pump E and the pump tubing C above piston D is filled with any suitable actuating liquid. I have found in practice a liquid composed of 95% kerosene oil and 5% lubricating oil to constitute a satisfactory medium. Thus the compression stroke of piston 54 through the column of actuating liquid in the pump tube produces the downward power stroke of piston D in the suction pump at the bottom of the well against the tension of springs 35 and 36 which will be hereinafter described and forces liquid out of the pump through egress openings 23, into and up through the egress duct B to the surface above the well.

The up stroke of the suction pump piston 14 is assisted by the helical retractile springs 35 and 36 during the suction stroke of piston 54 in the drive pump E. These springs are coiled longitudinally in the pump tubing C, the coils of spring 35 being arranged about and concentric with the axis of the sucker rod 16 and spring 36 being arranged above the upper end of the sucker rod. The lower loops of spring 35 are secured to the coupling 38 in the head end of piston D and the coils at the upper end of spring 35 are secured in the inner wall of a hollow coupling 39. Coupling 39 is externally threaded and formed with an annular shoulder 40 between its ends and serves to join the abutting ends of two sections of the pump tubing united with shoulder 40 serving and an intervening abutment. Thus the down stroke of piston D is against the tension of spring 35 and the spring tends to raise the piston into superior position. The outer and inner columns of liquid, respectively in ducts B and C, tend to counterbalance each other and substantially compensate the normally greater weight of the column of operating liquid held in the pump tubing plus the force required to raise piston 14 and transfer liquid from the well into the pump tubing. Thus piston 54 is substantially relieved from all work during its suction stroke, leaving the two columns of liquid substantially counterbalanced at the end of the up stroke of piston D.

As many helical actuating springs may be employed as desired. For illustration, two are shown, the spring 36 being superimposed above spring 35 in tandem arrangement. The means of attaching spring 36 to piston 16 is by means of a sucker rod extension section 41, the lower end of which is threaded in axial alignment with sucker rod 16 in coupling head 38. This rod 41 extends freely upwardly through the coils of spring 35 and above the same where it is secured by threading in a coupling 42 over which the lower convolutions of spring 36 are secured. The upper end of spring 36 is secured by a coupling 43 similar to coupling 39 between sections of the pump tubing. In this manner the force which is exerted in the return stroke of piston 14 is augmented. By supplying a sufficient number of springs connected in the manner stated the auxiliary force which they exert will substantially produce the suction stroke of piston 14.

Master pump E is provided with an equalizing chamber F connected by a port passage 44, entering cylinder 53 near the end of the suction stroke of piston 54. This chamber keeps the actuating column of liquid maintained at all times and allows for any surge backwardly during the suction stroke.

Operation

In operation, the piston in master pump E is reciprocated and the pump acts as a ram or pulsator to reciprocate the column of actuating liquid in the pump tubing C extending downwardly into the well. Normally, that is substantially at the beginning of the power stroke of piston 54, the springs stand under sufficient tension to counterbalance the extra weight of the inner column of actuating liquid in the inner pump duct C over that of the outer column of liquid pumped from the well in the outer egress duct B. They also serve to return the pump pistons D and 14 to superior position during the suction stroke of the master pump piston. Each power stroke of piston 54 impels piston D downwardly and transmits energy to the pump actuating springs 35 and 36 and through sucker rod 16 transmits a down stroke to piston 14 of the pump in the bottom of the well. This intake down stroke of piston 14 transfers liquid previously admitted into the pump chamber past valve 18 and into the pump tube C above piston 14, while valve 27 automatically checks any liquid which has been pumped from returning into the well. During each return or suction stroke of the master pump piston the column of pump actuating liquid is raised principally by the power which has been transmitted to the springs 35 and 36, through piston D. The diminishing area within the pump lying between piston D and check valve 27 during the compression stroke of piston 54, forces the amount of liquid admitted into the pump by the previous intake stroke of piston 14 through openings 23 and upwardly through egress duct B and outwardly through pipe 13 above the surface of the ground. The strength of the springs when desired may be lessened or increased, or other means may be provided within the spirit of my invention whereby the two columns of liquid may normally be maintained in substantial equilibrium in the well so that the work of pumping is only substantially equal to the work of transferring the liquid delivered by each stroke of the pump piston from the inner pump tube into and up through the outer egress duct. The springs allow for variations in gas pressure in the well and during the operation of the master pump the equalizing chamber F also assists in maintaining the columns of liquid in the pump actuating and egress ducts in equilibrium so that substantially even operation of the pumping apparatus is maintained.

In accordance with the patent statutes, I have described the principles of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof but I desire to have it understood that the structure shown is only illustrative and that the invention can be carried out by other means and applied to uses other than those above set forth within the scope of the following claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Pump apparatus, comprising, in combination with a well, a pump near the bottom of the well having an inlet adapted to be connected

with liquid to be pumped from the well and a reciprocable pumping element, a duct for transmitting liquid from the pump upwardly through the well, an actuating piston connected with said reciprocable pumping element, a cylinder in which said piston is reciprocable having a duct extending to the surface above the well by which a column of piston actuating liquid is held, means near the surface above the well for reciprocating said liquid to assist in causing the reciprocation of said piston, and a retractile spring connected with said actuating piston to be energized thereby during its downward stroke and adapted by its retractile energy to assist in raising said reciprocable pumping element and lift the column of actuating liquid.

2. Pump apparatus, comprising, in combination with a well, a pump in the bottom of the well having an inlet adapted to be connected with liquid to be pumped from the well and a reciprocable pumping element, a duct for transmitting liquid from the pump upwardly through the well, an actuating piston connected with said reciprocable pumping element, a cylinder in which said piston is reciprocable having a duct extending to the surface above the well by which a column of piston actuating liquid is held, a ram having a reciprocable actuating element and cylinder near the surface above the well for reciprocating the actuating liquid and causing the reciprocation of said actuating piston, an equalizing chamber connected with said ram cylinder, and a retractile spring connected with said actuating piston to be energized thereby during its down stroke and adapted by its retractile energy to impart a pumping effort to said reciprocable pumping element and to minimize any difference in weight between said actuating liquid and the liquid pumped from the well.

3. Pump apparatus, comprising, in combination with a well, a pump near the bottom of the well having an inlet adapted to be connected with liquid to be pumped from the well and a reciprocable pumping element, a duct for transmitting liquid from the pump upwardly through the well, an actuating piston connected with said reciprocable element, a cylinder in which said piston is reciprocable having a duct extending to the surface above the well by which a column of piston actuating liquid is adapted to be retained, a ram near the surface above the well having a cylinder connected with said column of liquid and a piston reciprocable in said ram cylinder, and a series of retractile springs anchored to the wall of said duct and connected with said actuating element whereby they are adapted to be energized by the power stroke of said ram piston through said column of actuating liquid and tending during the receding stroke of said actuating piston to sustain the load of said column of actuating liquid and minimize any difference in weight between the actuating liquid and the liquid pumped from the well.

4. Pump apparatus, comprising, in combination with a well having an inner pump actuating duct extending to the surface above the well in which an inner column of actuating liquid is held, a plunger pump connected with said duct near the bottom of the well having a check valved inlet from the well and a check valved reciprocable pumping element, an outer egress duct extending from the pump to the surface above the well adapted to transmit an outer column of liquid pumped from the well, a piston in said pump actuating duct coupled to said reciprocable pumping element and reciprocated by said column of actuating liquid, whereby liquid is adapted to be admitted into the pump from the well by an up stroke and is forced from the pump upwardly through said egress duct by a down stroke, means near the surface above the well for reciprocating said column of actuating liquid whereby said piston and pumping element are reciprocated, and a retractile spring connected with said piston and anchored to the wall of said actuating duct near the lower portion of said inner pump actuating duct adapted to be energized by the downward movement of said piston and tending by its energy to raise said piston and minimize the difference of weight between said columns of liquid.

5. Pump apparatus, comprising, in combination with a well having an inner pump actuating duct extending to the surface above the well in which an inner column of actuating liquid is held, a plunger pump connected with said duct near the bottom of the well having a check valved inlet from the well and a check valved reciprocable pumping element, an outer egress duct extending from the pump to the surface above the well adapted to transmit an outer column of liquid pumped from the well, a piston in said pump actuating duct coupled to said reciprocable pumping element and reciprocated by said column of actuating liquid, whereby liquid is adapted to be admitted into the pump from the well by an up stroke and is forced from the pump upwardly through said egress duct by a down stroke, means near the surface above the well for reciprocating said column of actuating liquid whereby said piston and pumping element are reciprocated, and a series of springs anchored to the wall of said actuating duct and connected with said actuating piston whereby they are adapted to be energized by the power stroke of the actuating liquid reciprocating means and tend during the receding stroke of said piston to lift the load of said column of actuating liquid and equalize the difference in weight between said columns of liquid.

JAMES T. DICKSON.