

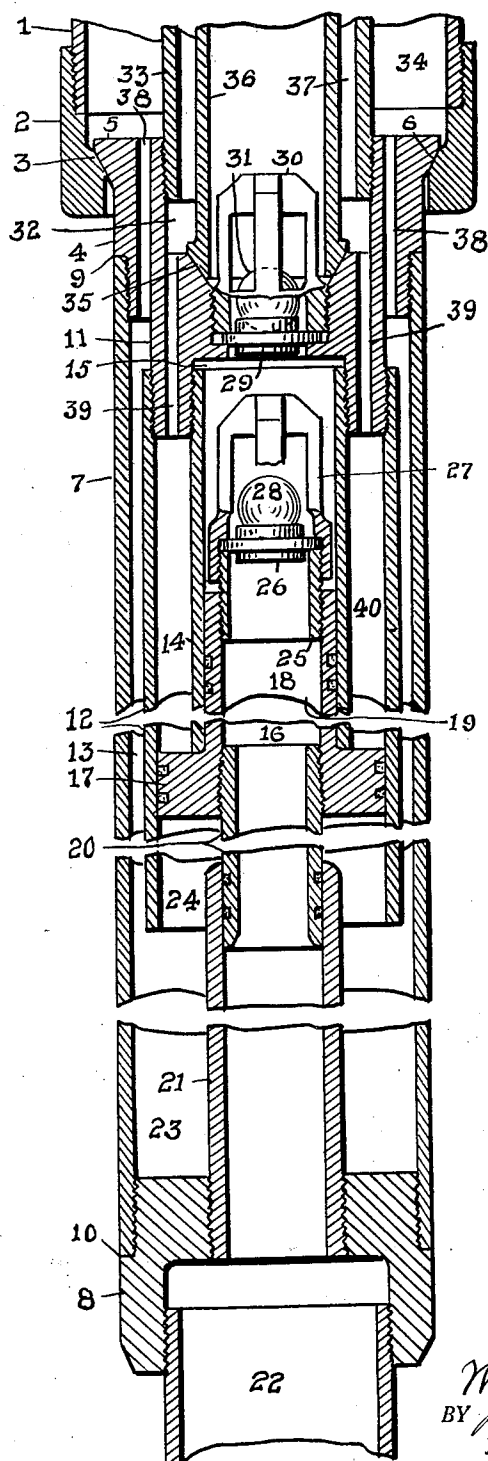
March 1, 1932.

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1,848,070

PUMP

Filed May 14, 1927



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PUMP

Application filed May 14, 1927. Serial No. 191,405.

My invention relates to pumps.

One object of this invention is to reciprocate a pump piston or plunger by alternately reversing the pressures on static heads of two columns of fluid. Another object is to provide against the contact or mixture of the piston-actuating fluid with the fluid being pumped, and provide a straight passage for the fluid being pumped. Another object is to dispense with mechanical devices, such as rods, attached to the pump piston for reciprocating the latter, or with complicated valve mechanism used in some types of fluid-operated pumps. Another object is to provide a non-mechanically operated pump of the force pump type having only two valves, the standing or fixed valve being above the traveling valve or piston. Another object is to provide a complete pump unit which can be lowered down through the well tubing and supported by the tubing, a portion of the unit depending below the seat. Another object is to provide a construction whereby the oil production tube string may be lowered in the said unit after the lowering of the other pump elements and form a seal on a seat in the unit and become a conduit for conducting the fluid from the standing valve to the surface of the ground. My invention contemplates the omission of the said oil production string particularly in cases where owing to the comparative cleanness of the pumped oil, it may be mingled with the actuating fluid. Another object is to provide a double-acting pump whose plunger is so proportioned that approximately equal work is done on both strokes, but some of the features of my invention are independent of this object. Other objects appear hereinafter.

The drawing shows a central vertical section of that portion of the well pumping apparatus which contains my invention, the valves and their seats being shown in side elevation.

On the drawing, 1 designates a well-tubing

or pipe having the ring, coupling or collar 2 screwed thereon and having therein the annular beveled seat 3 whose diameter is somewhat smaller than the internal diameter of the tubing 1. 4 is a special coupling having the head 5 whose diameter approximates the internal diameter of the tubing 1. It has the downwardly tapering shoulder 6 shaped to engage the seat 3 and form a fluid-tight joint therewith. This shoulder forms a means whereon the pump is supported. The coupling 4 has a reduced portion projecting down past the seat 3 and has screwed thereon the pump casing or pipe 7 into whose lower end is screwed the fitting or coupling 8, the ends of the pipe being seated in annular recesses or reduced portions 9 and 10 in the couplings 4 and 8. The diameters of the pipe and the coupling are approximately that of the opening in the seat 3, so that they will pass through the same without undue friction.

Below the recess the coupling 4 has another reduced portion 11 extending to the end thereof. The pendent outer pump barrel which does not reach the coupling 8 is screwed on the exterior of the reduced portion 11. The diameter of the said portion 11 and the exterior diameter of the barrel 12 are such as to provide an annular space 13 between the casing 7 and the barrel.

14 is the inner pendent pump barrel screwed into internal threads in a central recess 15 in the under side of the coupling 4. The inner pump barrel is concentric with the outer barrel and is somewhat shorter.

16 is the valved plunger of the pump. It has the head or piston member 17 reciprocable on the interior surface of the barrel 12 below the barrel 14. It has the reduced piston member 18 attached integrally to the member 17 and is reciprocable on the interior surface of the barrel 14. The plunger 16 has an axial passage 19, whose lower end carries the pendent pipe or conduit 20. The coupling

8 has an axial opening into which is screwed the pipe or conduit 21 which is telescopic with the conduit 20. The hollow coupling 8 has its lower end internally threaded to receive the conduit 22 which may suspend the usual perforated inlet pipe or a string of pipe extending downwardly the desired distance into the well with which the pump is to be used.

The space 13 communicates at its lower end with the annular space 23 between the pipes 7 and 21, which in turn communicates above with the annular space 24 between the barrel 12 and the pipe 20.

The top of the piston member 18 has the nipple 25 screwed into it. The valve seat 26 sits on the nipple and is clamped thereon by the cage 27 containing the ball valve 28 seating downwardly.

The upper wall of the recess 15 has an axial opening in which the valve seat 29 is clamped by the cage 30 containing the ball valve 31 seating downwardly.

Above the opening containing the valve seat 29 and cage 30, the axial opening in the coupling 4 is enlarged forming the recess 32. The interior wall of this recess is threaded to receive the upstanding or vertical pipe or pump tubing 33 which is concentric with the well tubing 1, both extending to the top of the well and including between them the annular space 34.

The upper end of the reduced opening in the coupling for the valve cage 30 is beveled to form a seat 35 for the correspondingly beveled lower end of the vertical conduit, pipe or tube string 36 which is within the tubing 33 and concentric therewith, whereby an annular space 37 is provided between the tubing 33 and the pipe 36, extending to the top of the well.

The coupling 4 has a suitable number of passages 38 connecting the spaces 13 and 34, and a suitable number of passages 39 connecting the space 37 with the annular space 40 between the two pump barrels 12 and 14.

Let it be assumed that the parts are as in the drawing, and the pump is submerged in oil in a well, and that the hydraulic passage, comprising the space 34, the passages 38, and the spaces 13, 23 and 24, and also the hydraulic passage comprising the space 37, the passages 39 and the space 40 are filled with a fluid, preferably a non-compressible liquid, as water or oil. It is to be further assumed that at the top of the well there is some means for applying suitable and preferably equal pressures at will to the two hydraulic columns. The plunger as shown in the drawing is at the limit of its up-stroke which was produced by pressure transmitted through the first hydraulic passage to the lower face of the piston member 17. If now pressure is released on the first hydraulic passage and applied on the second hydraulic passage, the

plunger 16 will be moved downwardly by force acting on the upper face of the piston member. At this time the column of oil on the ball valve 31 holds it on its seat. As the plunger goes down a vacuum tends to be created between the two valves. The pressure due to this vacuum tendency and to the static head of the oil in the well, causes it to fill the inner pump barrel, the ball valve 28 being floated off from its seat. When the plunger reaches its lower limit, which would be when the plunger engages the top of the pipe 21 unless the hydraulic pressure is relieved before, the pressure is applied to force the plunger upwardly, during which time the valve 28 remains closed, so that the oil in the inner barrel 14 is forced up past the valve 31 and thence up the tubing 36 to the top of the well. The cycle of steps described will be continued as the conditions require.

In order to force the plunger 16 upwardly, the pressure applied to the hydraulic column which operates on the lower annulus of the plunger between the barrel 12 and the tubular member 20 must lift not only the hydraulic column resting on the upper annulus between the barrel 12 and the piston member 18 but also the column of oil resting on the piston member 18. The area of the lower annulus is greater than that of the upper annulus, but preferably less than the area of the upper annulus plus the cross area of the piston member 18, that is, equal to the area of a circle having the diameter of the piston member 17. When the plunger is forced downwardly, the pressure applied to the upper or smaller annulus is freed from the load of the column of oil being pumped, but is required to lift the hydraulic column supported by the lower and larger annulus. In order that the plunger may be operated in each direction by equally applied or operating pressures, it is essential that the total upward pressure on the lower annulus including the static as well as the operating pump pressure shall equal or exceed the downward static pressure on the upper annulus plus the static pressure set up by the oil being pumped or delivered during the ascending movement of the piston member 18. The total downward pressure including both static and operating pump pressure on the upper annulus of the plunger 17 should equal or exceed the static pressure on the lower annulus of the pump plunger. These equal pressures will be secured when the area of the upper annulus is to the area of the lower annulus as the latter area is to the total area of the plunger 16. I do not restrict my invention to the proportion of areas just stated.

My invention as described hereinbefore is designed particularly for pumping dirty oil or other fluid without contaminating the plunger-actuating fluids. In cases where the fluid to be pumped is free from dirt or it is

not regarded as necessary or desirable to keep the pumped and actuating fluids from inter-mixing, the tube 36 may be omitted. Actuating pressure is applied to the hydraulic column sustained by the lower annulus of the plunger, as hereinbefore described, to effect the up-stroke of the plunger. The down-stroke of the plunger is effected by applying pressure to the top of the column of fluid occupying the pump casing 33. Upon the up-stroke of the plunger, a quantity of fluid equal to that delivered from the barrel 14 into the casing 36 will be delivered from the latter at the top of the well.

It is thus seen that I do away with rods for operating the pump plunger. The reciprocation of pump plungers by means of pump rods produces in the latter great deterioration due to exceedingly large stresses, fatiguing of the metal and the like. This deterioration from whatever cause produces numerous failures in the pumping string, resulting in large losses in production and in costly fishing jobs. My invention avoids these disadvantages of pumps operated by pump rods.

I claim—

1. In a well pump, a well tubing in the well, a coupling connected to the tubing and having inner and outer longitudinal passages therethrough, two concentric pump barrels connected to the coupling, the said inner passages opening into the space between the barrels, a hollow pump plunger having piston members fitting the barrels, a check valve to control the passage of fluid through the hollow of the plunger, a standing valve supported by the coupling, a pump casing suspended on the coupling and surrounding the outer barrel, the said outer passages communicating with the space between the said casing and the outer barrel, separate hydraulic columns communicating with the respective inner and outer passages and acting on opposite sides of the plunger, means supported by the coupling to convey pumped fluid to the surface of the well, a hollow fitting closing the bottom of the casing around the hollow in the fitting, and telescopic tubes screwed into the hollows of the plunger and fitting.

2. In a well pump, a well tubing, a coupling connected to the string and having a central vertical passage, two concentric pump barrels suspended on the coupling, the inner barrel being in line with the passage in the coupling, and shorter than the outer barrel, a pump plunger having a central vertical passage and two piston members, one telescopic with the inner barrel and the other with the outer barrel below the inner barrel, a check valve carried by the inner member to control the flow of fluid through the said passage in the plunger, a standing valve carried by the coupling, a casing surrounding the outer barrel

and suspended on the coupling, a fitting in the lower end of the casing, a pendent pipe carried by the plunger, an upstanding pipe supported by the fitting and telescopic with the pendent pipe, a seat on the coupling, a vertical conduit having its lower end removably resting on the latter seat and in line with the said central passage in the coupling, and separate hydraulic columns communicating one with the space between the pump barrels and the other with the space limited by the said casing, the outer pump barrel and the said two pipes, whereby hydraulic power may be applied to either side of the piston member which cooperates with the outer barrel.

3. In a well pump, a well tubing, an annular coupling connected to the tubing, a pumping string supported by the coupling, a central seat on the coupling and around the central opening therein, and a vertical fluid conduit removably resting on said last seat, the said pumping string including hydraulically-operated means for forcing fluid from the well up through the coupling and the conduit, and also including means for keeping the operating fluid from mixing with the fluid being forced from the well.

4. In a well pump, a well tubing, and annular coupling connected to the tubing, a pumping string supported by the coupling, a central seat on the coupling and around the central opening therein, and a vertical fluid conduit removably resting on said last seat, the said pumping string including a pump plunger for forcing fluid from the well up through the coupling and conduit and also including hydraulic means for operating the plunger and further including means for keeping the operating fluid from mixing with the fluid being forced from the well.

5. In a well pump, a plunger, a tube to contain a hydraulic column, the said column operating against a portion of the lower side of the plunger, a tube to contain a hydraulic column, the said column operating against a portion of the upper side of the plunger, and a conduit to contain the column of fluid to be lifted by the plunger, the latter column being sustained by the remainder of the upper surface of the plunger, the first portion having a larger area than the second portion, the area of the second portion being to the area of the first portion as the latter area is to the area of the second portion plus the cross area of that part of the plunger which lifts the fluid being pumped, and the said plunger operating in one of the tubes.

6. In a well pump, a plunger, a tube to contain a hydraulic column, the said column operating against an annulus on the lower side of the plunger, a tube to contain a hydraulic column, the said column operating against an annulus on the upper side of the plunger, and a conduit to contain the column of fluid to be lifted by the plunger, the latter

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5 to the area of the first annulus as the area of
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annulus plus the cross-area of that portion
of the plunger which lifts the fluid being
pumped, and the said plunger operating in
10 one of the tubes.

In testimony whereof, I hereunto affix my
signature.

MERTON T. ARCHER.

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