Jan. 6, 1953 J. B. REILLY 2,624,288

WELL PUMP WITH SUCCESSIVE PISTONS

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Fig. 1.

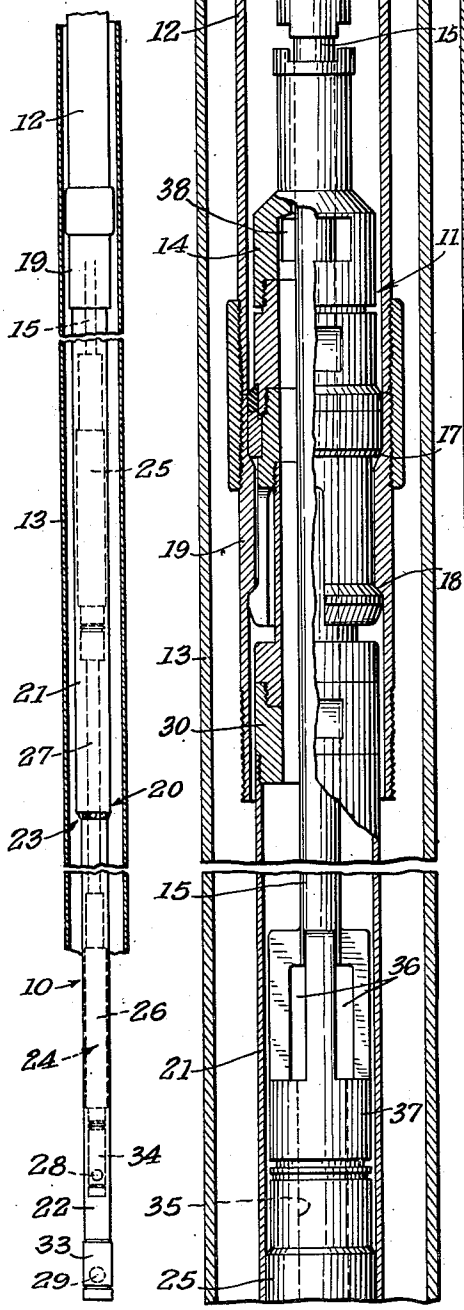


Fig. 2.

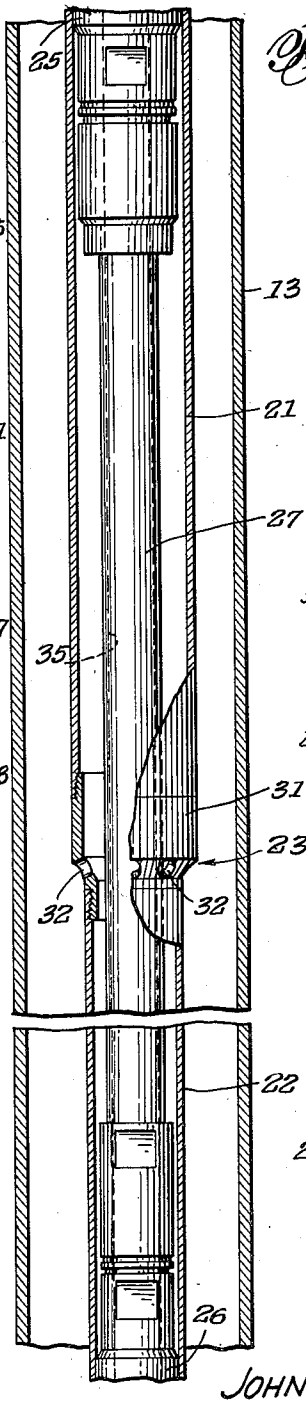
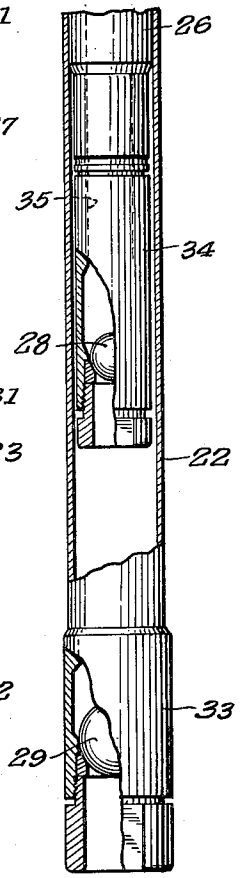


Fig. 3.

Fig. 4.



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WELL PUMP WITH SUCCESSIVE PISTONS

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4 Claims. (Cl. 103—79)

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This invention relates to pumps for oil wells and the like and seeks to provide a pump more particularly adapted for use in deep wells, or for pumping highly viscous fluid, etc.

In a conventional pump having a traveling plunger reciprocated from the well surface through the medium of a string of sucker rods and operating in a barrel having a foot valve, said plunger having a valve controlling admission of fluid from the barrel into an axial passage through the plunger, the stroke of the plunger is infrequently as great as that sought to be imparted by the surface-operating mechanism. When wells are of great depth, the resultant high operating pressure, the great weight of the long string of sucker rods and the elasticity thereof, the heavy load when lifting fluid, and the alternating lesser load when the plunger is being lowered, frequently result in a considerable difference in the distance of travel of the plunger and the movement of the operating mechanism. The plunger travel is invariably shorter with a resultant loss in pumping efficiency. The deeper the well, the greater is this loss of efficiency.

The most important factor causing this loss of efficiency is the force required to displace fluid at high pressure, at the bottom of the barrel, as the plunger and its operating string move downward. The foregoing is also true for pumps handling highly viscous fluid such as tars, said fluids resisting penetration of the plunger thereinto.

It will be understood, then, that many hundred pounds of downward pressure must be expended to force the lower end of these rods and plunger down through the barrel with the result that the string of sucker rods is alternately under considerable compression and severe tension for each reciprocation cycle of the pump. In addition to loss of pumping efficiency by shortening of the stroke, the sucker rods, because of alternate compression and tension, are subjected to the effects of crystallization, fatigue, and eventual failure.

Recognizing the above-stated faults of conventional well pumps, the present invention has for its primary object to provide a well pump wherein downward loading on the pump plunger, at all times, maintains the plunger-operating rods in tension, said tension being greater during the up stroke of the plunger and less during the down stroke.

Another object of the invention is to provide a well pump in which an intermediate portion of the barrel is vented to relieve pressure therein, the barrel being preferably vented back to the well.

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Another object of the invention is to provide a pump having a smaller plunger part that effects the pumping operation and a larger plunger part that is subjected to the weight of fluid thereabove and is not resisted in its downward movement because it operates in a vented barrel, whereby said larger plunger part is maintained under downward pressure during descent of the plungers to thereby maintain the pump-operating string in tension.

My invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in a working position and easily disconnected therefrom, economical of manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. However, the drawings merely show and the following description merely describes one embodiment of the present invention, which is given by way of illustration or example only.

In the drawings, like reference characters designate similar parts in the several views.

Fig. 1 is a broken elevational view of a well pump embodying the present invention, the casing in which the pump is disposed being shown in longitudinal section.

Figs. 2, 3 and 4, are considerably enlarged, partial elevational, and partial sectional views of the upper, intermediate and lower portions, respectively, of said well pump.

In keeping with conventional practice, the pump 10 is assembled with a top hold-down 11 in well tubing 12 and the assembly, by adding sucker rods and tubing sections, is lowered into the well within well casing 13.

In the present instance, the hold-down 11 is provided with a guide cage 14 for a pull rod 15 extending therethrough, said pull rod, through the medium of a threaded pin 16, being joined to the lowermost sucker rod of the string by threading into the box 16a thereof. The hold-down is firmly anchored between shoulders 17 and 18 provided in an end fitting 19 of the well tubing 12.

The pump assembly which is illustrated comprises, generally, a barrel 20 comprising an upper larger barrel tube 21 and a lower smaller barrel tube 22, a vent 23 located between the barrel tubes and particularly for venting the larger tube 21 to the well through well casing 13, a plunger 24 conected to pull rod 15 and comprising an upper plunger part 25 operating in the upper

barrel tube, a lower plunger part 26 operating in the lower barrel tube and a rigid connecting tube 27 for the plunger parts, a control valve 28 in the lower plunger and a fluid admitting standing foot valve 29 in the lower end of the barrel.

The upper or large barrel tube 21 is carried by the hold-down 11 through the medium of an adapter 30. The barrel tubes are connected by an adapter 31 and the latter is provided with suitable openings 32 which comprise the vent 23. The valve 29 is housed in a suitable blind cage 33 on the lower end of the barrel tube 22.

The plunger parts 25 and 26 are each suitably fitted to their respective barrel tubes and the latter, at its lower end, is provided with a blind cage 34 for the traveling valve 28.

In operation, upward pull on rod 15 raises the plunger 24 and causes the valve 29 to open and admit fluid from the well into barrel tube 22, and a downward push on rod 15 depresses the plunger 26 to move the same through fluid in barrel tube 22 and trapped by closed valve 29. Said fluid will then escape past valve 28 to flow upwardly through axial passage 35 in plunger parts 25 and 26 and connecting tube 27 and enter the portion of barrel tube 21 above plunger part 25 through ports 36 of rod adapter 37. Upon the next upward pull on rod 15, this fluid will be displaced upwardly through hold-down 11 and through side ports 38 therein into well tubing 12 and, simultaneously, an additional quantity of fluid will be drawn into barrel tube 22. Successive reciprocations of rod 15 and plunger 24 will build up the quantity of fluid in the well tubing until the same arrives at the surface for storage.

It will be noted that on the upward stroke, plunger part 26 performs the operation that draws fluid into barrel tube 22 and that both plunger parts serve to lift or displace fluid upwardly, and that on the downward stroke the smaller plunger part 26 is resisted by the pressure of the trapped fluid in barrel tube 22 whereas the larger plunger part 25 is not so resisted since its barrel tube 21 is vented to the well through openings 32. It follows, then, that a greater area of plunger is effective to lift or hold fluid than is resisted upon the down stroke. In the first instance, the total area of the plunger 24 comprising lower plunger 26 and upper plunger 25 supports the weight of fluid in tubing 12 thereby exerting a tension force on said string. In the second instance, said weight of fluid and of the operating string is counteracted only by the resistance against the smaller plunger part so that the mentioned tension force on the string is diminished only by this latter smaller resistance and the string remains in tension during the down stroke of the pump. Consequently, the previously-mentioned elasticity of the string cannot become effective to materially shorten the effective stroke of the plunger. Also, the mentioned tendency of the sucker rods to fail under alternate tension and compression is obviated.

It is evident that the differential plunger-parts provide for a difference of active areas during the operation of the pump to maintain constant downward loading on the operating string whether in upward or downward motion or at rest, and that this downward loading acts to stabilize the operation regardless of depth of well or viscosity of the fluid being pumped.

While I have illustrated and described what I now regard as the preferred embodiment of my invention, the construction is, of course, subject to modifications without departing from the spirit and scope of my invention. I, therefore, do not wish to restrict myself to the particular form of construction illustrated and described, but desire to avail myself of all modifications that may fall within the scope of the appended claims.

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

1. A pump for a well, said pump comprising fixed vertically aligned barrels of different size and the upper barrel being the larger, rigidly connected axially-hollow plungers, one operatively fitting each barrel, means to connect said plungers to an operating string for reciprocation thereof, said means extending upwardly from the larger upper barrel and including an adapter having ports disposed to communicate the hollow of the plungers with the larger barrel above the larger plunger, the smaller barrel and plunger having control valves whereby the same intermittently draws fluid in the hollow of the plungers from a well in which the pump operates, and the larger barrel having a vent directly to the well below the lowermost position of its plunger whereby the latter is loaded by the weight of fluid thereabove to thereby load the mentioned connecting means and the operating string.

2. In a pump for a well, a fixed barrel construction comprising an upper larger barrel part, a lower smaller barrel part, and an adapter connecting the barrel parts and having openings therein; a plunger construction comprising a plunger in each barrel part, and a rigid tubular connection between said barrel parts, each barrel part being operatively movable entirely within its respective barrel part and respectively on each side of the adapter whereby the openings in the latter are open during all positions of the plungers in their respective barrels; and a well casing in which said pump is disposed and receptive of flow from the larger barrel part through the adapter openings.

3. A well pump comprising a traveling axially hollow plunger having an upper larger portion and a lower smaller portion, means connected to the upper plunger portion to reciprocate said plunger from above a barrel in which said plunger is reciprocated, said barrel being formed to have larger and smaller portions in which the respective plunger portions operatively fit, a valve carried by the plunger and arranged to open to admit fluid from a well in which the pump operates into the hollow of said plunger upon downward movement of the plunger in the barrel, a standing valve carried by the barrel below the bottom end of the plunger, and an always open vent directly into the well in an intermediate part of the barrel and between the mentioned larger and smaller portions of the plunger and beyond the range of stroke movement of the plunger portions.

4. A pump for a well, said pump comprising a string of well tubing, a pump barrel, a hold-down fixedly connecting the upper end of the barrel and the lower end of the string of tubing, said barrel comprising an upper larger barrel portion and a lower smaller barrel portion and embodying a vent to a well in which said pump is operating, said vent being disposed between the barrel portions, a foot-standing valve in the lower part of the lower barrel portion to admit flow from the well into said lower barrel portion and to check flow back to the well, an axially-hollow operating plunger in the smaller lower barrel portion, an upwardly-opening check valve carried by said plunger to control flow from the

lower barrel into the hollow of said plunger, an axially-hollow plunger in the larger upper barrel, the mentioned vent being located below the lowermost position of the latter plunger, a rigid tubular connection between the plungers and connecting the hollows of said plungers, the upper plunger having openings communicating the hollow therein and the upper barrel, means to reciprocate the plungers including a connection extending downward through said hold-down and connected to the upper plunger, whereby, upon upward movement of said connection, the standing valve opens to admit fluid into the lower barrel portion and the hollows of the plungers and said latter connection is tensioned by the weight of fluid supported by the plungers and the closed check valve of the smaller plunger, whereby, upon downward movement of the connection, the standing valve closes and the valve in the smaller plunger opens to admit fluid through the plungers and their tubular connection for displacement above the larger plunger, and whereby, upon said downward movement, only the smaller plunger is resisted by fluid in the smaller barrel, the larger plunger moving with less resistance through the vented upper barrel and, by the weight of fluid thereon, maintaining tension on the mentioned connection.

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