Sept. 21, 1954 H. W. MARTIN 2,689,535

DEEP WELL ROD PUMP

Filed Sept. 11, 1950

2 Sheets-Sheet 1

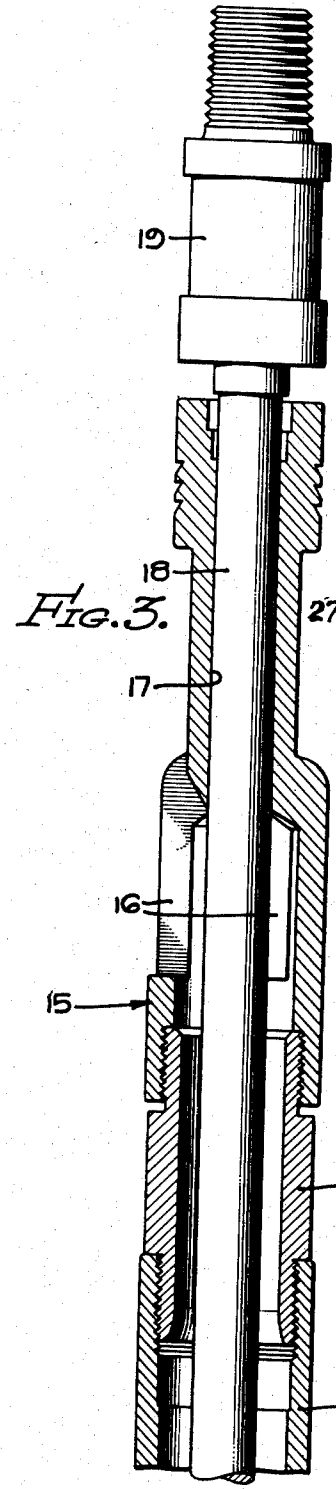
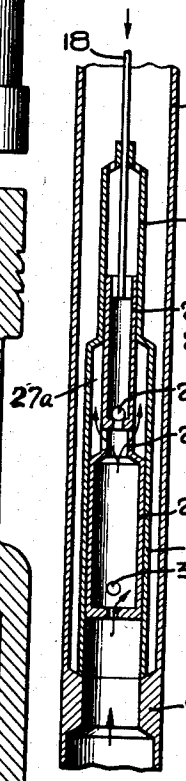


FIG. 3.



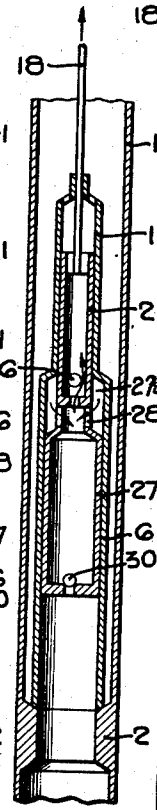


FIG. 1. FIG. 2.

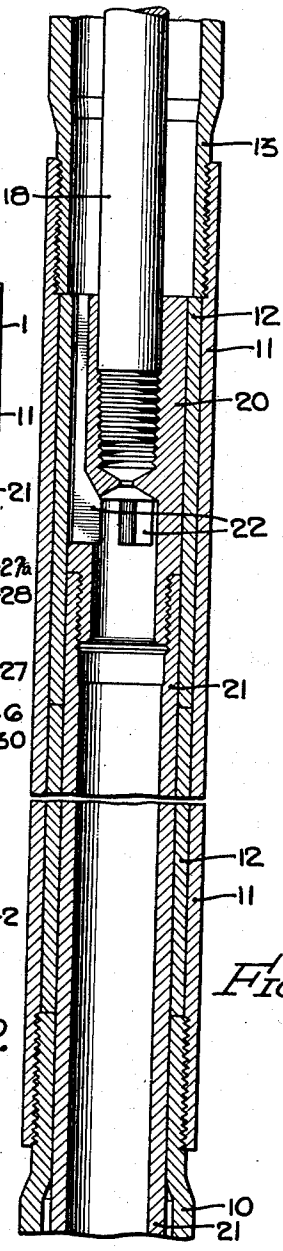


FIG. 4.

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2 Sheets-Sheet 2

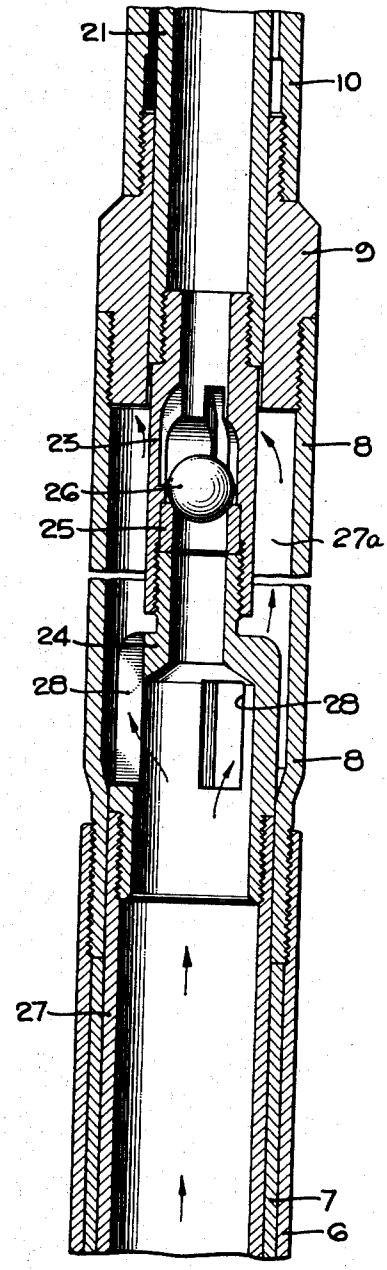


FIG. 5.

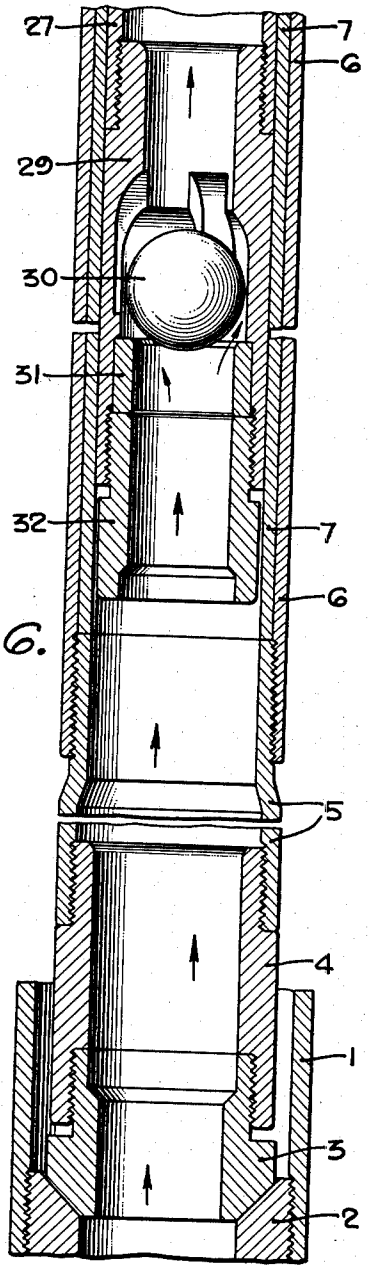


FIG. 6.

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DEEP WELL ROD PUMP

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5 Claims. (Cl. 103—184)

1

My invention relates to deep well rod pumps, and included in the objects of my invention are:

First, to provide a deep well pump, operated by sucker rods, which is particularly suitable for pumping viscous fluids or sand laden fluids having the tendency of retarding the return stroke of the sucker rods and pump.

Second, to provide a deep well pump of this class wherein the weight of the fluid column is applied against the pump and is supported by the sucker rods during the return stroke, so that the viscosity of the fluid column does not retard movement of the sucker rods, but instead, its weight aids in effecting rapid return movement even under adverse conditions.

Third, to provide a deep well pump of this class wherein the weight of the fluid column is applied to the sucker rods at all times, so that the sucker rods are maintained under substantial tensile load during both the working stroke and the return stroke of the pump.

Fourth, to provide a deep well pump of this class which does not employ a standing valve; instead all valves are travelling valves and by reason of the fact that they are in continuous motion, the possibility of "sending up" or being rendered inoperative by incoming solid matter is materially reduced.

With the above and other objects in view as may appear hereinafter, reference is made to the accompanying drawings, in which:

Figure 1 is a diagrammatic view illustrating the operation of the pump during its down or return stroke.

Figure 2 is a similar diagrammatic view showing the pump during its working or upstroke.

Figure 3 is a fragmentary longitudinal sectional view showing the upper portion of the pump.

Figure 4 is a sectional view continuing from Figure 3.

Figure 5 is another sectional view continuing from Figure 4, and

Figure 6 is still another sectional view continuing from Figure 5, showing the lower portion of the pump.

My deep well rod pump is mounted in a production casing or tubing string 1 having a suitable seat 2 located at the level at which it is desired to place the pump.

With reference to Figure 6, the pump includes a bottom fitting 3 which rests and seals against the seat 2. The bottom fitting is screw threaded into an adaptor 4 which in turn is joined to an insert collar 5. The insert collar

2

5 is screw threaded into a lower barrel 6. The barrel is provided with a liner 7 and the upper end of the barrel is connected by an insert collar 8 to an adaptor 9, as shown in Figure 5, which in turn is joined through an insert collar 10 to an upper barrel 11 smaller in diameter than the lower barrel 6, as shown in Figure 4.

The upper barrel is provided with a liner 12 and the upper barrel is joined to an insert collar 13 which is connected by an adaptor 14 to a top body 15, as shown in Figure 3. The top body 15 is provided with ports 16, forming outlets for the upper barrel 11. The upper portion of the top body 15 forms guide 17 for a plunger stem 18, the upper end of which is provided with a coupling 19 for attachment to a sucker rod string, not shown. The lower end of the stem 18 is joined to a plunger head 20, as shown in Figure 4, which in turn is secured to a tubular top plunger 21 slidable in the liner 12 of the upper barrel.

The plunger head is provided with ports 22 which communicate between the interior of the plunger 21 and the space above the head 20 surrounding the stem 18.

Secured to the lower end of the top plunger 21, as shown in Figure 5, is an upper valve body 23 which is secured to a cage 24. The upper end of the cage 24 is screw threaded into the valve body 23 and retains a cylindrical seat 25 which supports an upper ball valve 26. The cage 24 is connected to a lower plunger 27 slidable in the liner 7. The cage is provided with ports 28 communicating with the space within the lower barrel 6 and collar 8 above the lower plunger 27 which forms a transfer chamber 27*a*.

The lower end of the lower plunger, as shown in Figure 6, carries a valve body 29 which receives a ball valve 30 and cylindrical seat 31. The seat is held in place by an annular lock nut 32 screw threaded into the lower end of the valve body.

Operation of my deep well rod pump is as follows:

The pump is lowered into position while suspended from the sucker rod string in the manner of the conventional deep well pump. Once seated in the seat 2 the fluid column above maintains in place the pump housing comprising the pump barrels and connecting parts. With reference to Figure 1, it will be seen that during the down stroke of the plungers 21 and 27, that fluid is displaced from the region under the valve 30 to the region above the valve within the upper portion of the lower barrel 6.

During the down stroke, the upper valve 26 is

closed so that the weight of the fluid column in the production tubing is applied against the upper plunger 21, that is, the upper plunger supports that proportion of the total fluid column corresponding to the area of the upper plunger. This load is sufficient to place the entire sucker rod string under tension and insure downward movement of the sucker rods and plungers even though the fluid be highly viscous or laden with sand.

During the upstroke of the pump as shown in Figure 2, the valve 30 is closed. Fluid entrapped above the valve 30 in the upper portion of the lower barrel 6 and insert collar 8 is forced through the ports 28 and upwardly through the valve 26, and discharged into the production tubing. The upper portion of the lower barrel and the insert collar thus form a transfer chamber. The amount of fluid which is thus displaced is in proportion to the difference in area of the lower barrel 6 and upper barrel 11. During the upper stroke, the fluid load on the sucker rods is in proportion to the area of the lower plunger 27, so that the rods during the upward stroke are maintained under tension.

It will thus be seen that the sucker rods are maintained under tension during both down or return and working or upstroke of the pump. It will also be observed that no standing valve is needed, but instead both valves 26 and 30 are travelling valves, and thus tend to free themselves of any sand which might otherwise interfere with their operation.

It is to be understood that the form of the invention shown and described is to be taken as a preferred example of the same, and that various modifications thereof may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A deep well rod pump, comprising: a plunger stem for attachment to a sucker rod string; a tubular upper plunger suspended from said stem; a check valve in said upper plunger preventing downward flow of fluid therethrough but permitting upward flow of fluid therethrough; a tubular lower plunger suspended from said upper plunger; a check valve in said lower plunger preventing downward flow of fluid therethrough, said lower plunger being larger than said upper plunger but permitting upward flow of fluid therethrough; ingress-egress ports at the upper end of said lower plunger; an upper barrel adapted to receive said upper plunger and having discharge ports at its upper end; a shell at the lower end of said upper barrel surrounding the lower portion of said upper plunger and forming therewith a transfer chamber communicating with said ingress-egress ports; and a lower barrel extending from said shell to receive said lower plunger; means for sealing said lower barrel within a surrounding casing; said plungers on reciprocation in said barrels arranged to pump fluid through said lower barrel into said transfer chamber and from said transfer chamber through said upper barrel into said casing above said sealing means; said check valves being alternately operable whereby the fluid head in said casing above said upper barrel is continuously applied to said plungers.

2. A deep well pump, comprising: a lower barrel having an intake at its lower end; an upper barrel continuing upwardly from said lower barrel and having an outlet at its upper end, said lower barrel having a greater diameter and capacity than said upper barrel; means for sealing said barrels in a well casing, said intake being below said seal and said outlet being above said seal; a lower tubular plunger in said lower barrel; an upper tubular plunger in said upper barrel and connected to said lower plunger, said lower plunger being larger than said upper plunger, said upper plunger adapted for connection with a sucker rod string whereby said plungers are reciprocable in unison; a check valve for each plunger permitting upward flow therethrough but preventing back flow therethrough; confronting shoulders formed between said upper and lower barrels and between said upper and lower plungers, said upper plunger being movable into said lower barrel and defining therewith an annular chamber between said shoulders; ports between the valves in said plungers communicating between the interior of said plungers and said chamber, to deliver fluid to said chamber during down stroke of said plungers and receive fluid from said chamber for discharge through the upper plunger and into said casing above said seal during upstroke of said plungers.

3. A deep well pump, comprising: a tubular upper plunger adapted to be suspended from a sucker rod string; a tubular lower plunger connected to the lower end of said upper plunger, said lower plunger being larger in diameter than said upper plunger; a housing having a constricted upper end slidably receiving said sucker rods above said upper plunger and retained thereon by said upper plunger for insertion in and removal from the production casing of a well bore, the lower end of said housing having a seal seat adapted to sealingly engage a mating seat at the bottom of said production casing; an upper barrel and a lower barrel formed in said housing, the upper barrel adapted to receive said upper plunger, the lower barrel adapted to receive said lower plunger, said lower barrel being larger than said upper barrel; said lower barrel having an intake at its lower end communicating with said well bore below said production casing seat; said upper barrel having an outlet at its upper end above said seat communicating with said production casing; confronting shoulders formed between said upper and lower barrels and between said upper and lower plungers, said upper plunger movable into said lower barrel to define between said shoulders an annular transfer chamber; said lower plunger having an inlet at its lower end communicating with the intake end of said lower barrel, said upper plunger having an outlet at its upper end communicating with the outlet of said upper barrel; a check valve in each plunger permitting upward flow therethrough but preventing back flow therethrough; ports between said valves communicating between the interior of said plungers and said transfer chamber through which fluid flows to said transfer chamber during down stroke of said plungers and through which fluid flows from said transfer chamber during upstroke of said plungers.

4. A deep well pump, comprising: a tubular plunger having an upper plunger portion and a lower plunger portion, the lower plunger portion being larger in diameter than said upper plunger portion and forming an external shoulder; a tubular barrel having an upper portion and a lower portion, the lower barrel portion being larger than said upper barrel portion and forming an internal shoulder, the upper barrel portion adapted to reciprocably receive the upper plunger portion and the lower barrel portion adapted to

reciprocably receive the lower plunger portion, said upper plunger portion movable into said lower barrel portion to define therewith an annular transfer chamber between said shoulders; sealing means between said barrel and a surrounding casing; an intake at the lower end of the lower plunger portion below said sealing means; an outlet at the upper end of the upper plunger portion above said sealing means; ports communicating between the interior of said plunger and said transfer chamber; traveling valves in said plunger portions above and below said ports permitting upflow but preventing down flow of fluid; said transfer chamber adapted to receive fluid passing the traveling valve of said lower plunger portion during down stroke of said plunger, and adapted to deliver fluid through the traveling valve and outlet of the upper plunger portion during upstroke of said plunger.

5. A deep well pump, comprising: a tubular plunger having an upper plunger portion and a lower plunger portion, the lower plunger portion being larger in diameter than said upper plunger portion and forming an external shoulder; a tubular barrel having an upper portion and a lower portion, the lower barrel portion being larger than said upper barrel portion and forming an internal shoulder, the upper barrel portion adapted to reciprocably receive the upper plunger portion and the lower barrel portion adapted to reciprocably receive the lower plunger portion, said upper plunger portion movable into said lower barrel portion to define therewith an annular transfer chamber between said shoulders; said plunger adapted to be suspended from a sucker rod string and reciprocable therewith; said barrel having a seat adapted to seal against a shoulder formed in a surrounding well casing and held thereon by the head of fluid in said casing; an intake port for said lower plunger portion below said seat; an outlet port for said upper plunger portion above said seat; ingress-egress ports communicating between said plunger and said transfer chamber; alternately operable traveling valves in said plunger portions above and below said ingress-egress ports to pump fluid through said lower plunger portion into said transfer chamber during down stroke of said plunger and to pump fluid from said transfer chamber through said upper plunger portion during upstroke of said plunger, each traveling valve adapted, when closed, to support the head of fluid in said casing above said plunger thereby to place said sucker rods under continuous tension.

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