July 30, 1957 R. L. CHENAULT 2,800,859

SUBSURFACE PUMP

Filed Jan. 12, 1955

FIG. 1.

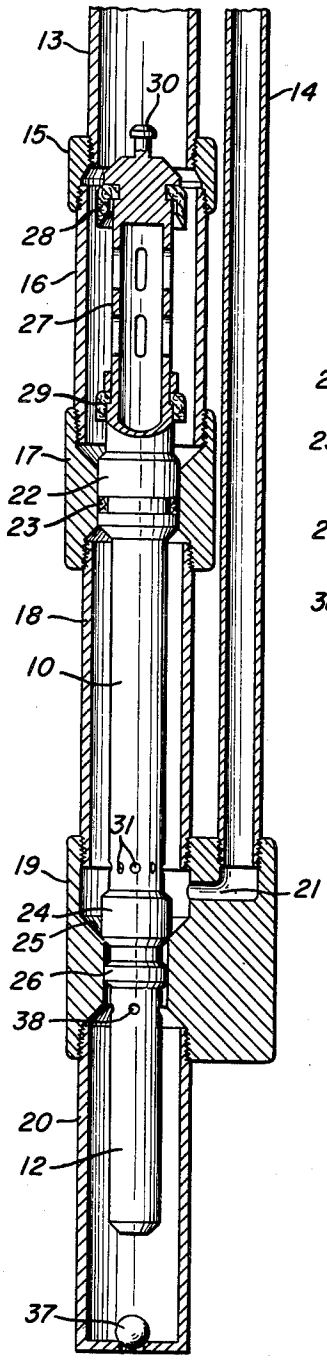



FIG. 2.

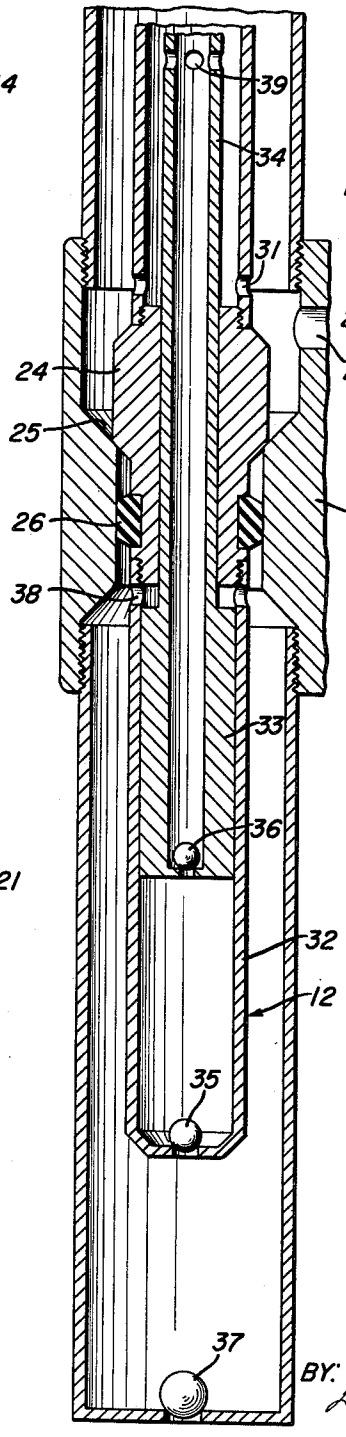



FIG. 3.

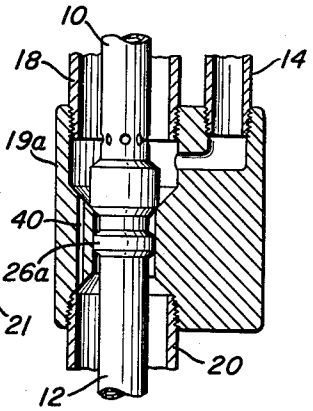
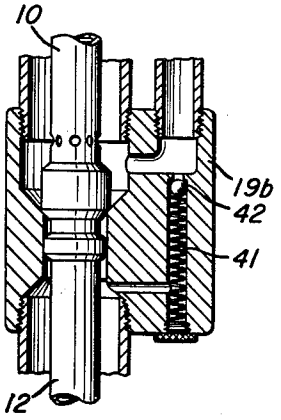



FIG. 4.




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# SUBSURFACE PUMP

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2 Claims. (Cl. 103—46)

This invention relates to improved hydraulically operated free-type subsurface pumps.

Hydraulically operated pumps, which can be used in oil wells in lieu of the more common sucker rod pumps, are equipped with a hydraulic motor powered by an oil stream forced down the well from the surface. A "free-type" pump can be removed from the well by forcing oil down the well in the reverse direction, as opposed to those which require removal of the tubing. One difficulty encountered with previous free-type pumps is that oil forced down to raise the pump acts initially on only a very small area to unseat the pump, although once the pump is unseated, this oil acts on the full cross-sectional area of the pump. Consequently the initial unseating requires abnormally high pressure, and equipment must be available for producing peak pressures considerably greater than needed for normal operations.

An object of the present invention is to provide an improved free-type pump in which oil forced down to unseat the pump acts initially on the entire cross-sectional area, thereby facilitating unseating and reducing pressure requirements.

My earlier Patent No. 2,679,806, dated June 1, 1954, shows a hydraulically operated subsurface pump combination which embodies a single-acting pump and yet achieves a balanced load on both the upstroke and downstroke, although not illustrated as of the free-type. A further object of the present invention is to provide a free-type construction especially adapted for single-acting pumps, for example as shown in my earlier patent, although similar principles are applicable to double-acting pumps, more common in hydraulically operated installations.

A more specific object is to provide an improved free-type pump which includes means for transmitting the initial unseating pressure beneath the pump, thereby applying this pressure to the full cross-sectional area of the pump and reducing pressure requirements.

In accomplishing these and other objects of the invention, I have provided improved details of structure, preferred forms of which are shown in the accompanying drawing, in which:

Figure 1 is a vertical sectional view of a motor and pump combination constructed in accordance with my invention;

Figure 2 is a fragmentary vertical sectional view on a larger scale showing part of the combination in more detail;

Figure 3 is a fragmentary vertical sectional view showing a modification; and

Figure 4 is a fragmentary vertical sectional view showing another modification.

Figure 1 shows a free-type pump combination which includes a hydraulic motor **10** and a pump **12** joined to form a unit. The well contains parallel first and second strings of tubing **13** and **14**. The first tubing **13** includes a coupling **15**, a nipple **16** extending downwardly from said coupling, a seating coupling **17** joined to the bottom



of said nipple, a spacer tube **18** extending downwardly from said seating coupling, a crossover coupling **19** joined to the bottom of said spacer tube, and an extension **20** extending downwardly from said crossover coupling. The lower end of the second tubing **14** is joined to the crossover coupling and communicates with the interior of the spacer tube **18** via a transverse passage **21**. The motor and pump combination is housed within the first tubing. The upper end of the motor **10** has a head **22**, the exterior of which carries a packing ring **23** that fits closely within the coupling **17** to furnish an upper seat. An external shoulder member **24** is connected between the motor **10** and pump **12** and seats on a corresponding internal shoulder **25** in the crossover coupling **19** below the transverse passage **21** to furnish a lower seat. The outside of the pump **12** carries a packing ring **26** that fits closely within the crossover coupling **19** below the shoulder **25**.

A strainer **27** is joined to the top of the head **22** on the motor **10** and also forms part of the unit. The exterior of this strainer carries two vertically spaced packers **28** and **29**. When the pump is seated, the strainer **27** and packers **28** and **29** are housed within the nipple **16**. This nipple has a somewhat larger internal diameter than the tubing sections thereabove, and the packers fit loosely therein. When the pump is unseated and the strainer ascends above the nipple **16**, the packers fit tightly within the tubing, except at the joints. Since there are two packers, one or the other is always away from a joint to provide a continuous fit. Preferably the strainer carries a fishing neck **30** for handling the unit when needed.

The motor **10** per se can be of any standard or desired construction, although I prefer that shown in my earlier Patent No. 2,191,369, dated February 20, 1940. The motor is powered by an oil stream forced down the tubing **13**. The lower portion of the motor barrel contains outlet openings **31** through which a blend of exhaust power oil from the motor and oil pumped from the well discharge into the spacer tube **18** and thence flow through the transverse passage **21** and up tubing **14** to the surface.

As Figure 2 shows, the pump **12** is single-acting. The motor and pump are proportioned to produce a balanced load on both strokes, as explained in my Patent No. 2,679,806. The pump includes a barrel **32** joined at its upper end to the shoulder member **24**, a plunger **33** mounted for reciprocable movement in said barrel, and a plunger tube **34** joined to said plunger and to the reciprocating element of the motor **10**. The lower end of the pump barrel carries a standing valve **35**, and the plunger a traveling valve **36**. In addition the lower end of the extension **20** carries a special standing valve **37**. The upper end of the pump barrel **32** has a relief port **38**, through which oil in the space above the plunger **33** escapes into the tubing extension **20**. The upper end of the plunger tube has a port **39** through which oil pumped from the well reaches the motor barrel where it blends with exhaust power oil.

In accordance with the present invention, the fit between the plunger tube **34** and the bore of the shoulder member **24** intentionally allows some leakage, although the fit is sufficiently close not to impair pumping efficiency. To remove the pump from the well, an oil stream is forced down the well in the reverse direction, that is, down the tubing **14**. In the absence of leakage which my arrangement affords, such oil would act initially upwardly against the head **22** and downwardly against the shoulder member **24**. The former has a larger area than the latter to provide a net upward force on the pump, but the effective area is only the difference between these areas and is necessarily small. Once the pump is unseated, the upward pressure acts on the bottom of the

pump and the effective area is much greater. With my invention, the unseating pressure is transmitted through the outlet openings **31** into the lower section of the motor barrel and thence through the leakage space between plunger tube **34** and the bore in the shoulder member **24** and through the relief port **38**. Such pressure thus acts immediately on the bottom of the pump on the full cross-sectional area thereof. The parts are proportioned so that the packing **26** clears the crossover coupling **19** before the packing ring **23** clears the seating coupling **17**. Hence the pressure very soon acts directly on the bottom of the pump. As the pump ascends the tubing **13**, packers **28** and **29** provide a close fit to give the necessary piston action and the special standing valve **37** is closed. The pump is installed in the well by pumping it down the tubing **13** until it seats as shown in Figure 1.

Figures 3 and 4 show modifications which enable the principles of the present invention to be applied to pumps which lack relief ports corresponding with port **38** shown in Figures 1 and 2. In Figure 3 the crossover coupling **19***a* has a restricted vertical passageway **40** to provide communication between the space above the packing ring **26***a* and the space therebelow. In Figure 4 the crossover coupling **19***b* has a restricted passageway **41** which contains a normally closed spring loaded valve **42**. Pressure exerted to raise the pump opens this valve, which then allows the passage **41** to transmit the pressure to the bottom of the pump.

From the foregoing description it is seen that the present invention affords a simple means for applying the unseating pressure initially to the full cross-sectional area of a free-type pump. Thus the peak power requirements are materially reduced over arrangements where this pressure acts on only a small differential area. While the invention is especially applicable to pumps which have relief ports in their barrels, the modifications of Figures 3 and 4 enable the same principles to be applied to free-type pumps generally.

While I have shown and described certain preferred embodiments of my invention, it is apparent that other modifications may arise. Therefore, I do not wish to be limited to the disclosure set forth but only by the scope of the appended claims.

I claim:

1. A subsurface pump installation comprising parallel first and second strings of tubing, a crossover coupling to which said tubings are connected adjacent their lower ends and having a transverse passage providing communication between the tubings, a motor and pump combination housed in said first tubing and including a hydraulic motor powered by fluid forced down this tubing and a pump for delivering fluid up said second tubing, said first tubing having upper and lower seats for said combination located on opposite sides of said transverse passage, said pump being single acting and having a relief port in its exterior below said lower seat, said combination being removable from the tubing by fluid forced down said second tubing, and means for transmitting fluid forced down said second tubing through said relief port beneath said lower seat to apply the pressure of this fluid against the full cross-sectional area of the combination initially for unseating it.

2. A subsurface pump installation comprising parallel first and second strings of tubing, a crossover coupling to which said tubings are connected adjacent their lower ends and having a transverse passage providing communication between the tubings, a motor and pump combination housed in said first tubing and including a hydraulic motor powered by fluid forced down this tubing and a pump for delivering fluid up said second tubing, said first tubing having upper and lower seats for said combination located on opposite sides of said transverse passage, said pump being single acting and including a barrel having a relief port in its upper end below said lower seat and a plunger and tubular plunger rod mounted for reciprocable movement in said barrel, said combination being removable from the tubing by fluid forced down said second tubing, and means allowing leakage around said rod for transmitting fluid forced down said second tubing through said relief port beneath said lower seat to apply the pressure of this fluid against the full cross-sectional area of the combination initially for unseating it.


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