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TOP STANDING VALVE FOR SUBSURFACE PUMP

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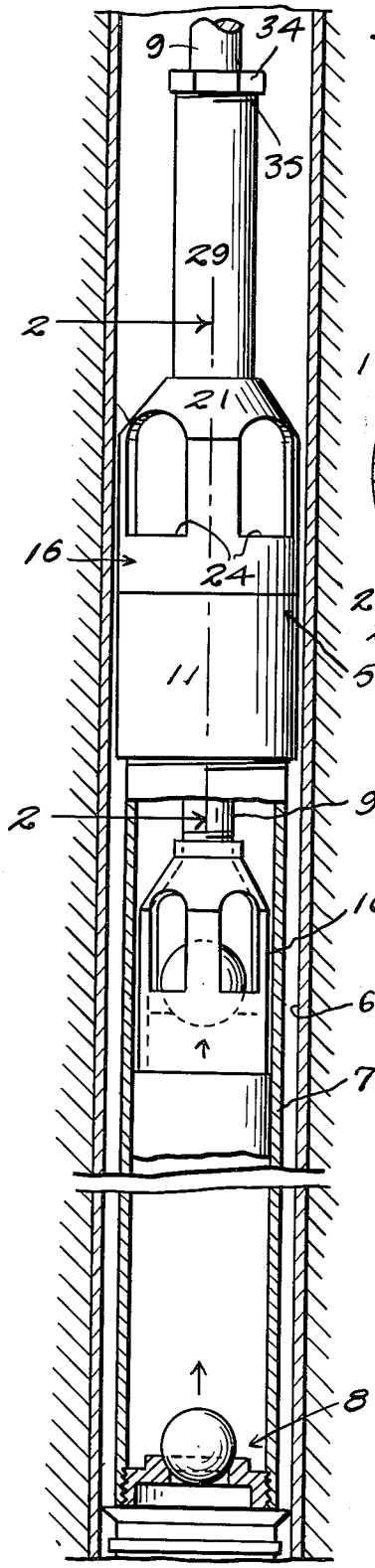


Fig. 1.

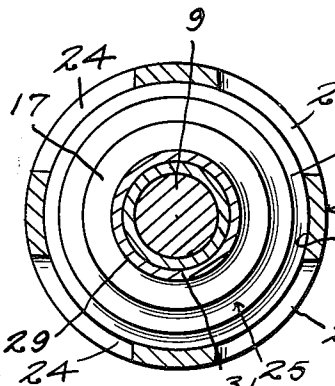


Fig. 3.

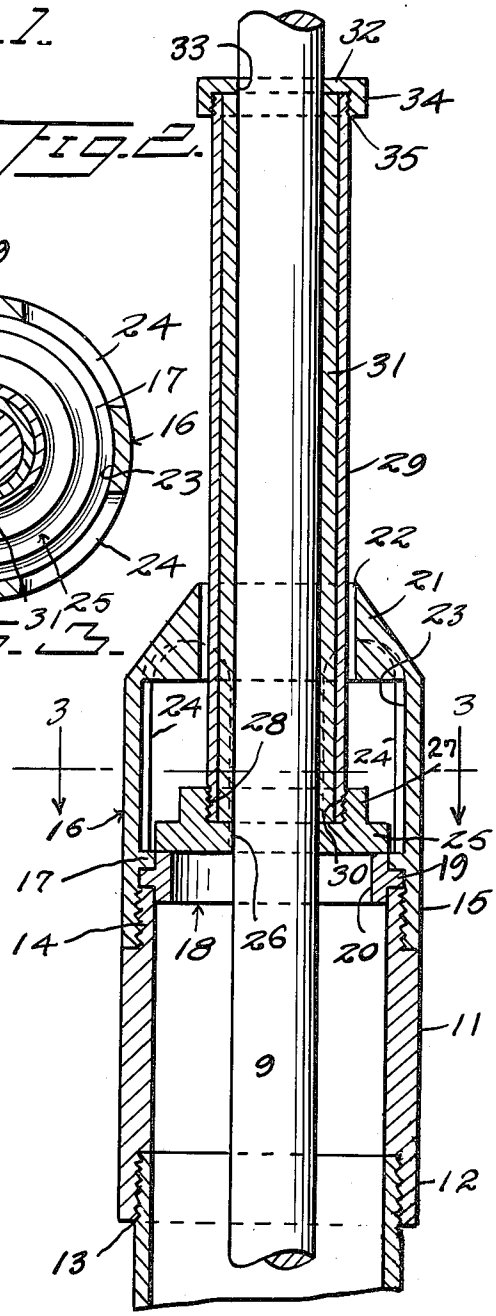


Fig. 2.

INVENTOR

William I. Nichols

BY John H. Randolph

ATTORNEY

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TOP STANDING VALVE FOR SUBSURFACE PUMP

William I. Nichols, Henry, S. Dak.

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3 Claims. (Cl. 103—179)

This invention relates to a novel top standing valve for attachment to a conventional stationary tube-type subsurface pump, and more particularly to an oil well pump, and wherein the top standing valve forms a complete unit which is assembled with and as an attachment to an insert pump, which pump constitutes a complete pump unit separate and apart from the stationary tube.

More particularly, it is an aim of the invention to provide a top standing valve wherein no part of the stationary pump valve or tube forms any part of the valve so that the complete valve is run and pulled with the pump and without pulling any part of the stationary tubing.

Another object of the invention is to provide a valve which is supported by and has a fluid seal on the pull rod and which constitutes one movable unit which is assisted in opening and closing by the frictional engagement of its fluid seal with the pump rod.

The primary object of the present invention is to provide a top standing valve to eliminate the common cause of failure of a subsurface oil field pump to operate, known as "gas locking," and which eliminates this operational failure by shutting off the pressure of the fluid column in the pump tubing from the traveling valve on the downstroke of the pump.

In conventional types of subsurface oil field pumps, the fluid head pressure in the tubing string is held by the traveling valve on the upstroke of the pump and by the lower standing valve on the downstroke thereof. The downstroke of the traveling valve builds up pressure on the fluid between the traveling valve and standing valve which causes the traveling valve to open to allow fluid to pass to above the traveling valve. However, in a well producing both oil and gas, the chamber between the traveling valve and standing valve frequently fills with gas and due to the compressibility of gas, the downstroke of the traveling valve may not build up sufficient pressure in the chamber below said valve to equal the pressure of the fluid column above the valve resulting in the traveling valve remaining closed during its downstroke, so that the gas between the standing valve and traveling valve merely compresses and expands with each stroke of the pump, producing the operational failure of the pump known as "gas locking." This condition may remedy itself after a short time or may continue indefinitely.

Accordingly, it is the primary object of applicant's top standing valve to provide a device which will eliminate "gas locking" by excluding the pressure of the fluid column from the traveling valve on the downstroke of the pump, allowing the gas or oil between the valves to pass upwardly through the traveling valve at a very low pressure or at even a negative pressure. The gas or oil thus passed to above the traveling valve on its downstroke will be forced to above the top standing valve on the upstroke of the traveling valve, as a sufficient amount of fluid remains in the chamber between the top standing valve and traveling valve after each upstroke of the traveling valve to fill

the space between these valves so that an amount of fluid will move upwardly past the top standing valve on each upstroke thereof equal to the amount passing the traveling valve on its previous downstroke.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawing, illustrating a presently preferred embodiment thereof, and wherein:

Figure 1 is a vertical sectional view, partly in side elevation, showing a conventional stationary tube-type subsurface oil well pump with the top standing valve applied thereto;

Figure 2 is an enlarged fragmentary vertical sectional view taken substantially along a plane as indicated by the line 2—2 of Figure 1, and

Figure 3 is a cross sectional view of the top standing valve taken substantially along a plane as indicated by the line 3—3 of Figure 2.

Referring more specifically to the drawing, for the purpose of illustrating a preferred application and use of the top standing valve unit, designated generally 5 and comprising the invention, a portion of a well tubing is illustrated at 6 in Figure 1 in which a stationary pump tube or barrel 7 is shown positioned. The pump tubing 7 is provided with a conventional standing valve 8 at its lower end, hereinafter referred to as a "lower" or "bottom" standing valve to distinguish it from the standing valve of the invention forming a part of the unit 5. A conventional part of the pump also includes a pull rod 9 which is reciprocated in any suitable manner and which has a lower end extending into the pump tube 7. The upper end of the cage of a conventional traveling valve 10 is detachably connected to the lower end of the pull rod 9 and is supported thereby for reciprocating movement in the pump tube 7. The pull rod 9 is preferably chrome plated. The parts 6 to 10 are all of conventional construction.

The top standing valve unit 5 replaces the usual guide or bushing which is secured to the upper portion of the pump barrel 7 and by means of which the pull rod 9 is guided. The unit 5 includes an adaptor bushing 11 having an internally enlarged internally threaded lower end 12 which is threadedly connected to the externally threaded upper end 13 of the pump barrel 7 and which fits therein, as best illustrated in Figure 2. It will thus be seen that the adaptor bushing 11 is of larger external diameter than the pump barrel 7 and of approximately the same internal diameter. The bushing 11 has an externally restricted externally threaded upper end 14 to which the internally threaded lower end 15 of a valve cage 16 of the unit 5 is threadedly connected. The interior diameter of the cage 16 is somewhat larger than the bore of the adaptor bushing 11 and said cage is provided with an internal projection 17 which is preferably annular and the internal diameter of which is preferably approximately equal to the bore diameter of the bushing 11. A ring shaped valve seat 18 fits snugly into the upper portion of the bushing 11 and is provided intermediate of its top and bottom edges with an external enlargement or flange 19 which rests upon the upper end 14 of the bushing 11 and is disposed within the cage 16 below its internal enlargement 17. The upper portion of the valve seat 18 fits snugly within the internal enlargement 17 and said enlargement is disposed above and bears on the valve seat flange 19 to thus detachably secure the valve seat between the adaptor bushing 11 and cage 16. The valve seat 18 has a relatively large bore 20 through which the pull rod 9 extends and having ample clearance around said pull rod for the passing of the fluid being pumped through the valve seat. It will be obvious that the valve seat 18 is applied to the upper end of the bushing 11 before the lower end

15 of the valve cage is attached to the bushing portion 14. The valve cage 16 is provided with an upwardly tapered upper end or head 21 having a central bore 22 extending therethrough which opens outwardly of the upper end thereof and into a chamber 23 of the cage 16. The wall of the cage 16 is provided with a plurality of elongated longitudinally extending openings 24 which are circumferentially spaced relatively to one another and which have upper portions extending into the tapered head 21.

A disk 25, forming the valve of the unit 5, is provided with a central opening 26 through which the pull rod 9 slidably extends. The valve 25 is provided with an upstanding annular flange 27 which is internally threaded as seen at 28 and the internal diameter of which is substantially larger than the opening 26. The flange 27 is disposed concentrically around the opening 26. The diameter of the valve 25 is larger than the diameter of the valve seat bore 20 but substantially smaller than the internal diameter of the valve cage chamber 23. The diameter of said valve 25 preferably being approximately equal to the external diameter of the valve seat 18 or the bore of the adaptor bushing 11.

A tubular jacket 29, preferaby formed of steel, is provided with an externally threaded lower end 30 which is threadedly secured in the flange 27. The jacket 29 extends upwardly from the valve 25 loosely through the bore 22 of the cage 16 and fits loosely around a portion of the pull rod 9. A sleeve 31, preferably formed of cast iron, fits into the jacket 29. The sleeve 31 is machined so that its bore has a close fitting sliding engagement with the rod 9 to form a fluid seal with said rod. A cap 32 has a central opening 33 in the top thereof through which the pull rod 9 slidably extends and is provided with a depending internally threaded flange 34 which threadedly engages over the upper externally threaded end 35 of the jacket 29 to retain the sleeve 31, in combination with the valve 25, against sliding movement in the jacket 29. The sleeve 31 is preferably made twelve inches in length and the jacket 29 may be either twelve inches, twenty-four inches or thirty-six inches long to enclose one, two or three sleeves 31.

From the foregoing it will be readily apparent that on the downstroke of the pull rod 9 the traveling valve 10 will move downwardly in the pump tubing 7 in which it has a relatively close fitting engagement. The bottom standing valve 8 will be closed by the pressure of the fluid, not shown, in the pump tubing between the valves 8 and 10. Consequently, as the traveling valve 10 moves downwardly with the pull rod 9 the fluid between said valves will be forced upwardly through the traveling valve 10 and into the pump tubing above said traveling valve. During the initial downward movement of the pull rod 9, the top standing valve 25 which forms a unit with the sleeve 31 and jacket 29 moves downwardly with the pull rod due to the frictional engagement formed by the surface tensioned oil seal of the sleeve 31 with the pull rod 9. This downward movement of the valve 25 continues until it seats on the upper end of the valve seat 18, after which the pull rod moves downwardly relatively to the parts 25, 29 and 31. The traveling valve 10 has a sufficiently close fitting engagement in the pump barrel 7 to prevent liquids from escaping past the valve between its outer surface and the pump barrel. Accordingly, as the traveling valve and pull rod commence their upward travel the fluid above the traveling valve is supported thereby and elevated with the traveling valve. During the initial upward movement of the pull rod 9 the top standing valve 25, jacket 29 and sleeve 31 are elevated as a unit with the pull rod due to the frictional engagement of the sleeve 31 with the pull rod to unseat and open the valve 25. The travel of the valve 25, jacket 29 and sleeve 31 within the cage chamber 23, between the head 21 and valve seat 18 is preferably about three-quarters of an inch in each direction. Accordingly, the valve 25 is opened by the initial upward movement of the pull rod and traveling valve so that the pump fluid elevated by the traveling valve may flow freely through the bushing 11, valve seat 18 into the cage chamber 23 and outwardly therefrom into the well tubing 6 above the cage 16 on the upward travel of the traveling valve 10. The fluid escapes from the cage 16 through its openings 24 into the well tubing 6 above said cage. During the initial downward movement of the pull rod 9 the sleeve 31, jacket 29 and valve 25 travel downwardly with the pull rod due to the frictional engagement of the sleeve with the pull rod to cause the valve 25 to return to a closed position seated on the valve seat 18 to relieve the traveling valve 10 from the pressure of the fluid disposed thereabove so that as the traveling valve 10 moves downwardly the chamber between said traveling valve and the valve 25 will contain a very slight pressure or even a negative pressure. As the bottom standing valve 8 is closed as soon as the traveling valve 10 starts its downward travel, the pressure built up between the traveling valve 10 and bottom standing valve 8 will cause the traveling valve to open even though the chamber between said valves is filled with a compressible gas and consequently the increasing chamber above the traveling valve 10 will be filled from the diminishing chamber beneath said traveling valve, during the downward travel of the valve 10 and the fluid thus displaced into the chamber above the traveling valve 10 will be pumped through the cage 16 into the well tubing 6 on the next upstroke of the pull rod 9, as previously described. Thus, the top standing valve unit 5 will prevent "gas locking" of the pump and in addition will increase the capacity of the pump since the fluid below the traveling valve 10 does not have to overcome a pressure above the traveling valve during the downstroke of the pull rod and traveling valve in order for said fluid to pass through the traveling valve and into the chamber thereabove.

From the foregoing it will be noted that the top standing valve unit 5 constitutes an attachment for the pump composed of the pull rod 9 and traveling valve 10 which constitutes an insert-type pump forming a complete unit separate and distinct from the stationary pump tube 7 and bottom standing valve 8. Accordingly, the top standing valve 5 is a complete unit and no part of the tubing 7 constitutes a part thereof so that the top standing valve 5 may be run and pulled with the pull rod 9 and traveling valve 10 without pulling any part of the pump tubing 7. It will also be noted that the valve 25 and the fluid seal sleeve 31 constitutes a unitary structure when assembled and wherein the valve 25 is assisted in opening and closing by the frictional engagement of the sleeve 31 with the pull rod 9.

Various modifications and changes are contemplated and may obviously be resorted to, without departing from the spirit or scope of the invention as hereinafter defined by the appended claims.

I claim as my invention:

1. The combination with a subsurface-type pump including a stationary pump tubing having a bottom standing valve adjacent its lower end, a pull rod extending downwardly into the pump tubing and a traveling valve attached to the lower end of the pull rod for reciprocation thereby in the pump tubing toward and away from the bottom standing valve, of a top standing valve comprising a valve cage, an adaptor bushing connecting the upper end of the pump tubing to the lower end of the valve cage, a valve seat detachably secured in the valve cage by the adaptor bushing and having a large bore through which the pull rod loosely extends, a disk-type valve disposed in the valve cage above the valve seat of a diameter substantially smaller then the internal diameter of the valve cage and larger than the internal diameter of the valve seat, said disk-type valve having an

opening through which the pull rod slidably extends, and a fluid sealing unit detachably secured to and rising from said disk-type valve including an elongated sleeve disposed around and in frictional engagement with a portion of the pull rod and forming a fluid seal between the pull rod and said sleeve, said valve cage having a head at its upper end provided with a central opening through which the fluid sealing unit slidably extends, said cage having an outer wall provided with openings disposed above the valve seat and opening into a well tubing in which the pump is disposed, said disk-type valve being displaced upwardly to an open position during the initial upward travel of the pull rod by the frictional engagement of the pull rod with the sleeve and being returned to a closed position on the valve seat during the initial downward travel of the pull rod, said disk-type valve being limited in its travel by the valve cage.

2. A top standing valve unit as in claim 1, said disk-type valve having an internally threaded upstanding annular flange disposed concentrically around the pull rod

to which the lower end of the fluid sealing unit is detachably secured.

3. A top standing valve unit as in claim 2, said fluid sealing unit having a tubular jacket surrounding said sleeve and provided with an externally threaded lower end detachably secured in said annular flange, and a cap detachably secured to the upper end of said jacket and engaging the upper end of the sleeve, said cap having a central opening through which the pull rod slidably extends, said sleeve being retained against sliding movement within the jacket by the cap and disk-type valve.

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