Nov. 27, 1928.

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J. P. WORTHINGTON

OIL WELL PUMP

Filed Feb. 23, 1926

Fig. 2.

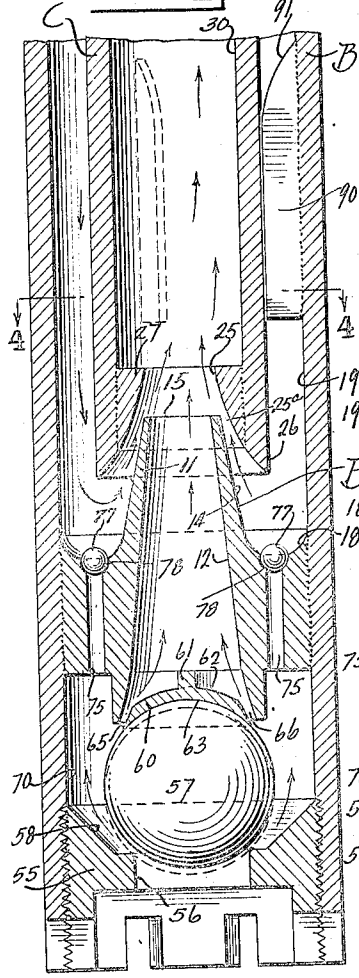


Fig. 3.

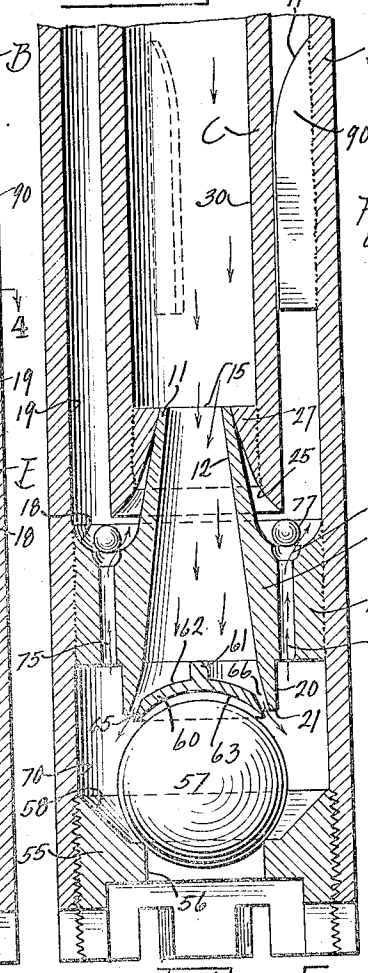


Fig. 1.

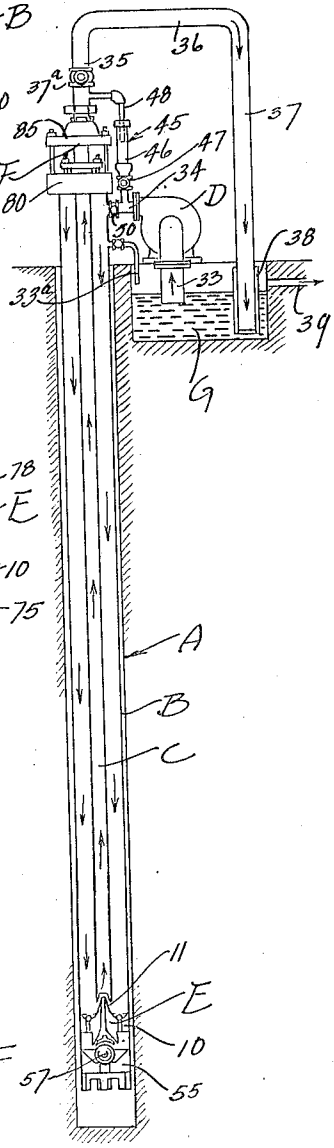


Fig. 5.

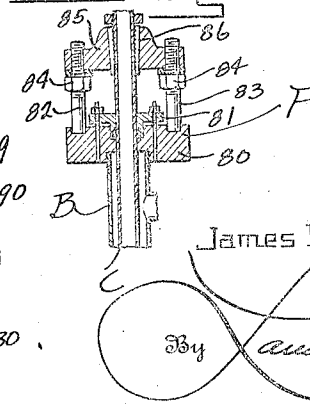
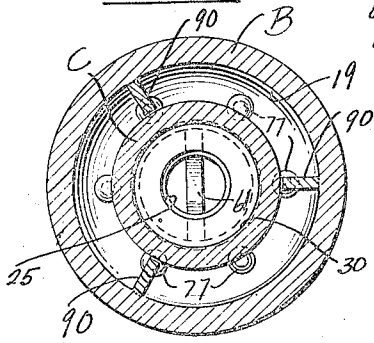


Fig. 4.



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UNITED STATES PATENT OFFICE.

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OIL-WELL PUMP.

Application filed February 23, 1926. Serial No. 90,119.

This invention relates to improvements in oil well pumps.

The primary object of this invention is the provision of a novel type of hydraulic or fluid operated pump construction adapted to be used in connection with the pumping of oil from deep wells, including a novel construction by which to create suction in the oil pipe line at a considerable distance below the ground surface, for the elevation of a column of oil.

A further object of this invention is the provision of novel pump mechanism for the pumping of deep oil wells including inner and outer pipes and means in the well below the ground surface cooperating with said pipes to direct an operating fluid, such as oil, for the creation of a suction which will draw oil into the well and elevate the same.

A further object of this invention is the provision of an oil well pump structure of the class described, including novel means for reversing the direction of the operating medium within the well, to effect a cleaning of the pump structure, without the necessity of removing the same.

A further object of this invention is the provision of a novel oil well pump construction including relatively adjustable port controlling elements placed in the oil well below the ground surface, which may be adjusted with ease from the ground surface, for the purpose of rendering the pump construction applicable for the pumping of different wells, at different depths, and operating under different liquid head pressures.

Other objects and advantages of this invention will be apparent during the course of the following detailed description.

In the accompanying drawing, forming a part of this specification, and wherein similar reference characters designate corresponding parts throughout the several views,

Figure 1 is a diagrammatic representation of the improved oil well pump construction, showing the pump features as associated with an oil well.

Figures 2 and 3 are fragmentary sectional views taken thru a portion of the pump construction located within the oil well, for the regulation of an operating medium, to create a suction in the oil well for the removal of oil therefrom, these two views showing different operative positions of the parts.

Figure 4 is a sectional view taken substantially on the line 4—4 of Figure 2.

Figure 5 is a reduced sectional view taken through an adjustable tube support used in connection with the oil pump.

In the drawing, wherein for the purpose of illustration is shown only a preferred embodiment of this invention, the letter A may generally designate an oil well, within which an outer tube B is positioned, preferably stationary, and within which an inner tube or pipe C is relatively movable, being supported at the upper end of the tube or pipe B, by means F. Means E is placed in the oil well below the ground surface, cooperating with the lower ends of the tubes or pipes B and C, for the deflection of an operating medium from the tube B into the tube C, and for the creation of suction for withdrawal of oil from the bottom of the well into the tube C. A pump D is used for agitating and directing the flow of the operating medium, which is preferably oil supplied from a sump or reservoir G in which the pump D operates for its supply of operating medium.

The well A may be lined with a suitable casing, if desired, or the pipe B may take the place of the well casing. The pipe B may be supported in any approved manner by means of a casing head or other supporting construction at the ground surface of the well. The pipe C as above mentioned is adjustably supported by means F from the upper end of the pipe B, as will be subsequently described.

Referring to the means E, the same preferably comprises a deflector 10, which may be placed in the passageway of the tube or pipe B, upwardly from the lower end thereof, providing an obstruction in the pipe B. The member 10 may be placed in the pipe B in any approved manner, as by welding, screw threads, or the like, and the same is preferably axially provided with an upwardly tapering nozzle 11, having a passageway 12 therethrough. The nozzle 11 is externally tapered at 14, and decreases in diameter, or is formed in a converging relation from the body portion of the member 10 towards the upper edge 15 of said nozzle. The top surface of the body of the member 10 surrounding the nozzle 11 is preferably concaved, providing a deflecting surface 18, which at the outer edge of the body 10, merges into the internal peripheral surface of the passageway 19 thru

the pipe B, sloping downwardly therefrom, in a concaved relation, and then merging upwardly into the tapered surface 14 of the nozzle 11, as illustrated in Figures 2 and 3 of the drawing. The body of the member 10 is preferably also provided with a depending annular flange or extension 20, thru which the passageway 12 also extends; the passageway 12 preferably tapering downwardly from the top edge 15 of the nozzle 11, on a gradually increasing diameter, to the lower edge 21 of the flange 20, where the diameter of the passageway 12 is greatest.

The lower end of the adjustable pipe or inner pipe C is cooperatively formed to receive the upper end of the nozzle 11 therein. The pipe C is thus provided with a tapered passageway or opening 25 at the lower end thereof, which extends from the outer surface 26 at the lower end of the pipe B, in an upwardly tapering relation, with a diminishing diamter, to provide the upwardly restricted opening 25 in which the upper end of the nozzle 11 may cooperate and seat. As the thickness of the pipe C is not sufficient to provide the restricted passageway 25 of a desired length, it is preferred to weld or otherwise position a ring-shaped piece 27 in the lower end of the tube or pipe C, as illustrated in Figures 2 and 3 of the drawing.

Upon longitudinal adjustment of the pipe C with respect to the nozzle 11, it can readily be understood that when supporting the pipe C, the tapered opening 25 will be spaced at a certain distance from the upper end of the nozzle 11, to provide an annular passageway or port between the surface of the opening 25 and the upper outer edge of the nozzle 11, which regulates the quantity of operating fluid which may pass from the pipe B into the passageway 30 thru the pipe C. The tapered opening 25 is so formed with relation to the nozzle 11, that when the pipe C is lowered sufficiently, as illustrated in Figure 3 of the drawing, the pipe C at the upper end of the restricted opening 25 will seat directly against the upper end of the nozzle 11, to close off all communication between the passageways of the pipes B and C, above the deflecting member 10. The purpose for which this feature is provided will be subsequently mentioned.

The pump D is of any approved type, having a supply connection 33 which enters the sump or reservoir G for pumping operating fluid, such as oil, therefrom, and the pump D is provided with an outlet connection 34 which enters the upper end of the pipe B.

During normal operation the pump D will take the liquid, which is preferably the same liquid as pumped from the well, from the reservoir G, and force it through the outlet 34 into the upper end of the pipe B. It passes downwardly therethrough, incident to the pumping action, and is deflected over the concaved surface 18, upwardly along the outer surface of the nozzle 11, thru the port between the nozzle 11 and the lower tapered opening 25, and forced upwardly into the passageway of the pipe C. The oil or operating medium thus has an upwardly forced body of liquid surrounding the passageway 12 thru the nozzle or deflector member 10, and will create suction thru the passageway 12, tending to draw oil from the well below the member 10, as is readily apparent, and which will pass upwardly thru the nozzle 11 and mingle with the operating medium which is forced upwardly thru the passageway 30 of the pipe C.

The pipe C at its upper end extends above the adjustable support F, at 35, and is provided with a preferably horizontal lateral extension 36, and a downwardly extending portion 37 which enters a silencer or muffler 38 located in the sump G. The reservoir or sump G is provided with an overflow conduit 39 of any approved character.

A by-pass 45 is connected with the outflow line 34 of the motor D, extending upwardly and being connected in the portion 35 of the pipe C above the adjustable mechanism F, for the purpose of pumping the liquid of the reservoir G directly into the passageway of the tube C, to reverse the direction of flow of operating medium, for the purpose of cleansing the pipes B and C, and deflecting mechanism at the lower portion of the pipe C. This by-pass construction 45 includes a portion 46 connected with the pump B, in which a valve 47 is mounted, and furthermore includes an upper portion 48 mounted in the pipe C, telescopically received in the portion 46, in a sliding leak-proof connection, of any approved character. A valve 50 is placed in the outlet 35 of the pump D, between the by-pass connection and the pipe B, which of course will be shut when the by-pass 45 is being used, and in this case the valve 47 will be opened. Normally, during the pumping ofthe operating fluid directly into the pipe B, the by-pass 45 will be closed, as can readily be understood. A valve 37ª is placed in pipe C above the by-pass.

In order to permit the pumping of the oil from the well, a check valve will have to be provided below the deflector member 10. To this end a valve seat, in the nature of a ring-shaped member 55 is placed, as by screw threading, in the lower end of the pipe B, immediately below the deflector member 10, which has a reduced opening 56 therethrough in which the ball valve 57 seats, by gravity; the ball valve 57 in diameter being greater than the diameter of the opening 56. The seat ring 55 is provided with an upwardly diverging tapering surface 58, sloping upwardly from the opening 56 towards the passageway surfaces of the pipe B, normally free of contact by the ball valve 57 when the latter is

seated. The ball valve 57 seats in the opening 56 at a considerable distance below its maximum diameter and the tapered surface 58 slopes downwardly in a spaced convergent relation with respect to the facing surfaces of the ball 57 when seated, as illustrated in Figure 3 of the drawing.

A baffle plate or movement limiting stop 60 is supported by means of a cross bar 61, in the lower end of the passageway 12, immediately above the check valve 57; the baffle 60 being concavo-convex in cross section, providing an upper convex surface 62 facing upwardly within the passageway 12 and a lower concave surface 63, of preferably the same diameter as the ball valve 57. The cross bar 61 is connected at its ends (not shown) in the passageway 12, to the nozzle flange 20, so that the outer tapered periphery 65 of the baffle 60 is annularly spaced with respect to the facing surface of the passageway 12, to provide an annular opening 66, thru which the liquid may pass from the well upwardly, or from the pipe C downwardly, in accordance with the manner in which the invention is operated. It is to be noted that the peripheral surface 65 of the baffle member 60 is so related with respect to the check valve 57 that upon forcing of a liquid downwardly thru the opening 12, as illustrated in Figure 3 of the drawing, the liquid will be directed tangentially with respect to the ball valve 57, into the compartment 70 laterally of the ball valve 57, and will be baffled over the surface 58 of the ball seat 55, to exert its pressure on the ball valve 57 below the maximum diameter thereof, which will have a tendency to lift the ball valve 57, as illustrated in Figure 2 of the drawing, so that the ball valve 57 will be vibrated back and forth, to permit some of the liquid which is pumped downwardly thru the passageway 12 to enter the bottom of the well thru the opening 56, under circumstances to be described.

The deflector member 10 is preferably provided with vertical ducts 75 extending therethrough, at their lower end communicating with the compartment 70, and at their upper ends outletting on the deflector surface 18. Small ball check valves 77 are seated in enlarged seats 78 in the upper ends of the ducts 75; so that the ball valves 77 will only be unseated upon the occurrence of liquid pressure upwardly thru the ducts 75. Pumping of liquid downwardly thru the pipe B will not displace the ball valves 77, since they seat in their enlarged sockets 78, so that at their maximum diameter they are disposed below the deflector surface 18, and the impelling liquid may pass thereover.

The means F for adjustably supporting the pipe C upon the pipe B comprises a supporting head 80 carried at the upper end of the stationary tube B, with which a packing 81 may be associated. Supporting bolts 82 and 83 may rest in sockets provided on the support 80, the upper ends of which are screw threaded and upon which adjustable nuts 84 are positioned. An adjusting spider 85 is provided with arms having openings therethrough into which the screw threaded ends of the bolts 82 and 83 slidably extend. The spider 85 has a center opening thru which the upper end of the adjustable pipe C extends; this opening being tapered on a downwardly decreasing diameter, and supporting slips 86 therein, which grip and support the tube C in the spider 85, as illustrated in Figure 5 of the drawing. In lieu of the means F for supporting the tube, the tubing support shown in Patent #1,344,922, patented June 29, 1920 may be used, as well as any similar construction adaptable for the purpose.

With respect to the operation of the device, the pump D normally operates to pump fluid from the sump G into the pipe B. The pipe C is adjusted to open the port 25^a between the passageways of the pipes B and C, above the deflector 10, and upon operation of the pump D the fluid will be pumped downwardly into the pipe B, and will pass at a predetermined velocity, and in regulated quantity thru the annular port 25^a, according to the pressure at which the pump is operated to control flow. The impelling fluid will thus be forced upwardly thru the pipe C, and will create a suction in the passageway 12, which will lift the ball 57 as illustrated in Figure 2 of the drawing, and permit the oil from the bottom of the well to pass the annular port 66, upwardly thru the nozzle and into the operating fluid, and to pass into the sump or reservoir G; the excess of fluid pumped passing thru the overflow 39 to any suitable location desired.

In order to reverse the direction of the impelling fluid, for cleaning the pump details below the ground surface, it is merely necessary to lower the pipe C by means of the adjuster mechanism F, until the same at its lower tapered opening 25 seats against the upper end of the nozzle 11, as illustrated in Figure 3 of the drawing, and upon adjustment of the pump by-pass to receive the impelling fluid, the fluid will be pumped from the reservoir G directly into the passageway of the inner pipe C, and pass downwardly thru the nozzle passageway 12, and into the compartment 70 about the ball valve 57 vibrating the same and permitting a portion of the fluid to wash downwardly into the opening 56, for cleansing the operating details about the check valve. Also, a quantity of the liquid will be forced upwardly thru the ducts 75, incident to pumping, lifting the small check valves 77 and it will pass upwardly in the passageway 19 between the pipes B and C, for cleansing the pipe B as can readily be understood, and cleansing any foreign materials from the deflecting sur-

faces. The oil then passes through the pipe 33ª into the sump.

An important feature of the invention is the formation and placing of the pipes B and C, so that when adjusted for normal pumping, the cross sectional area in the pipe B between the same and pipe C is equivalent to the cross sectional area of the chamber in the pipe C above the nozzle 11, in order to balance the columns of liquid, so that no exceptional work is necessary upon the part of the pump D, in order to efficiently force the oil from the pump thru the nozzle 11.

The quantity of oil which is pumped thru the nozzle 11, from the bottom of the well, of course depends upon the velocity with which the impelling medium is forced thru the tapered opening 25 surounding the nozzle, and upon the quantity of the impelling medium which so passes the nozzle 11. The fact that the pipe C is readily adjustable from the ground, with respect to the nozzle 11 renders the adjustment of velocity and volume of impelling medium efficient for controlling the desired quantity of oil pumped, and renders the improved pump structure capable of use in wells of varying depth, wherein various heads of liquid are maintained in the pipes. The fact that the pipe C is adjustable with respect to the nozzle also permits of compensation for wear upon the parts, as well as permitting the reversing of the direction of the flow of impelling medium, as above described.

In order to properly center the lower end of the pipe C with respect to the nozzle 11, and to guide the pipe C in its lowered position, it is preferred to provide a plurality of guide ribs or vanes 90, secured as by welding to the inner periphery of the pipe B, above the deflector 10, and preferably extending to the same degree into the passageway 19, and at their upper ends having preferably convex edges 91, which taper downwardly from the inner surface of the pipe B, towards the center of the pipe B. The free edges of the ribs 90 are spaced from the center or axis of the pipe B a sufficient distance slightly greater than the radius of the pipe C, so that the latter upon being lowered will be guided over the surfaces 91 and thence between the facing edges of the ribs 90, into a centered relation with respect to the nozzle 11, and in which position it will be held by the ribs 90, as is obvious from Figures 2, 3 and 4 of the drawing.

Various changes in the shape, size, and arrangement of parts may be made to the form of invention herein shown and described, without departing from the spirit of the invention or the scope of the claims.

I claim:

1. In combination with an oil well, relatively spaced inner and outer pipes in the oil well, a pump at the top of the oil well, means connecting the pump with said pipes including valves for selectively directing a liquid from the pump directly into either the inner or the outer pipes, deflecting means in the oil well below the top thereof for directing all of the liquid from one pipe to the other without directing liquid to the well, and an intake device from said pipes to the well below the deflecting means operated by the pump controlled liquid in said pipes to draw liquid from the well into said liquid first mentioned.

2. In an oil well pump the combination of an outer pipe adapted to be located in an oil well, the said outer pipe having a passageway therethrough, an inner pipe located in the passageway of the outer pipe in spaced relation therewith, a deflector located in the passageway of the outer pipe below the lower end of the inner pipe, said deflector having a nozzle extending upwardly thereof into cooperating relation in the lower end of the inner pipe, the nozzle having a passageway therethrough extending thru the deflector, means for adjusting the inner pipe with respect to the nozzle to regulate the spaced relation of the nozzle with respect to its position within the inner pipe at the lower end of the latter, check valve means carried by the outer pipe below the nozzle and deflector, said inner pipe being capable of adjustment to seat on the nozzle to close the passageway of the inner pipe from the passageway of the outer pipe above the deflector, pump means for selectively directing impelling fluid downwardly thru either the inner or outer pipes, and check valve controlled port means carried by the deflector laterally of said nozzle to permit upward flow of liquid past the deflector and preventing downward flow of liquid past the deflector.

3. In an oil pump the combination of an outer pipe having a passageway therein, an inner pipe having a passageway therein and being open at the lower end thereof, a deflector member in the passageway of the outer pipe below the open end of the inner pipe, said deflector member including an upwardly extending nozzle projecting into normally spaced port providing relation in the lower open end of the inner pipe, said nozzle and deflector member having a passageway therethrough, a valve seat in the outer pipe below the deflector and having an opening therethrough, a ball valve for said opening seated thereon below its maximum diameter, means to limit the upward movement of the ball valve with respect to the passageway thru the deflector to prevent closing of the same at any time by said ball valve, said deflector having ports therethrough laterally of the passageway of the deflector above mentioned, and check valves supported upwardly by the deflector for the last mentioned ports.

4. In an oil pump the combination of an

outer pipe having a passageway therein, an inner pipe having a passageway therein and being open at the lower end thereof, a deflector member in the passageway of the outer pipe below the open end of the inner pipe, said deflector member including an upwardly extending nozzle projecting into normally spaced port providing relation in the lower open end of the inner pipe, said nozzle and deflector member having a passageway therethrough, a valve seat in the outer pipe below the deflector and having an opening therethrough, a ball valve for said opening seated thereon below its maximum diameter, means to limit the upward movement of the ball valve with respect to the passageway thru the deflector to prevent closing of the same at any time by said ball valve, said deflector having ports therethrough laterally of the passageway of the deflector above mentioned, check valves supported upwardly by the deflector for the last named ports, and means for adjusting the position of the inner pipe with respect to the nozzle to close off the passageways of the inner and outer pipes with respect to each other above said deflector by the seating of the upper end of said nozzle in the lower open end of the inner pipe.

5. In an oil well pump the combination of inner and outer pipes adapted to be extended into an oil well, a reservoir at the top of the well, a fluid pump having a connection at the top of the outer pipe for pumping fluid into the outer pipe, said pump having an inlet connection in said reservoir for withdrawing liquid therefrom, a valve in the pump connection with the outer pipe, a by-pass pipe connected with said connection from the pump to the inner pipe between the valve in said connection and the pump, said by-pass having a construction permitting extension of the by-pass, the by-pass at its opposite end having a connection with the inner pipe, a valve in said by-pass, said inner pipe having a portion extended to the reservoir for directing liquid into the reservoir from the inner pipe, a valve on said inner pipe portion between the reservoir and the by-pass connection with the inner pipe, an outlet pipe connected with the outer pipe and extending to the reservoir, having a valve therein, deflecting means in the outer pipe below the lower end of the inner pipe for deflecting liquid from the outer pipe into the inner pipe, an intake device from the well to said pipes below said deflecting means operated by the liquid circulating in said pipes to draw liquid from the well and means for longitudinally adjusting the inner pipe in the outer pipe towards and away from said deflecting means.

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