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OIL WELL PUMP

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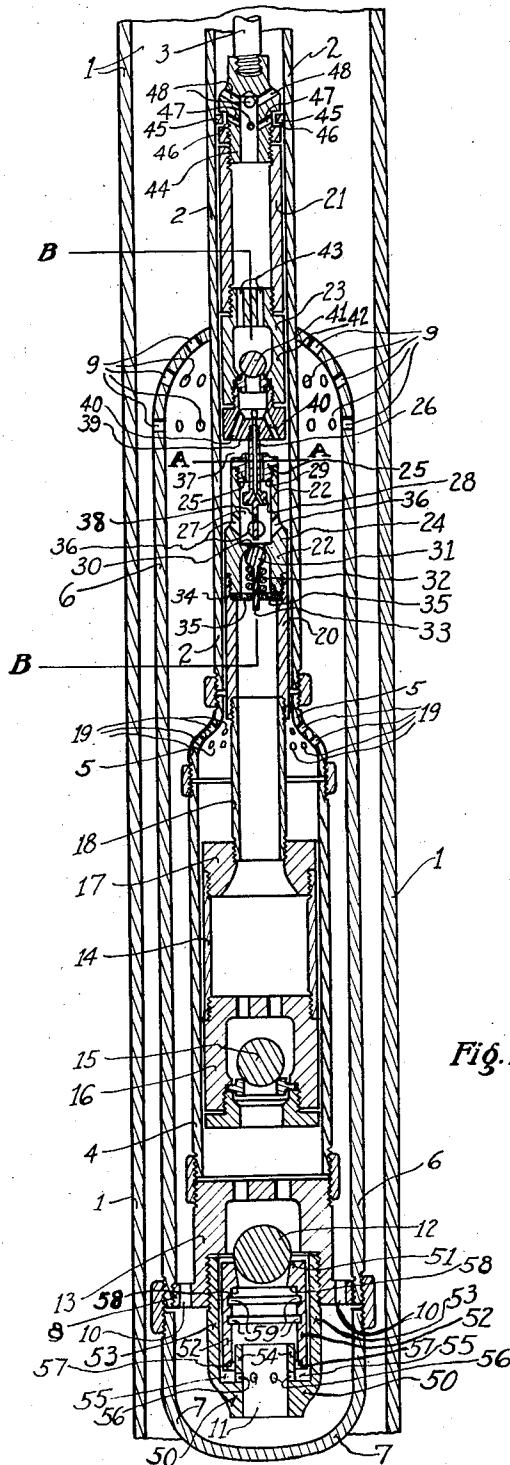
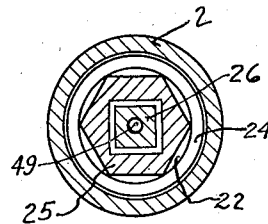


Fig. 2

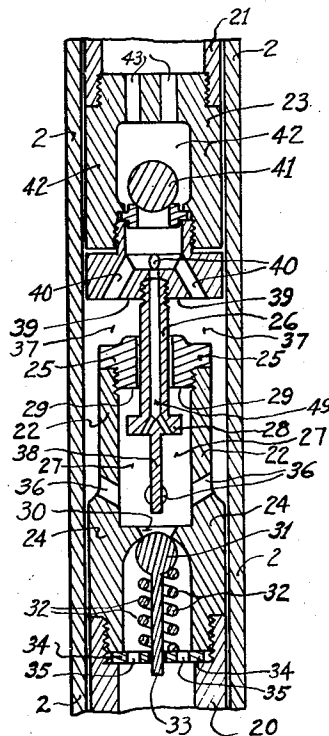


Fig. 3

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OIL WELL PUMP

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6 Claims. (Cl. 103—179)

Our invention relates to new and useful improvements in oil well pumps of the reciprocating plunger type and has for its chief objects; first, to provide a pump wherein the gas held in solution in the liquid oil in the well may be separated from the liquid oil by mechanical operation of the pump prior to the entrance of the liquid into the pump chamber; second, to provide a pump wherein a composite plunger consisting of an upper plunger and a lower plunger are connected together by a universal joint coupling for the purpose of permitting the two plungers to independently align themselves with the wall of the cylinder wherein they are reciprocated; third, to provide means in said composite plunger whereby the upper plunger is slidably held in spaced relationship to the lower plunger and with the space between the two plungers providing a trap wherein liquid slipping past the upper plunger from the tubing above it may be trapped on the upstroke of the pump and expelled from said trap on the downward stroke of the pump, for the purpose of increasing the fluid seal between the plungers and their cylinder wall on the downward stroke, and for the further purpose of cushioning the impact of the plunger on the fluid in the displacement chamber of the pump on the downstroke; fourth, to provide a pump wherein the liquid which has been pumped may not return by way of travel between the plunger and its cylinder wall into the pump chamber but will be forced to re-enter the tubing above the pump or to re-enter the well outside of the pump chamber for the purpose of preventing the gas-oil fluid under the heavy pressure of the static head of fluid in the tubing above the pump from entering the displacement chamber of the pump where the gas in the fluid slipping past the plunger would expand under released pressure and tend to gas-lock the pump on the upstroke, and, by its expansion, fill a large portion of the displacement chamber of the pump and thereby reduce the volume of fluid entering said chamber from the well; fifth, to provide a degasified liquid above the main plunger of the pump, which degasified liquid will better lubricate the cylinder wall of the plunger than if the lubrication was supplied by oil with gas held in solution and suspension therein; sixth, to provide a self-aligning, full-floating wiper ring between the plunger and its cylinder wall in manner whereby the pressure on it from above and below will be equalized to the effect that said wiper ring will be relieved from the weight of the column of liquid in the

tubing above the pump and less strain and abrasion will be placed on the wiper ring; and seventh, to provide a cushioned valve seat to lessen the pounding of the valve thereon.

With the above and other objects in view, which will appear as the description proceeds, our invention consists in the novel features hereinafter set forth in detail, illustrated in the accompanying drawing, and more particularly pointed out in the appended claims.

Referring to the drawing in which numerals of like character designate similar parts throughout the several views:

Fig. 1 is a view in longitudinal cross-section of the pump.

Fig. 2 is a view in cross-section on line A—A of Fig. 1 of certain parts of the pump, including the coupling pin between the two plungers of the composite plunger.

Fig. 3 is an enlarged view of the pump parts in cross-section on line B—B of Fig. 1.

In the drawing, 1 represents the well casing, 2 the pump cylinder wherein the composite plunger works and which empties into the well tubing, not shown, through which the fluid that is pumped travels to the surface of the ground, 3 the string of sucker rods through which the pump is operated, 4 the working barrel of the pump and which forms a continuation of the plunger cylinder 2, and is joined thereto by a pipe adapter or swagged nipple 5, by means of which the pump cylinder 2 becomes enlarged to form the main plunger cylinder or working barrel of the pump, of which the part below the plunger therein constitutes the displacement chamber of the pump. 6 represents an outer shell of the pump, into which the well fluid first enters, in which it is agitated to work off the gas held in the liquid oil, and through which it travels to the intake port of the pump. 7 represents the closure of said shell at the bottom and is shown in the form of a bull plug. 8 is a spider holding the working barrel 4, and the shell 6, in spaced relationship to each other, 9 are the intake ports in the shell 6, through which the well fluid enters to the pump, and 10 are fluid passageways in spider 8. The intake port 11 of the pump is located in spider 8 and communicates with the standing valve 12 of the pump, which said valve is held in a standing valve cage 13, which couples the working barrel 4 to the spider 8.

14 represents the main plunger of the pump and is located in the pump cylinder or working barrel 4 from which it is packed off by a fluid

seal. This main plunger may be as long as desired and may be formed of tubing, as shown in the drawing. At the bottom of the main plunger 14 is a traveling valve 15 held in a traveling valve cage 16. The main plunger is connected at its upper end by means of a tubular coupling 17 to the main plunger stem 18, through which the main plunger is operated. The upper end of the main plunger stem 18 is connected to the sucker rods 3 by intermediate connections in the form of two plunger members which work in cylinder 2 and which are coupled together with the lower plunger directly connected to the main plunger stem 18 and the upper plunger directly connected to the sucker rods 3, all of which will later be explained in detail.

In the upper part of the working barrel 4 and above the uppermost point of travel of the main plunger 14 therein are located fluid surge ports 19, communicating with the chamber of the shell 6, and through which ports the well fluid may enter the working barrel above the main plunger 14 on its downstroke and from which the well fluid may be expelled on its upstroke.

Directing attention to the working parts of the pump structure between the main plunger stem 18 and the string of sucker rods 3, 20 represents a lower tubular plunger connected at its lower end to said main plunger stem 18, and 21 represents an upper tubular plunger connected at its upper end to the string of sucker rods 3. Both of said plungers are packed off from the wall of plunger cylinder 2 by a fluid pack. At its upper end, plunger 20 carries affixed thereto a combined coupling joint and valve cage, designated generally by numeral 22. A connecting link or shaft connects this combined coupling joint and valve cage with another combined coupling joint and valve cage, designated generally by numeral 23 on an upper tubular plunger. The parts and their functions are more readily apparent by reference to Fig. 3 of the drawing, wherein 24 is the body portion of coupling joint 21, and has a plug 25 threaded into its upper end and constituting a part thereof. Through an aperture in this plug 25 is slidably inserted a coupling shaft 26, which at its upper end is affixed to the upper plunger 21, and with its lower end inserted into a traveling way 27 in the body portion of said coupling joint. The coupling shaft 26 may be made in a square form to permit a torque to be applied to the lower plunger 20 and the main plunger 14 through the string of sucker rods 3, when desired. The lower end of said coupling shaft 26 is enlarged to form a flanged collar 28 thereon, which may travel in said traveling way 27, and the shoulder of which is aligned in said traveling way to contact the shoulder 29, provided therefor at the upper end of said traveling way on the upstroke of the plungers mentioned. In the lower end of the combined coupling joint and valve cage 22 is a fluid passageway 30 with a valve 31 therein which is normally held closed by a compression spring 32. The valve 31 has a guide stem 33, slidably held in a spider 34. The spider has therein fluid passageways 35, which communicate between the duct of the lower plunger 20 and the valve 31, and lead into the traveling way 27. The traveling way has outlet ports 36 communicating with the exterior of the combined coupling joint and valve cage 22, and which lead into a fluid trap 37, as will later be explained. The coupling shaft 26 may also have there-through a passageway 49 between the traveling way 27 and the valve

41, through which the pumped fluid may travel in addition to passing out of the traveling way 27 by egress through ports 36.

On the coupling shaft 26 is a valve-operating pin 38, aligned to contact valve 31 and held in spaced relationship to said valve to the effect that, on the upward stroke of the plungers mentioned, the valve will close when contact of the pin therewith is withdrawn, and on the downward stroke the pin will urge the valve to open against the pressure of the spring, and also against the fluid pressure in the working barrel of the pump.

The upper combined coupling joint and valve cage 23, attached to the upper plunger 21, is provided with a shoulder 39, adapted to bear upon the top of plug 25 on the downward stroke of the pump. Ports 40 are provided in said coupling joint through which the fluid traveling from the working barrel of the pump may flow from the fluid trap 37 past the valve 41 in the upper plunger 21 into the valve cage 42, and from thence, through ports 43 into the duct of the upper plunger 21.

At the top end of plunger 21 is a crown 44 to which the string of sucker rods 3 is connected. The crown carries thereon a full-floating wiper ring 45, which bears against the wall of the plunger cylinder 2 to wipe it from sand and foreign sediment. The wiper ring is loosely held in an annular slot in said crown, and a space 46 between said crown and ring is provided with ducts 47 leading thereto from the duct in the plunger 21, so that the fluid pressure will at all times be equalized above, below, and about said wiper ring. 48 are outlet ducts from said crown 44, providing an outlet from the duct in plunger 21 to the well tubing to which the plunger cylinder 2 is connected.

In operation, with the pump submerged in the well fluid, the shell 6 of the pump will fill with said fluid through its entrance through the intake ports 9 and until it is exhausted the well fluid will continually fill said shell and flow from said intake ports 9 to the intake port 11 of the pump proper. The well fluid in said shell 6 will also enter the fluid surge ports 19 to fill the working barrel 4 above the tubular coupling 17 of the main plunger 14 of the pump. On the downward stroke of said main plunger 14, the well fluid enters the surge ports 19 and on the upward stroke of said plunger, it is expelled through said surge ports 19, being forced to return into the shell 6. This mechanical agitation of the well fluid works off the gas therein, as is well known, and the gas then may rise and escape through the intake ports 9 while the liquid portion of the well fluid may continue its downward course in shell 6 until on the upward stroke of the pump, it is drawn into the pump proper past the standing valve 12, and through the standing valve cage, and into the working barrel cylinder of the pump below the main plunger 14.

On the downward stroke of the pump, the fluid is forced past the traveling valve 15 into the duct of the main plunger stem 18, and up through the duct in the lower plunger 20, thence through the fluid passageway 35 and past valve 31, which has been opened by the pressure of the valve-operating pin 38 thereon, then through outlet ports 36 into the space in the plunger cylinder 2 between the wall of said cylinder and the outer perimeter of the combined coupling joint and valve cage 22; thence, through ports 40 of the

combined coupling joint and valve cage 42, past valve 41, or past valve 31 into traveling way 27, and thence through fluid passageway 49 to the valve 41, and then into the duct of the upper plunger 21, thence, out ducts 48 into the tubing of the well through which it is conveyed to the surface of the ground.

On the downward stroke of the pump, the upper combined coupling joint and valve cage 23, which is on the upper plunger 21, engages the plug 25 on the lower combined coupling joint and valve cage 22 to cause its shoulder 39 to bear on said plug and force the lower plunger 20 and the main plunger 14 downwardly. This also causes the coupling shaft 26 to move downwardly and to cause the valve-operating pin 38 to open valve 31, actuating said valve against the pressure of spring 32 and the fluid pressure in the pump below said valve.

On the downward stroke of the pump, fluid which has been trapped in the fluid trap 37 will be forced from said trap to travel between the wall of the plunger cylinder 2 and the plungers 20 and 21, and that portion of said trapped fluid which may flow past the upper plunger 21 provides an additional fluid pressure seal for said plunger as a back pressure is created against the flow of fluid past said plunger from the well tubing. Such fluid as may be trapped serves to cushion the impact between the two plungers and also cushions the impact of the main plunger on the fluid in the displacement chamber of the pump, and results in greatly decreasing the pounding of the main plunger on the fluid in the displacement chamber of the pump at the time of impact of said main plunger with fluid.

On the downward stroke, the fluid pressure in the crown 44 is communicated through ducts 47 to the space 46 in back of and below the wiper ring 45 so that the pressure above and below said ring is approximately equalized, and the weight of the fluid in the tubing on the wiper ring relieved.

On the upward stroke of the pump, the upper plunger 21 first moves upwardly until the coupling shaft 26 has also moved with it sufficiently to cause the flanged collar 28 on said shaft 26 to engage the shoulder 29 on the plug 25 of the combined coupling joint and valve cage 22 attached to the lower plunger 20, whereupon both the lower plunger 20 and the main plunger 14 move upwardly to cause the well fluid in the working barrel 4 above the main plunger 14 to be expelled through surge ports 19, and to cause the well fluid to be drawn into the working barrel 4 below the main plunger 14. The upward stroke of the pump also causes the fluid trap 37 to expand to receive any fluid slipping into it past the plunger 21, and the valve 31 is urged by spring 32 to close, the valve-operating pin 38 having been withdrawn from contact with said valve. The slippage fluid which passes between plunger 21 and cylinder wall 2 drops into trap 37, and because of the lower region of pressure in trap 37, the gas in the slippage fluid expands and separates from the oil, allowing the degasified oil to settle to the bottom of trap 37, and the gas to rise to the top of the trap. This dead oil makes a more perfect lubricant for lower plunger 20. The fluid above the pump is held by the plungers 20 and 21, and by the traveling valve 41 in the upper plunger 21, as well as by traveling valve 15, located in the main plunger 14.

Attached to the valve cage 13 of the standing valve 12 is a cushioned valve-seat mechanism

for said valve 12, the body portion 50 of said mechanism being attached to the standing valve cage 13 by threaded connection as shown in the drawing. The valve seat 51 is held on, or may be integral with, a valve-seat retaining sleeve 52, which is slidably mounted in a cylinder 53, wherein it may slide and from the walls of which it is packed off. The cylinder 53 is made with the valve intake 11 of the pump protruding into the chamber of said cylinder 53, the protrusion 54 being such that the lower part of the sleeve 52 may slidably telescope between it and the inner wall of said cylinder 53, the pocket 55 thus formed being vented into the valve intake 11 by surge orifices 56. At the bottom of sleeve 52 is an annular recess 57 in open communication with the orifices 56 so that the sleeve may be readily lifted from its contact with the bottom of the pocket 55 when the valve is seated under pressure. The sleeve is also packed off from the protrusion 54 by a fluid seal. The movement of the sleeve 52 is limited so that the sleeve will at all times remain telescoped in said pocket 55.

In the fluid passageway through said sleeve 52 are projections or shoulders or flanges against which the fluid passing through said passageway may exert an upward pressure on the sleeve and cause it to move upwardly, thus drawing fluid into pocket 55 under the sleeve. Such projections are shown in the drawing in the form of an annular flange shoulder 58, and annular grooves 59, having a flanged shoulder against which the upward pressure of said fluid may bear. As the sleeve 52 moves upwardly, fluid from the fluid intake 11 enters pocket 55 through surge orifices 56. When the valve closes, that is, when valve 12 is in the course of being seated and is exerting pressure on sleeve 52, the pressure on valve 12 drives the sleeve 52 to its seat in the bottom of pocket 55 with an impact which is cushioned in that, as pressure is placed on the sleeve 52, it forces the sleeve to move downwardly in pocket 55 in manner such that a hydraulic or pneumatic cushion is afforded to said sleeve by reason of the fluid in pocket 55 having to be expelled therefrom through the orifices 56, which are of predetermined size calculated to effect this result. As a consequence of this cushioning effect on the valve-seat retaining sleeve 52, the action of valve 12 on its seat 51 is also cushioned, and the valve does not pound so heavily as would be the case were no such cushion provided. Such a cushioned valve seat is particularly adaptable to the pump disclosed as it, together with the previously mentioned cushioning action on the plungers of the pump, provide a pump in which the shock loads are greatly reduced in the pump. It is of course obvious that this valve cushioning mechanism may be used in other valves.

Having thus fully disclosed our invention, what we claim and desire to secure by Letters Patent is:

1. In an oil well pump having a plunger cylinder, a composite plunger therein of two plungers one of which is positioned above the other connected together by a slidable connecting shaft, means for applying power to the lower of said plungers by transmitting the power thereto thru the upper plunger, a fluid trap between said plungers, and means for expanding and collapsing said trap.

2. In an oil well pump having a plunger cylinder, a composite plunger therein of two plungers located one above the other and connected

together in slidably movable spaced relationship to each other, means for trapping pumped gas-oil fluid between said two plungers, and means for working off the gas in said gas-oil fluid, permitting the degasified oil to flow into contact with the surface of that part of the wall of said plunger cylinder wherein the lower plunger moves.

3. In an oil well pump of the reciprocating plunger type, a displacement chamber in said pump, a displacement plunger in said displacement chamber, and means for cushioning the impact of said displacement plunger on fluid in said displacement chamber, including a link connection between said displacement plunger and its source of power.

4. In an oil well pump having a plunger cylinder, a composite plunger comprised of two tubular plungers, a swivel joint connecting means between said two tubular plungers, and a duct in said swivel joint connecting means communicating between the interiors of said tubular plungers.

5. In an oil well pump of the reciprocating plunger type, a displacement chamber in said pump, a displacement plunger in said displacement chamber, a fluid trap positioned in said

pump between said displacement plunger and its source of power and wherein a portion of the fluid displaced by said displacement plunger may be trapped and then expelled under pressure exerted on said displacement plunger in causing it to displace fluid in said displacement chamber, and a sliding link coupling passed thru said fluid trap and connecting said displacement plunger with its source of power.

6. In an oil well pump of the reciprocating plunger type, a working barrel, a main plunger therein, an upwardly extending stem therefrom, a second plunger located above said main plunger and connected to it thru the aforesaid stem and with said last named plunger of smaller cross-sectional area than said main plunger, a plunger cylinder for said second plunger, a third plunger located above said second plunger and of the same cross-sectional area as said second plunger and working in the same plunger cylinder as said second plunger, and with said second and third plungers spaced apart from each other, and a coupling shaft connecting said last named plungers together and slidable with relation to one of said plungers.

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