May 2, 1939. C. C. TAYLOR 2,156,709

OIL WELL DEVICE

Filed April 20, 1936

FIG. 1

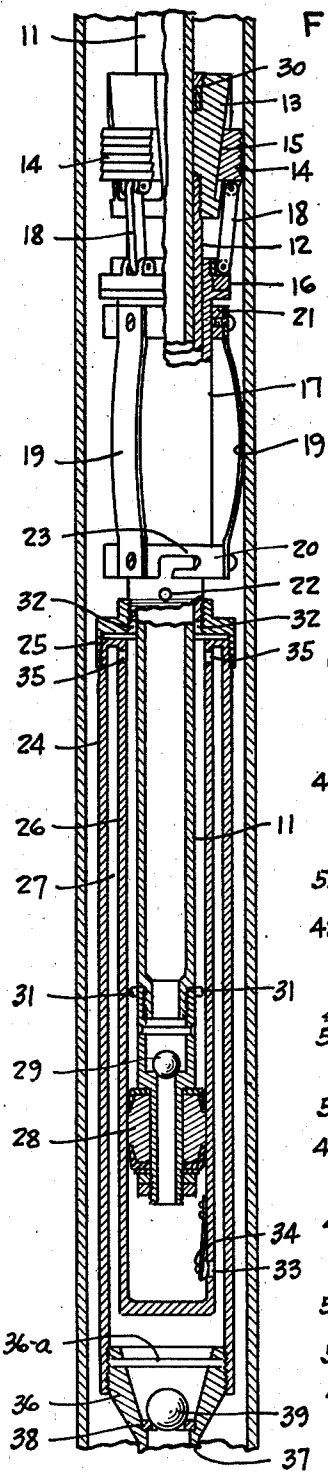


FIG. 5

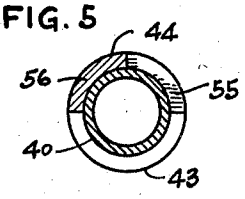


FIG. 3

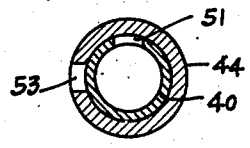


FIG. 6

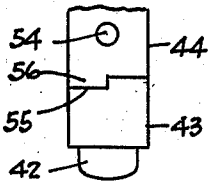


FIG. 4

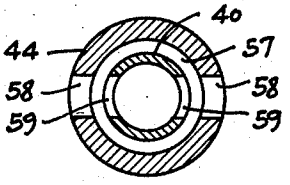


FIG. 2

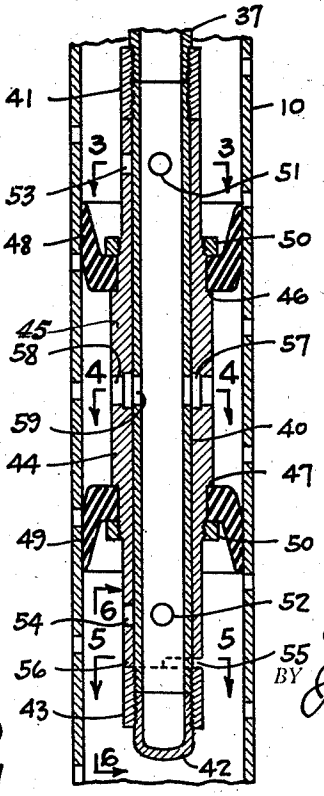
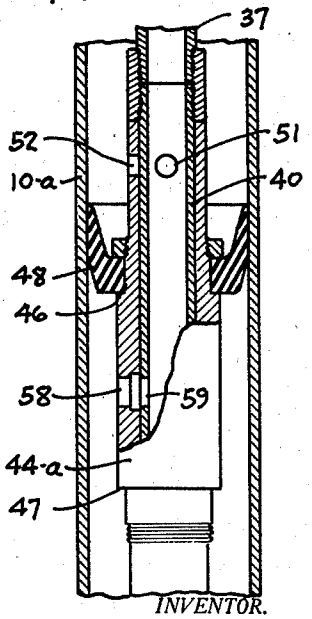


FIG. 7



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OIL WELL DEVICE

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Application April 20, 1936, Serial No. 75,296

10 Claims. (Cl. 166—20)

This invention relates to combination well cleaners and formation testers and contemplates the creation of suction in any desired zone within a well casing bore.

The perforations of casing, which is usually employed in the producing zones of oil wells, occasionally become clogged, as do also the fissures of the oil sands, by various accretions such as of shale or mud, usually mixed with heavy constituents of oil, which impede seepage of oil into the casing, reducing and restricting production. Prior art methods of removing such detritus from within and around the perforations by swabbing or by flushing or washing the casing, or of building up and suddenly relieving pressure within the casing, and the like, while tending to break up the accumulations, result only in temporary relief. The constituents of the clogging accretions reunite and congeal adjacent the casing as the normal operation of the well is resumed.

An important object of the present invention is to remedy such defects of the prior art perforation cleaning means and methods by providing a powerful suction within a restricted zone of perforations, whereby the clogging detritus is drawn into the casing and then pumped out of the well.

It is frequently desirable in the drilling of wells to secure a sample of the natural fluid existent in the bottom of the well, particularly in the case of deep wells. Another important object of my said invention is to seal off an area within the well and to take a sample of the fluid in the well below such point of sealing.

Other objects such as simplicity and consequent economy of construction, and efficiency of operation will be obvious to all those of skill in this art from an examination of the accompanying drawing in which—

Fig. 1 is a view in section and elevation of the upper part of my invention positioned on a tubing within a preforated well casing;

Fig. 2 is a sectional view of a continuation of the structure below that illustrated in Fig. 1;

Figs. 3, 4 and 5 are transverse sectional views taken on correspondingly-numbered lines of Fig. 2;

Fig. 6 is an elevation of the lower end of the device taken on lines 6—6 of Fig. 2;

Fig. 7 is a modified form shown in section and elevation of the packing assembly particularly adaptable as a formation tester.

Referring to the drawing in detail, the numerals of which indicate similar parts throughout the several views, 10 designates a well casing screen which is desired to be cleaned, and 10a an imperforate well casing in which a formation test is to be made. A well tubing 11 adapted to be rotated and axially reciprocated with respect to the casing 10 or 10a extends from the top of the well into the screen or imperforate casing. A pipe 12 encircling tubing 11 has threaded to its upper end an expander 13 of conventional downdrive spear mechanism which is generally described below.

A plurality of slips 14 slidably mounted in inclined faces 15 of expander 13 are pivotally connected to a collar 16 rotatably connected to the upper end of a sleeve 17 which is supported around pipe 12 below the expander, by means of connecting arms 18, in a manner well known in the art. A series of bowed springs 19 are provided to frictionally engage the casing, having their lower ends mounted to a collar 20 which is welded or otherwise fastened to sleeve 17. Another collar 21 slidably encircles the sleeve 17 above collar 20 to which the upper ends of the bowed springs 19 are connected. The friction of the springs on the wall of the casing tends to hold the sleeve stationary as the tubing is lowered into the casing bore and enables the expander to urge the slips 14 into engagement with the wall of the casing. The slips, however, are releasably retained at the base of the expander while positioning the device in the well by a stud 22 located on pipe 12 so as to engage in bayonet slot 23 cut in the lower end of sleeve 17 and collar 20.

A cylinder 24 diametrically larger than pipe 12 is secured on the lower end of said pipe by a coupling 25. Cylinder 24 incloses a working barrel 26 of slightly smaller diameter which is also suspended from coupling 25 by well known means. The difference in diameter between cylinder 24 and barrel 26 forms an annular chamber 27 therebetween for a purpose hereinafter referred to.

Tubing 11 extends through pipe 12 into working barrel 26. A plunger of a type well known in the art, generally indicated at 28, is connected to the end of tubing 11. An axial bore through the plunger communicates tubing 11 with the space within the working barrel below the plunger 28. Passage through the bore of the plunger is controlled by a traveling valve 29 to permit fluid below the plunger to enter the tubing and prevent its return. Dissipation of the suction, created within the barrel on the down stroke of the plunger, between the tubing 11 and pipe 12

is prevented by a conventional form of packing element 30 encircling the tubing and having its gland threaded in expander 13.

The slip mechanism is released for operation by rotation of pipe 12 conveyed from tubing 11 through a pair of lugs 31 formed on the upper end of traveling valve 29. When the tubing is at the upper end of its stroke relative to the barrel 26, the lugs 31 engage in recesses 32 formed in the lower end of pipe 12.

An inlet port 33 in the lower end of working barrel 26 is provided with a flap valve 34 which prevents egress of fluid from the barrel drawn through said port on the upward movement of the plunger. Ports 35 in the upper end of working barrel 26 are provided by which pressure within the barrel above the packer and in cylinder 24 may be equalized.

Cylinder 24 extends slightly below the lower end of the working barrel and into the lower end of the cylinder an externally threaded flange 36 of a pipe 37 is threaded. The bore of pipe 37 at the base of flange 36 is equipped with an annular seat 38, welded or otherwise secured therein, having a ball valve 39 which is adapted for upward displacement by the suction created during reciprocation of the plunger in the working barrel. To insure maximum sensitivity of the valve 39 to pressure differentials, the bore of the flange 36 is provided with a web 36*a* which limits the upward movement of the valve relative to its seat 38.

A section 40 of pipe 37 is secured to the lower end of said pipe by a coupling collar 41. A plug 42 closing the lower end of section 40, is attached to section 40 by a collar 43. Between collars 41 and 43 a mandrel 44 rotatably encircles pipe section 40, having its central portion 45 enlarged to form oppositely directed shoulders 46 and 47. A pair of annular packers 48 and 49 are each mounted on said mandrel against, respectively, shoulders 46 and 47 by collars 50—50 threaded to the mandrel so as to compress the packers against their respective shoulders and prevent their displacement.

Ports 51 and 52 in pipe section 40 above and below, respectively, the packers are located in horizontal alignment with ports 53 and 54 respectively, in mandrel 44. When respective ports are rotated into registry, as when the device is lowered to position in the well, fluid will be bypassed through the pipe section 40 by the creation of a pressure differential above and below the packers. A notch 55 is cut in the upper periphery of collar 43 of a length approximately one-half of its circumference into which a downwardly-directed tooth 56 on the lower end of mandrel 44 protrudes. When the zone of the casing to be cleaned is reached and it is desired to close the by-pass, pipe section 40 may be rotated relative to mandrel 44, which is restrained from rotary movement by the frictional contact of its packers 48 and 49 with the casing wall, by turning the tubing 11 with lugs 31 engaged in recesses 32, until one end of notch 55 contacts tooth 56. The length of notch 55 and the width of tooth 56 are so proportioned to insure the registry of ports 51 and 52 with ports 53 and 54 while raising or lowering the device in the well when the tooth is at one end of the notch 55, and their mis-alignment when the tooth is in contact with the opposite end of the notch.

The inner bore of mandrel 44 between the packers is annularly cut to provide a channel 57 with which ports 58 through the mandrel intersect. Also in horizontal alignment with channel 57 are ports 59 in pipe 40 to insure communication of the interior of said pipe with the chamber between the packers, regardless of the relative rotation between the pipe and the mandrel.

The operation of the above-mentioned embodiment will now be described: The device is lowered into the well with the stud 32 in bayonet slot 23, which retains the slips 14 in retracted position. Ports 51 and 52 are placed in registry with ports 53 and 54. If it is desired to clean the perforated casing, the packers are positioned opposite the lower end of the section thereof to be cleaned. As the device is suspended on tubing 11, lugs 31 will be in engagement with the recesses 32. Clockwise rotation of the tubing at the top of the well will convey the motion to pipe 12 and will move the stud 22 out of the slot 23. Simultaneously, ports 51 and 52 in pipe 40 are moved out of registry with ports 53 and 54 of the mandrel which resists rotative movement due to the friction of the packers on the casing wall. Further lowering of the tubing will wedge the expander between the slips, and the slips against the casing to mount the barrel, packers and associated elements therein.

Continuing the downward movement of the tubing lowers the plunger 28 in the working barrel 26, closing the valve 34 over port 33 and opening traveling valve 29 to fluid within the barrel below the plunger. Simultaneously, suction caused in the upper portion of the barrel raises ball valve 39 and draws fluid through the partially clogged perforations in the casing through ports 58 and 59, filling pipes 40 and 37 and chamber 27, as well as barrel 26 above the plunger. Reciprocation of the tubing will thus alternately draw clogging detritus into the casing and discharge the same into the tubing and subsequently from the well..

Fig. 7 illustrates a modification of my invention particularly adaptable as a formation tester. Pipe 37 has pipe section 40 secured thereto by a collar 41, as above described. Collar 43 (not shown), threaded to the lower end of section 40, supports a rotatable mandrel 44*a* having ports 53 and 54 therein, which are adapted to be turned into and out of registry with ports 51 and 52 in section 40, in the manner and for the same purpose as in the embodiment above described. Packer 48, carried by the mandrel 44*a* above ports 54, separates fluid thereabove from the formation to be tested. The lower packer is preferably omitted in this embodiment for reasons obvious to those of skill in this art. In other particulars this embodiment is similar to that described above and illustrated in Figs. 1 to 6.

My device, as illustrated and described, is subject to many changes without departing from the spirit of my invention, such, for example, as variation in the type and location of valves, construction of the spear mechanism, as well as relative position of the packers with respect to the barrel, and the reversal of the various parts. The packers may be of any well known type, but are preferably inclined in a direction opposite to the chamber between the packers, so as to insure isolation of the interior of the casing to which the suction is to be applied. It is also to be understood that the plunger may be secured immovable relative to pipe 37, and the working barrel reciprocable with the tubing. Similarly, the packers may be reciprocated with the tubing or stationary as illustrated and described.

What I claim and desire to secure by Letters Patent is:

1. In a combination well cleaner and tester, a working barrel, a cylinder secured to and encircling said barrel, a plunger within said barrel, a tubing connected to said plunger to reciprocate said plunger with respect to said barrel, spaced packers immovable with respect to each other connected within said cylinder, communicating means to communicate suction from said barrel created by the downward movement of said tubing to the zone between said packers, and other communicating means to permit the passage of fluid from said barrel into said tubing on the downward movement of the tubing.

2. In a combination well cleaner and tester, a tubing, a pump connected to said tubing, packers connected with said pump, said pump being adapted to create suction by both upward and downward longitudinal strokes of reciprocal movement of said tubing, and means to communicate said suction to the zone between said packers throughout the effective suction strokes of said pump.

3. In a device of the character described, a stem, a vacuum pump connected to said stem adapted for actuation by reciprocation of said stem, spaced packers connected to said stem immovable with respect to each other, means to communicate suction of said pump to the zone between said packers throughout both strokes of said stem.

4. In a device of the character described, a tubing string, a pump connected to said tubing, spaced packing means connected to said tubing string, said pump being adapted for actuation by downward movement of said tubing string to create a partial vacuum, means to communicate the suction of said pump at the beginning of the downward movement of said tubing string to the zone between said packing means to draw fluid from said zone into said pump, and means to communicate the fluid drawn into said pump to the tubing string.

5. In a device of the character described, a tubing string, a pump connected to said tubing string, spaced packing means connected to said tubing string, said pump being adapted for actuation by downward movement of said tubing string to create a partial vacuum, means to communicate the suction of said pump to the zone between the packing means throughout the downward suction stroke of said pump to draw material from said zone between the packing means into said pump, and a passage from said pump to said tubing string through which fluid drawn into said pump is pumped into said tubing.

6. In a device of the character described, a stem, a vacuum pump connected to and actuated by reciprocation of said stem, a pair of packers spaced apart and connected to said stem, a passage to communicate suction from said pump to the zone between said packers on both strokes of the pump, valvular means in said passage to open at the beginning of the downward movement of said stem.

7. In a device of the character described, a tubing string, a pump connected to and actuated by reciprocation of the tubing string to create suction in said pump on both strokes of the tubing, a pair of packers spaced apart connected to said tubing, means to communicate the suction of said pump to the zone between said packers throughout the effective suction stroke of said pump, and a passage for fluid from said pump to said tubing string.

8. In a device of the character described, a tubing string, a pump connected to and actuated by said tubing string, a pair of packers spaced apart and connected to said tubing string, means to communicate suction created in said pump by both upward and downward strokes of the tubing to the zone between said packers, valvular means normally closing said means adapted to open at the beginning of the downward movement of said tubing string, and a passage between said pump and said tubing for the flow of fluid into the tubing drawn by suction of said pump from the zone between said packers.

9. In a device of the character described, a stem, a pair of packers connected to said stem, a pump connected to said stem comprising a working barrel and a plunger within said working barrel dividing the barrel into two chambers, said pump being adapted for actuation by reciprocation of said stem to create pressure and suction in each of said chambers, means to communicate suction created by said pump in each of said chambers to the zone between said packers while pressure is created in the respective opposite chamber of said pump.

10. In a device of the character described, a tubing string, a pair of packers connected to said tubing string, a pump connected to said tubing string comprising a working barrel and a plunger within said barrel dividing the barrel into two chambers, said pump being adapted for actuation by reciprocation of said tubing string to create suction in one of said chambers and pressure in the other of said chambers, a passage to communicate suction from one of the chambers of said pump to the zone between said packers while pressure is created in the other chamber of said pump, and means to communicate fluid drawn from between said packers into the pump to the tubing string.

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