Aug. 8, 1944. C. C. BANCROFT ET AL 2,355,259

APPARATUS FOR CLEANING SUBTERRANEAN WELLS

Original Filed March 27, 1941

Fig. 1

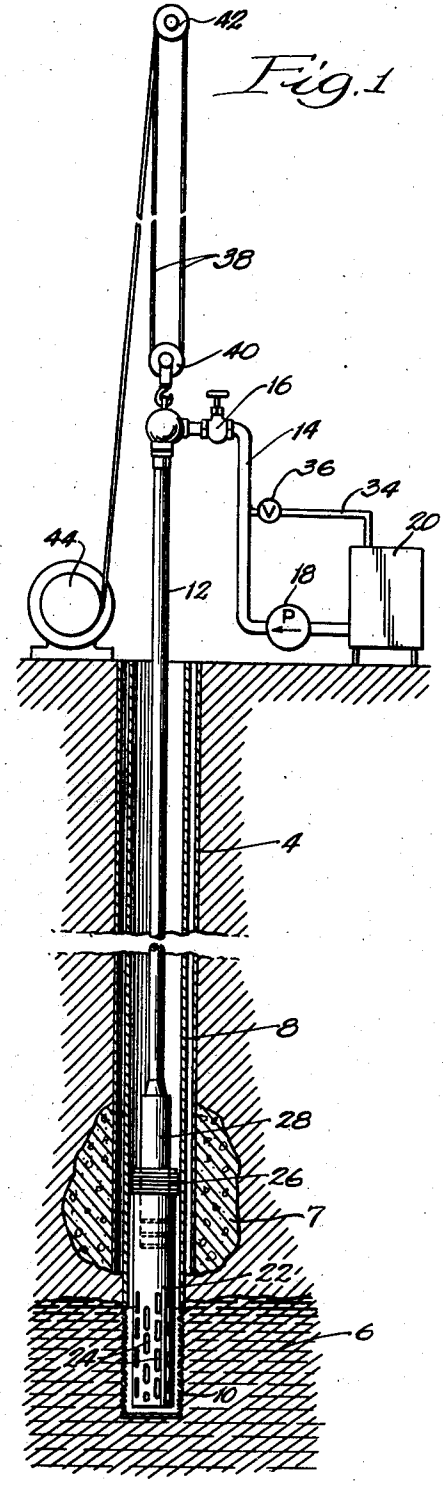


Fig. 2

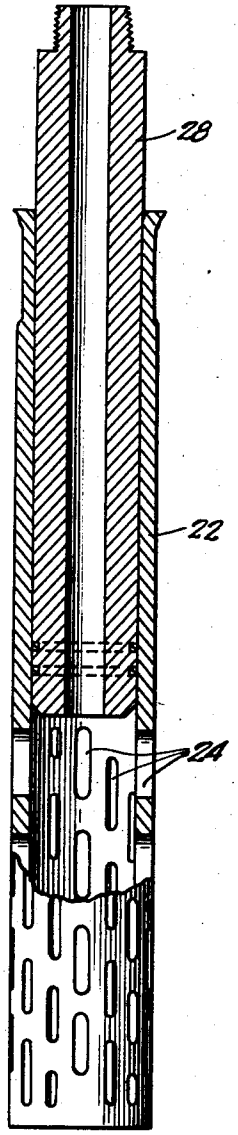
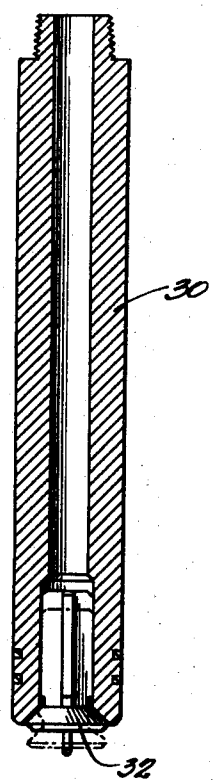


Fig. 3



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APPARATUS FOR CLEANING SUBTERRANEAN WELLS

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Substituted for abandoned application Serial No. 385,420, March 27, 1941. This application May 22, 1944, Serial No. 536,662

4 Claims. (Cl. 166—20)

This invention relates to apparatus for cleaning subterranean wells and more particularly for cleaning the screens and bearing strata in oil and gas wells and the like.

This application is a substitute for prior application, S. N. 385,420, filed March 27, 1941.

Oil wells are commonly provided with a tube extending into the well and equipped with a screen at or adjacent the oil horizon or bearing strata. It has been found that after long continued operation of such wells, the screens and the adjacent bearing strata become clogged due to coagulation of paraffine or other asphaltic or bituminous materials or waxes carried by the oil. This clogging results in lowered productivity of the wells and it has heretofore been extremely difficult, if not impossible, to remove the coagulated material from the screen and the adjacent bearing strata.

One of the objects of the present invention is to provide apparatus for cleaning the screens and adjacent bearing strata in wells of this type. It has been found that after cleaning is effected, productivity of the wells is increased materially.

The invention will be better understood by reference to the accompanying drawing in connection with the following detailed description. In the drawing:

Figure 1 is a diagrammatic view illustrating one application of the apparatus for carrying out the invention to a well;

Figure 2 is an enlarged partial section through the apparatus of Figure 1; and

Figure 3 is a similar section of an alternative plunger construction.

The well of Figure 1 is provided with a casing 4 which may be in the form of a metal pipe or a concrete casing of the type which is usually provided in wells. It will be understood that the provision of a casing is not essential and that the invention is applicable equally well to those wells which are not provided with casings. As shown, the casing terminates slightly above the strata 6 forming the horizon or bearing strata of the well, and is secured in place by a concrete plug 7 pumped in place from the surface as is usual in wells of this type. A tube 8 extends through the casing into the bearing strata and is formed with a screen 10 opposite and communicating with the bearing strata. The construction of the well with the casing and tube as shown is conventional, particularly in oil and gas wells.

In the operation of a well of this type over a substantial period of time, the screen 10 and the strata 6 around the screen tend to become clogged, due to accumulations of waxy, asphaltic or bituminous materials, so that the flow from the well is choked. According to the present invention, this accumulation of materials choking the screen and the strata may be removed by forcing heated fluid through the screen and into the strata to loosen or melt such materials, the loosened material being flushed from the well.

In carrying out the invention, the first step is to clean out the tubing 8 with a bit on the end of a usual drill stem such as shown at 12. This operation will remove any accumulation of wax, asphaltic or bituminous materials on the interior of the tubing, such materials preferably being flushed from the well during the operation by circulating oil or other flushing liquid through the drill stem to wash up around the bit. The bit is then removed from the drill stem and the drill stem is again placed in the tube and has a heated fluid circulated therethrough to heat the well, thereby tending to melt the accumulated materials in the well. For this purpose the stem is connected by a pipe 14 having a control valve 16 therein to a pump 18. Fluid is supplied to the pump from a salamander or boiler 20. During the flushing operation, the fluid will flow into the well through the drill stem, returning thru the tube 8 or the natural wall of the well to the surface of the well. Preferably, for cleaning oil wells, a high gravity oil is employed as a flushing fluid, although various other types of fluids could be used. This flushing operation is continued for a period of time sufficient to heat the well, as indicated by fluid overflowing from the well. Preferably the fluid is forced into the well at a temperature of about 210° F. and circulation is continued as described until the fluid returns to the top of the well at a temperature of about 140° F.

After the heating operation by circulating hot fluid through the well has been completed, a cylindrical barrel 22 of smaller diameter than the tubing 8 is placed in the well. As best seen in Figure 2, the barrel comprises a cylindrical metal casing, imperforate throughout its upper portion, but having in its lower portion a series of axially elongated slots 24 closely spaced throughout the circumference of the barrel and forming discharge openings. The barrel is placed in the well and is secured therein by a packing 26. The packing may be of any desired form, but as shown is a standard rope packing formed by wrapping dry hemp rope tightly around the barrel, with each coil of the rope connected to an adjacent coil by nails. When

this rope packing becomes wet, it expands against the tubing to seal the spaces between the barrel and the tube and to hold the barrel tightly in place in the tube. It will be noted that the barrel is so located in the well that the outlet openings 24 lie opposite the screen 10.

A tubular piston 28 is slidably received in the barrel and has its upper end connected to and communicating with the drill stem 12. As shown in Figure 2, the piston 28 has a continuous bore therethrough, backflow of fluid being prevented by the valve 16 at the upper end of the drill stem. However, if desired, a piston as shown at 30 in Figure 3 may be employed, this piston having a poppet type check valve 32 in its lower end adapted to close upon the application of pressure to prevent backflow through the drill stem.

When the barrel and piston and the packing 26 have been assembled in the tube, as shown, the valve 16 is closed, discharge from the pump 18 being by-passed back to the boiler 20 at this time through a pipe 34, past a pressure-relief valve 36. The drill stem is adapted to be raised by a rope 38 passing over a pulley 40 connected to the drill stem and over a sheave 42 secured to a supporting structure. The rope 38 is wound on to a windlass 44 driven by a suitable motor.

In operation, the rope is wound up on the windlass or an adjustable eccentric pulley to raise the drill stem to a position adjacent the top of the barrel, the barrel at this time being full of heated fluid. The rope is then released, allowing the piston and drill stem to drop by gravity, it being noted that the weight of these parts will be substantial. Thus the piston 28 moves down into the barrel, subjecting the fluid therein to a high pressure and forcing it out through the openings 24 in the form of high velocity jets. These jets strike the screen 10 and pass therethrough into the strata 6, loosening accumulations of material clogging the screen and the strata. The action of the heated liquid on waxy material in the screen and strata melts it to open up and clean the well thoroughly. This operation is continued, intermittently raising and lowering the drill stem, to subject the screen and adjacent strata to a series of pressure pulsations, forcing the fluid back into the strata. As fluid is displaced from the barrel 22, the pressure developed therein will decrease as may be indicated by gauges connected to the upper end of the drill stem. When this occurs, the valve 16 may be opened, allowing additional fluid to be pumped into the barrel thru the drill stem and piston to replenish the supply therein. The operation may be continued for any desired length of time, depending upon the character and condition of the well, it having been found that the fluid may be forced back into the strata a distance of 30 or more feet by this operation.

After completion of the operation as described above, the barrel, the packing and the piston are removed from the well and the drill stem is replaced in the well. The pump is again operated to force hot fluid through the drill stem to flush out the well, the fluid, as described before, passing partially around the drill stem and out through the tube 8, and partially through the screen 10 and out of the natural wall of the well between the tube 8 and the casing 4. This operation removed loosened material from the well and keeps the well structure heated. With the well structure and bearing strata at a temperature of 140° F. or higher, waxy asphaltic or bituminous material clogging the well will be melted and will be carried from the well in suspension in the heating fluid. Flushing fluid flowing from the well may be accumulated in slush pits where it is allowed to cool so that foreign matter will settle and the waxy or bituminous materials will coagulate. This flushing fluid may then be screened and returned to the boiler for re-heating and further use.

After the flushing operation has been continued a sufficient time to remove all of the foreign material from the well, the drill stem may be withdrawn and the well is again ready for production.

We have found that many wells when cleaned as described above, and in particular, oil wells, whose productivity has been materially impaired by clogging, can be cleaned to such an extent as to return substantially to their original productivity. It is particularly important in this connection that the flushing fluid be forced back into the bearing strata of the well, and we have found that this can be accomplished by creating pulsations of pressure as described. By utilizing pressure pulsations, much higher pressure can be employed than would be possible to maintain in a static condition, and at the same time the degree of penetration is materially increased.

While one particular apparatus embodying the invention has been shown and described in detail, it will be understood that this is illustrative only and is not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. In apparatus for cleaning oil wells, a unitary cylindrical barrel of substantially uniform diameter throughout its length, the upper portion of the barrel being imperforate and the lower portion being formed with a multiplicity of lateral outlet openings spaced closely adjacent each other around the entire circumference of the barrel, a tubular plunger slidable in the imperforate upper portion of the barrel, a tubular drill stem connected to the plunger to supply fluid thereto, and means to reciprocate the drill stem and plunger.

2. In apparatus for cleaning oil wells, a unitary tubular barrel of substantially uniform diameter throughout its length, the barrel being formed in its lower portion with a plurality of vertically elongated lateral outlet openings spaced closely adjacent each other around the entire circumference of the barrel, a tubular plunger slidable in the barrel, a tubular drill stem connected to the plunger to supply fluid thereto, and means to reciprocate the drill stem and plunger.

3. Apparatus for cleaning oil wells of the type having a tubing therein with a screen at its lower end comprising a unitary tubular barrel of smaller diameter than the tubing opposite the screen, the barrel being formed with a plurality of lateral outlet openings spaced closely adjacent each other around the circumference of the barrel to direct free jets of fluid against the screen, a tubular plunger slidable in the barrel and formed at its upper end for connection to a tubular drill stem whereby fluid may be supplied through the drill stem to the plunger and barrel, the plunger being adapted to be reciprocated with the drill stem to force periodic jets of fluid through the openings against the screen.

4. Apparatus for cleaning oil wells of the type having a tubing therein with a screen at its lower end comprising a unitary tubular barrel of smaller diameter than the tubing adapted to be inserted

in the tubing opposite the screen, the barrel being formed with a plurality of lateral outlet openings spaced closely adjacent each other around the circumference of the barrel to direct free jets of fluid against the screen, packing means carried by the upper end of the barrel to seal against the tubing, a tubular plunger slidable in the barrel and formed at its upper end for connection to a tubular drill stem whereby fluid may be supplied through the drill stem to the plunger and barrel, the plunger being adapted to be reciprocated with the drill stem to force periodic jets of fluid through the openings against the screen.

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