

June 7, 1938.

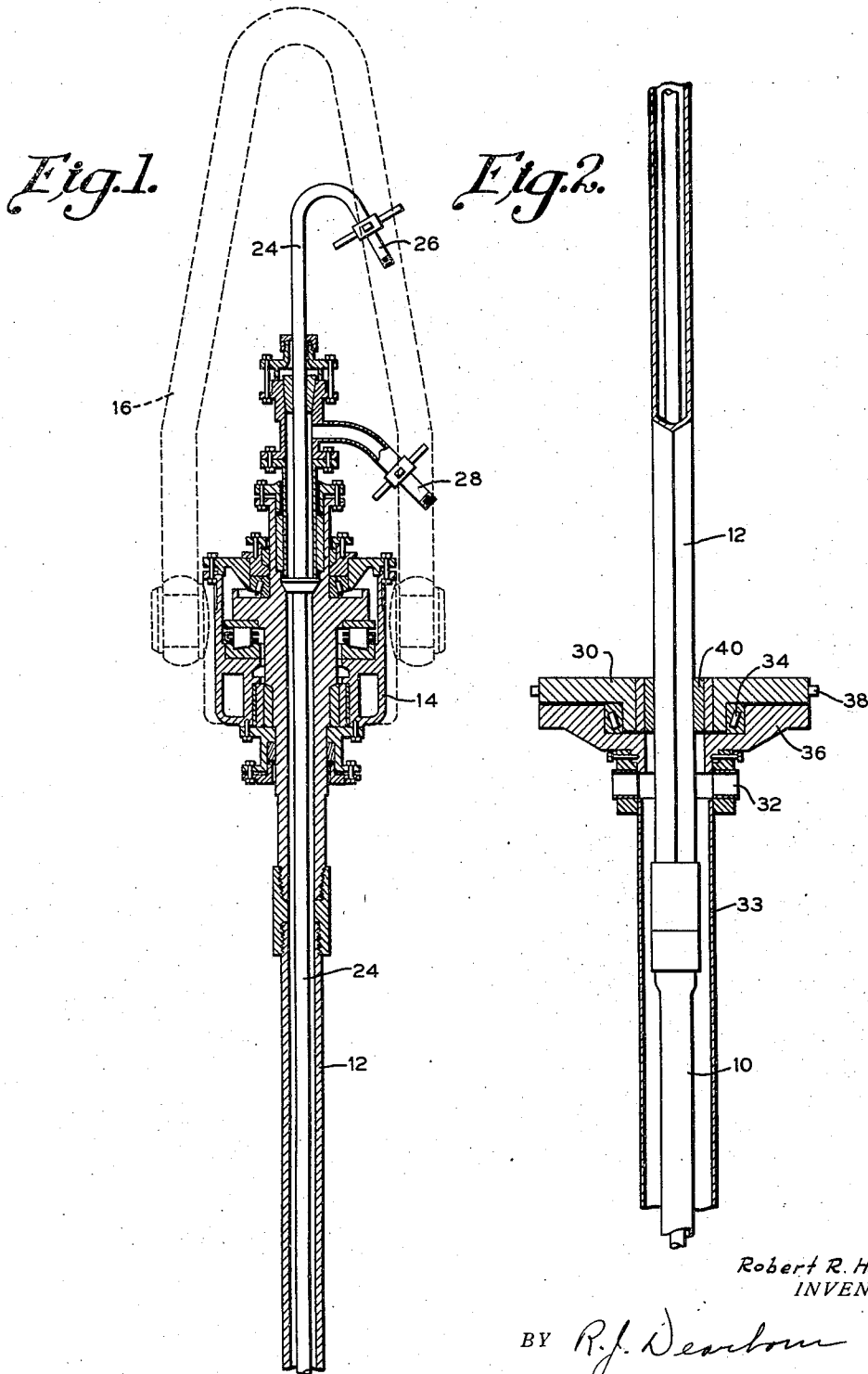
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2,120,132

METHOD AND APPARATUS FOR CLEANING WELLS

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2 Sheets-Sheet 1



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Fig. 3.

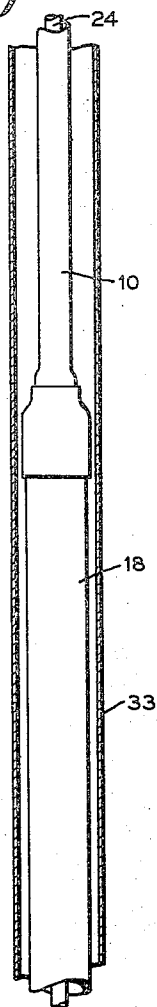


Fig. 4.

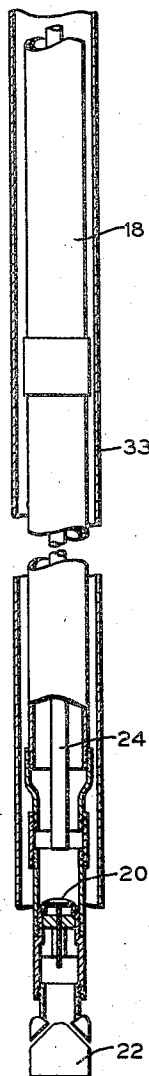
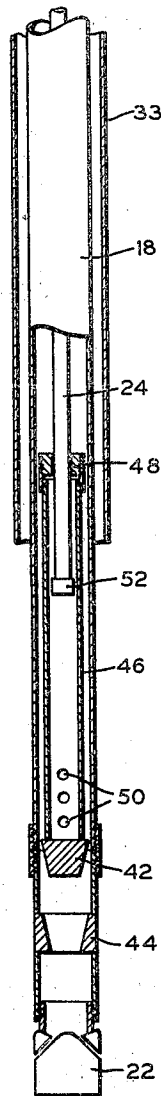


Fig. 5.



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METHOD AND APPARATUS FOR CLEANING
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7 Claims. (Cl. 255—24)

This invention relates to the cleaning of wells and more particularly to a method and apparatus for cleaning out oil wells by a combination of the practices of rotary drilling and air lift. The principal object of the invention is the provision of a method and apparatus through the use of which both low and high pressure wells, i. e., wells having low and high fluid levels, can be thoroughly cleaned with a minimum of effort and time consumption.

Many of the more common methods of cleaning oil wells require considerable time and many wells are often damaged because of disturbances of the strata caused by eruptions of the oil, gas and sand. It is usually the case that different methods and apparatus must be used when cleaning different types of wells. For instance, the method used in cleaning a dry well will be quite unlike the method in cleaning a high pressure well having a high fluid level.

The method and apparatus comprising the present invention can be used effectively in cleaning the various kinds of wells and the same apparatus is used regardless of the height of the liquid in the well. The sand, shale and other material to be removed from the bottom of the well is first thoroughly mixed with the water or oil in the well by the rotation of a tubing string having a bit secured thereto, after which a chamber associated with the tubing is caused to fill with the mixture to be removed. Artificial pressure is then used to discharge to the surface the contents of the chamber after which the cycle of operations is repeated as often as necessary. The bit can be rotated either during the entire operation or only when stirring up the detritus, as desired.

For a better understanding of the invention, reference may be had to the accompanying drawings in which

Figure 1 is a vertical sectional view of the upper end of the string and the associated swivel;

Figure 2 is a similar view of the apparatus directly below that shown in Figure 1;

Figure 3 is a view partly in section of a still lower portion of the string, showing the upper end of the chamber;

Figure 4 is a view partly in section of the lower end of the string showing the chamber, bit, and valve, while

Figure 5 is a view similar to Figure 4 but illustrating a modified form of valve structure.

Referring to the drawings, a string of tubing or small drill pipe 10 is carried on a square or "kelly" joint 12 which in turn is supported by a swivel 14. The swivel 14 may be of any type suitable for the purpose and suspended as by means of a bail 16. At the lower end of the tubing 10 the chamber 18 is suspended, this chamber being formed of an elongated section of pipe larger in

diameter than the tubing 10. The chamber 18 is provided in its lower portion with a valve 20 below which is suitably attached a drill bit 22. The valve 20 may be of a type adapted to remain in its lower or closed position by gravity and free to move upwardly when the pressure below the valve head is greater than that above.

Suspended within and passing through the swivel 14, "kelly" joint 12, tubing 10 and chamber 18 is an inner and smaller string of tubing or pipe 24 supported in any suitable manner by the swivel 14. The inner tubing string 24 extends to within a few inches of the valve 20 and may either rotate or not depending on the type of swivel which is used. The upper end of the inner tubing 24 is provided with a suitable nozzle or pipe connection 26. Access to the space between the inner tubing string 24 and the outer tubing 10 is provided by means of a pipe connection 28 projecting from the swivel 14.

A rotary table 30 is supported by the casing head 32 on the casing 33, suitable anti-friction bearings 34 being placed between the rotary table and an annular stationary member 36 supported by the casing head. The table 30 may be rotated by any suitable means and is shown as provided with peripheral teeth 38 adapted to be engaged by a chain or gear, not shown. The rotary table is provided with bushings 40 or other means for engaging the "kelly" joint 12 so as to permit vertical movement of the "kelly" joint through the table while preventing relative angular movement between the table and the string of tubing.

In carrying out the method of the invention, the preferred procedure is as follows:

The entire string of pipe including the tubing 10, "kelly" joint 12, chamber 18 and the inner tubing 24 is suspended within the hole and allowed to rest on the bottom with any degree of pressure desired by the operator. The suspension is obtained by attaching the bail 16 of the swivel 14 to a suitable line over the pulley at the top of the derrick or other supporting device, not shown. In order to prevent the chamber 18 from filling with fluid contained in the well, suitable superatmospheric pressure is maintained within the inner tubing 24 and in the space between the inner tubing and the outer tubing 12. The string is then rotated until the bit 22 has sufficiently stirred up the sand, shale and other material in the bottom of the hole and the pressure is then released from within the chamber 18 whereupon the valve 20 will open, allowing the chamber 18 to fill. In case the outside pressure is not sufficiently great to cause the chamber 18 to fill with fluid, a vacuum can be applied at the connections 26 and 28 to facilitate filling the chamber. After the chamber 18 has been filled, compressed air or gas is introduced at 28, the end 26 of the inner tubing 24 remaining open to the atmosphere. The

material contained within the chamber 18 is forced out of the chamber upwardly through the inner string of tubing 24 and this cycle of operations is then repeated as many times as is found necessary to thoroughly clean the well. During the operation the rotation of the string and bit may either be continued or stopped and the bit may be left on the bottom or raised during any part of the operation.

10 In case it is desired to permit fluid to pass from the chamber 18 out into the well, the valve between the bit and the chamber may be arranged to be opened at will from the surface. To this end a valve has been shown in Figure 5
15 which may be opened from the surface merely by raising the inner string of tubing 24. A tapered valve 42 adapted to cooperate with a fixed seat 44 is affixed to one end of a cylindrical member 46, the other end of the latter member being provided with a packing cap 48 adapted to encase the inner tubing string 24. Several openings 50
20 are provided in the lower walls of the cylindrical member 44. The lower end of the inner tubing 24 is provided with a nipple or other enlargement 52, the arrangement being such that the valve 42 will normally remain closed by gravity or by pressure applied within the chamber 18, but when it is desired to open the valve, for instance to allow fluid from the chamber to pass outwardly
30 into the well, it is necessary merely to raise the inner tubing 24 whereupon the nipple 52 will engage the cap 48 so that the valve will be pulled upwardly away from the seat 44. In other respects the operation of the valve 42 is the same as that of the valve 20, shown in Figure 4. The openings 50 permit the passage of fluid from the chamber 18 to the small tubing 24 or vice versa, as desired.

It will thus be seen that the method and apparatus which have been described can be used
40 in cleaning all wells regardless of the pressure existing therein. In the case of a high pressure well, the fluid and other material to be removed will fill the chamber 18 because of the surrounding gas pressure, and in the case of a low pressure well, it is merely necessary to maintain a slight vacuum in the chamber in order that it will fill with the material to be removed. In
45 case of a dry hole, liquid may be let down either through the tubing 10 or the inner tubing 24 into the bottom of the well by merely raising the inner string 24 so as to lift the valve 42 from its seat 44. As has been pointed out hereinbefore, rotation of the bit 22 may either be made continuous or intermittent, as desired.

The sampling and testing of reservoirs in wells drilled by other means can be effected by this method regardless of the amount of drilling mud or other fluid contained in the hole.

60 Obviously many modifications and variations of the invention may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated by the appended claims.

65 I claim:

1. A method of cleaning out a well which comprises mechanically loosening up the detritus in the well, causing a chamber in the well to be filled with said detritus, forcing said detritus from said chamber to the surface by means of artificially produced gas pressure and repeating this cycle of operations until the well has been thoroughly cleaned.

2. A method of cleaning out a well which comprises rotating a bit attached to a string of tubing so as to stir up the detritus in the well, intermittently filling a chamber associated with said tubing at the bottom of the well with said detritus and then forcing the contents of said chamber to the surface by compressed gas introduced into the chamber through said tubing.

3. A method of cleaning out a well which comprises rotating a bit attached to a string of tubing so as to loosen the detritus in the well while maintaining superatmospheric pressure in a chamber connected to said tubing near its lower end so as to prevent said chamber from filling with liquid from said well, discontinuing the rotation of said bit and reducing the pressure in said chamber so that said chamber will fill with said detritus and then forcing said detritus from said chamber to the surface by means of artificially produced gas pressure.

4. A method of cleaning out a well which comprises lowering into said well a string of tubing having a chamber and a bit secured to the lower end thereof, maintaining pressure in said chamber while lowering said string so as to prevent liquid from entering the chamber, rotating said string and bit to stir up the detritus in the well, reducing the pressure in said chamber so that it will be filled with detritus due to the natural gas pressure and then forcing the contents of the chamber upwardly to the surface by means of compressed gas introduced into said chamber through said tubing.

5. A method of cleaning out a well which comprises lowering into said well a string of tubing having a chamber and a bit secured to the lower end thereof, rotating said string and bit to loosen the detritus in the well, applying a partial vacuum to said chamber so as to cause it to fill with said detritus and then applying superatmospheric pressure to said chamber so as to force the contents of the chamber upwardly to the surface, and repeating this cycle of operations until said well has been thoroughly cleaned.

6. An apparatus for cleaning out a well, comprising a string of tubing adapted to be lowered into the well, said tubing being provided at its lower end with a chamber, a bit disposed at the lower end of said chamber, an inwardly opening valve in said chamber, means for rotating said tubing string and bit to loosen the detritus in the well, and an inner string of tubing extending downwardly through said first mentioned tubing to a point within and slightly above the lower end of said chamber.

7. A well cleaning apparatus comprising a string of tubing adapted to be lowered into the well, a swivel suspension for said string, means for rotating said string while permitting vertical movement thereof, said string being provided near its lower end with an enlarged chamber, a bit disposed at the lower end of said string, an inwardly opening valve in said chamber adapted to open when the outside pressure exceeds the pressure within the chamber so that the detritus in the well will enter the chamber, and means for closing said valve and forcing the contents of the chamber upwardly to the surface, said last named means including a smaller string of tubing extending downwardly through said first mentioned string to a point within said chamber.

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