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METHOD FOR ACIDIZING WELLS

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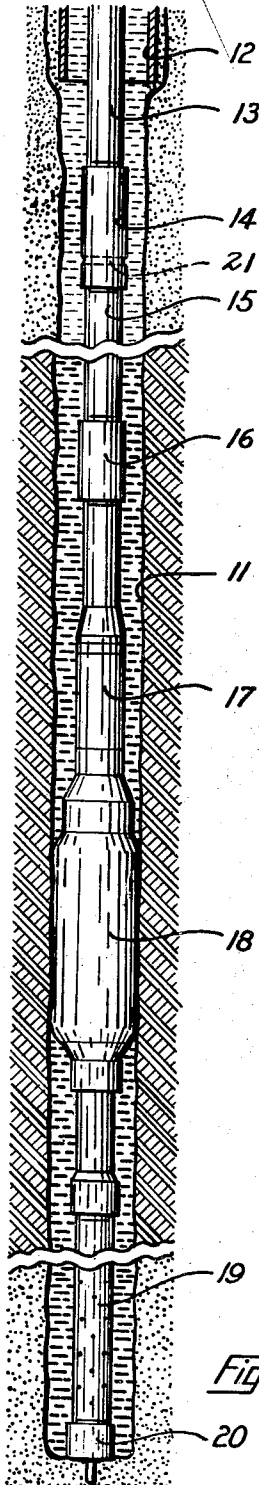


Fig. 1.

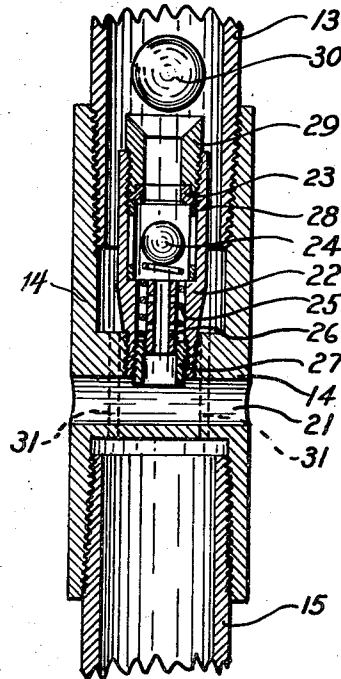


Fig. 2.

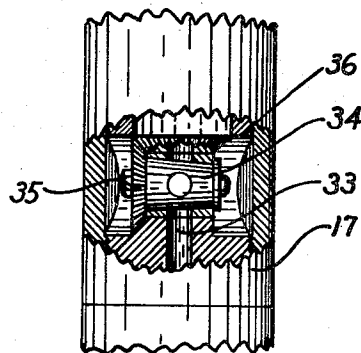


Fig. 3.

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METHOD FOR ACIDIZING WELLS

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4 Claims. (Cl. 166—21)

This invention relates to the method and apparatus for acidizing oil wells and the like, and more particularly to an arrangement and method for placing acid in a well at a particular spot or location.

The acidizing of oil wells is now well known to those skilled in the art. In treating limestone formations which bear oil, strong acid, such as hydrochloric, is pumped into the limestone to attack it and thus provide channels through which the oil may flow.

In the process of acidizing it is desirable to prevent the acid from contacting formations other than the one to be treated, and it is also sometimes desirable to treat spaced layers of limestone or other oil-bearing strata without causing the acid to contact the intermediate strata. Ordinarily different pressures are required to force the acid into different oil-bearing formations and for this reason it is usually not feasible to treat two spaced formations at the same time.

It is one object of the invention, therefore, to devise means and method for confining the acid used in the acidizing process to a particular stratum and to provide means and method for treating spaced strata in an oil well.

It is a further object of the invention to provide a novel apparatus and process for treating oil wells in which accurate control of the acid may be had.

Other objects and advantages reside in certain novel features of the arrangement and method as will be more apparent from the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a vertical cross-sectional view of an oil well with fragmentary portions of apparatus constructed in accordance with the present invention therein;

Fig. 2 is a vertical cross-sectional view of a portion of the apparatus shown in Fig. 1; and

Fig. 3 is a fragmentary side view of another portion of the apparatus of Fig. 1 with a portion cut away to show the internal construction.

Referring to the drawing in detail, and first to the assembly shown in Fig. 1, it will be seen that the lower portion of an oil well is there represented at 11. A portion of the casing in the well is indicated at 12 and in the arrangement shown the casing is seated some distance above the bottom of the well. A drill stem or tubing 13 is placed in the well and carries at its lower end a device called a circulation sub 14, another section of drill stem or tubing 15, a connecting collar 16,

a valve arrangement 17, a packer 18, a section of perforated pipe 19 and an anchor member 20.

The circulation sub 14 is shown in detail in Fig. 2. The main body portion of the sub has screw threads at its upper end adapted to receive the screw threads on the lower portion of the drill stem 13 while the lower end contains similar drill threads adapted to receive the threads on the upper portion of the drill stem section 15. The main body section also has a transverse hole 21 connected through valve mechanism with the interior of the drill stem 13.

The valve assembly in the circulation sub 14 consists of a bushing 22 screw threaded into a longitudinal opening therein. The upper end of the bushing carries a valve seat member 23 upon which a ball valve 24 normally seats under the influence of the coil spring 25. A perforated liner 26 may be placed beneath the ball valve 24 to aid in holding the spring 25 in place and to insure the passage of fluid through the lower portion of the bushing 22. The lower end of the coil spring 25 preferably abuts against an inner collar 27 screw threaded on the inside of the lower portion of the bushing 22 as illustrated.

The valve seat 23 is preferably clamped in position by means of a bushing 28 and an upper ring 29. The upper portion of the ring 29 is preferably tapered so that it also may act as a valve seat to receive a ball valve 30 placed in the well during the operation of the apparatus.

In addition to the transverse opening 21 in the main body 14 of the circulation sub there are a number of longitudinally extending holes or ports 31 shown by dotted lines in Fig. 2 which connect at all times the interior of the drill stem 13 with the interior of the section of drill stem 15. It is to be noted that these ports 31 are open regardless of the position of either of the ball valves 24 and 30, there being sufficient clearance between the bushing 22 and the wall of the main body member 14 to permit fluid to pass therebetween.

With this construction it will be seen that with the ball valve 24 closed no fluid, such as mud, normally found in the well, will pass into the drill stem 13 while the same is being lowered into the well. The ball valve 24 may be opened by fluid pressure, however, whenever the pressure in the drill stem 13 exceeds that in the well around the circulation sub and in the transverse opening 21. The valve 24 is therefore not controlled by movement of the drill stem but only by fluid pressure.

Located some distance below the circulation sub 14 in the arrangement of Fig. 1 is a second valve assembly 17 controlled by movement of the drill

stem. The particular structure of the valve arrangement 17 is not material to the present invention and any one of several constructions of valves used in the testing of oil wells may be employed. For example, an arrangement like that shown in the U. S. patent to Simmons, No. 1,930,987, may be employed. The particular arrangement shown in Figs. 1 and 3 of the drawing illustrates a construction well known to those skilled in the art and called a Halliburton tester. As shown in Fig. 3, the arrangement may include a main body portion 17 having a longitudinally extending port 33 therein controlled by a valve 34. The valve 34 may be rotated by means of bevel gears 35 and 36, the latter of which is connected to the drill stem so that as the drill stem is rotated the valve 34 may be opened and closed. To keep the main body portion 17 of this valve from rotating the anchor shoe 20 is provided and anchored in the bottom of the well.

The valve 34 is normally in the closed position as shown in Fig. 3 when the assembly is being lowered into the well. This prevents any mud or extraneous fluid from entering the drill stem through the perforated section 19.

The operation of the apparatus to acidize oil wells is as follows:

Assuming that it is desired to acidize two spaced sections of limestone formation one of which is at the bottom of the well and the other of which is spaced some distance above the bottom, the assembly is so made up as to length as to bring the circulation sub 14 opposite the upper section of limestone formation when the apparatus is placed in the well. After the assembly is lowered into the well the packer 18 is set in accordance with known practice.

Hydrochloric acid is then pumped into the drill stem 13 and causes the valve 24 to open. The acid then flows outwardly through the transverse opening 21 and into the upper limestone formation. No acid will flow downwardly through the ports 31 at this time because the valve 34 is closed. Likewise no appreciable amount of acid will flow downwardly around the outside of the section 15 of the drill stem and the valve arrangement because of the packer 18. There will normally be some mud or other fluid in the well and this fluid will remain stagnant between the packer 18 and the circulation sub 14. In order to locate the acid properly around the circulation sub some of the mud or fluid above the circulation sub may be allowed to flow upwardly through the casing 12, in accordance with known practice, until the location of the acid is determined when the top of the casing will be sealed by a bradenhead or other construction, so that pressure may be placed upon the acid in the drill stem.

This process will continue until sufficient amount of acid has been pumped through the upper limestone formation. A ball valve 30 will then be dropped into the well to seat upon the valve seat 29 and the drill stem will then be rotated to open the valve 34. This will cause the valve 24 to seat and will prevent any acid from flowing back out of the upper limestone formation into the drill stem. At the same time any pressure exerted upon the acid in the drill stem 13 will cause the same to flow into the lower formation through the perforated pipe 19 due to the fact that the ball valve 30 will close the opening through the bushing 22. Acid may thus be pumped into the lower oil-bearing formation until a sufficient quantity has been supplied thereto and the valve 34 may then be further

rotated to hold the pressure in the lower formation.

The above described operation of the device illustrates the particular advantages resulting from the use of the invention to treat two separate formations, but the apparatus may also be put to additional uses. For example, where it is desired to treat only one formation in the lower part of the well the arrangement of the packer 18 and the valve 34 is particularly useful, and in this operation no circulation sub need be employed. On the other hand, where it is desired to treat a formation some distance up from the bottom of the well, the assembly can also be used to advantage and may be made up of any desired length so as to bring the circulation sub opposite the oil-bearing formation.

It is also within the purview of the invention to employ a plurality of packers to treat spaced formations. Thus, for example, two packers may be used, one positioned like the packer 18 in Fig. 1, and the other on the lower end of the perforated pipe 19. The packers can of course be spaced any desired distance and the perforated pipe may be of the desired length to treat any particular depth of formation. The anchor shoe 20 may also be of any desired length to bring the perforated pipe into proper location.

Where three or more oil-bearing formations occur in the well, it is possible to use the principles of the invention in treating any two formations without removing the apparatus from the well. For example, the lower of three strata may be sealed off by a packer and plug in the lower part of the tubing and supply the acid to the two upper strata as described above.

Where conditions are right, it is also possible in some cases to acidize three separate strata without removing the apparatus from the well. In some regions, the lower of three strata requires less pressure to force acid into it than is required by the two upper strata. In such a case, the two upper strata may be treated as indicated above and then the packer or packers may be released and additional acid pumped into the well. This acid will then flow into the lower stratum.

While only one embodiment of the invention has been shown and described herein, it is obvious that various changes may be made both in structure and in the method of the operation, without departing from the spirit of the invention or the scope of the annexed claims.

I claim:

1. The method of treating a stratum of a well with a fluid while preventing the fluid from contacting a lower stratum of the well which includes placing a conduit in the well, setting a packer between the said strata, opening the conduit above said packer, pumping the treating fluid under pressure into the upper stratum to be treated through said conduit and opening, closing the opening to hold the pressure in the fluid and allowing the treating fluid to react with the formation while under pressure.

2. The method of successively treating separate and vertically spaced strata in a well which includes the steps of placing controllable conduit means in the well, packing off the conduit means at a point between the strata so as to prevent fluid from flowing in the well from one strata to another on the outside of said conduit means, causing a predetermined amount of a treating fluid to flow through the conduit means and into one of the strata, then operating the controllable conduit means to prevent further flow of treating

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fluid into that stratum while permitting treating fluid to flow into another of said strata, and then causing a predetermined amount of treating fluid to flow into the last mentioned stratum.

- 5 3. The method of successively treating separate and vertically spaced strata in a well which consists in first sealing one stratum from another, supplying treating fluid to one stratum, closing off that stratum to prevent ingress or egress of
10 fluid therefrom, supplying treating fluid to another stratum while the first mentioned stratum is so closed, allowing time to elapse for the reaction of the treating fluid with the strata and removing the products of the reaction from the
15 strata.

4. The method of treating a petroleum bearing stratum of a well with a fluid to increase the production of petroleum therefrom which includes the steps of first packing and sealing off the well below the stratum to be treated, then pumping 5 the treating fluid into the stratum under pressure while preventing the flow of said fluid downwardly beneath the point where the well is packed and sealed off, allowing time to elapse for the 10 reaction of the fluid with the stratum to be treated and removing the products of reaction from the stratum and from the well.

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