

UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR SIDETRACKING IN DEEP-WELL DRILLING.

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To all whom it may concern:

Be it known that I, NIELS ESPERSON, a citizen of the United States, and a resident of Houston, in the county of Harris and State of Texas, have invented certain new and useful Improvements in Methods of and Apparatus for Sidetracking in Deep-Well Drilling, of which the following is a specification.

My invention is an improvement in the process known, in the art of drilling oil wells, as "side tracking" and it also concerns improvements in the apparatus by which the improved process is carried out.

The invention is shown in the accompanying drawing in which the figure represents a central vertical sectional view of the well being drilled, the apparatus being shown partly in section and partly in elevation.

In these drawings, 1 indicates the well casing which is let down into the well as in ordinary practice, and 2 indicates what is known as a whipstock consisting of a member tapering upwardly to a thin edge, and at its lower end being thick enough to reach about two thirds of the way across the bore of the casing. This whipstock has a concave face 3. It is let down into the well casing to a point where the obstruction exists in the well and it may be held in any suitable way. It is customary to first let down into the casing a string of pipes of smaller diameter than the well casing to afford a support upon which the whipstock or guide may rest. After the whipstock has been positioned a milling tool is lowered into the casing and rotated so as to cut a long hole through the side of the casing. In this milling action, the milling tool by bearing on the concave face of the whipstock is deflected laterally as it passes down along the inclined face and thus the cutting through the side of the well casing is effected so that the drilling tool which is let down to continue drilling, after the milling tool is withdrawn, may follow this "side track" past the obstruction and the drilling then can go on to the required depth. The hole cut through the side of the well casing is about as long as the whipstock, starting at a point at or near the level of the upper end thereof and terminating at a point at or near the level of its lower end.

Ordinarily the hole cut is very irregular

and by reason of limitations necessarily imposed by the diameter of the well casing the hole is not of sufficient length to avoid too great a bend in the drill stem, which is subsequently introduced, or to avoid bringing the side of the stem against the ragged edge of the hole and cutting the stem in two.

By my process and apparatus, the wall of the casing at the top of the hole is spread outwardly for some distance above the upper edge of the hole and one effect of this is the same as though the hole were enlarged upwardly to this extent, and furthermore the ragged edge of the wall at the upper part of the hole is directed outwardly in respect to its original position and cutting through of the drill stem by it is avoided.

After the hole is cut through the casing and the milling tool has been withdrawn, I introduce the improved tool or apparatus which is provided with a pilot 4 of any suitable form, such as a roller bit or a fishtail bit. This is carried by a stiff or rigid hollow stem 5 composed of sections which have between them at certain distances reamers composed of toothed rollers 6 carried by collars 7 of larger diameter than the stem. There are three of these reamers, one, *a*, near the lower drill head, another, *b*, at a suitable distance above *a* to come against the wall of the casing above the milled hole therein, when the apparatus has been deflected to a suitable inclination by the bit bearing on the inclined face of the whipstock, and the third, *c*, at a suitable distance above *b* to bear on the casing on the side thereof opposite the side in which the hole lies.

As the pilot or the lower reamer passes down along the inclined face of the whipstock it will be deflected out through the hole cut in the casing, and the second reamer *b* will be brought to bear on the casing at a point above the hole therein, and the upper reamer *c* will bear on the opposite wall of the casing. As the drill progresses downwardly the reamer *b* held rigidly by the stiff stem, and traversing an inclined path will press the wall of the casing outwardly, beginning at a point, say at X, some distance above the upper edge of the hole and will make a long pathway for the drill stem at a very low angle to the axis of the casing so that the said stem will

be subjected to deflection only at this low angle departing but little from the straight line of the casing. Sharp bends are thus avoided and damage to the drill stem prevented.

Furthermore the spreading of the wall of the casing at the top of the opening directs the ragged edge of the opening outwardly in respect to the position and direction this ragged edge originally occupied so that the drill stem instead of being cut by this ragged edge will find a bearing surface consisting of the comparatively smooth interior of the casing wall.

I do not limit myself to the use of the number of reamers shown nor to the particular construction of these spaced apart elements.

The greater thickness of the stem of the improved apparatus as compared with the thickness of an ordinary tubular drill stem will be observed by comparison with the portion of the stem shown at 8.

The above specification is to be regarded in a descriptive sense, and not as limiting the invention to the particular features described and shown, the scope of the invention being defined by the appended claims.

The sections of the well casing are held together by couplings which are of greater diameter than the casing and there is some clearance between the exterior of the collars or couplings and the original wall of the well and expansion of the casing can take place sufficient for the purpose described.

The pipe or bar carrying the reamers is hollow and flushing water can pass there-through to the cutters as in common practice.

When the pilot cutter and its reamer pass through the hole in the casing, the wall is expanded considerably. This is followed by the intermediate member which does further expanding of the wall under the control of the upper member *c* which holds the intermediate member to its work and causes it to make a more gradual and a longer deflection of the wall than would be the case if the upper member were not used.

The second reamer may not bulge the casing much, and the pressure will be distributed between second and third reamers. Second reamer will enlarge the casing to the right, third reamer will enlarge the casing to the left.

The usual practice is to insert in the hole a milling tool of a diameter just enough under the inside diameter of the casing to permit the milling tool readily to pass through the pipe. It, therefore, happens that when the milling tool, which has a bevelled nose, reaches the whipstock, it is immediately held against the casing at the opposite side and begins to cut the same.

The bevel on the end of the milling tool

starts about an inch and a half or two inches back from the end; the bevel is on a 45° angle. The pilot cutter 4 at the bottom would be the same diameter as the body of the milling tool which is first introduced.

The original cutting through the casing is performed by the first milling tool and after the milling tool has been withdrawn, the remainder of the entire drilling action is done by the improved tool and flushing water goes down through this the same as in ordinary practice.

I claim:

1. The herein described method of side tracking in drilling oil wells consisting in cutting an opening through the wall of the casing and thereafter spreading the wall of the casing outwardly at the upper end of said opening, substantially as described.

2. The herein described method of side tracking in drilling oil wells consisting in cutting an opening through the wall of the casing and thereafter spreading the wall of the casing outwardly, beginning at a point above the upper edge of the opening and progressively to said edge whereby said edge will be located out beyond the point it originally occupied.

3. Apparatus for side tracking in drilling oil wells, comprising a whipstock, a stem having a pilot at its lower end, and an enlargement on the stem at a point above the pilot to press the wall of the casing outwardly beginning at a point above and extending to said opening when the pilot is deflected by the whipstock.

4. Apparatus for side tracking in drilling oil wells, comprising a whipstock, a stem having a pilot at its lower end, and an enlargement on the stem at a point above the pilot to press the wall of the casing outwardly beginning at a point above and extending to said opening, when the pilot is deflected by the whipstock, and another enlargement above that first mentioned to bear on the opposite wall of the casing to that in which the opening is cut.

5. Apparatus for side tracking in drilling oil wells, comprising a whipstock, a stem having a pilot at its lower end, and an enlargement on the stem at a point above the pilot to press the wall of the casing outwardly beginning at a point above and extending to said opening, when the pilot is deflected by the whipstock, said enlargement having rollers.

6. Apparatus for side tracking in drilling oil wells, comprising a whipstock, a stem having a pilot at its lower end, and an enlargement on the stem at a point above the pilot to press the wall of the casing outwardly beginning at a point above and extending to said opening, when the pilot is deflected by the whipstock, and another enlargement above that first mentioned to bear

on the opposite wall of the casing to that in which the opening is cut, both of said enlargements having rollers.

5 7. Apparatus for side tracking in drilling oil wells, comprising a whipstock, a stem having a pilot at its lower end, and an enlargement on the stem at a point above the pilot to press the wall of the casing out-
10 wardly beginning at a point above and extending to said opening, when the pilot is deflected by the whipstock, there being an enlargement also at the pilot, and at a point above and apart from the enlargement first mentioned.

15 8. Apparatus of the class described comprising a whipstock for deflecting a tool for side tracking, a stem portion of extra stiffness in respect to the main portion of the drill stem to which it is connected, a pilot at
20 the lower end of said stiff stem, an enlargement at an intermediate portion of said stiff stem, and a second enlargement on the said stiff stem above and spaced apart from the enlargement first mentioned.

25 9. A well drilling apparatus comprising a drill head, a main drill stem, a stiffer stem interposed between the main drill stem and the drill head and forming the connection between them and a pair of reamers on said
30 stiff stem spaced apart one above the other, said stiffer stem being substantially non-flexible under conditions where the main stem would be deflected, substantially as described.

35 10. Apparatus for side tracking in drilling oil wells, comprising a whipstock for

deflecting a drill head through the side of the well casing, a drill head having cutters, means above the cutters for expanding the wall of the casing at the upper end of the opening therethrough, and a drill stem, substantially as described. 40

11. Apparatus for side tracking in drilling oil wells, comprising a whipstock for deflecting a drill head through the side of the well casing, a drill head having cutters, means above the cutters for expanding the wall of the casing at the upper end of the opening therethrough, and a drill stem, said means being of a diameter greater than the orbit of outer edge of the cutters, substantially as described. 45 50

12. A well drilling apparatus comprising a drill head, a main drill stem, a whipstock for deflecting the drill head laterally, and a substantially non-flexible stem connecting the drill head with the drill stem and carrying an enlargement above the drill head to bear on the well casing for expanding the same above the lateral aperture thereof, substantially as described. 55 60

13. A well drilling apparatus comprising a drill stem, a stiffer stem attached to the lower end of the drill stem and forming an extension thereof, a drill head at the lower end of the stiffer stem and an enlargement on the stiffer stem at a point above the drill head and below the lower end of the ordinary stem, substantially as described. 65

In testimony whereof, I affix my signature. 70

NIELS ESPERSON.