

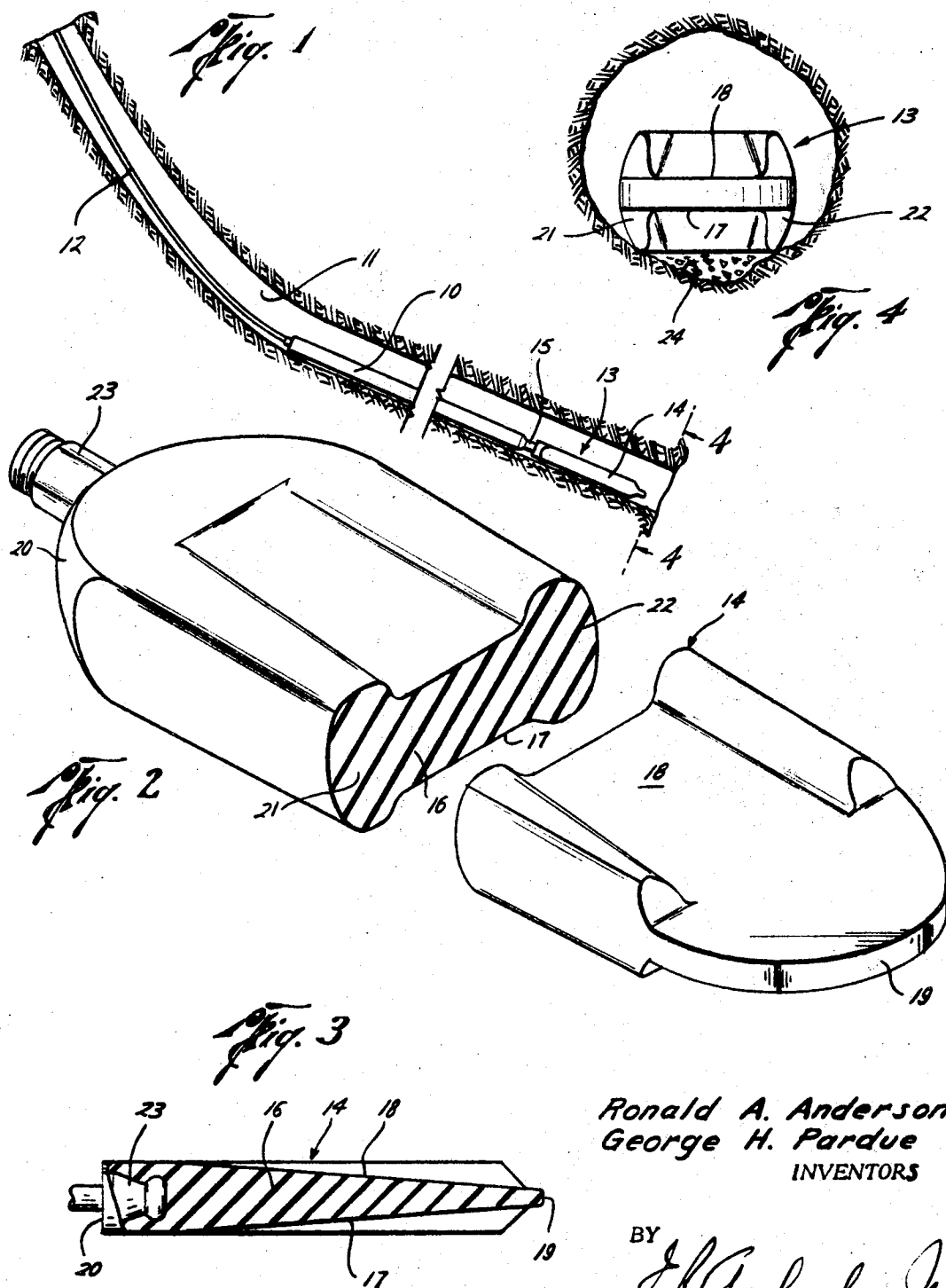
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DESCENT-FACILITATING APPARATUS FOR WELL TOOLS

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DESCENT-FACILITATING APPARATUS FOR WELL TOOLS

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This invention relates to apparatus for use in a well bore; and, more particularly, to apparatus for facilitating the descent of well tools in deviated well bores.

In some oil fields it is not at all uncommon to find well bores having highly slanted sections therein that may approach angles deviating from the vertical of as much as 80°. Whether such slanted sections are near the bottom or not, it is, of course, all but impossible to lower a cable-suspended well tool to the bottom of such extremely crooked or highly deviated well bores. It will be appreciated, therefore, that unless suitable means are devised to move cable-suspended well tools through such highly deviated holes, they can not be perforated or logged in the usual manner.

Accordingly, it is an object of the present invention to provide new and improved means for facilitating the descent of cable-suspended well tools through highly deviated well bores.

This and other objects of the present invention are accomplished with apparatus which includes an elongated, flattened guiding member that is rotatably connected to the lower end of a well tool. In a preferred embodiment, the guiding member is made of an elastomeric material and is appropriately shaped to deflect the nose of a descending well tool upwardly over obstructions on the downward surfaces of slanted sections of the well bore so as to guide the tool through a highly deviated well bore. By allowing the well tool to gain momentum in those sections of a well bore that are more vertical than others, the guiding member of the present invention will assist in lifting the forward end of the tool up and over obstructions, debris, and the like along those more slanted sections in the well bore so as to conserve the downward momentum of the tool.

The novel features of the present invention are set forth with particularity in the appended claims. The operation together with further objects and advantages thereof, may best be understood by way of illustration and example of a certain embodiment when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an elevational cross-sectional view of a cable-suspended well tool having the present invention as it might appear in a highly deviated borehole;

FIG. 2 is an isometric view of a preferred embodiment of the present invention;

FIG. 3 is a reduced elevational cross-sectional view of the embodiment of FIG. 2; and

FIG. 4 is a cross-sectional view taken along the lines 4—4 of FIG. 1.

Turning now to FIG. 1, a well tool 10 is shown as it might appear within a highly deviated portion of a borehole 11, with the well tool being suspended from a cable 12 spooled at the earth's surface from a winch (not shown) in the usual manner. Guiding apparatus 13 arranged in accordance with the principles of the present invention is secured to the lower end of the tool 10 and includes an elongated guiding member 14 rotatably coupled to the tool by a swivel or bearing 15.

As best seen in FIG. 2, the guiding apparatus 14 of the present invention is a flat, paddle-like member which has been likened by some as being quite similar to the nose of a platypus. As will be seen in FIG. 2 as well as in particular the cross-sectional views of FIGS. 3 and 4,

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the central portion of the guiding member 14 is a generally flat, transverse, web section 16 with a somewhat wedge-shaped longitudinal cross-section and having opposed upper and lower inclined, planar surfaces 17 and 18 that gradually diverge outwardly away from one another from a thinner leading edge 19 of the section to a thicker rear edge 20. The longitudinal marginal edges of the guiding member 14 are each provided with outstanding, runner-like projections 21 and 22 of a substantially uniform height and substantially parallel to one another. To secure the guiding member 14 to the swivel 15, means, such as an axially aligned shank 23 partially imbedded into the rear edge 20, are provided. By making the guiding member 14 symmetrical on both sides, it will, of course, be immaterial which side is down.

In this manner, it will be realized that a somewhat wedge-shaped recess is formed on each side of the guiding member 14 by the inclined surfaces 17 and 18 and between the inwardly directed surfaces of the longitudinal marginal projections 21 and 22. As best seen in FIGS. 2 and 3, it will be appreciated that the transverse cross-sectional area of these recesses progressively decreases from the front to the rear of the guiding member 14.

As the guiding member 14 moves ahead of the tool 10 downwardly along a deviated borehole, such as at 11 in FIGS. 1 and 4, the viscous well control liquids or so-called "muds" will flow under the forward edge 19 and into the opening or forward end of whichever one of the recesses is facing downwardly and be confined therein below the inclined surface 17 (or 18) and between longitudinal marginal projections 21 and 22. These liquids will naturally be exhausted along the rear edge 20. By virtue of this flow of liquids along the inclined surface 17 (or 18), a pressure gradient will be developed within the recess which will impose upwardly directed lifting forces under the recessed web portion 16 tending to lift the entire guiding member 14. It will also be understood that the exhausting liquids will also maintain a thin film of liquid along the lower transverse surfaces adjacent to the rear edge 20. This thin film will, therefore, act as a lubricating film tending to decrease the friction between these surfaces and the adjacent borehole surfaces. Since most of the weight of the tool 10 that is imposed on the guiding member 14 will be carried on these rearward transverse surfaces, a great deal of this load will be relieved by the lubricating film and the upwardly directed pressure forces.

Thus, as the well tool 10 moves downwardly through a slanted portion of the deviated borehole 11, the forward motion of the guiding member 14 with respect to the muds will develop sufficient pressure forces tending to lift the guiding member over accumulated debris and the like laying on the bottom surface of the borehole. In this manner, the nose of the tool 10 is prevented from digging in or plowing into the bottom surface of the borehole 11 and impeding the forward progress of the well tool. It will be understood, of course, that when the downwardly facing surface (as, for example, 17) strikes an obstruction, the guiding member 14 will be further deflected to assist in guiding the nose of the tool 10 up and over such obstructions.

It will be recognized, of course, that only one inclined surface 17 or the other 18 of the guiding member 14 is effective to develop upwardly acting pressure forces at any given moment. Accordingly, the swivel 15 is provided to ensure that the member 14 remains in a nominally horizontal position as seen in FIG. 4 rather than being tipped up on one marginal edge 21 or the other 22.

As a typical example of dimensions for the guiding member 14, one embodiment has an overall length of 26 inches an overall width of 6 inches, and a thickness of 4 inches along the rear edge 20. The overall height of the

marginal edges 21 and 22 is also 4 inches. The transverse width of the recess is 4 inches (between the inside surfaces of the marginal projections 21 and 22) at the forward edge 19 of the guiding member 14 and this decreases to about 2¾ inches before merging into the rearmost transverse surfaces along the rear edge 20. The thickness of the forward leading edge 19 of the guiding member 14 is 1 inch. The material used is a 65-durometer Hycar rubber. Although neither the material nor any of these dimensions are critical, the overall width of 6 inches was selected so that the marginal projections 21 and 22 could easily straddle a keyseat, as at 24 (FIG. 4), that are often cut into the lower surfaces of deviated borehole sections during the drilling of the well. It will also be understood that the surfaces 17 and 18 could also be curved along their transverse dimensions rather than flat or planar.

It will also be appreciated that the heavier the well tool 10 is, the more momentum it can accumulate as it moves down substantially vertical portions of the borehole 11 so that when it enters a highly deviated portion (as shown in FIG. 1), its momentum will tend to carry the tool on through the deviated portion. This does not mean, however, that the present invention is limited only to heavy well tools. Where a relatively light tool is used, the member 14 will still function to lift the nose of the well tool 10 up and over obstructions that would otherwise halt the tool. Moreover, although the guiding member 14 can be made of more rigid materials, it is preferred to use such relatively stiff elastomeric materials to allow the member to flex upwardly as the forward edge 19 encounters an obstruction. The guiding member 14 should, of course, have sufficient rigidity that it can move downwardly without being bent so far upwardly by the upward flow of the borehole liquids as to unduly impede the forward progress of the tool 10.

Accordingly, it has been seen that the present invention provides new and improved means for facilitating the descent of a cable-suspended well tool through highly deviated well bores. By providing an upward lift through the guiding member to the lower end of a well tool, the tool will be more easily diverted upwardly over debris and the like in such slanted portions so as not to impede its forward progress.

While a particular embodiment of the present invention has been shown and described, it is apparent that changes and modifications may be made without departing from this invention in its broader aspects; and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. Apparatus particularly for use in deviated well bores and comprising: a well tool having a central axis; and guiding means on the lower end of said well tool adapted for riding along the upwardly facing surfaces of a deviated well bore, said guiding means including an elongated member having a rearward end adjacent to said lower end of said well tool and a forward end extending therebeyond along said central axis, said elongated member having at least one transverse lower surface between its said ends and bounded on its opposite sides by generally longitudinal edges.

2. The apparatus of claim 1 wherein said transverse lower surface is inclined upwardly toward said forward end of said elongated member.

3. The apparatus of claim 1 wherein said transverse lower surface is substantially planar.

4. The apparatus of claim 1 further including outstanding depending projections extending along said longitudinal edges.

5. The apparatus of claim 4 wherein said outstanding depending projections are of a substantially uniform height and said transverse lower surface therebetween is substantially planar and inclined upwardly and toward said forward end.

6. The apparatus of claim 5 wherein said elongated member is of an elastomeric material.

7. The apparatus of claim 5 wherein said elongated member further includes a second, substantially planar, transverse upper surface inclined downwardly toward said forward end of said elongated member; second outstanding upright projections of a uniform height extending along said longitudinal edges; and means rotatably connecting said rearward end of said elongated member to said lower end of said well tool.

8. The apparatus of claim 7 wherein said elongated member is of a fairly rigid elastomeric material.

9. Apparatus particularly for use in deviated well bores and comprising: a well tool having a central axis; an elongated, generally flat member having a rearward end adjacent to the lower end of said well tool and a forward end extending therebeyond along said central axis, said elongated member having opposed upper and lower inclined transverse surfaces between its said ends with said transverse surfaces converging toward one another and said forward end to define a generally wedge-shaped, flattened, central portion, and outstanding elongated marginal projections of a substantially uniform height and extending longitudinally along the opposite sides of said central portion above and below each of said transverse surfaces, respectively; and swivel means rotatably connecting said rearward end of said elongated member to said lower end of said well tool.

10. The apparatus of claim 9 wherein said transverse surfaces are substantially planar.

11. The apparatus of claim 10 wherein said elongated member is of a fairly rigid elastomeric material.

12. Apparatus particularly for use in deviated well bores having liquids therein and comprising: a well tool; and guiding means coupled to the lower end of said well tool and including an elongated body having a length greater than its transverse width and its transverse width greater than its height, said body having means extending along its length for spacing said body above the upwardly facing surfaces of a deviated well bore to permit well bore liquids to flow under said body and exert pressure forces thereon tending to lift said body as said well tool progresses down the well bore.

13. The apparatus of claim 12 further including swivel means rotatably coupling said guiding means to said lower end of said well tool.

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