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DEFLECTING TOOL

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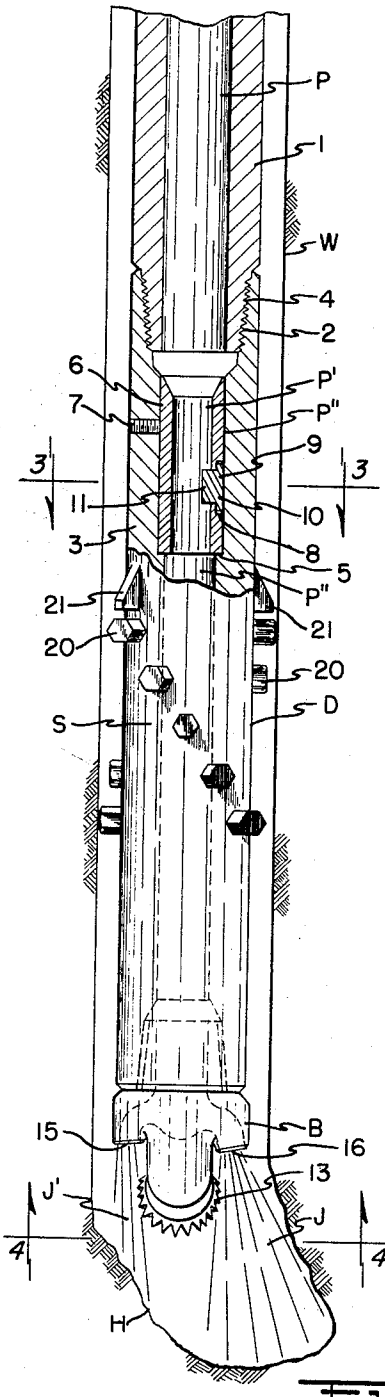


Fig. 1

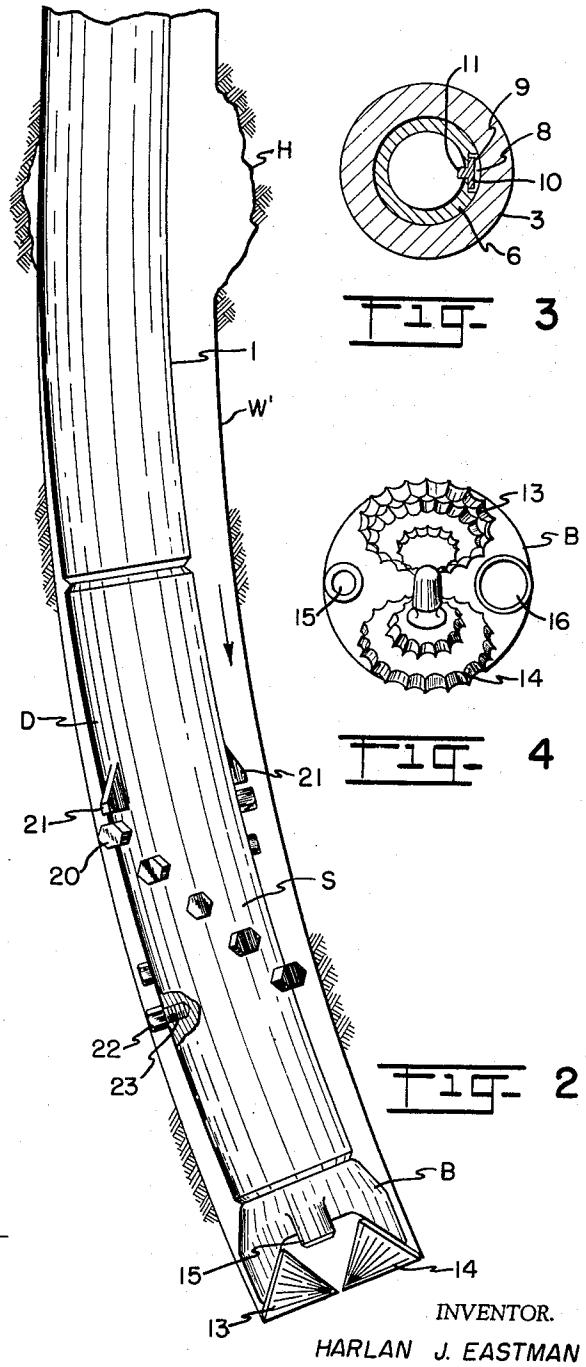


Fig. 2

Fig. 3

Fig. 4

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DEFLECTING TOOL

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This invention relates to new and useful improvements in deflecting tools and particularly to an improved deflecting tool of the type that is adapted to be connected to the lower portion of a drill pipe and used for directionally drilling formations upon subsequent rotation of the drill pipe whereby the bore will be drilled at a desired angle with respect to the remainder of the bore.

There are available many deflecting tools for effectively drilling a well bore at an angle from the vertical whereby controlled directional drilling of the well may be accomplished. As examples of such, reference is made to the G. E. Brown U.S. Patents 2,643,859 and 2,691,507, as well as recently issued Lindsay et al. and James et al. Patents 2,819,039 and 2,819,040 respectively, all of said patents together with the present invention being owned in their entirety by a common assignee. Irrespective of the foregoing, there has been found to be a need for providing a deflecting tool particularly usable in connection with directionally drilling soft formations and this is the primary purpose of the present design.

Thus it is the primary object of this invention to provide an improved deflecting tool for effectively drilling a well bore in soft formations at a desired angle from the vertical whereby directional drilling of the well may be accomplished.

Another object of the invention is to provide an improved deflecting tool of the type described that is particularly designed to directionally drill soft formations and wherein directional drilling time and cost by the use thereof will be reduced considerably.

Yet another object is to provide an improved deflecting tool for soft formations which is simple and rugged in construction and which incorporates structure permitting improved orientation.

The construction designed to carry out the invention will be hereinafter described, together with other features thereof and will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof wherein an example of the invention is shown and wherein:

Figure 1 is an elevational view, partly in section, of the lower portion of a drill stem within a well bore and showing the improved deflecting tool connected thereto;

Figure 2 is an elevation view similar to that of Figure 1 but taken approximately 90 degrees in relation thereto and illustrating the position of the parts following the initial deflection in the well;

Figure 3 is a sectional view taken along the lines 3—3 of Figure 1; and

Figure 4 is a view taken along the lines 4—4 of Figure 1.

As previously mentioned, there has been a definite need for providing a simple and rugged deflecting tool specifically designed for use in directionally drilling soft formations at a minimum of time and expense. It is to be understood that this is the main purpose of the present deflecting tool, although other uses thereof will be apparent. In the drawing and particularly referring to Figures 1, 3 and 4, numeral W represents the lower portion of a well bore. At numeral 1 is the lower portion of the drill stem which is adapted to impart rotation to the drill bit B as will be explained hereinafter. Portion 1 is in the form of a hollow cylindrical member having a passage P extending longitudinally therethrough and for orientation purposes member 1 is constructed of non-magnetic material and in actuality takes the form of a drill collar securable to the drill pipe not shown. At its lower terminal point drill collar 1 is threaded as at 2 to receive the improved deflecting tool of this invention, generally represented by the numeral D, and including as principal elements thereof an elongated body 3 and bit B.

Member 3 is hollow throughout its longitudinal length to provide a passage P″ enlarged at its upper end to provide shoulder means 5 and communicating in fluid flow relationship with passage P when the deflecting tool D is secured to the drill collar 1. At its upper end tubular member 3 is threaded as at 4 and such meshes with the threads 2 of the collar 1 to properly secure in the usual manner deflecting tool D to the drill collar. Positioned within passage P″ adjacent and at the upper end thereof and supported on shoulder 5 is an orienting sleeve 6 which takes the form of a tubular or hollow member, also having a passage P′ longitudinally extending therethrough and due to the thickness of the wall of the sleeve 6 it is apparent that there is no real restriction of fluid flow between passages P, P′ and P″. The sleeve 6 is maintained in position in passage P′ of portion 3 by means of one or more screws 7 extending transversely through the wall of member 3 or, in other words, upon unloosening screw means 7 sleeve 6 may be rotated a desired amount within passage P″ and thereafter positioned and locked securely in place by tightening screw means 7. As shown clearly in Figures 1 and 3, the wall of sleeve 6 is slotted or recessed as at 8 for receiving and carrying a T-shaped member 9 having a head 10 and a part 11 which extends inwardly of the sleeve and into the passage P′ to form what is known as an orienting key, the purpose of which will be explained hereinafter.

Now considering bit B and referring to Figures 1 and 4, it will be noted that the bit is provided with two cones 13 and 14 (instead of the usual symmetrically arranged three cones) and these cones are, as is clearly shown in Figure 4, diametrically opposed. Also diametrically opposed but in a plane at 90 degrees to the plane of cones 13 and 14 are two orifices 15 and 16 which communicate with passage P″ as shown in dotted lines and bit B is integrally secured by the threaded connection shown in dotted lines in the usual manner to member 3. Thus it will be apparent that as fluid under pressure is pumped from the surface down through the passages and to orifices 15 and 16 a jetting action will be directed against the lower part of bore W.

Obviously one of the objects of the deflecting tool D is in providing in the desired direction by fluid passing through the tool a deflected hole in the well bore W and this is shown at H. Following the provision of this hole H it is desirable to have the deflecting tool D enter same for the purpose of continuing the desired direction of drilling. Although the individual cones 13 and 14 are actually larger in size than the individual cones of the usual tri-cone bit, the net effect of the two cones is to cover less area at the bottom of the bore than the three cones of a tri-cone bit. This is important, as is the fact that cones 13 and 14 are diametrically opposed, as such results in making it possible for more area to be exposed to jetting action and in having the entire bit narrow at its bottom to simulate a chisel for easy entry of the bit into the deflected hole H. Also of great importance is the fact that the diameter and size of orifice

16 is much larger than the diameter and size of orifice 15 and this will be readily apparent by referring to Figure 5. In addition it will be noted that the axial direction of orifice 16 is at an angle to the longitudinal axis of member 3 and bore W to the extent of about 10 degrees and orifice 15 is also at an angle to this longitudinal axis of preferably from 3 to 5 degrees with both orifices being downwardly directed in a substantially common direction.

As is well known in the field of directional drilling, stabilizers are common for the purpose of maintaining a hole straight or they may be employed to maintain a given directional course of the drill bit. It has been found most desirable to provide tool D with the stabilizer section S on the exterior surface of a portion of body 3. In the particular stabilizer S there are three longitudinally arranged rows of spaced buttons 20 and the rows are spaced substantially 120 degrees apart and they spiral about the exterior surface of body 3. With this arrangement of the buttons there will be adequate space between the rows and buttons so that circulating liquid can readily circulate up outside the body 3 during its return path to the surface. These buttons vary in size as illustrated and although it is preferable to have them of the interchangeable type as exemplified by the hexagonal head 22 and threaded stem 23, they may take various forms. Positioned above the uppermost button of each row is a tapered fin 21 which prevents any serious damage to the stabilizer during removal of the tool D from the well bore and the fins also function to prevent damage to the lower end of the casing (not shown) and to prevent sticking of the assembly in the well.

Assuming for the moment that a straight bore W has been drilled and it is desired to alter the course of direction of this bore. Also assume that the formation of bore W is a soft one wherein a strong fluid jetting action will properly form washout areas. Still further assume that it is desired that the direction of the well bore be altered from straight to follow the approximate path of the arrow in Figure 2. At this time the deflecting tool D is attached to the drill collar 1 and prior to running this assembly into the hole W the orienting sleeve 6 is rotated to align the key 11 thereof with the large jet 16 of the drill bit B and obviously this may be accomplished by various means at the surface of the well. Next the drilling string with the deflecting tool D secured thereto assumes the position shown in the well in Figure 1 and at this time both the orifice 16 and the key 11 aligned therewith are oriented in the desired direction by, for example, the mule shoe technique illustrated in Bremner et al. United States Patent 2,207,505 and thus orifice 16 will be facing in the deflection direction desired.

Referring to the latter patent, key 13 thereof which is to travel in slot 25 is comparable to the present key 11 and it is to be noted that sleeve 6 and key 11 are positioned in tool D immediately adjacent collar 1, thus eliminating the necessity of additional elements being installed and connected, all of which provides improved orientation.

Upon now forcing mud or other hydraulic fluid under pressure through the passages P, P' and P'' and through orifices 15 and 16, the jet actions illustrated by J and J' in Figure 1 take place to form in the soft formation the hole H and, of course, during this operation the drilling string is not rotated. It is emphasized again that the size and angular direction of orifices 15 and 16 is particularly important in properly forming the hole H. For example, the main washout is desired in the direction of jet J and the size and angular position of orifice 16 permits this and on the other hand to permit easy entry of the bit B into hole H, some washout is necessary at J' and the size and angular position of orifice 15 results in the latter occurring. Following this jetting action, drilling commences in the usual manner by rotating the drill string and due to the described design of bit B it easily enters the deflecting hole H. By continuing rotation of the drill pipe and the action of the drill bit the bore is further drilled in a downwardly direction and takes the path represented by W' and the arrow of Figure 2. During the latter action when rotation is started, the stabilizer S assists in turning the corner by smoothing out the dog leg or hole H on the high side and throughout the movement of the drilling assembly in the direction of the arrow the stabilizer acts as a fulcrum for building up additional angle. Of course, the drill pipe itself is somewhat flexible to permit, in the usual manner, following the deviated course and to control the direction of drilling periodic readings are taken to determine the position and direction of bit B whereupon, if necessary, further deflection may be caused to take place.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A deflecting tool particularly designed for use in directionally drilling soft formations and adapted to be connected to the lower portion of a drill stem and lowered in a well bore comprising an elongated tubular member having a longitudinal passage therethrough from its lower end to its upper end through which fluid under pressure may pass, a drilling bit secured to the lower end of said tubular member, said bit having a pair of downwardly directed orifices proportioned for the discharge of fluid in a predetermined direction to cause the formation of a deflected opening for altering the course of drilling, both of said orifices being in fluid flow relationship with said passage, one of said orifices being of larger size than the other for discharging a major portion of fluid therefrom, said orifices being spaced from one another and located in diametrically opposed relationship in a vertical plane extending through the longitudinal center of said bit, said bit also having a pair of drilling cones located in diametrically opposed relationship and disposed in a vertical plane extending through the longitudinal center of said bit transverse to the vertical plane of the orifices.

2. A deflecting tool as defined in claim 1 wherein the one orifice is directed at a small angle away from the longitudinal axis of the tubular member.

3. A deflecting tool as defined in claim 2 wherein the other orifice is directed at a small angle towards the longitudinal axis of the tubular member.

4. A deflecting tool as defined in claim 3 wherein there is provided an orienting part engageable by an orienting tool adjacent the upper end of the tubular member with which the one orifice is aligned whereby the direction of the one orifice may be determined.

5. A deflecting tool as defined in claim 4 wherein there is provided stabilizer means on the exterior surface of said tubular member, said stabilizer means comprising longitudinally extending rows of buttons with each row arranged in a spiral, the rows and buttons in each row being spaced from one another.

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