Jan. 7, 1964 R. LEMONS 3,116,799

WHIPSTOCK APPARATUS AND METHOD OF USING THE SAME

Filed Aug. 1, 1960 2 Sheets-Sheet 1

FIG. 1.

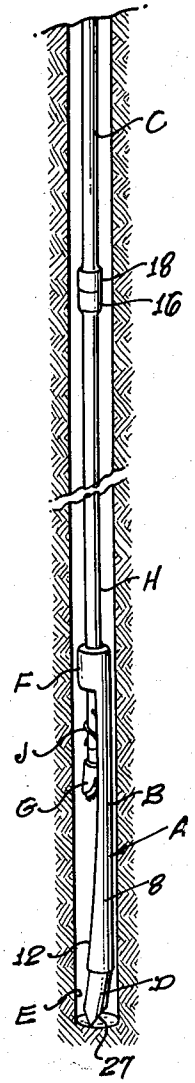


FIG. 2.

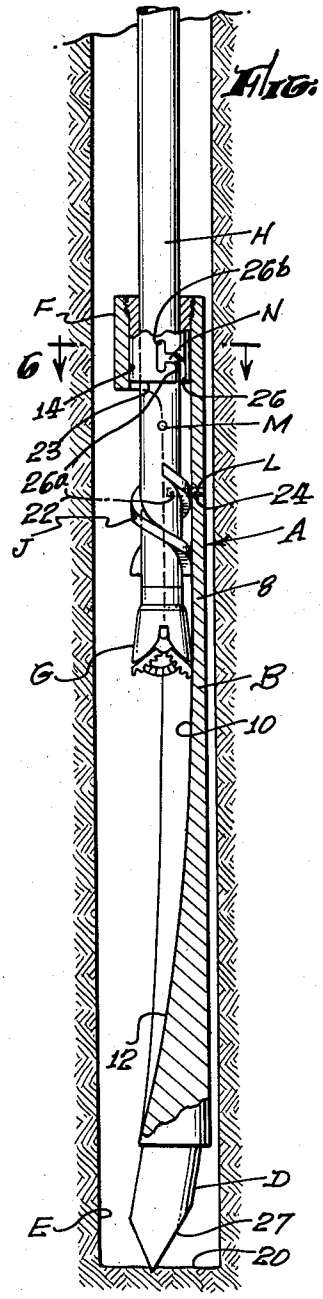
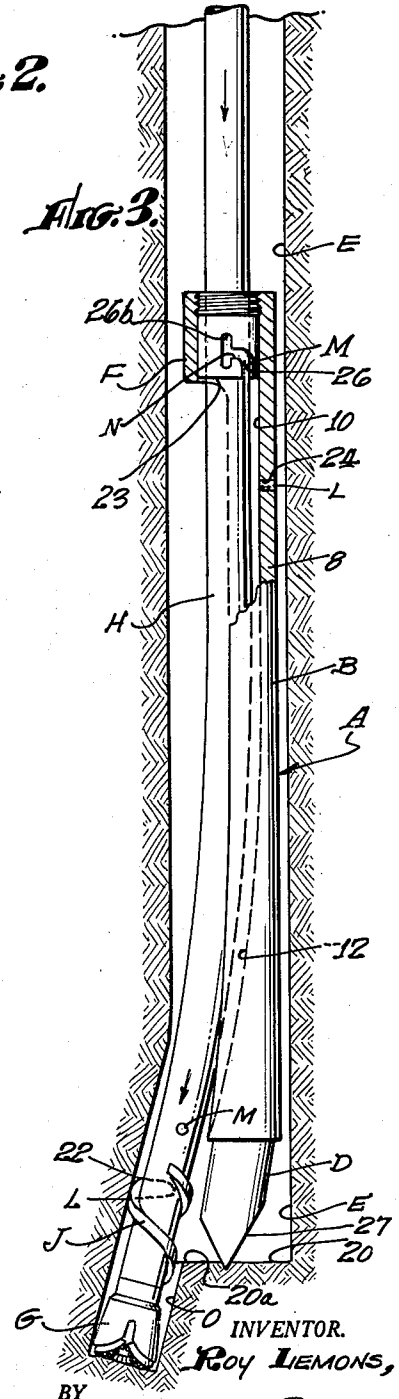


FIG. 3.



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Filed Aug. 1, 1960 2 Sheets-Sheet 2

FIG. 4.

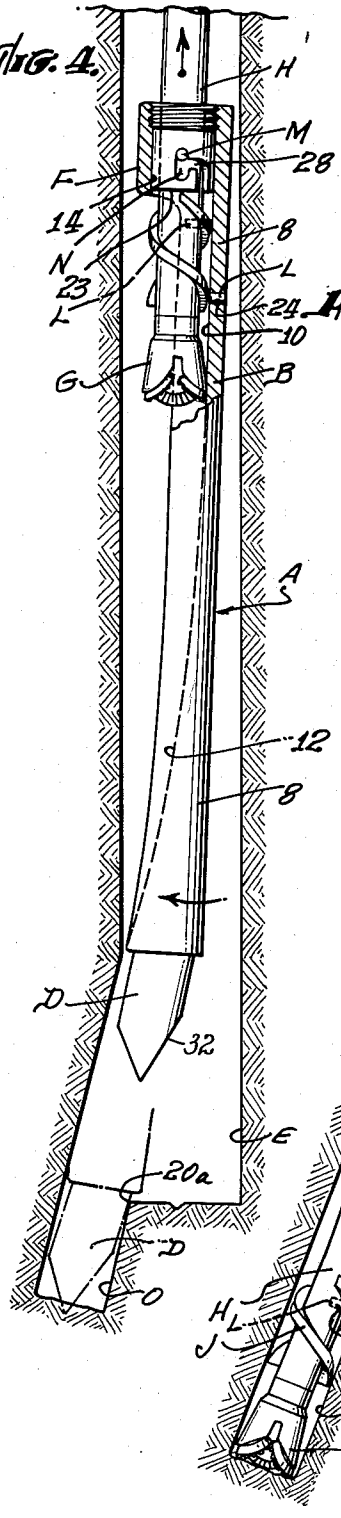


FIG. 5.

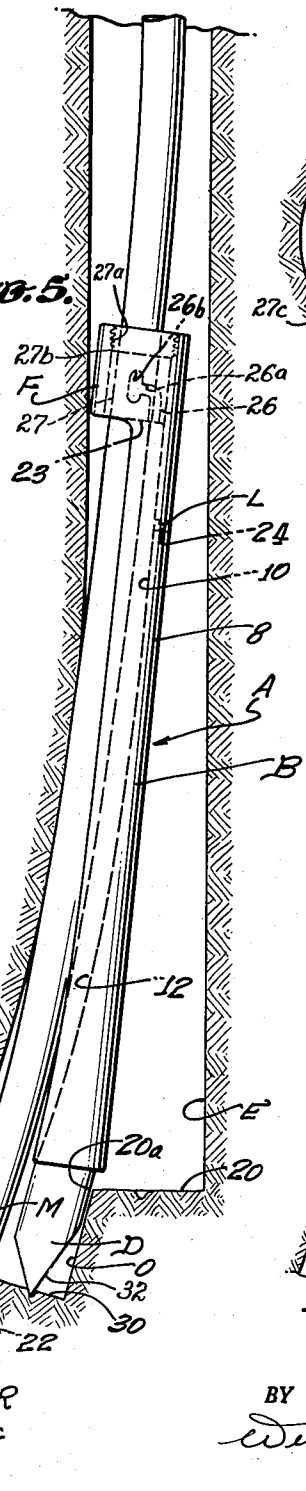


FIG. 6.

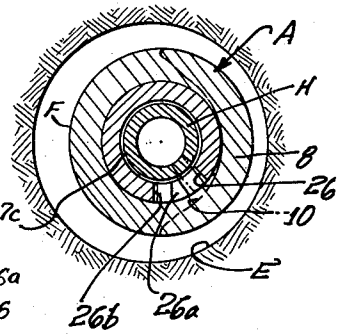
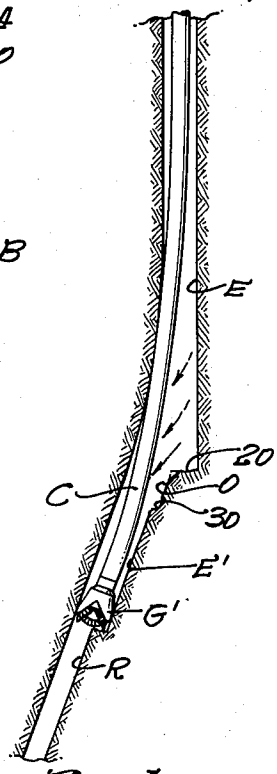


FIG. 7.



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WHIPSTOCK APPARATUS AND METHOD OF USING THE SAME

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7 Claims. (Cl. 175—61)

The present invention relates generally to the field of oil field equipment, and more particularly to an improved and useful whipstock apparatus, and the method of using the same.

The whipstock type of drilling apparatus has been in general use for some time, and is particularly well adapted for use in directing a drilling bit at an angle relative to a first portion of a bore which has already been drilled. Whipstock apparatus is also useful in sidetracking operations wherein the drilling bit is deflected from its first course to a second course that is angularly disposed relative thereto, and for the purpose of intentionally curving the well bore to reach a desired objective.

Although many types of whipstock apparatus have been devised in the past and are in present-day use, there are certain operational disadvantages in this equipment which render the results attained thereby uncertain, and some of them are of such structure that they must remain in the bore hole during the drilling operation.

A major object of the present invention is to provide a whipstock apparatus that is of extremely simple mechanical structure, may be quickly installed and is easy to use, and may be used to form a section of a first bore hole adjacent the bottom thereof or a plug in said bore hole defining said bottom into an angularly disposed upper section of a second bore hole which the drilling bit is to enter and follow, with the angular section being located at a desired depth and at a desired angle relative to said first bore hole portion.

These and other objects and advantages of the invention will become apparent from the following description of a preferred form thereof as shown in the accompanying drawings in which:

FIGURE 1 is a side elevational view of the invention shown suspended from a drilling string and resting on the bottom of a first portion of a bore hole;

FIGURE 2 is a combined vertical cross-sectional and side elevational view of the apparatus shown in FIGURE 1;

FIGURE 3 is a combined side elevational and vertical cross-sectional view of the invention shown in FIGURE 2 after actuation thereof with the bit portion in readiness to drill a first pilot hole;

FIGURE 4 is a combined vertical cross-sectional and side elevational view of the invention after the first pilot hole has been drilled, showing the bit portion thereof retracted into an upwardly disposed position;

FIGURE 5 is a side elevational view of the invention with the whipstock portion thereof shown supported in the first pilot hole after the drill bit portion has drilled a second pilot hole outwardly disposed from said first pilot hole and of greater depth;

FIGURE 6 is a transverse cross-sectional view of the apparatus taken on line 6—6 of FIGURE 2; and

FIGURE 7 is a side elevational view of a drilling string shown supporting a second drill bit of substantially the same transverse cross section as the first portion of the bore hole after the bit has entered the upper ends of the first and second pilot holes and continues to follow the course defined by said second hole.

Referring to the drawing for the general arrangement of the invention, it will be seen that the letter A generally designates a whipstock apparatus which includes an elongate body 8 that is arcuate in transverse cross section.

The upper portion of body 8 has a wall of constant thickness whereby a face 10 of this portion of the body is substantially straight or parallel to the longitudinal axis of the whipstock apparatus A. This straight portion of body 8 extends from the upper end thereof to an intermediate point indicated by the letter B (FIGURES 1 and 2).

Below point B the body 8 is wedge-shaped to form an elongate inclined guide surface 12 which is transversely concave, and in a longitudinal direction extends downwardly and outwardly. The lower end of body 8 develops into an extension D that is pointed or sharpened to facilitate engagement thereof with the bottom of a bore hole E or a cement plug (not shown) that defines the bottom of the bore hole. A retrieving collar F is provided at the upper end of the whipstock body 8 and is preferably an integral part thereof.

A first drill bit G of substantially lesser transverse cross section than the bore hole E is positioned below the collar F and connected to the lower end of an elongate sub H, best seen in FIGURE 1. The upper end of sub H is connected to the lower end of a string of drill pipe C. As may be clearly seen in FIGURES 1 and 2, the outer diameter of the sub H is smaller than a bore that extends through a sleeve 27 later to be described. Sleeve 27 is mounted in the collar F. The upper portion of the sub H is freely movable in sleeve 27. A spirally extending spacer J is formed on the lower exterior surface of sub H, which spacer is capable of slidably and rotatably engaging the face 10 and surface 12 and serves to hold the first drill bit G outwardly therefrom during the time the drill bit G moves downwardly thereby.

The sub H and first bit G are, prior to using the invention, connected to the whipstock body 8 by a first frangible means such as an externally threaded shear pin L. A tapped bore 22 extends inwardly from the external surface of spacer J into the body of sub H. The tapped bore 22 is horizontally alignable with a tapped bore 24 formed in body 8, as best seen in FIGURE 2. When bores 22 and 24 are in horizontal alignment they may be threadedly engaged by the shear pin L. Bores 22 and 24 are so horizontally aligned that the sub H and first bit G are held in the fixed position shown in the drawings relative to the body 8 when the bores are engaged by the externally threaded pin L. Also, it will be noted that when the pin L engages bores 22 and 24, the sub H is disposed within the collar F, with the first bit G located a substantial distance below the lower edge 23 thereof.

A locking pin M projects outwardly from sub H. Pin M is situated above and in FIGURE 2 is shown as being spaced 90° therefrom. Locking pin M projects outwardly from sub H a distance no greater than the thickness of spacer J so that the locking pin will not interfere with rotation of sub H or slidable movement of the sub relative to the face 10 or surface 12 on body 8. A sleeve 27 is provided which has external threads 27*a* formed on the upper portion thereof. The threads 27*a* engage threads 27*b* formed in collar F as shown in FIGURE 5 to hold the sleeve in position therein.

An inverted J-shaped slot N is formed in sleeve 27 which extends upwardly from the lower edge thereof. Slot N is defined by a first vertically extending portion 26, a horizontal portion 26*a*, and a second vertical portion 26*b* that is in longitudinal alignment with the pin M. The transverse cross section of locking pin M is such as to permit slidable movement thereof within the confines of slot N. When locking pin M is disposed in slot N it prevents rotation of sub H and first bit G relative to body 8. Pin M is preferably formed of a frangible material that breaks when subjected to a substantial downwardly

directed force. The diameter of the interior of sleeve 27 is sufficiently larger than the external diameter of sub H that collar F, sleeve 27, whipstock body 8 can pivot laterally relative to the sub H when the pin M is in engagement with slot 25 and the invention is disposed as shown in FIGURE 4. Collar F and sleeve H, as may be seen in FIGURE 6, are separated by an annulus-shaped space 27c.

Before the invention is used the shear pin L is placed in engagement with bores 22 and 24 whereby the sub H and first bit G are held in a fixed position relative to body 8. The upper end 16 of sub H is threaded and connected to a lower threaded end 18 of the tubing string C. The whipstock apparatus is then ready to be lowered into the bore hole E in the form shown in FIGURE 1 until the extension D rests on the bottom 20, or the upper surface of a plug (not shown). Prior to actual use the apparatus is so oriented adjacent the bottom 20 that the surface 12 of body 8 slopes downwardly and outwardly in the direction it is desired to drill the second angularly disposed well bore portion E'. The shear pin L, together with sleeve 27, serve to hold the whipstock body 8 in a substantially fixed, downwardly extending position relative to sub H as the whipstock assembly A is lowered into bore hole C to the position shown in FIGURE 1.

Upon orientation of body 8 and with the extension D in contact with bottom 20, a downward force is applied to the sub H sufficient to break the shear pin L. The sub H and first bit G can then be lowered relative to body 8, with the sub and first bit being guided downwardly and outwardly away from the body by the spacer J which is in slidable and rotatable contact with the surface 12. As sub H and first bit G start to move downwardly relative to body 8, the string of drill pipe C is caused to rotate by power means (not shown). When bit G is so rotated it does not contact body 8 as the spacer J is in slidable and rotatable contact with surface 12.

Rotation of drill string C, when extension D is resting on bottom 20, permits the bit G to drill a first angularly disposed pilot hole O. Pilot hole O is preferably drilled to such depth that the extension D can be disposed substantially within the confines thereof, as may best be seen in FIGURE 4. The transverse cross section of at least a portion of extension D is substantially the same as that of the pilot hole O drilled by the first bit G.

After the first set of the invention has been made as described hereinabove and the first pilot hole O drilled, the sub H and first bit G are moved upwardly relative to body 8 until the pin M contacts the lower edge 23 of sleeve 27. Drill pipe C is then slowly rotated with a slight upward pull thereon. When pin M is rotated to a position in vertical alignment with the first portion 26 of slot N, the pin moves upwardly therein. By manipulation of drill pipe C, the sub H is so rotated and moved as to place the pin M in the vertical portion 26b of the slot N (FIGURE 4). Drill pipe C is thereafter moved upwardly, and the body 8, sub H and first bit G are also moved upwardly as an integral unit to the position shown in FIGURE 4 of the drawings. The center of gravity of the whipstock body 8 is such that when the body 8, collar F, and sleeve 27 are pivotally supported by pin M as shown in FIGURE 4, the assembly A will, by force of gravity, assume the position shown therein.

The drill pipe C is a gain lowered, with concurrent lowering of body 8, extension D, sub H and first bit G. Extension D has a tapered face 32 that slidably engages the most outwardly disposed portion 20a of the bottom 20, and the face 32 serves to guide extension D into the first pilot hole O to effect a second set of the whipstock apparatus. On some occasions it will be found that the outermost part of the bottom 20 is sluffed off by the extension D as it is lowered into the well bore, but this does not affect the operation as the extension D is still guided into the pilot hole O. After extension D is disposed in pilot hole O, the drilling string C is either rotated and

moved to disengage pin M from slot N, or a substantial downward force is applied through the drill string C to the sub H to cause pin M to be sheared from the sub. Irrespective of which of the above steps is pursued, the sub H and first bit G can thereafter be moved downwardly relative to body 8.

Drill string C is continuously rotated after disengagement of pin M from slot N and concurrently moved downwardly. Rotation of the first bit G results in drilling of a second pilot hole R, as may best be seen in FIGURE 5. Drilling of pilot hole R is continued until it is approximately twelve to fifteen feet deep. Drill string C is then raised, with concurrent upward movement of sub H and first bit G relative to body 8. If the pin M has been previously sheared, this upward movement of sub G will result in the upper end of spacer J contacting the lower edge 23 of sleeve 27 whereby the sub H, first bit G and body 8 are thereafter moved upwardly through bore hole E to the ground surface. The same result is achieved if the pin M has not been sheared off. However, in such a situation the pin M rather than the upper end of the spacer contacts the lower edge 23 of sleeve 27. It will be particularly noted in FIGURE 5 that after the pilot holes O and R are drilled, at least the upper portions thereof are in communication and the pilot holes are radially aligned relative to the first portion of bore hole E.

A second drill bit G' is then mounted on the lower end of drill pipe C. The transverse cross section of bit G' is such that when the second bore hole portion E' is drilled it will be of substantially the same diameter as that of the first portion of bore hole E. The drill pipe C with second drill bit G' supported therefrom is lowered into the well bore, and rotated in a direction so that when bit G' contacts the outer section of the bottom 20 which remains, the drill bit G' will tend to drift in a direction following the outer surface S of the second pilot hole R, as may best be seen in FIGURE 7. By the time the second drill bit G' has traversed the length of the second bore hole R and enlarged it to the same diameter as that of the first portion of bore hole E, the directional deviation of the drill bit G' has been established, and the second bore hole portion E' will be drilled at a desired angle and at a desired depth from the first portion of the hole E. Drill bits G and G' are of a type that have smooth cylindrical side walls, with cutting faces on only the lower extremities of the bits. Orientation of the whipstock body 8 in a desired position as shown in FIGURES 2 to 5 inclusive is, of course, effected by rotation of drill pipe C. To orient the whipstock body 8 in a particular direction by rotation of the drill pipe C, apparatus and methods are employed which are well known in the art and commonly used in orienting whipstocks in a bore hole. One such method and apparatus is the Eastman Surface Orientation Service and Equipment described and illustrated on pages 1510 and 1511, volume 1, Composite Catalog of Oil Field and Pipeline Equipment. This apparatus and method is provided by the Eastman Oil Well Survey Co., Denver 1, Colorado. Inasmuch as the above means were well known in the art as of the filing date of the present application, and furthermore since they form no part of the present invention, they are not described herein.

It will be obvious to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof, and therefore the invention is not limited by that which is shown in the drawing and described in the specification, but only as defined in the appended claims.

I claim:

1. A method of drilling an oil well bore that has a first portion which extends to a desired depth, with a second portion thereof extending from the lower extremity of said first portion at a desired angle, including the steps of: drilling said first portion of said bore to said desired depth; drilling a first pilot hole of lesser transverse cross section than that of said first bore portion, with the center

line of said first pilot hole being offset from the center line of said first bore portion, said first pilot hole being angularly disposed relative to said first bore portion at an angle that is substantially the angle said second bore portion will have relative to said first bore portion, which first hole originates at substantially the same depth as the bottom of said first bore portion; drilling a second pilot hole of substantially the same transverse cross section as that of said first pilot hole, said second hole originating at substantially the depth of said bottom of said first bore portion, with the center line of said second pilot hole being offset outwardly from said center line of said first pilot hole by a distance which is substantially the same as the diameter of said first pilot hole, with the angle of said center line of said second pilot hole relative to said center line of said first bore portion being at said desired angle; lowering a hard rotating drilling surface which has a cylindrical non-drilling side surface into said first bore portion until said hard surface contacts that part of the bottom of said first bore hole portion which has not been drilled away in forming said first pilot hole, said drilling surface being substantially greater in transverse cross section than that of said first pilot hole; applying a downward force to said drilling surface while concurrently rotating the same to cause said drilling surface to drift toward and enter the combined upper sections of said first and second pilot holes and thereafter drill downwardly at said desired angle, with the orientation of said drilling surface initially taking place at said desired angle when said non-drilling side surface of said drilling surface is in slidable rotating contact with the outermost interior surface of said second pilot hole as said drilling surface moves downwardly through said second pilot hole.

2. A method as defined in claim 1 which includes the further steps of temporarily disposing an elongate, downwardly and outwardly extending surface in said first bore portion adjacent said bottom thereof, drilling said first pilot hole with a rotating drilling surface that is substantially smaller in transverse cross section than that of said drilling surface used in drilling said first bore portion, and orienting said smaller drilling surface to drill said first pilot hole at an angle by causing said smaller drilling surface to rotate and slide against said elongate surface prior to lowering said smaller drilling surface below said elongate surface.

3. A method as defined in claim 2 which includes the further steps of moving said elongate surface after said first pilot hole has been drilled to dispose said elongate surface in a fixed position relative thereto, after which said smaller drilling surface is moved downwardly relative to said elongate surface and is in slidable and rotatable contact therewith, which smaller drilling surface is so oriented due to said contact as to drill said second pilot hole at said desired angle.

4. A method as defined in claim 3 wherein said elongate surface has a downward extension that is not contactable by said smaller drilling surface, and including the further step of lowering said extension into said first pilot hole to snugly engage the same and hold said elongate surface in a position to guide and orient said smaller drilling surface to drill said second pilot hole at said desired angle.

5. An apparatus for use with a vertically movable, power rotated drilling string in drilling first and second angularly disposed, radially aligned pilot holes downwardly from the bottom of a first bore hole portion, including: an elongate whipstock body having at least the lower portion of a first face thereof sloping downwardly and outwardly; tubular means supported on the upper end of said body, said means having a J-slot formed therein that extends upwardly from the lower edge thereof and is in communication with the interior surface of said means; an elongate drill sub, the upper portion at least of which is of smaller transverse cross section than that of the interior of said tubular means, with said upper portion being connected to the lower end of said string; a drill bit mounted on the lower extremity of said sub below said tubular means for drilling said pilot holes; rigid spacing means on said sub for holding said bit in desired lateral spacing relative to said first face of said body, with the combined transverse cross section of said sub and spacing means being greater than the interior transverse cross section of said tubular means to prevent separation of said sub from said tubular means and body by force of gravity; frangible means extending between said sub and said whipstock body for holding said sub and said bit at a fixed first position relative to said whipstock body while said body, bit and sub are being lowered to said bottom; a pin extending outwardly from said sub and located intermediate said tubular means and bit that is capable of removably engaging said slot after said frangible means has been broken to pivotally support said tubular means and whipstock body, with said body being of such shape and the center of gravity thereof so located that said body pivots by force of gravity when so supported on said pin to a second position; and a depending rigid extension on the lower end of said whipstock body, said extension having an upper part that is of maximum transverse cross section of substantially the same area as the transverse cross section of one of said pilot holes, with said frangible means being broken when said extension forcibly contacts said bottom by downward movement of said drill string, whipstock body, sub and bit relative thereto, said sub, spacing means, pin, bit and drill string thereafter being vertically and rotatably movable relative to said whipstock body.

6. An apparatus as defined in claim 5 wherein said spacing means is a rigid spiral member mounted on the exterior surface of said sub.

7. An apparatus as defined in claim 5 wherein said frangible means is a breakable rigid member that extends between said sub and an upper portion of said whipstock body.

References Cited in the file of this patent

UNITED STATES PATENTS

1,806,509	Straatman	May 19, 1931
2,105,721	Cutrer et al.	Jan. 18, 1938
2,687,282	Sanders	Aug. 24, 1954
2,821,362	Hatcher	Jan. 28, 1958
2,873,092	Dwyer	Feb. 10, 1959