

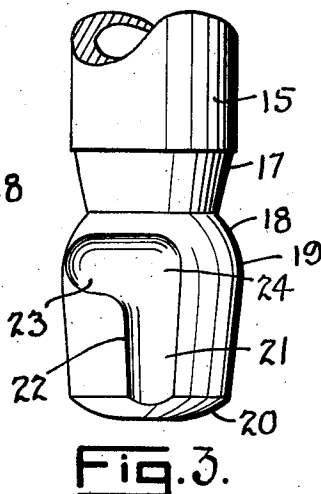
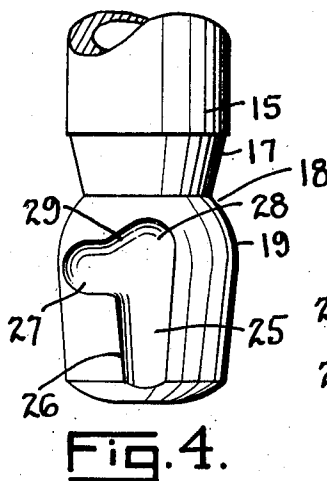
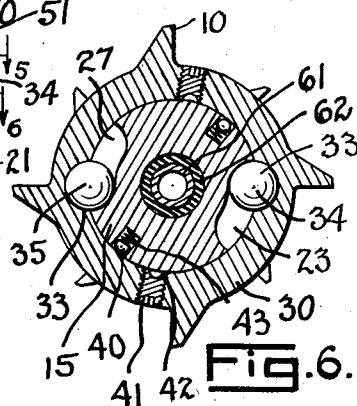
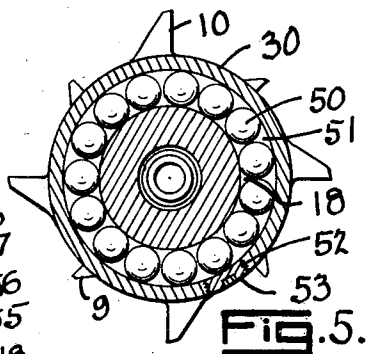
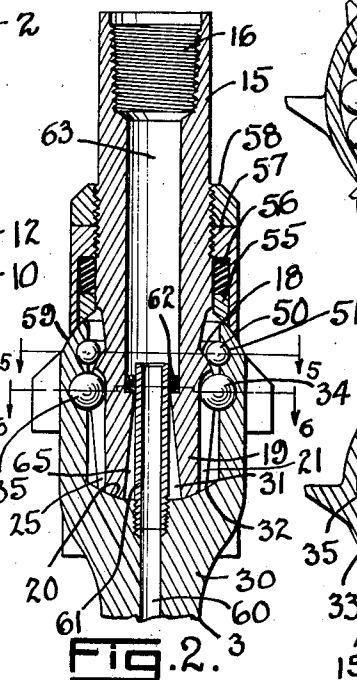
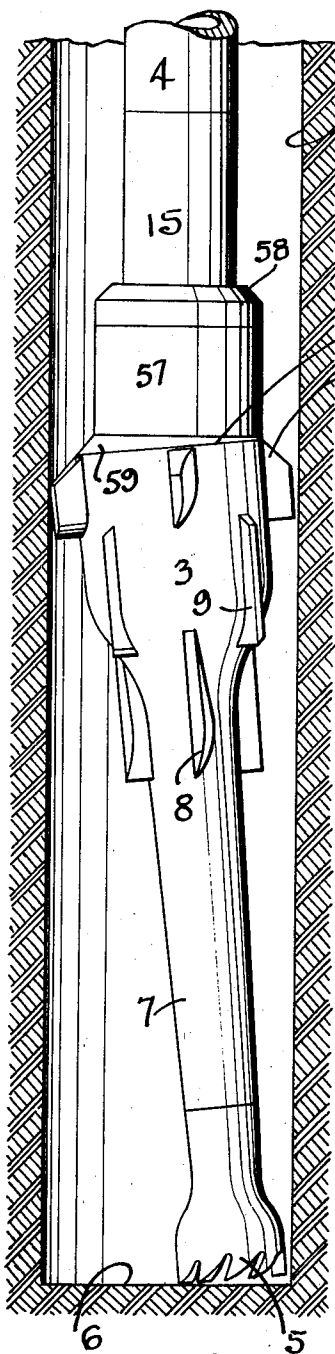
March 19, 1940.

J. D. BROCK ET AL

2,194,267

DRILLING TOOL

Filed Oct. 30, 1939



J.D. BROCK
R.A. WARREN
L.R. LEISSLER

Jesse R. Stone
Lester B. Clark
INVENTOR.
ATTORNEYS.

BY

UNITED STATES PATENT OFFICE

2,194,267

DRILLING TOOL

Jerome D. Brock, Lee R. Leissler, and Ralph A. Warren, Houston, Tex., assignors to Fullgauge Deflecting Tool Company, a corporation of Texas

Application October 30, 1939, Serial No. 301,984

13 Claims. (Cl. 255—1)

The invention relates to a full-gage drilling tool which is adapted to perform deflecting operations in order to direct the well bore in a desired direction.

In the rotary method of drilling practically all of the well bores are inclined or crooked due to the fact that the bit is rotating in a clockwise direction and tends to spin off of the various formations encountered. In other instances too much weight may cause buckling of the drilling stem and result in a crooked hole. It is therefore very often necessary to straighten the hole by deflecting it from its position into a more desirable direction. In other instances where the well bore is to be directed to a predetermined location the bore may be deflected from time to time and the present invention directs itself to a tool and a method of using the same whereby the hole may be directed and a full-gage hole drilled during the deflecting operation.

It is one of the objects of the invention to provide a deflecting tool which can be cocked in the deflected position to be lowered into the well bore and which may be released when rotation of the drill stem occurs in order to drive the bit.

Another object of the invention is to provide a full-gage deflecting drill.

Still another object of the invention is to provide a method of deflecting well bores wherein the deflecting tool can be lowered into the well bore, oriented into the desired position and a full-gage bore continued in the desired direction.

Another object of the invention is to provide a deflecting tool wherein the bit may be cocked relative to the drill stem by means of a guide means and trackway in a tiltable joint in the tool.

Still another object of the invention is to provide a tiltable joint for deflecting tool which can be cocked and uncocked by relative rotation in the joint.

Still another object of the invention is to provide a deflecting tool which includes a tiltable joint having a housing wherein multiple stage blades are carried by the housing to permit the drilling of a full-gage deflected bore.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawing wherein:

Fig. 1 is a vertical section of the lower end of the well bore and illustrating the deflecting tool in position engaging the bottom of the bore ready to conduct the deflecting operation.

Fig. 2 is a vertical section through the tiltable joint.

Fig. 3 is a side elevation of one side of the stem or mandrel illustrating one side of the trackway therein.

Fig. 4 is a side elevation of the opposite side of the stem or mandrel and illustrating the configuration of the trackway.

Figs. 5 and 6 are sections taken on the lines 5—5 and 6—6, respectively of Fig. 2.

In Fig. 1 a well bore 2 is to be deflected from the direction illustrated and to accomplish this the deflecting tool 3 has been lowered into the well bore by means of the drill or operating stem 4.

The cutting bit 5 of the deflecting tool has been engaged upon the bottom 6 of the well bore and as shown the tool is ready to be rotated so as to deflect the hole at the angle indicated by the shank 7 of the bit 5.

The several sets of blades 8, 9 and 10 are vertically arranged upon the tapered housing 3 so that they will ream out the small diameter bore which is cut by the bit 5. The blades 10 are of the same gage as the bit which drilled the bore 2 so that the deflected hole will be of full gage and no additional reaming operation will be necessary after the deflection has been performed, as is now the practice with other types of deflecting tools.

In order to position the bit 5 at an angle with respect to the drill stem 4 a tiltable joint 12 has been included as a part of the tool. This joint permits a predetermined amount of tilting of the bit relative to the stem and includes the interfitting parts which are best seen in Fig. 2 wherein a stem or mandrel 15 is threaded at its upper end at 16 for connection to the drill pipe 4. This stem is formed with a peculiar configuration at its lower end, the opposite sides of which are seen in elevation in Figs. 3 and 4. The stem has a tapered portion 17 which reaches an apex with the shoulder 18 and therebelow a rounded portion 19 is formed which terminates in a spherical-shaped lower end 20.

On the periphery of the portion 19 a trackway 21 is formed which has the lower or vertical leg portion 22. This trackway is substantially semi-circular in cross section and extends upwardly to merge with the lateral leg portion 23 which is upwardly inclined on its lower side. It is obvious that this trackway is therefore in substantially the shape of an inverted L having a heel portion 24, and is arranged to receive a guide means which will permit relative rotation of the interfitting parts of the tiltable joint so that the guide

means can travel laterally and upwardly in the leg 23.

The leg 21 is merely provided to permit insertion of the stem or mandrel into the outer portion of the joint.

Fig. 4 shows the opposite side of the mandrel or stem 15 and another trackway 25 is provided which has the vertical leg 26, the lateral leg 27 and in addition is provided with a socket portion 28 which is arranged at the junction of the vertical and the horizontal legs because the horizontal leg 27 is set downwardly a slight distance below the upper end of the vertical leg 26 so as to provide a beveled face 29. The comparative elevations of the legs 23 and 27 is apparent from comparison of Figs. 3 and 4. That portion of the vertical leg 25 which extends vertically upward beyond the horizontal leg 27 provides a socket 28. It seems obvious, therefore, that upon relative rotation of the stem and the other interfitting part of the joint the guide means in the leg 23 will travel laterally and upwardly around the lower face of the face 22 and into the leg 23, whereas the guide means in the leg 27 will travel downwardly from the socket 28 into the extreme left end of the trackway 27, as viewed in Fig. 4. Thus on one trackway 23 the guide means will be forced up while in the other trackway 27 the guide means will be forced down. This action accomplishes tilting of the bit which carries the guide means as will be now described.

Fig. 2 shows the other interfitting part of the joint 12 as arranged about the stem 15 and includes the housing 30 which has a chamber or recess 31 therein. This chamber is arranged to receive the portion 19 of the stem 15 so that the spherical portion 20 can move or slide upon the curved base 32 of this chamber, and in this manner a vertical thrust may be transmitted from the stem 15 to the housing 30 and the bit 5 in order to advance the bit in the drilling operation.

The housing 30 as best seen in Fig. 6 has diametrically opposed hemispherical recesses 33 therein which are arranged to receive the guide means or balls 34 and 35, the ball 34 fitting into the trackway 23 and the ball 35 fitting into the trackway 27. The balls 34 and 35 will be inserted in their respective sockets and the stem 15 moved downwardly into the chamber 31, the balls passing upwardly through the trackways 22 and 26, respectively, so that they arrive at the elevation of the transverse trackways 23 and the socket 28.

It seems clear that with the parts in this position the bit 5 will dangle from the stem 15 due to gravity because the balls 34 and 35 are both at the same horizontal elevation in the leg 22 in the trackway 21 and in the leg 27 of the trackway 25 respectively. The bit is now free to tilt in any direction. If the bit 5 is now grasped and rotated a portion of a turn in a clockwise direction, while the stem remains stationary, the ball 35 will be carried to the lefthand as viewed in Fig. 4 along the inclined surface 29 over to the lefthand end of the trackway 27 while the ball 34 will move in the trackway 23. The difference in elevation of the two balls caused by this movement will compel the housing 30 to be tilted. This in turn tilts the shank 7 and the bit 5 to the position shown in Fig. 1.

This tilting movement is permitted due to the taper of the portion 19 of the stem which fits in the recess 32.

The bit is now cocked at an angle and will nor-

mally remain in this position until the stem 15 is rotated in a clockwise direction.

If desired in order to maintain the bit in this cocked position the snap device 40, as seen in Fig. 6, may be provided. This device is in the form of a socket screw 41 carried by the housing 36, which is arranged to receive the ball 42 which is normally urged radially outward by a spring 43. Two of these devices are provided on opposite sides of the stem 15 so that the bit will not inadvertently be moved from this cocked position, and prevent any side swing in the bit and tend to provide a more accurate deflection. When the stem 15 is rotated in a clockwise direction, however, the torque will be sufficient to depress the balls 42 and allow the periphery of the wall of housing 30 to turn past the balls and allow the guides 34 and 35 to move in the trackways.

It seems obvious that when the bit is cocked, as seen in Fig. 1, and lowered into the well bore, and the bit 5 is placed upon the base 6 of the well bore, turning of the drill stem 4 will cause the immediate release of the tilting mechanism. The bit will remain in this tilted position because the bit 5 is pressed against the bottom of the well bore but when the stem 15 is turned the trackway 27 will slide along the ball 35. The upper socket portion 28 of the trackway 27 will not receive the ball, however, because the bit is inclined. Therefore, the ball will move into the upper portion of the vertical trackway 25 somewhat below the socket portion 28, as shown in Fig. 4.

In order to retain the housing 30 in proper position upon the stem 15 a series of retaining balls 50 are arranged in a groove 51 so as to abut the shoulder 18 on the stem. These balls are inserted through an opening 52, as seen in Fig. 5, which is thereafter closed by a plug 53. This retaining arrangement prevents longitudinal movement of the stem and the housing but permits relative rotation as is limited by the parts 34 and 35 as well as universal tilting when the bit is unlatched.

In order to seal the upper portion of the housing 30 about the stem 15 a seal ring 55 has been provided, which is surmounted by a resilient packing ring 56. These two parts are confined in a sleeve 57, which is threaded onto the outside of the stem and which is in turn locked in position with a lock ring 58. The surface of the sealing ring 55 is of the same configuration as the curved surface 59 on the upper end of the housing so that the housing may tilt. The resilient packing normally urges the seal ring against the surface 59 on the housing to prevent leakage. The inside of the joint may be filled with a suitable plastic lubricant.

In order to conduct fluid under pressure from the hollow stem 4 to discharge through the passage 60 in the bit a conduit 61 has been positioned in the upper end of the passage 60 so as to project upwardly into the chamber 31. This conduit may be in the form of a pipe and is arranged to be surrounded by a packing 62 carried in the lower end of the passage 63 in the stem 15. A suitable lip type of packing may be used so that the pressure in the passage 63 will tend to provide a seal around the conduit.

In order to permit the tilting of the stem relative to the conduit the inside of the stem is cutaway at 65 to provide a tapered opening which is of a size to permit tilting movement of the stem. It seems obvious that the bit can be

cocked before it is lowered into the well bore and merely pressed on the bottom of the bore. If the deflection is to occur in a predetermined or particular direction the bit may be suitably oriented. One such method is that disclosed generally in the patent to Heyer, No. 2,120,670, issued June 14, 1938, wherein a magnet is carried by the drill stem 4 adjacent the deflecting tool and a suitable detector instrument lowered into the drill stem to ascertain the orientation of the magnet. The position of the bit 5 relative to the magnet being known the tool can then be turned to the desired position, and then placed against the bottom of the bore. The stem 4 is now rotated which serves to unlatch the tilting joint so that the bit can drill at an angle with respect to the drill stem. The driving of the bit by the stem is accomplished through the balls 34 and 35 when the righthand side of the slots 21 and 25 abut against the balls. When sufficient deflecting has been accomplished the bit may be withdrawn from the well bore. In some instances it may be desirable to re-cock the bit and if such is the case the drill stem 4 may be rotated sharply to the left or in a counter-clockwise direction and unless the bit 5 is engaged against the well bore it seems clear that the bit would again be moved to cocked position.

Broadly the invention contemplates a means and method of deflecting well bores by using a bit which will drill a full gage hole at an angle with respect to the well bore.

What is claimed is:

1. A drilling tool of the character described comprising a stem, a bit, a tiltable joint to rotate said bit with said stem, and means in said joint including a guide and trackway to tilt the joint upon relative turning of the bit and stem.

2. A drilling tool of the character described comprising a stem, a bit, a tiltable joint to rotate said bit with said stem, and means in said joint including a guide and trackway to tilt the joint upon relative turning of the bit and stem, said trackway including a portion to elevate and depress one side of the bit.

3. A tiltable joint construction for deflecting bits for wells including a stem and housing having interfitting parts, a guide carried by one part, a guideway in the other part, said guideway being of a configuration to tilt said one part relative to the other upon relative turning of the parts.

4. A tiltable joint construction for deflecting bits for wells including a stem and housing having interfitting parts, a guide carried by one part, a guideway in the other part, said guideway being of a configuration to tilt said one part relative to the other upon relative turning of the parts, and reamer means on said housing so as to drill a full gage bore in a single deflecting drilling operation.

5. A tiltable driving joint for deflecting bits including a stem, a trackway on the outer periphery thereof, a housing about the end of said stem, a guide projecting inwardly in the housing to ride in said trackway so that turning of the stem relative to the housing in one direction will cock the bit in deflecting position and turning the stem in the other direction will allow the bit to dangle from the stem in substantially non-deflecting position.

6. A tiltable driving joint for deflecting bits including a stem, a trackway on the outer periphery thereof, a housing about the end of said stem, a guide projecting inwardly in the hous-

ing to ride in said trackway so that turning of the stem relative to the housing in one direction will cock the bit in deflecting position and turning the stem in the other direction will allow the bit to dangle from the stem in substantially non-deflecting position, said guide comprising a ball seated in the housing.

7. A tiltable driving joint for deflecting bits including a stem, a trackway on the outer periphery thereof, a housing about the end of said stem, a guide projecting inwardly in the housing to ride in said trackway so that turning of the stem relative to the housing in one direction will cock the bit in deflecting position and turning the stem in the other direction will allow the bit to dangle from the stem in substantially non-deflecting position, said guide comprising a ball seated in the housing, and means to lock said housing against longitudinal movement on said stem.

8. A tiltable driving joint for deflecting bits including a stem, a trackway on the outer periphery thereof, a housing about the end of said stem, a guide projecting inwardly in the housing to ride in said trackway so that turning of the stem relative to the housing in one direction will cock the bit in deflecting position and turning the stem in the other direction will allow the bit to dangle from the stem in substantially non-deflecting position, said guide comprising a ball seated in the housing, and means to lock said housing against longitudinal movement on said stem comprising a ring of balls inserted in the housing to engage a shoulder on said stem.

9. A tiltable driving joint for deflecting bits including a stem, a trackway on the outer periphery thereof, a housing about the end of said stem, a guide projecting inwardly in the housing to ride in said trackway so that turning of the stem relative to the housing in one direction will cock the bit in deflecting position and turning the stem in the other direction will allow the bit to dangle from the stem in substantially non-deflecting position, and means to seal off the end of the housing about the stem.

10. A tiltable driving joint for deflecting bits including a stem, a trackway on the outer periphery thereof, a housing about the end of said stem, a guide projecting inwardly in the housing to ride in said trackway so that turning of the stem relative to the housing in one direction will cock the bit in deflecting position and turning the stem in the other direction will allow the bit to dangle from the stem in substantially non-deflecting position, and means to seal off the end of the housing about the stem including a resilient packing which will yield by flowing under pressure as the housing tilts.

11. A full gage deflecting tool for drilling wells including a housing, reamer blades thereon, a bit on the lower end of the housing, a stem, a tiltable joint connecting said stem and housing so that a full gage bore may be drilled while deflecting, and means to cock said bit in deflecting position operated by turning the stem relative to the housing.

12. A deflecting tool for wells including a stem, a bit, a deflecting joint to cock the bit at an angle relative to the stem including means operable when the bit is turned in one direction relative to the stem to cock the bit, said means being operable upon relative rotation of the stem and bit in the other direction to release the bit.

13. A method of directional drilling which

comprises cocking a tiltable joint bit relative to the drill stem by turning the bit, lowering the bit into the well bore, orienting the cocked bit to a direction to be drilled, lowering the bit against the formation, turning the drill stem to uncock the bit and release the tiltable joint so as to impart rotation to the bit, drilling in the deflected direction, and reaming the deflected bore to the full gage of the well bore during the deflecting operation.

JEROME D. BROCK.
LEE R. LEISLER.
RALPH A. WARREN.