

Jan. 7, 1958

W. G. JAMES ET AL

2,819,040

DEFLECTING TOOL

Filed July 13, 1956

4 Sheets-Sheet 1

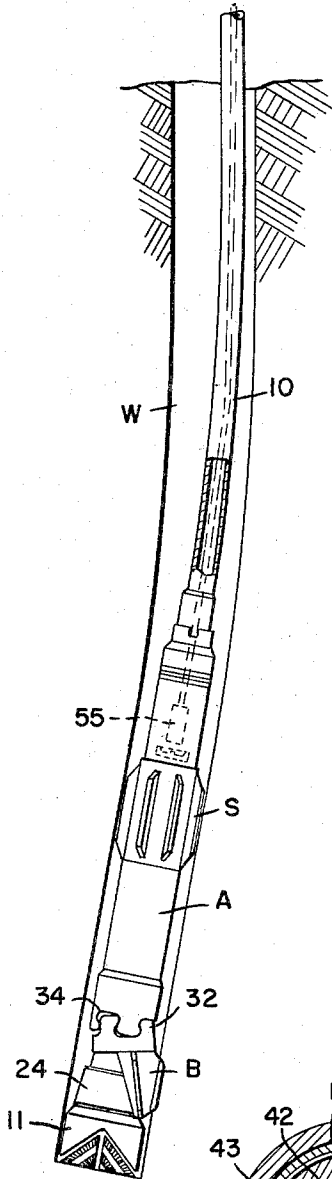


FIG. 1.

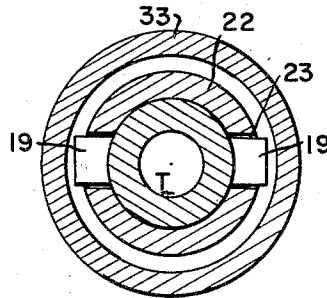


FIG. 4.

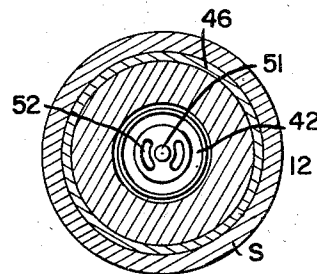


FIG. 8.

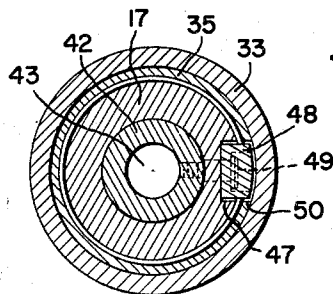


FIG. 9.

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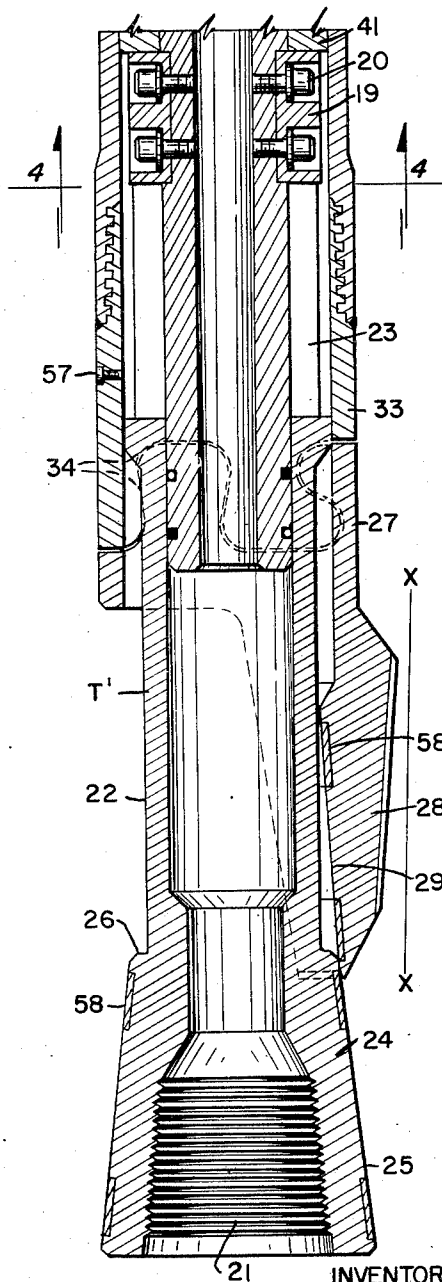
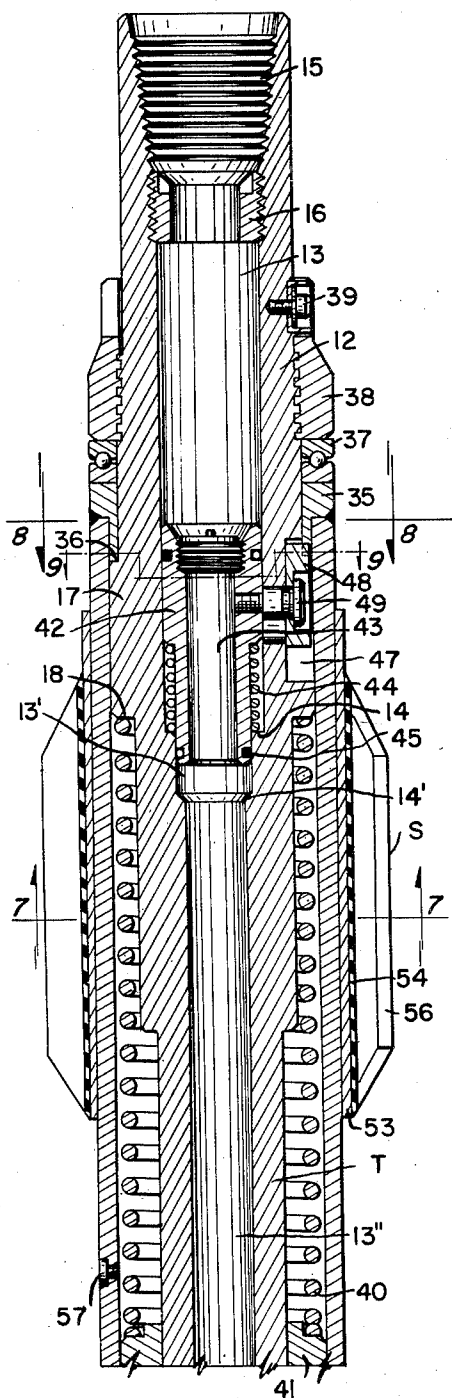
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DEFLECTING TOOL

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4 Sheets-Sheet 3

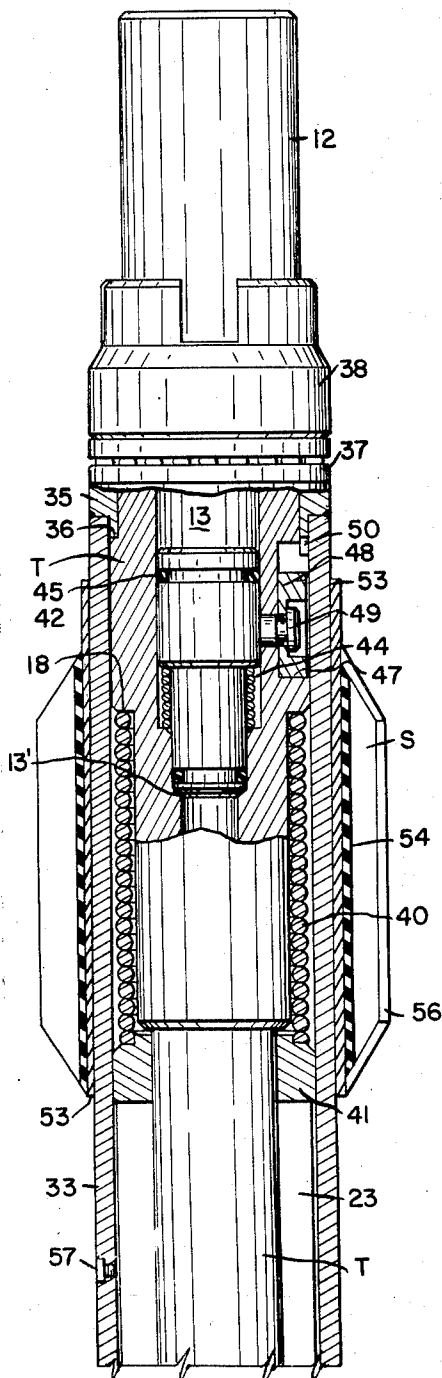


FIG. 3.

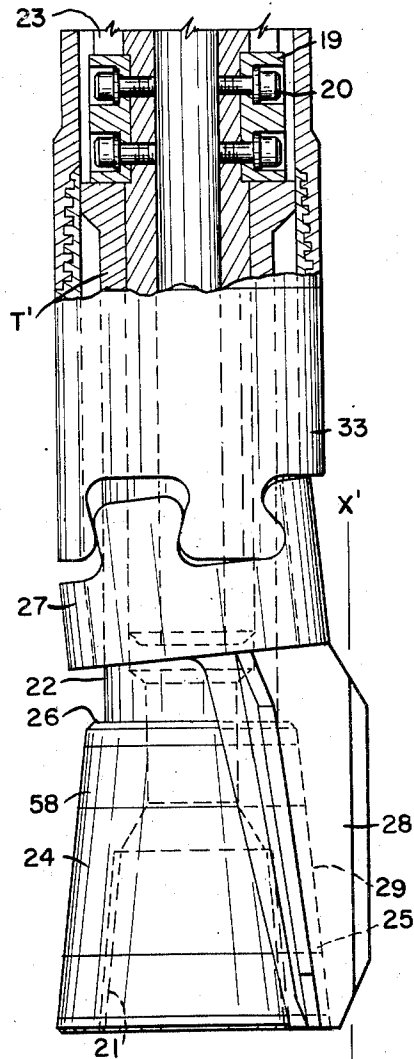


FIG. 3a.

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4 Sheets-Sheet 4

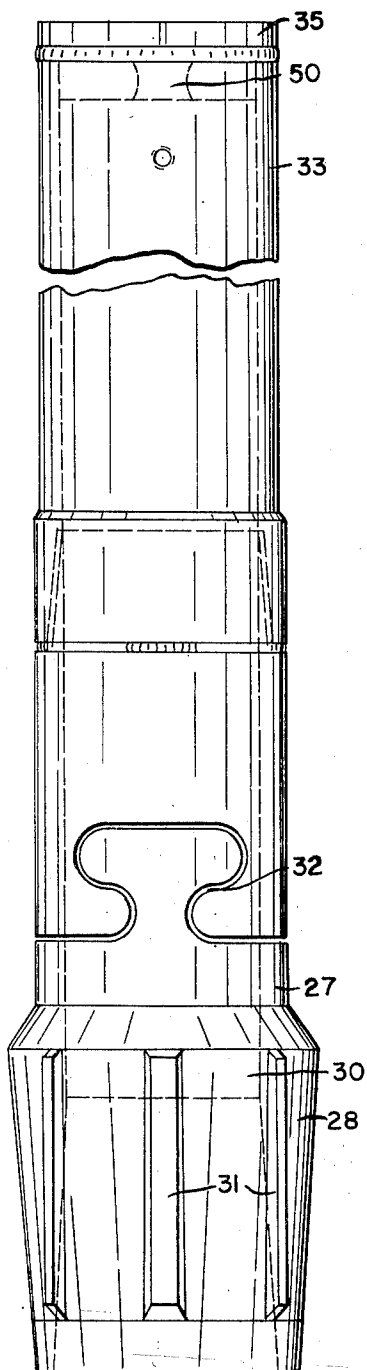


FIG. 5.

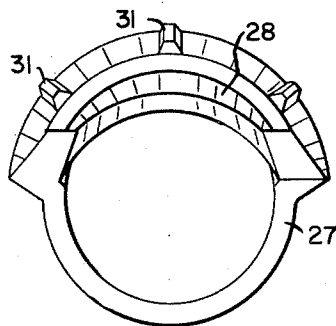


FIG. 6.

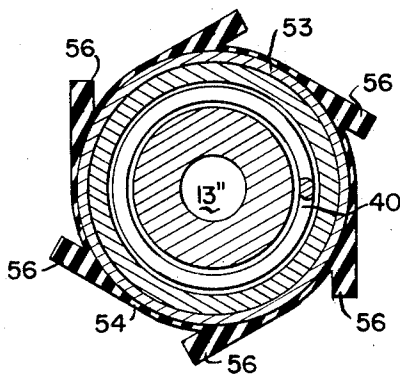


FIG. 7.

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2,819,040

DEFLECTING TOOL

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Application July 13, 1956, Serial No. 597,672

19 Claims. (Cl. 255—1.6)

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 in the lower portion of a drill pipe or string and having a radially extendable means for urging the lower portion of the drill pipe and the drill bit attached thereto laterally toward one side of the well bore whereby subsequent rotation of the drill pipe and bit will result in drilling the well bore at an angle with respect to the remainder of said bore.

Deflecting tools of this general type are quite numerous, such as those shown in the Strength U. S. Patent 2,179,567 and the G. E. Brown U. S. Patents 2,643,859 and 2,691,507. In this connection reference is made to the Lindsay et al. pending U. S. application Serial No. 477,437 filed December 24, 1954, this latter application being owned by the same assignee as the present invention. Deflecting tools of the type mentioned in said application incorporate telescoping sections arranged to mechanically urge by the imposition of the weight of the drill pipe thereon a deflecting element, carried by a sleeve surrounding the sections, outwardly into a radially extended position and to maintain the element in such a position. As will be explained hereinafter, the sleeve carrying the deflecting element must normally be arranged to rotate with the telescoping sections, but must be capable of being unlocked so that the telescoping sections may rotate relative thereto and in the past this unlocking has generally been accomplished by applying weight to the sleeve and deflecting element carried thereby whereby occasionally such will cause a jamming of the deflecting element on its means for moving it laterally. Secondly, the tools made reference to generally incorporate as a deflecting element a pivotally mounted member and, as is apparent, such type of connection is able to stand only so much weight and has limited tension characteristics.

Bearing the above in mind, one of the objects of this invention is to provide an improved deflecting tool for effectively drilling a well bore at an 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 adapted to be connected in the lower portion of the drill pipe or string and having a radially extendable means for urging the lower portion of the drill pipe and the drill bit attached thereto laterally toward one side of the well bore, said means including a rigid wedge flexibly mounted by means of special lobe cut joints.

A further object of this invention is to provide a deflecting tool having telescoping sections adapted to urge a deflecting wedge, which is carried by a sleeve surrounding the sections, outwardly into a radially extended position upon the imposition of weight upon the drill pipe thereon, said wedge being of a special construction and being flexibly mounted on said sleeve by means of a special lobe cut

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arrangement which provides improved torque, compression and tension characteristics.

Another object of the invention is to provide a tool of the type described in the preceding paragraph including means under the control of fluid pressure for controlling, without the application of weight on the drill pipe, the locking of the sleeve and wedge carried thereby so that it will rotate with the sections and the unlocking thereof so that there will be relative rotation between the sections and the sleeve.

Yet another object of the invention is to include in a tool of the type described a deflecting element in the nature of an arcuate wedge and adapted to cooperate with an expander in such a manner that when the wedge is in a retracted or orienting position it is within the gauge or outside diameter of the bit and when in a compressed or expanded position it extends outside of the gauge of the bit, thereby functioning to impart a lateral thrust to the bit.

Finally, it is an object of the invention to provide an improved deflecting tool of the character described which is simple in construction and which comprises a unitary assembly capable of being connected in the usual drill pipe, said tool having its deflecting element in the nature of a durable wedge mounted by means of a connection providing improved flexibility, tension and compression characteristics and whereby the element will not rotate when the bit and drill pipe are rotated to perform the drilling operation.

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 elevation of the lower portion of a drill pipe within a well bore and showing the improved deflecting tool connected therein;

Figure 2 is a vertical sectional view of a portion of the deflecting tool and illustrating the deflecting element thereof in its retracted position;

Figure 2a is a view similar to that of Figure 2 showing the remaining portion of the tool;

Figure 3 is a view similar to that of Figure 2 with the deflecting element in its expanded position;

Figure 3a is a view similar to that of Figure 3 showing the remaining portion of the tool in its expanded position;

Figure 4 is a horizontal cross sectional view taken along the line 4—4 of Figure 2a;

Figure 5 is an elevational view of the back of the deflecting wedge and the sleeve which carries the wedge, with that part of the sleeve which carries the stabilizer being broken away;

Figure 6 is a bottom view of Figure 5;

Figure 7 is a sectional view taken along the lines 7—7 of Figure 2;

Figure 8 is a sectional view taken along the lines 8—8 of Figure 2; and

Figure 9 is a sectional view taken along the lines 9—9 of Figure 2.

In the drawings the numeral 10 designates the usual drill pipe or drill stem which is adapted to extend through a well bore W and which is utilized to impart rotation to the drill bit 11, as will be explained hereinafter. The improved deflecting tool A comprising the present invention is arranged to be interposed between the drill pipe 10 and the drill bit 11 and said tool includes a deflecting element or wedge B which is movable radially of the tool A between a retracted and an expanded or compressed position. When in a compressed position, as illustrated in an exaggerated manner in Figures 1 and 3a

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portions of the deflecting wedge B engage the wall of the well bore W at one side of the bore just above and in close proximity of the drill bit 11 and said wedge functions to urge the lower portion of the drill bit 11 in a direction away from the point of contact of the wedge with the wall of the well bore. In other words, assuming X'—X' (shown in Figure 3a) represents the gauge or outside dimension of the bit 11, the wedge B, when in a compressed or extended position, is outside the gauge to impart a lateral thrust to the bit and when the wedge is in a retracted position, as shown in Figure 2a, it is within the gauge or exterior dimension of the bit represented by X—X. It is apparent that with this deflecting element in its expanded, compressed or radially extended position, as shown in Figures 1, 3 and 3a, the bit 11 is constantly urged toward that area of the well bore which is directly opposite the deflecting element and the subsequent rotation of the drill pipe and bit results in the drilling of a well bore at an angle with respect to the main portion of said bore.

The deflecting tool A is clearly shown in Figures 2 to 8, inclusive, and includes a pair of telescoping sections T and T'. The upper section T includes an elongated tubular body 12 having an axial bore 13 communicating with a slightly reduced bore 13' which in turn communicates with a further reduced bore 13''. Shoulders 14 and 14' divide the bores, but in any event it is apparent that the tubular body 12 includes an axial bore for fluid passage extending entirely therethrough and the drill pipe 10 is adapted to have its lower end secured to the upper end of body 12 by threaded connection within socket 15 whereby the lower end of the drill pipe rests against the landing collar 16. Body 12 is provided with an external flange 17, the underside of which forms an annular shoulder 18 and near its lower end the body 12 is provided with outwardly extending drive lugs or blocks 19 (illustrated in Figures 2a and 3a) that are secured to the body by any suitable means, such as shown at 20, these lugs being further illustrated in Figure 4.

The lower telescoping section T' is formed of a generally cylindrical portion 22 which engages over the lower portion of the tubular body 12 of the upper section. The member 22 is provided, as clearly shown in Figures 2a, 3a and 4, with diametrically opposed slots 23, which slots receive the outwardly directed drive lugs or blocks 19 on the body 12, whereby the upper section T is rotatively coupled to the lower section T' while permitting telescoping movement of the sections with respect to one another. The lower end of section T' is formed with an expander 24 which is generally in the shape of a pyramidal cone whereby its outer surface 25 is inclined downwardly and outwardly, the surface 25 being divided from the cylindrical outer section of T' by the annular shoulder 26. The drill bit 11 is arranged to be threaded into bore 21 on the lower end of the section T', as should be apparent by reference to Figures 2a and 1. As best shown in Figures 2, 2a, 3, 3a and 5, the deflecting element B comprises a substantially cylindrical hollow upper segment 27 from which depends a substantially half round arcuate rigid wedge 28, the interior surface thereof being shown at 29 and the outer surface 30 having longitudinally extending spaced ribs 31 with the central rib being substantially axially centralized of the wedge. The cylindrical portion of the wedge is flexibly secured by means of special lobe cut joints to the lower end of an outer sleeve 33.

The lobe joints, which are an important part of this invention, are preferably three in number spaced 120 degrees apart, the one shown in Figure 5 being a T cut 32 positioned directly above the central rib 31 and, as should be apparent, this cut or joint permits exceptionally good radial pivoting action of the wedge with respect to the sleeve. The other two cuts or joints 34 (only one of which is shown) are in the form of trapezoidal cuts and, of course, all joints include a tongue extending from the

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cylindrical portion 27 received in a slot in the bottom of sleeve 33. The trapezoidal cuts permit flexing of wedge B in about all directions with respect to sleeve 33, while the T cut connection is practically limited to the pivoted action described which constitutes the flexing necessary to accomplish deflecting of the bit 11. It can be appreciated that if there were provided another T connection, say one about 90 degrees from that shown, then the radial movement of wedge B would be limited.

The sleeve 33 surrounds the upper part of the portion 22 of section T' and a substantial portion of the upper section T and is suspended from the upper surface 36 of the flange 17 on the body of the upper section by means of an annular addition 35 welded or suitably secured to sleeve 33. The annular ball bearing means 37 facilitates rotation of section T with respect to outer sleeve 33 and the outer sleeve is retained against displacement from its supporting shoulder 36 by a retaining collar 38 threaded on body 12 and secured thereto by any suitable means 39. As will be explained hereinafter, outer sleeve 33 is normally arranged for and keyed to rotate with both sections T and T', but during deflecting of the bit 11 this sleeve which carries the deflecting wedge B must be maintained stationary in the sense that it does not rotate with the sections and therefore it is necessary to provide means for disengaging the key and permitting relative rotation of the sections with respect to sleeve 33.

When the sections T and T' are as shown in Figures 2 and 2a, they are in an extended position and when they assume by further telescoping action the position of Figures 3 and 3a, they will be considered in a retracted position. The telescoping sections T and T' are normally urged toward an extended position, as illustrated in Figures 2 and 2a, by a suitable coil spring 40 which is confined between the shoulder 18 on the upper section T and the upper end 41 of the lower section T'. When the sections are extended with respect to each other, the arcuate deflecting wedge B is in a retracted position, since its lower end is in a plane above the inclined surface 25 of the expander 24. To prevent rotation of the outer sleeve 33 which carries the deflecting wedge B with respect to the sections T and T' when the latter are in an extended position, referring particularly to Figures 2, 3 and 5, the following structure is provided and this also is an important part of the invention. Within bore 13 there is a piston 42 having a hollow bore 43 of less diameter than bore 13 and communicating with bores 13' and 13''. The piston 42 is normally biased upwardly to the position shown in Figure 2 by the coil spring 44, but may be moved downwardly to the bottom of bore 13' and, of course, O-rings 45 are provided along the exterior surface of piston 42 as a fluid seal and packing. The exterior of elongated body 12 is provided with a rectangular slot 47 of a width comparable to that of slots 23 and movable within this slot is a block 48 keyed for movement with piston 42 by suitable means 49. As shown in Figure 2, the block 48 is in the upper limits of recess 47 and this in turn limits the upward position of piston 42 and which is its normal position. When the block 48 is in the upper part of recess 47 it is also located within slot 50 of outer sleeve 33—35, as shown more clearly in Figures 3 and 5, and, as is obvious, at this time the sleeve and sections T and T' rotate together. As shown in Figure 8, the top of piston 42 is provided with a bridger plate 46 having a pin 51 extending upwardly therefrom and provided with recesses 52 of any suitable shape and which permit fluid to pass under restriction from bore 13 to bore 43. As explained, when the parts are as shown in Figures 2 and 2a, the deflecting element B is locked against rotation with respect to the drill pipe. To unlock whereby the telescoping sections may be rotated relative to the sleeve and wedge, it is merely necessary to apply fluid under pressure, such as the mud circulating medium, to bore 13 and due to the difference in sizes of bores 13 and 43 and the openings 52, there will be a

fluid pressure differential created between bores 13 and 43 which will overcome the bias of spring 44 and force piston 42 to the bottom of bore 13'. This in turn means that the block 48 moves out of the slot 50 and against the bottom of recess 44 as shown in Figure 3. It is important to note that this unlocking is caused by fluid pressure alone and without the necessity of applying weight on sleeve 33 or wedge B, thus eliminating any possibility of jamming wedge B on surface 25. Furthermore, following unlocking, the wedge B is for all practical purposes still above expander 24 and within the gauge or outside dimension of bit 11, as depicted by referring to line X—X of Figure 2a.

Again assuming that the parts are as shown in Figures 2 and 2a and the sleeve and wedge are keyed for rotation with sections T and T', the deflecting wedge, as should be apparent, is locked in a fixed position with respect to the drill pipe. By locating a magnet 55 (Figure 1) in the drill pipe in a known radial position or relationship to the deflecting element, it is possible to determine the radial position or azimuth of the deflecting element by known methods of bottom hole orientation. For example, a method or orientation which may be employed is that shown in the patent to Miller 2,327,658 or Hyer 2,120,670. With the magnet 55 in a known radial relationship to the deflecting element B when the same is locked against rotation on the drill pipe, a suitable well survey instrument illustrated in the dotted lines in Figure 1 may be lowered, then operated and its record subsequently examined so that the compass position of the deflecting element may be readily determined after the tool has been lowered into position within the well bore. It is important to note that the pin 51 which extends upwardly from the restrictor plate may function as a "tell tale" to point out that the tool is in an orienting position and guarantee that the sleeve is locked relative to the sections. This is accomplished by the pin 51 marking the disc of the survey instrument when it is lowered and, of course, if the piston 42 were not in its upward position there would be no such marking.

In operation of the tool the parts are normally in the position shown in Figures 2 and 2a with the sections T and T' in an extended position. In such position the deflecting wedge B is in its retracted position and the block 48 is within the recess 50. As explained, the drill pipe is connected to the upper section T which is coupled to the lower telescoping section T' by means of the drive lugs 19 within the diametrically opposed slots 23.

After the tool is lowered near the bottom of bore W, the compass position of the deflecting element B may be determined by ascertaining the position of the magnet 55 by means of any well known orientation method, such as the techniques described. Thereafter the drill pipe may be rotated to locate the deflecting element in the desired azimuthal position. The tool is lowered, if necessary, further until the bit 11 strikes the bottom of the bore and at this time no further weight is applied on the drill pipe for if such were, it would impose weight upon the deflecting tool and possibly cause jamming of wedge B. It is important to note again at this time that if weight were applied to the tool through the pipe 10, as in prior practice, there would be the danger of jamming wedge B between the expander 24 and the formation of the bore W and, of course, such could prevent rotation of bit 11. Instead, at this time fluid pressure is injected to cause piston 42, in the manner previously explained, to be moved downwardly whereby the block 48 is removed from slot 50 and in turn the sections may be rotated independently or relative to the sleeve 33 and wedge B. The fact that the sleeve may be unlocked without applying further weight, as is required in the tools of the co-pending application referred to, is important. At this time further downward movement of the drill pipe causes the upper section T to move downwardly with respect to the lower section T' toward retracted position of the sections, which

in turn results in the deflecting wedge B being moved downwardly along the inclined face 25 to cause the deflecting element to be moved radially outwardly into contact with the wall of the well bore W as shown in Figures 3 and 3a. Throughout this movement the sections T and T' (the latter carrying bit 11) may be rotated with respect to the outer sleeve and deflecting element. When the deflecting wedge is moved radially outwardly, said element contacts the wall of the bore and in such compressed or expanded position it is outside the gauge of bit 11 (see X'—X' of Figure 3a) and thus applies a lateral pressure or thrust to the bit 11 to urge the bit in a direction which is opposite the position of the deflecting wedge and therefore the bit is urged toward one side of the bore. By the said proper orientation of the element the drill bit is urged laterally in a desired compass direction so that subsequent rotation of the drill pipe and of the bit will perform the drilling operation. So long as the weight of the pipe is imposed upon the tool, the sections T and T' remain in fully telescoped and retracted position and maintain the deflecting element in its radially expanded or compressed position. Obviously, the element B will not rotate during rotation of the drill pipe and drill bit, and as drilling proceeds, the deflecting element merely slides down the wall of the well bore but constantly maintains a lateral pressure on the bit to urge it toward the opposite wall. It is preferable that the element B be located in close proximity or adjacent to the drill bit 11 so that the required constant lateral pressure can be maintained throughout the drilling operation.

It is important to note that the flexible lobe cuts joining the wedge B with the sleeve 33 not only permit the wedge to readily flex radially, due in particular to the T cut 32 being axially aligned with the center of the wedge, but also that the overall joint or flexible connecting means transmits extremely good torque and compression. Also, when the tool is pulled out of the hole the lobe cuts and especially the T connection give improved tension characteristics or, in other words, the flexible connecting means provides the necessary flexibility and is much more sturdy and rugged than the usual type of hinged connection employing a pivot pin. The fact that the wedge B is maintained within the outside diameter or gauge of the bit when in a retracted position and is only moved outside of the gauge when in a compressed or expanded position is important for reasons that should be apparent.

Secured by any suitable means including the metal ring 53 to the exterior of sleeve 33 substantially intermediate the longitudinal length thereof is, referring particularly to Figures 2 and 7, a stabilizer S which includes a molded rubber ring 54 having extending outwardly therefrom in spaced annular relation the ribs or projections 56. These ribs are all angled to face in a direction of normal rotation of the drill string and are of a size to engage the bore W and thus function to centralize sleeve 33 and maintain the latter, when unlocked, from rotating with the drill bit 11.

Of the parts shown and not described, it probably should be mentioned that numeral 57 represents grease fittings and numeral 58 hard metal wear bands and in this latter connection ribs 31 are of a comparable material.

As should be apparent, the deflecting element is positively urged radially outwardly during the drilling operation, and therefore a constant lateral pressure is maintained against the drill bit. Since the deflecting wedge may be properly oriented, it is apparent that a directional drilling operation may be accomplished.

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.

We claim:

1. A deflecting tool adapted to be lowered in a well bore including an upper section, a lower section having a telescoping connection with the upper section, said sections being movable axially with respect to each other from an extended position to a retracted position, resilient means normally urging the sections toward an extended position, means rotatably connecting the sections in all positions of said sections, an expander mounted on the lower end of said lower section and having an external inclined surface inclined inwardly from the bottom to the top thereof, an outer sleeve rotatably suspended from the upper section, a radially movable deflecting element for coacting with said surface to radially deflect said element, flexible means for connecting said element on the lower end of said sleeve, said element being located in a plane above the expander when the sections are in extended position, means operable when the sections are extended for locking the outer sleeve against rotation with respect to the sections and fluid pressure actuated means for unlocking the outer sleeve and for further telescoping the sections toward retracted position whereby the sections may be rotated relative to the sleeve, said deflecting element being movable downwardly relative to the inclined surface of the expander when the sections are moved to retracted position upon the imposition of weight thereto, whereby the co-action between the expander and the element moves the element outwardly in a radial direction.

2. A tool as defined in claim 1 wherein said flexible means includes a plurality of lobe cut joints comprising cooperating tongues and grooves carried by the sleeve and element.

3. A tool as defined in claim 2 wherein one of the cuts consists of a T-connection axially aligned with the substantial axial center of said element.

4. A tool as defined in claim 1 wherein the outer surface of the sleeve is provided with a stabilizer for maintaining the outer sleeve, when unlocked, from rotating within the bore with the sections, said stabilizer including a plurality of annularly spaced projections extending in the direction of normal rotation of the sections.

5. A tool as defined in claim 1 wherein the sections include an axial bore and the locking and unlocking means includes a piston mounted in the bore with a portion of the wall forming a cylinder for said piston, said piston being movable by fluid pressure applied within the axial bore, a slot in the outer surface of said upper section, a block keyed for movement with said piston, and a recess in said sleeve for receiving a portion of the block when it is positioned adjacent one end of said slot whereby the block locks the sleeve for rotation with the sections.

6. A deflecting tool adapted to be lowered in a well bore including an upper section, a lower section having a telescoping connection with the upper section, said sections being movable axially with respect to each other from an extended position to a retracted position, resilient means normally urging the sections toward an extended position, means rotatably connecting the sections in all positions of said sections, an expander having an external inclined expanding surface mounted on the lower section below the upper section, and a radially movable deflecting element, means for flexibly mounting the deflecting element on said upper section, means operable when the sections are extended for locking the element against rotation with respect to the sections, fluid pressure actuated means for unlocking the element and for further telescoping the sections toward retracted position whereby the sections may be rotated relative to the element, said sections being movable following said unlocking to a retracted position upon the imposition of weight thereto and said element moving downwardly relative to the expander surface and coacting with the expander for movement radially outwardly, said element being sub-

stantially in a plane above the expander until said sections are moved following said unlocking.

7. A tool as defined in claim 6 wherein there is provided a stabilizer for maintaining the element from rotating; said stabilizer including a plurality of annularly spaced projections engageable with the bore wall and extending in the direction of normal rotation of the sections.

8. A tool as defined in claim 6 wherein the locking and unlocking means includes a piston movable within the upper section by fluid pressure, a slot in the outer surface of said upper section, a block keyed for movement with said piston, and a recess in the mounting means for said element for receiving a portion of the block when it is positioned adjacent one end of said slot whereby the block locks the element for rotation with the sections.

9. A tool as defined in claim 6 wherein the flexible means for mounting the element includes spaced lobe cut joints comprising cooperating tongues and grooves with one cooperating tongue and groove forming a T-connection.

10. A tool as defined in claim 9 wherein the element is in the form of an arcuate wedge and the T-connection and axial center of the wedge are substantially axially aligned.

11. A deflecting tool adapted to be lowered in a well bore including an upper section, a lower section having a telescoping connection with the upper section, said sections being movable axially with respect to each other from an extended position to a retracted position, resilient means normally urging the sections toward an extended position, means rotatably connecting the sections in all positions of the sections, an expander having an external inclined expanding surface mounted on the lower section below the upper section, a radially movable deflecting wedge, an outer sleeve suspended from the upper section, and flexible means for connecting the wedge to said sleeve whereby the wedge is flexed radially with respect to said sleeve upon coacting with the expander when the sections are moved toward a retracted position; said flexible connecting means including a plurality of annularly spaced lobe cut joints.

12. A deflecting tool as defined in claim 11 wherein said wedge is arcuate in shape and one of said joints is in the form of a T-connection axially aligned with the axial center of the wedge.

13. A tool as defined in claim 12 wherein the other joints are substantially trapezoidal in configuration.

14. A deflecting tool adapted to be lowered in a well bore including an outer sleeve and at least one section movable longitudinally relative to the sleeve and axially within the bore from an extended position to a retracted position, means normally urging the section toward an extended position, an expander having an external inclined expanding surface mounted on the lower end of said section, a radially movable deflecting wedge, flexible means for connecting the wedge to said sleeve whereby the wedge is flexed radially with respect to said sleeve upon co-acting with the expander when the section is moved toward a retracted position, said flexible connecting means including at least one lobe cut joint.

15. A deflecting tool as defined in claim 14 wherein there are a plurality of annularly spaced lobe cut joints, each comprising a cooperating tongue and groove with one cooperating tongue and groove forming a substantial T-connection which is substantially axially aligned with the axial center of said wedge.

16. A deflecting tool as defined in claim 14 wherein there is provided means operable when the section is in extended position for locking the wedge against rotation with respect to the section, and fluid pressure actuating means for unlocking the wedge whereby the section may be rotated relative thereto, said section being movable

following said unlocking to a retracted position upon the imposition of weight thereto.

17. A deflecting tool adapted to be lowered in a well bore by the drilling string and being positioned adjacent the drill bit, comprising an upper section, a lower section having a telescoping connection with the upper section, said sections being movable axially with respect to each other from an extended position to a retracted position, resilient means normally urging the sections toward an extended position, means rotatably connecting the sections in all positions of the sections, an expander having an external surface mounted on the lower section below the upper section, a radially movable deflecting element arranged to cooperate with said surface when said sections are moved from their extended position to a retracted position and thereby gradually move radially outwardly with respect to the bit to engage the bore and impart lateral thrust to the bit, said element being positioned within the gauge of said bit and in a plane above the expander when the sections are in extended position, and said element being positioned outside of the gauge of the bit when said sections are in a retracted position, said deflecting element being flexibly mounted on said upper section by means of spaced lobe cut joints comprising cooperating tongues and grooves with one cooperating tongue and groove forming a substantial T-connection.

18. A deflecting tool as defined in claim 17 wherein the element is in the form of an arcuate wedge and the T-connection and axial center of the wedge are substantially axially aligned.

19. A deflecting tool adapted to be lowered in a well bore by the drilling string and being positioned adjacent the drill bit, comprising an upper section, a lower section having a telescoping connection with the upper section,

said sections being movable axially with respect to each other from an extended position to a retracted position, resilient means normally urging the sections toward an extended position, means rotatably connecting the sections in all positions of the sections, an expander having an external surface mounted on the lower section below the upper section, a radially movable deflecting element arranged to cooperate with said surface when said sections are moved from their extended position to a retracted position and thereby gradually move radially outwardly with respect to the bit to engage the bore and impart lateral thrust to the bit, said element being positioned within the gauge of said bit and in a plane above the expander when the sections are in extended position, and said element being positioned outside of the gauge of the bit when said sections are in a retracted position, means operable when the sections are extended for locking the element against rotation with respect to the sections and fluid pressure actuated means for unlocking the element and for further telescoping the sections toward retracted position whereby the sections may be rotated relative to the element, said sections being movable following said unlocking to a retracted position upon the imposition of weight thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

2,120,670	Hyer	June 14, 1938
2,142,859	McMahan	Jan. 3, 1939
2,179,567	Strength	Nov. 14, 1939
2,327,658	Miller	Aug. 24, 1943
2,643,859	Brown	June 30, 1953
2,691,507	Brown	Oct. 12, 1954
2,699,920	Zublin	Jan. 18, 1955