May 9, 1950 H. G. LIVINGSTON 2,506,799

CASING WHIPSTOCK

Filed Jan. 22, 1945 2 Sheets-Sheet 1

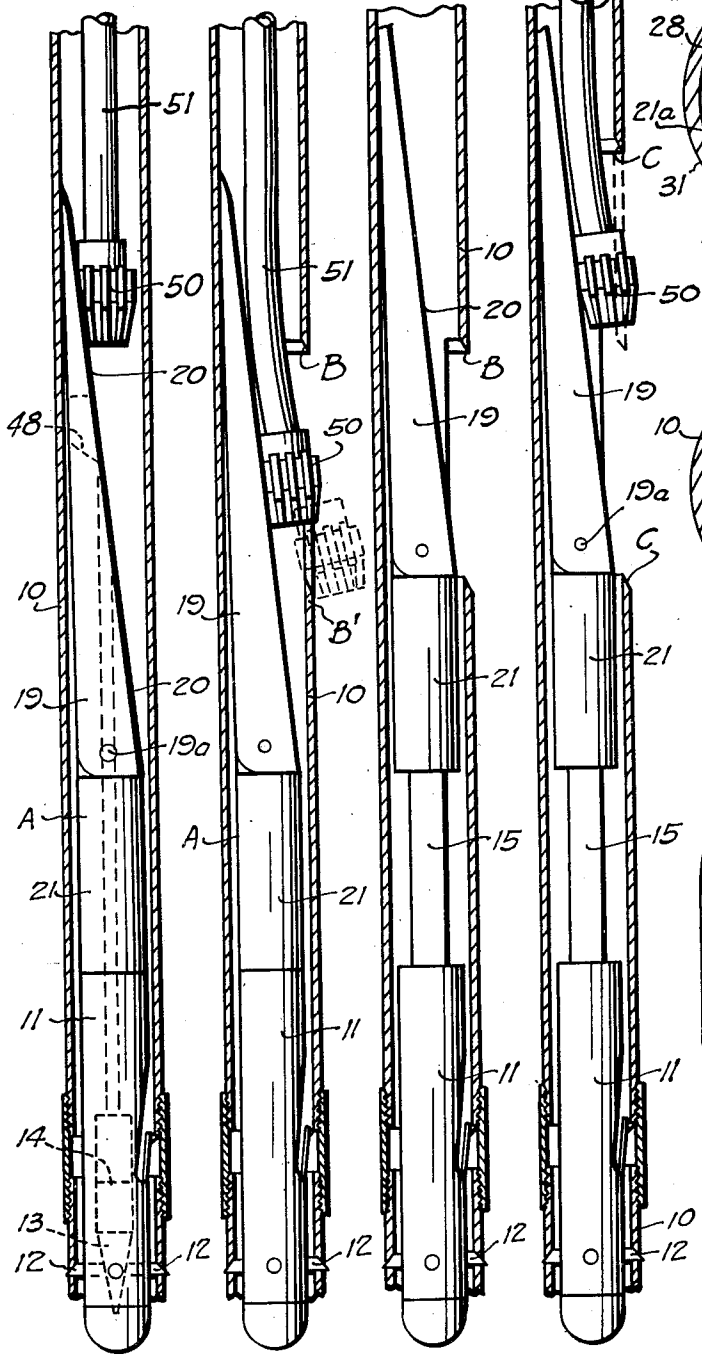

Fig. 1 Fig. 2 Fig. 3 Fig. 4

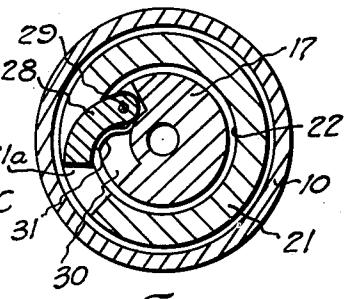

Fig. 7

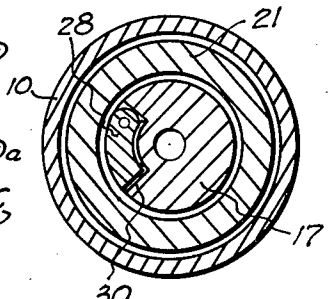

Fig. 8

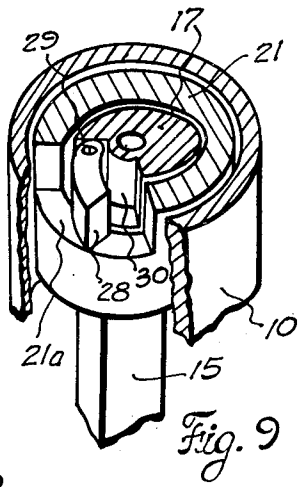

Fig. 9

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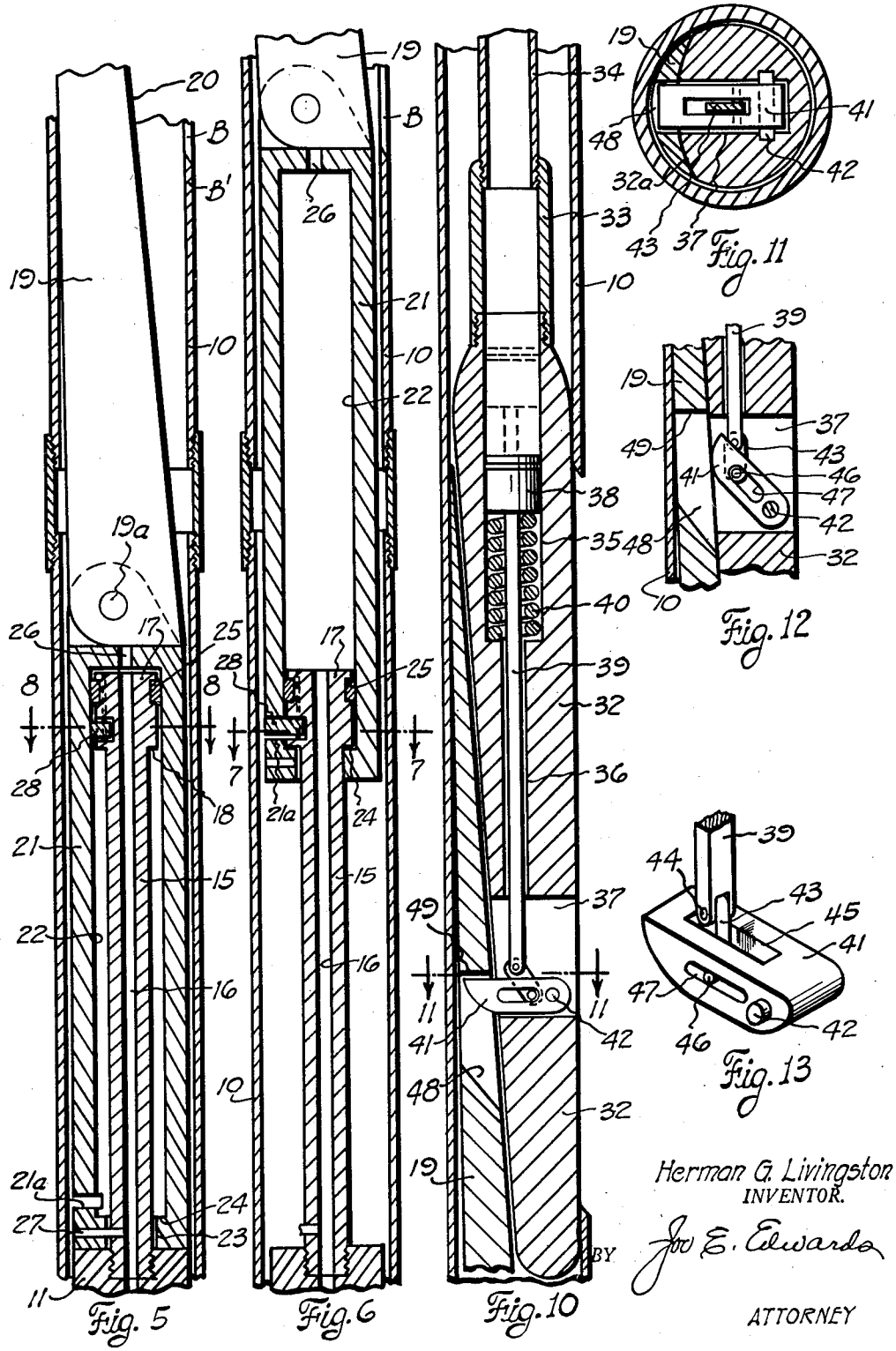

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UNITED STATES PATENT OFFICE

2,506,799

CASING WHIPSTOCK

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Application January 22, 1945, Serial No. 573,865

12 Claims. (Cl. 255—1.6)

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This invention relates to new and useful improvements in casing whipstocks.

As is well known a casing whipstock is adapted to be set within a well casing or pipe and is utilized to deflect or guide a drill bit outwardly into the formation at an angle from the main well bore. Prior to any offset drilling operation from a cased well bore it is first necessary to cut or mill a window or opening in the casing immediately opposite the whipstock face to provide an opening through which the drill may subsequently pass outwardly into the formation. Milling tools for performing this milling operation are in general use and successfully cut the first half or upper portion of the window; however, when the center line of the milling tool reaches the center line of the wall of the casing, there is a tendency for the milling tool to jump out into the formation beyond the casing since said tool will naturally follow the line of least resistance. In other words as soon as the opening in the casing is sufficiently large to permit passage of the milling tool therethrough, said tool will move out into the formation instead of continuing the milling of said window. This results in the window or opening being incomplete, that is, said window does not extend the full length of the longitudinal deflecting face of the whipstock, whereby subsequent attempts to properly "drill off" of the whipstock are interfered with.

It is one object of this invention to provide an improved casing whipstock which is so constructed that a satisfactory elongate window or opening may be cut in the well casing after said whipstock has been set therein.

An important object of the invention is to provide an improved casing whipstock adapted to be set within a well casing and having its deflecting surface movable longitudinally within said casing after the device is in a set position, whereby said deflecting surface may be properly manipulated to assure milling of a window which extends substantially throughout the length of the deflecting surface of said whipstock.

Another object of the invention is to provide an improved casing whipstock having a body portion arranged to be set within the well casing and having a deflecting element attached to and movable relative to said body, whereby when the device is in a set position, the deflecting element may be in a lowered position and a window or opening opposite the upper half of the deflecting element may be milled; the construction permitting raising of the deflecting element after said opening is milled, whereby said element is

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moved into a position locating the lower portion of said deflecting element opposite said previously formed opening to permit a subsequent milling operation to be successfully carried out to complete a window or opening extending throughout the entire length of the deflecting element.

Still another object of the invention is to provide an improved casing whipstock, of the character described, wherein the deflecting element is arranged to be locked in a raised or lifted position, whereby after the milling operation is complete, said deflecting element provides a rigid surface for guiding the subsequent drilling operation.

A still further object of the invention is to provide an improved casing whipstock, of the character described, having an improved lifting tool which is arranged to co-act with said whipstock to effect lifting or raising of the deflecting element of said whipstock after the initial milling operation is completed; said lifting tool permitting manipulation of the deflecting element without removal of the whipstock from its set position.

The construction designed to carry out the invention will be hereinafter described together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawing, wherein an example of the invention is shown, and wherein:

Figure 1 is a view partly in section and partly in elevation and illustrating a casing whipstock, constructed in accordance with the invention and set within a well casing,

Figure 2 is a similar view showing the first milling operation which forms a portion of the window in the well casing,

Figure 3 is a similar view showing the milling tool removed and the deflecting element of the whipstock in a raised position,

Figure 4 is a similar view illustrating the completion of the milling operation which forms the complete window in the casing,

Figure 5 is a view partly in elevation and partly in section and showing the deflecting element of the whipstock in a lowered position,

Figure 6 is a view similar to Figure 5 with the deflecting member in a raised position,

Figure 7 is an enlarged, horizontal, cross-sectional view taken on the line 7—7 of Figure 6,

Figure 8 is an enlarged, horizontal, sectional view taken on the line 8—8 of Figure 5,

Figure 9 is a partial isometric view of the latching means for locking the deflecting element of the whipstock in a raised position,

Figure 10 is a longitudinal, sectional view of the lifting tool which is utilized to raise the deflecting element of the whipstock,

Figure 11 is an enlarged, horizontal, cross-sectional view taken on the line 11—11 of Figure 10,

Figure 12 is a sectional detail illustrating the lifting arm of the lifting tool in a retracted or disengaged position, and,

Figure 13 is an isometric view of the lifting arm and its connection with the operating rod.

In the drawings the numeral 10 designates a well casing which extends through a well bore in the usual manner. A casing whipstock A is arranged to be lowered through the well casing and set at a desired position therein and when so set will serve to guide tools which are moved downwardly through the bore into engagement with the whipstock outwardly at an angle from the main well bore in the usual manner. The whipstock includes a body 11 which may be of any desired construction. The particular body illustrated is one now in general use and said body includes outwardly movable locking pins 12 which are arranged to be forced into engagement with the casing to lock the body in position therein. Outward movement of the pins is effected by a tapered mandrel 13 which has its upper end secured to a pressure-actuated piston 14, the latter being actuated by pumping pressure fluid downwardly through the casing. As noted, this type of casing whipstock body together with the particular locking arrangement forms no part of the present invention and any suitable body having means for locking the whipstock within the casing may be employed.

It has been the usual practice to attach a deflecting element which is merely a wedge shaped member to the whipstock body 11 by a pivotal connection and in such case the deflecting member and body portion comprise a single unit with said deflecting element capable of a limited swinging movement with respect to the body.

In carrying out the present invention an elongate shank or extension 15 has its lower end threaded or otherwise fastened to the upper end of the body 11 and this shank is in axial alignment with said body and projects upwardly therefrom. The shank is provided with an axial bore 16 to permit fluid pressure to pass downwardly to the whipstock body to actuate the locking pins. If pressure-actuated locking pins are not employed, the shank could be solid in cross-section. An enlarged circular head 17 is made integral with the upper end of said shank, as is clearly shown in Figures 5 and 6 and the provision of said head 17 forms an annular shoulder 18 at the intersection of the shank and head.

A wedge shaped deflecting element 19, having an inclined guide surface 20 which tapers to substantially a point at its upper end, is provided with an elongate tubular body or sleeve 21 which is connected thereto by a pivotal connection 19a. As is clearly shown in Figures 5 and 6 the sleeve 21 has a bore 22 within which the head 17 of the shank 15 is slidable. The extreme lower end of the bore 22 of the sleeve is reduced as shown at 23, whereby an internal annular shoulder 24 is formed within said sleeve and the reduced portion 23 of the bore 22 is square in cross-section so as to substantially fit the square external surface of the shank 15. As explained, the head 17 has a sliding fit within the bore 22 of the sleeve 21 and said head is provided with an annular packing ring 25 which is located near its upper end, said packing sealing off between the head and the bore 22. The upper end of the sleeve bore 22 is closed except for a port or opening 26 which registers with the axial bore 16 of the shank.

Normally the deflecting element 19 has its sleeve 21 are in a lowered position with respect to the body portion 11 of the whipstock, as shown in Figure 5 and the parts are held in this position by means of a shear pin 27 which extends through the lower portion of the sleeve and which has its inner end connected to the shank 15. When upward pull is exerted upon the deflecting member 19, upward movement of the body portion of the whipstock 11 is prevented by the locking pins 12 which are engaged with the casing 10, whereby such upward pull will shear the pin 27. When this occurs a continued lifting of the deflecting member 19 will cause the sleeve to slide upwardly on the shank 15 until the internal shoulder 24 within the lower end of the sleeve strikes the external shoulder 18 formed by the underside of the enlarged head 17 (Figure 6).

For latching the sleeve 21 and the deflecting element connected therewith in a raised or lifted position with respect to the body 11 of the whipstock, the head 17 has a spring-pressed latch member 28 pivotally mounted on a pin 29. As is clearly shown in Figures 7 to 9 the latch 28 is arcuate in shape and is normally disposed within an arcuate recess 30 formed in the head 17. A flat spring 31 constantly urges the latch member outwardly so that said latch member engages the wall of the bore 22 of the sleeve 21. As the sleeve 21 is lifted after shearing of the pin 27 and said sleeve moves into the position shown in Figure 6, an arcuate slot 21a which extends through the wall of the sleeve 21 near its lower end moves opposite the spring-pressed latch 28 so that said latch swings outwardly into this slot (Figure 7). It is apparent that when the latch is engaged within the slot 21a that further movement of the sleeve 21 with respect to the shank 15 is prevented. Thus, the deflecting element 19 and its sleeve 21 will be locked or latched in a raised position with respect to the body portion 11 of the whipstock, as is clearly shown in Figures 3, 4 and 6.

For effecting a lifting or raising of the deflecting element 19 to its upper position, a suitable lifting tool which is shown in Figures 10 to 13 is provided. This tool includes an elongate body 32 which is generally tapered so that it may be lowered into the well casing 10 in a position opposite the inclined guide surface 20 of the deflecting element 19. The body has a longitudinally extending surface 32a which conforms to the contour of the inclined surface 20 of the deflecting element 19 so as to fit against said surface (Figure 11) and it is these complementary surfaces which co-act to orient the body with respect to the deflecting element when said body is lowered into position adjacent said element. The body 32 has its upper end connected by a sub 33 to a tubular drill pipe 34 which is utilized to lower said body into position. The upper portion of the body 32 is drilled out to form a cylinder 35 and the diameter of this cylinder is substantially the same as the diameter of the bore of the sub 33 and is slightly larger than the bore of the drill pipe 34. Below the cylinder 35 an axial reduced bore 36 is provided and this bore extends from the lower end of the cylinder to a transversely

extending slot 37 which as shown in Figure 10 is cut transversely through the main body 32.

A piston 38 is slidable within the cylinder 35 and has a piston rod 39 projecting downwardly therefrom and through the reduced bore 36 of the body 32 and the lower end of said rod extends into the transverse slot 37. A coil spring 40 normally urges the piston 38 to a raised position within its cylinder 35. The lower end of the rod 39 is arranged to actuate a lifting arm 41 which arm has one end pivoted on a pin 42 which is mounted in the body. The lower end of the rod 39 is pivoted to the upper end of a link 43 by a pin 44. The lower portion of the link extends into a longitudinal slot 45 formed in the upper end of the actuating arm 41 (Figure 13). A connecting pin 46 extends transversely through the lower end of the connecting link 43 and has its ends engaged in longitudinal slots 47 provided in the side walls of the lifting arm 41. With this arrangement it will be apparent that vertical or longitudinal reciprocation of the rod 39 will result in a swinging of the lifting arm 41 on its pivot 42.

As explained, the piston 38 is normally in a raised position being held so by the spring 40 and in this position the lifting arm 41 is in a retracted position as shown in Figure 12. The lifting tool assembly is lowered into the well casing 10 with the parts in such position and the body 32 of said assembly will move into a position with the transverse slot 37 aligned with a transverse slot or opening 48 which is formed in the deflecting member 19. Proper orientation or positioning of the slot 37 in the body 32 with the slot 48 in the element is effected by the co-acting surfaces 32a of the body and the surface 20 of the element. As illustrated in Figure 10 the upper wall 49 of the slot or opening 48 is substantially flat. When the lifting tool assembly moves into a position aligning the slot 37 in the body 32 with the slot or opening 48 in the deflecting member, a pressure fluid is pumped downwardly through the drill pipe 34 and this pressure is exerted against the piston 38 to move said piston to a lowered position; such downward movement will, of course, be against the tension of the coil spring 40. As the piston 38 moves downwardly the rod 39 is also moved downwardly whereby the link 43, because of its particular connection with the lifting arm 41 will cause a swinging of said arm to an extended or lowered position. This causes the end of the arm to swing inwardly into the slot or opening 48 of the deflecting element 19. It will be obvious that subsequent lifting of the assembly and body 32 while maintaining the piston 38 in its lowered position will result in the lifting arm 41 engaging the flat upper wall 49 of the slot 48 and thereby lift the deflecting member 19. It is through the use of the lifting tool assembly that an upward force is exerted on the deflecting element 19 sufficient to shear the connecting pin 27; after the pin is sheared it is apparent that the lifting tool assembly will raise the sleeve 21 and the element 19 to its raised position so that the spring pressed latch 28 may lock said sleeve in such raised position.

In the operation of the apparatus it has been pointed out that difficulty is at present encountered in attempting to mill a window or opening within a well casing when an angular drilling operation is to be carried out in a cased well bore. The particular apparatus hereinbefore described is arranged to make possible the milling of a window or opening in the well casing which extends substantially throughout the length of the guide surface 20 of the deflecting member 19.

In using the apparatus, the whipstock which consists of the body portion 11 and the deflecting element 19 with its pivotally attached sleeve 21 is lowered within the well casing and is set therein by moving the locking pins 12 outwardly into engagement with the casing through the application of fluid pressure. At this time the deflecting element 19 and its sleeve is in a lowered position with respect to the body 11, being secured in such position by the shear pin 27. After the device is set within the well casing 10 a suitable milling tool 50 is lowered within the casing on a rotatable drill pipe 51. The milling tool strikes the inclined guide surface 20 of the deflecting element and is guided outwardly into contact with the wall of the well casing. As the drill pipe is rotated to rotate the mill an opening, indicated at B in Figure 2, will be formed by the milling tool. As explained, the milling tool will operate satisfactorily until the center line of said tool moves past the center of the wall thickness of the well casing and when this occurs the mill will tend to move out into the formation because said formation will form less resistance to its movement than will the metallic wall of the casing. Thus, it has been found that when the mill 50 reaches the position shown in dotted lines in Figure 2 further milling of an opening cannot be accomplished. It is apparent that an opening of the size indicated at B in Figure 2 would not be sufficient to permit free movement of a drill bit outwardly into the formation because the lower edge B' of said opening is a considerable distance above the base or lower end of the guide surface 20 of the deflecting element. It is obvious that the drill bit would hang on the lip formed by that portion of the casing extending upwardly above the base of the guide surface.

After the initial opening B is formed, the mill 50 and the drill pipe 51 are removed from the well casing 10 and the lifting tool assembly shown in Figure 10 is lowered through the casing. This assembly is moved downwardly with the lifting arm 41 in a retracted position (Figure 12) until the slot 37 in the body 32 is aligned with the slot 48 in the deflecting member 19. When this position is reached a pressure fluid is pumped downwardly through the pipe 34 on which the body 32 is lowered and a pressure is applied to the piston 38 to move said piston downwardly. As has been described the downward movement of the piston 38 will swing the lifting arm 41 outwardly into the opening or slot 48 in the deflecting member. The lifting tool assembly is then raised so as to engage the arm 41 with the flat upper wall 49 of the slot 48 and continued upward movement of the lifting tool assembly will result in exerting an upward pull on the deflecting member 19 and its sleeve 21. Such upward pull will shear the pin 27 whereby continued upward movement will slide the sleeve upwardly on the shank 15 which is attached to the body portion 11 of the whipstock.

As the sleeve 21 moves to its raised position the spring pressed latch 28 will engage or swing outwardly into the arcuate slot 31 formed in the wall of the sleeve whereby the sleeve 21 and deflecting member 19 are locked in a raised position. The length of upward travel of the sleeve 21 is determined by the length of the shank 15 and is such as to locate the lower end of the guide surface 20 of the deflecting member opposite the lower end of the opening B which was previously formed by the first milling operation. This position of the device is clearly illustrated in Figure 3.

After the deflecting element is moved to a raised position the mill 50 is again lowered into the well casing 10 and as it strikes the upper end of the deflecting member it is moved outwardly into engagement with the casing to mill out an additional portion of said casing. It will be obvious that by means of the two milling operations an enlarged window or opening C which extends throughout the major portion of the guide surface 20 is formed. This window will permit the free passage of a drill bit upon a subsequent drilling operation. The particular advantage of the opening or window C is that its lower end is in alignment with or slightly below the base of the guide surface 20 whereby there is no obstruction to the passage of the bit from said guide surface into the formation.

The apparatus is relatively simple in construction and involves the use of a deflecting member which is capable of an axial movement with respect to the body of the whipstock so that said element may undergo movement after the body is in a set or locked position within the well casing. By use of the movable deflecting element it is possible to mill a portion of the window and then raise the element into a position so that its base is aligned with the bottom of that portion of the window which is milled on the first milling operation. The window is then completed by a second milling operation which cuts out an additional portion of the casing. As has been stated no difficulty is encountered in milling a section from the well casing provided that the center line of the mill may be held inside of the center line of the wall of the well casing. Thus, it might be said that under normal and usual practices the upper portion of a window, that is, a window opposite the upper portion of a whipstock can be readily formed and through the use of the present apparatus the milling all takes place opposite such upper portion of the deflecting member. The particular lifting tool which is illustrated has been found satisfactory but it is apparent that other types of lifting devices could be employed to raise the deflecting member to its locked position after the initial milling operation. Therefore, the invention is not to be limited to the specific construction of the lifting tool which has been shown.

The foregoing description of the invention is 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 I claim and desire to secure by Letters Patent is:

1. A casing whipstock for use with a milling tool to permit said tool to make two contiguous openings in the casing including, a support having means for anchoring the same within a well casing, a deflecting element having an inclined guide surface mounted on the support and movable axially thereof to an extreme lower position for one milling operation and an extreme upper position relative to said support for a second milling operation, said element being normally in its lower position on said support, and co-acting means on said element and said support assuming operable engageable condition when the element is moved upwardly to its upper position to secure said element in such upper position to positively prevent subsequent lowering of said element with respect to the support.

2. A casing whipstock as set forth in claim 1, together with additional co-acting stop means on the support and on said element for limiting movement of said element with respect to said support to locate the upper and lower positions of said element on the support.

3. A casing whipstock as set forth in claim 1, together with frangible means connecting the deflecting element to the support in its normally lower position, said frangible means being adapted to be fractured by an upward pull on the deflecting element to permit movement of the element to its upper position, and also wherein the co-acting means on said element and said support is a spring-actuated latch mechanism.

4. A casing whipstock including, a support, means for anchoring the support within a well casing, an upstanding shank extending axially from the support, a deflecting element having its lower portion slidable on the shank, said element being normally in a lowered position on said shank and being movable to a raised position whereby said element is spaced from the support.

5. A casing whipstock as set forth in claim 4, together with frangible means for fastening the element in a lowered position, said means being fractured by an upward pull on the element to permit raising of said element, and means for locking said element in its raised position.

6. A casing whipstock including, a body portion having means for anchoring the same within a well pipe, a deflecting member above the body and having a telescoping connection with said body portion, said member being normally in a lowered position supported on said body portion, whereby a deflecting operation off of the deflecting member may be accomplished with said member in its lowered position, the telescoping connection permitting the deflecting member to be raised with respect to the body portion to locate said member at a higher elevation and co-acting means carried by the body and member and capable of being brought into co-acting relationship when the member is raised to its higher elevation and thereby secure the member to the body and hold it in said higher elevation, whereby a subsequent deflecting operation may be carried out at said higher elevation.

7. A casing whipstock as set forth in claim 6, together with a frangible means for connecting the deflecting member to the body portion with said member in its lowered position, fracturing of said frangible means being necessary to allow movement of the member to its raised position.

8. A casing whipstock as set forth in claim 6, wherein the co-acting means is a spring-pressed latch means for locking the deflecting member in its raised position with respect to the body portion.

9. A casing whipstock including, a body having means for anchoring the same within a well pipe, an upstanding shank on said body, a deflecting member, a tubular extension on the lower portion of said member engaging over and being slidable on the shank, the member being normally in a lowered position with the lower end of the extension being supported on the upper end of the body, and latching means on the upper end of the shank adapted to co-act with means on said extension for latching the extension and deflecting member in a raised position when said extension and member are moved upwardly with respect to the body.

10. A casing whipstock as set forth in claim 9, wherein the co-acting latching means on said shank and said extension is a pivoted latch on

one element and an opening for receiving said latch on the other element.

11. A casing whipstock as set forth in claim 9, together with frangible means connecting the extension and shank when said extension and deflecting member are in their lowered position on the body, said frangible means being fractured by an upward pull on said deflecting member to allow subsequent upward movement of the member with relation to the body.

12. A casing whipstock including, a body having means for anchoring the same within a well pipe, an upstanding shank on said body, a deflecting member, a tubular extension on the lower portion of said member engaging over and being slidable on the shank, the member being normally in a lowered position with the lower end of the extension being supported on the upper end of the body, a pivoted latch member mounted in the upper end of the shank and movable outwardly thereof, resilient means engaging the latch member and constantly urging said member into contact with the inner wall of the extension, the lower end of the extension having an opening therein which opening moves into alignment with and receives the latching member when the extension is moved upwardly on the shank, whereby said extension is latched to the shank in its raised position.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,278,361	Lewis	Sept. 10, 1918
1,502,428	Getty	July 22, 1924
1,529,848	Reeder	Mar. 17, 1925
1,625,600	Getty	Apr. 19, 1927
1,738,819	Cormier	Dec. 10, 1929
2,102,055	Brauer	Dec. 14, 1937
2,107,420	Kothny	Feb. 8, 1938
2,132,061	Walker	Oct. 4, 1938
2,158,329	Kinzbach	May 16 ,1939
2,207,920	Hughes	July 16, 1940
2,234,438	Kothny	Mar. 11, 1941
2,334,747	Brantly	Nov. 23, 1943