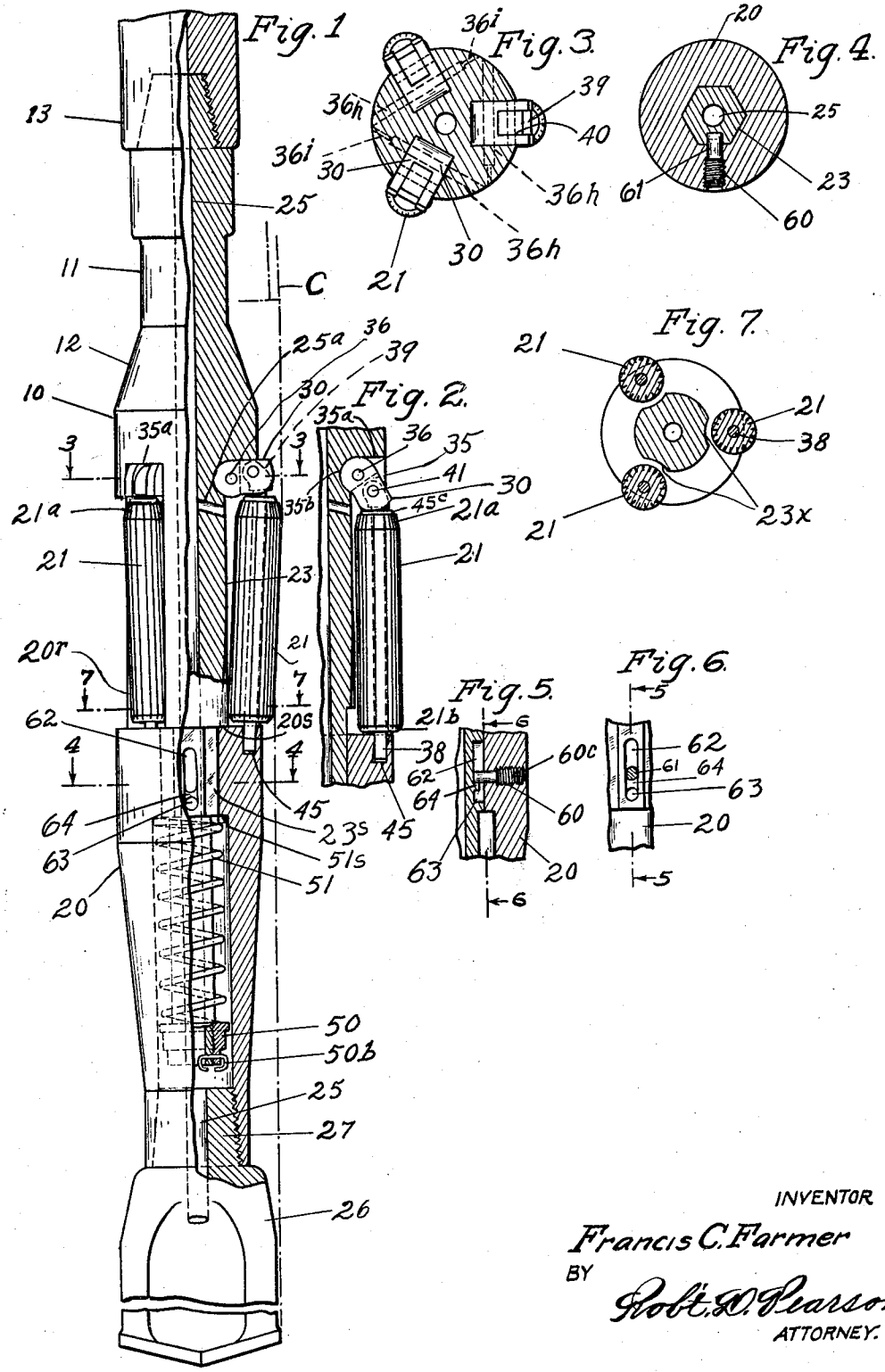
Feb. 2, 1932. F. C. FARMER 1,843,667

UNDERREAMING TOOL

Filed Feb. 24, 1930



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Patented Feb. 2, 1932 1,843,667

UNITED STATES PATENT OFFICE

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UNDERREAMING TOOL

Application filed February 24, 1930. Serial No. 430,752.

This invention relates to an underreamer drill adapted for use in general in drilling operations wherever it is desired to enlarge the diameter of the well bore beneath the lower end of the well casing.

Among the objects of the invention are to provide a tool of the character stated which will be an improvement upon others of its class with respect to efficiency and dependability of operation; one in which the cutting elements may be more readily and conveniently inserted and removed after they have become worn in order that new cutting elements may be inserted; and a general construction which improves upon the prior devices of the class with respect to various other details, all of which will hereinafter more fully appear.

Referring in detail to the accompanying drawings which illustrate what is at present deemed to be a preferred embodiment of the invention,

Fig. 1 is a side elevation of the complete tool mounted in position for use, a portion of the view being shown in mid-section.

Fig. 2 is a sectional detail showing one of the cutting elements in a different position from that wherein it is shown in Fig. 1.

Fig. 3 is a cross section on line 3—3 of Fig. 1.

Fig. 4 is a cross section on line 4—4 of Fig. 1.

Fig. 5 is a fragmental sectional detail of the releasing device to permit removal of the rotary cutter, on line 5—5 of Fig. 6.

Fig. 6 is a fragmental view of a part of Fig. 1, and also may be regarded as a section on line 6—6 of Fig. 5.

Fig. 7 is a cross section on line 7—7 of Fig. 1.

Referring in detail to the drawings, the tool is provided with a cylindrical body portion 10 having a shank 11 which is united thereto by a tapered portion 12 whereby the tool may be attached to the usual tool joint 13. The body portion of the tool is formed in two sections, a main upper section 10 and a lower section 20, these sections being longitudinally movable with relation to each other and having between them a broad circumferential recess or groove 20*r* which provides space for inserting the rotary cutters 21, two or more of said cutters being usually employed. Within said groove 20*r* the body 10 is provided with a diametrically reduced cylindrical extension 23 whereby the portion 10 of the tool is united to the lower portion 20 thereof. Through said stem 23 extends an axial water supply passage 25, said passage continuing the entire length of the tool. At the lower end of the tool a fish-tail bit 26 is shown attached by a conventional screw-threaded shank 27, or other drilling means.

The invention resides more particularly in the links 30 and the parts which cooperate with them, whereby the upper end portions of the cylindrical cutters 21 are expansibly attached in the operative position to underream the sides of the well bore below the lower end of the well casing C.

Each of said links 30 is mounted to swing through a vertical plane in a recess 35 in the tool body 10, and is pivotally attached at its inner end by means of a horizontally extending pin 36 which is inserted into a suitable hole provided therefor. The end portions of links 30 are preferably rounded as shown.

Each of the pivot pins 36 for attaching the links 30 fits into a hole 36*h*, indicated in dotted lines in Fig. 2, said hole being bored in the direction of a chord with respect to the cylindrical body of the tool, but not being drilled quite through the tool, there being a diametrically reduced hole 36*i* which leads from the base of hole 36 to the adjacent side of the tool. The pin 36 is driven tightly into the hole 36*a* so that it will not be accidently displaced. When it is desired to remove the pin 36, a nail or suitable tool is inserted through the hole 36*i* and is then driven against the end of said pin.

Each cylindrical cutter 21 is rotatably mounted upon a shaft 38 which is of greater length than the cutter so that each end of said shaft projects beyond the adjacent end of the cutter. The upper end of said shaft is provided with a transversely flattened head 39 which, occupies a slot 40 cut into the outer end of the link, and by means of a pin 41 is pivotally connected with said link.

Each link 30 is mounted to swing from a somewhat inclined position, shown in Fig. 2, to a substantially horizontal position as shown in Fig. 1, the upward movement of said link being limited by a shoulder 35*a* at the upper end of recess 35. The rotary cutter elements are by preference and as shown, formed in two parts, namely; the main cylindrical cutter 21, and the small auxiliary frustro-conical cutter 21*a* which is seated upon the upper end thereof. The lower end of each cutter 21 is preferably beveled at 21*b*.

The lower sleeve section 20 of the tool is operatively secured to the hexagonal stem part 23*s* by means of a set screw 60 having a shank 61 at its inner end which cooperates with a groove 62 formed in one face of said hexagonal stem. Said groove 62 comprises a lower end portion or recess 63 which is separated from the upper portion of the groove by means of a shoulder or rise 64 of less height than the depth of the groove as well shown in Fig. 5. This construction makes it possible to allow the shank portion 61 of the screw 60 to form a key which permits a longitudinal but non-rotatable movement between the sleeve part 20 and the stem 23 when said screw shank 61 is brought into register with said recess 62 and screwed down thereinto. If the screw is screwed down far enough to project beyond the outer surface of the shoulder or rise 64, said rise will act as a stop to limit the downward movement of the screw.

The compression spring 51 acts between the shoulder 51*s* and the nut 50.

Assuming the screw to be inserted to the extent and in the position just mentioned, if it is desired to remove one or more of the cylindrical cutters 31, the screw 61 is unscrewed a sufficient distance to permit it to be moved across the rise 64 and brought into register with the recess 63. Under the condition just described the lower section or body 20 of the tool may be extended from the remainder of the tool against the opposition of spring 51 a sufficient distance to permit the lower ends of the shafts 38 to be swung out of their seats 45, whereupon the cutters 31 and 31*a* may be slid off from the shafts 38 permitting worn cutters to be replaced by new ones.

In order to prevent the screw 60 from unscrewing so far as to entirely withdraw itself from the groove 62, the outer end of the bore into which said screw is inserted is preferably peened over at 60*c*.

The axial water supply passage 25 which extends from end to end of the tool, is provided with radial ports or passages 25*a*, one of which is shown in Fig. 1, which open out adjacent to the upper ends of the cylindrical cutters 31 to efficiently supply a cleansing stream of water to these cutters during their operation.

The nut 50 at the lower end of stem 47 is preferably prevented from working loose by means of a locking clip 50*b*.

At the inner end of each shoulder 35*a* the recess 35 is provided with a semi-circular depression or seat 35*b* into which the rounded adjacent end portion of the link 30 is seated with a working fit. The shoulder 35*a* is so positioned with respect to the pivot pin 36 of the link that when the link swings up into contact with the shoulder the link will then have passed a little above the horizontal dead center line along which pressure is applied thereto during the operation of the cylindrical cutter 21. This construction causes the pressure during operation of the cutters to be received by the curved bearing surface 35*b* instead of by the pivot pin 36, thus preventing the pin from being broken and insuring efficient service.

Also the lower end parts of each of the cutters 31 of the stem 23 is preferably provided on its adjacent face with a scalloped outer or recessed portion 23*x* to provide additional clearance between the cutter 31 and the stem 23 so that gritty substances will not be apt to become impacted between the lower portion of the cutter and the adjacent part of the stem. This recess allows the water to more freely circulate around the lower portion of the cutters to keep them clean.

In operation, while the tool is being lowered into the casing of a well in which it is desired to perform an underreaming operation below the lower end of the well casing C, each of the links 30 will drop to the inclined position shown in Fig. 2 thus permitting the upper ends of the respective cutters 31 to swing sufficiently inward to clear the inner wall of the casing C during the descent of the tool. This inward swing of the links 30 is permitted by reason of the weight of the relatively heavy sleeve section 20 overcoming the opposition of spring 51 and causing the upper end of the sleeve section 20 to withdraw from the shoulder 20*s* thus permitting the cutter shafts 38 together with the links 30 to which they are pivoted to fall to the position shown in Fig. 2.

When the drill 26 encounters the bottom of the well, the weight of the upper shank member 10 and the parts thereabove will cause the upper and lower sections of the tool to approach each other until the upper end of the lower section 20 again engages the shoulder 20*s* of the stem, thus forcing the upper ends of the shafts 38 together with the cutters 31 and 31*a* mounted thereupon, into the operating or underreaming position shown in Fig. 1. It is to be understood that the sockets 45 in which are seated the lower ends of the shafts 38 will be of sufficient diameter to permit the swinging movement to occur between the positions of said shafts shown in Figs. 1 and 2. Said sockets 45 act as

guides which keep the cutters in place during the swinging movement of the links 30.

Although I have shown and described what is at present deemed to be a preferred embodiment of the invention, yet it is to be understood that various changes, such as come within the scope of the appended claims, may be made in the construction disclosed without departing from the spirit of the invention.

The upper end of each of the shafts 38, upon which the cutters 21 and 21*a* are mounted, is provided with a collar 45*c* preferably integral therewith which prevents excess upward movement of the cutter 21*a* and also guides both of the cutters on each shaft effectively toward their cutting position.

Claims:

1. An underreaming tool comprising an elongated body adapted to be lowered through a well casing, said body being formed in two sections which normally have a limited longitudinal movement with relation to each other, a shaft extending lengthwise of said body, one end of said shaft being seated in a recess provided in one of said body sections, said recess being of sufficient diameter to permit a tilting movement of said shaft therein, a swingable link with which the opposite end of said shaft is connected, and a cylindrical cutter mounted upon said shaft, said link shaft and body sections being so related to each other that a movement of the body sections toward each other will cause said link to swing said shaft and cutter out from an inoperative position to an underreaming position.

2. An underreaming tool comprising an elongated body adapted to be lowered through a well casing, said body consisting of two sections which normally have a limited longitudinal movement with relation to each other, a shaft extending length-wise of said body, one end of said shaft being seated in a recess provided in one end portion of one of said body sections, the end portion of said shaft which is seated in said recess extending thereinto a sufficient distance to prevent withdrawal thereof from said recess during the normal relative longitudinal movement of said body sections, stop means to arrest the movements of said body sections away from each other at the normal limit, said stop means being adjustable to permit the movement of the body sections to exceed the normal when it is desired to free from said recess the portion of the shaft normally contained therein, and a cutter mounted upon said shaft and removable therefrom when said shaft is disengaged from said recess.

3. An underreaming tool comprising an elongated body adapted to be lowered through a well casing, said body consisting of two sections which normally have a limited longitudinal movement with relation to each other, a shaft extending lengthwise of said body, one end of said shaft being seated in a seat provided by one of said body sections and the other end of said shaft being pivotally connected with the other of said body sections, and stop means normally to limit the movement of said body sections away from each other, said stop means being adjustable to permit the movement of said body sections away from each other to be increased beyond the normal for the purpose of freeing said shaft from said seat, and a rotary cutter mounted upon said shaft and removable therefrom when the latter is freed from its seat.

4. An underreaming tool comprising an elongated body adapted to be lowered through a well casing, said body being formed in two sections which normally have a limited longitudinal movement with relation to each other, a shaft extending lengthwise of said body, one end of said shaft being seated in a guide provided in one of said body sections, a swingable link with which the opposite end of said shaft is connected, and a cutter mounted upon said shaft when said cutter is in its most retracted position, said link being outwardly inclined with relation to the axis of said body sections so that a movement of the body sections towards each other will cause said link to swing said shaft and cutter out from an inoperative position to an underreaming position.

In testimony whereof I hereunto affix my signature.

FRANCIS C. FARMER.