

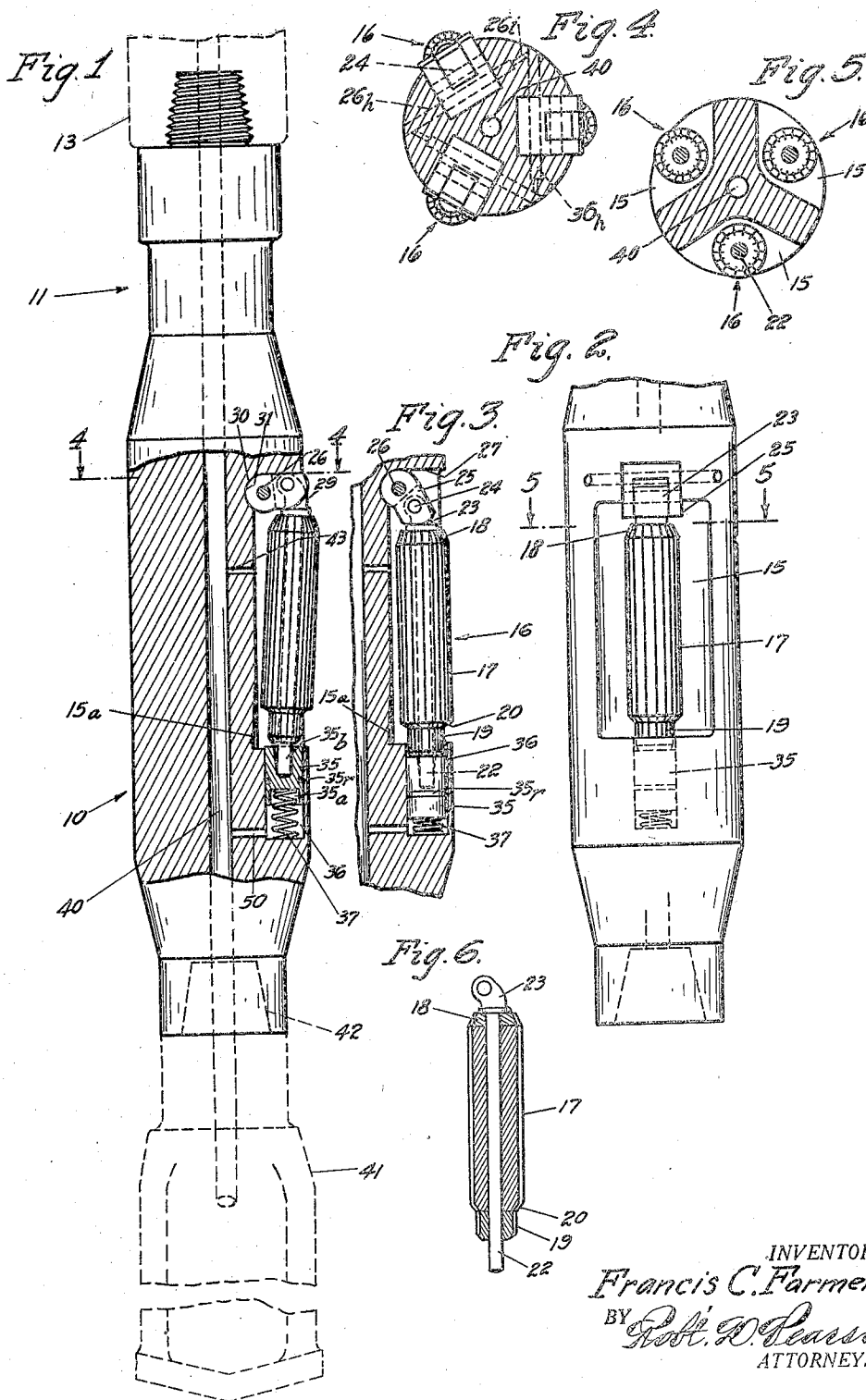
Feb. 2, 1932.

F. C. FARMER

1,843,668

UNDERREAMER

Filed March 18, 1930



INVENTOR.
Francis C. Farmer
BY *Robt. W. Pearson*
ATTORNEYS.

UNITED STATES PATENT OFFICE

FRANCIS C. FARMER, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO JOHN GRANT, OF
LOS ANGELES, CALIFORNIA

UNDERREAMER

Application filed March 18, 1930. Serial No. 436,760.

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.

Among the objects of the invention are to provide improved means for supporting the cutter shafts in such a manner that they may be safely subjected to heavy strain during drilling operations.

Yet another object of the invention is to provide superior means for moving the reaming elements from a normal sheltered, retracted, inoperative position outwardly into contact with the portion of the well bore which is to be reamed away.

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 side elevation of the central portion of Fig. 1, looking at said Fig. 1 from right to left, the cutting elements being shown in a different position.

Fig. 3 is a sectional detail showing one of the cutting elements in the same position as in Fig. 2.

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

Fig. 5 is a cross section on line 5—5 of Fig. 2.

Fig. 6 is a sectional detail of one of the reaming elements together with its shaft and adjacent parts.

Referring in detail to the drawings, the

tool is provided with a cylindrical body portion 10 having a shank portion 11 whereby it is united to the usual tool joint 13. The body portion of the tool is provided with a plurality of recesses 15 which are equally spaced from each other, three of said recesses being shown in the drawings. These recesses 15 are each adapted to shelter one of the composite reaming elements 16 which will later be described. Said recesses 15 are desirably, as viewed in cross section, of a broad shallow nature as shown in Fig. 5 to avoid clogging, but the invention is not limited to any particular shape of recess 15.

Each of the composite reamers 16 comprises a main central cutter 17, a frusto-conical upper cutter 18 and a cylindrical lower cutter 19, the central cutter 17 being bevelled at 20 adjacent to said cutter 19. These cutters are all supported in axial alignment with each other upon a shaft 22 whereon they may freely rotate.

The upper end of shaft 22 is provided with a flattened head 23 whereby, by means of a pin 24, it is pivotally secured to the outer bifurcated end of a link 25, the upper end of said link 25 being in turn pivotally secured to the body of the tool by means of a pivot pin or bar 26. Each link 25 has a swing through a limited arc, the upward movement of said link being limited by a shoulder 27 which is positioned to arrest the movement of said link after the pivot pin 24 has reached a point slightly above the level of the pivot pin 26. The outer end portion of said link is preferably provided with a curved face 29.

The inner end portion of said link is provided with a curved face 30. These curved faces 29 and 30 are formed as arcs having for their respective centers the pivots 24 and 26. The face 30 is shaped to have a working fit upon a curved face or recess 31 formed at the upper end of the recess 15 in order to provide an abutment to support the link and relieve pressure from the pivot pin 26 during reaming, as will hereinafter more fully appear.

At the lower end of each cutting device 16 is located a follower 35 which is seated with

a working fit in a circular recess or pocket 36 provided therefor in the body portion of the tool beneath the main recess 15. The lower end of follower 35 is recessed at 35a to receive a compression spring 37. The upper end of follower 35 is recessed at 35b to receive the lower portion of shaft 22 which projects beneath the composite cutting element 16 mounted thereon. This recess 35b is widened toward its mouth so as to permit the shaft 22 to swing from one to the other of the positions shown in Figs. 1 and 3.

Longitudinally through the entire tool extends a water supply passage 40. At the lower end of the tool a fish-tail bit 41 is shown attached by a conventional shank 42, or other drilling means may be substituted for said fish-tail bit. With said passage 40 communicates radial ducts or passages 43, there being a passage 43 to supply water to each of the main recesses 15.

Referring to further details regarding the means for pivotally attaching the links 25, each of the pivot pins 26 of the links 25 fits into a hole 26a provided therefor as indicated in Fig. 4, 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 26b which leads from the base of hole 26a to the adjacent side of the tool.

The pin 26 is driven tightly into the hole 26a so that it will not be accidentally displaced. When it is desired to remove the pin 26, a nail or other suitable tool is inserted through the hole 26b and is then driven against the end of said pin in order to loosen it.

After the pin has thus been loosened it may readily be removed permitting the link 25 together with shaft 22 and composite reaming element 16 to be completely removed so that the cutters 19, 17 or 18, may one or all be removed and replaced with new cutters.

In addition to the ducts or passages 43 which have already been described, additional ducts or passages 50 are provided, one of these passages 50 being furnished to supply water from the main passage 40 to each of the recesses or pockets 36 wherein one of the followers 35 operates. One of these passages 50 is supplied for each recess 36 and leads to the lower end portion of said recess in order to supply liquid pressure thereto from the passage 40 thus to aid the spring 37 in moving the reaming element 16 up to the operative position shown in Fig. 1. The upper passage 43 is desirably made smaller than the lower passage 50 because said lower passage is designed to freely supply hydraulic pressure beneath the follower 35, but the upper passage 43 will perform its cleansing function more effectively if water passes therethrough in a more rapidly moving stream.

The spring element 37 which has already been described, comprises a spring of as great a compressive power as can be used without interfering with the lowering of the tool into the well, that is to say, the rotary reaming elements 16 must not be forced too violently into engagement with the sides of the well casing and yet the spring 37 should be strong enough to be depended upon to move said elements up to the operative position when said spring is aided by the hydraulic pressure supplied through passage 50 beneath the follower 35.

The frustro-conical cutter 18 around its base portion is of the same diameter as the main cutter 17, and normally seats upon the upper end of said cutter 17. This construction adapts the reaming element as a whole to smoothly and effectively engage the material to be reamed away, as each reaming device is forced upward to its operative position.

The short cylindrical cutter 19 is of a smaller diameter than the main cutter 17 in order that said cutter 19 may as nearly as possible fill the upper end of the recess 36 and may therefore, more effectively keep said recess from becoming clogged up with materials detached by the reaming operation.

The follower 35 has a circular recess 35c extending therearound filled with a packing of any approved kind, in order to cause the hydraulic pressure below the follower 35 to act thereupon effectively.

Each of the recesses 15 is desirably provided adjacent its lower end with a deepened portion 15a in order to safeguard against soil or other material clogging up the cutting elements 16 by accumulating back of the lower end thereof.

While I have shown and described, by way of example, a preferred embodiment of my new invention, yet it is to be understood that various changes, within the scope of the appended claim, may be made in the invention without departing from the spirit thereof. For example, the number and location of the cutting devices 16 may be varied, as desired.

In operation, the tool is lowered into the well casing and as the rotary reaming elements 16 enter the top of the well casing they are manually depressed, if need be, against the opposition of springs 37 in order that the tool may be smoothly fed into the well casing. The tool is then completely lowered into the well until the reaming elements 16 arrive at the position to be used for under-reaming. Then liquid pressure is supplied through the main passage 40 and duct 50 thus to aid the spring 37 in raising the follower 35 of each of said reaming devices 16, thereby forcing up the drill shafts 22 to the position shown in Fig. 1 wherein the pivot 24 in the outer portion of each link 25 occurs.

pies a higher position than pivot 26 through the other end portion of said link. In this position of the links the upper edges of the links abut against the shoulders 27 while the inner ends of said links rest against the face 30 provided therefor. Hence when the tool is rotated the reaming elements 16 are supported in a very substantial manner at their upper ends and no matter how heavy a force is applied to them in a radially inward direction, they maintain their operative position by reason of the pivot pins 24 being positioned above dead center with relation to the pivot pins.

When a follower 35 is in the depressed position illustrated in Fig. 3, the pressure of the spring 37 thereagainst is the greatest. Therefore, since said spring safeguards against the follower becoming stuck in its most depressed or starting position, the spring and hydraulic pressure means cooperate to improve the functioning of the device.

Claim:

An underreaming tool comprising an elongated body portion adapted to be lowered through a well casing, a cylindrical cutter mounted adjacent said body portion and positioned to perform an underreaming operation, said cutter being mounted upon a shaft which extends lengthwise of said body, a link pivotally connecting said shaft with said body, a spring to force said shaft lengthwise of said body and thereby cause said link to force said shaft radially outward from said body, a follower against which said spring operates to move said shaft in the direction of its length as aforesaid, and means to supply hydraulic pressure to said follower to supplement the action of said spring thereagainst.

In testimony whereof I hereunto affix my signature.

FRANCIS C. FARMER.