

June 29, 1926.

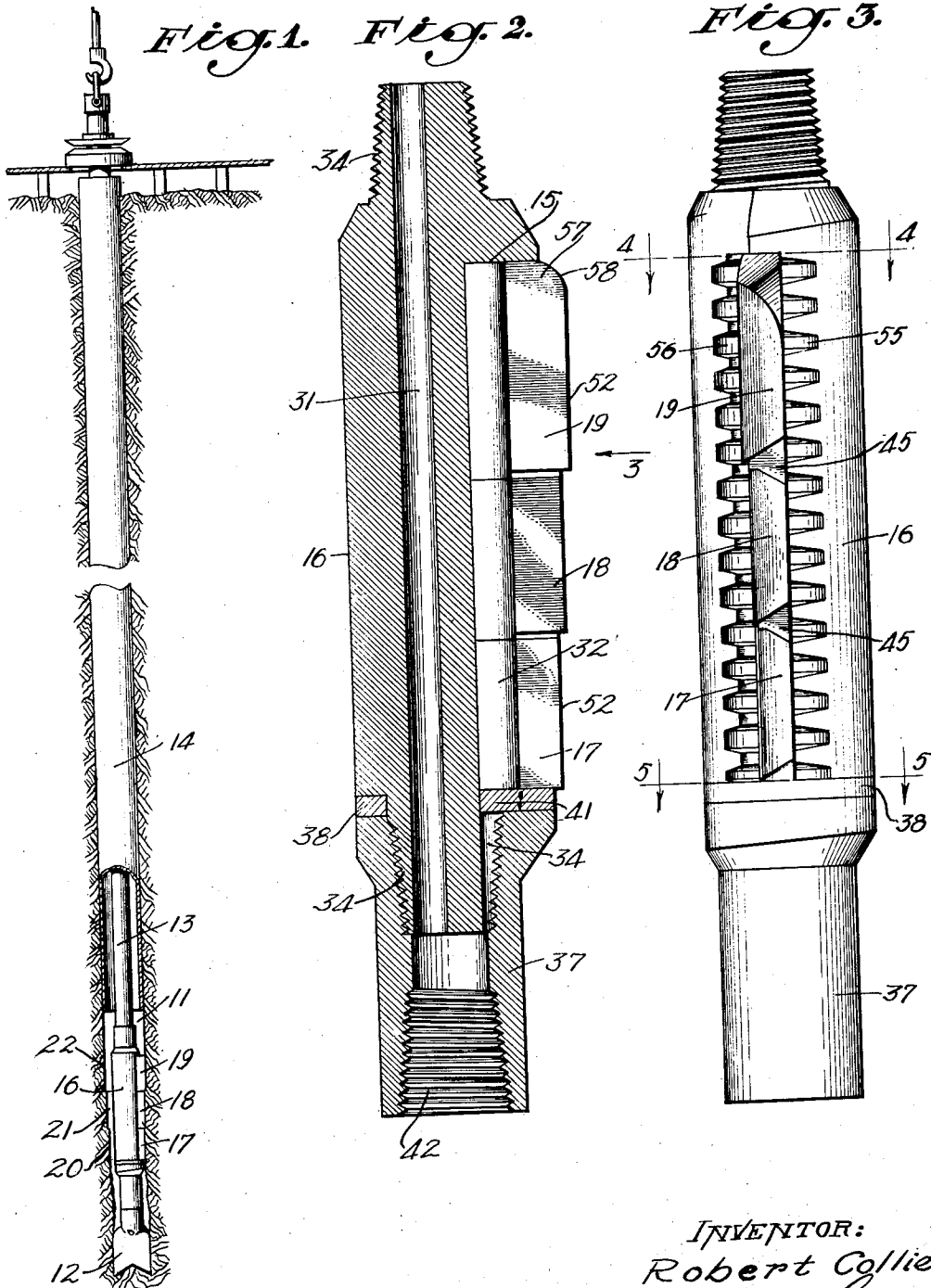
1,590,422

R. COLLIER

UNDERREAMER

Filed June 25, 1923

2 Sheets-Sheet 1



INVENTOR:
Robert Collier,
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Fig. 4.

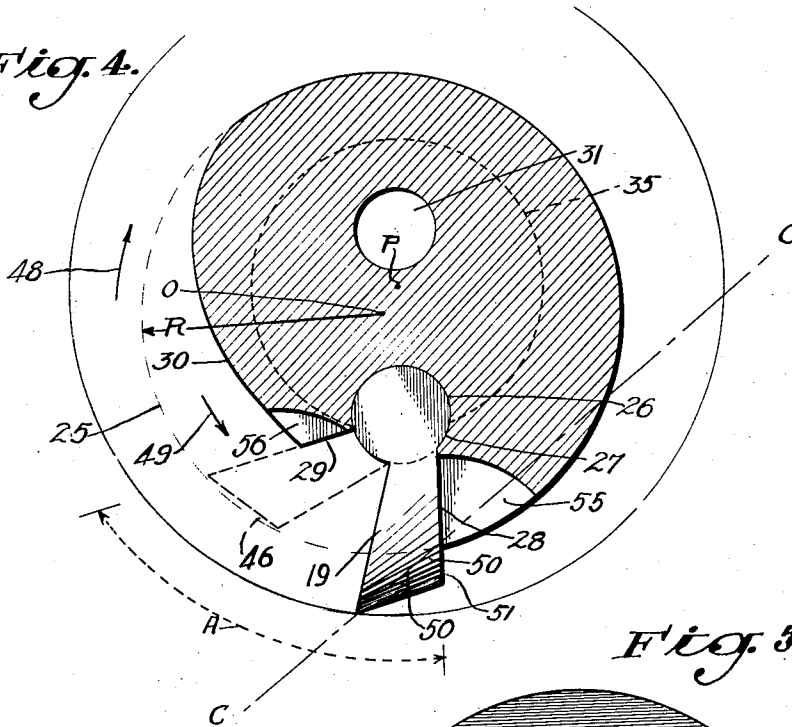


Fig. 5.

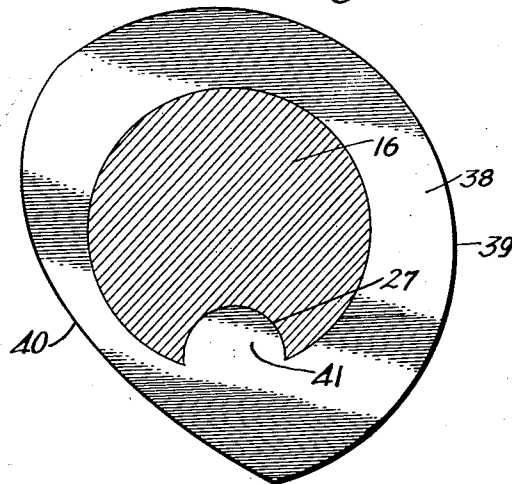
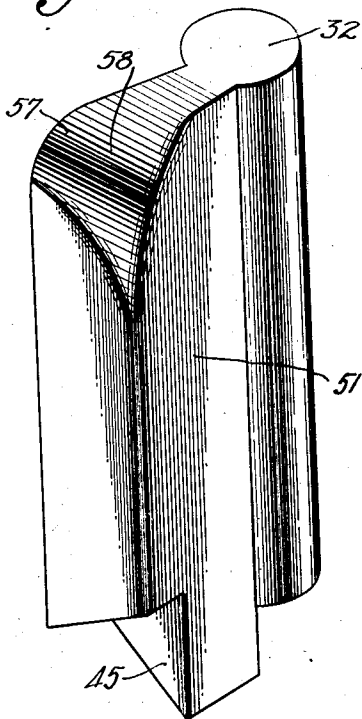


Fig. 6.



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UNITED STATES PATENT OFFICE.

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UNDERREAMER.

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This invention relates to well drilling apparatus and relates particularly to a device for reaming out the hole being drilled to a size which will receive the casing to be inserted therein.

It is an object of the invention to provide an underreamer having blades which may be collapsed so as to lie within an area which will freely pass through the casing and which blades when extended will operate in such a manner as to enlarge the hole to a diameter admitting the well casing.

It is a further object to provide a reamer of this type in which no springs are employed in the expanding of the cutting members.

It is a further object of the invention to provide a reamer having cutting blades which are pivotally secured in the reamer body and are adapted to swing upon a vertical axis between retracted and extended positions.

It is a further object of the invention to provide the cutting element in cooperating sections, each section being of regularly increased diameter, so that the removal of material from the wall of the hole is taken in a number of small cuts instead of a single cut as is now customary in the use of single blade underreamers. The use of separate cooperating blade members enables the replacement of those parts which have become worn and likewise enables the use of any one blade until it has become worn to an extent, rendering it incapable of further utility. The accomplishment of the principal objects of the invention is made possible by the use of a cylindrical body adapted to utility as part of a drilling string, this body having formed therein an under-cut channel in which cylindrical enlargements on the inner edges of the cutting members are received. The under-cut channel is open at one end so that the cutting members may be quickly placed therein or replaced as they become worn.

The especial advantages of the invention and further objects thereof will be made evident hereinafter.

Referring to the drawings which are for illustrative purposes only:

Fig. 1 is a view illustrating the use of the invention in drilling an underreaming well in which well casing is being placed.

Fig. 2 is a vertical section through the

underreamer in position corresponding to the position in which it is shown in Fig. 1.

Fig. 3 is an elevation of the underreamer derived as indicated by the arrow 3 in Fig. 2.

Fig. 4 is a section taken on a plane represented by the line 4—4 of Fig. 3.

Fig. 5 is a section taken on a plane represented by the line 5—5 of Fig. 3.

Fig. 6 is a perspective view of the upper blade member.

In Fig. 1 of the drawing, I show a hole being bored by means of a fish tail bit which is rotated by means of a string of drill pipe 13. In most drilling operations, the fish tail bit does not form a hole of sufficient larger size than its own diameter to receive the well casing 14, therefore it becomes necessary to employ an underreamer for the purpose of removing enough material from the sides of the hole to enlarge the hole sufficiently to receive the casing 14.

In the drawing, I show my invention, which consists of a cylindrical body 16 arranged for connection between the drill pipe 13 and the fish tail head 12. This body 16 supports cutting blades 17, 18 and 19 which are of regularly increased extension so that the removal of the material from the wall of the hole is divided into a number of separate cuts, the lower blade 17 enlarging the hole to the size indicated at 20, the intermediate blade 18 enlarging it as indicated at 21, and the upper blade finishing the hole to the full required diameter as indicated at 22.

In the construction of the body 16, reference may be had at this time to the section, Fig. 4, which shows a cylindrical bar of steel having the circumference indicated by the dotted line 25 generated at a radius R around a central point O. Forwardly from the center O a hole 26 is bored from the end of the bar intended to be the lower end of the body 16. This hole is stopped off at a point near the upper end of the bar, or in other words, is discontinued at the point 15 indicated in Fig. 2, thus leaving a hole which extends upwardly from the bottom of the bar and is blind at the other end. By the use of suitable milling cutters, the material between the dotted lines indicated at A is removed, thus forming in combination with the hole 26 a vertically extending channel having a face 28 and a face 29 which both

communicate with an under-cut portion formed by the reaming wall of the hole 26. The under-cut portion of the channel, therefore being circular in cross section as shown.

5 The material to the left of the face 29 is then milled down to the line 30.

Rearwardly from the center O, a hole 31 is bored entirely through the body to provide a water channel which will communicate between the drill pipe 13 and the fish tail bit 12. The blade members 17, 18 and 19 are provided with cylindrical enlargements 32 which are formed at the inner edges of the blades, these cylindrical enlargements being of a diameter slightly smaller than the hole 26 from which the under-cut portion 27 of the channel is formed, therefore, making it possible to insert the enlargements 32 in the lower end of the under-cut portion 27 and to move them upwardly therein until the upper blade 19 comes against the end 27 of the channel. Upon each end of the body 16, a tool joint pin 34 is turned, these pins 34 being situated upon an axis indicated by the point P which is spaced rearwardly from the center O of the body as indicated by the dotted lines 35 in Fig. 4.

Upon the lower tool joint pin, a sleeve member 37 is screwed. This sleeve being forced against a washer 38 which has the form shown in Fig. 5. The greater portion of the washer 38 is defined by a circular line 39 but is relieved at 40 to correspond with the relieved portion 30 of the body 16. Inwardly extending from the washer 38 is a semi-circular projection 41 which fits in the under-cut portion 27 of the blade channel, thus providing a closure means for the lower end thereof. The lower end of the sleeve 37 is threaded as indicated at 42 to receive the threaded pin customarily provided on the upper end of the fish tail bit 12. Since the pins 34 formed on the body 16 are in alignment with the drill pipe 13 and the fish tail bit 12, the axis represented in Fig. 4 by the point P then becomes the axis of rotation of the body 16, thus giving it an eccentric movement. The lower end of each blade 18 and 19 is provided with a downwardly extending portion 45 which engages the upper end of the succeeding blade. This engagement between the blades is provided for the purpose of rendering the swinging motion thereof simultaneous. Being pivotally secured upon the vertical axis defined by the hole 26, the blades when in retracted position as indicated by the dotted line 46 in Fig. 4 are within the circumference 25 of the body 16.

Before lowering the tool into the hole, the blades are swung into retracted position and will in this position freely pass through the casing 14. After the engagement of the fish tail bit with the bottom of the hole and the starting of the drilling space which in this

case is in the right hand direction indicated by the arrow 48 in Fig. 4 the reacting pressure of the mud against the retracted blades in a direction indicated by the arrow 49 causes the blades to swing into extended position as indicated at 50 in Fig. 4 and as shown in Figs. 1, 2 and 3, the backs 51 of the blades resting against the face 28 of the channel.

It will be recognized that in this position, the cutting edges 52 of the blade extend outwardly beyond the circumference of the body 16 so that engagement thereof with the wall of the hole is accomplished. As indicated at 55 and 56 in Figs. 3 and 4, relieving channels are milled in the body, these channels extending rearwardly in evenly spaced relationship from the faces 28 and 29. Whatever mud may be collected between the blades and the faces 28 and 29 is forced outwardly into the channels 55 and 56 when the blades swing against these faces.

The upper outward corner 57 of the upper blade 19 is curved off as indicated at 58, this curving off being disposed upon a diagonal line C—C, Fig. 4, so that when it is desired to raise the tool from the hole, the engagement of this curved face with the lower end of the casing 14 will cause the upper blade to be swung inwardly against the face 29. As shown especially in Fig. 3, each of the lower blades 17 and 18 is formed with its upper edge sloped downward in the direction of rotation, thus presenting a face adapted to be engaged by the extension 45 of the blade above it. The inward swing of the upper blade due to the extension 45 at the lower end thereof causes the swinging of the intermediate blade 18 inwardly therewith and likewise the lower blade 17 is swung inwardly by the intermediate blade 18, thus producing a simultaneous retracting of the blades.

It will be recognized that a force in a direction indicated by the arrow 49 against the lower blade 17 will also cause the simultaneous opening of the system of blades when the drilling operation is started. Owing to the under-cut structure of the channel, it will be impossible for the blades to be removed from the body, other than through the lower open end thereof. The threads on the pin extensions 34 are in a right hand direction, therefore, producing a tightening action of the sleeve 37 against the washer 38 during the drilling operation. If upon removal of the tool from the well, it is found that certain of the blades are worn and other of the blades remain in fairly good condition, the worn blades may be quickly replaced and the good blades left in the body for further utility. It is to be understood that although the one system of blades is shown mounted in the body that

two or three of these systems may be employed if desired without departing from the following claims.

Considerable difficulty is now being encountered in reamers due to the presence of pockets or depressions in front of the reaming plates, which pockets become filled with cuttings to the level of the cutting edges of the plates. These cuttings packing in tightly, become substantially as hard as the wall being operated upon, and prevent cutting action of the tool. To remedy this condition, it has been found necessary to divert the circulating stream of water from near the cutting edges of the drill bit to the faces of the reamer plates, by the forming of holes in the reamer body. The circulation of water across the face of the reamer blades through the openings provided in the reamer body, washes away the cuttings, thus keeping the reamer free; but it will be recognized that in this arrangement, the circulating stream does not reach the blades of the drilling bit where there is great need thereof for removal of cuttings. The reamer body employed in the practice of my invention is of eccentric form and a vertical channel of relatively large size is formed therein in position adjacent to the faces of the reamer blades, thus providing a passage through which the upwardly circulating water will principally pass, carrying with it the cuttings removed from the walls of the hole by the reamer blades. The removal of material from the reamer body in order to form this water circulating passage in front of the reaming blades is best shown in Figs. 4 and 5.

I claim as my invention:

1. In a reaming tool the combination of: a body adapted for use in a drilling string; and a plurality of cutting blades arranged consecutively in vertical order and pivoted on a vertical axis so as to be swung from retracted position against said body to extended position in which the cutting edges of said blades project outside said body, said blades being of regularly increased extension and separately replaceable in said body and having their abutting ends interengaging so that they will swing simultaneously between retracted and extended positions.

2. In a reaming tool the combination of: a body adapted for use in a drilling string; and a plurality of cutting blades arranged consecutively in vertical order and pivoted on a vertical axis so as to be swung from retracted position against said body to extended position in which the cutting edges of said blades project outside said body, said blades being of regularly increased extension and separately replaceable in said body and having their abutting ends interengaging in such a manner that an outward swing

applied to the lowermost of said blades will be transferred to said other blades, and in such a manner that an inward swing applied to the uppermost of said blades will swing said other blades inwardly.

3. In a reaming tool, the combination of: a body adapted for use in a drilling string, said body having faces against which cutters rest when in retracted or extended positions and channels leading rearwardly from said faces, into which channels substances collected between said faces and said cutters are forced when said cutters swing against said faces; and cutters pivotally secured upon a vertical axis and arranged to be swung from a retracted position against said body to a radially extending position in which the cutting edges of said blades project outside said body.

4. In a reaming tool the combination of: a body having a vertical channel formed therein, said channel being undercut; a plurality of cutting blades having enlargements at the inner edges thereof operative in said undercut channels and arranged to swing on the vertical axis defined by said undercut channel from retracted position against said body to extended position in which the cutting edges of said blades project outside said body, said blades being of regularly increased extension and separately replaceable in said body and having their abutting ends interengaging in such a manner that an outward swing applied to the lowermost of said blades will be transferred to said other blades, and in such a manner that an inward swing applied to the uppermost of said blades will swing said other blades inwardly.

5. In a reaming tool, the combination of: a cylindrical body adapted for use in a drilling string, said body having an undercut channel in the face thereof, said channel extending from a blind wall near one end of said body and having the other end thereof open at the opposite end of said body; a cutting blade having an enlargement formed along the inner edge thereof, receivable in said undercut channel through the open end thereof; a washer member having an inward projection arranged to close the open end of said undercut channel when said enlargement has been placed therein; and a cap member for holding said washer in place.

6. In a reaming tool, the combination of: a cylindrical body adapted for use in a drilling string, said body having an undercut channel in the face thereof, said channel extending from a blind wall near one end of said body and having the other end thereof open at the opposite end of said body; cutting blades having cylindrical enlargements along the inner edge thereof, receivable in said undercut channel; said blades being of

regular increased extension and means for closing the open end of said channel after said enlargements have been placed therein.

7. In a reaming tool, the combination of:
8 a cylindrical body adapted for use in a drilling string, said body having an undercut channel in the face thereof, said channel extending from a blind wall near one end of said body and having the other end thereof open at the opposite end of said body; cutting blades having cylindrical enlargements along the inner edge thereof, receivable in said undercut channel, said blades having engagement portions formed at the abutting ends thereof whereby said blades will be caused to move simultaneously between retracted and extended positions; a washer member having an inward projection arranged to close the open end of said channel when said enlargements have been placed therein; and a cap member for holding said washer in place. 15 20

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 12th day of June, 1923.

ROBERT COLLIER.