Aug. 4, 1925. 1,548,541

E. H. McCLEASE

UNDERREAMER

Filed July 27, 1923 4 Sheets-Sheet 1

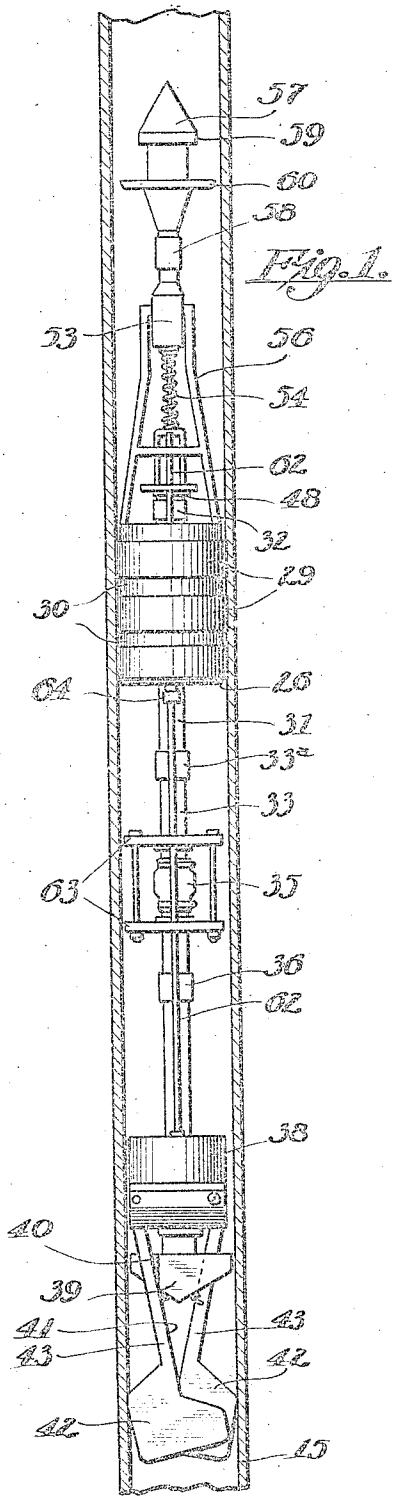


Fig. 1.

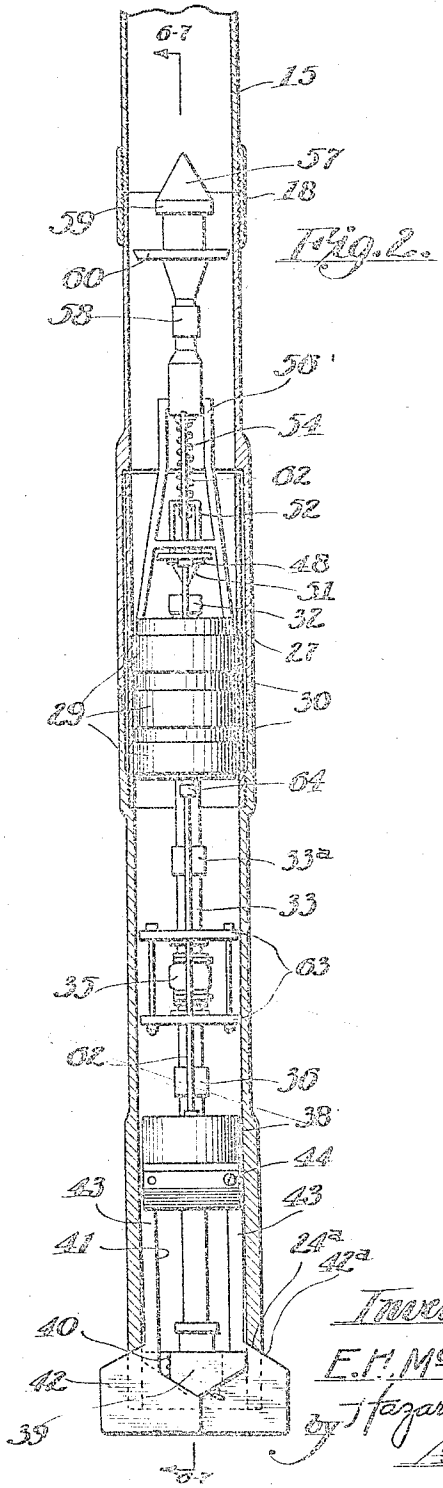


Fig. 2.

Inventor
E. H. McClease
by Fagard & Miller
Attys

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E. H. McCLEASE

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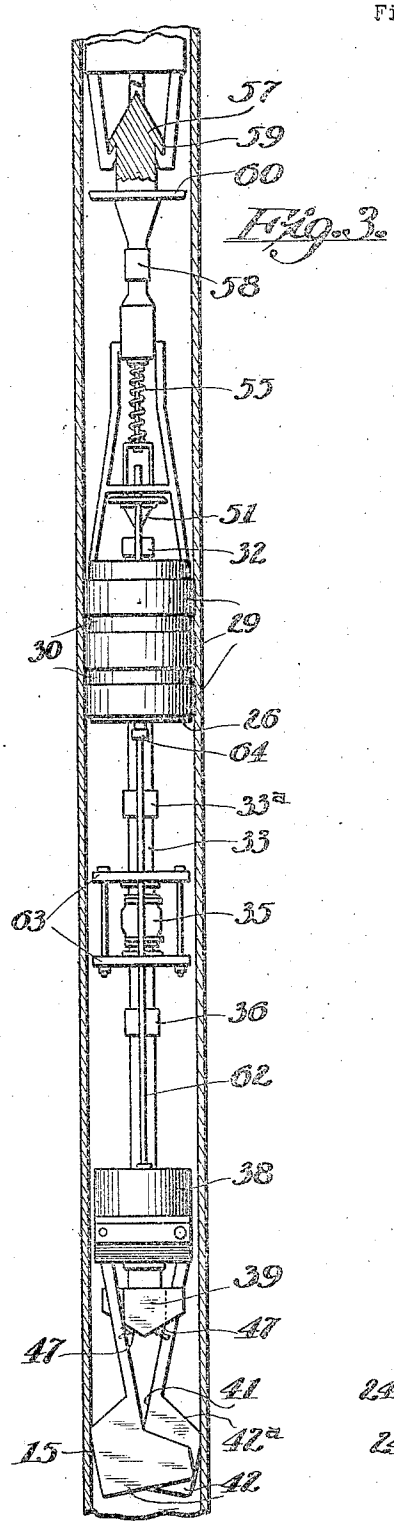


Fig. 3.

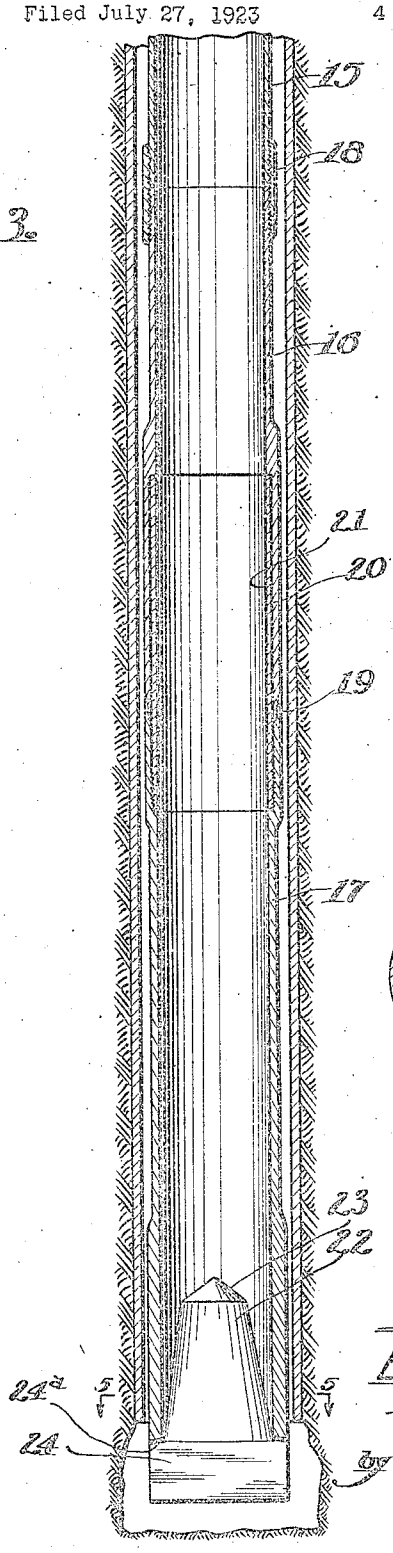
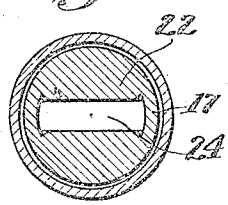


Fig. 4.

Fig. 5.



Inventor
E. H. McClease
Hazard and Miller
Attys

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E. H. McCLEASE

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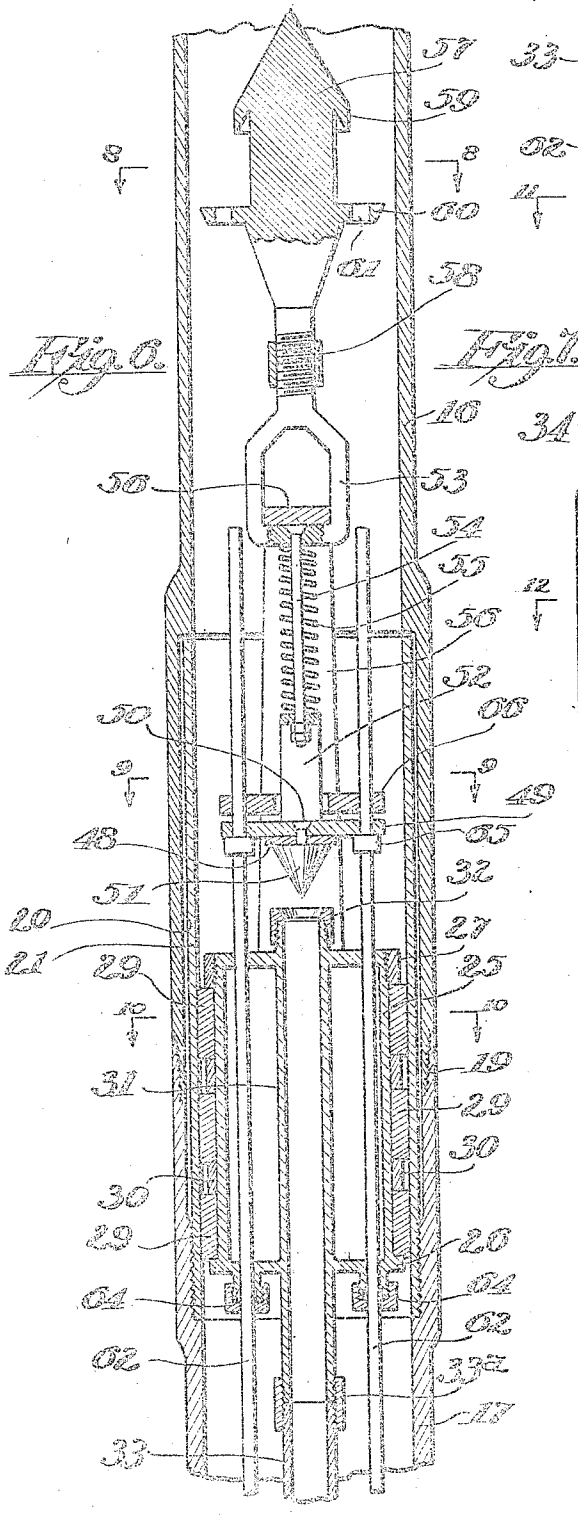


Fig. 2.

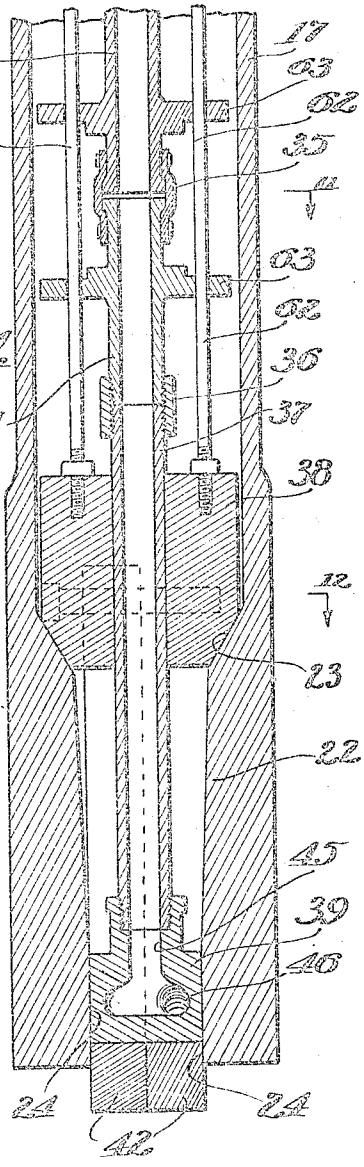


Fig. 1.

Inventor
E. H. McClease
Hazard & Miller
Attys

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E. H. McCLEASE

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Fig. 8.

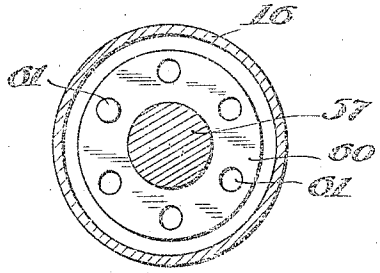


Fig. 11.

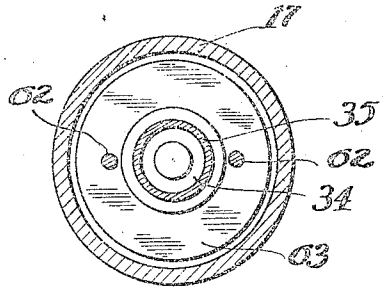


Fig. 9.

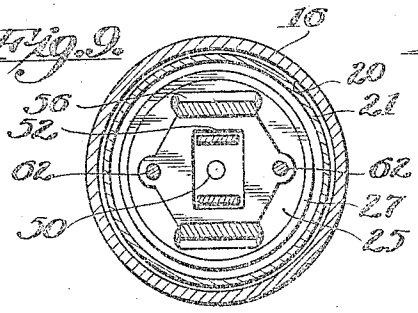


Fig. 12.

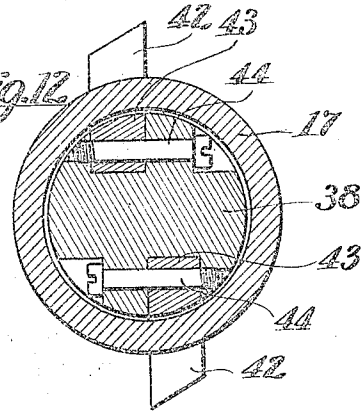


Fig. 10.

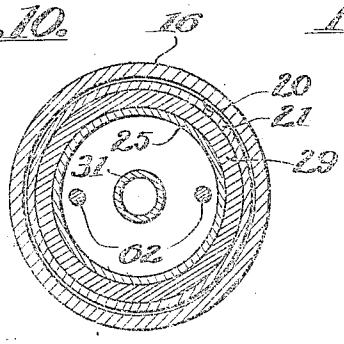
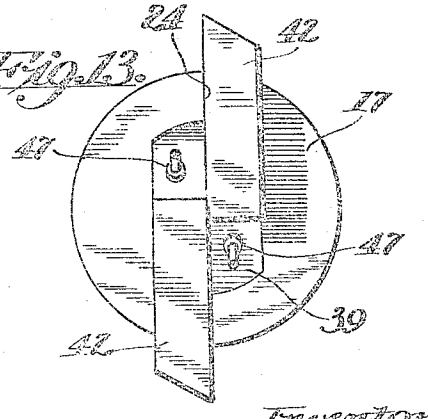


Fig. 13.



Inventor

E. H. McClease

by Hazard and Miller

Attys

Patented Aug. 4, 1925. 1,548,541

UNITED STATES PATENT OFFICE.

ERVIN H. McCLEASE, OF LONG BEACH, CALIFORNIA.

UNDERREAMER.

Application filed July 27, 1923. Serial No. 654,149.

To all whom it may concern:

Be it known that I, ERVIN H. McCLEASE, a citizen of the United States, residing at Long Beach, in the county of Los Angeles and State of California, have invented new and useful Improvements in Underreamers, of which the following is a specification.

My invention relates to well drilling apparatus and more particularly to an underreaming apparatus of the rotary type.

A purpose of my invention is the provision of an underreaming apparatus which is detachably associated with the drill tubing to permit of the apparatus being readily inserted into or withdrawn from the drill tubing while the latter remains within the well, thereby eliminating the necessity of lifting the drill tubing and the attendant disadvantages.

It is also a purpose of my invention to provide an underreaming apparatus which when in applied position within a specially constructed drill tubing functions to automatically move the drill bit of the apparatus from a contracted position within the tubing to an expanded position in which the blades are projected from the tubing in drilling engagement with the walls and bottom of the well, and automatically controlled means for allowing the circulation of water to the drill bits during operation of the latter, such means being operable upon the apparatus settling into operating position within the tubing.

Further, my invention includes a flexible connection between portions of the apparatus to compensate for irregularities in the construction of the drill tubing.

Although I have herein shown and will describe only one form of underreaming apparatus embodying my invention, it is to be understood that various changes and modifications may be made herein without departing from the spirit of the invention and the spirit and scope of the appended claims.

In the accompanying drawings,

Fig. 1 is a view showing in vertical section a portion of the drill tubing having applied thereto one form of underreaming apparatus embodying my invention.

Fig. 2 is a view similar to Fig. 1 showing the lowermost portion of the drill tubing, such portion also embodying my invention and having applied thereto the underreaming apparatus shown in Fig. 1.

Fig. 3 is a view similar to Fig. 1 showing the position of the apparatus while being lifted upwardly within the drill tubing.

Fig. 4 is an enlarged vertical sectional view of the lower portion of the drill tubing embodying my invention in applied position within a well.

Fig. 5 is a transverse sectional view taken on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged fragmentary vertical sectional view of the upper portion of the underreaming apparatus shown in the preceding views, and Fig. 7 is a view similar to Fig. 6 showing the lower portion of the drill tubing of the underreaming apparatus.

Figs. 8, 9 and 10 are transverse sectional views taken on the lines 8—8, 9—9 and 10—10, respectively, of Fig. 6.

Figs. 11 and 12 are transverse sectional views taken on the lines 11—11 and 12—12, respectively, of Fig. 7.

Fig. 13 is a bottom plan view of the apparatus shown in Fig. 7.

Similar reference characters refer to similar parts in each of the several views.

Referring specifically to the drawings, and particularly to Figs. 4, 6 and 7, the underreaming apparatus embodying my invention is shown as including the lower portion of a drill tubing which comprises an upper section 15, an intermediate section 16 and a lower section 17, the intermediate section being connected to the upper section by a collar 18 and to the lower section by a threaded connection 19. The sections 16 and 17 are constructed at their confronting ends to provide an annular recess or pocket 20 in which is removably fitted a bearing sleeve 21. The lower section 17 is provided adjacent its lower end with ribs 22 arranged at diametrically opposed points on the inner wall of the tubing and having at their upper ends upwardly inclined projections 23. As clearly shown in Figs. 7 and 13, the lower end of the section 17 is formed with slots 24 which are arranged substantially at right angles to the ribs 22.

Adapted to be contained within the drill tubing to engage the bearing sleeve is a piston including a hollow body 25 (Fig. 6) provided at its lower end with a flange 26 and at its upper end with a collar 27 which co-operate to maintain packing rings 29 upon the periphery of the body. These rings are maintained in spaced relation to

each other by spacing bands 30. The body 25 is formed centrally thereof with a conduit or pipe 31, the upper end of which projects above the body and carries a valve seat 32. The lower end of the conduit 31 projects from the lower end of the body and is connected to a similar conduit or pipe 33 by a coupling 33ª. As shown in Fig. 7, the conduit 33 is adapted for connection at its lower end with a similar conduit 34, these conduits 33 and 34 being flexibly connected to each other by a flexible conduit 35 which may be in the form of a rubber hose suitably secured in embracing relation to the confronting ends of the conduits. A coupling 36 serves to connect the lower end of the conduit 34 with a conduit 37, the latter extending loosely through a supporting head 38 and carrying at its lower end an expansion head 39. The expansion head 39, as shown in Figs. 1 and 2, is provided with inclined edges carrying rollers 40 which are adapted to co-operate with similar edges 41 of blades 42 for moving the latter from the contracted position shown in Fig. 1 to the expanded position shown in Fig. 2. These blades 42 which constitute the bit of the underreamer are provided with shanks 43 pivotally mounted on bolts 44 (Fig. 12) extending through flanges formed on the supporting head 38. In the contracted position of the blades 42, they are disposed wholly within the drill tubing, but when moved to expanded position they are extended through the slots 24, as clearly shown in Fig. 2. The upper end walls of these slots are inclined, as indicated as 24ª and are adapted to co-operate with inclined edges 42ª of the blades 42 for returning the blades to contracted position when it is desired to remove the apparatus from the drill tubing.

The lower end of the conduit 37 is in communication with a cavity 45 formed in the expansion head 39 (Fig. 7) and this cavity provides communication between the conduit and ducts 46 which extend to the lower edges of the head where they communicate with nozzles 47.

Referring again to Fig. 6, the upper end of the conduit 31 is adapted to be closed by a valve 48 secured to a plate 49 by means of a screw 50. An inverted conical shaped guide 51 depends from the valve 48 and serves to properly position the valve upon the seat 32. Secured to the plate 49 is a bail 52 which is movably connected to a yoke 53 through the medium of a bolt 54. An expansible spring 55 surrounds the bolt 54 and is interposed between the yoke 53 and the bail 52 to normally urge the bail downwardly upon the bolt and to thereby provide a yielding mounting for the valve 48. A stirrup 56 is rigidly connected to the upper end of the body 25, and this stirrup has its horizontal portion extended through and loosely mounted in the yoke 53. The yoke 53 is rigidly connected to a fish head 57 through a conventional connection 58, such head being of conical form and provided with an annular flange 59 which is adapted to be engaged by a fishing tool, as indicated in Fig. 3. A centering flange 60 is formed on the fish head 57, and this flange is provided with openings 61 for a purpose which will be hereinafter described.

As previously explained, the supporting head 38 is movable vertically on the conduit 37, and this head carries upstanding rods 62 which are circumferentially spaced, as shown in Fig. 10. These rods 62 are slidably fitted in guide flanges 63 formed on the conduits 33 and 34, and above these flanges the rods are slidable through openings formed in the body 25, the lower openings of which are provided with packing glands 64 to prevent leakage of water through the body, as will be understood. Above the body 25, the rods are formed with projections 65 upon which the plate 49 is adapted to normally rest. The rods are slidably extended through the plate 49 and through another plate 66 formed integral with the stirrup 56 so as to provide a guide for the upper portions of the rods.

The operation of the underreaming apparatus is as follows: With the drill tubing positioned in the well, as shown in Fig. 4, the apparatus may now be forced downwardly through the drill tubing by pumping liquid downwardly into the tubing and above the apparatus, it being noted that the piston, although having a sliding fit within the tubing, is sufficiently tight to prevent passage of liquid below the same so that the force of the pumped liquid can be utilized to move the piston and consequently the entire apparatus downwardly within the tubing. In the normal position of the apparatus, the valve 48 is tightly positioned on the seat 32 so as to close the upper end of the conduit 31 and thereby prevent the passage of water downwardly through the conduit. The valve 48 is maintained in closed position during the lowering of the apparatus by virtue of the fact that the supporting head 38 gravitates into the lowermost position shown in Fig. 1, thereby pulling the rods 62 downwardly to cause the projections 65 to be likewise lowered thereby permitting the spring 55 to move and maintain the valve 48 in closed position.

As the apparatus continues to be pumped downwardly within the well tubing, it finally settles into operating position, as shown in Fig. 2. Before reaching this operating position, the supporting head 38 engages the upper ends 23 of the ribs 22 and thereby checks further downward movement of the rods 62. But as the head 38 is

loosely supported upon the conduit 37, the piston continues to move downwardly thereby lowering the seat 32 out of engagement with the valve 48 and thus opening the upper end of the conduit 31. During the lowering of the piston, the expansion head 39 moves downwardly and thus forces the blades 42 into expanded position within the slot 24, as shown in Fig. 2. It will be particularly noted that the location of the ribs 22 with respect to the slots 24 is such that the blades of the bit will properly register with the slots so they can be moved into expanded position.

With the blades 42 in expanded position, and the valve 48 in open position with respect to the conduit 31, the apparatus is now ready for operation. Rotation of the drill tubing is now effected to impart a corresponding movement to the drill bit, and simultaneously with such movement water is supplied to the blades so as to effectively lubricate the latter and thus insure their proper operation at all times. Water pumped down through the drill tubing enters the conduit 31 and successively passes through the conduits 33, 34 and 37, entering the cavity 45 and passing through the ducts 46 from whence it is discharged onto the blades from the nozzles 47. The openings 61 of the centering flange 60 allow the unrestricted passing of water downwardly to the conduit 31, as will be understood.

Should it be desired to remove the bit from the drill tubing for the purpose of substituting new blades, in the event that the former should become broken or dull, it will be manifest that the apparatus can be completely removed from the drill tubing while the latter is retained within the well, and without the necessity of lifting the column of water above the apparatus. When removing the apparatus from the drill tubing, a fishing tool is applied to the fish head in the manner shown in Fig. 3, and by lifting the fishing tool, an upward movement is imparted to the piston and the supporting head. During the upward movement of the supporting head, the inclined edges 42ª of the blades 42 engage the upper end walls of the slots 24 so that the blades are moved into contracted position. It will be understood that prior to this movement, the piston is elevated in advance of the supporting head, so that the expansion head 39 is elevated out of engagement with the blades 42. As the valve 48 continues to remain in the open position, it will be clear that water above the apparatus is free to pass through the several conduits as the apparatus is elevated so that the necessity of lifting the column of water above the apparatus is eliminated.

Although I have shown the liquid conduit as comprising in part two pipe sections 33 and 34 between the piston and the supporting head, it is to be understood that any number of sections can be used to vary the vertical position of the piston in the bearing sleeve 21 so that should the bearing sleeve become unduly worn through continued use of the apparatus so as to allow the passage of liquid past the piston, the piston can be moved to the new position within the bearing sleeve to provide a tight joint between the two and thus prevent the leakage of liquid past the joint.

What I claim is:

1. In a well drilling apparatus, a drill tubing, a supporting head movable within the tubing, a piston movable within the tubing, a liquid conduit extending loosely through the supporting head, an expansible bit carried by the supporting head, an expanding head carried by the conduit, a valve adapted to control the passage of liquid into said conduit, means in the drill tubing for supporting the supporting head at a predetermined point within the tubing, and means operable by said supporting head for controlling said valve in the manner and for the purpose described.

2. In a well drilling apparatus, a drill tubing, a piston having a snug but sliding fit within the tubing, a drill bit depending from the piston and operatively connected thereto, a conduit adapted to supply liquid to the bit, and a valve operable automatically to close the conduit during downward movement of the piston into the tubing but to open the conduit when the bit is in drilling position within the tubing.

3. In a well drilling apparatus, a piston, a conduit extending above and depending from the piston, said conduit being formed of sections certain of which are flexibly connected, a supporting head movable on the conduit, an expansible bit carried by said head, an expanding head for the bit carried by the conduit, a valve for controlling the upper end of the conduit, and means operable by movement of the piston toward the supporting head for opening said valve.

4. In a well drilling apparatus, a piston, a conduit extending above and depending from the piston, a supporting head movable on the conduit, an expansible bit carried by said head, an expanding head for the bit carried by the conduit, a valve for controlling the upper end of the conduit and means operable by movement of the piston toward the supporting head for opening said valve.

5. In a well drilling apparatus, a piston, a liquid conduit extending above and below the piston, a supporting head below the piston and movable on the conduit, an expansible bit carried by the supporting head, an expanding head carried by the conduit,

a valve for controlling the passage of liquid into the upper end of the conduit, rods carried by the supporting head having projections engageable with the valve for moving the latter to open position and permitting the valve to move to closed position, a yoke connected to the piston, and a fish head operatively connected to said valve and movably associated with said yoke.

In testimony whereof I have signed my name to this specification.

ERVIN H. McCLEASE.