July 16, 1940. W. G. HURLEY 2,208,457

EXPANSIBLE AND CONTRACTIBLE ROCK DRILL

Filed May 8, 1939 4 Sheets-Sheet 1

FIG. 14.

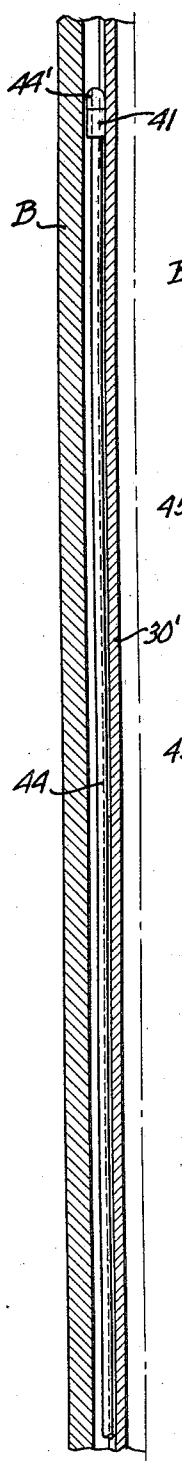


FIG. 15.

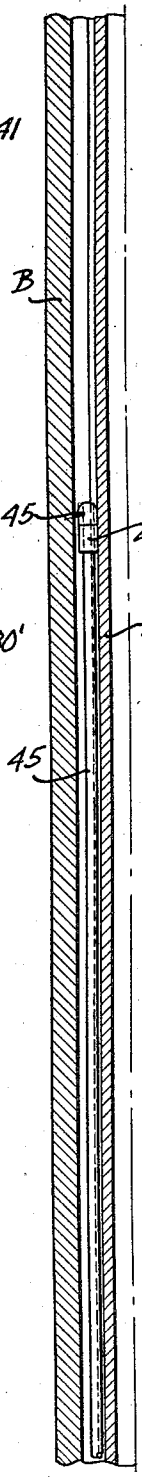


FIG. 16.

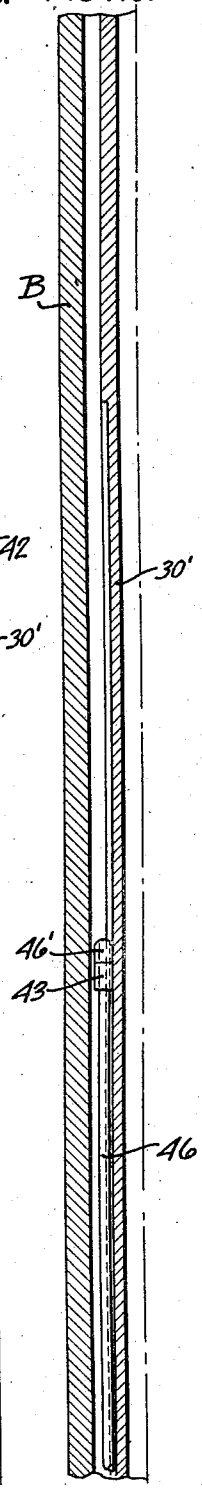


FIG. 1.

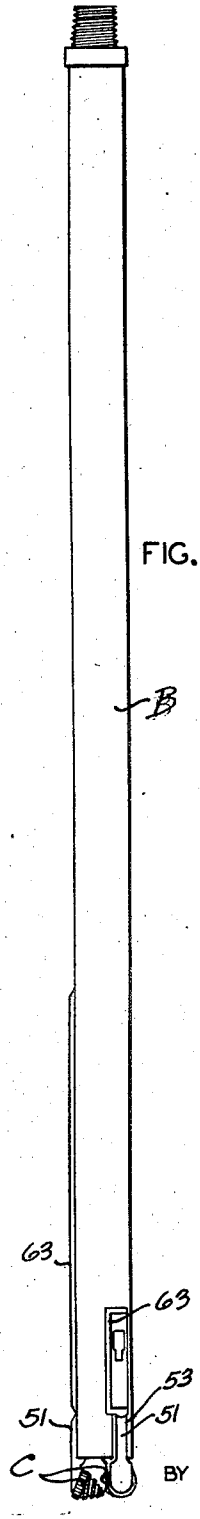
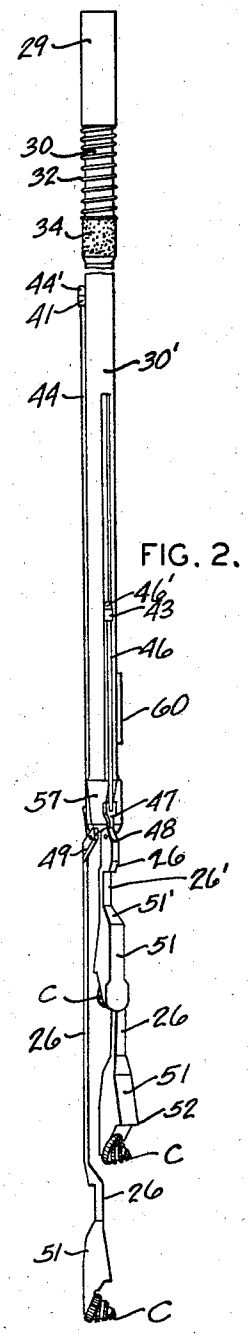


FIG. 2.



INVENTOR
WALTER G. HURLEY

BY J. H. Cook

ATTORNEY

July 16, 1940. W. G. HURLEY 2,208,457

EXPANSIBLE AND CONTRACTIBLE ROCK DRILL

Filed May 8, 1939 4 Sheets-Sheet 2

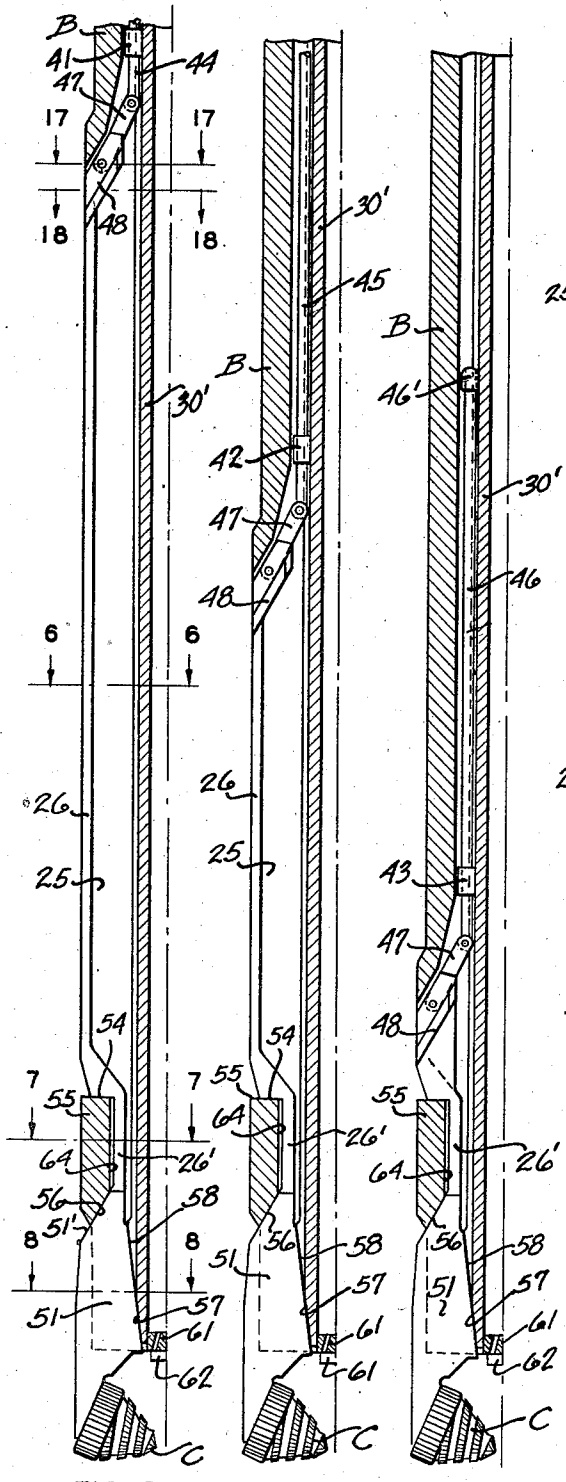


FIG. 3.

FIG. 4.

FIG. 5.

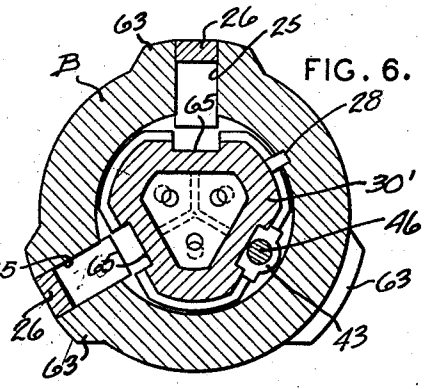


FIG. 6.

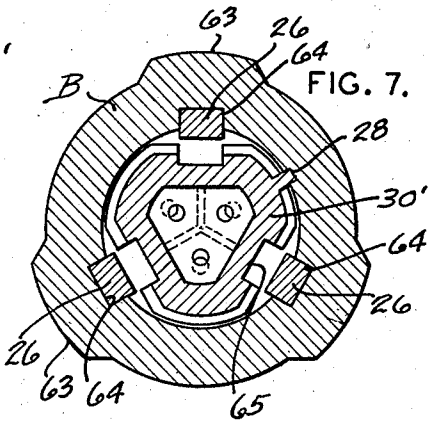


FIG. 7.

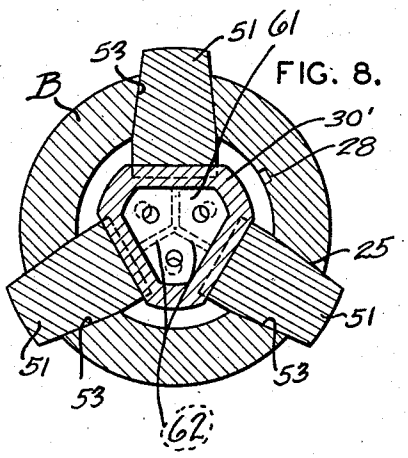


FIG. 8.

INVENTOR
WALTER G. HURLEY

BY J. S. Cook

ATTORNEY

July 16, 1940. W. G. HURLEY 2,208,457

EXPANSIBLE AND CONTRACTIBLE ROCK DRILL

Filed May 8, 1939 4 Sheets-Sheet 3

FIG. 9.

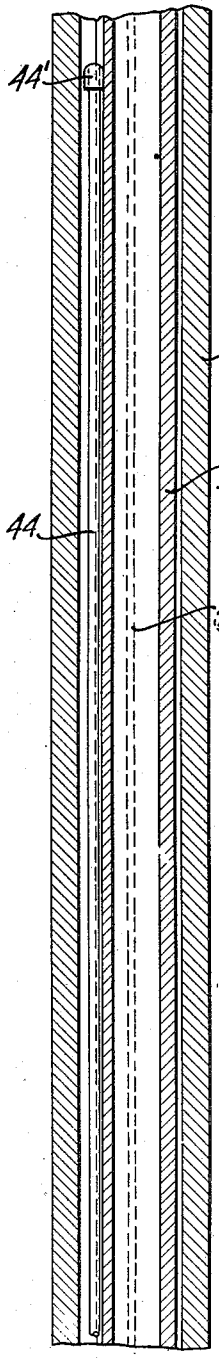
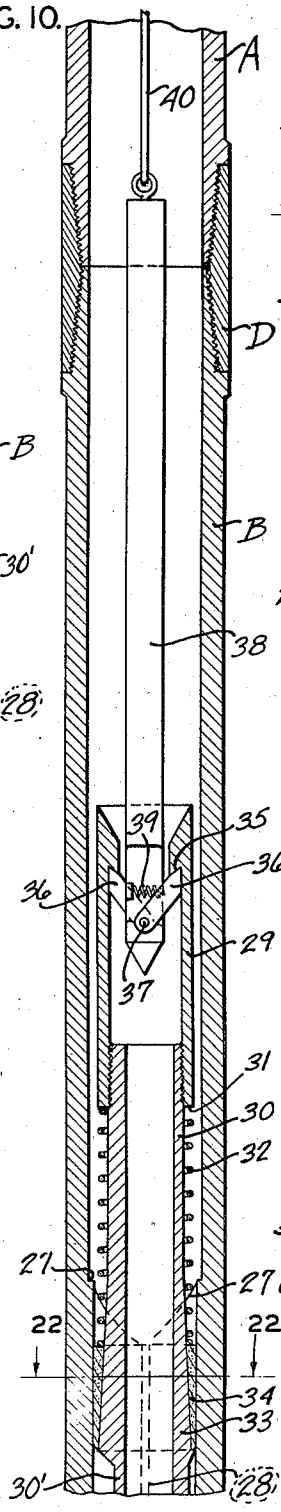


FIG. 10.



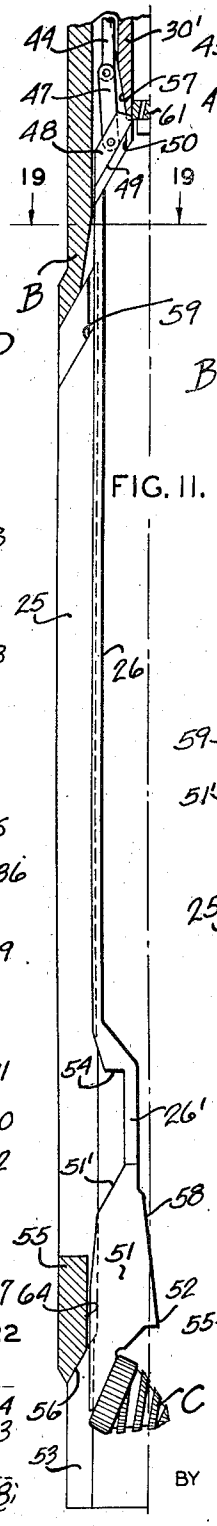


FIG. 11.

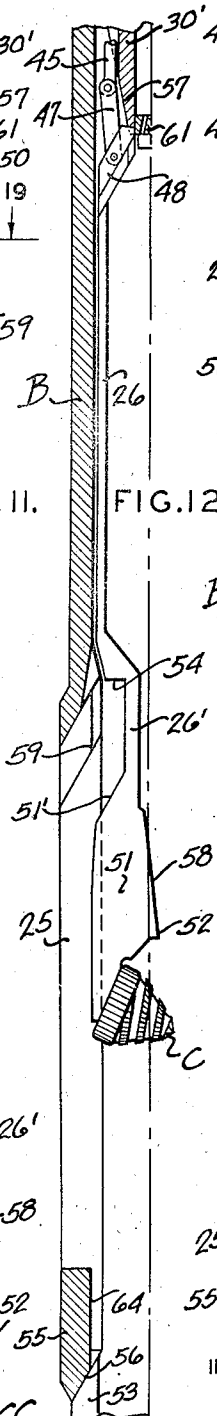


FIG. 12.

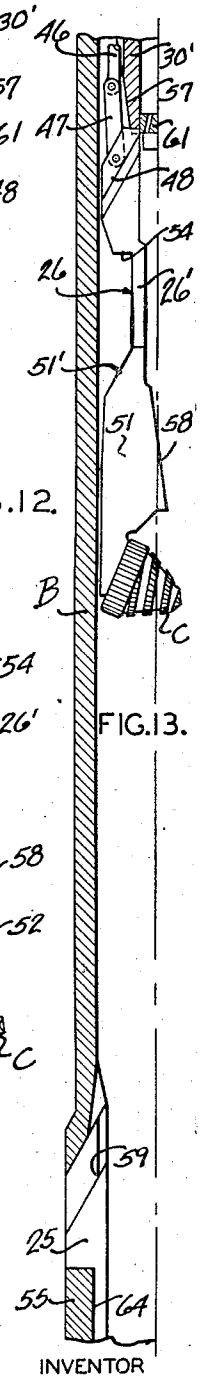


FIG. 13.

INVENTOR

WALTER G. HURLEY

BY J. H. G. Cook

ATTORNEY

July 16, 1940. W. G. HURLEY 2,208,457

EXPANSIBLE AND CONTRACTIBLE ROCK DRILL

Filed May 8, 1939 4 Sheets-Sheet 4

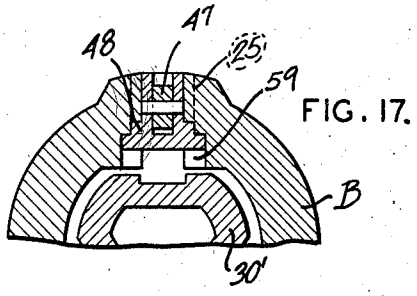


FIG. 17.

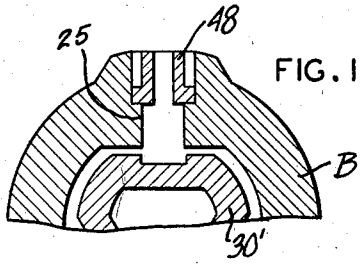


FIG. 18.

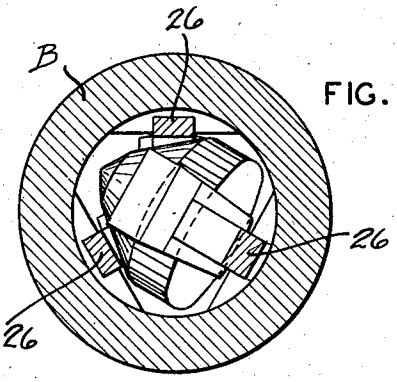


FIG. 19.

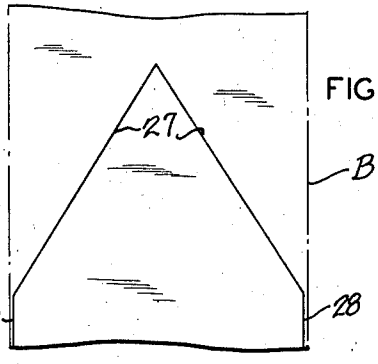


FIG. 21.

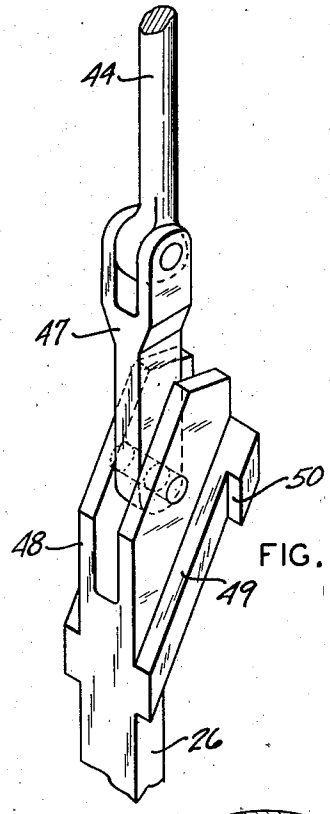


FIG. 20.

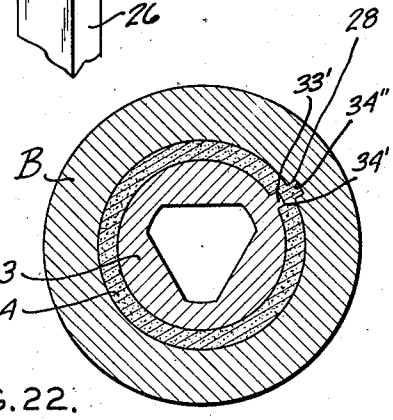


FIG. 22.

INVENTOR
WALTER G. HURLEY

BY J. S. Cook

ATTORNEY

Patented July 16, 1940 2,208,457

UNITED STATES PATENT OFFICE

2,208,457

EXPANSIBLE AND CONTRACTIBLE ROCK DRILL

Walter G. Hurley, East St. Louis, Ill., assignor of one-half to Lester A. Crancer, Webster Groves, Mo., and one-half to George B. Fleischman, University City, Mo.,

Application May 8, 1939, Serial No. 272,406

10 Claims. (Cl. 255—75)

My invention relates to a new and useful improvement in expansible and contractible rock drills, and has for one of its objects to provide an improved drill that may be lowered through the rotatable pipe and will automatically adjust itself into drilling position at the lower end of the drilling mechanism, and which may be readily removed for repairs or replacement of drill bits without disturbing the position of the rotatable pipe in the well. My invention includes a drill collar secured to the lower end of the rotary pipe or casing that is provided with slots for receiving certain parts of the drill-carrying mechanism and guiding means for directing such mechanism to said slots and a locking arrangement for locking the drills in expanded position in the drill collar when said drills have assumed their cutting position. My invention also includes means for quickly and easily contracting the drill-carrying parts phen it is desired to withdraw said drills from the pipe or casing.

With these and other objects in view, the invention consists in the novel construction, arrangement, and formation of parts, as will be hereinafter more specifically described, claimed, and illustrated in the accompanying drawings forming a part of this specification.

Fig. 1 is an elevation of the whole unit with the drill bits in expanded position.

Fig. 2 is an elevation of the inner unit carrying the drill bits with said bits in contracted position.

Figs. 3, 4 and 5 are half-sections taken 120° apart, showing the central portion of lower end of the drill collar and the bit-carrying unit with the carrying bars in contact with projections on the inner sleeve.

Figs. 6, 7 and 8 are cross-sections taken on lines 6—6, 7—7, and 8—8, respectively, Fig. 3, looking in the direction of the arrows.

Fig. 9 is a longitudinal section through a portion of the drill collar and the drill-carrying mechanism.

Fig. 10 is a longitudinal section through the lower end of the casing, a part of the drill collar and upper portion of the bit-carrying unit and the device for withdrawing said bit-carrying unit from the casing.

Figs. 11, 12, and 13 are longitudinal sections showing the bits in retracted position.

Figs. 14, 15, and 16 are half-sections showing parts of the drill collar and the bit-carrying unit when the bits are in retracted position.

Figs. 17 and 18 are cross-sections taken on lines 17—17, and 18—18, respectively, Fig. 3, looking in the direction of the arrows.

Fig. 19 is a cross-section taken on line 19—19, Fig. 11, showing one of the bits which is in retracted position.

Fig. 20 is a perspective view of the upper end of one of the bit-carrying arms.

Fig. 21 is a developed view of the positioning shoulder in the drill collar.

Fig. 22 is a cross-section taken on line 22—22, Fig. 10, looking in the direction of the arrows.

In the drawings the rotatable pipe or casing is designated by A, the drill collar by B, and the drill bits by C.

It will be understood that the pipe or casing A employed in oil well drilling is rotatable. The drill collar B being attached by the collar or tool joint D to the lower end of said pipe A is also rotatable with said pipe. The drill collar B acts as a housing for the drill bit-carrying mechanism and is provided with a series of longitudinal slots 25 in which the bit or cone hangers 26 move to place the drill cones or bits into expanded and retracted postion, as will be hereinafter described. Also in said drill collar B is a spiral guide 27 (Fig. 10) near the top of said drill collar to guide the drilling mechanism units into place. A groove or keyway 28 (Fig. 10) connecting with the spiral guide 27 is provided interiorly of the drill collar B through which the bits or cones are guided to their expanded or drilling position, as will be hereinafter more fully described.

The carrier shaft for the bits or cones C is composed of a tubular member 29 screwed onto another tubular member 30 (Fig. 10), the lower end of the tubular member 29 providing an abutment 31 against which the upper end of a spring 32 rests. The lower end of the tubular member 30 is flared outwardly as at 33, and surrounding such flared portion is a rubber or fiber packing seal 34, against the upper end of which rests the lower end of spring 32, whereby said packing seal is pressed downwardly and expanded in order to form a water-tight seal between the inside surface of the drill collar B and the tubular member 30. A tongue 33' is formed longitudinally on the flared portion 33 of the tubular member 30 for entering a recess 34' in the packing seal 34. Another longitudinal tongue 34'' is formed on the seal 34 and enters groove 28 in the drill collar B (Fig. 22). In the upper end of the tubular member 29 is a flange 35 against which the lugs 36 engage. These lugs are pivoted at 37 to the flattened end of a carrier rod 38 and a spring 39 tends to force the lugs outwardly to engage the flange 35. To the upper end of the carrier rod 38 is secured a cable 40 for raising and lowering the bit-carrying mechanism.

U-shaped lugs 41, 42, and 43 are welded to the side of the carrier shaft tubular member 30', which extends below the flared portion 33, at points intermediate the length of said member 30'. Through the said lugs 41, 42, and 43 pass

the rods 44, 45, and 46, which carry the bit-carrying unit, which in turn carries the bits or cones C. At the upper end of each rod is a projection 44', 45', and 46', respectively, which projections engage the lugs 41, 42, and 43.

At the lower end of each rod is pivoted a link 47, which in turn is pivoted at its opposite end in the bifurcated upper end 48 of the bit or cone hanger 26. Adjacent the end 48 is an inclined cam member 49 having a projection 50 extending outwardly therefrom (Fig. 20) to limit the downward movement of the cone hanger 26. As all of the cone hanger mechanism is identical except as to length, it is only necessary to describe one of them in detail. By reference to Fig. 2 it will be noted that the cones C are secured to the lower ends of the cone hangers 26 in a slightly tilted position, so that the ribbed cone-shaped surfaces are utilized in engaging the rock formation and for cutting therethrough as the cone bits are rotatably moved when in contact with such rock formation. The cone hangers 26 enter the longitudinal slots 25 in the drill collar B. The cones C are removably attached to the cone hangers 26. The lower end 51 of each of the cone hangers 26 is wedge-shaped and has a shoulder 52 extending just above the cone C. This portion 51 extends into a slot 53 in the lower end of the drill collar B. Above the wedge-shaped portion 51 is an offset portion 26' of the cone hanger 26, and where this portion 26' is joined to the hanger 26 is a shoulder 54 which seats on the circular section 55 near the lower end of the drill collar B. The upper end of the wedge-shaped portion 51 is inclined, as shown at 51', and when the cones C are in expanded position, as shown in Figs. 1, 3, 4, and 5, this inclined portion contacts an inclined shoulder 56 on the circular section 55 when the cones are expanded outwardly.

The lower end of the cone hanger 30' is beveled as at 57, which end contacts the inclined face 58 of the wedge-shaped member 51 as the cone carrier is lowered and forces the cones or bits C into their outer expanded position.

As the cone carrier 30' is lowered in the drill collar the cams 49 strike against an abutment 59 adjacent the upper end of each slot 25, causing the member 48 to slide outwardly through the slot 25, and this carries the cone hanger 26 also outwardly as well as the cones or bits C. Also, on the tubular member 30' is a longitudinal guide key 60 which is adapted to enter the groove or keyway 28 in the interior of the drill collar B, which causes the cone carrier to assume a position whereby the proper parts will be presented in a position to cause the cones C to assume an expanded position as the cone carrier mechanism is being lowered through the drill collar B.

When it is desired to withdraw the cone carrier mechanism from the casing A, an upward pull on the cable 40 is exerted which first withdraws the beveled end 57 from contact with the inclined faces 58 of the wedge-shaped members 51. Then as the upward movement of the cone carrier mechanism is continued, the U-shaped lugs 41, 42, and 43 each in turn contact the projections 44', 45', and 46', and the upward movement continuing, the cones C and their associated parts are carried upwardly and inwardly until the cones C are in contracted position, as shown in Figs. 11, 12, and 13, and then only the upward movement is continued until the cone-carrying mechanism is withdrawn from the casing A.

In Figs. 6, 7, and 8 is illustrated the tubular member 30' which has a perforated bottom 61, such perforations being preferably inclined, through which water may be introduced to the surface being contacted by the cone bits C. An angularly shaped projection 62 may extend from the bottom 61 to break up any material which may have escaped the cones C. Reinforcing shoulders 63 (Figs. 6 and 7) are provided near the lower end of the drill collar B for additional strength. Grooves 64 are provided interiorly of the circular section 55 to accommodate sections of the cone hanger 26. The lower portion of the tubular member 30' is grooved as at 65 to receive the cone hangers 26.

As the cone carrier 30' is lowered through the drill collar B, first the rod 44 reaches a point where the expanding action takes place, and the rod 44 slides in the lug 41. Then as the carrier 30' continues to descend, the intermediate cone-carrying mechanism engages the expanding device provided for it in the drill collar B, and the said device is expanded into drilling position and the rod 45 slides in the lug 42. Thereafter, the cone carrier 30' continues its descent until the shortest section is expanded into drilling position and the rod 46 slides in the lug 43. The cone carrier descends sufficiently further to cause the inclined face 57 on its lower end to engage the wedge-shaped portions 51, thus locking the drilling bits or cones C in their expanded position. When the cone carrier 30' is raised the wedge-shaped members 51 are first released and then, as the projections 44', 45', and 46' are engaged by the lugs 43, 42, and 41, respectively, the cone-supporting devices are retracted into their smaller diameter, thus permitting the cone carrier 30' and its associated parts to be raised through the drill collar B and the pipe or casing A.

I claim:

1. In a device of the character described, a casing, a drill collar attached to the lower end of said casing and having a plurality of spaced outwardly opening slots, a series of bits and a bit carrier longitudinally passable through said casing and said drill collar, a series of rods movably mounted on said bit carrier, bits attached to the lower ends of said rods, guide means formed in said slots and extending interiorly of said drill collar for successively directing said bits into expanded drilling position at the lower end of said drill collar and for moving the rods into expanded position in said slots, means for permitting the drill carrier to move a predetermined distance longitudinally in said drill collar independently of said bits, and means for locking said bits in expanded position.

2. In a device of the character described, a casing, a drill collar attached to the lower end of said casing and provided with a plurality of peripherally spaced outwardly opening slots in its side wall, a series of bits and a bit carrier longitudinally passable through said casing and said drill collar, a series of rods movably mounted on said bit carrier, bit carriers secured to the lower ends of said rods, each being provided with a wedge-shaped member adjacent the bit, and means for wedging said wedge-shaped members in the slots in said drill collar when the bits are in expanded drilling position.

3. In a device of the character described, a casing, a slotted drill collar attached to the lower

end of said casing, a series of bits and a bit carrier longitudinally passable through said casing and said drill collar, a series of rods mounted for movement in a longitudinal direction on said bit carrier, a guide interiorly placed in said drill collar, a key on said bit carrier co-operating with said guide for directing said bit carrier to a predetermined position in said drill collar, a cam member pivoted to one end of each rod, another guide member in said drill collar adapted to contact each of said cam members for moving the bit-carrying parts outwardly to expanded position, a bit-carrying hanger attached to each of said cam members, and means for locking said bits in expanded position, said bit carrying parts being successively movable to an expanded or a contracted position.

4. In a device of the character described, a casing, a slotted drill collar attached to the lower end of said casing, a series of bits and a bit carrier longitudinally passable through said casing and said drill collar, a series of rods mounted for movement in a longitudinal direction on said bit carrier, a guide interiorly placed in said drill collar, a key on said bit carrier co-operating with said guide for directing said carrier to a predetermined position in said drill collar, a cam member pivoted to one end of each rod, another guide member in said drill collar adapted to contact each of said cam members for moving the bit-carrying parts outwardly to expanded position, a bit-carrying hanger attached to each of said cam members, the sets of rods and bit carrying hangers being of different lengths for supporting the bits in superposed nested relationship in the drill collar, a wedge-shaped member attached to each bit-carrying hanger, means for wedging said wedge-shaped members in longitudinally disposed peripherally spaced slots in said slotted drill collar when the bits are in expanded drilling position, and means for locking said bits in expanded position.

5. In a device of the character described, a casing, a slotted drill collar attached to the lower end of said casing, a bit carrier longitudinally passable through said casing and said drill collar, a plurality of bits suspended therefrom in superposed relationship, when contracted, a packing seal surrounding said bit carrier and adapted to contact the inner wall of said drill collar at a predetermined point when the bits are in expanded position, a series of rods mounted for movement in a longitudinal direction on said bit carrier, a guide interiorly placed in said drill collar, a key on said bit carrier co-operating with said guide for directing said bit carrier to a predetermined position in said drill carrier, a cam member pivoted to one end of each rod, another guide member in said drill collar adapted to contact each of said cam members for successively moving the bit-carrying parts outwardly to expanded position, said drill collar having longitudinal outwardly opening slots, a bit-carrying hanger attached to each of said cam members and movable into the slots when the bits are expanded, and means for locking said bits in expanded position.

6. In a device of the character described, a casing, a slotted drill collar attached to the lower end of said casing, a series of bits and a bit carrier longitudinally passable through said casing and said drill collar, a series of rods of varying lengths mounted for movement in a longitudinal direction on said bit carrier whereby said rods are progressively presented to expanding mechanism in said drill collar, a guide interiorly placed in said drill collar, a key on said bit carrier cooperating with said guide for directing said bit carrier to a predetermined position in said drill collar, a cam member pivoted to one end of each rod, another guide member in said drill collar adapted to contact each of said cam members for moving the bit-carrying parts outwardly to expanded position, a bit-carrying hanger attached to each of said cam members, and means for locking said bits in expanded position.

7. In a device of the character described, a casing, a slotted drill collar attached to the lower end of said casing, a series of bits and a bit carrier longitudinally passable through said casing and said drill collar, a series of rods mounted for movement in a longitudinal direction on said bit carrier, a guide interiorly placed in said drill collar, a key on said bit carrier co-operating with said guide for directing said bit carrier to a predetermined position in said drill carrier, a cam member pivoted to one end of each rod, another guide member in said drill collar adapted to contact each of said cam members for moving the bit-carrying parts outwardly to expanded position, a bit-carrying hanger attached to each of said cam members, and means for progressively withdrawing said bits from their expanded to their contracted positions so said bits and bit-carrying mechanism is movable longitudinally through said drill collar on said casing.

8. A well drill comprising a casing, a drill collar mounted at the lower end thereof and provided with a plurality of circumferentially spaced longitudinal slots opening outwardly of its side wall, each of said slots having cam means at its upper end extending into the bore of the collar; a bit support slidably mounted in said drill collar, bit carriers of varying lengths slidably mounted in the drill collar and slidably connected to the bit support; each of the bit carriers including a rod slidably connected to the outer side of the bit support, a bit hanger having an upper cam portion and a lower enlarged wedge portion, a link pivotally connected at one end to the cam portion and at its opposite end to the rod; and bits fixed to the enlarged wedge portions, said bits being successively movable through the lower end of the drill collar, and said cam portions being successively engageable by the cam means for moving the bits outwardly to an expanded position beneath the drill collar and for moving the hangers outwardly into expanded position in said longitudinal slots.

9. An apparatus as in claim 8, said bit support having a tapered lower end, and being movable relatively to said bits, when in an expanded position, for engaging said enlarged wedge portions for wedging the bits in expanded positions.

10. An apparatus as in claim 8, said outwardly opening longitudinal slots each including spaced upper and lower portions forming an abutment therebetween having a beveled bottom edge, said enlarged wedge portions being recessed to receive said abutments when the bits are expanded to limit the outward movement of the lower ends of the hangers, and cam portions on said enlarged wedge portions for engaging the beveled bottom edges of the abutments to retract the bits when they are raised.

WALTER G. HURLEY.