Feb. 14, 1933. H. MECOM 1,897,267

ROCK DRILL

Original Filed Oct. 5, 1929

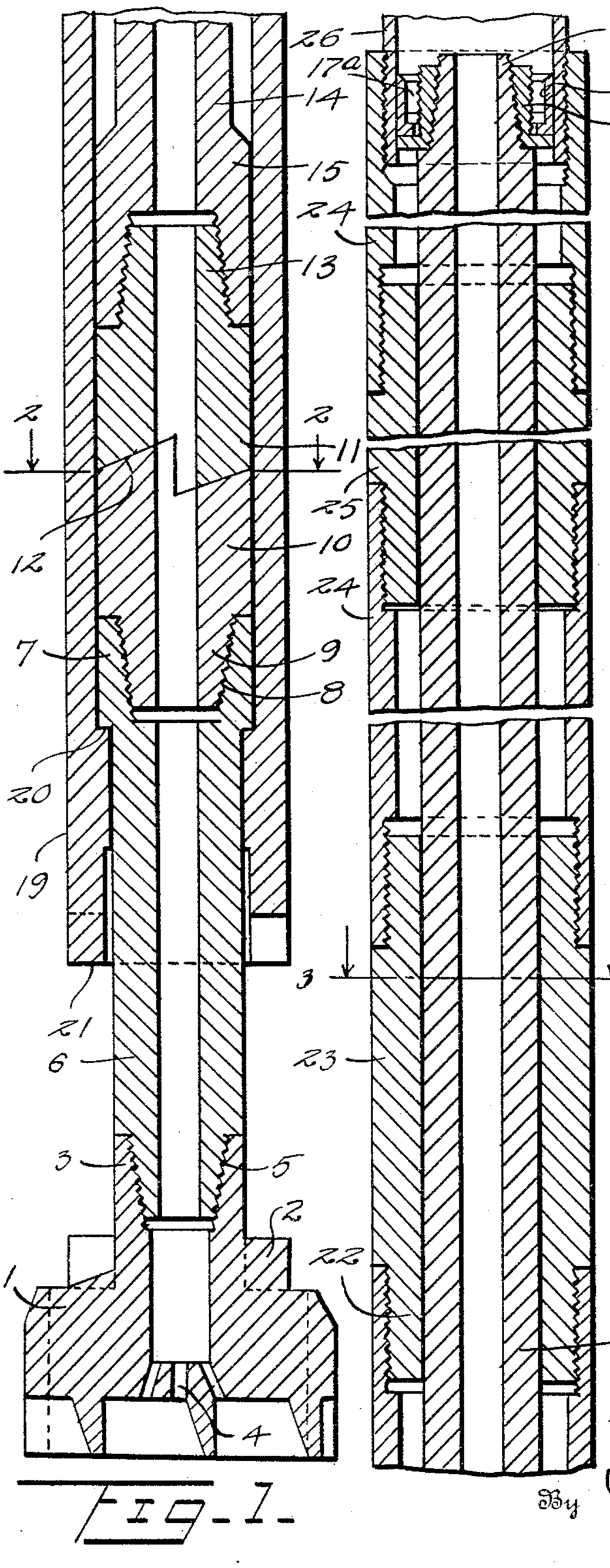

Fig. 1.

Fig. 1A.

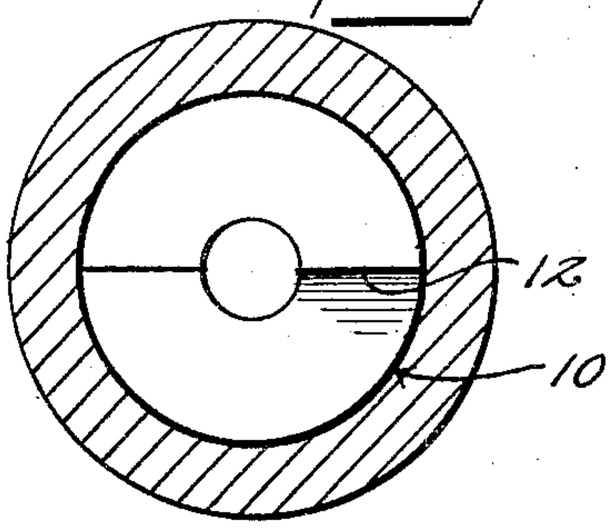

Fig. 2

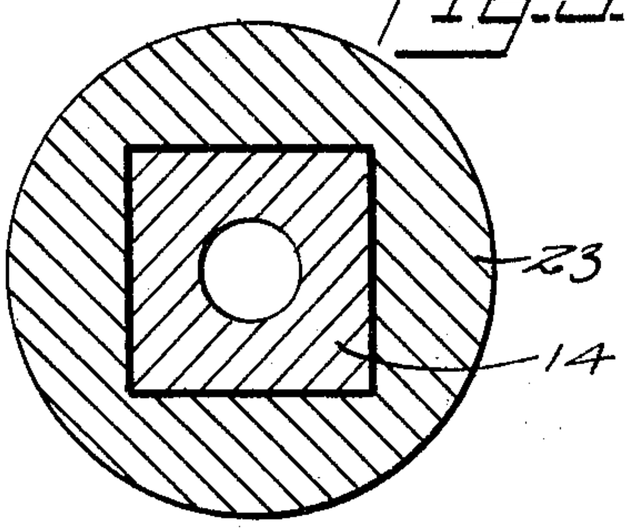

Fig. 3.

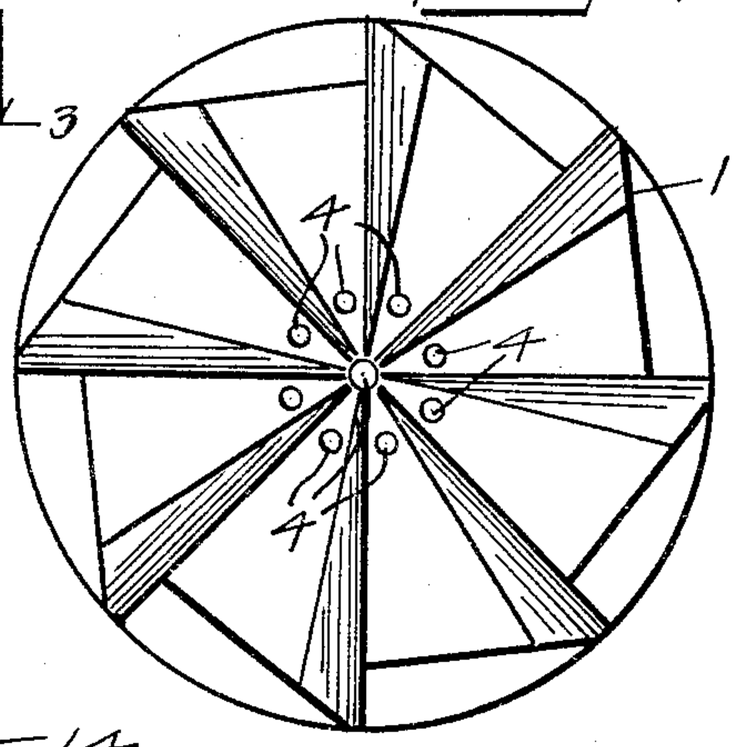

Fig. 4.

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UNITED STATES PATENT OFFICE

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ROCK DRILL

Application filed October 5, 1929, Serial No. 397,605. Renewed December 27, 1932.

This invention relates to improvements in rock drills.

One of the primary objects of the present invention is to provide a rock drill structure having an improved connection between the drill stem and the hammer whereby entrance of sand and cuttings between the hammer and an encasing collar will be prevented, a single packing only being employed for establishing this connection.

Another important object of the invention is to provide means whereby the collar surrounding the drill hammer may be coupled with the drill head or cutter for direct rotation of the head.

Still another object of the invention is to provide a rock drill structure in which wash liquid will be permitted to escape between the confronting faces of the hammer cams to flow down about the stem connecting the drill or cutter head with the clutch keeping the surrounding collar lubricated and free of grit.

A further object of the invention is to provide a rock drill of a character whereby easy replacement of the hammer cams may be effected.

A still further object is to provide a rock drill structure in which additional hammer sections may be readily attached to the hammer as desired.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawing forming part of this specification, with the understanding, however, that the invention is not confined to any strict conformity with the showing of the drawing but may be changed or modified so long as such changes or modifications mark no material departure from the salient features of the invention as expressed in the appended claims herein.

In the drawing:—

Figure 1 is a view in longitudinal section of the lower half of the tool embodying the present invention.

Figure 1A is a longitudinal sectional view of the upper half of the tool.

Figure 2 is a transverse sectional view taken upon the line 2—2 of Figure 1.

Figure 3 is a transverse sectional view taken upon the line 3—3 of Figure 2.

Figure 4 is a bottom plan view of the cutter head.

Referring more particularly to the drawing wherein like numerals of reference indicate corresponding parts throughout the several views, the numeral 1 indicates generally a cutter head which may be of any approved design, the top of the head being formed to provide a pair of oppositely disposed clutch jaws 2 which are formed about the tubular shank portion 3 through which wash liquid passes for escape through the discharge apertures 4 in the face of the cutter.

Threadedly attached as at 5 to the shank 3 is a stem 6 which is tubular as shown and has an enlarged head 7 formed at its opposite end and is also interiorly threaded as at 8 to receive a threaded portion 9 of a cam section 10. Associated with the cam section 10 is a similarly formed cam section 11 the opposed faces of the two cam sections being provided with the oppositely disposed complementary inclined faces 12 by means of which jars are transmitted to the cutter head.

Attached to the cam section 11 by means of the threaded extension 13 is a hammer section 14, the lower end of which is enlarged as indicated at 15 and centrally bored and threaded to receive the cam section 13. This hammer section 14 is, of course, tubular and is exteriorly square in cross-section and at its upper end is reduced and threaded at 16 to receive an enlarged end of a similarly formed hammer section or it may receive a cup washer carrying collar 17, the washer 18 constituting a packing.

The upper or head end of the cutter stem 6 extends into a sleeve 19, constituting one section of a tubular drill stem, the interior of which adjacent the lower end is enlarged to receive the head 7 of the cutter head stem and to form the shoulder 20 upon which the head may rest thus preventing separation of the sleeve and stem. This sleeve also houses the cam sections 10 and 11 and the lower portion of the lower hammer section 14.

At its lower end the sleeve 19 is formed to provide a pair of diametrically oppositely positioned clutch jaws 21 which are adapted to engage the complementary clutch lugs 2, formed upon the back of the cutter head, when the sleeve is lowered on the stem 6.

The upper end of the sleeve or tubular drill shank 19 is interiorly enlarged and threaded to receive a reduced threaded portion 22 of a hammer rotating and guiding collar 23, this collar having the same exterior diameter as the sleeve and being provided with a square bore designed to snugly receive the body of the hammer 14 which is also square in cross section.

The collar 23 has connected to its other end a sleeve 24 to which is attached a second collar 25 of the same construction as the collar 23.

The number of collars 23 and sleeves 24 employed is governed by the length of hammer used, in ordinary practice two of the collars and two of the coupling sleeves 24 being employed with one of the hammer sections 14.

To the upper end of the uppermost one of the coupling sleeves 24 is attached the drill stem 26 which runs to the top of the well hole and to which the mechanism employed for operating the tool is attached.

In practice rotary motion is applied to the drill stem composed of parts 26, 25, 24, 23 and 19, which motion causes the inclined faces of the cam section 11 to ride up on the inclined faces of the cam section 10. As the apices of the teeth of section 11 pass the apices of the teeth on section 10, the hammer section 14 will fall and impart to the cutter head which bears against the rock being drilled a jarring or hammering as the tooth sections come together. This action causes the hammer 14 to reciprocate in the drill stem pipe and during this movement the washer or packing 18 maintains close contact with the drill pipe 26 and prevents wash water from getting between the hammer and the rotating collars 23 and 25.

However, some of the wash liquid escapes between the confronting faces of the cam sections 10 and 11 during the operation of the tool and flows down between the stem 6 and the sleeve 19 keeping these contacting surfaces free of sand or other abrasive.

It is to be noted that all of the threads connecting the various sections forming the hammer and the drill stems 6 and drill head 1, are right hand threads and that the faces of the cam sections are right hand spirals and will therefore not lock together on a clockwise rotation, but will rotate over each other causing the hammer to lift, in practice, about two inches twice on each revolution of the drill stem. In actual practice, the whole assembly is rotated to the right or clockwise with the clutch members 21 and 22 engaged. Under these circumstances, the hammer will not rise and fall, or is, in other words, inoperative. By centering the assembly on the bottom with the bit cutters 4 on the formation to be drilled or lifting the weight of the drill stem to disengage the clutches 21 and 2 and then rotating the drill stem to the right, the assembly is rotated around the cutter stem 6 and the hammer is operated when the inclined faces of the cams 11 and 12 pass each other as heretofore described. The rotation during the drilling operation is always to the right or clockwise, and the striking of the blows and the drag of the cam faces, as well as the friction around the stem 6, has a tendency to keep the cutters in the formation jumping ahead in a clockwise rotation, although very much slower than the rotation of the drill stem formed by the parts 19, 23, 24 and 25. The rotation of the drill stem, therefore, has a tendency to tighten all the joints. In actual practice, I find that the cutter head 1 does move clockwise at each blow of the hammer if the cutters are properly pitched forward on the cutting edge. If the cutters 4 are straight, they have a tendency to hold against rotation while the hammer is in operation, but by sloping the cutters from the rear side to the cutting edge, the cutters strike the formation at an angle from 20° to 30° and the movement of the head is, therefore, constantly but slowly moved forward or clockwise with the drill stem. The rotation of the hammer and the stem is continuous and at about 100 R. P. M., thus striking 200 blows per minute, if the head 1 were standing still, but the slow rotation of the head in the same direction as the stem reduces these blows per minute in direct proportion to the speeds of rotation of the head and stem. This is controlled by the forward pitch of the cutting edge of the cutters, and experiments have shown that with a stem rotation of a 100 R. P. M., the cutter head rotation can be had from nothing to 50 R. P. M. by simply changing the pitch of the cutter on the cutting edge.

In my former Patent No. 1,697,570, granted on January 1, 1929, I illustrated a drilling apparatus in which the shank of the cutter head is provided with a clutch tooth and a tubular drill collar or cutter head stem is provided with an upwardly opening clutch recess or sockets for the clutch tooth on the hammer. It will be noted that the present construction is just the reverse of this, whereas in my former patent, it was necessary to lift the drill stem in order to operatively connect it to the cutter head. In the improved construction which I have now devised, it is necessary to lower the drill stem 19 in order to rotatably engage it with the cutter head. This secures a very greatly improved result, for the reason that with the present construction, the whole weight of the drill stem sections rests upon the cutter head and urges this cutter head downward against the forma-

tion being drilled, whereas in my former patent, the weight of the drill stem had to be removed from the cutter entirely before the cutter and the drill stem could be rotatably engaged with each other. With this construction also, there was a likelihood of lifting the cutting head off of the formation when the drill stem was lifted or the drill stem had to be very delicately raised in order to stop the lifting movement just to the point where the cutting head still bore against the formation. In my present construction, it is only necessary to lower the tubular drill stem as far as it will go and the driller may be certain that the clutch faces have under these circumstances engaged, and that the whole weight of the tubular stem is borne upon the gear weight and is forcing it downward. It will be noted that when the outer rotatable drill stem is lowered that rotation and force is applied directly to the cutter head and not through the stem of the cutter head as in my former patent. Thus, there is less danger of twisting or shearing off the stem 6 of the cutter head than it would be if this rotational force were communicated to the upper portion of the stem. This permits the stem 6 of the cutter head and the parts allied therewith to be made with a greater bore than would otherwise be the case as the stem 6 of the cutter head is submitted to less torsional strain.

From the foregoing description it will be readily seen that any number of hammer sections 14 may be applied to the tool to increase the weight of the blows imparted to the cutter head as necessary; a tight connection is maintained between the upper end of the hammer member 14 and the drill stem pipe by the use of a single packing which prevents the entrance of sand or other matter into the coupling sleeves thus preventing locking or freezing of the hammer guiding and rotating collars 23 and 25 on the hammer member and the cam members 10 and 11 connecting the lower portion of the hammer member 14 with the cutter head. Stem 6 may be readily removed for examination or replacement.

It is to be understood that where only one length of hammer section 14 is used the packing formed with the parts 17 and 18 is placed on the upper end of this section, but that additional hammer sections may be used if desired, as previously stated, but that in this case, the packing 17 and 18 is removed from the upper end of the lower hammer section and replaced at the upper end of the upper section so as to render as easy as possible any possible water with attendant sand and grit downward between the hammer section and the guiding collars 25 and 23, for instance, as the hammer section. The packing, as illustrated in Figure 1[a] constitutes a cup carrying collar 17, the lower end of which is outwardly flanged. Resting upon this outward flange and bearing against the inner face of the section 26 is the cup 17 and holding this cup in place upon the flange is an intermediate annular member 17*a* having screw threaded engagement with the collar 17 which, when it is turned home, urges the upwardly extending portion of the cup outward against the inner face of the section 26. It is also pointed out that the sleeves 19 and 24 and the collars 23 and 25 have uniform exterior diameters. This is secured by reducing the exterior diameters of the collars 25 and 23 so that they fit interiorly of the sleeves. In all other drilling apparatus of the same character as mine known to me, these connecting collars which connect the sleeves of the drill stems have been larger in diameter than the sleeves themselves so that the exterior diameter of the drill stem has not been uniform throughout practically its entire extent.

Having thus described my invention, what I claim is:—

1. In a rock drill, a cutter head, a stem carried thereby, a sleeve receiving in one end one end of said stem, means permitting limited longitudinal movement of the sleeve upon the stem and relative rotary movement therebetween, a hammer member, the stem and hammer member having coacting cam faces, a collar surrounding said hammer having movement longitudinally thereof but prevented from rotating thereabout, means for coupling said collar with a drill stem, and means whereby upon movement of said sleeve in one direction upon the first mentioned stem a coupling of the sleeve and cutter head may be effected.

2. In a rock drill a centrally bored cutter head, a tubular stem connected with the head and having a head formed upon its outer end, a sleeve receiving said stem head in one end thereof, cam elements having confronting cam faces and housed within said sleeve, one thereof having connection with said stem head, a hammer comprising an elongated tubular member connected at one end to the other of said cam members and of polygonal cross-sectional design, a casing enclosing said hammer and connected at one end to said sleeve, collars connected with said casing having polygonal bores therethrough for snugly receiving the hammer, packing detachably secured to the other end of said hammer member and adapted to engage the wall of a drill stem pipe connected with said casing, clutch jaws formed upon the back of said cutter head, and coacting clutch jaws formed upon the lower end of said sleeve.

3. A rock drill comprising a cutter head having a central passage therethrough, a tubular stem detachably connected at one end with the head and having its other end enlarged to form a head, a sleeve receiving the said other end of the stem and cut away to provide a shoulder limiting the movement

of the stem head therein, opposed tubular cam faced members housed with toothed connected members of tubular formation and housed within said sleeve, one of the members being detachably connected with the stem head, a hammer comprising an elongated member enlarged at one end and formed for connection with the other of said cam members, the intermediate portion of said hammer being of square cross-section, coupling sleeves encasing said hammer member, guiding collars having square bores therethrough for the passage of said hammer member and connecting said coupling sleeves, one of said coupling sleeves being connected with said first mentioned sleeve, means for connecting the coupling sleeve with a drill stem pipe, and packing removably attached to the other end of said hammer and formed to position in the drill stem pipe.

4. A rock drill comprising a cutter head having a central passage therethrough, a tubular stem detachably connected at one end with the head and having its other end enlarged to form a head, a sleeve receiving the said other end of the stem and cut away to provide a shoulder limiting the movement of the stem head therein, a pair of cam faced coacting tubular cam members housed within said sleeve, one of the members being detachably connected with the stem head, a hammer comprising an elongated member enlarged at one end and formed for connection with the other of said cam members, the intermediate portion of said hammer being of square cross-section, coupling sleeves encasing said hammer member, guiding collars having square bores therethrough for the passage of said hammer member and connecting said coupling sleeves, one of said coupling sleeves being connected with said first mentioned sleeve, means for connecting the coupling sleeve with a drill stem pipe, packing removably attached to the other end of said hammer and formed to position in the drill stem pipe, and means whereby upon the shifting of the first mentioned sleeve toward the cutter head connection between the head and the sleeve may be effected.

5. A drilling mechanism including a tubular drill stem, a cutter head, a stem therefor having sliding rotative engagement with the drill stem, means disposed within the drill stem for causing blows to be imparted to the cutting head stem, and means engaging the drill stem directly with the cutting head when the drill stem is lowered into engagement with the cutter head.

6. A drilling mechanism including a tubular rotatable drill stem, a cutting head disposed below the lower end of the drill stem and having a stem extending upward within the drill stem and having sliding rotative engagement with the drill stem, means disposed within the drill stem for causing blows to be imparted to the cutting head stem when the drill stem is rotated, and clutch means between the drill stem and the cutting head whereby to directly connect the cutting head with the drill stem when the drill stem is lowered downward and rests upon the cutting head.

7. A drilling mechanism including a tubular rotatable drill stem, a cutting head disposed below the drill stem and having a stem extending upwardly within the drill stem and having sliding rotative engagement therewith, the upper end of the cutting head stem carrying a cam member, a hammer section disposed within the tubular drill stem and freely movable vertically therein but rotatable therewith, the lower end of the hammer section carrying a cam member confronting the cam member on the cutting head stem whereby when the drill stem is rotated the hammer will cause blows to be imparted to the drill stem, the upper face of the cutting head and the lower end of the drill stem having coacting clutch members whereby when the drill stem is lowered upon the cutting head the cutting head will rotate with the drill stem

8. A drilling apparatus including an outer tubular rotatable drill stem, a cutting head having downwardly extending teeth having inclined under faces, the cutting head having an upwardly extending stem, the upper end of which carries a cam portion formed with a plurality of inclined cam faces inclined all in the same direction, a hammer section having downwardly facing cam faces confronting and coacting with the first named cam faces, the stem of the cutting head and its cam portion being freely revoluble and reciprocable within the tubular drill stem, the hammer section having rotative engagement with the tubular drill stem.

9. A drilling apparatus including an outer tubular rotatable drill stem, a cutting head disposed below the drill stem and having downwardy extending radial teeth, the teeth upon one face being vertical and on the rear face being inclined downward and toward the lower edges of the teeth, the cutting head having an upwardly extending stem disposed within the drill stem, the upper end of the cutting edge stem having a cam portion formed with a plurality of inclined cam faces inclined all in the same direction, a hammer section having downwardly facing cam faces confronting and coacting with the first named cam faces, the stem cutting head and its cam portion being freely revoluble and reciprocable in the tubular drill stem, the hammer section having rotative engagement with the tubular drill stem.

In testimony whereof I affix my signature.

HARVEY MECOM.