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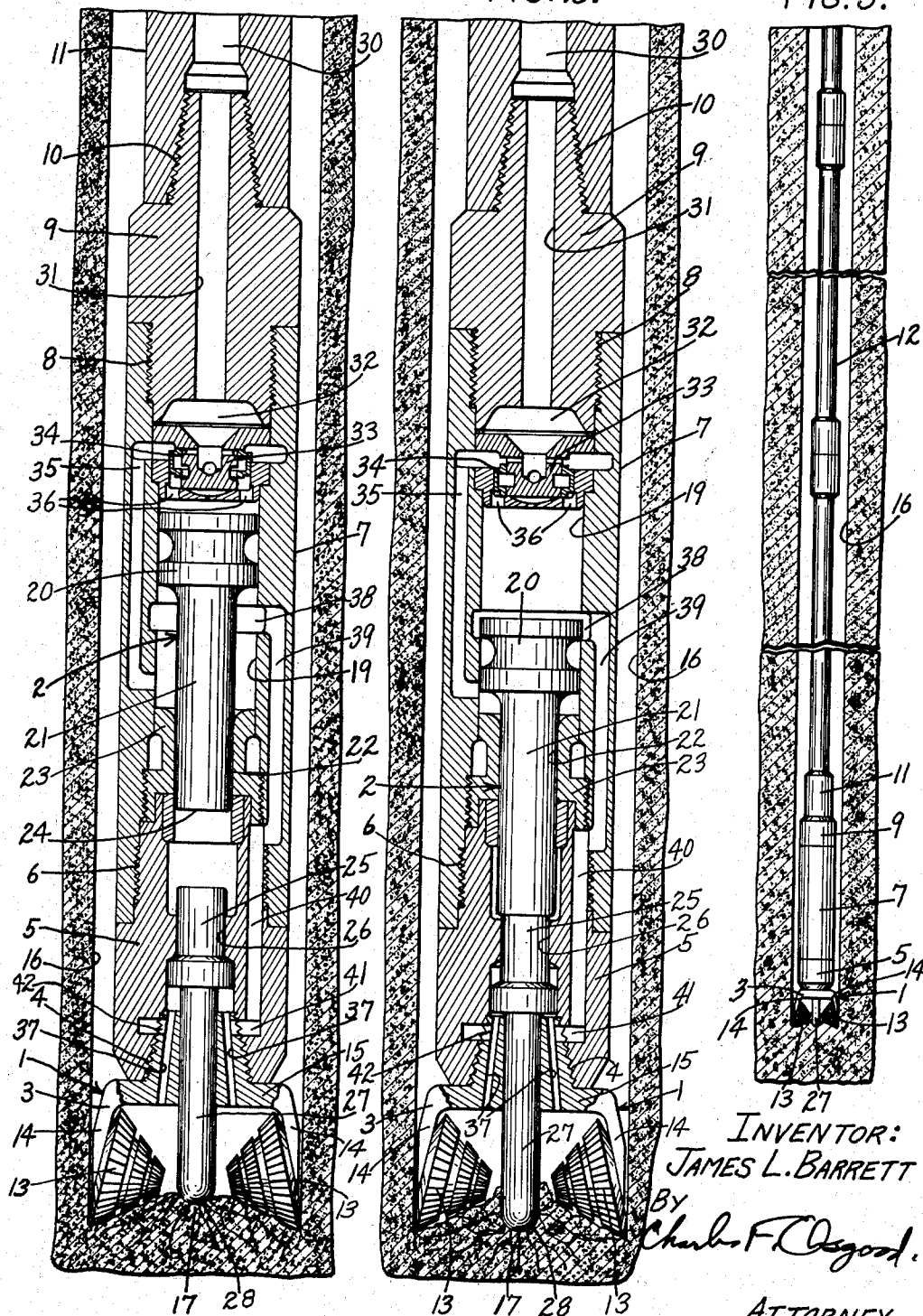
APPARATUS FOR ROTARY DRILLING

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Fig. 1.

Fig. 2.

Fig. 3.



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APPARATUS FOR ROTARY DRILLING

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4 Claims. (Cl. 255—302)

This invention relates to rotary drilling apparatus and more particularly to a rotary roller bit of the cone type having a centrally located impact element for fracturing the cone-shaped rock segment left at the hole-bottom by the roller cutters, enabling easier cutting action by the cone teeth.

The roller bit of the present invention may for illustrative purposes be of the well-known Hughes "Tri-Cone" type and the toothed rollers are so arranged and so constructed that a cone-shaped section of rock is left at the hole-bottom integral with the bed-rock by the roller cutters and the drill is of the dry type wherein the cuttings are cleared away by air pressure to leave a clean surface at the hole-bottom. The present invention contemplates improvements over known rotary drilling apparatus in that impact blows are transmitted to the apex portion of the conical section of rock at the hole-bottom integral with the bed-rock left by the toothed roller cutters, thus to create primary fractures in conjunction with the cutting action of the toothed roller cutters to cut and remove fractures in a unique and more economical way, particularly in the drilling of rock of the harder types. In accordance with the present invention an impact device is arranged centrally of the roller bit for delivering impact blows to the rock section for creating the primary fractures therein.

An object of the present invention is to provide an improved rotary drill of the cone roller type having an impact mechanism coaxial therewith for delivering impact blows to the conical section of rock left at the hole-bottom by the roller cutters. Yet another object is to provide an improved cone-type roller bit having an impact device associated therewith for creating primary cone fractures in the rock at the hole-bottom, enabling easier cutting action by the cone teeth, resulting in a more efficient and rapid drilling of a hole particularly in relatively hard rock. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawing there are shown for purposes of illustration one form which the invention may assume in practice.

In this drawing:

Fig. 1 is a central longitudinal section through a rotary drilling apparatus embodying an impact mechanism in accordance with the preferred illustrative embodiment of the invention.

Fig. 2 is a sectional view similar to Fig. 1, showing the moving parts in a different position.

Fig. 3 is a vertical section on reduced scale showing the rotary drilling apparatus in elevation, in operating position in a drill-hole.

The rotary drilling apparatus is generally designated 1 and the associated impact mechanism is generally designated 2.

The rotary drilling apparatus comprises a rotary drill bit 3 having a hollow threaded shank attached to 4 to

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the lower portion of a head member 5, the latter in turn detachably secured at 6 to an elongated cylindrical casing 7. The casing 7 is attached at 8 to an upper head member 9, in turn detachably secured at 10 to the lower end of a rod section 11 of a drill string 12 of a conventional rotary drill.

In this construction the drill bit 3 may be of the well-known Hughes "Tri-Cone" type comprising toothed cone-shaped rollers 13 suitably journaled on arms 14 of a drill head frame 15. In a rotary drilling apparatus the drill string 12 may be rotated by any conventional rotary mechanism located at the ground surface and as the bit rollers are rotated a hole 16 is formed and during the formation of the hole a cone-shaped section 17 of rock is left by the roller cutters at the hole-bottom, integral with the rock-bed.

The impact mechanism 2 may be of any suitable design and herein, for illustrative purposes, comprises a bore 19 formed within the elongated cylindrical casing 7 and the latter, in this instance, may comprise a cylinder of a percussive motor. Reciprocable in the motor cylinder is a piston 20 having a forwardly extending striking bar 21 slidably guided in a bore 22 of a front cylinder head 23 detachably secured within the forward portion of the motor casing. The piston-striking bar 21 has a front impact surface 24 for delivering impact blows to a tappet 25 reciprocably mounted in a bore 26 in the front head member 5. This tappet has a forward cylindrical or rod-like projection 27 guided within the hollow bit shank and provided with a rounded front striking end 28. The rod sections 11 of the drill string are made hollow at 30 and the bore of the drill string communicates with an axial passage 31 in the upper head member 9 and fluid under pressure, desirably compressed air, may be conducted through the tubular drill string and the passage 31 to an inlet chamber 32 of a conventional fluid distributing valve mechanism 33. This valve mechanism includes a fluid actuated distributing valve 34 of the sleeve type and the motor casing has passages 35 and 36 controlled by the distributing valve for supplying pressure fluid to the cylinder bore at the opposite sides of the piston head for effecting reciprocation of the piston.

Fluid under pressure may be conducted in various known manners to passages 37 in the drill head 15 and herein, for illustrative purposes, pressure fluid is conducted to these passages from an annular motor exhaust groove 38 which is connected by passages 39 and 40 with a forwardly located chamber 41 at the forward portion of the lower head member 5. Ports 42 connect the chamber 41 with the passages 37 and fluid under pressure may be discharged in the form of a blast from the latter against the toothed roller cutters at the bottom of the hole to clear away the cuttings from the hole-bottom. Evidently, pressure fluid may be conducted in various known manners to the passages 37, from the supply passage 31 independently of the motor exhaust.

During the rotary drilling operation the toothed roller cutters of the rotary bit form a cone-shaped section 17 of rock at the hole-bottom integral with the rock-bed and during the hole-forming operation the hammer piston is concurrently reciprocated desirably at a relatively slow speed intermittently to deliver impact blows to the cone-shaped section of rock to create primary cone fractures, fractures theoretically taking the cone profile, thereby enabling easier cutting action by the cone teeth of the roller cutters. Thus, by creating primary fractures in conjunction with the roller bit cutters the rock may be cut and the fractures of the cone section may be removed by breaking away, thus to provide a unique and more economical method of mechanical drilling particularly in relatively hard rock.

As a result of this invention, an improved apparatus

for rotary drilling is provided whereby drilling efficiency is substantially increased in a relatively simple manner. By the provision of the impact motor associated with the rotary cone bit the rock at the hole-bottom may have impact blows imparted thereto creating primary fractures, thus to increase the breaking away of the rock by the roller cutters. The structure is not only relatively compact but is rugged and durable in design, well adapted for its intended purpose. Other advantages of the invention will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In combination, a rotary drill bit of the toothed roller cutter cone type attachable to a rotatable drill rod and having spaced apart roller cutters, said drill bit rotatable with the drill rod to effect drilling of a hole in solid bed-rock, the cone roller cutters of said drill bit so arranged and constructed that during the drilling operation they form a frusto-conical section of rock projecting axially upwardly at the bottom of the hole being drilled with the apex portion of the rock section lying at the bit axis between and spaced rearwardly of the forward cutting portion of the spaced roller cutters, and an impact mechanism carried by said drill rod and extending rearwardly of the drill bit, said impact mechanism including impact imparting means, means for effecting operation of said impact imparting means and an impact element axially aligned with the drill bit for receiving the blows of said impact mechanism, said impact element guided for reciprocation in adjacency to said drill bit and extending axially forwardly between the spaced roller cutters, said impact element in all positions of reciprocation disposed rearwardly of the foremost cutting portions of said roller cutters and having a blunt striking face which, when retracted, lies in a transverse plane disposed at the rearmost cutting portions of said cutters, said striking face as said impact element is driven forwardly delivering an impact blow to the apex portion of the conical rock section for creating primary fractures in the latter with the fractures generally taking the profile of the cone, thereby to facilitate the rolling cutting action of the roller cutters in the drilling of the hole.

2. In combination, a rotary drill bit of the toothed

roller cutter cone type attachable to a rotatable tubular drill rod and having spaced apart roller cutters, said drill bit rotatable by said rod to effect drilling of a hole in solid bed-rock, said drill bit during the drilling operation leaving a frusto-conical section of rock projecting axially upwardly at the hole bottom integral with the bed-rock with its apex portion lying between the roller cutters, an impact mechanism carried by the drill rod and arranged rearwardly of the drill bit with its longitudinal axis aligned with the axis of rotation of said bit, said impact mechanism being mounted to rotate with the bit and including a reciprocable blow-transmitting member for delivering impact blows to the apex portion of the frusto-conical rock section for creating primary fractures in the latter with the fractures generally taking the profile of the cone, to facilitate the cutting action of the roller cutters in the drilling of the hole, said impact mechanism also including a reciprocable impact element for delivering blows to said blow transmitting member and means for effecting reciprocation of said impact element, and means connected to said mechanism in adjacency to said bit for supporting and guiding said blow transmitting member during its reciprocation, said blow transmitting member when retracted having its forward striking portion disposed a substantial distance rearwardly of the foremost cutting portions of said roller cutters and disposed in a transverse plane lying at the rearmost portions of said cutters in position to strike a blow against said apex portion of the frusto-conical rock section.

3. The combination as set forth in claim 2 wherein said reciprocable blow transmitting member which receives the blow of said impact element extends centrally forwardly between the roller cutters, the roller cutters being spaced apart to receive the forward portion of said member therebetween, said member having a forward impact surface and in all positions of its reciprocation disposed rearwardly of the foremost cutting portions of said roller cutters.

4. A combination as set forth in claim 3 wherein the forward impact surface of said blow transmitting member has a blunt forward striking face.

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