

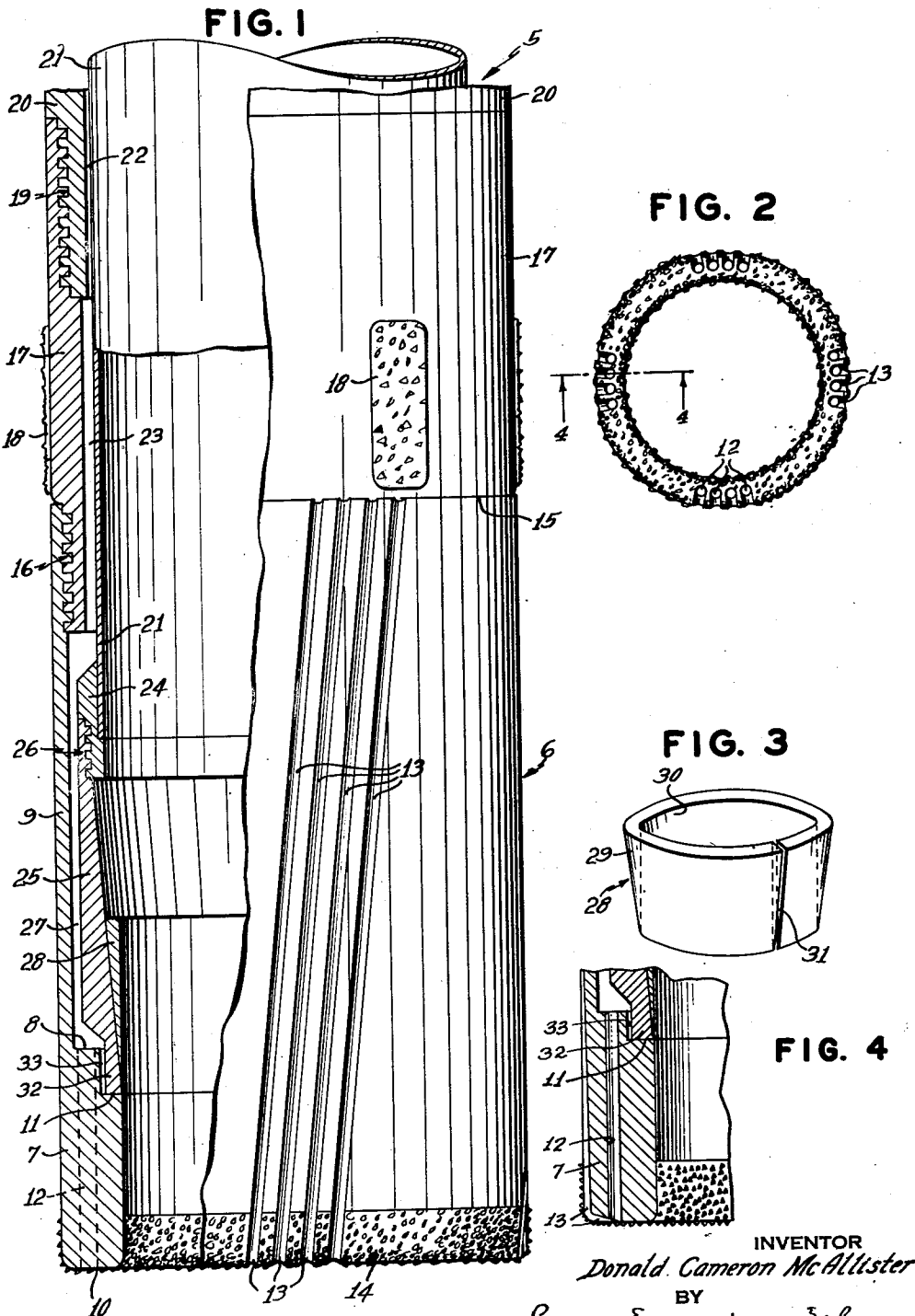
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CORE DRILL

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CORE DRILL

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3 Claims. (Cl. 255—72)

This invention relates to core drills such as are used for cutting cylindrical cores from geological formations and for removing such cores intact for purposes of studying the formation through which the drill has penetrated. The invention is particularly directed to the provision of an improved core drill assembly so designed that water to facilitate the drilling operation is delivered to the cutting face without coming in contact with the core itself and is then directed outwardly away from the core being cut. The invention further contemplates the provision of an improved core lifter structure for withdrawing the core from vertical and near-vertical holes.

Core drilling, in common with other earth drilling operations, entails delivering a flow of water to the cutting face of the bit in order to wash away cuttings and to facilitate penetration of the drill through the earth formation. It is important, in core drilling, that such water be not passed in contact with the core being cut. Otherwise the core will be eroded by the water, and in soft formations it may be completely disintegrated. It is also important that the cuttings be washed away from the core, and not toward it, so that they do not tend to abrade it while it is being cut. It is of course desirable that the annular cutting face of the bit be of narrow radial width, both for the purpose of including as much as possible of the cross-sectional area of the drill hole in the core, and, in the case of diamond core drills, to minimize the width of the cutting face that must be set with diamonds. Provision must be made for lifting the core, after it has been cut, from vertical holes, and the structure for doing so must be mounted within the radially narrow confines defined by the bit cutting face, while at the same time providing space for the flow of water to such face.

The core drill of the present invention has been found in practice to meet all of the foregoing requirements, and at the same time to be of adequately rugged design to give long and reliable service in the field. It includes the conventional core barrel having inner and outer tubes spaced apart annularly to provide a water channel between them. At the lower end of the core barrel is a core bit comprising a head portion joined at its rearward end to a skirt portion, and having a core cutting face formed at its forward end. The skirt portion of the bit is considerably thinner in wall thickness than the head portion, and an internal annular shoulder is formed at the rearward end of the head portion. A core lifter holder is mounted within the bit skirt in annularly spaced relation therewith, and the lower end of the holder is seated in water-tight engagement against said shoulder. Mounted in the holder is a core lifter, in the form of a split ring spring having a conical outer surface. The inner surface of the holder is correspondingly conical, so as to hold the core lifter in place.

The skirt of the bit is attached to the outer tube of the core barrel, and the core lifter holder is attached to the inner tube of the core barrel, with the annular

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space between the bit skirt and holder being a direct communication with the annular water channel between such inner and outer tubes. Ample radial clearance is provided between the holder and the bit, throughout the length of the holder, so that none of the radial stresses to which the core lifter is subjected in breaking and lifting a core are transmitted to the bit.

The head portion of the bit is formed with water passages (arranged substantially parallel to the axis of the bit) which communicate at one end with the annular space between the bit skirt and the holder, and extend at the other end to the bit cutting face, whereby water may be passed through the water channel between the inner and outer tubes of the core barrel and through said annular space to the cutting face of the bit without coming in contact with the core. Shallow grooves are formed in the cutting face of the bit extending from the water passages to the outer periphery of the bit, whereby water delivered to the cutting face through said passages is directed radially outwardly, away from the core. The grooves may be continued around the edge of the cutting face and up the outer surface of the bit, where, advantageously, they follow a very steeply pitched helical path (of right-hand pitch in the case of a drill intended to be rotated right-handed).

The foregoing and other features of the new core drill are described below with reference to the accompanying drawings, in which

Fig. 1 is an elevation, partially in longitudinal section, showing the core drill assembly of the invention;

Fig. 2 is an end view on a reduced scale of the cutting face of the core bit shown in Fig. 1;

Fig. 3 is a perspective on a reduced scale of the core lifter spring employed in the assembly shown in Fig. 1; and

Fig. 4 is a longitudinal section of the lower portion of the core bit along line 4—4 of Fig. 2.

The new core drill assembly comprises a core barrel indicated generally at 5, having a core bit 6 secured to its lower end. The bit comprises a cylindrical head portion 7 integrally joined at its rearward (upper) end 8 to a skirt portion 9. The forward (lower) end of the cutting head 7 is set with industrial diamonds in the usual manner to form an annular cutting face 10. An internal annular shoulder 11 is formed in the bit adjacent the juncture of the head 7 with the skirt 9. Water passages 12, parallel to the axis of the bit, are drilled or otherwise formed through the head portion from its cutting face 10 to its rearward end 8. Shallow radial grooves 13 extend across the cutting face from the open end of the water passages 12 to the outer periphery 14 of the bit, and these grooves are continued up the outer peripheral surface of the bit to its upper end 15. As shown in Fig. 1, where the grooves 13 traverse the outer periphery of the bit they follow a very steeply pitched helical path (such helical path being of right-handed pitch when the drill assembly is designed to be rotated in a right-handed direction, and vice versa). The grooves 13 serve to direct water delivered through the passages 12, and the cuttings, outwardly from the core that is cut by the bit and upwardly along the outer surface of the bit. The water passages 12 through the head portion 7 of the bit and the shallow grooves 13 that direct water delivered through the passages 12 outwardly from the core are best shown in Fig. 4 of the drawing.

The bit skirt 9 is joined at its upper end by screw threads 16 to a tubular reamer section 17 of substantially the same outside diameter as the bit 6. The reamer section is provided with a plurality of vertical cutting faces 18 set with diamonds. Its function is to ream out the hole drilled by the bit 6 to a uniform size large enough so that the core barrel 5 will pass through it

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readily. The reamer section is not a necessary part of the assembly, although it is often advantageous to employ it.

The reamer section (or the bit skirt itself if no reamer section is used) is joined by screw threads 19 to the outer tube 20 of the core barrel. This outer tube 20 extends to the upper end of the core barrel (which may be, for example, about ten feet in length), where it is joined in conventional fashion to the drill pipe or drill rod (not shown) customarily employed for supporting and operating the core drill.

A core barrel inner tube 21 is mounted coaxially inside the outer tube 20, and is spaced therefrom sufficiently to provide a narrow annular water channel 22. The inner tube extends down through the reamer section 17 (in spaced relationship therewith so as to form an annular water passage 23) into the interior of the bit skirt 9.

An exteriorly threaded lock ring 24 is press-fitted on or otherwise securely attached to the lower end of the core barrel inner tube 21. A tubular core lifter holder 25 is attached to the lock ring 24 by a screw thread connection 26. The holder 25 and the lock ring 24 are received wholly within the confines of the bit skirt 9, but their outer surfaces are spaced annularly from the inner surface of the bit skirt to form an annular water passage 27.

The outer surface of the holder 25 is substantially cylindrical, but its inner surface is conical, tapering from a relatively large diameter at the end where it joins with the lock nut 24 to a relatively small diameter at its other end. Mounted inside the holder 25 is a core lifter 28 in the form of a split ring spring (the core lifter is shown separately in perspective in Fig. 3). The core lifter has a conical outer surface 29 conforming with the conical inner surface of the holder 25, and a substantially cylindrical inner surface 30. When unstressed, the inside diameter of the core lifter 28 is slightly less than the inside diameter of the head portion 7 of the bit. The core lifter is however severed by a longitudinal slit 31, so that as the bit cuts downwardly about a core, the latter pushes the core lifter up toward the lock nut and distends it sufficiently for the core to pass through it and into the inner tube of the core barrel. The lock ring 24 prevents the core lifter from being pushed out of the holder 25.

The end of the holder 25 opposite the lock ring 24 is seated in end-to-end abutting water-tight engagement with the annular shoulder 11 formed adjacent the rearward end 8 of the bit head portion 7. Advantageously the lower end 32 of the holder is reduced in diameter and is received in a corresponding recess (the bottom of which is defined by the shoulder 11) formed in the rearward end portion of the bit head portion 7. In this manner the holder 25 and the lower end of the core barrel inner tube 21 are substantially centered in spaced relation within the core barrel outer tube 20, the reamer section 17, and the bit skirt 9. The outer diameter of the reduced end portion 32 of the holder is enough smaller than the recess in which it is received so as to leave a substantial radial clearance 33 between holder and bit, so that the holder, throughout its entire length, is spaced radially from the bit itself. By this provision, the expensive diamond-set bit is protected from undue radial stress when the core is broken off at its bottom and brought to the surface.

It is apparent from the foregoing that the annular spaces 22, 23 and 27 between the inner and outer components of the core drill assembly, and the water passages 12 extending through the head portion of the bit, form a continuous path for the flow of water from the upper end of the core barrel to the cutting face of the bit. In normal operation, water is forced along this path to the cutting face to facilitate the cutting action of the bit and to wash away the cuttings. Owing to the substan-

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tially water-tight engagement of the lower end of the core lifter holder 25 with the internal shoulder 11 of the bit, such water is denied access to the core that is cut by the bit and which is collected inside the core barrel inner tube as the bit cuts its way through the formation being drilled. The grooves 13 provide a path of least resistance for the water in a direction outwardly from the core, and thereby direct the water and the cuttings away from the core. In this way the core is further protected from erosion and abrasion as it is being cut by the drill bit.

When a core of the desired length has been cut, the drill is withdrawn from its hole. Initial movement of the drill out of the hole causes the core lifter 28, which by its spring action tends to grip the core, to move downwardly along the tapered inner surface of the holder 25. The wedge action of this tapered surface causes the core lifter to clamp even more tightly about the core, with the result that the portion of the core lying in the inner tube of the core barrel above the core lifter is held therein and withdrawn with the drill from the hole. Mounting of the core lifter 28 in the holder 25 above the head portion of the bit serves the double purpose of providing a zone of ample length (extending from where the core lifter grips the core to the bottom of the annularly drilled hole) to facilitate breaking the bottom of the core from the earth formation from which it was cut, and of protecting the bit itself from radial stresses when the drill and the core it has collected are withdrawn from the hole. The provision of ample radial clearance (at 30 27 and 33) between the bit 6 and the core lifter holder 25 assures that the most severe stresses incident to breaking loose and lifting the core will be taken by the relatively inexpensive core lifter holder and not by the expensive bit itself.

It will be noted that the new core drill assembly provides excellent protection of the core from erosion and abrasion by water and cuttings during operation of the drill. Also, arrangement of the core lifter and its holder wholly within the thin-walled bit skirt results in minimizing the radial thickness of the annular space it occupies, and so minimizes the radial thickness of the bit cutting face. Thereby the amount of diamonds required to set the cutting face of the drill bit is kept at a minimum.

In actual use, the new drill assembly has been found highly effective for collecting a core of maximum diameter and for bringing it to the surface in substantially its original condition, unmarred by appreciable erosion or abrasion of its softer constituents, so that it is truly representative of the earth formation from which it was cut.

I claim:

1. In a core drill assembly including a core barrel having inner and outer core barrel tubes spaced apart annularly to provide a water channel between them, the improvement which comprises a core bit comprising a head portion joined at its rearward end to a skirt portion and having a core cutting face formed at its forward end, said bit having an internal annular shoulder formed at the rearward end of its head portion, a core lifter holder mounted within the bit skirt in annular spaced substantially centered relation therewith to provide a radial clearance throughout the length of the core lifter holder between said skirt portion and said core lifter holder, means maintaining the lower end of the core lifter holder seated in substantially water-tight engagement against said shoulder, and a core lifter mounted in and held in place by said holder, the bit skirt being attached to the core barrel outer tube and said holder being attached to the core barrel inner tube with the annular space between the bit skirt and holder being in direct communication with the annular water channel between said inner and outer tubes, the bit head portion being formed with water passages communicating with said annular space and extending to the bit cutting face, the interior of the inner core barrel being out of communication with

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the water channel between said inner and outer core barrels, whereby water may be passed through said water channel to the cutting face without coming in contact with the core cut by said bit, the bit further being formed with grooves extending across the cutting face from said water passages to the outer periphery of the bit, thereby to direct such water at the cutting face away from the core.

2. A core drill assembly including a core barrel comprising outer and inner core barrel tubes spaced annularly apart to provide a water channel therebetween, a core bit comprising a head portion joined at its rearward end to a skirt portion and having a core cutting face formed at its forward end, a core lifter holder mounted wholly within the skirt portion of the bit in annularly spaced relation therewith to provide a radial clearance throughout the length of the core lifter holder between said skirt portion and said core lifter holder, and a core lifter within said core lifter holder, said bit being secured at the rearward end of its skirt portion to the forward end of the outer core barrel tube and being formed with water passages which communicate with the annular space between the bit skirt and the core lifter holder and which extend through the head portion from its rearward end to its cutting face, said head portion having shallow grooves extending across said cutting face from said water passages to the outer periphery of the bit, said grooves being continued around the outer edge of the cutting face and up the outer surface of the bit, said holder being secured at its rearward end to the inner core barrel tube and being in substantially centered spaced relation within the skirt portion of the bit, and means maintaining the lower end of the core lifter holder in substantially water-tight abutting engagement at its forward end with the rearward end of the head

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portion of the bit, the interior of the inner core barrel tube being out of communication with said water channel between the inner and outer core barrel tubes, whereby water delivered to said cutting face through said annular space and through said passages is directed away from the core cut by said bit.

3. The combination with a cylindrical core bit comprising a head portion joined at its rearward end to a skirt portion and having an annular cutting face at its forward end, said bit having water passages extending through its head portion from the cutting face to the rearward end thereof and being formed with an internal annular shoulder at the rearward end of the head portion of core lifting means comprising a core lifter and holder therefor, said holder being mounted wholly within the core bit in annular spaced substantially centered relation therewith, to provide a radial clearance throughout the length of the core lifter holder between said skirt portion and said core lifter holder, means maintaining the forward end of said holder substantially in water-tight abutting engagement with said shoulder, and the water passages of the bit head portion being in communication with the annular space between the bit skirt and said holder, whereby the bit is isolated from radial stresses imposed on the core lifter and holder while at the same time the bit and holder are in substantially water-tight engagement with each other.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 18,500	Stone	June 14, 1932
473,908	Bullock	May 3, 1892
1,796,488	Stone	Mar. 17, 1931
1,883,321	Allen	Oct. 18, 1932