

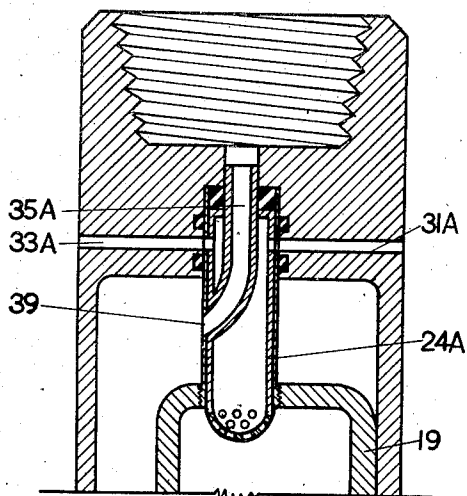
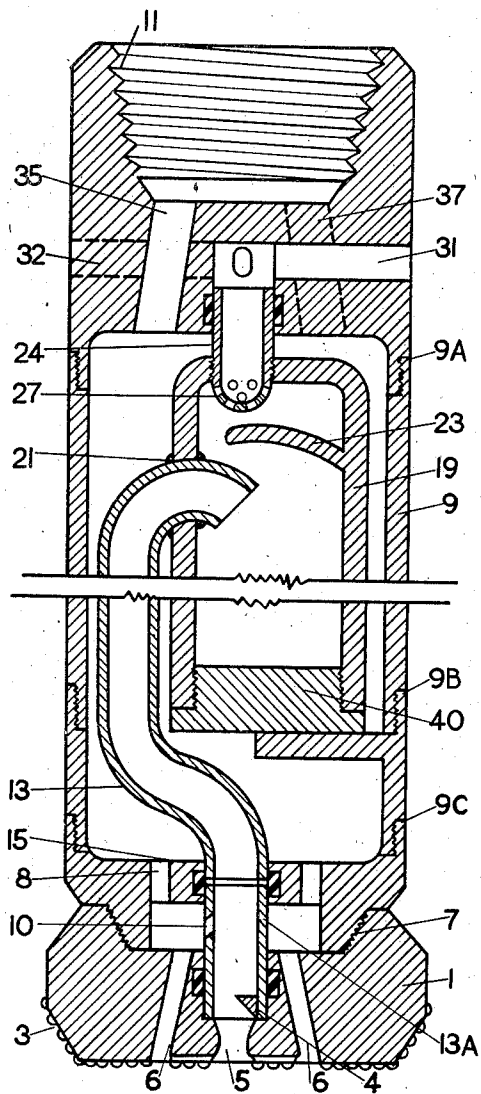
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CORE BARREL

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CORE BARREL

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4 Claims. (Cl. 255—1.4)

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This invention pertains to the art of coring underground formations during rotary drilling operations and relates more particularly to a coring method and a core barrel for use in combination with core bits adapted to drill through hard formations.

In using coring equipment, it has not been found practical to give the core barrel dimensions exceeding approximately 20 or 30 feet in length. When such a core barrel is substantially completely filled with a core, it must be removed to the surface, either by raising the whole drill string, or by lifting the core barrel to the surface by means of a wire line or of reverse circulation. This causes interruptions of drilling operations during time periods necessary for a round trip of the core barrel, said periods recurring every time that the core barrel is filled, that is, every time a well interval having a length approximately equal to that of the core barrel has been drilled.

Another coring method consists in breaking the core into relatively small fragments and lifting them to the surface through the drill string by reverse circulation, thereby dispensing with the use of a core barrel.

The use of these methods is often undesirable when drilling through hard formations by means of diamond set or hard surfaced bits. Reverse circulation is not very suitable for this type of drilling, while coring itself is in such cases of only secondary interest, the primary purpose of using core bits when penetrating hard formations residing in the elimination of a dead-center point on the face of the bit, where diamonds or hard surfaced materials are particularly subject to damage.

It is therefore an object of this invention to provide a core barrel for use in combination with a core bit, whereby said core bit may be used for drilling throughout vertical intervals of the well considerably exceeding the length of the core barrel without having to stop the operation for removing the core from the core barrel.

It is also an object of this invention to provide a core bit and core barrel combination, whereby relatively small diameter cores are cut by the bit and stored in a relatively large diameter core barrel in such a manner as to provide the driller with a log of the formations drilled therethrough.

It is also as an object of this invention to provide a coring method and apparatus particularly well adapted for coring hard formations.

Other objects of this invention will be under-

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stood from the following description taken with reference to the attached drawings, wherein:

Figure 1 is a diagrammatic view in cross section of an embodiment of the present apparatus;

Figure 2 is a diagrammatic view in cross-section of a modified detail of the apparatus of Figure 1.

Briefly, the coring process of the present invention consists in cutting a core of a relatively small diameter, such as about one-tenth of the coring bit, from a formation at a well level which may be referred to as the coring zone, breaking said core into small fragments, conveying these fragments in a stream of drilling fluid to a storing space maintained within the drill string adjacent the drill bit, the cross-section area of said storing space in a horizontal plane being substantially greater, that is, at least five times greater, than the diameter of the core as originally cut, retaining said fragments in said storing space, and exhausting the drilling fluid, in which said fragments were entrained, back into the well.

Referring to the drawing, a drill bit 1, such as a hard-faced bit, or a bit set with diamonds for drilling through hard formations, has a central axial core passage 5 adapted to receive cores cut by the bit, said passage being of a relatively small diameter preferably not exceeding one tenth of the diameter of the bit. The core bit 1 is provided with a desired number of axial offset passages 6 for circulating the drilling fluid. The core bit is provided in its upper portion with screw-threads 7 by means of which it is attached to a core barrel generally designated by the numeral 9, and consisting of any desired number of axial sections joined together by screw threads, as indicated at 9A, 9B and 9C. The core barrel is in turn provided in its upper portion with screw-threads 11 adapted for attachment to the end of a drill string, not shown, whereby rotational motion may be transmitted from the surface to the bit 1.

Arranged within the core barrel 9 is a core tube or conduit 13 whose lower end 13A is supported by a spider 15 and extends downward into an upper somewhat enlarged portion of the core bit passage 5.

The core tube 13 may be given any desired shape, a preferred form being shown in the drawing, and has its upper end extending into an inner core barrel or chamber 19, passing through and being welded or brazed to the walls thereof, as shown at 21. A baffle plate 23 is provided within the core receptacle 19 somewhat above the

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downwardly inclined mouth of the core tube 13. The chamber 19 may be given a cylindrical or any other desired shape.

A fluid exhaust tube 24 has a perforated portion 27 likewise extending into the core chamber 19 and forms, together with ports shown at 31 and 32, a passage for communication with the outside of the core barrel. A desired number of passages such as shown at 35 and 37 are provided in the body of the core barrel 9 for the circulation of the drilling fluid.

An alternative arrangement of the fluid exhaust tube 24 is shown in Figure 2, where the passage 35A, corresponding to passage 35 of Figure 1, is arranged concentrically within the exhaust tube 24A and opens to the space within the outer core barrel transversely through the walls of tube 24A, as shown at 39.

In operation, with the core barrel 9 and core bit 1 attached to the lower end of a drill string, the circulation of the drilling fluid takes place downwardly through a flow channel comprising passages 35 and 37, the space provided within the outer core barrel 9 exteriorly of the core chamber 19 and the core tube 13, passages 8 in the spider 15, and out through the passages 6 in the core bit. The upward flow of the drilling fluid takes place partly along the outer surface of the core bit and barrel, and partly through the central passage 5.

The core which is drilled by the rotary action of the core bit enters the passage 5, and is broken therein into small fragments by a core-breaker element 4, provided in said passage or in the lower portion of the core tube 13 in register therewith. These small core fragments are carried upwards by the flow of the drilling fluid entering together with the core through the lower opening 5, and, if desired, also through an upwardly slanting jet opening 10, provided in the walls of the core tube to accelerate the effect of the fluid in washing upwards the comminuted core fragments.

Upon entering the core chamber or barrel 19, these fragments are projected downwards and settle down by gravity in the chamber, the downwardly inclined upper end of the tube 13 and the baffle plate 23 cooperating to maintain turbulence at a minimum. The liquid entering the core chamber is exhausted through the perforated tube 24 and ports 31 to the annular space between the walls of the borehole and the drill string.

It will be seen that when a core chamber having a horizontal cross-section area substantially greater than the horizontal cross-section of the core passage is used in accordance with the present invention, a considerable amount of core fragments may be stored, and a considerable vertical interval of the well may be drilled before the core chamber is filled with core fragments, and it becomes necessary to raise the core barrel to remove the contents of the core chamber. Thus, with a core chamber with an area of about 7 square inches, corresponding in the case of a cylindrical chamber to an inside diameter of 3 inches, more than 100 feet of one-half inch diameter core may be cut for every 10 feet of the axial length of the core barrel, making the necessary allowance for the pore space between the core fragments. The term "substantially greater," as applied herein to the relative horizontal cross-section areas of the core-chamber and the core or core-passage, is therefore used to denote a ratio of at least 10:1, or, in the case of cylindrical chamber, a diameter ratio of at least 3:1.

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Since the fragments of cores from different formations settle in the core barrel in the order in which these formations were cored by the bit, an inspection of the contents of the inner core barrel provides the driller with the desired essential information regarding said formations. The cores can be removed from chamber 19 at the surface by disassembling the core barrel and removing the lower plug 40.

I claim as my invention:

1. A coring device comprising a core bit having an axial core passage, core breaker means for breaking cores entering said passage into fragments, an axially elongated core chamber adjacent said bit, said chamber having a horizontal cross-section area substantially greater than that of said passage, a core tube in communication between said passage and said chamber, said core tube having a lower end co-axial with said passage and in register therewith, and an upper end transverse to said lower end opening to the upper portion of said chamber, and conduit means in communication between the upper portion of said chamber and the outside of the coring device.

2. A coring device adapted to be connected to the lower end of a drill string, said device comprising a core bit having an axial core passage, core breaker means for breaking cores entering said passage, a tubular body connected between said drill string and said bit, an axially elongated core chamber within said tubular body, said chamber having a horizontal cross-section area substantially greater than that of the core passage through the bit, a core tube in communication between said core passage and said chamber, said core tube having a lower end co-axial with said passage and in register therewith, and an upper end transverse to said lower end opening to the upper portion of said chamber, fluid passage means through said bit and said tubular member arranged exteriorly of said core tube and said chamber to deliver a drilling fluid from said drill string to said bit, and conduit means in communication between the upper portion of said chamber and the outside of the coring device.

3. The device of claim 2 having within the core chamber a baffle plate arranged between the core tube opening to said chamber and the conduit means in communication between said chamber and the outside of the core device.

4. The device of claim 2, having upwardly slanting jet opening means through the wall of the core tube communicating between said tube and the fluid passage means delivering the drilling fluid to the drill bit.

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