

Sept. 20, 1971

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CORE DRILLING APPARATUS WITH MEANS TO INDICATE
AMOUNT OF CORE IN BARREL

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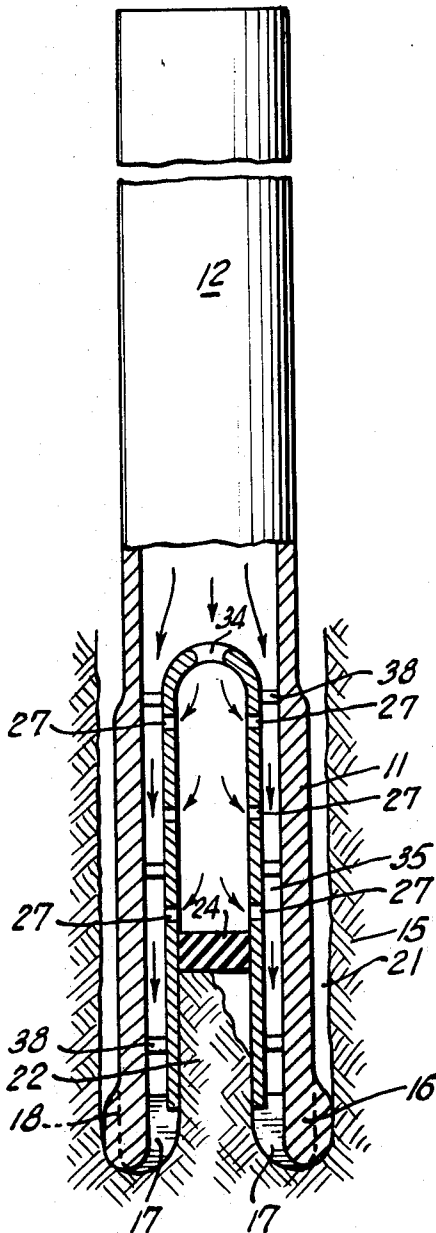
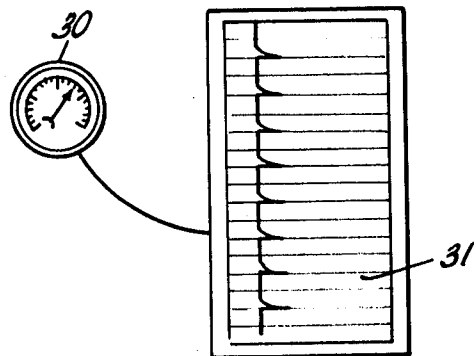


Fig. 2.



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CORE DRILLING APPARATUS WITH MEANS TO INDICATE AMOUNT OF CORE IN BARREL

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Filed Dec. 30, 1969, Ser. No. 889,046

Int. Cl. E21b 25/00, 45/00

U.S. Cl. 175—46

1 Claim

ABSTRACT OF THE DISCLOSURE

The core barrel of a core drill has longitudinally spaced ports in its sidewalls and a plug slidable in the barrel. As the core enters the barrel it raises the plug, blocking the ports in turn and thus producing pressure changes or anomalies in the drilling fluid indicative of the amount of core in the barrel.

BACKGROUND OF THE INVENTION

Field of the invention

This invention concerns core drilling in general, and more specifically relates to a method and/or apparatus for drilling a core sample of a formation while also providing an indication of the presence and extent of the core.

Description of the prior art

Heretofore core drilling structures have provided for receiving the core of a formation in a core barrel, which may then be brought up to the surface for recovery of the core. All such known structures had the drawback that no surface indication could be had as to the presence or extent of a core in the core barrel. Consequently, on occasion, a core drilling operation was carried out for a given amount of penetration without (for whatever reason) the formation of a core in the core barrel. This was not known until the core barrel and related equipment was brought up to the surface and the core barrel inspected. Under such circumstances a substantial loss of time and effort was occasioned without the recovery of any sample core. This problem is overcome by the subject invention because a surface indication is provided that shows the presence and extent of a core downhole as the same is being drilled.

SUMMARY OF THE INVENTION

Briefly, the invention concerns a method of core drilling which method comprises the steps of drilling into a formation while forming a core thereof and circulating a drilling fluid around said core. It also comprises the steps of blocking part of said circulation adjacent to said core as a function of the formation of said core, and determining the amount of said core formation by noting the effect of said circulation blocking.

Again briefly, the invention concerns a core drill which comprises in combination an annular bit for forming a core of the formation being drilled and a core barrel associated with said bit for receiving said core as formed. It also comprises a plurality of ports in said core barrel spaced longitudinally thereof and means for blocking said ports successively as said core enters said barrel whereby the presence and the length of said core may be determined at the surface.

Once more briefly, the invention pertains to apparatus that is in combination with a core drill which has (a) an annular bit for forming a core of the formation being drilled and (b) a core barrel associated with said bit for receiving said core as formed. The invention comprises the combination of a first port at the top of said core barrel to permit limited flow of drilling fluid into

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said barrel and a plurality of second ports through the side walls of said core barrel to permit flow out from the inside of said barrel. The combination also comprises a plug slidable longitudinally within and being in fluid sealing relationship with the side walls of said core barrel, and means for detecting the pressure on the drilling fluid whereby movement of said plug past said second ports may be noted to indicate the amount of core in the barrel.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects and benefits of the invention will be more fully set forth below in connection with the best mode contemplated by the inventor of carrying out the invention, and in connection with which there are illustrations provided in the drawings, wherein:

FIG. 1 is a schematic elevation, partly in cross section, illustrating a core drilling bit in accordance with an embodiment of the invention, and

FIG. 2 is a schematic illustration showing the manner of determining at the surface the presence and extent of a core in the core barrel.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings, it is pointed out that one embodiment according to the invention is schematically illustrated. In FIG. 1 there is shown a core drill bit 11 that may be conventional as to the exterior structure thereof. It is attached at the lower end of a string of drill pipe 12.

As is indicated by the FIG. 1 illustration, the drilling of a core entails penetration into a formation 15. This is carried out by an annular bit 16 at the lower edge or tip of the drill bit structure 11. The construction of this annular bit 16 may be conventional and, as illustrated, includes abrasive surfaces 17 that have radially situated slits or openings 18. These slits provide passageways to permit flow of drilling fluid that is circulated down inside of the drill pipe 12, to flow up in an annulus 21 of the borehole that is being drilled. Such drilling fluid circulation is maintained in order to carry the cuttings of the formation as it is drilled, up to the surface. Such drilling action causes a core 22 to form because of the open center of the annular bit 16. The core 22 is part of the formation 15 which is being drilled. It extends up inside the bit 11, within a core barrel 23.

The core barrel 23 is constructed with a slidable plug 24 therein. This may be constructed in any feasible manner in order to be vertically movable within the cylindrical open center of the core barrel 23. At the same time it will create fluid sealing conditions between the edges of the plug and the side walls of the barrel.

There are a plurality of ports 27 that are spaced apart longitudinally of the core barrel 23. These ports extend radially through the side walls of the barrel for permitting flow of drilling fluid out therethrough. They are preferably located in circumferential groups with the indicated longitudinal spacing between such groups. It will be appreciated that as the plug 24 is moved vertically upward within the core barrel 23, it will close off or block each of the groups of the ports 27 in sequence. This blocking action affects all of the ports 27 in each group at the same time and so causes a relatively rapid change in the back pressure on the drilling fluid. Consequently, an indication may be observed at the surface when this happens.

FIG. 2 schematically indicates how a pressure change reflected on the drilling fluid may be observed at the surface. This is accomplished by means of a pressure meter 30. The change also may be recorded on a strip chart 31 which will be driven in synchronism with the depth of penetration of the drill bit. In this manner, the depth at which a change in pressure is recorded may be

interpreted to determine the presence and extent of a core, e.g. the core 22 in the core barrel 23 of the illustrated bit 11.

At the top of the core barrel 23 there is an opening or port 34 which limits the flow of drilling fluid into the core barrel 23. This provides for a predetermined division of the flow of the drilling fluid which is being pumped down through the interior of the drill pipe 12. It may be observed that this arrangement provides a plurality of paths of flow for the drilling fluid. It may flow down around core barrel 23 in an annular space 35 while also flowing down through the interior of the core barrel and out through the ports 27.

It may be noted that drilling fluid completes its circulation in a conventional manner. This includes the flow paths that connect with the lower end of the annular space 35, through the various radial slits 18 to the outside of the abrasive tip 16 of the bit 11 and into the drilled hole annulus 21.

It will be appreciated that the core barrel 23 may be supported in any feasible manner within the structure of the bit 11. The illustration indicates a plurality of rods or pipes 38 which extend radially and connect the core barrel 23 to the inner walls of the drill bit 11.

As indicated above, the invention also concerns a method of core drilling. Such method might employ any feasible structural elements for carrying it out. It may be described with reference to the figures of the drawings, for clarity. It includes the following steps that are not necessarily carried out in the order recited.

Thus, the method comprises a first step of drilling into a formation while forming a core of such formation. This is, of course, a conventional step that is a prerequisite to the method.

A second step is that of circulating drilling fluid around the core, as it is formed. It will be appreciated that this step also, taken broadly, is conventional in core drilling. However, a more specific aspect includes the causing of the circulating fluid to flow in a plurality of parallel paths in reaching the core. With the illustrated structure, these paths are those beginning at the opening 34 and going out through the separate groups of ports 27. It will be understood that the structure for carrying out this step might vary widely and the method does not depend upon any particular structure.

A third step is that of blocking part of the circulation of drilling fluid. Such blocking is carried out as a function of the formation of the core. In other words, there is a direct relationship between the amount of core being formed, as the drilling progresses, and the blocking of part of the circulation path adjacent to the core. In its more specific aspects, this step includes cutting off of individual ones of the parallel paths of circulating fluid. With the illustrated structure, it is the plug 24 that closes each of the rings, or groups of ports 27 as it reaches them. Here again, the structure might be very different from that illustrated without altering the method.

Finally, the method includes a step of determining the

amount of core formation. This is accomplished by noting the relationships of the blocking effects and the extent of penetration of the core drill as the core is formed. The blocking effects are noted by providing pressure indicating equipment at the surface to indicate the pressure being applied to the drilling fluid. Thus, when a blocking of each ring of ports 27 takes place, the flow path for the drilling fluid will be rapidly altered and there will be a back pressure indication on the drilling fluid. Such pressure change or anomaly may be observed and/or recorded at the surface. Then by correlating the dimensions of the bit structure employed with the recording of the blocking actions, there will be a direct determination of the amount of a core, as it is formed in the core barrel.

While particular embodiments of the invention have been described above in considerable detail, in accordance with the applicable statutes, this is not to be taken as in any way limiting the invention but merely as being descriptive thereof.

I claim:

1. In combination with a core drill having

(a) an annular bit connected to a hollow drill pipe for forming a core of the formation being drilled;

(b) a core barrel positioned within and spaced from the interior of said bit for receiving said core as formed, the interior of said core barrel being open from top to bottom;

the combination comprising

a first port at the top of said core barrel communicating with said drill pipe to permit limited flow of drilling fluid into said barrel,

a plurality of longitudinally spaced second ports through the side walls of said barrel communicating with the space between said core barrel and bit to permit flow out from the inside of said barrel,

a plug initially positioned at the lower end of said core barrel and slidable longitudinally within and being in fluid sealing relationship with the side walls of said core barrel, and

means for detecting the pressure on the drilling fluid whereby movement of said plug past said second ports may be noted to indicate the height of core in the barrel.

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IAN A. CALVERT, Primary Examiner

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