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CORE DRILL WITH AUXILIARY REAMER

Filed Sept. 13, 1929

2. Sheets-Sheet 1

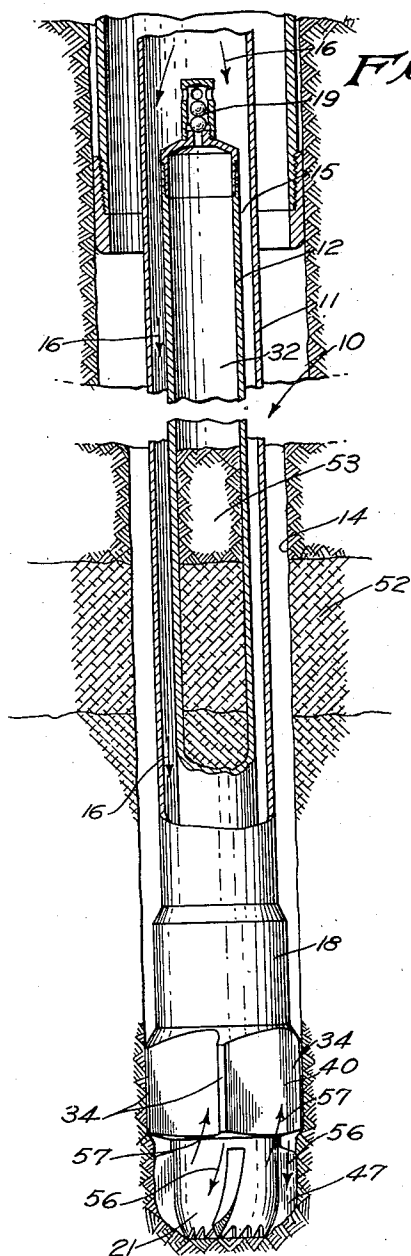


Fig. 1.

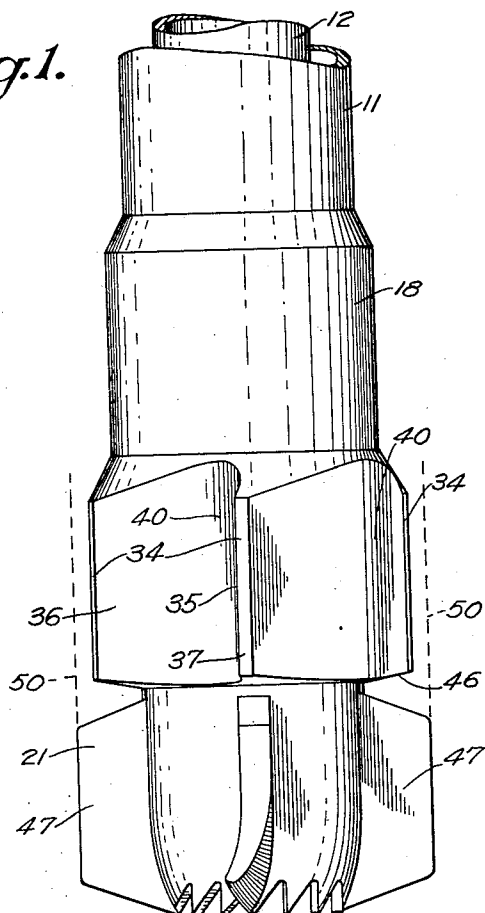


Fig. 2.

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2 Sheets-Sheet 2

Fig. 3.

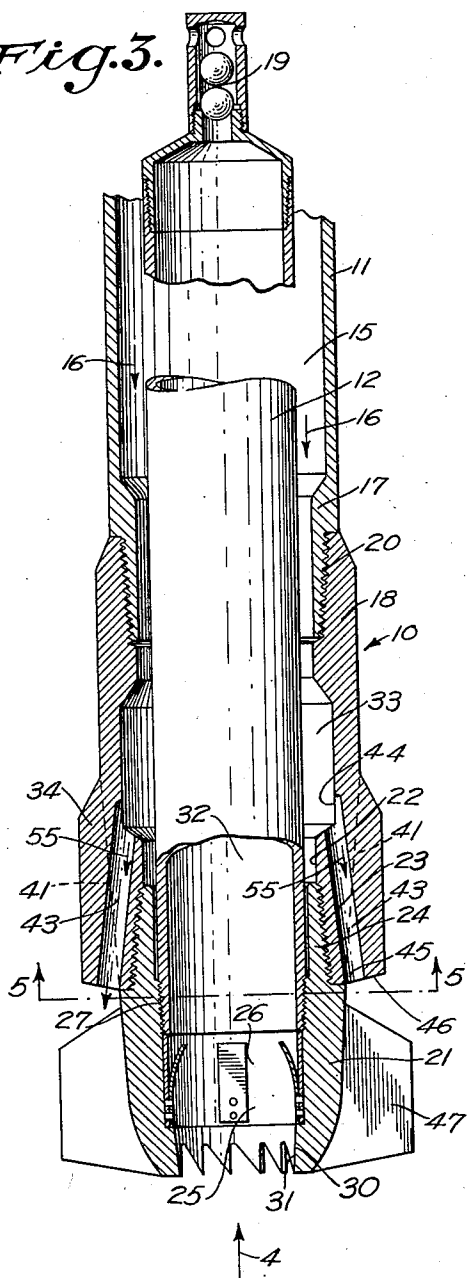


Fig. 5.

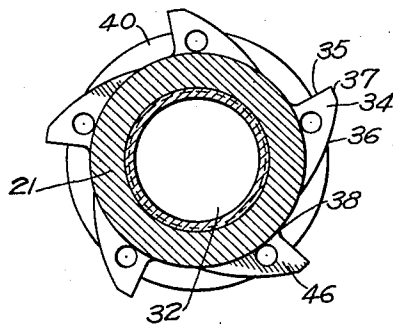
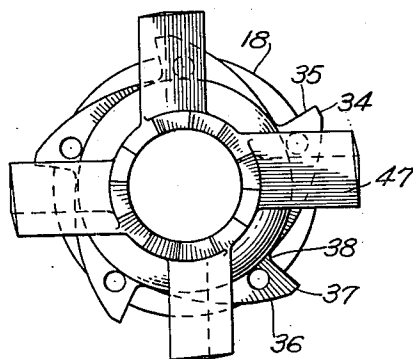


Fig. 4.



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CORE DRILL WITH AUXILIARY REAMER

Application filed September 13, 1929. Serial No. 392,348.

This invention relates to tools for drilling holes and wells by the rotary system, and relates particularly to a core drill or core barrel having means for preventing the freezing or sticking of the core drill or barrel in the hole being drilled due to reduction in diameter of the hole resulting from wear of the cutters of the core drill.

In the drilling of wells by the rotary system, cores are obtained by use of a core drill or core barrel having an annular cutter and a central tubular recess in which the core left by the annular cutter is received and in which tubular recess the core is lifted from the well.

Our invention is of especial value to the various types of core drills. For simplicity in disclosure of the invention it will be hereinafter shown and described with the well known core barrel for rotary drilling, which consists of an inner barrel and an outer barrel, the inner barrel receiving the core and the outer barrel connecting the core barrel or core bit to the drill pipe which extends through the well to the surface of the ground where it is rotated by suitable rotary equipment.

In these core barrels, an annular space exists between the inner barrel and the outer barrel and provides a passage for circulation of the drilling fluid or mud water, there being a number of holes at the lower end of the core barrel which throw the circulating mud water against the blades of the core bit in order to remove the cuttings which accumulate during the drilling operation. The external diameter of the core barrel used in a hole of a given size is made as large as possible so that the internal diameter of the core barrel may be maintained at a correspondingly large size in order to procure as large a core as possible.

The making of the core barrel of but slightly smaller diameter than the cutter or cutting blades at the lower end thereof permits a very limited wearing away of the cutter blades before the diameter of hole cut by the cutter approaches the external diameter of the core barrel to such an extent that there is insufficient space for proper circulation of the mud water and cuttings upwardly

around the exterior of the core barrel, thus producing a pronounced hazard in the liability of the core barrel freezing or sticking in the hole due either to accumulation of cuttings or to the hole becoming smaller in diameter than the core barrel. This desire to obtain the largest core possible in a hole of a given size leaves little clearance between the core barrel and the wall of the hole, and it happens quite frequently that a core barrel, when run too long in the hole, freezes at the bottom thereof, causing a bad fishing job.

Contributing to the freezing of the core bit in the hole is the fact that when the core bit wears to such an extent that it drills a hole of about the same diameter as the exterior of the core barrel, circulation is interfered with and reduced to such an extent that the cuttings accumulate, and if the flow of circulating fluid should be interrupted for one reason or another the cuttings will settle around the outer core barrel, thus causing it to be bound, or in other words, producing what is known as freezing of the core bit in the hole.

It is an object of our invention to eliminate the danger of a core drill freezing in a hole by equipping the core bit with auxiliary reamer blades placed immediately above the cutter of the core drill, these reamer blades coming into operation when the blades of the cutter have been worn to such an extent that they fail to maintain a desired diameter of hole, the auxiliary reamer blades then operating on the walls of the hole so as to maintain a desired diameter therein and likewise to prevent a decrease in the diameter of the hole to such an extent that there is danger of the core barrel freezing in the hole.

A further object of our invention is to eliminate this danger of freezing by use of a sub or reamer body adapted for incorporation in a core barrel structure, such sub having reamer elements formed therewith in position immediately above the cutting blades of the core barrel and being adapted to enter into operation when the diameter of the cutting blades has been lost or reduced due to wear.

A further object of the invention is to pro-

vide a device of this character in which the reaming teeth are so formed that the passages or holes for circulation of a drilling fluid may be extended therein from communication with the circulation passages in the core barrel to points of discharge at the lower ends of the reaming teeth, the passages being so directed that the drilling fluid or mud water will be delivered in a proper manner to remove cuttings as they are formed and to clean the blades of the core barrel cutter.

In the operation of core drills, the desire to obtain a core of full length often results in the working of the core barrel beyond the capacity of its cutting blades to maintain a diameter which will enable a free rotation of the core barrel. It is during such times that danger of freezing of the core barrel in the well exists, owing to the fact that the cutter will continue to drill downwardly or, in other words, make hole after the peripheral portions of the blade have become worn to a dangerous extent. In the use of our invention, should the core barrel be operated until the gauge of its cutters is lost, the auxiliary reaming blades will enter into operation and maintain a required safe diameter of hole during the time the cutting blades have lost gauge but still continue to penetrate downwardly.

When the cutter blades entirely lose their cutting ability, such condition will be made known to the driller by the stopping of the downward progress of the drilling string, and he may then pull the string from the well without danger of the core barrel being frozen, owing to the fact that a safe size of hole has been maintained by the auxiliary reaming elements of the invention.

Further objects and advantages of the invention will be perceived from the following part of the specification.

Referring to the drawings which have been exaggerated to the extent of emphasizing the essential features of the invention:

Fig. 1 is a partly sectioned elevational view showing a core barrel embodying the invention in operation in a hole.

Fig. 2 is an enlarged elevation of the lower end of the core barrel showing the cutter and auxiliary reamer thereof.

Fig. 3 is an enlarged fragmentary cross section showing details of construction of this embodiment of the invention.

Fig. 4 is a face view of the lower end of the core barrel, derived as indicated by the arrow 4 of Fig. 3.

Fig. 5 is a section on the plane represented by the line 5—5 of Fig. 3.

As disclosed in Figs. 1 and 3, a core barrel or core drill 10 suitable for embodying and including our invention comprises an outer tubular wall 11 and an inner tubular wall 12,

it being customary to secure the upper end of the outer tubular member 11 to and in communication with the lower end of a string of drill pipe by which the core drill is operated in a hole 14, and to provide the upper end of the inner tubular member 12 with a valve 19 for permitting escape of fluid from its interior but preventing entrance of drilling fluid from the surrounding space within the other tubular member 11.

The inner tubular member 12 is of such diameter that a circulation space or passage 15 is formed between the outer tubular member 11 and the inner tubular member 12, through which space the drilling fluid, which is generally a mud and water mixture, may flow downwardly, as indicated by arrows 16. Attached to the lower end 17 of the outer tubular member 11 is a sub or reamer body 18, this attachment being preferably accomplished by a threaded engagement such as indicated at 20. The lower end of the annular reamer body 18 is equipped to receive and support the cutter body 21 of the core drill. For this purpose it is desirable to thread the lower portion of the reamer body bore 22, as indicated at 23, and to provide a threaded extension 24 on the upper end of the cutter body 21, thus enabling the screwing of the cutter body 21 into position of operation at the lower end of the sub or reamer body 18.

The cutter body 21 is of annular form and has a central opening 25 extending from its lower end to communication with the lower end 26 of the inner tubular member 12 which is supported in operative position and in upward extension from the cutter body 21 due to its threaded engagement with the cutter body 21 at 27. The bore or opening 25 of the cutter body 21 is decreased in diameter by the presence of an inwardly projecting collar or flange 30 having a downwardly converging inner face 31 forming a mouth of slightly reduced diameter through which the core, formed by operation of the core bit, enters the core recess 32 provided by the upper portion of the cutter body bore 25 and the interior of the inner tubular member 12. The reamer body 18 is of such external diameter that a space or annular passage 33 exists therein around the exterior of the lower portion of the inner member 12. Adjacent to the lower end of the reamer body 18 reaming elements are provided in the form of vertically directed blades 34, the front or forward faces 35 of which extend substantially radially, as shown in Figs. 4 and 5, and the rearward or back faces 36 of which extend tangentially from the outwardly disposed outer or edge faces 37 to meet the inner portions 38 of the rearwardly adjacent reaming blades 34. By adopting this form, the reaming blades 34 are enlarged in circumferential width toward their inner portions, and

large channels 40 are formed between each of the reaming blades 34, the bottoms of the channels 40 sloping outwardly as they progress upwardly, as indicated by dotted lines 41 in Fig. 3.

The making of the reaming blades 34 of such massive character enables the forming of circulation passages 43 therein in the manner shown in Fig. 3, these circulation passages 43 having communication at their upper ends 44 with the annular chamber 33 of the reamer body 18 and extending downwardly within the blades 34 so that their lower mouths 45 will open in the lower end faces 46 of the blades 34.

The cutter body 21 is provided with cutting means which may be conveniently in the form of blades 47 of such extent as to cut a hole the diameter of which is indicated by the dotted lines 50 of Fig. 2. When the core barrel is first put into operation in a hole from which it is desired to obtain a core, the cutter blades 47 will project diametrically beyond the auxiliary reamer blades 34, and the hole cut thereby, such as indicated by the dotted lines 50, will entirely clear the reaming elements so that during the normal operation of the cutter of the core bit the reaming blades will do no work but exist only as a safety measure, entering into the function when the core bit has, due to wear, lost its diameter to an extent which might endanger the core barrel.

In Fig. 1 we have shown the core barrel in operation in the hole 14, it being assumed that during this operation sufficient structure 52 has been penetrated to produce a core 53 which is shown projecting into the core recess 32 of the inner tabular member 12. During this operation of the core barrel, the drilling fluid passes downwardly in the interior annular space 15 of the core barrel, as indicated by the arrows 16, and is directed outwardly, as indicated by the arrows 55 of Fig. 3, through the circulation passages 43 of the safety reamer sub or reamer body 18, this discharge fluid entering the cutting zone or spaces between the cutting blades 47, as indicated by arrows 56 in Fig. 1. The drilling fluid or mud water then passes upwardly through the channels 40 of the reamer device, as indicated by arrows 57, carrying with it the cuttings which have been formed by operation of the blades 47 against the earth structure. In Fig. 1 the cutter blades 47 are shown worn to such an extent that the hole produced thereby is of about the same diameter as the upper portion of the outer core barrel 11. There is no danger, however, of the core barrel freezing in the hole, as the auxiliary or safety reaming blades 34 have entered into operation so as to maintain a safe diameter of hole 14 in which the core barrel may rotate.

The blades 47 have nearly reached the limit

of their penetrating capacity, and when the limit is reached, there will be no other result than the failure of the core drill to penetrate further into the earth structure, and the core bit will merely rotate on the bottom until the condition of the cutting blades has been noted by the driller from the failure of the drilling string to continue to move downwardly as it does during the time a hole is being cut by a core drill. From the foregoing, it will be perceived that the termination of the cutting operation due to the wearing completely away of the cutter blades cannot possibly be accompanied by serious or disastrous results owing to the fact that during the period of decrease of the cutter blades a required diameter of hole will be maintained by the auxiliary reaming blades.

It is intended that the reaming blades shall be faced with a hard wear-resistant metal in the same manner as may the cutting blades 47, the reaming blades being thereby given ample capacity to perform the reaming duties imposed thereon toward the end of the cutting operation of the core drill cutters which are of replaceable or renewable character. Therefore, it will be recognized that a single auxiliary reamer of the character herein described will outlast a large number of standard core barrel cutters, and will be always present to assure freedom from any possibility of the core barrel freezing in the hole.

We have herein shown our invention in practical and operative form, but it is recognized that certain parts and elements thereof are representative of other parts, elements, or mechanisms which may be employed in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but shall have the scope set forth in the following claims.

We claim as our invention:

1. In a core drilling tool of the character described: a core barrel including an annular wall structure having cutters at the lower end thereof for cutting an annular hole around a central core, and reaming members above and of less diameter than said cutters for preventing decrease in the outer diameter of said annular hole to a size smaller than the external diameter of said core barrel when said cutters have become worn so as to fail to maintain a diameter greater than that of said core barrel.

2. In a core drilling tool of the character described: a core barrel including a tubular wall structure with cutters at the lower end thereof adapted to cut an annular hole of greater external diameter than said core barrel, and an auxiliary reamer above and of less diameter than said cutters, the portion of said tubular wall structure between said

reamer and said cutters being of smaller diameter than said reamer.

3. In a core drilling tool of the character described: a core barrel including a tubular wall structure with a cutter at the lower end thereof, said cutter including an annular cutting body wall with cutting elements extending therefrom adapted to cut a hole of larger diameter than said core barrel, an annular wall forming a reamer body above said annular cutting body wall having reaming members of less diameter than said cutting elements and adapted to prevent a decrease in the diameter of hole cut by said cutter to a size smaller than said core barrel, the annular wall structure between said cutter and said reamer body being of smaller diameter than the hole cut by said cutter.

4. In a core drilling tool of the character described: a core barrel including a tubular wall structure with a cutter at the lower end thereof, said cutter including an annular cutting body wall with cutting elements extending therefrom adapted to cut a hole of larger diameter than said core barrel, an annular wall forming a reamer body above said annular cutting body wall having reaming members of less diameter than said cutting elements in order that said reaming members will not be brought into operation unless said cutting elements are worn away to insufficient diameter, said reamer body having downwardly directed circulation openings therein for directing drilling fluid from the interior of said core barrel to the cutting zone of said cutter of the core drilling tool.

5. In a core drilling tool of the character described: a core barrel including a tubular wall structure with a cutter at the lower end thereof, said cutter including an annular cutting body wall with cutting elements extending therefrom adapted to cut a hole of larger diameter than said core barrel, an annular wall forming a reamer body above said annular cutting body wall having reaming members of less diameter than said cutting elements in order that said reaming members will not be brought into operation unless said cutting elements are worn away to insufficient diameter, the annular wall structure between said cutter and said reamer body being of smaller diameter than said reamer body, said reamer body having downwardly directed circulation openings therein for directing drilling fluid from the interior of said core barrel to the cutting zone of said cutter of the core drilling tool.

6. A core drilling tool of the character described, including: a core barrel having an inner tubular wall and an outer tubular wall providing a space therebetween for passage of a drilling fluid; an annular cutter body at the lower end of said core barrel having a central opening communicating with the interior of said inner tubular wall and having

cutting means therewith for cutting an annular hole of larger external diameter than said core barrel; and an annular reamer body at the lower end of said core barrel and above said cutter body, said reamer body having reamer elements of less diameter than said cutting elements in order that said reaming members will not be brought into operation unless said cutting elements are worn away to insufficient diameter, there being circulation passages downwardly directed from the interior of said reamer body and through the reamer elements of said reamer body for directing a drilling fluid from the space between said inner tubular wall and said outer tubular wall into the cutting zone of said core drilling tool.

7. In a core barrel including a body, a core-receiving tube and cutter means at the lower end thereof for cutting the core, the combination with an auxiliary reamer means adapted to come into operation when said cutter means has been worn away and will not cut a hole of desirable diameter.

8. In a core barrel including a body, a core-receiving tube and cutter means at the lower end thereof for cutting the core, the combination with an auxiliary reamer means above said cutter means and of smaller diameter than said cutter means, said auxiliary reamer means being adapted to come into operation when said cutter means has been worn away and will not cut a hole of desirable diameter.

9. In a core barrel including a body, a core-receiving tube and cutter means at the lower end thereof for cutting the core, the combination with an auxiliary reamer means adapted to come into operation when said cutter means has been worn away and will not cut a hole of desirable diameter, there being circulation ducts in said auxiliary reamer means for directing a stream of fluid downward to said cutter means.

10. In a core barrel including a body structure, and a core-receiving tube, the combination with: a reamer body at the lower end of the core barrel, having auxiliary reamer means capable of reaming a hole large enough to pass the body of said core barrel; and a cutter body threadedly secured to the lower end of said reamer body, having a core-receiving opening and cutter for cutting away the bottom of the hole, said cutter being adapted to cut a hole of larger diameter than said reamer means.

11. In a core barrel including a body structure, and a core-receiving tube, the combination with: a reamer body at the lower end of the core barrel, having auxiliary reamer means capable of reaming a hole large enough to pass the body of said core barrel, and circulation ducts formed in said auxiliary reamer means; and a cutter body threadedly secured to the lower end of said reamer body,

having a core-receiving opening and cutter for cutting away the bottom of the hole, said cutter being adapted to cut a hole of larger diameter than said reamer means.

5 In testimony whereof, we have hereunto set our hands at Los Angeles, California, this 6th day of September, 1929.

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FORD A. PILGRIM.

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