

Feb. 4, 1941.

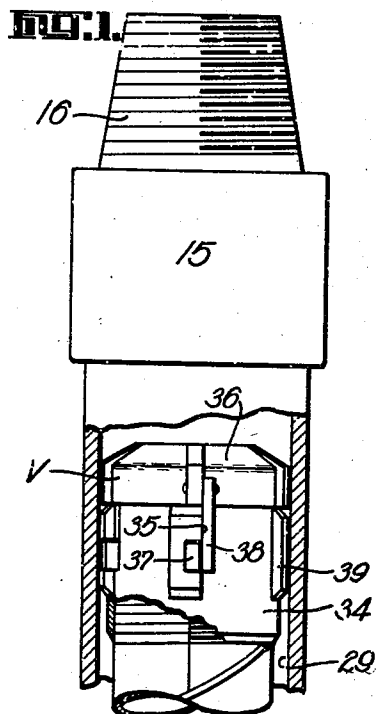
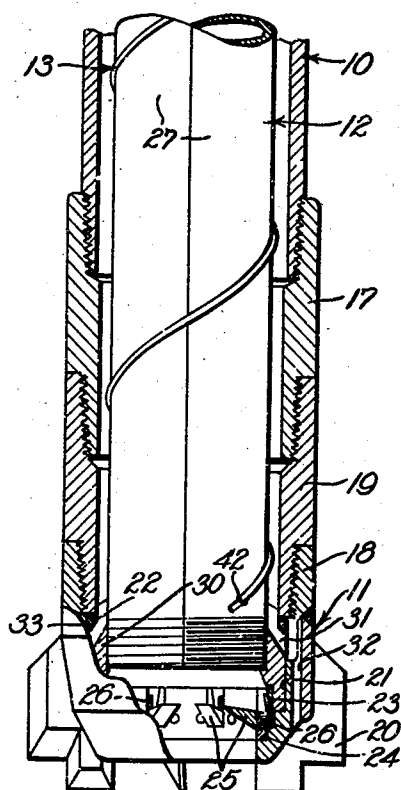
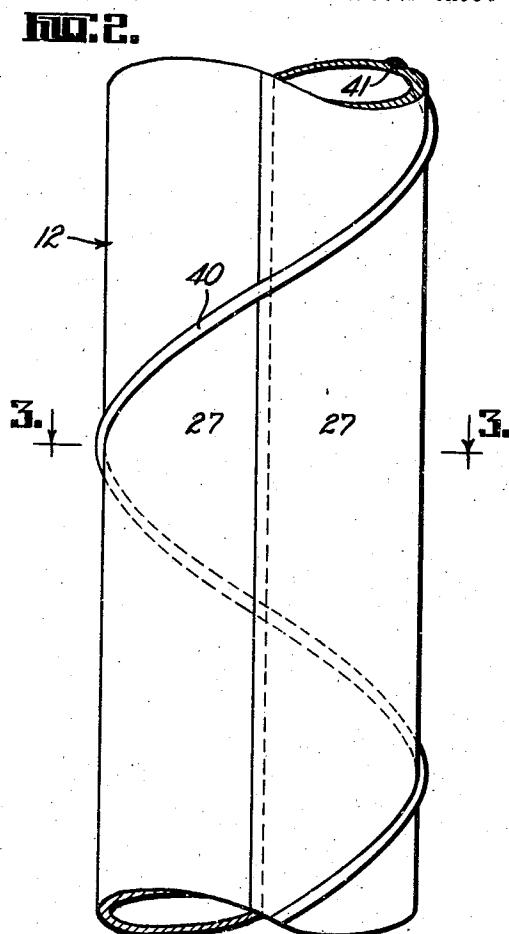
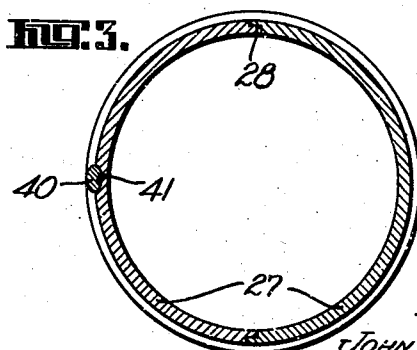
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2,230,568

CORE DRILL

Filed Oct. 14, 1938

2 Sheets- Sheet 1



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CORE DRILL

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2 Sheets-Sheet 2

FIG. 4.

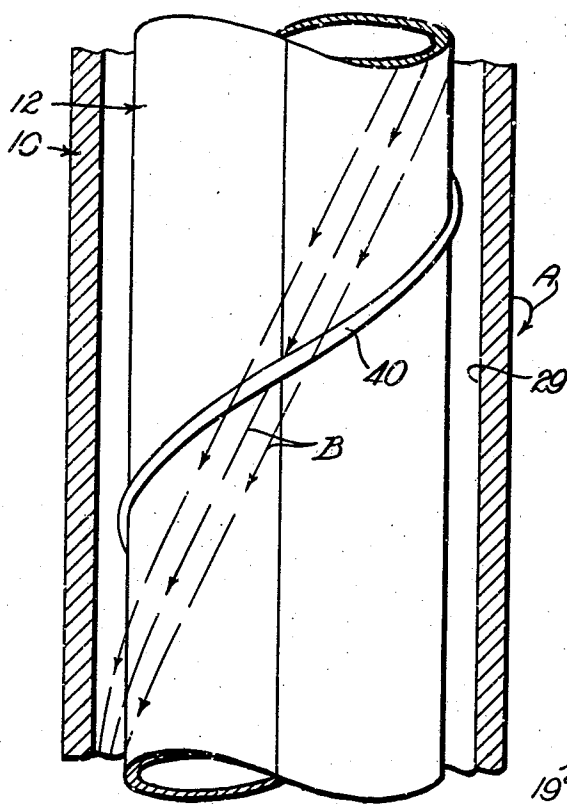


FIG. 5.

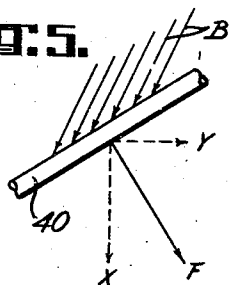
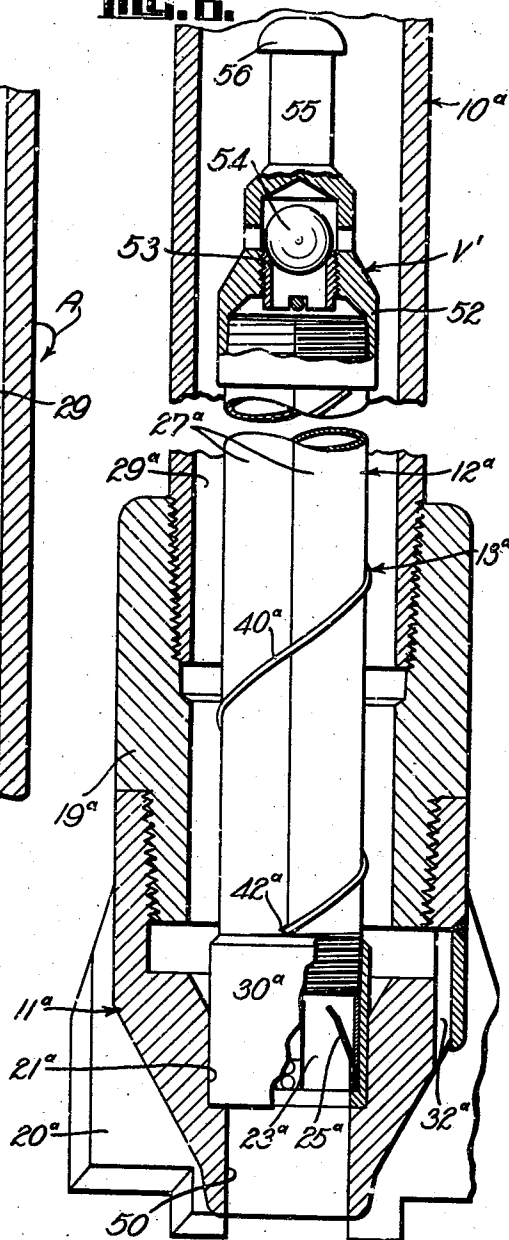


FIG. 6.



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2,230,568

CORE DRILL

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Application October 14, 1938, Serial No. 234,908

5 Claims. (Cl. 255-72)

This invention relates to well drilling tools and relates more particularly to core drills for use in the rotary method of well drilling. A general object of the invention is to provide an improved core drill embodying an inner barrel of novel construction and operation.

Rotary core drills embodying floating inner barrels have gone into extensive use. The inner core receiving barrels of such drills are rotatably supported in the outer barrels in order that they may "float" or remain non-rotatable with the core during the core taking drilling operations. Quite frequently the inner barrel of a core drill of the character referred to rotates during the core cutting operation due to excessive friction at its bearings and other causes. The rotation of the inner core receiving barrel grooves and burns the core and oftentimes shatters the core.

Another object of this invention is to provide a core drill embodying a floating inner barrel provided with novel means for resisting rotation during the drilling or the core taking operation.

Another object of this invention is to provide a core drill of the character mentioned in which the flow of circulation fluid is utilized to resist or prevent rotation of the inner barrel.

Another object of this invention is to provide a core drill of the character mentioned in which a free circulation of fluid is maintained at all times.

Another object of this invention is to provide a core drill of the class referred to embodying a novel sectional inner barrel or core receiving barrel that is simple and easy to assemble and that is inexpensive to manufacture.

Another object of this invention is to provide a core drill of the so-called wire line type in which latches for the retention of the inner barrel are unnecessary and may be dispensed with, thus simplifying the construction and rendering the removal of the inner barrel simple and easy.

A further object of this invention is to provide a core drill of the character mentioned in which the means for holding the inner barrel against rotation serves to assist in holding the sections of the inner barrel in assembled relation.

The various objects and features of our invention will be fully understood from the following detailed description of typical preferred forms and applications of our invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a central longitudinal detailed sectional view of one core drill of the invention showing the inner barrel in elevation and portions

of the outer barrel in elevation. Fig. 2 is an enlarged fragmentary side elevation of the inner barrel. Fig. 3 is a transverse detailed sectional view taken as indicated by line 3-3 on Fig. 2. Fig. 4 is an enlarged fragmentary longitudinal detailed sectional view showing the inner barrel in elevation and illustrating the action of the fluid. Fig. 5 is a diagram further illustrating the action of the fluid on the vane and Fig. 6 is a central longitudinal detailed sectional view of another form of drill of the invention with a portion of the inner barrel in elevation.

The form of the invention illustrated in Figs. 1 to 5, inclusive, of the drawings may be said to include, generally, an outer barrel 10, a head 11 on the lower end of the outer barrel 10 for cutting a core, a sectional inner barrel 12 rotatably supported within the outer barrel 10 and means 13 associated with the inner barrel 12 for resisting its rotation during the drilling or core taking operations.

The outer barrel 10 is adapted to be connected with the lower end of a tubular rotary well drilling string to be rotated thereby. The outer barrel 10 is an elongate structure or assembly provided at its upper end with means for connection with the drilling string. In the case illustrated a sub 15 is secured to the upper end of the outer barrel 10 and has a threaded pin 16 for facilitating the connection of the outer barrel with the drilling string. A sub 17 may be threaded on the lower end of the tubular outer barrel 10. The outer barrel 10 is of substantially uniform internal diameter and is connected with the drilling string through the medium of the sub 15 to receive the circulation fluid from the string.

The head 11 is secured to the lower end of the barrel 10 and is provided to make an annular cut in the earth formation and to thus form a core for reception by the inner barrel 12. In accordance with the broader aspects of the invention the head 11 may be of any suitable type or form. In the construction illustrated the head 11 includes a tubular body 18 threadedly connected with a tubular sub 19 which in turn is threaded on the outer barrel sub 17. Cutting elements are provided on the body 18 to act on the earth formation. In the typical embodiment of the invention illustrated in the drawings the cutting elements of the head 11 are in the nature of circumferentially spaced cutting blades 20 projecting downwardly and outwardly from the head 18. A socket 21 is provided in the drill head 18 and the lower wall of the socket constitutes an

upwardly facing internal shoulder in the head body. The lower end of the sub 19 forms a downwardly facing annular shoulder 22 spaced above the bottom wall of the socket 21. The cutting blades 20 of the head 11 are operable to form a core that is received in the head body 18 and the inner barrel 12 with suitable clearance and make an annular cut that receives the drill with suitable clearance.

10 The core drill preferably includes means for trapping or retaining the core of earth formation. Any suitable type or form of core catcher or core catching means may be embodied in the tool. In the particular application of the invention

15 illustrated a core catcher of the type described and claimed in Patent No. 2,030,297, granted February 11, 1936, is arranged in the body 18 of the head 11. The core catcher includes a floating or rotatable sectional ring 23 supported on an annular internal shoulder 24 in the head body 18. A plurality of circumferentially spaced core gripping and supporting dogs 25 is provided on the ring 23. The dogs 25 are pivotally supported in notches in the ring 23 and are yieldingly urged

20 downwardly and inwardly by springs 26. The dogs 25 are retractable by the core during the drilling or coring operations and are adapted to bite into and support the core when the drill is raised at the end of the drilling operations. The core catcher ring 23 is held against upward movement and displacement by a part on the inner barrel 12 as will be hereinafter described.

The inner barrel 12 is arranged longitudinally within the outer barrel 10 to receive the core of earth formation formed or cut by the head 11. The barrel 12 is disposed longitudinally in the outer barrel 10 in concentric relation thereto and may be of substantial length to receive a long core. In accordance with the invention the inner

35 barrel 12 is an elongate sectional structure. The improved inner barrel 12 includes a main elongate tubular part divided longitudinally on a diametric plane to constitute two complementary sections 27. The abutting or adjacent edges of the barrel sections 27 are connected to prevent leakage between the sections by lapped or offset shouldered joints 28. The tubular assembly of the sections 27 is of sufficient internal diameter to receive the core with some clearance and has an external

40 diameter less than the internal diameter of the outer barrel 10 to leave an annular fluid passage 29 through the outer barrel. The lower portions of the barrel sections 27 are threaded to receive a bearing collar 30. If desired or believed necessary the collar 30 may be locked or secured against unthreading by any convenient or suitable means. The bearing collar 30 is received in the socket 21 of the head body 18 and may bear downwardly

45 against the lower wall of the socket to support the barrel 12. The collar 30 is freely rotatable in the socket 21 and has extensive rotary bearing engagement in the socket to support the inner barrel 12 in the position where it is centrally and concentrically disposed within the outer barrel 10.

Vertical or longitudinal grooves 31 are provided in the upper portions of the bearing collar 30 to connect the passage 29 with ports 32 in the drill head 18. The upper portions of the several ports 32 are joined or connected. The ports 32 serve to discharge the circulation fluid at the lower end of the drill head 18 to flush the blades 20 and to provide the necessary circulation in the well. The collar 30 may carry a bearing ring 33 to op-

50 pose and bear on the shoulder 22. The lower por-

tion of the bearing collar 30 may receive the core catcher ring 23 and the collar may be shaped to stop or limit the upward movement of the core catcher.

The inner barrel 12 includes a valve V for preventing the entrance of the circulation fluid to the interior of the inner barrel. Any preferred or selected type of core catcher valve may be applied to the inner barrel 12. In the drawings we have illustrated a type of valve V that is described and claimed in Patent No. 2,058,154, granted August 7, 1933. The valve V includes a collar 34 threaded on the upper end of the tubular assembly of the barrel sections 27. Bayonet slots 35 are provided in the collar 34 and extend downwardly from the upper end of the collar. The valve V further includes a head 36 partially received by the collar 34. The head 36 is provided with lugs 37 cooperating with the bayonet slots 35. A latch 38 is pivoted on the head 36 and operates with the vertical portion of one of the slots 35 to retain the head 36 in the position where its lugs 37 cooperate with the lateral portions of the bayonet slots. The head 36 carries a valve means operable to prevent the downward-

55 ly flowing circulation fluid from entering the inner barrel 12 and capable of permitting the free escape of fluid from the upper end of the inner barrel. The valve means embodied in the head 36 may be of the character illustrated in Fig. 6 of the drawings. The collar 34 and the head 36 of the valve V have clearance with the internal wall of the outer barrel 10 to permit the flow of fluid downwardly through the passage 29. Vertical stabilizing ribs 39 may be provided on the collar 34 and the head 36 to assist in retaining the inner barrel 12 in a centralized position in the outer barrel 10. It is to be observed that the bearing collar 30 and the valve collar 34 serve to connect the upper and lower ends of the assembled barrel sections 27.

The means 13 is an important feature of the invention. The means 13 utilizes the force of the downwardly flowing circulation fluid to stop or resist rotation of the inner barrel 12 during the rotary drilling or coring operations. In accordance with the usual practice rotary mud or circulation fluid is pumped downwardly through the drilling string at a substantial pressure and flows through the passage 29 to discharge from the ports 32. During the coring or drilling operations the outer barrel 10 and the drilling string are rotated in the righthand direction indicated by the arrow A in Fig. 4. This rotation of the drilling string and the barrel 10 gives the circulation fluid a rotary or helical motion so that it flows downwardly through the annular passage 29 substantially as indicated by the arrowed lines B of flow in Fig. 4. The pitch or inclination of the lines of flow of the fluid through the passage 29 depends upon the pressure and velocity of the fluid and upon the rate of rotation of the string and the outer barrel 10 as will be more fully described. The means 13 includes a helical fin or vane 40 on the exterior of the inner barrel 12. The vane 40 is pitched in the same direction as the path of flow of the fluid flowing through the passage 29 but, as illustrated in Fig. 4 of the drawings, is pitched at a greater angle to the vertical than the lines of flow B of the fluid. The vane 40 is of substantial length and may extend between the collars 30 and 34 of the inner barrel 12. The thickness or extent of projection of the vane 40 from the exterior of the inner barrel sections 27 is such that the vane has clearance with

the inner surface of the outer barrel 10 so that the fluid may flow over it or past it. The vane 40 is partially cylindrical in cross section, that is, the exposed or projecting portion of the vane 40 is cylindrical in transverse cross section.

Reference is now made to Fig. 5 of the drawings which illustrates the action of the circulation fluid on the vane 40. As above described, the circulation fluid flows through the passage 29 in a rotary or spiral manner, the direction of flow being indicated by the arrowed lines B. The circulation fluid acts on the vane 40 to exert a force indicated by the line F which force F is made up of the components X and Y. From an inspection of Fig. 5 it will be seen that the component X acts to urge the inner barrel 12 downwardly and to some extent acts to resist rotation of the inner barrel. The component Y acts in a direction counter to the direction of rotation A of the outer barrel 10 and operates to prevent or resist rotation of the inner barrel 12. It will be seen how the force F exerted on the vane 40 throughout the length of the vane effectively holds the inner barrel 12 against rotation. The direction of the lines of flow B of the fluid and, therefore, the intensity of the force F depend upon the relative diameters of the inner and outer barrels 12 and 10, the rate of flow of fluid through the passage 29, and the speed of rotation of the outer barrel 12. With a high rate of flow of fluid through the passage 29 and a low rate of rotation of the barrel 12 the lines of flow B will be more nearly vertical or parallel with the longitudinal axis of the barrel 12. With a slower rate of flow of fluid and a higher speed of rotation of the outer barrel 10 the angle between the direction of flow B of the circulation fluid and the longitudinal axis of the barrel 10 increases. Accordingly, the holding or non-rotative force F exerted on the barrel 12 by the action of the fluid on the vane 40 may be controlled or varied at will.

The character of the vane 40 and the mode of its attachment to the inner barrel 12 are features of the invention. The vane 40 is in the nature of a length of wire of suitable gauge given a spiralled or helical form. Prior to the application of the vane 40 to the inner barrel 12 a spiralled groove 41 is formed in the assembled barrel sections 27. The groove 41 is of sufficient depth to partially receive the wire of the vane 40 but is not deep enough to materially weaken the inner barrel 12. The wire of the vane 40 is laid or arranged in the helical groove 41 and the groove may hold or may assist in holding the wire vane 40 in shape. The vane 40 is preferably secured to the barrel 12 at one or more points. In the preferred construction the opposite end portions of the vane 40 are welded to the barrel sections 27 at 42. It will be observed that the vane 40 is simple and inexpensive and easy to install. The wire vane 40 being wrapped about the sections 27 throughout a substantial portion of their length serves to assist in holding the sections together. Where the barrel 12 is of considerable length the vane 40 engaging about the sections 27 throughout a substantial distance materially assists in holding the sections together.

In the operation of the core drill illustrated in Figs. 1 to 5, inclusive, the outer barrel 10 is secured to the lower end of a rotary well drilling string and is lowered into the well for operation. During the coring operation the string is rotated

to turn the barrel 12 in the direction indicated by the arrow A and rotary mud or circulation fluid is pumped down through the string. The circulation fluid flows down through the passage 29 and discharges from the ports 32 to flush the blades 20 and to provide circulation in the well. The blades 20 act on the earth formation to form an annular cut and leave a central upstanding core. As the drilling progresses this core is received in the inner barrel 12. The friction of the collar 30 engaging in the socket 21, the other factors may tend to cause the barrel 12 to rotate with the outer barrel 10. The circulation fluid passes through the annular passage 29 in a spiral course as indicated by the lines B and impinges against or acts on the vane 40 to exert the force F on the barrel 12. The force F, and particularly the component Y of this force F, effectively resists turning of the barrel 12 with the outer barrel 10. The contact of the inner barrel or parts thereon with the core of earth formation may also resist rotation of the inner barrel. The inner barrel remains non-rotatable throughout the coring operation so that its engagement with the core does not score, groove, burn or otherwise injure the core. When a core of sufficient length has been cut the drill is raised and the dogs 25 pivot downwardly and inwardly to grip the core. The dogs 25 cause the core to be broken free from the earth formation and support the core in the barrel 12 so that it is removed from the well in the drill.

Fig. 6 of the drawings illustrates the present invention embodied in what is known as a wire line core drill. The drill illustrated in Fig. 6 may be said to include, generally, an outer barrel 10^a, a head 11^a on the lower end of the barrel 10^a, an inner barrel 12^a and means 13^a holding the inner barrel 12^a against rotation and upward movement.

The barrel 10^a may be identical with the above described barrel 10. The head 11^a is secured to the lower end of the barrel 10^a. In the construction illustrated the head 11^a is threaded to a sub 19^a on the lower end of the outer barrel 10^a. The head 11^a is a tubular member provided with cutting means for making an annular cut and forming a core. The cutting means may take the form of spaced blades 20^a projecting downwardly and outwardly from the lower end of the head 11^a. A central vertical opening 50 extends through the head 11^a and its upper portion is enlarged in diameter to constitute a socket 21^a. Vertical ports 32^a are provided in the head 11^a to communicate with the interior of the sub 19^a and the outer barrel 10^a.

The inner barrel 12^a is arranged centrally and longitudinally in the outer barrel 10^a to receive the core cut by the bit head 11^a. The inner barrel 12^a is an elongated tubular assembly comprising a major intermediate portion longitudinally divided on a diametric plane to have two sections 27^a. The abutting edges of the sections 27^a may be similar to the abutting edges of the above described sections 27. A collar 30^a is screw-threaded on the lower ends of the assembled sections 27^a. The collar 30^a may be locked against unthreading. The lower portion of the collar 30^a is received in and bears in the socket 21^a to support the inner barrel 12^a. The lower end of the collar 30^a may rest on the bottom wall of the socket 21^a to support the inner barrel. The collar 30^a is freely rotatable in the socket 21^a whereby the inner barrel 12^a may remain non-rotatable during the rotary drilling operation. Core catching and re-

taining means is associated with the inner barrel 12^a. In the construction illustrated the core catcher includes a ring 23^a arranged in the collar 30^a and upwardly and inwardly projecting spring fingers 25^a carried by the ring 23^a. The ring 23^a may be rotatable in the collar 30^a. The fingers 25^a are retracted as the core enters the inner barrel 12^a and are adapted to grip and support the core when the drill is raised from the well.

10 A valve V' is provided on the upper end of the inner barrel 12^a. The valve V' may include a collar-like body 52 threaded on the upper ends of the sections 27^a. A valve seat 53 is provided in the valve body 52 and a ball 54 cooperates with the seat 53. The ball 54 seats downwardly against the seat 53 to prevent the entrance of circulation fluid to the upper end of the barrel 12^a and is adapted to rise from its seat and permit the escape of fluid from the barrel 12^a as the core C is received therein. The valve body 52 is ported above the seat 53. A stem 55 is provided at the upper end of the body 52 and has an enlarged head 56. The stem 55 and its head 56 are engageable by a suitable grappling tool (not shown) for removing the barrel 12^a from the drill. It is to be observed that the collar 30^a and the valve body 52 serve to connect the opposite ends of the barrel sections 27^a. The inner barrel 12^a just described extends through the outer barrel 10^a with substantial clearance, leaving an annular fluid passage 29^a. The lower end of the passage 29^a communicates with the opening in the sub 19^a which in turn communicates with the ports 32^a so that circulation fluid may pass down through the passage 29^a to discharge from the ports.

The means 13^a may be similar to or identical with the means 13 described above. The means 13^a comprises a spiralled or helical vane 40^a on the assembled barrel sections 27^a. The vane 40^a preferably extends from the collar 30^a to the valve body 52. In practice the vane 40^a may be a length of wire partially embedded in the helical groove in the sections 27^a. The opposite end portions of the wire vane 40^a may be welded to the sections 27^a at 42^a.

The operation of the drill illustrated in Fig. 6 is as follows. The barrel 10^a carrying the drill head 11^a may be attached to the lower end of a rotary well drilling string to be rotated in the well in the well known manner. When it is desired to obtain a core the barrel 12^a is dropped, pumped or lowered through the string to come to rest in the position illustrated in Fig. 6. Drilling is continued or resumed and the core is received in the opening 50 and the inner barrel 12^a. The circulation fluid pumped down through the drilling string flows through the passage 29^a to discharge from the ports 32^a. The circulation fluid acts on the helical vane 40^a to exert a force corresponding to the force F described above. The component X of this force F is downward and acts to hold the inner barrel 12^a against upward movement while the force Y is counter to the direction of rotation of the outer barrel 10^a and acts to hold the inner barrel 12^a

against turning. Thus the means 13^a operates to hold the inner barrel 12^a down in place to receive the core and acts to hold the inner barrel 12^a against rotation. When a core of sufficient length has been obtained a grappling tool is lowered through the string on a wire line or cable and is engaged with the stem 55 and the head 56. In this manner the inner barrel 12^a containing the core may be withdrawn from the drill and the drilling string. A new or second inner barrel 12^a or a so-called plug bit may then be dropped or pumped down the drilling string to the operating position and the drilling may be resumed.

Having described only typical preferred forms and applications of our invention, we do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to ourselves any variations or modifications that may appear to those skilled in the art, or fall within the scope of the following claims.

Having described our invention, we claim:

1. A rotary core drill comprising an outer barrel having a drill head on its lower end for cutting a core, a rotatably supported inner barrel in the outer barrel for receiving the core, there being an annular passage between the barrels, and a wire helically wound onto the inner barrel to extend from adjacent the upper end of the inner barrel to adjacent the lower end of the inner barrel and acted on by the fluid flowing downwardly through said passage to resist rotation of the inner barrel.

2. In a core drill, an inner barrel divided longitudinally into two sections, and a wire helically arranged around the barrel to hold the sections together.

3. In a core drill, an inner barrel divided longitudinally into two sections, collars on the ends of the barrel holding the sections together, and a wire helically arranged around the barrel to hold the sections together.

4. A rotary core drill comprising an outer barrel to be connected with a fluid conducting drilling string and having a cutting head for cutting a core, an inner barrel arranged longitudinally in the outer barrel to receive the core and spaced from the interior of the outer barrel to leave an annular passage for conducting the circulation fluid, the inner barrel being longitudinally split into sections, means rotatably supporting the lower end of the inner barrel in the outer barrel, and a wire helically wrapped about the inner barrel to hold the sections together and to form a vane on the inner barrel acted upon by the fluid flowing through said passage.

5. In a core drill, an inner barrel for receiving the core and having a helical external groove, the inner barrel being longitudinally divided into sections, and a wire helically wrapped about the inner barrel to hold its sections together and to be received in the groove, the wire projecting from the groove to form an external helical vane on the barrel.

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