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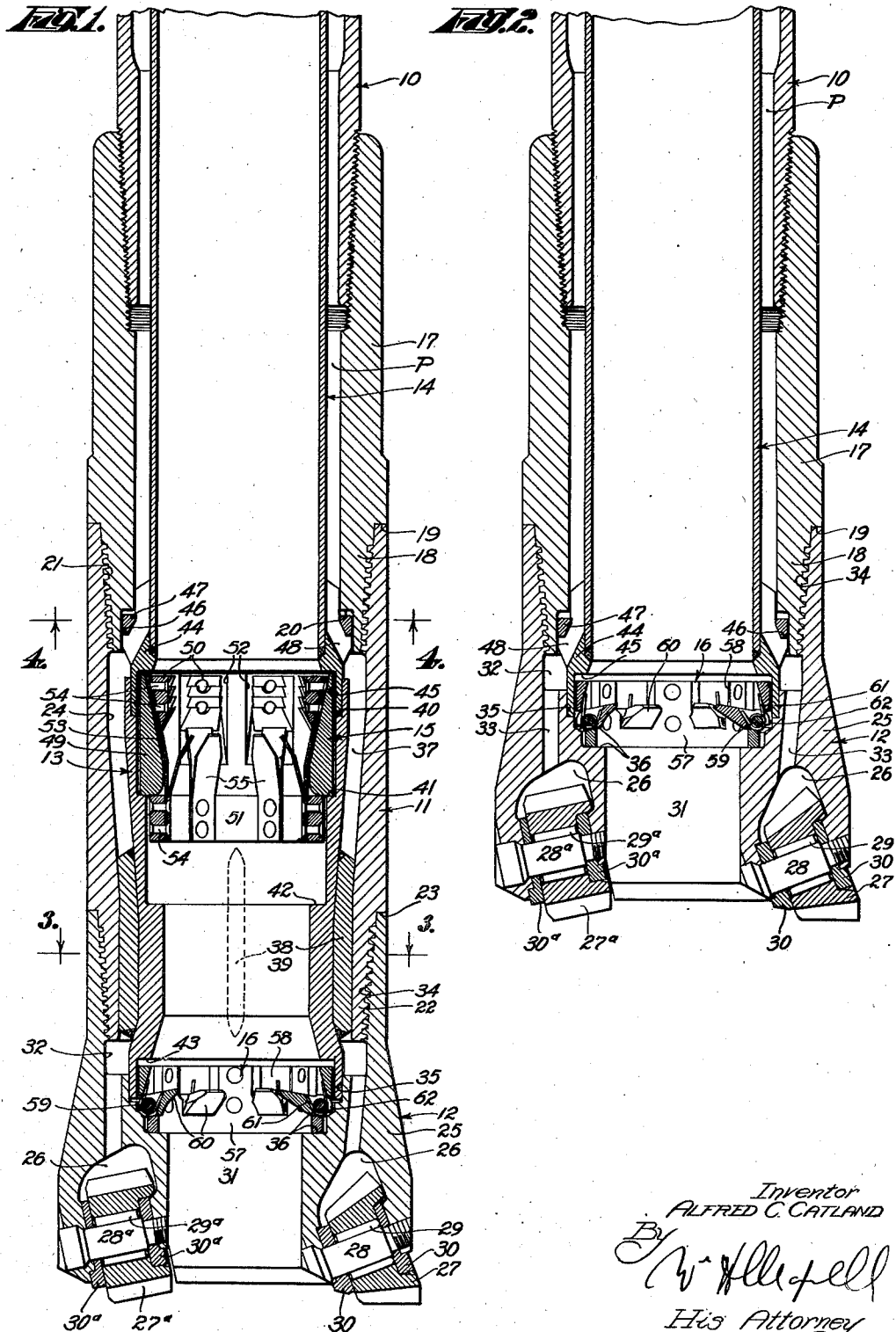
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CORE DRILL

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CORE DRILL

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This invention relates to well drilling tools and relates more particularly to a well core drill. A general object of this invention is to provide a simple, practical rotary core drill embodying interchangeable bit heads and core catchers.

Another object of this invention is to provide a core drill that may be readily provided with a bit head for use in hard earth formations and that may embody a dog type core catcher or a slip type core catcher, or both, when employing either type of bit head. The core drill of the present invention may be easily and quickly provided with either type of bit head and with either form of core catcher, or with both forms of core catchers for use under practically any conditions.

Another object of this invention is to provide a core drill embodying a novel and improved means for mounting or carrying a core catcher.

Another object of this invention is to provide a core drill in which the circulation fluid is conducted downwardly past the core catcher through an annular passage which leads directly to the fluid discharge ports in the bit head.

Another object of this invention is to provide a core drill embodying a simple, inexpensive sleeve for mounting and enclosing the core catcher, which sleeve also operates to define the inner wall of the annular passage for conducting the circulation fluid past the core catcher to the bit head.

Another object of this invention is to provide a convertible core drill of the character mentioned that is simple and inexpensive and that is rapid and efficient in operation.

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

Fig. 1 is a central longitudinal detailed sectional view of the principal lower portion of the core drill of the present invention embodying both forms of core catchers and a roller rock bit. Fig. 2 is a central longitudinal detailed sectional view of the core drill embodying the pivoted dog type core catcher and the roller rock bit. Figs. 3 and 4 are transverse detailed sectional views taken as indicated by lines 3—3 and 4—4, respectively, on Fig. 1. Fig. 5 is a view similar to Fig. 2 showing the drill embodying a drag type bit and Fig. 6 is a transverse detailed sectional view taken as indicated by line 6—6 on Fig. 5.

The core drill of the present invention is adapted

to embody a drag type bit for use in relatively soft or medium hard earth formations and may embody a roller rock bit for use in harder earth formations. Further, the core drill may embody a pivoted dog type core catcher or a slip type core catcher, or both, with either form of bit head. In Figs. 1, 3 and 4 of the drawings I have illustrated the drill embodying both types of core catchers and a roller rock bit. Fig. 2 illustrates the drill embodying a dog type core catcher and the roller rock bit and Fig. 5 illustrates the drill as provided with the dog type core catcher and a drag type bit. I will first describe the structure illustrated in Figs. 1, 3 and 4 of the drawings and then describe the manner in which the drill may be modified by the removal and interchanging of the core catchers and the bit heads, as illustrated in the other figures.

The core drill of the present invention illustrated in Figs. 1, 3 and 4 of the drawings comprises, generally, the combination of an outer barrel 10, a bit head sub 11 secured to the lower end of the outer barrel 10, a roller type bit 12 on the sub 11, a sleeve 13 within the sub 11, an inner barrel 14, a slip type core catcher 15 mounted within the sleeve 13, and a dog type core catcher 16 mounted within the sleeve 13 and the bit 12.

The outer barrel 10 of the core drill is adapted to be connected with the drilling string (not shown). The outer barrel 10 is an elongate tubular structure which surrounds the inner barrel 14 and which carries the sub 11 and the parts connected therewith. In practice the outer barrel 10 may be connected with the rotary drilling string in the usual manner. In accordance with the invention a tubular connecting member or sub 17 is provided on the lower end of the outer barrel 10. In the arrangement illustrated in Figs. 1, 3 and 4 of the drawings the sub 17 carries the sub 11 while in the arrangements illustrated in Figs. 2 and 5 of the drawings the sub 17 carries the bits. The sub 17 may be threaded on the lower end portion of the outer barrel 10. Connecting means is provided on the lower end of the sub 17 to receive the removable sub 11 and the bits. In the preferred construction illustrated this connecting means is in the form of a tapered threaded pin 18 formed on the lower portion of the sub 17. A downwardly facing external shoulder 19 may occur on the sub 17 at the upper end of its pin 18. An annular recess 20 may be provided in the lower end of the pin 18. The recess 20 is open at its lower end and is adapted to receive a part on the inner barrel 14, as will be hereinafter described.

The bit head sub 11 is adapted to be removably secured to the sub 17 to carry the bit head 12 and to enclose the sleeve 13. The sub 11 is a tubular member of substantially the same external diameter as the lower portion of the sub 17. A socket 21 is provided in the upper end of the tubular sub 11 and is threaded to cooperate with the threaded pin 18. When the sub 11 is threaded on the pin 18 its upper end may bear against the shoulder 19. The sub 11 may be relatively long and is provided at its lower end with means for receiving or carrying the bit 12. A pin 22 is provided on the lower end of the sub 11. The pin 22 is of the same size as the pin 18 and has a thread similar to the thread of the pin 18. A downwardly facing annular shoulder 23 may be provided on the sub 11 at the upper end of the pin 22. The longitudinal opening 24 of the sub 11 may be tapered or downwardly convergent between its ends to provide ample stock or wall thickness for the pin 22. The opposite end portions of the opening 24 may be cylindrical.

The bit 12 is in the nature of a roller rock bit for use in hard earth formations and is operable to cut or form a core for reception in the inner barrel 14. The bit 12 includes a tubular shoe or body 25 whose wall is thickened at its lower end. Circumferentially spaced recesses 26 enter the wall of the bit body 25 from its lower end and receive cutters 27 and 27^a. The cutters 27 and 27^a project from the lower end of the bit body 25 to act on the formation of the bottom of the well bore. The cutters 27 are rotatable about downwardly and inwardly inclined axes and act on the outer portion of the well bore to cut the bore to gauge. The cutters 27^a are rotatable about downwardly and outwardly inclined axes and act on the inner portion of the well bore to form or trim the core for reception in the drill. Bearings 29 and 29^a respectively may rotatably support the cutters 27 and 27^a on the pins 28 and 28^a and suitable washers 30 and 30^a may space the ends of the respective cutters from the walls of the sockets 26.

The central longitudinal opening 31 of the tubular bit body 25 is proportioned to properly receive the core as trimmed by the inner cutters 27^a. An annular recess 32 is provided in the wall of the opening 31 some distance above the lower end of the body 25 and fluid ports 33 extend downwardly from the recess 32 to the cutter carrying recesses 26. A socket 34 is provided in the upper end of the bit body 25 and may extend downwardly to the recess 32. The socket 34 is of the same size as the socket 21 in the sub 11 and has a thread similar to the thread on the wall of the socket 21. Thus the bit 12 may be threaded on the pin 18 of the sub 17 as illustrated in Fig. 2 of the drawings. In the assembly illustrated in Figs. 1, 3 and 4 of the drawings the pin 22 of the sub 11 is received or threaded in the socket 34 whereby the bit 12 is secured to the lower end of the sub 11. When the bit body 25 is properly threaded on the pin 22 its upper end may bear on the shoulder 23.

The sleeve 13 is provided to house or mount the core catcher 15 and to support the inner barrel 14. The sleeve 13 is preferably an integral tubular member as illustrated in the drawings. In accordance with the invention the sleeve 13 is removably arranged longitudinally in the sub 11 to have its lower portion received in the bit body 25 and to have its upper end adjacent the lower end of the pin 18. The interior of the bit body 25 is formed to receive the lower portion of the

sleeve 13 and to carry a portion of the core catcher 16. An annular recess 35 is provided in the wall of the opening 31 below the recess 32. The wall of the recess 35 is stepped to present a plurality of upwardly facing annular shoulders 36. The lower portion of the sleeve 13 extends into the upper end of the recess 35. The lower end of the sleeve 13 may engage or bear on the uppermost shoulder 36. In practice the sleeve 13 may rotatably bear in the recess 35.

The sleeve 13 extends upwardly from the recess 35 to pass through the sub 11 with clearance. The exterior of the sleeve 13 substantially parallels the wall of the opening 24, that is it has cylindrical portions concentric with the cylindrical end portions of the opening 24 and a downwardly and inwardly tapering portion within the tapering portion of the opening 24. In accordance with the invention the sleeve 13 has substantial clearance in the opening 24 leaving an annular fluid passage 37. The passage 37 is continuous or uninterrupted and its lower end has direct full communication with the recess 32 which in turn communicates with the ports 33 whereby fluid passes directly from the annular passage 37 to the ports of the bit head 12. If desired or believed necessary a plurality of circumferentially spaced ribs 38 may be provided on the exterior of the sleeve 13 to cooperate with the wall of the opening 24 to centralize the sleeve 13 in the opening. The ribs 38 may be welded to the sleeve 13 as illustrated in the drawings. It is to be understood that the ribs 38 are not essential and may be eliminated, if desired. The interior of the sleeve 13 is shaped and formed to carry the core catcher 15 and to partially receive the core catcher 16. The longitudinal opening 39 of the sleeve 13 is proportioned to freely receive the core and is open at its opposite ends. The upper portion of the sleeve opening 39 is stepped or shouldered being provided with three vertically spaced annular shoulders 40, 41, and 42. An annular recess 43 is provided in the lower end of the sleeve 13 to communicate with and form a continuation of the space provided by the recess 35 in the bit body 25. It will be observed that the sleeve 13 is a simple, inexpensive part removably arranged in the sub 11.

The inner barrel 14 is arranged longitudinally in the outer barrel 10 and is provided to receive the core cut by the bit 12. The inner barrel 14 is preferably a thin walled tubular structure to be light in weight and to receive as large a core as possible. The inner barrel 14 extends through the barrel 10 and its sub 17 with substantial clearance to leave an annular fluid passage P. A bearing collar 44 is fixed to the lower end of the inner barrel 14. In practice the collar 44 may be welded to the inner barrel 14. The collar 44 extends downwardly from the lower end of the inner barrel 14 and is rotatably received in the upper portion of the sleeve 13. The lower end of the collar 14 may rotatably bear on the shoulder 40 to rotatably support the inner barrel 14 in the sleeve 13. A socket or recess 45 enters the collar 44 from its lower end to form a continuation of the space provided by the adjacent part of the sleeve opening 39. The collar 44 is provided with an external shoulder 46 and a hardened wear taking ring 47 is arranged on the shoulder 46. The hard wear taking ring 47 operates in the recess 20 and is adapted to rotatably bear upwardly against the upper wall of the recess 20 during operation of the drill. The collar 44 with

its ring 47 is confined between the shoulder 40 and the upper wall of the recess 20 for free rotation whereby the inner barrel 14 may remain non-rotatable during the drilling operation. The collar 44 preferably projects upwardly into the sub 17 to stabilize the free inner barrel 14. A plurality of circumferentially spaced ports 48 is provided in the collar 44 to conduct the circulation fluid from the annular passage P in the sub 17 to the annular passage 37. The ports 48 are preferably inclined downwardly and outwardly. The lower end of the inner barrel 14 is open to receive the core after its passage through the core catcher 15.

The core catcher 15 is provided to assist in gripping and retaining the core to recover the same when the drill is withdrawn from the well bore. The core catcher 15 is arranged within the sleeve 13 and is in the form of a slip type core catcher embodying gripping wedges or slips. The upper core catcher 15 may be of the general type fully described and claimed in the co-pending application, Serial No. 34,649. The slip type core catcher 15 includes a free sleeve 49 within the sleeve 13, a body 51 below the sleeve 49, and slips 50 connected with the body 51 and operable through cooperation with the sleeve 49. The sleeve 49 is arranged within the upper portion of the sleeve 13 to have its lower end at the shoulder 41 and to have its upper portion extend into the recess 45. The sleeve 49 has a cylindrical exterior and fits within the sleeve 13 and the recess 45 with suitable clearance to rotate or remain non-rotatable at will. The upper wall of the recess 45 and the shoulder 41 prevent excessive longitudinal movement of the sleeve 49. A plurality of longitudinally extending guide-ways or grooves 52 is provided in the interior of the sleeve 49. The grooves 52 are equally spaced and extend downwardly from the upper end of the sleeve 49. The side walls of the grooves 52 may diverge inwardly toward the vertical center of the bit. The bottom walls of the grooves 52 are inclined downwardly and inwardly relative to the central vertical axis of the bit. Due to this inclination of their bottom walls the grooves 52 may terminate above the lower end of the sleeve 49. The body 51 of the core catcher 15 may be a simple annular member and is freely arranged in the sleeve 13 below the sleeve 49. The lower end of the sleeve 49 limits the upward movement of the body 51 while the engagement of the body 51 with the shoulder 42 prevents excessive downward movement of the body.

The slips 50 of the core catcher 15 are operable in the guide-ways or grooves 52 and are wedge-like parts having inclined outer sides for cooperating with the inclined bottom walls of the grooves. The inner sides of the slips 50 are toothed to grip and support the core. The slips 50 are connected with the core catcher body 51 to move longitudinally therewith and to move inwardly upon longitudinal movement of the sleeve 49 relative to the body 51. Reins or spring arms 53 connect the slips 50 with the body 51. The spring arms 53 may be riveted to the interior of the body 51 and the outer sides of the slips 50. It is preferred to embed or countersink the arms 53 in the slips 50 so that they do not interfere with the engagement of the slips with the walls of the grooves 52. Rivets 54 may secure the spring arms 53 to the body 51 and the slips 50.

Means are provided on the body 51 to resist relative vertical movement between the body and the core to retain the body in an "up" position

where the slips 50 are inactive during downward movement of the drill and to resist upward movement of the slips 50 when the drill is raised so that the upwardly moving walls of the grooves 52 actuate the slips inwardly to grip the core. This movement resisting means on the body 51 may be in the form of spring fingers 55. The fingers 55 may be secured to the body 51 by the rivets 54 connecting the arms 53 with the body. The spring fingers 55 extend upwardly and inwardly from the body 51 and their upper end parts are turned inwardly to bear against the core. The operation of the core catcher 15 will be hereinafter described.

The core catcher 16 is arranged within the bit 12 and is provided to assist in gripping and recovering the core. The core catcher 16 includes a ring-like body 57 received in the recess 35 and the recess 43. The body 57 is shaped and proportioned to be free in the recesses 35 and 43 so that it may rotate or remain non-rotatable at will. Further, the core catcher 57 is proportioned to have limited vertical movement in the recesses 35 and 43. A plurality of circumferentially spaced openings 58 is provided through the wall of the annular body 57. The openings 58 may extend upwardly on the inner wall of the body 57 to the upper end of the body. Transverse pivot pins 59 extend through the lower portions of the openings 58 and pivotally support core gripping dogs 60. The dogs 60 project inwardly in the body 57 and their inner edges are sharpened to properly grip and support the core. The dogs 60 are adapted to pivot upwardly into the upper inner portions of the openings 58 when the core passes through the core catcher so that they do not interfere with the free reception of the core in the drill. Springs 61 surround the pins 59 and bear against the dogs 60 to urge them downwardly and inwardly into contact with the core. Cam faces 62 may be provided on the outer lower ends of the dogs 60 to cooperate with one of the shoulders 36 and assist in urging the dogs into proper gripping engagement with the core. The dogs 60 have flat faces cooperating with the walls of the openings 58 to support the dogs in the core gripping and supporting position.

During operation of the core drill assembly illustrated in Figs. 1, 3 and 4 of the drawings the drill is rotated on the lower end of a drilling string and circulation fluid is pumped downwardly through the string. As the drill rotates the roller cutters 27 and 27^a act on the formation at the bottom of the well bore to cut the bore to size and to leave or form a central up-standing core. The circulation fluid passes downwardly through the annular passage P in the outer barrel 10 and its sub 17 and discharges from the ports 48 into the passage 37. The fluid flows downwardly through the passage 37 into the annular recess 32 and discharges from the recess 32 through the ports 33 to flush the cutters 27 and 27^a. It will be observed that the circulation fluid flows downwardly around the sleeve 13 and the core catchers 15 and 16 and does not enter the core receiving opening of the drill to wash away the core or sand up the core catchers. The passage 37 is continuous and annular throughout its length offering a minimum of resistance to flow of the fluid. The fluid passing through the passage 37 has little tendency to erode or cut away the drill parts. The ports 33 in the bit body 25 are short and straight, to discharge the fluid directly against the cutters 27 and 27^a.

As the drilling progresses and the core is 75

formed the opening 31 receives the core. As the drill is fed downwardly the core is received in the core catcher 16, the sleeve opening 39, the core catcher 15 and ultimately in the inner barrel 14. As described above, the dogs 60 retract or pivot upwardly and outwardly to prevent the free passage of the core through the body 57. In a like manner the spring fingers 55 may flex outwardly to pass the core. The engagement of the spring fingers 55 with the core tends to hold the body 51 upwardly as the drill is fed downwardly so that the slips 50 remain in the upper portions of the grooves 52. Thus the slips 50 remain retracted during the drilling operation. The core catcher body 57 is freely rotatable in the recesses 35 and 43 so that the engagement of the dogs 60 with the core may hold the core catcher 16 against turning. In a like manner the sleeve 49 and the body 51 are freely supported in the sleeve 13 so that the engagement of the spring fingers 55 with the core may hold these parts against turning during rotation of the drill. The inner barrel 14 is rotatably supported at its lower end through the collar 44 and the engagement of the core with the interior of the inner barrel may hold the inner barrel against rotation. Thus the drill does not embody any parts which score, groove, or cut into the core during rotation of the drill and the core remains intact and undamaged.

When sufficient core has been cut the drilling action is suspended and the drill is raised. Upon upward movement of the drill the dogs 60 pivot downwardly and inwardly into biting engagement with the core. The springs 61 and the cam faces 62 assist in this movement of the dogs. Upon upward movement of the drill the spring fingers 55 engaging the core resist upward movement of the body 51 so that the sleeve 49 moves upwardly relative to the slips 50. When the sleeve 49 moves upwardly relative to the slips 50 the inclined walls of the grooves 52 cooperate with the slips 50 to force the slips inwardly into gripping contact with the core. Thus both core catchers 15 and 16 are simultaneously actuated to obtain gripping and supporting engagement with the core. The core catchers grip the core at longitudinally spaced points to effectively hold and support the same for recovery from the well in the drill.

Fig. 2 of the drawings illustrates the drill provided with the roller rock bit 12 and a single core catcher 16. When it is desired to employ the drill as illustrated in Fig. 2 of the drawings the bit body 25 is threaded directly on the pin 18 of the sub 17. In the event that the sleeve 11 has been secured to the sub 17 as described above the sleeve 11 is unthreaded from the pin 18 and the body 25 is unthreaded from the pin 22. The core catcher 15 and the sleeve 13 are removed together with the sub 11. The dog type core catcher 16 is readily inserted in the bit body 25 to assume the position illustrated in Fig. 2 of the drawings. The bit body 25 is then threaded on the pin 18. It will be observed that the lower portion of the collar 44 is received in the recess 35 of the bit body 25 so that the inner barrel 14 is rotatably supported at its lower end within the body 25 and the lower portion of the sub 17. The upper wall of the recess 20 and the upper shoulder 36 limit the vertical movement of the collar 44 and the inner barrel 14. The ports 48 in the collar 44 have their upper ends in communication with the interior of the sub 17 and their lower ends in direct communication with the recess 32 so that the circulation fluid is dis-

charged from the sub 17 into the body 25 of the bit. From the above it will be seen that the sub 17 is adapted to directly carry the bit 12 and the bit body 25 is formed to receive the collar 44 when threaded on the pin 18. Thus the bit 12 is interchangeable with the sub 11 and may be employed on the drill when the sub 11 and the core catcher 15 are not utilized.

Figs. 5 and 6 of the drawings illustrate the drill embodying a drag type bit 12^a and the single core catcher 16. The bit 12^a includes a shoe or body 25^a and cutting blades 70 project downwardly and outwardly from the body 25^a. The body 25^a may be similar, generally, to the body 25. The body 25^a is a tubular member having a central vertical opening 31^a to receive the core. A recess 35^a corresponding in shape and size to the opening 35 is provided in the interior of the body 25^a. A threaded socket 34^a corresponding in size and shape to the socket 34 is provided in the upper end of the body 25^a. An annular recess 32^a similar to the recess 32 occurs at the interior of the body 25^a between the socket 34^a and the recess 35^a. Fluid discharge ports 33^a extend downwardly from the recess 32^a to discharge the fluid into the well. The bit body 25^a may be threaded directly on the sub 17 or may be threaded on the sub 11 in substitution for the bit 12 when the assembly illustrated in Figs. 1, 3 and 4 of the drawings is to be employed. When the bit 12^a is used as illustrated in Fig. 5 of the drawings the core catcher 16 is positioned in the recess 35^a to have its upper portion received in the recess 45 in the collar 44. The lower portion of the collar 44 is received in the recess 35^a and the upper portion of the collar is received in the recess 20 and the sub 17. Thus the core catcher 16 and the inner barrel are supported in substantially the same manner as in the assembly illustrated in Fig. 2.

The circulation fluid is passed downwardly through the passage P to flow through the ports 48 and the recess 32^a to discharge from the ports 33^a. The bit 12^a illustrated in Fig. 5 of the drawings may be threaded on the pin 22 of the sub 11 in the same manner as the bit 12. When secured to the sub 11 the bit body 25^a receives the lower portion of the core catcher 16 and the lower portion of the sleeve 13. The lower portion of the sleeve 13 is of the same diameter as the lower portion of the collar 44 to properly fit the recess 35^a. Thus the bit 12^a may be interchanged for the bit 12 when the drill is provided with the single core catcher 16 and when the bit is provided with the two catchers 15 and 16. The core drill provided by the present invention may be assembled for operation in practically any type of earth formation. The bits 12 and 12^a may be interchangeably employed and the drill may be operated with either the core catcher 15, the core catcher 16, or both core catchers in combination with either bit 12 or 12^a.

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

Having described my invention, I claim:

1. In a core drill having an internal shoulder, the combination of, a sleeve within the drill adapted to seat on the shoulder and spaced from the interior of the drill to leave an annular fluid passage therethrough, a second sleeve free within

the first sleeve, and a core catcher movable vertically in the first sleeve, the core catcher including gripping parts actuated through cooperation with the second sleeve upon relative vertical movement between the core catcher and the said second sleeve.

2. In a core drill having an internal shoulder and an internal fluid recess above the shoulder, a sleeve arranged longitudinally within the drill where it may seat on the shoulder and spaced from the interior wall of the drill to leave an annular fluid passage which discharges into said recess, a core catcher supported within the sleeve, and a collar on the lower end of the inner barrel resting on the sleeve to support the inner barrel.

3. In a core drill having a bit head with an internal fluid recess and a shoulder below the recess, the combination of, a sleeve arranged longitudinally in the drill to extend through the recess and seat on said shoulder, there being an annular fluid conducting space between the interior of the drill and the sleeve extending between the upper and lower ends of the sleeve and in full communication with the said recess, an upwardly facing shoulder on the sleeve, and a rotatable inner barrel seating downwardly on the shoulder.

4. In a core drill having a bit head with an internal fluid recess and a shoulder below the recess, the combination of, a sleeve arranged longitudinally in the drill to extend through the recess and seat on said shoulder, there being an annular fluid conducting space between the interior of the drill and the sleeve extending between the upper and lower ends of the sleeve and in full communication with the said recess, there being a recess in the upper end of the sleeve, and an inner barrel extending longitudinally through the drill with clearance to leave an annular fluid passage communicating with said fluid space and rotatably bearing downwardly in the recess of the sleeve.

5. In a core drill having a bit head with an internal fluid recess and a shoulder below the recess, the combination of, a sleeve arranged longitudinally in the drill to extend through the recess and seat on said shoulder, there being an annular fluid conducting space between the interior of the drill and the sleeve extending between the upper and lower ends of the sleeve and in full communication with the said recess, there being a recess in the upper end of the sleeve, a core catcher in the sleeve, and an inner barrel extending longitudinally through the drill with clearance to leave an annular fluid passage communicating with said fluid space and rotatably bearing downwardly in the recess of the sleeve.

6. In a core drill having an internal shoulder and an internal fluid recess above the shoulder, a sleeve arranged longitudinally within the drill where it may seat on the shoulder and spaced from the interior wall of the drill to leave a continuous annular fluid passage communicating with said recess, spaced ribs on the sleeve cooperating with the wall of the recess to hold the sleeve centralized in the drill, and a core catcher in the sleeve.

7. In a core drill having an internal shoulder and an internal fluid recess above the shoulder, a sleeve arranged longitudinally within the drill where it may seat on the shoulder and spaced from the interior wall of the drill to leave an annular fluid passage communicating with the recess, there being an upwardly facing shoulder in the sleeve, an inner barrel in the drill rotatably seated on the sleeve and having a downwardly facing shoulder, and a core catcher arranged in the sleeve between the two last mentioned shoulders.

8. In a core drill having a barrel and a bit head, the combination of, a tubular sub interposed between the barrel and bit head, the sub having a threaded socket in its upper end to receive the barrel, a threaded pin on the lower end of the sub of the same diameter as the socket to thread into the head, a sleeve extending longitudinally through the sub with clearance to leave an annular fluid passage therethrough, and a core catcher in the sleeve.

9. In a core drill having a barrel and a bit head, the combination of, a tubular sub interposed between the barrel and bit head, the sub having a threaded socket in its upper end to receive the barrel, a threaded pin on the lower end of the sub of the same diameter as the socket to thread into the head, a sleeve extending longitudinally through the sub with clearance to leave an annular fluid passage therethrough, an inner barrel rotatably supported on the sleeve to extend upwardly through the first mentioned barrel, and a core catcher in the sleeve.

10. In a core drill having a barrel and a bit head, the combination of, a tubular sub interposed between the barrel and bit head, the sub having a threaded socket in its upper end to receive the barrel, a threaded pin on the lower end of the sub of the same diameter as the socket to thread into the head, a sleeve extending longitudinally through the sub with clearance to leave an annular fluid passage therethrough, ribs on the sleeve holding the sleeve centralized in the sub, and a core catcher in the sleeve.

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