April 28, 1936. J. H. HOWARD ET AL 2,038,792

CORE DRILL

Original Filed Aug. 7, 1933

Fig. 1

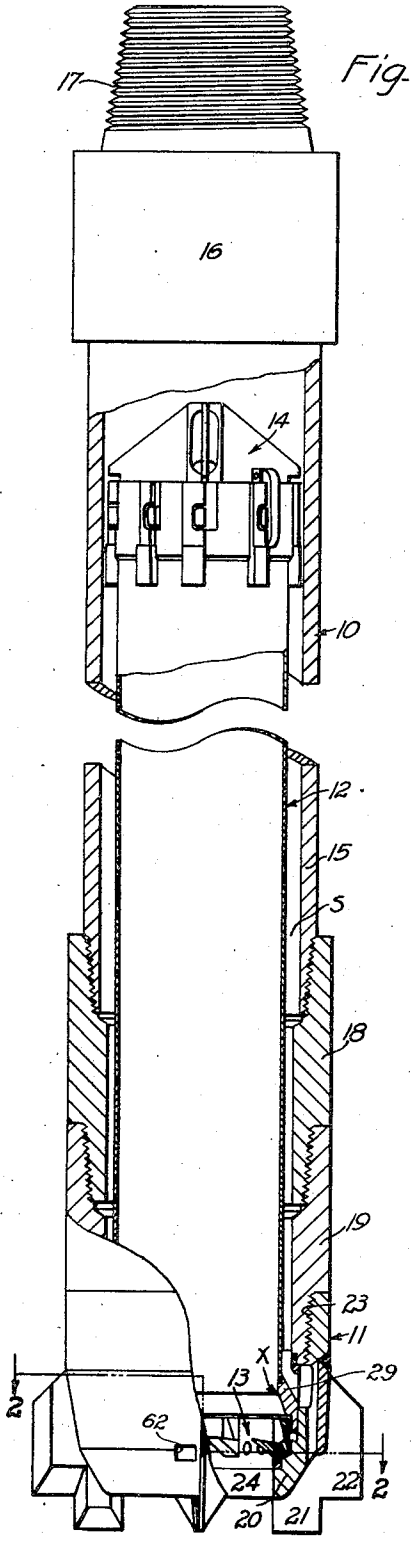


Fig. 2

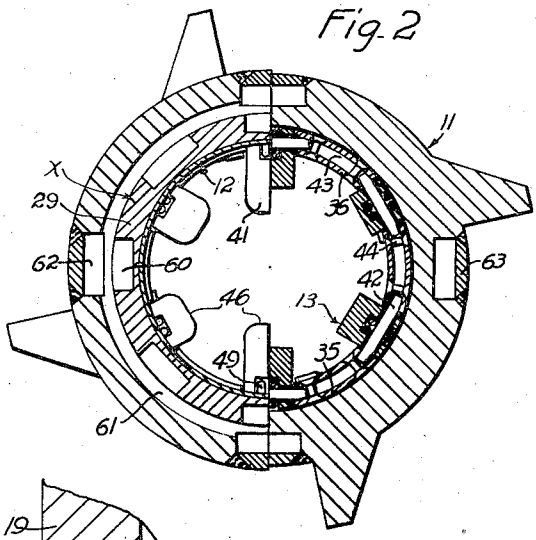
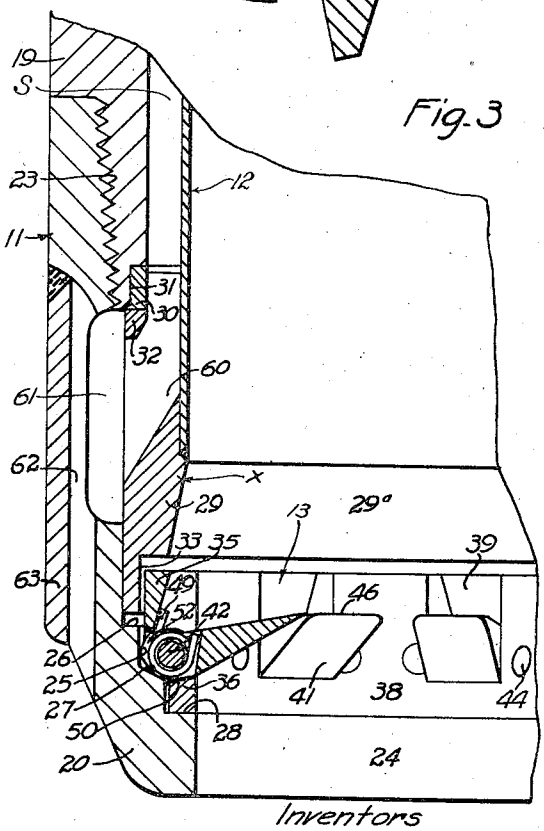


Fig. 3



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CORE DRILL

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Original application August 7, 1933, Serial No. 684,018. Divided and this application February 2, 1934, Serial No. 709,460

3 Claims. (Cl. 255—72)

This invention relates to a well drilling tool and relates more particularly to a well core drill for obtaining cores or samples of the earth formations. A general object of the invention is to provide a simple practical and improved core drill having a "floating" or rotatably supported inner barrel for receiving the core.

This application is a division of our application for United States Letters Patent entitled Core drill, filed August 7, 1933, Serial No. 684,018.

It has been found desirable to mount the inner core receiving barrel of a rotary core drill in a manner so that it may not rotate with respect to the core when the drill is rotated during the drilling operation. In the core drills that have been introduced having "floating" inner barrels that may be held against rotation through contact with the core, the inner barrels are usually rotatably supported from their upper ends. Rotatably supporting the inner barrel of a core drill from its upper end greatly complicates the construction of the drill and necessitates the provision of guiding means and packing means at the lower end of the barrel to prevent the circulation fluid from washing away the core.

An object of the present invention is to provide a core drill having an inner barrel for receiving a core that is rotatably supported at its lower end in a simple effective manner, so that it may be held against rotation through contact with the core when the drill is rotated during drilling.

Another object of the invention is to provide a core drill including a "floating" inner barrel whose rotatable mounting at its lower end is entirely within the bit head of the drill whereby the construction is materially simplified and whereby the circulation fluid flows directly from the annular space between the inner and outer barrels to the discharge ports in the bit head without interfering with the rotatable mounting of the inner barrel.

Another object of the invention is to provide a core drill embodying an inner barrel rotatably supported in the bit head and a core catcher independently rotatably mounted in the bit head at the rotatable mounting of the inner barrel.

A further object of the invention is to provide a core drill embodying an inner barrel rotatably mounted at its lower end within the bit head and a core catcher independently supported in the bit head at the lower end of the barrel for independent rotation and limited longitudinal movement, and having core gripping dogs which are positively actuated or forced into the core by upward movement of the drill.

Other objects and features of the invention may be better and more fully understood from the following detailed description of a typical form and application of the invention, throughout which description reference is had to the accompanying drawing, in which:

Fig. 1 is a side elevation of a core drill embodying the present invention with the principal parts broken away to appear in vertical cross section. Fig. 2 is an enlarged transverse detailed sectional view taken substantially as indicated by line 2—2 on Fig. 1 and Fig. 3 is an enlarged fragmentary detailed sectional view of the lower portion of the drill illustrating the rotatable mounting of the inner barrel and the core catcher.

The core drill provided by this invention includes, generally, an outer barrel 10, a bit head 11 on the lower end of the outer barrel 10, an inner barrel 12 for receiving the core cut by the bit head, means X rotatably mounting or supporting the inner barrel 12 in the bit head 11, and a core catcher 13 rotatably supported in the bit head 11.

The outer barrel 10 is an elongate tubular structure adapted to be attached to the lower end of a well drilling string of drill pipe, or the like. The outer barrel 10 comprises a tubular main section 15 provided at its upper end with a sub 16. The sub 16 has an upstanding screw threaded pin 17 for facilitating connection of the drill with the drilling string. A sub 18 is threaded on the lower end of the section 15 and carries a bit head sub 19.

The bit head 11 is attached to the lower end of the sub 19 and is adapted to make an annular cut in the earth formation and provide a core for reception by the inner barrel 12. The bit head 11 includes a tubular shoe or body 20 having a plurality of circumferentially spaced cutting blades. Each of the cutting blades includes a pilot portion 21 and a reaming portion 22. The pilot teeth or portions 21 project downwardly directly below the lower end of the bit head body 20 and operate to cut a comparatively narrow annular channel in the formation and form a core which is received in the inner barrel 12 with suitable clearance. The reaming portions 22 of the cutting blades project substantially radially from the bit head body 20 and operate to cut or enlarge the bore to size. The cutting blades formed as just described prevent the excessive washing away of the core by the downwardly dis-

charging circulation fluid. The bit head body 20 has a central longitudinal opening for passing the core into the inner barrel 12 and has a screw threaded socket 23 in its upper end for receiving the threaded pin on the lower end of the sub 19.

The inner barrel 12 extends longitudinally through the outer barrel 10 and is provided to receive the core cut by the bit head 11. It is a feature of the invention that the inner barrel 12 is rotatably supported in the bit head 11 by the means X in a manner so that it may be held against rotation through contact with the core during drilling. The inner barrel 12 is an elongate tubular member extending from within the bit head 11 to a point adjacent the sub 16. The lower end of the barrel 12 is open to receive the core while the upper end of the barrel 12 is closed by a valve 14. The valve 14 prevents the downwardly flowing circulation fluid from entering the upper end of the barrel 12 and is adapted to open to permit the discharge of fluid from the inner barrel as it is displaced by the core entering the inner barrel. The assembly of the inner barrel 12 and the valve 14 is more fully described and is claimed in our application for Letters Patent referred to above. The inner barrel 12 may not be threaded at any point and, therefore, may have comparatively thin walls as illustrated throughout the drawing. As the inner barrel 12 is not provided with threads its walls do not have to withstand engagement and handling by wrenches, tongs or other turning tools, and, therefore, may be comparatively thin. The core drill provided with the thin-wall inner barrel 12 may be proportioned to cut and receive a core of maximum diameter with respect to the external diameter of the drill. The thin-walled inner barrel 12 may be formed of a length of tubing and may be light in weight and inexpensive.

The means X for rotatably supporting the inner barrel 12 mounts the inner barrel in the bit head 11 so that it may be held against rotation through engagement with the core when the drill is being rotated during drilling. In accordance with the invention the means X includes or provides an annular recess 25 in the interior of the bit head body 20. The recess 25 is spaced above the lower end of the bit head body 20 and its bottom or lower end forms an upwardly facing shoulder 26. Two vertically spaced annular shoulders 26 and 27 are provided on the wall of the recess 25. The upper shoulder 26 is normal to the longitudinal axis of the drill and the shoulder 27 is inclined downwardly and inwardly. The lower end of the inner barrel 12 is rotatably supported in the upper portion of the recess 25 and the core catcher 13 is supported in the lower portion of the recess.

The inner barrel supporting or mounting means X includes a ring or enlargement 29 on the lower end of the inner barrel for cooperating with the interior of the bit head body 20. The enlargement 29 is preferably welded to the inner barrel 12 and surrounds a substantial portion of the lower end of the inner barrel. The enlargement 29 projects downwardly from the inner barrel 12 into the upper portion of the recess 25. The lower end of the enlargement 29 is adapted to engage or rotatably bear on the shoulder 26 to limit the downward movement of the inner barrel in the drill and to rotatably support the inner barrel. The means X provides for the effective transmission of upward thrusts from the inner barrel to the bit head sub 19 when the engagement of the core with the inner barrel imposes such thrusts on the inner barrel. A hardened bushing or bearing ring 30 is pressed into an annular recess 31 in the lower end of the sub 19. The enlargement 29 is shaped so that its upper portion projects upwardly into this ring 30. A bushing 32 is provided on the enlargement 29 to rotatably bear upwardly against the lower end of the ring 30. The ring 32 surrounds the lower end of the reduced portion of the enlargement 29 which extends upwardly into the ring 30. An annular internal recess 33 is provided in the end portion of the enlargement 29 to receive the upper part of the core catcher 13. The opening 29^a in the enlargement 29 may have upwardly and inwardly inclined walls as clearly illustrated in Figs. 1 and 3 of the drawing. With the rotatable mounting just described the lower end of the inner barrel 12 is effectively supported in the bit head body 20 so that the inner barrel is free to "float" during the drilling operation but is held against lateral movement or wobbling. The enlargement 29 on the inner barrel 12 has extensive engagement with the walls of the recess 25 in the bit head body.

The core catcher 13 is rotatably supported in the bit head 11 so that it may be held against rotation with respect to the core. The core catcher 13 illustrated in the drawing is described and claimed in our Letters Patent entitled Core catcher, granted to us February 11, 1936, and numbered 2,030,297. The annular body of the core catcher 13 is rotatably arranged in the recess 25 between the shoulder 28 and the upper end of the recess 33. The core catcher body includes two rings, an outer ring 35 and an inner ring 36. The opening 38 of the core catcher is in vertical register and alignment with the opening 24 in the bit head and is adapted to freely pass the core upwardly into the inner barrel 12. Circumferentially spaced sockets or slots 39 extend downwardly in the core catcher body from its upper end and continue through the wall of the core catcher body to have their lower ends opposing the shoulder 27.

Core catching dogs 41 are pivotally mounted in the slots 39 to project into the core catcher for engaging the core. The pivotal mountings of the dogs 41 include pins 42 which extend through transverse openings in the dogs and have their opposite end portions received in an annular opening 43 in the core catcher body. The annular opening 43 may be formed by making an annular groove in one of the rings 35 or 36. The projecting ends of the dog supporting pins 42 may be flattened to cooperate with the wall of the annular opening 43 to prevent rotation of the pins. Rivets 44 extend through radial openings in the rings 35 and 36 to securely connect them. The rivets 44 are preferably positioned to intersect the annular opening 43 adjacent the ends of the pins 42 and thus prevent longitudinal shifting of the pins. The rivets 44 may be such that they may be drilled out to permit disconnection of the rings 35 and 36 and allow the removal of the pins 42 and dogs 41 for replacement, etc. The core catcher dogs 41 are adapted to project into the opening 38 of the core catcher to grip and support the core. The upper and lower sides of the dogs 41 converge to comparatively sharp edges 46. The slots 39 are proportioned to receive the dogs 41 so that the dogs may pivot to "up" inoperative positions where they do not interfere with the core.

The dogs 41 are of different lengths whereby some of them are capable of effectively gripping and supporting hard cores, while others are adapted to bite into and support cores of softer formations. The longest of the dogs 41 are such that they may support cores which are broken or shattered to prevent such cores from being lost when the drill is withdrawn from the well. The longer dogs 41 may project upwardly beyond the core catcher body when in the inoperative positions and the opening 29a is proportioned to receive their upper ends when in these positions.

In accordance with the invention means is provided for normally yieldingly urging the dogs 41 downwardly and inwardly and means is provided for positively pivoting the dogs downwardly and inwardly into engagement with the core when the drill is raised. The means for yieldingly urging the dogs 41 into contact with the core comprises torsional springs 49 surrounding the pins 42 in notches 48 in the dogs. The springs 49 each have an end reacting against the body of the core catcher and an end reacting against a dog 41 to normally tend to pivot the dogs downwardly and outwardly. The means for positively pivoting the dogs 41 downwardly and outwardly into the core when the drill is raised also operates to dependably support the pivoted ends of the dogs on the body 20 of the bit head. This dog operating and supporting means comprises a cam part or shoulder 52 on the pivoted end of each dog 41 for cooperating with the shoulder 27. In accordance with the invention the core catcher is proportioned to have limited relative longitudinal movement in the recesses 25 and 33 and the cam parts 52 cooperate with the shoulder 27 to pivot the active ends of the dogs downwardly and outwardly into the core when the drill is raised. With the dogs 41 in the projected core supporting positions the upper ends of the cam parts 52 cooperate with the lower end of the ring 35 whereby the dogs are dependably supported. Flat faces 50 are provided on the dogs 41 to cooperate with the lower ends of the slots 39 when the dogs are in the core supporting positions. The engagement of the cam parts 52 with the lower end of the ring 35 and the engagement of the faces 50 with the lower ends of the slots 39 positively limits the downward pivoting of the dogs and provides for the dependable supporting of the dogs when they are carrying the core.

The invention includes improved means for circulating or conducting the drilling fluid or rotary mud directly from the annular space S between the barrels 10 and 12 to passages in the bit head 11. In accordance with the usual practice rotary mud or circulation fluid is pumped downwardly through the drilling string and flows downwardly through the annular space S between the two barrels. Downwardly and outwardly extending ports 60 are provided in the enlargement 29 of the inner barrel to conduct the circulation fluid from the lower end of the space S to an annular channel 61 in the bit head body 20. The ports 60 are spaced a considerable distance above the lower end of the enlargement 29 and extend below or under the bushing ring 32. The channel 61 is also spaced a substantial distance above the shoulder 26 and the lower end of the enlargement 29. The annular channel 61 is provided to distribute the fluid to a plurality of vertical discharge passages 62 in the bit head body 20. The passages 62 discharge downwardly at the lower end of the bit head body adjacent or immediately in front of the cutting blades. The passages 62 may be rectangular in transverse cross section and their outer sides may be closed by replaceable plates 63. It is to be particularly noted that the circulation fluid or rotary mud passing through the ports 60, channel 61 and passages 62 does not in any way interfere with the freedom of the inner barrel 12 or the core catcher 13. The fluid flowing through the passages has no tendency to mud up the rotatable mounting means X or the core catcher 13.

During operation the core drill is operated on the lower end of a string of drilling pipe in the usual manner. The circulation fluid is continuously pumped down through the drilling string to discharge from the lower ends of the ports 62. The pilot portions 21 of the cutting blades make a comparatively narrow annular channel in the earth formation cutting a core which is received in the opening 24 and the inner barrel 12. As the core enters the drill the dogs 41 are pivoted upwardly into the slots 39 and the engagement of the dogs with the core during the drilling operation retains the dogs in this inoperative position. The springs 49 yieldingly urge the dogs against the core so that the core catcher 13 may be held against rotation. The core catcher 13 in being independently rotatably mounted in the bit head 11 may be held against rotation through the engagement of the dogs 41 with the core, without endangering the dogs and without destroying or cutting away the core. As the core catcher is mounted to remain stationary with respect to the core there may be but slight clearance between the wall of the core catcher body 3 and the core, so that there is little or no danger of the core slipping back through the core catcher when the drill is raised and removed from the well. As the core is cut or formed by the bit head 11 it is received by the inner barrel 12 and the frictional engagement of the core with the interior of the inner barrel may hold the inner barrel against rotation.

The means X supports the inner barrel 12 at its lower end, so that it may have but little tendency to turn or rotate as the drill is rotated, when it is in contact or engagement with the core. It is to be noted that the inner barrel 12 and the core catcher 13 are independently rotatably supported in the bit head 11 so that the rotation of either one will not affect the other. The location of the ports 60 and the annular channel 61 is such that the downwardly flowing circulation fluid does not deposit sand or solid matter in the rotatable mountings of the inner barrel 12 or the core catcher 13. Any circulation fluid that may leak around the enlargement 29 merely acts to lubricate the mounting X. The inner barrel 12 is light in weight and is effectively rotatably supported by the means X so that a minimum amount of engagement or contact of the inner barrel with the core is required to hold the inner barrel against turning.

When a core of sufficient length has been cut the drill may be raised and withdrawn from the well. Raising of the drill results in upward movement of the bit head 11 relative to the core catcher 13. The engagement of the dogs 41 with the core yieldingly holds the core catcher against upward movement during the initial raising of the drill. In this manner the shoulder 27 is brought into actuating contact with the cam parts 52 causing the dogs 41 to be pivoted downwardly and into the core. Upward movement of the drill thus results in full positive actuation of the core gripping dogs 41 so that they obtain firm holds on the

core and cause the core to be broken away from the formation as the drill is raised. The independent supporting of the inner barrel 12 on the shoulder 26 prevents the inner barrel 12 or its enlargement 29 from interfering with the proper operation of the core catcher 13.

Having described only a typical form and application of our invention, we do not wish to be limited or restricted to the specific form and application herein described, but wish to reserve to ourselves any changes or variations 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 core drill including, an outer barrel, a tubular bit head on the lower end of the outer barrel, the bit head having an internal recess, an inner barrel extending through and spaced from the interior of the outer barrel, an enlargement on the inner barrel rotatable in the recess to rotatably support the inner barrel in the bit head, there being a recess in the interior of the enlargement joining the recess in the bit head and having a diameter greater than the opening in the inner barrel, and a core catcher movably supported in the last mentioned recess and the communicating portion of the recess in the bit head.

2. A core drill including, an outer barrel, a bit head on the lower end of the outer barrel having an annular internal recess, an upwardly facing shoulder on the wall of the recess, an inner barrel extending through the outer barrel, an enlargement on the inner barrel in the recess and adapted to have its lower end rotatably bear on said shoulder to support the inner barrel in the bit head, there being an internal recess in the enlargement joining the portion of the first mentioned recess below the shoulder and having a diameter greater than the opening in the inner barrel, and a core catcher rotatable in the last mentioned recess and said portion of the first mentioned recess.

3. In a core drill, a bit head for making an annular cut and having an opening for receiving the core, there being an upwardly facing shoulder in the opening, a member on the upper end of the head presenting a downwardly facing shoulder spaced from and opposing the first named shoulder, an inner barrel, a projecting bearing on the lower portion of the inner barrel rotatable in the said opening, the lower end of the bearing being adapted to bear on the first named shoulder, the bearing having a portion of reduced diameter rotatably bearing on the interior surface of said member and a shoulder opposing the second named shoulder, a bearing ring on the second named shoulder, and a bearing ring on the shoulder of the barrel adapted to cooperate with the first mentioned ring.

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