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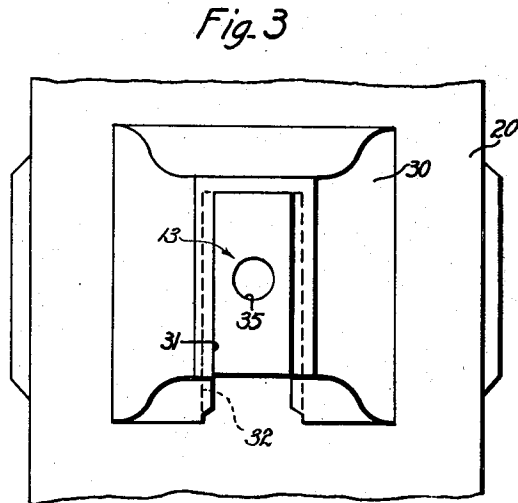
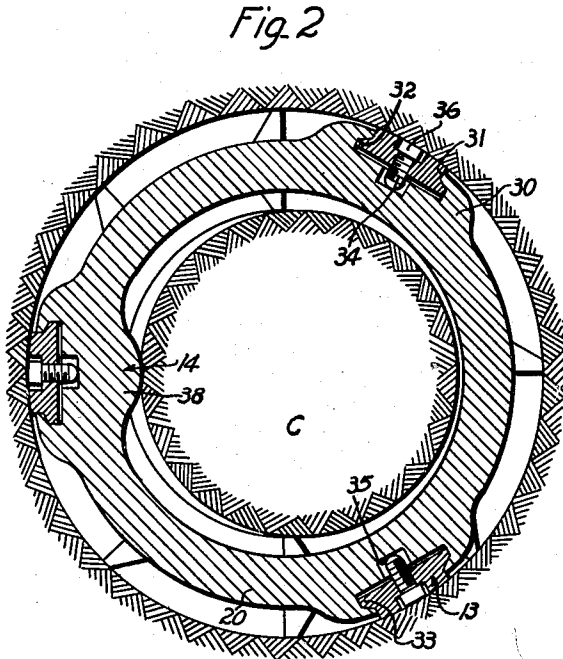
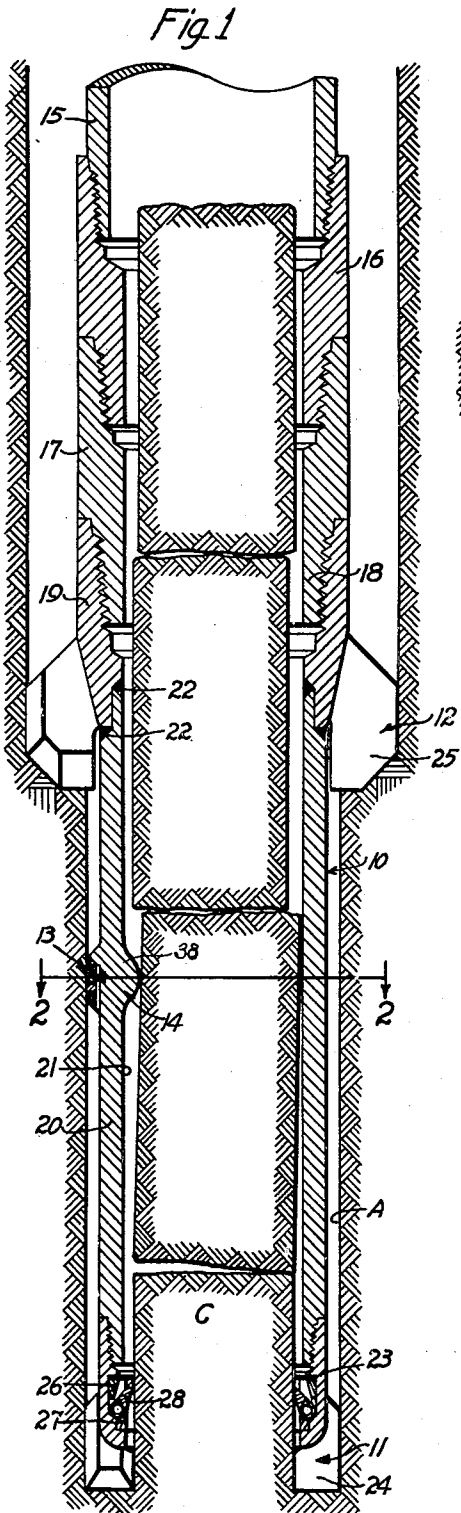
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2,034,072

CORE DRILL

Filed Sept. 18, 1933

2 Sheets-Sheet 1



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2,034,072

CORE DRILL

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2 Sheets-Sheet 2

Fig. 4

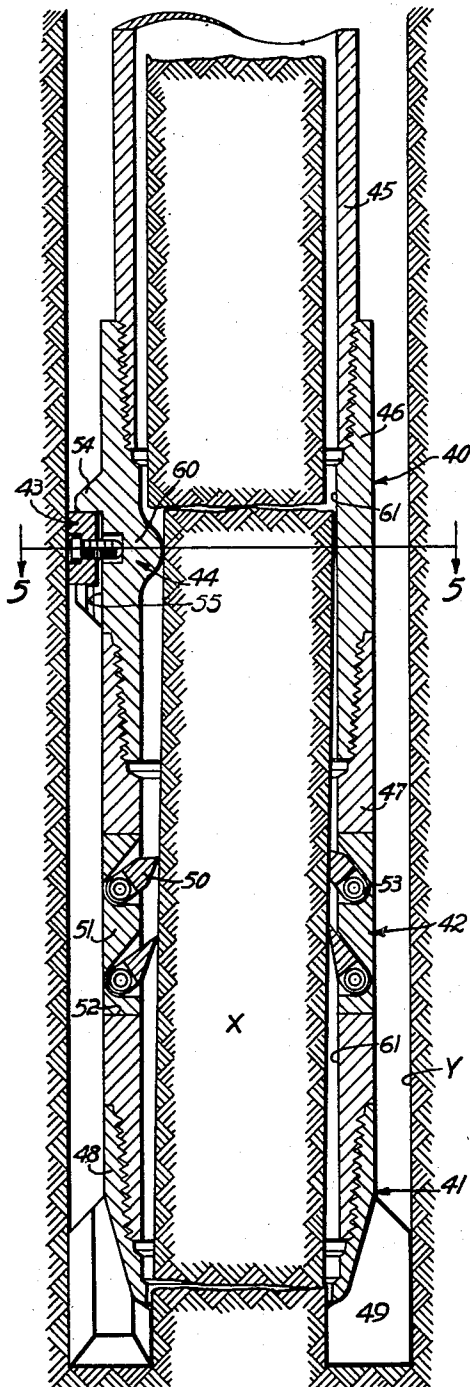
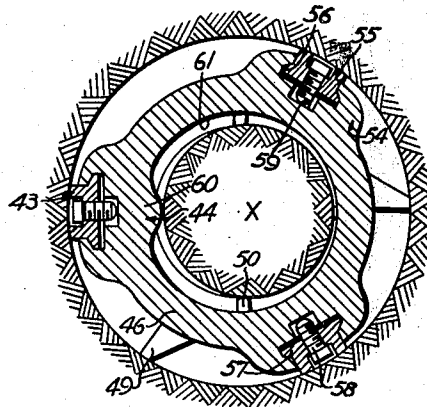


Fig. 5



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UNITED STATES PATENT OFFICE

2,034,072

CORE DRILL

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Application September 18, 1933, Serial No. 689,897

5 Claims. (Cl. 255—72)

This invention relates to a well tool and relates more particularly to a well core drill or core receiving drilling tool. It is a general object of the present invention to provide a simple, practical core receiving well tool that is particularly effective in obtaining or recovering cores of hard, tough earth formations.

In drilling through certain earth formations with a core drill or core receiving drilling tool, the cores obtained are very hard and tough and have great tensile strength. The core drills that have been introduced are usually provided with a core catcher for gripping the core when the drill is raised to break the core loose from the formation and thereafter retain the core in the drill as it is withdrawn from the well. When a hard core is obtained, the typical core catcher is not capable of properly gripping the core and its core engaging parts are not sufficiently strong to resist the great strains necessary to break the core loose from the formation, and as no other provision is made to free the core from the formation, it remains in the well and the drill must be removed from the well without recovering or obtaining a core.

It is an object of the invention to provide a core drill or core receiving drilling tool that is operable to automatically break the core free from the formation upon the core obtaining a suitable length so that the core catcher is not required to perform the core breaking function.

It is another object of the invention to provide a core drill that is operable to break the core free from the formation when the core has attained a suitable length and to successively break sections or lengths of core free from the formation as the drill advances so that the drill is adapted to obtain or recover a plurality of lengths of core of such length that they may be conveniently and safely removed from the drill at the surface of the ground.

It is another object of the invention to provide a core drill that is operable to automatically break the core from the formation as the drilling continues to obtain a plurality of sections of core of suitable length without breaking the core into small pieces or fragments.

It is another object of the invention to provide a core drill having a simple and effective means for automatically breaking the core loose from the formation that does not affect or interfere with the proper functioning of the other parts of the drill.

It is another object of the invention to provide a means for breaking a core free from the earth

formation that may be embodied in various forms of core drills and core receiving drilling tools with but slight inexpensive additions or modifications.

It is a further object of the invention to provide a core drill that is operable to drill a straight vertical bore and that is operable to automatically break a core of substantial length free from the formation by imposing a lateral strain on its upper end causing its lower end to break loose from the formation.

It is a further object of the invention to provide a core drill or core receiving drilling tool having an internal projection for engaging the upper end portion of a core to impose a lateral strain on the core to break its lower end free from the formation and having external parts for centering the drill in the well bore and for guiding the drill to make a straight vertical bore so that the engagement of the said internal projection with the core does not cause the drill to make an inclined or crooked hole.

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

Fig. 1 is a vertical detailed sectional view of one embodiment of the invention illustrating it in operation in a well bore. Fig. 2 is an enlarged transverse detailed sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is an enlarged fragmentary elevation of a portion of the body illustrating one of the bearing parts and the socket carrying the bearing part. Fig. 4 is a vertical detailed sectional view of another form of the invention illustrating it in operation in a well bore, and Fig. 5 is a transverse detailed sectional view taken as indicated by line 5—5 on Fig. 4.

The features of the present invention are capable of embodiment in core drills and core receiving drilling tools of various types and characters. Throughout the following detailed disclosure I will describe the invention embodied in two single barreled core drills or core receiving drilling tools, it being understood that the invention may be carried out in various other classes of tools, and that the invention is not to be construed as limited or restricted to the specific forms or applications about to be described, but is to be taken as including any features or modifications that may fall within the scope of the claims.

The form of the invention illustrated in Figs. 1, 2 and 3 of the drawings includes, generally, a tubular body 10, a pilot cutter 11 operable to make an annular cut in the earth formation and form a central core C, a reaming or bore enlarging cutter 12 on the body 10, guiding parts or bearing parts 13 on the body for guiding the drill, and means 14 for breaking the core C free from the earth formation upon the core obtaining a substantial length.

The body 10 is an elongate tubular structure connected with the lower end of a barrel 15. The barrel 15 is adapted to be connected with the lower end of an operating string of drill pipe, or the like, and is provided to receive or hold the core C. In the particular construction illustrated, the body 10 includes two threaded connecting members or subs, an upper sub 16 threaded on to the lower end of the barrel 15 and a lower sub 17 having a downwardly projecting screw threaded pin 18 on its lower end. A tubular or annular shoe 19 is threaded on the pin 18 and constitutes the body of the reaming cutter 12 as will be subsequently described. In the form of the invention being described, the body 10 includes an elongate lower section 20 extending downwardly from the shoe 19. The lower section 20 is preferably of considerable length and its core receiving opening 21 is of substantially the same diameter as the opening through the subs 16 and 17. The lower section 20 is of smaller external diameter than the subs 16 and 17, and the shoe 19, so that it may freely pass into the comparatively narrow annular channel or cut A made by the pilot cutter 11. In accordance with the broader aspects of the invention, the lower section 20 may be connected with the shoe 19 in any suitable or practical manner. In the particular case illustrated in the drawings, the section 20 is welded to the shoe 19 as at 22.

The pilot cutter 11 is provided on the lower end of the lower body section 20 and is operable to make the comparatively narrow annular cut A. The pilot cutter 11 operates far in advance of the reaming cutter 12 so that the comparatively narrow annular cut A is of considerable vertical extent. The pilot cutter 11 includes a tubular body or shoe 23 threadedly connected with the lower end portion of the section 20. Circumferentially spaced cutting blades 24 project downwardly and outwardly from the shoe 23. The cutting blades 24 operate to make the annular cut A sufficiently wide to freely or safely receive the body section 20 and project inwardly at the lower end of the drill to cut the core C to pass into the opening 21 with suitable clearance.

The reaming or bore enlarging cutter 12 includes the shoe 19 at the upper end of the body section 20. A plurality of circumferentially spaced cutting blades 25 is provided on the shoe 19. The blades 25 project outwardly and downwardly from the shoe 19 and are proportioned and formed to enlarge the well bore to a considerable extent so as to safely pass the body subs 16 and 17 and the barrel 15. The cutting blades 25 are of considerable vertical length to have engagement with the wall of the well bore for a considerable distance to effectively guide and stabilize the drill. The lower outer corners of the blades 25 may be bevelled in the manner illustrated. The outer edges and the lower edges of the blades 25 may be suitably sharpened. It will be apparent how the reaming cutter 12 is operable to materially enlarge the well bore and to effectively stabilize the drill.

In the rotary method of well drilling, rotary mud or circulation fluid is pumped downwardly through the drilling string to discharge from the drill into the lower end of the well. In the form of the invention being described, the circulation fluid passes downwardly through the barrel 15 and through the body 10 to discharge from the pilot cutter 11 at the lower end of the comparatively narrow annular cut A. This discharging circulation fluid effectively flushes the blades 24 of the pilot cutter and flows upwardly between the section 20 and the outer wall of the cut A to prevent the pilot cutter and section 20 from sticking or from becoming sanded in the bore. The upwardly flowing circulation fluid operates to wash and flush the blades 25 of the reaming cutter 12 as it passes from the cut A into the main bore of the well. The circulation fluid, in flowing downwardly through the body 10, washes around the core C and prevents the core 20 from being sanded in the drill.

The drilling tool includes a core catcher to support and retain the core C in the drill when the tool is removed from the well. In accordance with the broader principles of the invention, any suitable form of core catcher may be embodied in the tool. Further, the core catcher may be arranged or carried in either the shoe 23 of the pilot cutter or in the lower section 20 of the body 10. In the particular structure illustrated in the drawings, the core catcher is carried by the shoe 23 of the pilot cutter. An annular recess or groove 26 is provided in the internal wall of the shoe 23 to carry the body 27 of the core catcher. The particular core catcher shown in the drawings includes a plurality of core engaging and supporting dogs 28 pivotally attached to the body 27. The dogs 28 have sharpened inner ends for biting into the core and are yieldingly urged inwardly and downwardly by springs in the well known manner. As the core C advances into the shoe 23 the dogs 28 are retracted or pivoted upwardly and outwardly to the positions illustrated in Fig. 1 of the drawings where they do not interfere with the free passage of the core into the tool.

The bearing parts or guiding parts 13 are provided on the exterior of the lower body section 20 and are adapted to engage the lower wall of the annular cut A to stabilize the drill and to center the drill to make a straight vertical bore. The bearing parts 13 are operable to closely or accurately guide the lower body section 20 and the pilot cutter 11, and in accordance with the invention are adapted to wear away as the cutting blades 24 become reduced in size through wear so that they have no tendency to jam or stick in the bore. In accordance with the broader principles of the invention, the bearing parts 13 may be varied considerably in construction and their mode of connection with the section 20. In the drawings, I have shown one type of bearing part mounted on the exterior of the body section 20, the bearing parts and mountings being fully described and claimed in my copending application filed on an even date herewith and entitled Well drill, Serial No. 689,896, filed September 18, 1933.

There is preferably a plurality of circumferentially spaced bearing parts 13 provided on the exterior of the body section 20. The bearing parts 13 are preferably spaced a considerable distance above the pilot cutter 11 and the location of the parts 13 is definitely related to the position of the core breaking part 14 as will here-

after become apparent. In the particular form of the invention illustrated, there are three circumferentially spaced enlargements or bosses 30 provided on the exterior of the body section 20. The outer surfaces of the enlargements 30 are concentrically curved about the central longitudinal axis of the drill, and vertical slots or sockets 31 extend into the enlargements from their lower ends. The sockets 31 have comparatively wide open outer sides and closed upper ends. The longitudinal or vertical side walls of the sockets 31 are under-cut or provided with longitudinal grooves 32.

The guiding parts or bearing parts 13 are carried in the sockets 31 and project from the outer surfaces of the enlargements 30 to engage the outer wall of the annular cut A. The parts 13 are in the nature of blocks or pieces of relatively soft material removably held in the sockets 31. In practice, the bearing parts 13 may be formed of bronze or a like relatively soft material. The bearing parts 13 are shaped and proportioned so as to be slid or passed into the lower ends of the sockets 31. Tongues 33 are provided on the longitudinal edges or sides of the bearing parts 13 to fit the grooves 32. When positioned in the sockets 31, the upper ends of the bearing parts 13 bear upwardly against the upper walls of the sockets. Screws 34 are threaded through openings in the bearing parts 13 and extend into openings 35 in the inner walls of the sockets 31. The heads 36 of the screws 34 are preferably counter-sunk in the outer faces of the bearing parts 13. The screws 34 react against the inner walls of the openings 35 to clamp the bearing parts 13 outwardly so that their tongues 33 are tightly forced against the walls of the grooves 32 and thus securely clamp the bearing parts in the sockets 31. It will be apparent how the bearing parts 13, in engaging the outer wall of the cut A effectively center and guide the drill without in any way interfering with the free upward flow of the circulation fluid. The bearing parts 13, in being comparatively soft, wear away as the cutting blades 24 become reduced in effective cutting diameter through wear so that they do not cause the drill to stick or bind in the well and so that they are effective in guiding the drill after the blades have been materially reduced in size. The bearing parts 13 are inexpensive and are easily replaced.

The means 14 for breaking the core C free or loose from the formation is operable to automatically break the lower end of the core C loose from the earth formation when the entering core has attained a considerable length and to thereafter successively break free portions of core of substantially equal length as the drilling proceeds. It is a feature of the present invention that the means 14 is particularly simple and inexpensive and does not necessitate any complication of the drill structure. The means 14 includes or provides a core engaging projection 38 on the interior of the body 10. The projection 38 is provided to engage the upper end portion of the core C when the drill has penetrated the formation for a certain distance to impose a lateral or substantially horizontal force on the core and thus break its lower end free from the earth formation. The core engaging projection 38 is preferably located on the interior of the body 10 in the vicinity or neighborhood of the bearing parts 13. In the case illustrated in the drawings, the core engaging projection 38 is located in the horizontal plane of the series of

bearing parts 13 and is in substantially radial alignment with one of the bearing parts. Due to this relation between the projection 38 and the bearing parts 13, the engagement of the bearing part with the core C does not place any undesirable strains on the drill and does not cause the drill to take an inclined course. It will be obvious that the bearing parts 13 brace the body section 20 against the lateral thrusts caused by engagement of the projection with the core C and transmit these forces directly to the wall of the bore or cut A. The core engaging projection 38 may be integral with the body section 20 as illustrated in the drawings. In the preferred construction, the projection 38 has a gradually rounded or convex surface so that it does not score or cut into the core C to an appreciable extent. Further, the rounded exterior or surface of the projection 38 allows the projection to slide past the freed sections or portions of the core C as the drilling progresses without fracturing or destroying the core. In accordance with the invention, the projection 38 is of substantial width or thickness to positively and actively engage the core to force the core horizontally away from it toward the other side of the body and thus break its lower end free from the earth formation. In practice, the thickness of the projection 38 is greater than one-half of the total clearance between the core C and the wall of the opening 21 but its thickness does not equal the total clearance between the core and the wall of the opening so that the core may be received between the projection and the opposite wall of the opening 21 after being broken from the earth formation, without being crushed.

It is believed that the operation of the embodiment of the invention illustrated in Figs. 1 to 3 inclusive of the drawings will be readily apparent from the foregoing detailed description.

During operation, the drill is rotated in the usual manner so that the pilot cutter 11 makes the comparatively narrow annular cut A in the formation and provides the core C. The reaming cutter 12 enlarges the bore to provide for the safe passage of the barrel through the bore, and in being spaced a substantial distance above the pilot cutter 11, stabilizes the drill during operation. The core C is freely received in the opening 21 of the body and is washed free of sand etc., by the circulation fluid passing downwardly through the body. After the drill has advanced a considerable distance and the core C has attained a sufficient length, the projection 38 comes into engagement with the upper end portion of the core. The rounded or curved surface of the projection 38 slides downwardly on the upper end portion of the core until the engagement of the projection 38 with the core C puts a heavy lateral pressure on the upper end portion of the core which causes the lower end of the core to break free from the formation somewhat in the manner illustrated in Fig. 1 of the drawings. The freed portion of the core C is supported on the stump or remaining stationary base of the core and is forced over against the opposite wall of the opening 31 by the projection 38. As the drilling continues, the projection 38 passes downwardly past the broken or freed section of the core C until it comes into engagement with the newly formed or cut section of core. The engagement of the projection 38 with this lower newly cut portion of core breaks its lower end free from the formation. In this manner the drill is operable to obtain a plurality of

sections of core of a length that renders them safe and convenient to handle when being removed from the drill at the surface of the ground. The proportioning of the projection 38 is such that the projection does not mutilate or fracture the freed pieces of core as the drilling progresses and does not cause the pieces of core to become jammed in the drill. The bearing parts 13, in being located in the vicinity of the projection 38 effectively center and guide the body section 20 so that the drill continues to bore a straight vertical hole. The bearing parts 13, in being formed of a relatively soft material, wear away as the cutting blades 24 become reduced in width through wear so that they continue to function effectively without causing the drill to stick or jam in the bore. The drill in being provided with the two cutters 11 and 12 at vertically spaced points, and in having the bearing projections 13 spaced between the cutters is stabilized during operation, and operates to drill a straight vertical bore. When it is desired to remove the drill and core from the well, the drill is raised so that the dogs 28 of the core catcher come into engagement with the lower end of the lowermost freed section of core. The dogs 28 in engaging under the lower end of the lowermost piece of core, operate to support the plurality of stacked or super-imposed sections of core and retain them in the drill as the drill is pulled from the well.

The embodiment of the invention illustrated in Figs. 4 and 5 of the drawings includes, generally, a body 40, a cutter head 41 on the lower end of the body for making an annular cut in the earth formation, core catching means 42 on the body, bearing parts 43 on the body 40 for guiding the drill, and means 44 for automatically breaking the core X free from the earth formation.

The body 40 is an elongate sectional structure connected with or forming a part of the core receiving barrel 45. The barrel 45 is adapted to be connected with the lower end of an operating string in the usual manner. The body 40 includes a sub or coupling member 46 screw threaded on to the lower end of the barrel 45. A core catcher sub 47 is connected with the lower end of the member 46. The member 46 and sub 47 are preferably of substantially the same internal diameter as the barrel 45. The member 46 and sub 47 are preferably comparatively long so that the body 40 is of substantial length.

The cutter head 41 is provided on the lower end of the sub 47 to make an annular cut Y in the earth formation. In accordance with the broader principles of the invention, any form of cutting parts may be provided on the cutter head 41. The particular cutter head 41 illustrated in the drawings includes a body or shoe 48 attached to the lower end of the sub 47, and circumferentially spaced cutting blades 49 on the shoe. The blades 49 project downwardly and outwardly from the shoe 48 and are operable to make the annular cut Y which passes the body 40 with suitable clearance. The blades 49 project inwardly at the lower end of the tubular shoe 48 to cut a core X which is received in the body 40 with substantial clearance.

The core catching means 42 is provided to support or retain the sections of core in the drill when the drill is removed from the well. In practice, any suitable type of core catching device may be embodied in the drill structure. In the particular case illustrated in the drawings, the core catching or retaining means 42 includes

circumferentially spaced pairs of pivoted core supporting dogs 50. Vertically elongated blocks 51 are held in slots 52 in the wall of the sub 47 to carry the dogs 50. The dogs 50 are pivoted in recesses 53 in the inner sides of the blocks 51 and are adapted to project into the core receiving opening of the body. The dogs 50 are spaced one above the other, and are yieldingly urged to pivot downwardly and inwardly into the body opening by springs in the usual manner. The lower dog 50 of each pair is preferably comparatively long so as to effectively engage undersized cores or cores of reduced diameter while the upper dogs 50 are comparatively short to engage under and support large or full sized cores. When the core X enters the drill the dogs 50 are pivoted upwardly and outwardly to retracted positions where they do not interfere with the reception of the core by the body.

The guiding parts or bearing parts 43 are provided on the exterior of the body 40 to engage the wall of the bore Y to center the drill and to stabilize the drill. Further, the bearing parts 43 operate to prevent the engagement of the core breaking projection with the core from deflecting the drill from its vertical course. The bearing parts 43 may be similar to the bearing parts 13 described above. Projecting bosses or enlargements 54 are provided on the exterior of the coupling member 46 and have vertical sockets 55 for carrying the bearing parts 43. The sockets 55 have comparatively wide open outer sides and extend upwardly into the enlargement 54 from their lower ends to allow for the easy insertion of the parts 43. Longitudinal grooves 56 are provided in the side walls of the sockets 55 to receive tongues 57 on the parts 43. Screws 58 are threaded through openings in the parts 43 to react against the inner ends of openings 59 in the inner walls of the sockets to clamp the tongues 57 outwardly against the walls of the grooves 56. The heads of the screws 58 are preferably countersunk in the projecting outer ends of the parts 43. The bearing parts 43 are preferably formed of a relatively soft material such as bronze, or the like, so as to wear away as the cutting blades 49 become worn through use so that they do not cause the drill to jam or stick in the well bore. There may be any suitable or desired number of circumferentially spaced bearing parts 43. In the particular case illustrated in the drawings there are three equally spaced bearing parts 43.

The means 44 for breaking the core X free from the formation is operable through engagement with the upper end of a comparatively long piece of core to impose a heavy lateral strain on it, and thus break its lower end free from the earth formation. The means 44 includes or provides an internal projection 60 on the coupling member 46. The projection 60 is provided on the wall of the core passing opening 61 of the coupling member 46 and is preferably located in the vicinity of the bearing parts 43. In the preferred arrangement illustrated in the drawings the projection 60 is located in the plane of the plurality of bearing parts 43 and is radially inward of one of the parts 43.

In being located on the coupling member 46 the core engaging projection 60 is spaced a considerable distance above the cutter head 41 so that it is operable to break free sections of core of substantial lengths. The core engaging surface of the projection 60 is smooth and gradually rounded so that the projection does not bite into or destroy the core. In accordance with the in-

vention, the projection 60 is proportioned so as to positively engage the upper end portion of a core with considerable force to break it away from the formation, but is not sufficiently thick to cause the freed piece of core to become lodged or wedged between it and the opposite wall of the opening 61. The core engaging projection 60 may be integral with the coupling member 46 as illustrated in the drawings.

The operation of the form of the invention illustrated in Figs. 4 and 5 of the drawings is substantially the same as the operation of the previously described embodiment. During the drilling operation, the blades 49 make the annular cut Y to pass the body 40 with the suitable clearance and cut the core X which is received by the body. The rotary mud or circulation fluid is passed downwardly through the body 40 under pressure, and washes sand or loose material from the core and then discharges from the lower end of the cutter head 41 to wash the blades 49 and provide a turbulence in the lower end of the well bore. As the bearing parts 43 are spaced considerable distances apart, they do not interfere with the upward flow of circulation fluid around the body 40. When the core X attains a considerable length, the projection 60 comes into engagement with its upper end portion. The projection 60, in having a gradually flaring or rounded exterior, slides downwardly over the upper edge of the core X so that its inner side or top comes into pressural engagement with the periphery of the core to put a heavy lateral strain on the upper end of the core. This strain or pressure breaks the lower end of the core free from the earth formation. The freed piece of core is supported on the fixed stub or base of the core and is received in the barrel 40 as the drilling continues. The projection 60 functions to automatically break the sections of core free from the formation when they attain a suitable length as the drilling continues so that the drill may receive a plurality of pieces of core of substantially uniform length. These pieces of core may be safely and conveniently handled when they are removed from the drill at the surface of the ground. The bearing parts 43 effectively centralize the body 40 in the bore and prevent the engagement of the projection 60 with the core X from causing the drill to take an inclined course. As the bearing parts 43 and the projection 60 are provided on the sub or coupling member 46, their embodiment or inclusion in the tool does not in any way complicate or involve the construction.

Having described only typical forms and applications of my invention, I do not wish to be limited or restricted to the specific forms or applications 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 receiving well drilling tool, a body

having a longitudinal opening, cutting parts at the lower end of the body for making an annular cut in the formation and leaving a core for reception by the body opening, a core catcher in the body opening, a projection on the wall of the body opening spaced above the core catcher to engage the upper portion of the core and impose a lateral strain on the core to break its lower portion from the formation, and an external projection on the body directly backing up the first named projection by engaging the wall of the well to support the body against lateral pressures.

2. In a core receiving well drilling tool a body having a longitudinal opening, cutting parts at the lower end of the body for making an annular cut in the formation and leaving a core for reception by the body opening, a blunt projection on the wall of the body opening spaced between the opposite ends of the opening and operable to engage the upper portion of the core to put a lateral pressure on the core and break its lower portion from the formation, an external projection on the body operable to engage the wall of the well to directly back up the first named projection and hold the body against lateral displacement, and a core catcher on the wall of the opening below the projections to retain the freed portion of the core and other such portions of the core that may be stacked in the opening.

3. A core drill including a barrel, cutting means on the lower end of the barrel operable to make an annular cut and leave a core for reception in the barrel, a projection on the interior of the barrel above said means for engaging the core to break it free from the formation, and a projection on the exterior of the barrel directly backing up the first named projection by bearing on the wall of said cut to support the barrel against lateral forces.

4. A core drill including a barrel, cutting means on the lower end of the barrel operable to make an annular cut and leave a core for reception in the barrel, cutting parts on the barrel spaced above said means for enlarging said cut, a projection on the interior of the barrel above said means for engaging the core to break it free from the formation, and a projection on the exterior of the barrel directly backing up the first named projection by bearing on the wall of said cut to support the barrel against lateral forces.

5. A core drill including a barrel, cutting means on the lower end of the barrel operable to make an annular cut and leave a core for reception in the barrel, a projection on the interior of the barrel above said means for engaging the core to break it free from the formation, core catching means in the barrel for retaining the core, cutting parts on the barrel above its lower end for enlarging said cut, and a projection on the exterior of the barrel directly backing up the first named projection by bearing on the wall of said cut to support the barrel against lateral forces.

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