Nov. 26, 1935. J. C. WRIGHT ET AL 2,022,100

CORE CATCHING MEANS

Filed Aug. 28, 1933

Fig. 1

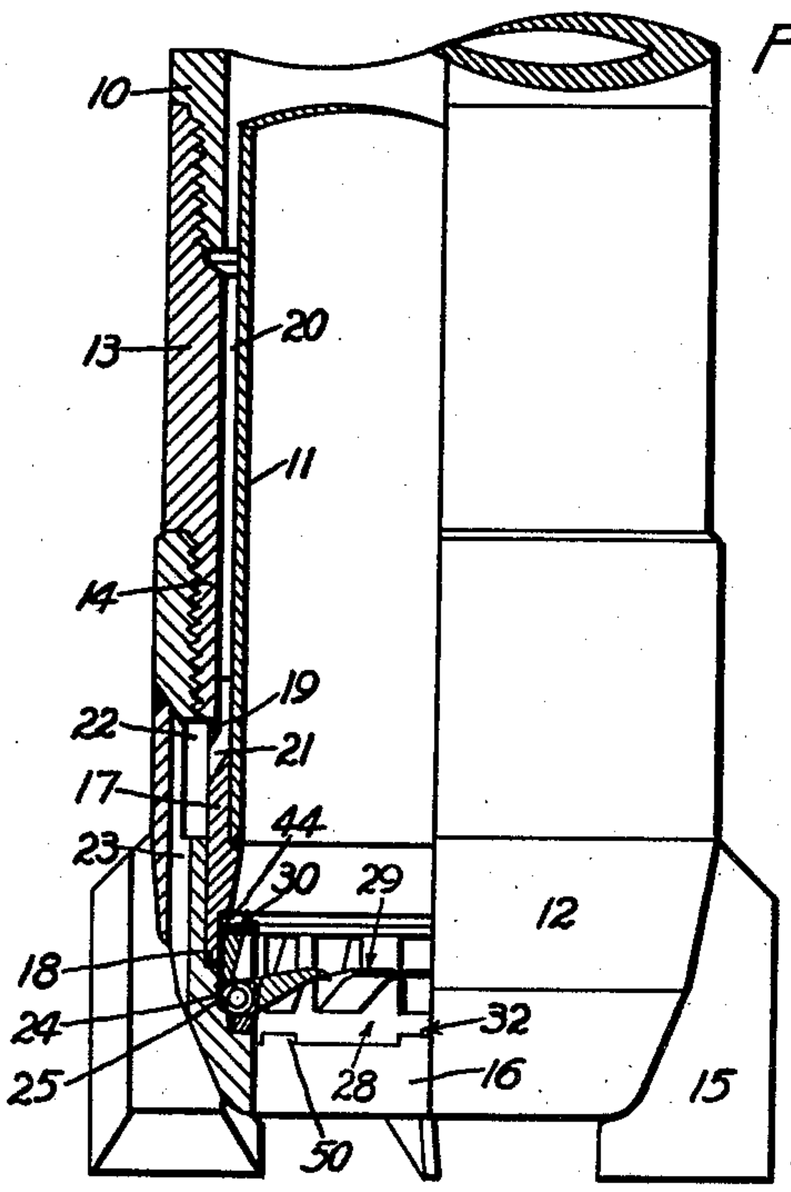


Fig. 2

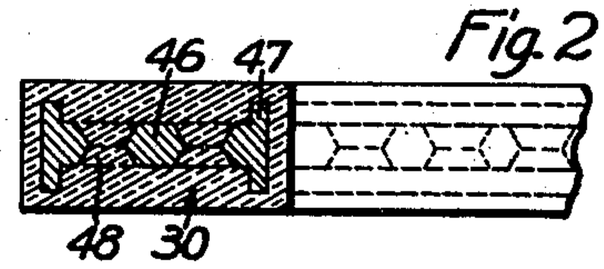


Fig. 3

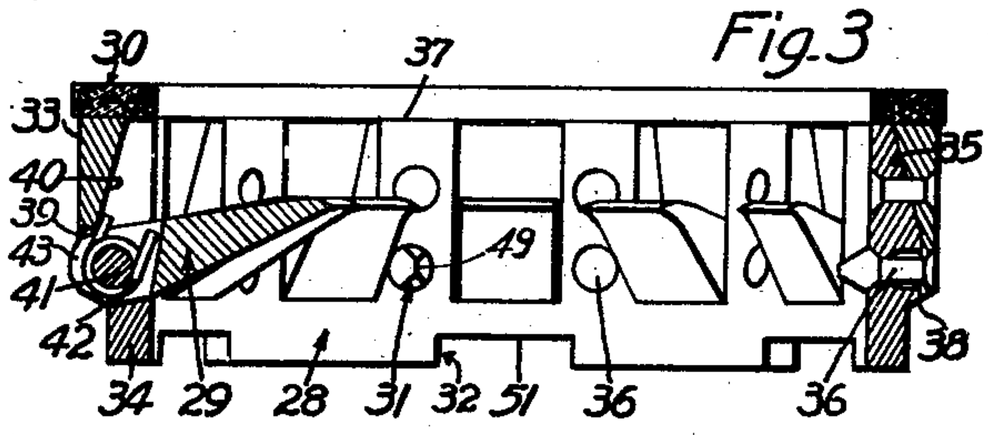


Fig. 5

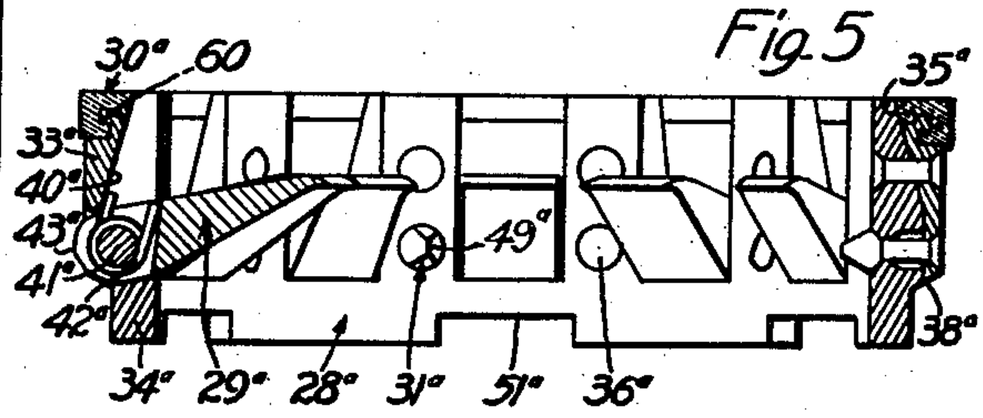
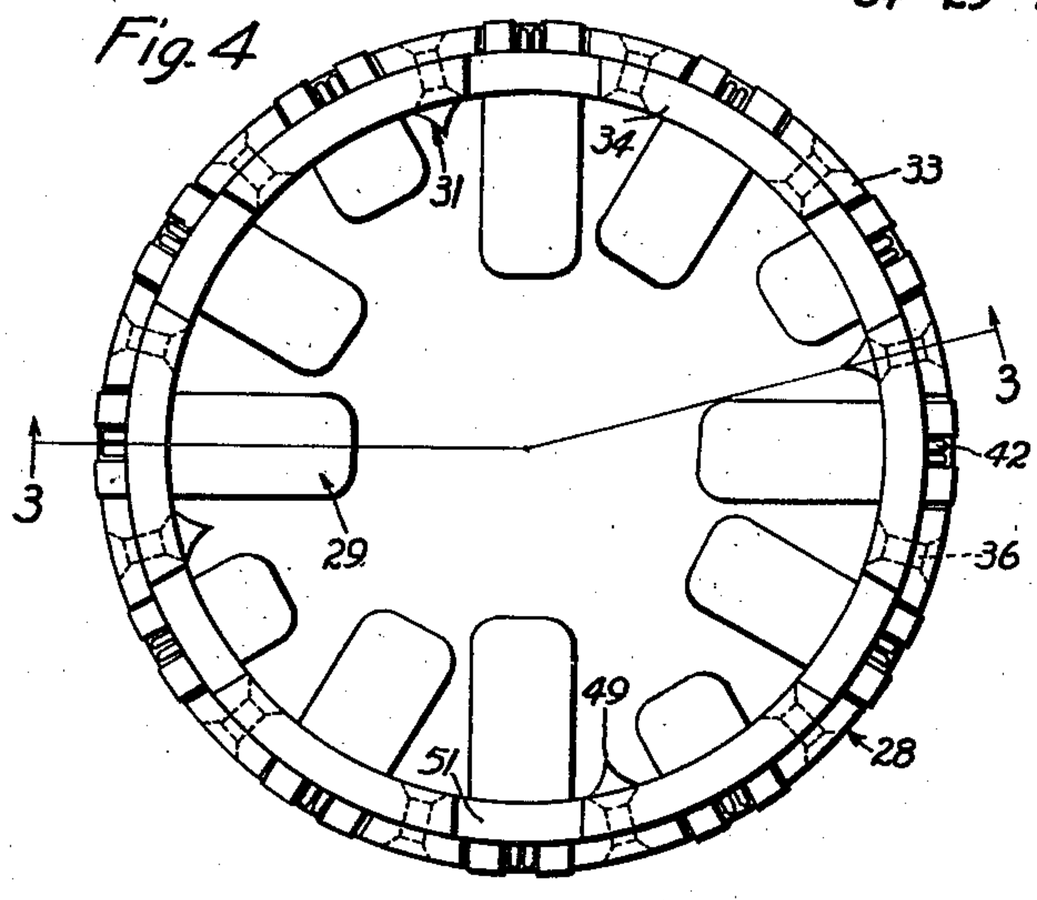


Fig. 4



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UNITED STATES PATENT OFFICE

2,022,100

CORE CATCHING MEANS

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Application August 28, 1933, Serial No. 687,146

15 Claims. (Cl. 255—72)

This invention relates to a well drilling tool, and relates more particularly to a core catching means for embodiment in a rotary core drill. It is a general object of the present invention to provide a simple, practical and particularly effective core catching means.

In the drilling of wells with the rotary method of drilling, cores or samples of the earth formations are obtained by means of core drills equipped with core catchers for gripping and holding the cores when the drills are withdrawn from the wells. During the actual drilling operation, the core gripping parts of a core catcher engage the core and when the core catcher rotates with the drill, the core may be seriously injured or destroyed. Core drills have been introduced in which the core catchers are rotatably mounted so that they may be held against rotation with respect to the cores during drilling. The engagement of the spring fingers or other core contacting parts of the core catchers with the core has been depended upon to hold the core catchers against rotation. In practice, considerable friction develops between the drills and the core catchers and the core catchers are caused to rotate with the drills which results in the injury or destruction of the cores and wearing away of the core engaging parts of the core catchers.

An object of the present invention is to provide a core drill structure including a core catcher rotatably carried by a body part of the drill and a novel and improved anti-friction bearing at the rotatable mounting of the core catcher whereby the core catcher may be held against rotation with respect to the core with a minimum amount of friction developing between the core catcher and the body of the drill.

It is another object of the invention to provide a core drill including an improved rubber anti-friction bearing on the core catcher or between opposing surfaces of the core catcher and body of the drill which allows the core catcher to be held against rotation with respect to the core with a minimum tendency for the core catcher to rotate with the drill.

It is another object of the invention to provide a core catcher having simple and particularly effective means for preventing rotation of the core catcher with respect to the core.

Another object of the invention is to provide a core catcher to be rotatably supported in a core drill and having rigid projections for engaging the core that are shaped or formed to effectively hold the core catcher against rotation with respect to the core and to offer a minimum amount of resistance to downward movement of the core catcher on the core.

It is another object of the invention to provide a core drill structure including a rotatably mounted core catcher that may not rotate with respect to the core during the drilling operation and a means for positively clutching the core catcher to the body of the drill to rotate therewith whereby the core catcher may be employed to cut a groove in the core to insure the proper engagement of its core gripping parts with the core. When large or hard cores are obtained, it is often desirable or necessary to cut a groove in the core to provide for the effective gripping engagement of the core contacting parts with the core to break the core loose from the formation. In the core drill provided by the present invention, the core catcher may be positively clutched or connected with the body of the drill to rotate therewith upon the drill being raised or pulled upwardly, so that the core engaging parts of the core catcher may be made to cut a groove or grooves in the core to have effective holding and gripping engagement with the core.

It is a further object of the present invention to provide an improved core drill and core catching means of the character mentioned that are simple and inexpensive of manufacture.

Other objects and features of the invention will be better and fully understood from the following detailed description of typical forms and applications 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 a portion broken away to appear in vertical cross section, illustrating one form of bearing in the rotatable mounting of the core catcher. Fig. 2 is an enlarged fragmentary vertical detailed sectional view of the bearing illustrated in Fig. 1. Fig. 3 is an enlarged vertical detailed sectional view of the core catcher taken substantially as indicated by line 3—3 on Fig. 4 showing the bearing in position on the upper end of the core catcher. Fig. 4 is an enlarged bottom plan view of the core catcher. Fig. 5 is a vertical detailed sectional view of the core catcher illustrating a form of bearing attached to or connected with the core catcher.

The various features of the present invention are capable of embodiment in core drill and core catcher structures varying considerably in type,

construction, etc. Throughout the following detailed disclosure, we will describe typical forms of the present invention embodied in or used in connection with a core drill involving a floating or rotatably supported inner barrel, it being understood that the invention is not to be construed as limited or restricted to the particular forms and 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 core drill illustrated in Fig. 1 of the drawing includes, an outer barrel 10, an inner barrel 11, and a bit head 12. The outer barrel 10 is an elongate tubular structure adapted to be connected with the lower end of a drilling string of drill pipe, or the like. A sub 13 is threaded on the lower end of the barrel 10 and is provided with a downwardly projecting threaded pin 14. The bit head 12 is a tubular member or structure threaded on the pin 14 of the sub 13. Suitable cutting parts are provided on the bit head 12 for making an annular cut in the earth formation. In the particular case illustrated, circumferentially spaced cutting blades 15 are provided on the bit head 12 and project downwardly and outwardly from the lower end of the head. The opening 16 in the bit head 12 is adapted to receive or pass the core cut by the blades 15 with suitable clearance. The inner barrel 11 which is provided to receive or hold the core is arranged longitudinally within the outer barrel 10. The inner barrel 11 is an elongate tubular member having its lower end rotatably supported within the bit head 12. A collar 17 is provided on the lower end of the inner barrel 11 and rotatably seats on an upwardly facing shoulder 18 in the bit head 12. The collar 17 has a bearing part or ring 19 adapted to bear upwardly against the lower end of the pin 14.

The inner barrel 11 is spaced inwardly from the interior of the outer barrel 10 so that an annular fluid passage 20 is provided between the two barrels. Means is provided for conveying circulation fluid downwardly from the passage 20 to discharge from the lower end of the bit head 12. Ports 21 are provided in the collar 17 and extend from the passage 20 to an annular passage 22 in the wall of the bit head 12. Spaced longitudinal ports 23 conduct circulation fluid downwardly from the annular passage 22 to discharge from the lower end of the bit head 12 at or adjacent the cutting blades 15. An annular channel or groove 24 is provided in the body of the core drill to hold or carry the core catcher. In the specific construction illustrated, the groove 24 has its lower portion in the interior of the bit head 12 and its upper portion in the collar 17. An upwardly facing inclined shoulder 25 is provided on the wall of the groove 24.

The form or embodiment of the invention illustrated in Figs. 1, 2, 3 and 4 of the drawing includes generally, a body 28 rotatably carried in the core drill, core gripping and supporting parts 29 on the body 28, an improved anti-friction bearing 30 in the rotatable mounting of the body 28, parts 31 on the body 28 for holding the body against rotation with respect to the core during the drilling operation, and means 32 for connecting or clutching the body 28 with the drill to rotate therewith.

In accordance with the broader aspects of the invention, the body 28 of the core catcher may be mounted in or carried in any suitable body part of the core drill. In the typical application of the invention illustrated in the drawing, the core catcher body 28 is arranged or held in the groove 24 within the bit head 12 and collar part 17. The body 28 is an annular or tubular member proportioned to fit the groove 24 with suitable clearance for free relative rotation between the drill and core catcher and to have limited longitudinal movement in the groove. In the particular form of the invention illustrated, the body 28 is sectional, being formed of an outer ring 33 and an inner ring 34. The rings 33 and 34 fit one within the other and have engaging or cooperating inclined faces 35. Rivets 36 extend through spaced radial openings in telescoping portions of the rings 33 and 34 to connect the rings. The upper end 37 of the body 28 is preferably flat and normal to the longitudinal axis of the core catcher. An annular downwardly facing shoulder 38 is provided on the exterior of the body 28 so that the lower end portion of the body is of reduced external diameter. The reduced lower portion of the core catcher body 28 is adapted to fit or operate in the reduced lower end portion of the groove 24 with suitable clearance.

The core gripping and supporting members 29 are provided on the body 28 and are operable to grip the core when the drill is pulled upwardly and to support the core when the drill is withdrawn from the well. In accordance with the broader aspects of the invention, any suitable form of core gripping and holding means may be provided on the body. In the particular case illustrated in the drawing, the core gripping and supporting members 29 are in the nature of dogs pivotally carried by the body 28. The outer ends of the core engaging dogs 29 extend into recesses 40 in the wall of the body 28 and are carried by pivot pins 41. The recesses 40 extend through the wall of the body 28 at the shoulder 39 and extend upwardly to the upper end of the body. The inclined inner side 35 of the outer ring 33 forms the upwardly and inwardly inclined walls of the recesses 40. Springs 42 are provided to normally yieldingly urge the dogs 29 downwardly to engage the core. The upper and lower sides of the dogs 29 converge to sharpened core engaging edges at the inner ends of the dogs. The inner end portions of the dogs 29 may be turned or curved downwardly as clearly illustrated in Fig. 3 of the drawing. The dogs 29 are proportioned and related to the recesses 40 to be received in the recesses as the core enters the drill and during the drilling operation so that they do not injure the core and do not become excessively worn through contact with the core. In order to adapt the core catcher to effectively handle and support cores of various characters, the dogs 29 are of different lengths. Several of the dogs 29 are comparatively short and are operable to effectively grip and hold large cores of hard formation. Other dogs 29 are longer and are operable to grip and support small or under sized cores. We have shown several comparatively long dogs 29 for holding or supporting broken cores and for preventing fragments or pieces of cores from slipping through the core catcher. Cam parts 43 may be provided on the dogs 29 to cooperate with the shoulder 25 of the drill to aid in pivoting the dogs downwardly when the drill is raised to actuate the dogs and to break the core loose from the formation.

The bearing 30 is arranged between opposing parts of the body 28 and the core drill and is in the nature of an anti-friction bearing for mate-

rially reducing the tendency of the core catcher to turn with the drill. The anti-friction bearing **30** is positioned between the upper end **37** of the body **28** and the upper wall **44** of the channel or groove **24**. It is a feature of the present invention that the bearing **30** is formed of rubber or a suitable rubber composition. In being formed of rubber or a rubber composition, the bearing **30** has a very low co-efficient of friction and is very long wearing when lubricated by the rotary mud or circulation fluid employed in the rotary method of well drilling. The bearing **30** is a continuous or unbroken annular member of substantially rectangular cross sectional configuration. The anti-friction bearing **30** is positioned in the groove **24** between the shoulder **44** and the upper end of the body **28** and is free to rotate or remain stationary at will. In the preferred construction, the bearing **30** is proportioned to allow suitable relative longitudinal movement between the drill and the body of the core catcher. The bearing **30** is preferably of greater external diameter than the core catcher body **28** to overlap or project outwardly beyond the periphery of the body **28** so that it may cooperate with or contact with the wall of the groove **24**. The upper and lower surfaces of the bearing **30** are flat and smooth and are parallel as illustrated throughout the drawing. The periphery of the bearing **30** is cylindric to properly contact with the wall **34** and the interior of the bearing may be spaced outwardly from the interior of the core catcher body **28**.

A reinforcing member may be embedded or molded in the bearing **30**. The reinforcing member illustrated in the drawing is of substantially H-shaped cross section, having a main horizontal web **46** and vertical peripheral and internal flanges **47**. The reinforcing member is annular and is completely embedded in the rubber bearing **30** so as to be suitably spaced from the external surfaces of the bearing. In practice, the reinforcing member may be formed of bronze or other material to which rubber effectively vulcanizes or bonds. A multiplicity of circumferentially spaced openings **48** is provided in the main web **46** of the reinforcing member to insure a more perfect connection or bond between the rubber body of the bearing and the reinforcement. The walls of the openings **48** may be inwardly convergent. The reinforcement just described provides the bearing **30** with suitable strength and rigidity.

The parts **31** are provided on the body **28** of the core catcher to contact the core for preventing rotation of the core catcher relative to the core. In accordance with the present invention, the core engaging parts **31** are formed so as to offer a minimum amount of resistance to downward or feeding movement of the core catcher on the core and to effectively prevent rotation of the core catcher relative to the core. The parts **31** are rigidly connected with or attached to the body **28** of the core catcher and project from its interior to engage the core during the drilling operation. There may be any desirable or suitable number of core engaging parts **31**. In the particular instance illustrated in the drawing, there are four equally spaced parts **31** on the body **28** of the core catcher. In accordance with the broader aspects of the invention, the parts **31** may be attached to or provided on the body **28** in any practical manner. In the simple form of the invention illustrated the core engaging parts **31** are integral with the rivets **36** being integral continuations of the inner heads of certain of the rivets **36**. The projections or parts **31** are pointed or sharpened so as to remove very little material from the core. The parts **31** are bevelled or sharpened to have vertical edges **49** for cutting into the core. The edges **49** are preferably very sharp and narrow so that they remove very little of the core and offer very little resistance to downward movement of the core catcher when the drill is fed downwardly during the drilling operation. The edges **49** of the core contacting parts **31** are preferably comparatively long so that the parts are operable to positively prevent rotation of the core catcher body **28** with respect to the core during drilling. The parts **31** may be easily removed for replacement by drilling out the rivets of of which they form parts.

The means **32** is operable to connect or clutch the body **28** of the core catcher to the bit head **12** so that the core catcher may be rotated with the drill when the drill is raised or pulled upwardly. When the core drill is penetrating hard earth formation and obtains a hard core, it is sometimes necessary to cut an annular groove or channel in the core to insure the perfect or effective engagement of the core gripping and supporting parts with the core. By clutching the body **28** of the core catcher with the bit head **12**, the core catcher may be made to rotate with the drill so that the dogs **29** may cut into the core to obtain firm holds. The means **32** includes parts on the bit head **12** and the body **28** of the core catcher adapted to mesh or cooperate upon upward movement of the core drill relative to the core catcher body **28**. In the particular form of the invention illustrated in the drawing, a plurality of clutch jaws or projections **50** is provided on the lower wall or end of the recesses **24** to cooperate with notches **51** in the lower end of the core catcher body **28**. A suitable number of circumferentially spaced projections **50** is provided on the lower end of the recess **24** and a like number of correspondingly spaced notches **51** is provided in the core catcher body **28** for receiving the projections. The core catcher body **28** is proportioned to have considerable vertical or longitudinal movement in the recess **24** so that its lower end clears the clutch projections **51** when the drill is being fed downwardly and the downward movement of the core catcher is resisted by the engagement of the parts **31** with the core. Upward movement of the drill brings the lower wall of the recess **24** into engagement with the lower end of the core catcher body **28** and partial rotation of the drill causes the projections **50** to enter the recesses **51**.

During operation the cutting parts **15** of the drill make an annular cut in the formation and provide a core which is received in the inner barrel **11**. The core entering or being received in the drill holds the dogs **29** in their up or unactuated positions and the engagement of the parts **31** with the core offers sufficient resistance to downward movement of the core catcher to maintain the core catcher body in an up position with respect to the recess **24** so that its lower end is free of the projections **50**. The active ends **49** of the parts **31** are pointed and comparatively narrow so that they cut into the core to prevent rotation of the core catcher relative to the core without causing excessive resistance to downward movement of th core catcher. Further, the active ends of the portion **31**, in being sharpened, remove only very

small parts of the core, that is, they make only narrow vertical cuts in the core during the drilling. Downward movement is transmitted from the drill to the core catcher body 28 through the bearing 30. The bearing 30 is normally held in cooperation with the shoulder 44 due to the resistance to downward movement of the core catcher offered by the parts 31 engaging the core. The rotary mud or circulation fluid present in the well bore operates to effectively lubricate the bearing surfaces of the rubber bearing 30 so that the bearing has a very low co-efficient of friction. While the inner core barrel 11 may not rotate with respect to the core under some conditions, its weight and the presence of sand or solid matter in the passage 20 may develop sufficient friction to cause it to turn with the drill. The bearing 30, in engaging the shoulder 44 and the wall of the recess 24, and in being effectively lubricated by the rotary mud, allows the core catcher to be held against rotation with respect to the core with but very little tendency to rotate. As there is little or no tendency for the core catcher to rotate, its core contacting parts 31 and the dogs 29 do not cut away or break up the core and are not excessively worn through continuous cutting engagement with the core.

When it is desired to break the core loose from the formation and to withdraw the drill from the well, the rotary motion of the drill is stopped and the drill is pulled upwardly. If it is thought necessary or desirable, the drill may be raised a short distance and then turned to insure the cooperation of the clutch projections 50 with the recesses 51, whereupon the drill may be rotated to cause the dogs 29 to make an annular groove or cut in the core. This groove or cut in the core may be necessary to provide for the proper engagement of the dogs 29 with the core and to provide for the easy breaking of the core away from the formation in the event that the core is hard or tough. Upward movement of the drill brings the shoulder 25 into cooperation with the cam parts 43 of the dogs so that the springs 42 are aided in pivoting the dogs 29 into proper gripping and supporting engagement with the core. When the core has been broken loose from the formation it is supported in the inner barrel 11 by the dogs 29 and is retained in the drill when the drill is withdrawn from the well. It is to be noted that the core catcher illustrated in Figs. 1, 2, 3 and 4 of the drawing is operable to effectively retain and support a core in the drill but does not break up or destroy the core during drilling. The provision of the anti-friction bearing 30 allows the core catcher to remain substantially stationary with respect to the core during drilling, thereby preventing destruction of the core and excessive wearing away of the core engaging parts of the catcher.

Fig. 5 of the drawing illustrates a form of the invention in which the bearing 30^a is carried by or attached to the body 28^a of the core catcher. The bearing 30^a is provided on the upper end of the core catcher body 28^a and is formed of rubber or a suitable rubber composition. The core catcher may be employed in the drill described above, in which case the bearing 30^a is adapted to bear upwardly against the shoulder 44 during the drilling operation. The bearing 30^a may be molded or vulcanized directly on the upper end portion of the core catcher body. The outer ring 33^a of the core catcher body may be relieved or cut away at its upper end and provided with a dove-tailed annular tongue 60. The rubber anti-friction bearing 30^a is vulcanized to the dove-tailed tongue 60 and is thus effectively connected with the core catcher body. The upper surface of the bearing 30 is preferably flat and smooth and may be flush with the upper end of the body 28^a. The periphery of the bearing 30^a is cylindrical and projects outwardly beyond the periphery of the body 28^a to engage the wall of the recess 24. In cooperating with the wall of the recess 24, the bearing 30 assumes a large part of the lateral or side friction between the drill and the core catcher body. It will be apparent that the bearing 30 operates in the same manner as the bearing 30 described above to materially reduce the friction between the drill and core catcher during the drilling operation so that the core catcher has very little tendency to turn or rotate with the drill. The body 28^a, the core gripping and supporting dogs 29^a, the parts 31^a, and the various other parts of the core catcher may be identical with the corresponding elements of the form of core catcher illustrated in Figs. 1 to 4.

Having described only typical forms and applications of our invention, we do not wish to be limited or restricted to the forms or applications herein set forth, but wish to reserve to ourselves any modifications 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. In a core drill, a tubular body, a core catcher rotatably mounted in the body, and a floating anti-friction bearing between the upper end of the core catcher and an opposing part of the body.

2. In a core drill, a tubular body, a core catcher rotatably mounted in the body, and a rubber anti-friction bearing interposed between opposing parts of the body and core catcher.

3. In a rotary core drill, a tubular body having a downwardly facing internal shoulder, a core catcher rotatably carried in the body below the shoulder, parts on the core catcher for engaging a core to hold the core catcher against rotation during rotation of the body, and a rubber anti-friction bearing interposed between the core catcher and said shoulder.

4. A core catcher for use in a tubular core drill having a downwardly facing internal shoulder, said core catcher including a body in the drill below said shoulder, parts on the body for engaging the core to hold the body against rotation with respect to the core, and a rubber anti-friction bearing attached to the body for engagement by said shoulder.

5. In combination, a rotary core drill having an annular internal recess, and a core catcher including an annular body rotatable in the recess, parts on the body for engaging a core, and a rubber anti-friction bearing between the upper end of the body and the wall of the recess.

6. A core catching means for use in a rotary core drill having an annular internal recess, including an annular body rotatable in the recess, parts on the body for engaging a core, a rubber anti-friction bearing between the upper end of the body and the wall of the recess, and a member carried by in the bearing to reinforce the same.

7. A core catching means for use in a rotary core drill having an internal recess, including an annular body rotatable in the recess, parts on the body for positively engaging a core, and means for connecting the body with the drill to

rotate therewith upon upward movement of the drill.

8. In a rotary core drill, a barrel having an internal annular recess, a core catcher in the recess, the barrel and core catcher being related for relative rotation and longitudinal movement, means for holding the core catcher against rotation relative to a core during drilling, and clutch means for positively preventing rotation of the core catcher relative to the barrel upon relative longitudinal movement between the barrel and core catcher in one direction.

9. In a rotary core drill, a barrel having an internal annular recess, a core catcher in the recess, the barrel and core catcher being related for relative rotation and longitudinal movement, means for holding the core catcher against rotation relative to a core during drilling, and means for preventing rotation of the core catcher relative to the barrel upon relative longitudinal movement between the barrel and core catcher in one direction, the last mentioned means including clutch parts on the barrel and core catcher adapted to come into non-rotative clutching cooperation upon said relative longitudinal movement between the barrel and core catcher.

10. In a rotary core drill, a barrel having an internal annular recess, a core catcher in the recess, the barrel and core catcher being related for relative rotation and longitudinal movement, means for holding the core catcher against rotation relative to a core during drilling, there being notches in the lower end of the core catcher, and projections on the barrel adapted to cooperate with notches to prevent rotation of the core catcher relative to the barrel upon upward movement of drill relative to the core catcher.

11. A core catcher including, an annular body adapted to be rotatably mounted in a core drill, and a rigid part rigidly attached to the body to project from the interior of the body and having its projecting end sharpened to a longitudinally extending edge for engaging a core to hold the body against rotation relative to the core.

12. In a rotary core drill, a tubular body part having an internal recess, a body rotatable in the recess, members on the body for supporting a core retractible during drilling, and a rigid part rigid with the body projecting from the interior of the body and having its sides converging to a vertically extending outer edge for engaging the core to prevent rotation of the body relative to the core.

13. In a rotary core drill, a tubular body part having an annular internal recess, an annular core catcher body in the recess, the said part and the body being relatively rotatable and relatively longitudinally movable, a rigid part rigidly attached to the body for engaging a core to hold the said body against rotation relative to the core, an anti-friction bearing between the upper end of the body and the wall of the recess for transmitting downward pressure from the said part to the body, and means for positively preventing rotation of the body relative to said part upon upward movement of said part relative to the body.

14. In a rotary core drill, a tubular body part having an annular internal recess, an annular core catcher body in the recess, the said part and the body being relatively rotatable and relatively longitudinally movable, a rigid part on the body for engaging a core to hold the said body against rotation relative to the core, an anti-friction bearing between the upper end of the body and the wall of the recess for transmitting downward pressure from the said part to the body, core supporting members on the body retractible during drilling, and clutch means for positively connecting the body with said part to rotate therewith when said part is moved upwardly whereby said members may cut into the core to obtain a hold thereon.

15. In a rotary core drill, a tubular body part having an annular internal recess, an annular core catcher body in the recess, the said part and the body being relatively rotatable and relatively longitudinally movable, a rigid part on the body for engaging a core to hold the said body against rotation relative to the core, a bearing between the upper end of the body and the wall of the recess for transmitting downward pressure from the said part to the body, core supporting members on the body retractible during drilling, and means for connecting the body with said part to rotate therewith when said part is moved upwardly whereby said members may cut into the core to obtain a hold thereon, the last mentioned means including clutch parts on the lower wall of said recess and the lower end of the body adapted to have non-rotative engagement.

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