Dec. 27, 1927. 1,653,928

C. E. REED

ROTARY DEEP WELL BORING APPARATUS

Filed June 5, 1924 3 Sheets-Sheet 1

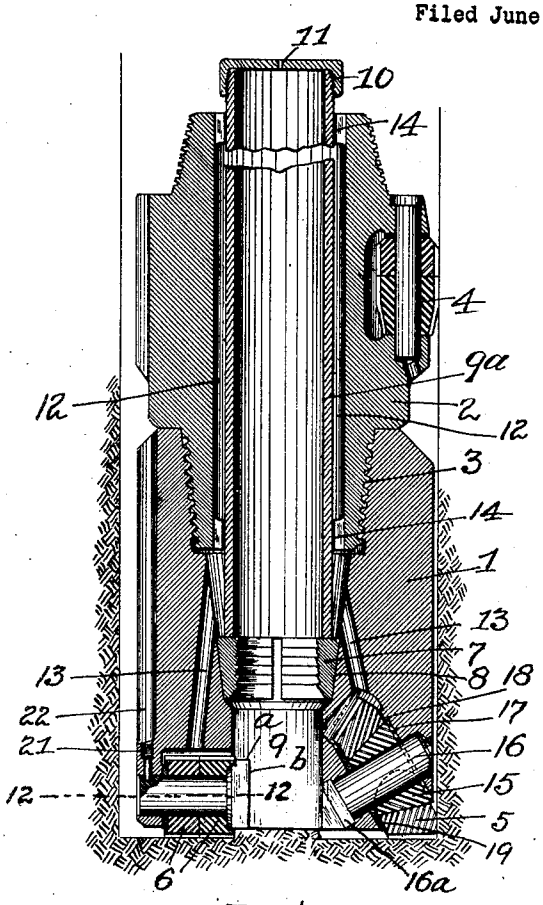


Fig. 1.



Fig. 3.

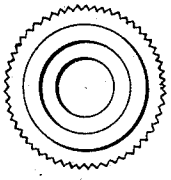


Fig. 4.

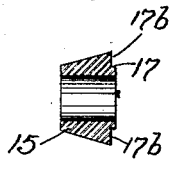


Fig. 5.

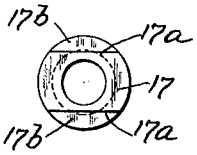


Fig. 6.

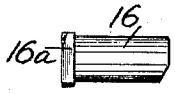


Fig. 7.

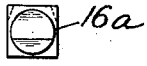


Fig. 8.

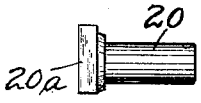


Fig. 9.

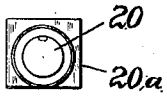


Fig. 10.

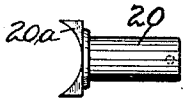


Fig. 11.

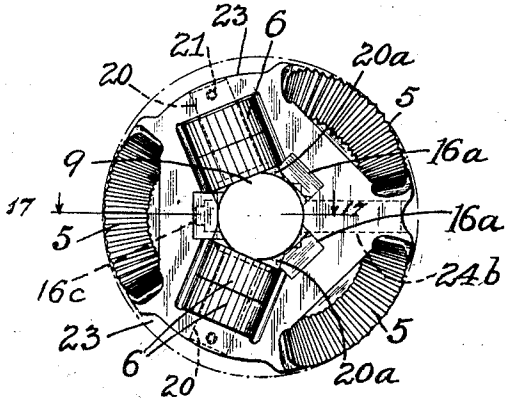


Fig. 2.

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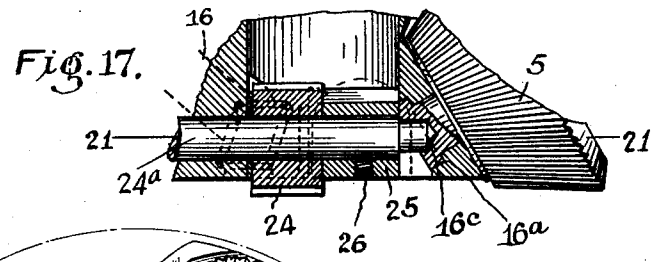
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C. E. REED

ROTARY DEEP WELL BORING APPARATUS

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Fig. 17.



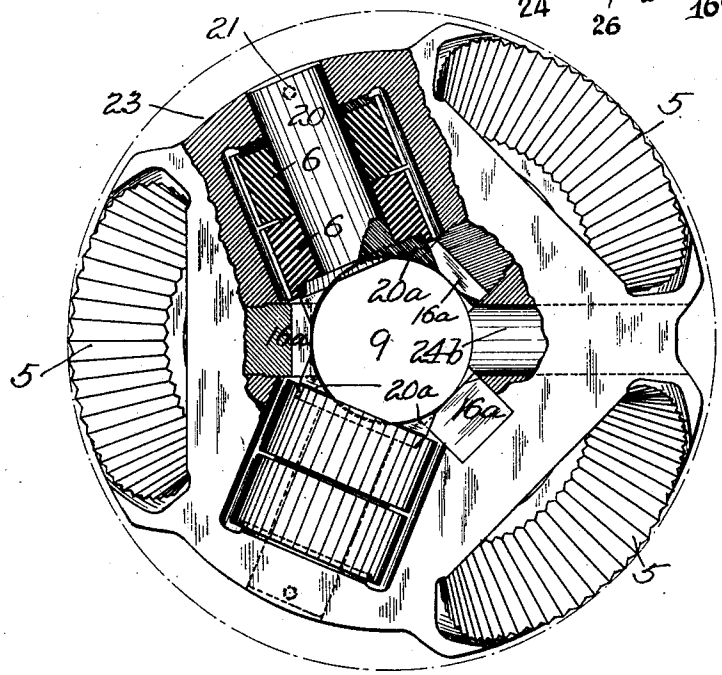


Fig. 12

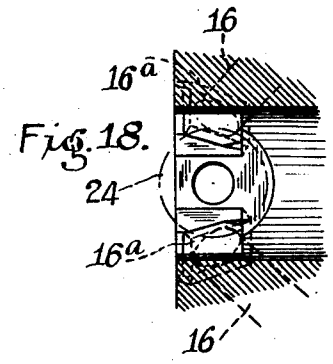


Fig. 18.

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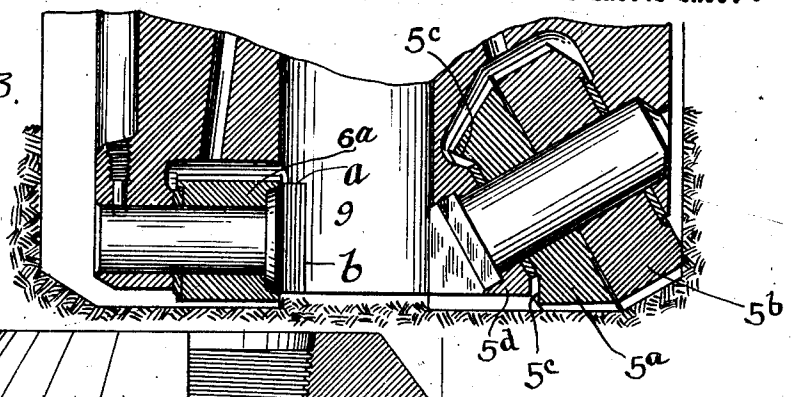
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C. E. REED

ROTARY DEEP WELL BORING APPARATUS

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Fig. 13.



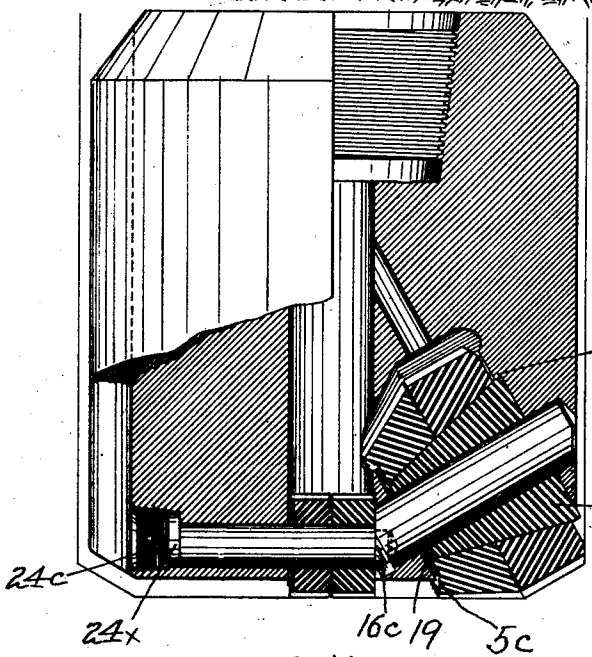


Fig. 14.

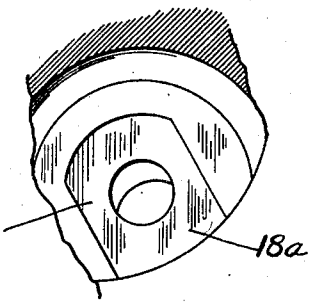


Fig. 15.

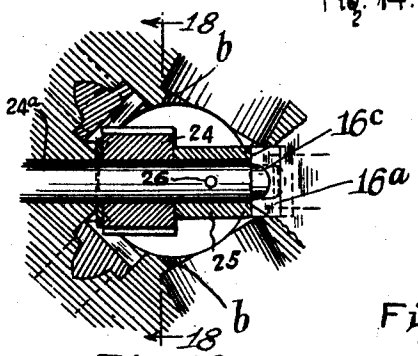


Fig. 19.

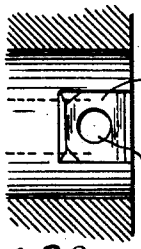


Fig. 20.

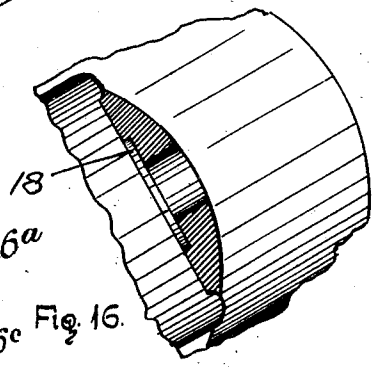


Fig. 16.

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Patented Dec. 27, 1927. 1,653,928

UNITED STATES PATENT OFFICE.

CLARENCE E. REED, OF HOUSTON, TEXAS.

ROTARY DEEP-WELL BORING APPARATUS.

Application filed June 5, 1924. Serial No. 718,030.

The invention concerns apparatus for use in drilling wells, and it embodies improvements relating to the rotary cutting mechanism and to means for obtaining a core of the formation through which the drilling is to be made and to various features hereinafter described and particularly claimed.

In the drawings forming a part of this specification:

Figure 1 is a central vertical section of a drill bit showing features of my invention.

Fig. 2 is a bottom plan view of Fig. 1.

Figs. 3 and 4 show rotary side cutters.

Figs. 5 and 6 show in section and elevation a cone bearing for the rotary side cutters.

Fig. 7 is a side view of a journal pin for the side cutters.

Fig. 8 is an end view looking from the right of Fig. 7.

Fig. 9 is a side view of a journal pin for cylindrical roller cutters.

Fig. 10 is a view looking from the right of Fig. 9.

Fig. 11 is a view like Fig. 9, a quarter turn therefrom.

Fig. 12 is a bottom plan view of the roller bit with parts in section on line 12—12 of Fig. 1.

Fig. 13 is a detail vertical sectional view of a part of the bit head, showing modified cutters.

Fig. 14 is a similar view to Fig. 13, showing further modifications.

Fig. 15 is a detail perspective view of a seat for a cone bearing for the cutter.

Fig. 16 is a detail view relating to the seat of Fig. 15.

Fig. 17 is a sectional view along line 17—17 of Fig. 2 with a removable roller cutter in place in the bore of the bit head.

Fig. 18 is a sectional view substantially on line 18—18 of Fig. 19 with the roller cutter and its mounting omitted from the bore opening.

Fig. 19 is a sectional view on line 19—19 of Fig. 17.

Fig. 20 is a view similar to Fig. 18 but looking in the opposite direction.

In these drawings 1 is the drill bit and 2 the reamer block connected thereto by screw threads 3. The reamer block has rotary cutters 4 of any suitable type. Various forms of roller cutters may be mounted in the head and in Figs. 1 and 2 I show frusto-conical side cutters 5, and cylindrical roller cutters 6, which will be hereinafter more fully referred to. The drill body composed, in the form chosen as a basis for illustrating my improvements, of the bit head 1 and reamer block 2 is attached to the lower end of a drill pipe, not shown, by which the body is rotated and by which flushing water is conveyed to passages leading to the cutters.

If the organization is to be used for obtaining a core of the earth formation it will be provided with grips 7 of segmental form resting in a downwardly tapered bore or seat 8 in the drill body and surrounding a bore 9 through which the core is received to pass up through the bore defined by the grip segments and into a core receiving tube 9a. This tube has a cap 10 closing its upper end, except for a small vent hole 11. This core tube sits inside of the drill stem or pipe and within the bore of the drill body, leaving an annular space at 12 for the downward passage of flushing fluid from said stem to the upper end of the tapered bore 8 and thence through passages 13 to the roller cutters.

No fastening means are employed for the core tube excepting that spacers such as 14 may be used, for centering the tube coaxially with the apparatus. The core tube at its lower end rests on the segmental grips. These grips present an internal diameter, when in their lowest position, less than the diameter of the core to be taken, by reason of the disposition of the rotary cutters, for instance, see in this connection the cylindrical roller cutters of Figs. 1 and 2, which slightly overlap at their inner ends the edge of the bore 9. The grips are corrugated on their inner faces to grip the core and retain it within the core tube when the apparatus is lifted from the well. The exterior faces of the grips are smooth. As the core rises within the bore 9 and contacts with the grips these will rise slightly and spread apart to permit the core to rise into the core tube. The weight of the core tube resting on the grips will, however, keep them in contact with the core, so that when the apparatus is lifted the core will be positively gripped and lifted from the well hole.

Referring to the roller cutters, there are three side cutters 5, two of which are located close to each other and the third one is widely separated from the others. This spacing provides room for the cylindrical roller cutters 6 to work in, all the cutters being located in radial planes.

The outside cutters 5 may be true rolling

cones, as shown in Figs. 1 and 2, that is, cones with their apices lying in the longitudinal axis of the apparatus, though it will be understood that other than true rolling frusto-conical bodies may be employed.

The bearings of the three outer cutters are cones 15, mounted on journal pins 16. These cone bearings have each a projecting portion 17 at its base to enter a recess 18 in the body of the bit head, or rather in the face of the outer wall defining the pocket or recess in which the rotary cutter is located. This recess is illustrated in Figs. 1, 14, 15 and 16. As shown, the projecting portion 17 is provided with straight sides 17^a and the recess is formed to correspond, so that when the cone bearing is seated in the recess it will be held against turning in its seat.

The recess 18 is open at its lower end, as at 18^a, so that the cone bearing, while in place within the rotary cutter, can be slipped into place by moving it upwardly into said recess until the opening through the cone registers with the openings for the journal pin in the wall of the bit head, whereupon the journal pin can be inserted from the inside of the structure, i. e., through the bore 9. The projection 17 finds a bearing at the shoulder or upper wall of the recess 18, and also, of course, along its side edges with the walls of said recess, and its rear or outer face finds a bearing on the bottom face of the recess.

The walls of the recess, as well as the bottom wall thereof, receive the thrust of the cone and carry the load on the rotary cutter. So do the faces or shoulders 17^b of the cone.

A washer 19 protects the metal of the bit head from wear at the inner side of the cutter. No washer is needed on the other side of the cutter because the large end of the cone itself will prevent the cutter from coming in contact with the wall of the recess or pocket in which the roller cutter is located.

The arrangement of the cone transfers the load to the body of the bit or head and relieves the journal pin and prevents breakage thereof. It leaves an amount of metal in the peripheral portion of the rotary cutter, which will maintain clearance for the bit head and thereby eliminate excessive wear on said head.

The journal pin 16 is provided with a square head 16^a. This pin may be formed from square stock machined in a lathe to provide the cylindrical portion.

These journal pins 16 of the side cutters are retained in place by the heads 20^a of pins 20 upon which the cylindrical roller cutters 6 are mounted. These pins are shown in detail in Figs. 9, 10 and 11. They bear in the solid metal of the drill body at opposite sides of the said cylindrical roller cutters, that is to say, the cylindrical shanks of these pins are supported in the body of the bit head at one side of the cylindrical cutters and the heads 20^a of these pins find support in the body of the drill head at the other side of said cylindrical cutters, that is, at the side near the central bore of the drill. The head 20^a of the journal pin is formed with a concave recess, which is a section of a cylindrical face, conforming substantially to the cylindrical wall of the bore 9 and of a larger radius than the core to be taken. Besides finding a bearing in the solid metal of the drill bit body at *a* and *b* Figs. 1 and 13, the head 20^a of the pin 20 overlies the corners of the heads 16^a of the journal pins 16 and retains the pins 16 in place. The heads 16^a are bevelled off at their upper corners to receive contact from the heads 20^a. These heads 20^a are square and they rest against the solid metal of the bit body at each of their two sides at *b* and across the top at *a*. They hold the pins 20 against rotation. The pins 20 are also held by lock screws 21 at their outer ends, which screws are put in place above the journal pins, grooves 22 being formed in the bit head to permit ready insertion of the lock screws.

It will be observed from Fig. 2 that the cylindrical roller cutters 6 at their inner ends or faces project inwardly across the line defining the circumference of the bore 9 of the bit head. This projecting portion of the cylindrical roller cutters 6 determines the size of the core. They cut the clearance between the core and the wall of the bore 9, so that the core in passing upward into the bit head will not have frictional contact with the wall of said bore, nor will it contact with the wall of the core receiving tube.

The disposition of these cylindrical roller cutters, together with the unequally spaced side cutters, gives a balanced cutting area on the bottom of the bit head, thereby imparting to the drill a tendency to go straight downward. The bit head has recesses or broad grooves 23 in its sides for return circulation of the flushing fluid.

The construction above described may be modified in various particulars, and still be within the underlying principles of this invention. I do not limit myself to the use of frusto-conical side cutters. In Fig. 13 is shown a modification of side cutter means made up of a conical portion 5^a and a cylindrical portion 5^b. This type of composite cutter is also shown in Fig. 14. A cone bearing may be used for this composite cutter as shown at 15^a in the latter figure. When this kind of side cutter is employed the cylindrical roller cutter shown at 6, Fig. 2, need not be so wide. The composite type of cutter combines in itself all the advantages of a cylindrical form of cutter not having a true rolling motion, thereby causing slippage of the teeth for rapidly breaking up

the material, and also the advantages of the true rolling conical cutter, which has a crushing action on the material. There is a heavy inward thrust of the side walls of the bore hole on the cylindrical portion of the cutter, but this will be offset by the upward thrust of the load on the conical portion of the cutter. The cone bearing, when this is used as in Fig. 14, will transfer this upward thrust to the solid body of the bit head, as explained heretofore.

The composite type of cutter covers a considerable width at the bottom of the bore hole in proportion to the diameter of the cutter. I do not limit myself to a cylindrical cutter as the outer member of the composite cutter. The composite cutter would give a maximum cutting surface for maintaining the clearance at the side of the bit and would also give independent rates of rotation within itself to secure the breaking up and crushing of the material at the bottom of the hole.

The bearing 15 having an extended portion to seat itself in the wall of the bit head is not limited to one of conical form. It is not necessary that the extension on the cone bearing which is seated in the recess of the bit head be provided with straight sides, but instead the circular base of the cone itself may be seated in the recess of the bit head, as indicated in Fig. 14. Such a construction would take the upward thrust and any suitable means may be provided to lock the cone bearing against rotation, such as a projection on the base to one side of the axis of the cone entering a recess in the cone seat, or the base of the cone may be eccentric or of a shape other than circular.

In this Figure 14 the recess in which the side cutter lies opens into the central bore at the upper inner portion of said recess.

Where herein various features are shown in separate figures of the drawing but are susceptible of being embodied in one and the same structure without conflict, it is to be understood that they are to be regarded as belonging to one embodiment of the invention.

When the bit is not to be used for taking a core of the earth formation, a small cylindrical roller cutter may be employed, as indicated in Figs. 17, 18, 19 at 24. This cutter is supported by a bearing pin 24^a which is seated at one end in the hole 24^b, Figs. 2 and 12, and extends across the bore 9 with its other end entering the journal pin of the side roller as at 16^c. A sleeve 25 is arranged on the pin to properly space the roller cutter 24. The sleeve 25 has a lock screw 26 projecting into the bearing pin 24^a to hold it against loss. This long bearing pin 24^a may be retained by other means. In Fig. 14 this pin is provided with an eccentric head 24^x and a screw plug 24^c holds the pin in place. This cutter, as shown in Fig. 19, would not completely close the bore 9 and sufficient opening would therefore be left for the downward passage of flushing fluid from the drill stem, it being understood that the core tube would not be used and the bore 9 would be in free communication with the interior of the drill stem through which the flushing fluid descends.

Two small cutters may be used at the exact center of the head to disintegrate the central portion of the bore hole, as shown in Fig. 14.

In Fig. 13 is shown a cutter 6^a in one piece instead of two pieces, as before described, this being mounted in a manner similar to the two cutters 6 of Fig. 1.

The cone bearing of the rotary cutter takes the thrust as before stated. The journal pin is thus relieved of strain and the cone may be fitted loosely to this pin.

It will be noted from Fig. 13 that the inner face of the frusto-conical cutter is of greater width at its periphery than at its central portion, thus providing for a wide tooth surface which overlaps the adjacent part of the frame or solid part of the bit head. This construction is shown at 5^c. While this construction gives maximum tooth length for cutting, ample bearing is afforded at the center of the cutter, for which purpose the metal of the bit head is thickened at 5^d by extending into the recess of the frusto-conical cutter. In assembling this composite cutter the frusto-conical member 5^a is placed first, then the cylindrical cutter is placed in position behind the frusto-conical cutter, and then the bearing pin is inserted from the central bore of the bit head. This composite type of roller cutter cuts a wide path at the bottom of the hole, leaving a minimum amount of material to be removed by the small cutter shown at the left of the bore of the bit.

In Fig. 14 the innermost cutter is recessed but only sufficient to receive the washer. This also gives a broader cutting surface than the thickness of the main part of this roller cutter.

I claim:

1. In combination in a core drill, a head having cutters and a bore to receive the core, slidable grips of segmental form disposed about said bore, and having movement upwardly and outwardly under upward pressure of the core, and adapted to grip and hold the core when the apparatus is raised, and a core tube resting on the grips, substantially as described.

2. In combination in a core drill, a head having a bore and segmental grips disposed about said bore, a tapered seat for the grips with widest diameter upward to permit

spreading of the grips as they rise, and a core tube resting on the grips and movable vertically therewith.

3. In combination in a deep well rotary drilling apparatus, a body having a central recess, rotary inclined side cutters, journal pins therefor inserted into place from said recess, other rotary cutters mounted in the head, journal pins therefor inserted into place from said recess, the latter journal pins having heads bearing in the body of the drill bit and overlying the journal pins of the side cutters to hold them in place, substantially as described.

4. In combination in rotary drilling apparatus, a body having a central recess, rotary cutters mounted in the head, journal pins for the cutters inserted into place from said central recess, one of said journal pins having a head on its inner end engaging another journal pin at its inner end to hold the latter in place, substantially as described.

5. In combination in a rotary drilling apparatus for deep wells, a drill body having a central bore, a rotary side cutter, a rotary cutter having its inner end located at the edge of said bore to define the diameter of the core, a journal pin for each rotary cutter, said journal pins bearing in the body of the head at both their outer and inner ends, one of said journal pins having a portion thereof engaging the other pin to hold the same in place, substantially as described.

6. In combination in a rotary deep well drilling apparatus, a body having a central recess, rotary cutters, journal pins mounted in the body and each having a head at its inner end seated in a cavity on the wall of the recess, one of said heads engaging the other to hold the latter with its pin in place.

7. In combination in rotary well drilling apparatus, a body having a central bore coaxial with the drill head for receiving the core, a rotary cutter exposed for cutting on the lower face of said body and extending to the edge of the said bore to be exposed at said bore and define the diameter of the core cut by the drill, a journal pin for said cutter having its axis in a plane radial to the longitudinal axis of the body and its outer end bearing in the body and having a head on its inner end also bearing in the body, substantially as described.

8. In combination in rotary well drilling apparatus, a body having a central bore coaxial with the drill head for receiving the core, a rotary cutter exposed for cutting on the lower face of said body and extending to the edge of the said bore to be exposed at said bore and define the diameter of the core cut by the drill, a journal pin for said cutter having its axis in a plane radial to the longitudinal axis of the body and its outer end bearing in the body and having a head on its inner end also bearing in the body, said head being curved on its inner face to conform substantially to the curved wall of the central recess or bore of the drill body, substantially as described.

9. In combination, a rotary deep well drilling apparatus comprising a body having a central recess, an inclined rotary side cutter, an inclined journal pin therefor having a head at its inner end seated in the wall of the central recess and having its corner slabbed off, a second cutter, a journal pin therefor having a head at its inner end overlying the slabbed off corner of the head first mentioned.

10. In combination in a rotary deep well drilling tool a body, a rotary side cutter, an upwardly and outwardly inclined journal pin therefor, and a member mounted on the pin within the rotary cutter and having its end bearing in a seat recess in the face of the wall which supports the high end of the pin to sustain the upward thrust of the rotary cutter, the seat recess being open at its lower end, for insertion of the cutter and member as a unit.

11. In combination with a rotary bit head having a recess to receive a rotary cutter and having a seat recess open at its lower end for insertion of the conical bearing member in the inner face of the wall of the recess first mentioned, a rotary cutter, a conical bearing member on which said cutter turns, a pin extending coaxially with the cutter and conical member and seated in the head, said cone having a portion seated within the second mentioned recess to bear the load by contact with the walls of said recess, substantially as described.

12. In combination with a rotary bit head recessed to receive a rotary cutter and having in the wall thereof a seat recess, a rotary cutter in the recess first mentioned, a cone on which the cutter turns having a base portion located in said seat recess to take the load by engaging the walls thereof, and a pin bearing in the head and passing through the cone, said seat recess being open at its lower end for the insertion of the cone, substantially as described.

13. In combination with a rotary drill bit head having a recess provided with a seat recess in the inner face of its wall, said seat recess being open at its lower end a rotary cutter in the recess first mentioned, a cone on which the cutter turns having a reduced extension with straight sides fitting in said seat recess to hold the cone against turning and to sustain the load by bearing against the walls of said seat recess, the cutter and bearing being inserted in first mentioned recess as a unit and a pin bearing in the head and passing through the rotary cutter and cone for holding the said parts in place, substantially as described.

14. In combination with a rotary drill bit

head having an inclined recess extending from its lower face upwardly and inwardly, and with a seat recess in the inner face of the outer wall of said inclined recess presenting an upper shoulder, and open at its lower end, a pin bearing in the walls of the recess, and a member on the pin and within the cutter, said member extending into the seat recess to engage the shoulder for bearing the load, substantially as described.

15. In combination, a rotary drill bit head having a recess extending upwardly from its lower face with a seat recess in the inner face of its outer wall, open at its lower end and having an upper wall and straight side walls, a rotary cutter in said upwardly extending recess, a pin extending across the recess, and a member surrounding the pin within the rotary cutter and having a reduced extension with straight sides, said extension engaging the top and side walls of the seat recess and having shoulders beyond its side edges bearing on the inner face of the outer wall of the recess first mentioned, substantially as described.

16. In combination, a drill body having a central bore to receive a core, movable grips for engaging the core to lift the same from the well when the apparatus is raised and a core tube resting upon the grips and imposing its weight thereon, and movable with said grips when the latter rise under pressure of the core, substantially as described.

17. A journal pin for rotary deep well drilling apparatus, having its axis in a plane at right angles to the longitudinal axis of the body in which it is carried and the head at its inner end of rectangular shape, undercut at its inner face to conform substantially to the bore of the apparatus to oppose no obstruction to the entrance of core into said bore, and a roller cutter on said journal pin and defining the core, the cutter being in a recess opening into the said bore.

18. In combination in a rotary deep well drilling tool, a body, an inclined rotary side cutter, an upwardly and outwardly inclined journal pin therefor, and a member mounted on the pin within the rotary cutter, and having its end bearing on a projection in the face of the wall which supports the high end of the pin to sustain the upward thrust of the rotary cutter, the cutter and member within the cutter assembled for insertion as a unit.

19. In combination in a rotary deep well drilling tool, a body having an upwardly and inwardly inclined recess, open at its lower end, an inclined rotary side cutter, an upwardly and outwardly inclined journal pin therefor, and a member mounted on the pin within the rotary cutter, the said member having its higher end extending into the said seat recess to abut the shoulder at the upper end of the same, with means for preventing rotation of the said member in said seat recess, said cutter and member within the same being assembled to be inserted into said inclined recess through the lower open end of the seat recess, substantially as described.

20. In combination in a rotary drilling tool for deep wells a body having a bore to receive a core, a side cutter for forming the core, a journal pin therefor inserted into the body from the bore and having a head at its inner end, an inserted piece resting against the head of the journal pin and removably held in the body of the drilling tool by a pin having its shank mounted in the body, the inserted piece bearing on the head of the journal pin to hold it in place.

21. In combination in a deep well rotary drilling apparatus, a bit head having a central bore to receive a core, a rotary side cutter for forming the core, a pin on which said cutter is mounted having a head exposed at said bore, and having a recess therein to afford a bearing for a removable pin extending across said bore to support a supplemental cutter, the opposite end of said pin finding a bearing in an opening in the said head, substantially as described.

22. In combination in a deep well rotary boring apparatus, a drill bit having a central bore, rotary cutters at the outer edge of said bit, said bit having radially disposed recesses opening into the central bore, journal pins disposed with their axes substantially at right angles to the vertical axis of the drill and mounted at their outer portions in the wall of the bit head, and extending through said radial recesses, said bit head having a bearing for the inner portions of said pins and roller cutter means on said pins and located in said radial recesses, said roller cutter means having active cutting portions at the edge of said bore, substantially as described.

23. In combination with a rotary drill bit head having a recess provided with a seat recess in the inner face of its wall and open at its lower end, a rotary cutter in the recess first mentioned, and a bearing on which the cutter turns, having an extension fitting in the seat recess to hold the bearing against turning and to sustain the load, the cutter and bearing being inserted as a unit.

24. In combination with a rotary drill bit head, having an inclined recess extending from its lower face upwardly and inwardly and with a seat recess in the face of the wall of said inclined recess presenting a shoulder, and open at its lower end, a bearing in the inclined recess with extension fitting the seat recess, and a rotary cutter.

25. In combination in a deep well coring apparatus, a rotary bit head having a cen-

tral bore, only three inclined side roller cutters variably spaced about the outer edge of said bit in recesses opening into the central bore other than through a fluid supply conduit, and a cylindrical roller cutter arranged at the edge of said bore in a recess opening into said bore and with its axis radial to the bore, each of the cutter bearings being supported at two places.

26. In combination in a deep well rotary drilling apparatus, a head having a central bore, only two inclined side roller cutters closely spaced, each in a recess opening into the central bore, a third inclined side roller cutter opposite the space between the pair first mentioned, leaving spaces between itself and the two cutters first mentioned, and cylindrical roller cutters arranged in said spaces in recesses opening into the central bore and with their axes radial to the axis of the head, each of the cutter bearings in the head being supported at two places.

27. In combination in a rotary coring apparatus for deep wells, a drill body having a central bore, a rotary side cutter in a recess inclining downwardly and outwardly in respect to the central bore and opening into the central bore other than through a fluid supply conduit, a rotary cutter located in another recess opening into the central bore and the cutter having its inner end located at the edge of said bore to define the diameter of the core, a journal pin for each rotary cutter, said journal pins bearing in the body of the head at two places.

28. In combination in a rotary deep well drilling apparatus, a body, a rotary cutter, and a journal pin therefor having its axis in a plane radial to the longitudinal axis of the body and with a head at its inner end of rectangular shape, curved on its inner face to conform substantially to the bore of the said body, the cutter being counter-bored to flare and thereby permit use of rectangular shaped head of pin to bear on body metal and at the same time not interfere with entrance of core into bore.

29. In a core drill, the combination of a head, a pair of inclined side roller cutters closely spaced in recesses that open into the central bore other than through the fluid supply conduit, a third inclined side roller cutter opposite the space between the pair first mentioned, leaving wide spaces between itself and the members of the pair, and cylindrical roller cutters arranged in said wide spaces in recesses opening into the central bore and with their axes radial to the axis of the head, the combination of elements disposing the metal of the head to rigidly support the cutter bearings, and the recess directing the flushing fluid to cool but not wash the core.

30. In a roller core bit, a body having a central bore to receive a core, side cutters differentially spaced about its edge in recesses that communicate with the central bore at their inner sides, the metal of bit head supporting the inner end of journals carrying cutters located in said recesses, and another cutter adjacent the bore to cut clearance for the core, the annular paths of the cutters covering all the annular bottom of the bore hole, and the bearing for the inner cutter supported at two places in the head.

31. In combination in a rotary deep well drilling apparatus, a body, a rotary cutter and a journal pin therefor, having its inner end concaved to conform substantially to the arc of the bore of said body, the cutter being counter-bored to permit use of said shaped head of journal pin to bear on body metal and at same time not interfere with the entrance of core into bore.

32. In combination in a rotary deep well drilling apparatus, a bit head having a bore for receiving a core, three inclined side cutters at the edge of said head, two of which are closely spaced relative to each other on one side of the vertical axis, and the third of which is more widely spaced from the others and is located on the opposite side of the axis with its axis in line with the space between the closely set cutters, and cylindrical roller cutters in the wide spaces between the said third cutter and each of the other two side cutters, said cylindrical cutters being on axes radial to the vertical axis of the apparatus and slightly overlapping the bore to cut clearance around the core to be received in said bore, substantially as described.

33. In combination in a rotary deep well coring apparatus, a bit head having a bore to receive a core, and a recess communicating with said bore, a horizontal cutter in said recess having its inner end at the bore to define the diameter of the core, a journal pin mounted at its outer end in the wall of the recess, said pin at its inner end having an enlarged head, which is curved at its inner face to conform to the curve of the bore, said enlarged head finding a bearing in the wall of the bit head adjacent said bore, and laterally in respect to the said journal pin, said cutter extending clear to the outer face of the head of said pin with no wall portion interposed.

In testimony whereof, I affix my signature.

CLARENCE E. REED.