

Dec. 27, 1927.

C. E. REED

1,653,929

ROTARY DRILLING APPARATUS FOR DEEP WELLS

Filed March 17, 1925

2 Sheets-Sheet 1

Fig. 1.

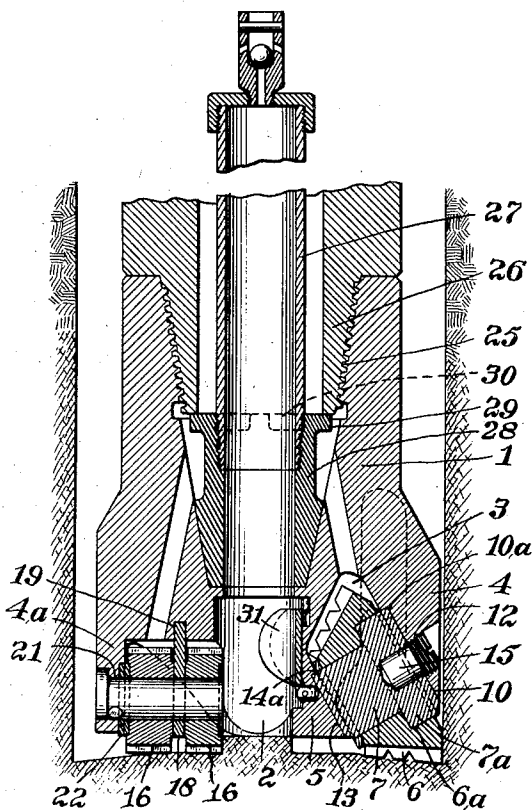


Fig. 3.

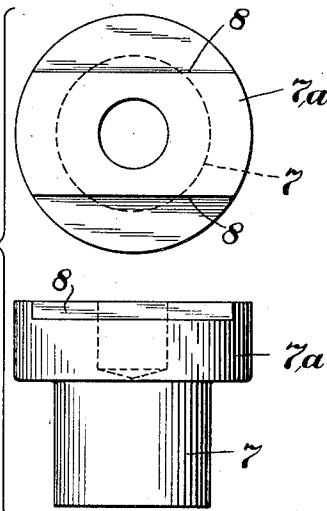


Fig. 4.

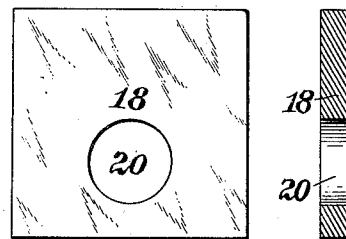


Fig. 2.

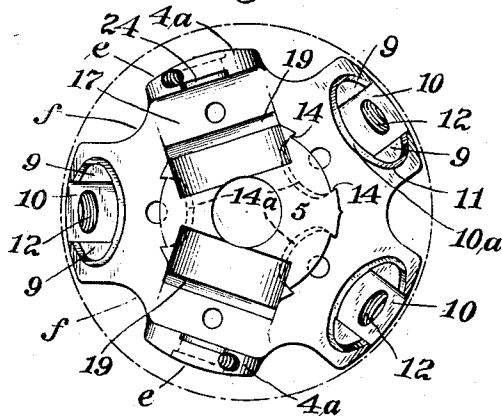
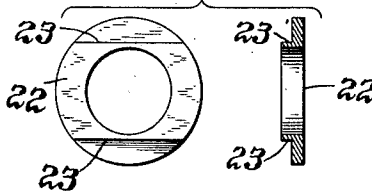


Fig. 5.



Inventor:



Fig. 2a.

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Fig. 6.

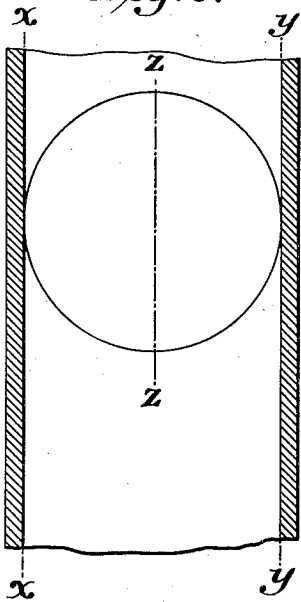


Fig. 7.

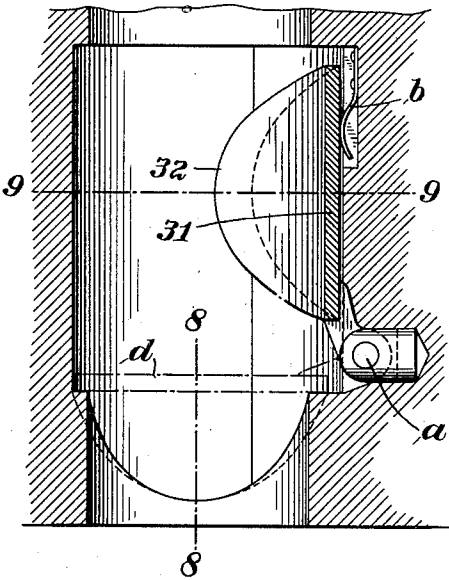


Fig. 8.

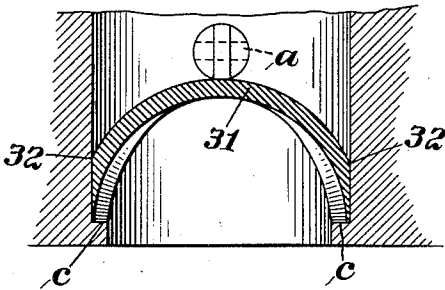


Fig. 9.

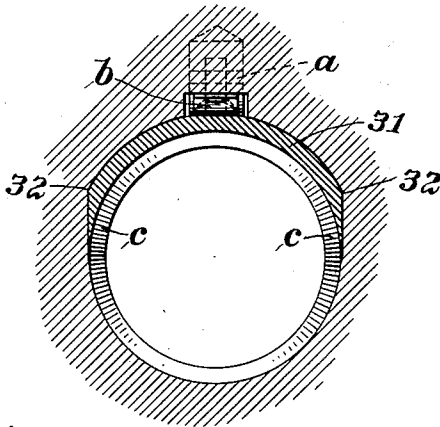


Fig. 11.

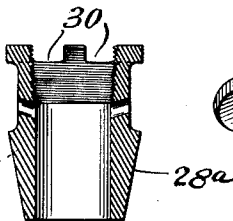
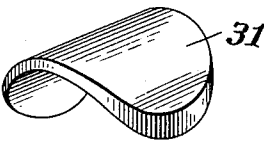


Fig. 10.



Inventor:

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By Spear, Middleton, Dumas & Hull

UNITED STATES PATENT OFFICE.

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ROTARY DRILLING APPARATUS FOR DEEP WELLS.

Application filed March 17, 1925. Serial No. 16,160.

The invention is designed to provide a simple and effective apparatus for coring deep wells, employing rotary roller cutters, and it consists in the features and combination and arrangement of parts hereinafter described and particularly pointed out in the claims.

In the accompanying drawings—

Figure 1 is a central vertical sectional view of an apparatus embodying the invention.

Fig. 2 is a bottom plan view with cutters omitted.

Fig. 2^a is a detail view showing one of the projections of the head furnishing the support for the bearing pin of the cylindrical cutter.

Fig. 3 shows a face and a side view of a cutter bearing.

Fig. 4 shows a bearing plate for the cylindrical roller cutter organization.

Fig. 5 shows views of a washer.

Fig. 6 is a diagrammatic view to show how the core trap may be developed.

Fig. 7 is a sectional view of a part of a core bit with the trap or retainer in place therein.

Fig. 8 is a vertical sectional view on line 8—8 of Fig. 7, with the trap closed.

Fig. 9 is a sectional view on line 9—9 of Fig. 7.

Fig. 10 is a perspective view of the core trap.

Fig. 11 shows a perforated shoe.

In these drawings, 1 is the core bit head made in one piece, and provided with a bore 2 to receive the core. This head is provided with spaces 3 formed between the outer overhanging projections 4 and the center portion 5 of the bit head, in which spaces are located rotary cutters 6 turning about axes inclining upwardly and outwardly with respect to the axis of the head. These cutters are mounted on bearings which have cylindrical portions of two diameters, as shown at 7, 7^a, the larger diameter portion being outermost. The rotary cutter is shouldered at 6^a to conform to the shape of the bearing member.

This bearing member is provided with slabbled off portions at 8, furnishing straight shoulders, and these conform in position to the walls 9 of a seat recess 10 formed in the inner face of the overhanging projection 4. This recess is formed by planing out the metal of the inner face of the projection after having made a circular groove 11 with

a suitable cutter introduced through the screw threaded opening 12 to get clearance for the planing tool.

The opposite wall or face 13 defining the space 3, is also provided with a seat recess indicated at 14, to receive the reduced cylindrical part 7 of the cutter bearing which finds an abutment at 14^a. The upper peripheral part of the enlargement 7^a finds a bearing or abutment at 10^a in the seat recess upon which the thrust is taken and the thrust of the cutter organization is so taken by the cylindrical part of the bearing engaging the shoulder 14^a at the top of the channel 14. The bearing is held in place by the screw 15, but by reason of the abutments 10^a and 14^a, this screw does not have to sustain any of the thrust.

The straight sides 8 of the bearing, by engaging the walls 9, prevent the bearing member from rotating, with the cutter. I show, in Fig. 2, a bottom plan view of the head arranged for receiving three of the inclined cutters, unequally spaced apart, and in the space between certain of these cutters I employ cylindrical cutters 16 in pairs. These are located in spaces 17 and these spaces are divided by removable bearing plates 18 seated in grooves 19 in the top walls of the spaces. These bearing plates are of rectangular form, as in Fig. 4, and they each have an opening 20 to receive the bearing pin 21 which has an eccentric head bearing in the body 1. There is also a washer 22 having one side slabbled off at 23 forming straight walls or edges to fit into a guide-way 24 in the outer wall of the space 17, and this washer forms a thrust resisting abutment device. The bearing plate finds bearings along its vertical side as well as along its top edge, and takes the twisting strain due to the rollers, and relieves the bearing pin. It also takes the upward thrust due to the rollers being on the bottom of the hole. The rollers of each pair 16 are of different width. At one pair the narrow roller is innermost and at the other pair, it is outermost, and the bearing walls are positioned to correspond, and they will not track so that the entire surface of the bottom of the hole, aside from the core, will be cut.

Suitable passages for flushing fluid will be formed through the head to flush the cutters.

The spaces in which the inclined side cutters are located merge into the spaces in

which the cylindrical roller cutters are located, and form substantially an annular continuous channel in the bottom face of the drill head for the churning and flow of the flushing fluid, which enters the spaces, in which the cutters are arranged, through the outlets in the head, in the usual manner. This annular channel surrounds the central portion 5 of the drill head at the center of which the core bore is placed.

The bit head is provided with a screw threaded socket at 25 to receive the end 26 of a reamer block carrying reaming tools such as that heretofore disclosed by me. See in this connection, for instance, Letters Patent of the United States No. 1,537,551, May 12, 1925. The core receiving tube is shown at 27, having a removable shoe 28 seated in the head, and having its flange 29 provided with openings 30 for the passage of the flushing fluid.

The shoe shown in Fig. 1 may be removed and replaced by one such as shown in Fig. 11 marked 28^a, perforated to allow flushing fluid to pass to the core for washing away the loose material thereof. The shoe is held to its seat by the reamer block 26 bearing on its flange 29.

It will be seen from Fig. 2 that the projections or walls 4^a in which the bearing pins of the cylindrical cutters are mounted extend substantially parallel with the axis of the drill and that these projections are set in towards the said axis closer than the projections 4 which furnish support for the inclined cutters.

This leaves spaces at *e* for the upflow of the flushing fluid, and to provide additional space vertical grooves are provided at *f* between the points where the projections occur.

Within the bore of this core bit and near the lower end thereof, say one-half or three-fourths of an inch from the lower end, is located the trap or retainer 31. This is of special shape and one way that this shape may be developed is to cut from a pipe, the diameter of which approximates that of the bore of the core bit, a piece of metal by a circular or ring-shaped cutter, the axis of which is at right angles to the axis of the pipe.

This might be done in a lathe and the edge of the resulting piece would be a section of a cylinder. The diagram, Fig. 6, illustrates how this trap or retainer may be developed. The lines *x-x* and *y-y* represent the opposite sides of the pipe from which the trap or retainer may be cut. In other words, *x-y* represents the inside diameter of this pipe and the circle inscribed between these lines *x-x* and *y-y* represents the outline of the piece cut from this pipe by directing a circular cutter at right angles to the axis of the pipe.

The trap of this formation is represented

at 31 in Figs. 7, 8 and 9, the trap as shown Fig. 7 being virtually a vertical section on line *z-z* of so much of Fig. 6, as appears within the circle shown in said figure. This trap is pivotally mounted at *a* at its lower edge. When the trap or core retainer is in what may be called its "open" position, due to the entering core, it lies, as shown in Figs. 1 and 7, with the diameter shown by the line 2-2 (Fig. 6) substantially vertical, and its wings 32 will extend around the wall of the bore of the tube about half-way. The bore will thus be entirely open for the upward passage of the core. When the boring apparatus is lifted from the well the trap will fall to the position shown at *d* in dotted lines, Fig. 7, this action being due to the weight of the core pressing the trap down from the full line position of Fig. 7, said trap in this action, of course cutting off the core.

When in its low or closed position, the trap presents an arch formation to sustain the weight of the core.

Comparatively thin metal may be employed for the trap and it may be located close to the lower end of the bore of the bit. When in its closed position the trap may find a bearing shoulder *c* in the bore of the core bit upon which to rest.

The trap may be formed by stamping or otherwise, it being understood that the diagram, Fig. 6, and the description relating thereto, are for the purpose of illustrating how the shape of the trap may be derived. A spring *b* will normally press the trap inwardly.

The side roller cutters, together with their bearings as 7, are assembled outside the head and are inserted into the head as a unit.

I claim:

1. In combination in a deep well coring apparatus, a drill head having a central bore to receive a core, and upwardly and inwardly inclined spaces at its lower end, the inner opposing walls of which spaces are provided with recesses terminating at their upper ends in shoulders and open at their lower ends, bearing members fitted to the inclined spaces and between said recessed walls, said bearing members being cylindrical on upwardly and outwardly inclined axes and having integral portions of two diameters with a shoulder between and with the larger diameter end uppermost, both the larger and smaller diameter ends of the bearing members contacting with the shoulders at the upper ends of the recesses, a roller cutter revoluble on the bearing and shouldered interiorly to fit the shoulder between the two diameter portions of the cylindrical bearing, and means passing through the wall of the recess for holding the bearing in place, substantially as described.

2. In combination in a deep well coring

apparatus, a drill head having a central bore to receive a core, and upwardly and inwardly inclined spaces at its lower end, the walls of which are provided with seat recesses open at their lower ends and having each a thrust sustaining shoulder at its upper end, a bearing of cylindrical form of two diameters, and with a straight shouldered formation at the larger outer end of the bearing, said straight shouldered portion fitting in the seat recess of the outer wall of the cutter receiving space to prevent turning of the bearing and to sustain thrust, the smaller end of the bearing fitting in the recess of the other wall of the space, a roller cutter on said bearing, the bearing and cutter being capable of insertion as a unit, and means for holding the bearing in place.

3. In combination in a deep well coring apparatus, a bit head having a core opening, depending projections at separated points about the edge of the head having inclined inner faces, and other projections about said edge extending parallel with the axis of the head and at a point nearer the axis of the bit than the outer faces of the projections first mentioned, said bit head having a depending central portion about the central bore to receive a core with spaces between the same and the said projections for receiving roller cutters, inclined roller cutters in the spaces defined by the projections first mentioned, and cylindrical roller cutters in the spaces defined by the other projections, the said spaces communicating with each other to form substantially an annular channel about the central bore of the bit head, means for conducting flushing fluid through the bit head to the said channel, and bearing plates seated removably in grooves in the top walls of the spaces in which the cylindrical roller cutters are located, and bearing pins mounted in the projections and bearing plates and free at their ends adjacent the core opening to present the cutter supported thereon at the edge of the bore for the core.

4. In combination, a core bit head with central bore to receive a core, and having a recess, roller cutters in the recess, a bearing pin mounted at one end in the head and free from support at end adjacent the core opening and a bearing plate on the pin intermediate its length fitting removably in a groove at the top of said recess, substantially as described.

5. In combination, a core bit head having a central projecting portion in its lower face around the core opening, projections around the edge of the bit head at different distances from the axis of the head, the spaces between said rejections and the central portion of the head defining the core opening connecting with each other to form substantially an annular channel about the said central bore,

recesses in said channel extending to the central bore of the head, cylindrical roller cutters in said recesses, pins held in the projections which define the outer ends of said recesses, bearing plates intermediate the length of said pins, on which pins the cylindrical roller cutters defining the core bearing, and inclined roller cutters mounted in the annular channel on bearings which are mounted in the projections located at the greater distance from the core opening, substantially as described.

6. In combination in a deep well coring apparatus, a bit head, a bearing pin mounted at one end in the bit head, and the other inner end adjacent the bore for the core free from support at the extreme end, a roller cutter on the pin, and means intermediate the length of the bearing pin to support the load on the pin, said pin by the same means being held against side thrusts.

7. In combination with a core bit having a central bore, a core tube within said bore with an annular space about it for flushing fluid, cutters on said bit head flushed by said fluid, a shoe removably carried by the core tube and seated in the head to direct flushing fluid from said annular space to the cutters, said shoe having a flange provided with openings for the passage of the flushing fluid and a member removably secured to the bit head and bearing on said flange to hold the shoe in its seat.

8. In combination with the bit head having a bore for flushing fluid, a core tube in the bore having a shoe with a conical lower end, said shoe having openings around its upper portion for the passage of flushing fluid, and a member screwed into the upper end of the bit head and bearing on the upper end of the shoe for holding it to the conical seat in the head, substantially as described.

9. In combination with a roller cutter bit head for deep well drilling, having a bore for a core, and a pocket communicating with said bore other than through the space between the lower face of the bit head and the bottom of the hole, a journal pin bearing in the outer wall of said pocket, roller cutter means on said pin, and a bearing for the pin other than that first mentioned located intermediate of the length of the pin, and spaced apart from the first bearing, substantially as described.

10. In a deep well rotary cutter coring apparatus, a core bit having a central bore to receive a core, three inclined rotary cutters each mounted with its axis inclined upwardly and outwardly, a pair of said cutters being located at one side of the bit and more closely spaced apart than space between each member of the pair and the third inclined rotary cutter, said third rotary cutter being located at the edge of the bit opposite the edge at which the pair of cutters is located

with its axis in a vertical plane extending diametrically of the bit and in line with the space between the pair of cutters, cylindrical roller cutters arranged in the spaces between the pair of inclined cutters and the third inclined rotary cutter, said cylindrical cutters being on axes radial to the axis of the bit, and located to cut a zone closer to the axis of the bit than the zone cut by the inclined rotary cutters, and bearings intermediate the length of the cylindrical cutter, substantially as described.

11. In combination in a deep well drilling apparatus, a bit head, having a core opening, depending projections at separated points about the edge of the head and having inclined inner faces, and other projections about said head extending substantially parallel with the axis of the head and at a point nearer the axis of the bit head than the projections first mentioned, said bit head having a depending central portion about the core opening with spaces between the same and the said projections for receiving roller cutters, inclined roller cutters in the spaces defined by the projection first mentioned and cylindrical roller cutters in the spaces defined by the other projections, the said spaces communicating with each other to form substantially an annular channel about the central bore of this bit head, and means for conducting flushing fluid through the bit head to the said channel, substantially as described.

12. In combination in a core bit for deep well drilling apparatus, a bit head having a bore for receiving a core and a recess communicating with said bore, and having a wall defining the outer end of said recess, a journal pin mounted in said wall, a removable bearing plate seated in a groove in the said recess and supporting said pin at a point intermediate of its length, and rotary cutter means mounted on said pin, said rotary cutting means cutting clearance about the core at the central bore, substantially as described.

13. In a deep well rotary roller coring apparatus, a core bit having a central bore to receive a core, and having in its lower face recesses located on different radii and communicating with said bore, a pair of cylindrical rotary cutters in each recess, one cutter of each pair being wider than the other, the wide cutter in one recess being located at the bore and the wide cutter in the other recess being located spaced apart from said bore, a journal pin in each recess supported at its outer end, and a bearing at each recess located between the members of the pair of rotary cutters in said recess, said bearings being spaced at different distances from the

axial center of the bit head, the wide cutters being substantially of equal size and the narrow cutters being substantially of the same size.

14. In combination in deep well drilling apparatus, a bit head having a pocket inclining upwardly and inwardly relative to the vertical axis of the head with recesses in opposing inner upwardly and inwardly inclined walls thereof, which recesses are open at their lower ends for the insertion of a bearing member, a bearing member insertable into the pocket with its ends in said recesses and bearing against the shoulders at the upper ends of the recesses, a rotary cutter on said bearing and a pin extending through only the outer wall of the pocket into the bearing member to hold it against dropping out, substantially as described.

15. A deep well drilling apparatus according to claim 14 in which the bearing member is of two diameters forming a shoulder between them, said bearing member being integral throughout and the roller cutter is formed to correspond, said bearing inclining upwardly and outwardly and the larger diameter portion being at the higher end of said bearing.

16. In a core bit, a trap of circular form in plan view, its shape being the section of a hollow cylinder taken at right angles to the axis of the cylinder, said trap being pivoted to lie with its convex face parallel to the wall of the bore, when in open position, said bore having a ledge having two vertically concaved portions to receive and support the edges of the wings of the said trap, substantially as described.

17. In a deep well roller cutter coring drill, the combination of a bit head having a central bore, and three only side pockets inclining upwardly and inwardly, side roller cutters in said side pockets, two of which side pockets being arranged close together and the third pocket being more widely and equally spaced from each of said two closely spaced side pockets, two only cylindrical roller cutter organizations located in recesses in the wider spaces between the two closely spaced side cutters and the third side cutter, journal pins mounted in the outer walls of said recesses and extending to the edge of the central bore, and bearings in the recesses intermediate of the lengths of the said pins, with a section of the cylindrical roller cutters on each side thereof, the innermost section of each cylindrical cutter roller cutting clearance at the edge of the bore hole, substantially as described.

In testimony whereof, I affix my signature.

CLARENCE E. REED.