July 19, 1927. 1,636,664

C. E. REED

ROTARY DEEP WELL DRILLING APPARATUS

Filed Oct. 27, 1926 2 Sheets-Sheet 1

Fig. 1.

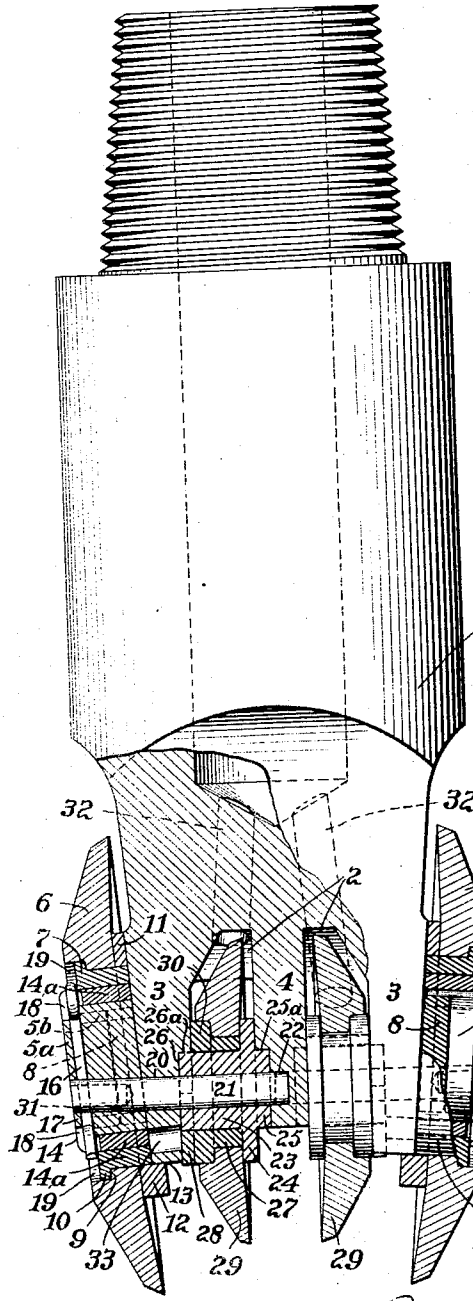


Fig. 2.

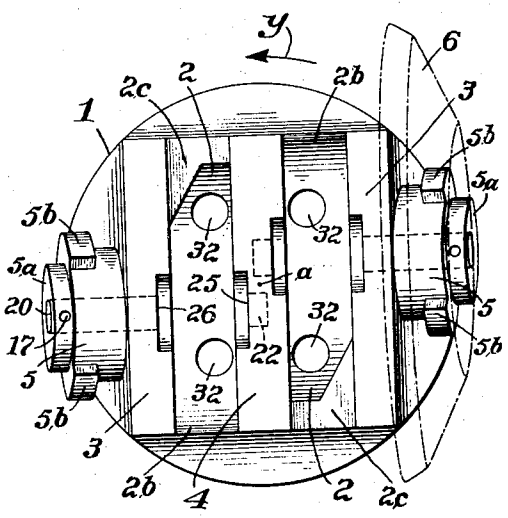
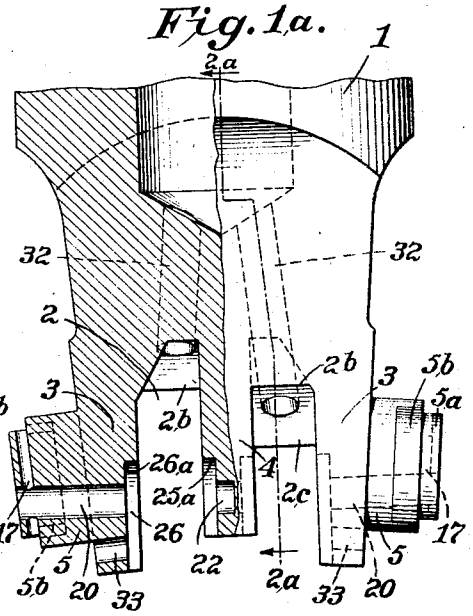


Fig. 1a.



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ROTARY DEEP WELL DRILLING APPARATUS

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Fig.3.

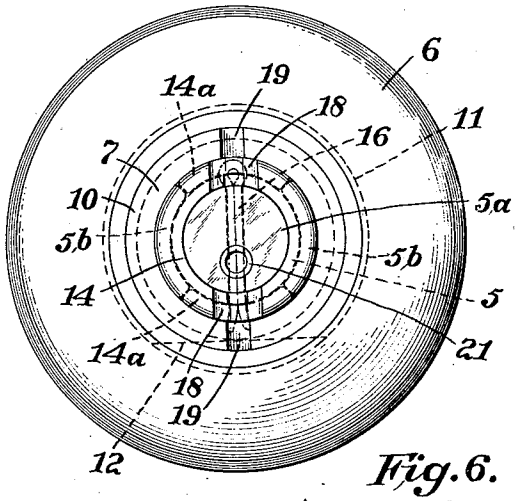


Fig.4.

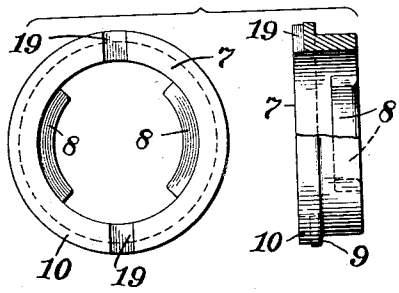


Fig.5.

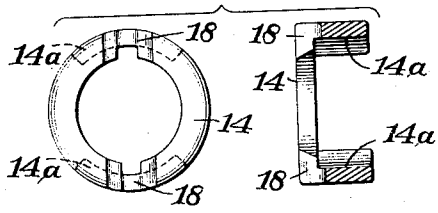


Fig.6.

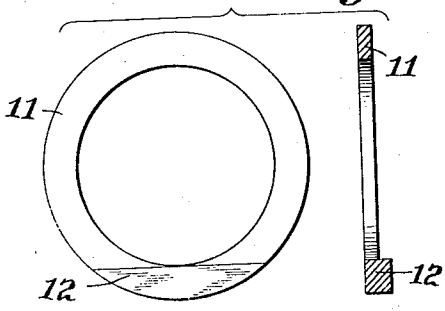


Fig.7.

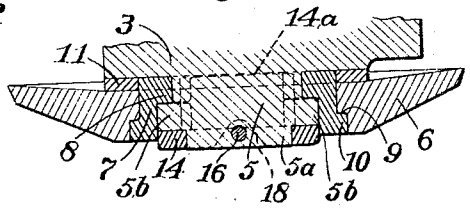


Fig.2a.

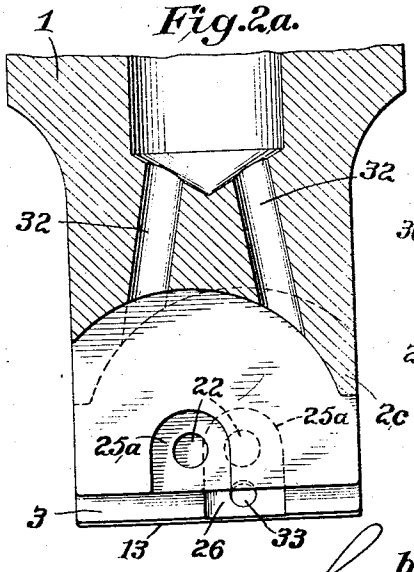


Fig.8.

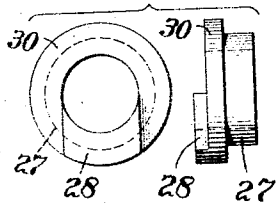
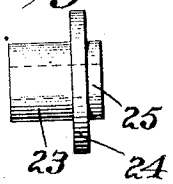


Fig.9.



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UNITED STATES PATENT OFFICE.

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ROTARY DEEP-WELL-DRILLING APPARATUS.

Application filed October 27, 1926. Serial No. 144,487.

The invention concerns a rotary deep well drilling apparatus employing disc cutters and is specially adapted for cutting shale and so called soft formations which can be readily penetrated by a cutter having a combined rolling and slicing cut.

One object of the invention is to provide a drilling tool of rugged construction to withstand the stresses and strains to which such tools are subjected.

Another object is to provide such a construction as will enable quick assembly of the parts to be performed and will save time and labor of the crew in the field in removing worn parts and replacing the same with new parts.

A further object is to provide such disposition of the disc cutters that each will operate upon the formation with a combined rolling and slicing cut.

Other objects will appear from the following description.

The invention 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 in part a vertical sectional view and in part a front elevation of the drilling tool.

Fig. 1[a] is a view of the head alone.

Fig. 2 is a bottom plan view of the bit head.

Fig. 2[a] is a vertical sectional view on line 2[a]—2[a] of Fig. 1[a].

Fig. 3 is a face view of the outer cutter assembly.

Fig. 4 is a detail view of the outer cutter disc bushing.

Fig. 5 is a detail view of the locking member.

Fig. 6 is a detail view of the washer belonging to the outer cutter assembly.

Fig. 7 is a sectional view taken horizontally through the outer cutter member, together with the adjacent parts.

Fig. 8 shows the bushing for the inner cutter.

Fig. 9 shows the bearing for the inner cutter.

The drill head 1 has recesses in its lower face at 2 leaving depending side walls 3 and a central wall 4.

On the outer sides of the side walls and integral therewith are projecting bosses 5, the axes of which incline slightly downwardly and outwardly.

These bosses are provided with end portions 5[a] of slightly reduced diameter, and with spaced apart locking ribs 5[b], to be engaged by companion ribs on the bearing collar or bushing of outer cutting disc for quick assembly or removal as will be more fully pointed out hereinafter.

These bosses which form supports for the outer cutter organizations are off-set in relation to each other around the central vertical axis of the drill head indicated in Figure 2 at *a*. The extent of this offset relation, desirably, may be as shown in said Fig. 2, the offset relation being in the direction of rotation of the drill head.

The outer cutting disc 6 is mounted upon a bushing or bearing collar 7 which in turn is mounted on the stud or projection 5. This bushing has lugs or ribs 8 on its interior and at or near its inner lateral face which engage in back of the lugs or ribs 5[b] on the boss or stud 5 to hold the bushing in place. These lugs or locking ribs are of segmental form and they are made to interlock with the companion segmental ribs or lugs 5[b] on the stud by moving the bushing axially along the stud towards the head so that its lugs 8 will pass through the spaces between the locking segments or ribs 5[b] of the stud and then by giving the bushing a quarter turn its lugs will engage behind the lugs of the stud or supporting projection.

It will be understood that previous to placing the bushing in place the outer cutting disc 6 has been mounted thereon so that these parts i. e. cutting disc and bushing may be handled as one body. The bushing 7 has a shoulder at 9 formed by a rib or flange 10 around its outer edge so that the cutter disc, which is correspondingly formed to receive said flange, will be held in place on the bushing.

At its inner face the outer cutting disc bears on a ring washer 11 which lies in contact with the outer face of the drill head 1.

This washer is held from turning by a lug or rib 12 extending from its inner lateral face to engage beneath the surface 13 at the lower end of the head, said lug or rib having a straight flat upper face engaging the like under face at 13 of the head of the bit. This washer may be assembled with the cutter and its bushing to be handled as one body therewith, for which purpose its interior diameter is equal to the exterior diameter of the inner end of the bushing 7. For locking the bushing 7 against turning and thereby to prevent its lugs or ribs from disengaging the ribs 5^b of the supporting stud or projection 5, a locking member is provided consisting of a ring shaped portion 14, the bore of which is of a diameter to slip onto the reduced diameter end 5^a of the stud or projection 5, the said ring having integrally formed therewith segments or wings 14^a projecting from its inner lateral face.

These segments or wings are concentric with the periphery of the stud or projection 5 and they fit in the recesses or spaces between the ribs or lugs 5^b and also in the recesses between the lugs or ribs 8, it being understood that these recesses align when the lugs align, that is when segmental lugs 8 of the bushing lie directly back of the lugs 5^b of the fixed stud or projection 5. By its segments 14^a fitting in and filling the recesses between ends of lugs or ribs 5^b, the said locking member will be held from turning in relation to the stud or projection and furthermore, its wings or segments 14^a fitting in the spaces between the lugs or ribs 8 will prevent these from turning and hence the bushing 7 will be locked in place by said locking member so long as this is maintained in position. For so maintaining this locking member in position a cotter pin 16 is employed which extends through an opening 17 in the stud or projection 5, which opening is transverse to the axis of said stud. The ends of the cotter pin overlie the outer face of the locking member to hold it in place, which face may have depressions or recesses at 18 in which the said ends of the cotter pin lie, and are there protected against grinding away by contact with the formation. For facilitating the insertion of the cotter pin the bushing is grooved or notched at 19. These grooves form extensions of the recesses or depressions 18 of the locking member.

There is a disc cutter within each of the recesses 2. These, like the cutters 6. are offset in relation to each other in the direction of rotation of the drill head. They are on axes which are horizontal and parallel and these axes, when viewed as in Fig. 2, are in the same vertical plane with the center lines of the adjacent external studs or projections 5, though when viewed as in Fig. 1, they are in a plane below the said axes of the studs, which latter axes as before described incline downwardly and outwardly. The studs and the depending side parts 3 of the head are bored with openings 20 to receive bearing pins 21, which extend across the recesses 2 and enter sockets or seats 22 at opposite sides of the central depending part 4 of the head. These sockets, due to the offset arrangement of the cutters above described, are axially out of line with each other. The outer ends of these bearing pins find seats in the head and bosses 5 thereof. On these pins and within the recesses, bearing members are mounted of cylindrical form as at 23, with a circular flange at 24 lying against the face of the depending wall 4 of the head and with a cylindrical projection 25 fitting in a channel or recess in said wall 4. This channel is open at its lower end so that the bearing can be slipped up into place in the recess, and find a thrust resisting shoulder at 25^a. There is a corresponding channel or recess 26 in the inner face of the wall 3. This receives the end of the cylindrical body portion 23 of the bearing member, this channel likewise being open at its lower end so that the bearing can be slipped up into place. The end of this body portion 23 also finds a thrust resisting shoulder, this being shown at 26^a. On this bearing member is mounted a bushing 27 which has a lateral projection 28 with straight sides to slip up into the channel 26 and by contact with the straight walls of said channel to be maintained against turning movement.

The disc cutter 29 is mounted on this bushing between the flange 30 thereof and the flange 24 of the bearing member 23.

These parts, i. e. bearing member 23, bushing 27, and cutter 29, are all assembled to be handled as one body in placing them in the bit head or in removing them therefrom, by slipping them as a body up into the recess 2 with the parts as described in engagement with the channels, or ways formed in the walls of said recess. These channel or ways 25, 26 have straight opposing vertical walls, while the shoulders 25^a and 26^a are semi-circular, to receive the cylindrical ends of the bearing 23. When inserted the cutter organization is held in place by the pin 21 which is thrust into position as shown through the bore of the stud 5. This pin is held in place by the cotter pin 16 before mentioned and for this purpose it is perforated at 31 transversely to receive said cotter pin.

All the cutters being offset forwardly in the direction of rotation of the head, they will perform a slicing cut on the formation as well as a rolling cut, and they will cut a larger hole than would be the case were they located on axes radial to the drill head. The outer cutters are of larger diameter

than the inner cutters and determine the diameter of the hole as well as digging or cutting at the bottom of the hole. The inner cutters do their cutting at the bottom of the hole. All the cutters can be quickly assembled in connection with the parts immediately associated therewith outside the head and then quickly assembled on or in the head, and they may be quickly removed.

As above stated the bosses or projections 5 extend at an inclination downwardly and outwardly. This positions the outer cutters at a downward and inward inclination in respect to the vertical axis of the drill head. These cutters and also the inner cutters 29 are of dish shape, and are bevelled on their outer sides. The inner cutters 29 rotate in vertical planes. The arrangement of cutters is such that the drill will maintain its direction.

Suitable provision is made for flushing the cuttings and for this purpose there are conduits 32 extending from the hollow center of the drill head.

An opening is provided at 33 in each of the depending side walls through which a suitable implement may be inserted to force the locking member 14, 14^a from its locking position should this have a tendency to stick.

From Fig. 2 and Fig. 2^a it will be noticed that the recesses 2 are open at one end, see 2^b, and at the other end each recess is defined by a wall 2^c reaching down as shown in Fig. 2^a to about midway of the height of said recessed portion of the bit head.

This wall 2^c adds strength to the structure and particularly to the wall carrying the outside cutter. The recess is open at the outer end only enough to permit extension of the cutter therethrough. This recess at its upper wall as shown in Fig. 2^a conforms to the circular periphery of the inner cutter, proper allowance being made for clearance. The flushing fluid conduits 32 open into these recesses at the top wall thereof and discharge directly on the inner cutting discs. The discharge of flushing fluid from the recesses takes place against the inner face of the outer cutting discs and washes them clean. When this drill is lowered into a hole containing soft, sticky material in the bottom, the discs open a wedge shaped passage and divert the slush from entering the holes and plugging the drill, which is liable to happen in tools providing an open hole opposed to the bottom of the well. It will be noted that the central partition 4 is shorter than the depending sides 3 of the drill head. This is because the inner cutters are of smaller diameter than the outer cutters. Hence it is desired to have the lower end of the partition to lie sufficiently high above the bottom of the hole to avoid friction.

I do not limit myself to the exact form of cutter shown or to the character of its cutting edge. The construction of the bit may be modified within certain limits without departing from the scope of the invention for a definition of which reference is made to the accompanying claims.

I claim:

1. In combination in a rotary deep well drilling apparatus, a drill head having at its lower end depending side walls and a depending central wall, said side walls having projecting bosses on their outer sides which are off-set in relation to the radii of the head and also in relation to each other in the direction circumferentially of the head, rotary disc cutters mounted on said bosses having a rolling and slicing cutting action by reason of their axes being offset in respect to the radii of the head, a pair of inner disc cutters, one of which is disposed in the recess on each side of the central wall, said inner cutters being offset in relation to each other and to the radii of the head and substantially in the same vertical axial plane with the adjacent outside cutter, pins passing through the bosses and having their inner ends seated in disaligned sockets on opposite sides of the central wall and means mounted on the bosses for holding the said pins in place, substantially as described.

2. In combination in deep well drilling apparatus a head recessed at its lower end, a pair of disc cutters rotatively mounted in said recessed portion, and turning about parallel horizontal axes located in the same horizontal plane but offset forwardly in respect to each other in the direction of rotation of the head and offset also in respect to the radii of the head, and disc cutters rotatively mounted on the exterior of the head on axes inclining downwardly and outwardly, said external cutters being offset similarly to the inner pair of cutters, and of larger diameter than the inner cutters, substantially as described.

3. In combination in a rotary deep well drilling apparatus, a drill head having depending side walls and a central wall, forming a pair of recesses, a bearing in each recess having its ends slidable into place in ways, or channels, in the inner and outer depending walls, a bushing on each bearing having a lateral projection to engage one of the channels to be held against rotation, a cutter rotatively mounted on each bushing, bosses projecting on the outer side of the side walls, rotary cutters mounted on said bosses, pins extending through the bosses, and the said inner bearings and seated at their inner ends in sockets in the central depending wall and means carried by the bosses for holding the pins in place, said bearings finding thrust resisting shoulders at the upper ends of the channels, each of said bearings, with its bushing and cutter, being handled as one body, substantially as described.

4. In combination in a rotary deep well drilling apparatus, a head having a recess, with a guideway and abutment shoulder in each wall, a rotary cutter, and a bearing therefor comprising an inner member having a flange or shoulder to bear on the wall of the recess to take the end thrust, and ends extending into said channels to engage the abutments to take the load, and a shouldered bushing on said inner member, bearing on the wall of the recess and having a projection, to engage one of the channels to prevent turning, and a pin bearing in the walls of the recess for holding the bearing in place, substantially as described.

5. In combination with the drill head having a recess in its lower face, removable cutter means in said recess, a projection on the exterior of the head, a bushing having interlocking lugs which are made to interlock by a partial turn of the bushing, a locking member, movable axially of the projection to hold the bushing against retrograde turning movement, means for holding the locking member in place, said head having an opening extending to said locking member from the lower recess of the head for the introduction of a tool to move said locking member axially of the projection for dislodging the same, substantially as described.

6. A rotary deep well drilling tool comprising a head having two recesses in its lower face, divided from each other by a central integral partition, said recesses each having one end open and with a depending wall at the other end connecting the partition with the side wall of the head, the open side of one recess being adjacent the closed side of the other recess, rotary cutters mounted on the outer side of side walls of the head, and rotary cutters mounted between the side wall and central partition of the head and offset relatively to each other, substantially as described.

7. A rotary deep well drilling apparatus according to claim 1 in which the axes of the outer cutters are in a higher plane than the axes of the inner cutters, said outer cutters being of larger diameter than the inner cutters, substantially as described.

In testimony whereof, I affix my signature.

CLARENCE E. REED.