Feb. 21, 1928. 1,660,309

O. DUDA

ROLLER BIT AND REAMER

Filed Sept. 19, 1925 3 Sheets-Sheet 1

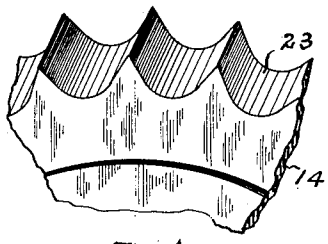


Fig. 4.

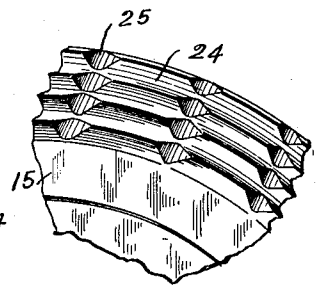


Fig. 5.

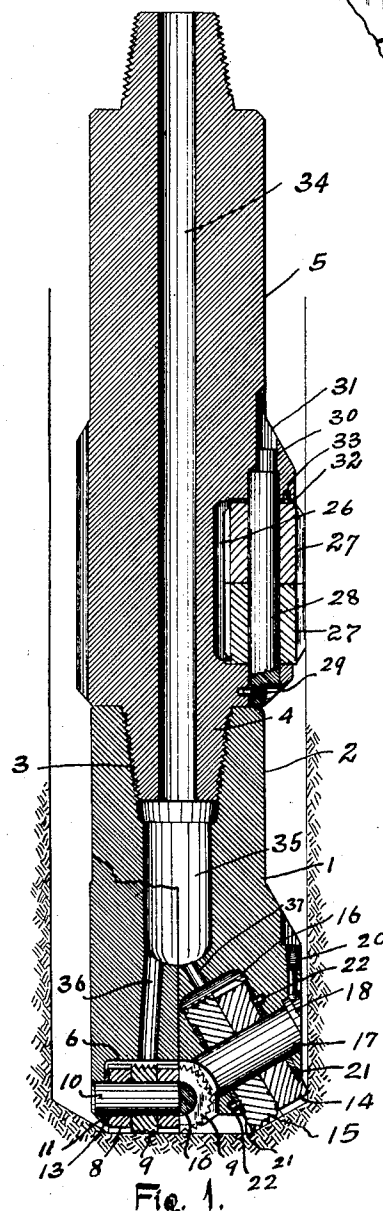


Fig. 1.

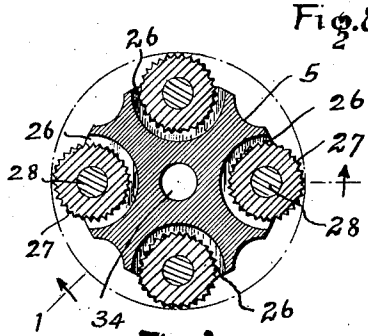
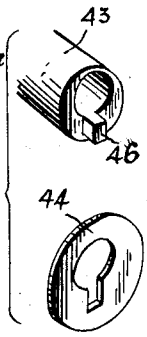


Fig. 3.

Fig. 8a.



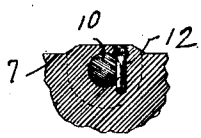


Fig. 6.

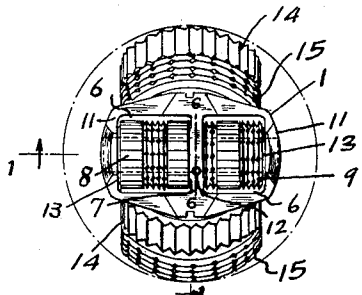


Fig. 2.

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Attys

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O. DUDA

ROLLER BIT AND REAMER

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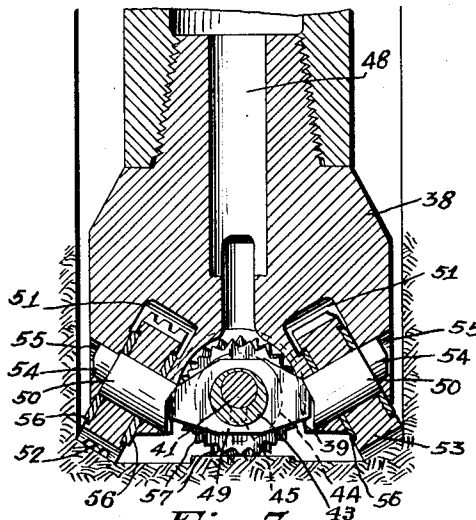


Fig. 7.

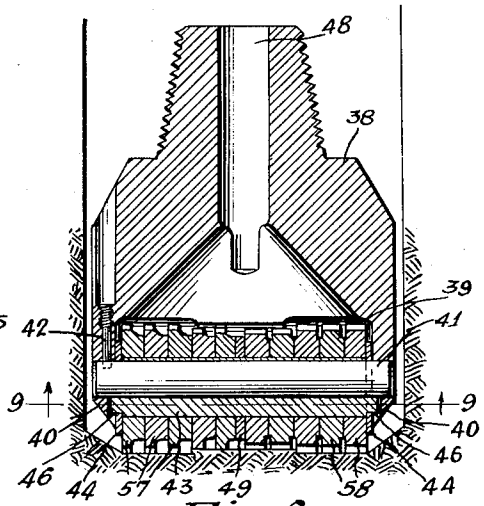


Fig. 8.

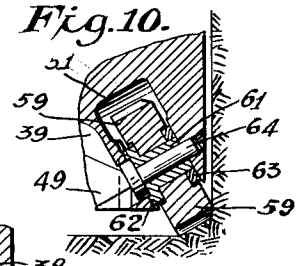


Fig. 10.

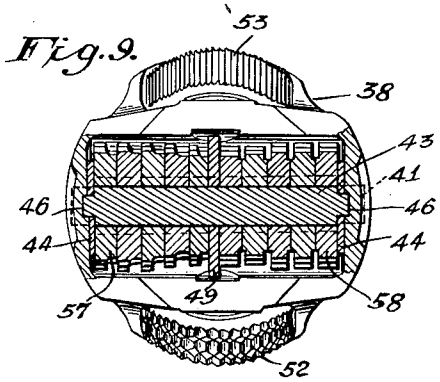


Fig. 9.

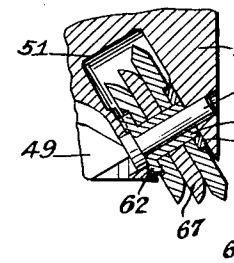


Fig. 12.

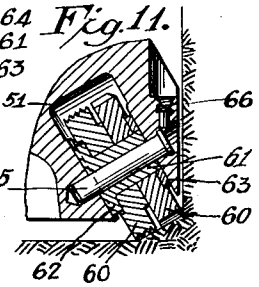


Fig. 11.

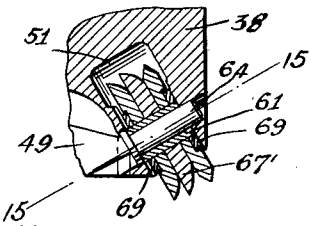


Fig. 14.

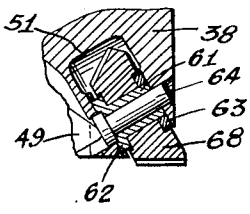


Fig. 13.

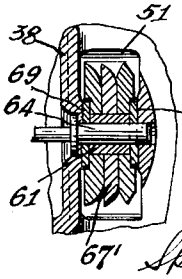


Fig. 15.

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ROLLER BIT AND REAMER

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Fig. 17.

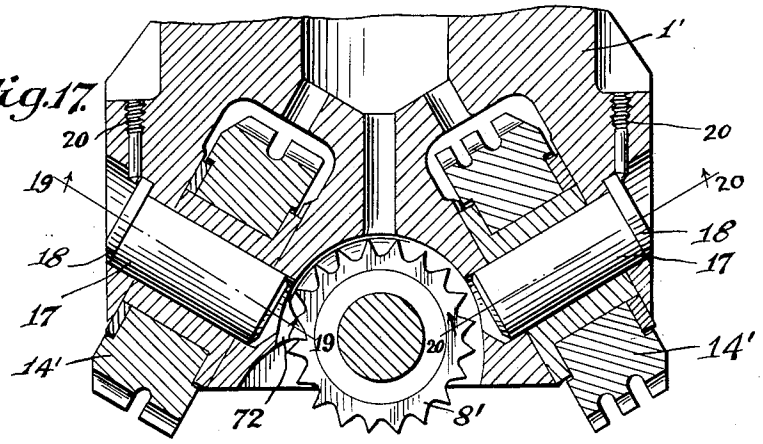


Fig. 18.

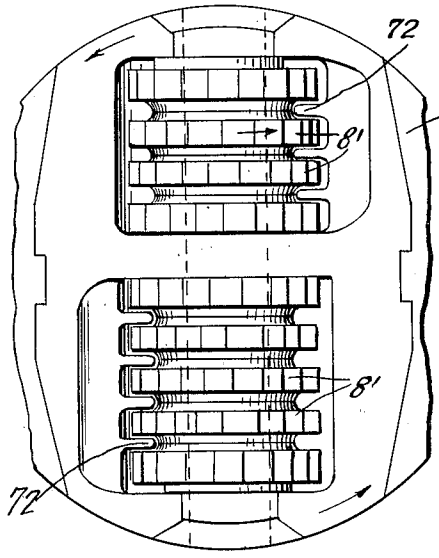


Fig. 19.

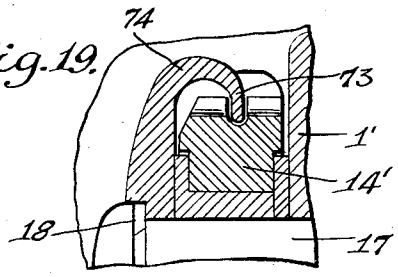


Fig. 20.

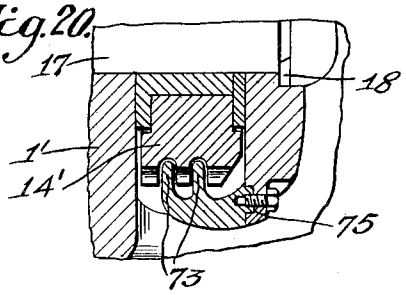


Fig. 21.

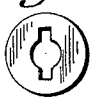
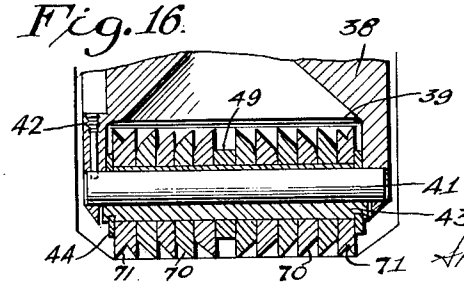


Fig. 22.



Fig. 16.



Inventors.

Oswald Duda

By Spear, Middleton, Donnelly & Hull
Attys.

Patented Feb. 21, 1928. 1,660,309

UNITED STATES PATENT OFFICE.

OSWALD DUDA, OF SOUTH HOUSTON, TEXAS, ASSIGNOR TO REED ROLLER BIT COMPANY, OF HOUSTON, TEXAS, A CORPORATION.

ROLLER BIT AND REAMER.

Application filed September 19, 1925. Serial No. 57,434.

This invention relates to new and useful improvements in a drill and reamer.

One object of the invention is to provide a boring tool, of the roller type and having an improved design to increase the clearance between the drill head and the sides and bottom of the bore, for the return of the "slush" and cuttings.

Another object of the invention is to provide a drill, of the roller type so constructed that the abrading rollers, working against the bottom of the bore, will disintegrate the material at the bottom so as to keep said bottom comparatively free from steps, or offsets, as formed by certain types of drills now used, to the end that the disintegrated material will be quickly swept from the bottom, by the flushing fluid, and will not remain under the drill to impede progress and wear away the roller teeth.

A further object of the invention is to provide a roller drill bit and reamer having a tong space between the bit proper and reamer, for the application of tongs in handling the tool in the derrick.

A further feature of the invention resides in the provision of a roller drill having the rollers arranged in pairs, the rollers of each pair being arranged to track and having teeth arranged to form cuts in the material of the bottom of the bore at angles to each other to facilitate the disintegration of the hard formation being pierced.

A still further object of the invention is to provide a drill having a drill head so formed as to permit the cutting rollers to be disposed therein in such relation that the entire bottom of the bore will be operated upon by said cutters, to the end that no central upstanding core will be left, whereon the head may ride, to retard drilling, as sometimes happens when certain types of drill, now commonly employed, are used. This type of drill head is also provided with courses for flushing fluid so arranged and designed as to insure the washing, or flushing, of the bore from the cutter towards the outside and to prevent congestion of cuttings beneath the rollers, thus reducing the wear on the roller teeth and speeding up the work.

A special feature of the invention consists of the toothed formation of the rollers, this formation being such that the troughs, or grooves, between the teeth are concaved to prevent the clogging of cuttings between said teeth and another special feature of the invention resides in a type of bearing pin employed, the same having an eccentric end extension, adapted to seat in a recess in the adjacent part of the drill, to lock said pin against turning.

It is also an object of the inventor to provide a roller drill and reamer so constructed and assembled that no movable parts are adjacent the head itself, thus reducing the wear on said head, so that the tool may be renewed, from time to time, by merely renewing the rolling cutters, bearing pins and minor parts thus resulting in great economy in use.

A still further feature of the invention resides in the provision of cleaning devices adapted to co-operate with the cross rollers and side cutters, and provided for the purpose of cleaning from said cross rollers and cutters the formation having a tendency to adhere thereto and retard the progress of the tool.

The invention also embodies novel construction and arrangement of reamers, and certain novel means for retaining the parts in assembled relation.

With the above and other objects in view this invention has particular relation to certain novel features of construction, operation and arrangement of parts, an example of which is given in this specification, and illustrated in the accompanying drawings, wherein:—

Figure 1 shows a vertical sectional view of the drilling tool, the drill bit head portion being shown on the line 1—1 of Figure 2 and the reamer portion being shown on the line 1—1 of Figure 3, looking in the direction indicated by the arrows in these respective Figures 2 and 3.

Figure 2 shows a bottom view.

Figure 3 shows a cross sectional view of the reamer.

Figures 4 and 5 respectively show enlarged fragmentary perspective views of abrading, or cutting rollers employed.

Figure 6 shows a fragmentary view on line 6—6 of Figure 2.

Figures 7 and 8 show vertical sectional views taken at right angles to each other, of a drill showing certain modifications of the form shown in the other figure.

Fig. 8a shows details relating to the eccentric sleeve and washer.

Figure 9 shows a horizontal sectional view on the line 9—9 of Figure 8.

Figure 10 shows a fragmentary sectional view of the type of drill shown in Figure 7 showing another form of mounting of the side cutters.

Figure 11 shows a fragmentary sectional view thereof showing said side cutters formed of sections, or in parts, with still another form of mounting therefor.

Figure 12 is a similar view to that shown in Figure 11, showing a side cutting member, of a general frusto-conical contour, and formed of a plurality of cutting discs.

Figure 13 shows a similar view to that shown in Figure 12 with a single frusto-conical shaped side cutter.

Figure 14 shows a similar view to that shown in Figure 12 with the cutting discs of substantially the same diameter and mounted to rotate on a stationary bushing with separate stationary washers.

Figure 15 shows a sectional view taken on the line 15—15 of Figure 14.

Figure 16 shows a vertical sectional view of the type of drill shown in Figure 8 with disc-like cross cutters.

Figure 17 shows a fragmentary vertical sectional view of the drilling tool embodying cleaning devices for the cross rollers and side cutters. These cleaning devices may be integral with the head as shown at 74 or detachable as shown at 75.

Figure 18 shows a fragmentary bottom end view thereof.

Figure 19 shows a fragmentary sectional view taken on the line 19—19 of Figure 17.

Figure 20 shows a fragmentary sectional view taken on the line 20—20 of Figure 17, and

Figures 21 and 22 are details.

Referring now more particularly to the drawings, wherein like numerals of reference designate similar parts in each of the figures, the numeral 1 designates the drill bit head, whose upper end or shank 2 is reduced, and elongated, forming a tong space for the reception of a tong while handling the drill in the derrick. This shank has a tapering, internally threaded box 3, to receive the tapering externally threaded pin 4 on the lower end of the reamer body 5.

The bit head as viewed from the bottom presents an approximately elliptical contour with two concaved cross roller pockets 6, 6, separated by a transverse, integral web or partition 7, slightly to one side of the axis on which the drill rotates. In the respective pockets 6 there are located the sets of rolling cross rollers 8 and 9, arranged alternately. These cross rollers are mounted to rotate on a cross pin 10 and the corresponding cutters 8 and 9 of the respective sets form pairs of cutters, the cutters of each pair tracking as the drill rotates. The cross pin 10 is mounted in the end bearings 11, 11, of the head 1 and also has an intermediate bearing in the web 7. A set screw 12 fitted into web 7 and cross pin 10 from beneath locks the cross pin 10 against rotation or lengthwise movement. Between each end cross roller 8, 9 and the adjacent head bearings as 7 or 11, are the stationary washers 13.

Rotatably mounted in the bit head, on opposite sides of the cross rollers, are the pairs of side cutters 14, 15, and 14, 15, the correspondingly arranged side cutters forming a pair and the members of each pair being arranged to track alternately. The bit head is provided with oppositely disposed downwardly diverging side cutter pockets 16, 16, to receive and form bearings for said side cutters. These cutters on each side are mounted to rotate on the respective pins 17, 17 which are inserted into the head from the outside and whose outer ends have eccentric heads as 18, which seat in corresponding side recesses in the head to hold said pins against turning. Set screws as 20 are threaded downwardly through tapped holes, in the head, provided for them and their lower ends engage behind the eccentric heads 18 to lock the pins 17 against displacement.

Washers 21 are fitted on the pins 17, and located between the respective cutters 14, 15, and the adjacent side walls of the pockets 16 and these washers are held stationary by means of suitable dowel pins 22, carried by them, fitting into pockets in said side walls.

The cross rollers 8 and the side cutters 14 have transverse marginal teeth, and their corresponding cutters 9 and 16 of the respective pairs, have peripheral cutting teeth, as illustrated in Figures 4 and 5. Since the cutters of each pair track the cuts in the formation made by one will be across the preceding cuts made by the other, thus conducing to rapid disintegration of the formation. It is to be further noted that the grooves of troughs, 23, 24 between the cutting teeth of these cutters, are concaved. This is an important feature. Heretofore these grooves, or troughs, have been triangular, in cross section, the facing sides of the teeth thus forming acute angles in which the cuttings had a tendency to collect and pack, until said grooves were partly or sometimes completely filled up with hard, closely packed material, causing the cutters to merely roll around on the formation and preventing the penetration of the formation by the teeth. It has been found that with the concaved grooves or troughs, between said teeth the cuttings will not collect between the teeth but will be forced out, the cutters thus being self cleaning. The teeth of the

cutters 15, also have spaced cross notches 25 which enable them to take hold of the formation and said cutters are thereby forced to turn on their axis, as the drill rotates, rather than to slip and wear flat on one side.

The reamer body 5 has an enlarged section with a plurality, preferably four, of concaved, semi-cylindrical pockets 26. In these respective pockets are the sectional reamers 27, preferably formed of two sections, an upper and lower. These reamers have the lengthwise cutting teeth adapted to ream out the side walls of the bore and the upper and lower ends of these teeth are beveled inwardly, as shown. These reamers are mounted on the respective bearing pins 28, whose respective ends have bearings in the reamer body. In assembling, these pins are held in place by the set screws 29, which are threaded through their lower ends into the reamer body, but when assembled and the reamer body is connected to the drill head, the bearing pins 28 are held in place by the upper end of said drill head. The upper end of each pin 28 has a reduced eccentric portion 30 which fits snugly in a bearing 31 in the reamer. Said pins 28 are thereby held against turning. During drilling operations there is an upward thrust imparted to the reamers so that only the upper ends of the reamer have any appreciable friction against the reamer body. Accordingly, only one friction washer 32 is provided for each reaming cutter and is inserted between the upper end of the cutter and the adjacent bearing face of the reamer body and held against turning by the dowel pin 33.

A fluid course 34 for flushing fluid leads downwardly through the reamer body and bit head and is formed into an enlarged chamber 35; in said head and leading from said chamber there is a relatively large fluid conduit 36, which discharges the main body of the flushing fluid at the center of the bore so as to flush the cuttings towards the outside of the bore. There are also relatively small fluid conduits 37 leading from the chamber 35 and entering the side cutter pockets 16 to flush the cuttings from said side cutters.

In Figures 7, 8 and 9 another form of the drill is shown. In this form the numeral 38 designates the bit head. The lower end of this head has a transverse concaved, or semi-cylindrical cross roller pocket 39 to receive the cross rollers, and also has the pin bearings 40, 40 at the ends of said pocket. A bearing pin 41 has its ends supported in the bearings 40 and is held against turning therein by means of a set screw 42 which is threaded downwardly through said head and whose free end seats in a socket in the pin 41.

Fitted over the pin 41 there is an eccentric bearing sleeve 43 whose ends abut the washers 44, 44, which are fitted on the cross pin 41 and are interposed between the end cross cutters hereinafter referred to, and the adjacent end bearings 40, 40. These washers are shown in elevation, in dotted lines, in Figure 7 wherein the washer bearings are shown to have side notches as 45, and the sleeve 43 has end projections 46, 46, which fit through said notches and into coinciding mortises in the inner sides of the end bearings 40, and the washers 44, as well as the sleeve 43, are thereby held against turning. This eccentric bearing sleeve is an important feature in that it makes it possible to locate the pin 41 well up in the pocket 39 where the bearings 40 have plenty of stock, and at the same time to locate the cross rollers, on the sleeve, well beneath the drill head so as to give ample clearance between said head and the bottom of the bore.

The head has a fluid course 48 leading downwardly through it and whose lower end is flared so as to discharge the flushing fluid on the cross roller cutting unit from end to end thereof.

There is a relatively thin plate-like removable bridge 49, which has a bearing on the sleeve 43 and is located slightly to one side of the axis of rotation of the drill. The ends of this bridge abut the inner ends of the side cutter bearing pins 50, 50 and hold said pins in place. On opposite sides of the cross roller unit hereinbefore referred to, the head has downwardly diverging side cutter pockets 51, 51 to receive the side cutters 52, 52 which are mounted to rotate on the pins 50. The outer ends of these pins have the reduced eccentric projections 54, 54 which fit snugly in the bores 55. 55 of the head and said pins are thereby held against turning. Fitted on the pins 50, on opposite sides of the respective side cutters 52 and 52 and fixed against rotation are friction washers 56, 56. It may be here noted that throughout the drill bit and reamer the construction is such that none of the movable parts are in frictional contact with the head itself, so that the movable and minor parts only are subject to any considerable wear and these may be readily replaced and practically a new tool thus produced at comparatively small expense.

There are a plurality of cross rollers 57, 58, mounted on the bearing sleeve 43. The rollers 57, 58 of each pair are located on opposite sides of the bridge 49 and are arranged to track. The rollers 57 have comparatively narrow teeth which readily penetrate the formation and scarify the same, in advance of the rollers 58, which have relatively wide blade-like teeth that move over said scarified surface and readily abrade it away with chisel-like effect. This is also true of the side cutting rollers, one 52, having penetrating teeth to penetrate, and scarify the formation, and the other, 53, having blade-like teeth which follow over the scari-

fied surface and abrade, or chisel, the same away.

Certain modifications of the drill structure have been shown and will here be noted:—

In Figures 10 and 11 the side cutters 59, and 60, 60 are mounted to rotate, in the pockets 51, on a stationary bushing 61, one end of which has an integral washer 62 and the other end of which has a removable, non-rotatable washer 63. These washers protect the side faces of the pocket 61 against wear. These bushings may be mounted on headed pins, as 64, inserted from the inside and held in place by the bridge 49, or as 65, inserted from the outside of the head and held in place by the set screws, as at 66.

In Figures 12 and 13 the same kind of cutter mounting is employed as shown in Figures 10 and 11, with frusto-conical cutting members, as 67 and 68, respectively, thereon. The cutting unit 67 is formed of a plurality of disc-like cutters, which taken as a whole form a unit of general frusto-conical contour.

In Figures 14 and 15 the side cutting unit 67′ consists of a plurality of disc-like cutters of substantially the same transverse diameter and mounted in the same manner as illustrated in Figures 10 and 11 excepting that both end washers as 69, 69, are separate from the bushings 61, and said bushings and washers are non-rotatable on the pins 64.

Figure 16 shows the same general type of drill as that illustrated in Figure 8, but disc-like cutters, as 70, 71, are substituted in place of the rolling cutters 57, 58. The cutters 70 are beveled inwardly toward the axis of the drill, to form sharp cutting edges and the end cutters 71 are of substantially uniform thickness and each is provided with the spaced marginal cutting edges being so formed to form a bore of uniform diameter and to overcome any tendency to form a downwardly contracting bore.

These disc-like cutters, above referred to, may be of any desired form, but should be provided with sharp cutting edges to operate on the formation with chisel-like effect.

In the form shown in Figures 17 to 20 inclusive the cross rollers and side cutters have co-operating cleaning devices, provided for the purpose of dislodging material which would otherwise adhere to them. In drilling through gumbo, or other sticky formation, the cuttings frequently adhere to the cutters to such an extent that they become completely encased with the material, often to such an extent that progress of the drill is seriously impeded or completely stopped. In order to remove this offending material, cleaners have been provided which, in the case of the cross rollers, consist of cleaning fingers 72, which are carried by the head 1′ and which project into the annular grooves between the cross rollers 8′, said grooves being formed by reducing, or narrowing, the serrated margins of said rollers. The side cutters 14′ are provided, one with a single peripheral groove, and the other with a plurality of peripheral grooves, as shown in Figure 17, and the cleaning fingers 73 are provided which project into said side cutter grooves.

The fingers 72, 73 are arranged in the rear of said cutters and may be formed integral with, or detachable from, the head. They effectively dislodge any material having a tendency to stick to said cross rollers, or side cutters.

From the foregoing it is clear that this type of drilling tool will provide ample clearance for the return of the slush and cuttings, inasmuch as there is ample clearance for this purpose, between the drill head and bottom of the bore and side clearance spaces, due to the fact that the cross cutting unit is considerably shorter than the span of the side cutters.

It is also clear that special provision has been made for protecting the head against wear, so that it can be used over and over again by renewing the minor parts of the drill.

It is for this purpose that the reamer teeth are cut straight, rather than of inverted conical contour. With the present construction of said reamers they will hold the drill from further downward progress when the drill side cutters become worn away, and thus prevent wearing down of the drill head by friction with the walls of the bore. The sections of each reamer may also be reversed, so that when the lower section, which is subjected to the hardest work, is worn away, the upper section may be substituted for it.

It is to be further noted that on account of the eccentric location of the partition 7 and bridge 49, there will be no central core left uncut and to be worn away, at the center of the bore, since every part of said bottom is traversed by the cutters. If said partition, or bridge, were at the center, or the axis, of the head, a central core would be left in the bottom of the bore which would form a bearing on which the partition, or bridge, would ride, thus retarding the progress of the bit through the formation.

It is still further to be noted that ample provision has been made for cleaning the cross rollers and side cutters and thus preventing the collection of clogging material thereon.

What I claim is:

1. A drill including a bit head having a lower cross roller pocket provided with end bearings, a bearing pin mounted in said bearings, an eccentric sleeve fitted on said pin, and cutting members in said pocket and mounted to rotate on said sleeve.

2. A drill including a bit head having a lower cross roller pocket provided with end bearings, a bearing pin mounted in said bearings, an eccentric sleeve fitted on said pin, cutting cross rollers in said pocket and mounted to rotate on said sleeve, friction washers between the end bearings and the adjacent cross rollers and common means for locking the sleeve and washers against rotation.

3. A drill including a bit head having a lower cross roller pocket provided with end bearings, a bearing pin mounted in said bearings, an eccentric sleeve fitted on said pin, cutting cross rollers in said pocket and mounted to rotate on said sleeve, friction washers mounted on said pin and located between the end bearings and the adjacent cross rollers, a projection on each end of said sleeve, each washer having an opening through which the corresponding projection extends.

4. A drill including a bit head having a lower cross roller pocket provided with end bearings, a bearing pin mounted in said bearings, an eccentric sleeve fitted on said pin, cutting cross rollers in said pocket and mounted to rotate on said sleeve, friction washers mounted on said pin and located between the end bearings and the adjacent cross rollers, a projection on each end of said sleeve, each washer having an opening through which the corresponding projection extends, the inner side of each end bearing having a mortise into which the corresponding sleeve projection fits whereby the sleeve and washers are locked against rotation.

In testimony whereof I have signed my name to this specification.

OSWALD DUDA.