April 27, 1926. 1,582,332

C. R. BRUTUS

ROLLER BITS DRILLING TOOL

Filed Dec. 8, 1923 2 Sheets-Sheet 1

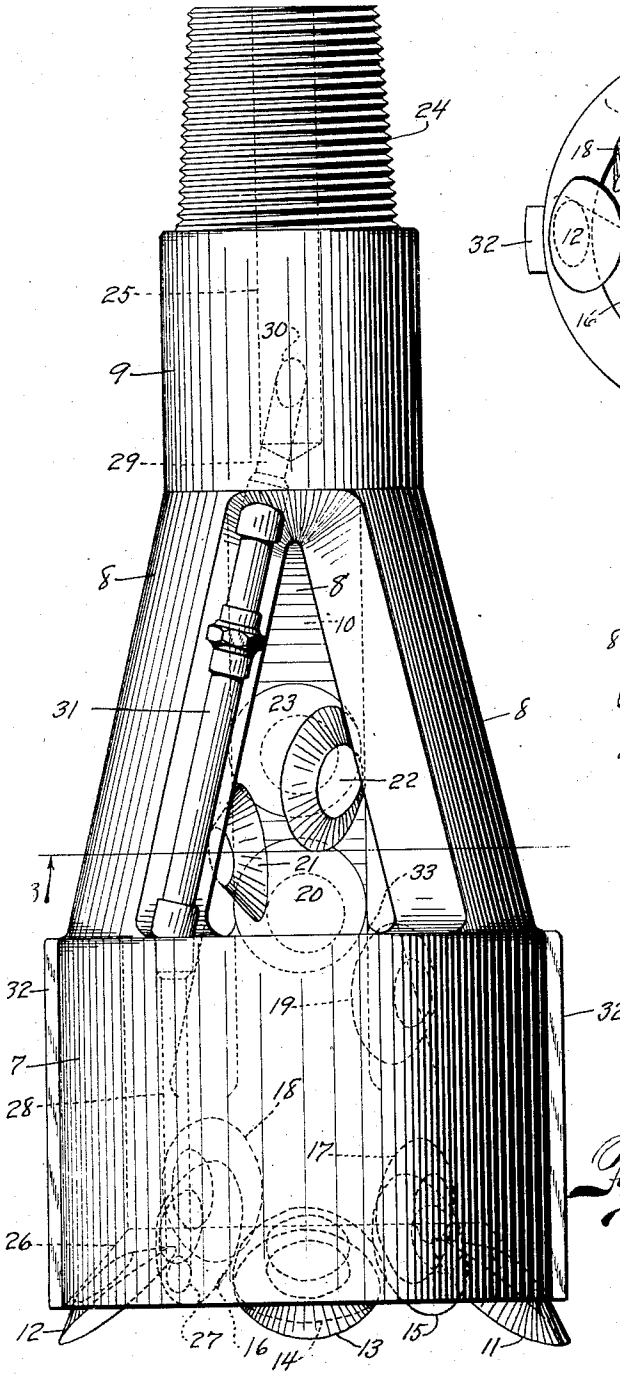

Fig. 1.

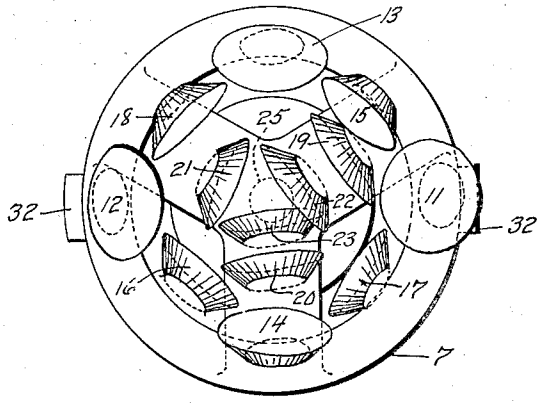

Fig. 2.

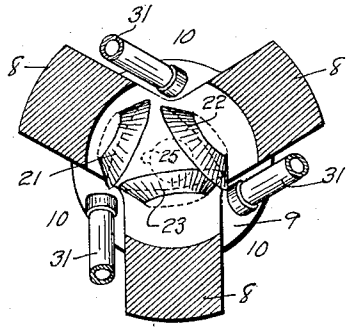

Fig. 3.

Witness:
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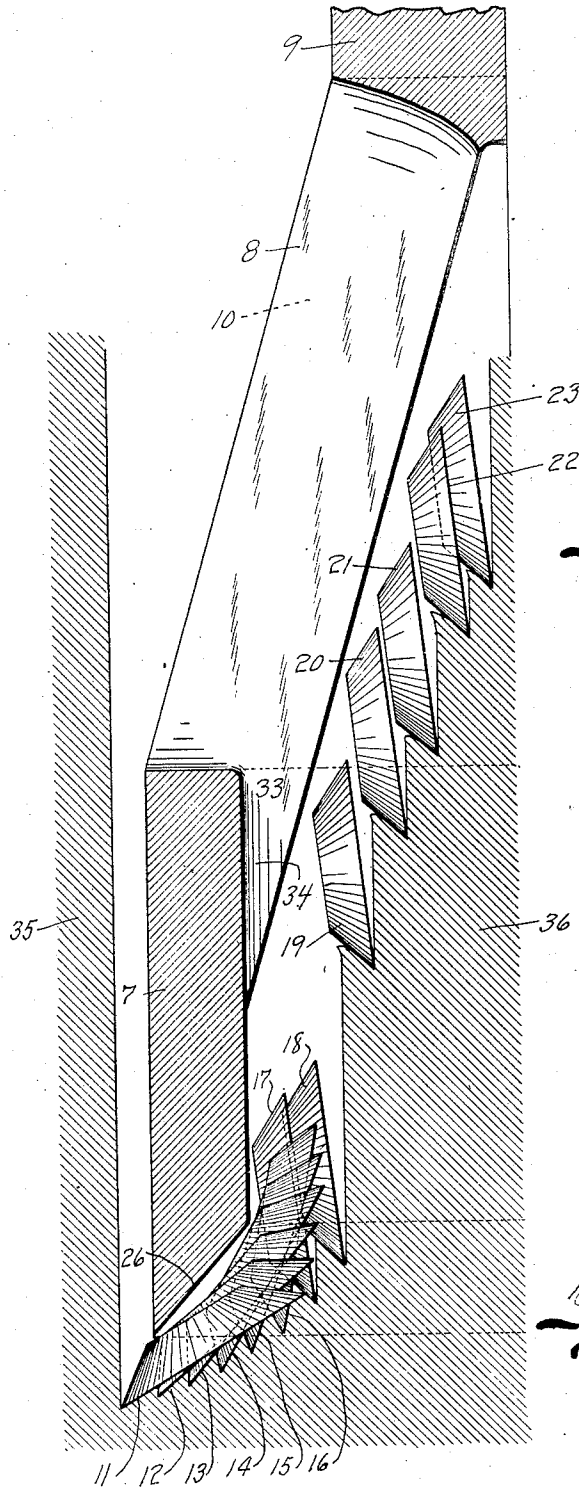

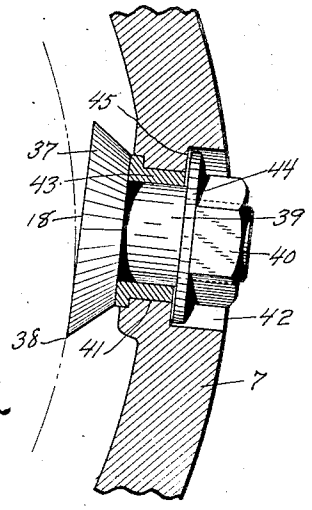

Fig. 5.

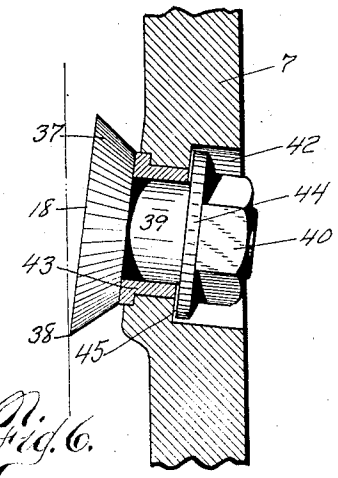

Fig. 6.

Fig. 4.

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Patented Apr. 27, 1926. 1,582,332

UNITED STATES PATENT OFFICE.

CARL RUSSELL BRUTUS, OF DENVER, COLORADO, ASSIGNOR TO WILLIAM V. SEIFERT, OF DENVER, COLORADO.

ROLLER-BITS DRILLING TOOL.

Application filed December 8, 1923. Serial No. 679,457.

To all whom it may concern:

Be it known that I, CARL RUSSELL BRUTUS, a citizen of the United States, and a resident of the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Roller-Bits Drilling Tools, of which the following is a specification.

This invention embodies improvements in roller-bits drilling-tools, and while it has been more especially devised with reference to the boring or drilling of earth, sand, rock, bed, strata, and analogous or other geological formations, whether the bore is to be drilled vertically, horizontally or otherwise, and whether or not employed for the drilling of wells or shafts, or for tunneling, mining, excavating or other purposes, still it is to be distinctly understood and emphasized at the outset that the improvements, as to their essential characteristics, are not necessarily to be restricted to any particular sphere of usefulness, although, for the purposes of simplicity of illustration and description, the same may be more generally disclosed with reference to the drilling of wells or shafts.

Taken as a whole, the improvements more particularly relate to those means for drilling which are characterized by the utilization of a suitable fluid or liquid, such as sufficiently dense sludge, forced under relatively high pressure into association with a drilling tool in operation, for flushing the drillings out of the bore concurrently with the advancement of the tool therein, which washing or flushing out fluid also has a tendency, under many circumstances, to soften and loosen up the substance being drilled. In some of these types of drilling tools at least, they embody a gang or gangs of suitably grouped rotatable disk-like bits or cutters, so mounted on the boring or drilling head thereof as to not only be revolved therewith but also to be individually rotated around their own axes solely by contact with the work, while at the same time severing or dislodging the latter, with a shearing or spawling action, owing to their rolling contact therewith as they travel annularly therearound.

It has heretofore been proposed to provide such a type of earth boring drill with which the said rolling bits or disk cutters are externally mounted on stepped surfaces extending annularly of an elongated downwardly tapering drilling head, whereby each successive cut is of increasing diameter, or in other words the tool drills as it were from inverted vertex towards base position, and eliminates any centering core arising within the tool. In other instances it has been proposed to even dispose rolling bits within the zone of the drilling head, as distinguished from exteriorly and longitudinally thereof, thus in truth forming an internal core arising within the tool, and this whether or not the rolling bits travel around substantially the same zone or path, or are arranged in stepped groups both longitudinally and transversely of the axis of the drill.

Such devices, however, although very efficient it is true, still leave much room for improvement, and one of the primary objects of my invention, in addition to attaining maximum efficiency, durability and economy in operations, is to cause the severance or annular cuts to be made of successively decreasing diameters, by means of roller bits mounted in individually stepped successive relation, as distinguished from grouped stepped relation, both longitudinally and transversely of the axis of the drilling head. This end is accomplished by combining a suitable shell or hollow drilling head with internally mounted rolling bits or disk-like cutters, which are complementally disposed to be relatively located at positions receding towards the axis of the drill from its boring extremity to the other end thereof, so that a core is initially formed therein, although being continuously disintegrated, whereby the drill is maintained centered against deflecting courses, such as would tend to happen when any of the cutters struck a boulder or other rounded or hard deflecting surface, and furthermore an axially extending passageway is provided to permit the more facile discharge of any foreign indurate matter, encountered by any of the cutters, such as broken tool parts or other chunks of metal, without the successive convergingly disposed cutters, when externally mounted necessarily contacting to their injury such disgorged indurate elements, which on the other hand would of necessity follow, however, should the roller

cutter disks be externally located, as heretofore referred to, when they would have to be divergingly disposed relatively to the boring extremity of the drill.

The foregoing as well as other objects and advantages, however, it is believed will be so clearly apparent, as incidental to the following disclosure, that no useful purpose would be served by further enlarging upon the same initially, and with these prefacing remarks, therefore, reference will now be immediately had to the accompanying drawings, illustrating a practical embodiment of the invention, in which drawings like characters designate the same parts in the several views, of which latter—

Figure 1 is an elevational view of the drilling tool, but illustrating only one of the flushing-out fluid inlet conduits, of which, however, there may be one or more; Figure 2 is a bottom plan view of the same; Figure 3 is a transverse sectional view substantially along the line 3—3 of Figure 1, looking in the direction of the arrow, and also illustrating three of said fluid inlet conduits; Figure 4 is a longitudinal sectional view through one-half of the hollow portion of the drilling head, the bore, and the core formed within said hollow head, with the various rolling cutters illustrated as they appear when arriving at that side in the same longitudinal plane, rather than being shown as actually mounted correlatively, for more clearly illustrating the functioning thereof; Figure 5 is a fragmentary cross-sectional view through a lower portion of the hollow drilling head, and showing the angular disposition of one of the rolling disk-like cutters, relatively to the internally formed core as aforesaid, as viewed in a transverse plane, the view being substantially a central cross-sectional view at right angles to Figure 6; and Figure 6 is substantially a central cross-sectional view at right angles to Figure 5, showing the angular disposition of the same cutter element as viewed in a plane longitudinally of the drill, and both Figures 5 and 6 illustrating a preferred arrangement for mounting the rolling cutters securely against dislodgment while permitting of their free rotation.

The numeral 7 designates a hollow base section of the drilling head, which may be cylindrical and which is preferably open-ended, especially for the larger sized tools, although in smaller sized tools the upper end may be closed, and 9 indicates a substantially solid head or boss section at the other end thereof for attachment to the drilling rod, not shown, the said boss and base sections being connected by an intermediate section which may have suitable outlet means therethrough.

The intermediate section, although it may be of other formation, is illustrated as comprising a spider-like construction that is formed by spaced arms 8, which provide laterally opening portways or outlet passages 10 therebetween, allowing for the discharge into the bore of the drillings and flushing-out fluid that pass into the drilling tool, although in small sized tools this intermediate section may be of closed construction peripherally, forming a hollow bell-shaped base, closed at its upper end by the boss or head section 9, equivalently of the base section 7, but for the purpose of description I shall generally refer to the larger sized tools, where the hollow base section is open at both ends as actually illustrated.

As a matter of practical construction, the skeleton casing of the drilling tool may be cast as an integral whole, with the hollow base section 7 of suitable enlarged dimensions relatively to the boss section 9, which latter may have a reduced threaded extension for attachment to the drilling rod, and the intermediate arms 8 being convergent from the section 7 towards the boss 9, the whole being fashioned somewhat like a bell, which provides for the boring extremity of the drill being of the greatest diameter, the said boring extremity being referred to as that end of the drill which is distant from the drilling rod, whether the bore is being drilled downwardly or otherwise.

Before more specifically describing the rolling disk-like cutters and the mountings thereof, of which one group is designated by the numerals 11—18 and another by the numerals 19—23, I will first briefly refer to the remaining features, illustrated by the drawings, which require less adequate description.

The threaded extension, for the boss 9 as before referred to, is indicated at 24, and there is a bore 25 that extends through this threaded extension and well into the boss 9, which bore 25 is adapted for communication with a supply conduit, not shown, for conveying the aforesaid flushing-out fluid to the tool under comparatively high pressure.

The lower end of the hollow base section 7 may be sharply beveled internally, as at 26, providing a discharge aperture 27 which is the outlet for a bore 28 that extends within the wall of the base 7, and there is also a branch bore 29, in the boss 9, in communication at 30 with the inlet bore 25, the two bores 28 and 29 being connected by a suitable pipe conduit 31, all as clearly illustrated at Figure 1. Of course, where there is more than one branching fluid inlet conduit, as would be indicated, at Figure 3, by the three pipe connections 31, then there would be supplied an equal number of bores 28, and associated elements, although these features are not so essential, as the delivery of the flushing-out fluid at the base of the drilling tool could be supplied in various

dinally in the direction of its base, or with the non-working part of the cutter leaning away from the core, as clearly seen from Figures 4, 5 and 6. In other words, this acute angle of incidence is such as to cause the working edge 38 of the cutter to bite into the core 36 in the direction of the advancement of the drilling tool, or towards the axtal line thereof in the direction of its boring extremity, as well as in the direction of rotation of the drilling tool, thus causing an inwardly and downwardly undercutting of the core 36, assuming that a downwardly directed bore is being drilled, as well as an annular severance thereof; and with each of the beveled disk-like cutters 17 to 23 shearing or spawling off the peripheral portion of the core formed by its preceding complementary rolling cutter element in the manner just set forth.

Substantially the same principle is involved with reference to the cutter elements 11 to 16, excepting that the base surface of the extreme outer cutter 11 is disposed at an analogously sharp acute angle to a plane transversely of the drilling tool, and slightly distant from the outer edge of the beveled surface 26 of the base shell 7, with the working edge of each successive cutter 12—16 slightly stepped inwardly, regardless of its position around within the base shell 7, and with its base surface gradually approaching a plane parallel to the axis of the drilling tool, relatively to its immediately preceding complementary cutter, as may be best understood from the composite view at Figure 4.

In other words, the action of the cutters 17—23 is to sever the core, formed by their immediately preceding complementary cutter, in annular and longitudinal directions, while the action of the cutters 11—16 follows substantially the same principle, excepting that their severance action is more or less in an outwardly transverse direction, as well as annularly and in part longitudinally with a beveling or slanting cut, somewhat in the fashion of a dishing-out action on the base portion of the core, being continuously formed, and as distinguished from the undeviating longitudinal severance action of the cutters 17—23, which are projected well within the hollow drilling tool, whereas the cutters 11—16 have to function to undercut the core with reference to the annular wall of the base shell 7.

In connection with the mounting of the rolling cutters, it is to be noted that the exact arrangement shown is not strictly essential, as each successive recedingly mounted cutter may be disposed in a true spiral inwardly convergent from the boring extremity of the drilling tool towards the boss section 9 thereof; but for convenience of illustration, and to more clearly distinguish the several cutters in the drawings, some of them have been shown in diametrically arranged pairs.

For instance, the extreme outer cutter 11 projects outwardly of the base shell 7 and also slightly beyond its peripheral surface, and it may likewise project slightly beyond the line of rotation of the presser bars 32, while the cutter 12 is shown also slightly projecting beyond the said shell and as diametrically opposed to the cutter 11, but in inwardly stepped relation both transversely and longitudinally of the drilling tool. The cutters 13 and 14 are shown in analogous relation to the cutters 11 and 12, inwardly stepped as aforesaid, but on a diameter at right angles thereto, and the cutters 15 and 16 are likewise disposed, although the cutter 16 is located wholly within the shell 7. In like manner the cutters 17 and 18 are shown diametrically disposed but wholly within the shell 7, each in inwardly stepped relation as aforesaid to the preceding cutters, whereas the three cutters 21, 22 and 23 are triangularly disposed in the aforesaid stepped relation but within the space encompassed by the arms 8.

The location of the cutters 19—20 is apparent, but as before stated the whole arrangement of the cutters as shown may be altered, within certain limits, the real essential feature being that each successive cutter is mounted as an individual unit in inwardly receding stepped relation, with reference to its immediately preceding complementary cutter and not in the plural relation of uniform series of conjointly stepped groups, both transversely and longitudinally of the drilling tool, and in a series that is convergent from the boring extremity of the tool towards the other end thereof.

It is further to be particularly noted, from the drawings and the description of the angular disposition of the frusto-conical cutters that all of their bases are disposed towards the axis of the tool, at varying angles, with their apices or what would be their apices projected away from said axis, and never lying in the zone thereof, and with no one of said apices merging into a point with another, all of which provides for the shearing or spawling action of the cutters in the improved manner previously set forth.

In operation, the rolling disk 11 initially slices out an annular cut, leaving a shallow beveled annular base core portion, which in turn is likewise sliced, with more or less outwardly transverse slanting or dished-like cuts, by the successive cutters 12 to 16, inwardly stepped in recedingly mounted relation and disposed at graduate angles approaching parallelism with the axis of the tool, all substantially in the manner as heretofore described. These particular cutters 11 to 16 are so mounted as to excavate immediately ahead of the advancing beveled

and obvious ways. At any event the pipe connections 31, if other equivalent means are not employed, are preferably disposed contiguously along the rear faces of their complementary arms 8, considering the direction of rotation of the drill, so that each arm 8 would serve as a guarding abutment or fender, in advance of one of the pipe connections 31, to ward off shocks on the pipe connection, as from the impact of rocks or other hard substances, as the drill is rapidly rotated.

The numeral 32 indicates a pair of ribs or abutments disposed externally of the hollow base 7, and extending longitudinally of the periphery thereof at diametric positions, of which, however, there may be a greater number, or perhaps even only one would suffice. While these are illustrated as substantially rectangular elongated lugs, or longitudinally disposed projections, obviously they may be of any other suitable formation, and their function is to press into the wall of the bore, where feasible, any loose hard obstructions, such as broken off chunks of metal from tool parts which may not be so easily floated out of the bore by the flushing-out liquid, that may in any way become disposed or lodged in between the hollow base 7 and the wall of the bore.

As before suggested, the upper end of the hollow base 7 is open, as at 33, in the larger sized drilling tools, to the space encompassed by the arms 8, and the lower ends of the arms 8 may extend as reinforcing ribs 34 well within the said hollow base.

The wall of the bore being drilled is indicated by the numeral 35, at Figure 4, and at 36 there is designated the pedestal-like core that is formed and initially extends not only within the hollow base 7 but also well up into the space encompassed by the arms 8, with reference to their inside faces, being gradually but continuously sheared or spawled off, as will hereinafter more fully appear.

Referring to Figures 5 and 6, the views more particularly illustrate the angular disposition of the disk-like cutters 17 to 23, as distinguished from the cutters 11 to 16. They also show the preferred manner of rotatably mounting all of the cutters, but the cutter actually shown in these views is cutter 18.

It may be stated that all of the cutters 11 to 18 are rotatably attached to the base shell 7, preferably grouped around within the outer end thereof at suitably spaced distances apart, while in the larger sized tools, as shown in the drawings the cutters 20 to 23 are rotatably attached to the arms 8, likewise grouped substantially within the space encompassed by the said arms, the arms being slightly enlarged at the positions of such attachment if desired, and the cutter 19, being located towards the upper part of the base shell 7, although forming a part of the group 19 to 23, may be attached to either the base shell or a rib 34 of one of the arms 8.

It may further be stated, however, that although I have illustrated eight cutters in one group and five in the other group, this is merely a matter of expediency in illustration, as obviously there may be a greater or a lesser number of cutters in either or both groups, and, for that matter, it is not strictly essential at all that there be two distinctive groups, as such, the principal idea being that a series of such cutters extend in successively receding relation, and at suitably spaced positions relatively to each other, around within the base shell 7 and the intermediate outlet section 8, when that section actually provides an outlet from the boring extremity of the drill, which is of the greatest diameter. By virtue of such arrangement, each successive annular cut is of decreasing diameter, thereby lessening the load and torsional strains and stresses on the drilling tool, by cutting away the work with graduate reduced cuts approaching the axis of the tool, the said cuts being concurrently made from a plurality of stepped and balancing positions, with the aforesaid cutters also cooperating in such balanced relation that the drilling tool is maintained centered at all times against a deviated course, as will later more clearly appear.

The rolling cutters themselves are preferably of disk-like frusto-conical form, the base thereof in conjunction with the beveled face 37 forming a sharp annular shearing or knife edge 38, and the face opposite the base having a cylindrical shank 39 that terminates in a reduced threaded end for the reception of a nut 40.

The wall of the base shell 7, or when attachment is made to one of the arms 8 then the arm itself, is bored as at 41 and counterbored as at 42, the former for the reception of a bushing 43, for journaling the shank 39, and the latter for the reception of a washer 44 and the nut 40. The washer 44, which encompasses the reduced threaded end of the shank 39, fits snugly up against the annular shoulder formed therebetween, so that there is left a slight annular clearance space 45, whereby the shank 39 has a limited axial play in its bushing 43, and thus allows for a free rotation therein, while anchored against axial dislodgment by the washer 44 and nut 40 turning therewith.

It will be observed that the angular disposition of the cutter 18 with reference to the core 36, and the same is true of the cutters 17, 19, 20, 21, 22 and 23, is such that the base surface thereof extends at a sharp inclination or acute angle to the periphery of the core 36, not only circumferentially thereof but also longitu-

face 26 of the shell 7, as clearly seen from the drawings and heretofore described. The remainder of the core 36, which extends from its base well up within the hollow drilling tool, is sheared or spawled off with annular longitudinal or spiraling cuts, by the rolling cutters 17 to 23, in the manner as clearly illustrated and heretofore fully described. At the same time, with this plural series of concurrent successively receding severances the flushing-out fluid or liquid, such as a sufficiently dense sludge-like mixture, is forced under comparatively high pressure through the fluid inlet line, 25—30—29—31—28, and discharges through the outlet 27, or outlets if there be more than one inlet line, into association with the boring extremity of the tool, thus washing out by flotation the drilling within the bore being formed in a manner that is well understood in the art, but with my particular improvements, especially with the larger sized drilling tools the major portion of the drillings and wash or flushing-out liquid passes up within the tool, through the longitudinal passageway established in the shell 7 between the stepped and substantially spaced rolling cutters, and out into the bore through the lateral outlet means provided for by the intermediate section 8, although a minor portion may pass between the base shell 7 and the contiguous wall of the bore. In the smaller sized tools, however, where the upper end of the base section may be closed and not open to provide an outlet means, all of the drillings and flushing out liquid pass out underneath the shell 7 and up between the latter and the contiguous wall of the bore, if a flushing out liquid be employed, and, whether or not a flushing out liquid be employed, these smaller sized tools may be withdrawn, at will, and any contents of the hollow shell discharged at the surface of the bore.

In addition to the main functioning of the angular disposition of the rolling cutters, it may be briefly suggested, in passing, that the outer edge faces of the base surface and the beveled surface 37 thereof are constantly and smoothly abraded, as it were, by their rolling incisive contact with the earthy or rocky matter of the core 36, so that the annular cutting edge 38 is maintained substantially sharpened after the fashion of hollow grinding.

Finally, it should also be seriously noted that, as each of the rolling cutters bites into the core at varied positions therearound and therealong for its full length, there are thus provided opposing or balancing forces for maintaining the drilling tool centered at all times. For instance, if the cutter 11 should strike a boulder, there would be a forceful tendency to deflect the course of the tool, but practically all of the other cutters would counterbalance or oppose that tendency with a much greater force; and the same would hold true if any of the other cutters were to strike an indurate deflecting surface within the core 36.

Although I have thus completely disclosed the improvements, it is to be understood that I do not wish to unnecessarily restrict the invention to all of the details exactly as set forth and illustrated, excepting as they may come within the terms of the ensuing claims, or equivalent combinations of elements thereof, or as fairly interpreted in the light of the specification if necessary.

What I do claim, as new and patentable, is:—

1. A drilling tool embodying means, in combination, coacting to concurrently make a constant set of annular spirally advancing spawling cuts that successively decrease in diameter, relatively to the direction of advance of said tool, the said cuts being so recedingly stepped that the peripheral portion of the core formed by an immediately preceding severance is itself annularly severed by the next immediately succeeding cut.

2. A drilling tool embodying a hollow section and roller cutter elements so formed and mounted within said hollow section as to coact, in combination, to concurrently make a constant set of annular spirally advancing spawling cuts that successively decrease in diameter, relatively to the direction of advance of said tool, the said cuts being so recedingly stepped that the peripheral portion of the core formed by an immediately preceding severance is itself annularly severed by the next immediately succeeding cut.

3. A drilling tool embodying a hollow section and roller cutter elements so formed and mounted within said hollow section as to coact, in combination, to concurrently make a constant set of annular spirally advancing spawling cuts that successively decrease in diameter, relatively to the direction of advance of said tool, the said cuts being so recedingly stepped that the peripheral portion of the core formed by an immediately preceding severance is itself annularly severed by the next immediately succeeding cut, with the foremost severances being dished out more or less transversely, in a graduate slanting approach towards the longitudinal direction of the bore, while the remaining severances are cut in substantially the longitudinal direction of the bore.

4. A drilling tool embodying a hollw section, open at its outer end, and a plurality of rolling cutter elements substantially wholly encased within said hollow section and mounted therein in recedingly stepped relation from the outer end thereof, some of said cutter elements being disposed at suitable angles in the path of advancement of

the wall of said hollow section, while others are disposed substantially in a direction longitudinally thereof.

5. A drilling tool embodying a hollow section, open at its outer end, and a plurality of frusto-conical rolling cutter elements encased substantially wholly within said hollow section, being mounted therein in recedingly stepped relation from the outer end thereof, both transversely and longitudinally relatively to said hollow section, and the said cutter elements being disposed with their bases towards the axis of said tool.

6. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, and a plurality of rolling cutter elements, internally disposed relatively to said hollow base and rotatably mounted in individually successive recedingly stepped relation from the outer end thereof.

7. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, and a plurality of rolling cutter elements, internally disposed relatively to said hollow base and rotatably mounted in individually successive recedingly stepped relation from the outer end thereof, some of said cutter elements being disposed at suitable angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof.

8. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, and a plurality of frusto-conical rolling cutter elements, internally disposed relatively to said hollow base and rotatably mounted in successive recedingly stepped relation from the outer end thereof, some of said cutter elements being disposed at suitable angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof, and all of said cutter elements being mounted with their bases disposed towards the axis of said tool.

9. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, a plurality of rotatably mounted cutter elements, internally disposed relatively to said hollow base in successive recedingly stepped relation from the outer end thereof, some of said cutter elements being disposed at suitable angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof, and presser bar means extending externally of the outer wall surface of said hollow base.

10. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, and a plurality of rolling cutters, internally disposed relatively to said hollow base in successive suitably receding stepped relation from the outer end thereof, being mounted to independently rotate as well as to be bodily revolved annularly with said tool, some of said cutters being disposed at suitable angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof at a sharp angle both as to the line of annular revolution and the axis of the tool in the direction of advancement thereof.

11. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, and a plurality of frusto-conical rolling cutters, internally disposed relatively to said hollow base in successive suitably receding stepped relation from the outer end thereof, being mounted to independently rotate as well as to be bodily revolved annularly with said tool, some of said cutters being disposed at suitable angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof at a sharp angle both as to the line of their annular revolution and the axis of the tool in the direction of advancement thereof.

12. A drilling tool, embodying a hollow open-ended base, a head portion, an intermediate section having discharge outlet means in communication with said base, and a plurality of rolling cutters, internally disposed relatively to said base and intermediate section and rotatably mounted in successive suitably receding stepped relation towards said head portion.

13. A drilling tool, embodying a hollow open-ended base, a head portion, an intermediate section having discharge outlet means in communication with said base, and a plurality of rolling cutters, internally disposed relatively to said base and intermediate section and rotatably mounted in successive suitably receding stepped relation towards said head portion, some of said cutters being disposed at suitable angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof.

14. A drilling tool, embodying a hollow open-ended base, a head portion, an intermediate section having discharge outlet means in communication with said base, and a plurality of rolling cutters, internally disposed relatively to said base and intermediate section, mounted to independently rotate as well as to be bodily revolved annularly of the axis of the tool, some of said cutters being disposed at suitable angles in the path of advancement of the wall of said

hollow base, while others are disposed substantially in a direction longitudinally thereof at a sharp angle both as to the line of their annular revolution and the axis of the tool in the direction of advancement thereof.

15. A drilling tool, embodying a hollow open-ended base, a head portion, longitudinally spaced arms therebetween to provide for lateral discharge openings in communication with said base, and a plurality of rolling cutters, internally disposed relatively to said base and spaced arms, rotatably mounted in successive suitably receding stepped relation from the outer open end of said base towards said head portion.

16. A drilling tool, embodying a hollow open-ended base, a head portion, longitudinally spaced arms therebetween to provide for lateral discharge openings in communication with said base, and a plurality of rolling cutters, internally disposed relatively to said base and spaced arms, rotatably mounted in successive suitably receding stepped relation from the outer end of said base towards said head portion, some of said cutters being disposed at suitable spirally dishing out angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof.

17. A drilling tool, embodying a hollow open-ended base, a head portion, longitudinally spaced arms therebetween to provide for lateral discharge openings in communication with said base, and a plurality of rolling cutters, internally disposed relatively to said base and said spaced arms, mounted to independently rotate on their own axes as well as to be bodily revolved annularly of the axis of the tool, some of said cutters being disposed at suitable spirally dishing out angles in the path of advancement of the wall of said base, while others are disposed substantially in a direction longitudinally thereof at a sharp angle both as to the line of their aforesaid annular revolution and as to the axis of the tool in the direction of advancement thereof, and all of said cutters being mounted in successive suitably receding stepped relation from the outer open end of said base towards said head portion.

18. A drilling tool, embodying a hollow open-ended base, a reduced boss-like head portion, longitudinally spaced arms therebetween, converging from said base to said head portion, to provide for lateral elongated discharge openings in communication with said base, and a plurality of rolling cutters, internally disposed relatively to said base and spaced arms, rotatably mounted in successive suitably receding stepped relation from the open outer end of said base towards said head portion, some of said cutters being disposed at suitable spirally dishing out angles in the path of advancement of the wall of said base, while others are disposed substantially in a direction longitudinally thereof.

19. A drilling tool, embodying a hollow open-ended base, a reduced boss-like head portion, longitudinally spaced arms therebetween, converging from said base to said head portion, to provide for lateral elongated discharge openings in communication with said base, and a plurality of rolling cutters, internally disposed relatively to said base and said spaced arms, mounted in successive suitably receding stepped relation, from the open outer end of said base towards said head portion, to independently rotate on their own axes as well as to be bodily revolved annularly of the axis of the tool, some of said cutters being disposed at suitable spirally dishing out angles in the path of advancement of the wall of said base, while others are disposed substantially in a direction longitudinally thereof at a sharp angle both as to the line of their aforesaid annular revolution and as to the axis of the tool in the direction of advancement thereof.

20. A drilling tool, embodying a hollow open-ended section having spaced arms longitudinally projected from one end thereof and convergingly disposed in the direction of their projection, the longitudinal spaces between said arms providing for elongated passageways opening from the exterior of the tool to the interior of said open-ended hollow section, and a plurality of rolling cutters mounted to rotate on their own axes as well as to be bodily revolved annularly of the axis of the tool, the said cutters being suitably disposed in successive suitably receding stepped relation from one end of the tool towards the other end thereof.

21. A drilling tool, embodying a hollow open-ended section having spaced arms longitudinally projected from one end thereof and convergingly disposed in the direction of their projection, the longitudinal spaces between said arms providing for elongated passageways between the interior of said open-ended hollow section and the exterior of the tool, a plurality of rolling cutters mounted to rotate on their own axes as well as to be bodily revolved annularly of the axis of the tool, the said cutters being suitably disposed in successive suitably receding stepped relation from one end of the tool towards the other end thereof, and fluid conduit means associated with said tool for delivering a suitable flushing out medium into association with said cutters within the bore being drilled.

22. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, a plurality of rolling cutters, internally disposed relatively to said

hollow base and rotatably mounted in successive suitably receding stepped relation from the open outer end thereof, some of said cutters being disposed at suitable angles in the path of advancement of the wall of said hollow base, while others are substantially disposed in a direction longitudinally theerof, and fluid conduit means associated with said tool for delivering a suitable flushing out medium into association with said cutters within the bore being drilled.

23. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, a plurality of frusto-conical rolling cutters, internally disposed relatively to said hollow base and rotatably mounted in successive suitably receding stepped relation from the open outer end thereof, some of said cutters being disposed at suitable angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof, and fluid conduit means associated with said tool for delivering a suitable flushing out medium into association with said cutters within the bore being drilled.

24. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, a plurality of rolling cutters, internally disposed relatively to said hollow base in successive suitably receding stepped relation from the outer open end thereof, being mounted to independently rotate on their own axes as well as to be bodily revolved annularly of the axis of the tool, some of said cutters being disposed at suitable spirally dishing out angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof at a sharp angle both as to the line of their aforesaid annular revolution and as to the axis of the tool in the direction of advancement thereof, and fluid conduit means associated with said tool for delivering a suitable flushing out medium into association with said cutters within the bore being drilled.

25. A drilling tool, embodying a hollow base open at its outer end, discharge outlet means therefor, a plurality of rolling frusto-conical cutters, internally disposed relatively to said hollow base in successive suitably receding stepped relation from the outer open end thereof, being mounted to independently rotate on their own axes as well as to be bodily revolved annularly of the axis of the tool, some of said cutters being disposed at suitable spirally dishing out angles in the path of advancement of the wall of said hollow base, while others are disposed in a direction substantially longitudinal thereof at a sharp angle both as to the line of their aforesaid annular revolution and as to the axis of the tool in the direction of advancement thereof, and fluid conduit means associated with said tool for delivering a suitable flushing out medium into association with said cutters within the bore being drilled.

26. A drilling tool, embodying a hollow open-ended base, a head portion, spaced elongated arms longitudinally projected therebetween to provide for elongated lateral discharge openings in communication with said hollow base, a plurality of rolling cutters, internally disposed relatively to said base and spaced arms, rotatably mounted in successive suitably receding stepped relation from the outer end of said base towards said head portion, some of said cutters being disposed at suitably spirally dishing out angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof, and fluid conduit means associated with said tool for delivering a suitable flushing out medium into association with said cutters within the bore being drilled.

27. A drilling tool, embodying a hollow open-ended base, a head portion, spaced elongated arms longitudinally projected therebetween to provide for elongated lateral discharge openings in communication with said hollow base, a plurality of rolling cutters, internally disposed relatively to said hollow base and said spaced arms, rotatably mounted in successive suitably receding stepped relation from the open outer end of said hollow base towards said head portion, some of said cutters being disposed at suitable spirally dishing out angles in the path of advancement of the wall of said hollow base, while others are disposed substantially in a direction longitudinally thereof, and fluid conduit means for delivering a suitable flushing out medium into association with said cutters within the bore being drilled, said fluid conduit means including piping disposed contiguously of the rear face of at least one of said elongated arms with reference to the direction of the working rotation of said drilling tool.

In testimony whereof, I affix my signature.

CARL RUSSELL BRUTUS.