

June 10, 1930.

C. H. M. BULL

1,762,504

ROLLER BIT

Filed Aug. 15, 1927

4 Sheets-Sheet 1

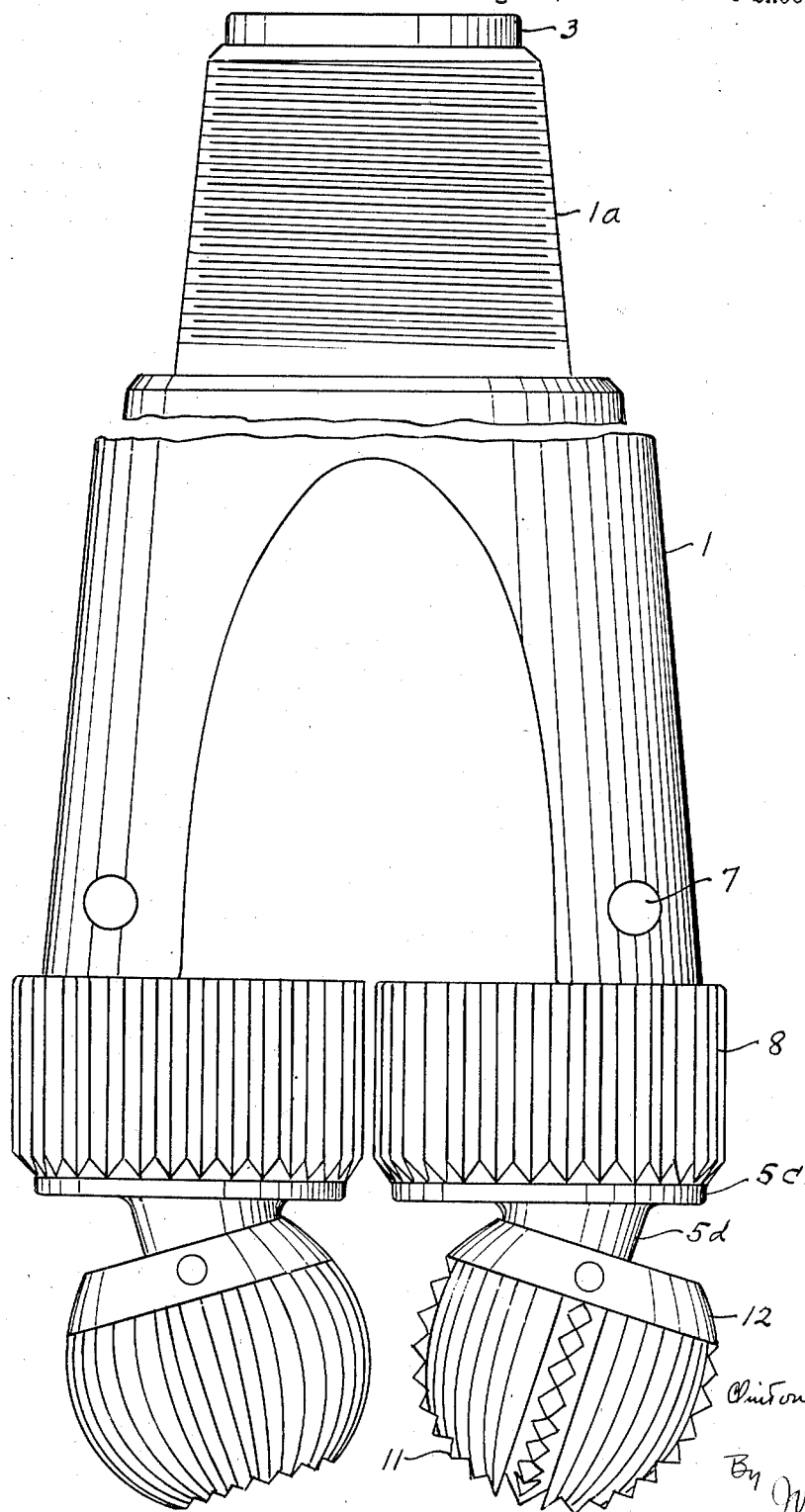


Fig. 1.

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4 Sheets-Sheet 2

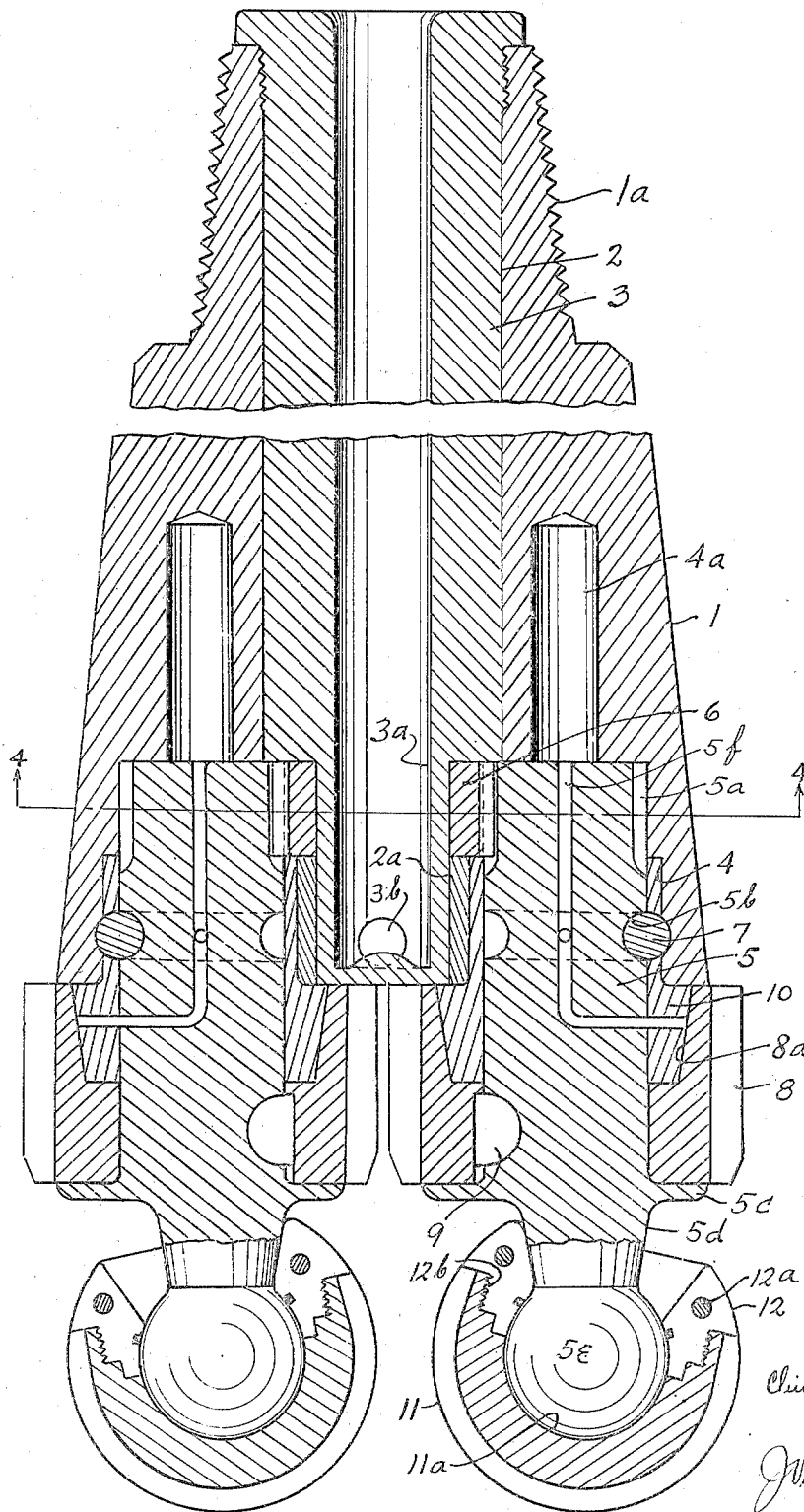


Fig. 2.

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4 Sheets-Sheet 3

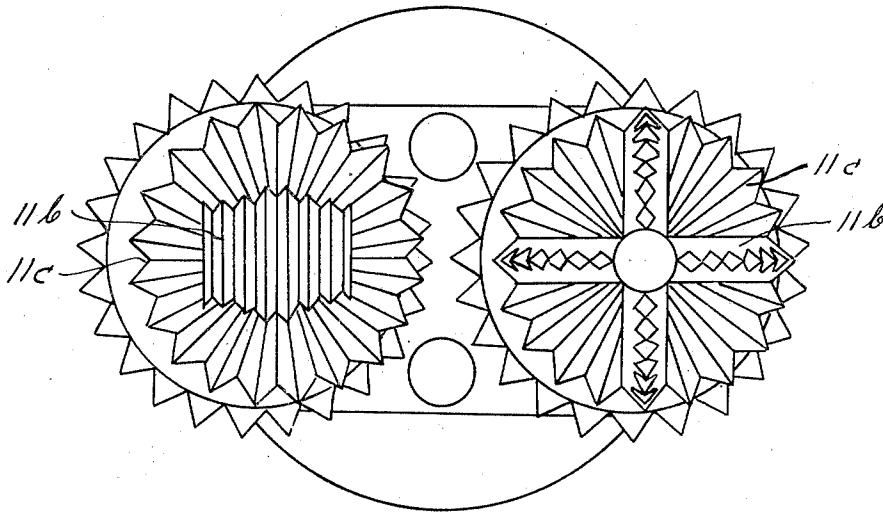


Fig. 3

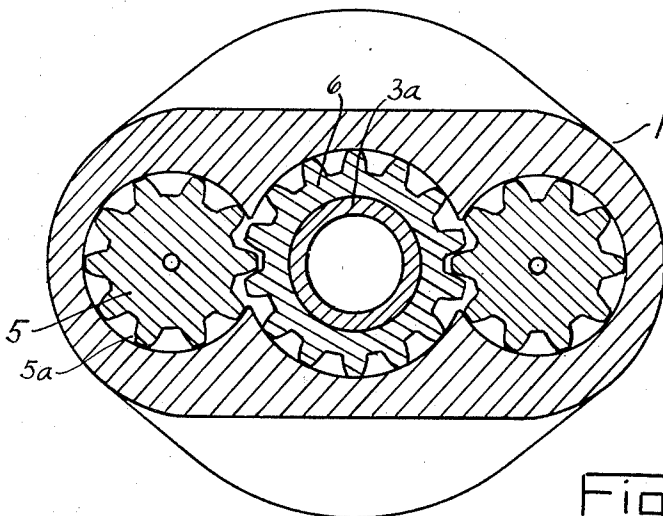


Fig. 4

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4 Sheets-Sheet 4

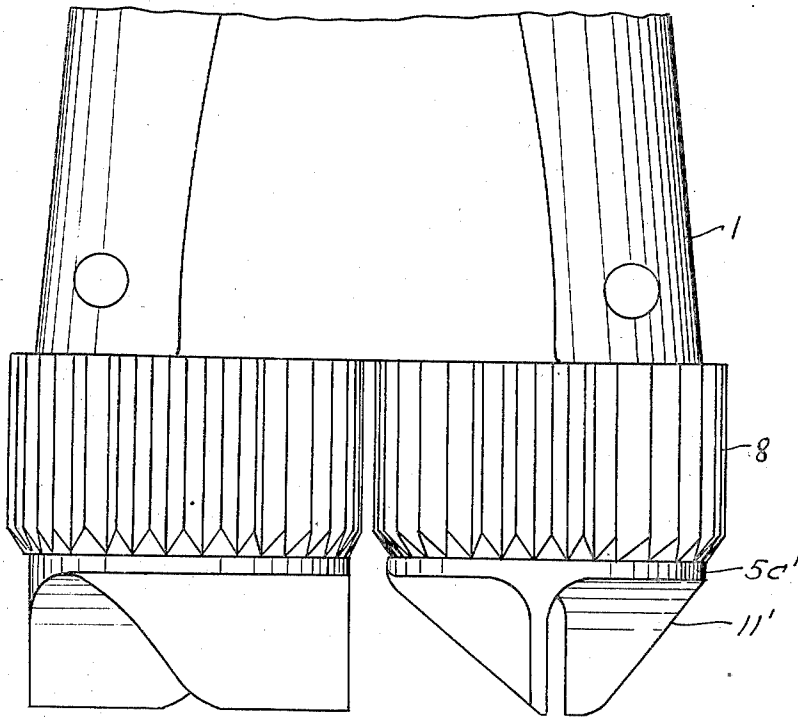


Fig. 5.

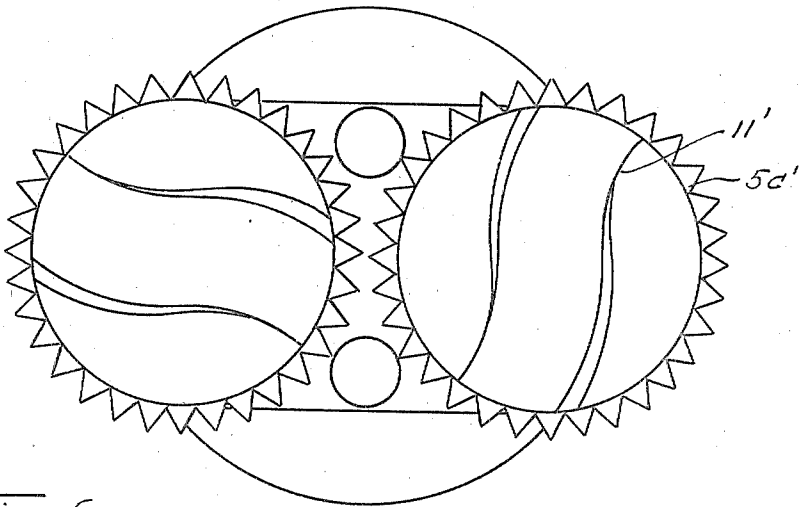


Fig. 6.

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# UNITED STATES PATENT OFFICE

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## ROLLER BIT

Application filed August 15, 1927. Serial No. 212,994.

This invention relates to deep well drilling apparatus, and more particularly to roller bits.

The invention has for its object the provision of a new and improved roller bit where-  
 5 in roller cutters and reamers are mounted on common shafts.

Another object is the provision in a bit head of a plurality of cutter shafts positively connected together in a new and improved manner so that rotation of any one will be attended by rotation of the other or others.

A further object of the invention is the provision of means to effect lateral oscillatory movement of roller cutters.

The invention also has for its object the provision of new and improved roller cutters and new and improved means to mount such roller cutters in bit heads.

20 Many objects, other than those above enumerated, will appear from the following description.

The preferred embodiment of my invention, and a modification thereof, are illustrated in the accompanying drawings, where-  
 25 in Fig. 1 is a side elevation; Fig. 2 a sectional side elevation; Fig. 3 a bottom plan view; and Fig. 4 a section on the line 4—4 of Fig. 2. A modification is illustrated in Figs. 5 and  
 30 6, the former being a fragmentary side elevation, and the latter a bottom plan view.

Referring specifically to Figs. 1, 2, 3 and 4, the bit head 1 has a central water course 2 with a reduced end 2<sup>a</sup>, to receive a water pipe  
 35 3 having a reduced end 3<sup>a</sup> and outlets 3<sup>b</sup>. The upper end of pipe 3 is screw-threaded into shank 1<sup>a</sup>, and has a flange to rest on the upper end of shank 1<sup>a</sup>, as shown.

Vertical bores 4, having reduced ends to form lubricant chambers 4<sup>a</sup> thereabove, are cut in the head on the sides of course 2 and communicate with said course adjacent its reduced end 2<sup>a</sup>, as shown.

45 Bores 4 receive shafts 5. Each of shafts 5 has gear teeth 5<sup>a</sup> cut in the upper end thereof, said teeth meshing with the teeth of idler gear 6, idler gear 6 being rotatable on reduced end 3<sup>a</sup> of pipe 3. The gearing just referred to positively connects the two shafts,  
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so that the rotation of one must be attended by rotation of the other.

A circumferential groove 5<sup>b</sup> is formed in shaft 5 to receive locking pin 7, whereby the shaft is rotatably locked in the head.

55 Shaft 5 also has a circumferential flange 5<sup>c</sup>, and a reamer 8 is mounted on said shaft between said flange and the lower end of the head, and locked against rotation on said shaft by a key 9, which rests in a recess in shaft 5 and projects into a slot in reamer 8,  
 60 as shown. A recess 8<sup>a</sup> in the upper end of reamer 8 is shaped to receive the frusto-conical lower end of a bushing 10, said bushing 10 also having an upper end in the form of  
 65 a reduced sleeve disposed between the upper part of spindle 5 and head 1. Pin 7 passes through the sleeve of said bushing to lock it in place.

Shaft 5 has on its lower end an integral  
 70 eccentric projection 5<sup>d</sup> with a ball 5<sup>e</sup> thereon. A cutter 11 has a socket 11<sup>a</sup> in which ball 5<sup>e</sup> is secured by a split collar 12, and the two sections of collar 12 have openings 12<sup>a</sup> there-  
 75 in adapted to be brought opposite to each other so that a pin may be passed through the same to hold the meeting faces of the two sections in alinement and rotate the same as one body so that screw threads 12<sup>b</sup> thereof may  
 80 be made to engage corresponding screw threads in cutter 11 to lock said collar in said cutter, and hold ball 5<sup>e</sup> movable therein.

Lubricant from chamber 4<sup>a</sup> passes through ducts 5<sup>f</sup> to lubricate the surfaces of bushing 10 and reamer 8 in wearing contact. Ducts 5<sup>f</sup>  
 85 comprise, it will be observed, a longitudinal duct and a transverse duct in spindle 5 and a duct in bushing 10.

Cutter 11 has teeth 11<sup>b</sup> extending around the same, and teeth 11<sup>c</sup> extending from teeth  
 90 11<sup>b</sup>, and at an angle thereto, to the edge of the cutter, as shown.

Assembly of the bit may be effected as follows:— Idler gear 6 is first placed on reduced end 3<sup>a</sup> of pipe 3, and pipe 3 is then inserted  
 95 in course 2. Reduced end 3<sup>a</sup> of pipe 3 will enter reduced end 2<sup>a</sup> of course 2 and idler gear 6 will be disposed, free to rotate, between the shoulders formed by said reduced ends, as shown. Pipe 3 is screwed into shank 1<sup>a</sup>,  
 100

and the flanged upper end of said pipe rests upon the end of shank 1<sup>a</sup>. Pipe 3 thus serves as a removable water course which prevents the wearing of head 1 by slush, and can itself be replaced when worn, and also as a shaft for idler gear 6.

Ball 5<sup>e</sup> of the shafts 5 is then inserted in the socket 11<sup>a</sup> of cutter 11. When the two sections of collar 12 have been brought together around projection 5<sup>d</sup>, a pin, not shown, is passed through the openings 12<sup>a</sup>, and the collar then screwed into cutter 12, to movably secure ball 5<sup>e</sup> in socket 11<sup>a</sup>. Key 9 is then placed in shaft 5. Reamer 8 is then slipped on shaft 5 and brought to rest against flange 5<sup>c</sup>, key 9 having entered the slot in said reamer to lock it on shaft 5. Bushing 10 is then slipped on shaft 5, the frusto-conical portion thereof entering recess 8<sup>a</sup> of reamer 8, the lubricant duct in said bushing being positioned opposite the transverse lubricant duct in shaft 5.

The parts having thus been mounted thereon, shaft 5 is inserted in bore 4, teeth 5<sup>a</sup> thereof meshing with the teeth of idler gear 6. Pin 7 is then driven in to rotatably lock the shaft in the head, and to lock bushing 10 against rotation. Shaft 5 may then be rotated until cutter 11 assumes its outermost position.

The corresponding parts having in a like manner been mounted thereon, the other shaft is inserted in its bore, and the teeth thereof made to mesh with the teeth of idler gear 6. The corresponding pin is then driven in to effect a locking like that described in the immediately preceding paragraph. And this shaft may be so inserted that its cutter assumes its innermost position.

The operation of the device may be outlined, and the advantages thereof briefly referred to, as follows:—

When shank 1<sup>a</sup> has been screwed into the end of the usual pipe, not shown, and the bit lowered in the hole, cutters 11 come into contact with the bottom of the hole, and reamers 8 with the sides, one of said cutters being then in its outermost position and the other in its innermost position. It will be at once obvious that when the head is rotated, shafts 5 will rotate, and balls 5<sup>e</sup> on eccentric projection 5<sup>d</sup> will produce an outwardly and inwardly oscillatory movement of cutters 11, and the gearing (5<sup>a</sup>, 6) between shafts 5 will maintain cutters 11 at a constant distance apart. Stated differently, when the rotation of one shaft throws one cutter outwardly, the other shaft will, at the same time, throw the other cutter inwardly, and vice versa.

It will be understood that the cutters 11 can originally be placed at any desired distance apart, and if both cutters are mounted originally in their outermost positions, the gearing (6, 5<sup>a</sup>) between shafts 5 will produce

an opposite oscillation of the cutters, so that they will alternately swing toward and away from each other. Various arrangements will appear to those skilled in the art, the shafts 5 being originally mountable in the head at various distances apart, whereby various movements (or no movement at all) of the cutters with respect to each other will be produced by the gearing therebetween.

Reamers 8, being keyed to shafts 5 are not rotatable thereon, and when the bit head is rotated and reamers 8 rotated by their contact with the wall of the hole, shafts 5 will be rotated and the inward and outward movement of eccentrically-mounted cutters 11 thereby effected.

Cutters 11 are free to rotate, and to a limited extent swing, on balls 5<sup>e</sup>, and when they encounter inequalities in the bottom of the hole, they yield to a limited extent, and thus all of the teeth are brought into use. The oscillation of the cutters also causes them to swing and rotate on balls 5<sup>e</sup>, whereby the cutting operation thereof is made most efficient.

When eccentric cutters 11 are pushed inwardly or outwardly, shaft 5 and reamer 8 will thereby be rotated, and the latter made to cut the wall of the hole.

Pipe 3 serves as a casing to prevent wearing by slush of head 1, and also to conduct said slush past the opening between course 2 and bore 4 so that it will not enter the bearing of shaft 5, and in addition serves as a shaft for idler gear 6.

The frusto-conical and the reduced sleeve portions of bushings 10 constitute an efficient means to sustain the thrusts of reamers 8 and to strongly support shafts 5, and protect shaft 5 and head 1.

A single pin 7 locks the parts in the head.

The construction of Figs. 1, 2, 3 and 4 is identical with the modified form of Figs. 5 and 6, except that eccentric projections 5<sup>d</sup>, balls 5<sup>e</sup>, and cutters 11 thereon, shown in the former, are in the latter omitted, and the ends of the shafts provided with the cutting blades shown. Referring specifically to Figs. 5 and 6, two curved and beveled blades 11' are formed in the end of each shaft below circumferential flange 5<sup>c</sup>.

The shafts may be originally mounted in the head, in the same manner as hereinabove described with reference to Figs. 1, 2, 3 and 4, so that the blades on the respective shafts will be at substantially right angles to each other. The gearing between the shafts will produce a positive movement of the blades on one shaft with respect to the blades on the other. And the shafts may originally be so mounted that the blades on one shaft will occupy a predetermined position with respect to the blades on the other, and the positive gearing between the two shafts will effect a corresponding predeter-

mined movement of the blades on the one shaft with respect to the blades on the other, whereby the cutting action, and therefore the wearing, of said blades may be regulated.

Two shafts have been illustrated in the embodiments of the invention, but it is to be understood that any number may be used.

The various features of the invention will at once be seen by those skilled in the art, and the physical embodiments thereof may differ widely without departure from the scope of the following claims.

I claim:

1. In a rotary boring drill, a head having a pipe bore and shaft bores, a pipe fitting in said pipe bore, an idler gear on said pipe, and shafts fitting in said shaft bores, and having gear teeth thereon meshing with the teeth of said idler gear, and cutters on said shafts.

2. In a rotary boring drill, a head having a plurality of bores, a plurality of shafts geared together and freely rotatable in said bores, and cutters on said shafts, said shafts being rotated by said cutters.

3. In a rotary boring drill, a head having a bore, a shaft rotatably mounted in said bore, said shaft having an eccentric projection, and a cutter rotatably mounted on said projection.

4. In a rotary boring drill, a head, a plurality of shafts rotatable in said head, geared together, and having eccentric projections, and cutters on said projections.

5. In a rotary boring drill, a head, a plurality of shafts rotatable in said head, geared together, and having eccentric projections, and cutters rotatably mounted on said projections.

6. In a rotary boring drill, a head having a bore, a shaft rotatably mounted in said bore and having an eccentric projection, a reamer mounted on said shaft, and a cutter mounted on said projection.

7. In a rotary boring drill, a head having a bore, a shaft rotatably mounted in said bore and having an eccentric projection, a reamer fixed to said shaft, and a cutter rotatably mounted on said projection.

8. In a rotary boring drill, a head, a plurality of shafts rotatable in said head, geared together, and having eccentric projections, reamers on said shafts, and cutters on said projections.

9. In a rotary boring drill, a head, a plurality of shafts rotatable in said head, geared together, and having eccentric projections, reamers fixed to said shafts, and cutters rotatably mounted on said projections.

10. In a rotary boring drill, a head, a plurality of shafts rotatable in said head, geared together, and having eccentric balls, reamers fixed to said shafts, and cutters rotatably mounted on said balls.

11. A rotary boring drill comprising a head having a ball thereon, and a rotary cutter freely rotatable on said ball about a sub-

stantially vertical axis, said ball being so spaced from said head that said cutter is freely movable on said ball about horizontal axes, whereby the axis of rotation of said cutter on said ball may frequently be shifted during the operation of the drill.

12. A rotary boring drill comprising a head, a shaft rotatable in said head and having an eccentric ball thereon, and a rotary cutter freely rotatable on said ball about a substantially vertical axis, said cutter being so spaced from said head that it is freely movable on said ball about horizontal axes, whereby the axis of rotation of said cutter on said ball may frequently be shifted during the operation of the drill.

13. In a rotary boring drill, a head having a bore, a shaft rotatable in said bore, a cutter locked on said shaft, and a cutter rotatable on said shaft.

14. In a rotary boring drill, a head having a bore, a shaft rotatable in said bore and having a flange and a projection below said flange, a reamer mounted on said shaft above said flange and a cutter mounted on said projection.

15. In a rotary boring drill, a head having a bore, a shaft rotatable in said bore and having a ball thereon, a reamer mounted on said shaft, and a cutter having a socket in which said ball is secured.

16. In a rotary boring drill, a head having a bore, a shaft rotatable in said bore and having an eccentric ball thereon, a reamer on said shaft and a cutter having a socket in which said ball is secured.

In testimony whereof, I hereunto affix my signature.

CLINTON H. M. BULL.