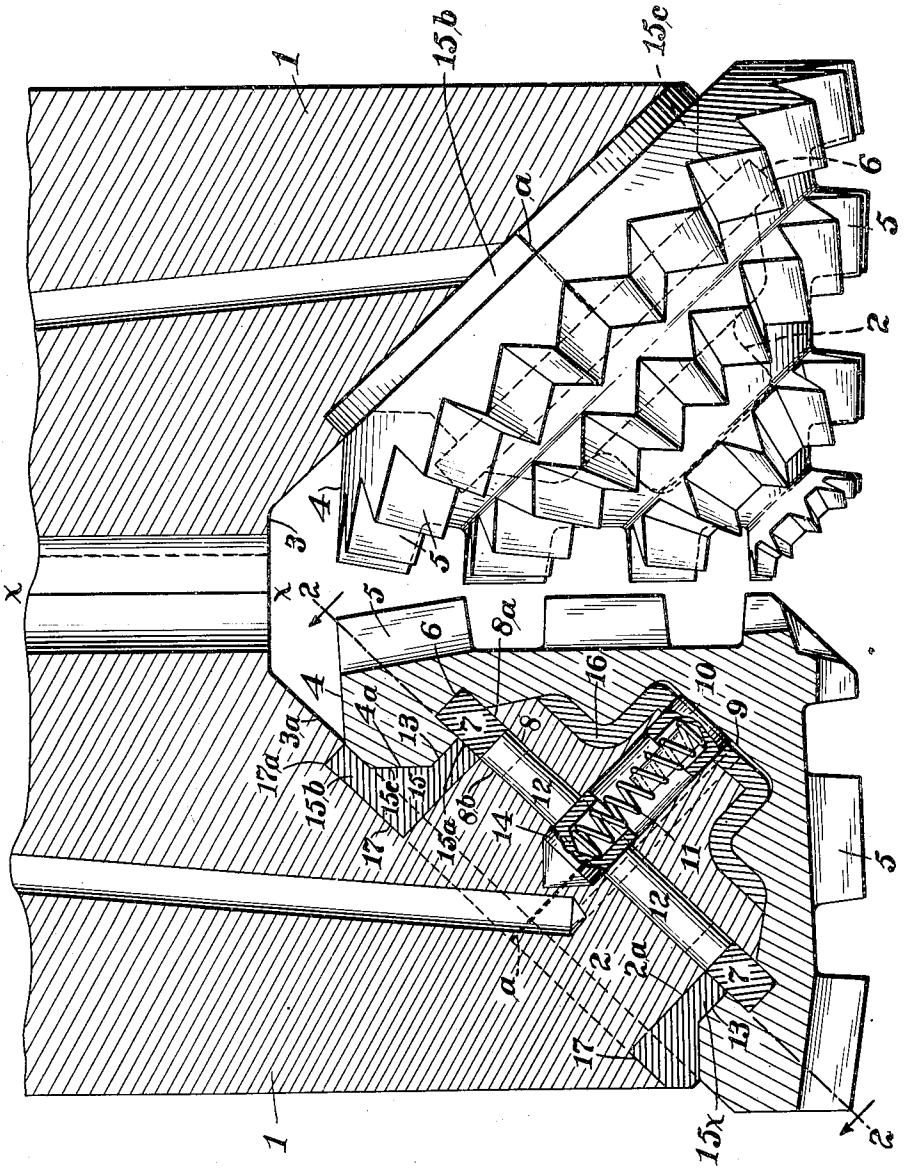
July 5, 1932. C. E. REED 1,865,706

EARTH BORING DRILL

Filed June 11, 1929 3 Sheets-Sheet 1

Fig. 1.



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EARTH BORING DRILL

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Fig. 2.

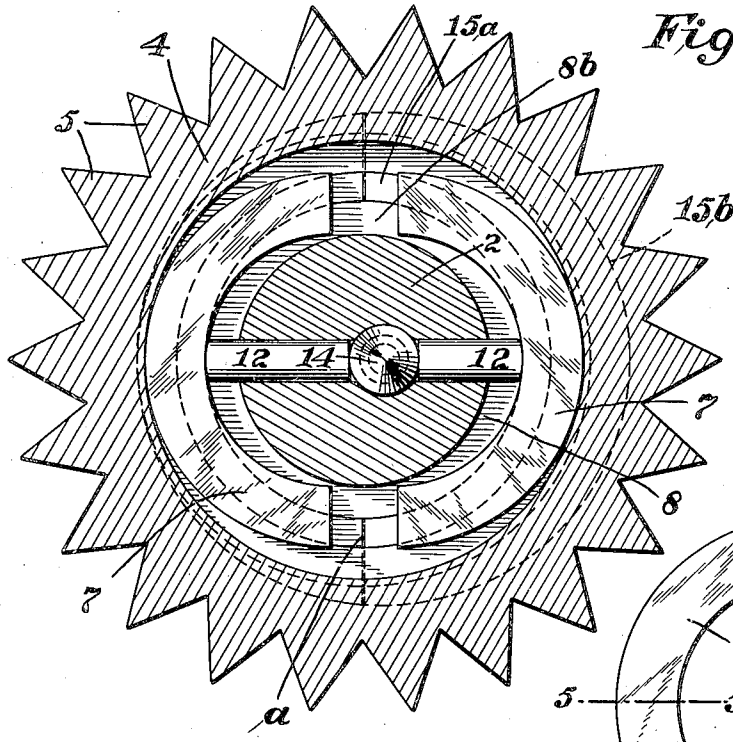


Fig. 5.

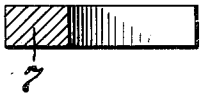


Fig. 4.

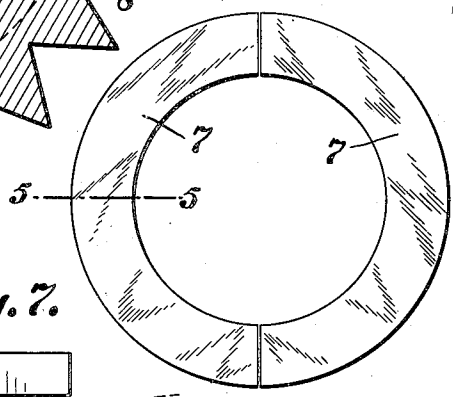


Fig. 7.



Fig. 3.

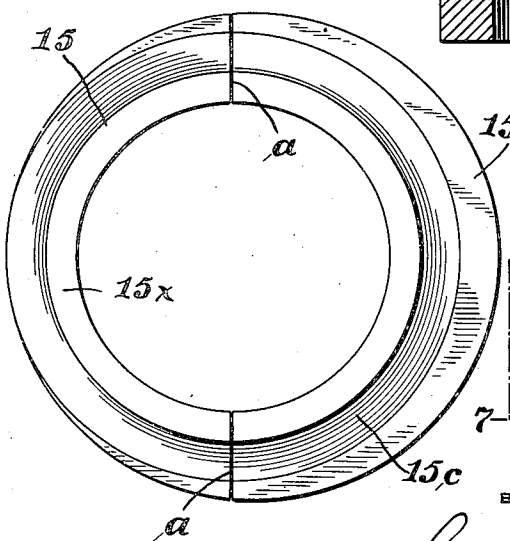
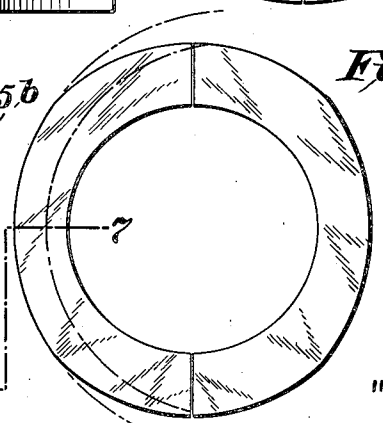


Fig. 6.



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EARTH BORING DRILL

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Fig. 8.

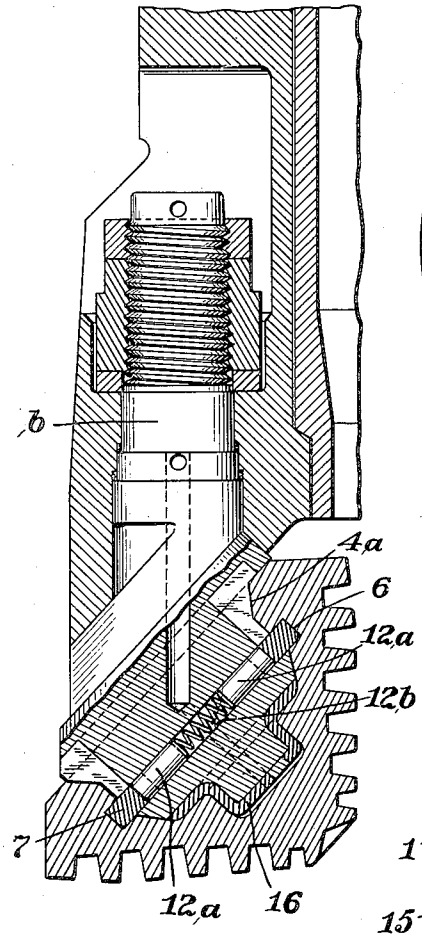


Fig. 9.

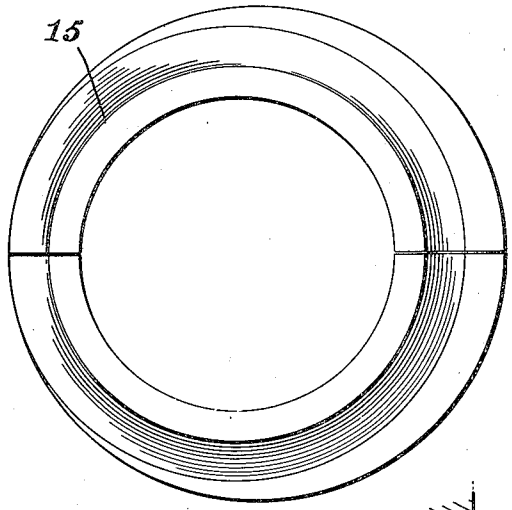
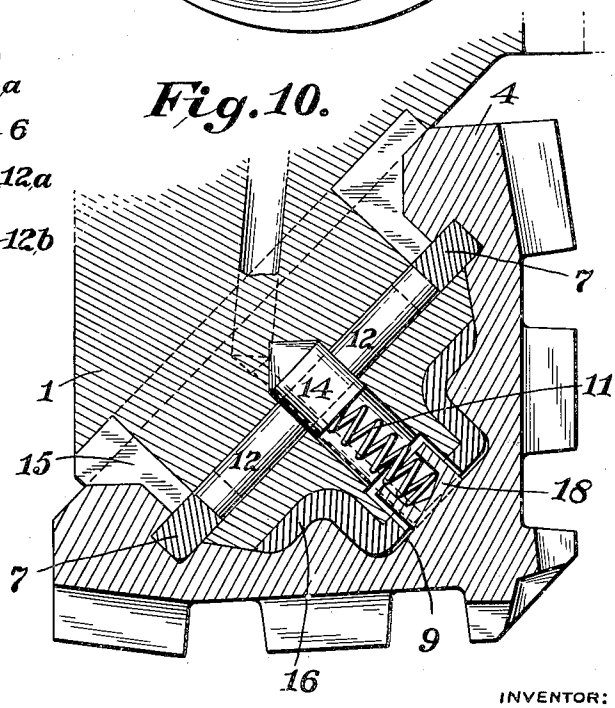


Fig. 10.



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UNITED STATES PATENT OFFICE

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EARTH BORING DRILL

Application filed June 11, 1929. Serial No. 370,087.

The invention concerns earth boring drills of the type employing rotary cutters. One object is to provide a roller cutter of special form which in association with locking means will have the capacity of becoming automatically locked on its supporting spindle against axial displacement, while at the same time being free to rotate, the locking effect taking place as a consequence of placing the roller cutter on the spindle in the prescribed operative relation thereto.

Other objects of the invention will be clear from the following description.

In the drawings forming a part of this specification

Figure 1 is a vertical sectional view of a part of a bit head showing one cutter in section and the other in elevation, and illustrating one embodiment of the invention.

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

Fig. 3 is a face view of a split bushing member.

Fig. 4 illustrates segmental locking ring.

Fig. 5 is a section of Fig. 4 on line 5—5.

Fig. 6 is a view similar to Fig. 4 of another form of segmental locking means.

Fig. 7 is a sectional view on line 7—7 of Fig. 6.

Fig. 8 is a vertical sectional view, with parts in elevation, of another embodiment of the invention, this view also indicating that the invention may be carried out in connection with a roller cutter unit adapted to be inserted in a socket of the bit head.

Fig. 9 is a view similar to Fig. 3 of a form of bushing in which the line of separation between the sections is differently disposed in respect to the form of Fig. 3.

Fig. 10 is a sectional view of another form of the invention.

In the drawings 1 is the bit head which in the particular embodiment shown in Fig. 1 is built in sections, and 2 are the spindles integral with the bit head. The bit head has an inverted V-shaped recess 3 at its lower end and the spindles project downwardly and inwardly towards the vertical axis of the head.

These spindles may assume different forms but in the present embodiment of the invention their inner ends are of smaller diameter than the bases of the spindles, or in other words, the portions which are joined to the wall of the bit head. In the form illustrated the spindles are shouldered, thus providing inner ends of smaller diameter than the bases of said spindles. The roller cutters 4 are of general frusto-conical form having circumferential rows of teeth 5, those of one cutter being arranged to overlap the annular spaces or grooves between the rows of teeth of the opposing cutter, that is to say, the teeth of one cutter are in part opposite the teeth on the other cutter, and in part opposite the grooves between the rows of teeth of said other cutter. The roller cutters are recessed to receive the spindles and they cover the ends of the spindles. They are provided each with a locking shoulder provided by the wall of an annular groove 6 on the interior adapted to receive segmental locking pieces 7 which will engage said shoulder and hold the roller cutter shell onto the spindle while allowing free rotation of said cutter about the spindle as a consequence of the cutter rolling upon the bottom of the hole being drilled during the rotation of the drill head about its vertical axis.

The spindle has an annular groove in its surface at 8 of a depth approximately equal to the width of the segmental piece measured along the radius thereof so that this segmental piece can lie within the groove of the spindle so as to permit the roller cutter shell to be thrust axially into place on the spindle.

In this act of placing the roller cutter on the spindle its wall 9 at the small end of the frusto-cone will engage a plunger member 10 and force the same inwardly parallel with the axis of the spindle. This will stress a spring 11 which bears at its inner end upon a member 14 of cap form having a conical end adapted to go between and force radially outward a plurality of plungers or pins 12 which at their outer ends bear upon the segmental locking pieces 7. In the act of placing the roller cutter shell on the spindle the segmental pieces at the outset will

be lying within the groove 8 of the spindle so that the cylindrical bore or inner wall of the roller cutter shell at 13 will move over the segmental pieces and hold them against outward movement, and at this time the plungers or pins 12 will be in their innermost positions, that is to say, with their inner ends not quite in contact. During the time this cylindrical bore of the roller cutter shell is moving over or across the segments and retaining them in their innermost positions the wall 9 of the roller cutter shell now in contact with the plunger or cup member 10 is moving this inwardly parallel with the axis of spindle thus compressing the spring 11 and storing power therein because the inner end of said spring will be bearing upon the conical member 14 which is now resting with its point just ready to go between the adjacent ends of the plungers or pins 12.

This tendency of the cone 14 to move between the pins 12 is resisted by said pins so long as the cylindrical portion 13 of the recess or bore of the roller cutter shell is passing across the segments 7. As soon, however, as the groove 6 in the roller cutter shell registers with the grooves 8 of the spindle, or in other words, with the segmental locking piece, the power stored in the spring 11 as a consequence of thrusting the roller cutter axially along the spindle will exert itself to force the conical pin or member 14 between the inner ends of the plungers 12 which therefore will move radially outward and thus the segmental locking pieces will be moved radially outward to enter the groove 6 in the roller cutter shell, the said outward movement being arrested by the outer edge of the segment coming against the bottom of the groove in the shell. In this position the segment will be lying partly within the groove of the spindle and partly within the groove in the shell, thus extending across the joint between the spindle and the roller cutter and retaining the latter on the spindle against displacement in the direction of its axis. The roller cutter is free to rotate on but is locked to the spindle so far as axial movement is concerned. The member 14 is cylindrical for a portion of its length and this cylindrical portion, when the roller cutter is in position on the spindle, will lie between the ends of the spreader pins 12 and effectually hold them in their outward positions to maintain the segments in locking position.

It will be seen from the above that in assembling the roller cutter with the spindle the locking means is set to hold the cutter on the spindle as a consequence of placing the roller in working position on the spindle. The spreader pins or plungers bear upon the segmental pieces about midway of the length thereof and maintain them in position against circumferential displacement. The segments are struck on curves whose radii (so far as the inner sides are concerned) are of the same length as the radii of the bottoms of the groove 8 and the outer edges of the segments are struck from the same center, and the radius of the outer curve is substantially equal to and no greater than the radius of the spindle at this point.

In the above description I have treated the subject as though the roller cutter were mounted on the spindle without a wear piece or bushing. I prefer, however, to employ wear pieces or bushings between the roller cutter and the spindle per se, and these wear pieces are shown at 15, 16. The wear piece or bushing 15 is split into two halves on the line *a* in Fig. 1. These two sections are placed about the spindle back of the shoulder or wall 8*a* defining the front side of the groove 8 of the spindle and spaced apart therefrom so that the front edge 15*a* of the bushing forms virtually a continuation of the inner wall 8*b* of the said spindle groove 8. The thickness of this bushing is such that its outer periphery is of a diameter equal to the largest diameter portion of the spindle. The bushing may be said therefore to fit on a reduced diameter portion of the spindle at 2*a* which reduced diameter portion lies between the groove 8 and the base of the spindle.

Because of this formation of the spindle the bushing is split in order that its sections may be placed in position around the reduced part of the spindle. The bushing at its base fits in a recess 17 in the inclined wall 3*a* defining the substantially inverted V shaped recess at the lower end of the bit head. In order to prevent the bushing from turning on the spindle it has its flange extended at 15*b* to provide a portion eccentric in relation to the spindle and this eccentric portion has bearing against a shoulder 17*a* defining the upper limit of the seat recess 17.

It will be noted that the line *a* upon which the bushing 15 is split is so related to the general organization that we have a lower section of the bushing at 15*x* adapted to take the load and upper section carrying the eccentric portion 15*b*, to go in the seat recess and hold the bushing from turning. The wear comes mostly on the lower section 15*x* and this may be renewed while the upper section may be repeatedly used without renewal.

The bushing is provided with a conical bearing surface or portion at 15*c*. The roller cutter shell has its bore or recess flared to provide an inclined bearing wall 4*a* to bear upon the conical or inclined face 15*c* of the bushing to sustain the thrust of the roller cutter.

This flared formation at the end of the recess in the roller cutter shell presents an inclined guiding or cam wall which will pre-

vent the segments, should they be slightly displaced, from obstructing the sliding of the roller cutter shell axially into place on the spindle, because should either segment be in this displaced position the inclined wall 4*a* will act as a cam thereon to force the segment back into its groove as the cutter shell is thrust onto the spindle.

This flared formation of the recess in the roller cutter contributes to the provision of a shell of a more uniform thickness of the shell wall than otherwise would be the case, and this aids in tempering the shell.

A second wear piece or bushing is shown at 16. This covers the front end of the spindle and the shouldered part of said spindle and takes the wear from the spindle itself. This bushing is made in one piece and is slipped onto the end of the spindle as one body before the roller cutter shell is put in place. The bushing 15 is held from turning by its eccentric portion 15*b* fitting in the seat recess 17 of the bit head. The bushing 16 is held from turning on the spindle because the spring plunger member 10 extends through the front wall of this bushing and the said member 10 is offset in respect to the axis of the bushing and spindle.

It will be understood in the construction shown in Fig. 1 the spring plunger made up for instance of the parts 10 and 14 with the spring 11 interposed will protrude from the spindle prior to the placing of the roller cutter in position on said spindle, and the thrusting of the roller onto the spindle will engage the wall 9 with the protruding end of said plunger and move it into the recess or bore of the spindle, thus compressing the spring ready to act in forcing the plunger section 14 between the pins 12 for spreading them, together with the locking segments, as soon as groove 6 in the roller cutter registers with the groove in the spindle.

In order that the plunger may be initially housed in the spindle I may form the roller cutter with a projection 18, Fig. 10 on its front wall 9 so that this projection would enter the bore of the spindle and act upon the lock actuating plunger. In this instance the plunger would not protrude from the spindle at any time.

It will be understood that while this projection is illustrated in Fig. 10 it is susceptible of use with the combination set up in Fig. 1.

In Fig. 8 I show a form in which the spreader pins 12*a* are spread apart by a spring 12*b*. They tend constantly to urge the segments outwardly so as to snap into the groove 6 of the roller cutter when said groove registers therewith.

The roller cutter in this instance would have its incline 4*a* at the flared end of its recess at such an angle that when the roller cutter is thrust onto the spindle this incline would force the segments radially inward against the tension of the spring and then when the groove registers with the segments the spring plungers would force the segments into the groove and thus lock the roller on the spindle, but allow it to rotate freely. To aid in the assembly the segments can be bevelled at one edge so that the incline 4*a* would more readily ride on and retract the segments.

In order to remove a worn cutter shell a torch may be applied thereto to separate it into sections capable of being removed leaving the spindle and working parts unaffected. This separation may take place at the region of the groove 6.

The bit head is shown in Fig. 1 as being in sections divided from each other along the axial plane *x*—*x*. I do not limit my invention to this type of bit head, nor to spindles which are fixed to the head, as the invention in its main aspects may be carried out in connection with a roller cutter unit insertible into a socket of the head as in Fig. 8.

In Fig. 4 I show the locking segments of a form to make up a circular ring when brought together.

In Fig. 6 these locking segments are shown as slabbed off on their outer edges along a region midway of their ends. The radius of the slabbed off portion is the same as that of the bottom of the groove in the roller cutter so that when the segments are in their outmost positions they will each be concentric with the bottom of the groove for about a quarter of the circle.

In Fig. 9 the bushing is shown as split apart in an plane at right angles to that of Fig. 3.

It will be understood that while I have shown modifications of the structure in different organizations or forms of the apparatus, it is possible to build up forms by transposing elements from one form to another. For instance, Fig. 8 shows a spring pin and bushing arrangement associated with a spindle having an integral shank *b* locked in a socket in the head. This spring pin and/or bushing may be used in a form such as in Fig. 1 where the spindle is integrally fixed to a section of the bit head. Or as a further instance, the locking mechanism of Fig. 1 can be used in a form of spindle with integral shank as in Fig. 8. In other words where a feature may be transposed from one form of the invention to another, it is to be regarded the same as though illustrated in connection therewith.

I claim:

1. In an earth boring drill, a spindle, a roller cutter having a bore to fit said spindle, and a front wall portion to cover the end of the spindle, means carried by the spindle to rotatively lock the roller cutter thereon, said means being operated to lock-

ing position through contact of said front wall portion with a part of said locking means in the act of moving the roller cutter onto the spindle, substantially as described.

2. A roller cutter for earth boring drills of substantially frusto-conical form with a bore having a general flare towards the base, said cutter having an annular groove with smooth walls in said bore, a flaring counterbore at the base and a cylindrical portion intermediate the groove and the counterbore.

3. An earth boring drill comprising a spindle, radially movable locking means on the spindle, means within the spindle for pressing said locking means outwardly with respect to the axis of the spindle, a roller cutter having a bore to fit the spindle, and a portion complementary to and engageable by said locking means when said locking means is in its outward position, the bore of said roller having a flared portion at its base to engage the locking means and move the same radially inward relative to the spindle axis, during the movement of the roller axially to its prescribed position on the spindle, substantially as described.

4. A spindle for an earth boring roller cutter, having a bearing surface of a plurality of diameters including cylindric and conical portions, and a circumferential groove with locking means therein movable substantially radially of the spindle and means for automatically moving the locking means radially outwardly in the groove to automatically engage a roller cutter when positioned thereon for holding it against axial movement while permitting its free rotation.

5. A spindle for an earth boring roller cutter having non-resilient spring pressed means to automatically lock a roller cutter thereon while permitting its free rotation, when said roller cutter is operatively positioned on said spindle, said locking means being mounted in said spindle to have movement substantially radially thereof.

6. A spindle for an earth boring roller cutter having an annular groove, segments in said groove for engaging a cutter, radial pins in the spindle engaging said segments for forcing them outwardly, and spring means for operating said pins.

7. A spindle for an earth boring roller cutter having an annular groove, a segment in the groove for locking a cutter to the spindle while permitting its free rotation, and a pin in the spindle for forcing the segment outwardly to engage the cutter, said pin connecting with the segment about midway of its length, substantially as described.

8. An earth boring drill having a spindle, means carried by the spindle for locking a roller cutter thereon, a segmental bushing at the base of the spindle, and a bushing at the front of the spindle in one piece and adapted to be slipped onto the spindle by an axial movement, said locking means being located intermediate said bushings, substantially as described.

9. An earth boring drill having a spindle, means carried by the spindle for locking a roller cutter thereon, said spindle having a reduced rear portion and a stepped forward end, a segmental bushing at the reduced rear portion of the spindle, and a bushing in step form at the front end of the spindle, said locking means being located intermediate the said bushings, substantially as described.

10. In combination in an earth boring drill, a spindle in one piece with its support and of reduced diameter adjacent said support, a cutter roller having a bore with a flared terminal counterbore, and a segmental bushing on the reduced part of the spindle having a conical surface to receive said flared counterbore, substantially as described.

11. In combination in an earth boring drill, a spindle having locking means to retain a roller cutter against axial displacement while allowing it rotary movement, a roller cutter adapted to be placed on said cutter by a movement axially thereof, operating means for said locking means comprising pins mounted in and movable radially of the spindle, and an actuating connection for the radial pins, said connection extending therefrom to be operated by the cutter as a consequence of moving the said cutter axially into working position on said spindle, substantially as described.

12. In combination a spindle for an earth boring drill externally recessed, locking pieces mounted in said external recess, radial pins to move the locking pieces outwardly, a spreader for said pins movable lengthwise of the spindle and a roller cutter contacting with said spreader to operate the same as a consequence of placing said cutter on the spindle in operative relation, said roller cutter having a portion to cooperate with the locking pieces to lock said cutter rotatably on the spindle.

13. A roller cutter for deep well drills having a bore with a wall closing the front end and a protuberance on said wall extending in a direction towards the open end of said cutter, said cutter having an annular groove in the wall of its bore, substantially as described.

14. A roller boring drill comprising a head, a spindle on said head integral with a shank, a seat recess in the head eccentric to the axis of the spindle, a segmental bearing having a portion fitting the seat recess, said bearing forming one wall of a groove the opposing wall of which is on the spindle, said spindle having a reduced diameter portion between the groove wall of said spindle and the shank on which reduced diameter portion the segmental bearing is located, and means located in said groove, adapted to ro-

tatably lock a cutting roller on the spindle.

15. In an earth boring drill, an approximately frusto-conical shaped cutter having an inside bearing surface of cylindrical shape to turn on a bearing, an annular stop shoulder at the rear end of said cylindrical bearing shoulder, a flaring portion extending rearwardly from said shoulder, an annular smooth walled recess in a cylindrical bearing portion of larger diameter than the first mentioned cylindrical bearing surface, and in rear of said flaring portion, and a flaring counterbore in rear of the recess and at the base of the cone.

16. A roller cutter unit having a spindle with a shank for insertion into a bit head, a roller cutter and means for rotatively locking the roller cutter onto the spindle, said means being inaccessibly and permanently enclosed by the roller cutter and spindle, and holding said roller cutter irremovably on said spindle, said locking means including a member movable radially of the spindle and operating means for said member housed within the spindle, substantially as described.

17. In an earth boring apparatus a spindle, a roller cutter on said spindle and means for rotatively locking the roller cutter onto the spindle, said means being inaccessibly and permanently enclosed by the roller cutter and spindle, and holding said roller cutter irremovably on said spindle, said locking means including a member movable radially of the spindle and operating means for said member housed within the spindle.

18. A roller cutter for earth boring drills of substantially frusto-conical form with a bore made up of substantially cylindrical portions and inclined portions flaring towards the base, an annular groove between one of the cylindrical portions and one of the inclined portions, the said cylindrical portion last mentioned being adjacent that one of the flared portions which is at the base of the cutter, said cutter having a wall portion closing its small end and having also a shoulder extending in a plane transverse to the axis of the cutter and connecting the other cylindrical portion and the other inclined portion, substantially as described.

19. In combination with a spindle for receiving a roller cutter, a pair of locking pieces of segmental form located in an annular groove with which the spindle is provided and spring means for pressing said locking pieces radially outward, substantially as described.

In testimony whereof, I affix my signature.

CLARENCE E. REED.