

June 23, 1942.

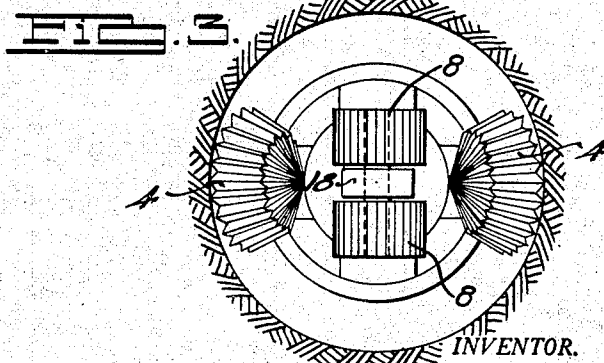
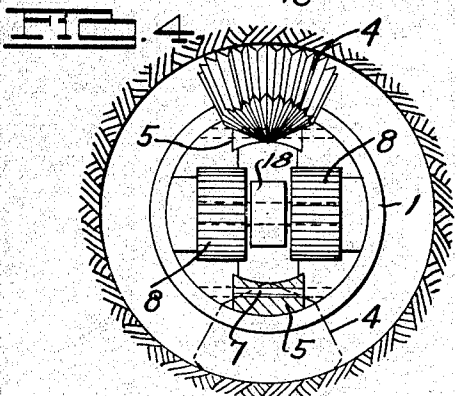
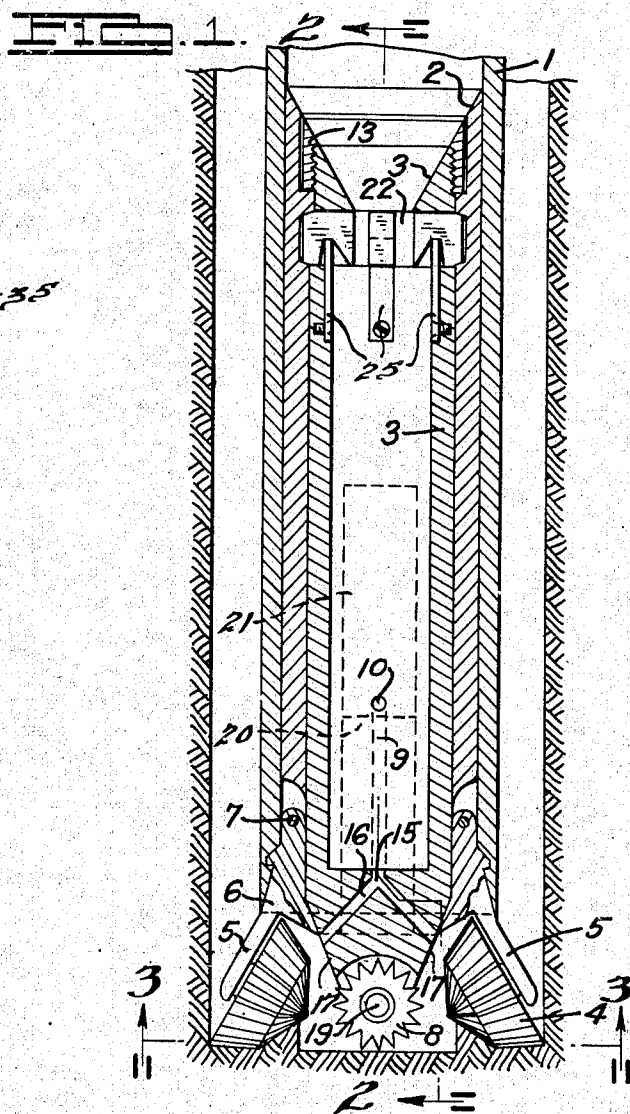
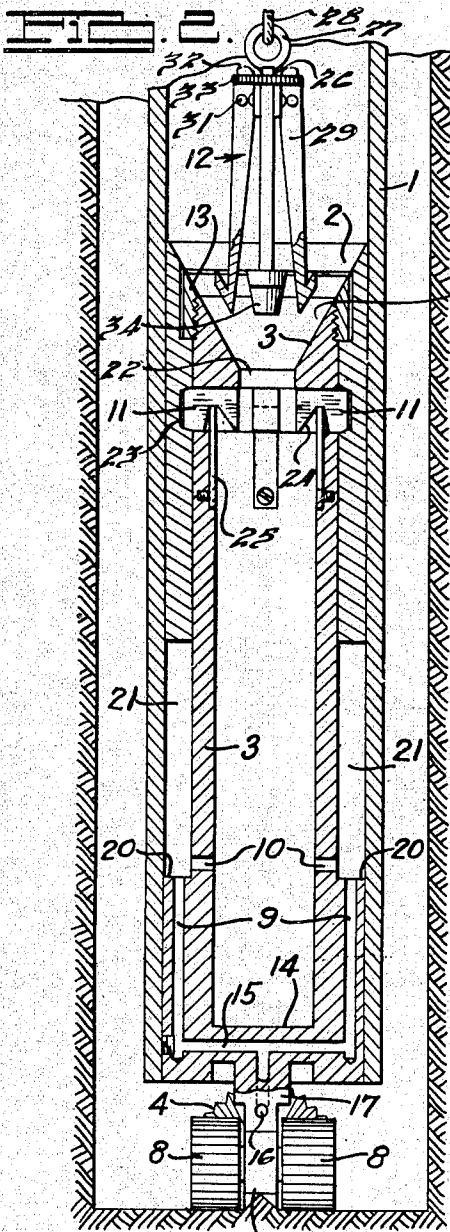
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2,287,714

DRILL BIT

Filed Nov. 6, 1939

2 Sheets-Sheet 1



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DRILL BIT

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2 Sheets-Sheet 2

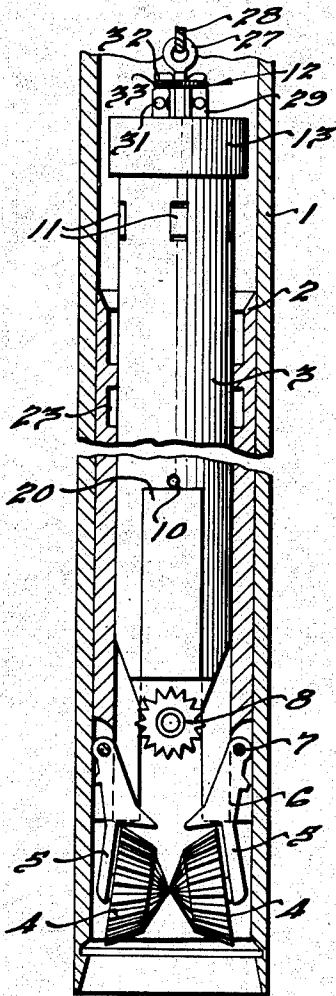


FIG. 5.

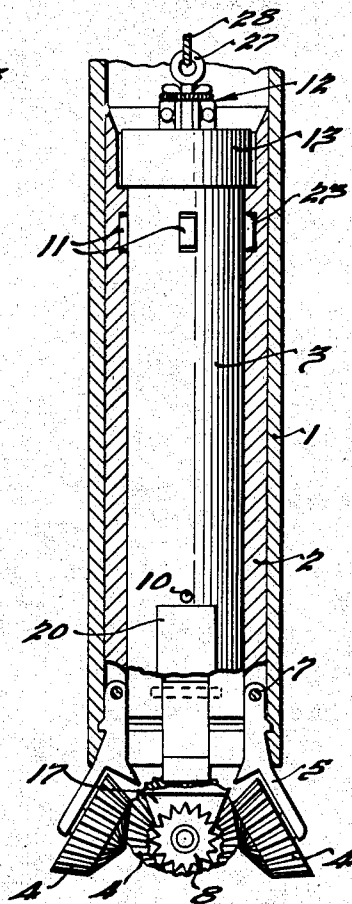


FIG. 6.

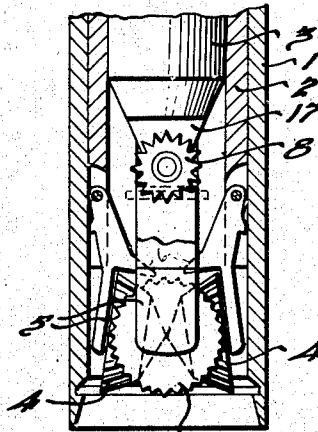


FIG. 7.

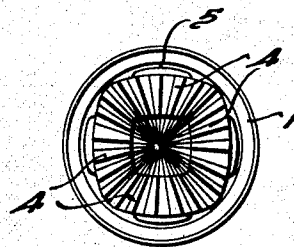


FIG. 8.

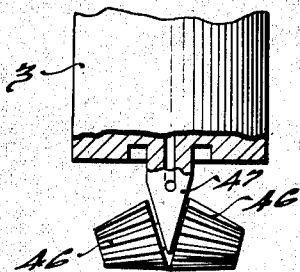


FIG. 9.

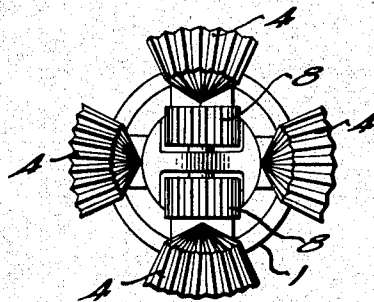


FIG. 10.

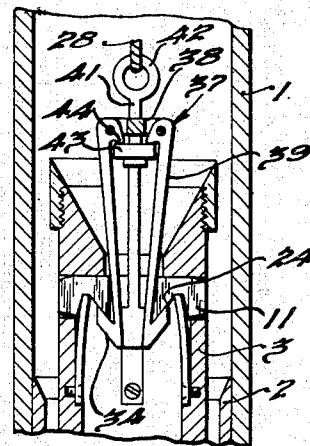


FIG. 11.

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UNITED STATES PATENT OFFICE

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DRILL BIT

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Application November 6, 1939, Serial No. 303,004

9 Claims. (Cl. 255—75)

My invention relates to apparatus for drilling wells, and particularly to a drilling tool or bit, which is attachable and detachable to and from the end of a hollow drill stem while in the bored hole.

The invention relates more specifically to the rotary type of well drilling apparatus wherein a rotary drill stem or shaft is progressively lowered within the hole as it is bored. The drill shaft is composed of sections which are progressively added as the bit extends the bore. The bit is secured to the end of the drill shaft and heretofore when broken or dulled, the entire shaft was withdrawn from the bore through the disconnection of the shaft sections. After the bit was repaired or replaced, the sections were again connected together as the bit was progressively lowered into the bore.

In practicing my present invention, I provide a bit for a hollow drill shaft which may be lowered through the shaft's hollow interior to its end where it is secured, eliminating the withdrawal of the shaft from the bore. Material time and cost in labor is saved when the necessity of repeated withdrawals of the drill shaft from the bore is avoided.

My device embodies a sleeve of a diameter less than that of the drill shaft, having a sleeve telescoped therewithin which is movable longitudinally relative to the outer sleeve. The sleeve carries arms upon which cutting rollers are mounted, operated outwardly into cutting position by a tapered end on the inner sleeve which engages cam surfaces on the arm. Recesses are provided in the end of the drive shaft for receiving and locking the arms relative thereto. Locking means are also provided between the inner and outer sleeve operated by tongs which are guided into the inner confines of the inner sleeve by conical ends on the two sleeves.

With the two sleeves in extended relation supported on the lowering tongs, the cutting bits are in retracted position so that the entire device will pass through the hollow interior of the drill shaft. When the end of the outer sleeve reaches the bottom of the bore, the inner sleeve continues to move downwardly, camming outwardly the arms and the rollers into cutting position. As the lowering tongs move downwardly out of engagement with the locking pins on the inner sleeve, the pins move outwardly to fasten the two sleeves together. When the tongs are released in this manner, they are so constructed as to collapse so that they may be withdrawn from the inner sleeve and the drill shaft.

When it is necessary to withdraw the cutting bits from the driving shaft, a set of withdrawing tongs are employed which are lowered through the drill shaft into engagement with the sleeves and guided by the sloping ends on the sleeves to

the interior of the inner sleeves. The ends of the tongs expand within the sleeve and engage the locking pins when initially raised and withdraw the pins from engagement with the outer sleeve, to thereby release the sleeves. Further upper movement of the tongs moves the inner sleeve upwardly relative to the outer sleeve, thereby permitting the arms and the associated drilling cutters to move inwardly and clear the inner surface of the driving shaft as the outer sleeve is withdrawn therefrom.

Accordingly, the main objects of my invention are; to provide a tool having roller cutters for the end of a drill stem or shaft of a well drilling rig which is insertable through the shaft to a position on the end thereof within the bore; to provide a drilling tool having collapsible roller cutters which pass through the drill stem of a drilling rig and thereafter are expanded and locked to the stem at the bottom of the bore; to provide an expansible roller cutter tool, with means for expanding the cutters, which is insertable through a drill stem of the tool into cutting position and for locking the tool on the end of the stem; to provide a tool having collapsible rock cutting rollers which may be lowered into the bore on a cable through the flush inside drill stem to which the tool is attached when the rollers are expanded and locked in position; to provide a pair of telescoping sleeves for supporting collapsible rock cutting rollers which expands the rollers to drilling positions and locks the sleeves to each other and to the end of the drill shaft; to provide a tool movable through a drill stem having adjustable rock cutting rollers on one element and non-adjustable rock cutting rollers on another element with the latter element having means for adjusting the position of the adjustable rollers; and in general, to provide a rock cutting tool for a drill stem of a drilling rig which is simple in construction, positive in operation, and economical of manufacture.

Other objects and features of novelty of my invention will be either specifically pointed out or will become apparent when referring, for a better understanding of my invention, to the following description, taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a sectional view of a drilling tool embodying features of my invention, with the tool in expanded position;

Fig. 2 is a sectional view of the structure illustrated in Fig. 1, taken on the line 2—2 thereof, illustrating tongs for removing the tool from the end of the drill shaft;

Fig. 3 is a view as indicated by line 3—3 of the lower end of the structure illustrated in Fig. 1;

Fig. 4 is a view, partly in section through a pivot member, of the structure illustrated in Fig. 1;

Fig. 5 is a view of the structure illustrated in Fig. 1 with the drilling tool in collapsed position;

Fig. 6 is a sectional view of structure similar to that illustrated in Fig. 1, showing a modified form of my invention;

Fig. 7 is a view of structure similar to that illustrated in Fig. 6, with the drilling tool in expanded position;

Fig. 8 is an end view of the structure illustrated in Fig. 7;

Fig. 9 is an end view of the structure illustrated in Fig. 6;

Fig. 10 is a view of the detachable tongs employed for lowering the drilling tool through the drill; and,

Fig. 11 is a broken view of structure similar to that illustrated in Fig. 2, showing a modified form of my invention.

Referring to Figs. 1 to 5 inclusive, I have illustrated a drill shaft 1 of a drilling rig which has secured to the end thereof at the bottom of the bore my new and novel drilling tool. The mechanism comprises an outer sleeve 2 and an inner sleeve 3 disposed in extensible, telescoping relation. A pair of conical shaped cutters 4 are supported on the end of the sleeve 2 on arms 5 which are disposed in slots in the sleeve end. The arms 5 have cam surfaces 6 thereon and are supported on pivots 7 for swinging movement to and from cutting position, as illustrated in Figs. 1 and 5.

A pair of roller cutters are mounted on a shaft 19 on either side of a support 18 on the end of the inner sleeve 3. The sleeve 3 has projections 20 on opposite sides thereof which operate in slots 21 in the outer sleeve 2. Passageways 9 in the projections 20 communicate through the passageway 15 with the orifices 16 in the support 18, providing a passage for the drilling fluid pumped down through the drill stem through apertures 10 in the wall of the inner sleeve 3 and out through the orifices 16 to the rollers. The closed end 14 of the inner sleeve 3 is provided with a tapered extension 17 on the end of which the support 18 is provided. The tapered walls 17 cooperate with the cam surfaces 6 of the arms 5 and thereby force the arms outwardly when in lowered position. When in this position the arms 5 and sleeve 2 are locked to the end of the stem 1 to resist the weight of the stem and the torque of the stem when driven.

A threaded element 13 is screwed upon the end of the inner sleeve 3, providing a projecting shoulder which mates with a ledge on the inner surface of the sleeve 2 to limit the downward movement of the inner sleeve. A plurality of pins 11 lock the inner sleeve 3 relative to the outer sleeve 2 through the projection of the pins into apertures 23 in the outer sleeve. Each pin is provided with a notch 24 having a sloping surface, by which the pins are retracted. Springs 25, projecting in the notches urge the pins outwardly within the notches 23 in the sleeve 2 and thereby lock the two sleeves together.

In Fig. 2, I have illustrated a set of tongs 12, employed to withdraw the pins 11 to produce the separation of the sleeves and the collapse of the tool, to permit the withdrawal of the tool from the drill shaft through the hollow interior thereof. The tongs embody a support 26, having an eye 27 supported on a cable 28. A plurality of hook elements 29 are pivoted to the support 26 on the pivots 31. The upper end of the arms are provided with extensions 32, encompassed by

a garter spring 33, which expands the ends 34 of the hook elements 29 outwardly, as illustrated in the figure. The ends 34, when the hook elements are collapsed, assume the shape of a truncated cone which passes through the opening 22 in the inner sleeve 3 when lowered. The tapered surface is provided on the ends of the sleeves 2 and 3 to guide the tongs through the opening 22 by having the ends of the tongs collapse against the bias of the spring 33 due to the weight of the tongs. When the tongs enter the aperture 22, the garter spring 33 expands the hooked ends 34 to a position of engagement with the sloping surface of the notch 24 in the pins 11. The pins are moved inwardly, withdrawing the ends from the apertures 23, thereby unlocking the inner sleeve 3 from the outer sleeve 2 upon the initial upward movement of the tongs.

Further upward movement of the tongs moves the inner sleeve upwardly relative to the outer sleeve until the projections 20 abut against the upper end of the slot 21. Thereupon, the outer sleeve 2 is supported on the inner sleeve 3 and is withdrawn through the drill shaft. Upon the initial upward movement of the inner sleeve 3, the cam surface 17 moves out of contact with the cams 6 on the arms 5, permitting the arms, and therefore the rollers 4, to move inwardly within the diameter of drill shaft 1. This inward position of the arms is illustrated in Fig. 5 where the outer casing 2 is illustrated as being supported on the inner casing 3 within the drive shaft 1, the casing being supported by the tongs 12 on the cable 28.

In Fig. 10 I have illustrated a second set of tongs 37 embodying a support 38 upon which a plurality of hook elements 39, herein illustrated as four in number, are pivotally mounted. The support 38 is slidable upon a body 41 of an I bolt 42, carrying a cylindrical element 43 against which lever arms 44 on the upper end of the elements 39 abut. Hook ends 34, similar to those above described relative to tongs 12, are engageable with the sloping surface of the notch 24 of the pins 11. The inner sleeve 3 is illustrated as being supported on the tongs with the pins 11 drawn inwardly by the ends 34 of the elements 39. When the rollers 4 project below the end of the casing 1 and strike the bottom of the bore, the continued downward movement of the inner sleeve 3 will cause the cam surfaces 17 to force the arms 5, and therefore the cutters 4 outwardly to cutting position, as illustrated in Fig. 1. Thereupon, the lowering of the tongs releases the pins 11, which are moved outwardly by the springs 25 into the apertures 23 in the outer casing 2. In view of the lever arms 44 resting upon the element 43, the elements 39, and therefore the hooks 34, are swung inwardly, so that upon the upward movement of the tongs 37 the ends 34 pass out of the opening 22, and are withdrawn from the drill shaft. After the bits 4 become dulled or damaged, requiring the drilling tool to be withdrawn, the tongs 12 are employed for disconnecting the tool from the end of the drill shaft and for withdrawing the device outwardly therethrough.

In Figs. 7, 8, and 9 I have illustrated a further form of my invention, that wherein four of the cutters 4 are employed on the end of the outer sleeve. Arms 5 are employed suspended on pins 7 equally spaced about the end of the sleeve 2 while the end of the inner sleeve 3 is provided with four sloping surfaces 17 for operating the arms 5 when the inner sleeve 3 is lowered rela-

tive to the outer sleeve 2. In Figs. 6 and 9 I have illustrated the expanded position of the four cutters 4 on the end of the drill shaft 1, while in Figs. 7 and 8 I have illustrated the collapsed position of the cutters when withdrawn within the end of the drill shaft 1. The operation of the device is exactly the same as that described above with relation to the structure illustrated in Figs. 1 to 5, and 10.

In Fig. 11 I have shown a slightly modified form of structure, that wherein a pair of conical rollers 46 are mounted on a tapered projection 47 on the end of the closure 14 of the inner sleeve 3. The shafts of the rollers are mounted at an angle so as to have the rollers contact the bottom of the bore along a straight line. The advantage of this construction is to have the rollers on the sleeve 3 contact the center of the bore which is not engaged by the rollers 8 because of the projection 18 extending downwardly therebetween. It is to be understood that the cutters 4 and other parts of the device function in the same manner as that described above when the cylindrical rollers 8 are employed.

While I have described and illustrated several embodiments of my invention, it will be apparent to those skilled in the art, that various changes, omissions, additions, and substitutions may be made therein without departing from the spirit and scope of my invention as set forth in the accompanying claims.

What I claim is:

1. The combination in a tool for a rotary drill stem of a drilling device, of a tubular support insertable through said stem, arms pivoted on the end of the support, roller cutters on said arms, a second tubular support telescoped within said first support on which the first support is suspended, means on said second support for moving the arms and therefore the cutters outwardly of the stem axis to cutting position, and means for locking said cutters on the end of the drill stem.

2. The combination in a tool for a rotary drill stem of a drilling device, of a tubular support insertable through said stem, arms pivoted on the ends of the support, roller cutters on said arms, a second tubular support telescoped within said first support on which the first support is suspended, means on said second support for moving the arms and therefore the cutters outwardly of the stem axis to cutting position, means for locking said cutters in drilling position, and additional roller cutters carried on the lower end of said second support.

3. The combination in a tool for a rotary drill stem of a drilling device, of an outer sleeve insertable through said stem, arms pivoted on the end of the outer sleeve, roller cutters on said arms, an inner sleeve on which the outer sleeve is suspended, means on said inner sleeve for moving the arms and therefore the cutters outwardly to cutting position, means for locking said cutters in drilling position, and means for locking said sleeves together.

4. The combination in a tool for a rotary drill stem of a drilling device, of an outer sleeve insertable through said stem, arms pivoted on the end of the outer sleeve, roller cutters on said arms, an inner sleeve on which the outer sleeve is suspended, means on said inner sleeve for mov-

ing the arms and therefore the cutters outwardly to cutting position, means for locking said cutters on the end of the drill stem, means for locking said sleeves together, and additional roller cutters carried on the end of said inner sleeve.

5. A well drilling device having a rotatable stem, a pair of telescoped sleeves insertable through said stem, fixed roller cutters on the end of the inner sleeve, pivoted arms on the outer sleeve, roller cutters on the end of said arms, means on said inner sleeve for swinging the cutters into cutting position, locking means between said sleeves, a cable, means on said cable insertable within said sleeves for engaging said locking means and supporting said sleeves during the lowering thereof through the drill stem, and comprising means for releasing said engaging means from the locking means and from the sleeves to permit the cable and engaging means to be withdrawn from the drill stem.

6. A well drilling device having a rotatable stem, a pair of telescoped sleeves insertable through said stem, non-adjustable roller cutters on the end of the inner sleeve, pivoted arms on the outer sleeve, roller cutters on the end of said arms, means on said inner sleeve for radially adjusting the cutters on the outer sleeve into cutting position, locking means between said sleeves, a cable, means on said cable lowerable through said drill stem into said inner sleeve, and comprising means for expanding said lowerable means to engage said locking means and for releasing the sleeves upon the upward movement of the cable to thereby permit the adjusted cutters to contract and be withdrawn through the drill stem.

7. In combination with a rotary drill stem, a rotary roller bit having a pair of telescoping sleeves, a set of rollers mounted on the end of one of said sleeves, an additional set of rollers pivotally mounted on the end of the other of said sleeves, means on said first sleeve for moving the pivotally mounted rollers outwardly of the axes of the stem while the set of rollers thereof are moved therebetween into cutting position, and means for locking said rollers relative to each other and to the stem for rotational movement about the stem axes.

8. A well drilling device having a rotatable stem, a sleeve insertable through said stem having slots on its inner face at the end thereof, arms pivoted on the ends of said stem mateable with said slots, cutting rollers on said arms shaped to nest with each other within said stem, and an additional element within said sleeve having cam means for forcing the arms within the slots of the stem to position the rollers beyond the outer surface thereof.

9. A well drilling device having a rotatable stem, a sleeve insertable through said stem having more than two slots on its inner face at the end, more than two arms pivoted on the ends of said stem mateable with said slots, a cutting roller on each of said arms having conical faces which engage each other when nested within the stem, and an additional element within said sleeve having cam means for forcing the arms within the slots to position the rollers beyond the outer surface of the stem.

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