(No Model.)

M. C. BULLOCK & S. W. DOUGLASS.

DRILLING APPARATUS.

No. 473,907. Patented May 3, 1892.

Fig. 1.

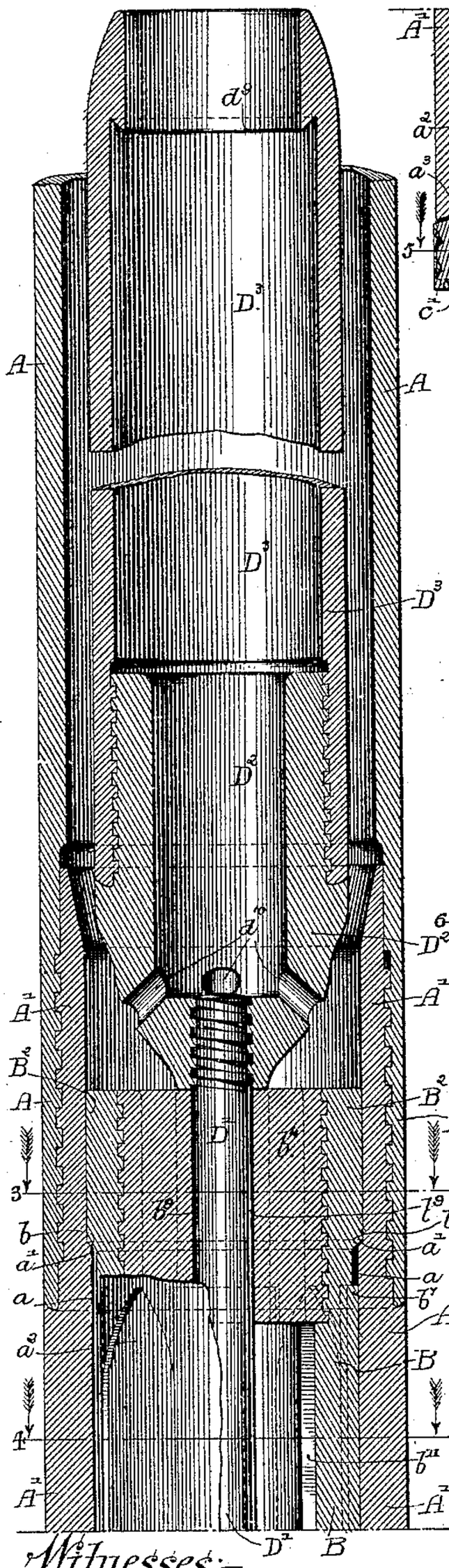


Fig. 2.

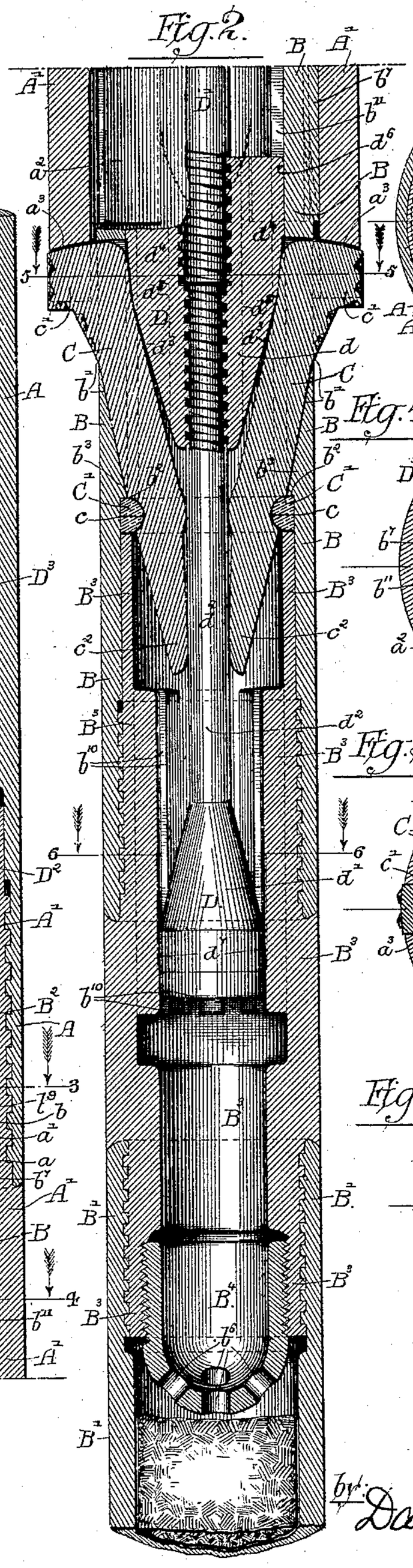


Fig. 3.

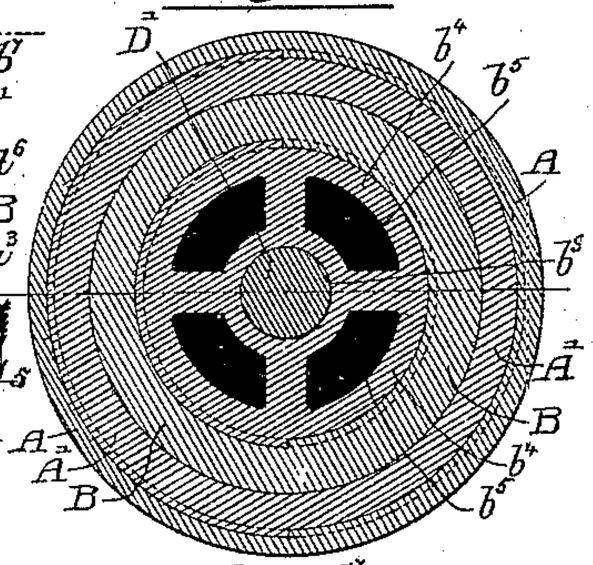


Fig. 4.

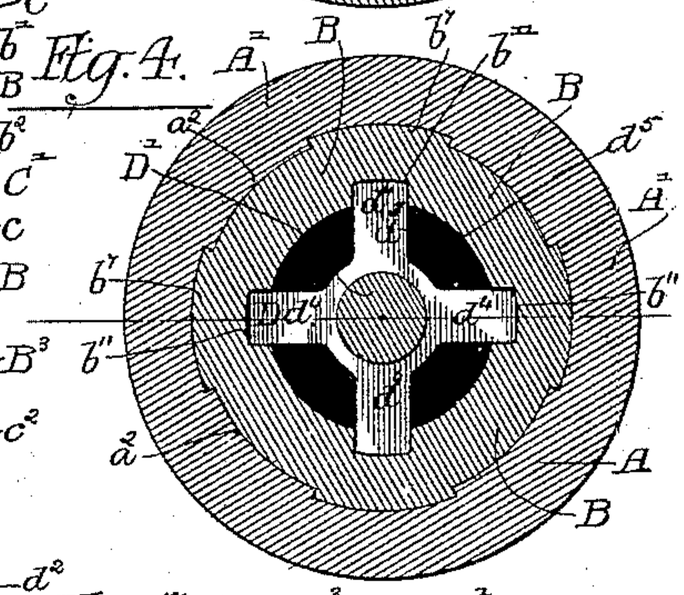


Fig. 5.

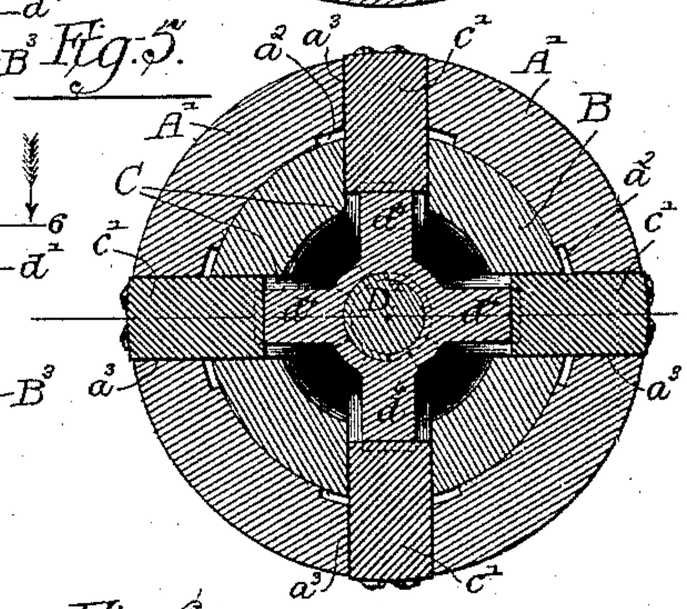
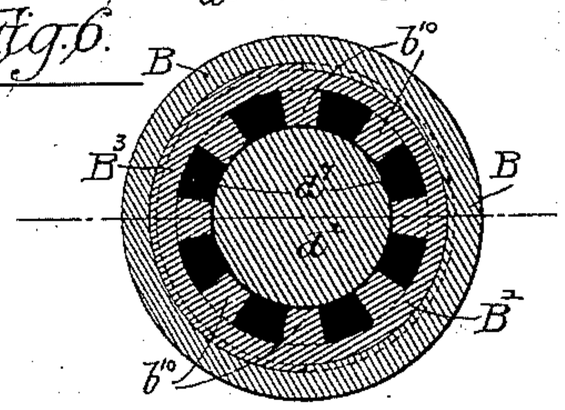


Fig. 6.



Witnesses:-

Louis H. F. Whitehead

Wm. F. Hemings.

Inventors:-

Milan C. Bullock.-

Samuel W. Douglass.

by: Dayton, Poole & Brown

Attorneys.-

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

MILAN C. BULLOCK AND SAMUEL W. DOUGLASS, OF CHICAGO, ILLINOIS; SAID DOUGLASS ASSIGNOR TO SAID BULLOCK.

DRILLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 473,907, dated May 3, 1892.

Application filed January 17, 1890. Serial No. 337,165. (No model.)

To all whom it may concern:

Be it known that we, MILAN C. BULLOCK and SAMUEL W. DOUGLASS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Drilling Apparatus; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to drilling apparatus for earth or rock boring of that class known as "diamond drills," or those having an annular cutting-head and a core-barrel and in which a core is formed as the cutting-head advances, and more particularly to that class of such drilling apparatus having a core-barrel to receive the core, in which the core is removed from the bored hole outwardly through a tubular drill-rod or casing-tube by which the cutting-head is actuated.

The invention consists in the features of construction and combinations of parts hereinafter fully described, and pointed out in the appended claims.

In the drawings, Figures 1 and 2 show in two parts or sections and in central vertical section the lower end of a casing-tube, the upper end of a core-barrel, and parts adjacent thereto. Figs. 3 and 4 are views in cross-section taken, respectively, on the lines 3 3 and 4 4 of Fig. 1. Figs. 5 and 6 are views in cross-section taken, respectively, on the line 5 5 and the indirect line 6 6 of Fig. 2.

As shown in said drawings, A is an outer casing-tube or tubular drill-rod, the lower end only of which is herein shown.

B is a core-barrel, having at its lower end a cutting-head, (not shown herein,) the upper end of said core-barrel only being shown. Said core-barrel and the cutting-head thereon are smaller in external diameter than the interior of the casing-tube, so that said parts may be removed upwardly through the said casing-tube for taking out the broken-off section of the core. The core-barrel has an upper tubular part B extending into the casing-tube and provided with devices for connecting the core-barrel with said tube. The said tubular part B is provided above the core-barrel with a series of reamers C C, which operate to enlarge the hole made by the cutting-head sufficiently to receive said casing-tube.

In the apparatus described in this application, as well as that described in another application, Serial No. 322,373, filed by us in the United States Patent Office August 29, 1889, it is intended to drive and rotate the cutting-head, core-barrel, and the reamers, which enlarge the hole to receive the casing-tube from the casing-tube A, by means of suitable connections between the same, adapted to be disconnected to allow the withdrawal through the tube of the core-barrel and connected parts. It will of course be understood that said casing-tube A protrudes above the surface of the ground and is driven or rotated by any suitable machine, so that in this apparatus the said casing-tube A serves the purpose of a drill-rod as well as that of a casing for the hole. In the apparatus shown in the said prior application the core-barrel is held from rising within the casing-tube, while in operation, by means of locking-dogs on the upper end of the core-barrel, which engage a shoulder within the casing-tube and which may be retracted and disengaged from the tube to allow the withdrawal upward of the core-barrel. The device herein shown differs from that illustrated in said prior application by the omission of the locking-dogs and the construction of the parts in such manner that the reamers themselves engage the lower end of the casing-tube and take the place of such locking-dogs for holding the core-barrel down to its work.

Near its lower end the said casing-tube A is provided with a section or casing-shoe A′. Said casing-shoe has an internal diameter smaller than that of the casing-tube proper, and is tapered gradually outward at its upper end to prevent the formation of any projections or shoulders thereat. The said shoe A′ is contracted in its lower part, thereby forming a shoulder a' about midway its ends, and the contracted portion a is provided with a plurality of vertical ribs a^2 a^2, having pointed upper ends. The lower end of said shoe is provided with a plurality of notches or open slots a^3 a^3, which are engaged by the

reamers C C when the latter are expanded, said reamers being adapted to engage the shoe A′ in such manner as to hold the core-barrel from rising within the casing-tube after said core-barrel has been lowered through the casing-tube to its operative position.

Near its upper end the said tubular part B is provided with an exterior enlargement B^2, which fits closely within the upper portion of the shoe A′, and a downwardly-facing shoulder *b*, formed by said enlargement, is adapted to engage the shoulder *a′* on the casing-shoe, thereby sustaining the said tubular part and serving to prevent the same from passing entirely through the said casing and becoming entirely separated from the same. Below the said shoulder *b* the tube B is provided with a series of vertical ribs b^7 b^7, having pointed lower ends. The said ribs b^7 are adapted to fit between the ribs a^2 on the shoe A′, and both series of ribs are so located that they act as guides for the tubular part B to bring the reamers thereon opposite or in line with or in position to engage the notches or slots a^3 in the lower end of the shoe. This feature of construction is shown and described in two separate applications for Letters Patent, namely: the application, Serial No. 322,373, before referred to, and an application of Milan C. Bullock, filed June 29, 1888, Serial No. 278,571. In said applications the said ribs are heavier than those shown herein and are used as the sole means of communicating rotary motion from one part to the other, while the ribs herein shown act mainly as guides for the purpose described, the engagement of the reamers with the notches a^3 a^3 serving as the principal means of driving the core-barrel from the casing-tube.

When the parts are in the position above described, the main portion of the tubular part B is located below the lower end of the casing-tube. Said part B is provided below and adjacent to the end of said casing with a series of vertical slots *b′ b′*, in which are located the reamers or reaming-cutters C C. Said reamers are pivoted to the tube B by means of notches or recesses *c c* in their front faces, with which notches a bearing-ring C′, located within the said tube, is engaged. The said bearing-ring is secured within the tube B between a downwardly-facing shoulder b^2, formed by a contracted portion b^3 of the tube and the upper end of a coupling-section B^3, which connects said tube B with the core-barrel B′. The reamers are provided on their outer sides above their pivots with overhanging heads or projections *c′ c′*, having diamonds or cutting-points in the outer or lower faces thereof. Below their pivots the said reamers are provided with actuating-arms c^2 c^2, which extend downwardly and engage devices hereinafter described for retracting and expanding said reamers. The outer faces of said arms are arranged at such an angle relatively to the heads *c′* that when said heads stand without the casing said arms will stand a considerable distance within the outer face of the same. The devices for retracting and expanding said reamers consist of an actuating-spool D, comprising two cones *d d′*, connected together with their smaller ends toward each other by means of a cylindric stem d^2. In the instance illustrated the said stem d^2 is formed integrally with the lower cone *d′* and is connected with the cone *d* by a screw-threaded joint. It follows that the said reamers are not secured or fastened to the said bearing-ring, but are held in engagement with said ring by the contact of their rear surfaces or edges with the cylindric stem d^2 of the spool, and that as the said cones in their upward and downward movement come between the upper or lower portions of the reamers said reamers will be either expanded or retracted. The upper cone *d* is formed on its upper end with an annular bearing-surface d^6, which is provided on its outer sides with V-shaped vertically-arranged notches or recesses d^3 d^3, Fig. 2, preferably four in number, and arranged at right angles with each other, thus forming four intermediate arms d^4 d^4, which register with and bear against the rear faces of the reamers above their pivots and which actuate and expand the same as the spool moves downwardly. The tube B is provided interiorly adjacent to the cone *d* with a plurality of vertical grooves or recesses b^{11} b^{11}, in which the arms d^4 fit and slide, Figs. 2 and 4, and thus serve to guide the said spool D and keep said arms in line with the reamers. The main purpose of the spaces d^5 d^5 between the said arms d^4 d^4 is to form passages for water. The lower cone *d′* is provided on its lower end with a cylindric bearing-surface d^7, which fits and slides within and is guided by the adjacent portion of the tube B, which is contracted to form a bearing-surface for the cone. A series of upright grooves, notches, or recesses b^{10} b^{10} in said bearing-surface forms passages for water past said cone *d′*. The said cone *d′* when thrust between the arms c^2 of the reamers will expand the same, and thereby retract the upper ends of said reamers, which carry the cutting devices. The devices for actuating said spools are constructed as follows.

D′ indicates an actuating-rod connected with the upper end of the spool D. In the instance illustrated the said rod has screw-threaded connection with the said spool. The said rod D′ extends upwardly above the upper end of the tube B and passes through a guide-aperture b^9 in a nut or plug b^4, fitted into the upper end of said tube. Said nut b^4 is preferably connected with the said tube by a screw-threaded joint, and it serves to limit the upward movement of the spool D, while the downward movement thereof is limited by the contact of said cone *d* with the upper arms of the reamers. The said nut or plug b^4 is provided with a plurality of vertical openings or passages b^5 b^5 for the flow of water from between the core-barrel and cas-

ing-tube. Above the nut b^4 the rod D′ is provided with a hollow head D^2, to which is attached an upwardly-extending sheath or tube D^3, being shown as connected with the head D^2 by a screw-joint. Said sheath is provided at its upper end with an internal downwardly-projecting or hooked flange d^9, and said sheath or tube is adapted to receive a detachable lifting device, commonly known as a "harpoon," such as shown in a separate application for patent, Serial No. 278,571, filed by Milan C. Bullock in the United States Patent Office June 29, 1888. Such lifting device is provided with expansible jaws adapted for automatic engagement with the flange d^9 of said tube, and when used is lowered by a rope through the casing-tube, so as to reach and engage said sheath. The recess formed in the upper end of the head D^2 is adapted to receive the lower end of the harpoon in the same manner as the corresponding feature in said separate application. The head D^2 is provided with a series of inclined water-passages d^{10} d^{10}, leading from the bottom of the recess therein to the space within the shoe A′, said passages allowing the escape of water and sediment from the sheath D^3 and the said recess.

The coupling B^3, which connects the tube B with the core-barrel B′ and extends within the upper end of the same, is provided on its lower end with a semi-spherical cap B^4, having a plurality of perforations b^6 b^6 therein. The said cap serves to prevent the cone from rising within the said core-barrel so as to close the lower end of said tubular coupling, and thus stop the flow of water therethrough.

The operation of the drilling apparatus above described is as follows: As before described, the casing-tube is used as a drill-rod to rotate and drive the cutting-head and reamers and also for the purpose of casing and protecting the hole. It is obvious that said casing-tube need not necessarily be used in the first instance when the boring of the hole begins, but can be applied at any stage of the drilling operation—as, for instance, when it is found necessary to provide a casing for a hole which has already been bored to a considerable depth.

The insertion of the core-barrel after it has been removed with the core is accomplished as follows: Said core-barrel and the tubular part B, with the reamers thereon retracted, are lowered into said casing-tube until the downwardly-facing shoulder b in said tube B comes into contact with the upwardly-facing shoulder a' of the casing. It is obvious when the said tubular part is being inserted into the casing-tube and before the shoulders come in contact with each other that the exterior radial ribs b^7 on said tube B will enter between the interior ribs a^2 on the casing, the pointed ends of said ribs serving to guide said parts so that the reamers C will be brought opposite the slots a^3 in the lower end of the casing, while the location of the shoulders a' and b bring the upper ends of said reamers in line with the upper walls of said slots a^3. During the insertion of the core-barrel the spool D is sustained at the upward limit of its movement, whereby the reamers are held retracted. When the tubular part reaches the position described, the spool is released and allowed to drop and expand the reamers, so that their heads c' will enter the slots a^3 in the lower end of the casing. It is manifest that in this position the core-barrel and tubular part B will be held in positive engagement with the casing, the shoulders a' and b and the contact of the heads c' of the reamers with the upper walls of the slots a^3 serving to prevent any relative longitudinal movement of said parts. When power is applied to the casing-tube to drive and rotate the same, the side walls of the slots a^3 press against the sides of the heads of the reamers and rotate the same and also the cutting-head, while the upper walls of said slots will press against the tops of the reamers, and thus serve to force the same downwardly.

In reaming out a previously-bored hole for the reception of the casing the cutting-head does not come into operation until the hole has been reamed out a sufficient distance from its top to bring the cutting-head to the bottom thereof. After this point is reached the cutting-head operates in its advance to cut a new core at the same time that the reaming of the hole is being accomplished. After a core has been cut and it is desired to remove or take out the same, which becomes necessary in all cases as soon as the total length of the core equals that of the core-barrel, a harpoon such as has been heretofore described is lowered by a rope through the casing-tube until it enters and engages the sheath D^3. The said harpoon is then drawn upwardly, thereby lifting the spool D, which retracts the reamers C, whereupon the entire tubular part B and the core can be withdrawn upwardly through the casing-tube, the tension of the rope tending to keep the spool in its uplifted position. When the core has been removed from the core-barrel and it is desired to reinsert the tubular part B, the harpoon is again connected therewith and said part is lowered until it comes into position, as before described, whereupon the harpoon is disconnected and the spool allowed to drop and lock said parts together.

It is of course obvious that during the drilling operation the water for lubricating the reamers and cutting-head and for carrying off the detritus from the cutters can be forced either upwardly or downwardly through or outside of the casing; but it is preferable to force said water downwardly outside the casing-tube and core-barrel, so that it will flow around the cutting-head and then upwardly within said core-barrel and casing-tube. The employment of a water-current flowing in this manner is preferred for the reason that it affords a more forcible upward current of wa-

ter, and thereby insures the prompt and rapid removal of detritus from the cutters. After passing upwardly within the core-barrel the water passes through the perforations b^6 in the cap B^4 and then through the coupling B^3 and the grooves or recesses b^{10} therein, around the lower cone d' of the actuating-spool, then around the said actuating-spool, through the spaces d^5, formed in the cone d, and through the water-passages b^5 in the plug b^4, from whence it passes into the casing-tube and upwardly to the top of the same.

One important advantage gained by the use of the device herein described arises from the construction by which the reamers are driven or actuated by the direct engagement of the casing-shoe therewith. In the device shown in said prior application, Serial No. 322,373, in which the reamers are sustained and driven solely by their connection with the core-barrel, the strain due to the resistance of the reamers in cutting comes solely upon the pivotal connection between the reamers and the core-barrel, and even if part of the strain is taken by the sides of the slot through which the reamers pass the strain upon the pivot and the sides of the slot is very great, owing to the fact that the reamers extend a considerable distance outward from the barrel, so that considerable leverage is exerted, tending to displace the reamers as well as to break the same. In the construction herein shown all of these objections are obviated, inasmuch as the casing-tube acts against the reamers at their outer ends and close to their cutting-points, thereby taking the strain of cutting entirely from the core-barrel. It will of course be seen that a part of the torsional strain due to the action of the cutting-head on the lower end of the core-barrel is taken by the interlocking guide-ribs upon the casing-tube and core-barrel, so that all of such torsional strain is not sustained by the reamers themselves; but practically all of the strain due to the action of the reaming-cutters is taken directly by the end of the casing-tube. In said prior construction the entire twisting strain due to the action of the cutting-head at the advance end of the core-barrel, as well as that due to the action of the reamers, is transmitted to the casing-tube by means of the interlocking ribs on said parts, while the end or back thrust of both the cutting-head and reamers comes on the locking-dogs connecting the core-barrel with the casing-tube. In the construction herein shown the said interlocking ribs may be made thinner because the twisting strain due to the action of both the cutting-head and reamers is taken largely by said reamers, while the end or back thrust of the reamers is taken directly by the casing-tube with obvious advantages in affording a strong and simple construction in the parts.

We claim as our invention—

1. A drilling apparatus comprising a rotating casing-tube, a core-barrel smaller than and adapted to pass through the casing-tube and to project below the same and provided with an annular cutting-head, and means for detachably connecting said core-barrel with the casing-tube, comprising stops or shoulders on the tube and core-barrel for limiting the downward movement of the latter, and expansible reamers upon the core-barrel, adapted to engage the lower end of the casing-tube, substantially as described.

2. A drilling apparatus comprising a casing-tube having an internal upwardly-facing shoulder near its lower end, a core-barrel extending below the same, a tubular part attached to said core-barrel and extending upwardly within the casing-tube, and means for detachably connecting said tubular part with the casing-tube, comprising a downwardly-facing shoulder upon said tubular part, adapted to engage said shoulder in the casing-tube, and expansible reamers connected with the tubular part and adapted to engage the lower end of said casing-tube, substantially as described.

3. A drilling apparatus comprising a casing-tube having notches or open slots in its lower end, a core-barrel projecting below the same, means for detachably connecting said core-barrel with the casing-tube, comprising expansible reamers connected with said core-barrel and adapted to engage said notches or open slots, and guide-ribs located on said casing-tube and core-barrel and adapted to bring said expansible reamers opposite said notches or slots, substantially as described.

4. A drilling apparatus comprising a casing-tube, a core-barrel adapted to pass through the casing-tube and to project below the same, and means for detachably connecting said core-barrel with said casing-tube, comprising stops or shoulders to limit the downward movement of the core-barrel relatively to the casing-tube, and expansible reamers upon the core-barrel adapted to engage the lower end of the casing-tube and means for retracting said expansible reamers, whereby the said core-barrel can be drawn upwardly through the casing-tube, substantially as described.

In testimony that we claim the foregoing as our invention we affix our signatures in presence of two witnesses.

MILAN C. BULLOCK.
SAMUEL W. DOUGLASS.

Witnesses:
C. CLARENCE POOLE,
HARRY COBB KENNEDY.