(No Model.) 3 Sheets—Sheet 1.

M. C. BULLOCK.

ROCK CORE DRILL.

No. 473,908. Patented May 3, 1892.

Fig. 1.

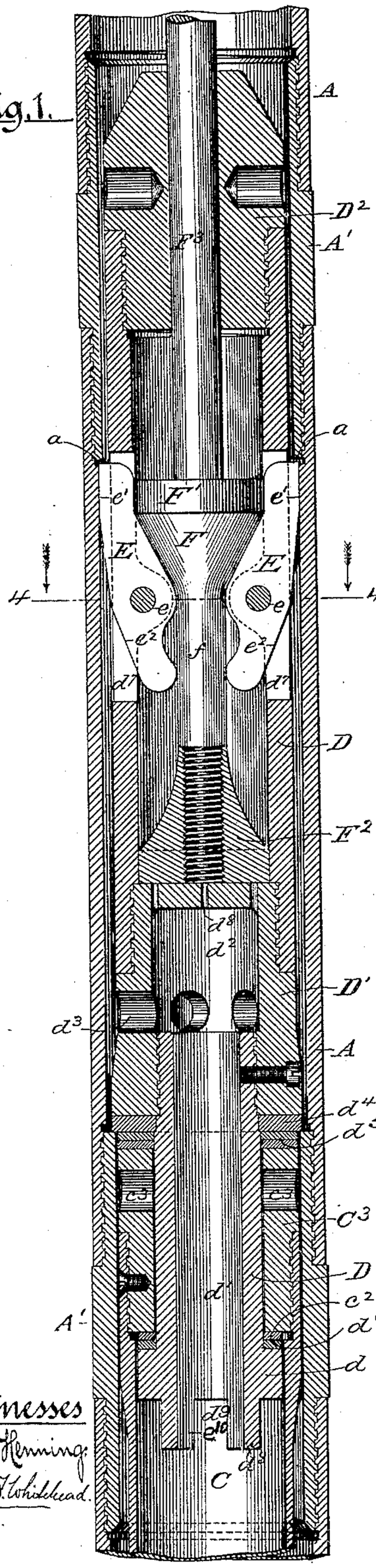


Fig. 2.

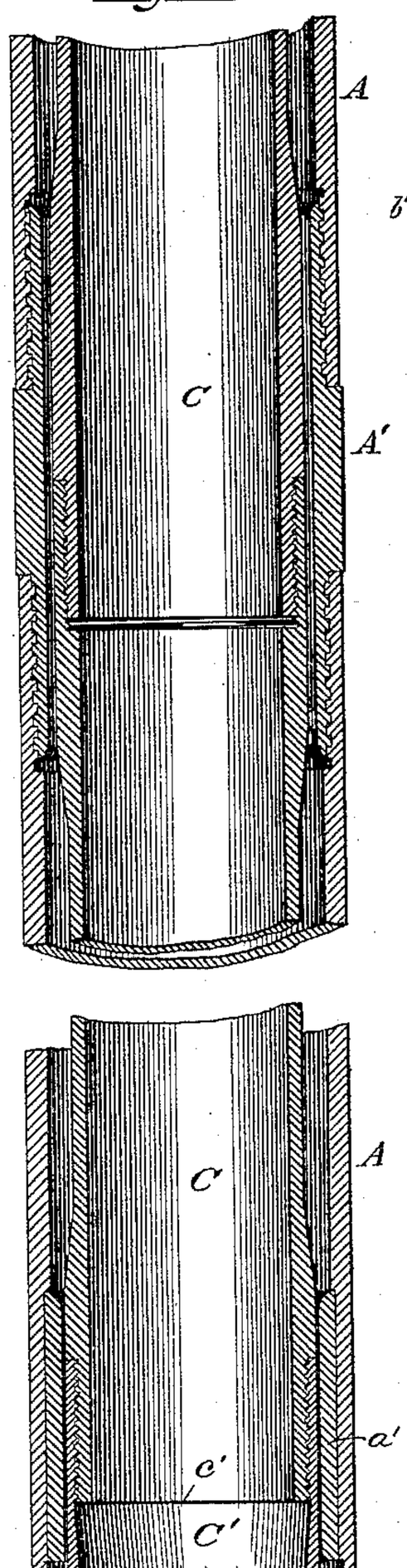


Fig. 3.

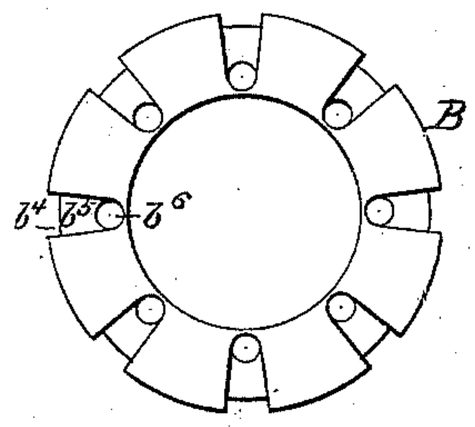


Fig. 4.

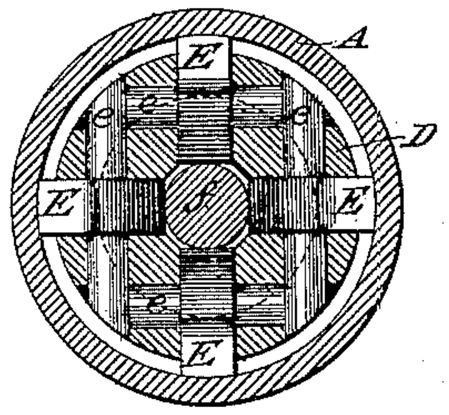
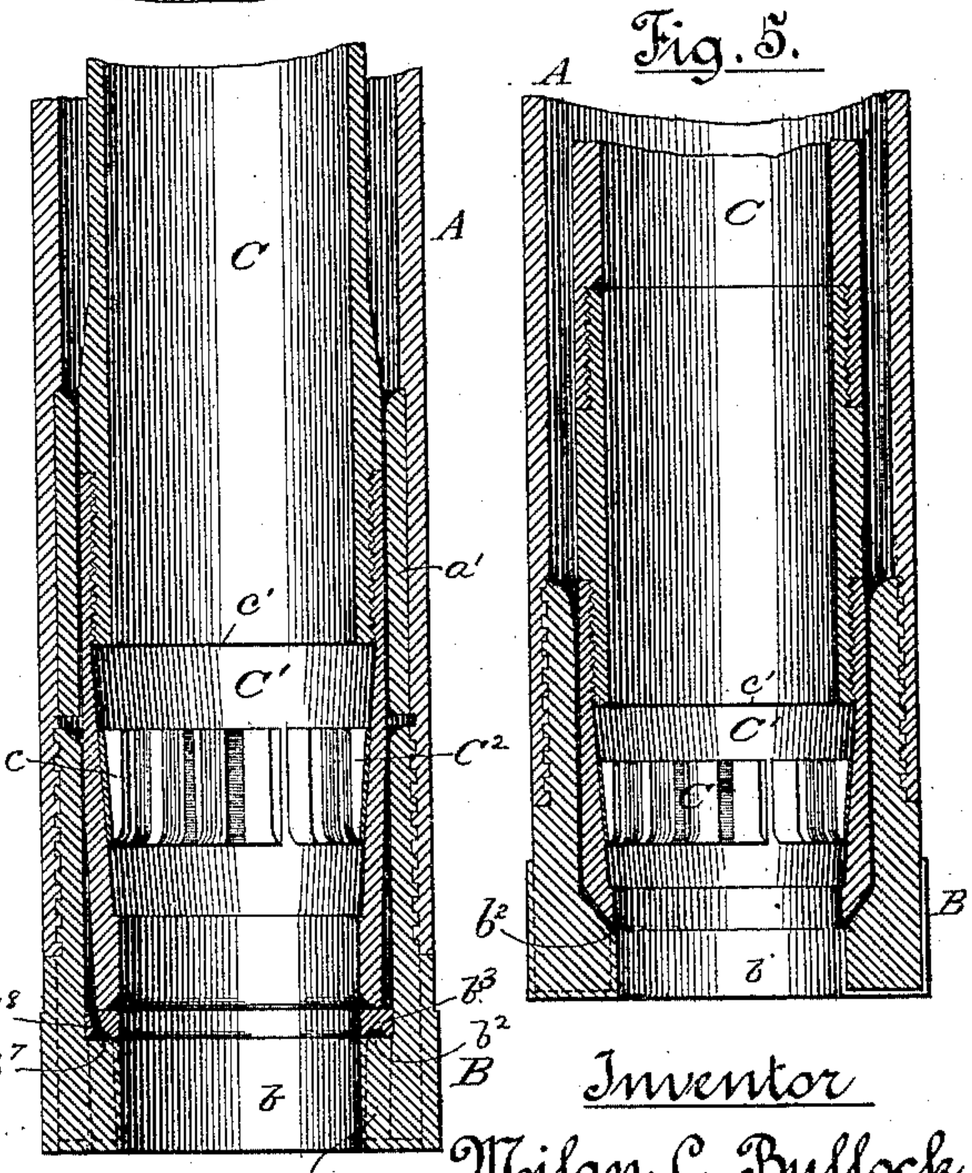


Fig. 5.



Witnesses
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(No Model.) 3 Sheets—Sheet 2.

M. C. BULLOCK.

ROCK CORE DRILL.

No. 473,908. Patented May 3, 1892.

Fig. 6.

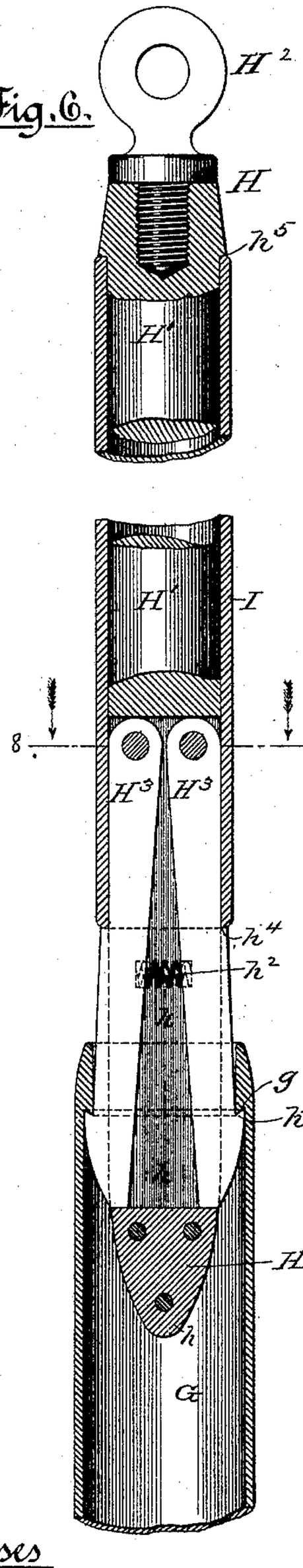


Fig. 8.

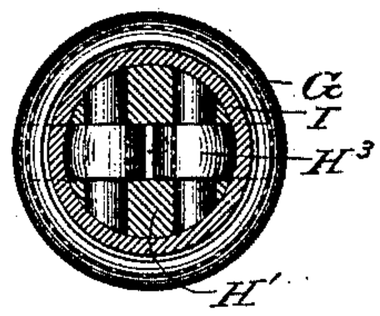
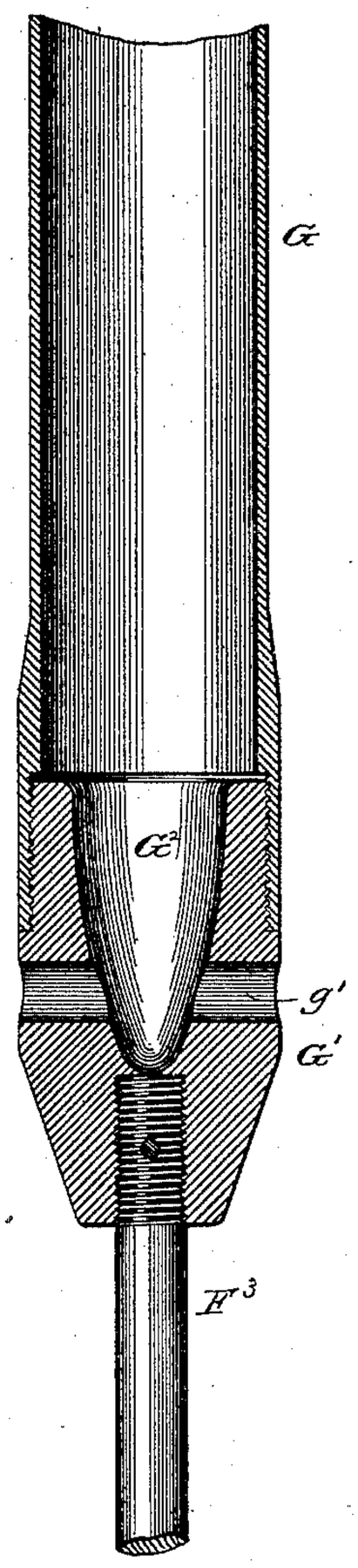


Fig. 7.



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(No Model.) 3 Sheets—Sheet 3.

M. C. BULLOCK.

ROCK CORE DRILL.

No. 473,908. Patented May 3, 1892.

Fig 9.

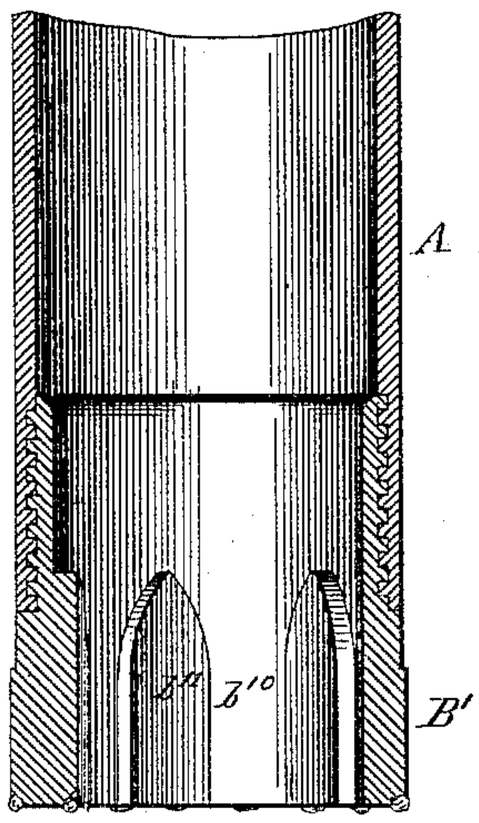


Fig 10.

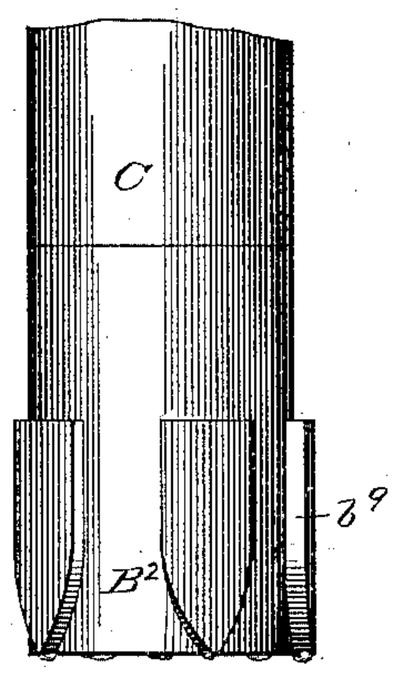


Fig. 12.

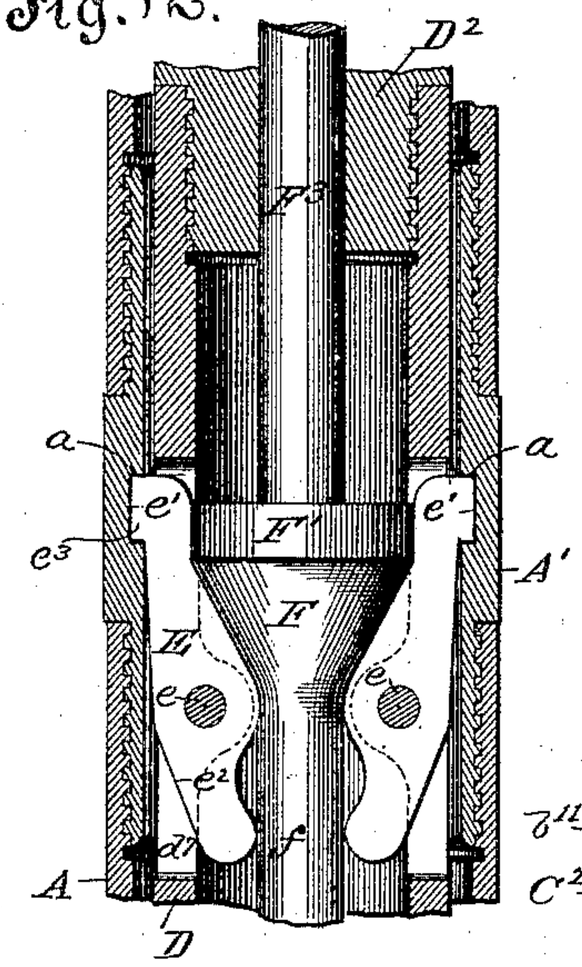
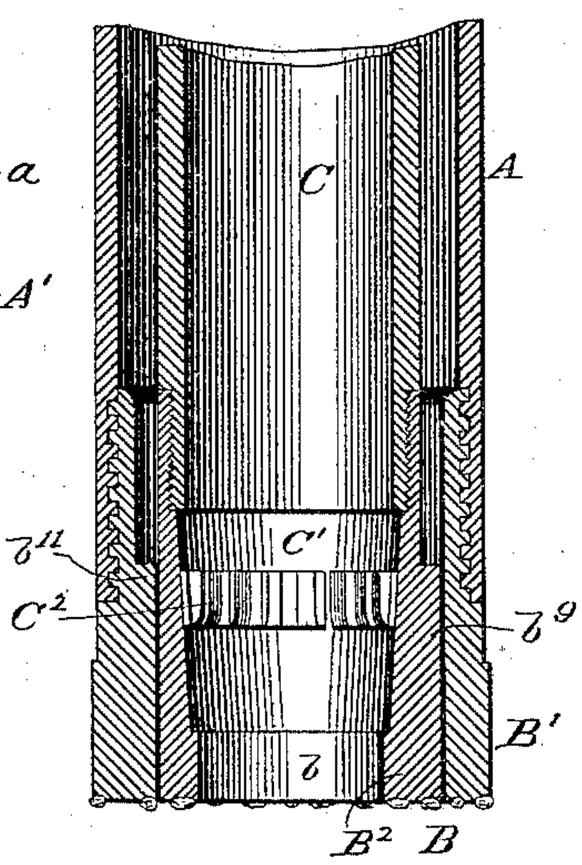


Fig 11.



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UNITED STATES PATENT OFFICE.

MILAN C. BULLOCK, OF CHICAGO, ILLINOIS.

ROCK-CORE DRILL.

SPECIFICATION forming part of Letters Patent No. 473,908, dated May 3, 1892.

Application filed June 29, 1888. Renewed October 5, 1891. Serial No. 407,669. (No model.)

To all whom it may concern:

Be it known that I, MILAN C. BULLOCK, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rock-Core Drills; and I 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 has for its primary object to provide a construction in rock-core drills by which the core of rock may be taken out of the hole being drilled without withdrawing the drill-rod.

To this end the invention consists, primarily and broadly, in a tubular drill-rod the interior diameter of which is throughout the length of the same as large or larger than the smallest diameter of the drill-head, whereby a core may be raised through the drill-rod and in the operation of removing the core the drill-rod may be left in the hole. This branch of the invention embraces subordinate features having for their object the more convenient accomplishment of the primary purpose stated, among which is a grapple for seizing and raising the core-lifter.

Another important object of the invention is to provide a construction by which to prevent attrition of the core and to enable it so far as possible to be withdrawn intact or uninjured. To this end another feature of the invention consists in a tubular rotating drill-rod provided with an interior core-lifter removable upwardly through the drill-rod and detachably connected therewith and having rotatable connection with the parts connecting it with the drill-rod, so that it may be held from rotation by engagement with the core, or at least may be retarded thereby, so that it will not rotate at the high speed of the drill-rod itself, and which therefore does not seriously wear away or tend to break up and destroy the core.

These and other features of the invention are illustrated in the accompanying drawings, in which the core-lifter is shown in the form of a tube or barrel.

Figure 1 is a central vertical section of a tubular drill-rod, showing therein and also in central vertical section the upper portion of a removable core lifter or barrel connected rotatably with devices by which the core-barrel is detachably held down when the drill is at work, together with other devices by which the catches that hold the core-barrel in place may be released for the removal of the core-barrel when it is desired to withdraw the core from the drill-rod. Fig. 2 is a central vertical section of the lower end of the tubular drill-rod and within it the lower end of the core-barrel, the upper end of which is shown in Fig. 1. Fig. 3 illustrates in end view the cutter-head shown at the bottom of the drill-rod in Fig. 2. Fig. 4 is a transverse section of the drill-rod and the locking devices of the core-barrel in the line 4 4 of Fig. 1. Fig. 5 is a vertical section of the lower end of a tubular drill-rod and the lower end of the core-barrel therein, the cutter-head being slightly different in construction from that shown in Fig. 2. Fig. 6 shows in partial section a form of harpoon or grapple adapted for the withdrawal of the removable core-barrel, the dogs of the harpoon being shown expanded into engagement with an interior shoulder on the upper end of a sheath or tube, (seen in section,) which connects with the removable core-barrel. Fig. 7 illustrates in central vertical section the lower end of the harpoon sheath-tube, the upper portion of which is shown in Fig. 6, and also a recessed head attached to the lower end of the sheath-tube, together with a portion of the rod, in side view, which connects the recessed head of the bottom of the sheath-tube with the core-barrel, and a continuation of which is shown in Fig. 6. Fig. 8 is a horizontal or transverse section in the line 8 8 of Fig. 6. Figs. 9, 10, and 11 illustrate another construction of the cutting devices in which part of the cutter is upon the drill-rod and part upon the removable core-barrel. These figures also show incidentally a construction of the two-part cutter by which the core-barrel is made to rotate with the drill-tube. Fig. 9 is a central vertical section of the outer part of the cutter which is attached to the drill-rod; Fig. 10, a side view of the cutter-head upon the core-barrel, and Fig. 11 a vertical section of the two parts united in working position. Fig. 12 illustrates a modification of the dogs which hold the core-lifter in place.

A A is a tubular drill-rod composed of sec-

tions of tubing connected by suitable couplings A′ A′.

B is any suitable form of annular drill or cutter-head, which is shown in Figs. 2 and 3 as a single piece attached to the lower end of the drill-rod A, but which is shown in Figs. 9, 10, and 11 as being made in two parts, one part being attached to the foot of the drill-rod and the other part (the lower end) to the core-barrel. By the rotation of the drill-rod and the cutter-head an annular cut will be made in a rock, leaving a central core standing within the core-barrel. The cutter-head B is commonly armed with diamonds; but for the general purposes of my invention it may be constructed in any suitable manner to cut away the rock.

C is the core lifter or barrel, located within the tubular drill-rod A. It occupies the lower part of the drill-rod and is of any desired length, being commonly from sixteen to thirty feet long, or of sufficient length to accommodate the longest section of core which it may be desired to take out at one time. The core-barrel is externally somewhat less in diameter than the interior of the drill-rod, in order that it may be freely lifted through said drill-rod for the purpose of removing the core and of being lowered again to its place for further work. Interiorly the core-barrel is of about the same diameter as the central passage *b* through the cutter-head, or it may be slightly larger than said passage. The core-barrel is commonly supported upon an annular shoulder projecting from the inner surface of the drill-rod. In the present instance such a shoulder is shown as being formed by the upper end of the coupling A′ of the drill-rod, (seen at the lower end of Fig. 1,) and the core-barrel structure is seen to be supported from this shoulder by the loose steel ring d^4. In Fig. 2 the lower end of the core-barrel is shown as also resting upon a loose ring b^3, which in turn is supported by an annular shoulder b^2 on the inner surface of the cutter-head B. In Fig. 5 the lower end of the core-barrel only proximates the shoulder b^2 on the cutter-head, and said shoulder is inclined for a purpose that will be hereinafter explained.

Interiorly the core-barrel C is provided near its lower end with a conical enlargement C′, having its greater diameter at the top, and within this conical enlargement or recess is located a contractible metal ring C^2 for the purpose of gripping and supporting the core when the core-barrel is raised. The ring C^2 is open at one side to permit of its spreading and contracting, and it is also desirably slashed or cut part way through vertically from the interior at several points, as shown, so as to be freely flexible. The gripping-ring C^2 is of such normal diameter as to drop to or near the lower part of the conical recess C′, and in this position its interior diameter is less than that of the core which will be cut by the drill. On the other hand, when expanded in the upper part of the conical recess C′ the ring C^2 has an interior diameter large enough to permit the core to pass through it. The ring will be forced upward and expanded by the core as the latter is formed, and when the core-barrel is lifted the ring, which embraces it closely, will be drawn downward in the conical recess. At the same time it bites the core, and through this gripping action of the ring the core will be broken off and brought upward with the core-barrel.

To the upper end of the core-barrel C is secured a tubular head C^3, presenting an interior shoulder c^2 at its lower end and having lateral passages c^3 for water. Above the head C^3 of the core-barrel is located a short tube D, having at its lower end an axially-recessed head D′ and at its upper end a longitudinally-pierced head D^2, secured thereto by screw-threads, as shown, or otherwise in any suitable manner. The head D′ is connected to the head C^3 by means of a swivel-pin D^3, which is provided at its lower end with a head or enlargement *d*, extending beneath the shoulder c^2 on the head C^3, and at its upper end is screwed or otherwise fastened to the lower end of the head D′. This swivel-pin D^3 thus forms a connection between the head D′ and the head C^3 which permits their relative rotation and through which the core-barrel may be raised by force applied to the head. The central passage *d′* through the pin D^3 communicates with the recess d^2 in the head D^2, and from the latter extend radial openings d^3 to afford passage for water either from the interior of the core-barrel to the interior of the drill-rod or in the opposite direction, according with the mode of introducing water to the cutters. Between the heads D′ and C^3 are desirably placed steel friction-rings d^4 d^5, and between the shoulder c^2 and the head *d* are placed corresponding rings d^6.

In the walls of the tube D, between the heads D′ and D^2, is cut a series of vertical slots d^7, in which are fitted dogs E, mounted between their ends on pivots *e* and having their outer faces *e′* e^2, respectively, above and below these pivots arranged at an obtuse angle with each other, as shown, so that when the upper ends of the dogs are thrown outward through the slots into bearing against the drill-tube A the lower ends stand inward, and vice versa. The dogs E are so placed that when the core-barrel rests upon its supporting-shoulder, as described, they may be expanded to project beneath a downwardly-facing shoulder *a*, formed by the lower end of an adjacent coupling A′ of the drill-tube, as shown in Fig. 1, or by a recess in said coupling, as shown in Fig. 2. The dogs E therefore retain the core-barrel in its proper position against any tendency on the part of the core or of water-pressure within the drill-rod to raise it.

For the purpose of expanding and retracting the upper ends of the dogs E a spool F is provided, consisting of two cones F′ F^2, connected with their smaller ends toward each

other by a spindle *f*. The spool F has a vertical movement between the heads D′ and D², and in a downward movement of said spool to the position shown in Fig. 1 its upper cone F′ descends between the upper ends of the dogs E and forces them outward, while an upward movement of the spool brings the lower cone F² between the lower ends of the dogs, and, spreading these, contracts the upper of said dogs, so as to release them from engagement with the shoulder *a* or to enable them to clear said shoulder. When the dogs E are thus retracted, the core-barrel and its immediate connections may be all lifted out of the drill-rod, and in such upward movement of the core-barrel the core is gripped firmly by the ring C² and broken off, allowing the core which occupies the core-barrel C to be withdrawn with said core-barrel precisely as in former constructions in which the core-barrel is part of the drill-rod.

The lifting of the core-barrel and its adjuncts described is accomplished through the medium of a short rod F³, which is connected to the upper end of the spool F, and, passing through the axial aperture in the head D², is attached at its upper end to a part adapted to be engaged by the grapple. Such part as here illustrated consists of a tube G, having near its upper end an inner annular undercut shoulder *g* and at its lower end a head G′, provided in its upper end with a recess G². This head G′ is fastened to the rod F³, which rod is enough longer than the head D², through which it passes, to allow of the desired vertical movement of the spool F between the heads D′ and D².

H, Fig. 1, is a harpoon or grapple consisting of a rod H′, having at its upper end an eye H² for the attachment of a suitable rope. The lower end of the rod H′ is contracted desirably to a conical form, as shown at *h*, and through the rod is a slot *h′*, extending nearly to its lower end. Within this slot are pivoted at their upper ends two expanding dogs H³, normally held apart or spread at their lower ends by a spring *h*². The dogs are provided each with a shoulder *h*³ on its outer face and near its lower end adapted in form to reliably engage with the correspondingly-shaped annular shoulder *g* on the inside of the tube G. A shoulder *h*⁴ is provided at a higher point on one or each of said dogs.

I is a sleeve, which loosely surrounds the rod H′ and which when raised rises above the shoulder or shoulders *h*⁴ on the dog or dogs and is supported thereby. The sleeve I is in thickness about equal to the projection of the shoulder *h*⁴ and equal to or greater than the projection of the shoulders *h*³ on the dogs and in diameter less than the mouth of the tube G. The dogs at the lower shoulder may therefore be sprung inward a distance equal to the length of said lower shoulders without releasing the sleeve from the upper shoulder or shoulders, but a further and sufficient retraction of the lower ends of the dogs will let the sleeve I fall. The dogs H³ are so proportioned and constructed that when the sleeve I is in its upper position, as shown in Fig. 1, they may expand beneath the shoulder *g* on the tube G; but when the dogs are forced inward, so that their shoulders *h*³ only project beyond the diameter of the rod H′, the tube I will drop down over them and against the shoulders *h*³ thereon, and thereby retain the dogs in their retracted position. In this retracted position of the dogs they may manifestly pass out of the tube G without engaging with the shoulder *g*. Below the shoulder *h*³ the dogs H³ are tapered to their ends, so that their lower extremities present no shoulder projecting beyond the diameter of the rod H′, but, on the other hand, a continuation of the taper or incline of the point *h* of said rod. If the grapple be lowered with the dogs extended, therefore, it enters the tube G by a partial retraction of the dogs in passing the shoulder *g*, while if the grapple be still farther lowered, until it rests in the recess G², its dogs will be found fully retracted and the sleeve I will fall until it rests on the lower shoulders *h*³. Accordingly when it is desired to grapple the core-barrel, as when a core is to be withdrawn, the harpoon is lowered only far enough to catch on the shoulder *g;* but when it is desired to release the harpoon from the core-barrel, as when the latter is returned to its place, the harpoon is let down within said tube G until it enters and rests with its weight in the recess G², and the dogs H³ being thus retracted the loose sleeve I drops down over them, after which the harpoon may be raised past the shoulder *g* and out of the drill-tube.

In letting the core-barrel and its connections down into the drill-tube by means of the harpoon above described the entire structure from the head D² downward is manifestly suspended by the rod F³ and spool F and the upper cone F′ is in bearing against the lower surface of said head D². The spool is therefore held in its elevated position in this operation and the dogs E are retained in their retracted attitude by the weight of the suspended structure. As soon, however, as the core-barrel strikes its stop or support the spool F will descend into contact with the head D′ by its own weight and that of the tube G and head G′. In such descent of the spool the lower cone F² thereof is removed from between the lower ends of the dogs E and the upper cone F′ enters between the upper ends of the said dogs and forces them outward, retaining them thus expanded until the spool is again raised.

To facilitate the lifting of the spool F, the upper end of the recessed head D′ is provided with one or more passages *d*⁸ for air or water for the equalization of pressure on opposite surfaces of the spool.

Water may be supplied to the cutter at the lower end of the tubular drill-rod either by the long-familiar mode of sending it downward through the rod and allowing it to rise

outside the rod to the surface of the ground or rock or by sending the water downward through the hole externally to the drill-tube and upwardly through the latter. To facilitate the passage of water from the exterior of the drill-rod to the space between the drill-rod and the core-barrel, either of several constructions may be employed.

Figs. 2 and 3, which present different views of the same single form of cutter, show the cutter-heads provided with external vertical grooves b^4, transverse grooves b^5 in the lower face of the cutter, and vertical holes b^6 through the inner projecting part of the cutter, said holes opening at the ledge b^2. If the friction-ring b^3 be present, it may be provided with an annular groove b^7 in its lower face, in constant communication with the holes b^6 and with a series of vertical holes b^8, leading from this annular groove to the space between the drill-tube and the core-barrel. A sufficient quantity of water will pass beneath the face of the cutter (between the diamond points or other cutting projections therein) from outside the drill-rod into the core-barrel around the core, or vice versa, to carry off the detritus.

In the form of cutter shown in Fig. 5, dotted lines show the cutter-head to be provided with external vertical grooves, transverse bottom grooves extending to the inner edge of the face of the cutter, and connecting-grooves which pass upward along the inner surface of the cutter-head into communication with the space between the foot-piece of the core-barrel and the inner wall of the tubular cutter-head. In this drawing the ring b^3 is omitted.

In Fig. 1 the lowermost coupling A′ of the tubular drill-rod is shown as proximating the exterior surface of the core-barrel and tubular head C^3, and in Fig. 2 the drill-tube is shown as having an interior sleeve a' just above the cutter-head, which similarly proximates the lower end of the core-barrel. While the space between the core-barrel and the coupling and sleeve mentioned is sufficient to allow free rotary motion of one relatively to the other and also a sufficiently free passage of water about the core-barrel to prevent the latter from binding in the drill-tube, such space is, on the other hand, small enough to insure suitable external support for the core-barrel to prevent undue vibration of the latter as the drill-tube is rotated and consequent breaking up of core. The lower end of the swivel-pin D^3 is shown in Fig. 1 as being provided with projections e^{10}, having spaces d^9 between them. These projections will be struck by the top of the core should the latter be cut long enough to reach them, and notwithstanding such contact the water will have free passage through the spaces d^9. The projections e^{10} therefore prevent interruption of the proper movement of water to the surface should the core be allowed to reach the extreme upper end of the core-barrel.

It will be understood that the swiveled connection of the core-barrel proper (shown in Fig. 1) is one that allows the tube D to rotate with the drill-tube through the bearing-contact of the dogs E with the shoulder a, while the core-barrel C may stand still with the core or may rotate only slightly from contact with rotating parts. Such slight rotation of the core-barrel is not sufficient to destroy or seriously wear away the core itself, although the latter be quite soft. It is also to be understood that this provision for the non-rotation of the core-barrel is a separate and distinct improvement upon which the principal improvement of a removable core-barrel does not depend. For the purposes of the last-mentioned and principal part of the invention the core-barrel may be directly and rigidly connected with the head D′, or it may be directly secured to the drill-rod, so as to rotate therewith, either as shown in Figs. 9, 10, and 11 or otherwise. The construction which allows the core-barrel to rotate at a less speed than the drill-rod or not at all is, however, preferable for the reasons stated, and is claimed, in combination with the other main features of the apparatus, as part of my invention.

Referring to the construction shown in Figs. 9, 10, and 11, the cutter-head B is shown as being constructed of two parts—to wit, an outer part B′, which is attached to the lower end of the drill-tube, and an inner part B^2, which is attached to the lower end of the core-barrel. The lower or working faces of these parts B′ B^2 are flush with each other when the core-barrel rests upon its support, and each is armed with diamonds or other form of cutters. A special advantage of this two-part construction of the cutter-head resides in the fact that when the core-barrel is removed for the withdrawal of a core the condition of the diamonds or cutters on the core-barrel may be inspected, and from their condition that of the diamonds or cutters on the drill-rod may be with reasonable certainty inferred. When, therefore, the diamonds on the core-barrel part of the cutter-head shall, for example, be found to have been loosened or the condition of the diamonds or cutters indicates the necessity for their renewal, it will be understood that the drill-tube should be withdrawn for corresponding treatment of the cutters thereon. In said Figs. 9, 10, and 11 is also shown another feature of construction by which the two parts B′ and B^2 of the cutter-head are locked together, so as to rotate in unison. For this purpose the part B^2 is provided with vertical ribs b^9, the lower ends of which are narrowed or pointed, and the inner surface of the outer part B′ of the cutter is provided with corresponding recesses b^{10}, the ribs b^{11} between which are pointed at their upper ends. This pointed construction of the interlocking ribs obviously permits them to readily engage when the core-barrel is lowered to its place. By placing diamonds on the ends of the ribs b^9 and b^{11} a proper distribution of the diamonds can be

made to cover the entire field. The core-barrel is shown to be non-rotatably attached to the part B^2 of this two-part cutter, (shown in Figs. 9, 10, and 11;) but manifestly it may be rotatably connected therewith, if desired, by familiar mechanical devices.

The principal advantage of a removable core-barrel results from the great saving thereby effected in the time required to remove a core. In the use of the former construction, in which the core-barrel cannot be lifted through the drill-rod, it is of course necessary to raise the drill-rod out of the hole to discharge the core. After reaching a considerable depth this operation consumes a long time. Thus in the case of a hole two thousand feet deep ten hours hard work by several men will be a short allowance in which to raise the rod, remove the core, and return the rod to the bottom of the hole ready to resume boring. By the use of a removable core-barrel the same work may be accomplished with far less help in the brief time of twenty or thirty minutes. The value of this saving is augmented by reason of the great cost of the plant and the expensive nature of the work and in many instances by the necessity of completing the work within available weather.

Being the first to employ an upwardly-removable core-barrel with a drill-tube, whereby the core may be lifted out of the hole through the tube and the latter left in the hole while the core is being removed, I do not wish to be restricted to the particular details of construction shown, since these may manifestly be widely varied in many ways.

I claim as my invention—

1. A tubular drill-rod provided with an annular cutting-head at its lower end, said drill-rod having an internal diameter not less than the smallest diameter of the drill-head throughout its entire length above the drill-head, thereby allowing the upward passage of a rock-core through the drill-rod, substantially as described.

2. A tubular drill-rod provided with an interior core-lifter which is removable upwardly through the drill-rod, whereby a core may be removed from a hole without withdrawing the drill-rod.

3. The combination, with a tubular drill-rod, of an interior core-lifter which is removable upwardly through the drill-rod and is provided with a clamp for gripping a rock-core and a detachable fastening for holding the core-lifter from rising within the drill-rod while the core is being formed and advanced therein.

4. In combination with a rotating tubular drill-rod, an interior core lifter or barrel which is removable upwardly through the drill-rod and is relatively rotatable in the drill-rod and a fastening for detachably holding the core-lifter in operative position within the drill-rod.

5. The combination, with a tubular drill-rod, of an interior core-lifter provided at its lower end with a grip for seizing a core and at its upper end with a shouldered part or extension for engagement with a suitable harpoon or grapple to be let down into the drill-rod for the purpose of seizing and lifting it out of the drill-rod.

6. The combination, in a rock-drilling apparatus, of a tubular drill-rod, a core-lifter within and upwardly removable through the drill-rod, a grip belonging to the core-lifter for seizing the core, and a separate grapple for seizing the core-lifter.

7. The combination, with a tubular drill-rod and a core-lifter upwardly removable through the drill-rod, of a two-part cutter, one part of which is attached to the drill-rod and the other part of which is attached to the core-lifter.

8. The combination, with a tubular drill-rod and a core-lifter within and upwardly removable through the drill-rod, of a cutter-head composed of two annular parts, one within the other, said parts of the cutter being provided with interengaging projections and recesses on their adjacent faces and said projections being armed with diamonds or other cutters.

9. The combination, with a tubular drill-rod provided with a downwardly-facing shoulder, of an interior core lifter or barrel which is removable upwardly through the tubular drill-rod and is provided with one or more retractible dogs arranged to engage the shoulder of the drill-rod.

10. The combination, with a tubular drill-rod provided with an interior shoulder facing upward and at a higher point with an interior shoulder facing downward, of an interior core lifter or barrel which is removable upwardly through the drill-rod and is adapted to rest upon the upwardly-facing shoulder and provided with one or more retractible dogs arranged to engage the downwardly-facing shoulder.

11. The combination, with a tubular drill-rod provided with a downwardly-facing shoulder, of an interior removable core-lifter provided with retractible dogs to engage said shoulder, a lengthwise-movable double-cone spool for throwing and retracting the dogs, which also, when lifted, suspends the core-lifter, and a harpoon or grapple which detachably connects with the spool.

12. In a grapple or harpoon for detachable connection with an interior upwardly-removable core-lifter of deep-rock tubular drills, the combination of a recessed rod H′, pivoted expansion-dogs H^3, provided with shoulders h^3 h^4, and a sliding sleeve I, substantially as described.

13. The combination, with a removable core-lifter for tubular rock-drills, provided with an interiorly-shouldered tube G, having a recessed bottom or base, of a harpoon or grapple H, comprising a rod H′, a loose sleeve I, and shouldered expanding dogs H^3, which are retracted by entering the recess of the base.

14. The combination, with a tubular drill-

rod A, of an interior core-lifter C, having a tubular extension D, provided with centrally pivoted dogs E for engaging the drill-rod, a double-cone spool in the tube D for shifting the dogs, an apertured head D′, attached to the tube D, a rod F^3, connected with the spool and extending through the head D′, a head G′, connected with the rod F^3 and provided with a recess G^2, a tube G, connected with the head G′ and provided with an annular shoulder *g*, and a harpoon H, comprising a rod H′, having its lower end formed to enter the recess G^2 and provided with shouldered expanding dogs, and a sliding sleeve I.

15. The combination, with a tubular drill-rod, of a core lifter or barrel which is removable upwardly through the drill-rod and which has swiveled thereto at its upper end a part having detachable engagement with the drill-rod.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

MILAN C. BULLOCK.

Witnesses:
M. E. DAYTON,
C. CLARENCE POOLE.