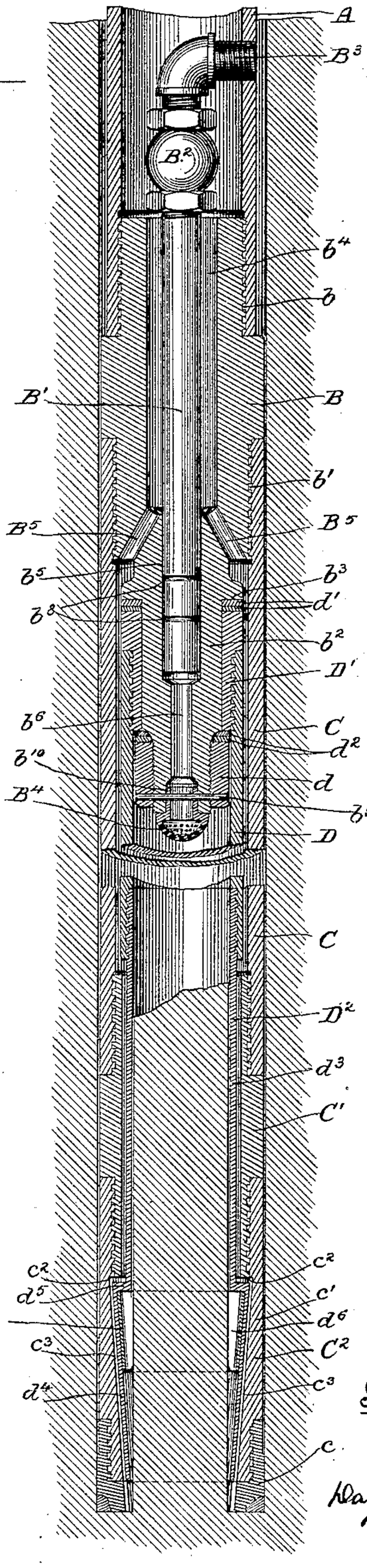
(No Model.) 2 Sheets—Sheet 1.

S. W. DOUGLASS.

ROCK CORE DRILLING APPARATUS.

No. 462,400. Patented Nov. 3, 1891.

Fig 1.



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

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Fig 2.

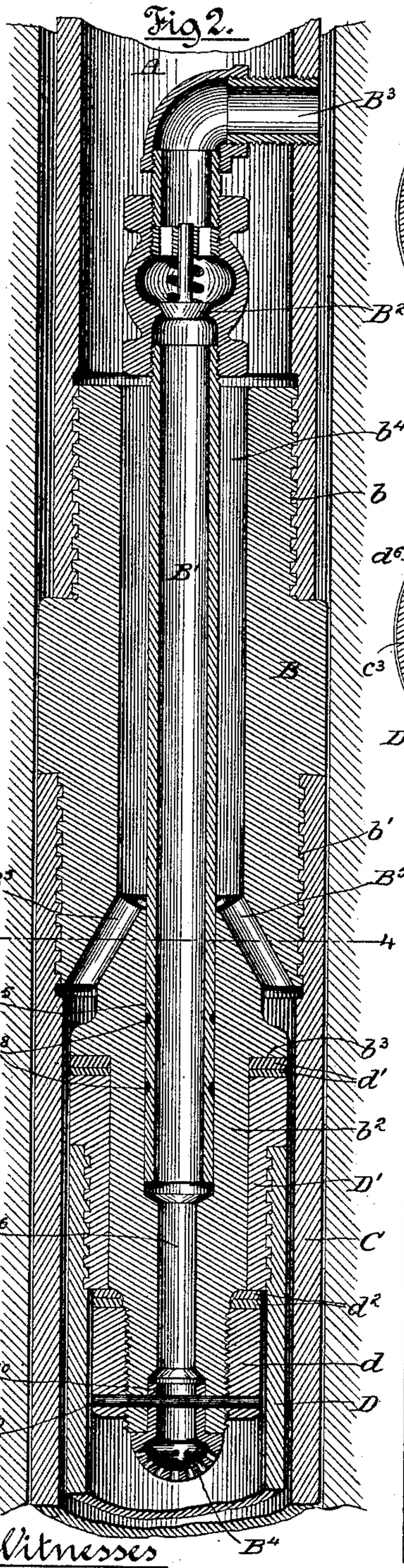

Fig 4.

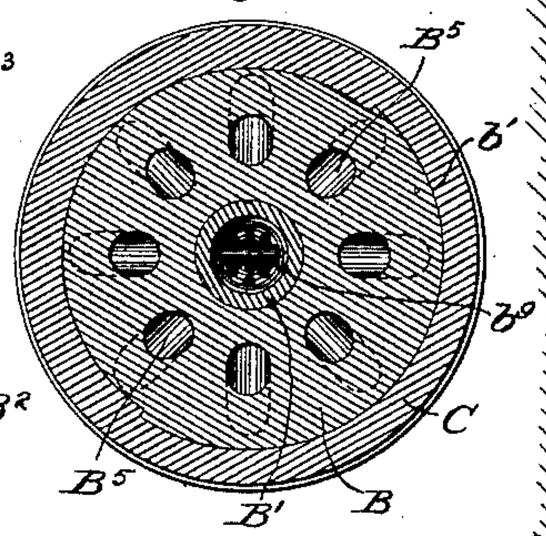

Fig 5.

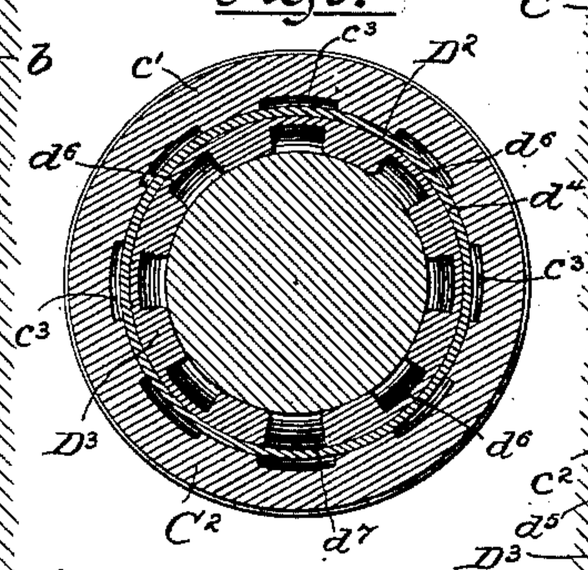

Fig 7.

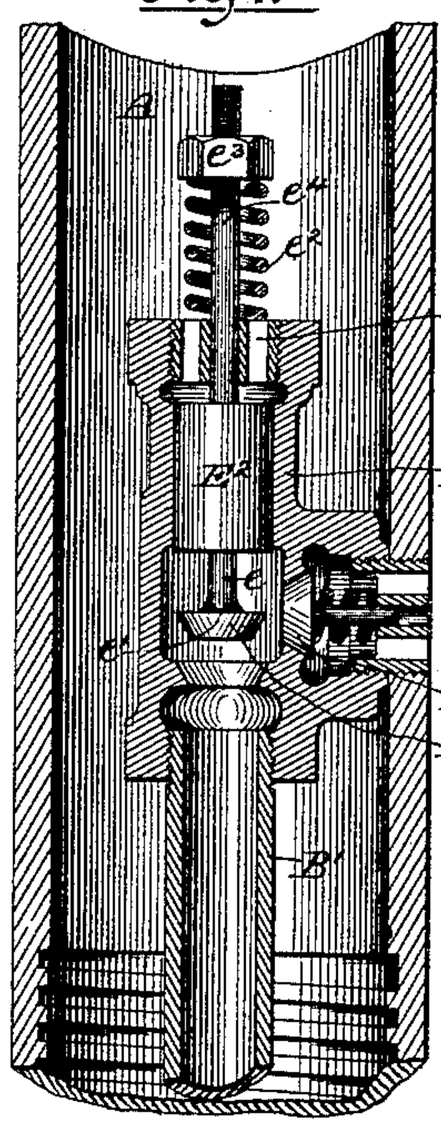

Fig 3.

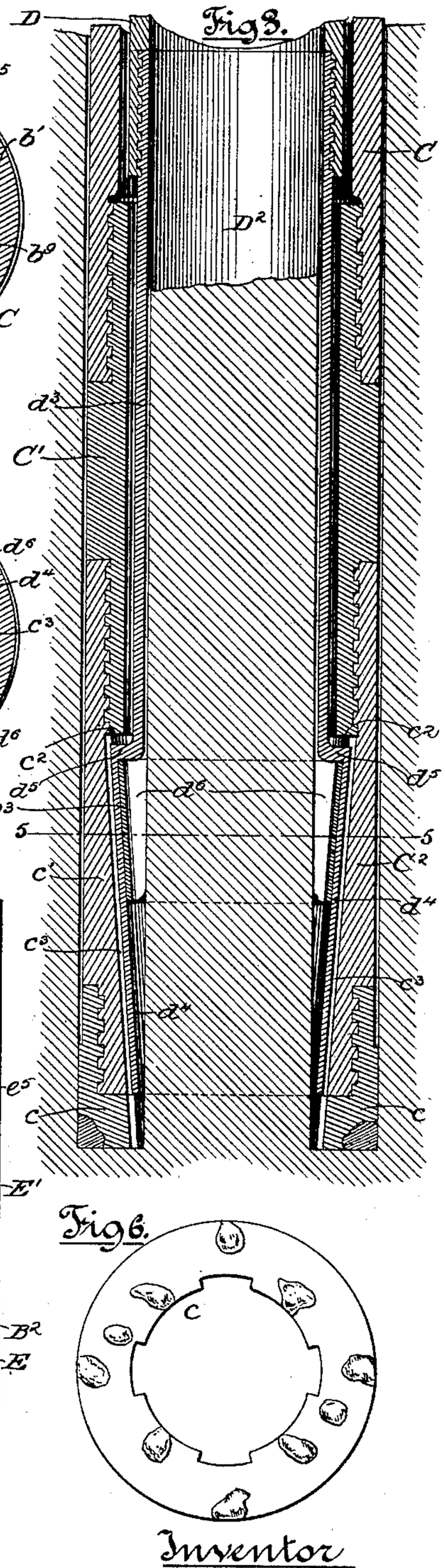

Fig 6.

Witnesses

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UNITED STATES PATENT OFFICE.

SAMUEL W. DOUGLASS, OF CHICAGO, ILLINOIS, ASSIGNOR TO MILAN C. BULLOCK, OF SAME PLACE.

ROCK CORE DRILLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 462,400, dated November 3, 1891.

Application filed January 7, 1890. Serial No. 336,121. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL W. DOUGLASS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rock Core Drilling Apparatus; 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 relates to rock-drilling apparatus of that class having an annular revolving cutting-head acting by attrition, and a core-barrel or tubular part adjacent to the cutting-head, which receives the core as the latter is formed.

The invention relates more particularly to features of construction in the parts of the apparatus adjacent to the cutting-head and core-barrel; and it consists in the features of construction and combinations of parts hereinafter fully described, and pointed out in the appended claims.

In the accompanying drawings, Figure 1 is a view in central vertical section of the lower end of a drill-rod and attached core-barrel constructed in accordance with my invention. Figs. 2 and 3 show in two separate parts or sections a central vertical sectional view of the parts shown in Fig. 1, said parts being shown on an enlarged scale. Fig. 4 is a horizontal sectional view taken on the line 4 4 of Fig. 2. Fig. 5 is a horizontal sectional view on the line 5 5 of Fig. 3. Fig. 6 is a plan view of the under face of the cutting-head. Fig. 7 is a view in central vertical section of a modified form of construction embodying one feature of my invention.

In said drawings, A is the lower end of a tubular drill-rod, the upward continuation of which reaches to the surface of the ground and is there connected with suitable apparatus, by means of which the rod is rotated and fed forward, and with means for forcing a current of water downwardly through said drill-rod. At the lower end of the drill-rod is located a long tubular part or section C, within which the core-barrel D is located and to the lower end of which the cutter-head *c* is attached. Said tubular part or section consists of a number of detachable parts or sections, which will be hereinafter described, and is connected with the main part of the drill-rod by means of a coupling-section B, which is also constructed to afford connection between the drill-rod and core-barrel, or, in other words, as a means of supporting the core-barrel from the drill-rod.

The coupling-section B is tubular, and is connected by a screw-threaded joint *b* with the lower end of the drill-rod A. The external diameter of said coupling-section B is the same as that of the section C, which latter is made somewhat larger in diameter than the drill-rod in order to afford a larger space for the passage of water between the drill-rod and the walls of the hole above said tubular section C than below it. The coupling-section B is connected by a screw-threaded joint b' with the upper end of the said core-barrel C. The said tubular section C is connected at its lower end by means of a coupling C′ with a drill-head C^2, which for convenience in construction comprises two parts—to wit, a short barrel c' and the cutting-head *c*, which is provided with cutting-diamonds set in its lower face in the usual manner. On the inner periphery of the barrel c' are formed vertical grooves c^3 c^3. The inner surface of the barrel c' is conical and tapered inwardly and downwardly from the lower end of the coupling C′ to the cutting-head *c*. The interior diameter of the upper end of said barrel c' is greater than the internal diameter of the coupling C′, and thereby forming an interior downwardly-facing shoulder c^2 at the upper end of the conical inner surface of the barrel. The said barrel is provided on its inner surface with a plurality of vertical grooves c^3 c^3, forming water-passages.

The core-barrel D is connected with the drill-rod by means allowing the said core-barrel to turn freely within the tubular casing C, a swivel-joint being employed to connect the upper end of the core-barrel with the coupling-section B. Said swivel-joint, as herein shown, is constructed as follows: Below the joint b' the said coupling-section is contracted to form a stem b^2, which extends downwardly into the tubular section C, and is provided near its upper end, a short dis-

tance below the joint b', with a downwardly-facing shoulder b^3, the diameter of the coupling-section above the shoulder being less than the interior diameter of the tubular section C to allow the free passage of water at this point. The said stem b^2 is cylindric below the shoulder b^3, and a hollow cylindric head D′, which is attached to the core-barrel by a screw-joint, fits upon said stem and is revoluble thereon. A retaining-nut d is placed upon the lower end of the said stem and holds the head D′ upon the same.

d' d' are washers interposed between the shoulder b^3 and the upper end of the head D′, and d^2 d^2 are similar washers placed between the lower end of said head and the upper surface of the nut d, said washers being employed to lessen the friction in the turning of the parts. The washers d' d' are preferably of leather, while the washers d^2 d^2 are desirably made of steel.

The external diameter of the core-barrel D is slightly less than the internal diameter of the tubular section C, thereby affording a space between said parts for the passage of water past the core-barrel.

To the lower end of the core-barrel D is secured by means of a screw-joint a core-lifting shell D^2. The said shell D^2 is hollow or tubular and of cylindric form in its upper part d^3 and conical in its lower part d^4 to correspond with the shape of the barrel c' of the drill-head, within which said conical lower part d^4 closely fits, an abrupt shoulder d^5 being formed at the junction of said parts, which fits beneath the shoulder formed by the lower end of the coupling C′. The vertical grooves c^3 c^3 in the inner face of the barrel c' form water-passages between the said barrel and the said conical part of the core-lifting shell.

D^3 is a core-lifting ring, which is arranged within the upper end of the conical lower portion d^4 of the shell D^2. The said ring is preferably formed of steel, so as to possess a certain amount of elasticity, and is split at one side thereof, as shown at d^7, Fig. 5, so that it may easily expand and contract. The said ring is provided interiorly with a plurality of vertical notches or grooves d^6 d^6, forming water-passages between the ring and the core within the same. Said ring is tapered externally to correspond to the taper of the conical part d^4, and is normally expanded and rests within the upper end of said conical part. The said core-lifting ring is free to move vertically within the core-lifting shell, and when moved downwardly therein will be contracted, owing to the inwardly-tapering form of the said shell. The shell D^2 and the core-lifting ring therein operate in a familiar manner to break off and retain within the core-barrel fragments of the core when the drill-rod is removed from the hole, thereby allowing the core to be removed as the drilling progresses.

The devices herein shown for supplying water to the cutting-head for the purpose of lubrication and to remove the detritus made in boring are made as follows:

As hereinbefore set forth, the coupling-section B is tubular, the same being provided in its upper part with a central aperture or water-passage b^4, which extends from the top of said coupling-section downwardly to a point about midway of its length.

B^5 B^5 indicate a plurality of inclined water-passages leading from the lower end of the passage b^4 outwardly to the space between the core-barrel and the external tubular section C.

B′ is a pipe located in the passage b^4, having an external diameter considerably less than that of the said passage. Said pipe is inserted at its lower end in a bore or socket b^5, which forms a downward prolongation of the recess b^4. Said pipe is provided at its lower end with packing-rings b^8 b^8 to form a tight joint between the pipe and the coupling-section. An axial opening b^6, extending downwardly from the bottom of the bore b^5 through the lower end of the coupling-section, forms a continuation of the pipe B′ and affords passage for water from said pipe to the interior of the core-barrel. The said pipe B′ projects above the coupling-section B into the drill-rod A, and the said pipe is provided on its upper end with an upwardly-opening check-valve B^2, having an elbow-pipe B^3, which passes through an aperture in the drill-rod A and communicates with the space between the outside of said drill-rod and the walls of the hole.

B^4 is a strainer, which is secured to the stem b^2, preferably, by means of a pin b^9, which passes through the retaining-nut d, the lower end of the said stem and a tubular neck b^{10} on the strainer.

The operation of the parts described is as follows: When the cutting-head is in operation, water is forced down within the drill-rod and passes into the passage b^4 and out through the inclined water-passages B^5 B^5 into the space between the tubular section C and the core-barrel D. The water then passes around the core-lifting shell D^2 through the vertical grooves c^3 c^3 and issues from said grooves adjacent to the lower face of the cutting-head. Here the current of water is divided, part of the same passing inwardly around the lower end of the core-lifting shell and then upwardly between the shell and core and through the notches d^6 d^6 in the core-lifting ring, and thence upwardly within the core-barrel between the core and the barrel, the water escaping from the core-barrel through the passage b^6 and the pipe B′, from where it is delivered to the space between the drill-rod and the walls of the bored hole. The upward current of water within the core-barrel serves to lift detached pieces of the core and hold the same suspended above and free from the stationary part of the core, thereby preventing the parts of the core from being ground or worn away by contact of the detached part of the core with the stationary

part, while said detached part is maintained in rotation by the turning of the drill-rod, as fully set forth in a prior application for patent, Serial No. 250,157, filed September 20, 1887. That part of the water which does not pass around the core-lifting shell passes outwardly around the drill-head and rises outside of said drill-head between the core-barrel and the walls of the hole, carrying with it the detritus from the cutting-head and cooling or lubricating the same. The divided currents of water which pass through the core-barrel and outwardly around the cutting-head are united in the space outside of the drill-rod and rise through the same to the surface of the ground.

By the construction described I am enabled to obtain an upward flow of water through the core-barrel while having a downward flow through the drill-rod—a feature which is often of great advantage in practice, because the boring is often in ground of such character that any attempt to force water downwardly outside of the drill-rod and upwardly inside of the same will be rendered futile by the escape of the water from the hole through porous strata. The check-valve B^2 prevents any backflow down through the pipe B′. It is obvious that by the use of the check-valve B^2 any backflow of water through the pipe B′ is prevented. This feature is of especial advantage, as it avoids any pressure on the tops of the detached pieces of the core when the drill-rod and core-barrel are being removed from the hole, which pressure would otherwise be liable to cause said detached pieces to grind upon each other, and thus become partially crushed or worn away, as the pressure might be sufficient to push the core bodily out of the core-barrel. The upward current of water through the core-lifting ring D^3 prevents said ring from clamping the core prematurely.

In Fig. 7 I have shown a modified construction embodying my invention involving an automatic valve for procuring an increase of pressure for carrying the water-current around the drill-head when such increase of pressure becomes necessary. E′ is a valve located in the pipe B′ inside of the valve B^2 or between said valve and the core-barrel, said valve E being arranged to open outwardly in the same direction as the valve B^2. E′ is a cylinder attached to the pipe B′, adjacent to the valve E and containing a piston or plunger E^2, to which is attached a valve-stem *e*, carrying the valve-disk *e′* of the valve E. Said cylinder opens at its upper end with the drill-rod, so that the upper or outer end of the piston E^2 is subject to the water-pressure within said drill-rod. The said valve E is normally held open or in an uplifted position conveniently by means of a coiled spring e^2, acting by expansion and bearing at its ends against the perforated top e^5 of the cylinder E′, and a head or nut e^3 upon a stem e^4, affixed to the piston E^2. The said spring e^2 encircles the stem e^4, and the nut e^3 has screw-threaded engagement therewith for adjustment of the tension of said spring. The area of the lower face of the valve-disk *e′* is obviously less than that of the upper face of the piston E^2, so that said valve can be held closed when the water-pressure in the drill-rod and pipe B′ is equal.

The operation is as follows: During the drilling operation it often occurs, when boring through certain formations, that the walls of the hole contract or close against the outside of the drill-head, and thus wholly or partially obstruct the passage of water around the cutter-head. This has the effect of directing a larger part of the entire current of water upwardly within the core-barrel, and owing to the reduced passage through which the water is thereby obliged to flow the pressure within said drill-rod is considerably increased and exceeds the pressure of the water within the pipe B′. Such excessive pressure acts upon the upper face of the piston E^2 and forces said piston downwardly, thereby closing the valve E. This has the effect of directing the entire current of water under the face of the drill-head and upwardly outside of the same, thereby removing or carrying away the obstruction. When this is accomplished, the water in the drill-rod is relieved of the excessive pressure and the piston rises, the water again passes through the pipe B′, and the drilling operation continues as before. It is obvious that by means of the adjusting-nut e^3 the pressure necessary to depress the piston and close the valve E can be regulated. The area of the valve-disk *e′* being less than that of the piston E^2, in no case can the pressure on the lower surface of said disk be sufficient to prevent the valve from being closed by the pressure on the top of the piston E^2.

One important advantage gained by the construction hereinbefore set forth is that the desired flow of water downwardly between the drill-rod and core-barrel and around the lower edge of the core-barrel and upwardly within the same is obtained without making the apparatus unduly complex or increasing the difficulty of handling or operating the same or removing the drill-rod from or inserting it in the bored hole.

I claim as my invention—

1. A drilling apparatus comprising a tubular drill-rod, a cutting-head, an internal core-barrel, a pipe or passage leading from the interior of said drill-rod to the space between the core-barrel and the drill-rod, and a pipe or passage leading from the interior of said core-barrel through the side of the drill-rod at a point above and adjacent to the core-barrel, substantially as described.

2. A drilling apparatus comprising a tubular drill-rod, a cutting-head, an internal core-barrel, a pipe or passage leading from the interior of the drill-rod to the exterior of the core-barrel, and a pipe or passage leading from the interior of the core-barrel through

the side of the drill-rod at a point above the core-barrel and provided with an upwardly-opening check-valve, substantially as described.

3. A drilling apparatus comprising a tubular drill-rod, a cutting-head, an internal core-barrel, a pipe or passage leading from the interior of said drill-rod to the exterior of said core-barrel, and a pipe or passage leading from the interior of said core-barrel to the exterior of said drill-rod and provided with an upwardly-opening check-valve, a valve located in said passage between the core-barrel and the said check-valve, a cylinder communicating with the interior of the drill-rod, a plunger or piston in said cylinder connected with said valve, and a spring for holding said valve normally open, substantially as described.

4. A drilling apparatus comprising a tubular drill-rod, a cutting-head, an internal core-barrel, and a coupling-section uniting said parts, said coupling-section being provided with a passage leading from the interior of the drill-rod to the exterior of the core-barrel and with another passage leading from the interior of the core-barrel through the side of the drill-rod above the core-barrel, substantially as described.

5. A drilling apparatus comprising a tubular drill-rod, an internal core-barrel, a coupling-section uniting said parts, said coupling-section being provided with a central chamber extending downwardly from its top and communicating with the exterior of the core-barrel by means of branch passages, and a pipe extending through said chamber and commnnicating at one end with the interior of the core-barrel and its other end extending through the side of the drill-rod above the core-barrel, substantially as described.

6. A drilling apparatus comprising a tubular drill-rod, a cutting-head, an internal core-barrel, and a coupling-section forming part of the drill-rod and provided with a stem upon which the core-barrel is swiveled, said coupling-section being provided with a passage leading through said stem from the interior of the core-barrel through the side of the drill-rod at a point above the core-barrel, and with a passage leading from the interior of the drill-rod to the exterior of the core-barrel, substantially as described.

7. A drilling apparatus comprising a tubular drill-rod, a cutting-head, an internal core-barrel having a conical part near its lower end tapered downwardly and inwardly on both its outer and inner surface, and a core-lifting ring located within the conical portion of said core-barrel, the drill-rod being provided in its lower end with a conical recess corresponding in shape with the conical part of the core-barrel, substantially as described.

8. A drilling apparatus comprising a tubular drill-rod, a cutting-head, an internal core-barrel having a downwardly and inwardly tapering part adjacent to its lower end, and a core-lifting ring located within said conical portion of the core-barrel, said drill-rod being tapered internally to correspond with the shape of the conical part of the core-barrel and being provided on its conical surface with a plurality of grooves forming water-passages, substantially as described.

9. A drilling apparatus comprising a tubular drill-rod, a cutting-head, an internal core-barrel having a conical part adjacent to its lower end tapered downwardly and inwardly on both its inner and outer surface, and a core-lifting ring located within said tapered portion of the core-barrel, said drill-rod being provided with a barrel surrounding the conical part of the core-barrel and tapered internally to correspond with the latter, said barrel being detachably connected with the drill-rod at its upper end, substantially as described.

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

SAMUEL W. DOUGLASS.

Witnesses:

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C. CLARENCE POOLE.