No. 648,920. Patented May 8, 1900.

M. C. BULLOCK, Dec'd.

M. A. BULLOCK, Executrix.

CORE BREAKER AND LIFTER FOR ROCK DRILLS.

(Application filed Sept. 22, 1898.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 2.

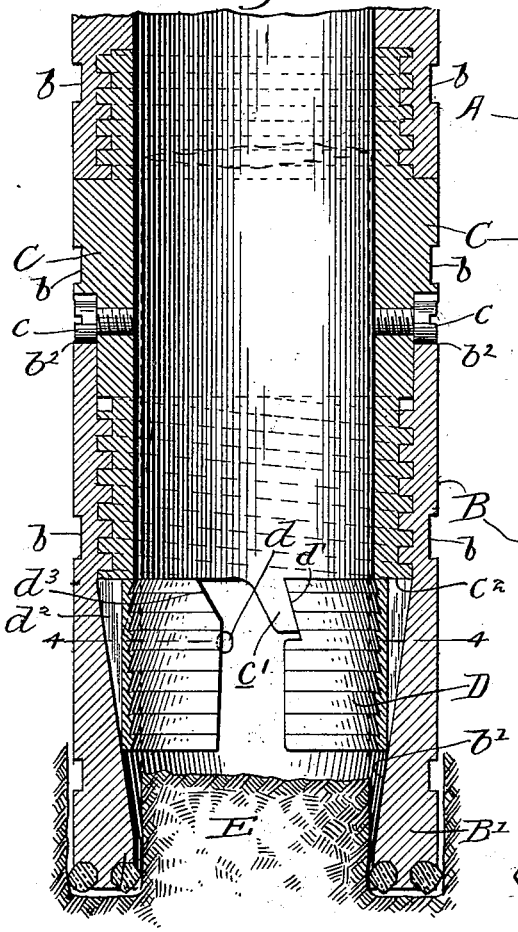


Fig. 1.

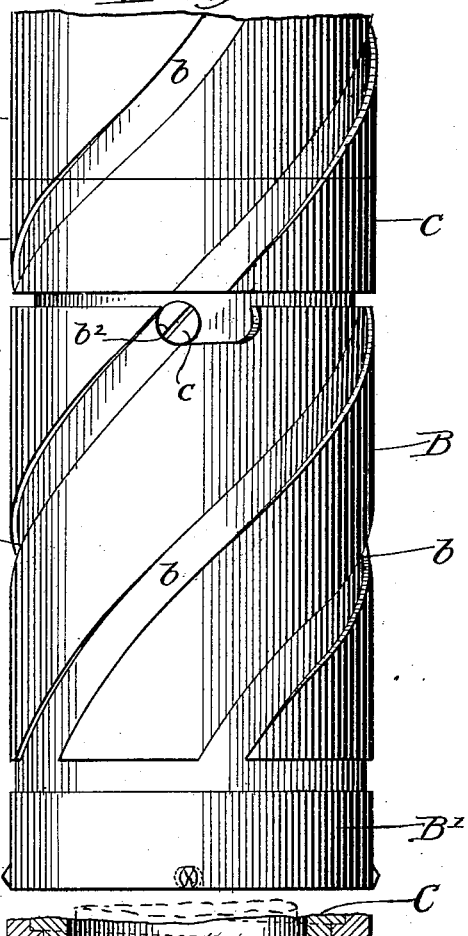


Fig. 4.

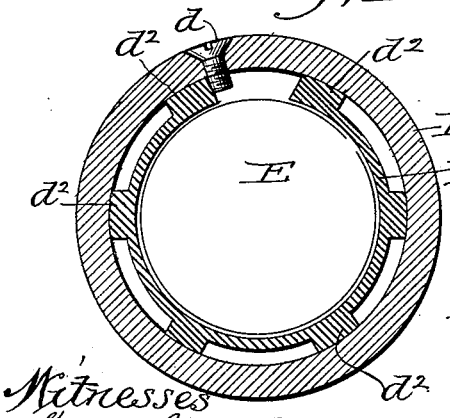
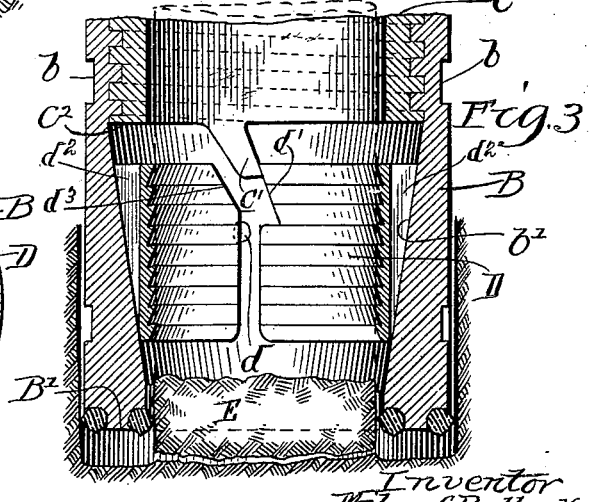


Fig. 3.



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(No Model.) 3 Sheets—Sheet 2.

Fig 5

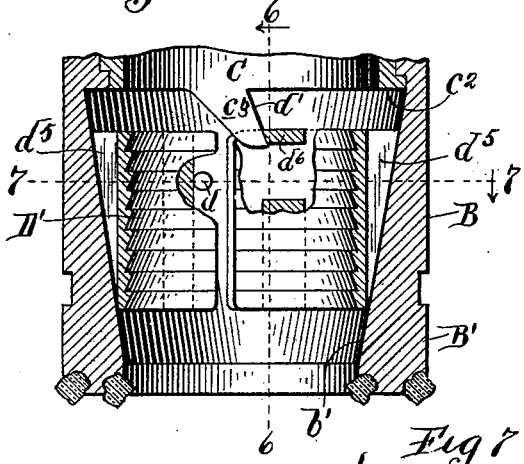


Fig 6

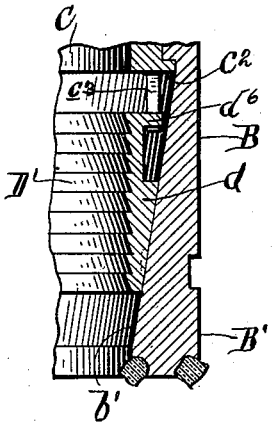


Fig 7

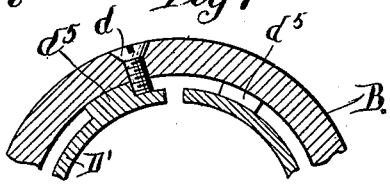


Fig 8

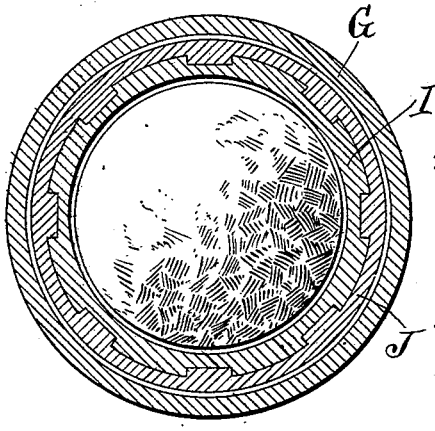
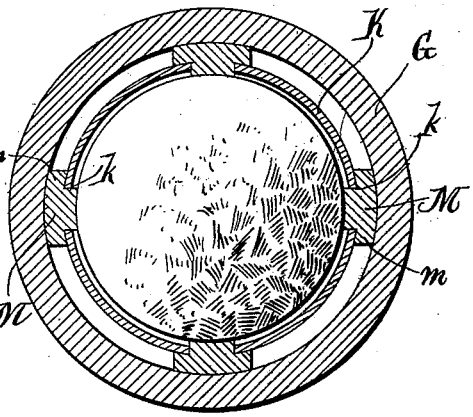


Fig 9



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(Application filed Sept. 22, 1898.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 10

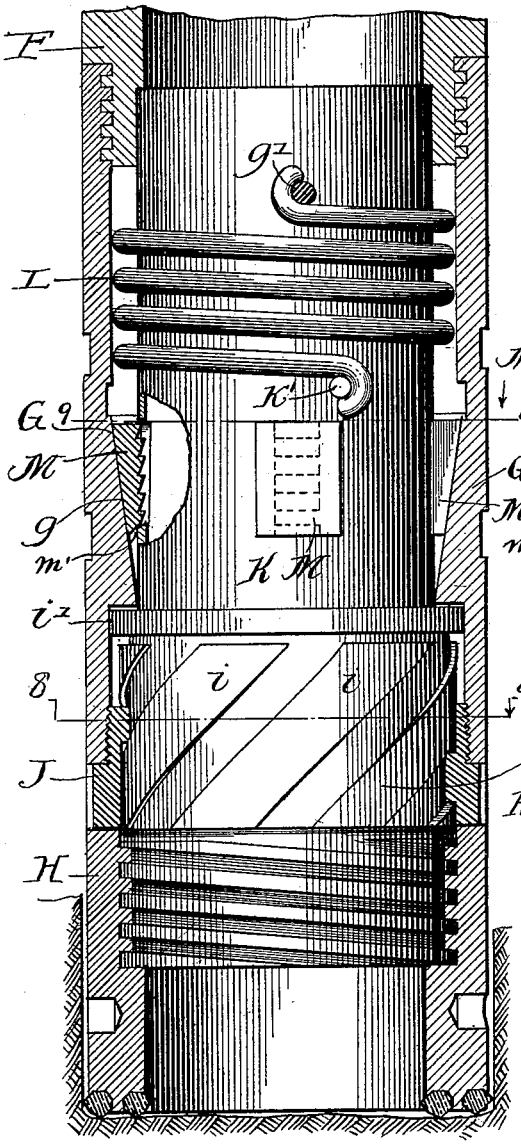
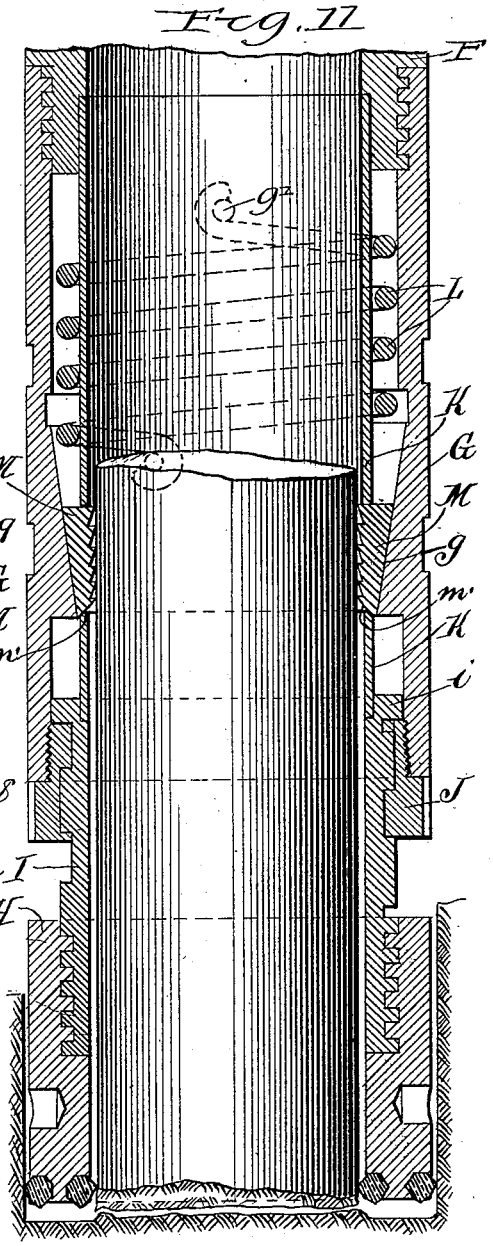


Fig. 11



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UNITED STATES PATENT OFFICE.

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CORE BREAKER AND LIFTER FOR ROCK-DRILLS.

SPECIFICATION forming part of Letters Patent No. 648,920, dated May 8, 1900.

Application filed September 22, 1898. Serial No. 691,603. (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 Core Breakers and Lifters for Rock-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 relates to an improvement in core-breakers and core-lifters for drills having rotary tubular bits or cutters, the same being known as "diamond drills."

So far as known to me diamond-drill core-breakers and core-lifters heretofore in use, which operate automatically upon the lifting or retraction of the drill-rod, have been of two different classes and can be grouped as follows: First, a great variety of wedges and cams have been devised, all of which are so designed that the gripping device shall always be in contact with the core while the core is being formed by the rotary action of the annular bit, thus being in position to seize the core and break it off when it is attempted to raise the line of driving-rods with the tubular bit and its core-lifter, and, second, springs of various forms arranged to be in constant contact with the core while it is being formed by the rotative action of the bit and to grip the core when the drill-rod is retracted. Many of these springs are only intended to catch under the edges of fragments or sections of the core that have been broken off or detached while drilling and will only lift out such broken or detached core-sections and are not intended to grip, hold fast, and break off cores which are still integral with the rock at the bottom. Some of this class, however, are on the principle of the core-breaking ring shown in my previous patent, No. 446,650, which is a split spring-ring in the form of a conical annular wedge. Said ring is somewhat smaller than the diameter of the core, so that as the ring is passed over the core it must necessarily be expanded and will have continual frictional engagement therewith as the core rises through it. The ring is caused to firmly grip the core by the action thereon of a beveled surface of the drill-rod when the latter is lifted, with the result of breaking off the part of the core gripped by the core-breaking ring.

Although it is intended that the friction of the annular wedge upon the core shall be so slight that as the bit passes down over the core in process of forming the same it shall require but little force to press the ring down over the core as fast as formed, yet the continual frictional engagement of the ring with the core constitutes the inherent weakness of all contact core-breakers, for obviously the tension required is an unknown quantity and varies with the character of the rock. It is evident that while the friction required may be slight and the device work perfectly in solid rock this small amount of friction will be an element of danger in boring through hard broken material, inasmuch as it may cause broken pieces of the core, especially such as may be of wedge shape, to slip past each other and become wedged in the core-lifter and prevent the core from passing upward in the core-barrel. The result is that as soon as this takes place the succeeding core is ground up and destroyed as fast as formed. This effectually destroys the record of the thickness and kind of rock through which the drill has passed and may wholly nullify the value of the work.

For the purpose of obviating the aforesaid defect and others which might be enumerated I have devised an automatically-acting non-contact core breaker and lifter, or, in other words, a core breaker and lifter that shall be held automatically and absolutely from all contact with the core while the same is being formed, but which shall be brought into action the instant that pressure is removed from the bit.

The invention consists in the various details of construction and combination of parts hereinafter fully described, and pointed out in the appended claims.

In the drawings, Figure 1 is a view in elevation of a drilling device embodying my in-

vention. Fig. 2 is a vertical section of the same, showing the position of the core breaking and lifting ring when the drill is in operation. Fig. 3 is a similar section showing the core breaking and lifting ring gripping the core when the drill is relieved from pressure. Fig. 4 is a cross-section on line 4 4 of Fig. 2. Fig. 5 is a sectional view of the lower part of a drill-head like that shown in Figs. 1 to 3, illustrating a somewhat-different construction in the devices for actuating the core-gripper. Fig. 6 is a sectional view taken on line 6 6 of Fig. 5. Fig. 7 is a detail plan section taken on line 7 7 of Fig. 5. Figs. 8 and 9 are sectional views taken on lines 8 8 and 9 9 of Fig. 10, which figure illustrates a form of apparatus differing from that illustrated in the preceding figures, but embodying some of the principal features of my invention. Fig. 10 is a view in central vertical section, with the parts in side elevation, of a device embodying the modified form of my invention above referred to. Fig. 11 is a sectional view similar to Fig. 10, showing the changed position of the parts illustrated in that figure.

As shown in said drawings, A indicates the lower end of a tubular drill-rod, B a drill-head embracing a core-lifting shell integral with diamond-drill bit B′, and C a coupling-sleeve connecting the aforesaid parts A and B.

D indicates the annular expansible core-breaking ring. The core is indicated by E in Fig. 3.

The drill-rod A at its lower end is of slightly less diameter than the drill-hole and is provided with external spiral clearance-grooves b of familiar construction. The internal diameter of the said drill-rod is slightly greater than the core to be formed. The drill-bit B is of the same external diameter as the said drill-rod and is also provided with external spiral clearance-grooves b. The interior diameter of the drill-head B at its cutting end is about the same as the interior diameter of the drill-rod. Near its lower end the drill-head B is provided with an interior tapered surface, forming an interior conical enlargement or chamber b', the interior diameter of which is greater at its upper than its lower end. The upper end of said shell B is interiorly screw-threaded and provided with one or more recesses b^2 for the purposes hereinafter to be described. The coupling-sleeve C has the same interior diameter as the said drill-rod A and near its middle the same external diameter as the drill-rod A and drill-head B. The ends of the said sleeve are provided with external screw-threads adapted to engage, respectively, the screw-threaded end of the drill-rod and the screw-threaded end of the drill-head. The said sleeve C is provided with external spiral clearance-grooves corresponding with the spiral groove of the drill-rod A and of the drill-head B, as heretofore described. The said coupling-sleeve is also provided at its lower end within the drill-head with an inclined depending spur or lug c' for purposes hereinafter described. One or more screw-stops c c are secured in the coupling-sleeve and extend radially outward therefrom in such manner that the external portions thereof rest in short segmental recesses b^2 b^2 at the top of the drill-head, and thereby prevent the unscrewing of the said head from the coupling-sleeve except to an extent equal to the length of the said recesses b^2. The lower end of the coupling-sleeve extends downwardly to the upper limits of the said conical recess in the interior of the drill-head. Within the said conical recess b' is located the core-breaking ring D. This is an expansible metal ring in the form of a strong spring open on one side to permit of expansion and contraction. The normal interior diameter of the ring D is less than the diameter of the core E, and it is provided with interior annular ridges or serrations designed to firmly grip the core in breaking and lifting the same. The exterior form of the said ring D is a frustum of a cone, the inclination of the same corresponding with the inclination of the conical recess in the lifting-shell in which the said ring is located. The largest normal diameter is approximately equal to the diameter of the said conical recess at about its middle. The upper angle of the said ring at its edge adjacent to the opening therein is cut away on one side, forming the incline d^3. The opposing edge is provided with a notch d', adapted to receive the lug or lip c' on the lower end of the coupling-sleeve C. A stud d extends radially inward through the shell of the drill-head sufficiently far to engage the edge of the lateral opening in the ring D at the side thereof opposite the notch d'. Said stud forms a stop to prevent rotation of the said ring when the stud or lip c' engages the recess d'.

The ring D being an open or split ring and made of tempered steel or other suitable resilient metal, and said ring being held from turning with the coupling-piece C by the stud d, it follows that pressure of the lug c' on the end of the spring in the rotation of the drill-rod will tend to open or expand the ring to the extent permitted by the movement of the limiting-stud c in the notch b^2. The ring is free to open, however, only when it is at the upper or outer part of the inclined surface b', and said ring is intended to rise or move upwardly along said surface as it is expanded by the lug C′ at the beginning of the drilling operation. To facilitate this upward movement, or, in other words, to insure that the ring shall be at the upper or larger end of the conical recess in the cutting-head at the time the expanding pressure comes on the ring, the forward or contact face of the lug C′ and the bearing edge of the notch d', which is in contact therewith, are made oblique or inclined, so that the ring will be drawn up or tend to rise toward the coupling-sleeve when the lug presses against the inclined edge of the notch in the ring. It will, however, of

course be seen that the same result will be produced by making the edges of either the lug or the notch inclined. The exterior surface of the said ring is shown as cut away at intervals, so as to form vertical ribs d^2, which bear against the inner conical surface of the cutting-head. This construction makes the parts of the ring between the ribs thinner and more flexible and gives it the desired degree of resiliency. It also lessens the area of the ring in frictional contact with the cutting-head.

The operation of the device is as follows: The parts at the beginning of the drilling operation are in the position shown in Fig. 3, with the ring D in a position slightly below the sleeve C, but with the lug c' engaged with the notch d'. When the drill-rod is turned and the drill-head rotated in contact with the rock by a suitable drilling apparatus, resistance afforded by the rock to the turning of the drill-head tends to turn the latter backwardly on the screw-threads which connect it with the coupling C, and the engagement of the lug c' with the said notch d' will cause the ring to be expanded to its fullest extent and entirely away from the core, as shown in Figs. 2 and 4. The backward turning of the drill-head is limited by the stud c. The drilling now proceeds with the ring entirely out of contact with the core and so continues until it is desired to break and lift the core. This is done by giving the drill-rod a slight reverse turn sufficient to cause the stop c, Fig. 1, to pass to the opposite side of the recess b^2, or the same may be accomplished by raising the cutting-head out of contact with the rock, when the core-ring will by its elasticity rotate the core-lifter shell to the position shown in Fig. 3. This action causes the stud or the lug c' of the coupling-sleeve to turn back far enough to permit the contraction of the ring about the core. The engagement of the conical outer surface of the ring with the tapering inner surface of the drill-head aids greatly in the gripping action of the ring upon the core, it being obvious that when the drill-rod is lifted the said tapering surface will cause the said ring to rigidly grasp the core, and thereby insure the breaking of the same away from the rock. As the core rises within the drill-head at the beginning of the drilling operation it will engage and carry upward the gripping-ring, so that the lifting of the ring to the upper part of the conical recess will be effected in most cases even if the lug were made without any inclined surface for that purpose, it being understood that when the ring is lifted it will be held at the upper part of said recess, because expanded therein by the engagement of its ends with the drill-rod and cutting-head.

While the devices described for producing engagement of the ends of the split ring with the drill-rod and cutting-head—namely, the stud in the drill-head—and the depending lug on the coupling-sleeve are desirable and effective for the purpose, yet other means may be employed for effecting such engagement, the essential feature of construction, so far as the split ring which acts both as a gripper and actuating-spring is concerned, being embraced in a construction in which the split ring has engagement through any suitable contacting parts or projections at one end with the drill-rod and at its opposite end with the cutting-head.

Figs. 5, 6, and 7 of the accompanying drawings illustrate a construction in the means for operating or expanding a spring or resilient core-gripping ring which differs from that shown in the preceding figures. In this instance a core-gripping ring D′ is employed, which is without any notch, such as is shown in Figs. 2 and 3, and which consists of a split ring, the ends of which are separated by a straight cut or slot. In this instance the coupling-sleeve C is provided with a lug c^3, which is located in a plane somewhat outside of the inner surface of the coupling-piece and in such position as to pass outside of the main or inner portion of the core-gripping ring D′. The ring D′ is provided with external ribs d^5, corresponding with the ribs d^2 shown in Fig. 4. The rib d^5, adjacent to the lug c^3, is cut away, Figs. 5 and 6, at its upper end to leave room for the passage of said lug, and an outwardly-projecting stud d^6 is formed near the upper edge of the ring in position to engage the inclined edge of said lug. In this instance, moreover, the stud d, which holds the opposite end of the gripping-ring from rotation, is arranged to engage the side edge of the rib d^5 nearest the margin of the ring. The result of this construction is that the actuating devices for the ring are located outside of the inner face of said ring and at some distance from the surface of the core.

Figs. 8 to 11 illustrate a form of core-breaking device differing in mechanical construction and arrangement from that shown in Figs. 1 to 4, but containing in common with that shown in Figs. 1 to 4 some of the principal features of my invention. As shown in said Figs. 8 to 11, F indicates the lower end of a tubular drill-rod or of a core-barrel which is attached to a drill-rod. G indicates a core-lifter shell which has screw-threaded engagement with the lower end of the drill-rod F, and H indicates a drill-head which is movably connected with the core-lifter shell and provided at its lower end with the usual diamond-cutters. The cutting-head H has attached to it, preferably by screw-threaded connection, a sleeve I, which enters within the lower part of the shell G and is provided with external screw-threads i and is adapted to engage a screw-threaded ring or nut J, attached to the lower end of the shell G, preferably by a screw-threaded connection. The screw-threads i of the sleeve I and those of the nut J are of very great pitch, the screw-threads being inclined in the construction shown at about an angle of forty-five degrees

to the central axis of the drill-rod. Said sleeve I has near its upper end an outwardly-extending flange i', which fits and slides in an annular recess or enlargement at the lower end of said shell G. Attached to the upper end of the sleeve I is a thin shell K, which passes upwardly through the shell G and has sliding engagement at its upper end with the lower part of the drill-rod F. The upper portion of said shell G is recessed or made larger in diameter than the sliding shell K, so as to form an annular space to receive an actuating-spring L. Above the upper end of the sleeve I the shell G is provided with an interiorly-tapered surface g, forming a conical chamber larger at its upper than at its lower end. The shell K is provided with a plurality of rectangular slots or openings k, of which four are shown in the accompanying drawings. In each of said openings is located a block, forming a gripping-jaw M, the inner surface of which extends through the shell and is serrated to engage the core and the outer surface of which is made inclined or oblique to fit against the inclined surface g. Said gripping-jaws M, as shown in Fig. 9, are provided with lateral flanges m outside of the shell K, which flanges hold the gripping-jaws from slipping inward through the openings k, while at the same time affording broad or extended bearing-surfaces for contact with the inclined surface of the shell. The lower ends of the blocks M are provided with beveled surfaces m', adapted to engage the edges of the shell K at the lower margins of said openings, so that upward pressure of the said edges against the blocks or jaws tends to throw the same outwardly. The spring L, which surrounds the shell K within the upper part of the shell G, is connected at its opposite ends with said shells K and G through the medium of a stud g', which projects inwardly from the shell G and engages a curved part or hook at the upper end of the spring, and a stud k', which extends outwardly from the shell K and engages a similar hook at the lower end of said spring. Said spring L is, moreover, so arranged that it will not only act by endwise expansion to thrust the shell K and connected parts outwardly and downwardly, but to also give torsional or rotative movement to said shell in a forward direction with respect to the direction of rotation of the cutting-head in drilling. In other words, said spring tends to both advance and rotate the drill-head and if allowed to expand when under compression operates to turn the screw-threaded sleeve I forwardly and downwardly through the ring or nut J. Moreover, by reason of the arrangement of the parts described it is obvious that the combined upward and torsional strains coming on the drill-head in the act of drilling will tend to turn the sleeve and thrust it upwardly through the nut J, and thereby both compress the spring L and place it under tension by torsional action. The engagement of the sleeve K with the jaws M will obviously produce a movement of the said jaws upwardly on the inclined surface g, so that when the sleeve K is at the upward limit of its movement the said jaws will be at the upper end of the inclined surface and in their expanded position or free from the core, and when the said sleeve is at the lower limit of its movement said jaws will be thrust inwardly by the action of said inclined surface and will be in position to engage or grip the core. The operation of the device described will be readily understood, it being plain that during the operation of cutting the core the pressure coming on the drill-head will hold the said drill-head and connected parts at the upper or inward limit of their endwise movement and also the backward limit of their rotative movement and that as soon as cutting ceases and it is desired to grip and break off the core the lifting of the drill-rod or backward turning of the same will allow the spring to assert itself, and thereby throw outwardly and forwardly the drill-head, with the result of bringing the gripping-jaws into contact with the core. Certain of the specific features of construction illustrated in said Figs. 8 to 11, which are in themselves novel, are claimed in the separate application for patent filed on the 22d day of September, 1898, Serial No. 691,604.

A principal feature of my invention is embraced in a construction in annular or core-forming drills in which the drill-head is movable with respect to the core-barrel or tubular drill-rod and an expansible and contractible core-gripper is employed, together with spring-actuated means, for contracting the core-gripper and means actuated through movement of the drill-head with respect to the core-barrel or drill-rod to expand the core-gripper and free it from the core, these parts being so arranged that during the drilling operation pressure coming upon the drill-head and tending to move the same with respect to the drill-rod will hold the core-gripping device in its expanded position and free from contact with the core, while a release of the pressure on the drill-head occurring upon cessation of the drilling or a backward turning or withdrawal of the drill-rod will result in the core-gripper being thrown into contact with the core. So far as this general feature of my invention is concerned, it is obvious that these features of construction may be embodied in devices mechanically different from the particular ones illustrated in the accompanying drawings, and I do not therefore desire to be limited to a construction in which the drill-head is movable with respect to the drill-rod by a rotative connection, as, for instance, the drill-head may have an endwise-sliding or telescopic connection with the drill-rod and operate through its endwise movement upon an expansible and contractible core-gripper, as illustrated in said separate application for patent, Serial No. 691,604,

filed September 22, 1898. Moreover, in the device herein shown in Figs. 1 to 4 a core-gripping ring is employed which operates as a spring to move the shaft or drill-head with respect to the drill-rod in the release movement of said drill-head, but obviously other forms of spring may be employed to secure the same general results, as shown in Figs. 8 to 11, and in a construction like that shown in the latter figure or any other in which the cutting-head has endwise movement with respect to the drill-rod the gravity of the cutting-head and connected parts may be utilized to advance the cutting-head in the withdrawal of the drill-rod.

Another important feature of my invention is embraced in the construction herein illustrated, wherein the drill-head has rotative movement with respect to the drill-rod, and movement of the core-gripper in a way to release it from contact with the core is produced by torsional strain on the drill-head, which occurs in drilling, such torsional strain serving to turn the drill-head backward with respect to the core-bearer at the beginning of the drilling operation and maintain the core-gripper in position free from the core so long as the drilling operation shall be continued. I desire to claim this feature of the invention also broadly and without restriction to the special mechanical features in which it is embodied in the present instance.

Many of the details or features of construction illustrated and above described are not essential to the carrying out of the broad features of my invention when separately considered. The scope of the invention will be set forth in the concluding claims, and it is to be understood that the omission of an element or the omission of the particular feature of any of the elements mentioned in any given claim is intended to be a formal declaration that the omitted elements or features are not essential to the invention therein covered.

I claim as my invention—

1. The combination with a drill-rod, of a tubular cutting-head having movable connection with the drill-rod and spring-actuated core-gripping means embracing an annular, expansible and contractible core-gripper which tends to remain normally in engagement with the core, and means actuated through the movement of the drill-head with respect to the drill in the act of drilling, acting to expand the core-gripper and hold the same free from contact with the core.

2. The combination with a drill-rod and a drill-head, which has rotative movement with respect to the drill-rod, of spring-actuated gripping means embracing a core-gripper which tends to remain normally in position to grip the core and is held out of contact with the core by the torsional strain on the drill-head in the operation of drilling.

3. The combination with a drill-rod and a tubular cutting-head having rotative movement with respect to the drill-rod, of core-gripping means embracing a split spring-ring constructed to act as a core-gripper and also as a spring to give rotative movement to the cutting-head, and means acting through the turning of the cutting-head on the drill-rod, acting on said ring to hold the same expanded when the drill is in operation.

4. The combination with a drill-rod and a cutting-head having a limited rotative connection with the drill-rod and an expansible and contractible core-gripper consisting of a metallic spring having the form of a split ring, means operated by the turning of the head with respect to the drill-rod acting to expand said ring out of contact with the core in the normal operation of the cutting-head and to permit said ring to contract into contact with the core when the cutting-head is out of action.

5. The combination with a drill-rod and a tubular cutting-head having a limited rotative connection with the drill-rod, and containing an inclined interior surface, an expansible and contractible core-gripper consisting of a metallic spring in the form of a split ring, and adapted to engage said inclined interior surface, and means operated by torsion of the drill-rod whereby the ring is lifted and held out of contact with the core during the normal operation of the cutting-head and is released and allowed to contract upon the core when the cutting-head is not in action.

6. The combination with a drill-rod, a cutting-head having rotative connection therewith and a split spring-ring engaged at its ends with the cutting-head and drill-rod whereby the said ring is held expanded during the operation of the cutting-head.

7. The combination with a tubular drill-rod, a cutting-head movable with respect to the drill-rod and provided with an inclined interior surface, a split or open core-gripping ring, engaging said inclined surface, a stop on the cutting-head engaging the end of said split ring, and interlocking means on the drill-rod and the other end of said ring whereby said ring is held expanded and out of contact with the core during the normal operation of the cutting-head and is allowed to contract upon the core when the cutting-head is not in action.

8. The combination with a drill-rod, a cutting-head having rotative connection with the drill-rod provided with a conical recess, a split spring-ring located in said recess, said ring being movable inwardly and outwardly in said recess and engaged at its ends with the cutting-head and drill-rod, whereby it is held expanded when the cutting-head is in operation.

9. The combination with a drill-rod, a cutting-head having rotative connection with said drill-rod and provided with a conical recess and a split, spring-ring located in said conical recess and engaged at its ends with the drill-rod and cutting-head, the said drill-rod and ring having contact-surfaces, one of which is inclined to carry the ring to the up-

per part of the conical recess when said ring is expanded.

10. The combination with a drill-rod, a cutting-head having rotative movement with respect to the drill-rod and provided with an interior conical recess, a split, spring-ring in said recess, a stop in said recess engaging one end of said split ring, said drill-rod being provided with a lug and the ring with a bearing-surface engaging said lug, whereby the ring will be expanded in the turning of the cutting-head on the drill-rod.

11. The combination with a drill-rod, a cutting-head having screw-threaded engagement with the drill-rod, a split spring core-gripping ring engaged at its opposite ends with said drill-rod and cutting-head and stop projections on the drill-rod and cutting-head, limiting the rotative movement of the cutting-head with respect to the drill-rod.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 2d day of September, A. D. 1898.

MILAN C. BULLOCK.

Witnesses:
CHARLES S. BARTHOLF,
R. CUTHBERT VIVIAN.