No. 683,352. Patented Sept. 24, 1901.

J. C. SWAN.

UNDERREAMER.

(Application filed Dec. 10, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 2.

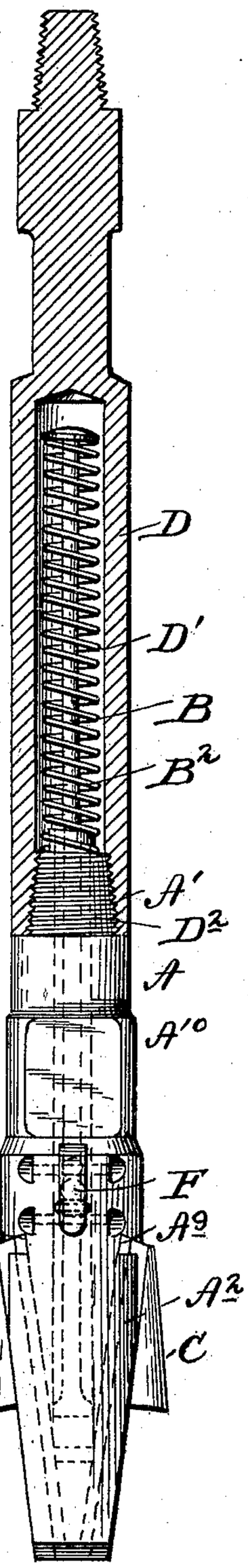


Fig. 1.

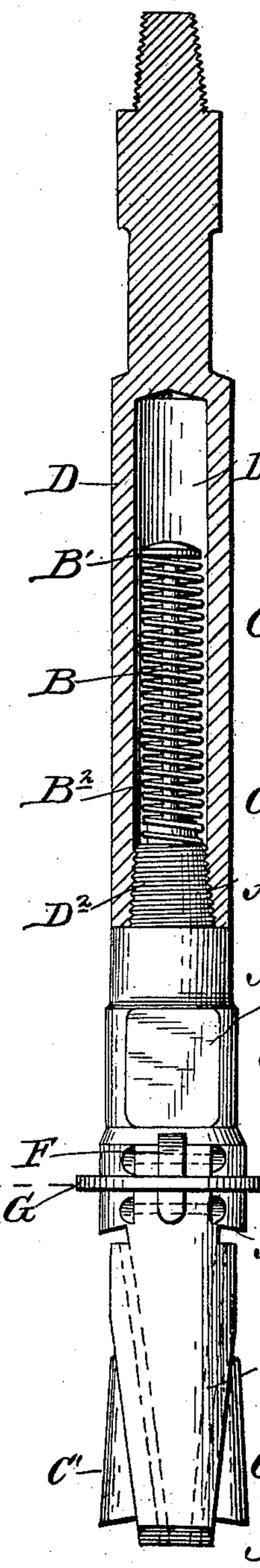


Fig. 11.

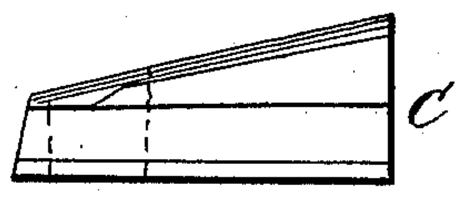


Fig. 12.

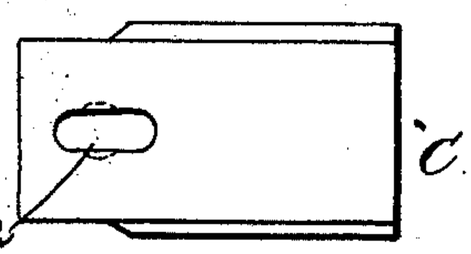


Fig. 13.

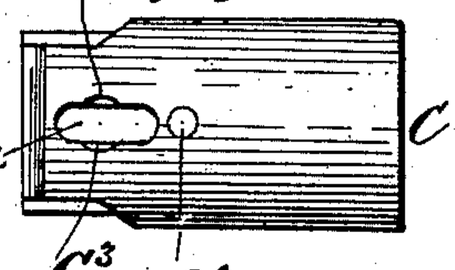
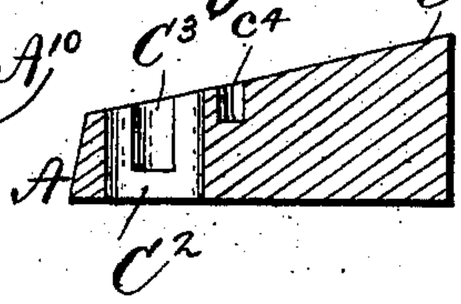


Fig. 14.



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(No Model.) 2 Sheets—Sheet 2.

Fig. 6.

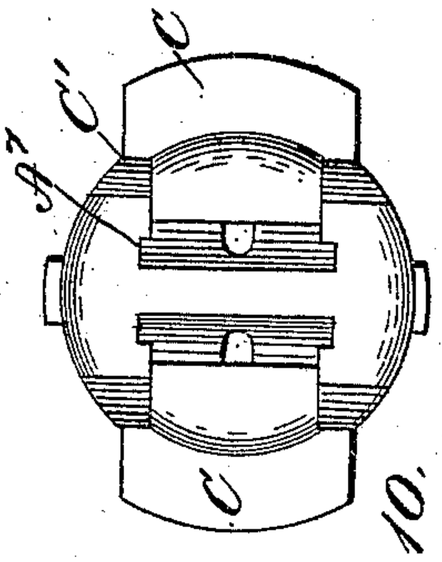


Fig. 9.

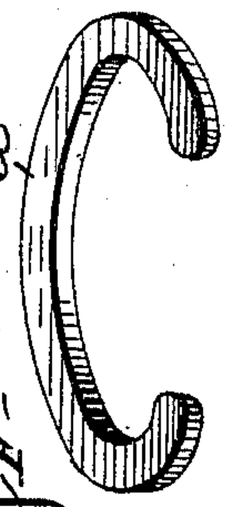


Fig. 10.

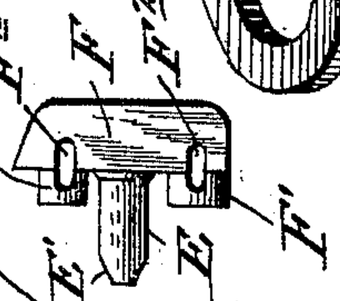


Fig. 8.

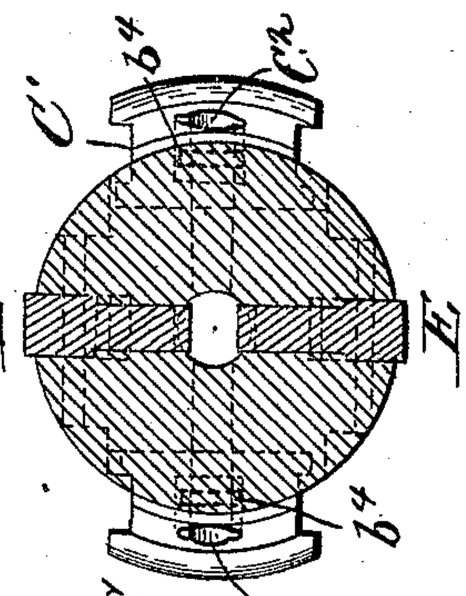


Fig. 5.

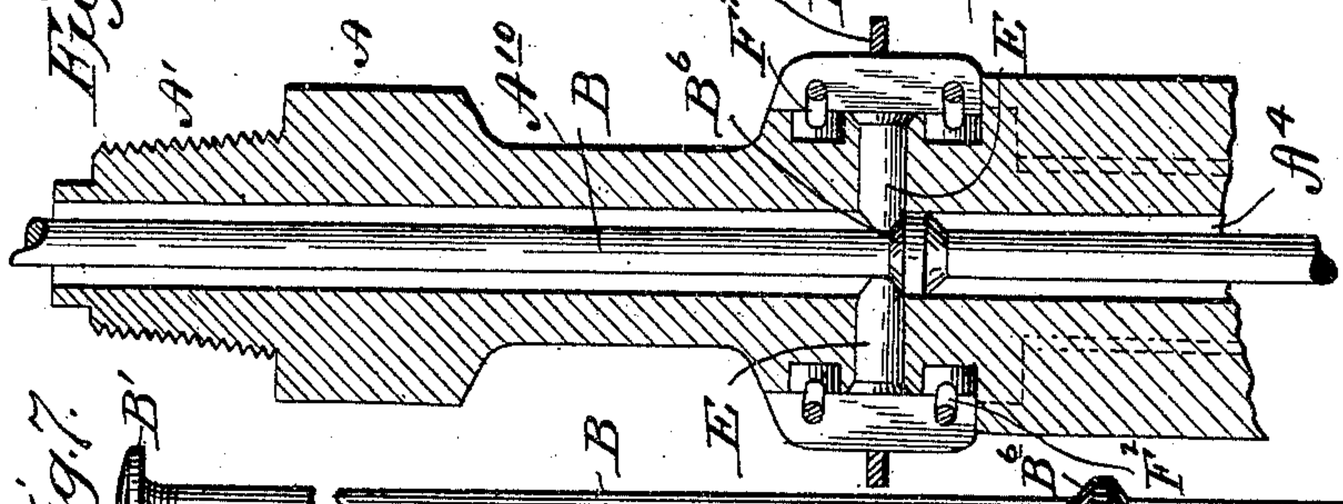


Fig. 15.

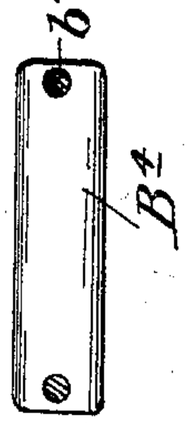
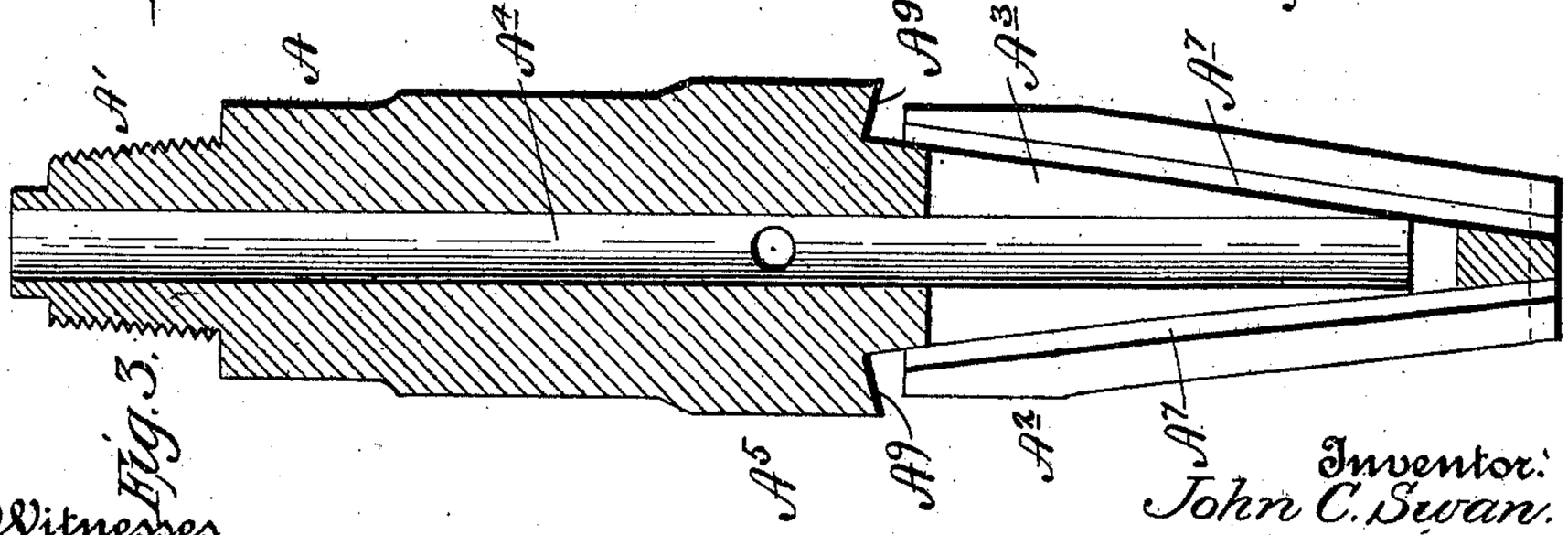


Fig. 7.

Fig. 4.

Fig. 3.



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Inventor:
John C. Swan.
by Sturtevant & Brady
Attorneys.

UNITED STATES PATENT OFFICE.

JOHN C. SWAN, OF MARIETTA, OHIO, ASSIGNOR TO SWAN MACHINE & TOOL COMPANY, OF SAME PLACE.

UNDERREAMER.

SPECIFICATION forming part of Letters Patent No. 683,352, dated September 24, 1901.

Application filed December 10, 1900. Serial No. 39,404. (No model.)

To all whom it may concern:

Be it known that I, JOHN C. SWAN, a citizen of the United States, residing at Marietta, in the county of Washington, State of Ohio, have invented certain new and useful Improvements in Underreamers, of which the following is a description, reference being had to the accompanying drawings and to the letters of reference marked thereon.

My invention relates to devices for reaming out or enlarging well-holes, and particularly to devices of such character intended for underreaming—that is, reaming out or enlarging the well-hole drilled below a casing in order to permit the casing to be lowered farther down; and my invention consists in the construction and combination of devices for this purpose hereinafter described.

In the drawings, Figure 1 is a perspective view, partly in section, showing the reaming-heads held in contracted position by means of the removable ring. Fig. 2 is a corresponding view showing the reaming-heads in expanded position ready for operation. Fig. 3 is a longitudinal sectional view of the reamer-body. Fig. 4 is a longitudinal sectional view of the reamer-body, taken on a plane at right angles to that on which Fig. 3 is taken. Fig. 5 is a longitudinal sectional view of the same plane as Fig. 4, showing the actuating-rod and trips in position. Fig. 6 is a cross-sectional view showing the reaming-heads in expanded position. Fig. 7 is a detail of the actuating-rod and spring. Fig. 8 is a cross-section on line 8 8 of Fig. 1. Fig. 9 is a detail of the removable ring. Fig. 10 is a detail view of one of the trips. Figs. 11, 12, 13, and 14 are detail views of the reaming-heads, and Fig. 15 is a detail of the pin which carries the reaming-heads.

In the drawings, A is the reamer-body, having at its upper end the screw coupling or pin A′ and having its lower end A^2 wedge-shaped or tapered, as shown. Through the wedge-shaped or tapered portion is formed a slot A^3, extending from a point near the lower end of this portion nearly to its upper end. A central bore A^4 extends from the upper end of the reamer-body nearly to the lower end of the slot. In the sides or housing of the wedge-shaped or tapered portion A^2 ways A^7 are cut. These ways are made substantially dovetailed or wider at their inner ends, as shown at A^8, in order to receive and retain corresponding extensions on the sides of the reaming-heads C. At the upper ends of the ways A^7 are arranged abutments A^9, preferably formed by cutting away the material of the reamer-body at an angle of about nineteen degrees to the horizontal. A short distance above these abutments radial holes A^5 at right angles to the central bore A^4 are formed. At the outer ends of these holes A^5 are formed longitudinal recesses A^6. Above these recesses is formed the usual tool-square A^{10}.

In the central bore A^4 of the reamer-body is arranged the spring-rod B. The rod extends above the upper end of the reamer-body and has a head B′ at its upper end. Around the rod, between the head B′ and the upper end of the reamer-body, is arranged a coiled spring B^2. The lower end of the rod B is also provided with a head B^3. This head is slotted, as shown, and through it passes a flat pin B^4. This pin extends radially outward in both directions through the slot A^3 and carries at each end a reaming-head C, the reaming-heads being arranged to have free movement on the pin and the pin being arranged to be freely movable in the slot in the head B^3. The reaming-heads C are provided with slots C^2, in which the ends of the pin B^4 are received. These slots are countersunk at their outer ends, as shown at C^3, to receive the heads of rivets b^4, which are passed through the outer ends of the pin B^4 and serve to prevent the removal of the reaming-heads from the pin. The outer faces of the reaming-heads are curved, preferably, on the arc of a circle of the diameter to which the well-hole is to be enlarged. The heads are wider at their lower ends than at their upper ends. Their rear portions are made narrower than their faces in order to fit within the ways A^7 of the reamer-body and are substantially dovetailed in cross-section to fit and be retained by the ways. The upper ends of the reaming-heads are cut at an angle corresponding with the faces of the abutments A^9, against which they rest when in expanded position, as hereinafter described. The reaming-heads are provided in their outer faces with

recesses c^4 for the insertion of hooks, by which they may be drawn downward into the position shown in Fig. 1.

Secured to the upper end of the reamer-body by its box D^2, which screws onto the screw coupling or pin A', is a spring-case D, having a central longitudinal bore D' of a diameter sufficient to receive the rod B with its spring B^2. This bore D' extends upward a distance sufficient to permit the rod B to pass freely into it. The bore D' being closed at its upper end forms an air-tight chamber, which in operation will be so far filled with air under pressure as to exclude the water and sediment in which the tool ordinarily works from contact with the spring under ordinary pressures and to expel any water or sediment which may have entered the chamber under extraordinary pressures as the reamer is drawn upward. The spring B^2, acting against the head B', forces the rod B, and with it the pin B^4, upward until the pin reaches the upper end of the slot A^3. The pin will carry with it in its movement the reaming-heads C, and as these heads move upward they will be caused to move outward by their engagement with the central wedge and with the ways A^7, cut in the housing or sides of the wedge-shaped or tapered lower portion A^2 of the reamer-body. At the limit of their upward movement the reaming-heads will rest with their upper angular ends in contact with the angular faces of the abutments A^9. In this position the heads are ready for use. By drawing the reaming-heads downward they are caused to travel inward by reason of their engagement with the ways A^7 of the wedge-shaped or tapered portion A^2 of the reamer-body. The pin B^4, and with it the spring-rod B, will be drawn downward with the heads until the pin reaches the lower end of the slot A^3. In order to hold the reaming-heads in this position, I provide the rod B with an obstruction, preferably in the form of a shoulder B^5, having a beveled upper face B^6. When the reaming-heads are drawn down as far as possible, this shoulder B^5 is in position to have its beveled face engaged by the tapered ends E' of pins E, which are inserted in the holes A^5, above described. These pins are preferably integral with trips F, which are preferably narrow strips of metal fitting the longitudinal recesses A^6, above described. The angle of the beveled face B^6 of the shoulder B^5 and the taper E' of the pins E is such that if the pins are not positively held against the rod the spring B^2 will cause the bevel B^6 to force the pins outward sufficiently to permit the shoulder to pass the ends of the pins. The trips F are preferably provided on their inner faces with projections F', which enter recesses a^6 in the reamer-body and are provided with slots F^2, through which pass pins a^7. By means of these pins and slots the movement of the trips is guided and at the same time limited. The projections F' and recesses a^6 also aid in guiding the movement of the trips. It should be understood, however, that the form of the trips may be varied, it being essential only that the trips be capable when held at the limit of their inward movement of holding the pins E with their inner ends against the beveled faces of the shoulder B^6, and thus preventing the upward movement of the spring-rod.

In order to insert the tool in the casing of the well, the reaming-heads will be drawn downward, as above described, to the limit of their movement in that direction. This will compress the spring B^2 and bring the shoulder B^5 in position to have its upper face B^6 engaged by the inner ends of the pins E. The pins E are then forced inward by pressure on the trips F, and the trips and pins are temporarily held in position by a removable ring G, made open at one side, as shown in Fig. 9, so that it can be readily slipped into place and removed at the tool-square formed on the reamer-body. The tool is then lowered into the casing. The reaming-heads will enter the casing freely and will pass through it without contact with its interior. The trips F will enter the casing and will be held from outward movement by contact with its interior. The ring G will not enter the casing; but as the tool enters the ring will be pushed upward until it reaches the tool-square, when it may be readily removed. The trips F are preferably rounded at their lower ends, so as to enter the casing readily and to pass any slight obstruction which may be met with as the tool is lowered through the casing. Their upper ends are preferably inclined and rounded, as shown, so as to enter the lower end of the casing when the tool is drawn upward through the casing. As the tool is lowered the reaming-heads, through the action of the interior walls of the casing holding the trips and pins from outward movement, and thus holding the spring-rod from upward movement, will be held out of contact with the interior of the casing, thus avoiding wear on the reaming-heads and possible injury to the casing. It will be understood that it is essential to the successful introduction of the reamer into the casing that the heads be held in this contracted position out of contact with the interior. As soon as the trips pass below the lower end of the casing, which, as will be understood, is elevated a short distance from the shoulder of the small hole to be reamed for the purpose of affording the space necessary for an effective stroke of the reamer, they will be forced outward by the action of the bevel B^6 on the ends of the pins E, the shoulder B^5 will pass the ends of the pins, and the reaming-heads through the action of the spring B^2 will be forced upward on the wedge-shaped or tapered portion A^2 until their upper ends rest against the abutments A^9. They are then in position for operation. In operation this tool is made a part of the usual string of oil and Artesian well drilling tools. As the tool is raised and

allowed to fall, as in the usual operation of drilling, the lower outer edges of the reaming-heads will strike upon the shoulder left below the lower end of the casing and cut it away, thus enlarging or reaming out the hole already drilled to the size desired. The lower end of the portion A^2 of the reamer-body below the lower edges of the reaming-heads will enter the hole already drilled, and thus serve as a guide for the tool. If, as is often the case, the reaming-heads stick at the point of impact, the lift of the tool will free them by causing them to be drawn inward.

While it should be understood that sufficient metal is left in the tapered or wedge-shaped portion A^2 to give the necessary strength, the main effect of the impact of the reaming-heads on the material acted on by them is sustained by the abutments A^9. The force of the impact tends to drive the lower ends of the reaming-heads inward and by a lever action to force the upper ends of these heads outward. This tendency to force the upper ends outward is overcome by forming the abutments A^9 angular, as shown. The strain is thus taken off the upper portion of the ways A^7.

In withdrawing the reamer as the tool is drawn upward the lower end of the casing coming in contact with the trips will force them inward, and as the tool is raised farther the end of the casing will cause the reaming-heads to move downward on the inclined portion A^2 until they are carried inward sufficiently to permit of their entrance within the casing. As the tool is raised through the casing the outer edges of the heads will necessarily be in contact with the interior of the casing.

The ways A^7 are open at their lower ends, this construction permitting the reaming-heads to be readily removed and replaced, the pin B^4 preventing the heads from dropping out in operation. The portion of the wedge or taper in which the ways A^7 are formed is made of sufficient thickness to not only serve as a guide for the tool, as above described, but to also sustain the wear caused by the sidewise movement of the end of the tool in operation and the side blows of the reaming-heads, due to irregularities of the shoulder in hard rock.

It should be understood that the shoulder B^5 may be of any preferred form, it being essential only that it be of sufficient size to have the beveled upper face B^6 formed on it.

I prefer to make the reaming-heads in one piece of steel; but it should be understood that they may be made in one or more pieces and may be made part of steel and part of iron, as found most desirable. It should also be understood that I do not desire to be limited to the precise form or precise construction of the several parts of my device as shown and described, it being obvious that many changes may be made without departing from the essential features of my invention.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an underreamer, the combination of a reamer-body having a tapered or wedge-shaped portion, a reaming-head arranged to be movable on said tapered or wedge-shaped portion, means for automatically moving the reaming-head to the base or thick end of the tapered or wedge-shaped portion, and means arranged to contact with the interior of the casing for holding the reaming-head at the narrow end of the tapered or wedge-shaped portion during the passage of the tool through the casing; substantially as described.

2. In an underreamer, the combination of a reamer-body having an oblique face formed thereon, an abutment at the upper end of the oblique face, retaining-ways along the oblique face, a reaming-head arranged to slide on the oblique face and to stop against the abutment, a spring above said abutment, connections between the spring and reaming-head for holding the reaming-head against the abutment and means arranged to contact with the interior of the casing for holding the reaming-head away from the abutment during the operation of lowering the tool through the casing; substantially as described.

3. In an underreamer, the combination of a reamer-body having a tapered or wedge-shaped portion, retaining-ways along the faces of the tapered or wedge-shaped portion, abutments at the upper ends of said faces, reaming-heads arranged to be movable on the tapered or wedge-shaped portion, a spring arranged to automatically move the reaming-heads into contact with said abutments and means arranged to contact with the walls of the well-casing for locking the spring against operation during the passage of the tool through the casing; substantially as described.

4. In an underreamer, the combination of a reamer-body, having a tapered or wedge-shaped lower portion, the lower end of which is adapted to enter the hole to be reamed or enlarged, abutments at the upper end of the tapered or wedge-shaped portion, reaming-heads movable on the tapered or wedge-shaped portion and arranged to stop against said abutments, yielding means for moving the reaming-heads to the wider end of the tapered or wedge-shaped portion into contact with said abutments, means arranged to contact with the interior of the casing for temporarily locking said yielding means against operation to hold the reaming-heads at the narrow end of the tapered or wedge-shaped portion, and means for retaining said locking means in operative position before the tool is inserted in the well-casing; substantially as described.

5. In an underreamer, the combination of a reamer-body, having a tapered or wedge-

shaped lower portion, reaming-heads movable in ways on said tapered or wedge-shaped portion, a rod within the reamer-body having near its lower end a pin extending through a slot in the reamer-body, and carrying the reaming-heads, a spring arranged to force the rod and with it the reaming-heads, upward into expanded position, pins carried by the reamer-body having their inner ends adapted to engage a shoulder carried by the rod to hold the rod from upward movement, and means for holding the pins in engagement with the shoulder on the rod during the passage of the tool through the well-casing; substantially as described.

6. In an underreamer, the combination of a reamer-body, having a tapered or wedge-shaped lower portion, reaming-heads movable in ways on said tapered or wedge-shaped portion, a rod within the reamer-body having near its lower end a pin extending through a slot in the reamer-body, and carrying the reaming-heads, a spring arranged to force the rod and with it the reaming-heads, upward into expanded position, pins carried by the reamer-body having their inner ends adapted to engage a shoulder carried by the rod to hold the rod from upward movement, and means adapted to contact with the interior of the casing for holding the pins in engagement with the shoulder on the rod during the passage of the tool through the well-casing; substantially as described.

7. In an underreamer, the combination of a reamer-body having a tapered or wedge-shaped portion provided with ways, reaming-heads carried in said ways, a pin connecting the reaming-heads and movable therein, a longitudinal rod having a shoulder thereon within the reamer-body, through which the pin passes and is freely movable, means for moving the rod and means engaging the shoulder on the rod and arranged to contact with the interior of the casing for preventing the movement of the rod during the passage of the tool through the well-casing; substantially as described.

8. In an underreamer, the combination of a reamer-body having a tapered or wedge-shaped portion provided with ways, reaming-heads carried in said ways having their upper ends terminating at an oblique angle, and abutments formed on the reamer-body above the ways, having faces arranged at an oblique angle adapted to receive the upper ends of the reaming-heads and yielding means arranged above said reaming-heads for holding them against said abutments; substantially as described.

9. In an underreamer, the combination of a reamer-body having ways formed in its lower portion, reaming-heads carried in said ways, having their upper ends terminating at an oblique angle, and abutments formed on the reamer-body above the ways having their faces arranged at an oblique angle adapted to receive the upper ends of the reaming-heads whereby the force of the blow upon the abutments is directed inward toward the center of the reamer-body and yielding means for holding the reaming-heads against said abutments; substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN C. SWAN.

Witnesses:
GRAFTON L. MCGILL,
A. P. GREELEY.