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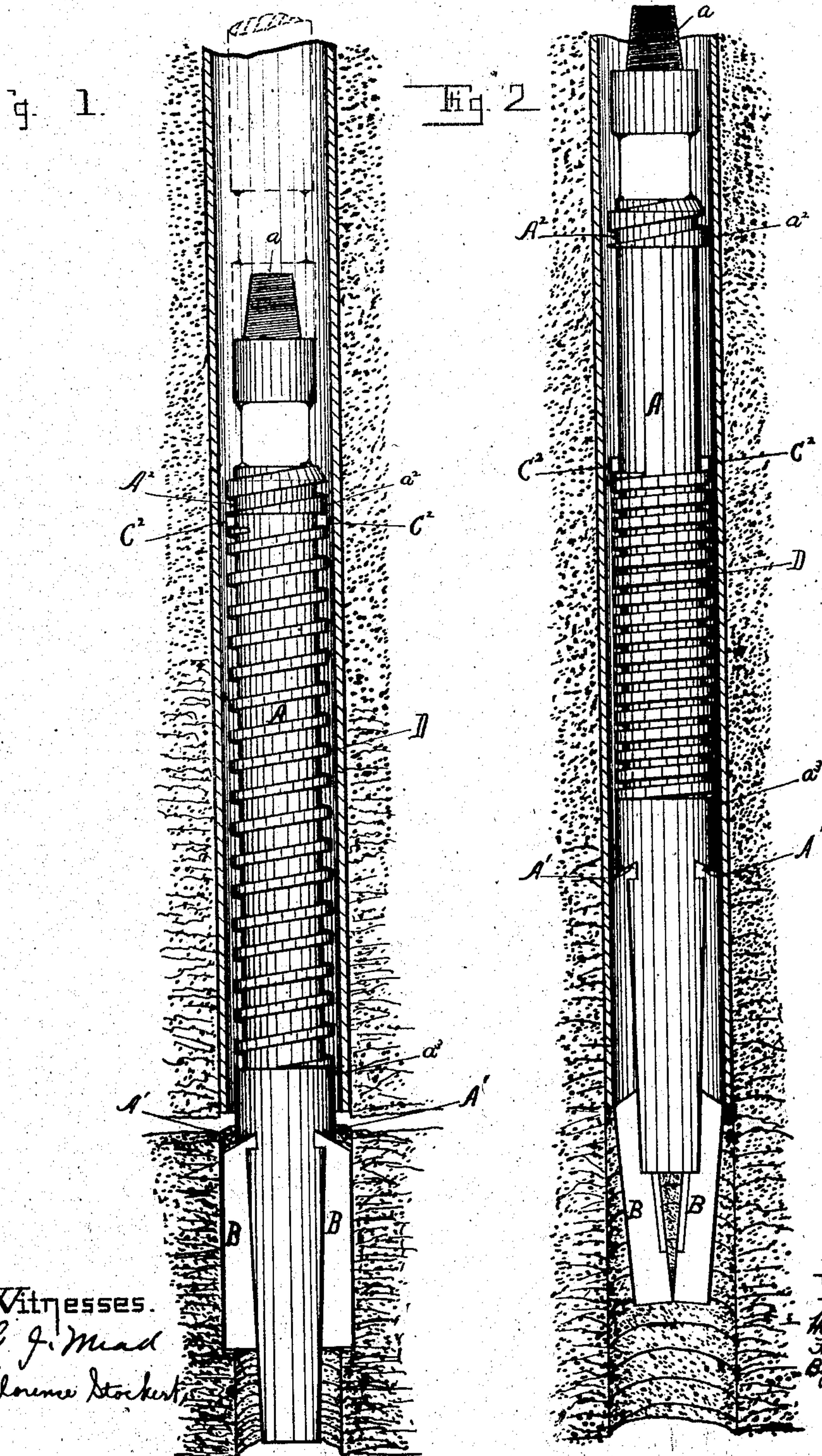
PATENTED MAR. 13, 1906.

H. R. HARDENBURG & F. SAGER.

WELL REAMER.

APPLICATION FILED OCT. 6, 1905.

2 SHEETS—SHEET 1.



Witnesses.

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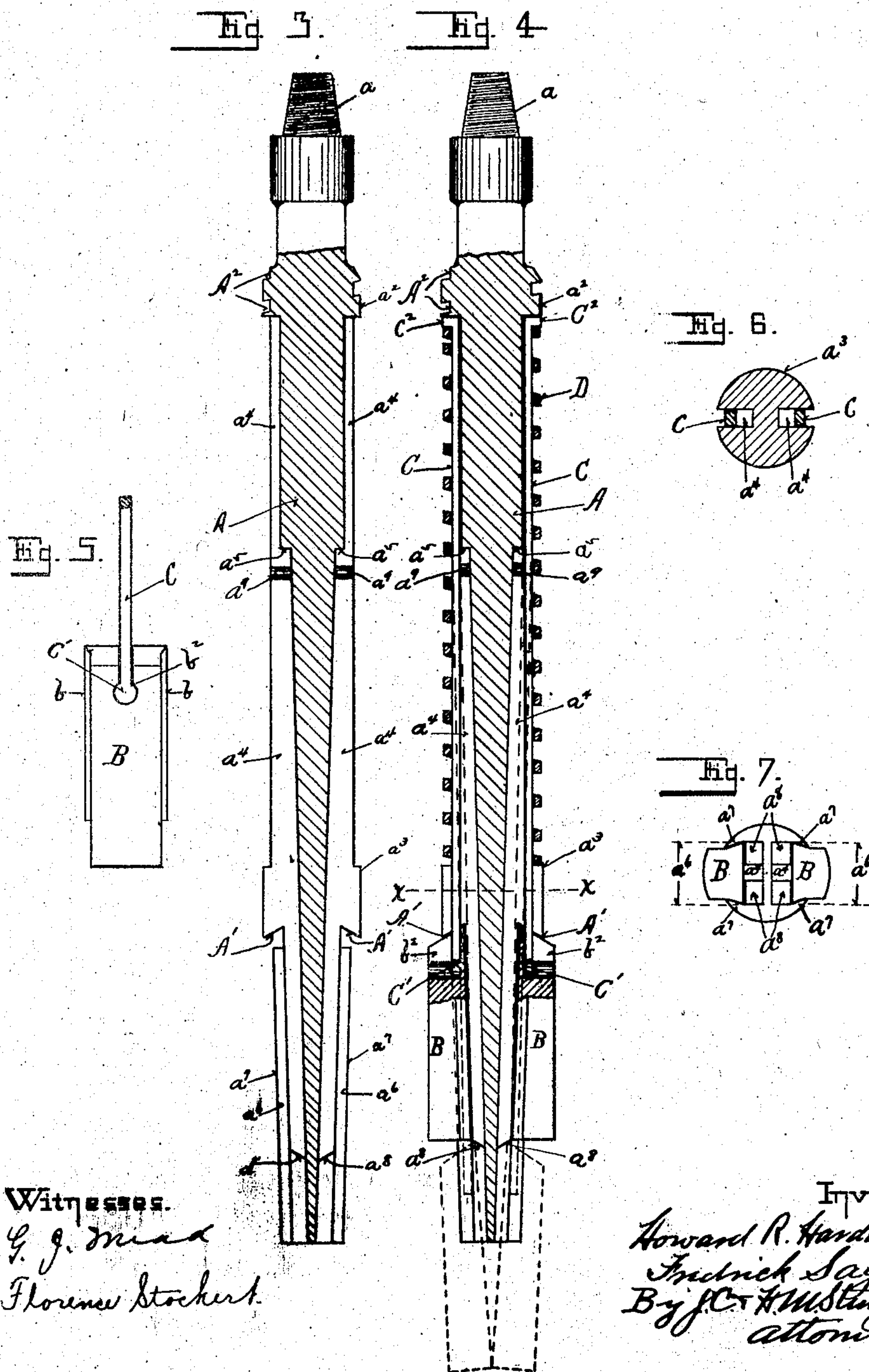
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UNITED STATES PATENT OFFICE.

HOWARD R. HARDENBURG AND FREDRICK SAGER, -OF SAGINAW,
MICHIGAN.

WELL-REAMER.

No. 815,012.

Specification of Letters Patent.

Patented March 13, 1906.

Application filed October 6, 1905. Serial No 281,653.

To all whom it may concern:

Be it known that we, HOWARD R. HARDENBURG and FREDRICK SAGER, citizens of the United States, residing at Saginaw, in the county of Saginaw and State of Michigan, have invented certain new and useful Improvements in Well - Reamers; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, forming part of this specification.

This invention relates to reamers for use in drilling oil and other deep wells, and has for its object the construction of a reamer that will expand when it passes down beyond the end of the well-casing in order to ream the hole out large enough to permit the lowering of the casing and when it is desired to draw out the reamer that it will contact sufficiently to pass up through the well-casing.

In the drilling of oil and other deep wells where there are deep strata of sand and other loose material that will cave into the hole it is customary to sink a casing-pipe into the hole as fast as the well is drilled, and the drill used in boring the initial hole of necessity must pass down through the casing, and therefore will not bore a hole of sufficient diameter to permit the casing to be lowered. Therefore it becomes necessary to ream the hole larger below the casing, and it is to accomplish this purpose that the present invention is designed.

The manner of constructing a reamer embodying this invention and the features thereof are hereinafter set forth and explained, and illustrated in the accompanying drawings, in which—

Figure 1 is a view in elevation of a reamer constructed according to this invention with in a well-casing, the bits thereof having passed below the casing and expanded to ream the hole larger for the casing. Fig. 2 is a like view of the same with the bits contracted by the casing as the reamer is being withdrawn from the well. Fig. 3 is a vertical section of the body portion of the reamer with the operative parts removed. Fig. 4 is a like section of the same, showing the arrangement of the operative parts thereon. Fig. 5 is a

plan view of one of the bits, showing the manner of connecting the spring-link thereto. Fig. 6 is a cross-section of the same on the line $x x$ in Fig. 4. Fig. 7 is a plan view of the lower end of the reamer, showing the arrangement of the bits in the inclined ways.

In the construction of a reamer embodying this invention the body portion A of the reamer is of solid metal, the upper end being provided with the usual screw-pin a , by means of which it is secured to the drill-stem. The body portion A has a collar a^2 adjacent to its upper end and also another collar a^3 adjacent to the lower end thereof. Longitudinal slots $a^4 a^4$, having shoulders at their upper ends adjacent to the collar a^2 , are cut in opposite sides of the body portion A, which are of uniform depth from the upper collar a^2 down to an offset or shoulder a^5 in said slots, from which point the said slots a^4 gradually increase in depth until the wall between them at the lower end of the body portion A is very thin. The lower end of the body portion A below the collar a^3 is faced off on the sides in which the slots $a^4 a^4$ are cut, so as to be somewhat wedge-shaped, and these wedge faces are channeled out, as at a^6 , with the sides thereof, a^7 , undercut, as shown in Fig. 7, and at the point a^8 the metal forming the side walls of the slots a^4 is cut away to the full width of the channels a^6 and depth of the slots a^4 , so as to form shoulders or offsets a^8 therein or, in other words, increase the width of the slots $a^4 a^4$ below the shoulders a^8 to the full width of the undercut of the channels a^6 . The upper ends of the channels a^6 terminate in undercut shoulders A' for the purpose hereinafter set forth. In the sides of the slots a^4 slightly below the offset a^5 therein are small recesses a^9 , the purpose of which will be hereinafter explained.

Within the undercut sides a^7 of the channels $a^6 a^6$ are placed bits B B, (see Fig. 5,) which are provided with longitudinal splines or ribs $b b$ on their sides, adapted to fit the undercut sides a^7 of the channels a^6 . The upper ends of these bits B B are beveled off preferably to fit the undercut shoulders A' in the collar a^3 , and they have also recesses b^2 cut in their upper ends, which recesses have contracted openings in their upper walls. Within these recesses b^2 in the bits B are then placed spring-links C C, having enlarged lower ends C' and the upper

ends thereof upturned, so as to form shoulders C^2 , (see Fig. 4,) the spring-links lying in the slots a^4 with their upper ends or shoulders C^2 below and against the offsets or shoulders a^5 in the slots a^4 . A spiral spring D is then turned or screwed on over the upper collar a^2 (for which purpose a thread A^2 is cut around the collar a^2) down over the body portion A of the reamer and is then compressed until the upper end of the spring D is below the shoulders C^2 of the spring-links C C, when, by means of a small hook or other suitable instrument inserted in the recesses a^6 beside the spring-links C C in the slots a^4 , the spring-links C C are lifted outward in the slots a^4 until they will clear the offsets or shoulders a^5 in said slots and contact with said spring D when the spring D is released, the upper end thereof contacting with the under side of the shoulders C^2 of the spring-links C, which forces them and the bits B B, attached to their lower ends, upward until the upper ends of the bits B B contact with the undercut shoulders A' in the collar a^3 .

In operation the reamer is secured upon the tool-stem of the drilling-rig. The spring D is compressed until the bits B B are below the offset or shoulders a^5 in the bottom of the channels a^6 in the lower end of the reamer, when the bits are pressed toward each other and the reamer inserted in the upper end of the well-casing and lowered down below the casing. When the casing has not been previously lowered to the bottom of the last-reamed portion of the well; the bits of this reamer will expand immediately on leaving the bottom end of the casing, and as the reamer is lowered the spring D will draw the bits B B upward until their upper ends contact with the shoulders A' in the collar a^3 , where they will stay until the reamer is raised upward until the upper ends of the bits B B contact with the lower end of the well-casing, which forces them downward on the body portion A as it is raised upward, the wedged channels a^6 drawing the bits inward until their upper ends are below the shoulders or

offsets a^5 in the bottoms of the channels a^6 , when the bits B B will pass upward through the casing. When the casing has been previously lowered to the bottom of the then reamed portion of the well, it can first be raised sufficiently to give working space for the reamer to commence work.

Having thus described this invention so as to enable others to construct and operate the same, what is claimed as new and desired to be secured by Letters Patent of the United States, is—

1. The combination in a well-reamer of a body portion adapted to be secured to a drill-stem, and provided with longitudinal slots therein, a collar on the lower portion of said body portion, shoulders on the lower face of said collar, inclined ways below said shoulders, bits operating vertically in said inclined ways and against said shoulders, a spiral spring seated upon said collar, mechanism actuated by said spring to retain said bits in a normally upward and expanded position, substantially as described.

2. The combination in a well-reamer of a body portion adapted to be secured to a drill-stem, and provided with longitudinal slots therein, a collar adjacent to the lower end thereof, undercut shoulders on said collar, inclined ways below said shoulders, bits operating vertically in said inclined ways and against said undercut shoulders, links having shoulders on their upper ends removably secured to said bits and resting in said longitudinal slots, and a spiral spring, compressed between said collar on the body portion and the shoulders on said links, operating to retain the bits normally on the upper portion of said inclined ways, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

HOWARD R. HARDENBURG.
FREDRICK SAGER.

Witnesses:

M. C. SLOAN,
JONAS P. SMITH.