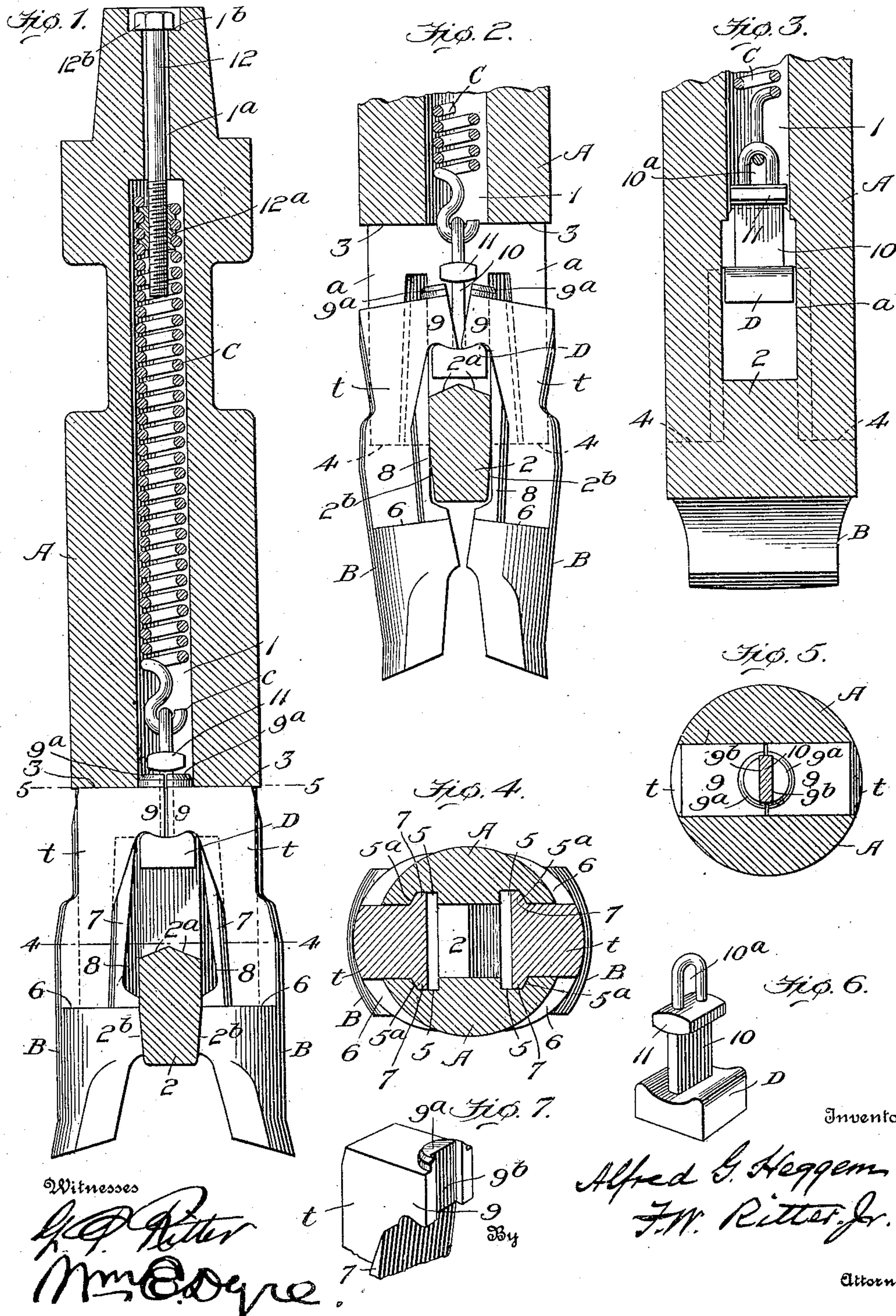


A. G. HEGGEM.
UNDERREAMER.
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982,059.

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UNITED STATES PATENT OFFICE.

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UNDERREAMER.

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To all whom it may concern:

Be it known that I, ALFRED G. HEGGEM, a citizen of the United States, residing at Coraopolis, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Underreamers; and I 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.

My invention relates to the construction of that class of devices known as underreamers, which are employed for enlarging the bore of Artesian and like drilled wells where casing is used and the tool is introduced and withdrawn through the casing. In this class of devices, the reaming bits should not only be so connected to the stock or mandrel as to be expansible and collapsible, but the connections should be such as will permit the ready removal of the bits for sharpening when required. The bits and their supports on the mandrel or stock should also be of a character which will insure the integrity of the bits and their connections when subjected to the severe shocks and strains of service, while the tool as a whole should be of such a character that it will readily free itself from sand and silt when it is desired to withdraw said tool from the well. The preferred form of this class of tools is one wherein the bit-stock or mandrel is provided with bit-slots having in their lateral walls ways for retaining and guiding the bits, abutments to support the bits against shocks when in service, and a distance block to maintain the bits in an expanded or operative position. To such a mandrel or stock the bits are slidingly connected and are actuated by a spring through the medium of a cross-key or bar the ends of which enter slots in the tangs of the bits.

In service several points of weakness have developed in the present constructions of underreamers, leading, at times, to the loss of the bits in the well and expensive fishing operations to remove said bits and thus reclaim the well. Among the most important of these defects are: weakness of the stock adjacent to the bit receiving guide-ways formed therein; weakness of the bit-shanks due to slotting the same for the reception of a cross-key connecting the bits with the

actuating spring; and defects in the form of the distance block and bits which prevent the cavity of the stock from readily freeing itself from sand and silt when the tool is withdrawn from the well. This latter defect often causes the tool to stick and necessitates the use of drill jars which, on account of the packing of the sand, are apt to deform or shear off the key or break the bit-shank, and cause the loss of one or more of the bits in the well.

To overcome these several defects in underreamers is the object of my present invention.

To effect the reinforcement of the stock at the points where the lateral strains from the bit are resisted, I bevel the outer walls of the bit ways, so that said outer walls shall form an obtuse angle, whereby an increase in the body of metal of the stock is effected and the depth of the ways may be reduced; and such a construction embodies one feature of my invention.

To effect the reinforcement of the bit-shanks I dispense with slot and key connections between the bits and the actuating spring and in lieu thereof employ a solid bit shank with an inwardly projecting over-hang which is adapted to engage a bit-block that is interposed between the bits and the actuating spring, whereby not only is the body of metal in the bit-shank increased at the point most liable to suffer fracture, but the bearing and support of the bit on the abutment of the stock is also greatly increased; and such a construction embodies a second feature of my invention.

To effect the ready clearance or discharge of sand, etc., from the cavity of the stock when withdrawing the tool from the well, the top of the distance-block is inclined and the lateral walls thereof are tapered downwardly, whereby jarring operates to displace laterally any sand which may have accumulated in the stock cavity and to permit its easy escape through the spaces between the bits and the side walls of the distance block, said spaces, on account of the tapering form of the said distance block, affording increased opportunity for the egress of the sand as the bits slide downwardly: and such a construction embodies a third feature of my invention.

There are other, minor, features of inven-

tion, embracing particular combinations and features of elemental construction, all as will hereinafter more fully appear.

In the drawings chosen for the purpose of illustrating my invention, the scope whereof is pointed out in the claims, Figure 1 is a longitudinal central section of the bit-stock, showing the bits in side elevation, in an expanded or operative position. Fig. 2 is a similar view of the lower end of the bit-stock, the reamer-bits being in the position they occupy when being introduced in or withdrawn from the casing; Fig. 3 is a longitudinal central section of the lower end of the bit-stock taken in a plane at right angles to Fig. 2; Fig. 4 is a transverse section of the bits and bit stock or mandrel, taken in the plane of the line 4—4, Fig. 1; Fig. 5 is a transverse section of the device, taken in the plane of the line 5—5, Fig. 1; Fig. 6 is a detail perspective view of the bit-block; and Fig. 7 is a detail perspective view of the upper end of the bit-shank, showing the overhang thereof which engages the bit-block.

Like symbols refer to like parts wherever they occur.

I will now proceed to describe my invention more fully so that others skilled in the art to which it appertains may apply the same.

In the drawings, A indicates the bit-stock, B the reaming bits which are slidingly arranged in the bit slots *a* of the stock, C a tension spring for actuating the bits, and D a bit-block for connecting the bits with the bit-actuating spring C.

The bit-stock or mandrel A is provided with a central bore 1 for the reception of the bit actuating spring C, the lower portion of said bore being of sufficient diameter to accommodate the spring, but the upper portion thereof being preferably formed with decreased diameter, as at 1^a, to thus form a shoulder 1^b for the support of a bolt by which the bit actuating tension spring is anchored to the bit-stock.

The stock A at its lower end is transversely and vertically slotted to form the lateral slots *a* for the reception of the tangs of the bits B, and to also form the distance block 2 for expanding the bits and maintaining them in operative position. This slotting of the stock also results in forming thereon upon or inner abutments 3 which serve as bearings for the upper ends of the bits. On the lower end of the stock are formed the abutments 4 for the lateral shoulders of the bits. The bits, therefore, are firmly and solidly supported by the stock A not only at their upper ends but also adjacent to their cutting edges.

Formed in the lateral walls of the bit-slots of the stock are ways 5 for the guidance and lateral support of the bits. These

ways, which taper or decrease in width from below upward, are formed with the beveled walls 5^a, or so that the outer walls of the ways form an obtuse angle, such a construction resulting in an increased cross-section of metal in the stock at the points where the lateral strain of the bits is to be resisted, and also enabling the depth of said ways or recesses to be decreased.

In order to cause the lateral displacement of any fine sand or like matter which may accumulate in the cavity of the stock, the top surface of the distance block 2 is sloped or inclined, as at 2^a; and in order to provide for the discharge of the displaced sand the lateral surfaces of said distance block are tapered downwardly and inwardly, as at 2^b, so that as the bits descend to the collapsed position, as shown in Fig. 2, a clearance channel will be formed between the shanks of the bits and the lateral surfaces of the distance block. The lower surface of the distance block may be flat if desired.

The bits B have the usual lateral shoulders or abutments 6 which engage the abutments 4 on the lower end of the stock A, and are provided with lateral ribs 7 on the tangs *t* which enter the ways 5 in the lateral walls of the bit slot *a* of the stock. The ribs 7 are beveled to correspond with the bevel 5^a on the wall of the way 5, or guide recess. The interior faces of the shanks of the bits are cut back or recessed, as at 8, to accommodate the intermediate distance block 2 when the bits are drawn down and collapsed, as indicated in Fig. 2 of the drawing, and the upper ends of the bits project inward to form shoulders or overhangs 9 which, when the bits are in position in the stock, extend over and engage the bit block D. Upon the upper and inner end of each bit-shank is a projection or nipple 9^a which corresponds with the diameter of the spring receiving bore of the stock. These nipples are adapted and intended to enter said bore 1 and assist in supporting the bit against lateral strain and displacement when in operation. This construction of the bits not only leaves the bit tangs solid and therefore better adapted to resist strains or crushing force, but also materially increases the bearing area of the upper ends of the bits on the abutments 3 of the stock. The under surfaces of said overhangs 9 are preferably hollowed out slightly, but may be perfectly plain or flat if desired, while their inner faces are vertically recessed or slotted, as at 9^b for the reception of the stem 10 of the bit block D.

D indicates the bit-block which is of slightly less width than the width of the bit-slot *a* in which it moves, the area of the under surface of the bit-block being approximately that of the cross section of that portion of the slot in the stock intermediate of

the reamer bits. The bit-block is provided with a flat bar stem 10 having at its upper end an elongated eye or slot 10^a for the reception of a hook on the lower end of tension spring C. Intermediate of the block D and eye 10^a, preferably at the bottom of the eye, the stem 10 is provided with an enlargement or collar 11, the function of which is to cause the bits B to descend uniformly in case one bit should stick or for any reason tend to lag behind the other.

The spring C, by means of which the bits B, B are held in place on the abutments 3 and 4 when the underreamer is in operation, is provided at its lower end with suitable means, such as a hook c, for engaging the bit-block D, and said spring is preferably anchored at its opposite end on the stock A by means of an internally threaded plug or nut 12^a, and a threaded bolt 12, the head 12^b of which engages the shoulder 1^b in the upper end of the bore of the stock A.

In assembling the elements of the underreamer the hook c on the lower end of the tension spring C is entered in the eye 10^a of the bit block D, and the spring is inserted in the bore 1 of the stock A. The spring is then anchored at its upper end to the stock by means of the bolt 12 and plug 12^a. The spring C having been thus anchored on the stock the bit-block D is drawn down until the eye 10^a emerges from the bore 1 of the stock into the bit-slot a thereof and a rod is passed through said eye below the hook c to hold the spring extended. The bits B, B are next inserted in the bit-slots a, a from below, so that the ribs 7 on the bit shanks t shall enter and pass up in the ways 5. When the upper ends of the bit shanks have reached the lower face of the bit-block D, the upper ends of the bit-shanks t are tilted outwardly, which the lateral play of the ribs 7 in the ways 5 permits, until the over-hangs 9 pass the bit-block D, after which the bits may be tilted inwardly until the over-hangs 9 thereof extend over and engage the said bit-block. Thereafter, upon withdrawing the rod which has been passed through the eye 10^a of the bit block stem 10 to retain the spring C extended, the reaction of the spring will draw the bits B, B upward until the upper ends of the tangs t rest solidly on the abutments 3 of the stock and the shoulders 6 engage the abutments 4 on the lower end of stock A. In this movement of the bits the nipples or projections 9^a on the upper ends of the tangs, enter the bore 1 of the stock, in which position they afford support for the bits during the operation of the tool, and also resist the inward movement of the bits resulting from wear of the cutting edges thereof.

When it is desired to introduce the tool into the casing the bits are drawn down into the position shown in Fig. 2 of the drawing,

when the underreamer will pass into and through the casing.

If it is desired to remove a bit for sharpening or for any other purpose, the bits are first drawn down to the position shown in Fig. 2 and a rod is then passed through the eye 10^a of the bit-block D to hold the latter down and the spring C extended, after which either or both of the bits may be readily removed from the stock A by reversing the several movements of the bits noted in the foregoing description of the manner of assembling the elements of the underreamer.

In withdrawing the underreamer from the well, the tool is lifted until the engagement of the outer surfaces of the bits with the lower end of the casing arrests the upward movement of said bits, while the upward movement of the stock A continues. This causes the spring C to be put in tension, which permits the distance block D to ascend until it is opposite the recesses 8 in the inner faces of the shanks, whereupon the bits B, B collapse and assume the position shown in Fig. 2. This permits the bits to enter and pass through the casing.

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

1. In an underreamer, the combination of a mandrel or stock having bit-slots the lateral walls of which are provided with ways the outer walls of said ways meeting at an obtuse angle, and sliding reamer bits each provided with laterally projecting ribs said ribs having a cross section conforming to that of the ways in the walls of the bit stock.

2. In an underreamer, the combination of a mandrel or stock which is slotted transversely to form communicating bit slots having their lateral walls provided with ways, reamer bits movable on the stock, each of said bits having laterally projecting ribs movable in the ways of its bit slot and having a solid tang formed with an inwardly projecting overhang whereby it is supported by a bit block, a bit block slidable in the slot of the mandrel intermediate of the reamer bits, the area of the under surface of said bit block being approximately that of the cross-section of that portion of the slot which is intermediate of the reamer bits, and means on the bit stock for maintaining the reamer bits in expanded position.

3. In an underreamer, the combination of a mandrel or stock having a bit-slot, reamer bits and a bit-block slidable in the said bit-slot, the reamer-bits having overhangs which engage the bit-block, and the bit-block having a stem provided with a collar which projects over the overhangs of the reamer-bits.

4. In an underreamer, the combination of

a mandrel or stock which is slotted transversely to form communicating bit slots having their lateral walls provided with ways, a distance block at the lower end of the mandrel for maintaining the reamer bits in expanded position, said distance block having its upper surface inclined, reamer bits movable on the stock, each of said bits having laterally projecting ribs movable in the ways of its bit slot and having a solid tang formed with an inwardly projecting overhang whereby it is supported by a bit block, and a bit block slidable in the slot of the mandrel intermediate of the reamer bits, the area of the under surface of said bit block being approximately that of the cross section of that portion of the slot intermediate of the reamer bits.

5. In an underreamer, the combination of a mandrel or stock which is slotted transversely to form communicating bit-slots having their lateral walls provided with ways, a distance block at the lower end of the mandrel for maintaining the reamer bits in expanded position, said distance block having its upper surface inclined and lateral surfaces which converge from above downward, reamer-bits movable on the stock each of said bits having laterally projecting ribs movable in the ways of its bit slot and having a solid tang formed with an inwardly projecting overhang whereby it is supported by a bit block, and a bit block slidable in the slot of the mandrel intermediate of the reamer-bits, the area of the under surface of said bit-block being approximately that of the cross section of that portion of the slot which is intermediate of the reamer bits.

6. In an underreamer, the combination of a mandrel or bit stock having a bore, bit-

slots, and lateral abutments formed by said bit-slots, a distance block at the lower end of the mandrel for maintaining the reamer-bits in operative position, a bit-block or bit support movable in the slot of the mandrel above said distance block, and reamer-bits supported by said bit-block and having on their upper surfaces which engage the abutments projections which enter the bore of the stock between said abutments.

7. In an underreamer, the combination of a mandrel or stock having a bore, bit-slots and abutments adjacent to the bore and in planes at right angles thereto, a distance block at the lower end of the mandrel which maintains the reamer-bits in operative position, a bit-block or bit-support having a stem and which is movable in the slot of the mandrel above the distance block, and reamer-bits each having on its upper end an inwardly projecting overhang which engages an abutment on the stock and which takes over the bit-block and is supported thereby, said overhang having a projection which enters the bore of the stock.

8. A mandrel or stock for underreamers said mandrel having a slot which extends transversely therethrough forming communicating bit slots, the lateral walls of the bit slots provided with ways the outer walls of which form an obtuse angle, said ways adapted to receive ribs of corresponding cross-section on reamer bits which are adapted to co-act with the stock.

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

ALFRED G. HEGGEM.

Witnesses:

LOUIS C. SANDS,

W. W. ANDERSON.