

982,514.

P. H. MACK.
UNDERREAMER.
APPLICATION FILED DEC. 11, 1909.

Patented Jan. 24, 1911.

2 SHEETS—SHEET 1.

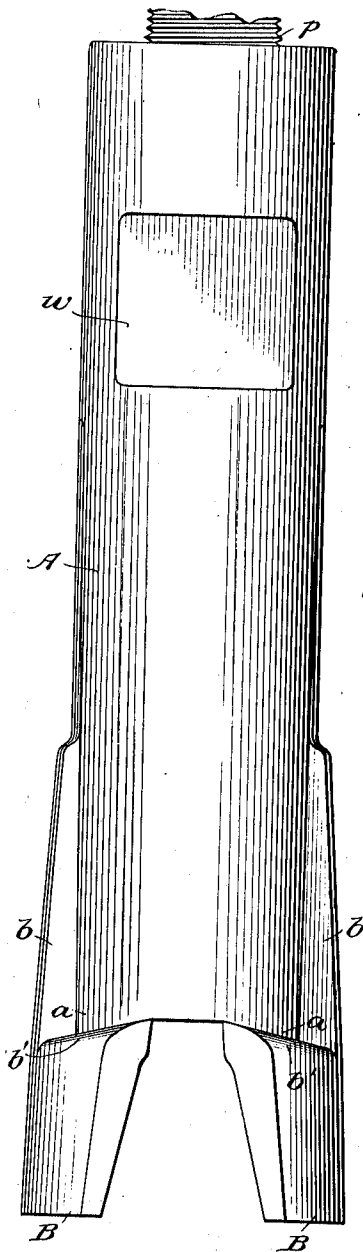


Fig. 1.

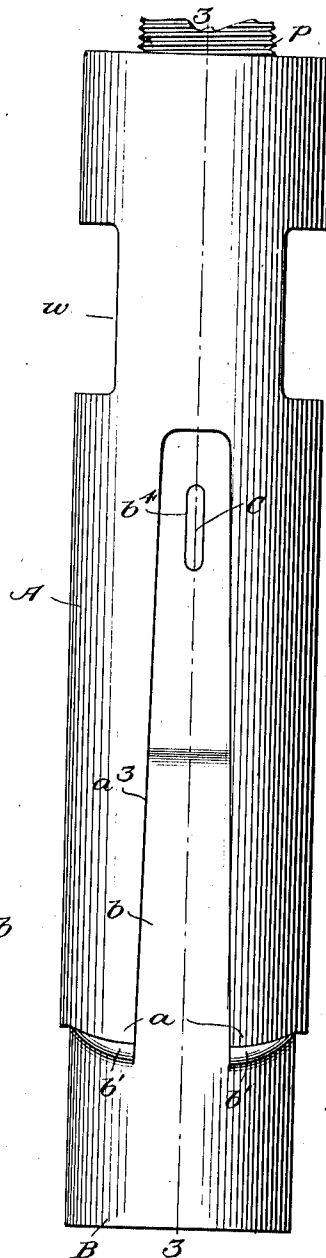


Fig. 2.

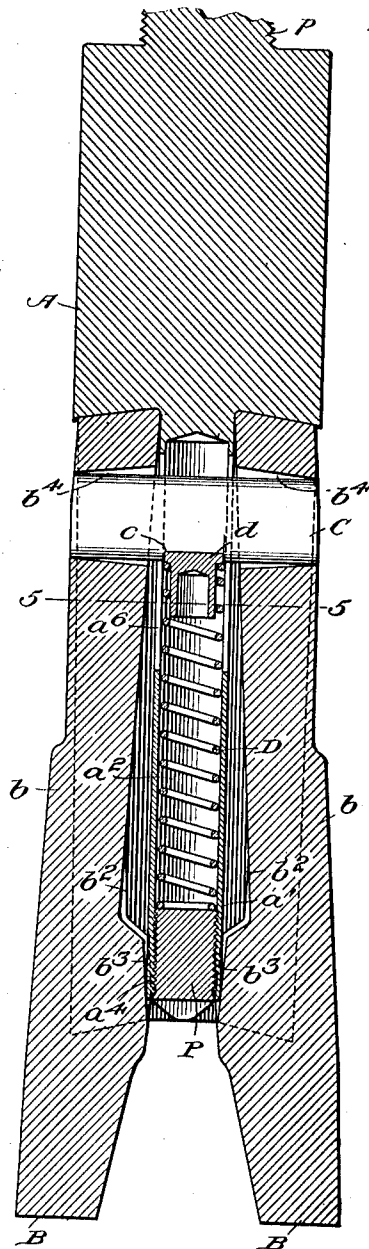


Fig. 3.

Witnesses
Edwin L. Bradford
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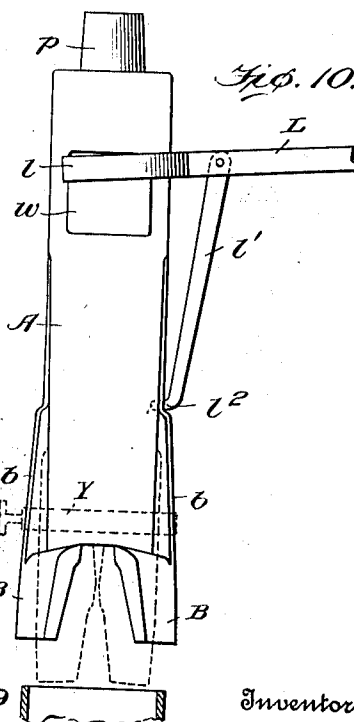
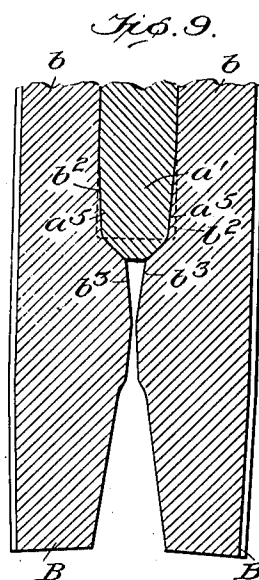
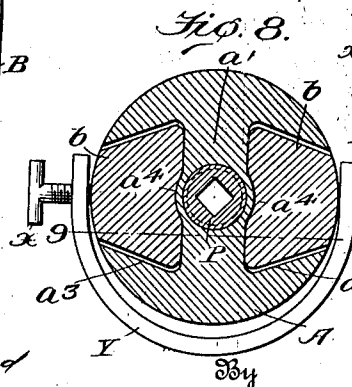
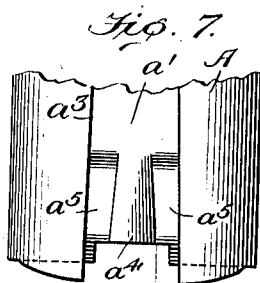
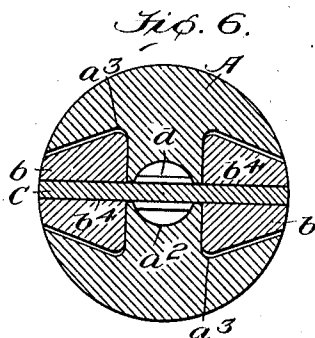
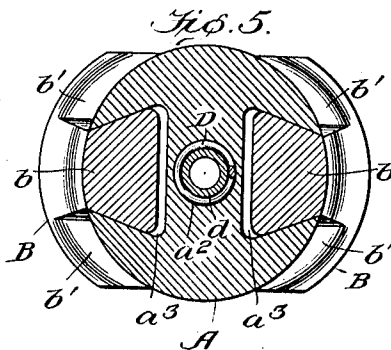
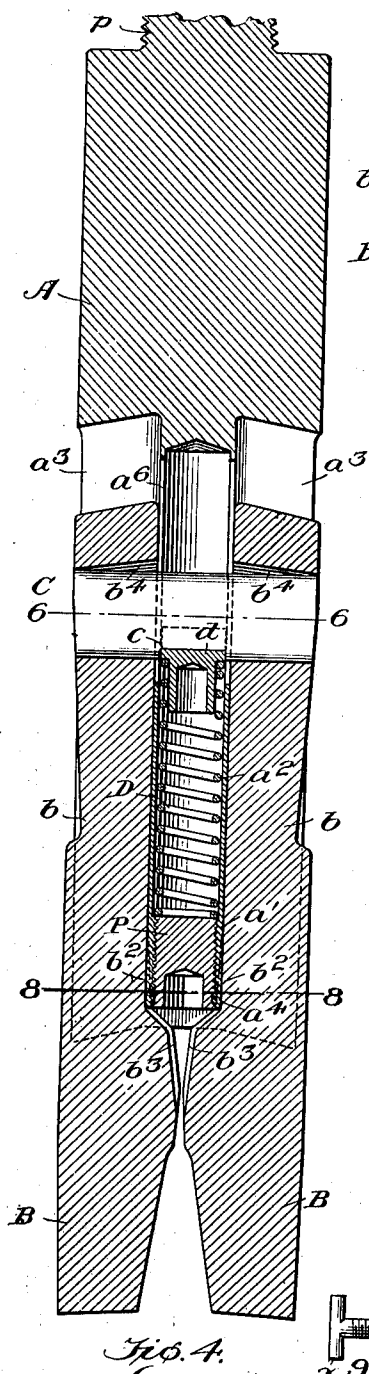
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2 SHEETS-SHEET 2.



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UNITED STATES PATENT OFFICE.

PATRICK H. MACK, OF BRADFORD, PENNSYLVANIA, ASSIGNOR TO OIL WELL SUPPLY COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

UNDERREAMER.

982,514.

Specification of Letters Patent. Patented Jan. 24, 1911.

Application filed December 11, 1909. Serial No. 532,621.

To all whom it may concern:

Be it known that I, PATRICK H. MACK, a citizen of the United States, residing at Bradford, in the county of McKean 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.

This invention relates to the construction of that class of devices commonly termed underreamers, employed for enlarging the borers of oil or Artesian wells where casing is inserted. In drilling with this class of tools the tool is inserted and withdrawn through the casing, and therefore the underreamer must be collapsible so that the extreme diameter of the cutting portion of the tool may be reduced at the time the tool is passed through the casing.

The prevailing types of underreamers are those wherein a sliding connection between the stock and bits is effected either by means of dovetailed ways or equivalent interlocking parts, or by means of an axial socket in the stock for the reception of the tangs of the bits, and in both of said types an interposed spring or equivalent resilient means is employed for maintaining the bits in a normally expanded or operative position.

My present invention relates more especially to that type of underreamers wherein the stock and bits are slidingly connected by means of interlocking parts, and has for its object such a formation and combination of the coacting parts as shall provide for the reducibility of the diameter of the underreamer at its cutting portion, without complicating or weakening the structure, and which will also provide for taking up any lost motion which may arise from the wear or upsetting of the coacting parts.

To this end, in that class of underreamers wherein are combined a bit-stock having a distance block for supporting the bits in their projected or operative position, and bits longitudinally movable on the stock, I form the recesses in the stock for the reception of the bit-tangs with lateral walls inclined to each other both outwardly and upwardly, and the bit tangs I form with lateral walls which correspondingly converge

both outwardly and upwardly, whereby the initial downward movement of the bits results in such clearance between the stock and bits as will not only permit the tool to free itself of any accumulated fine sand or silt, but which will also permit of a tilting movement of the bit, while the wedging of the tang when the tool is being operated takes up any lost motion and obviates any tendency of the bit to tilt, and such a construction embodies the main feature of my invention.

There are other, minor, features of invention 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 view in elevation of an underreamer embodying my invention. Fig. 2 is a similar view taken at right angles to Fig. 1. Fig. 3 is a longitudinal central section taken in the plane of the line 3—3, Fig. 2, the bits being in the expanded or operative position. Fig. 4 is a longitudinal central section similar to Fig. 3, the bits being in the collapsed position. Fig. 5 is a transverse section taken in the plane of the line 5—5, Fig. 3. Fig. 6 is a transverse section taken in the plane of the line 6—6, Fig. 4. Fig. 7 is a detailed view in elevation of the lower end of the stock, showing the tang recess of the stock adjacent to the distance block and abutments of the stock. Fig. 8 is a transverse section of the underreamer taken in the plane of the line 8—8, Fig. 4, showing, as applied thereto, a clamp device for confining the collapsed bits when introducing the underreamer into the casing. Fig. 9 is a longitudinal section of the lower end of the stock and bits taken in the plane of the line 9—9, Fig. 8, and Fig. 10 is a view in elevation of the underreamer showing the application thereto of a tool for collapsing the underreamer for introducing it into the casing.

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 stock of

the underreamer and B, B the bits or cutters thereof. The stock A is provided at its upper end with the usual pin p for attachment to the "sub" ordinarily interposed between the underreamer and the drill rod, and with the wrench seat w for the reception of the wrench used in attaching and detaching the underreamer from the "sub" and drill rod.

At its lower end, and on opposite sides of the intermediate portion of the stock, are upwardly and inwardly inclined abutments a for engaging the shoulders on the bits B, B. Between the abutments a at the lower end of the stock, and integral therewith is a distance block a' which supports the bits B, B in their projected or operative position.

The intermediate portion of the stock is bored centrally from below upward, through the distance-block a' the required distance to constitute an axial spring chamber a^2 for the reception of the spring which actuates the bits B, B. The spring chamber a^2 is threaded at its lower end, in the distance-block, and is closed by a screw-plug P to retain the actuating spring in position in the axial spring chamber a^2 .

The stock A, on diametrically opposite sides of the spring chamber a^2 , is provided with bit recesses a^3 , or recesses for the reception of the tangs b of the bits B. The lateral walls of the recesses a^3 of the bit-stock converge, or are inclined, to each other both outwardly and upwardly, or in other words, the recesses are dovetailed in cross section, taper longitudinally of the stock for a distance corresponding to the length of the bit tangs, and are of uniform depth throughout their length. Said bit recesses a^3 communicate at their upper ends, or are connected by a transverse slot through which passes the key C which supports the two bits B, B, and causes them to move in unison under the influence of the spring D. The clearance between the stock and bits which permits the escape of fine sand and silt, as well as permits of the tilting of the bits when collapsed, is effected by the downward movement of the bits. At the lower end of the bit recesses a^3 there is a slight increase in the width of the distance block as at a^4 (see Figs. 7 and 8) to accommodate the screw plug closure P of the bore or axial spring chamber a^2 , and on either side of said portion of the distance-block the clearance between the bits and the stock may be increased by slightly tapering the distance-block as at a^5 .

B, B indicate the cutters or bits which are formed with tangs b , and with upwardly and inwardly inclined shoulders b' that engage the abutments a on the lower end of the stock A.

The lateral walls of the bit-tang b converge, or incline to each other, both up-

wardly and outwardly, that is to say, the bit tang is of dovetail cross-section and tapers longitudinally from the shoulders b' to the extremity of the tang, said taper corresponding with the longitudinal taper of the bit recesses a^3 of the stock A, and said bits are cut back on the inner faces of the shanks so as to form recesses b^2 to accommodate the distance-block a' when the bits are in the lowest or collapsed position, as shown in Fig. 4 of the drawing. This recessing of the inner faces of the tangs b results in the production of the projections b^3 on the inner faces of the bits which projections engage the sides of the distance-block a' when the bits are raised into their operative position by the action of the spring as indicated in Fig. 3 of the drawings. The tangs b of the bits are provided at their upper ends with key slots b^4 for the reception of a key C which key passes through a transverse slot a^6 in the stock and supports the two bits B, B. It is through this key as an intermediary that the bits are actuated by the spring. The relative size of the key slots b^4 and the key C should be such as will not interfere with the tilting of the bits in their sliding movement to and from their operative position on the stock A. The key C has a slight notch or recess c in its under edge for the reception of the disk of a spring cap carried by the upper end of the actuating spring.

D indicates the spring for actuating the bits B, B, that is to say, for raising the bits from their lower or collapsed position (Fig. 4) to their normal or operative position (Fig. 3) and maintaining them in the latter position. This spring is located in the bore or axial spring chamber a^2 of the stock A between the bits and below the key C which connects the bits, and is provided at its upper end with a spring cap d which engages in the notch or recess c in the under edge of the key C. This engagement of the spring cap d in the notch or recess c of the key prevents the endwise displacement of the key, and the spring cap d is preferably forked on its upper face so as to straddle the key. The lower end of the spring D has its bearing on the screw plug P which closes the lower end of the bore or spring chamber a^2 .

The longitudinal taper of the tang of the bit and the corresponding tang recess of the stock is preferably, though not essentially, a uniform taper, not only because such a taper is more readily produced but because it is more effective in counteracting the effects of wear and lost motion.

The elemental construction of the stock A and bits B, B being of substantially the character hereinbefore noted, the elements are easily and readily assembled by sliding the tangs b of the bits into the tang recesses a^3 of the stock from below, passing

the key C through the key slots b^4 of the tangs b and through the transverse key slot a^6 of the stock, placing the spring cap d on the upper end of spring D, inserting spring D in the spring chamber a^2 of the stock, and finally closing the lower end of the spring chamber a^2 with the screw plug P. When thus assembled the elements will occupy their normal or operative position as seen in Figs. 1, 2 and 3 of the drawing, and if it is desired to pass the underreamer into and through a casing for drilling purposes, the bits are drawn down into the collapsed position shown in Fig. 4 of the drawing. This may be done in any suitable manner, but I prefer to use a device such as shown applied to an underreamer in Fig. 10 of the drawing, in which L indicates a lever having a forked end l' adapted to engage the wrench-seat w of the underreamer stock A, and a pivoted brace member l'' provided with a toe l^2 adapted to enter a suitable opening in the bit B. When the lever L is applied to the underreamer as shown in Fig. 10 of the drawing, the lever L may be operated to force down the brace member l'' and with it the bit B until the spring is compressed and the bits forced into the collapsed position. The bits can then be entered in the casing, or can be confined by a clamp as desired. For this purpose any suitable means of holding the bits in the collapsed position may be employed. In Fig. 8 of the drawing I have shown a semi-circular yoke Y provided at one end with a clamp screw x and this is employed by applying one end of the yoke to one bit and the other to the opposite bit and then tightening up the clamp screw x . When the underreamer is in the collapsed condition shown in Fig. 4 of the drawings the bits are inserted in the end of the casing and the clamp Y^x removed. The casing will confine the bits and maintain the underreamer in the collapsed position shown in Fig. 4 until the bits pass from the lower end of the casing, whereupon the expansion of the spring D which was compressed by the drawing down and forcing inwardly of the bits, will lift the bits into the normal and operative position shown in Fig. 3 of the drawing. As a result of the longitudinal taper of the bit tang and tang recess of the stock, the initial downward movement of the bits with relation to the stock produces such a clearance of the parts as will permit of the tilting of the bits required for their inward or collapsing movement. This also reduces the friction and the consequent load on the actuating spring in the reverse movement of the bits. Furthermore, the final upward movement of the bits on the stock will eliminate all lost motion from wear or upsetting of the parts, counteract any tendency of the bits to tilt and thus properly and effectively support the bits during the cutting

operations thereof. The underreamer will be drawn into and through the casing in the usual way, that is to say, the upward pull on the underreamer will bring the outer surfaces of the bits into engagement with the lower end of the casing which will hold the bits until the continued upward movement of the stock compresses the actuating spring and the recesses b^2 of the bit tangs are opposite the distance block a' of the stock, whereupon the bits will move inward, or collapse, so that they can pass into and through the casing.

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

1. In an underreamer, the combination with a stock having bit recesses the lateral walls of which are inclined to each other, of bits longitudinally movable on the stock into and out of operative position said bits provided with tangs having lateral walls which are inclined to each other.

2. In an underreamer, the combination with a stock having bit recesses the lateral walls of which are inclined to each other upwardly, of bits longitudinally movable on the stock into and out of operative position, said bits provided with tangs having lateral walls which are inclined to each other upwardly.

3. In an underreamer, the combination with a stock having bit recesses the lateral walls of which are inclined to each other both upwardly and outwardly, of bits longitudinally movable on the stock into and out of operative position, said bits provided with tangs having lateral walls which are inclined to each other both upwardly and outwardly.

4. In an underreamer, the combination of a stock having a distance block which supports the bits in operative position, and provided with bit recesses the lateral walls of which are inclined to each other, of bits longitudinally movable on the stock into and out of operative position, said bits provided with tangs having lateral walls which are inclined to each other.

5. In an underreamer, the combination of a stock having a distance block which supports the bits in operative position and provided with bit recesses the lateral walls of which incline to each other upwardly, of bits longitudinally movable on the stock into and out of operative position, said bits provided with tangs having lateral walls which incline to each other upwardly.

6. In an underreamer, the combination with a stock having a distance block which supports the bits in operative position, and provided with bit recesses the lateral walls of which incline to each other both upwardly and outwardly, of bits longitudinally movable on the stock into and out of operative

position, said bits provided with tangs having lateral walls which incline to each other both upwardly and outwardly.

7. In an underreamer, the combination
5 with a stock having a distance block at its lower end which supports the bits in operative position, lateral abutments for the bits, and bit recesses the lateral walls of which incline to each other, of bits having lateral
10 shoulders, and tangs the lateral walls of which incline to each other, said bits being longitudinally movable on the stock into and out of operative position, and means for maintaining the bits in their normal or operative position.

8. An underreamer bit having lateral
15 shoulders and a tang of uniform taper from the shoulders of the bit to the extremity of the tang.

9. An underreamer stock having a distance block for supporting bits in operative position, and having longitudinally extend-

ing bit recesses the lateral walls of which converge upwardly and outwardly said recesses adapted to permit the movement of reamer
25 bits longitudinally of the stock.

10. An underreamer bit having shoulders, and a tang the lateral walls of which converge in two directions.

11. An underreamer stock having at the
30 lower end and opposite sides thereof longitudinally extending bit recesses for the reception of bit-tangs, said recesses having lateral walls inclined to each other both outwardly and upwardly said recesses adapted
35 to permit the movement of reamer bits longitudinally of the stock and said recesses communicating at their upper end.

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

PATRICK H. MACK.

Witnesses:

G. P. RITTER,

HUGH M. STERLING.