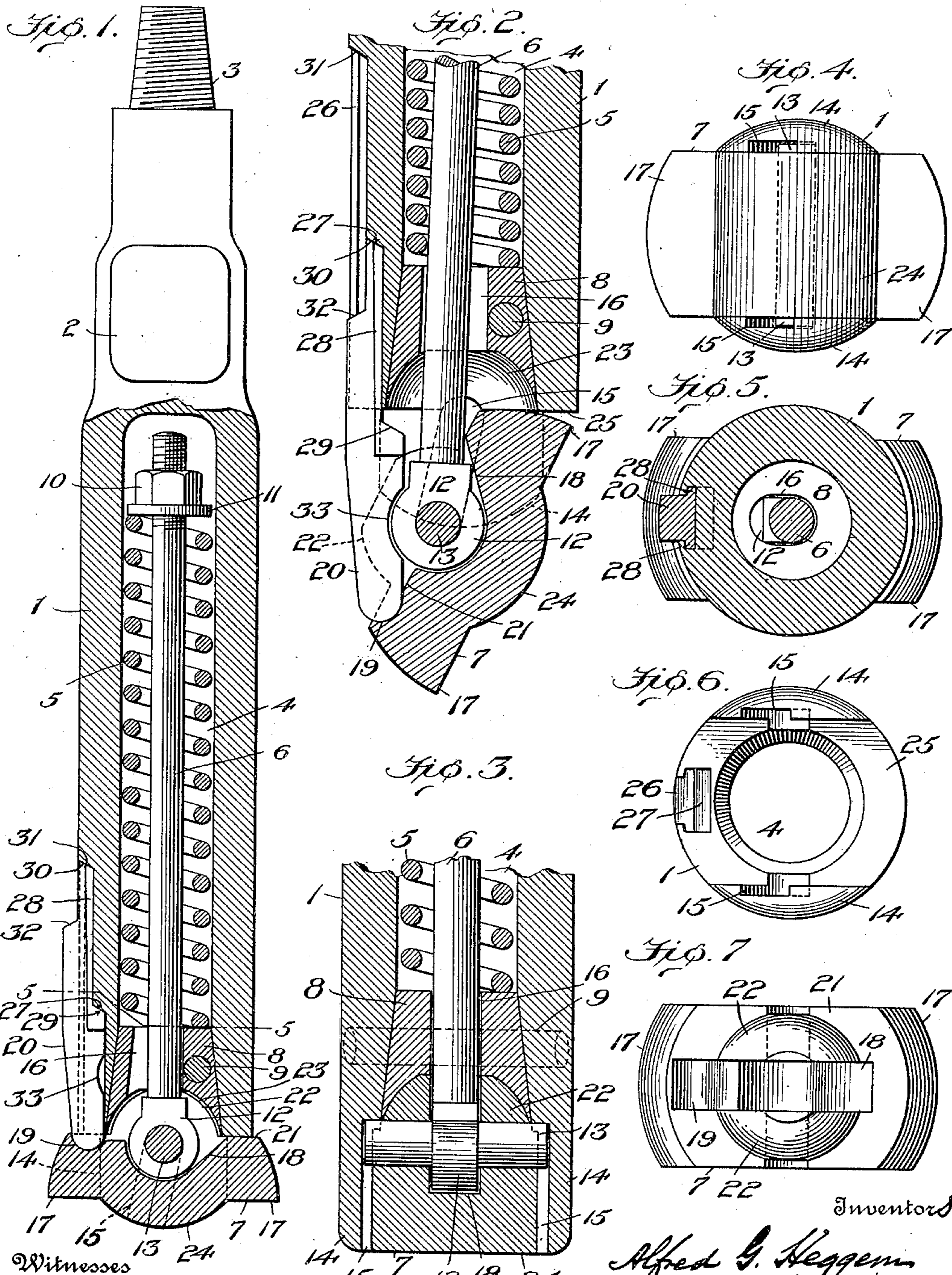


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 UNDERREAMER.
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Patented July 11, 1911.



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UNITED STATES PATENT OFFICE.

ALFRED G. HEGGEM, OF PITTSBURG, PENNSYLVANIA, AND GILBERT P. RITTER, OF WASHINGTON, DISTRICT OF COLUMBIA.

UNDERREAMER.

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To all whom it may concern:

Be it known that we, ALFRED G. HEGGEM and GILBERT P. RITTER, citizens of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, and at Washington, District of Columbia, respectively, have invented certain new and useful Improvements in Underreamers; 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.

Our invention relates to the construction of tools for drilling wells and is particularly directed to the production of a strong, durable and efficient underreamer in which the parts are so combined that a single large reaming bit which insures the reaming of the hole to a uniform diameter throughout may be employed, large and effectively disposed bearing areas are afforded for supporting the bit against the shocks and strains incident to the use of the tool, and liability to breakage and consequent loss of parts of the device in the well hole is minimized.

The principal feature of our invention, generally stated, may be said to consist in so constructing the drilling tool for underreaming that there is a stock or body portion upon which is movably mounted a bit having a plurality of cutting edges or portions the maximum distance between which is greater than the transverse dimension of the stock, the cutting edges of the bit when in drilling position being adapted to project transversely beyond the stock and means being provided for moving the bit with respect to the stock to cause the cutting portions of the bit to approach the axis of the stock.

There are other, minor, features of invention residing in particular combinations of elements and in special features of construction, all as will hereinafter more fully appear and be particularly specified in the claims.

In the drawings illustrating our invention, the scope whereof is pointed out in the claims, Figure 1 is a view, partly in elevation and partly in vertical central section, of an underreamer embodying our invention, the parts being shown in their normal or drilling positions; Fig. 2 is a view, partly in

elevation and partly in vertical central section, showing the lower portion of the reamer illustrated in Fig. 1, the parts being shown in the positions they occupy when the tool is collapsed to permit it to enter and pass through the well casing; Fig. 3 is a vertical central section of the lower portion of the reamer shown in Figs. 1 and 2, the section being taken in a plane at right angles to that of the preceding views, the spring rod and connecting pin being in elevation, and the parts being shown in drilling position as in Fig. 1; Fig. 4 is an inverted plan view of the underreamer; Fig. 5 is a transverse section taken on the line 5—5, Fig. 1; Fig. 6 is a bottom plan view of the stock or body; and Fig. 7 is a detail plan view of the bit.

Like symbols refer to like parts wherever they occur.

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

The stock or body 1 of the tool is, as shown, preferably formed with the usual oppositely disposed wrench seats 2 and its upper end is preferably provided with the well known form of threaded tapered pin 3 commonly employed as a means for connecting the underreamer to the devices with which it is associated in drilling operations. The lower portion of the stock, which may be conveniently fashioned of cylindrical form, is provided with a chamber or recess 4 which is adapted to receive a spring 5 and cooperating rod 6 by means of which the bit 7 is preferably mounted upon the stock so as to be yieldingly movable with respect thereto. For the sake of reducing the cost of manufacture of the tool the longitudinally extending spring receiving chamber 4 of the stock may be advantageously made of cylindrical form, its lower end being conical or tapering to form a socket for the reception of a correspondingly shaped plug 8 that forms a seat for the lower end of the spring 5. The plug 8 may be secured to the stock 1 in any suitable manner, as, for example, by means of a pin 9.

As a means for supporting the rod 6 upon the encircling spring 5 the upper end of the rod is preferably threaded to receive a nut 10 by which a washer 11 that bears upon the

upper end of the spring is maintained in position on the rod. By manipulating this nut when assembling the device the initial compression desired for supporting the bit 7 may be imparted to the spring 5, as will be readily understood. The lower end of the rod 6 engages the bit 7 in a manner permitting the latter to change its angular relation with the stock 1, the rod 6 being for this purpose preferably provided with an eye 12 that is adapted to receive a pin 13 which passes through corresponding apertures in the bit to thus pivotally connect the latter with the stock through the yieldingly supported spring rod 6.

For the purpose of causing the bit 7 to move laterally as it is turned to a position in which it will pass through the casing of the well, the downwardly extending portions 14 of the stock, which form vertical guides and afford lateral support to the bit 7, are preferably formed on their inner faces with parallel guideways 15 which are inclined to the axis of the stock and which receive the outer ends of the pivot pin 13 and direct and control its path of travel when the bit 7 is caused to move either to or from its normal position. In order to allow the rod 6 to swing laterally and permit the bit to move transversely of the stock the aperture 16 in the plug 8 through which the rod passes is elongated in cross-section. By causing the bit 7 to execute a transverse bodily movement it may be made to contain a large body of metal and yet be brought into position for entering the well casing within a comparatively short vertical turning space, the compression of the spring 5 is not unnecessarily increased, and the direction of upward pull of the rod 6 on the bit is shifted in direction so as to be more effectively applied in returning the bit to normal or drilling position.

The bit 7, which when in drilling or operative position is designed to extend transversely of the stock 1 and to project outwardly beyond the periphery thereof, is provided with a plurality of cutting faces or portions 17, preferably of segmental form, which are appropriately spaced from each other to accord with the diameter of the hole to be drilled, the maximum distance between the cutting faces 17 being greater than the transverse dimension of the stock in order that the bit may project outwardly on diametrically opposite sides of the stock. The upper face of the bit is slotted, as more particularly shown in Figs. 2 and 7, to form a recess 18 which receives and permits the operation of the eye 12 of the spring rod 6 and to also form a seat or rocking bearing 19 for the reception of the operating member 20 through which the bit is actuated by the well casing. Extending upwardly from the flat bearing face or surface 21 of the bit

7 are projections or lugs 22 which permit the rod 6 to move between them and which are adapted to fit into a corresponding socket 23 formed in the lower end of the tapered plug 8, the bit 7 being thus prevented from shifting transversely on the stock during drilling operations. In order to facilitate the movement of the bit to and from its position for entering the well casing, the lugs 22 and socket 23, as shown, are preferably formed with curved or generally spherical surfaces, the center of curvature being at or in the neighborhood of the center of the pivot pin 13 by which the rod 6 and bit 7 are connected; and for a similar reason the end faces of the bit adjacent to the cutting faces 17 are also preferably curved or rounded. The bit or cutter 7 is preferably thickened in its center, as at 24, in order to give not only increased strength but also a surplus of metal which can be utilized when the bit becomes worn from use and is dressed from time to time to restore it to its proper dimensions. This thickened portion of the bit, or protuberance 24, should be located inwardly from the cutting faces 17 at a sufficient distance not to interfere with the reaming of the hole to be enlarged, and its contour is preferably curved to conform to that of the lower ends of the downwardly extending portions 14 of the stock 1.

From an inspection of Fig. 6 it will be seen that the flat lower end 25 of the stock 1 presents a large bearing area for the upper side of the bit or cutter 7.

As a means for turning the bit 7 to cause the cutting portions 17 thereof to approach the axis of the stock and assume positions within the outline of the latter, it is preferred to employ an operating member 20 which is mounted upon the stock 1 so as to be slidable with respect thereto. This bit operating member may be conveniently constructed as a bar having a rounded lower end which engages the bit 7 and rests upon the correspondingly formed seat 19 thereof, the upper section of the bar being of less thickness than the lower section and the slot or slideway 26 in which the bar slides being correspondingly deeper below the lower inclined shoulder 27 formed on the stock, to thus allow the bar 20 to move inwardly toward the axis of the stock and assume the position illustrated in Fig. 2 permitting the tool to pass through the well casing. To maintain the connection of the bar 20 and stock 1 the guideway 26 of the stock is preferably formed of dovetail cross-section, the operating bar 20 being provided on opposite sides with laterally projecting lugs 28 which, by engaging the outer walls of the slideway 26, prevent the bar 20 from moving outwardly and becoming disassociated from the stock. Adjacent to the lower

ends of the projecting guide lugs 28 the operating bar 20 is formed with an inclined shoulder 29 which is adapted to bear against the correspondingly inclined shoulder 27 formed on the stock, and the upper end of the operating bar is also likewise formed with a parallel incline 30 which is adapted to engage the correspondingly inclined shoulder 31 formed on the stock at the upper end of the slideway 26. These inclined shoulders operate to force the operating bar 20 outwardly at the beginning of its upward movement and also serve, when the bar is in its uppermost or normal position, to force the guide ribs 28 against the outer walls of the slideway, thus preventing movement of the bar when the tool is in use.

In order that it may be actuated by the well casing the operating bar is preferably provided with a downwardly sloping shoulder 32 which, when the parts of the tool are in drilling position as shown in Fig. 1, projects outwardly through the slot 26 sufficiently far to come into contact with the bottom of the casing or casing shoe as the underreamer is raised from the well. After the shoulder 32 has been brought into engagement with the lower end of the casing shoe by an upward movement of the tool, the continued upward movement of the underreamer causes the stock 1 to slide upwardly on the operating bar 20 until the upper inclined end 30 of the latter reaches the lower inclined shoulder 27 on the stock, when the shoulder 32 rides inwardly off the bottom of the casing shoe, forcing the bar 20 inwardly to the position shown in Fig. 2. In this position the tool may pass through the casing, the cutter 7 being held in position against the upward pull of the spring 5 by reason of the engagement of the outer face of the bar 20 with the inside of the casing and also through the engagement of the inclined face 30 with the lower inclined shoulder 27 of the stock. When the underreamer passes out of the well casing sufficiently far to let the bit operating member 20 move outwardly and upwardly in the slideway 26, the spring 5 acting through the rod 6 returns the bit 7 to normal position as shown in Fig. 1.

The inner face of the operating bar 20 is suitably notched or recessed, as at 33, to accommodate the eye 12 of the spring rod 6 when the tool is collapsed to enter the casing as shown in Fig. 2, and for the purpose of preventing binding of the bar and permitting it to be capable of a slight swinging motion to accommodate itself laterally as it moves downward, as well as for the purpose of allowing the slideway 26 to more readily free itself from any detritus, the laterally projecting guide lugs 28 of the bit operating bar are preferably tapered slightly, being somewhat thicker at the top than at their junctions with the inclined shoulder 29.

Having thus described our invention, what we claim is:

1. An underreamer having a stock, a bit movably mounted therein, said bit having cutting portions which when in drilling position project outwardly beyond said stock on opposite sides thereof, and means movable into engagement with the casing of a well for moving the bit to cause the cutting portions thereof to approach the axis of the stock.

2. An underreamer having a stock, a bit movably mounted on said stock and having a plurality of cutting portions the maximum distance between which is greater than the transverse dimension of the stock, said bit when in drilling position extending transversely of the stock and the cutting portions thereof projecting outwardly beyond the periphery of the stock, and means adapted to be engaged by the casing of a well for moving the bit to cause the cutting portions thereof to approach the axis of the stock.

3. An underreamer having a stock, a bit movably mounted thereon and provided with a plurality of cutting portions, and means actuated by the casing of a well for turning said bit to cause the cutting portions thereof to move in opposite directions and assume positions within the periphery of the stock.

4. An underreamer having a stock, a bit movably mounted on said stock, said bit having a plurality of cutting portions and its length transversely of the stock when the parts are in drilling position being greater than the corresponding transverse dimension of the stock, and means adapted to be engaged by the casing of a well for moving said bit to cause it to assume a position within the periphery of the stock.

5. An underreamer having a stock, a spring, a bit yieldingly connected to said stock through said spring, said bit having cutting portions which when the bit is in drilling position project outwardly beyond the stock on opposite sides thereof, and means for moving said bit vertically and turning it to change its angular relation with respect to the stock, whereby the cutting portions of the bit are caused to assume positions beneath the base of the stock permitting the underreamer to pass through the casing of a well.

6. An underreamer having a stock, a bit yieldingly connected thereto, said bit having cutting portions which when the bit is in drilling position project outwardly beyond the stock on opposite sides thereof, and means for turning said bit and moving it bodily transversely of the stock.

7. An underreamer having a stock, a bit yieldingly and pivotally connected thereto, said bit having cutting portions which when in drilling position project outwardly be-

yond said stock on opposite sides thereof, means for rotating said bit, and means for causing the point of pivotal attachment of the bit to shift laterally with respect to the
5 stock.

8. An underreamer having a stock, a bit yieldinglly connected thereto, said stock and bit when in drilling position having socketed engagement and said bit having cutting
10 portions at opposite ends thereof which when in drilling position project outwardly beyond said stock on opposite sides thereof, and means adapted to engage the casing of a well for moving said bit downwardly and
15 turning it to cause the cutting portions thereof to approach the axis of the stock.

9. An underreamer having a stock, a bit yieldinglly connected thereto, said bit having cutting portions which when in drilling position project outwardly beyond said stock
20 on opposite sides thereof, and a bit operating member engaging said bit and movable with respect to said stock to cause the cutting portions of said bit to approach the
25 axis of the stock, said bit operating member being adapted to project outwardly beyond the stock so as to engage the bottom of the casing of a well and be temporarily arrested thereby during a period of upward move-
30 ment of the stock.

10. An underreamer having a stock, a spring supported by said stock, a rod supported by said spring, a bit pivotally connected to said rod at the lower end of said
35 stock, said bit having cutting portions which when in drilling position project outwardly beyond the stock on opposite sides thereof, and means for changing the angular relation of the bit and stock, whereby the under-
40 reamer may pass through the casing of a well.

11. An underreamer having a stock, a bit having cutting portions which when in drilling position project outwardly beyond
45 the stock on opposite sides thereof, yielding means for mounting said bit on said stock, said yielding means engaging said bit between said cutting portions, and means for turning said bit with respect to said stock, whereby the cutting portions are caused to
50 approach the axis of the stock.

12. An underreamer having a stock, a spring supported by said stock, a rod supported by said spring, a bit having cutting
55 portions which when in drilling position project outwardly beyond the stock on opposite sides thereof, said bit being pivotally connected to said rod and the point of pivotal attachment of said rod to said bit being
60 located between the cutting portions of the bit, and means for turning said bit to cause the cutting portions thereof to approach the axis of the stock.

13. An underreamer having a chambered
65 stock, a spring mounted on said stock within

said chamber, a rod supported by said spring, said rod being capable of a lateral swinging movement, a bit pivotally connected to said rod, said bit having socketed engagement with said stock and having cut-
70 ting portions which when the bit is in drilling position project outwardly beyond the stock on opposite sides thereof, and an operating member slidably mounted on said stock and engaging said bit to turn the same. 75

14. An underreamer having an axially extending chamber therein and provided at its lower end with a socket and with downwardly extending portions having parallel
80 guideways in their inner faces, a spring housed within the chamber of the stock, a rod supported by said spring, a bit pivotally connected to said rod and interposed between the downwardly extending portions of the stock, the pivot pin connecting said
85 bit and rod entering the guideways of the downwardly extending portions of the stock and the bit being provided with upwardly extending lugs adapted to enter the socket at the lower end of the stock and being also
90 provided with cutting portions which when the bit is in drilling position project outwardly on opposite sides of the stock, and a longitudinally and laterally movable operating member slidably mounted on said stock
95 and engaging the bit at one side of its pivotal connection with said rod.

15. An underreamer having a stock, and a bit pivotally connected thereto, said bit having bearings on its upper face on oppo-
100 site sides of the stock and cutting portions which when the bit is in drilling position project outwardly beyond the stock on opposite sides thereof.

16. An underreamer bit having parallel
105 side faces, a pivot pin opening intermediate of its length, curved end faces, bearing faces on opposite sides of the pivot pin opening, cutting portions located at the ends of the bit, and an eccentrically located recess
110 adapted to receive a bit operating member.

17. An underreamer bit having cutting portions at its opposite ends and having a bearing face on its upper side and a pivot
115 pin opening located intermediate of its ends, said cutting portions being adapted to project outwardly beyond the stock of an underreamer so as to simultaneously act as cutters and said bearing face on the upper side of said bit being adapted to engage an
120 underreamer stock.

18. An underreamer having a stock, a spring mounted thereon, a bit pivotally connected to said stock, said bit having a bearing
125 on the bottom of the stock and being provided at opposite ends with cutting portions which when the parts are in drilling position project outwardly beyond the stock, and means for turning the bit with respect
130 to said stock to cause one of the said cutting

portions to move upwardly and inwardly toward the axis of the stock and to cause the other of said cutting portions to simultaneously move downwardly and inwardly toward the axis of the stock.

19. An underreamer having a stock, a bit movably connected thereto, said bit having cutting portions which when the bit is in drilling position project outwardly beyond the stock on opposite sides thereof, inclined means mounted on said stock for moving said bit bodily transversely with respect to the stock, and means for turning said bit with respect to said stock.

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

ALFRED G. HEGGEM.
GILBERT P. RITTER.

Witnesses as to the signature of Alfred G. Heggem:

R. E. SMALL,
H. GEARING.

Witnesses as to signature of Gilbert P. Ritter:

R. C. CRUIT,
WM. E. DYRE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."