C. L. MUNSINGER.

UNDERREAMER.

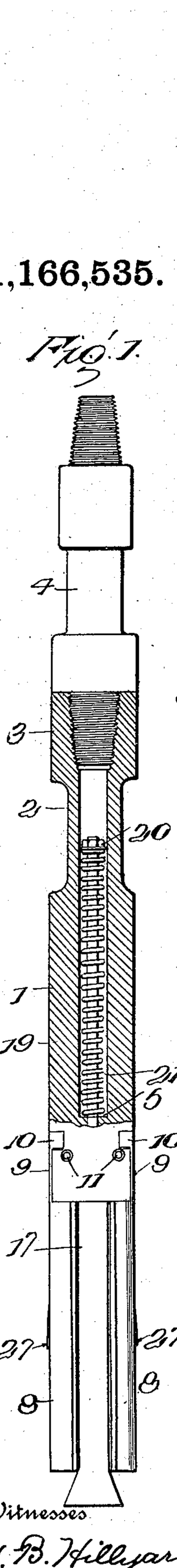
APPLICATION FILED DEC. 23, 1914.

1,166,535.

Patented Jan. 4, 1916.

2 SHEETS—SHEET 1.

Fig. 1.



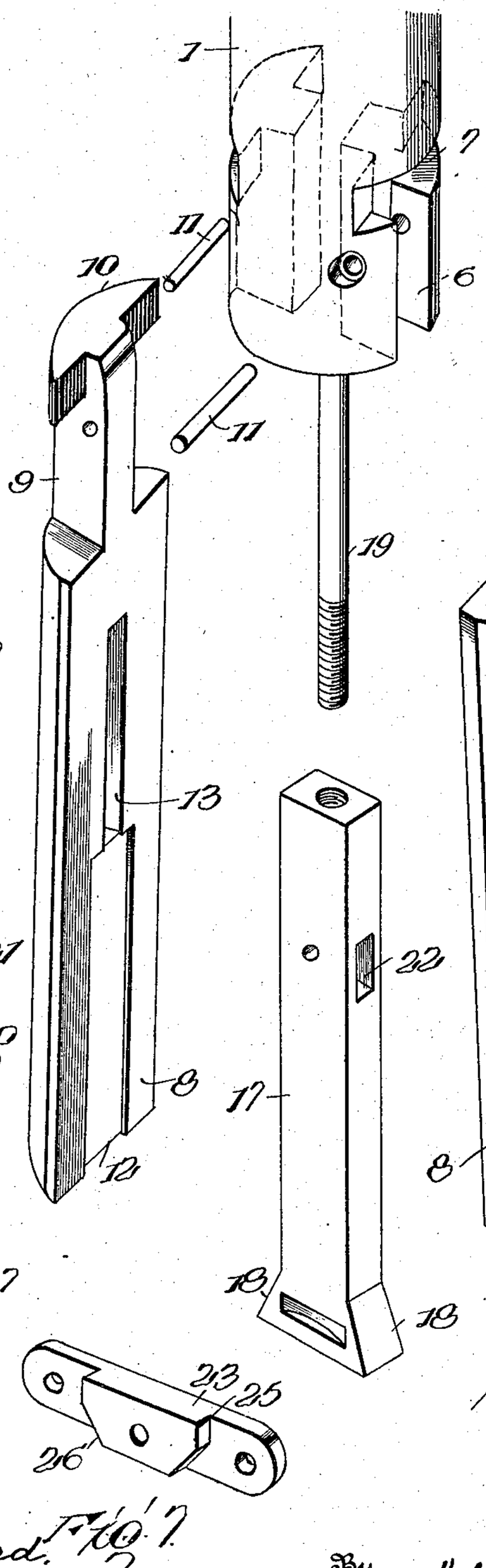


Fig. 6.

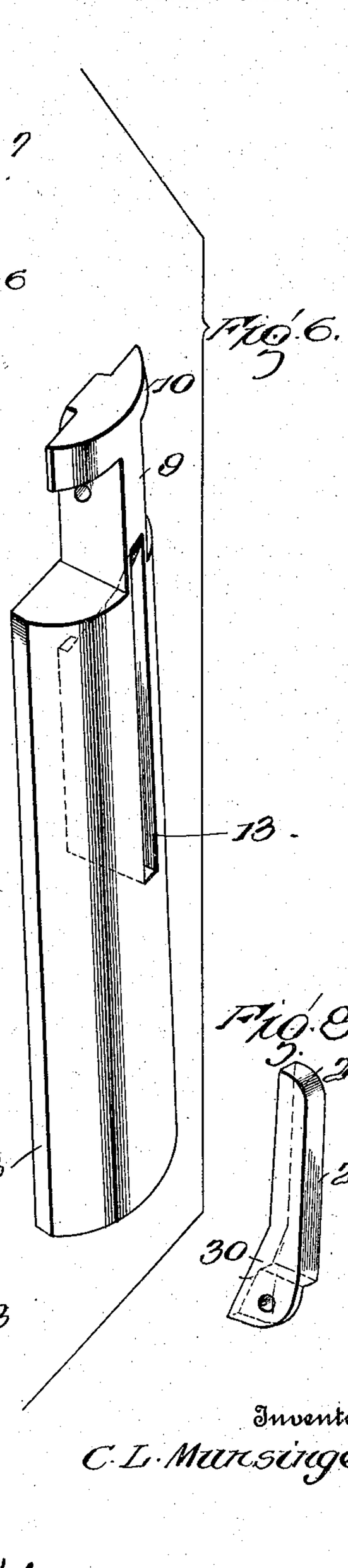


Fig. 8.

Witnesses

U. B. Hillyard.

Fig. 7.

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2 SHEETS—SHEET 2.

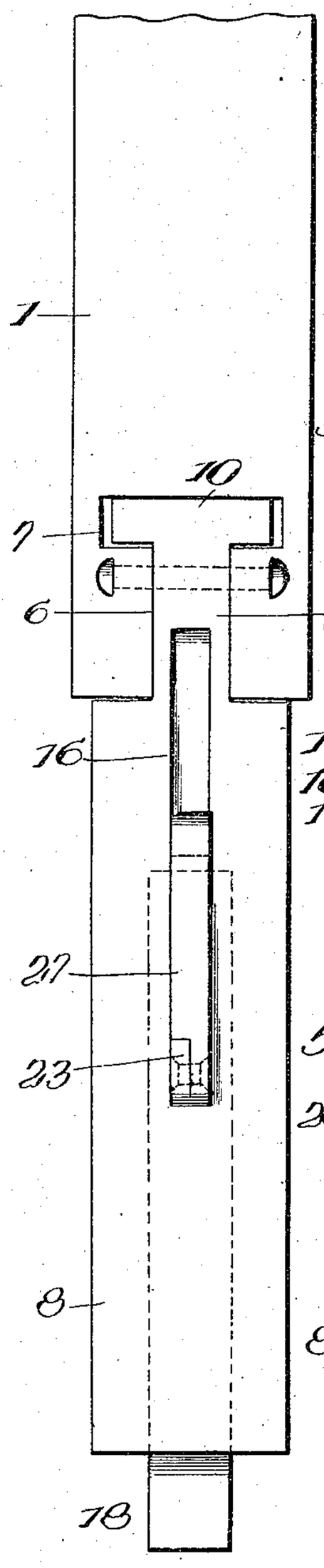

Fig. 2.

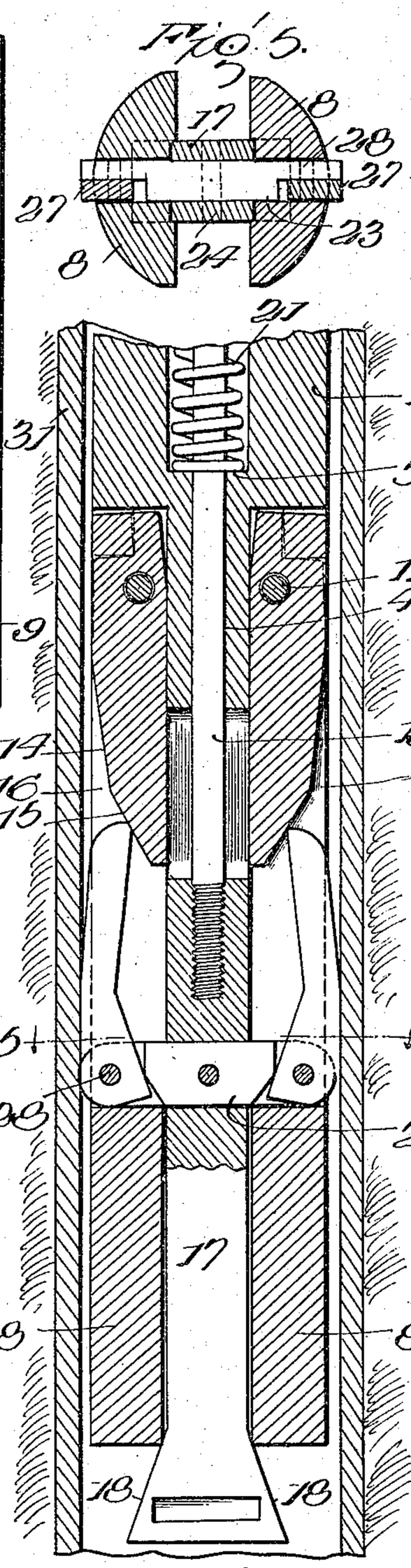

Fig. 3.

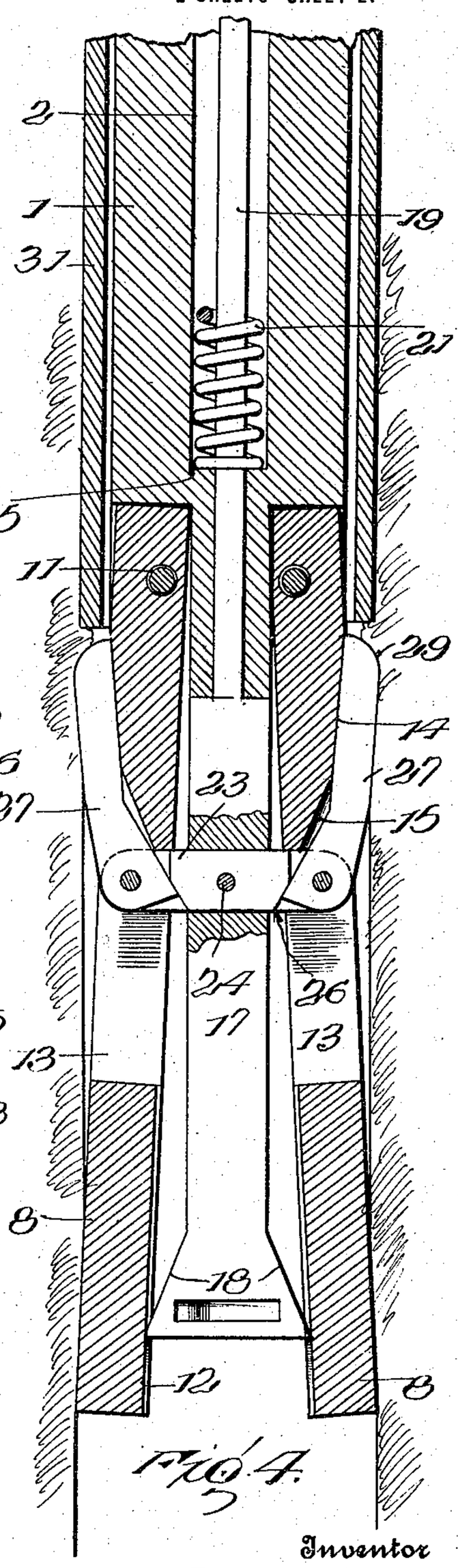

Fig. 4.

Witnesses

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UNDERREAMER.

1,166,535. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed December 23, 1914. Serial No. 878,768.

To all whom it may concern:

Be it known that I, CHARLES L. MUNSINGER, a citizen of the United States, residing at Lima, in the county of Allen and State of Ohio, have invented certain new and useful Improvements in Underreamers, of which the following is a specification.

This invention has relation to deep well tools being designed most especially to provide a reamer for enlarging the bore or opening to facilitate the lowering of the casing in the process of forming a deep well and lining the same.

The invention has for its object to provide a tool which may be readily passed through the casing both when lowering the reamer into the bore or withdrawing the same therefrom, the tool being of such structural formation as to admit of the cutters automatically expanding when clearing the lower end of the casing and contracting when drawing the tool into the casing preliminary to removing the same from the well.

A further purpose of the invention is the provision of an under reamer for deep wells which embodies a minimum number of parts and which admits of any one of the parts being readily replaced at a nominal cost, such tool being effective and positive in operation for the purpose designed.

With the foregoing objects in view and such others as result from the peculiar structure and which may suggest themselves as the nature of the structure is understood the invention may be said to consist of the novel features, details of construction and combinations of parts which hereinafter will be more particularly set forth, illustrated in the drawings hereto attached and finally claimed.

Referring to the drawings, Figure 1 is a view in elevation of an under reamer embodying the invention, a portion of the stock being in section; Fig. 2 is an enlarged view of the lower portion of the tool; Fig. 3 is an enlarged section of the parts shown in Fig. 2 illustrating the relation of the elements when the reamer is located in the casing; Fig. 4 is a view of the parts illustrated in Fig. 3 showing the relation of the elements when the cutters and casing riders have cleared the casing; Fig. 5 is a horizontal section of the tool on the line 5—5 of Fig. 3; Fig. 6 is a detail perspective of the tool with the several parts separated and disposed in a group; Fig. 7 is a detail perspective view of the cross bar to which the casing riders are pivotally attached; Fig. 8 is a detail perspective view of one of the casing riders.

Corresponding and like parts are referred to in the following description and indicated in all the views of the drawings by the same reference characters.

The tool comprises a stock 1 to which the working parts are attached. This stock may be of any length and diameter depending upon the particular work for which the tool is designed. A bore or opening 2 is formed in the stock and extends axially therethrough. The bore is enlarged at its upper end and internally threaded, as indicated at 3, to admit of the tool being coupled to the ordinary rods 4 or like means generally employed for operating drills and like tools in deep wells. The lower end of the bore 2 is contracted, as indicated at 4. A shoulder 5 is formed at the inner end of the contracted portion 4 of the bore. T-openings are formed in opposite sides of the stock at the lower end thereof, each of such openings comprising a longitudinal opening 6 and a transverse opening 7. These T-openings are adapted to receive the upper ends of the cutters, as will be explained more fully hereinafter.

Similar or like cutters 8 are located upon opposite sides of the stock and are pivotally connected at their upper ends thereto so as to swing laterally at their lower ends. Each of the cutters 8 is formed at its upper end with a T-head, the same comprising a centrally disposed member 9 and a transverse member 10. The parts 9 and 10 are adapted to obtain a relatively snug fit within the T-opening formed in the stock 1 it being understood that the transverse member 10 and the transverse opening 7 are of such relative proportions as to admit of the cutter having a limited lateral movement at its lower end. When the cutters are in place they are retained in position by means of pins 11 which pass through transverse openings formed in coincident relation in the member 9 and the parts of the stock 1 at the sides of the member 9. Each of the cutters 8 is formed upon its inner face with a longitudinal channel 12 which forms a guide for the lower end of the expander to ride in, thereby holding the expander and cutters in a given position. Each of the cutters is also formed with a longitudinal slot 13 and this slot at its upper end merges into a recess extending along the

outer side of the cutter, such recess tapering toward its upper end and vanishing into the outer side of the cutter. The inner wall of this recess is formed with inclined faces 14 and 15, the latter being inclined more rapidly than the face 14 and disposed adjacent the slot 13. The recesses are indicated at 16 and are designed to receive the upper portion of the casing riders when the cutters are expanded.

The expander 17 consists of a bar which is arranged between the cutters 8 and at the lower end of the stock 1. The expanding head formed at the lower end of the body of the expander has oppositely inclined faces 18 which are adapted to ride upon the inner faces of the cutters 8 and force the lower ends of such cutters apart, as indicated most clearly in Fig. 4. A rod 19 is attached at its lower end to the upper end of the expander 17 being preferably threaded thereto and this rod passes through the contracted portion 4 of the bore 2 and extends upwardly into such bore and is threaded at its upper end to receive a nut 20. A stout expansible helical spring 21 is mounted upon the upper portion of the rod 19 and is confined between the shoulder 5 and the nut 20 and normally exerts an upward pressure upon the expander to force the expanding head thereof between the lower ends of the cutters 8. When the expander 17 is moved downwardly to carry the expanding head beyond the lower ends of the cutters 8, the latter are free to move inward, thereby admitting of the tool passing through the casing either into the well or from the well. When the expander is moved to cause its expanding head to clear the lower ends of the cutters the upper ends of the casing riders are pressed inward as indicated most clearly in Fig. 3 but when the expander is moved upward to bring its expanding head between the cutters the upper ends of the casing riders are thrown outward, as indicated most clearly in Fig. 4. The expander is formed with a transverse slot 22 to receive the cross bar 23 to which the casing riders are attached.

The cross bar 23 is fitted in the opening 22 of the expander and its opposite end portions project equally from opposite sides of the expander and enter the slots 13 of the cutters 8. A pin 24 secures the cross bar 23 within the opening of the expander. The outer ends of the expander are cut away upon one side, as indicated most clearly in Figs. 5 and 7 and the shoulders formed at the inner ends of the reduced portions comprise vertical faces 25 and inclined faces 26. The cross bar 23 is movable with the expander and its end portions are adapted to travel in the slots 13 of the cutters 8.

The casing riders 27 have their lower ends cut away upon one side, the reduced ends overlapping the reduced ends of the cross bar 23 and being connected thereto by means of pivot fastenings 28 which pass through registering openings formed in the overlapping reduced end portions of the parts 23 and 27. The upper ends of the casing riders are made rounding or beveled, as indicated at 29, so as to ride upon the lower end of the casing when pulling upward upon the tool and thereby cause the casing riders to come together and pass within the casing. The lower ends of the casing riders are inwardly inclined, as indicated at 30, thereby enabling the upper ends of the casing riders to be pressed together without causing the lower ends of the casing riders to project to an objectionable distance and thereby prevent the casing riders from passing within the casing. As shown most clearly in Fig. 4 the inner lower ends of the casing riders engage the inclined faces 26 of the shoulders formed at the inner ends of the reduced portions of the cross bar 23, thereby limiting the outward movement of the casing riders at their upper ends.

When the parts comprising the tool are assembled they occupy the position shown most clearly in Figs. 3 and 4. When the tool occupies a position within the casing the upper ends of the casing riders 27 are pressed together and the expander is moved downward to bring its expanding head beyond the lower ends of the cutters 8. When the tool is in position in the well with the casing riders below the casing the spring 21 is expanded and the lower ends of the cutters 8 are pressed outward by the expanding head coming between them. The casing is indicated at 31 in Figs. 3 and 4. When it is desired to place the tool within the casing preliminary to moving it to a position within the well below the casing it is necessary to force the expander downward so as to withdraw the expanding head from between the cutters, thereby admitting of the lower ends of such cutters coming together whereby the tool is enabled to be introduced into the casing. The expander may be held projected by passing a binder around the upper ends of the casing riders and for convenience such rider may consist of a ring which may be slipped upon the stock and cutters. As the tool is pressed downward into the casing the binder will become disengaged from the tool by engaging the upper end of the casing and may be removed. The rod 4 or other means for operating the tool may be coupled thereto and this rod may comprise sections which are added in the well known manner as the tool is lowered. When the casing riders clear the lower end of the casing 31 the spring 21 expands and moves the expander 17 upward thereby forcing the head of the expander between the lower ends of the cutters 8 which are thereby thrown out-

ward. As the expander moves upward the upper ends of the casing riders are thrown outward by riding upon the inclined faces 15 and 14 forming the inner walls of the recesses 16. When it is required to remove the tool the same is drawn upward into the casing by a pull upon the rod 4 or like operating means. When the upper ends of the casing riders engage the lower end of the casing 31 the expander is momentarily retarded in its upward movement and as the stock 1, with the cutters attached thereto, continues to move upward the expander is relatively moved downward thereby bringing its expander head to a position beyond the lower ends of the cutters. As the cutters 8 move upward the upper ends of the casing riders 27 gradually move inward by riding upon the inclined faces 14 and when the upper ends of the casing riders reach the abrupt or more rapidly inclined faces 15 they move inward more quickly and this occurs simultaneously with the projecting of the expanding head beyond the lower ends of the cutters and at this time the rounded or beveled ends 29 of the casing riders clear the lower end of the casing and enter the same, as indicated most clearly in Fig. 3, thereby admitting of the tool passing through the casing upon a continued upward pull thereon.

It is to be understood that the drawings illustrate a preferred embodiment of the invention but within the scope of the invention as claimed various changes in the form, proportion and minor details of construction may be resorted to when adapting the invention to meet certain conditions and requirements without departing from the nature of the invention as claimed.

Having thus described the invention, what is claimed as new is:—

1. A tool of the character set forth comprising a stock, laterally movable cutters connected with the stock and formed with longitudinal slots, an expander arranged between the cutters, a cross bar movable with the expander and having its end portions entering the slots of the cutters and riders pivotally connected to the projecting ends of the cross bar.

2. In a tool of the character specified, the combination of a stock, cutters connected with the stock and adapted to be spread by a lateral movement, each of the cutters being formed with a longitudinal slot, a longitudinal movable expander arranged between the cutters, and riders having pivotal connection with the said expander and arranged to operate in the slots of the cutters and having a limited longitudinal and lateral pivotal movement.

3. A tool of the character specified comprising a stock, cutters connected with the stock and adapted to move laterally, each of the cutters being formed with a longitudinal slot, a longitudinally movable expander arranged between the cutters, riders having their lower ends inclined inwardly and pivotally connected with the expander and adapted to operate in the longitudinal slots of the cutters.

4. In a tool of the character specified, the combination of a stock, cutters having connection with the stock and movable laterally, each of such cutters being formed with a longitudinal slot and a recess in its outer side in communication with the slot, the inner wall of such recess being inclined and vanishing at its upper end into the outer side of the cutter, a longitudinally movable expander arranged between the cutters, and riders having their lower ends pivotally connected with the expander and adapted to operate in the longitudinal slots of the cutters and having their upper ends adapted to operate in the recesses of the cutters and to travel upon the inclined walls of such recesses.

5. In a tool of the character specified, the combination of a stock, cutters connected with the stock and movable laterally, each of such cutters being formed with a longitudinal slot and a longitudinally extending recess in its outer face in line with the slot, the inner wall of such recess being inclined throughout its length, the lower portion being more rapidly inclined than the upper portion and the latter vanishing into the outer side of the cutter, a longitudinally movable expander arranged between the cutters, and riders having pivotal connection with the expander at their lower ends and adapted to operate in the longitudinal slots and recesses of the cutters, said riders having their upper ends beveled.

6. A tool of the character specified comprising a stock, cutters connected with the stock and movable laterally, each of such cutters having a longitudinal slot, a longitudinally movable expander arranged between the cutters, a cross bar mounted upon the expander and having its end portions cut away and the shoulders formed at the inner ends of the cut away portions inclined, and riders having their lower ends reduced and pivotally connected to the reduced ends of the cross bar and having their lower ends inwardly inclined and their upper ends beveled.

7. In a tool of the character specified, the combination of a stock, cutters having pivotal connection with the stock and formed upon their inner faces with longitudinal guides and having longitudinal slots and longitudinal recesses in their outer sides in line with the longitudinal slots, said recesses having their inner walls inclined, a longitudinally movable expander arranged between the cutters and adapted to engage the

guides upon the inner faces of the cutters and riders having pivotal connection with the expander and movable longitudinally in the slots and recesses of the cutters and having their upper ends beveled.

8. In a tool of the character specified, the combination of a stock, oppositely disposed cutters pivoted at their upper ends to the stock, each being formed with a longitudinal slot, a longitudinally movable expander arranged between the cutters, a cross bar mounted in the expander and having its outer ends reduced and the shoulders formed at the inner ends of the reduced portions inclined and riders having their lower ends reduced and pivotally connected to the reduced ends of the cross bar, the upper ends of the riders being beveled and the lower ends of the riders being inwardly inclined and adapted in one position to engage the inclined shoulders formed at the inner ends of the reduced portions of the cross bar.

9. In a tool of the character specified, the combination of a stock provided in opposite sides at its lower end with T-shaped openings, cutters arranged upon opposite sides of the stock and having their upper ends of T-shape and fitted in the T-openings of the stock and pivoted to the latter, a longitudinally movable expander arranged between the cutters and riders pivotally connected with the expander and having their upper ends adapted to engage the outer sides of the cutters.

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

CHARLES L. MUNSINGER. [L. S.]

Witnesses:
JAMES W. NEELY,
RANSFERD HARRIS.