No. 734,833. PATENTED JULY 28, 1903.

E. DOUBLE.

UNDERREAMER.

APPLICATION FILED OCT. 26, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. I.

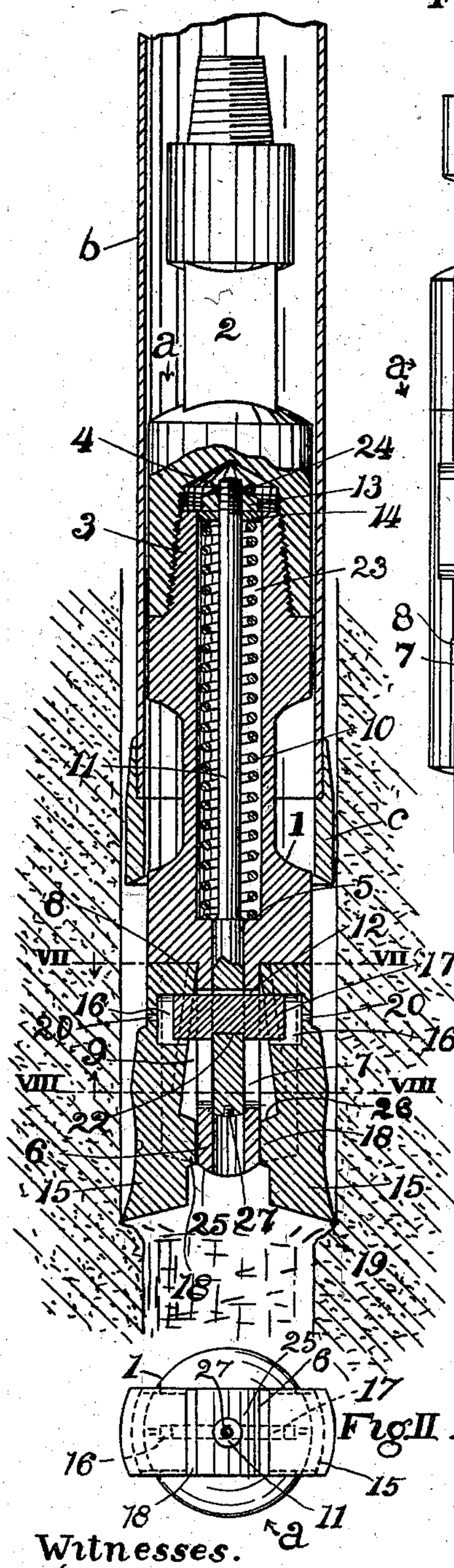

Fig. IV.

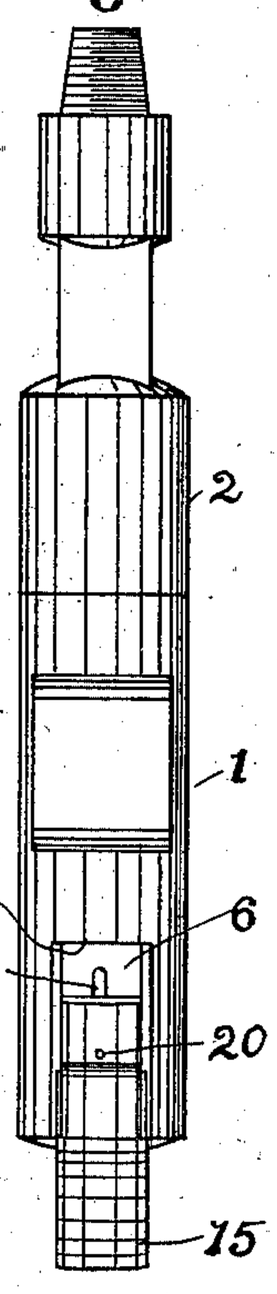

Fig. V.

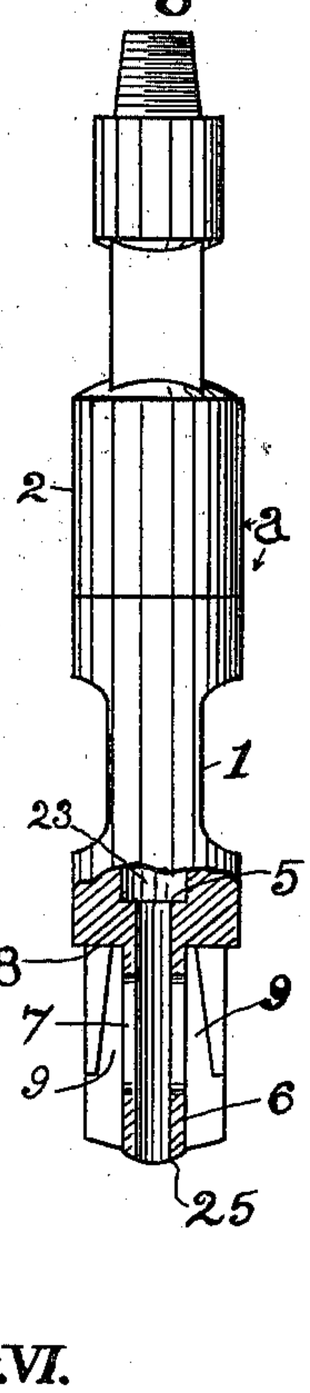

Fig. III.

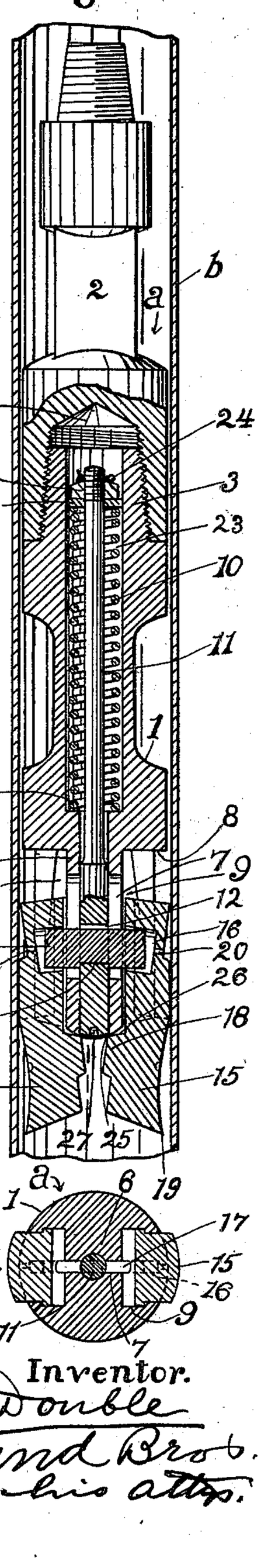

Fig. VI.

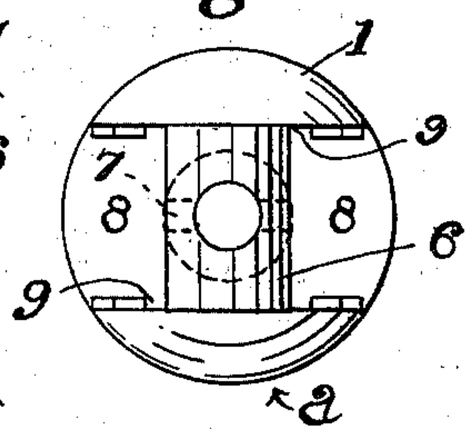

Fig. VII.

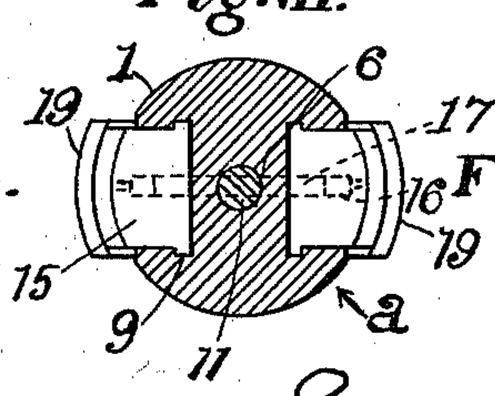

Fig. II.

Fig. VIII.

Witnesses.
C. F. Richey.
I. Townsend.

Inventor.
Edward Double
by Townsend Bros.
his attys.

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E. DOUBLE.

UNDERREAMER.

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NO MODEL. 2 SHEETS—SHEET 2.

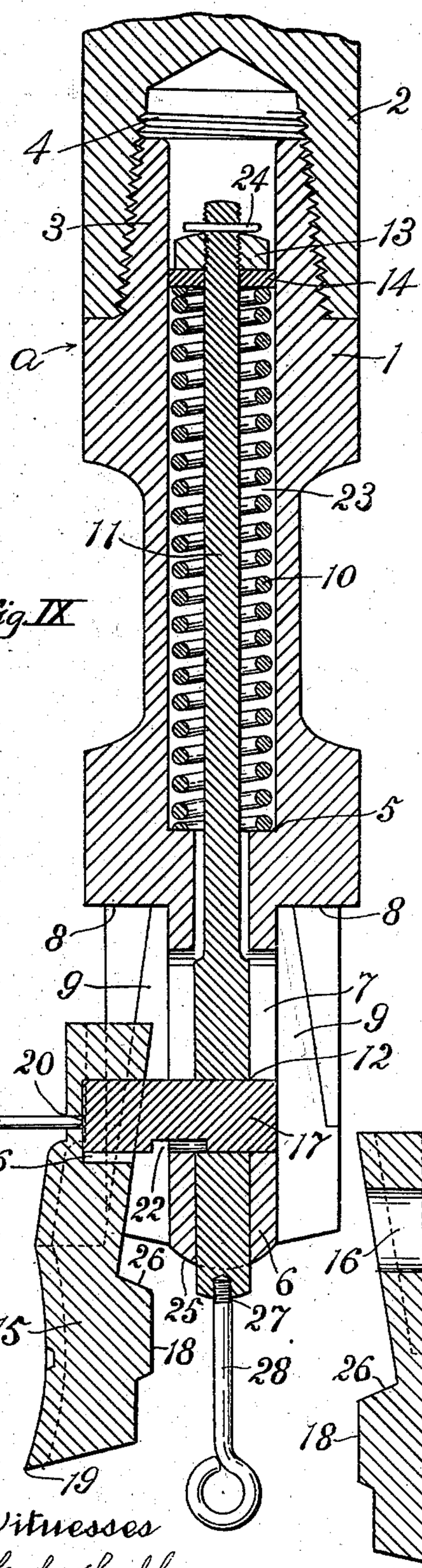

Fig. IX

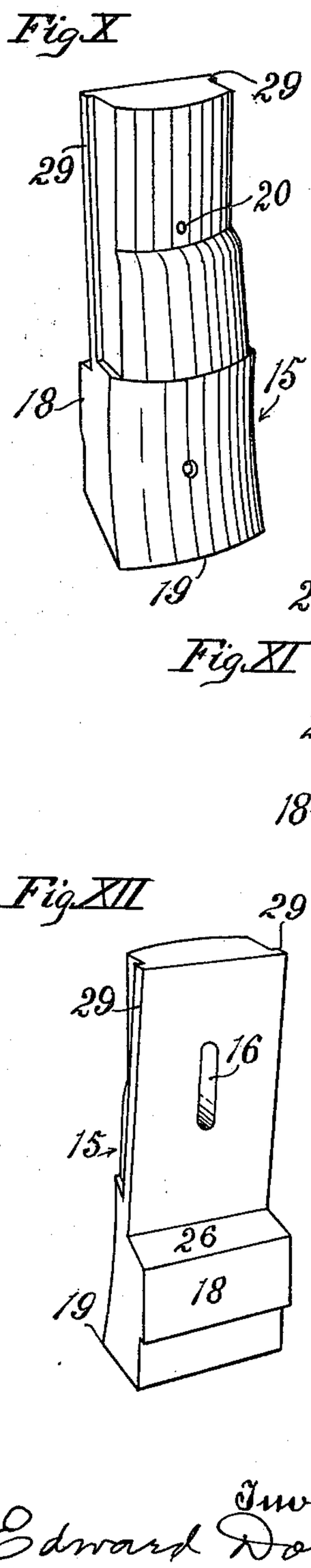

Fig. X

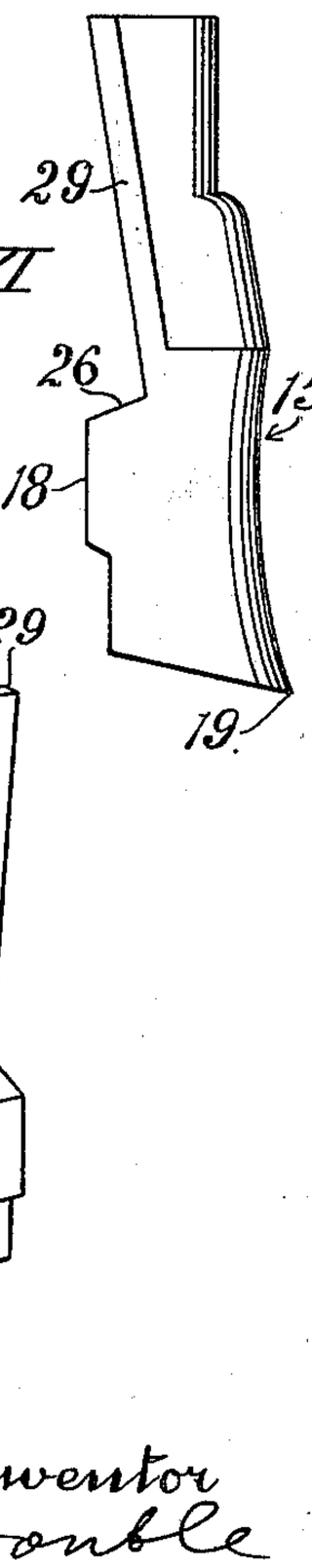

Fig. XI

Fig. XII

Witnesses
C. C. Holly.
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Edward Double
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No. 734,833. Patented July 28, 1903.

UNITED STATES PATENT OFFICE.

EDWARD DOUBLE, OF SANTA PAULA, CALIFORNIA.

UNDERREAMER.

SPECIFICATION forming part of Letters Patent No. 734,833, dated July 28, 1903.

Application filed October 26, 1901. Serial No. 80,144. (No model.)

To all whom it may concern:

Be it known that I, EDWARD DOUBLE, a citizen of the United States, residing at Santa Paula, in the county of Ventura and State of California, have invented a new and useful Underreamer, of which the following is a specification.

An object of this invention is to provide an underreamer which is easily constructed, effective in action, and will not be liable to any breakage or loss of parts while in operation.

My invention includes the novel underreamer and the combinations and parts hereinafter described and claimed and is capable of being carried out in various ways.

The accompanying drawings illustrate my invention.

Figure I is a view partly in vertical mid-section of an underreamer in operation below a well-casing, a portion of which is shown. Fig. II is a plan of the lower end of the underreamer with the slips in the position shown in Fig. I. Fig. III is a view of an underreamer with parts in position for passing through the casing. Portions are shown in vertical mid-section. A fragment of the casing is shown in axial section. Fig. IV is an elevation of the underreamer intact viewed from the right of Fig. III. Fig. V is an elevation of the underreamer-mandrel viewed from the right of Fig. IV, portions being broken away to expose the inner construction of the lower part of the mandrel. Fig. VI is an enlarged plan of the lower end of the underreamer-mandrel inverted. Figs. VII and VIII are sections on lines indicated by VII and VIII, respectively, in Fig. I, looking in the directions of the arrows, respectively. Fig. IX is an enlarged mid-sectional detail to illustrate the manner of applying or taking off the slips. Figs. X, XI, and XII illustrate one of the slips from different points of view.

a designates a hollow mandrel desirably constructed of a hollow body 1 and a joint member 2 screwed thereon, the hollow body 1 being furnished at its upper end with a screw-threaded pin 3 to screw into the socket 4 in the lower end of the joint member 2. The hollow mandrel is furnished with an internal shoulder 5, a downward extension 6, with oppositely-arranged parallel bearing-faces having a keyway 7 therein, shoulders 8 at the sides of such extension, and upwardly and inwardly sloping tapering dovetail slipways 9 beneath said shoulders.

10 designates a spring on the shoulder 5 in the hollow mandrel.

11 designates a rod playing up and down in the mandrel and furnished with a key-seat 12 and supported by the spring 10. Preferably the rod 11 is furnished with a nut 13, screwed on its upper end, to be upheld by the spring 10.

14 designates a washer between the nut and the spring.

15 designates tilt-slips slidingly connected with the mandrel and playing in the slip-ways 9 and furnished with key-seats 16, respectively.

17 designates a key in the key-seats of the slips and rod and playing in the keyway 7 of said extension and upheld by the spring-supported rod 11 to hold the slips against the shoulders 8.

The sockets or key-seats 16 are somewhat larger than the key 17 to permit the slips 15 to partake of a tilting action, the key 17 thus forming a portion on the rod 11, on which the tilt slips or bits 15 are loosely swung or pivoted, adapting their lower ends to tilt or swing in toward the center of the stock or mandrel portion to pass through the well-casing or to tilt away from the center to assume the proper position for reaming. The tilt-slips are provided with shoulders 18, adapted to slide upon a spreading portion provided in connection with the mandrel-body. Said slips are furnished with inward projections 18 to slide upon the downward extension 6 of the mandrel to spread apart the cutting edges 19 of the slips when the slips are drawn up. The slips 15 are slidingly mounted on opposite sides of the downwardly-extending portion of the mandrel, and the key-seats 16 thereof are on the inner faces of the slips, respectively, and are practically closed at their outer ends, thus to exclude any mud or other foreign materials when the underreamer is in operation.

20 designates small holes in the slips, respectively, to allow a punch 21 to be inserted for adjusting the key in the operation of applying or taking off the slips. The key is preferably a notched key, being provided in

its lower edge with a notch 22, so that when the key is in place in its seat 12 the walls of the notch will engage the rod 11, thus to guard against displacement of the key from the position shown in Figs. I and III. The spring 10 affords yielding means for constantly holding the rod 11 up in the notch 22 and to hold the slips 15 against the shoulders 8, the parts of the underreamer being constructed to allow the key to be inserted through the rod 11 into the key-seat of a slip only when the slips and rod are drawn down with the key-seat 12 of the rod flush with the bottom of the keyway 7 in the mandrel. For this purpose the tapering dovetail slipways 9 open laterally just above the plane of the lower end of the bottom of the keyway 7 in the extension to allow the key 17 to be inserted in the key-seats 12 and 20 only when said seats are flush with the lower end of the keyway 7 and the slip drawn out as far sidewise as it can be drawn, as shown in Fig. IX.

To assemble the parts of the underreamer in the first instance, the hollow body 1 being unscrewed from the joint member 2, the spring 10 will be inserted into the chamber 23 of the mandrel to rest on the shoulder 5 therein, and the slip-carrying rod 11 will be inserted into place and the washer 14 and nut 13 adjusted, as shown in Fig. I. The nut is preferably held from unscrewing by means of a cotter-pin 24 passed through the rod 11 after the nut has been screwed home. The rod is then forced or pulled downward by any suitable means into the position shown in Fig. IX, thus bringing the bottom of the key-seat 12 flush with the bottom of the slot 7 in the extension 6 of the mandrel. Then one of the slips is applied in position, with its key-seat 16 ready to receive the key 17, when the same is inserted through the key-seat 12 and the slot 7. Then the key is inserted and is passed through the key-seat of the rod sufficiently far to allow the other slip to be brought into position, so that the key may be pushed back into the key-seat of said other slip. Then a suitable instrument, such as the punch 21, will be inserted through the hole 20 and the key will be pushed back into the key seat of the slip last applied, whereupon the notch 22 will be brought into position to receive the lower wall of the key-seat 12. Then the rod 11 is released, thus allowing the yielding means 10 to draw the rod up into the mandrel, thus bringing the slips 15 up against the shoulders 8 and the inward projections 18 against the sides of the downward extension 6, thereby spreading apart the lower ends of the slips.

The face 25 of the lower end of the downward extension 6 of the mandrel is upwardly sloping at its edges and the upper faces 26 of the extensions are downwardly sloping, so that when the slips are drawn upward they are readily forced outward by the sliding contact of the sloping faces 25 and 26.

By the construction shown wherein the hollow mandrel is provided at its upper end with a pin screwed into the lower end of the joint member 2 great strength of the hollow mandrel is insured.

In Fig. I, *b* designates the well-casing and *c* the usual shoe at the bottom of such casing.

In order to conveniently remove and reapply the slips for the purpose of sharpening or for any other porpose, the lower end of the rod 11 is furnished with a screw-threaded socket 27, and means for drawing down the rod against the pressure of the spring 10 are temporarily screwed into the socket to enable the operator to bring the rod 11 into position to allow the slips to be removed and replaced without unscrewing the body of the mandrel from the joint member.

The eyebolt 28 (shown in Fig. IX) indicates a form of such means.

To remove the slips, the rod will be drawn down into the position shown in Fig. IX, thus bringing the key against the lower end of the keyway 7 in the extension 6 and allowing the rod to be drawn out of engagement with the notched edge of the key 17, whereupon a suitable instrument, such as the punch 21, will be inserted into the hole 20 and the key driven into the position substantially shown in Fig. IX, thus releasing one of the slips, whereupon the punch 21 will be inserted into the hole 20 in the other slip and the key will be driven out of the key-seat 16 in said other slip, thereby releasing the other slip.

To replace the slips, the operation just described will be reversed.

When the slips have been replaced, the rod will be released and the eyebolt unscrewed and the apparatus is ready for use.

29 designates the dovetail flanges of the slips to play in the ways 9.

To introduce the underreamer into the well-casing, the slips will be tilted and drawn down into the position shown in Fig. III, thus bringing the projections 18 below the extension 6, whereupon the edges 19 are brought toward each other sufficiently to allow the tool to pass down through the casing, and when the slips escape below the shoe *c* the spring 10 draws up the rod 11, which tilts the slips into cutting position, as indicated in Fig. I. When the tool is drawn upward, the slips coming into contact with the shoe will be tilted and pressed into the position shown in Fig. III and will readily pass out through the casing.

The rounded end 25 of the extension 6 when pressed against the abrupt projections 18 causes a quick tilting of the slips to throw their cutting edges outwardly, and the slips are thus brought into position with a comparatively slight longitudinal movement.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. An underreamer comprising a hollow mandrel furnished with an internal shoulder, a downward extension having opposite parallel bearing-faces having a keyway therein, shoulders at the sides of such extension, and upwardly and inwardly sloping dovetail slip-

ways beneath said shoulders; a spring on the shoulder in the hollow mandrel; a rod playing in the mandrel furnished with a key-seat and supported by the spring; dovetail tilt-slips playing in the slipways and furnished with key-seats respectively; a key in the key-seats of the slips and rod and playing in the keyway of said extension to hold the slips against the shoulders; said slips being furnished with inward projections to slide upon the downward extension of the mandrel to spread apart the cutting edges of the slips when the slips are drawn up.

2. An underreamer furnished with a mandrel having a downward extension provided with opposite parallel bearing-faces and a keyway in the extension; a spring-supported rod furnished with a key-seat and playing up and down in the mandrel; tilt-slips slidingly connected with the mandrel and furnished with inward projections to slide upon the opposite bearing-faces of the downward extension to spread the slips apart at the lower ends when the slips are drawn up; and a key carried by the rod and carrying the slips.

3. In an underreamer, the combination of a mandrel; slips slidingly mounted on opposite sides of a portion of said mandrel and furnished on their inner faces respectively with key-seats, said key-seats being somewhat larger than the key on the operating-rod; a yieldingly-supported rod playing lengthwise of the mandrel and furnished with a key-seat; and a notched key in the key-seats of the rod and slips, a portion of said rod taking into the notch of said key.

4. A mandrel furnished with shoulders and a slotted extension beyond said shoulders and with dovetail ways on opposite sides of said extension; dovetail tilt-slips for said ways furnished on their inner faces respectively with key-seats; a rod sliding in said mandrel and furnished with a key-seat; a notched key in the key-seats of the slips and rod; a portion of said rod taking into the notch of said key, and yielding means to draw the rod up; the parts being constructed to allow the key to be inserted through the rod into the key-seat of a slip only when the slip and rod are drawn down with the key-seats thereof flush with the bottom of the keyway in the mandrel.

5. In an underreamer, dovetail tilt-slips furnished with key-seats respectively on their inner faces; a rod furnished with a key-seat; a key for said key-seats; a mandrel in which the rod plays constructed with a slotted extension and tapering dovetail slipways which open laterally just above the lower end of the bottom of the slot in the extension, to allow the key to be inserted in the slot and key-seats only when the key-seats are flush with the lower end of the slot.

6. In an underreamer, a mandrel furnished with a hollow slotted extension, the lower end of which slopes upward at the edges; tilt-slips slidingly connected with the mandrel and furnished on their inner faces with projections, the upper faces of which slope downward to slide upon the extension of the mandrel; and means connecting the slips with the rod.

7. In an underreamer, the combination with a hollow mandrel, provided with a slotted extension, a spring-actuated slip-operating rod provided with a pivot-key, tilt-slips provided with key-seats adapted to be engaged by said pivot-key, said key-seats being somewhat larger than the key to allow the slips to tilt, said slips provided with inwardly-projecting shoulders, and said slotted extension provided with surfaces adapted to tilt said slips and hold the same in expanded position.

8. In an underreamer the combination of a hollow mandrel with a hollow slotted extension, said extension having opposite parallel bearing-faces, a slip-carrying rod in said mandrel, slips connected to said rod, said slips having projections which bear against said extension, said slips being provided with key-seats, a key carried by said rod, each end of the key lying in a key-seat of a slip, and the key-seat in each slip being somewhat larger than the key to allow the slips to partake of a tilting action.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, at Santa Paula, in the county of Ventura and State of California, this 19th day of October, 1901.

EDWARD DOUBLE.

Witnesses:

WALTER WEEKLEY,

W. F. DINGER.