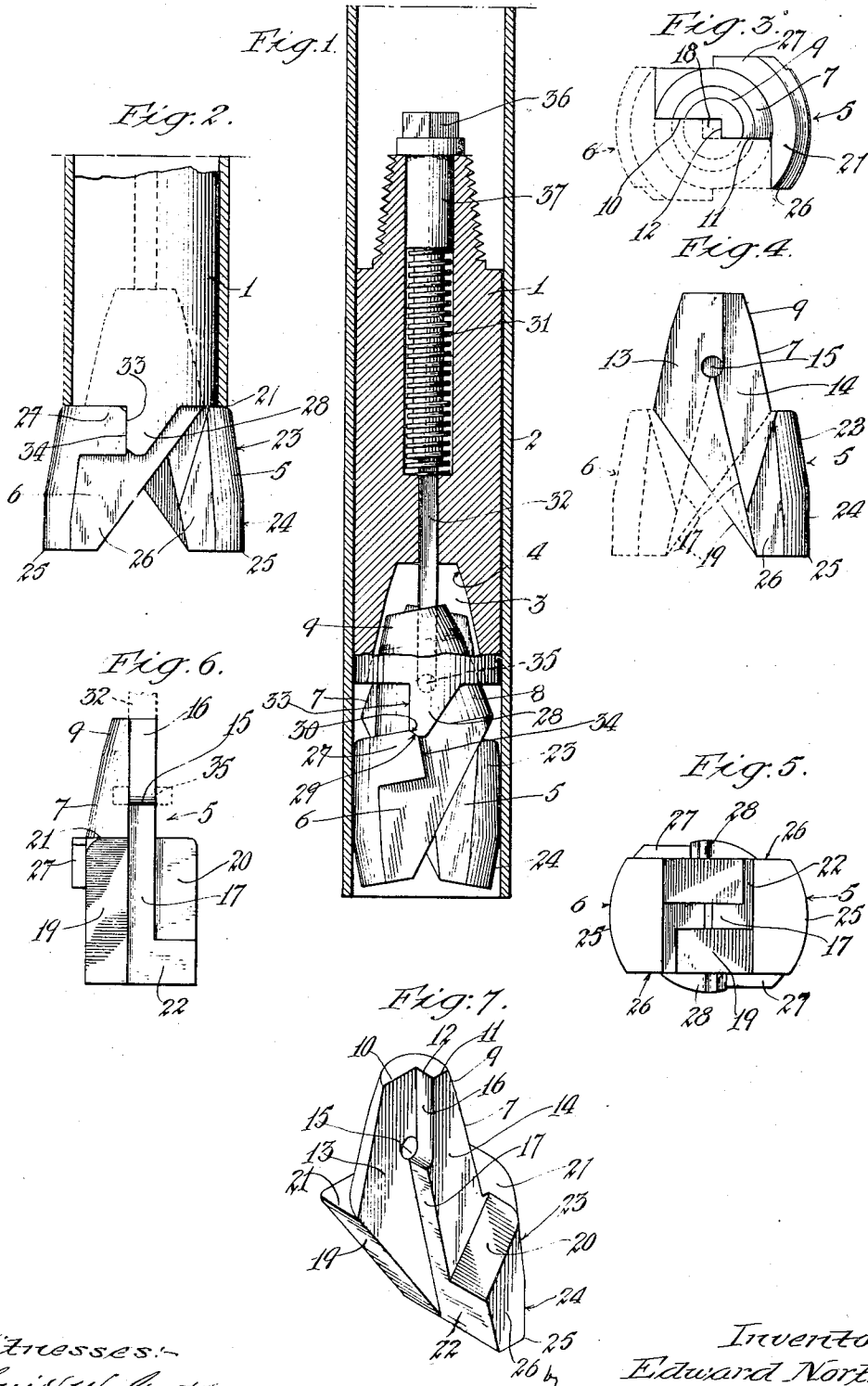


E. NORTH.
UNDERREAMER.
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UNITED STATES PATENT OFFICE.

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UNDERREAMER.

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Specification of Letters Patent.

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To all whom it may concern:

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

This invention relates to underreamers and has for its object to so construct the different parts of the same that the greatest possible strength will be secured and said parts will be so arranged as to perform the most effective service. These objects are best secured by constructing the underreamer with a socketed mandrel or body with two jaws located at the lower end thereof and provided with a stem which fits in said socket and is divided longitudinally substantially on the line of the axis, and beveling or inclining the main portion or lower ends of the jaws in planes at substantially right angles to the plane of division of the stem.

The accompanying drawings illustrate the invention and form a part of the description of the same.

Figure 1 is a vertical longitudinal sectional view of a portion of a well casing with the underreamer in position therein, the mandrel of the underreamer being shown in broken section, and the jaws being shown in side elevation. Fig. 2 is a broken side elevation of the lower end of the mandrel with the jaws expanded and located at the lower end of the casing. Fig. 3 is a top plan view of the cutters, one of them being shown in dotted lines. Fig. 4 is a side elevation of the two jaws, one being shown in full lines and the other in dotted lines. Fig. 5 is a bottom plan view of the reamer. Fig. 6 is a side elevation of one of the jaws of the reamer. Fig. 7 is a perspective view of the same.

Referring more particularly to the drawings which are for illustrative purposes, and, therefore, are not drawn to any particular scale, 1 indicates the mandrel or body portion of the underreamer which is preferably of the usual cylindrical form adapted to fit within a casing 2 and being provided at its lower end with a socket 3. The socket preferably has its upper end formed on a sharper pitch or angle, as shown at 4, than the lower end. The body or mandrel thus forms a holder for the cutter or operative portion of the device, which is pref-

erably formed as two jaws 5 and 6, and has a conical stem that is adapted to be seated in said socket, whereby the jaws are held in their expanded or open position. The stem is divided longitudinally substantially on the line of its axis, whereby said jaws are provided with semiconical portions 7 and 8, the upper end of each of which is made slightly more tapering than the lower portion or base, as shown at 9, to fit within the reduced portion 4 of the socket 3.

The line of division between the stem portions of the cutter body is preferably formed on two planes, as shown at 10 and 11, which are preferably located upon opposite sides of the center or axis of the stem and are joined by a line of division 12 at right angles thereto. The faces 13 and 14 formed by the lines of division 10 and 11, respectively, extend in two parallel planes from the top of the stem downward, and the line of division 12 is formed on two planes, one of which extends from a socket or recess 15 upward and forms the face 16, and the other one extends from said recess downward at an angle and forms the face 17. The faces 16 of the two jaws each extends substantially tangentially from the periphery of the recess 15, whereby a socket or cavity 18 is formed in the stem, as shown in Fig. 3, and the faces 17 extend substantially radially from their sockets, whereby their upper ends are adjacent to each other, as shown more particularly in Fig. 4, while their lower ends are at a distance from each other when the cutters are open or in their expanded position for operation, as shown in Fig. 4, but are comparatively close to each other when the jaws are collapsed or in their retracted position for fitting within the casing, as shown more particularly in Fig. 1.

The main or lower portions of the two jaws are each preferably beveled or inclined upon its inner face, as shown at 19 and 20, the face 19 extending from a shoulder 21 down to the lower end of the jaw, while the face 20 extends from said shoulder down to a point where it cuts the face 17 at a distance above the lower end of the cutter, thereby causing the lower end of the face 17 to be wider than the upper end, as shown at 22. The shoulders 21 are formed by extending the lower portion of the cutter body outwardly a suitable distance beyond the base of the stem.

The external or outer surface of each jaw

is substantially conical, as shown at 23, with the tip nearly cylindrical, as shown at 24, whereby two semicircular cutting edges 25 are formed which are located diametrically opposite each other, as shown more particularly in Fig. 5. The sides of the jaws are preferably formed flat in two parallel planes, as shown at 26, and one side of each jaw is preferably provided at the upper end of its side 26 with a projection or shoulder 27 against which a projection 28 upon the lower end of the mandrel 1 is adapted to engage when the jaws are in their expanded or retracted position, as shown more particularly in Figs. 1 and 2.

The upper corner of the projection 27 is preferably cut off at an angle, as shown at 29, against which a corresponding angle 30, on the lower end of the projection 28, is adapted to engage, as shown in Fig. 1, whereby the jaws are held with their shoulders 21 at a distance from the lower end of the mandrel and the stem partly removed from the socket 3. This permits of the stem portions 7 and 8 being set at an angle to each other within the socket of the mandrel, as shown in Fig. 1, but as soon as the cutters pass below the lower end of the casing 2 the pressure of the projections 28 upon the shoulders 29 forces the jaws outward or into their expanded position, and thereby permits the spring 31 within the mandrel to force the pin 32 upward and draw the stem of the cutter or jaws up into the socket and thereby cause said stem to be firmly seated in said socket, as shown in dotted lines in Fig. 2, with one face 33 of the projection engaging with a corresponding face 34 of the shoulder 27 said faces 33, 34 being vertical so that they lock and hold the jaws against lateral or rotative movement relative to the axis of the underreamer.

The lower end of the pin 32 is provided with the usual cross head 35, shown in dotted lines in Fig. 6, which is seated within the sockets 15 in the usual manner, while the stem or main portion of the pin 32 extends up through the socket or recess 18 formed by cutting away the upper portions of the stem sections to form the walls 16 as heretofore described. The cross head 35 serves as a pivotal connection between the two jaws and extends perpendicularly to the plane of division of said jaws, so that the jaws swing on said pivotal connection with a shearing movement relatively to one another. The upper end of the pin 32 is provided with a nut 36 and sleeve 37 in the usual manner for permitting the longitudinal movement of the pin when the jaws are moved from their operative to inoperative positions and vice versa.

By constructing an underreamer as above described, it will be seen that the only portion of the stem sections that is cut away,

and the stem thereby weakened to that extent, is the small amount of material removed to form the recesses 15 and the socket 18 extending from there to the top of the stem. In this manner the greatest possible amount of strength is secured for the stem, and by seating the same within a socket of the mandrel that engages therewith at all points of the circumference of the same, the greatest possible strength is secured for the union between the mandrel and the jaws. It will also be seen by reference to Fig. 3, that the line of division of the stem is substantially at right angles to the cutting edges of the lower ends of the jaws, which thereby causes the strain from the cutting edges to fall upon the halves of the stem edgewise, as it were, instead of transversely or crosswise, as would be the case if the stem were divided on the same plane as the plane of division of the lower portion, instead of at right angles to it. This will almost double the strength of the stem, for the amount of material across the diameter of the stem which will resist the strain from the cutters is almost double the amount on the sections, which would have to resist the strain if the line of division to form the stems and cutters were all in the same vertical plane.

By inclining the inner or opposing faces of the jaws in planes substantially at right angles to the plane of division of the stem, the least possible amount of material is removed therefrom, thereby securing the greatest possible strength, and by causing the divided portions of the jaws and of their stems to overlap or extend beyond each other when assembled, they thereby mutually assist in supporting each other against rotary or torsional strain or pressure, thereby securing the greatest possible strength and rigidity in that direction. In addition to the strength that is secured in this manner, the addition of the tongues or projections to the lower ends of the mandrel also adds further strength to the device by causing the two jaws to fit between the two tongues or projections when in their operative position, which will have a tendency to hold them against lateral separation, and at the same time the engagement of one of the faces of each tongue with the shoulder 27 of its respective jaw, will add to the strength and rigidity for sustaining rotary or torsional strain.

In operating the underreamer as above described, the jaws are withdrawn from the lower end of the mandrel the desired distance to permit of their being collapsed until the faces 19 of one jaw approaches, or even engages with the faces 20 of the other jaw, as shown in Fig. 1, and the reamer is then inserted into the upper end of the casing in the usual manner. As soon

as the reamer has been lowered to a point below the lower end of the casing, the jaws are forced into their expanded position by the action of the spring within the mandrel and are locked in that position by means of the tongues or projections on the lower end of the mandrel. The reamer is then reciprocated in the usual manner and the well is thereby enlarged or cut out to the desired diameter below the casing. When the reamer is to be withdrawn it is pulled upward until the shoulders 21 engage with the lower end of the casing which will cause the jaws to stop until after the mandrel has been drawn up a sufficient distance to withdraw the tongues 28 from in front of the shoulders 27 when the pressure of the casing against the shoulders 21 will cause the lower ends of the two jaws to be swung toward each other until the shoulders will pass into the casing, when the reamer can be withdrawn to the top of the casing and then removed in the usual manner.

It is to be understood that when the underreamer has been lowered below the casing and the cutters have been released into their operative position, the semi-conical portions 7 and 8 thereof are pulled upwardly into the socket 3 practically filling the same, while the shoulders 21 engage with the end of the mandrel 1. The projection or shoulder 27 on the cutters being in engagement with the projection 28 upon the lower end of the mandrel locks the cutters in the socket 3 and thereby forms a strong and rigid construction adapted to withstand the strain of cutting.

Having described my invention I claim:—

1. In an underreamer, two oppositely facing jaws, the opposing faces of which are each inclined in three planes, the central face extending to the bottom of one of the side faces and below the bottom of the other one, whereby it is wider at its lower end than at its upper end.

2. In an underreamer, two oppositely facing jaws, the opposing faces of which are in three planes, the central face extending substantially the entire length of the jaw, and the other faces being inclined in opposite directions relatively to each other, and each extended longitudinally of the jaw in planes which intersect the plane of the central face.

3. In an underreamer, two oppositely facing jaws, the opposing faces of which are each inclined in three planes, the central face being narrower at its upper end than the other faces and extending substantially the entire length of the jaw with its upper end recessed, the other faces being inclined relatively to each other, and each extended longitudinally of the jaw in planes which cut the plane of said central face.

4. In an underreamer, a cutter, and a holder, said holder being socketed and the

cutter being provided with a tapering stem to fit therein and divided longitudinally on two parallel planes, one plane upon each side of the axis of the cutter to form two jaws, the inner face of each jaw being recessed and the portion of the jaw between said planes being cut away from said recess to the top of the jaw, and a pin between said cut away portions with a cross head at its lower end extending into said recesses, the upper end of said pin being yieldingly connected with the holder so as to be longitudinally movable therein.

5. In an underreamer, a cutter, and a holder, the holder being socketed and the cutter being provided with a tapering stem which fits therein and is divided longitudinally on two planes, one on each side of the axis of the cutter to form two jaws, the inner face of each jaw being recessed at a point intermediate the length of the stem, and the portion of the jaw between said planes of division being cut away from said recess to the top of the stem, and the lower portion of the jaw having faces inclined on planes at substantially right angles to the planes of said division so that the faces of the two jaws will oppose each other, one of said faces extending from said recess downward to the lower end of the jaw, and the other faces terminating at a point even with the base of the stem, and a pin between said cut away portions of the stem and having its lower end provided with a cross head which fits in said recesses, the upper end of said pin being yieldingly connected with said holder.

6. In an underreamer, a cutter, and a holder, the holder being provided with a socket, and the cutter being provided with a head and a tapered stem and divided longitudinally on two planes, one on each side of the axis of the cutter to form two jaws with opposing faces, one of said faces extending from the lower end of the cutter to said recess, and the other faces extending only through the head and at angles to each other, one of said two faces being shorter than the other and the central face being wider at its lower end than at its upper end, and a pin provided at its lower end with a cross head which fits in said recesses and being yieldingly connected at its upper end with said holder.

7. In an underreamer, a cutter, and a socketed holder therefor, said socket extending from the lower end of the holder upward and said cutter being reciprocally movable relatively to the holder and provided with a stem which projects into said socket and said cutter being divided longitudinally to form two similar jaws, each jaw being provided upon its periphery with a vertical shoulder, the upper corner of which is inclined, and the holder being pro-

vided at each side with a projection which extends from its lower end and has a vertical shoulder extending in position for engaging with the shoulder of the jaw at that
5 side to hold said jaw in operative position, the lower end of each projection being inclined to engage with the inclined portion of its respective shoulder, the inclinations of said shoulder portions being such that
10 the pressure of the jaws toward the holder tends to push the jaws outwardly, and a

spring pressed pin for normally holding said jaws in engagement with the lower end of the holder, and for pressing the jaws toward the holder.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 11th day of May 1908.

EDWARD NORTH.

In presence of—

W. S. BOYD,

FRANK L. A. GRAHAM.

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