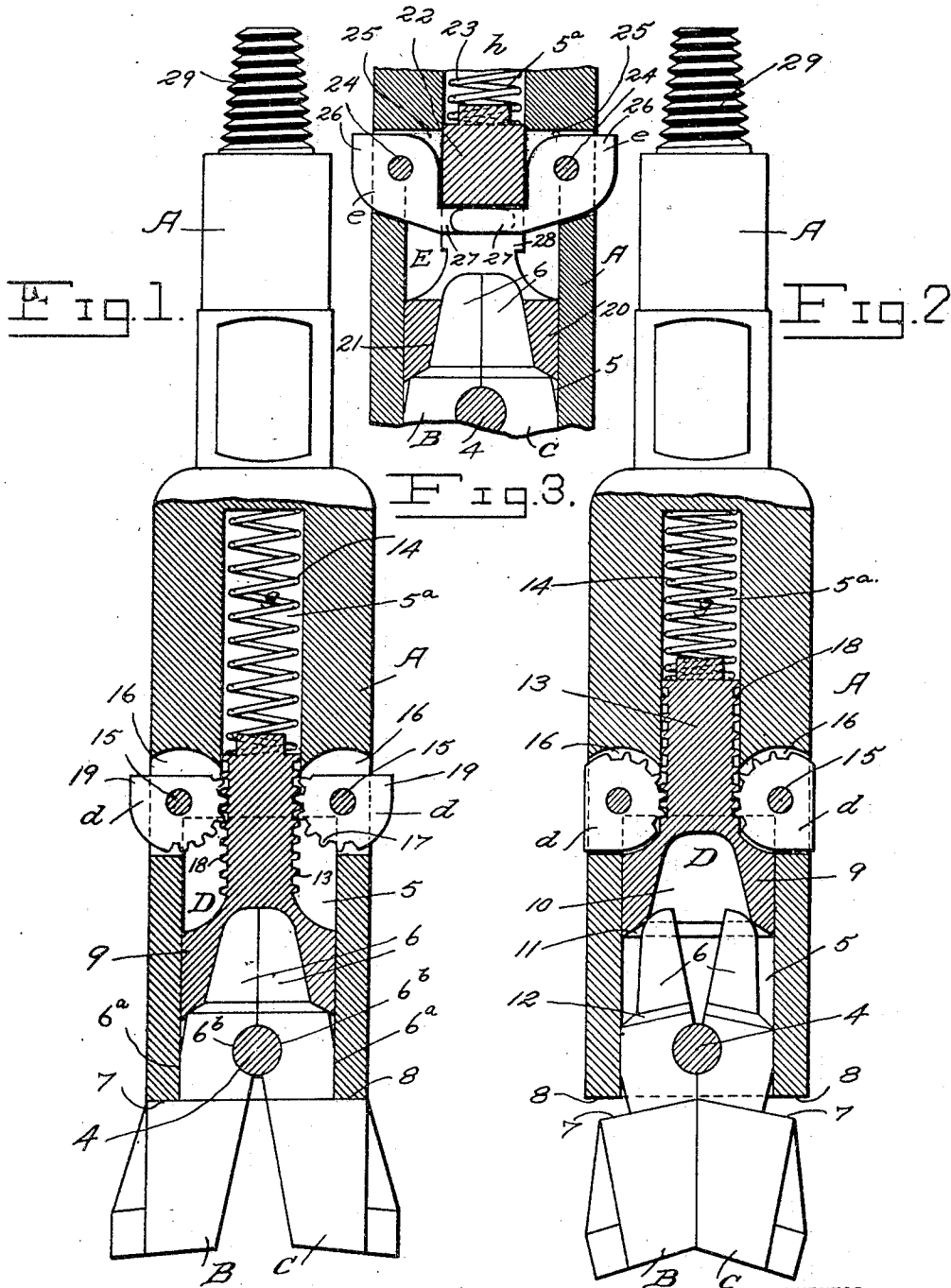


H. GEARING.
UNDERREAMER.

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WITNESSES:

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HARRY GEARING, OF LOS ANGELES, CALIFORNIA.

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Specification of Letters Patent.

Patented Mar. 31, 1914.

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To all whom it may concern:

Be it known that I, HARRY GEARING, a subject of the King of Great Britain, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Underreamers, of which the following is a specification.

This invention relates to underreamers for enlarging well holes to permit the lowering of casing therein, in oil and other wells; and it has for its object to provide improvements in underreamers which will be superior in point of relative simplicity and inexpensiveness in construction and organization, positiveness and reliability in operation, durability under the hard service and stress to which such apparatus is subjected in use, and facility in assembling and disconnecting the parts in initially putting the underreamer together and for purposes of repair, and which will be generally superior in efficiency and serviceability.

With the above and other objects in view, the invention consists in the novel and useful provision, formation, construction, combination and relative arrangement of parts, members and features, all as hereinafter described, shown in the drawing and finally pointed out in claims.

In the drawing: Figure 1 is an axial vertical sectional view, partly in elevation, of an underreamer constructed and organized in accordance with the invention, the parts being in reaming condition or positions; Fig. 2 is a similar view, the parts being shown in collapsed position for passage through the casing; and, Fig. 3 is a similar fragmentary view of a modified form of construction.

Corresponding parts in all the figures are designated by the same reference characters.

Referring with particularity to the drawing, and to all the figures thereof, A designates the mandrel or body, C and B the tilting or rocking slips, bits or cutters which directly perform the reaming operations and are held to the body A so as to rock upon a transverse fixed shaft or arbor 4, spanning a chamber 5 in the lower end of the body within which the shanks 6 of the bits or cutters or slips are accommodated in their rocking and drilling motions in the expansion and collapse of the cutters.

D in Figs. 1 and 2 and E in Fig. 3 designates means causing the expansion and per-

mitting the contraction of the working ends of the cutters, such means having members *d* and *e*, respectively, cooperating with the casing and the shoe thereon in the passage of the underreamer through the casing and its exit from the shoe and entrance therein. Such means are provided respectively with compression members *g* and *h*, respectively, tending to force such means D and E into position to hold the cutters in expanded condition. Such compression members are housed within a contracted extension 5^a of the chamber 5, such extension being bored axially of the body A. The cutters are provided below their shanks with shoulders 7 which engage with and bear upwardly against a continuous shoulder 8 at the lower end of the body A, such shoulders 7 transmitting to the shoulder 8 the upthrust upon the cutters. When in collapsed position, the cutters at their working ends are tilted or rocked inwardly so that they may be passed through the casing with the body A. When the cutters are in expanded condition they project laterally of the body A so as to enlarge the hole when the underreamer is reciprocated within the hole by the raising and dropping thereof in the operation of the drilling rig.

The means D in Figs. 1 and 2 comprise a block or head 9 mounted to play vertically within the chamber 5, and having an interior bowl or chamber 10 tapering upwardly and open at its lower end and formed to exactly fit and receive the tapered shanks 6 of the cutters when the cutters are in expanded positions. A continuous shoulder 11 on the lower end of the block cooperates with shoulders 12 on the shanks of the cutters, such shoulders being complementarily beveled to produce a close working fit, and cooperation between the shanks and the block. From the block 9 extends upwardly an integral stem 13 playing in the chamber extension 5^a, and against which bears compression member *g*, consisting of a coil spring 14 which urges the block and stem downwardly into the position shown in Fig. 1, whereby the means D hold the cutters in expanded working positions. The members *d* comprise dogs pivoted upon pins 15 spanning lateral openings or slots 16 in the sides of the body A at the lower end of the chamber extension 5^a, and cooperating with the stem 13 through teeth 17 which are interengaged with teeth 18 upon the stem 13,

thus constituting a rack and pinion engagement between the dogs and the stem. The dogs are formed to lie approximately within the slots 16 when the block 9 is in elevated position and the cutters are collapsed, and to extend outwardly of such slots when the cutters are in expanded positions, such dogs being provided with noses 19 disposed for engagement with the lower end of the casing or the shoe thereon when the dogs project outwardly through the slots.

Referring to Fig. 3, the means E likewise include a block or head 20 provided with a similar bowl or chamber 21, corresponding to the bowl or chamber 10 and similarly cooperating with the shanks 6 of the cutters; such block or head having a similar upwardly extending stem 22 playing in the chamber extension 5^a under the downward urgency of a coil spring 23 constituting the tension member *h*. The member *c* comprises dogs pivoted upon pins 24 in slots 25 at the sides of the body A, and having noses 26 projecting outwardly of such slots when the cutters are in expanded positions, such dogs lying approximately within the slots when the cutters are in contracted positions. Such dogs likewise have over-lapping fingers 27 received within an elongated transverse slot 28 in the stem 22 and whereby the dogs are inter-engaged with the stem.

The mode of operation and method of use and advantages of the underreamers will be readily understood from the foregoing description taken in connection with the accompanying drawing and the following statement: The forms of construction shown in all the figures operate the same with the exception that the fingers 27 and slot 28, shown in Fig. 3, take the place of the teeth 17 and 18 shown in the other figures. When the reamer is being lowered through the casing the parts are in the positions shown in Fig. 2. The casing pressing against the contracted dogs or members *d* holds them within the slots 16, and such dogs in turn hold the stem 13 and block 9 up against the action of the spring 14, allowing the shank 6 of the cutters to rock apart at the lower orifice of the chamber 10 in the head, thus permitting the working ends of the cutters to fall together or contract, by gravity, rocking upon the shaft 4. When the dogs *d* have cleared the casing and the shoe thereon, the pressure of the casing and the shoe is removed from the dogs, and they are free to swing outwardly as the spring 14 pushes the block 9 downwardly, over the shanks of the cutters, bringing the shanks together within the bowl or chamber 10 and rocking the cutters to tilt their working ends outwardly into the expanded positions shown in Fig. 1. The reamer is now in position for service, the up-thrust is taken by the

shoulders 8 on the body, any out-thrust is taken by the co-engagement of the shanks of the cutters above the shaft 4 and by the engagement of the shanks of the cutters at their outer surfaces with the wall of the chamber 5, such shank surfaces being faced off as at 6^a to that end; and any in-thrust is taken by the inner surface of the bowl 10 of the block 9 which has a working fit within the chamber 5; and any down drag is taken by arbor or shaft 4 which fits within facial sockets 6^b in the inner faces of the shanks 6 below the shoulders 12. The cutters are thus solidly braced against all the influences and stresses encountered in the reaming operation. When the reamer is drawn upwardly, after use, the dogs *d* strike the shoe at the lower end of the casing and swing within the slots 16 so as to elevate the stem 13 and block 9 against the pressure of the spring 14. The shanks 6 of the cutters are thus freed to rock apart, the working ends of the cutters swinging in toward each other into collapsed positions as shown in Fig. 2, so that the reamer complete may be withdrawn through the casing.

The upper end of the body A is provided with the usual threaded connection 29 whereby it may be connected with the string of operating tools.

It will be seen that the cutters when in expanded position practically form solid continuations of the body, and cooperate with the same through the means D to take up all the thrusts and impacts produced in operating the reamer. There is but little liability of breakage of parts or their displacement and loss in the hole. The method of collapse and expansion is positive and enables the reamer to be passed through the casing and to enter the casing through the shoe without difficulty or obstruction, and no independent locking means or tying device is necessary to hold the cutters in collapsed position, as their outer faces ride over the inner surface of the casing and shoe without any interference with the passage of the reamer through the casing. The particular conformation and shape of the cutters, other than as generally described, does not enter into the invention. It is manifest that as to these matters and other features of construction and combination of parts and features many variations may be made without departing from the spirit of the invention.

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

1. An underreamer comprising a body provided with a chamber in its lower end, cutters mounted to rock at the lower end of the body and provided with shanks extending upwardly within the chamber above the points of oscillation of the cutters, a mem-

ber mounted to play within the chamber and cooperating with the shanks of the cutters to hold the same in contracted positions and the working ends of the cutters in expanded positions, compression means acting upon said member, and another member projecting outwardly of the body for engagement with the casing to hold said first named member against the action of the spring; said members being operatively connected for joint movement.

2. An underreamer, comprising a body provided at its lower end with a chamber, cutters mounted to rock at the lower end of the body and provided with shanks entering the chamber and with cutting portions extending below the body, the cutters and lower end of the body having cooperating shoulders to take the up-thrust of the cutters, a member mounted to play within the chamber, means urging said member toward the shanks of the cutters, said member having a pocket receiving and holding the shanks of the cutters in contracted positions, and a further member projecting outwardly of the body and cooperating with the casing to hold the first named member against said

means urging the same toward the cutters; said members being operatively connected for joint movement.

3. An underreamer, comprising a body provided at its lower end with a chamber and with a transverse shaft spanning the lower portion of the chamber, cutters mounted upon said shaft to rock thereon, said cutters having shanks projecting upwardly within the chamber, a block mounted to play within the chamber and having a pocket fitting over the shanks of the cutters to hold the working ends of the cutters in expanded positions, a spring acting to hold the block to the shanks of the cutters, and means cooperating with the block and projecting outwardly of the body for engagement with the casing to hold the block against the pressure of the spring so that the cutters can contract at their working ends.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY GEARING.

Witnesses:

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